Supplementary Biodiversity Baseline Assessment

The Proposed Shëngjin to Velipojë Road Scheme, Albania

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Author	Iain Lednor and Dr Joanne Nightingale	**Technical reviewer**	Nikki O'Donnell
Signature	Joanne Nightingale	Signature	Nikki O'Donnell
Date:	09/07/19	Date:	15/07/19
Project manager	Dr Nightingale	**Technical reviewer**	Simon Boulter
Signature	Joanne Nightingale	Signature	
Date:	26/08/2019	Date:	30/08/2019
Project Manager Albanian Development Fund	Ermir Omari	**Director of Infrastructure Department Albanian Development Fund**	Arben Skënderi
Signature		Signature	
Date:	18/09/2019	Date:	18/09/2019

Reviewer Environmental and Social Unit Albanian Development Fund	Nertis Mero and Genti Cupi	**Road Infrastructure Intervention Unit Albanian Development Fund**	Dritan Mehdi Agolli
Signature		Signature	
Date:	18/09/2019	Date:	18/09/2019

Executive Summary

This document constitutes a supplementary biodiversity baseline assessment for the proposed Shëngjin to Velipojë road scheme, Albania (hereafter 'the Project'). This assessment supplements the baseline information presented in the Environmental Impact Assessment for the Project prepared by the Albanian Development Fund (ADF; 2019) to ensure Project compliance with European Bank for Reconstruction and Development (EBRD) Performance Requirement 6.

The Project is located on the west coast of Albania and consists of upgrading an existing road and constructing a new road section, measing approximately 15 km in length, between the towns Shëngjin and Banks Rrjollë near Velipojë. The Project traverses a portion of the Buna River Protected Landscape (zones 1b and 2b), which is also designated as an IUCN Category 5 site, National Park, Ramsar, Important Bird Area, Important Plant Area and candidate Emerald Network site.

The supplementary biodiversity baseline assessment was based on information yielded by a literature and data review, walkover biodiversity survey, targeted ecological surveys, habitat mapping, critical habitat and priority biodiversity feature screening and stakeholder consultation.

The assessment confirmed that the Project is located within an area of high biodiversity value. A summary of the critical habitat-qualifying features and Priority Biodiversity Features (PBFs) are presented in Table E1 and Table E2 respectively.

Table E1: Summary of Critical Habitat-qualifying features for the Project

EBRD PR6 Criteria	IFC PS6 Criterion Threshold Numbers	Critical Habitat-qualifying Features	Justification
Highly threatened or unique ecosystems	4a	No critical habitat qualifying features	-
	4b	Lake Shkoda and River Buna Ramsar complex Coastal lagoon	Protected area status Priority Annex 1 habitat
Habitats of significant importance to endangered or critically endangered species	1a:	• Slender-billed curlew • Atlantic sturgeon • Adriatic sturgeon • Starry sturgeon • European eel	Precautionary due to the paucity of data

	1b	No critical habitat-qualifying features	-
	1c	- Atlantic sturgeon - Adriatic sturgeon - Stellate sturgeon - European eel	Expert opinion is required to validate this
Habitats of significant importance to endemic or geographically restricted species	2	*Querqus robur* spp *scutariensis*	Precautionary due to the paucity of data
Habitats supporting globally significant (concentrations of) migratory or congregatory species	3a	No critical habitat-qualifying features	-
	3b	No critical habitat qualifying features	-
Areas associated with key evolutionary processes	N/A	No critical habitat qualifying features	-
Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features)	N/A	Buna River, connecting waterbodies and wetland habitats of the Lake Shkoda and River Buna Ramsar complex	Precautionary basis assuming the presence of the critical habitat-qualifying species listed above

Table 1.1: Summary of priority biodiversity features for the Project

EBRD PR6 Criteria	Priority Biodiversity Features
Vulnerable Species	Plants x 25; insect x1; fish x 5, mammals x 9; reptiles x 2; amphibians x1; birds x 33
Threatened Habitats (EU Habitats Directive Annex 1 priority habitats)	Calcareous rocky slopes with chasmophytic vegetation Embryonic shifting dunes A number of scree types are categorised as

	Annex 1 habitats (i.e. 8110, 8120, 8130, 8140, 8150, 8160) Coastal lagoon
Significant Biodiversity Features Identified by a Broad Set of Stakeholders or Government	Buna River Protected Landscape, IUCN Category 5; national park category 2, Ramsar site, IBA, IPA and candidate Emerald Network Site
Ecological Structure and Functions Needed to Maintain the Viability of Priority Biodiversity Features	The hydrological regime of these protected areas is essential for the structure and function of the wetlands, coastal lagoon and associated network of rivers and waterways.

The key biodiversity sensitivities for the Project are summarised as follows:

- The proposed Project traverses the Buna River Protected Landscape, IUCN Category 5; national park, Ramsar site, Important Bird Area, Important Plant Area and candidate Emerald Network Site. This area is classified as Critical Habitat. As such, a key priority for the Project will be the continued support for the conservation of the River Buna Protected Landscape and the Lake Shkoda and River Buna Ramsar Complex.
- The majority of the habitats present in the Project area are common and do not qualify as Annex 1 priority habitats. However, a small section overlaps the Annex 1 habitat type 'embryonic shifting dunes' (EU code 2110) which is likely to be artificially maintained by overgrazing and erosion.
- The Viluni coastal lagoon is located north-east of the proposed road scheme approximately 390 m from the footprint at the closest point. Coastal lagoons are categorised as priority Annex I habitat types and is a critical habitat-qualifying feature.
- Nationally endemic, rare and threatened plant species (and PBFs) are located within the project footprint and most likely occur throughout the PDA namely: *Punica granatum, Colchicum autumnale, Galatella albanica, Origanum vulgare, Hypericum perforatum, Quercus ilex, Arbutus unedo, Erica arborea, Juniperus oxycedrus ssp. Macrocarpa, Ostrya carpinifolia, Quercus pubescens, Salvia officinalis* and *Satureja montana*.
- The Project area is known to provide important habitat for breeding and nesting birds of which five species are globally rare and threatened and 17 are classified as rare and threatened by the national Albania Red List.
- Taking a precautionary approach, it is assumed that oak woodland in the project area provides habitat for the great Capricorn beetle (*Cerambyx cerdo*; IUCN listed VU, Albanian Red Data Book listed EN). Deadwood within *Quercus* sp dominated

woodland located within the PDA is also considered to provide habitat for great Capricorn beetles.

- The project is reportedly located within a much wider wildlife corridor for several mammal species including wolves (*Canis lupus*; IUCN LC and National Red List NT) and European roe deer (*Capreolus capreolus*; IUCN LC; National Red List VU) potentially commuting through the area. Brown bears (*Ursus arctos*; IUCN LC; National Red List VU) have also been reported in the area and may be using it as a transitory corridor; however, this is likely to be extremely sporadic.
- The camera trapping survey confirmed that the project area provides foraging and commuting habitat for the Eurasian badger (IUCN LC, Albanian Red Listed EN). The location of any badger setts within the PDA is currently uncertain at this stage in the project development.
- Bat surveys confirmed that 18 bat species use habitats within the Project area, of which, five bat species are rare and threatened at the national, regional and global scales, namely: long-fingered bat (*Myotis capaccinii*; IUCN VU; Albania Red Listed VU); Blasius' horseshoe bat (*Rhinolophus blasii*; IUCN VU in the Mediterranean); Mediterranean horseshoe bat (*Rhinolophus Euryale*; IUCN Mediterranean VU; Albanian Red Listed VU); lesser horseshoe bat (*Rhinolophus hipposideros*; NT in Europe); and Schreiber's bent-winged bat (*Miniopterus schreibersi*; IUCN NT). Five bat roosts were observed within proximity to the proposed road alignment. One bat roosting site, an abandoned house, was recorded within the Project footprint. Two bat species were observed roosting in this location, namely *Rhinolophus hipposideros* and *R. ferrumequinum*, and the surveyors thought that the house may serve as a maternity roost for *Rhinolophus hipposideros*. A bat roosting site of regional and national importance supporting seven species and over 1600 individuals were recorded 1.5 km northwest of the project footprint. The oak woodland located on Mount Renci was identified as potentially important habitat for foraging and roosting bats.
- The vocalisation recall survey and camera trapping survey confirmed that golden jackals (*Canis aureus*; Albanian Red Listed VU) are present within the PDA and the Buna River Protected Landscape. In total, 6 to 7 different territorial groups were recorded in the survey area, in the region of the PDA, comprising approximately 10 to 14 individuals in total. The survey confirmed that the jackals are breeding within the project area. Jackal groups showed to have a stronger preference for lowland areas, agricultural fields and wetland ecosystems, rather than the dry rocky areas in the uplands of Mount Renci, which is consistent with findings from studies in other parts of the Balkans and Europe. These results indicate that golden jackals use the upland areas of Mount Renci to commute back and forth from one lowland area to another, whilst denning / residing in the lowland habitats. The evidence of cubs in the vocalisation recall survey further supports this assumption.
- The camera trapping survey recorded what appears to be a wildcat (*Felis silvestris*; IUCN LC, Albania Red Listed EN) in the upland area of Mount Renci. Given the proximity of cameras to human habitations and villages, it is uncertain whether all the detections belong to pure wildcats or to feral domestic cats or hybrids between wild and domestic cats.

- Evidence of *Marten* species were recorded during the camera trapping and walkover surveys within maquis and Mediterranean evergreen *Quercus* sp woodland in the PDA. It is likely that given the range and distribution of marten species in Albania and their habitat usage, that all the individuals recorded in the project area are stone martens (*Martes foina*; IUCN LC; Albanian Red Listed LRnt).

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1 INTRODUCTION

On behalf of the European Bank for Reconstruction and Development (EBRD) and the Albanian Development Fund (ADF), RSK have undertaken a supplementary biodiversity baseline assessment for the proposed Shëngjin to Velipojë road scheme, Albania (hereafter 'the Project'). EBRD is considering providing a sovereign loan to the Republic of Albania for the benefit of the ADF to finance the works. An Environmental Impact Assessment (EIA) has been prepared. This biodiversity baseline assessment will supplement the existing biodiversity information presented in the EIA. It is understood that this information will be used by ADF to update the Environmental Impact Assessment for the Project.

1.1 Project Description

The proposed Shëngjin to Velipojë road scheme is located on the west coast of Albania, approximately 55 km from Tirana and entails rehabilitation and upgrade of an existing road and the construction of a new section of road (approximately 15 km in length) between these two towns (Figure 1-1). According to the Government of Albania, the project is of great public importance, especially for the tourism sector.

To manage environmental and social risks associated with the project, five key documents have been prepared as follows:

- Environmental Impact Assessment: Design of Road Shëngjin – Velipojë Project Ideas (December 2017)
- Albania Regional and Local Roads Connectivity Project: Operational Manual (August 2018)
- Albania's Improvement of the Management and Conditions of the Secondary and Local Roads Project: Environment Safeguards Framework (March 2008)
- Environmental and Social Management Framework (December 2017)

It has been identified that the proposed footprint of the Shëngjin to Velipojë road will traverse the Buna River Protected Landscape (IUCN Category 5; National Park), which is under the management of the Skadar Forestry Service Directorate and is also designated as a RAMSAR wetland and an Emerald Site.

Figure 1-1 Proposed Project Location

1.2 Scope of Work

This supplementary biodiversity baseline assessment comprises the following components:

- literature and data review
- habitat mapping
- ecology surveys
- critical habitat and priority biodiversity feature screening

1.3 Study Area

1.3.1 Literature Review

The study area for the literature review encompassed the project footprint and the adjoining habitats of Mount Recci, the beach and dunes, and connecting protected areas. The review aimed to ascertain ecological information regarding terrestrial and aquatic habitats, species, ecological communities and protected areas. This Information was contextualised at the local, regional, national and global scales.

1.3.2 Habitat Mapping

Habitats were mapped within the project footprint and a 50 m buffer either side of the centre of the proposed road alignment. The proposed road measures 12.6 km in length, resulting in a mapped area of 126 ha.

1.3.3 Walkover Survey Study Area

The study area for field surveys comprised the project footprint and a 50 m buffer either side of centre of the proposed road alignment.

1.3.4 Area of Analysis for the Priority Biodiversity Feature / Critical Habitat Screening

The area of analysis is described in detail in Section 3.4.2.2.

1.4 Good Practice Guidelines

This report has been compiled using the following best practice guidance documents and industry standards:

- EBRD Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (EBRD, 2014).
- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012).
- Design Manual for Roads and Bridges. Volume 10 environmental design (Highways Agency et al 1992).
- Design Manual for Roads and Bridges. Volume 11 environmental assessment (Highways Agency et al 1993).

- Good Practices for the Collection of Biodiversity Baseline Data. Prepared for the Multilateral Financing Institutions Biodiversity Working Group & Cross-Sector Biodiversity Initiative (Gullison et al., 2015).

2 LEGISLATION AND GUIDANCE

2.1 Introduction

This section summarises the environmental regulatory requirements that will apply to project activities on three levels:

- the applicable international requirements such as international conventions and treaties to which Albania is a signatory, as well as European Union (EU) frameworks
- applicable Albanian national legislation, permitting related to forests and other relevant approval conditions (such as permits to cross fish-bearing watercourses)
- EBRD Performance Requirements.

This section lists all relevant national and international legislation, guidance and policy to provide a framework for the development of the project, and any relevant legislation or policies relating to the identification and conservation of rare and endangered species or habitats.

2.2 International Conventions and Treaties

Albania has ratified several international biodiversity conventions and treaties. These are summarised in Table 2-1.

Table 2-1 Biodiversity-related Conventions and Treaties to which Albania is a Signatory

International Convention	Date of signing	Description
Convention on Biological Diversity, 1992 (Rio Convention)		The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources. The agreement covers all ecosystems, species, and genetic resources. The Rio Convention describes requirements for ratifying countries so they can address key biodiversity issues through the development and implementation of national strategies focusing on the conservation and sustainable use of biological diversity, such as National Biodiversity Strategies and Action Plans (NBSAPs). The convention also describes requirements to ensure that these strategies are mainstreamed into the planning and activities of those sectors whose activities could have an impact (positive or negative) on biological diversity. *Cartagena Protocol on Biological Safety, 2003 (the Biosafety Protocol)* As a supplement to the Rio Convention, the Biosafety Protocol aims to ensure the safe

		handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health. *Nagoya Protocol, 2010* As a second supplementary agreement to the Rio Convention, the 'Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity' provides a transparent legal framework for the implementation on the fair and equitable sharing of benefits arising out of the utilisation of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.
United Nations Convention to Combat Desertification, 1994 (UNCCD)	27 April 2000	The UNCCD aims to combat desertification and mitigate the effects of drought through national action programmes that incorporate long-term strategies supported by international cooperation and partnership arrangements.
Bern Convention on the Conservation of European Wildlife and Natural Habitats, 1982 (Bern Convention)	1st May 1999	The Bern Convention is particularly concerned about protecting natural habitats and endangered species, including migratory species. Its overall goals are to conserve wild flora and fauna and their natural habitats, promote cooperation between states and give particular attention to endangered and vulnerable species including endangered and vulnerable migratory species. *Emerald Network* The Emerald Network is an ecological network of terrestrial, coastal and marine protected areas in Europe and North America and is set up by the contracting parties to the Bern Convention with the aim to ensure the conservation and protection of those particular habitats. Albania currently has 25 sites which are official candidate sites to join the Emerald Network.
Bonn Convention on the Conservation of Migratory Species of Wild Animals, 1983 (Bonn Convention)	September 2001	The Bonn Convention requires contracting parties to cooperate in the aim to conserve migratory species and their habitats. These goals are implemented by providing strict protection for endangered migratory species, multilateral agreements for the conservation and management of migratory species that require or would benefit from international cooperation and by undertaking cooperative research activities. *Agreement on the Conservation of Populations of European Bats, 1991 (EUROBATS)* EUROBATS is an international treaty that binds the Parties on the conservation of bats in their territories. The overall goal of the EUROBATS agreement is to provide a framework for bat

		conservation for the member states and those that have not yet joined. Member states prohibit the deliberate capture, keeping or killing of bats except for research purposes for which a special permit is required. Furthermore, the member states identify important sites for bat conservation, survey the status and trends of bat populations and study their migratory patterns. Based on the result of these monitoring activities the agreement develops and reviews recommendations and guidelines that shall be implemented by the Parties on national levels. The EUROBATS agreement aims to protect all 53 European bat species through legislation, education, conservation measures and international co-operation with members and with those who have not yet joined. The agreement provides a framework of co-operation for the conservation of bats throughout Europe, Northern Africa and the Middle East. *Agreement on the Conservation of African-Eurasian Migratory Waterbirds, 1999 (AEWA)* AEWA is an intergovernmental treaty dedicated to the conservation of migratory water birds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian.AEWA covers 255 species of birds which cross international boundaries and that are ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, flamingos, ducks, swans, geese, waders, terns, auks and even the South African penguin.
Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES)	25th September 2003	The CITES treaty aims to protect endangered plants and animals, particularly ensuring that international trade in specimens of wild animals and plants does not threaten the survival of the species. CITES accords varying degrees of protection to more than 35,000 species of animals and plants listed in its appendices: • Appendix I comprises about 1,200 species that are threatened with extinction and are, or may be, affected by trade. Commercial trade in wild-caught specimens of these species is illegal (permitted only in exceptional licensed circumstances). • Appendix II covers about 21,000 species that are not necessarily threatened with extinction but may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilisation incompatible with the survival of the species in the wild. International trade in specimens of Appendix II species may be authorised by

		the granting of an export permit or re-export certificate. - Appendix III includes 170 species that are listed after a member country has asked other CITES parties for assistance in controlling trade in a species. The species are not necessarily threatened with extinction globally. However, in all member countries, trade of these species is only permitted with appropriate export permitting and a certification of origin from the state of the member country who has listed the species
Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1971 (Ramsar)	29th February 1996	Intergovernmental treaty that provides a framework for national action and international cooperation for the conservation and sustainable use of wetlands and their resources. Wetlands that are covered by the Ramsar Convention include lakes and rivers, swamps and marshes, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans.

2.3 EU Biodiversity Framework

2.3.1 Biodiversity Strategy

In 2011, the European Commission adopted a new strategy aimed to halt the loss of biodiversity and ecosystem services within the EU by 2020. The strategy is aligned with the commitments made at the tenth meeting of the Rio Convention held in Nagoya, Japan in 2010.

The Biodiversity Strategy aims that by 2050 European Union biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity. In this way, catastrophic changes caused by the loss of biodiversity shall be avoided.

The strategy contains six targets and 20 actions. The six targets cover

- full implementation of EU nature legislation to protect biodiversity
- better protection for ecosystems, and more use of green infrastructure
- more sustainable agriculture and forestry
- better management of fish stocks
- tighter controls on invasive alien species
- a bigger EU contribution to averting global biodiversity loss.

2.3.2 Biodiversity legislation

The EU has adopted four key directives in relation to biodiversity legislation for wildlife and nature conservation.

2.3.2.1 *Birds Directive - 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds*

The Birds Directive acknowledges that wild bird populations are most threatened through habitat loss and degradation. The directive places great emphasis on the protection of habitats for endangered bird species, as well as migratory species, especially through the establishment of a coherent network of special protection areas comprising all the most suitable territories for these species.

The Birds Directive bans activities that directly threaten birds, such as the deliberate killing or capture of birds, the destruction of their nests and taking of their eggs, and associated activities such as trading in live or dead birds, with a few exceptions.

2.3.2.2 *Habitats Directive - 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*

The Habitats Directive was adopted in 1992 as an EU response to the Bern Convention. It aims to promote the maintenance of biodiversity by requiring member states to take measures to maintain or restore natural habitats and wild species listed in the Directive's annexes at a favourable conservation status through the introduction of robust protection for those habitats and species of European importance.

In applying these measures, member states are required to take account of economic, social and cultural requirements, as well as regional and local characteristics.

The directive is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. Overall, the directive protects over 1,000 animal and plant species and over 200 so-called 'habitat types' (special types of forests, meadows, wetlands, etc.) that are of European importance that are listed in the directive's Annexes:

- Annex I covers habitats
- Annex II covers species requiring designation of Special Areas of Conservation
- Annex III covers species in need of strict protection
- Annex IV covers species whose taking from the wild can be restricted by European Law.

2.3.2.3 *The EU Water Framework Directive - 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*

The purpose of the water policy directive is to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It expands the scope of water protection to all waters and sets out clear objectives that must be achieved by specified dates. It will ensure that all aquatic ecosystems and, with regards to their water needs, terrestrial ecosystems and wetlands meet 'good status' by 2015.

The directive requires member states to establish river basin districts and, for each of these, a river basin management plan.

2.3.2.4 *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy Marine Strategy Framework Directive (MSFD)*

The MSFD aims to protect the European marine environment to ensure it is healthy, productive and safeguarded for the use of future generations.

As many of the threats to Europe's marine resources require cooperation and collective action to be tackled effectively, this coherent framework for joined up governance of the marine environment has been developed.

The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities, which supports the sustainable use of marine goods and services. The overarching goal of the directive is to achieve 'Good Environmental Status' by 2020 across Europe's marine environment.

2.4 National Legislation

Basic environmental law was first developed in Albania in 1967 but the development of a modern framework only began in 1991. There are a number of laws in Albania with reference to biodiversity. Although improvement to the environmental legal system has been made there are still gaps in some aspects of nature conservation, over-lapping responsibility and some contradictory language within the provision. The National Environmental Agency (NEA) is defined as the responsible authority for the implementation of environmental law in Albania (UNEP 2002)

On a national level, various laws and policies address and implement the international biodiversity framework signed and/or ratified by the Albanian government. This section addresses the Albanian national biodiversity framework.

Albania's general nature protection principles are guaranteed through Law No. 10431 "On Environmental Protection", dated 09/06/2011. Article 5 of the law defines "conservation of biological diversity" as one of the environmental elements.

Additional legislation includes the following (described in more detail in Appendix 1):

- Law no. 9587/2006 on Biodiversity Protection, as amended in 2014
- Law no. 81/2017 On protected areas, replacing law no. 8906/2002
- Law no. 10006/2008 on Wild Fauna Protection, amended in 2012
- Law no. 9867/2008 on rules and procedures for international trade of endangered species of flora and fauna, amended in 2012
- Law no. 10234/2010 on the integrated management of the coastal zone in the Mediterranean Sea
- Law no. 10120/2009 on the protected of medicinal, essential oil and tannin plants
- Law no. 5/2016 on the Moratorium in Forests
- Law no. 61/2016 on the Moratorium on hunting, amending Law n. 10253/2010 on hunting.

Supportive bylaws have been published to complete the legal basis for specific elements of nature protection, including, for example, the listing of protected fauna and flora species published in the Red List of Albanian Flora and Fauna 2013.

Protection of species of conservation interest is accomplished through specific provisions of the biodiversity protection law and the wild fauna protection law. The biodiversity protection law also contains provisions for invasive species and protection measures for species conservation.

Habitat protection is accomplished through the provisions of the law on protected areas, and the network of protected areas. This network serves to identify and establish the Natura 2000 ecological network. Important habitats for birds in general and migratory birds in particular are included in the law on wild fauna protection.

2.4.1 National Biodiversity Strategy and Action Plan

The National Biodiversity Strategy and Action Plan (NBSAP) 2016 lists the following achievements:

- enhancement of the legal framework
- The protected areas network has been extended from 5.8% in 2005 to about 16.61% of the territory. The protected areas network currently covers 477,566 hectares.
- Action plans have been developed for: brown bear (*Ursus arctos*), Eurasian lynx *(Lynx lynx*), pygmy cormorant (*Phalacrocorax pygmeus*), cetaceans, Posidonia oceanic meadows, and marine turtles and their natural habitats (prepared in cooperation with MEDASSET). An Alien Invasive Species Action Plan has also been developed, this is described in more detail below.
- drafting of a framework project (2013) for kick-starting the process of Natura 2000 in the country
- Regular reporting to the Convention on Biological Diversity.

The 2016 NBSAP envisages the expansion of the protected areas network to cover 17% of the land surface and internal waters and 6% of the coastal and marine areas. It envisages the development of management plans for five protected areas and implementation of the 12 plans already adopted. Various measures are envisaged for the protection and conservation of habitats, promoting natural regeneration and regeneration with autochthonous species of forest trees, and conservation of freshwater and marine habitats. Particular emphasis is placed on monitoring, education and awareness-raising.

2.4.1.1 *Invasive Alien Species Action Plan*

The Albanian Invasive Alien Species Action Plan aims to coordinate and harmonise measures to minimise or prevent adverse impacts on current or future biodiversity, economy and health arising as a result of invasive alien species.

The plan acknowledges invasive alien species (IAS) as alien species whose introduction and/or spread threatens biological diversity. They are the second biggest cause, after damage to habitats, of the significant losses of biodiversity, with harmful effects on the environment, economy and social life.

The purpose of the action plan on invasive alien species is defined through the Rio Convention for all taxonomic groups and to all levels (species, subspecies, varieties, etc.). The IAS Action Plan does not include genetically modified organisms.

The overall goals of this plan are to:

- make people aware of the issues associated with IAS and mechanisms for their control

- establish priorities in the list of actions for implementation at a national and regional level
- establish a cooperating science, state and government network focussing on IAS
- prevent new introductions of invasive species
- build capability for quick responses to new introductions
- reduce the impacts of existing invading species
- Recover native species and restore natural habitats and ecosystems that are currently affected by biological invasions.

The plan outlines a methodology for the identification and prevention of invasion, as well as mechanisms for rapid response to invasion.

It addresses IAS in all three natural environments (freshwater, marine and terrestrial) and establishes a biological baseline of currently known species that fall under these categories that are present in Albania, including but not limited to molluscs, insects, fish, marine worms and mammals.

The plan prioritises IAS according to the species' risk level and whether they pose a threat to biological diversity or cause economic or health problems.

It recommends potential improvements to the current situation in Albania. In terms of tackling the introduction of invasive species, the following problems are outlined:

- lack of coordination between government agencies, state and other groups dealing with the introduction and impact of IAS
- lack of public awareness about the introduction of invasive species
- lack of priorities and overall plans for action
- inadequate and outdated legislation
- lack of monitoring capacity
- lack of measures to respond quickly to new threats
- lack of general information, its fast and effective collection and distribution, and quick responses
- Lack of and inadequate scientific information.

The IAS action plan, while considering the above-mentioned issues, has outlined the following actions and priorities:

- education and public awareness raising, including the creation of an information centre, brochures, e-newsletter, seminars, workshops
- capacity building of experts, authorities and stakeholders' cooperation on national and international levels, including creation of an IAS working group, lectures at universities, and national and international workshops
- investment in research and monitoring, including management and updating of key research data, scientific study of impacts and mitigation measures of IAS on ecology, monitoring of IAS, and development of predictive models
- Implementation of sound legal and organisational structures, including the development of preventive measures as per Rio Convention prevention principles, a review of the current legislative framework, the development of recommendations for actions, and the harmonisation of national and international practices.

The implementation of the IAS action plan will be launched primarily for those species that are invasive or potentially invasive and could cause problems for nature conservation or the economy. It will also take into consideration the species that pose a risk to human health or veterinary science.

2.5 EBRD Guidelines and Policies

The European Bank for Reconstruction and Development (EBRD) is an international financial institution which uses investment as a tool to build market economies. Commitment to sustainable energy and safeguarding the environment are central to the EBRD's activity. The EBRD Performance Requirements were introduced to provide guidance for EBRD clients to manage and improve their environmental and social performance through a risk and outcomes-based approach. The most relevant performance requirement in terms of ecology and ecosystem services is Performance Requirement 6 (PR6): Biodiversity Conservation and Sustainable Management of Living Natural Resources (EBRD, 2014). PR6 promotes the importance of protecting and conserving ecological functions of ecosystems, the biodiversity supported by these functions and the sustainable management of natural resources to ensure environmental and social sustainability. Some of the key components and concepts of EBRD PR6 are as follows:

- The provision of a robust biodiversity impact assessment package that manages risks in alignment with the stages of the mitigation hierarchy to avoid, minimise, rehabilitate / restore impacts to biodiversity and offset residual impacts. This should include an assessment of cumulative biodiversity impacts. These assessments should form a component of a wider physical, environmental and social impact assessment process for a project with the understanding that there are significant overlaps and influences between these fields.
- the identification of priority biodiversity features and critical habitat-qualifying features with high levels of irreplaceability or vulnerability, consideration of the implications of their identification and the effective management of these features
- the development and implementation of a biodiversity mitigation and management strategy to minimise project-related direct and indirect impacts, followed by the continued monitoring and evaluation of these measures to ensure their suitability and identify triggers that show when measures are suboptimal and need to be adapted and re-evaluated
- the scope and benefits of biodiversity management plans and / or monitoring plans
- the identification and effective management of invasive alien species (i.e. species that are introduced by man, accidently or intentionally, outside their natural geographical range into an area where they are not naturally present (IUCN 2018))
- the continual improve the existing management of biodiversity, ecosystem services and living natural resources
- Sustainable management of living natural resources for projects where these resources are central to the project's core function and projects involved in the primary production of living natural resources.

3 METHODOLOGIES

3.1 Literature Review

A review of publicly available studies and data regarding the ecological characteristics of the Study Area was undertaken with the aim of supplementing the ecological information presented in the Environmental Impact Assessment Report for the Shëngjin to Velipojë Project Idea (J.V Klodioda & Sphaera Ltd, 2017) and other supporting documentation. Key literature sources included, but were not limited to:

- Government of Albania fauna and flora legislation, policies and local development plans
- the National Red List of Wild Flora and Fauna, Albania (2013)
- previous flora and fauna studies conducted in the Study Area and broader region by universities, research centres, NGOs and international organisations
- Global Forest Watch database (2018)
- the List of Wetlands of International Importance (Ramsar 2018)
- World Database of Protected Areas (WDPA): a joint venture of UNEP and IUCN, produced by UNEP-WCMC and the IUCN World Commission on Protected Areas (IUCN-WCPA) working with governments and collaborating NGOs. The WDPA is compiled from multiple local and national sources and is the most comprehensive global dataset on marine and terrestrial protected areas available.
- Key Biodiversity Areas (KBAs): KBA status is triggered by the presence of key biodiversity criteria, informed by the IUCN Red List of Threatened Species. KBA mapping builds upon the work of a number of existing partnership-supported initiatives - such as BirdLife International’s Important Bird Areas, PlantLife International’s Important Plant Areas and sites identified by the Alliance for Zero Extinction.
- Alliance for Zero Extinction (AZE): AZE sites are the last refuges for some of the most threatened species on the planet. AZE sites are discrete areas that contain 95% of the known global population of an Endangered (EN) or Critically Endangered (CR) species or 95% of one life history segment (e.g. breeding or wintering) of an EN or CR species.
- IUCN Red List of Threatened Species™ (2018): The Red List is widely recognised as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. This is based on a scientifically rigorous approach to determine risks of extinction that is applicable to all species, and has become a world standard.
- the European Red List (IUCN, 2018)
- the European Red List of Amphibians (Temple and Cox, 2009)
- Evolutionarily Distinct and Globally Endangered (EDGE) species database
- Broad-scale conservation priorities, including Biodiversity Hotspots, Endemic Bird Areas and High Biodiversity Wilderness Areas.

This literature review informed all aspects of this supplementary biodiversity assessment.

3.2 Satellite Imagery, Remote Vegetation Interpretation and Habitat Mapping

Habitat mapping was undertaken using visual interpretation of satellite imagery, supplemented by existing baseline data and GPS ground-truthing conducted during fieldwork.

Habitats located in the study area were classified based on the EUNIS and EU Habitats Directive Annex I habitat types classification system (European Environment Agency, 2018). This is a comprehensive pan-European classification system that covers modified and natural habitat types including terrestrial, freshwater and marine habitats.

The dates and types of satellite images utilized are summarised in Table 3-1 and the habitat types and descriptions located in the study area are described in detail in Section 4.1.1.

The mapping was further validated and refined based on the findings of the field surveys to include any priority habitats that were not previously identified.

Table 3-1 Satellite Imagery Used for Habitat Mapping

Image Used	Date of Imagery
Aerial imagery (Albanian Development Fund)	2018
Sentinel-2 multispectral imagery	24/10/2018

3.3 Ecology Surveys

3.3.1 Priority Species Walkover Survey

A walkover priority species survey of the project footprint and buffer was undertaken between 10th November 2018 and 14th November 2018 by two experienced ecologists. The primary objective of the survey was to increase the current level of understanding regarding existing priority species' habitat usage and behaviour in the vicinity of the project.

Surveyors searched for direct (i.e. sightings, vocalisations) and indirect evidence of fauna activity (i.e. prints, scats, feeding remains, scents-urine). Surveyors also searched for the occurrence of priority vascular plant species.

Surveyors used binoculars to maximise their field of vision. Hand-held GPS units and maps were used to follow the proposed road alignment. Surveyors deviated from the prescribed routes when access was restricted or when following a trail or investigating a particular habitat of importance for wildlife.

If evidence of a priority fauna or flora species was observed, the following parameters were recorded:

- species
- location
- type of observation: direct evidence (i.e. sighting, call) and indirect evidence (e.g. faeces, prints, feeding remains, nests, burrows etc.)

- number of observations
- age range of observation (e.g. old faeces, fresh print)
- surrounding habitat type
- the location of any potential watering points
- indicators of current threats to fauna and their habitats (i.e. timber collection, artisanal mining, fire and hunting)
- Photographs taken where possible.

3.3.2 Priority Habitat Survey and Mapping

In combination with the priority species survey, the surveyors searched for and mapped priority habitats located within the study area. Prior to the commencement of the survey, the preliminary habitat map of the project area was uploaded on ruggedized tablets along with key GIS data. The delineated habitat types were checked and amended where necessary in the field. The preliminary habitat map was verified using the results of the survey.

3.3.3 Targeted Botanical Survey

A targeted botanical survey was undertaken by a botanical specialist on 1st and 2nd June 2019 (see transects in Figure 3-1) to fully characterise the habitat types and their floristic composition within the project footprint and surrounding environs. The survey confirmed the presence / likely absence of any Annex 1 priority habitats and vascular plant species of conservation importance within the project area. This information was used to refine the habitat map.

Figure 3-1 Botanical survey transects

3.3.4 Breeding Bird Survey

A breeding bird survey was undertaken from 1st to 3rd June 2019 by two experienced ornithologists to ascertain the importance of the project area for breeding / nesting birds and birds of conservation importance. Each survey day commenced one hour after sunrise to coincide with the period of peak bird activity. The surveyors were equipped with binoculars (8 x 40, 10 x 42), spotting scope (zoom 20-60), GPS unit, camera and loud speaker. The methodology used during the field survey combined both walkover transect surveys and point count surveys as the combination of both methods was considered the most appropriate for the characteristics of the habitats to be surveyed. Line transects were used in the open part of the project area, mainly in the most northern and southern areas, the agricultural plots, the marshes and the sand dunes along the coast. Point counts were used mainly in the central segment of the project area, in the areas covered by scrub and dense forest. The locations of the transect routes and point count surveys are presented in

Figure 3-2. Both methods are based on recording birds along a predefined route within a predefined survey unit. In the case of line transects, bird recording occurs continually, whereas for point counts, it occurs at regular intervals along the route and for a given duration at each point. The study area focused on the road alignment and targeted habitats within the Protected Landscape.

At each vantage point and whilst walking between vantage points, the ornithologists searched and recorded indirect evidence (i.e. prints) and direct evidence (i.e. sightings and vocalisations) indicative of bird species of conservation importance for the project. Habitats within the study area were inspected for the presence of freshly built nests and nests with eggs of ground nesting birds. Surveyors also recorded evidence of breeding behaviour in birds such as birds in display. Notes were recorded regarding the type of breeding evidence for each of the species observed in accordance with EBBA2 Breeding categories. Data were recorded immediately in the Observation.org database. On some occasions, playback calls were used to better identify songbirds.

The following parameters were recorded for each observation:

- scientific and common name
- type of evidence

- habitat of occurrence
- number of birds sighted
- IUCN Red List of Threatened Species status (IUCN, 2019)
- Albanian Red List status
- level of endemism, where relevant
- migratory / congregatory status
- Breeding status.

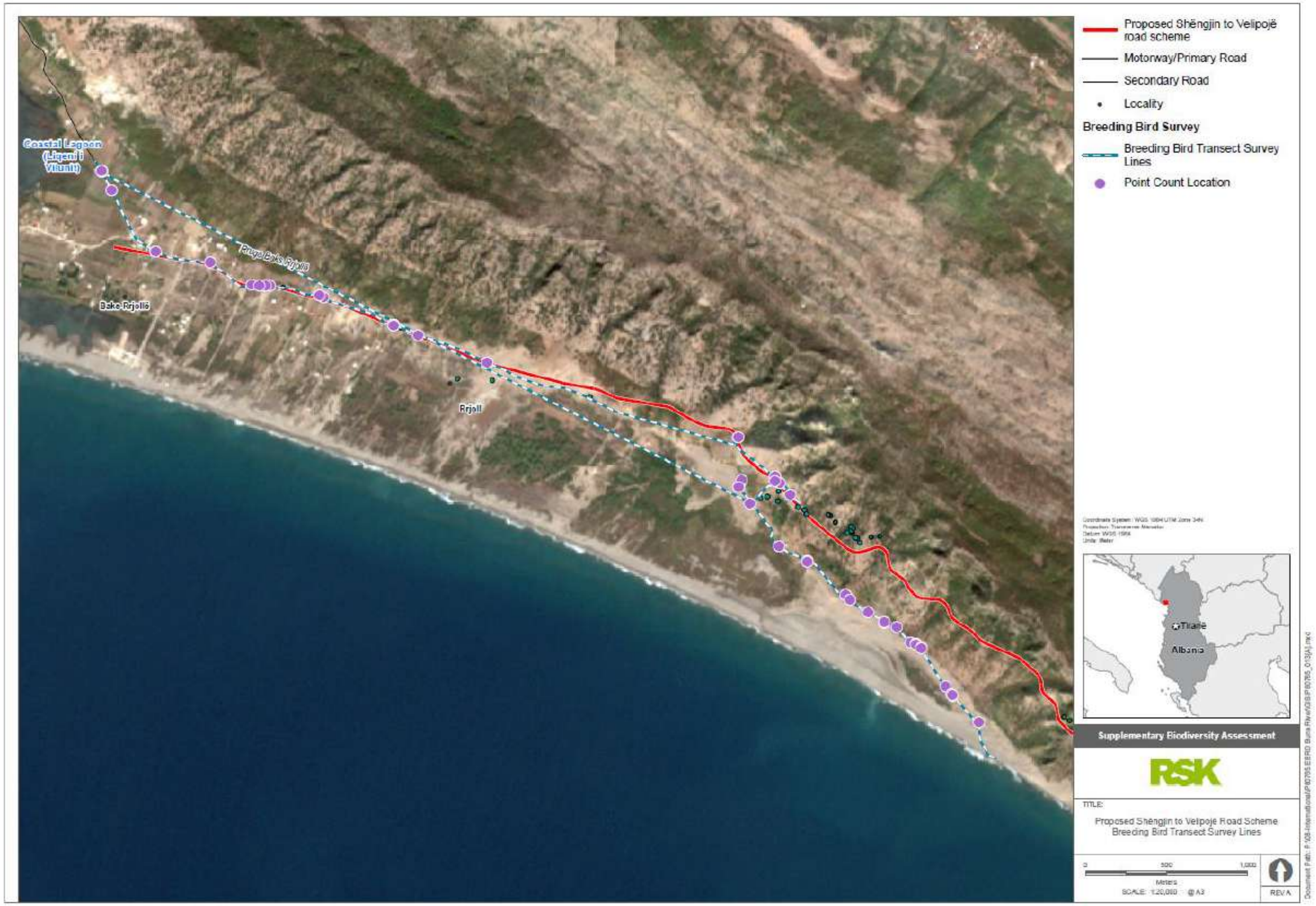

Figure 3-2 Bird survey walkover transects and point count locations

3.3.5 Bat Activity Surveys and Roost Inspections

Bat activity transect surveys were undertaken on 23rd May 2019 and 30th May 2019, both by two experienced bat ecologists. The walkover transect routes were determined prior to the commencement of survey during daylight hours and potential bat roosting sites were recorded. The locations of the transect routes are presented in Figure 3-3.

Both surveys were undertaken in a range of habitats in suitable weather conditions. The dusk surveys commenced 15 minutes before sunset and finished approximately two hours after sunset. Surveyors used a GPS unit to follow the transect route and a handheld bat detector (i.e. D1000X bat detector) was used to detect the echolocations (calls) of different bat species during the survey. The surveyors recorded key information i.e. location and time of echolocation, species name, number of individuals, activity type (i.e. commuting or foraging) and flight direction.

Mist netting was undertaken on 30th May 2019 in which four mist nets were installed in key habitats along the transect route as presented in Figure 3-3. The nets were used as a rapid capture and release approach to identify bats species in the survey area.

Over the periods of 23rd – 24th May and 30th -31st May 2019, bat roost inspections were undertaken by an experienced bat ecologist of several targeted structures based on prior knowledge of the Protected Landscape and secondary data. These structures included:

- a network of military bunkers (Site 01)
- two disused military bunkers (mushroom bunkers) located on the beach c. 500m from the project footprint (Site No 13 and 14)
- network of four military bunkers (Site No 11)
- abandoned house (Site No 2)
- two bridges situated outside of the project area but within the Buna River Protected Landscape (Site No 9 and 10)
- a cave (Shpella Suka e vogel), strictly protected as Natural Monument (Cat. III) was visited (site n°16) located approximately 700m from the proposed route (Site No 16)
- vertical cave (Site 30)
- an abandoned electrical tower was also visited (Site No 17)
- two abandoned houses (Sites No 26 and 27)
- A cave (Site 28).

The locations of these structures are presented in Figure 3-3. During each inspection surveyors searched for indirect (i.e. droppings, feeding remains and scrapes) and direct evidence of roosting bats. The surveyors also assessed the potential of each structure to support features that may favour roosting bats (i.e. suitable crevices, gaps in between brickwork, etc) for summer roosting and hibernation. Surveyors used torches to aid the detection of direct and indirect evidence. During each inspection the surveyors recorded the following parameters:

- structure location (using a hand-held GPS unit)

- a description of the structure and an assessment of its potential to support roosting bats
- the number of direct and indirect observations present at each structure, e.g. estimated number of roosting bats, dropping etc
- bat species (scientific name and common name)
- Photographs were taken of the bats where feasible whilst avoiding disturbance to any bat roost.

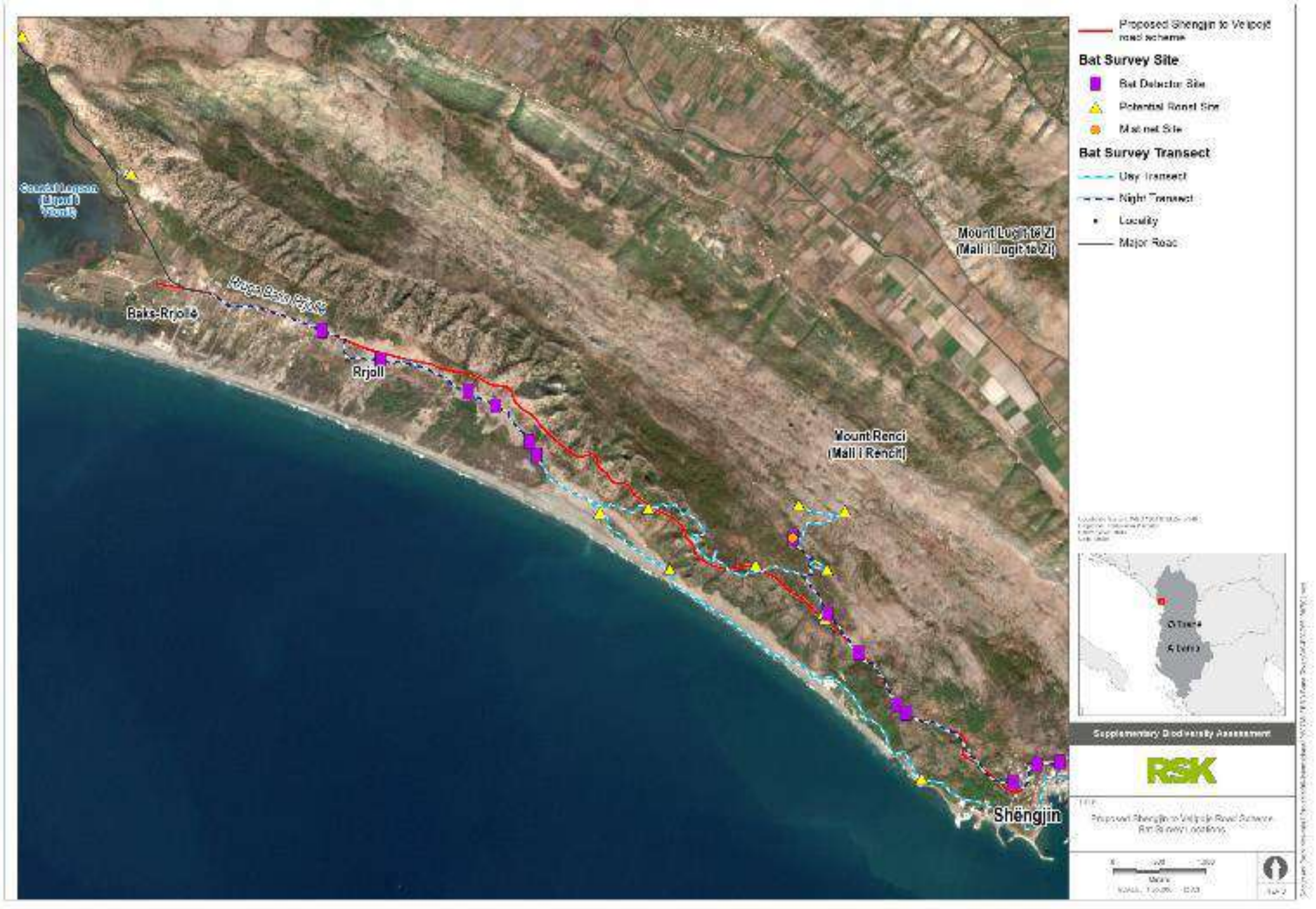

Figure 3-3 Walkover transects, mist nets and structures inspected for roosting bats

3.3.6 Camera Trapping Survey

A camera trapping survey was undertaken by a mammal specialist to confirm the presence / likely absence and potential habitat usage of grey wolf and other priority medium to large sized mammals within the project area (i.e. golden jackals, badgers and Eurasian otters). This is the most suitable non-invasive approach to detecting the presence of these elusive / cryptic species.

The camera trapping survey followed an opportunistic approach as outlined by Breitenmoser et al., 2006, whereby devices are strategically installed in a range of habitat types of likely occurrence for priority fauna (i.e. in habitats where indirect evidence was previously identified, near wildlife trails, potential watering points, etc) based on prior knowledge of the target species' ecology and movement patterns. For this project, prior knowledge on the presence of jackals in the area, and additional information garnered through tracking and habitat assessment, were used to finalise the locations of the camera traps. Habitat condition is one factor that may affect the movement of mammals throughout the project area, hence where possible, camera traps were not placed amongst highly disturbed habitats. Cameras were set as close to the planned route of the road as possible, however where no good alternatives were found close to the planned road, the most suitable adjacent trails were selected for camera placement. This opportunistic survey approach is limited in respect to its statistical usability and estimating the populations of target species, however it is successful in proving the presence of species in an area and collecting sporadic information on their dispersal, reproduction and feeding behaviour.

Eight high-definition Bushnell infrared camera traps were installed within the project area on 27th May 2019 by two experienced ecologists (see Figure 3-4 The camera traps were programmed to run for 24 hours a day. When movement in the environment is detected by a camera's infrared sensor a video was taken. In daylight, the traps produce digital colour video footage. At night or in poor light conditions, the camera uses infrared black LEDs and takes a monochrome video in the infrared spectrum. Thus, it produces no visible flash to most species of animal. Cameras have a 52° field of view and passive infrared detection range of 20-25 m. The survey was undertaken for a period of thirty camera-trap nights, with the cameras collected on 23rd June 2019. Over this period, three camera traps were tampered with resulting in the loss of data from three survey points. The data was then analysed to determine camera trapping rates for each species filmed in the project area and their habitat usage.

Figure 3-4 Camera Trap Locations

3.3.7 Vocalisation Recall Survey

A vocalisation recall survey was undertaken over four nights from 13th June to 15th June 2019 and 21st June to 23rd June 2019, with the aim of establishing the habitat usage of golden jackal and grey wolves in the project area. The survey was carried out during June which falls within the optimum survey period characterised by the highest howling responses.

This acoustic survey method provides an efficient tool for monitoring social and territorial canid species (Harrington & Mech 1982). Canid species respond to human imitation of howls or acoustic broadcasts of actual howls which is the basis of the acoustic survey method, a common technique for detecting accurate position of territorial animals by their vocalisations (Gazzola et al. 2002; Giannatos et al. 2005; Palacios et al. 2016).

The estimated locations of the calling stations were identified prior to the commencement of field work and were based on examination of satellite data, habitat maps and habitat suitability for jackals, as well as previous information on jackal presence (Kryštufek et al. 1997, Schneider-Jacoby et. al. 2006). Calling stations were placed no more than 2 km apart as this is the maximum human hearing distance on windless nights from a vantage point in an open terrain and with no background noise (Giannatos et al. 2005; Szabó et al. 2007; Trbojević et al. 2018). The exact position was then refined during a site visit to check on the terrain, access and existing disturbance (i.e. human, livestock, dog presence) in order to optimize sound transmission. The total area covered was 70.88 km^2 based on a 2 km buffer zone around each calling station. Responses of territorial jackals were recorded at five calling stations, see Figure 3-5, Figure 3-6 and Figure 3-7.

The survey commenced one hour after sunset and finished at least one hour before sunrise during windless and rainless nights (Krofel 2008; Trbojević et al. 2018). From each calling station a recorded yip-howl of two to three golden jackals was broadcasted using a megaphone with a USB reader and USB with stored recordings of jackal howls. Each broadcasted howl (recorded in Greece) lasts for thirty seconds and was followed by a five-minute pause. This was repeated five times at each calling station giving a total maximum time of approximately 30 minutes per station. At each station, the first broadcast was of low volume to avoid scaring the jackals and gradually the volume was increased over the successive broadcasts. When jackals responded to the broadcast, the direction (azimuth) of each howling group was determined using a compass and the distance estimated based on the volume of howling. Geographical coordinates and altitude of calling stations were recorded through the GPS Essentials application. After each response, the area surrounding the calling stations was also scanned with a spotlight.

Figure 3-5 Calling stations 02, 03, 08 & 09. One territorial group with at least 2 individuals responded from V08

Figure 3-6 Calling stations 04 & 06. One territorial group with 3-4 individuals responded from V04 and one territorial group with at least 3 individuals responded from V06

Figure 3-7 Calling stations 10 & 11. Two territorial groups with at least one individual each responded from V10 and two territorial groups with at least 3 and 1 individuals respectively responded from V11

3.4 Critical Habitat/Priority Biodiversity Feature Screening

3.4.1 Identification of Priority Biodiversity Features for the Project

The first step in the identification of the priority biodiversity features for the project was to define the spatial study area. In this instance, the same area of analysis was used for the critical habitat screening described in Section 3.4.2.2. The existing biodiversity baseline data and supplementary information identified by this assessment were then used to develop a list of priority biodiversity features which are present or potentially present within the study area. This list underpinned the screening process of candidate critical habitat-qualifying features against PR6 criteria. Information was collated about each priority biodiversity feature to inform the screening process. Key species information included:

- the species name (scientific and common)
- habitat preference type
- conservation status
- date, location and author of the record
- population data (i.e. distribution, abundance and range) within the study area, region as well as on the national and global scales
- Known breeding sites within the study area, region, Albania and across their global range.

Key habitat information included:

- habitat name
- conservation status

- location
- Date and author of the record.

Key information regarding protected areas included:

- conservation status
- protected area boundary
- Key ecological characteristics and functions.

The following data sources were used to inform the assessment and identification of priority biodiversity features for the project (i.e. habitats and species):

- EU Habitats Directive (Annex I habitats)
- EU Birds Directive (Annexes 1, 2.1 and 2.2)
- Birds of Conservation Concern (Red/Amber list and not based on IUCN criteria)
- Convention on Migratory Species if any relevant species likely to be present (Appendices 1 and 2, AEWA, ASCOBANS, EUROBATS)
- IUCN Red List of Threatened Species (IUCN 2018)
- National Red List for Albania (2013)
- protected area citations (i.e. Buna River Ramsar citation) and published information regarding protected areas in the vicinity of the proposed project (i.e. Buna River Protected Landscape)
- Birdlife International Data Zone and information database
- Alliance for Zero Extinction (AZE) database
- Evolutionarily Distinct and Globally Endangered (EDGE) species database
- Published information regarding specific species and habitat information (i.e. journals and studies).

Candidate features were screened against PR6 criteria for priority biodiversity features as presented in Table 3-2.

Table 3-2 Criteria for the Identification of Priority Biodiversity Features

Priority Biodiversity Features	Criteria
Threatened habitats	Habitats considered under pressure by national, regional or international assessments. These include natural and priority habitats identified under the EU Habitats Directive (Annex I).
Vulnerable species	Species listed by the International Union for Conservation of Nature (IUCN) or any other national/regional lists (such as national Red Lists) as Vulnerable (VU) or equivalent. These include animal and plant species of community interest identified under the EU Habitats Directive (Annex II).
Significant biodiversity features identified by a broad set of stakeholders or governments	Key Biodiversity Areas and Important Bird and Biodiversity Areas; nationally and internationally important species or sites for conservation of biodiversity; many areas meeting natural habitat definitions of other international financial institutions.

Priority Biodiversity Features	Criteria
Ecological structure and functions needed to maintain the viability of priority biodiversity features	Where essential for priority biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.

(Source: EBRD 2014)

3.4.2 Determination of Critical Habitat

3.4.2.1 *Critical Habitat Definition*

The most sensitive biodiversity features are defined as critical habitat which have the highest degree of irreplaceability and vulnerability and as such are of the highest biodiversity value. No all priority biodiversity features qualify as critical habitat even though they remain of conservation importance.

The designation of an area as critical habitat is independent of the state of the habitat as critical habitat-qualifying biodiversity may be present in heavily degraded habitat. Critical habitat may also include an area that is not currently occupied by a species but is necessary for its recovery. Critical habitat is defined by EBRD PR6 as follows:

1. Highly threatened or unique ecosystems
2. Habitats of significant importance to endangered or critically endangered species
3. Habitats of significant importance to endemic or geographically restricted species
4. Habitats supporting globally significant migratory or congregatory species
5. Areas associated with key evolutionary processes
6. Ecological functions that are vital to maintaining the viability of biodiversity features described in this paragraph.

EBRD PR6 provides a more detailed explanation of these criteria, as presented in Table 3-3. To evaluate and assess EBRD's criteria 2 to 4, EBRD recommend using the threshold values as defined by IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources guidance notes (IFC, 2012) and the accompanying Guidance Note 6 (IFC, 2018). These IFC criteria and thresholds for determining critical habitat are presented in Table 3-4. These thresholds serve merely as a guide for decision-making and as there is no all-encompassing approach for the determination of critical habitat. IFC (2018) strongly promote the involvement of external experts particularly when data are limited.

IFC PS6 also recognises that Internationally Recognised Areas of high biodiversity value will also often qualify for critical habitat designation. For example:

- areas that meet the criteria of the IUCN's Protected Area Management categories Ia, Ib and II
- the majority of Key Biodiversity Areas (KBAs) which encompass, among others, Important and Biodiversity Bird Areas (IBA)
- UNESCO Natural and Mixed World Heritage Sites
- Sites that fit the designation criteria of the Alliance for Zero Extinction (AZE).

Table 3-3 EBRD PR6 Criteria for the Identification of Critical Habitat

Criteria	Definition
Highly threatened or unique ecosystems	Ecosystems that are at risk of significantly decreasing in area or quality; have a small spatial extent; and/or contain concentrations of biome-restricted species. For example: • Ecosystems listed as, or meeting criteria for, Endangered or Critically Endangered by the IUCN Red List of Ecosystems • Areas recognised as priorities in official regional or national plans, such as National Biodiversity Strategy and Action Plans • Areas determined to be of high priority/significance based on systematic conservation planning carried out by government bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally-recognised NGOs).
Habitats of significant importance to endangered or critically endangered species	Areas supporting species at high risk of extinction (Critically Endangered or Endangered) on the IUCN Red List of Threatened species (or equivalent national/regional systems). For example: • Alliance for Zero Extinction sites • Animal and plant species of community interest in need of strict protection as listed in EU Habitats Directive (Annex IV).
Habitats of significant importance to endemic or geographically restricted species	Areas holding a significant proportion of the global range or population of species qualifying as restricted-range under Birdlife or IUCN criteria. For example: • Alliance for Zero Extinction sites • Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for restricted-range species.
Habitats supporting globally significant (concentrations of) migratory or congregatory species	Areas that support a significant proportion of a species' population, where that species cyclically and predictably moves from one geographical area to another (including within the same ecosystem), or areas that support large groups of a species' population that gather on a cyclical or otherwise regular and/or predictable basis. For example: • Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for congregatory species • Wetlands of International Importance designated under criteria 5 or 6 of the Ramsar Convention.
Areas associated with key evolutionary processes	Areas with landscape features that might be associated with particular evolutionary processes or populations of species that are especially distinct and may be of special conservation concern given their distinct evolutionary history. For example: • Isolated lakes or mountaintops • Populations of species listed as priorities by the Edge of Existence programme.
Ecological functions that are vital to maintaining the viability of biodiversity	Ecological functions without which critical biodiversity features could not persist. For example: • Where essential for critical biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.

features described (as critical habitat features)	

Table 3-4 IFC PS6 Criteria for the Determination of Critical Habitat

IFC Criterion Type	Definition	Threshold Values
Criterion 1: Critically Endangered and Endangered Species	Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild.	(a) areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population and ≥ 5 reproductive units of a CR or EN species); The IUCN KBA Standard definition of reproductive unit: “the minimum number and combination of mature individuals necessary to trigger a successful reproductive event at a site (Eisenberg 1977). Examples of five reproductive units include five pairs, five reproducing females in one harem, and five reproductive individuals of a plant species.” (b) Areas that support globally-important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a). (c) As appropriate, areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species.
Criterion 2 Endemic and Restricted-range Species	The term endemic is defined as restricted-range. Restricted range refers to a limited extent of occurrence (EOO). For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 km^2. For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2. For coastal, riverine and other aquatic species in habitats that do not exceed 200 km width at any point (e.g., rivers), restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).	(a) areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.
Criterion 3: Migratory and Congregatory Species	Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem).	(a) areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a

IFC Criterion Type	Definition	Threshold Values
	Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis. For example: Species that form colonies. Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non-breeding purposes (e.g., foraging, roosting). Species that move through bottleneck sites where significant numbers of individuals of a species pass over a concentrated period of time (e.g., during migration). Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed. Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species).	migratory or congregatory species at any point of the species' lifecycle. (b) areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.
Criterion 4: Highly Threatened or Unique Ecosystems	The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species (see https://iucnrle.org). This should be used where possible. Where an IUCN assessment has not been performed, an assessment should be made using systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally-recognized NGOs).	(a) areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. (b) other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.
Criterion 5: Key Evolutionary Processes	Maintaining physical or spatial features which are of importance for evolutionary and ecological processes. Such features are often associated with species diversification. By conserving species diversity within a landscape, the processes that drive speciation, as well as the genetic diversity within species, ensures the evolutionary flexibility in a system, which is especially important in a rapidly changing climate.	No thresholds

3.4.2.2 *Identifying the Area of Analysis*

The spatial scale at which the critical habitat determination takes place depends on underlying ecological processes for the habitat in question and is not limited to the footprint of the project. The first stage in the screening process was to define the overall area of analysis (AOA or study area) for screening. In this instance landscape units were selected which encompassed key biodiversity features of interest and the ecological functions required to maintain them and the project footprint. The coverage of these landscape units is presented in Table 3-5 and their locations are illustrated in Figure 3-8.

Considering a broader landscape than just the project site demonstrates that the project is taking a precautionary approach to biodiversity so that all project risks are taken into consideration. Different landscape units may be required for different biodiversity features (i.e. species, habitats, ecological processes etc.) or in some cases the entire area of analysis may be considered during screening.

Table 3-5 Coverage of the Spatial Area of Analysis (or Study Area) and Landscape Units

Landscape Unit Type	Area (ha)	Area (km^2)
Beach and dune	214.7	2.1
Coastal lagoon	367.3	3.7
Lake Shkodra and River Buna Ramsar Site	48907.5	489.1
Renci Mountain and Agro-pastoral land	11580.3	115.8
Waterways	822.5	8.2
Wetlands	1035.2	10.4
Total Coverage of the Area of Analyses:	**62927.5**	**629.3**

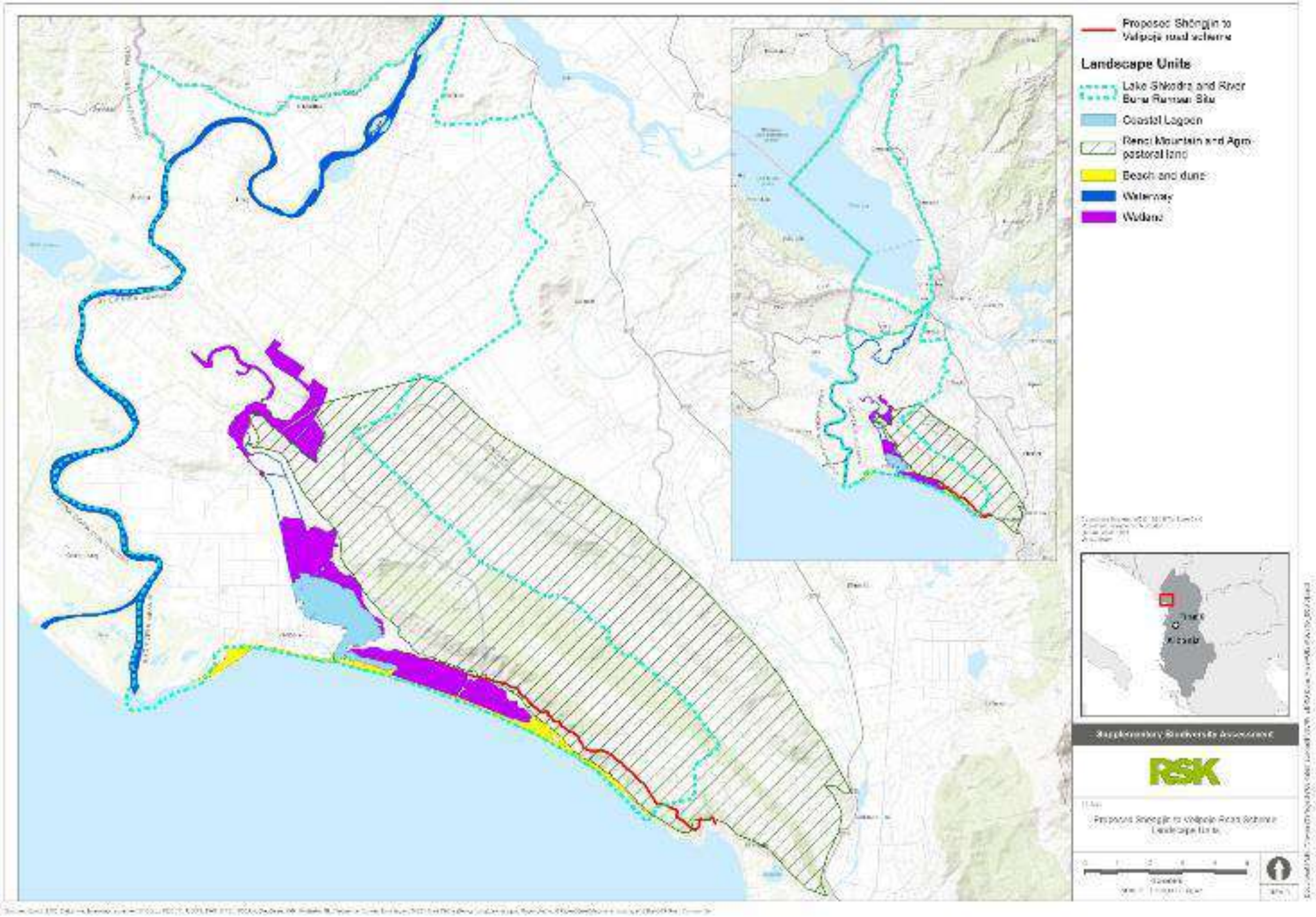

Figure 3-8 Area of Analysis and the associated Landscape Units

3.4.2.3 *Screening*

The first step in the screening process was to prepare a list of candidate habitats, species, sub-species and sub-populations based on the literature review, existing baseline data and the findings of the walkover survey. This candidate list built on that used for the determination of priority biodiversity features for the project. Where possible, as much additional information was collected about these biodiversity features as follows:

- estimates of population size at the global, national levels
- estimates of population density at the global, national levels
- ranges of extent of occurrence (EOO[1]) at the global, national levels
- distribution maps of species ranges
- area of occupancy (AOO[2]) at the global, national levels
- reproductive units of a species at the global and national levels (i.e. number of breeding pairs)
- Reliable records of species distribution and numbers and reproductive units within known protected areas relevant to the area of analysis and the surrounding landscapes.

Candidate features were then screened against the EBRD and IFC critical habitat criteria to determine critical habitat.

When considering the threshold criteria relevant to a species, the proportion of the global (or national) population represented by the units of analysis was based on the estimates of population and/or its distribution extent and, for some criterion, the number of reproductive units. The output value is a percentage of extent of its global or national population (and reproduction units) in which the area of analysis covers.

For some species the population size within the area of analysis was estimated by dividing the area of analysis by the known home range of an individual animal. Hence, if the global range of a species covers 1,000 km^2 and 100 km^2 of this range is included within the area of, the proportion is 10%. In some instances, the EOO or AOO provided a surrogate for population size. For some species where the estimates of population numbers and reproductive units are known, at the global scale and within the area of analysis (i.e. a protected area species account) the proportion was calculated as a percentage. For many species, particularly those that face a very high risk of extinction, no data was available, hence a precautionary approach was taken.

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[1] EOO is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy (IUCN, 2001)

[2] EOO is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy (IUCN, 2001)

4 RESULTS

4.1 Baseline Condition of the Study Area

4.1.1 Habitats

4.1.1.1 *Habitat Description, Condition and Conservation Status Within the Footprint and Buffer of the Proposed Development*

Habitats located within the footprint of the proposed road scheme and adjoining buffer zone were identified and described in accordance with the EUNIS Classification Scheme (European Environment Agency 2007 and 2010) during the walkover survey and targeted botanical survey. The habitat types and their coverage in the project footprint and buffer zone are summarised in Table 4-1. The locations of these habitat types are illustrated on the habitat map in Appendix 2 and a more detailed description is provided in Appendix 3.

The majority of the habitats located within the footprint of the proposed road and the adjoining buffer are common and widespread in nature and as such do not qualify as Annex 1 habitats (Table 4-1). However, a small section of the buffer overlaps the Annex 1 habitat type ‘embryonic shifting dunes’ (EU code 2110) which is likely to be artificially maintained by overgrazing and erosion. Furthermore, a significant proportion of the footprint comprises bare screes and stony / rocky Mediterranean grasslands. These screes were not thought to qualify as Annex 1 scree habitat types due to their poor floristic composition.

The footprint of the proposed road is 12.6 km in length and covers approximately 12.5 ha. Approximately 2.3 km of the road scheme, located at the north-western end of the proposed road near Velipojë, falls within the alignment of the existing Rruga Banks Rrjollë road. This is a predominantly unsurfaced road that extends from the settlement at Baks-Rrjollë, beyond Rrjolli, across exposed sand and connects houses located either side of the alignment (see Figure 1.1).

From this point the proposed road alignment gradually rises to the ridge of Mount Renci and the site of a degraded settlement over a distance of approximately 5.25 km. This section of the proposed alignment crosses unvegetated dunes located at the base of Mount Renci, followed by a mosaic of oak scrubland, small stands of Mediterranean evergreen Quercus forest dominated by *Quercus ithaburensis* (IUCN least concern, LC), areas of sparsely vegetated scree, poorly vegetated cliffs and small areas of exposed rock faces.

Over the ridge of Mount Renci, the alignment traverses a mosaic of degraded pasture, fallow and regenerating fallow (grazed by cattle and pigs at the time of survey) that surrounds the degraded settlements. From this point the footprint crosses an adjoining area of maquis, arborescent matorral and thermo-Mediterranean scrub, before joining an existing unsurfaced road / track. The footprint of the proposed road then roughly follows the alignment of this existing road / track for approximately 3.7 km before joining Bulevardi Nënë Tereza near Shëngjin port. Habitats located along this portion of the proposed alignment were dominated by a mosaic of bare ground, maquis, arborescent matorral and thermo-Mediterranean scrub, and miscellaneous inland habitats with sparse or no vegetation. This transitioned into coniferous forest dominated by pine plantations, regenerating pine scrub (arising from the clearance of pine stands) and settlements near Shëngjin. Pomegranate trees line the track near Shëngjin.

Habitat quality varied across the extent of the proposed alignment. Habitat degradation arising from felling trees and habitat clearance was most apparent in close proximity to scattered households near Shëngjin, Baks-Rrjollë and the degraded settlements. The area represents a good food resource for livestock, hence evidence of grazing by goats, cattle and pigs was observed throughout the majority of the proposed road alignment and represents a significant pressure on habitats and flora. However, grazing is concentrated more in the lower altitudes and northern and southern margins close to the villages in Velipojë and Shëngjin. Habitats located at higher altitudes e.g. old relict woodlands and well-preserved pastures, appear to be under less pressure. Habitats are regenerating in which some vegetation communities represent successional phases towards climax conditions with a fast regeneration ratio. New access roads to some individual houses located on Mount Renci are being opened resulting in habitat fragmentation in a few locations. Erosion was evident near Baks-Rrjollë resulting in the un-stabilisation of areas of the dune system. Discarded household waste and litter were recorded adjacent to the scatted households near Shëngjin.

Table 4-1 Habitat Types and Estimated Coverage Within the Proposed Road Footprint and Buffer Zone

EUNIS Habitat Types	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Habitats Located within the Footprint and / or Buffer Zone of the Proposed Road Alignment			
Broadleaved deciduous woodland (G1.78 *Quercus trojana* woodland)	Does not qualify	4.1	28.11
Thermophilous Deciduous Woodland	In wider terms this vegetation community is related with two Annex 1 habitats, one of which is priority habitat:	NA	NA
	*91H0: Pannonian woods with *Quercus pubescens*		
	91M0: Pannonian-Balkanic turkey oak –sessile oak forests		
	Further field work and data elaboration is needed on order to clearly define the Annex 1 relevance		

EUNIS Habitat Types	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Coniferous woodland	Does not qualify	2.0	12.63
Punica granatum dominated communities	Does Not qualify	0.1	0.77
Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)	Does not qualify	1.3	9.12
Maquis, arborescent matorral and thermo-Mediterranean scrub	Does not qualify	2.1	14.1
F6.3 - Illyrian garrigues (F6.36 - Illyrian Teucrium and other labiates garrigues)	Does not qualify	NA	NA
E.1 – Dry grasslands (E1.3 : Mediterranean xeric grassland)	Does not qualify	NA	NA
Miscellaneous inland habitats with sparse or no vegetation	Does not qualify	1.5	10.7
Bare screes and stony / rocky medtiterranean grasslands	A number of scree types are categorised as Annex 1 habitats (i.e. 8110, 8120, 8130, 8140, 8150, 8160). Annex 1 scree habitat was not encounter during the field survey. Some screes were observed, but these were bare screes with no typical vegetation and as such were not classified as any of the Annex I scree habitats.	1.3	9.97
H3 : Inland cliffs, rock pavements and outcrops (H3.5 : Almost bare rock	*8240 – Limestone pavement 8210 - Calcareous rocky slopes with chasmophytic vegetation	NA	NA

EUNIS Habitat Types	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
pavements, including limestone pavements)			
Coastal dune and sandy shore	(EU code 2110) Embryonic shifting dunes	1.2	7.17
Coastal saltmarshes and saline reedbeds	1410 : Mediterranean salt meadows (*Juncetalia maritimi*)	NA	NA
Arable and market gardens	Does not qualify	0.2	1.96
Low density buildings	Does not qualify	3.9	32.0
Additional Habitats Located Outside the Footprint and Buffer of the Proposed Road Alignment, Within The AOI			
Coastal habitats	N/A	N/A	N/A
B1.31 : Embryonic shifting dunes	1210- Annual vegetation of drift lines	NA	NA
Coastal saltmarshes and saline reedbeds	1410 : Mediterranean salt meadows (*Juncetalia maritimi*)	NA	NA
F9.3 - Southern riparian galleries and thickets	92D0: Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)	NA	NA
B.1.7 – Coastal dune woods	*2270: Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*	NA	NA
Sand beaches above the driftline	Does not qualify	N/A	N/A
Coastal dune and sandy shore	(EU code 2110) Embryonic shifting dunes	N/A	N/A
Brackish coastal lagoons	(EU Code 1150) Coastal lagoons priority Annex 1 habitat	N/A	N/A
Inland cliffs, rocky pavements and outcrops	(EU code 8210) Calcareous rocky slopes with chasmophytic vegetation	N/A	N/A
Geolittoral wetlands and meadows: reed, rush and sedge stands: natural stands	Does not qualify	N/A	N/A

EUNIS Habitat Types	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Inland dune juniper scrubs	Does not qualify	N/A	N/A
Arable and market gardens	Does not qualify	N/A	N/A
Low density buildings	Does not qualify	N/A	N/A

4.1.1.2 *Habitat Description and Condition of the Surrounding Landscapes*

Principal habitats within the vicinity of the proposed road scheme are agro-pastoral land, sand dunes, beach, lagoon and wetlands. The closest portion of the beach to the proposed project is located at the foot of Mount Renci and adjoins an area of dune wetland. Primary sand dunes located between the beach and the base of Mount Renci are unvegetated and mobile. In some areas, the dunes are approximately 50 m high and are formed by wind action. Within sections of the more stabilised and vegetated dune system, over grazing, habitat clearance and vehicle movement compounded by water and wind action appear to have caused erosion, exposing the sand.

Wetlands were recorded in the lowlands between the hill range, beach and lagoon. At the time of survey, these wetlands were dominated by swards of *Juncus* sp interspersed with herbs and *Carex* species. Several scattered waterbodies were also observed within this wetland area at the time of survey. The encroachment of settlements and grazing have impacted the integrity of wetlands within this area including the halophytic habitats, *Juncus maritimus* / *Juncus acutus* communities including the saltmarshes with the annual *Salicornia europaea*.

The Viluni coastal lagoon is located north-east of the proposed road scheme approximately 390 m from the footprint at the closest point. At the time of survey, aqua culture and fishing were being undertaken within the lagoon. Coastal lagoons are categorised as priority Annex I habitat types (Table 4-1).

Mount Renci and the adjoining wetlands and lagoon are flanked by agro-pastoral land and scattered settlements to the north (Figure 1-1). The prevailing wind has resulted in the deposition of sand on Mount Renci basement, covering water depressions and changing the soil typology in some areas.

4.1.2 Protected Area Status

The proposed project traverses the Buna River Protected Landscape, IUCN Category 5; national park category 2, RAMSAR, Important Bird Area, Important Plant Area and candidate Emerald Network Site. The boundaries of these protected areas are presented in Figure 4-1 and are discussed below in more detail.

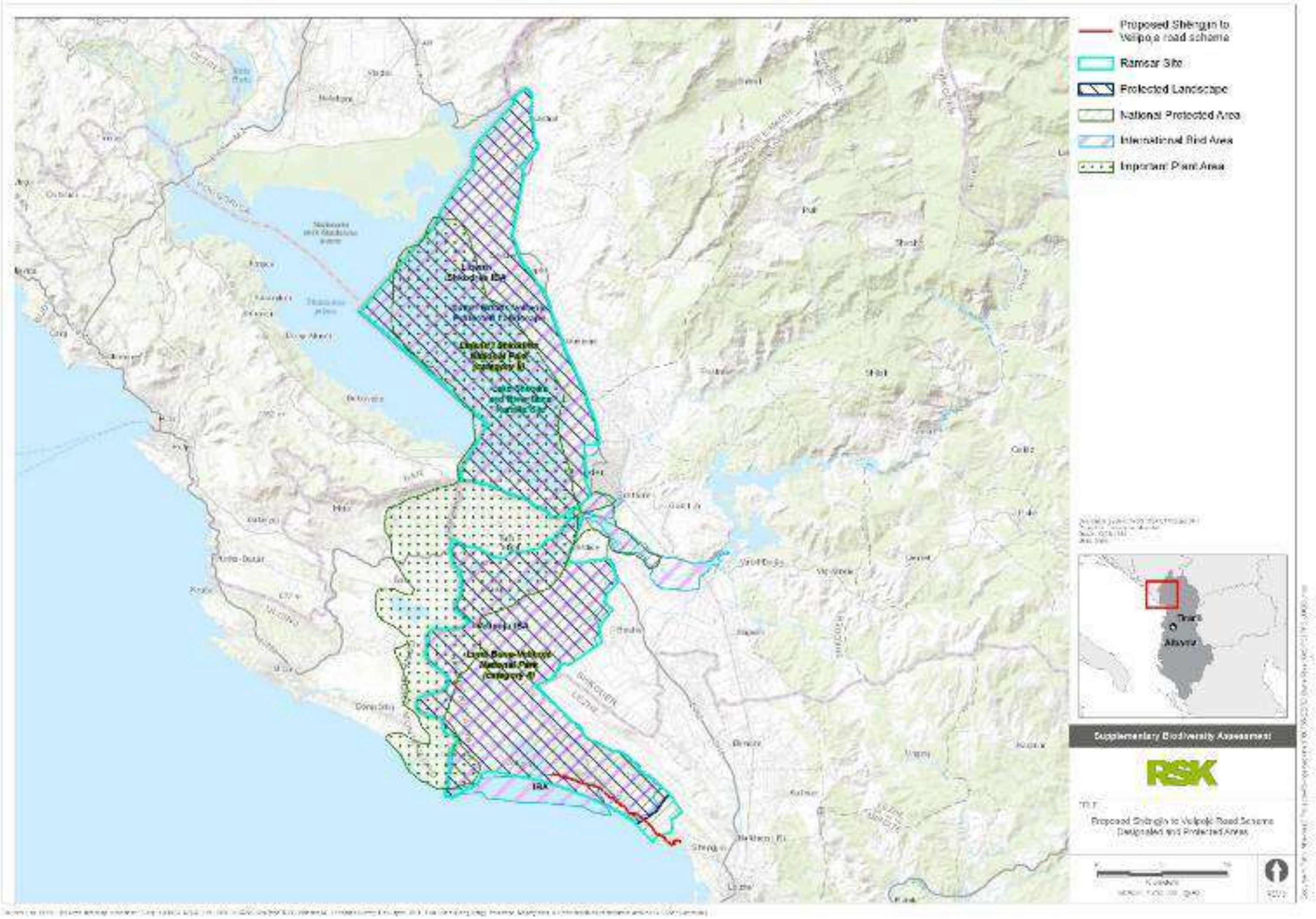

Figure 4-1 Distribution of Protected Areas in the Study Area

4.1.2.1 *Buna River Protected Landscape*

The Buna River Protected Landscape (IUCN Category 5, also national park category 2) is situated in Skadar district and covers 1900 ha. It encompasses the estuary of Drin, the lagoon of Viluni, the river of Buna / Bojana with its estuary, and the gulf of Drin that runs across the city of Velipojë adjacent to the Adriatic Sea (Figure 4-1).

The Ministry of Environment, Forestry and Water Administration, is responsible for administration of the Buna River Protected Landscape / Landscape Management and the development of the management plan for the protected area. The site is currently under the management of the Skadar Forestry Service Directorate.

The Protected Landscape is characterised by a complex hydrologic system with rich water resources and wetlands interspersed by small islands. Habitat within the protected landscape comprises aquatic habitats, wetlands, forests, riparian habitats and dune systems.

The Protected Landscape provides habitat for threatened and protected species. The site is known to support approximately 320 threatened and rare flora species including water caltrop (*Trapa natans*; IUCN LC; national Red List endangered, EN) and European oak (*Quercus robur*; IUCN LC; National Red List vulnerable, VU). The delta wetlands provide important habitat for birds including the nationally rare species, the pygmy cormorant (*Microcarbo pygmaeus*; IUCN LC; National Red List critically endangered, CR) and wintering migratory species, some of which are protected by the Bonn Convention. The landscape supports 107 fish species including the Atlantic sturgeon (*Acipenser sturio*; IUCN CR; National Red List EN). Protected mammals in the area include golden jackal (*Canis aureus*; IUCN LC, National Red List VU), brown bears (*Ursus arctos*; IUCN LC; National Red List VU), common bottlenose dolphins (*Tursiops truncates;* IUCN LC; National Red List low risk, LRcd) and Eurasian otter (*Lutra*; IUCN near threatened, NT; National Red List VU) (IUCN, 2012; AKZM National Agency of Protected Areas Date, 2018).

The Buna River Protected Landscape was designated under Regulation No. 682 and is divided into zones. A description and the locations of these zones are presented in Figure 4-2 and Table 4-2. The majority of the proposed project is located in Zone B (2b) and a small portion is located in the Central Zone 1b.

Figure 4-2 Zonation of the Buna River Protected Landscape

Table 4-2 Description of the Buna River Protected Landscape Zones

Zones	Descriptions
Central Zone A (1a)	This zone is regarded the most sensitive and as such the first degree of protection is applied, in support of Law No. 8906, dated 6.6.2002 On Protected Areas. The area comprises: • Part of the Buna River and its banks by joining the Drin River up to the village of Obot • The banks of the Buna River in the western part of the Velipoja reservoir, from the mouth of the river to the northern edge of the island Ada and 200 m to the inland reserve • Franc Joseph's coast and east coast of the estuary, up to 2 km in length and 300 m in width, to the south • The central and northern part of the Vilun lagoon; • The peninsula on the beach of Baks-Rrjollit and a width of 300 m south of the coastline to the sand of the Jail. • The central part of Domn and Murtemza marshes
Central Zone A (1b)	The second degree of protection is applied in this area, in support of the law no.8906, dated 6.6.2002 On Protected Areas. The area comprises: • the part of the Buna River at a length of 3 km in the right side of the river, in the north of the village of Oblika • the part of the river from the village of Obot (bounded to the north by the part mentioned at point A.1 to the point opposite the northern edge of the island Ada (limited to

Zones	Descriptions
	the south by the part mentioned in point A.1), with a width 200 m to the east - the whole area of the Velipoja reservoir, with the exception of that included in point A.1 above - the southern part of the lagoon of Vilun (residing from the part included in point A.1) and the entire marshy area surrounding the lagoon shores - the Baks-Rrjoll area, remaining from the part included in point A.1 to the altitude of 335 m on the slope of Mount Kolaj, in the north - the part of the swamps of Domni and Murtemza, surrounding the one mentioned in point A.1.
Central Zone A (1c)	In this area the third degree of protection applies, in support of law no.8906, dated 6.6.2002 On Protected Areas This area comprises: - the part of the Buna River, with a length of 2 km, between the villages of Shirq and Obot, on the right side of the river - at the length of the bridges 2 km of Buna River, north of Dajç village, on the left side of the river.
Traditional development zone (zone B – 2a on map)	Comprises: - areas of Velipoja, with an area of 2500 ha; - Pentar fields, with an area of 850 ha; - ponds (former fish tanks) of Reç village, with surface area of 114 ha; - Pastures of the Bridge of Joy and Domni Bridge, with a surface of 2200 ha. In this area, the fourth degree of protection is implemented, in support of Law No. 8906, dated 6.6.2002 "On Protected Areas", where recreational, educational, eco-tourism activities are permitted, as well as traditional land use, in full harmony with the preservation of the nature and the social and cultural values of the local community.
Traditional development zone (Zone B on map 2b)	Comprises: - the territory that starts from the village of Pentar, on the border with Montenegro, continues through the swamps of the river Buna of the Rrencë hills and descends to the coast at the sand of Jumping, dubbed a migration corridor. In this area, the fourth degree of protection is implemented, in support of Law No. 8906, dated 6.6.2002 "On Protected Areas", but for the characteristics it offers, special management plans are required.
Transition area (zone C) on the map marked 3	Comprises: - Velipoja beach, limited to the west by the Velipoja reserve, north of the motorway and stretch, to the east, up to 500 m in front of the channel communication of the lagoon of Vilun with the sea. In this area, the fourth degree of protection is implemented, in support of the law no.8906, dated 6.6.2002 "On Protected Areas".

Zones	Descriptions
	Farming activities can be conducted in this area, and land can be used for various tourist, sporting, educational, recreational purposes, which do not affect nature and biodiversity, based on the sustainable development and management of the natural resources of the area.

The Buna Delta Protection Project has been established to ensure the long-term conservation of species and habitats in the Protected Landscape. The project aims to halt or reduce unsustainable development and water abstraction which are threatening the site's biodiversity and integrity. The project is supported by several stakeholders including the Ministry of Tourism and Environment, the Ministry of Agriculture, Rural Development and Water Administration, Municipality of Shkoder, the National Agency for Protected Areas and Skadar Regional Administration for Protected Areas (IUCN, 2018).

The Integrated Resources Management Plan for the Buna / Bojana Area has been developed which promotes an ecosystem approach to the conservation and sustainable use of natural resources and combines methodologies for Integrated Water Resources Management and Integrated Coastal Zone Management into an integrated framework (GWP-Med, PAP/RAC and UNESCO-IHP, 2017).

4.1.2.2 *Lake Shkoda and River Buna Ramsar Complex*

The majority of the proposed project is located in the Lake Shkoda and River Buna Ramsar site. This Ramsar complex covers 49,562 ha and is located on the east of border between Albania and Montenegro (Figure 4-1). The northern portion of the site falls into the district of Malesia e Madhe and the remaining portion is located in the district of Skadar. The site comprises a mosaic of freshwater habitats, brackish water habitats, woodland, freshwater marshes, wet pastures, sandy shore and rocky habitats.

The hydrological connection of Lake Skadar, Buna River and Drin River and the presence of wetlands are of importance in terms of flood control, sediment trapping and shoreline stabilization.

Thirty-six plants listed on the National Red List of Albania (2013) as being of unfavourable conservation status inhabit the site, of which twelve are listed as endangered, twelve as vulnerable, ten as rare and one as endemic (*Querqus robur* subsp. *scutariensis*). There is insufficient knowledge regarding the remining two species. A total of 108 plant species recorded in the Ramsar Site are listed in the Red List of Peatlands of International Biodiversity Conservation Importance in Europe (Heinicke & Joosten).

The Ramsar site supports rich fauna biodiversity, particularly in context of biodiversity at the national scale, including species of national and global conservation importance. These include:

- Insects:
    - great capricorn beetle (*Cerambyx cerdo*) - IUCN VU; Albanian Red List EN
- Fish:
    - European sea sturgeon (*Acipenser sturio*) - IUCN CR; Albanian Red List EN

    - Adriatic sturgeon (*Acipenser naccarii*) - IUCN CR; Albanian Red List EN
    - stellate sturgeon (*Acipenser stellatus*) - IUCN CR; not evaluated by the Albanian Red List
    - *Salmothymus obtusirostris* - IUCN LC; Albanian Red List EN
- Birds
    - Dalmatian pelican (*Pelecanus crispus*) - IUCN LC; Albanian Red List CR
    - red-breasted goose (*Branta ruficollis*) - IUCN VU; Albanian Red List CR
    - white-headed duck (*Oxyura leucocephala*) – IUCN EN; Albanian Red List CR
    - marbled teal (*Marmaronetta angustirostris*) – IUCN VU
    - slender-billed curlew (*Numenius tenuirostris*) – IUCN CR; Albanian Red List CR
- Mammals:
    - Mediterranean horseshoe bat (*Rhinolophus Euryale*; IUCN NT; Albanian Red List VU)
    - long-fingered bat (*Myotis capaccinii*; IUCN VU; Albanian Red List locally rare (LR/cd)).

This area is characterised by a high diversity of fish species, due to the diversity of its water resources (i.e. fresh, brackish and marine) and habitats. The hydrological network of the Southwestern Balkan, Lake Skadar and Buna and Drin rivers (including Ohrid and Prespa lakes) provide foraging, spawning habitat and nursery grounds for fish in addition to habitats for migratory fish (ichthyofauna). The Buna River is a migration corridor for thirteen fish species who migrate from the sea to these lakes and rivers. Six of these migratory fish species are globally rare and threatened as listed above.

The Ramsar site is one of the three migration routes for European birds in the north to south direction and provides wintering habitat (in the Eastern Mediterranean) for woodlark (*Lullula arborea*; IUCN LC) that accounts for approximately 1% (over 10.000 individuals) of the species' European population. Bird monitoring at the site has reported wintering water birds to have reached between 24,000 – 30,000 individuals (Hagemeijer et al. 1993; Bino 2002, Schneider-Jacoby et al. 2004). Waterbirds recorded in the site in 2003- 3004 in large numbers include great cormorant (*Phalacrocorax carbo*; IUCN LC; approximately 3100 individuals), Dalmatian pelican (approx. 30 individuals) and spotted redshank (*Tringa erythropus*; IUCN LC; approx.1000 individuals) (Schneider-Jacoby et al. 2004).

4.1.2.3 *Important Bird Area and Key Biodiversity Area*

The northwest end of the footprint of the proposed project is located within the Velipoja – Albania Important Bird Area (IBA) and Key Biodiversity Area (KBA) (Figure 4-1). The IBA and KBA comprises two coastal areas, namely the Viluni or Velipoja lagoon (covering 390 ha) and surrounding Velipoja Game Reserve (covering 694 ha), and the Dumi wetland (Keneta e Dumit). Habitats located within the IBA include a large reedbed within the inland Dumi wetland and surrounding marshes; shallow coastal lagoon; drainage channel; a rocky and forested mountain area (Bregulbunes mountains) that abuts with the lagoon; sand-dunes; beaches; small brackish pools; and riparian deciduous woodland (BirdLife International, 2018).

The site is important for wintering waterfowl (approximately 8,000 individuals were recorded in 1993) and for migratory waterbirds. Eurasian spoonbills (*Platalea leucorodia*;

IUCN LC; National Red List EN) and pygmy cormorants use habitats within the IBA. These species used to breed inside the IBA near the mouth of Buna River, but due to anthropogenic disturbance these species now breed on Ada island in Montenegro (BirdLife International, 2018).

4.1.2.4 *Important Plant Area*

The project is located outside of the Skoda Lake and Buna River Important Plant Area (IPA). This IPA supports nine EU Habitats Directive or Bern Convention threatened habitats including one priority habitat, and two species of conservation concern (Shuka, Xhulaj and Quiro, 2010a).

The project is however located within the Grykederdhja e Bunes – Velipojës IPA (Figure 4-1). This IPA covers 3,527 ha and supports sixteen EU Habitats Directive or Bern Convention threatened habitats including two priority habitats and three species of conservation concern including two species of European threat (Shuka, Xhulaj and Quiro, 2010b).

4.1.2.5 *Alliance for Zero Extinction Sites*

There are no Alliance for Zero Extinction Sites in Albania. These sites are of high conversation importance and are designated when the site meets a set of criteria including the following: “if the site is the sole area where an EN or CR species occurs, contains the overwhelmingly significant known resident population (>95%) of the EN or CR species, or contains the overwhelmingly significant known population (>95%) for one life history segment (e.g. breeding or wintering) of the EN or CR species” (Alliance for Zero Extinction, 2018).

4.1.2.6 *Emerald Network Candidate Site Status*

The Emerald Network is an ecological network of Areas of Special Conservation Interest (ASCIs), which were established to conserve the species and habitats of the Bern Convention requiring specific protection measures.

The network was launched by the Council of Europe as part of its work under the Convention on the Conservation of European Wildlife and Natural Habitats (or Bern Convention). These habitats and species are listed respectively in Resolution No. 4 (1996) and Resolution No. 6 (1998) of the Standing Committee to the Bern Convention. The Natura 2000 sites are considered as the contribution from the EU member States to the Emerald Network.

The identification of Emerald sites for Albania took place during 2002-2008 and in total, 25 candidate sites were selected. The proposals were evaluated by ETC/BD and Council of Europe during 2010-2012. The Standing Committee of the Bern Convention, in its 32 meeting, in December 2012 accepted the proposal of all 25 areas for Albania (Ministre E Mjedist 2015).

The Buna River Protected Landscape is therefore a candidate Emerald site (Council of Europe, 2018). Once a candidate site is officially adopted as an Emerald Network site, it is designated and managed at national level by employing measures that contribute to the main objective of the Network.

“Management

2.1 The national designation of the adopted Emerald sites will ensure that they are protected from external threats and subject to an appropriate regime for achieving a satisfactory conservation status of the species and natural habitats listed in Resolutions no. 4 (1996) and no. 6 (1998) present on the site, involving, if and where appropriate, management plans, administrative measures and contractual measures;

2.2 The authorities responsible for the implementation of the management measures and their monitoring will be clearly identified;

2.3 Specific short and long-term site objectives will be drawn up for the management of Emerald sites, in compliance with the national/regional conservation objectives of the country, in order to facilitate the monitoring of their implementation and the regular assessment of their achievement;

2.4 National, regional and local stakeholders will be involved, if and where appropriate, in the planning of the management of the sites, as well as in the implementation of the conservation and protection measures foreseen, and in the monitoring of the sites' management."

4.1.3 Flora

4.1.3.1 *Flora Species of Conservation Importance*

The walkover survey undertaken in November 2018 did not identify the presence of endemic, nationally and / or globally threatened or rare vascular plants within the project footprint and buffer. It is however important to acknowledge that the survey was undertaken at a sub-optimal time of survey when many annual species had senesced.

The subsequent botanical survey undertaken in June 2019 confirmed the presence of 97 plant species in the project area. A full list of vascular plant species and their habitats of occurrence is presented in Appendix 4. Only a small portion of these species have been assessed by the IUCN Red List of Threatened Species (2019) and these assessed species are categorised as LC. In total, 14 plant species located within the project footprint are rare and threatened at the national scale, see Figure 4-3 for recorded locations. These species are listed as follows and are further described in Table 4-3:

- Albanian Red Listed CR:
    - *Punica granatum*
- Albanian Red Listed EN:
    - *Colchicum autumnale*
    - *Galatella albanica* - A national endemic located in *Quercus trojana* woodlands
    - *Origanum vulgare*
    - *Hypericum perforatum*
    - *Quercus ilex*
- Albanian Red Listed VU:
    - *Arbutus unedo*
    - *Erica arborea*
    - *Juniperus oxycedrus ssp. Macrocarpa*
    - *Ostrya carpinifolia*
    - *Quercus pubescens*

    - *Salvia officinalis*
    - *Satureja montana*
- Albaian Red Listed LRcd:
    - *Crataegus heldreichii*

Figure 4-3 Location of Rare, Threatened and Endangered Flora Species

Table 4-3 Rare and Threatened Flora Species Recorded during the Botanical Survey

Scientific name	IUCN 2019 status	Albanian Red List (2013)	Endemic status	Habitat of Occurrence	GPS points
Species Located Within the Road Alignment					
Arbutus unedo		VU A2c		Maquis	392, 396
Colchicum autumnale		EN A1b		*Quercus trojana* woodland	431 (The assumtion is that this species is all over the same habitat)
Crataegus heldreichii		LR cd		*Ostrya caprinifolia* woodland,	409, 419
Erica arborea		VU A2c		Maquis	392, 396
Galatella albanica		EN A1b	National endemic	*Quercus trojana* woodlands	438, 440-480
Hypericum perforatum		EN A1b		Everywhere (in all vegetation communities)	398, 412, 415
Juniperus oxycedrus ssp. macrocarpa		VU A1b		Coniferous forests and mediterranean stony grasslands	389, 392
Matthiola tricuspidata		EN A1b	Subendemic	*Quercus trojana* woodland	Literature
Origanum vulgare		EN A1b		*Quercus trojana* woodland	409, 414
Ostrya carpinifolia		VU A2c		*Ostrya caprinifolia* woodland	419, 431
Punica granatum		CR B1		*Punica grannatum* shrublands, Coniferus forests	389-393, 422, 423
Quercus ilex		EN A1b		Maquis	Literature
Quercus pubescens		VU A2c		*Quercus trojana* woodland, *Ostrya caprinifolia* woodland	431
Salvia officinalis		VU A1b		*Quercus trojana* woodlands, Mediterranean stony grasslands, but more or less everywhere	400, 408, 416, 429, 430, 431, 432, 435, 437

Satureja montana		VU A1c		*Quercus trojana* woodlands, Mediterranean stony grasslands, but more or less everywhere	398, 400, 408, 410, 413, 416, 431, 432, 435, 436, 437
Viburnum tinus		EN			Literature

According to the Lake Skadar and River Buna Ramsar site information sheet (Ramsar, 2005) this Ramsar site supports the endemic *Querqus robur* spp *scutariensis.* The literature review identified one account of this subspecies as occurring within fragmented agro-pastoral land and meadows near the village of Gostilj near Lake Skadar (Pešić et al., 2018). European oak (*Quercus robur*) is IUCN LC and listed as VU by the National Red List, however neither red list mentions this particular sub-species. Furthermore, the review did not yield any information to validate the authority and validity of the taxonomic classification of this sub-species.

Lake Skadar and River Buna Ramsar site also reportedly supports the following vascular plant species which are threatened and rare in Albania:

- European waterclover (*Marsilea quadrifolia*) – EN
- Marsh pennywort (*Hydrocotile vulgaris*) – VU
- European frogbit (*Hidrocharis morsus-ranae*) – EN
- Lax-flowered orchid (*Anacamptis laxiflora*) – EN
- *Anacamptis palustris* – EN
- Sea daffodil (*Pancratium maritimum*) – EN
- *Desmazeria marina* – EN
- Sea grape (*Ephedra distachya*) – EN
- *Olea oleaster* – EN
- Bay laurel (*Laurus nobilis*) – EN
- Flowering-rush (*Butomus umbellatus*) – VU
- Great fen-sedge (*Cladium mariscus*) – VU
- Yellow water-lily (*Nuphar lutea*) – VU
- European white waterlily (*Nymphaea alba*) – VU
- *Nymphoides peltate* – VU
- Arrowhead (*Sagittaria sagittifolia*) – VU
- Water caltrop (*Trapa natans*) – EN
- *Adiantum cappilus-veneris* – VU
- Lesser water-plantain (*Baldellia ranunculoide*) - CR
- Greater duckweed (*Spirodela polyrhiza*) – VU
- Field elm (*Ulmus minor*) – VU
- *Hippuris vulgaris* - CR
- Crack willow (*Salix fragilis*) – VU
- *Nymphoidetum peltate* - VU

These species are all listed LC by the IUCN Red List of Threatened Species (2018). The presence of these species outside of the Ramsar site is uncertain in the absence of a detailed botanical survey.

4.1.3.2 *Alien Invasive Species of Flora*

The accidental or intentional introduction of alien invasive species into ecosystems poses a threat to the integrity and floristic diversity of habitats. Many species of alien invasive flora rapidly spread (e.g. through the effective transfer of seeds) and are aggressive competitors, capable of progressively dominating areas of natural habitat. The proportion of alien invasive flora species in Albania is the lowest in Europe. This is likely to be a consequence of the long-term seclusion of the country and the low level of economic development (Barina 2014). The Ministry Environment, Forests and Water Administration stated that invasive species are not yet a major threat to the biodiversity of Albania, but there has been a lack of research to validate this (MoE, 2011). However, according to the Global Invasive species database (IUCN GISD 2018) there are 59 alien invasive terrestrial flora species in Albania. Alien invasive species that may potentially be present in the area are presented in Table 4-4. No invasive vascular plant species were observed within the project footprint during the walkover survey undertaken in November 2018 or the botanical survey undertaken in June 2019.

Table 4-4 Alien Invasive Vascular Plant Species

Scientific Name	Common Name	Habitat of Occurrence
Xanthium spinosum	Rrodhe	Sand dunes
Datura stramonium	Tatull	Everywhere
Solanum nigrum	Ikër, idhnakth i zi, rrushzogu	Sand dunes
Eucalyptus globulus	Eukalipt rruzullor	Alongside the roads, saltmarshes
Erigeron canadensis	Erigeron i Kanadasë	Saltmarshes
Helianthus tuberosus	Mollë e dheut, mollëdheu	-
Paspalum paspalodes	Gram uji, krisje uji, krisël	Sand dunes
Oenothera biennis	Enotherë dyvjeçare	Sand dunes
Aster squamatus	Aster luspor	Sand dunes and water channels
Amaranthus albus	Nenë e bardhë	-
Cuscuta sp. Div.	Roth, viranot	-
Robinia pseudacacia	Akacie	In the vegetation margins nearby, human interventions and agriculture activities

(Source: unpublished scientific data provided by Dr Ermelinda Mahmutaj)

4.1.4 Mammals

4.1.4.1 *Mammals of Conservation Importance*

The proposed project is reportedly located within a wider wildlife corridor for mammal species and may potentially provide habitat for commuting wolf (*Canis lupus* IUCN LC and National Red List NT) and European roe deer (*Capreolus capreolus;* IUCN LC; National Red List VU) (Schneider-Jacoby et al, 2006). According to Schneider-Jacoby et al (2006) the presence of bears (*Ursus arctos;* IUCN LC; National Red List VU) has been reported in the area, however other comprehensive accounts (Kaczensky et. al. 2013) do not indicate that the area is permanent bear habitat. There is potential that the area is sporadically used by bears as a transitory corridor.

This corridor extends from Klezna to Shëngjin and comprises the two parallel hill ranges (Mount Renci where the project is located and Mount Jushi - Mali i Jushit), surrounded by agro-pastoral land, the beach and delta. According to Schneider-Jacoby et al (2006), this corridor is of conservation importance at the European scale.

The Buna River Protected Landscape and Ramsar Site which overlaps a portion of this corridor reportedly supports a number of fauna species of conservation importance (IUCN, 2012; AKZM National Agency of Protected Areas 2018) namely, brown bears (*Ursus arctos*), golden jackal (*Canis aureus;* IUCN LC; National Red List VU), Eurasian otter (*Lutra Lutra;* IUCN NT; National Red List VU), Mediterranean horseshoe bat (*Rhinolophus euryale;* IUCN NT; National Red List VU) and long-fingered bat *(Myotis capaccinii;* IUCN VU; National Red List LR/cd).

The walkover survey undertaken in November 2018 identified indirect evidence indicative of fauna activity (i.e. faeces; scrapes and prints) within the footprint of the proposed road and adjoining buffer, namely;

- Eurasian badger (*Meles meles*) – IUCN LC; Albanian Red List EN
- red fox (*Vulpes vulpes*) - IUCN LC
- wild boar (*Sus scrofa*) - IUCN LC
- Marten species (*Martes sp.*)

Prints of golden jackals and brown hare (*Lepus europaeus*) were also recorded outside the search area, approximately 650 m from the road at the closest point. The locations of these fauna records are presented in Appendix 6.

In addition to direct evidence from the field, local residents met during the field survey identified the presence of wolves, golden jackals and wild boars within and in close proximity to the project area and provided anecdotal accounts of the damage that these species cause to property and cattle. Local residents considered the presence of bears and roe deer in the area to be unlikely. Further informal discussions were held where possible during the additional surveys in June 2019. Three respondents confirmed the presence of golden jackals in the area and stated that they have been permanent in the area with increasing numbers and frequency since the end of the communist regime, corresponding with golden jackals being given protected status. All locals confirmed the species that were recorded via the camera trap survey, as well as stating that wolves and wild boar do use the area, albeit rarely.

Mammal species recorded during the camera trapping survey are listed in Table 4-5. Four of these species are nationally rare and threatened: the Eurasian badger, golden jackal, wildcat and stone marten.

Eurasian badger was recorded on five sperate occasions by camera trap 3 amongst broadleaved deciduous woodland (*Quercus trojana* woodland) approximately 4.5 km from Shëngjin. One individual golden jackal was recorded by camera trap 3 on one occasion and one individual golden jackal was recorded by camera trap 2 located amongst maquis, arborescent matorral and thermo-Mediterranean scrub near the road alignment approximately 4 km from Shëngjin. This confirms habitat usage by golden jackals in the upland rocky areas of Mount Renci within the section of the proposed route between Shëngjin and Margjoaj village. The vocalisation survey results (presented below) also confirmed the presence of a group of golden jackals within this area and the lowland habitats at the base of Mount Renci. Collectively these results indicate that golden jackals use the upland areas of Mount Renci to commute back and forth from one lowland area to another, whilst denning / residing in the lowland habitats. The evidence of cubs in the vocalisation recall survey further supports this assumption.

Wildcat (*Felis sylvestris*; IUCN LC, Albania EN) was recorded by camera traps 1, 3 and 4 (located amongst miscellaneous inland habitats with sparse or no vegetation approximately 700m from camera trap 3 in the upland area of Mount Renci). Given the proximity of cameras to human habitations and villages, it is uncertain whether all the detections belong to pure wildcats or to feral domestic cats or hybrids between wild and domestic cats. There is also some uncertainty regarding the species of *Marten* recorded in the project area by camera traps 2, 3 and 4 due to the type of video footage. Two marten species are present in Albania, the beech or stone marten (*Martes foina*) and the pine marten (*Martes martes*) which are usually distinguished by the different colouring of the throat patch (i.e. white a throat patch for stone martens and yellow patch for pine martens). Given that cameras capture infrared videos during night-time the throat patch colourations could not be distinguished in the video footage. It is likely that given the range and distribution of marten species in Albania and habitat usage by each, that all the individuals recorded in this study area belong to the *Martes foina* species.

The most abundantly recorded mammal was the fox, followed by brown hare. The survey also confirmed the presence of breeding red fox in the project area based on the detection of a mother with a cub by camera trap 3. No evidence of ungulates (e.g. European roe deer) or wild boar was recorded, which implies their rarity or possible absence in the region. However, it is important to consider whether these species were not recoded as they generally do not follow the same movement pattern as carnivores and cameras were positioned to capture the movement patterns of species such as golden jackals, wolves and badgers etc. No evidence of wolves or bears was collected, despite locals confirming the occasional / rare presence of wolves based on informal discussions in the area.

The camera traps also captured domestic mammal activity and the movement of people within the project area which is unsurprising given the proximity of the camera traps to nearby settlements.

Table 4-5 Camera Trapping Results

Species Name	Frequency of Recordings Per Camera Trap Number							Total Number of Recordings
	1	2	3	4	5	6	7	
Golden jackal	-	1	1	-	Camera failed	Camera was stolen	Camera was stolen	**2**
Wildcat (potential hybrid)	2	-	7	1				**10**
Red fox	6	1	27	-				**34**
Eurasian badger	-	-	5	-				**5**
Marten sp, probably stone marten	-	1	4	2				**7**
Brown hare	10	18	-	-				**28**

Species Name	Frequency of Recordings Per Camera Trap Number							Total Number of Recordings
	1	2	3	4	5	6	7	
Bird sp.	-	-	1	-				**1**
Dogs	1	3	1	2				**7**
People	1	3	1	2				**7**
Cows	2	28	26	-				**56**
Pigs (domestic)	11	-	30	-				**41**
Goats/Sheep	3	1	13	-				**17**
Horses	-	1	2	3				**6**
Unidentified	-	1	-	-				**1**
Total Rare and Threatened Species Per Camera trap:	2	1	13	1	NA	NA	NA	**-**

Figure 4-4: Potential wild cat (Camera Trap 1)

Figure 4-5: Golden jackal (Camera Trap 2)

Figure 4-6: Marten species (Camera Trap 3)

Figure 4-7: Eurasian badger (Camera Trap 3)

Figure 4-8: Golden jackal (Camera Trap 3)

Figure 4-9: Potential wild cat (Camera Trap 3)

Figure 4-10: Marten species (Camera Trap 3)

Figure 4-11: Potential wild cat (Camera trap 3)

Figure 4-12: Marten Species (Camera trap 3)

Fauna species of conservation importance are discussed below in more detail below.

Brown Bear

The global population of brown bears is spread over three continents with an excess of over 200,000 individuals. As such the species is IUCN LC (2018). In Europe, brown bears occur in twenty-two countries and the population of the Dinaric-Pindos region, the second largest brown bear population in Europe, is reportedly stable to decreasing (IUCN, 2018). Bears are threatened in Europe by habitat loss, disturbance, ineffective management, accidental mortality and persecution, and these pressures are considered likely to continue (Kaczensky et al. 2013).

The Albanian brown bear population is categorised as vulnerable and comprises an estimated 180–200 individuals over approximately 5,000 km² (IUCN, 2018; National Red List 2013; Kaczensky et al. 2013; Bego, 2007). The distribution of bears in Albania in 2013 is illustrated in Figure 4-13. Based on this information alone, brown bears are unlikely to use habitats in the project area.

The characteristics of brown bear habitat ideally comprise a variety of forest types (including key deciduous tree species i.e. beech, chestnut and oak), thickets, meadows and wetlands. Low disturbance levels are important, particularly during the winter when new-born cubs are in the dens. Bears also require habitat connectivity between foraging sites (Bego, 2007).

Brown bears have anecdotally been reported to cross the beach at Bax-Rrjolli where the Rrenci Mountain meets the beach and move through the Ramsar site, across the Buna River and into Montenegro (Schneider-Jacoby et al, 2006; Ramsar, 2005). Whilst there are records of brown bear activity in the area (i.e. Schneider-Jacoby *et al*., 2006; IUCN, 2012; AKZM National Agency of Protected Areas, 2018) evidence indicative of brown bear activity was not identified within the project footprint and buffer area during the walkover survey. Surveyors also identified that habitats within the project footprint and surrounding landscapes are suboptimal to support brown bear due to the existing levels of disturbance and habitat quality. These findings were further supported by accounts from local people. Hence the project area is considered highly unlikely to serve as core habitat for brown bears.

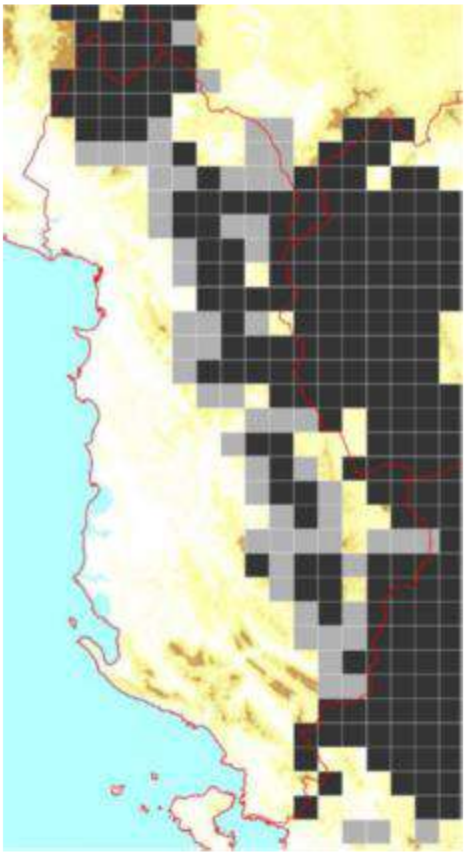

Figure 4-13: Brown bear distribution in Albania (Kaczensky et. al. 2013) Key: Dark cells indicate core and reproduction areas with permanent presence, light grey cells peripheral areas of occurrence. Cells are 10x10 km in size.

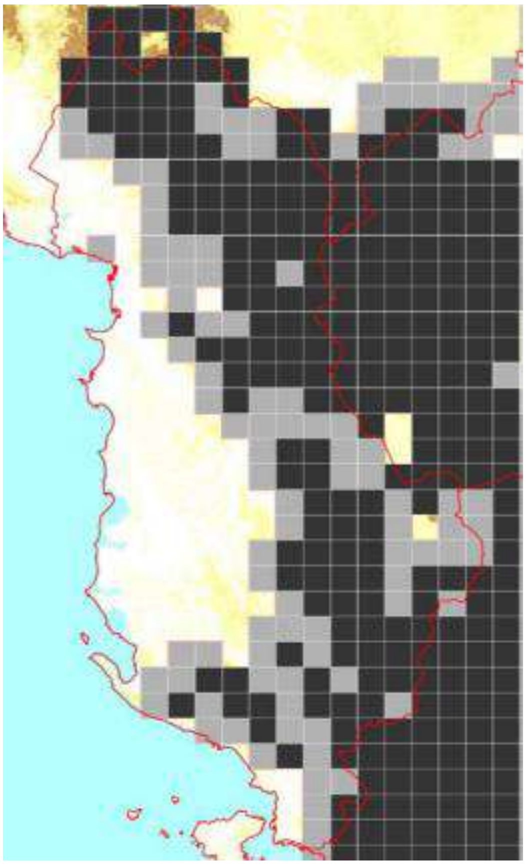

Figure 4-14: Wolf distribution in Albania (from Kaczensky et. al. 2013). Dark cells indicate core and reproduction areas with permanent presence, light grey cells peripheral areas of occurrence. Cells are 10x10 km.

Grey Wolf

Whilst direct (sighting and vocalisation) and indirect evidence of wolf activity (i.e. prints, faeces etc) were not recorded during the surveys, the project footprint and surrounding landscapes were considered to provide suitable habitat for commuting and foraging wolves. The suitability of this area as a breeding site for wolves is uncertain. Furthermore, discussions with four residents all indicated their presence in the area.

The distribution of grey wolves in Albania is illustrated in Figure 4-14. Wolves live in the most diverse types of habitat and their broad distribution ranges show the species' adaptability to the most extreme habitat conditions. In Albania wolves are known to be distributed in almost all mountainous areas of the country. They are found across habitats covering hilly, mountainous and alpine zones in the northern, eastern, south-eastern and south-western parts of the country and are missing only from the densely populated coastal and lowland areas in the west. In general, large forest areas are particularly suitable for wolves in Europe, although wolves are not primarily a forest species. Habitat quality for wolves is influenced by human disturbance, prey densities and range size. Based on the distribution information alone as illustrated in Figure 4-14, wolves may potentially use habitats in the project area and surrounding landscape, however this region is unlikely to serve as core habitat or a reproduction area.

The wolf is a protected species in Albania and is classified as Near Threatened (LR/nt) in the most recent Albanian Red List of Flora and Fauna (MoE 2013). Monitoring and research on grey wolves in Albania has been largely lacking in the past, thus information on their numbers is mostly based on expert estimations. Experts estimate that 200 – 250 wolves are likely to be present within their distribution areas in Albania (Chapron et al. 2014, Kaczensky et al. 2013). The Albanian wolf population is part of the larger Dinaric-Balkan population that spreads across the Balkan Peninsula (Kaczensky et al. 2013). In the National Biodiversity Strategy and Action Plan (Bego & Koni 1999) the wolf is selected as a priority species for conservation and the development of an action plan is recommended as an immediate action to take. However, to date, there is no official plan for the management and conservation of wolves in Albania.

The most evident threats to the survival of wolves in Albania are habitat destruction, habitat fragmentation and human persecution; however, little is still known about the extent and magnitude of these threats. There are no systematic data on the number of individual wolves killed per year, as the species is protected by law including the Wildlife Protection (2008) and Hunting (2010) laws which prohibit wolf hunting in Albania; however, there are consistent indications that wolves are often victims of retaliatory killing due to livestock damage they cause to local people (Bego et al. 2002, Trajçe et al. 2008). Historically wolves were heavily persecuted in Albania and there were eradication programmes in place involving regular poisoning and bounty hunting (Bego 2005, Bego et al. 2002).

The global population of grey wolf is estimated to be between 200,000-250,000 individuals. The species is relatively widespread with a stable population trend and as such is listed as LC (IUCN, 2018).

Golden Jackal

Indirect evidence indicative for golden jackal activity (namely prints) were observed outside of the project footprint on the beach at the foot of Mount Renci near an area of dune wetland during the priority species survey (Figure 4-17). The occurrence of four separate parallel prints indicates the presence of four individuals which is likely to be part of a family group, however, there are likely to be more individuals present in the area. This species has also been reported as occurring in the Buna River Protected Landscape (IUCN, 2012; AKZM National Agency of Protected Areas Date2018). The presence of golden jackals within the project footprint on Mount Renci was also confirmed by the camera trapping survey in two separate locations approximately 4 km and 4.5 km from Shëngjin respectively (Figure 4-8).

The vocalisation recall survey provided more detailed information regarding habitat usage of golden jackals in the project area. Responses of territorial jackals were recorded at five calling stations (i.e. 62.5% response). In total, 6 to 7 different territorial groups were recorded in the survey area comprising approximately 10 to 14 individuals in total. Further survey work would be required to identify the exact number of groups. For example, the groups that responded from the calling stations V04 and V06 (Figure 3-6) could have potentially been the same group given the proximity of the estimated location and the proximity of the calling stations to each other. Equally groups J05 and J06 may have been one or two separate groups. The survey confirmed that the jackals are breeding within the project area as two of the groups (J04 and J06) included vocalisation calls from cubs (Figure 3-7 and Figure 3-6).

All groups, with the exception of group number J07, were recorded residing on the lowland habitats of the area. Group number J07 was assessed as being present on the northern slopes of Mount Renci. Jackal groups showed to have a stronger preference for lowland areas, agricultural fields and wetland ecosystems, rather than the dry rocky areas in the uplands of Mount Renci, which is consistent with findings from studies in other parts of the Balkans and Europe. These results indicate that golden jackals use the upland areas of Mount Renci to commute back and forth from one lowland area to another, whilst denning / residing in the lowland habitats. The evidence of cubs in the vocalisation recall survey further supports this assumption.

Figure 4-15 Locations of call stations(green squares) and buffer zone of 2 km from calling station; identified territorial jackal groups in the study area are marked with yellow rhombus

The golden jackal, according to the IUCN List of Threatened Species, is classified as Least Concern (LC) at the global level, with an increasing trend. In Europe, the species is a “species of Community interest”, listed in Annex V of the Habitats Directive (92/43 EEC). According to the National Red List (2013), the golden jackal is classified as VU. There is a very limited up to date information regarding the distribution, abundance, biology and ecology of golden jackal in the country due to a lack of research and monitoring (Arnold et al. 2012; Giannatos 2004 and Trouwborst et al. 2015). Published accounts dating back to the 1950s and 1960s report a discontinuous distribution mainly along the coastline (Krustufek et al. 1997).

During the summer of 2016, as part of a Natura 2000 project, an extensive camera trapping survey was conducted along the coastline in Divjaka – Karavasta National Park, Skadar Managed Nature Reserve and Orikum area. The data gathered showed the presence and distribution of golden jackal in these regions and proved the reproduction of the species in all three study areas. The information from these surveys were included in the BIONNA database (www.bionna.al) administered by the National Agency for Protected Areas (NAPA).

Between 1945 to 1990, the golden jackal was considered a pest species and the eradication of this species was promoted by management authorities. There were bounties in place for the killing of jackals and the species was heavily persecuted. After this period, the golden jackal was protected and active eradication of the species was no longer promoted. Currently, the golden jackal is considered a protected species. The legal provisions that grant their protection are the Law for Protection of Wild Fauna (No. 10 006, 23.10.2008) and Law on Hunting (No. 10253, 11.3.2010).

The golden jackal range covers areas of central, eastern and southern Europe, parts of Asia and northern Africa. This species is relatively common throughout its global range, with an increasing population trend and is therefore listed globally as IUCN LC (2018).

An omnivorous species, the golden jackal is a highly adaptive and opportunistic mid-sized canid, that is currently undergoing a remarkable range expansion, with spread of the Balkan populations towards Central Europe (Arnold et al. 2012; Trouwborst et al. 2015; Krofel et al. 2017), For example in Bulgaria, jackal expanded its distribution by 33-fold during the period 1962-1985 (Kryštufek et al. 1997). Similar trends have been detected all over southeastern Europe and during the past two decades, jackals have colonized Switzerland, Germany, Poland, and the Baltics (Trouwborst et al. 2015; Krofel et al. 2017).

This increase in the jackals’ range and abundance could have considerable effects on communities and ecosystems (Lanszki et al. 2006; Ćirović et al. 2016). The golden jackal as a mesopredator is an important predator of small vertebrates (i.e. lagomorphs, birds and rodents), including pest species and could indirectly shape plant communities through predation on seed predators or by directly dispersing seeds themselves (Tambling et al. 2018). In fact, golden jackals provide valuable ecosystem services as every year they remove substantial amounts of discarded animal waste and potential crop pests (Ćirović et al. 2016). Furthermore, jackals can have a negative impact on smaller predators, such as the red fox, especially in the absence of large apex predators, as predicted by the mesopredator release hypothesis (Ritchie & Johnson 2009). Moreover, their increase can bring significant challenges for management and policy-makers, especially because the species may cause damages on agriculture and livestock, while its management is governed by international legal frameworks (Trouwborst et al. 2015).

The reasons behind the expansion of the golden jackal are still unclear (Šálek et al. 2014; Trouwborst et al. 2015; Krofel et al. 2017). Possible factors include the socioecological changes brought by climate change, the Balkan wars, alterations in hunting management or land-use, as well as changes in its interactions with the grey wolf, its natural intra-guild predator (Šálek et al. 2014; Trouwborst et al. 2015; Krofel et al. 2017).

Golden jackals are primarily threatened by habitat loss and disturbance, particularly arising from the decline in traditional land use practices, an increase in the intensification of agro-pastoral practices and the loss of remote undisturbed habitats (IUCN, 2018).

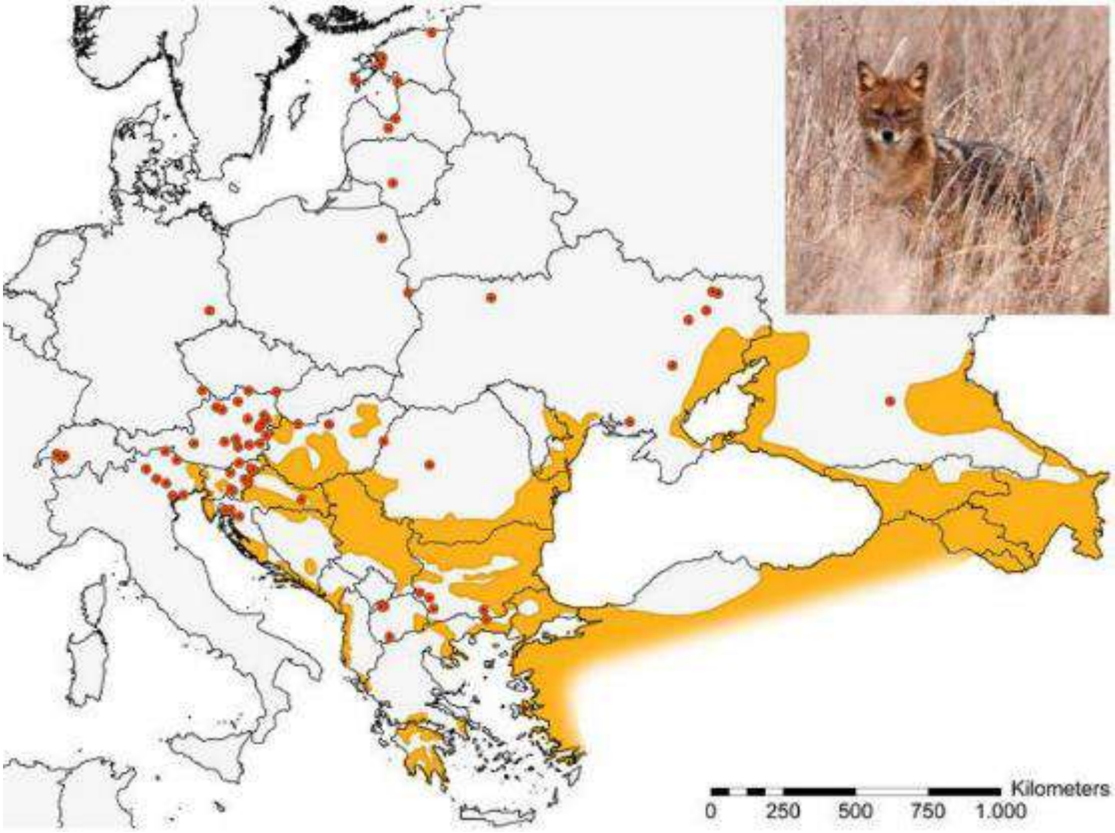

Figure 4-16: Current distribution of golden jackal in Europe. Shaded areas represent areas of permanent presence of jackals and circles individual records (Trouwborst et al. 2015)

Eurasian Badger

A badger dropping was observed within maquis vegetation within the project footprint during the walkover survey (Figure 4-18) and were recorded in the camera trapping survey 4.5 km from Shëngjin (Figure 4-7). This confirms badger activity within the project area and the proposed road alignment.

Badgers are widely distributed in Europe and are categorised globally as LC (IUCN, 2018). In Albania, badgers are listed as EN by the National Red List (MoE 2013). This assessment is thought to be based on expert estimation of population status. Monitoring and research is required to inform an up to date assessment of the population status in Albania. Badgers are widely distributed in Albania and occur in a range of habitats from lowland and agricultural areas to highland forests. Recent camera trapping surveys conducted by PPNEA between 2009 and 2018 have confirmed their presence in a multitude of regions across the country (Trajce, unpubl. data).

Badgers are an opportunistic forager with an omnivorous diet feeding on a variety of plants, insects and carrion etc. They are found in deciduous and mixed woodlands, meadows, pastureland and scrubland, including Mediterranean maquis. They are increasingly reported to also occupy suburban and urban areas in various European cities (IUCN, 2018).

Badgers do not face any imminent threats in Albania. Conflict with farmers due to crop/corn damage seems to be widespread but not a concern for large-scale retaliatory killings of badgers. In the long term, badgers may potentially be threatened by habitat loss and disturbance arising from continuous intensification of agriculture and rapid uncontrolled urbanization.

Figure 4-17: Golden jackal tracks

Figure 4-18: Eurasian badger dropping

Marten Species

Two separate marten species droppings were observed during the walkover survey within maquis and Mediterranean evergreen Quercus forest within the survey area, indicating the presence of martens within the project area (see Figure 4-19 and Figure 4-20). Marten species were also recorded during the camera trapping survey within the proposed road alignment. (Figure 4-6). Of the two species of martens present in Albania, the possible presence of the stone marten (*Martes foina*) is more likely in the study area, as opposed to the pine marten (*Martes martes*). Pine martens usually occupy highland habitats and are not found in lowland areas or near densely populated and agricultural regions; however more detailed studies using more adequate methodologies (e.g. camera-trapping) would be needed to fully confirm this. In Albania, the stone marten is listed on the National Red List as LRnt and the pine marten is listed as VU, whilst on the global scale both species are listed as LC (IUCN 2018).

Unlike the pine marten, which is a forest specialist, the stone marten is a habitat generalist and can survive in a variety of habitats, including forest, scrubland, agricultural areas and even suburban and urban areas. Recent camera trapping efforts conducted by PPNEA between 2009 and 2018 has proven their presence in a multitude of regions across Albania (Trajce, unpubl. data).

The stone marten's diet has a considerable amount of plant food, compared to the pine marten. These include a variety of fruits and seeds. Among animal food the stone martens feed on different bird species (including their eggs), rats and mice, but can also take prey much larger than their own body.

Figure 4-19: Marten species dropping

Figure 4-20: Marten species dropping

Eurasian Otter

Evidence of Eurasian otter activity (i.e. spraints, prints, feeding remains, slides etc) was not observed within the project footprint or buffer area during the walkover survey or the camera trapping survey. This may be attributed to either a lack of survey effort amongst potentially suitable habitats (note, the data from camera traps 6 and 7 in or near wetland habitat were lost) or an absence of Eurasian otter in and around the project area.

Eurasian otters are predominantly nocturnal and inhabit a variety of aquatic habitats (i.e. highland and lowland lakes, rivers, streams, marshes, swamp forests, brackish water and coastal areas). The majority of otter activity is generally restricted to the waterbody itself and riparian / adjoining marginal vegetation (Roos et al., 2018); rivers and streams often serve as wildlife corridors facilitating movement across their range. Otter distribution in coastal areas, especially near holts, is linked to a freshwater source (Roos et al., 2018). Eurasian otters are nocturnal and mainly solitary in nature, with adults only associating with each other for mating.

The project footprint and buffer do not provide suitable habitat to support foraging, commuting and breeding otters. However, wetlands, the lagoon and associated network of waterways (including the Buna River) located in the environs near Mount Renci were considered to offer potentially support Eurasian otter activity. Eurasian otters reportedly inhabit the Buna River Protected Landscape (IUCN, 2012; AKZM National Agency of Protected Areas 2018).

Eurasian otters are nationally listed as VU (MoE, 2013). There have been several large-scale surveys regarding the presence and distribution of otters in Albania during the last 30 years (e.g. Prigioni et al., 1986 and Balestrieri et al., 2015). These surveys showed the otter to be relatively widespread throughout Albania and to frequently occur in and around the region of the proposed project. The distribution of Eurasian otters in Albania is illustrated in Figure 4-21. Based on this information, otters frequently occur in the region of the proposed project.

The global population of the Eurasian otter is widespread across Europe and parts of Asia and north Africa. This species is listed as NT globally as the population is in a state of decline due to the loss of aquatic habitats arising from high levels of pollutants, accidental mortality caused by vehicle collisions and drowning in fishing nets, illegal hunting and the decrease in prey species from wetlands and waterways (Roos et al., 2018).

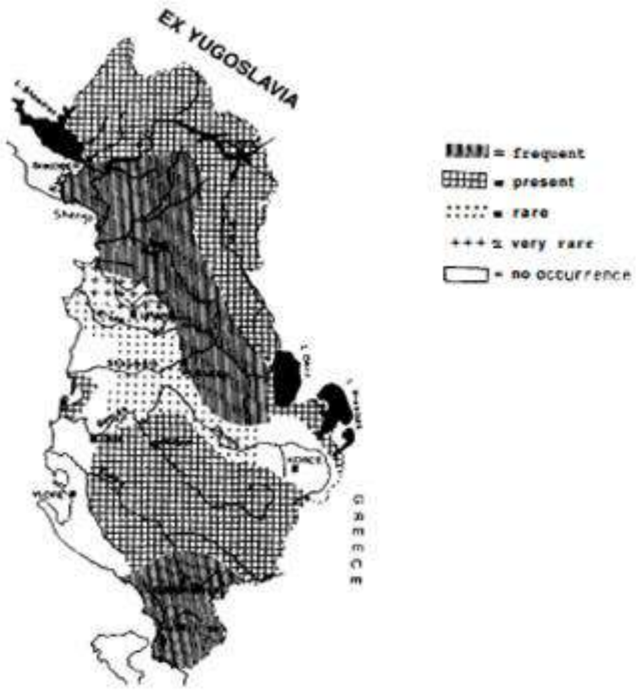

Figure 4-21: Distribution of Eurasian otters in Albania

European Roe Deer

Evidence of European roe deer was not detected during the walkover survey. Habitats within the project area were considered to be suitable to support foraging deer however anthropogenic disturbances may serve as a deterrent for habitat usage in some areas. Several local residences thought that deer were not present in the project area.

European roe deer use a wide range of habitat types (i.e. a mosaic of coniferous, deciduous and mixed woodlands, moorland, agro-pastoral land and suburban gardens) and occur in a large number of protected areas across its range (Lovari et al., 2018). In Albania, this species is listed as VU on the National Red List (MoE 2013).

The European roe deer has an expansive global range throughout the Palaearctic region with an estimated European population of 15,000,000 individuals. The population is in a state of increase and as such is IUCN LC. The species is also listed on the Bern Convention in Appendix III. The primary threat to the European roe deer is the mixing of the gene pool of genetically distinct peripheral populations located in northern Portugal, the southern Italian Apennines, and Greece (i.e. Italian roe deer *Capreolus capreolus* spp *italicus*). In Albania, the main threat to roe deer is poaching and their population has been drastically reduced in the past.

Bats

In total, 32 bat species have been recorded in Albania (Théou and Đurović 2015). Information presented in the Ramsar Information sheet (Ramsar, 2006) and Conservation Action Plan for Bats in Shkodër / Skadar Lake Area (Théou and Đurović 2015) indicates that several *Rhinolophus* sp and *Myotis* sp bat species are present within the Buna River Protected Landscape and LakeShkoder region (

Table 4-6).

Table 4-6 Bat species present in the proposed project area

Scientific Name	Common Name	IUCN (2019) Status	Albania Red List Status (2013)	RAMSAR Site (2006)	Action Plan on Bats (2015)
Rhinolophus hipposideros	Lesser horseshoe bat	NT (Med and Europe)	LRnt		+
Rhinolophus ferrumequinum	Greater horseshoe bat	NT inMed and Europe	LRcd	+	+
Rhinolophus euryale	Mediterranean horseshoe bat	VU in Europe	VU	+	+
Rhinolophus blasii	Blasius's horeshoe bat	VU in Europe)	LRnt	+	
Myotis blythii	Lesser mouse-eared bat	NT in (Europe)	NA		+
Myotis myotis	Greater mouse-eared bat	LC	NA	+	

Myotis capaccinii	Long fingered bat	VU	LRcd	+	
Myotis emarginatus	Geoffroy's bat	LC	DD		+
Myotis mystacinus	Whiskered bat	LC	NA		+
Miniopterus schreibersii	Schreibers Bent-winged bat	NT	LRnt		+

Of the 32 bat species recorded in Albania, the bat surveys undertaken in May 2019 confirmed that 18 bat species use habitats within the survey area. This area therefore supports a high diversity of bat species which is likely to be attributed to the mosaic of different habitats found in the area (i.e. caves, bunkers, woodland, agro-pastoral land and abandoned infrastructure) and the absence of artificial lighting. The majority of bat species identified in the survey area are categorised as Least Concern by the IUCN Red List of Threatened Species (2019) as follows:

- Geoffroy's bat (*Myotis emarginatus*)
- Daubenton's myotis (*Myotisdaubentonii*)
- whiskered myotis (*Myotis mystacinus*)
- Natterer's bat (*Myotis nattereri*)
- geat mouse-eared bat (*Myotis myotis*)
- greater horseshoe bat (*Rhinolophus ferrumequinum*)
- Savi's pipistelle (*Hypsugo savii*)
- noctule (*Nyctalus noctula*)
- Eptesicus serotinus or lesser noctule (*Nyctalus leisleri*)
- pipistrelle (*Pipistrellus nathusii*)
- Kuhl's pipistrelle (*Pipistrellus kuhlii*)
- European Free-tailed Bat (*Tadarida teniotis*)

A total of five bat species recorded in the survey area are rare and threatened at the national, regional and global scales. These are listed as follows:

- long-fingered bat (*Myotis capaccinii*) – IUCN VU; Albania Red Listed VU
- Blasius' horseshoe bat *(Rhinolophus blasii*) – IUCN VU in the Mediterranean
- Mediterranean horseshoe bat (*Rhinolophus Euryale)* – IUCN Mediterranean VU; Albanian Red Listed VU
- lesser horseshoe bat (*Rhinolophus hipposideros*) - NT in Europe
- Schreiber's bent-winged bat (*Miniopterus schreibersi*) – IUCN NT

The bat roost surveys confirmed the presence of five bat roosts within proximity to the proposed road alignment (Table 4-7 and

Figure 4-22). These were located in military bunkers, an abandoned house, bridges and a cave. Only one roosting site, the abandoned house (Site 2) was located within the project footprint. Two bat species were observed roosting, namely *Rhinolophus hipposideros* and *R. ferrumequinum*, and the surveyors thought that the house may serve as a maternity roost for *Rhinolophus hipposideros*.

A maternity colony of *Myotis emarginatus, Myotis schreibersii* and possibly *R.hipposideros* was also identified in a military bunker located 500 m from the project footprint within the Protected Landscape (Site 1, Table 4-7 see Figure 4-23). Two of the four entrances to the bunker showed signs of disturbance due to modification works (indicated by the presence of rocks and concrete bags) and signs of a fire were observed inside the bunker.

The most significant bat roost in terms of the abundance and diversity of bat species was a network of four military bunkers located within the Buna River Protected Landscape, 1.5 km northwest of the project footprint (Site 11). Seven species and over 1600 individuals were recorded roosting at this site. The surveyors considered it likely that other bat species also use this structure as roosting habitat. The bat specialists consider this bat roosting site to be of regional and national importance. It is highly likely that individuals roosting in this bunker will use habitats in the project area (including the project footprint) for commuting and foraging.

A cave (Shpella Suka e vogel), protected as a National Monument (Cat III) and located approximately 700 m from the project was also surveyed (Site 16) Three species were observed namely *R. ferrumequinum, R. hipposideros* and *R.euryale / blasii*. Whilst only a few individuals were recorded in the cave, a large amount of guano (bat faeces) was present suggesting that many individuals may use the cave throughout the year.

An abandoned electrical tower was also inspected for roosting bats (Site17). Whilst bats were not sighted in this structure, a small amount of guano was observed indicating the occasional usage of the tower by bats.

Table 4-7 Bat Roosts Located Within Proximity to the Proposed Shëngjin to Velipojë Road Scheme

Structure Type	**Location**			**Confirmed Roost**	**Bat Species**	**Estimated Number of Individuals**
	In the Protected Landscape	**Outside of the Protected Landscape**	**Distance from Project Footprint**			
Military bunker (Figure 4-22, Site 1)		+	SW of Project, circa 500 m	Maternity roost	*Myotis emarginatus*	252
				Maternity roost	*M.schreibersii*	55
				Possibly a maternity colony	*R.hipposideros*	15
				Confirmed	*R.ferrumequinum*	1
Abandoned house (Figure 4-22, Site 2 and Figure 4-23)		+	On the proposed alignment	Maternity roost	*R. hipposideros*	11
				Confirmed	*R. ferrumequinum*	1
Two bridges (	+		7km	Confirmed	*M.daubentonii.*	12
					M.mystacinus	10

Structure Type	**Location**			**Confirmed Roost**	**Bat Species**	**Estimated Number of Individuals**
	In the Protected Landscape	**Outside of the Protected Landscape**	**Distance from Project Footprint**			
Figure 4-22, Sites 9 and 10;)					*M.nattereri*	3
Network of four military bunkers (Figure 4-22, Site 11)	+		North of project - approx 1.5km	Confirmed – roosting site of national and regional importance	*Myotis myotis*	1
					Myotis myotis/blythii	1200
					R. euryale	200
					Rhinolophus ferrumequinum	1
					Rhinolophus hipposideros	1
					Miniopterus schreibersii	100
					Myotis emarginatus	100
					Myotis capaccini	1
Cave (Shpella Suka e vogel) (Figure 4-22, Site 16)	+		Approx. 700 m	Confirmed – Guano also present in significant quantities.	*R.ferrumequinum*	1
					R.hipposideros	3
					R.euryale/blasii	2

Figure 4-22 Active bats roosts and sites of bat activity (i.e. commuting and foraging)

Figure 4-23 Location of the *R. hipposideros* maternity roost in the abandoned house Site 2

Figure 4-24 Mixed colony of *Myotis emarginatus* and *M.schreibersii* at Site 1

Figure 4-25 Unidentified species under bridges at Sites 9 and 10

Figure 4-26 Bats recorded in the network of bunkers at Site 11

Figure 4-27 Horseshoe bat recorded in the network of bunkers at Site 11

Bat activity transect surveys and mist netting were undertaken in combination with the bat roost inspections. In total, six bat species were recorded foraging and / or commuting during these surveys, namely *Hypsugo savii, Pipistrellus kuhlii, Miniopterus schreibersii, Tadarida teniotis, Eptesicus serotinus / Nyctalus leisleri* and *Pipistrellus kuhlii / P.* nathusii (Table 4-8, Sites 19, 20, 21, 22, 23, 24 & 25). The surveyors were unable to differentiate between *Eptesicus serotinus* versus *Nyctalus leisleri* and *Pipistrellus kuhlii* versus *P. nathusii* based on the quality of the bat echolocation recordings and the lack of social calls. Bat activity (i.e. foraging and commuting) appeared to be centred over habitats located in the north-western portion of the project footprint near Rrjollë and the last 4 km of the project footprint near Shëngjin. Whilst bat activity was not recorded amongst the oak woodland located within the project footprint on Mount Renci, this habitat was identified as being of potential importance for foraging and roosting bat species known to be present within the region.

Table 4-8 Location and species of bats recorded during transect and mist net surveys

Site Numbers (and method)	Location of Bat Sighting / Recording			Bat Species
	In the Protected Landscape	Outside of the Protected Landscape	Distance from Project Footprint	
Sites 3 to 8 (Hand held bat detector - D1000X)	+		Max of 0.4 km	*Hypsugo savii*
				Nyctalus noctula
				Eptesicus serotinus/Nyctalus leisleri
				Pipistrellus kuhlii/nathusii
Site 18 (Mist net)	+		0.5 km	*R. ferrumequinum* N.B. Pregnant female indicating a maternity roost close by.
Sites 19 to 25	+		Max of 0.5 km	*Hypsugo savii*
				Pipistrellus kuhlii
				Miniopterus schreibersii
				Tadarida teniotis
				Eptesicus serotinus/Nyctalus leisleri
				Pipistrellus kuhlii/nathusii

4.1.4.2 *Alien Invasive Mammals*

Four mammal species are classed as alien invasive species according to the global invasive species database, including the European hare, the stoat, lesser white-toothed shrew and the alpine chamois. Very little information currently exists about the impacts that these species are having on native fauna.

4.1.5 Avifauna

4.1.5.1 *Avifauna Species of Conservation Importance*

The walkover surveys confirmed the presence of the following bird species within the project footprint and buffer:

yellowhammer (*Emberiza citronella*) – sighted within Mediterranean evergreen Quercus forest

- common raven (*Corvus corax*) – sighted within Mediterranean evergreen Quercus forest
- greylag goose (*Anser anser*) – sighted over 50m south of surveyors in flight
- Eurasian jay (*Garrulus glandarius*) – sighted in regenerating agro-pastoral land / scrubland
- carrion crow (*Corvus corone*) – sighted in sparse Mediterranean evergreen Quercus forest with exposed areas of scree
- great tit (*Parus major*) – sighted in Mediterranean evergreen Quercus forest

These species are widespread and common in nature; they are listed as IUCN LC and are not included on the National Red List for Albania. The project area was also identified as providing foraging habitat for the common kestrel (*Falco tinnunculus*; IUCN LC). The common kestrel was observed hovering over an area of scrub, interspersed with exposed rocks and scree over the ridge edge of Mount Renci during the walkover survey of the proposed alignment. This species is listed as VU on the National Red List of Albania.

The breeding bird survey, undertaken in early June 2019, confirmed the presence of 95 bird species within the survey area. The majority of the birds recorded were small passerines of which 53 different species were identified during the visit. The rest comprised members of other taxonomic orders including raptors, woodpeckers, owls, waders, herons, gulls and terns, doves, cormorants, moorhens, hoopoes, bee-eaters, grebes, cuckoos, nightjars, pelicans, partridges and swifts.

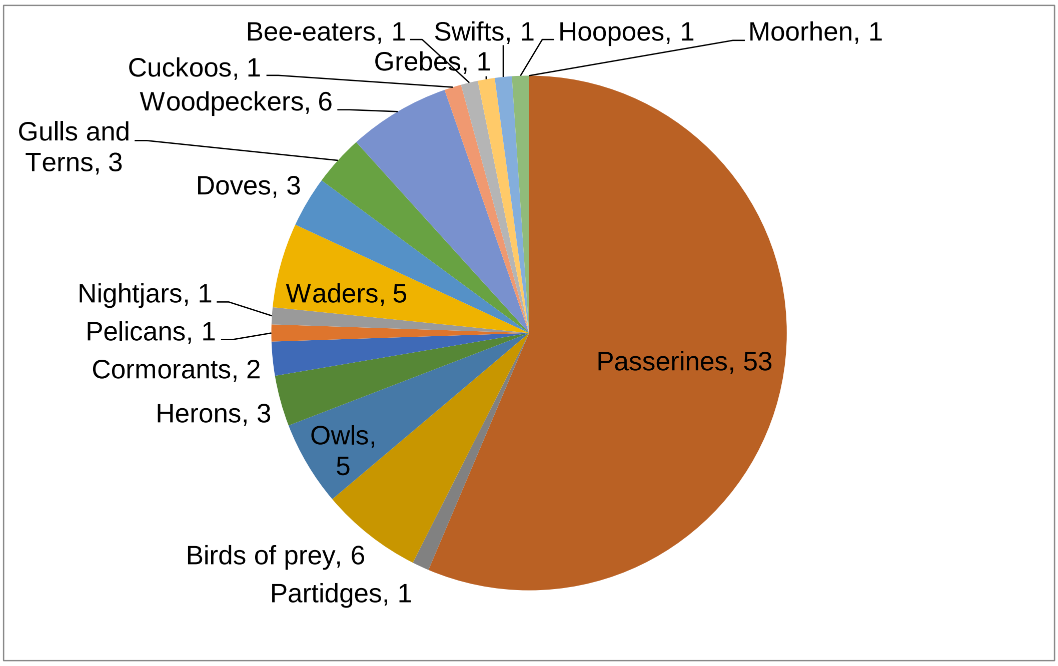

Figure 4-28 Taxonomic distribution of birds observed during survey

Birds were present in different habitats within the project area including urban areas, pine forests, natural oak forest, Mediterranean maquis, inland cliffs, areas with sparse vegetation, arable land and sand dunes.

Urban areas were mostly used by breeding goldfinches (*Carduelis carduelis*), black-eared wheatear (*Oenanthe hispanica*), great tit (*Parus major*), magpie (*Pica pica*), house sparrow (*Passer domesticus*), greenfinch (*Chloris chloris*), barn swallows (*Hirundo rustica*), house martin (*Delichon urbicum*), red-rumped swallow (*Cecropis daurica*), scops owl (*Otus scops*) and little owl (*Athene noctua*).

Forest patches of either coniferous forest or natural oak forest were inhabited mostly by great tit, greenfinch, turtle dove (*Streptopelia turtur*), chaffinch (*Fringilla coelebs*), blackcap (*Sylvia atricapilla*), Syrian woodpecker (*Dendropos syriacus*), golden oriole (*Oriolus oriolus*), short-toed eagle (*Circaetus gallicus*), jay (*Garrulus glandarius*), great spotted woodpecker (*Dendrocopos major*), green woodpecker (*Picus viridis*), middle spotted woodpecker (*Dendrocoptes medius*), spotted flycatcher (*Muscicapa striata*), sombre tit (*Poecile lugubris*), tawny owl (*Strix aluuco*), hoopoe (*Upupa epops*), etc.

The Mediterranean maquis habitat was dominated by warblers and other passerine species. The most abundant species in this habitat were the subalpine warbler (*Sylvia cantillans*), cirl bunting (*Emberiza cirlus*), goldfinch, blackbird (*Turdus merula*), black-headed bunting (*Emberiza melanocephala*), nightingale (*Luscinia megarhynchos*), stonechat (*Saxicola torquata rubicola*), red-backed shrike (*Lanius collurio*), whitethroat (*Sylvia communis*), lesser whitethroat (*Sylvia curruca*), woodchat shrike (*Lanius senator*), Mediterranean warbler (*Sylvia melanocephala*), olivaceous warbler (*Iduna pallida*), olive-tree warbler (*Hippolais olivetorum*) and eastern orphean warbler (*Sylvia crassirostris*).

The inland cliffs are particularly interesting for the presence of golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), common kestrel (*Falco tinnunculus*), Alpine cough (*Pyrrhocorax graculus*), crag martin (*Hirundo rupestris*), Alpine swifts (*Tachymarptis melba*), blue rock thrush (*Monticola solitarius*), rock nuthatch (*Sitta neumeyer)* and jackdaw. The inland cliffs are also interesting for the presence of the eagle owl (*Bubo bubo*) with several holes likely to be used as nesting or roosting sites.

The areas with sparse vegetation are interesting for the presence of ground nesting birds such as rock partridge (*Alectroris graeca*), black-headed wheatear (*Oenanthe hispanica*), stonechat (*Saxicola torquata*), short-toed lark (*Calandrella brachydactyla*), crested lark (*Galerida cristata*) and corn bunting (*Emberiza calandra*).

The coastal dunes and sandy shore habitats were inhabited by nesting European bee-eaters (*Merops apiaster*), yellow wagtails (*Motacilla flava*) and zitting cisticola (*Cisticola juncidis)*. The vicinity of the above habitats to coastal wetlands makes them useful also for waterbirds. During the survey the following waterbirds were observed: black-winged stilt (*Himantopus himantopus*), oystercatcher (*Haematopus ostralegus*), Kentish plover (*Charadrius alexandrinus*), redshank (*Tringa totanus*), little egret (*Egretta garzetta*), moorhen (*Gallinula chloropus*) and pygmy cormorant (*Microcarbo pygmaeus*).

The most abundant species throughout the survey area was the jackdaw (*Coloeus monedula*) followed by barn swallow (*Hirundo rustica*), European starling (*Sturnus vulgaris*), goldfinch (*Carduelis carduelis*), red-rumped swallow (*Cecropis daurica*) and European bee-eater (*Merops apiaster*). The specific abundance of each species is illustrated in Figure 4-29and further details provided in Appendix 5.

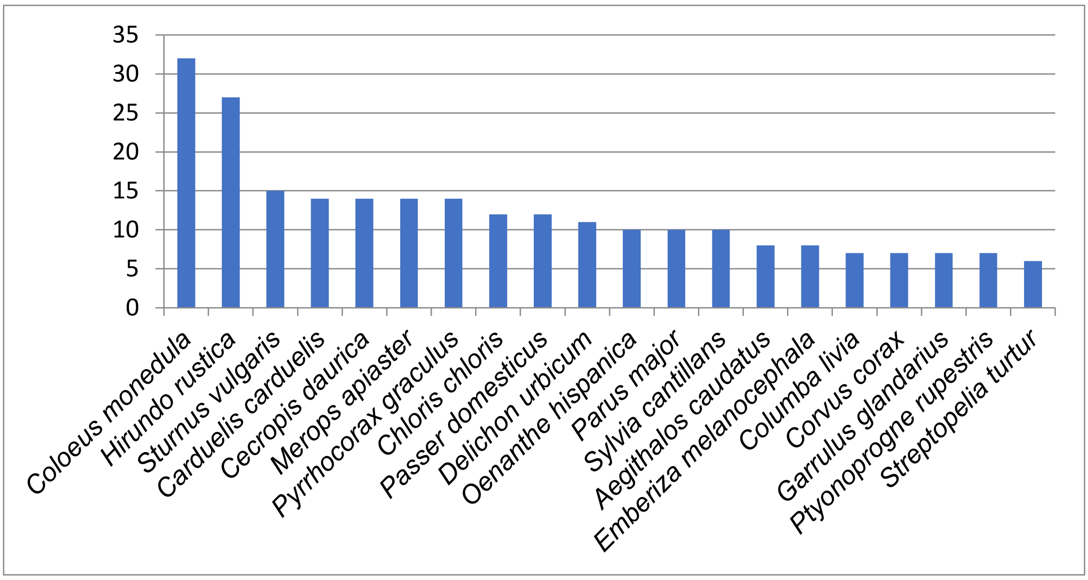

Figure 4-29 Breeding bird species abundance

Of the 95 species observed, 87 bird species were considered to be breeding in the survey area. Fifty-eight species were confirmed breeding while the remainder were categorised either as probable breeding (12 species) or possible breeding (17 species). A detailed list of birds together with their respective breeding codes is provided in Appendix 5 and summarised in Table 4-9.

Table 4-9 Breeding bird categories

No.	Breeding Category	No. of species
1	Non breeding	7
2	Possible breeding	17
3	Probable breeding	12
4	Confirmed breeding	58
5	Unknown	1
Total		95

Of the species observed, five are globally rare and threatened, as follows:

- European turtle-dove (*Streptopelia turtur*) – IUCN VU
- rock partridge (*Alectoris graeca*) – IUCN NT
- oystercatcher (*Haematopus ostralegus*) – IUCN NT at the global scale and VU in Europe
- European curlew (*Numenius arquata*) – IUCN NT at the global scale and VU in Europe
- Dalmatian pelican (*Pelecanus crispus*) – IUCN NT

Turtle dove and rock partridge both breed in the Project Development Area (PDA; i.e. the project footprint, working width and associated working sites). Turtle dove breeds in forested patches whilst the rock partridge is present in sparse vegetation habitats.

Other globally threatened species are waterbirds which occur in wetlands near Baks-Rrjoll. Among them the oystercatcher is a possibly breeding but the European curlew and the Dalmatian pelican do not breed in the area.

Furthermore, the survey confirmed the presence of 17 bird species that are classed as rare and threatened at the national level by the Albanina Red List (2013). These are listed as follows:

- golden eagle (*Aquila chrysaetos*) - EN
- grey heron (*Ardea cinerea*) – EN (during breeding)
- eagle owl (*Bubo bubo*) – CR
- common buzzard (*Buteo buteo*) – VU (during breeding)
- short-toed eagle (*Circaetus gallicus*) – VU
- little egret (*Egretta garzetta*) – VU (during breeding)
- peregrine falcon (*Falco peregrinus*) – VU (during breeding)
- hobby (*Falco subbuteo*) – VU
- common kestrel (*Falco tinnunculus*) – VU (during breeding)
- oystercatcher (*Haematopus ostralegus*) – VU
- black-winged stilt (*Himantopus himantopus*) – EN
- olive-tree warbler (*Hippolais olivetorum*) – Data deficient
- yellow-legged gull (*Larus michahellis*) – EN (during breeding)
- European bee-eater (*Merops apiaster*) – EN
- pygmy cormorant (*Mycrocarbo pygmaeus*) – CR (during breeding)
- Dalmatian pelican – CR (during breeding)
- European hoopoe (*Upupa epops*) – VU

Most of the above species are threatened during breeding due to human disturbance at breeding grounds, persecution and loss or fragmentation of breeding habitats. The breeding bird status of golden eagle, eagle owl and tawny owl within the project area is currently uncertain and further survey work would be return to confirm this.

A biodiversity study undertaken in the region of the proposed road alignment by Schneider-Jacoby et al., (2016) identified the presence of the following avifauna species of conservation importance:

- The golden eagle reportedly uses breeding habitat within karst galleries of Mount Renci – IUCN LC; Albanian Red List EN; Appendix II of the Bern Convention; Annex I of the Birds Directive; Annex II of the Bonn Convention; Appendix II CITES.
- The Levant sparrow hawk (*Accipiter brevipes*) has been recorded in the Bojana-Buna delta floodplain forest, located some distance from the project footprint. This species is IUCN LC, Albanian Red List CR; Appendix II of the Bern Convention; Annex I of the Birds Directive; Annex II of the Bonn Convention; Appendix II CITES, CMS Appendix II.
- European rollers (*Coracias garrulous*) have been sighted in the Bojana- Buna delta floodplain forest, pastures and semi-natural woodlands in the region – IUCN

LC, Albanian Red List CR; Appendix II of the Bern Convention; Annex I of the EU Birds Directive; Annex I of the Bonn Convention.

- Lesser grey shrikes (*Lanius minor*) use pastures, agro-pastoral land and woodland habitats in the region - IUCN LC, Albanian Red List CR; Appendix II of the Bern Convention; Annex I of the Birds Directive.
- Stone curlews (*Burhinus oedicnemus*) have been sighted within the Bojana-Buna delta and Ada Island – IUCN LC, Albanian Red List CR; CMS Appendix II; Birds Directive Annex I; Bern Convention Appendix II.

The Velipoja – Albania IBA and KBA (wherein the proposed road alignment partly traverses) is known to support foraging pygmy cormorants (*Phalacrocorax pygmeus*; IUCN LC) that overwinter amongst wetland habitat. This species is listed as CR on the National Red List for Albania. It is listed on CMS Appendix II, Annex II of the Bern Convention and Annex I of the EU Birds Directive. Pygmy cormorants historically used to breed within this IBA, near the mouth of the Bua River, however due to disturbance, their breeding habitat is now restricted to Ada Island, located in Montenegro (BirdLife International, 2018).

In addition, the Lake Shkoda and River Buna Ramsar site also reportedly provides habitat for the following species that are nationally and / or internationally rare and threatened (Ramsar, 2005):

- Dalmatian pelican – IUCN NT; Albania Red List CR. Listed on CMS Appendices I and II, Birds Directive Annex I, Annex II of the Bern Convention, Annex I of the Bonn Convention and CITES Appendix I
- lesser white-fronted goose (*Anser erythropus*) – IUCN VU; now extinct in Albania according to the National Red List of Albania. Listed on CMS Appendices I and II, Annex II of the Bern Convention, and Annex I of the Birds Directive
- red-breasted goose (*Branta ruficollis*) - IUCN VU; Albania Red List CR. Listed on CMS Appendix I, Annex II of the Bern Convention, and Annex I of the Birds Directive.
- white-headed duck (*Oxyura leucocephala*) - IUCN EN; Albania Red List CR. Listed on CMS Appendix I and II, Annex II of the Bern Convention, Annex I of the Birds Directive and Annex II of CITES
- ferruginous duck (*Aythya nyroca*) - IUCN NT; Albania Red List CR. Listed on CMS Appendix I and II, Annex II of the Bern Convention, Annex I of the Birds Directive and Annex II of CITES
- slender-billed curlew (*Numenius tenuirostris*) - IUCN CR; Albania Red List CR. Listed on Annex I of the Birds Directive, Annex II of the Bern Convention, Annex I and II of CMS and Annex I of CITES
- great snipe (*Gallinago media*) - IUCN NT; Albania Red List CR. Listed on Annex I of the Birds Directive, Annex II of the Bern Convention and Annex I of CMS
- marbled teal (*Marmaronetta angustirostris*) -IUCN VU. Listed on CMS Appendix I and II and Annex I of the Birds Directive
- Eurasian oystercatcher– IUCN NT; Albania Red List VU. Listed on Annex II (B) of the Birds Directive
- Eurasian thick-knee or stone curlew (*Burhinus oedicnemus*) - IUCN LC; Albania Red List CR. Listed in Annex I of the Birds Directive
- Eurasian spoonbill (*Platalea leucorodia*) – IUCN LC; Albania Red List EN. Listed in Appendix II of CITES, Annex I of the Birds Directive and Annex II of the Bern Convention.

These species are also categorised as congregatory (and dispersive) and full migrants. Hence, Lake Shkoda and River Buna Ramsar site is not only recognised as an important area for migratory and congregatory birds in the region but for supporting a high diversity of migrant birds (Ramsar, 2005). Habitats located at the mouth of the Bojana-Buna delta (i.e. wetlands and coastal habitats) are of particular importance to many migrating birds to this region (Denac et al., 2010). In addition to the spices listed above, the Ramsar site also provides wintering habitat for wood larks (*Lullula arborea;* IUCN LC; not included on the National Red List for Albania). This species a migratory species that inhabits agro-pastoral land, woodlands and scrub (IUCN, 2018) and has reportedly supported a significant portion of the European population in 2003-2004 (Ramsar, 2005). Other migratory and / or congratory bird species that use habitats within the Ramsar site and are common and widespread in nature include:

- Kentish plover (*Charadrius alexandrines*; IUCN LC) – migrant. Listed on Annex I of the Birds Directive, Annex II of the Bern convention and CMS Appendix II
- European nightjar (*Caprimulgus europaeus*; IUCN LC; National Red Book of Albania listed Low Risk) – migrant. Listed in Annex I of the Birds Directive and Appendix II of the Bern Convention
- common redshank (*Tringa tetanus;* IUCN LC) - congregatory (and dispersive) and full migrant. Listed on Annex II of the Birds Directive
- common sandpiper (*Actitis hypoleucos*; IUCN LC) - congregatory (and dispersive) and full migrant. Listed on Annex II of the Birds Directive
- European roller (*Coracias garrulous*; IUCN LC) - full migrant
- black-headed bunting (*Emberiza melanocephala*; IUCN LC; National Red Data Book list Data Deficient (DD)) - full migrant
- lesser grey shrike *(Lanius minor*; IUCN LC National Red Data Book listed DD) - full migrant
- woodchat shrike (*Lanius senator*; IUCN LC) - full migrant. Listed on Appendix II of the Bern convention
- black-eared wheatear (*Oenanthe hispanica*; IUCN LC) - full migrant. Listed on Appendix II of the Bern convention
- Eurasian scops-owl (*Otus scops;* IUCN LC) - full migrant
- great cormorant (*Phalacrocorax carbo*; IUCN LC) - congregatory (and dispersive) and full migrant
- Spotted redshank (*Tringa erythropus*; IUCN LC) - congregatory (and dispersive) and full migrant.

The majority of these migratory and congratory species do not occur within the Ramsar Site or IBA in globally significant numbers. However, during bird counts undertaken between 2001-2004 three bird species reached the 1% criterion of the Ramsar Convention namely: great cormorant with an estimated 3100 individuals, Dalmatian pelican with 30 individuals and spotted redshank with 1000 individuals (Schneider-Jacoby et al. 2004; Ramsar, 2005). Some of the key species of rare and threatened avifauna are discussed in more detail below.

Golden Eagle

The golden eagle is widespread globally but persecution in many countries is leading to a drastic decline in population numbers. In Albania, anecdotal evidence has shown that illegal poaching of the species is on the increase, due to the golden eagle being the national symbol.

The species occupies a wide range of flat or mountainous, largely open habitats, often above the tree line (Watson 2010), from sea level to 4,000 m. Nesting occurs on cliff ledges and where these are not available, in large trees or similar artificial structures. As stated, the major threat to this species is persecution.

Levant Sparrowhawk

The species is a migrant, likely wintering in sub-Saharan Africa. The population is estimated to number in the tens of thousands, with Europe forming 75-94% of the global range and the population in Europe of 700-13,800 individuals. In Albania, the population is estimated at 10-40 pairs.

The Levant sparrowhawk inhabits wooded plains, often near water and usually ranges up to 1000m (del Hoyo, 1994). The threats to this species are largely unknown but they are highly vulnerable to the impacts of potential wind energy development (Stix 2012). There is also evidence across its range, especially in Georgia, that whilst they are considered unsuitable for falconry, they are often captured by falconers who are attempting to catch other, more desirable species.

European Roller

The European population is estimated at 614,000-1,100,000 calling or lekking males, which equates to 1,230,000-2,200,000 mature individuals (BirdLife International 2015). The population of Albania is estimated to be only 10-50 breeding pairs, showing a decline over the last 3 generations but the data quality is deemed to be poor (BirdLife International 2008).

All populations of the European roller are long-distance migrants. The European roller migrates diurnally, singly or in small parties, birds follow each other in a steady stream. The species over-winters in two distinct regions of Africa, from Senegal east to Cameroon and from Ethiopia west to Congo and south to South Africa. It winters primarily in dry wooded savannah and bushy plains (BirdLife International 2018a).

The European roller breeds throughout temperate, steppe and Mediterranean zones characterized by reliable warm summer weather. Accordingly, it occurs in the continental interior avoiding oceanic influence.

Threats include persecution on migration in some Mediterranean countries. The loss of suitable breeding habitat due to changing agricultural practices, conversion to monoculture, loss of nest sites, and use of pesticides (reducing food availability) are the main threats to the species in Europe.

Lesser Grey Shrike (*Lanius minor)*

In Europe, the breeding population is estimated to number 331,000-896,000 pairs, which equates to 662,000-1,790,000 mature individuals (BirdLife International 2015). Europe forms c.55% of the global range. The population is suspected to be in decline owing to a multitude of possible ongoing threats (Harris and Franklin 2000). In Europe, trends between 1999 and 2013 have shown a steep decline (EBCC 2015).

The species is a long-distance migrant and spends less than four months on its breeding grounds. The entire breeding population winters in southern Africa (Yosef and International Shrike Working Group 2008). European birds depart in the autumn and overwinter in southern Africa before beginning to return in late February or early March

(Hagemeijer and Blair 1997). It uses open lowlands and hills in steppe and forest-steppe and Mediterranean zones. Suitable breeding habitats in Europe include orchards, groves, parks, woodland edges and overgrown ditches even if close to human settlement or cultivation (Tucker and Heath 1994).

Threats to this species include an intensification of agriculture across its range, which have had negative effects on the large arthropod fauna on which the lesser grey shrike relies (BirdLife International 2018e).

Stone Curlew (*Burhinus oedicnemus*)

The European population of stone curlew is estimated at 53,400-88,200 pairs, which equates to 107,000-176,000 mature individuals (BirdLife International 2018b). The global population has not been estimated following recent taxonomic splits. In Europe, trends show that in the short-term (1998-2013 and 2000-2012 respectively) the population was stable (EBCC 2015) or increasing (BirdLife International 2015). Population estimates in Albania are low, with only 20-70 breeding pairs estimated to be present at the last survey effort in 2012.

The species inhabits lowland heath, semi-natural dry grassland, infertile agricultural grassland, steppe on poor soil, desert and extensive sand-dunes (Tucker and Heath 1994).

Threats to this species include pressures from habitat loss and disturbance, particularly associated with forestry, agricultural intensification, decline in sheep rearing in places, and human recreational pressure on coasts. Many birds are shot and trapped on migration in the Mediterranean region but numbers and effects on populations are uncertain. Collisions with overhead wires and fences, and predation by foxes also cause numerous losses (Hume and Kirwan 2013).

Pygmy Cormorant

The pygmy cormorant has a very large range – breeding in south-east Europe (east from Italy), Russia, Iran, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan, and winters primarily in Albania, Greece, the Balkan states, Turkey, Cyprus, Iraq, Iran, Azerbaijan and also Israel, Bulgaria, Romania and Syria (BirdLife International 2018c).

The species occurs in reedbeds, transition zones between reedbeds and open waters, extensively grazed or mowed shores and wet meadows and, in winter, in coastal wetlands, along rivers, and sometimes on inland lakes. The preferred nesting habitat is willow trees (del Hoyo et al., 1992).

Dalmatian Pelican

The Dalmatian pelican breeds in eastern Europe and east-central Asia. Following large declines in populations throughout the 19th and 20th centuries, the global population stabilised and several colonies, including in Albania, have seen numbers increase. Conservation measures have resulted at an overall population increase in Europe, particularly at the species largest colony (Lake Mirkri Prespa in Greece) but also at Karavasta Lagoon (120 km south of the proposed project area).

Its global Extent of Occurrence (EOO) is estimated at 12,600,000 km^2 and it is known from 11-100 locations (Birdlife International, 2018d). The global population is estimated to be 6,700-9,300 mature individuals with 4,350-4,800 of those in the Black Sea and

Mediterranean regions. The species is dispersive in Europe and migratory in Asia. It breeds in March/April in colonies of up to 250 pairs. It occurs mainly at inland, freshwater wetlands but also at coastal lagoons, river deltas and estuaries (del Hoyo et al. 1992).

The major threats to this species are primarily wetland drainage, hunting or persecution by fishers. The breeding colonies in Mediterranean lagoons in Albania and Turkey are threatened by coastal developments and the alteration of the functioning of the lagoons (Peja et al. 1996).

Lesser White-fronted Goose

The lesser white-fronted goose is listed on the Albanian National Red List as extinct (MoE, 2013). However, on the IUCN red list it is listed as vulnerable and stated that it is a vagrant species that uses Albania through part of its migration route. The vulnerable listing is because of a rapid population reduction in its key breeding populations, primarily in Russia, whilst the Fennoscandian population has undergone an historic decline and has not yet recovered. The species is a full migrant, with breeding grounds in northern Scandinavia and arctic Russia and wintering grounds primarily in south-east Europe (Kear 2005).

During winter and on migration this species frequents open short grassland in the steppe and semi-arid zones. Winter roosting colonies are also formed on large lakes and rivers. Hunting is a major threat to this species and is often mistaken for the closely related species the greater white-fronted goose; the two species often migrate in mixed flocks. Habitat loss and deterioration is another threat.

Red-breasted Goose

The red-breasted goose nests in the Russian arctic and migrates to winter in temperate regions, predominantly along the Black Sea coast. The global population of the species was thought to have declined from 60,000 to 25,000 since the 1950s, but a more recent comprehensive count effort has found a sizeable proportion of the population was missed in previous surveys, and puts the current global population estimate at approximately 56,000 (Weltand International, 2015). Their extensive geographical range and migration makes the species population difficult to estimate accurately.

This species breeds in northern Siberia to the east of the Urals and winters along the coast of the Black Sea (Tucker and Heath 1994). It winters in low arable land near lakes and reservoirs (Carboneras and Kirwan 2014) which they use to roost at night. It arrives October to November and departs between March and early May. The species feeds on grasses, sedges and some aquatic plants, particularly in winter, as well as green sprouts of cereals, grains and tubers.

White-headed Duck

The central and east Asian populations of this species are migratory and during the winter the species inhabit larger alkaline or saline waters. These include saline inland lakes and coastal lakes and lagoons.

The species has undergone a significant decline in population since the turn of the 20th Century, and an estimated further decline of 50-79% in three generations (BirdLife International, 2015).

The greatest long-term threat to the species survival is thought to be competition and introgressive hybridisation (i.e. genetic swamping) with the non-native North American Ruddy Duck (*Oxyura jamaicensis*) (Muñoz-Fuentes et al. 2007). Habitat loss, and particularly the loss of breeding habitat is a major threat, with approximately 50% of breeding habitat of the species being drained in the 20th century.

Ferruginous Duck

The ferruginous duck is a chiefly migrant species, although little is known about its migratory routes and some individuals in southern populations may remain on the breeding grounds all year. The species breeds principally in south-west Asia, central and eastern Europe and North Africa (del Hoyo et al. 1992).

The species shows a strong preference for fresh standing water and is rarely found in flowing streams or rivers (Petkov in litt. 2008). Its habitat requirements outside of the breeding season are similar to those of the breeding season (Kear 2005), although it may also frequent large lakes, open lagoons, coastal marshes with reedbeds (del Hoyo et al. 1992, Kear 2005) and shallow coastal bays, straits and estuaries (Robinson and Hughes 2006).

The species is classified as Near Threatened globally by IUCN, on the basis that it is expected to be undergoing a moderate to rapid decline across its range. A European specific assessment lists the species as Least concern but cites the Albanian population at only 5-30 breeding pairs and only 0-10 individuals as a wintering population (BirdLife International, 2015).

The major threats to this species include the degradation and destruction of well-vegetated shallow pools and other wetland habitats as a result of excessive drainage and water abstraction, building of infrastructure on flood-plains and river canalisation. Changing land management practices which have the potential to alter the breeding and feeding behaviours of the species are also a threat.

Slender-billed Curlew

There are very few recent confirmed records of this species, and no regular breeding, passage or wintering populations are known. The most recent population estimates suggest there are less than 50 mature individuals.

The threats to this species are largely unknown but it is thought that habitat modification of wetlands in Europe may have heavily impacted the species in depriving it of important habitats during migration (Gretton 1991).

Great Snipe

The European population of this species is estimated at between 150,00-291,000 mature individuals. However, there has been an estimated decline at a rate of less than 25% in three generations (Wetlands International, 2012).

The species is migratory however, some birds irregularly winter in north-west Europe and southern Scandinavia. It breeds in northern Europe and Russia, and winters in tropical Africa (del Hoyo et al. 1996). There appears to be no regular migration pattern and the species migrates through all countries between the breeding and wintering range.

Marbled teal

The global population of the marbled teal is thought to be approximately 55-61,000 individuals with 3-5000 of those in the west Mediterranean. The species is dispersive and partially migratory, and shows variable, nomadic movements being capable of dispersal in search of suitable habitat at any time of year as changing conditions require (del Hoyo et al, 1992). During the non-breeding season it occurs in large monospecific flocks of up to 2000 individuals (del Hoyo et al., 1992).

It is adapted to temporary, unpredictable, Mediterranean-type wetlands (Green 2000, 2007) and breeds in fairly dry, steppe-like areas on shallow freshwater, brackish or alkaline ponds with well vegetated shorelines (Green 1993), and rich emergent and submergent vegetation (Kear 2005).

The major threats to this species are primarily wetland drainage, hunting or persecution by fishers. The breeding colonies in Mediterranean lagoons in Albania and Turkey are threatened by coastal developments and the alteration of the functioning of the lagoons (Peja et al. 1996).

Greater Spotted Eagle

In Europe, the breeding population is estimated to number 810-1,100 breeding pairs, equating to 2,430-3,300 individuals (BirdLife International 2004). This species is suspected to have undergone at least a moderately rapid decline over the last three generations because of habitat loss and degradation throughout its breeding and wintering ranges, together with the effects of disturbance, persecution and competition with other predators (BirdLife International 2018f).

The greater spotted eagle occurs in lowland forests near wetlands, nesting in tall trees. It is a migratory species, with birds leaving their wintering grounds in October – November to winter in southern Europe, southern Asia or north-east Africa (del Hoyo et al, 1994).

Black-eared Wheatear

In Europe, the breeding population is estimated to number 1,280,000-3,680,000 pairs, which equates to 2,560,000-7,350,000 mature individuals (BirdLife International 2015). Europe forms 55% of the global range. The IUCN European assessment of the species estimated the Albanian population at between 5,000-15,000 breeding pairs. The species is migratory and travels on a broad front across the Mediterranean and Sahara to winter in the African Sahel (Collar 2015). In Europe, trends between 1998 and 2013 show that populations have undergone a moderate decline (EBCC 2015).

This species breeds in warm climatic zones in stony, scrubby, often broken terrain (slopes and foothills) around open woodland of alerce (*Tetraclinis*), juniper (*Juniperus)* or oak (*Quercus*), amid Olea and Pistacia scrub, olive trees, cactus groves, and in fallowland, vineyards, dry maquis steppe and shrub-covered limestone hills.

Eurasian Spoonbill

Palearctic breeding populations of this species are fully migrant (del Hoyo et al., 1992) but may only travel short distances while other populations are resident and nomadic or partially migratory (Snow and Perrins, 1998). When not breeding the species forages singly or in small flocks of up to 100 individuals and migrates in flocks of similar numbers.

The Eurasian spoonbill shows preference for extensive shallow wetlands, generally avoiding waters with rocky substrates, thick vegetation or swift currents (del Hoyo et al., 1992).

The species is threatened by habitat degradation through drainage and pollution and is especially affected by the disappearance of reed swamps due to agriculture and hydroelectric development. Over-fishing and disturbance have caused population declines through some parts of its range (Greece) and human exploitation of eggs and nestlings for food has threatened the species in the past.

In Albania, the most recent population numbers are estimated at just 2-23 wintering individuals.

Common Redshank

The population of this species is very large, estimated at between 1,300,00-3,100,000 individuals (Wetlands International 2015). In Europe, the population is estimated at 340,000-484,000 pairs, which equates to 680,000-968,000 mature individuals (BirdLife International 2015). The overall trend in population is uncertain, with some populations stable, some increasing, some decreasing and some unknown. In Europe, the population is thought to have undergone a moderate decline between 1980 and 2013.

Most populations of this species are fully migratory and travel on a broad front over land and along coasts, some Icelandic and Western European populations remaining close to their breeding grounds (del Hoyo *et al.* 1996). It breeds from March to August (Hayman *et al.* 1986) in solitarily pairs or in loose colonies (Hayman *et al.* 1986, del Hoyo *et al.* 1996), departing the breeding grounds from June to October, and returning from the wintering grounds again between February and April (Hayman *et al.* 1986). Outside of the breeding season the species forages singly, in small groups (del Hoyo *et al.* 1996) or occasionally in larger flocks of up to c.1,000 individuals (Snow and Perrins 1998) especially at roosting sites (Hayman *et al.*1986) or when feeding on fish (del Hoyo *et al.* 1996).

The species is threatened by the loss of breeding and wintering habitats through agricultural intensification, wetland drainage, flood control, afforestation, land reclamation, industrial development (del Hoyo et al. 1996).

Kentish Plover

Due to taxonomic splits, the population of this species hasn’t been fully estimated. The European population is estimated at 21,500-34,800 pairs, which equates to 43,100-69,600 mature individuals (BirdLife International 2015) with the European range approximating 15% of the global range. The population in Albania is estimated at 200-450 breeding individuals and 100-600 wintering individuals.

Although some populations of this species are sedentary or only disperse short distances (del Hoyo *et al.* 1996), most inland and northern coastal populations (Hayman *et al*. 1986) are fully migratory and have distinct separate breeding and wintering ranges (del Hoyo *et al.* 1996). The species nests solitarily or in loose semicolonial groups (Johnsgard 1981, Urban *et al*. 1986, del Hoyo *et al.* 1996), usually in densities of 0.5 to 20 pairs per hectare (exceptionally up to 100 pairs per hectare) (Johnsgard 1981).

During all seasons the species is predominantly coastal (Johnsgard 1981, Hayman *et al*. 1986, del Hoyo *et al.*1996) and is usually found on sand, silt or dry mud surfaces (del

Hoyo *et al.* 1996), generally avoiding very exposed oceanic coastlines (Snow and Perrins 1998) and rocky or broken ground (del Hoyo *et al.* 1996). It also shows a preference for sparsely vegetated and sandy areas when breeding (Johnsgard 1981).

This species is threatened largely by disturbance of coastal habitats, and degradation and loss of wetland habitat.

Little Ringed Plover

The global population is estimated to number c.280,000-530,000 individuals (Wetlands International 2006). The European population is estimated at 134,000-262,000 pairs, which equates to 269,000-524,000 mature individuals (BirdLife International 2015). The overall population trend is decreasing, although most populations have unknown trends (Wetlands International 2015). In Europe the population size is estimated to be decreasing by less than 25% in 15 years (three generations) (BirdLife International 2015).

This species is fully migratory in much of its range. The European and North African populations migrate across the Sahara Desert. This species is mainly solitary throughout the non-breeding season and on migration, occasionally occurring in flocks of not more than 10 individuals (del Hoyo et al., 1996). During the breeding season this species shows a preference for bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers (Johnsgard, 1981; del Hoyo *et al.* 1996), including river islands, dry, stony riverbeds, sand, shingle or silt flats (Johnsgard 1981, del Hoyo *et al.* 1996), dry wadis and dune slacks.

This species is threatened primarily by the degradation and loss of its preferred habitats (del Hoyo *et al.* 1996).

Eurasian Oystercatcher

The global population is estimated to number c. 1,004,000-1,160,000 individuals (Wetlands International 2012). The European population is estimated at 284,000-354,000 pairs, which equates to 568,000-708,000 mature individuals (BirdLife International 2015). The population increased strongly between the 1960s and the 1990s (van de Pol *et al*. 2014), but has subsequently declined significantly, at a rate exceeding 40% over three generations.

Most populations of this species are fully migratory, inland breeders moving to the coast for the winter (del Hoyo *et al.* 1996). The species breeds from April to July (Hayman *et al.* 1986) in solitary pairs or small groups (Flint *et al.* 1984), during the winter foraging singly or in small groups of up to 10 individuals (Snow and Perrins 1998) and with larger flocks often forming in major bays and estuaries and at roosting sites (Hayman *et al.* 1986, del Hoyo *et al.* 1996).

The species breeds on coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water (Hayman *et al.* 1986, del Hoyo *et al.* 1996).

The main threat to the species is the over-fishing of benthic shellfish and the resulting disappearance of intertidal mussel and cockle beds (Atkinson et al, 2003). Sea level rise leading to increased coastal erosion and flooding is contributing to habitat loss, and in some parts of its range the species is hunted.

Woodchat Shrike

The European population is estimated at 1,930,000-3,110,000 pairs, which equates to 3,870,000-6,230,000 mature individuals (BirdLife International 2015), with Europe equating to 65% of it's global range. This population is estimated to be declining following widespread declines late in the 20th century owing to an array of factors (Harris and Franklin 2000). In Europe, trends between 1998 and 2013 show that populations have undergone a moderate decline (EBCC 2015). The species is migratory, wintering in sub-Saharan Africa, north of the equator and in small numbers in southern Arabia (Yosef *et al*. 2013).

Loss and degradation of habitat through agricultural intensification, afforestation, and large fires are the main threats to this species (Yosef *et al*. 2013). The abandonment of traditional charcoal-making, the canalization of rivers and heavy use of herbicides and insecticides are also threats (Tucker and Heath 1994), whilst draught in the Sahel and changes to agricultural practices in its wintering grounds may lead to long term population declines (Tucker and Heath 1994).

Common Sandpiper

The global population is estimated to number c.2,600,000-3,200,000 individuals (Wetlands International 2015). The European population is estimated at 794,000-1,460,000 pairs, which equates to 1,590,000-2,920,000 mature individuals (BirdLife International 2015. The overall population trend is decreasing, although some populations may be stable and others have unknown trends (Wetlands International 2015). The European population declined moderately between 1980 and 2013 (EBCC 2015).

This species is a full migrant, migrating at night overland on a broad front across both deserts and mountains (del Hoyo *et al.* 1996). The European population that winters in West Africa migrates south between mid-July and August and returns from the breeding grounds in late March to April (del Hoyo et al 1996). The species normally migrates in small flocks and breeds in scattered pairs approximately 60-70m apart in optimal breeding habit. A wide variety of habitats are used such as small pools, ditches, riverbanks (del Hoyo et al.1996, Snow and Perrins 1998), streams, dam shores (Yalden 1992), marshy areas (Johnsgard 1981), estuaries, freshwater seeps on coastal shores, tidal creeks in mangrove swamps and saltmarshes, harbours and docks.

The threats to this species are largely unknown, but the breeding population in the UK is threatened by disturbance from recreational anglers (Yalden 1992).

European Nightjar

The European population is estimated at 614,000-1,100,000 calling or lekking males, which equates to 1,230,000-2,200,000 mature individuals (BirdLife International 2015). The population is suspected to be in decline owing to ongoing habitat destruction, pesticide use reducing the availability of food, and disturbance (del Hoyo *et al*. 1999). In Europe the population is estimated to be stable.

The species is highly migratory, wintering mainly in south and east Africa, although small numbers may winter in West Africa (Cleere and Christie 2013). The species nests on bare or sparsely vegetated ground, often on free-draining soils (Cramp 1985). It uses mainly dry, open country including lowland heaths with scattered trees and bushes, commons and moorland, forest and woodland (especially glades, clearings and edges), recently felled woodland and young forestry plantations.

The main threats to this species are the reduction of insect availability due to pesticide use (Tucker and Heath 1994, Cleere and Christie 2013) and habitat loss or degradation.

4.1.5.2 *Alien Invasive Species*

According to the Global Invasive species database, three species of birds are classed as alien invasive species in Albania. These included the rock pigeon, Eurasian collared dove and the cattle egret. The impacts of these species on native avifauna is poorly studied, and little information is available.

4.1.6 Reptiles

The wider region of the Buna/Bojana delta with Lake Shkoder/ Skadar is recognized as a centre of reptile biodiversity for the Balkan region (Đukić, 1995). This is likely to be attributed to the diversity of habitat types and refuges within this landscape.

Several reptiles were sighted basking during the walkover survey which was an unexpected finding, as reptiles are normally in hibernation at this time of year in Albania. Two juvenile snakes, one of which was a nose-horned viper (*Vipera ammodytes*; IUCN LC; Albanian Red List LR/nt) were observed within the project footprint amongst regenerating agro-pastoral land / thicket, near the ridgeline of Mount Renci. A smooth snake (*Coronella austriaca*; IUCN LC; Albanian Red List LR/nt) was also observed basking on an area of exposed coastal dune outside of the project footprint, in close proximity to the dune wetland (located near the settlements of Rrjolli). Two additional snakes were sighted basking in the same location the following morning, however, these individuals moved too quickly to be able to make a fully identification of these species. Two lizards were sighted basking on rocks amongst Mediterranean evergreen *Quercus* forest located within the project footprint and buffer on Mount Renci, and one lizard was observed basking on a rock amongst regenerating agro-pastoral land within the project footprint and buffer on Mount Renci. These individuals dispersed before a full identification was made.

4.1.6.1 *Reptile Species of Conservation Importance*

Lake Skadar and River Buna Ramsar site and the Buna River Protected Landscape provide habitat for 31 species of reptile (Ramsar, 2005). Of these, only one species was reported as being of conservation importance, namely the European pond turtle (*Emys orbicularis*; IUCN NT; Albanian Red List LR/nt).

Loggerhead turtles (*Caretta caretta*; IUCN VU; Albanian Red List EN) are known to use marine habitats in Dirinit Bay (White, Boura and Venizelos, 2011) and in 2002, loggerhead turtles were reportedly recorded egg-laying at Ada island which is located in close proximity to the Buna River Protected Landscape in Montenegro (Schneider-Jacoby et al. 2006). It is however hypothesised that disturbance caused be vehicles and pedestrians, particularly during peak tourist season, are likely to deter turtles from nesting on the beach at the foot Mount Renci, near the proposed project footprint. Green turtles (*Chelonia mydas*; IUCN EN; Albanian Red List CR) are also known to use the marine habitats of Drini Bay for foraging and migration, but on a very sporadic basis (White, Boura and Venizelos, 2011).

The project area is also considered to offer potentially suitable habitat to support the following reptile species of conservation importance:

- Hermann's Tortoise (*Testudo hermanni)* – IUCN NT; Albanian Red List LR/nt; Annex II of the Bern Convention; Annex II and IV of the EU Habitats Directive; Annex II of CITES; Annex A of EU Wildlife Trade Regulation 338/97
- Western Caspian Turtle (*Mauremys rivulata)* – Not IUCN listed; Albanian Red List VU; Annex III of the Bern Convention
- European adder (*Vipera berus*) – IUCN LC; Albanian Red List LR/nt; Annex III of the Bern Convention
- nose-horned Viper (*Vipera ammodytes*) - IUCN LC; Albanian Red List LR/nt; Annex II of the Bern Convention; Annex IV of the EU Habitats Directive
- smooth Snake (*Cornella austriaca*) - IUCN LC; Albanian Red List LR/nt; Annex II of the Bern Convention; Annex IV of the EU Habitats Directive
- four-lined snake (*Elaphe quatuorlineata*) - IUCN LC; Albanian Red List CR; Annex II of the Bern Convention; Annex II and IV of the EU Habitats Directive
- European ratsnake (*Zamenis situla* synonym *Elaphe situla*) - IUCN LC; Albanian Red List CR; Annex II of the Bern Convention; Annex II and IV of the EU Habitats Directive
- Aesculapian ratsnake (*Zamenis longissimus* synonym *Elaphe situla*) - IUCN LC; not listed on the Albanian Red List; Annex II of the Bern Convention; Annex IV of the EU Habitats Directive
- Balkan whip snake (*Hierophis gemonensis*, synonym *Coluber gemonensis*) - IUCN LC; Albanian Red List CR; Annex III of the Bern Convention
- Balkan green lizard (*Lacerta trilineata*) - IUCN LC; Albanian Red List LR/cd; Annex II of the Bern Convention; Annex IV of the EU Habitats Directive
- Kotchys gecko (*Mediodactylus kotschyi*) - IUCN LC; not listed on the Albanian Red List; Annex IV of the EU Habitats Directive; Annex II of the Bern Convention.

Reptiles of conservation importance are discussed in more detail below.

Loggerhead Turtles

The global range of loggerhead turtles extends across the subtropical and temperate regions of the Mediterranean Sea and Pacific, Indian, and Atlantic Oceans. The global population of loggerhead turtles is thought to be in a state of decline (IUCN, 2018). There are six subpopulations and according the IUCN (2018) the Mediterranean sub-population is categorised as LC.

The loggerhead turtle is a migrant species and nests on insular and mainland sandy beaches throughout the temperate and subtropical regions worldwide (IUCN, 2018). Although nesting sites for loggerhead turtles are not common along the Adriatic coast, in 2002, loggerhead turtles were reportedly recorded egg-laying on Ada island which is located in close proximity to the Buna River Protected Landscape in Montenegro (Schneider-Jacoby et al. 2006), while further south in the Albanian Divjaka-Karavasta National Park, 50 hatchlings were recorded to have hatched in August 2018 (Invest in Albania 2018).

The Adriatic Sea is important for loggerhead turtles with numerous studies indicating its importance as a foraging ground for all life history stages, and foraging ground for adult turtles from the major rookery at Zakynthos (Greece) (Casale et al. 2018, Zbinden et al. 2008). It also supports medium to long-term residence of juveniles with the southern

Adriatic in particular known to be an important developmental area for juveniles in the first years of life (Casale et al. 2014). Loggerhead turtles are known to use marine habitats in Drinit Bay for foraging with large numbers of adolescent males present and as a migratory corridor (White, Boura and Venizelos 2011). They seasonally occur in the shallow bays along the Albania coast, particularly Drinit Bay and Rodoni Bay, and are distributed around the mouths of the Drini, Mati, Ishmi, Shkumbi and Semani Rivers (Haxhiu 2010).

The main threats to the species in Albania are primarily fishing activities, with loggerhead turtles caught as bycatch, and pollution (Haxhiu 2010).

Green Turtles

The range of the green turtle is circumglobal, and they occur throughout tropical and, to a lesser extent, subtropical waters, including the Mediterranean Sea (Seminoff 2004). The only known nesting sites of green turtles in the region are in the north-eastern Mediterranean, but as a migratory species, they are present in Albanian waters (White, Boura and Venizelos 2011). Juveniles in particular are present in Drinit Bay sporadically, with approximately 15 caught as bycatch since 2003 (Haxhiu 2010). Hence, this species is unlikely to nest on the beaches near the project area.

European Pond Turtle

The European pond turtle is resident throughout Europe, the Caspian and Middle East regions; including Albania. This is a semi-aquatic species utilising habitats including ponds, lakes, brooks, streams, rivers and drainage canals (TTFSG, 1996).

Hermann’s Tortoise

Hermann’s tortoise is extant in nearly all of Albania but is otherwise distributed patchily throughout Mediterranean Europe. The population is relatively stable in the Balkans, with a more continuous distribution (van Dijk et al. 2004, Bertolero et al. 2011).

In the Mediterranean, including Albania, the Hermann’s tortoise prefers open patchy evergreen oak forest, but also inhabits coastal dunes, pastures, scrubs and sparse vegetation. It is not found in areas of intensive agriculture, marshy areas or dense forests (Bertolero et al. 2011). The main threats to the species are habitat loss and degradation, wildfires and collection for pet trade (van Dijk et al. 2004, Bertolero et al. 2011).

Western Caspian Turtle

The western Caspian turtle occurs in the Balkan region of southeastern Europe and the eastern Mediterranean, including southern coastal Turkey and the western Middle East. Its Mediterranean distribution includes Albania, Montenegro, Croatia and Greece and it occurs in a variety of natural and man-made habitats such as rivers, seasonal ponds, brackish coastal lagoons, irrigation channels and reservoirs, but is not normally found in fast running water (Mantziou and Rifai 2014). Within Albania it is common in the west and is found in brackish water around Shëngjin (Haxhiu 1998). The main threat to the species is habitat loss (Mantziou and Rifai 2014).

European Adder

Although the European adder is a widespread species throughout Europe, on the Balkan peninsula it is largely restricted to montane areas and has a very fragmented distribution.

Throughout its range it has been recorded from sea-level up to 2,700 m asl (Temple and Cox 2009). This species has a broad tolerance of habitat types including open woodland and shrubland, hedgerows, field edges, heathland, moors, grasslands, alpine meadows, dunes and marshes. Intensification of agricultural methods and practices have led to the fragmentation of populations.

Nose-horned Viper

The nose-horned viper is found from 0 to 2,500 m above sea level and ranges eastward from north-eastern Italy and down through the Balkans to Greece and into Turkey. The nose-horned viper is primarily associated with rocky habitats but is opportunistic in its use of other areas, and can often be found in open woodland and scrub, sand dunes, hillsides and traditionally cultivated land and vineyards (Agasyan et al. 2009). It is locally threatened by overcollection for venom extraction in some parts of its range and is generally persecuted by people (Agasyan et al. 2009).

Smooth Snake

The smooth snake has a wide distribution, and is generally common in its southern distribution, which includes Albania, with fragmented populations in the northern parts of its range (Crnobrnja-Isailovic et al. 2009). It inhabits multiple habitats including moorland, rocky coastlines, sandy coastal sites, scrubland and subalpine areas with sparse vegetation. Threats to the species include intensification of agricultural practices, global climate warming and isolation of populations (Crnobrnja-Isailovic et al. 2009).

Four-lined Snake

The four-lined snake has a fragmented distribution that extends across Mediterranean and sub-Mediterranean zones particularly across the Balkan region and central and southern Italy (excluding Sicily). The global population is thought to be in a state of decline (Crnobrnja-Isailovic et al. 2009). This species has a relatively widespread distribution in Albania and inhabits a broad range of habitats including open woodlands and woodland edge habitats, hedgerows, rocky habitat types and agro-pastoral land. It is characterised by large home ranges. This principle threats to the global and Albanian populations are habitat loss arising from the intensification of agricultural practices and infrastructure development. In some parts of this species range, the four-lined snake is also persecuted (Crnobrnja-Isailovic et al. 2009).

European Ratsnake

The global population of European ratsnake is located between 0 to 1,600 m above sea level and extends across 11 countries in Europe including Albania (Böhme et al. 2009). In the Balkans it is a common to uncommon species and is said to be declining in Albania. This species inhabits a wide range of habitat types including scrubland, macchia, karst habitats, field edges, marshes, stream edges, and also in vineyards and olive groves, as well as in rural gardens and buildings (Böhme et al. 2009).

Aesculapian Ratsnake

The global population of Aesculapian ratsnake is located between 60 to 2,000 m above sea level and extends across 23 countries in Europe including Albania (Agasyan et al., 2018). Whilst common throughout much of its range, the Aesculapian ratsnake is considered one of the three rarest snakes in Ukraine (Kotenko 2006). This species inhabits a wide range of habitat types including deciduous, mixed and coniferous woodlands, forest ravines, scrub and thickets, rocky habitats, agro-pastoral land, meadows and manmade structures.

Balkan Whip Snake

The Balkan whip snake is native to Albania, Bosnia and Herzegovina, Croatia, Greece; Italy, Montenegro, Slovenia and occurs on a number of islands in the Adriatic Sea near Greece. This species has a stable population status throughout its range (Lymberakis and Ajtic, 2009) but is in a state of decline in Albania, threatened by habitat loss. This species occurs in a variety of habitat types including Mediterranean shrubland, plantations, agro-pastoral land, gardens, open woodlands and stony habitats (Lymberakis and Ajtic, 2009).

Balkan Green Lizard

The global range of Balkan green lizard extends across ten countries including Albania. This species commonly occurs in a broad range of habitat type including bushy areas, sand dunes, boundary walls, orchards, and abandoned cultivated land, usually in dry areas within the Mediterranean (Schneder-Jacoby et al. 2006).

Kotschys Gecko

The global range of Kotschys geckos extends across south-eastern Europe and the Middle East and it is thought to be common throughout its range. In Albania, this species inhabits coastal habitats from Shkoder to Vlore. Key habitats include rocky habitats, scrubalnds, cliffs, stone walls and the walls of houses (Böhme et al. 2009).

4.1.6.2 *Alien Invasive Species*

No records of alien invasive reptiles inhabiting the project area and / or the Buna River Protected Landscape and Ramsar complex were identified.

4.1.7 Amphibians

The wider Buna/Bojana delta region hosts a large number of amphibian species, likely attributed to the diversity of habitat types and refuges within this landscape (Schneider-Jacoby et al. 2006).

No living amphibians were sighted basking during the walkover survey. One desiccated frog was observed outside of the project footprint and buffer, on the periphery of the dune wetland at the foot of Mount Renci.

4.1.7.1 *Amphibian Species of Conservation Importance*

Lake Skadar and River Buna Ramsar site and the Buna River Protected Landscape provide habitat for 11 species of amphibian (Ramsar, 2005). Of these, only one species was reported as being of conservation importance, namely the European tree frog (*Hyla arborea*; IUCN LC; Albanian Red List LR/cd). The walkover survey identified that habitats present within the project footprint on Mount Renci are suboptimal to support amphibians throughout their entire lifecycle.

The project area is also considered to offer potentially suitable habitat to support the following amphibian species of conservation importance:

- Balkan water frog (*Pelophylax kurtmuelleri*) – IUCN LC; Albanian Red List VU. Listed on Appendix III of the Bern Convention
- Alpine salamander (*Salamandra atra*) – IUCN LC; Albanian Red List LR/nt. Listed on Appendix II of the Bern Convention and Annex IV of the EU Habitats Directive
- yellow-bellied toad (*Bombina variegate*) – IUCN LC; Albanian Red List LR/cd. Listed on Appendix II of the Bern Convention and on Annexes II and IV of the EU Habitats Directive
- European green toad (*Bufotes viridis*) – IUCN LC; Albanian Red List LR/nt. Listed on Appendix II of the Bern Convention and is listed on Annex IV of the EU Habitats Directive
- European tree frog (*Hyla arborea*) – IUCN LC; Albanian Red List LR/cd. Listed on Appendix II of the Berne Convention and Annex IV of the EU Habitats Directive
- Greek stream frog (*Rana graeca*) – IUCN LC; Albanian Red List low risk (LR/nt). Listed on Annex IV of the EU Habitats Directive and Appendix III of the Bern Convention
- Common frog (*Rana temporaria*) – IUCN LC; Albanian Red List low risk (LR/cd). Listed on Appendix III of the Berne Convention and on Annex V of the EU Habitats Directive.

Amphibians of conservation importance are discussed in more detail below.

Balkan Water Frog

The Balkan water frog is found in Albania and Greece, and is common and widespread throughout its range (Gasc et al. 1997). The species is present in the Lake Skadar protected area, on the border of Montenegro and Albania, and presumably in several other protected areas.

It is largely an aquatic species, generally found in areas close to suitable open water wetland habitats. The species is threatened by drainage of wetland areas in its range. In the Lake Skadar area, it is threatened by overcollection for commercial purposes (Uzzel et al, 2009).

Alpine Salamander

This species is present in the European Alps and in isolated populations in the Balkan Dinaric Alps in Slovenia, Croatia, Bosnia-Herzegovina, Serbia-Montenegro and northern Albania, occurring at elevations between 400-2800m. It is found in cool, damp alpine meadows, stony pastures, dwarf heath and mixed, broadleaf and coniferous woodland. The main threat to this species in the northern part of its range is over-collecting for commercial purposes (Andreone et al, 2009).

Yellow-bellied Toad

This species is distributed over much of central and southern Europe. The species has an altitudinal range of 100-2,100m asl.

The species uses many types of wetlands, including lakes, ponds, swamps, rivers, stream pools, springs, puddles and reservoirs. It can be found in coniferous, deciduous and mixed forests, bushlands and meadows, floodplains and grasslands.

Generally, this species has few major threats, but local populations may be threatened by the loss of suitable habitat to urbanization, road construction, industry and pollution of wetlands.

European Green Toad

Populations of green toads are distributed through much of Europe, and although populations are thought to be decreasing in numbers it is still considered a relatively abundant and common species over large parts of its range.

This species lives in a wide range of forests, forest steppe, scrubland, grassland and alpine habitats. It may also be found in modified habitats and often benefits from disturbed habitats.

The main threat over much of the range (most especially in the north) appears to be the loss of breeding habitats through wetland drainage, desiccation and aquatic pollution (industrial and agricultural).

European Tree Frog

The European tree frog is a widespread species occurring from Iberia (where there are scattered populations within its range) and France, eastwards to western Russia and the Caucasian region, and southwards to the Balkans and Turkey (except extreme eastern, south-eastern parts).

This species is generally associated with open, well-illuminated broad-leaved and mixed forests, bush and shrublands, meadows, gardens, vineyards, orchards, parks, lake shores and low riparian vegetation. Dark and dense forests are avoided.

Changes in habitat, pollution of wetlands, drainage of wetlands and predatory fish species are the species' major threats.

Greek Stream Frog

This species is restricted to the Balkan region, at altitudes of 200-2000 asl. It is a largely aquatic, montane species associated with cold, small, clear rivers, streams or springs in shady mixed or deciduous forest.

The major threat to this species is the loss of suitable habitat, resulting from forest fires, wetland drainage, construction of dams, etc. It is also affected in some places by pollution.

Common Frog

This species It is widespread throughout most of Europe but has a patchy distribution in the mountainous part of the Balkans. It is generally very common, with many terrestrial and aquatic habitats used. There are no major threats to this species but pollution and drainage of breeding sites and wetlands may pose a localised threat to some parts of its range.

4.1.7.2 *Alien Invasive Species*

No information of alien invasive amphibian species could be found for the project area or Albania as a whole.

4.1.8 Fish

Whilst a fish survey was beyond the scope of this supplementary biodiversity assessment, the literature review identified that Lake Skadar and River Buna Ramsar site and the Buna River Protected Landscape is considered to support a high diversity of fish species, due to diversity of its aquatic habitat types (i.e. fresh, brackish and marine). The hydrological network of the Southwestern Balkan, Lake Skadar and Buna and Drin rivers (including Ohrid and Prespa lakes) provide foraging, spawning habitat and nursery ground for fish.

Lake Skadar and freshwater wetlands are known to provide important spawning ground for Cyprinidae species. The Vilunit lagoon also provides spawning and nursery habitat for flathead mullet (*Mugil cephalus*; IUCN LC) and thinlip grey mullet (*Chelon ramada*; IUCN LC).

4.1.8.1 *Fish Species of Conservation Importance*

According to the Lake Skadar and River Buna Ramsar site information sheet (Ramsar 2005) the Buna River is a migration corridor for thirteen fish species who migrate from the sea to these lakes and rivers. Of these, six migratory fish species are globally or nationally rare and threatened:

- European sea sturgeon (*Acipenser sturio*) - IUCN CR; Albanian Red List EN and Bern Convention Appendix III
- Adriatic sturgeon (*Acipenser naccarii*) - IUCN CR; Albanian Red List EN and Bern Convention Appendix II
- stellate sturgeon (*Acipenser stellatus*) - IUCN CR, not evaluated by the Albanian Red List and Bern Convention Appendix III
- Twaite shad (*Alosa fallax*) - IUCN LC, Albanian Red List VU and Bern Convention Appendix III
- brook lamprey (*Lampetra planeri*) - IUCN LC, not evaluated by the Albanian Red List and Bern Convention Appendix III
- river lamprey *(Lampetra fluviatilis*) - IUCN LC and Albanian Red List EN.

Additional fish species that are listed as being present within this Ramsar site that are of conservation importance are listed as follows:

- marble trout (*Salmo marmoratus*) – IUCN LC; Albanian Red List EN
- *Salmothymus obtusirostris* - IUCN EN; Albanian Red List VU
- *Cyprinus carpio* - IUCN VU; not evaluated by the Albanian Red List
- nase *(Chondrostoma nasus)* - IUCN LC; Albanian Red List low risk and Bern Convention Appendix III
- Skadar shad (*Alosa sp.nov.'Skadar')* – IUCN VU; Bern Convention Appendices II and V.

This Ramsar site is also known to support congregatory species of fish including the Albanian roach (*Pachychilon pictum*; IUCN LC; not evaluated by the Albanian Red List and Bern Convention Appendix III). This is a small cyprinid that inhabits rivers, lakes and wetlands that is currently threated at the global scale by habitat destruction (i.e. the construction of dams) and water pollution (2018).

4.1.8.2 *Invertebrates*

According to the Lake Skadar and River Buna Ramsar site information sheet (Ramsar 2005) the great Capricorn beetle (*Cerambyx cerdo*) inhabits this area. This species is IUCN listed VU, Albanian Red Data Book listed EN and is listed on the Habitats Directive under Annex II & IV. Although the IUCN assessment in 1996 does not cite Albania as part of this species' geographical range, stakeholder consultation, undertaken in 2019 as part of the Habitat Regulations Assessment for the Project, identified that this beetle may be present in the *Quercus* forests located both within the Ramsar site and the wider area and is therefore assumed to be present in the PDA.

4.1.8.3 *Alien Invasive Species*

There is little information regarding the specific project area (or Albania as a whole) in relation to aquatic alien invasive species and their impacts. However, there are reportedly 22 fish species and subspecies in Lake Skadar that are non-native from which the Buna river flows, which accounts for more than a third of all the fish species of the lake (Ramsar, 2005). Some of these fish species, such as *Carassius auratus gibelio, Perca fluviatilis* and *Pseudorasbora parva* are dominating the indigenous fish populations of the lake. This has negatively impacted the population dynamics of the indigenous fish (Ramsar, 2005).

4.2 Ecosystem Services

Whilst the provision of a detailed ecosystem service assessment was beyond the scope of this biodiversity assessment, the literature search, field observation and anecdotal interviews with local residents undertaken during the walkover survey identified that the habitats located within the study area together with the species they support, provide a range of ecosystem services as set out below.

Provisioning services:

- The region's main economic activities are agricultural, fishing, tourism and trade sectors which employ most of the region's population (IUCN, 2012). Vascular plants are used for provisioning services by local communities (i.e. trees used for construction and fuel; plants for food and medicinal products). At the time of survey, pine trees near Shëngjin appeared to have been felled for timber for construction and fuel. Evidence of sage collection for sale and consumption (i.e. to make tea and to use in cooking) was apparent throughout the study area and two residents of Rrjolli were observed collecting sage on separate occasions.
- Fauna and avifauna are used for food (hunting, gathering and foraging). Evidence of hunting (i.e. used gun cartridges) were frequently observed within the project footprint near Shëngjin. Aquaculture and fishing were observed in the lagoon at the time of survey.

Regulating services:

- climate change amelioration, in terms of carbon sequestration and carbon sinks, and attenuating directional and or hemispherical surface albedo
- microclimate climate regulation by vegetation and soils in terms of regulating ambient temperatures and water vapour levels
- local water and air pollution control - through waste assimilation, water and air filtration
- water regulation, erosion control and water catchment protection in terms of maintaining higher flows in rivers and for longer duration; reducing flood surges; and reducing sedimentation of receiving waters through the stabilisation of riverbanks and steep slopes by vegetation including riparian, emergent habitats
- erosion control of terrestrial habitats (i.e., arising from wind erosion) – in terms of controlling ambient fugitive dust emissions though the stabilisation of soil by

terrestrial habitats and maintaining edaphic conditions including soil moisture levels

- Regulation of ambient noise levels – habitats and vegetation acts as a natural sound barrier, buffering noise emissions including those arising from anthropogenic sources (i.e., vehicle movement, people, and machinery).

Cultural services:

- Ethical and biodiversity 'non-use values', particularly in terms of maintaining populations of endangered and endemic species. These values are difficult to ascertain.
- sense of place and way of life – these locations are likely to provide value to local people living near and utilising these areas in terms of the way of life and special connection with such areas
- Eco-tourism and tourism. For example, the beaches and woodlands within the region of the project attract nearly 250,000 tourists a year, mostly between July and August (IUCN, 2012).
- Locations within the project landscape may provide spiritual, sacred or religious values; inspiration for culture and design; and cognitive development. During the walker survey a burial site was observed outside of the project footprint near Rrjolli.

Habitat and species support:

- Habitats within the project footprint and surrounding landscapes, including the Buna River Protected Landscape, provide important refuge, feeding, watering, breeding and nursery areas for a host of animals.

Other supporting services:

- The abovementioned habitats and species within provide a range of supporting services such as photosynthesis and water, carbon and nutrient cycling, whose values are typically accounted for in other ecosystem services.

4.3 Existing Threats to Biodiversity

The current threats to habitat quality and species diversity were identified as occurring or potentially occurring within the project area. These threats are predominantly linked to human habitation and anthropogenic activities in the region. Existing threats to biodiversity in the project area are as follows:

Poaching: Since the 1990s hunting has become one of the major causes of wildlife decline in Albania (Ruppert 2018). To combat the issue, in 2014 the Albanian government approved a complete hunting ban for the whole of Albania. It came into force in March 2014 and was intended to remain effective for two years until March 2016 (law no. 7/2014 "proclaiming the moratorium of hunting in the republic of Albania"). However, because of ineffective management the ban was extended until 2021 (law no. 61/2016 "On the Promulgation of the Moratorium in the Republic of Albania"). Illegal hunting is still occurring even in protected areas. Birdlife International published the report "The Killing" in 2016 which denounces the illegal killing of 25 million birds in the Mediterranean, with Albania being in the ten most problematic areas for the illegal killing of birds (BirdlLife International 2015b). The hunting ban is unpopular with the public and there is limited enforcement but it has reduced the number of foreigners coming to Albania on hunting holidays. Lake Schkoder and its associated wetlands are targeted for hunting of game and migratory birds. A study by an Albanian non-governmental organisation in January 2017 observed up to 50 gunshots heard and 66 used cartridges found during their survey of the Lake Skadar area (ASPBM 2017). Evidence of hunting (five used gun cartridges) was observed during the walkover field surveys within the project footprint on Mount Renci near Shëngjin (Figure 4-30).

Unsustainable fishing: Uncontrolled fishing is causing a decline in a number of marine fish species in the Bojana-Buna Protected landscape, with some considered to be extinct (all species of sturgeon are considered extinct in the region (Schneider-Jacoby et al, 2006). Local people are heavily dependent on fishing for livelihoods and there is additional external pressure from large international fishing boats. Evidence of illegal fishing within Lake Skadar was also observed by ASPBM in their 2017 survey (ASPBM 2017.)

Alien invasive species encroachment: Whilst alien invasive species were not observed in the study area during the field surveys, invasive species continue to pose a threat to biodiversity. In recognition of this, Albania has adopted an invasive alien species management plan.

Poor waste water and water management: Albania has 0.7 million hectares of arable land of which about 60% is irrigated (figures from 1990) and produced 80% of the agricultural value. More than half the irrigated area is located in the coastal plains (Ministry Environment, Forests and Water Administration 2011.) There are proposals for new dams and channelling of water from other catchments into the Bojana-Buna delta which would ultimately result in the lowering of Lake Skadar and the creation of additional agricultural land. This would cause the loss of fringing alluvial wetlands which are considered key fish spawning grounds (Schneider-Jacoby et al, 2006).

Poor waste management: Albania's waste management infrastructure is limited, and much household waste is not appropriately disposed of (Lico et al 2015). Litter was observed within the study area around settlements (in particular near Shëngjin and on the beach) during the field surveys (Figure 4-31). Plastic waste can have detrimental effects on the biological fitness of wildlife and / or result in the mortality of individuals if ingested. Chlorinated plastic can release harmful chemicals into the surrounding soil, which can then seep into groundwater, causing potentially harmful effects to the aquatic environment and species dependant on it (UNEP website). Poor waste management may also attract pest species (i.e. vermin) which in turn may result in the displacement of natural wildlife and act as vectors of disease.

Habitat loss and degradation: localised habitat clearance was observed within and in close proximity to the proposed project footprint, particularly within pine plantations near Shëngjin (Figure 4-32). The risk of uncontrolled habitat clearance for the development of agro-pastoral activities and housing pose a threat to natural habitats and wildlife in the project area. Furthermore, the conversion of natural habitats to agro-pastoral land, over grazing and vehicle damage were identified during the walkover survey as contributing to erosion of the habitats (i.e. dune wetland and vegetation dunes) located at the base of the Mount Renci (Figure 4-34).

In 1997, the Albanian population reached 3.7 million, or triple its level of 50 years ago (Cat specialist group 1998.). The population of Albania is still thought to be increasing. In combination with this trend, habitat clearance for the development of agro-pastoral activities, the development and expansion of settlements and industries and the establishment and upgrade of transport infrastructure is thought to be a driver for the loss and degradation of natural habitats in Albania. The advancement of intensive agricultural methods, as a result of the introduction of a free market economy has also led to a degradation of natural habitats and subsequent loss of biodiversity (Ministry of Environment 2011). Since the 1950s, the forest area has decreased from 45 per cent to 36 per cent of the land cover, resulting in the loss, degradation and fragmentation of habitat for biodiversity and problems with soil erosion (UN 2002). The lack of sustainable management of forest and conversion to agriculture has impacted biodiversity. Pasture area in Albania has reduced from 816,000 ha in 1950 to 445,000 ha in 1997 and can no longer maintain the national flock of about 3 million sheep and goats (UN 2002). This has caused the overgrazing of pastures and lack of regeneration of forests.

Tourism: The Adriatic coastline, beaches and seascapes of the Bojana -Buna delta are important for tourism which fuel regional development and long-term economic growth of the region, in which beaches and woodlands attract nearly 250,000 tourists a year, mostly between July and August (UN 2002). However, unchecked tourism poses a risk to habitat quality and species diversity in the region. Disturbance arising from increased noise and human activity has the potential to cause disturbance and displacement of wildlife. Unauthorised vehicle use on the beaches (Figure 4-33), secondary dune systems and dune wetland and high levels of trampling pose a risk to the quality of these sensitive habitats and driving at night in these habitats increases the risk of accidental vehicle-wildlife collisions.

Figure 4-30: Used gun cartridge

Figure 4-31: Household waste

Figure 4-32: Habitat clearance

Figure 4-33: Vehicle tracks on the beach

Figure 4-34: Erosion

5 PRIORITY BIODIVERSITY FEATURES AND CRITICAL HABITATS

5.1 Identification of Priority Biodiversity Features for The Project

EBRD PR6 defines Priority Biodiversity Features (PBFs) as features that are particularly irreplaceable or vulnerable, albeit a lower priority than critical habitats (see Section 5.2). PR6 identifies the following as likely PBFs:

- threatened habitats
- vulnerable species
- significant biodiversity features identified by a broad set of stakeholders or governments (such as Key Biodiversity Areas or Important Bird Areas)
- Ecological structure and functions needed to maintain the viability of the features listed above.

5.1.1 Vulnerable Species

A list of vulnerable species (IUCN 2019) that are present or potentially present within the total area of analysis was identified for the project based on the findings of the literature search and field survey:

Insect:

- great capricorn beetle (*Cerambyx cerdo*)

Fish:

- *Cyprinus carpio*

Mammal:

- long fingered bat
- Blasius' horseshoe bat
- Mediterranean horseshoe bat (VU in the Mediterranean)

Reptiles:

- loggerhead sea turtle *(Caretta caretta)*
- meadow viper (*Vipera ursinii)*

Birds:

- common pochard (*Aythya farina*)
- great bustard (*Otis tarda*)
- greater spotted eagle (*Aquila clanga*)
- lesser white-fronted goose (*Anser erythropus*)
- red-breasted goose (*Branta ruficollis*)
- marbled teal (*Marmaronetta angustirostris*)
- European turtle-dove (*Streptopelia turtur*)
- oystercatcher (*Haematopus ostralegus*; VU in Europe)
- European curlew (*Numenius arquata*; VU in Europe)

Species categorised by the National Red List for Albania as VU that occur or potentially occur within the area of analysis are presented in Table 5-1. Species of community interest listed in Annex II of the EU Habitats Directive that occur or potentially occur within the area of analysis are presented in Appendix 7, Table A7-1. Eurasian badger and wildcat, golden eagle, eagle owl, European bee-eater, black-winged stilt, yellow-legged gull, pygmy cormorant, dalmatian pelican, *Punica granatum, Colchicum autumnale, Origanum vulgare, Galatella albanica, Hypericum perforatum* and *Quercus ilex* have also been included in the Priority Biodiversity Features due to their conservation status in Albania (i.e. EN to CR) and confirmed presence in the PDA.

Table 5-1 Vulnerable Species per the National Red List of Albania, 2013

Taxon Type	Common Name	Scientific Name	IUCN (2018) Status
Plant	Marsh pennywort	*Hydrocotile vulgaris*	Least Concern
	Flowering-rush	*Butomus umbellatus*	Least Concern
	Great fen-sedge	*Cladium mariscus*	Least Concern
	Yellow water-lily	*Nuphar lutea*	Least Concern
	European white waterlily	*Nymphaea alba*	Least Concern
	-	*Nymphoides peltata*	Least Concern
	Arrowhead	*Sagittaria sagittifolia*	Least Concern
	-	*Adiantum cappilus-veneris*	Least Concern
	Greater duckweed	*Spirodela polyrhiza*	Least Concern
	Field elm	*Ulmus minor* (synonym *Ulmus campestris*)	Data Deficient
	Crack willow	*Salix fragilis*	Not evaluated
	-	*Nymphoidetum peltata*	Least Concern
	Western strawberry-tree	*Arbutus unedo*	Not evaluated
	-	*Erica arborea*	Least Concern
	-	*Juniperus oxycedrus ssp. Macrocarpa*	Lest Concern
	European hop-hornbeam	*Ostrya carpinifolia*	Least Concern
	Downy oak	*Quercus pubescens*	Least Concern
	Sage	*Salvia officinalis*	Least Concern
	-	*Satureja montana*	Not evaluated
Fish	-	*Salmothymus obtusirostris*	Endangered
	Twaite shad	*Alosa fallax*	Least concern

Taxon Type	Common Name	Scientific Name	IUCN (2018) Status
	-	*Petromyzon Marinus*	Least concern
	-	*Salmo trutta lacustris*	Least concern
Mammal	Mediterranean horseshoe bat	*Rhinolophus euryale*	Near Threatened
	Eurasian otter	*Lutra lutra*	Near Threatened
	Golden jackal	*Canis aureus*	Least Concern
	Brown bear	*Ursus arctos*	Least Concern
Amphibian	Balkan water frog	*Pelophylax kurtmuelleri* (synonym *Rana balcanica*)	Least Concern
Bird	Common buzzard	*Buteo buteo*	Least Concern
	Common kestrel	*Falco tinnunculus*	Lest Concern
	Eurasian oystercatcher	*Haematopus ostralegus*	Near Threatened
	Eurasian bittern	*Botaurus stellaris*	Least Concern
	Grey heron	*Ardea cinerea*	Least Concern
	Little egret	*Egretta garzetta*	Least Concern
	Black-crowned night heron	*Nycticorax nycticorax*	Least Concern
	Sandwich tern	*Sterna sandvincensis*	Least Concern
	Short-toed snake eagle	*Circaetus gallicus*	Least Concern
	Slender-billed gull	*Larus genei*	Least Concern
	Squacco heron	*Ardeola ralloides*	Least Concern
	Western marsh harrier	*Circus aeruginosus*	Least Concern
	European hoopoe	*Upupa epops*	Least Concern
	Short-toed eagle	*Circaetus gallicus*	Least Concern
	Hobby	*Falco subbuteo*	Least Concern
	Grey heron	*Ardea cinerea*	Least Concern
	Peregrine falcon	*Falco peregrinus*	Least Concern

5.1.2 Threatened Habitats

Threated habitats are habitats considered under pressure by national, regional or international assessments. These include natural and priority habitats identified under the EU Habitats Directive (Annex I). EU Habitats Directive Annex 1 priority habitats located in the project footprint, buffer and surrounding environs (i.e. within the area of analysis) are listed as follows:

- Calcareous rocky slopes with chasmophytic vegetation: chasmophytic vegetation consists of plant communities that colonise the cracks and fissures of rock faces. The type of plant community that develops is largely determined by the base-status of the rock face. Calcareous sub-types develop on lime-rich rocks such as limestone.
- Embryonic shifting dunes: embryonic shifting dunes exists in a highly dynamic state that is dependent on the continued operation of physical processes at the dune/beach interface. These transient dunes will either be displaced by early successional dune plant communities or will be washed away by storms. The majority of this habitat type located in the project footprint is likely to be a result of exposed sand arising from erosion and not from the formation of natural dunes.
- Scree was recorded within the project footprint and a number of scree types are categorised as Annex 1 habitats (i.e. 8110, 8120, 8130, 8140, 8150, 8160). A botanical survey would be required to characterise the floristic composition of scree habitat within the project footprint and surrounding environs. However Eastern Mediterranean screes may be a possibility.

Additional Annex I habitat types recorded outside of the project footprint but within the area of analysis are listed as follows:

- Coastal lagoon: coastal lagoons are areas of shallow, coastal salt water, totally or partially separated from the sea by sandbanks, shingle or, less frequently, rocks. Lagoons show a wide range of geographical and ecological variation. The lagoon of Viluni Annex I habitat type is described as a lagoon inlet, where seawater enters the lagoon inlet during each tide, hence salinity is likely to be high in the areas closest to the inlet.

5.1.3 Significant Biodiversity Features Identified by a Broad Set of Stakeholders or Government

Whilst stakeholder consultation was beyond the scope of this assessment, published information presented in Section 4.1.2 clearly identifies that the proposed project traverses a portion of nationally and internationally important site for biodiversity namely: the Buna River Protected Landscape, IUCN Category 5; national park category 2, RAMSAR, Important Bird Area, Important Plant Area and candidate Emerald Network Site. Hence these protected areas are priority biodiversity features of conservation importance.

5.1.4 Ecological Structure and Functions Needed to Maintain the Viability of Priority Biodiversity Features

The hydrological regime of the Buna River Protected Landscape, IUCN Category 5; national park category 2, Lake Shkoda and River Buna Ramsar complex, Velipoja –

Albania Important Bird Area and Key Biodiversity Area, Important Plant Area and candidate Emerald Network Site are essential for the structure and function of the wetlands, coastal lagoon and associated network of rivers and waterways. The integrity and quality of these habitats will inevitably influence the abundance, diversity and habitat usage of species, many of which are of conservation importance, within these protected areas. For example, wetland habitats are highly productive and support a high diversity of species, particularly birds and plants that are adapted and dependent on the hydrological conditions of the wetland system. The Vilunit coastal lagoon, Buna River and associated network of waterways provide habitat for aquatic species including migratory and spawning fish, several of which are globally and nationally rare and threatened.

5.2 Identification of Critical Habitat-qualifying Features

Critical habitats are the most sensitive biodiversity features and are defined by EBRD PR6 as:

- highly threatened or unique ecosystems
- habitats of significant importance to endangered or critically endangered species
- habitats of significant importance to endemic or geographically restricted species
- habitats supporting globally significant migratory or congregatory species
- areas associated with key evolutionary processes
- Ecological functions that are vital to maintaining the viability of biodiversity features described above.

5.2.1 Summary of the Findings of the Critical Habitat Screening

A summary of the key finding of the critical habitat assessment are presented in Table 5-2. Consultation with protected area managers and fish and plant experts would be required to further refine the findings of this critical habitat screening. The screening process is discussed below for each EBRD criteria (Sections 5.2.2 to Section 5.2.7).

Table 5-2 Summary Findings of the Critical Habitat Screening

EBRD PR6 Criteria	IFC PS6 Criterion Threshold Numbers	Critical Habitat-qualifying Features	Justification
Highly threatened or unique ecosystems	4a	No critical habitat qualifying features	-
	4b	Lake Shkoda and River Buna Ramsar complex Coastal lagoon	Protected area status Priority Annex 1 habitat
Habitats of significant importance to endangered or critically endangered species	1a:	Slender-billed curlew Atlantic sturgeon Adriatic sturgeon Starry sturgeon European eel	Precautionary due to the paucity of data

	1b	No critical habitat-qualifying features	-
	1c	Atlantic sturgeon Adriatic sturgeon Stellate sturgeon European eel	Expert opinion is required to validate this
Habitats of significant importance to endemic or geographically restricted species	2	*Querqus robur* spp *scutariensis*	Precautionary due to the paucity of data
Habitats supporting globally significant (concentrations of) migratory or congregatory species	3a	No critical habitat-qualifying features	-
	3b	No critical habitat qualifying features	-
Areas associated with key evolutionary processes	N/A	No critical habitat qualifying features	-
Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features)	N/A	Buna River, connecting waterbodies and wetland habitats of the Lake Shkoda and River Buna Ramsar complex	Precautionary basis assuming the presence of the critical habitat-qualifying species listed above

5.2.2 EBRD Criterion: Highly Threatened or Unique Ecosystems

IFC Threshold 4a: “*Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of Critically Endangered or Endangered*” (IFC, 2018).

The IUCN Red List of Ecosystems Categories and Criteria is a global standard for assessing the conservation status of ecosystems at different spatial scales (i.e. the local, national and global scales) (IUCN 2018). The criteria defined by the Red List of Ecosystems can be used to identify ecosystems that are on the brink of collapse / the final stages of degradation, such as Critically Endangered or Endangered ecosystems. This may be through the reduction in geographical extent or degradation of the key processes and components. Critically Endangered ecosystems face an extremely high risk of collapse and Endangered ecosystems have a very high risk of collapse (IUCN, 2018).

Whilst a formal IUCN assessment of the status of ecosystems within the area of analysis was beyond the scope of this assessment, the area of analysis was identified as supporting an Annex I priority habitat which is of particular conservation importance, namely coastal lagoons (Code: 1150) which covers an area of approximately 3.7 km^2. This priority habitat is part of a sub-set of the Annex I habitats, identified by the Habitats Directive, as habitats “in danger of disappearance” in the European Union (Article 1d). The importance of Annex I priority habitats are discussed in the Directive in Articles 4, 5, 6, 11 and Annex III. Conservation intervention is required in order to halt the expected decline of these habitats. The designation of Annex 1 priority habitats is assumed to be sufficient to meet the threshold for the IUCN Red List Critically Endangered or Endangered ecosystems in accordance with the Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria Version 2.2 (IUCN, 2017; see Appendix 9).

Lagoons represent nearly 13% of the total coverage of the shoreline at the global scale (Sriyanie, 2013). The estimated percentage coverage of coastal lagoons within coastlines in different continents, as identified by Sriyanie (2013), are as follows:

- Europe - 5.3%
- North America - 17.6%
- South America - 12.22%
- Asia - 13.8%
- Australia -11.4%

The longest stretch of coastal lagoons in the world measures approximately 2,800 km of the Atlantic and Gulf coastline of the USA (Sriyanie, 2013). Whilst the estimated global extent of coastal lagoon is uncertain, based on the data presented above, the area of analysis is not thought to support ≥5% of the global extent of coastal lagoons. Hence the Vilunit coastal lagoon does not trigger critical habitat in accordance with IFC Criterion 4a.

IFC Threshold 4b: "*Other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning*" (IFC, 2018).

EBRD also define highly threatened or unique ecosystems as "*Ecosystems that are at risk of significantly decreasing in area or quality; have a small spatial extent; and/or contain concentrations of biome-restricted species"* (EBRD, 2014). Examples include Endangered or Critically Endangered ecosystems, priority areas identified by official regional or national plans and areas of high priority / significance based on systematic conservation planning undertaken by appropriate governmental authorities and organisations (EBRD, 2014).

The Draft National Biodiversity Strategy of Albania (2012-2020) recognises that wetlands, lagoons, sand dunes and river deltas in Albania (among other habitats) are of importance for biodiversity and ecosystem services. Wetlands in Albania are reportedly under severe threat by unsustainable development and natural resource use. The protected river landscape of Bunë-Velipojë is also recognised as an important catchment. Whilst coastal lagoons in Albania (i.e. the Vilunit coastal lagoon) qualify as an Annex 1 priority habitat, the Draft National Biodiversity Strategy of Albania (2012-2020) does not specifically mention this habitat to be of high conservation importance. This is unsurprising as one of the key operational objectives of the plan is to identify and monitor priority species, habitats, genetic and functional components of biodiversity. The plan does however consider protected areas including the Lake Shkoda and River Buna Ramsar complex to be of conservation importance.

Based on this information, the Lake Shkoda and River Buna Ramsar complex is considered to trigger critical habitat in accordance with IFC criterion 4b. Vilunit coastal lagoon Annex 1 priority habitat is also considered to trigger critical habitat in accordance with EBRD criteria for highly threatened or unique ecosystems.

5.2.3 EBRD Criterion: Habitats of Significant Importance to Endangered or Critically Endangered Species

The literature review identified that the area of analysis does not qualify as an Alliance for Zero Extinction site. Furthermore, these sites are absent in Albania. The area of analysis was however identified as supporting, or potentially supporting several species that are IUCN listed CR and face an extremely high risk of extinction in the wild, and EN species that face a very high risk of extinction in the wild. Information relating to their population statuses and distribution at the global and national levels were limited due the lack of up-to-date surveys and monitoring. Therefore, a precautionary approach was taken to the assessment of these species.

5.2.3.1 *IFC Threshold 1a*

"Areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species) (IFC, 2018)

The IUCN KBA Standard uses the following definition for reproductive unit: "the minimum number and combination of mature individuals necessary to trigger a successful reproductive event at a site (Eisenberg 1977). Examples of five reproductive units include five pairs, five reproducing females in one harem, and five reproductive individuals of a plant species." (IFC, 2018)

The following IUCN listed CR species were identified as being present or potentially present in the area of analysis:

- Atlantic sturgeon (*Acipenser sturio*) - National Red List EN
- Adriatic sturgeon (*Acipenser naccarii*) - National Red List EN
- starry sturgeon (*Acipenser stellaus*) - National Red List not evaluated
- European eel (*Anguilla Anguilla*) - National Red List CR
- slender-billed curlew (*Numenius tenuirostris*) - National Red List CR

All species, excluding the European eel, are listed by the Lake Shkoda and River Buna Ramsar information sheet as being present within this Ramsar site and as such within the area of analysis. It is highly unlikely that the area of analysis supports ≥ 0.5% of the global population and ≥ 5 reproductive units of all of these species, excluding the European eel. However due to the lack of monitoring and up-to-date survey data regarding these species at the national level and within the Ramsar site itself, it is assumed that all of these species qualify the area of analysis as critical habitat under IFC criterion 1a (IFC, 2015), until this assumption can be disproven on the bases of defensible information or expert opinion.

Two IUCN listed EN species were also identified as being present or potentially present in the area of analysis, namely the white-headed duck (*Oxyura leucocephala*; National Red List CR) and the green turtle (*Chelonia mydas*; CR on the Albania National Red List). Lake Shkoda and River Buna Ramsar complex reportedly supports the white-headed duck (Ramsar. 2005). However, according to IUCN (2018), the white-headed duck does not use habitats in Albania, whist Birdlife International (2018) identify the potential for habitats in Albania, located south of Tirana, to support this species during passage when moving between wintering sites. Considering this, the recorded presence of white-headed duck within the Lake Shkoda and River Buna Ramsar complex may potentially reflect the short temporal habitat usage of stray individuals during passage. Monitoring is required to validate this hypothesis. The extent of occurrence of breeding / resident white-headed duck is 17,600,000 km^2 (Birdlife International, 2018) with breeding sites located in Algeria, Armenia, China; Mongolia and the Russian Federation (i.e. European Russia, Central Asian Russia, Eastern Asian Russia; IUCN, 2018). Albania is not thought to provide breeding habitat for white-headed ducks (IUCN, 2018; Birdlife International, 2018). It is therefore unlikely that this candidate species will meet the threshold values for this criterion. Hence, the white-headed duck does not trigger critical habitat in accordance with IFC Criterion 1a.

Green turtles use the marine habitats of Drini Bay for foraging and migration on a very infrequent basis. Furthermore, nesting has not been reported within the area of analysis and the coastline of Drini Bay. It is therefore unlikely that this candidate species will meet the threshold values for this criterion. Hence, the green turtle does not trigger critical habitat in accordance with IFC Criterion 1a.

A more detailed account of this assessment is provided below

Atlantic sturgeon

Conservation status:

- IUCN listed CR
- Albanian Red List EN

The Area of Analysis:

- The Atlantic sturgeon is anadromous; adults spawn in freshwater rivers and migrate into estuarine and marine waters where they spend most of their lives. Important habitats for Atlantic sturgeons are wetlands, permanent rivers, streams or creeks, estuaries and marine neritic habitats (IUCN, 2018). Hence the wetland, River Buna (and estuary) and lagoon landscape units were selected for the analysis.

Population data is available for Atlantic sturgeon is as follows:

- Global estimates: IUCN (2018) stated that between 20-750 individuals are present in the wild and that this species is restricted to the Garonne River in France
- National Estimates: Unknown. IUCN (2018) do not list Albania as a country of occupancy

Number of Atlantic sturgeon potentially supported by the area of analysis in Albania:

- According to the Lake Shkoda and River Buna Ramsar information sheet, Atlantic sturgeon reportedly uses habitats within this protected area. Up to date information regarding the species abundance, distribution and habitat usage within the Ramsar site is unknown. Monitoring is required to determine if aquatic habitats within the area of analysis support the regular occurrence of a single individual of Atlantic sturgeon.

Number of reproductive units of Atlantic sturgeon potentially supported by the area of analysis in Albania:

- The number of breeding individuals within the area of analysis is unknown.
- This species is anadromous and breeds in rivers (IUCN, 2018), hence the Buna River and associated waterways could potentially provide habitat to breeding individuals. Monitoring would be required to validate this.

Analysis output:

- A precautionary approach to the assessment and designation of critical habitat has been taken. Hence the area of analysis supporting Atlantic sturgeon qualifies as critical habitat in accordance with Criterion 1a.

Adriatic sturgeon

Conservation status:

- IUCN listed CR
- Albanian Red List EN

The Area of Analysis:

- The Adriatic Sturgeon is an anadromous species, predominantly found in rivers. Following a period of growth in marine habitats, this species spawns in freshwater (IUCN, 2018). Hence, River Buna (and estuary) and lagoon landscape units were selected for the analysis.

Population data available for Adriatic sturgeon is as follows:

- Global estimates: Uncertain, but potentially less than 250 individuals. Global AOO 1-10 km^2 (IUCN, 2018). The remaining potential suitable spawning grounds are restricted to very few areas in the Po River. In Italy, rivers are artificially stocked however, there is no evidence to confirm successful reproduction in the wild (IUCN, 2018).
- National estimates: This species was last recorded from Albania in 1997 in the Buna River (Ludwig et al. 2003). IUCN (2018) consider this species to be regionally extinct in Albania as there has been no evidence of natural reproduction since 1990. However, IUCN (2018) acknowledge that there a chance that wild individuals may inhabit this area.

Number of Adriatic sturgeon potentially supported by the area of analysis in Albania:

- According to the Lake Shkoda and River Buna Ramsar information sheet (Ramsar, 2005) this species was known to inhabit the River Buna. Based on the available information, the continued presence of this species in the area of analysis is unlikely, however, monitoring would be required to fully determine the presence / likely absence of this species.

Number of reproductive units of Adriatic sturgeon potentially supported by the area of analysis in Albania:

- The number of breeding individuals within the area of analysis is unknown.
- This species may potentially still breed in the Buna River; monitoring would be required to confirm this.

Analysis output:

- A precautionary approach to the assessment and designation of critical habitat has been taken. Hence the area of analysis supporting Adriatic sturgeon qualifies as critical habitat in accordance with Criterion 1a.

Starry sturgeon

Conservation status:

- IUCN listed CR
- National Red List not evaluated

The Area of Analysis:

- The starry sturgeon is anadromous (spending at least part of its life in salt water and returning to rivers to breed). Key habitats include the sea, coastal waters and estuaries and rivers (IUCN, 2018). This species spawns in large, deep rivers with stone or gravel substrate and on flooded river banks on sand or sandy clay substrates (Khodorevskaya et al. 2009). Hence the wetland, River Buna (and estuary) and lagoon landscape units were selected for the analysis.

Population data available for the starry sturgeon is as follows:

- Global estimates: inhabits in the Caspian, Black and Azov Seas, and rarely in the Aegan Sea. The Volga, Ural, Terek, Sulak, Kura, Don, Danube, Kuban Rivers are the major spawning rivers. In the Black Sea, in Romania, from 2002-2005 the catches of wild individuals (stocking only started in 2006 in the Danube) dropped from 12.427 tonnes to 3.43 tonnes. In Azov Sea, no wild mature females have been caught [for a stocking programme] since 2004 (Chebanov pers. comm.). Over recent decades, starry sturgeon abundance in the Caspian Sea has reduced. Decrease of CPUE has been more apparent in the southern part of the sea. The starry sturgeon population has declined from 69.7 million specimens in 1978 to 15.6 million in 2002, and 7.6 million specimens in 2008. Commercial stock decreased by 12 times during this period (Khodorevskaya et al. 2009).
- National estimates: This species is not recorded as occurring in Albania by the IUCN Red List of Threatened Species (IUCN, 2018).

Number of starry sturgeon potentially supported by the area of analysis in Albania:

- According to the Lake Shkoda and River Buna Ramsar information sheet, Atlantic sturgeon reportedly uses habitats within this protected area. The abundance and distribution of this species is uncertain.

Number of reproductive units of starry sturgeon potentially supported by the area of analysis in Albania:

- The number of breeding individuals within the area of analysis is unknown.

Analysis output:

- A precautionary approach to the assessment and designation of critical habitat has been taken due to the paucity of monitoring data. Hence the area of analysis supporting starry sturgeon qualifies as critical habitat in accordance with Criterion 1a.

European eel

Conservation status:

- IUCN listed CR
- National Red List not evaluated

The Area of Analysis:

- The European eel is facultatively catadromous, living in fresh, brackish waterbodies and migrating down rivers to the pelagic marine waters to breed and spawn. Relatively little is known about its marine phase. As European eels inhabit coastal water, transitional waters (i.e. estuaries and lagoons) and freshwater habitats (i.e. lakes, rivers, ponds etc), the wetland, River Buna (and estuary) and lagoon landscape units were selected for the analysis.

Population data available for the European eel is as follows:

- Global estimates: the European eel has a ubiquitous distribution throughout its known European range. The exact numbers are uncertain.
- National estimates: Uncertain. These is a lack of reliable data regarding the distribution and abundance of eels in Albanian rivers.

Number of European eel potentially supported by the area of analysis in Albania:

- European eel spawn in the Sargasso Sea and larvae drift across the Atlantic using prevailing currents before they metamorphose. Eel densities are known to decrease with increasing distance from the tidal limit and increasing altitude. The network of waterways in the Buna River Protected Landscapes and Ramsar site are likely to support the regular occurrence of a single individual of this CR species. It is however less likely that these waterbodies support ≥10% of the global population.

Number of reproductive units of European eel potentially supported by the area of analysis in Albania:

- European eels migrating to pelagic marine waters to breed. There are no data regarding specific spawning sites of the European eel, however, it is thought that spawning takes place in the Sargasso Sea (West Central Atlantic) within an elliptic zone approximately 2,000 km wide (IUCN, 2018).
- Whilst the numbers of reproductively viable male and female eels within the area of analysis is unknown, it is reasonable to assume that there is sufficient suitable habitat to support the number of individuals required to meet the Criterion threshold values.

Analysis output:

- A precautionary approach to the assessment and designation of critical habitat has been taken due to the paucity of monitoring data. Hence the area of analysis supporting European eel qualifies as critical habitat in accordance with Criterion 1a.

Slender-billed curlew

Conservation status:

- IUCN CR
- Albanian Red List CR

The Area of Analysis:

- This species is migratory (del Hoyo et al. 1996). Slender-billed curlews reportedly use a wide variety of habitats (i.e. brackish wetlands, saltmarsh, saltpans, tidal mudflats, sandy farmland next to lagoons, wet grassland, steppe grassland, fishponds, brackish lagoons and semi-desert). Hence the Lake Shkoda and River Buna Ramsar complex offers potentially suitable to support this species. During wintering this species using inland habitats (i.e. marsh areas fed with freshwater) (Gretton 1991). The entire area of analysis was considered due to the species' habitat requirements.

Population data available for the slender-billed curlew is as follows:

- Global extent: the estimated global extent of slender-billed curlews is 1-49 mature individuals with an EOO of 303,000 km^2 (IUCN, 2018). The species is migratory (IUCN, 2018). There are few confirmed sightings of this species and no records of regular breeding, passage or the occurrence of wintering populations (Birdlife International, 2018).

- National extent: the slender-billed curlew was historically observed on many occasions in the Zogai marsh, the Hutovo marsh, Lake Skadar and inStari Vrbas in Albania. The only precise numbers for the slender-billed curlew in Albania is provided by Powys (1860). The current extent of slender-billed curlews is uncertain. However, based on the IUCN (2018) and Birdlife International (2018) accounts, there are likely to be very few individuals, if any, present in Albania.

Number of slender-billed curlew potentially supported by the area of analysis in Albania:

- According to the Lake Shkoda and River Buna Ramsar information sheet (Ramsar 2005), slender-billed curlew reportedly uses habitats within this protected area. The exact numbers are uncertain. However, habitat usage is likely to be restricted to this Ramsar complex, in particular Lake Skadar, if present.

Number of reproductive units of slender-billed curlew potentially supported by the area of analysis in Albania:

- Unknown

Analysis output:

- Based on the existing level of information, it is highly unlikely that slender-billed curlews inhabit the area of analysis or even Albania. However, a precautionary approach to the assessment and designation of critical habitat has been taken until expert opinion can confirm the likely absence of this species in Albania and the area of analysis. Hence slender-billed curlew triggers critical habitat in accordance with Criterion 1a.

White-headed duck

Conservation status:

- IUCN listed EN
- National Red List CR

The Area of Analysis:

- The wetland, River Buna and estuary, and coastal dune and beach landscape units selected for the area of analysis. This species uses a wide variety of habitats during migration and in winter including larger, deeper alkaline or saline waters which often have less emergent vegetation than in the breeding season, but still support algae and pondweeds Habitats include saline inland lakes, coastal lakes and lagoons, and even the coastal waters of inland seas although it is not found on areas of coast that are subjected to heavy wave action (IUCN 2017).

Population data available for white-headed duck is as follows:

- The global population was probably over 100,000 in the early 20th century, falling to an estimated 20,000 birds in 1996 (Green and Hunter 1996). Since then numbers were thought to have declined to around 8,000-13,000 individuals (Li and Mundkur 2003), however a coordinated count of 20,000 individuals in Kazakhstan in 2016 (ACBK 2016) suggest that the previous global estimate was likely too low.
- The extent of occurrence of breeding / resident white-headed duck is 17,600,000 km^2 (Birdlife International, 2018) with breeding sites located in Algeria, Armenia, China; Mongolia and the Russian Federation (i.e. European Russia, Central Asian Russia, Eastern Asian Russia; IUCN, 2018).

- Within Europe the breeding population is estimated at 250-610 pairs, which equates to 500-1,200 mature individuals. The number of wintering birds in Europe is estimated at 7,500-15,900 individuals (BirdLife International 2015).
- National estimates: according to IUCN (2018), the white-headed duck does not use habitats in Albania. According to Birdlife International (2018) habitats located south of Tirana, may be used by this species during passage when moving between wintering sites. Albania is not thought to provide breeding habitat to white-headed ducks (IUCN, 2018; Birdlife International, 2018). The exact number individuals recorded in Albania each year is uncertain.

Number of white-headed duck potentially supported by the area of analysis in Albania:

- According to the Lake Shkoda and River Buna Ramsar information sheet (Ramsar, 2005), the white-headed duck reportedly uses habitats within this protected area. Current information regarding the species presence / likely absence and the exact number of individuals are unknown. Monitoring is required to determine if habitats within the area of analysis support this species

Extent of global population within the area of analysis:

- The estimated numbers of white-headed duck present in Albania and the study area is uncertain and the occurrence of this species in the River Buna Ramsar site (and surrounding landscapes) is unknown.

Number of reproductive units in the area of analysis:

- The number of breeding pairs or reproductively viable females and males within the area of analysis is unknown.

Analysis output:

- Based on the existing level of information, it unlikely that this candidate species will meet the threshold values for this criterion. Hence, the white-headed duck does not trigger critical habitat in accordance with IFC Criterion 1a.

Green turtle

Conservation status:

- IUCN EN
- National Red List CR

The Area of Analysis:

- The beach landscape unit was selected for the area of analysis. This species is highly migratory and uses a wide range of broadly separated localities and habitats during their lifetimes. Beaches are used for nesting and it is hypothesized that hatchlings begin an oceanic phase perhaps floating passively in major current systems as they develop (IUCN 2004).

Population data available for green turtle is as follows:

- Global extent: the estimated global population size for green turtle is unknown. However, the Sea Turtle Conservancy (2018) estimates that there are between 85,000 and 90,000 nesting females worldwide and nesting occurs in more than 80 countries (Seminoff, 2004).
- National extent: the Adriatic Sea coast is not known to be of importance for turtle nesting activity, with only occasional reports of single individuals in recent years. In 1990, the major nesting beaches identified for green turtles were in Greece and Turkey, with smaller numbers recorded in Cyprus, Libya, Tunisia, Israel and Italy. In 2001, Turkey was identified as supporting the largest nesting

congregation in the Mediterranean Sea (Kasparek et al., 2001). Green turtles are known to use the marine habitats of Drini Bay for foraging and migration, but on a very sporadic basis (White, Boura and Venizelos, 2011).

Extent of global population within the area of analysis:

- Unknown due to the paucity of data from local bycatches or monitoring to suggest that green turtles use coastal habitats within the area of analysis for egg laying.

Number of reproductive units within the area of analysis:

- It is highly unlikely that green turtles lay eggs within the area of analysis, however the possibility remains that this species may nest within the area of analysis on a very infrequent basis.

Analysis output:

- Based on the available information, it is highly unlikely that the area of analysis supports ≥ 0.5% of the global population or ≥ 5 reproductive units. Hence, the green turtle does not trigger critical habitat in accordance with IFC Criterion 1a.

5.2.3.2 *IFC Threshold 1b*

"*Areas that support globally-important concentrations of an IUCN Red-listed Vulnerable species, the loss of which would result in the change of the IUCN Red List status to Endangered or Critically Endangered and meet the following thresholds: (≥ 0.5% of the global population AND ≥ 5 reproductive units)*" (IFC, 2018).

The literature review identified twelve IUCN listed VU species as being present or potentially present within the area of analysis as follows:

- lesser white-fronted goose (*Anser erythropus*)
- red-breasted goose (*Branta ruficollis*)
- marbled teal (*Marmaronetta angustirostris*)
- long fingered bat (*Myotis capaccinii*)
- great Capricorn beetle (*Cerambyx cerdo*)
- *Cyprinus carpio*
- long fingered bat (*Myotis capaccinii*)
- loggerhead turtle (*Caretta caretta*)
- meadow viper (*Vipera ursinii*)
- common pochard (*Aythya farina*)
- great bustard (*Otis tarda*)
- horned grebe (*Podiceps auratus*)
- greater spotted eagle (*Aquila clanga*)

Based on the existing known information regarding population and distribution data presented in Table 5-3, none of these species trigger critical habitat in accordance with IFC Criterion 1b.

Table 5-3 IUCN listed VU Species that are Present or Potentially Present within the Area of Analysis (Information source IUCN, 2018)

Key: VU = Vulnerable; EN = Endangered; CR = Critically Endangered; NL = Not Listed; LR/nt = Low Risk / Near Threatened; DD = data deficient; Lake Skadar and River Buna Ramsar site = LSRB Ramsar Complex

Scientific Name	Common Name	IUCN	Albanian Red List (2013)	EOO (Km^2)	Global Population Status	European Population Estimates	Albanian Population Estimate	Extent of Global Population Within the AOA (629.3 Km^2)	Number of Reproductive Units in the AOA
Insect									
Cerambyx cerdo	Great capricorn beetle	VU	EN	Unknown	Unspecified	Unknown	Unknown but not recognised by IUCN (2018) as occurring in Albania	Listed as occurring in the LSRB Ramsar Complex	Unknown
Fish									
Cyprinus carpio	Common carp	VU	NL				Invasive?	Listed as occurring in the LSRB Ramsar Complex	Unknown
Mammals									
Myotis capaccinii	Long fingered bat	VU	LR/CD	5387,022	Decreasing	Spain - 10,000 France - 3,800 individuals Bulgaria - ca. 20,000	Unknown	Listed as occurring in the LSRB Ramsar Complex 0.01%	Unknown
Reptile									

Scientific Name	Common Name	IUCN	Albanian Red List (2013)	EOO (Km^2)	Global Population Status	European Population Estimates	Albanian Population Estimate	Extent of Global Population Within the AOA (629.3 Km^2)	Number of Reproductive Units in the AOA
Caretta caretta	Loggerhead turtle	VU	EN	Wide ranging	Total population size is unknown c. 200,000 clutches are laid annually – equates to up to 67,000 nesting females annually. Decreasing	Mediterranean population is listed as LC with 7,200 nests annually	Unknown	Sporadic chance of occurrence	Unknown
Vipera ursinii	Meadow viper	VU	LR/nt	Unknown	Decreasing	Uncommon, patchy distribution	Unknown		Unknown
Birds									
Aythya ferina	Common pochard	VU	NL	27,800,000	Decreasing c. 1,950,000-2,250,000 individuals (2012)	Europe holds between 35% (breeding) and 40% (wintering) of the global population	Unknown	0.002%	Unknown
Otis tarda	Great bustard	VU	DD	20,100,000	c.44,000-57,000 individuals in 2014 Decreasing	Unknown	Unknown	0.003%	Unknown

Scientific Name	Common Name	IUCN	Albanian Red List (2013)	EOO (Km^2)	Global Population Status	European Population Estimates	Albanian Population Estimate	Extent of Global Population Within the AOA (629.3 Km^2)	Number of Reproductive Units in the AOA
Podiceps auritus	Horned grebe	VU	NL	52,900,000	c.239,000-583,000 individuals Decreasing	12,900-18,500 mature individuals	Unknown	0.01%	Unknown
Aquila clanga	Greater spotted eagle	VU	CR	18.100.000	3,300-8,800 mature individuals Decreasing	770-1,000 pairs	Passage or wintering bird numbers are uncertain	0.003%	Unknown
Anser erythropus	Lesser white-fronted goose	VU	Extinct	7,060,000	16,000-27,000 mature individuals Decreasing	Unknown	Unknown	Listed as occurring in the LSRB Ramsar Complex 0.008%	Non-breeding in Albania
Branta ruficollis	Red-breasted goose	VU	CR	871,000	Decreasing	Unknown	Not present (Birdlife International 2018)	Listed as occurring in the LSRB Ramsar Complex 0.007%	Unknown
Marmaronetta angustirostris	Marbled teal	VU	NL	14,600,000	Decreasing	650-2,300 mature individuals	Unknown	Listed as occurring in the LSRB Ramsar Complex 0.004%	Unknown

5.2.3.3 *IFC Threshold 1c*

"*Areas containing nationally / regionally-important concentrations of an IUCN Red-listed Endangered or Critically Endangered species*" (IFC, 2018).

The area of analysis was identified as supporting seven species that are categorised as either CR or EN by the IUCN Red List of Threatened Species (IUCN 2018) as follows:

- Atlantic sturgeon – IUCN CR
- Adriatic sturgeon – IUCN CR
- starry sturgeon – IUCN CR
- European eel – IUCN CR
- slender-billed curlew – CR
- *Salmothymus obtusirostris* - EN
- white-headed duck – EN
- green turtle - EN

There is no evidence to suggest that these species are present within the area of analysis (i.e. the entire Ramsar site) in nationally and / or regionally-important concentrations. However, the species of sturgeon are so rare at the global scale that even a few individuals present in the Buna River and adjoining waterways may equate to nationally and regionally important concentrations. This assumption may also apply to European eels within the area of analysis (refer to Section 5.2.3.1 for information regarding population estimates). As previously stated, consultation with protected area managers and experts would be required to confirm the presence / likely absence, abundance and distribution of these species within the area of analysis.

A precautionary approach to the assessment and designation of critical habitat has been taken due to the paucity of data. Therefore, Atlantic, Adriatic and starry sturgeons and European eels are considered to trigger critical habitat in accordance with IFC Criterion 1c.

Salmothymus obtusirostris is listed as occurring within the Lake Shkoda and River Buna Ramsar complex (Ramsar, 2005). However, this species is on the edge of its global range within the area of analysis, being extant in Bosnia and Herzegovina, Croatia and Montenegro (IUCN, 2018). This species is unlikely to occur within the area of analysis at nationally or regionally important concentrations and as such does not trigger critical habitat in accordance with IFC Criterion 1c.

Based on the known population data presented in Section 5.2.3.1, white-headed ducks, green turtles and slender-billed curlews are also unlikely to occur within the area of analysis at nationally or regionally important concentrations and as such do not trigger critical habitat in accordance with IFC Criterion 1c.

5.2.4 EBRD Criterion: Habitats of Significant Importance to Endemic or Geographically Restricted Species

Alliance for Zero Extinction Sites are not present in Albania and the Velipoja – Albania IBA and KBA was not identified as supporting restricted-range and / or endemic species. However, the literature review identified the presence of one candidate endemic sub-species, namely *Querqus robur* (L.) subsp. *scutariensis* located within the Lake Shkoda and River Buna Ramsar site.

IFC Threshold 2

The IFC PS6 guidance note (section GN72) defines "*the term endemic as restricted-range and restricted range refers to a limited extent of occurrence (EOO). For plants, a restricted-range species is defined as those plant species that have an EOO less than 50,000 km^{2}"* (IFC, 2018).

Threshold: areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species (IFC, 2018).

The IUCN Red List of Threatened Species (IUCN, 2018) have not recognised and assessed this particular sub-species and this sub-species is not included on the Albanian Red List. The literature review identified one account of *Querqus robur* (L.) subsp. *scutariensis* occurring within fragmented agro-pastoral land and meadows near the village of Gostilj near Lake Skadar (Pešić et al., 2018). There is very limited information regarding this sub-species and no information regarding its EOO, AOO or estimated population numbers were identified by the review. Furthermore, the review did not yield any information to validate the authority and validity of the taxonomic classification of this sub-species. Due to the paucity of information a precautionary approach has been taken, hence the area of analysis qualifies as critical habitat for this species in accordance with Criterion 2. It is however recommended that a specialist is consulted to confirm the validity of this taxonomic classification and the sub-species' global and national EOO, to make an informed assessment.

Querqus robur spp. *scutariensis*

Conservation status:

- European oak (*Quercus robur*) is IUCN listed LC and VU on the National Red list.
- *Querqus robur* spp *scutariensis* is not listed by IUCN or the Albanian Red List

Area of Analysis:

- Lake Shkoda and River Buna Ramsar site; this species is listed as occurring within this protected area.

Available population data:

- Global estimates: *Quercus robur* has a widespread distribution and is found in most countries in Europe in addition to Russia (IUCN, 2018). The EOO of this sub-species is unknown.
- National estimates: *Quercus robur* is well represented in Albania and present in many protected habitat types under Annex 1 of the EC Habitats Directive (IUCN 2018). National estimates of *Querqus robur* spp. *scutariensis* are unknown.

Number of *Querqus robur* spp. *scutariensis* supported by the area of analysis in Albania:

- *Querqus robur* spp. *scutariensis* is described by the Lake Shkoda and River Buna Ramsar information sheet as an endemic and is listed as occurring within this protected area. There is no information regarding the number or distribution of this sub-species. The literature review identified an account of *Querqus robur* spp. *scutariensis* as occurring on fragmented agro-postoral land and meadows near the village of Gostilj near Lake Skadar. There is insufficient information to assess if the area of analysis supports ≥10% of the global population size and ≥10 reproductive units of this species.

5.2.5 EBRD Criterion: Habitats Supporting Globally Significant (concentrations of) Migratory or Congregatory Species

IFC PS6 defines migratory species as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis (IFC, 2018).

5.2.5.1 *IFC Threshold 3a*

"*Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle*" (IFC, 2018).

The literature review identified the presence or potential presence of 115 migratory and / or congregarory species within the area of analysis. Out of these, twenty species are listed by the Lake Shkoda and River Buna Ramsar information sheet (Ramsar 2005) as being present within this Ramsar site and 95 species were identified as being present by the Rapid Assessment of Bojana Buna Delta. Information regarding the national population status of these species is limited. However, the literature review did not find any records to suggest that these species occur within the Ramsar site or IBA / KBA or area of analysis in significant concentrations.

The Velipoja – Albania IBA and KBA is located within the area of analysis and is designated in part because the site is of importance to wintering waterfowl (max. 8,000 individuals in 1993) and for migratory waterbirds (BirdLife International, 2018). Lake Skadar and River Buna Ramsar site which is also located within the area of analysis, partly qualified for this designation under criteria 5 and 6 as the maximal number of wintering water birds has historically reached 24,000 – 30,000 individuals (to Hagemeijer et al. 1993; Kayser et al. 1995, 1997; Bino et al, 1996; Bino 2001; Bino 2002, SchneiderJacoby et al. 2003, 2004). Furthermore, based on bird counts between 2001-2004 three bird species reached the 1% criterion of the Ramsar Convention namely: great cormorant (*Phalacrocorax carbo*) with an estimated 3,100 individuals, Dalmatian pelican (*Pelecanus crispus*) with 30 individuals and spotted redshank (*Tringa erythropus*) with 1,000 individuals (Schneider-Jacoby et al. 2004; Ramsar, 2005).

Based on the known population information of great cormorant, Dalmatian pelican and spotted redshank, these species will not qualify the Ramsar site as critical habitat in accordance with Criterion 3a. A detailed explanation is presented as follows:

Great cormorant

Conservation status:

- IUCN listed LC
- National Red List Not Evaluated

Area of Analysis:

- Wetlands, permanent freshwater lakes are a key habit for great cormorants however this species also use other habitats including sheltered coastal areas, coastal lagoons, rocky shores and cliffs, lakes and reservoirs (IUCN, 2018). Lake Shkoda and River Buna Ramsar is known to support this species. Hence the river and wetland area of analysis was selected for the assessment.

Available population data:

- Global estimates: this species has an extremely large distribution with an estimated global Extent of Occurrence of 304,000,000 km^2. The estimated global population comprises approximately 1,400,000-2,100,000 individuals (Wetlands International 2015; IUCN 2018).
- National estimates: uncertain: Historically the Kune area (south of the proposed project near Shëngjin) and the Island of Maligrad located at the Great Prespa Lake in the south east of Albania were the main historic breeding sites for great cormorants in Albania. However, in 1991 only 5-8 pairs were recorded.

Number of great cormorants supported by the area of analysis in Albania:

- Approximately 3,100 individuals were recorded within Lake Shkoda and River Buna Ramsar site, which equates to less than 0.2% of the global population. Assuming that this species still occurs within this area at these numbers, great cormorant will not qualify the area of analysis as critical habitat in accordance with IFC Criterion 3a. Consultation with protected area managers is required to confirm this assumption.

Dalmatian pelican

Conservation status:

- IUCN listed NT (note, this species was down-listed in 2017)
- National Red List - CR.

Area of Analysis:

- Dalmatian pelicans are known to inhabit inland freshwater and wetlands but also coastal lagoons, river deltas and estuaries. They generally breed on small islands in freshwater lakes or amongst dense emergent riparian vegetation. However small numbers have been recorded breeding in Mediterranean coastal lagoons (IUCN, 2018). Lake Shkoda and River Buna Ramsar is known to support this species. Hence the river and wetland area of analysis was selected for the assessment.

Available population data:

- Global estimates: this species global EOO is estimated at 12,600,000 km^2 and the global population estimates are between 11,400-13,400 individuals (IUCN 2018; Birdlife International, 2018). The largest current populations are believed to be in Kazakhstan (3,000-3,200 pairs), Russia (1,500-2,700 pairs) and Greece (1,900 pairs) (Catsadorakis and Portolou 2017; IUCN 2018).
- National Estimates: uncertain, however this species is known to breed in Albania (IUCN, 2018).

Number of Dalmatian pelican supported by the area of analysis in Albania:

- In 2003-4, thirty individuals were recorded within Lake Shkoda and River Buna Ramsar site. This is less than '≥ 1 percent of the global population' and does not meet the threshold values for IFC Criterion 3a. Assuming that this species still occurs within this area at these numbers, Dalmatian pelican will not qualify the area of analysis as critical habitat in accordance with IFC Criterion 3a. Consultation with protected area managers is required to confirm this assumption.

Spotted redshank

Conservation status:

- IUCN listed LC
- Not included on the National Red List

Area of Analysis:

- During migration and during overwintering, outside of the breeding season, this species uses a variety of habitats including freshwater and brackish wetlands including lagoons, irrigated fields, salt-marshes, sheltered muddy coastal shores, small bodies of standing water and flooded grassland (IUCN 2018). Lake Shkoda and River Buna Ramsar is known to support this species. Hence the river and wetland area of analysis was selected for the assessment.

Available population data:

- Global estimates: this species global EOO is estimated at 7,360,000 km^2 and the global population estimates are between110,000-270,000 individuals (Wetlands International 2015; IUCN, 2018).
- National estimates: uncertain. Non-breeding individuals are present in Albania.

Number of spotted redshank supported by the area of analysis in Albania:

- Approximately 1,000 individuals were recorded within Lake Shkoda and River Buna Ramsar site, which equates to less than 0.9% of the global population. Assuming that this species still occurs within this area at these numbers, spotted redshank will not qualify the area of analysis as critical habitat in accordance with IFC Criterion 3a. Consultation with protected area managers is required to confirm this assumption.

5.2.5.2 *IFC Threshold 3b*

"*Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress*" (IFC, 2018).

Based on the available information, the area of analysis, including the Velipoja – Albania IBA) and KBA and the Lake Skadar and River Buna Ramsar site does not quality as critical habitat in accordance with IFC criterion 3b (IFC, 2018).

5.2.6 EBRD Criterion: Areas Associated with Key Evolutionary Processes

Based on the findings of the literature review and publicly available research and reports, the area of analysis is not considered to be associated with key evolutionary processes. Habitats located within the area of analysis are not characterised with spatial features associated with evolutionary processes:

- isolated areas
- landscapes with high spatial heterogeneity, which are a driving force in speciation as species are naturally selected on their ability to adapt and diversify
- edaphic interfaces: specific juxtapositions of soil types (e.g. serpentine outcrops and limestone deposits) which have led to the formation of unique plant communities characterised by both rarity and endemism
- Connectivity between habitats ensures species migration and gene flow.

Furthermore, candidate species did not qualify as Evolutionarily Distinct and Globally Endangered (EDGE) species, excluding green turtles (with a score of 5.99) which are unlikely to nest on the beaches within the area of analysis.

5.2.7 EBRD Criterion: Ecological Functions That Are Vital to Maintaining the Viability of Biodiversity Features Described as Critical Habitat

Based on the available data, the Buna River and connecting waterbodies within the wetland habitat provide refuge for critical habitat-qualifying fish species, namely: Atlantic sturgeon, Adriatic sturgeon, starry sturgeon and European eel. The wetland habitats of the Shkoda and River Buna Ramsar complex provide habitat for the critical habitat-qualifying slender-billed curlew. Maintenance of the integrity, habitat quality and functionality of these habitats is essential for the continued habitat usage of these critical habitat-qualifying species in the area of analysis.

6 CONCLUSION

The proposed project traverses the Buna River Protected Landscape, IUCN Category 5; national park category 2, Ramsar, Important Bird Area, Important Plant Area and candidate Emerald Network Site.

The majority of the habitats located within the footprint of the proposed road and the adjoining buffer are common and widespread in nature and as such do not qualify as Annex 1 habitats (Table 4-1). However, a small section of the buffer overlaps the Annex 1 habitat type ‘embryonic shifting dunes’ (EU code 2110) which is likely to be artificially maintained by overgrazing and erosion.

The report also identifies the Priority Biodiversity Features (PBFs) and critical habitat-qualifying features for the project based on screening. These features are of high conservation importance for the project. A summary of the critical habitat-qualifying features are presented in Table 6-1.

Table 6-1 Summary Findings of the Critical Habitat Screening

EBRD PR6 Criteria	IFC PS6 Criterion Threshold Numbers	Critical Habitat-qualifying Features	Justification
Highly threatened or unique ecosystems	4a	No critical habitat qualifying features	-
	4b	Lake Shkoda and River Buna Ramsar complex Coastal lagoon	Protected area status Priority Annex 1 habitat
Habitats of significant importance to endangered or critically endangered species	1a:	Slender-billed curlew Atlantic sturgeon Adriatic sturgeon Starry sturgeon European eel	Precautionary due to the paucity of data
	1b	No critical habitat-qualifying features	-
	1c	Atlantic sturgeon Adriatic sturgeon Stellate sturgeon European eel	Expert opinion is required to validate this
Habitats of significant importance to endemic or geographically restricted species	2	*Querqus robur* spp *scutariensis*	Precautionary due to the paucity of data
Habitats supporting globally significant	3a	No critical habitat-qualifying features	-

(concentrations of) migratory or congregatory species	3b	No critical habitat qualifying features	-
Areas associated with key evolutionary processes	N/A	No critical habitat qualifying features	-
Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features)	N/A	Buna River, connecting waterbodies and wetland habitats of the Lake Shkoda and River Buna Ramsar complex	Precautionary basis assuming the presence of the critical habitat-qualifying species listed above

Other key sensitivities for the project are listed as follows:

- Habitats within project footprint and adjacent environs serve is of importance for a wide diversity of breeding birds including five globally rare and threatened species and 17 bird species that are classed as rare and threatened at the national level by the Albania Red List (2013)
- The presence of 97 plant species have been confirmed in the project area. Only a small portion of these species have been assessed by the IUCN Red List of Threatened Species (2019) and these assessed species are categorised as LC. In total, 14 plant species located within the project footprint are rare and threatened at the national scale and one species (*Galatella albanica*) is a national endemic located in *Quercus trojana* woodlands
- Taking a precautionary approach, it is assumed that the great Capricorn beetle (*Cerambyx cerdo*; IUCN listed VU, Albanian Red Data Book listed EN) inhabitats oak woodland in the PDA. Deadwood within Quercus sp forest located within the PDA is also considered to provide habitat for great Capricorn beetles.
- Eurasian badger (Albanian Red List EN), stone martin and potentially wildcat (Albania Red Listed EN) were recorded in the PDA. The location of any badger setts is unknown.
- Golden jackals (Albanian Red Listed VU) use the upland habitats of Mount Renci, within the project footprint, to commute back and forth from one lowland area to another, whilst denning / residing in the lowland habitats. There is evidence of cubs indicate breeding in the lowland areas near the base of Mount Renci.
- the Buna River Protected Landscape and adjoining Mount Renci area supports a high diversity of bat species, including nationally and globally rare and threatened species which is likely to be attributed to the mosaic of different habitats found in the area and the absence of artificial lighting
- oak woodland located with the project footprint on Mount Renci was identified as being of potential importance for foraging and roosting bat species known to be present within the region
- One bat roost located in an abandoned house is thought to be located within the project footprint. Two bat species were observed roosting, *Rhinolophus hipposideros* (IUCN . NT in Europe) and *R. ferrumequinum*, and the surveyors thought that the house may serve as maternity roost for *Rhinolophus hipposideros.*
- The Project is reportedly located within a wider wildlife corridor for mammal species and may potentially provide habitat for commuting wolf *(Canis lupus*; IUCN LC and National Red List NT) and European roe deer (*Capreolus capreolus*; IUCN LC; National Red List VU) (Schneider-Jacoby et al, 2006). According to Schneider-Jacoby et al (2006) the presence of brown bears (*Ursus arctos*; IUCN LC; National Red List VU) has been reported in the area, however

other comprehensive accounts (Kaczensky et. al. 2013) do not indicate that the area is permanent bear habitat. There is potential that the area is sporadically used by bears as a transitory corridor.

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APPENDIX 1
BIODIVERSITY LEGISLATION

Law no. 10431/2011 on the protection of environment, as amended

This law comprises high-level legislation for the general approach and requirements of environmental protection in Albania.

The law aims to protect, maintain and improve the environment; prevent and reduce risks to human life, health and safety; improve the quality of life for the benefit of generations present and future; and provide conditions for sustainable development of the country.

This law is fully aligned with Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

The law outlines the following principles of environmental protection:

- sustainable development
- prevention and taking precautions
- conservation of natural resources
- substitution and/or compensation;
- an integrated approach
- mutual responsibility and cooperation
- "polluter pays"
- the right to information and public participation
- promoting environmental protection activities.

It establishes an overall framework for environmental protection in the planning process by demanding environmental strategies and plans, local plans of action for the environment, development plans, strategic environmental assessment and environmental impact assessments as part of the process.

Furthermore, it addresses requirements for pollution prevention and control, as well as monitoring.

It also establishes an environmental information system to serve the protection and integration of environmental management and its components, monitoring the implementation of environmental policies at national and international level, as well as to provide public information.

Other aspects within the law include environmental liability and a framework for an environmental permitting framework for activities causing pollution to the environment, which are equipped with environmental licences, to ensure that activities/installations will meet the requirements of environmental legislation in force.

The approval of environmental permits is determined by a system consisting of three levels, based on the size and type of activity proposed, and the possibility that its activities could cause pollution to the extent that could bring harm to the environment and endanger human health. Three categories (A, B and C) apply.

Categories of activities and the boundaries between the three levels are defined in Law no. 10448, dated 14/07/2011 “On the Environmental Permits”, see below.

Law no. 10448/2011 on the Environmental Permits, as amended

The environmental permits law aims at preventing, reducing and controlling pollution caused by a range of activities, in order to achieve a high level of protection for the environment, human health and quality of life. In accordance with the law no. 10431, dated 09/06/2011 "On Environmental Protection", a system of three levels of environmental permits, type A, B and C, applies as follows:

- environmental permit type A is required for conducting the activities on the category A list, the relevant thresholds of which are set out in Annex 1/A of this law for a range of activities
- environmental permit type B is required for conducting the activities on the category B list, relevant thresholds for which are set out in Annex 1/B of this law for a range of activities
- environmental permit type C is required for conducting the activities on the category C list, the relevant thresholds of which are set out in Annex 1/C of this law for a range of activities.

Environmental permit types A, B and C are dependent on the capacity limit of industrial productions.

The competent authorities for environmental permitting of types A, B and C are as follows:

- The National Licensing Centre (NLC) processes the permit application for all categories.
- The Minister has the authority to approve type A and B environmental permits, after they have been reviewed and prepared by the National Environment Agency.
- The National Environment Agency is responsible for verifying the accuracy of the information provided by operator in his application for a type A or B environmental permit and providing a recommendation to the Minister for the issue of this permit, the conditions detailed, etc. The permit is then issued by the NLC.
- The regional environmental agency is responsible for verifying the accuracy of the information provided by the operator in his application for a type C environmental permit and deciding on whether to issue the permit, the conditions detailed, etc. The permit is then issued by the NLC.
- The State Inspectorate is the competent authority for verifying fulfilment of the conditions by the operator of this permit, after its issuance by the NLC.

Type A, B and C environmental permit conditions can be reviewed at any time by the ministry or regional environment agency, for example if there are changes in relevant environmental legislation or if the following occurs:

- new ecological issues arise that were unknown at the time of the original permit issued
- new environmental legislation enters into force that explicitly requires permit condition changes
- changes to pollution norms enter into force
- fundamental changes to the permitted activity occur
- improvements in the best techniques available are implementable industry wide, allowing significant reduction in discharges into the environment without disproportionate cost.

Law no. 9587/2006 on the protection of biodiversity, including amendments and additions as per Law no. 68/2014

The aim of this law is to ensure the protection and conservation of biological diversity and to regulate the sustainable use of the components of biological diversity through the integration of key elements of biodiversity in strategies, plans, programmes and decision making at all levels.

The key cornerstones of this legislation are as follows:

- requirement of a NBSAP (Article 8)
- network inventory and monitoring of biodiversity (Article 9)
- planning for emergencies, through action plans and procedures for handling of unexpected human activities or natural events that threaten biodiversity (Article 10)

The law also addresses ecosystems, habitats and landscapes that are outside the network of protected areas, while considering protective measures for all species types on land, water and sea. It also involves the identification, protection and management of native species.

Law no. 61/2016 on a moratorium for hunting in the Republic of Albania, amending Law no. 10253/2010 on hunting

The purpose of this law is to improve the situation of wild fauna species subject to hunting and therefore suspends the right to hunt in the entire territory of the Republic of Albania. The ban was initially introduced in 2014 and the 2016 law extends the ban for a further five years.

Law no. 81/2017 on Protected Areas, replacing Law no. 8906/2002

The object of this law is the declaration, preservation, administration, management and usage of protected areas and their natural and biological resources. It also deals with the facilitation of conditions for the development of environmental tourism, for the information and education of the general public and for economic profits, direct or indirect, by the local population and the public and private sectors.

The purpose of this law is to provide special protection of important components of natural reserves, of biodiversity and the natural environment as a whole, through the establishment of protected areas.

Protected areas are set to provide the preservation and regeneration of natural habitats, of species, of natural reserves and landscapes.

This law regulates the protection of six categories of protected areas applied in the territory of the Republic of Albania. The categorisation of areas and level of protection for each area is based on the criteria of World Conservation Monitoring Centre.

The law declares important or endangered parts of the territory protected areas, according to the following categories:

- strictly natural reserve/scientific reservation/ (Category I)
- national park (Category II);
- national monument (Category III) (including caves)
- natural managed reservation/area of management of habitats and species (Category IV)

- protected landscape (Category V)
- protected area of managed resources/protected area with multipurpose utilisation (Category VI), including regional natural parks.

The law outlines criteria for the selection, protection level and management process of the designated areas. It clarifies on the requirement of management plans for each protected area and the implementation of these plans, as well as monitoring of protected areas.

The updated Law no. 81/2017 establishes the National Agency of Protected Areas (NAPA) and reflects other aspects of institutional reform. It addresses the reform of the forestry industry introduces the Natura 2000 concepts.

Law no. 10006/2008 on the protection of wild fauna

The law aims to protect, manage and control wild fauna, with the aim of preserving types, populations, habitats and migration routes to ensure their needs for food, shelter and breeding are preserved. The law considers wild fauna in the Republic of Albania a national asset, which is administered and protected by law, in line with relevant international treaties to which the Republic of Albania is a party.

The following key targets of wild fauna protection are outlined:

- maintaining the recovery of the diversity of species and their genetic integrity
- protection of habitats, migration routes and propagation conditions
- maintaining the integrity of natural communities
- use of wild fauna for scientific research purposes, to ensure their regeneration
- re-introduction of fauna species that are extinct or endangered.

The law particularly considers types of threatened and endemic species, defined in the National Red List, and provides special legal protection in accordance to the Bern Convention, ratified by the Republic of Albania with the law no. 8294, dated 02/03/1998.

It considers the protection of habitats, migration routes and breeding conditions; protection from adverse effects of climate change; protection from materials and hazardous waste; and recovery of populations of keystone species.

It also outlines special measures for the preservation of wildfowl and species of wild fauna, the planning and recovery of species of wild fauna and the monitoring of wild fauna.

Law no. 9867/2008 on establishing the rules and procedures for international trading in endangered species of fauna and wild flora

This law establishes rules and procedures for implementing the provisions of the CITES Convention so that international trade does not endanger their survival and to ensure animals are not mistreated during international trading.

Law no. 10234/2010 on integrated management of the coastal zone in the Mediterranean Sea

This law is the implementation of the Barcelona Convention for integrated management of the Mediterranean area (as outlined in Section 2.2), within the Albanian territory.

Law no. 10120/2009 on the protection of medicinal, essential oil and tannin plants

This law aims to protect medicinal and essential oil plants that grow in the territory of the Republic of Albania, and to promote and develop their natural habitats. It sets out the conditions governing their collection and harvest and further promotes activities aimed at their cultivation and rehabilitation.

The law, which considers medicinal plants to be a national asset, is composed of the following chapters:

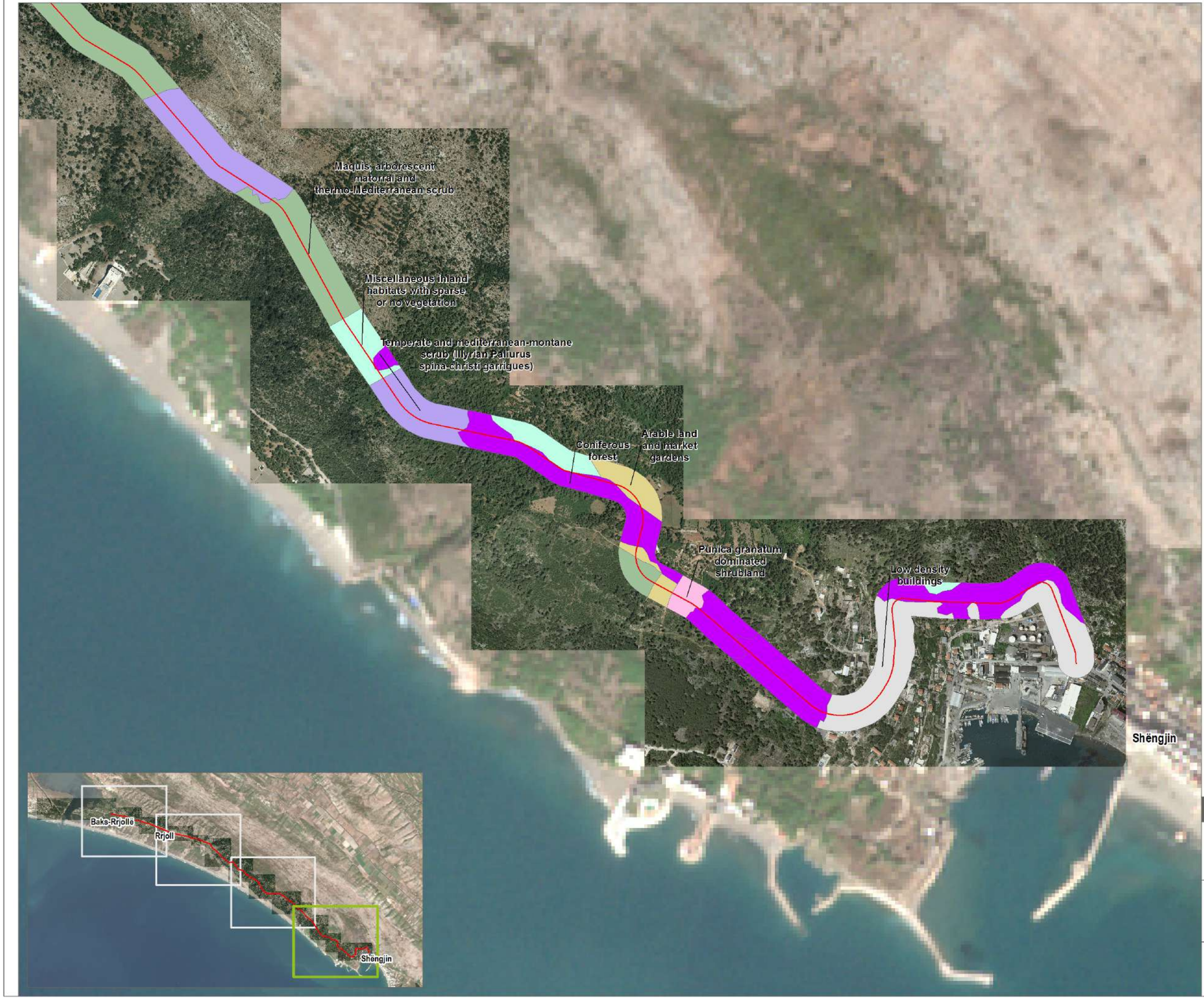
- general provisions
- protection and administration of the plants' fund
- harvesting, packaging and transport of plants
- control and monitoring
- public consultations
- penalties
- final provisions.

Law no. 5/2016 on the moratorium in forest, replacing Law no. 93852005 on forest[s] and forestry service

This law introduced a ten year ban on logging for industrial purposes and export, a drastic measure to address illegal logging (mostly logging in excess of permitted timber quantities, which has been a common practice). The law guarantees the supply of firewood to the population. The other exception refers to forest exploitation for the purposes of regeneration and sanitation. All other forest exploitation rights are suspended and / or require renegotiation.

APPENDIX 2

HABITAT MAP



Sheet 1 of 4

🟥 Proposed Shëngjin to Velipojë road scheme

Vegetation

- 🟩 Thermophilous Deciduous Woodland
- 🟪 Coniferous forest
- ▨ Punica granatum dominated shrubland
- ▨ Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)
- ▨ Maquis, arborescent matorral and thermo-Mediterranean scrub
- ▨ Miscellaneous inland habitats with sparse or no vegetation
- 🟨 Coastal habitats
- ▨ Arable land and market gardens
- ⬛ Screes
- ⬜ Low density buildings

Coordinate System: WGS 1984 UTM Zone 34N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Supplementary Biodiversity Assessment

RSK

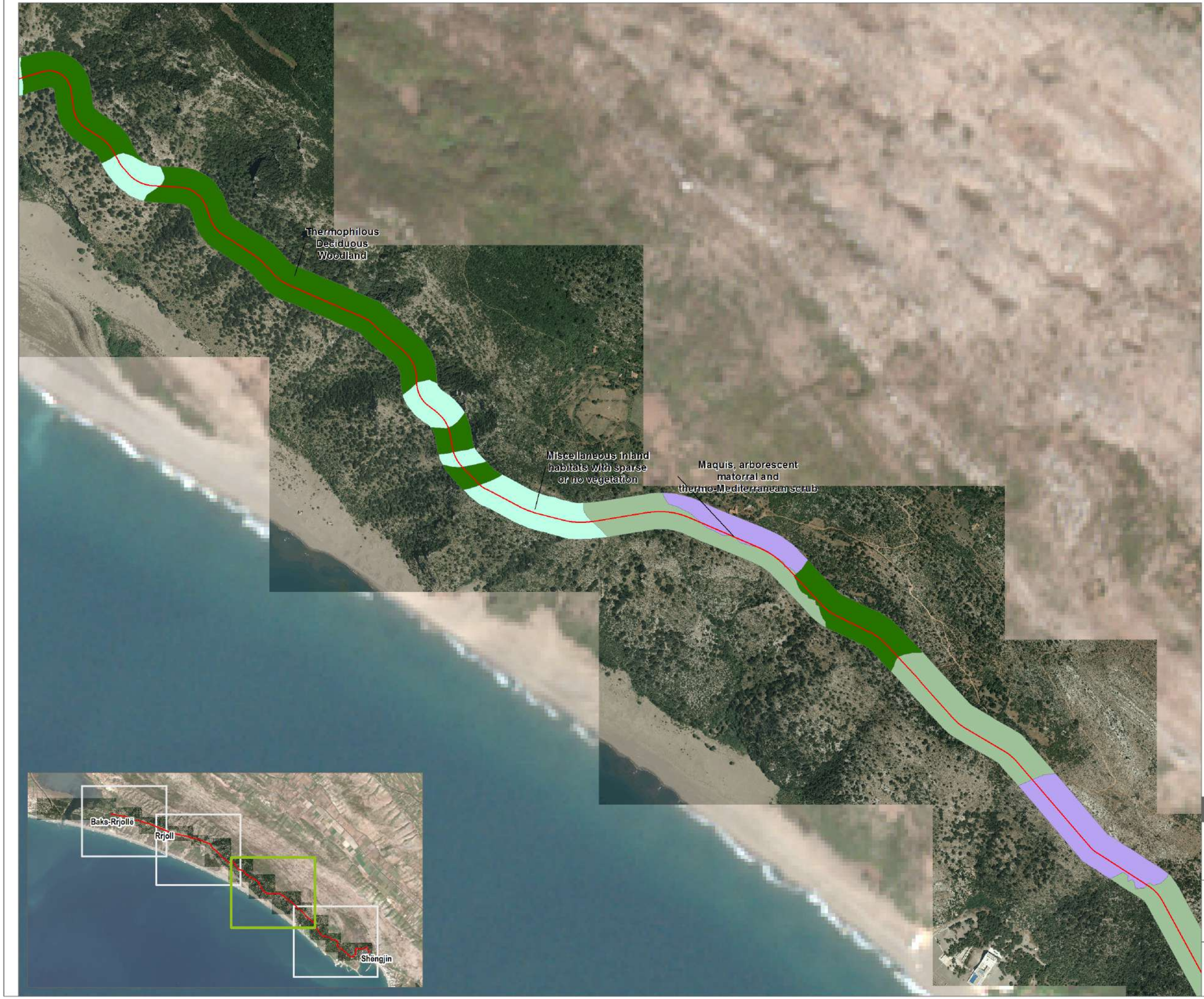
TITLE:

Proposed Shëngjin to Velipojë Road Scheme
Vegetation Mapping

0 100 200 300 400 500
Meters
SCALE: 1:10,000 @ A3

REV 0

Document Path: \\he-nas3\Projects\08-International\P80765 EBRD Buna River\GIS\P80765_004[0].mxd



Sheet 2 of 4

― Proposed Shëngjin to Velipojë road scheme

Vegetation

- 🟩 Thermophilous Deciduous Woodland
- 🟪 Coniferous forest
- ▨ Punica granatum dominated shrubland
- ▨ Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)
- ▨ Maquis, arborescent matorral and thermo-Mediterranean scrub
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Coordinate System: WGS 1984 UTM Zone 34N
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Supplementary Biodiversity Assessment

RSK

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Proposed Shëngjin to Velipojë Road Scheme Vegetation Mapping

0 100 200 300 400 500
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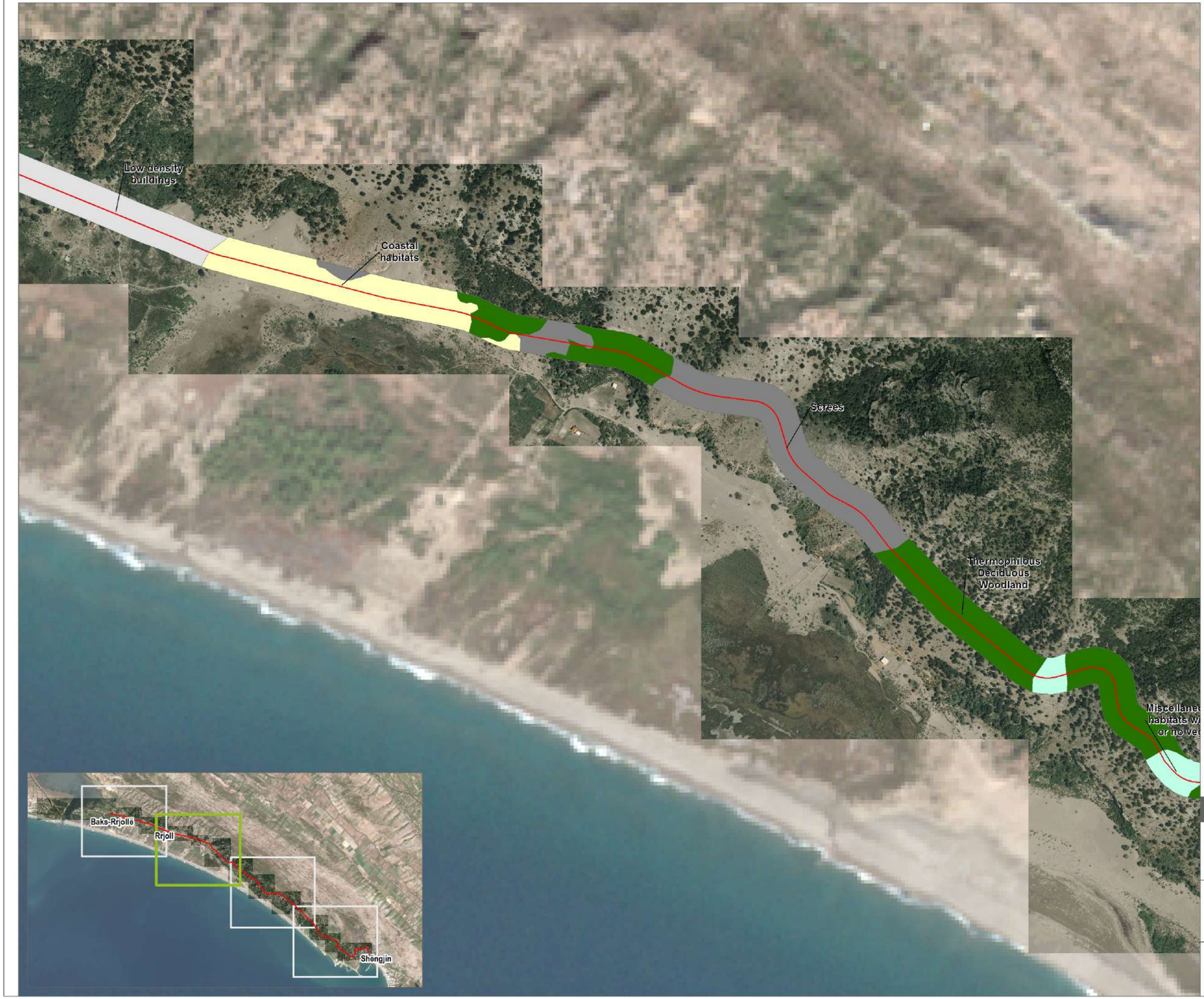

Sheet 3 of 4

— Proposed Shëngjin to Velipojë road scheme

Vegetation

🟩	Thermophilous Deciduous Woodland
🟪	Coniferous forest
▨	Punica granatum dominated shrubland
▨	Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)
▨	Maquis, arborescent matorral and thermo-Mediterranean scrub
▨	Miscellaneous inland habitats with sparse or no vegetation
🟨	Coastal habitats
▨	Arable land and market gardens
⬛	Screes
⬜	Low density buildings

Coordinate System: WGS 1984 UTM Zone 34N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Supplementary Biodiversity Assessment

RSK

TITLE:

Proposed Shëngjin to Velipojë Road Scheme
Vegetation Mapping

0 100 200 300 400 500
Meters
SCALE: 1:10,000 @ A3

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Sheet 4 of 4

🟥 Proposed Shëngjin to Velipojë road scheme

Vegetation

🟩 Thermophilous Deciduous Woodland

🟪 Coniferous forest

▨ Punica granatum dominated shrubland

🟪 Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)

🟩 Maquis, arborescent matorral and thermo-Mediterranean scrub

▨ Miscellaneous inland habitats with sparse or no vegetation

🟨 Coastal habitats

🟨 Arable land and market gardens

⬛ Screes

⬜ Low density buildings

Coordinate System: WGS 1984 UTM Zone 34N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Supplementary Biodiversity Assessment

RSK

TITLE:

Proposed Shëngjin to Velipojë Road Scheme
Vegetation Mapping

0 100 200 300 400 500
Meters
SCALE: 1:10,000 @ A3

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APPENDIX 3

DESCRIPTION OF HABITATS

Table A3.1 Habitat Types, Descriptions and Estimated Coverage Within the Proposed Road Footprint and Buffer Zone

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Habitats Located within the Footprint and / or Buffer Zone of the Proposed Road Alignment					
Broadleaved deciduous woodland (G1.78 Quercus trojana woodland)	Supra-Mediterranean, and occasionally meso-mediterranean woods dominated by the semideciduous *Quercus trojana* or its allies. Other typical species include *Quercus pubescens*, *Carpinus orientalis*, *Juniperus oxycedrus*, *Cistus creticus*, *Fraxinus ornus*, *Dactylis glomerata*, *Brachypodium pinnatum*, *Helictotrichum convolutum* and *Ostrya carpinifolia*	Oak woodand with *Quercus trojana* dominates the south western slopes of the Mount Renzi, within the area of the proposed project footprint. The forest is developed over a calcareous substraet with large, sparse trees, often centuries old but not taller than 15–18 m. At higher altitudes and on the more steep slopes which are more inaccessible, the forest is very dense and difficult to reach. A sparse shrubland layer for the most part, but where it is present it is characterised by *Juniperus oxycedrus, Asparagus acutifolius, Phillyera media* etc. At lower altitudes, the forest is more mixed with *Quercus pubescentis* becoming more prominent with occasional individuals of *Quercus cerris* and *Qercus petraea,*both of which can also be present within the shrub layer. The herb layer is dense and dominated by species such *Stipa bromoides, Brachypodim sylvaticum, Dactylus glomerata, Oenanthe pimpineloides, Cyclamen hederifolium, Teucrium chamaedrys.* Species such as *Galatella albanica* (an Albanian	Does not qualify	0.002811	28.11

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
		endemic) may well be present but couldn't be indentified for certain in the field due to seasonality. If confirmed, this would be a new location for the species. Floristically, the forest has a mixture ofof the mediteranean types of *quercus dehesas* in open formations but also it has mesophile species in the more dense ones (Fanelli et. al, 2015). As such it deserves conservation and further investigation			
Thermophilous Deciduous Woodland	Forests or woods of submeditteranean climate regions and suprameditteranean altitudinal levels, and the western Eurasian steppe and substeppe zones, domiated by deciduous or semideciduous thermophilous Quercus species or by other southern trees such as Carpinus orientalis, Castanea sativa or Ostrya carpinifolia. Thermophilous deciduous trees may, under local microclimatic or edaphic conditions, replace the evergreen oak forests in mesomediterranean or thermomediterranean areas, and occur locally to the	Within the project footprint this forest community type is dominated by *Ostrya carpinifolia* with very low abundance of *Quercus trojana*. It is an open forest with around 40% cover, due to anthropogenic activity.They are present over carbonatic rocks at altitudes of around 200m asl and represent old forests, 7-8m tall. *Ostrya carpinifolia* dominates the shrub layer which is an indicator of good forest regeneration, thus requiring preservation. Additional shrub layer species include *Fraxinus ornus, Quercus trojana, Pistacia terebinthus, Acer monspessulanum* and *Crataegus monogyna.* The herb layer is very diverse and dynamic being represented in our areas of relvees by: *Dactylis glomerata, Salvia officinalis, Coronilla emerus, Hedera helix, Tamus communis, Viola sp., Lychis viscaria, Cyclamen hederifolia* etc.	In wider terms this vegetation community is related with two Annex 1 habitats, one of which is priority habitat: *91H0: Pannonian woods with Quercus pubescens 91M0: Pannonian-Balkanic turkey oak –sessile oak forests Further field work and data elaboration is needed on order to clearly define		

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	north in central and western Europe.		the Annex 1 relevance		
Coniferous woodland	Forest, including plantations dominated by coniferous trees, mainly evergreen (*Abies, Cedrus, Picea, Pinus, Taxus, Cupressaceae*) but also deciduous *Larix*. Includes forest with mixed coniferous and deciduous broadleaved trees, provided that the cover by coniferous trees exceeds that of deciduous trees.	Pine plantation dominated by a monoculture of aleppo pine (*Pinus halepensis*; IUCN LC; not listed on the Albanian Red List).  This habitat type can be found in two different loactions, within the rocky areas (within the project footprint) with *Pinus halepnsis* and the mixed plantations with *Pinus halepensis, Pinus pineaster* and *Pinus pinea* in the coastal dune system (outside the project footprint – discussed in more detail below). The Aleppo pine plantations on calcareous rocks are dominated by *Pinus halepensis* with an open canopy. The shrubland layer is mainly dominated	Does not qualify	0.001763	17.63

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
		by *Punica granatum, Crataegus monogyna, Phillyrea latifolia, Juniperus oxycedrus* etc. Meanwhile in the herbs layer is represented by *Asphodelus ramosus, Clinopodium vulgare, Thymus longicaulis, Teucrium chamaedrys, Teucrium pollium, Dactylis glomerata, Clematis viticela, Asparagus acutifolius* etc. The forest is overgrazed.			
Punica granatum dominated communities	Whilst not included in the EUNIS classification nor in Annex I, it is very important within the Balkan Peninsula. Fanelli et. al 2015, describes it as an association nova hoc loco with the name *Clematido viticellae-Punicetum granati*. Some authors include those communities within the Mediterranean Maquis and some others consider them apart. We support the idea of considering them an important specific community of the area supporting the identification of the new plant association by Fanelli et al. 2015	Widespread within the area, paricular on the lower slopes of the mountain at the point where the calcareious rocks meet the alluvial plain. The average height of the trees is approximately 3m with a total canopy cover of 90% - therefore can (unusually) open or closed shrubland. *Punica granatum* is a tertiary relict species, with a distribution from former Yugoslavia to Afghanisatan (Meusel & Jäger 1992) and in Albania its distribution areal is only in the nothern part of the country, thus very limited. The other accompanying species are very interesting and also tertiary relicts sych as *Clematis viticella*, and others like: *Rosa sempervirens, Paliurus spina – christi, Crataegus monogyna.* The herbs layer is not very dense and characterised by species like: *Viola odorata, Catapodium rigidum, Dactylis glomerata, Tripholium campestre, Arum italicum* and other ruderal species like *Mercurialis annua, Hordeum murinum, Asphodelus ramosa* etc. whichi indicate the presence of grazing in the area.	Does not qualify		

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
Temperate and mediterranean-montane scrub (Illyrian Paliurus spina-christi garrigues)	Garrigues of the Adriatic lowlands and hills of the Balkan peninsula dominated by *Paliurus spina-christi*. *Punica granatum* is a frequent component.	*Paliurus spina – christi* shrubs are fairly spread out in the area representing highly fragmented communities. They can be found in small groups dominated by *Paliurus spina – christi* or larger ones when the thron brush is co-dominant. Usually it is accompanyed by *Phillyrea latifolia, Pyrus amygdaliformis, Punica granatum.* The herb layer is quite mixed due to the open canopy and includes species such as *Bupleurum praealtum, Euphorbia characias, Clematis viticella* etc. These formations appear very disturbed and in a degraded stage.	Does not qualify		
Maquis, arborescent matorral and thermo-Mediterranean scrub	Evergreen sclerophyllous or lauriphyllous shrub vegetation, with a closed or nearly closed canopy structure, having nearly 100% cover of shrubs, with few annuals and some vernal geophytes; trees are nearly always present, some of which may be in shrub form. Shrubs, sometimes tall, of *Arbutus, Cistus, Cytisus, Erica, Genista, Lavandula, Myrtus, Phillyrea, Pistacia, Quercus* and *Spartium* are typical. Included is pseudomaquis, in which the dominants are	Maquis vegetation with Greek juniper (*Juniperus excelsa*), common walnut (*Juglans regia*), strawberry tree (*Arbutus unedo*)  Eastern Phillyrea thickets	Does not qualify	0001549	15.49

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
	mixed deciduous and evergreen shrubs.	These communities represent dense shrublands up to 5m high, usually mono - dominated by *Phillyrea latifolia* and in some other cases accompanied by *Punica granatum, Pistacia terebinthus* etc. which at the same time represent the low shrub layer of the formation. The species that compose the herbaceous layer are: *Viola odorata, Hedera helix, Cyclamen hederifolia, Clematis viticella, Asparagus acutifolius* etc. Helleno-Balkanic pseudomaquis They represent shrub formations intermediate between Mediterranean maquis and schibljak (Southeastern sub-Mediterranean deciduous thickets), resulting from the degradation of the Ostryo-Carpinion of the Helleno-Balkanic peninsula. In the road project footprint area in Renzi Mt. these shrub formations represent the most common composition with monodomination of *Carpinus orientalis* and in some other more rare cases a mix formation of Carpinus orientalis, Pistacia *terebinthus, Paliurus spina-christi, Phillyrea latifolia, Crataegus monogyna* etc. The Carpinus orientalis shrublands are developed in calcareous rocky formations, like a thick bushland circa 3-4 m tall very dense usually in lower altitudes than *Quercus trojana* forests but surrounding its margins. The herb layer is poor and it is represented by *Viola sp., Hedera helix, Clematis viticella, Asparagus*			

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
		acutifolia, Arum maculatum, Ceterach officinarium etc.			
F6.3 - Illyrian garrigues (F6.36 - Illyrian Teucrium and other labiates garrigues)	Shrubby formations, often low, of the meso- and occasionally supra-Mediterranean zones of the Adriatic lowlands of the Balkan peninsula from Istria to southern Albania. Specifically, the Illyrian Teucrium garrigues represent garrigues of the Adriatic lowlands and hills of the Balkan peninsula of which the main components are labiate shrubs or robust perennials (except *Rosmarinus*), in particular *Salvia officinalis.*	This community represents vegetation of the stony Mediterranean grasslands dominted by *Salvia offcinalis* acoompanyed by other species like: *Satureja montana, Teucrium pollium, Teuchrium chamaedrys, Crysopogon gryllus, Teucrium montanum, Convolvulus elegantissimus, Dactylus glomerate, stipa bromoides* etc. Stones and rocks have an average cover of 30% and a slope of 30o. The community is widespread in Albania on dry, calcareous hills along the coasts and on the southern mountains (Buzo 1990; Hoda & Mersinllari 2000). In an upper belt of the stony vegetation dominated with *Salvia officinalis*, in the footprint area there are communities dominated by *Crysopogon gryllus*, accompanied by species such as *Orlaya grandiflora, Satureja montana, Teucrium pollium, Onosma arenaria, Psoralea bituminosa* etc. In other cases, there are rocky pastures which are dominated by *Satureja montana* and co-dominated by *Teucrium pollium* in warmer and less steapy aspects. The accompanying species are more or less the same and mixed with the species of other communities such as the garrigues around, which is an indicator of disturbed environments.	Does not qualify		
E.1 – Dry grasslands (E1.3	Meso- and thermo-Mediterranean xerophile,	This community of Mediterranean grasslands dominated by *Hyparrhenia hirta* occupies small but	Does not qualify		

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
: Mediterranean xeric grassland)	mostly open, short-grass perennial grasslands rich in therophytes; therophyte communities of oligotrophic soils on base-rich, often calcareous substrates e.g. vegetation of the class Thero-Brachypodietea.	very frequent surfaces in the project road footprint area. It develops on moderate slopes (10–15°) on S, SW or W aspects. This community is very stony, more than any other community of grasslands or garrigues in the study area; bare rocks have a very high cover from 60% to 90%. Other accompanied species are *Salvia glutinosa, Satureja montana, Teucrium pollium, Convolvulus elegantissimus, Micromeria juliana, Cetaurium erythrea* etc.			
Miscellaneous inland habitats with sparse or no vegetation	Miscellaneous bare habitats, including glacial moraines, freeze-thaw features, inland sand dunes, burnt ground and trampled areas. Vegetation, if present, is dominated by algae, lichens or bryophytes, with vascular plants absent or very sparse.		Does not qualify	0.001489	14.89

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Bare screes and stony/rocky medtiterranean grasslands	Scree is an accumulations of boulders, stones, rock fragments, pebbles, gravels or finer material, of non-aeolian depositional origin, unvegetated, occupied by lichens or mosses, or colonized by sparse herbs or shrubs. Included are screes and scree slopes produced by slope processes, moraines and drumlins originating from glacial deposition, sandar, eskers and kames resulting from fluvio-glacial deposition, block slopes, block streams and block fields constructed by periglacial depositional processes of downslope mass movement, ancient beach deposits constituted by former coastal constructional processes. Deposits originating from aeolian depositional processes (dunes) or from eruptive volcanic activity are not included; they are included in H5 and H6	Scree vegetated with graminoid species interspersed with herbs.  These represent stony/rocky medtiterranean grasslands dominated by grasses such as *Hyparhenia hirta*, *Stipa bromoides*, *Crysopogon gryllus* etc. and other herbal species like Salvia officinalis, Satureja montana, Teucrium pollium etc. The ones I have described above.	A number of scree types are categorised as Annex 1 habitats (i.e. 8110, 8120, 8130, 8140, 8150, 8160). Annex 1 scree habitat was not encounter during the field survey. Some screes were observed, but these were bare screes with no typical vegetation and as such they cannot be classified as any of the Annex I scree habitats.	0.000997	9.97

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	respectively. High mountain, boreal and Mediterranean unstable screes are colonized by highly specialised plant communities. They or their constituting species may also inhabit moraines and other depositional debris accumulations in the same areas. A very few communities form in lowland areas elsewhere.				
H3 : Inland cliffs, rock pavements and outcrops (H3.5 : Almost bare rock pavements, including limestone pavements)	Unvegetated, sparsely vegetated, and bryophyte- or lichen-vegetated cliffs, rock faces and rock pavements, not presently adjacent to the sea, and not resulting from recent volcanic activity. Parts of seacliffs free from the influence of wave or wind transported marine salt are included. More specifically, this includes level surfaces of rock exposed by glacial erosion, by weathering processes, or by aeolian scouring, bare or colonized by mosses, algae or lichens.	In the assessed area we encountered typical limestone pavement geologcal formation, which was populated with dufferent lychens and almost bare from vascular vegetation. In the fissures of the pavements there is *Geranium robertianum* and some ferns and other species of the genius *Festuca sp*. and *Bromus sp*. Hard to determinate because they were too dry at the period of the field mission. Additionally, in this vegetation group we can mention also the calcareous wall faces, or calcareous rocky slopes inhabited with very few species, distant from each other and sometimes mono dominant vegetation. We have encountered rocky vegetation with *Satureja montana* and *Putoria calabrica*.	*8240 – Limestone pavement 8210 - Calcareous rocky slopes with chasmophytic vegetation		

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	The hard rock surface may be exposed or partially covered by erosional rock debris. Included are rock surfaces in karst landscapes, rock dome tops, whaleback, roche moutonné, flyggberg and rock basin formations of periglacial areas, golec and felsenmeer formations, level surfaces of dykes and old lava flows. Vascular plant communities may colonize cracks and weathered surfaces				

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Coastal dune and sandy shore	Sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons, fashioned by the action of wind or waves. They include gently sloping beaches and beach-ridges, formed by sands brought by waves, longshore drift and storm waves, as well as dunes, formed by aeolian deposits, though sometimes re-fashioned by waves.	 A small area of a shifting, coastal dune located within the survey area at the foot of Mount Renci. It is likely that a combination of erosion (i.e. caused by wind and water), over grazig, conversion to agro-pastoral land and vehicle movement have inhibited natural sucession.	(EU code 2110) Embryonic shifting dunes	0.000717	7.17
Coastal saltmarshes and saline reedbeds	Angiosperm-dominated stands of vegetation, occurring on the extreme upper shore of sheltered coasts and periodically covered by high tides. The vegetation develops on a variety of sandy and muddy sediment types and may	This community in the surrounding environments of the road project footrpin is dominated by *Juncus maritimus* and *Juncus. acutus* accompanied by *Carex extensa, Aster tripolium, Plantago crassifolia, Blackstonia perfoliata, Centaurium tenuiflorum* etc. The status of this habitat in the road project footprint is in its majority very degraded.	1410 : Mediterranean salt meadows (*Juncetalia maritimi*)		

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	have admixtures of coarser material. The character of the saltmarsh communities is affected by height up the shore, resulting in a zonation pattern related to the degree or frequency of immersion in seawater.				
Arable and market gardens	Croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. They include fields of cereals, of sunflowers and other oil seed plants, of beets, legumes, fodder, potatoes and other forbs. Croplands comprise intensively cultivated fields as well as traditionally and extensively cultivated crops with little or no chemical fertilisation or pesticide application. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of natural vegetation between fields.	 Agro-pastoral land, some of which are delineated with walls and fences. In some areas, these sites are being left for fallow or have appeared to have been abandoned and are in a transitionary scrub-state.	Does not qualify	0.000129	1.29

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Low density buildings	Buildings in rural and built-up areas where buildings, roads and other impermeable surfaces are at a low density, typically occupying less than 30% of the ground. Excludes agricultural building complexes where the built area exceeds 1 ha (J1.4).	Scattered buildings located along the exisiting track near Shëngjin and burban development adjacent to the Baks-Rrjollë road.	Does not qualify	0.003201	32.01
Additional Habitats Located Outside the Footprint and Buffer of the Proposed Road Alignment, Within The AOI					
Coastal habitats	Coastal habitats are those above spring high tide limit (or above mean water level in non-tidal waters) occupying coastal features and characterised by their proximity to the sea, including coastal dunes and wooded coastal dunes, beaches and cliffs. Includes free-draining supralittoral habitats adjacent to marine habitats which are normally only affected by spray or splash, strandlines characterised by terrestrial invertebrates and moist and wet coastal dune slacks and dune-slack pools. Excludes	A number of coastal habitats are located in close proximity to the proposed road alignment including a beach and dune system.	N/A	N/A	N/A

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
	supralittoral rock pools and habitats adjacent to the sea which are not characterised by salt spray, wave or sea-ice erosion.				
B1.31 : Embryonic shifting dunes	Formatiomn sof the coasts of nemoral, steppe, Meditteranean and warm-temperate humid zones, representing the first stages of dune construction, constituted by rippes or raised sand surfaces of the upper beay or by a seaward fringe at the foot of the tall dunes. Typically *Elymus farctus, Otanthus maritimus, Sporobolus pungens, Pancratium maritimum, Medicago marina* or *Anthemis tomentosa* may be present. The vegetation may belong to the class Ammophiletea with communities of *Otanthus maritimus, Agropyro juncei-Sporoboletum pungentis, Cypero mucronati-Agropyretum juncei, Elymetum*	Found outside the project footprint, this plant community is represented by one-year or multi-year formations occupying marine deposits in the immediate vicinity or on the first line immediately after the marine line on marine fiber fanograms such as *Posidonia oceanica, Cymodocea nodosa* or seaweed. Its characteristic species are *Cakile maritima, Xanthium strumarium, Salsola horse, Atriplex hastata, Euphorbia peplis, Elymus farctus, Euphorbia paralias, Eryngium maritimum.* These communities are widely spread almost throughout all the study area, but are fragmented where the people walk or stay during the summer, and where the construction of tourist complexes has begun.	1210- Annual vegetation of drift lines		

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	sabulosi, Medicagini marinae-Ammophiletum australis and species Elytrigia bessarabica, Glycyrrhiza glabra, Limonium graecum, Limonium sinuatum, Zygophyllum album, Inula crithmoides, Scirpus holoschoenus, Paronychia argentea and *Centaurea spinosa.*				
Coastal saltmarshes and saline reedbeds	Angiosperm-dominated stands of vegetation, occurring on the extreme upper shore of sheltered coasts and periodically covered by high tides. The vegetation develops on a variety of sandy and muddy sediment types and may have admixtures of coarser material. The character of the saltmarsh communities is affected by height up the shore, resulting in a zonation pattern related to the degree or frequency of immersion in seawater.	This community is dominated by *Juncus maritimus* and *Juncus. acutus* accompanied by *Carex extensa, Aster tripolium, Plantago crassifolia, Blackstonia perfoliata, Centaurium tenuiflorum etc*. The recent assessment of the conservation status of this habitat in the Mediterranean bio-geographic region shows that the habitat is at serious risk of extinction (at least on a regional level) (EC, 2013). According to Bego et. al, (2013), this community is very fragmented in this area.	1410 : Mediterranean salt meadows (*Juncetalia maritimi*)		

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
F9.3 - Southern riparian galleries and thickets	Tamarisk, oleander, chaste tree galleries and thickets and similar low woody vegetation of permanent or temporary streams and wetlands of the thermo-Mediterranean zone, southwestern Iberia & Macaronesia	This plant community is spread in the shape of belts in different altitudes but still very fragmented. The dominant species are: *Vitex agnus-castus, Tamarix dalmatica and rarely Populus alba*. Other species of these communities are *Juncus acutus, Schoenus nigricans, Juncus littoralis, Plantago crassifolia* etc	92D0: Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)		
B.1.7 – Coastal dune woods	Coastal dunes colonised by woodland which are directly influenced by proximity to the sea.	Found bordering the sand dunes.The dominant species are *Pinus pinaster, Pinus halepensis* and rarely *Pinus pinea*, The forest was cultivated 40 to 50 years ago for the stabilization of sand dunes and protection of agricultural lands, but it has gain stability towards naturalisation. Among the other plant species are: *Helianthemum joniana, Juniperus oxucedrus, Satureja hortensis, Teucrium pollium, Ruscus aculeatus, Paliurus spina - christi, Punica granatum* etc.	*2270: Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*		

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
Sand beaches above the driftline	Gently sloping sand-covered shorelines fashioned by wind action along coasts and beside associated coastal lagoons.		Does not qualify	N/A	N/A
Coastal dune and sandy shore	Sand-covered shorelines of the oceans, their connected seas and associated coastal lagoons, fashioned by the action of wind or waves. They include gently sloping beaches and beach-ridges, formed by sands brought by waves, longshore drift and storm waves, as well as dunes, formed by aeolian deposits, though sometimes re-fashioned by waves.	 Large shifting, primary dunes were observed at the foot of Mount Renci. These dunes were poorly	(EU code 2110) Embryonic shifting dunes	N/A	N/A

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
		vegetated may be attributed to continued erosion and over grazing.			
Brackish coastal lagoons	Lagoons are expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Fully saline coastal lagoons are classified as X02. Flads and gloes, considered a Baltic variety of lagoons, are small, usually shallow, more or less delimited water bodies still connected to the sea or cut off from the sea very recently by land upheaval. Characterised by well-developed reedbeds and luxuriant submerged vegetation and having several morphological and botanical development stages in the process whereby sea becomes land. Mediterranean lagoons may host the [Ruppietum] community with halophytic vegetation, while at sites		(EU Code 1150) Coastal lagoons priority Annex 1 habitat	N/A	N/A

EUNIS Habitat Types	**Descriptions (source: European Environment Agency, 2018)**	**Habitat Descriptions Based on Field Observations**	**Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)**	**Estimated Coverage (ha) in the Road Footprint**	**Estimated Coverage (ha) in the Buffer and Road Footprint**
	with a fresh water supply, plant communities of [*Junctetum*] and [*Phragmitetum*] can develop. [*Sarcocornia perennis*] and [*Arthrocnemum macrostachyum*] may occur here.				
Inland cliffs, rocky pavements and outcrops	Unvegetated, sparsely vegetated, and bryophyte- or lichen-vegetated cliffs, rock faces and rock pavements, not presently adjacent to the sea, and not resulting from recent volcanic activity. Parts of sea cliffs free from the influence of wave or wind transported marine salt are included. Rock accumulations resulting from depositional processes are excluded and listed under H2 or H5.	These type of vegetation communities are spread in the entire area of Renzi Mt. They are represented by very low number of plant species and usually are specific to the locations. The ones encountered during the road project footprint are described above.	(EU code 8210) Calcareous rocky slopes with chasmophytic vegetation	N/A	N/A
Geolittoral wetlands and meadows: reed, rush and sedge stands: natural stands			Does not qualify	N/A	N/A

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
		 Dune wetland that grades into a lagoon wetland. Dominated by *Juncus* sp.			
Inland dune juniper scrubs	Juniperus communis-rich scrub of Germano-Baltic fluvioglacial inland dunes	Small areas of *Juniperus oxycedrus ssp. macrocarpa*fdominated scrub located at the foot of Mount Renci.	Does not qualify	N/A	N/A
Arable and market gardens	Croplands planted for annually or regularly harvested crops other than those that carry trees or shrubs. They include fields of cereals, of sunflowers and other oil seed plants, of beets, legumes, fodder, potatoes and other forbs.	Agro-pastoral land, some of which are delineated with walls and fences. In some areas, these sites are being left for fallow or have appeared to have been abandoned and are in a transitionary scrub-state.	Does not qualify	N/A	N/A

EUNIS Habitat Types	Descriptions (source: European Environment Agency, 2018)	Habitat Descriptions Based on Field Observations	Annex 1 Habitat Status (Current Name as Adopted in Directive 97/62/EC)	Estimated Coverage (ha) in the Road Footprint	Estimated Coverage (ha) in the Buffer and Road Footprint
	Croplands comprise intensively cultivated fields as well as traditionally and extensively cultivated crops with little or no chemical fertilisation or pesticide application. Faunal and floral quality and diversity depend on the intensity of agricultural use and on the presence of borders of natural vegetation between fields.				
Low density buildings	Buildings in rural and built-up areas where buildings, roads and other impermeable surfaces are at a low density, typically occupying less than 30% of the ground. Excludes agricultural building complexes where the built area exceeds 1 ha (J1.4).		Does not qualify	N/A	N/A

APPENDIX 4
VASCULAR PLANT LIST

Table A4.1 Botanical Survey Results

Key: EN = Endangered, VU = Vulnerable; LC = Least Concern, N/A = not applicable, LR/nt = Low Risk Near Threatened, NL = not listed

Scientific Name	Albanian Name	UK Common Name	IUCN Status (2019)	Albanian Red List Status (2013)	Endemic Species Status	Habitat of Occurance
Acer campestre	Kreka	Field Maple	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Acer monspessulanum	Krekeza	Montpellier Maple	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Alyssum sp.	Serica	-	-	-	-	In ruderal stony areas
Lysimachia foemina Synonym: *Anagallis foemina*	Anagali femer	Poorman's weatherglass	NA	-	-	*Quercus trojana* woodland
Arbutus unedo	Mareja	Strawberry Tree	LC	VU A2c	-	Maquis
Arum italicum	Kelkaza	-	NA	-	-	*Quercus trojana* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*, *Punica granatum* shrublands
Asparagus acutifolius	Ferremiu	Wild Asparagus	LC	LC	-	Everywhere (in all vegetation communities)

Asphodelus ramosus	Badhra	Common Asphodel	LC	-	-	Coniferous forests and mediterranean stony grasslands
Asplenium adianthum-nigrum	Fierguri i zi	Black Spleenwort	LC	-	-	*Quercus trojana* woodland
Asyneuma limonifolium	Asineuma gjethelimoni	-	NA	-	-	Mediterranean steppes
Brachypodium sylvaticum	Rudithi pyjor	-	NA	-	-	*Quercus trojana* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Bupleurum veronense	Brinjekau	-	NA	-	-	*Quercus trojana* woodland
Campanula lingulata	Lulekambana llapore	-	NA	-	-	Everywhere (in all vegetation communities)
Carlina corymbosa	Ushonjeza vastakore	Doldige Eberwurz	NA	-	-	*Quercus trojana* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Carpinus orientalis	Shkoza	Oriental Hornbeam	LC	-	-	Everywhere (in all vegetation communities)
Centaurea sp.	Kokoceli	-	-	-	-	Mediterranean steppes, *Quercus trojana* woodland
Cephalanthera rubra	Cefalantera e kuqe	Red Cephalanthera	LC	-	-	*Quercus trojana* woodland
Asplenium ceterach Synonym *Ceterach officinarium*	Bari i gjarprit mjekesor	Common Rustyback Fern	LC	-	-	*Quercus trojana* woodland
Chrysopogon grillus	Pirra					Mediterranean stony grasslands
Clematis flammula	Kulpra e bute	Brennende Waldrebe	NA	-	-	Everywhere (in all vegetation communities)
Clematis viticella	Kulpra e zeze	-	NA	-	-	*Quercus trojana* woodland

Clinopodium vulgare	Klinopodi i rendomte	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Colchicum autumnale	Xhërokull vjeshtor, luleshlline, lulepreshi	Meadow Saffron	LC	EN A1b	-	*Quercus trojana* woodland
Convolvulus elegantissimus	Dredhja	Elegant Bindweed	NA	-	-	Everywhere (in all vegetation communities)
Coronilla emerus	Mileza	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Crataegus heldreichii	Murriz i Heldraihit	_	LC	LR cd	-	*Ostrya caprinifolia* woodland,
Crataegus monogyna	Murrizi Njeberthamesh	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Crucianella latifolia	Krucianela gjethegjere	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Crupina vulgaris	Krupina e rendomte	-	NA	-	-	Mediterranean steppes, *Quercus trojana* woodland
Cyclamen hederifolia	Bukederri gjetheurthi					*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Dactylis glomerata	Telishi	-	NA	-	-	Everywhere (in all vegetation communities)
Dorycnium hirsutum	Dorikni qimeashper	-	NA	-	-	Everywhere (in all vegetation communities)

Dorycnium pentaphyllum	Dorikni pesegjethesh	-	DD	-	-	Everywhere (in all vegetation communities)
Echium plantagineum	Ushqereza si dejc	-	NA	-	-	Mediterranean steppes
Erica arborea	Shqopa	-	Lc	VU A2c	-	Maquis
Euphorbia platyphyllos	Qumeshtorja gjethegjere	-	NA	-	-	*Quercus trojana* woodland, Mediterranean steppes
Fraxinus ornus	Frasheri	Manna Ash	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Galatella albanica	Aster Shqiptar	-	NA	EN A1b	National endemic	*Quercus trojana* woodlands
Gallium lucidum	Ngjotesja e shndritshme					*Quercus trojana* woodlands, *Ostrya caprinifolia* woodland
Geranium molle	Kamaroshe	-	NA	-	-	*Quercus trojana* woodlands, *Ostrya caprinifolia* woodland
Geranium robertianum	Kamaroshe e robertit	-	NA	-	-	Limestone pavement
Geranium rotundifolium	Kamaroshe gjetherrumbullaket	-	NA	-	-	*Punica grannatum* shrublands, Coniferus forests
Gladiolus italicum	Gladiola italike					*Quercus trojana* woodland
Hedera helix	Urthi	Ivy	LC	-	-	*Quercus trojana* woodland, Shrublands with *Ph. latifolia* and *Carpinus orinetalis, Punica granatum* shrublands
Helianthemum nummularium	Heliantemi me pore	-	NA	-	-	Mediterranean stony grasslands/ Illyrian garrigues
Hieracium murorum	Kemashna e mureve	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland,

						shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Hieracium piloselloides	Kemashna si leshatake	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Hordeum murinum	Elbi i minjve	False Barley	LC	-	-	Everywhere (in all vegetation communities)
Hyparrhenia hirta	Belizma qimeashper	-	NA	-	-	Mediterranean xeric grasslands
Hypericum perforatum	Lule basami	St. John's-wort	LC	EN A1b	-	Everywhere (in all vegetation communities)
Iberis umbellata	Iberis umbrellore	-	NA	-	-	Mediterranean stony grasslands/ Illyrian garrigues
Iris sintenisii	Iris	-	NA	-	-	Humid meadows
Juniperus oxycedrus ssp. macrocarpa	Dellinja e kuqe frutmadhe			VU A1b		Coniferous forests and mediterranean stony grasslands
Lactuca muralis	Miceli i murit	Wall Lettuce	LC	DD	-	*Quercus trojana* and *Ostrya carpinifolia* woodlands
Linum nodiflorum	Liri lulendernyje	-	NA	-	-	Everywhere (in all vegetation communities)
Luzula johnstonii (synonym *Luzula forsteri)*	Luzule	-	LC	-	-	*Quercus trojana* woodland
Lychnis viscaria	Lulengjitesja	-	NA	-	-	*Quercus trojana* woodland
Matthiola tricuspidata	Pllatkë trithimthore	-	NA	EN A1b	Subendemik	*Quercus trojana* woodland
Medicago sp.	Jonxhe	-	-	-	-	*Punica grannatum* shrublands, Coniferus forests
Mercurialis annua	Merkuriali njevjecar	-	NA	-	-	Garrigues

Micromeria juliana	Bishtmiu juljan	-	NA	-	-	Meditarranean steppes/ Illyrian garrigues
Moltkia petraea	Moltkia e gurit	-	NA	-	Subendemic	Meditarranean steppes/ Illyrian garrigues
Onosma arenaria	Ciklla	-	NA	-	-	Mediterranean steppes and xeric grasslands
Ophrys scolopax	Ofris	Deep Forest Ophrys	LC	-	-	At the boarders of forests and open stony dry grasslands
Orchis coriophora	Orkide	Holy Orchid	LC - global NT - Europe	-	-	Mediterranean stony vegetation
Origanum vulgare	Rigoni	Oregano	LC	EN A1b	-	*Quercus trojana* woodland
Orlaya grandiflora	Orlaja lulemadhe	-	NA	-	-	Everywhere (in all vegetation communities)
Ostrya carpinifolia	Melleza	European Hop-hornbeam	LC	VU A2c	-	*Ostrya caprinifolia* woodland
Paliurus spina-christi	Drize	-	NA	-	-	Garrigues with *Paliururs spina - christi*
Phillyrea latifolia	Mreti gjethegjere	-	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Pinus halepensis	Pisha e bute	Aleppo Pine	LC	-	-	Coniferous forests
Pistacia terebinthus	Qelbesi	Cyprus Turpentine	LC	-	-	Everywhere (in all vegetation communities)
Plantago lanceolata	Gjethe heshtor	Ribwort Plantain	LC	-	-	Shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Polygala nicaensis	Poligala e Nices					*Quercus trojana* woodland

Populus nigra	Plepi I zi	-	DD	-	-	Riparian galleries
Bituminaria bituminosa (sysonym *Psoralea bituminosa)*	Psoralea	-	NA	-	-	Everywhere (in all vegetation communities)
Punica granatum	Shega	-	LC	CR B1	-	*Punica grannatum* shrublands, Coniferus forests
Putoria calabrica	Putore					Inland cliffs in rocky calcareous walls
Pyrus amygdaliformis	Gorrica	Almond-leaf Pear	LC	-	-	Almost everywhere but in bery low cover, approximately composed of 1-2 individuals
Quercus ilex	Ilqe	Holm Oak	LC	EN A1b	-	Maquis
Quercus pubescens	Dushku me push	Downy Oak	LC	VU A2c	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland
Ruscus aculeatus	Rrushkulli	-	LC	LC	-	Degraded shrubland with *Carpinus orientalis* and *Q. trojana*
Salvia officinalis	Sherebelë	Sage	LC	VU A1b	-	*Quercus trojana* woodlands, Mediteranean stony grasslands, but more or less everywhere
Satureja montana	Trumzë	-	NA	VU A1c	-	*Quercus trojana* woodlands, Mediteranean stony grasslands, but more or less everywhere
Sedum acre	Rrushqyqja	Biting Stonecrop	LC	-	-	Mediterranean stony vegetation
Sideritis montana	Sideriti malor	-	NA	-	-	*Quercus trojana* woodland
Sideritis romana	Sideriti roman	-	NA	-	-	*Quercus trojana* woodland

Sisymbrium officinale	Sisimbri mjekesor	Hedge Mustard	LC	-	-	Everywhere (in all vegetation communities)
Spartium junceum	Xane	-	NA	-	-	Garrigues with *Paliururs spina - christi*
Stipa bromoides	Pendekaposhi	Lino delle fate simile al forasacco	LC	-	-	*Quercus trojana* woodland
Tamus communis	Pejza	Black Bryony	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Teucrium chamaedrys	Arresi dushkvogel	Wall Germander	LC	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Teucrium montanum	Arresi malor	Mountain Germander	LC	-	-	Mediterranean stony grasslands
Teucrium pollium	Barmajaselli					Everywhere (in all vegetation communities)
Thymus longicaulis	Zhumbrica kercellgjate	-	NA	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Trifolium angustifolium	Terfil gjethengushte	White Clover	LC	-	-	Shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Trifolium campestre	Terfil i arrave	-	NA	-	-	Shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Viburnum tinus	Butinë, indës	Laurestine	LC	EN	-	
Vicia cracca	Grashina	Bramble Vetch	LC	-	-	Shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Vincetoxicum sp.	Qenmbytesja	-	-	-	-	*Quercus trojana* woodland

Viola sp.	Vjollca	-	-	-	-	*Quercus trojana* woodland, *Ostrya caprinifolia* woodland, shrublands with *Ph. latifolia* and *Carpinus orinetalis*
Vitex agnus-castus	Konopica	Chaste Tree	DD	-	-	Riparian galleries

APPENDIX 5
BREEDING BIRD SPECIES LIST

No	Common name	Scientific name	Breeding codes	IUCN Threat Status	Red book Albania	Habitat	Notes
1	Great reed warbler	*Acrocephalus arundinaceus*	12	LC		Reeds	Recently fledged young
2	Long-tailed tit	*Aegithalos caudatus*	12	LC		Forests	Recently fledged young
3	Rock patridge	*Alectorix graeca*	2	Near Threatened		Areas of parse vegetation	Singing male
4	Tawny pipit	*Anthus campestris*	14	LC		Sand dunes	Adult carrying food for young
5	Golden eagle	*Aquila chrysaetos*	1	LC	EN	Inland cliffs	Species in possible nesting habitat
6	Grey heron	*Ardea cinerea*	0	LC	EN	Wetlands	Summering non-breeder
7	Long-eared owl	*Asio otus*	12	LC	LRnt	Forests	Recently fledged young
8	Little owl	*Athene noctua*	12	LC		Urban areas	Recently fledged young
9	Eagle owl	*Bubo bubo*		LC	CR	Inland cliffs	Potential habitat. Research needed.
10	Common buzzard	*Buteo buteo*	14	LC	VU	Forests	Adult carrying food for young
11	Short-toed lark	*Calandrella brachydactyla*	14	LC		Sand dunes	Adult carrying food for young
12	Nightjar	*Caprimulgus europaeus*	1	LC	LRlc	Forests	Species in possible nesting habitat
13	Goldfinch	*Carduelis carduelis*	12	LC		Forests	Recently fledged young
14	Red-rumped swallow	*Cecropis daurica*	16	LC		Urban areas	Nest with young
15	Cetti's warbler	*Cettia cetti*	14	LC		Maquis	Adult carrying food for young

No	Common name	Scientific name	Breeding codes	IUCN Threat Status	Red book Albania	Habitat	Notes
16	Kentish plover	*Charadrius alexandrinus*	15	LC		Sand dunes	Nest with eggs
17	Greenfinch	*Chloris chloris*	12	LC		Forests	Recently fledged young
18	Short-toed eagle	*Circaetus gallicus*	14	LC	VU	Forests	Adult carrying food for young
19	Zitting cisticola	*Cisticola juncidis*	14	LC		Sand dunes	Adult carrying food for young
20	Jackdaw	*Coloeus monedula*	12	LC		Inland cliffs	Recently fledged young
21	Rock dove	*Columba livia*	12	LC		Inland cliffs	Recently fledged young
22	Raven	*Corvus corax*	12	LC		Inland cliffs	Recently fledged young
23	Hooded crow	*Corvus cornix*	12	LC		Urban areas	Recently fledged young
24	Black-headed gull	*Croicocephalus ridibundus*	0	LC		Wetlands	Summering non-breeder
25	Cuckoo	*Cuculus canorus*	1	LC		Forests	Species in possible nesting habitat
26	Blue tit	*Cyanistes caeruleus*	12	LC		Forests	Recently fledged young
27	House martin	*Delichon urbicum*	16	LC		Urban areas	Nest with young
28	Great spotted woodpecker	*Dendrocopos major*	6	LC		Forests	Adult visiting probable nest site
29	Syrian woodpecker	*Dendrocopos syriacus*	7	LC	LRlc	Forests	Agitated behaviour
30	Middle spotted woodpecker	*Dendrocoptes medius*	1	LC	LRlc	Forests	Species in possible nesting habitat
31	Lesser spotted woodpecker	*Dryobates minor*	1	LC	LRlc	Forests	Species in possible nesting habitat
32	Little egret	*Egretta garzetta*	0	LC	VU	Wetlands	Summering non-breeder
33	Corn bunting	*Emberiza calandra*	14	LC		Maquis	Adult carrying food for young
34	Rock runting	*Emberiza cia*	7	LC		Areas of parse vegetation	Agitated behaviour
35	Cirl bunting	*Emberiza cirlus*	14	LC		Forests	Adult carrying food for young

No	Common name	Scientific name	Breeding codes	IUCN Threat Status	Red book Albania	Habitat	Notes
36	Yellowhammer	*Emberiza melanocephala*	14	LC		Maquis	Adult carrying food for young
37	Peregrine falcon	*Falco peregrinus*	14	LC	VU	Inland cliffs	Adult carrying food for young
38	Hobby	*Falco subbuteo*	1	LC	VU	Forests	Species in possible nesting habitat
39	Kestrel	*Falco tinnunculus*	13	LC	VU	Inland cliffs	Adult entering/leaving nest site
40	Chaffinch	*Fringilla coelebs*	15	LC		Forests	Nest with eggs
41	Crested lark	*Galerida cristata*	14	LC		Sand dunes	Adult carrying food for young
42	Moorhen	*Gallinula chloropus*	12	LC		Wetlands	Recently fledged young
43	Jay	*Garrulus glandarius*	14	LC		Forests	Adult carrying food for young
44	Oystercatcher	*Haematopus ostralegus*	7	Near Threatened	VU	Wetlands	Adult visiting probable nest site
45	Black-winged stilt	*Himantopus himantopus*	7	LC	EN	Wetlands	Agitated behaviour
46	Olive-tree warbler	*Hippolais olivetorum*	14	LC	DD	Maquis	Adult carrying food for young
47	Barn swallow	*Hirundo rustica*	16	LC		Urban areas	Nest with young
48	Olivaceous warbler	*Iduna pallida*	7	LC		Maquis	Agitated behaviour
49	Little bittern	*Ixobrychus minutus*	3	LC		Reeds	Pair in suitable habitat
50	Wryneck	*Jynx torquilla*	13	LC	LRnt	Maquis	Adult entering/leaving nest site
51	Red-backed shrike	*Lanius collurio*	16	LC		Maquis	Nest with young
52	Woodchat shrike	*Lanius senator*	14	LC		Maquis	Adult carrying food for young
53	Yellow-legged gull	*Larus michahellis*	1	LC	EN	Wetlands	Species in possible nesting habitat
54	Nightingale	*Luscinia megarhynchos*	14	LC		Maquis	Adult carrying food for young
55	Bee-eater	*Merops apiaster*	13	LC	EN	Sand dunes	Adult entering/leaving nest site
56	Pygmy cormorant	*Microcarbo pygmeus*	0	LC	CR	Wetlands	Summering non-breeder

No	Common name	Scientific name	Breeding codes	IUCN Threat Status	Red book Albania	Habitat	Notes
57	Blue rock thrush	*Monticola solitarius*	7	LC		Inland cliffs	Agitated behaviour
58	Pied wagtail	*Motacilla alba*	14	LC		Wetlands	Adult carrying food for young
59	Yellow wagtail	*Motacilla flava*	14	LC		Sand dunes	Adult carrying food for young
60	Spotted flycatcher	*Muscicapa striata*	14	LC		Forests	Adult carrying food for young
61	European curlew	*Numenius arquata*	0	Near Threatened		Wetlands	Summering non-breeder
62	Black-eared wheatear	*Oenanthe hispanica*	13	LC		Areas of parse vegetation	Adult entering/leaving nest site
63	Golden oriole	*Oriolus oriolus*	12	LC		Forests	Recently fledged young
64	Scops owl	*Otus scops*	2	LC		Forests	Singing male
65	Great tit	*Parus major*	13	LC		Forests	Adult entering/leaving nest site
66	House sparrow	*Passer domesticus*	16	LC		Urban areas	Nest with young
67	Spanish sparrow	*Passer hispaniolensis*	16	LC		Urban areas	Nest with young
68	Field sparrow	*Passer montanus*	1	LC		Urban areas	Species in possible nesting habitat
69	Dalmatian pelican	*Pelecanus crispus*	0	Near Threatened	CR	Wetlands	Summering non-breeder
70	Cormorant	*Phalacrocorax carbo*	0	LC		Wetlands	Summering non-breeder
71	Chiffchaff	*Phylloscopus collybita*	14	LC		Forests	Adult carrying food for young
72	Magpie	*Pica pica*	12	LC		Urban areas	Recently fledged young
73	Green woodpecker	*Picus viridis*	2	LC	LRlc	Forests	Singing male
74	Sombre tit	*Poecile lugubris*	14	LC		Forests	Adult carrying food for young
75	Crag martin	*Ptyonoprogne rupestris*	13	LC		Inland cliffs	Adult entering/leaving nest site
76	Alpine cough	*Pyrrhocorax graculus*	1	LC		Inland cliffs	Species in possible nesting habitat

No	Common name	Scientific name	Breeding codes	IUCN Threat Status	Red book Albania	Habitat	Notes
77	Sand martin	*Riparia riparia*	1	LC		Wetlands	Species in possible nesting habitat
78	Stonechat	*Saxicola rubicola*	14	LC		Maquis	Adult carrying food for young
79	Rock nuthatch	*Sitta neumayer*	13	LC		Inland cliffs	Adult entering/leaving nest site
80	Little tern	*Sternulla albifrons*	3	LC		Wetlands	Pair in suitable habitat
81	Collared dove	*Streptopelia decaocto*	15	LC		Urban areas	Nest with eggs
82	Turtle dove	*Streptopelia turtur*	6	Vulnerable		Forests	Adult visiting probable nest site
83	Tawny owl	*Strix aluco*	1	LC	LRnt	Forests	Species in possible nesting habitat
84	Starling	*Sturnus vulgaris*	13	LC		Urban areas	Adult entering/leaving nest site
85	Blackcap	*Sylvia atricapilla*	14	LC		Forests	Adult carrying food for young
86	Subalpine warbler	*Sylvia cantillans*	14	LC		Maquis	Adult carrying food for young
87	Common whitethroat	*Sylvia communis*	7	LC		Maquis	Agitated behaviour
88	Eastern Orphean warbler	*Sylvia crassirostris*	2	LC		Maquis	Singing male
89	Lesser whitethroat	*Sylvia curruca*	2	LC		Maquis	Singing male
90	Sardinian warbler	*Sylvia melanocephala*	14	LC		Maquis	Adult carrying food for young
91	Little grebe	*Tachybaptus ruficollis*	12	LC		Wetlands	Recently fledged young
92	Alpine swift	*Tachymarptis melba*	7	LC		Inland cliffs	Agitated behaviour
93	Redshank	*Tringa totanus*	2	LC		Wetlands	Singing male
94	Black bird	*Turdus merula*	14	LC		Maquis	Adult carrying food for young
95	Hoopoe	*Upupa epops*	14	LC	VU	Forests	Adult carrying food for young
	Total	95 species					

Breeding categories and codes

0. Non breeding (species observed but suspected to be still on migration or to be summering non-breeder)

A. Possible breeding

1 Species observed in breeding season in possible nesting habitat

2 Singing male(s) present (or breeding calls heard) in breeding season

B. Probable breeding

3 Pair observed in suitable nesting habitat in breeding season

4 Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two different days a week or more apart at same place

5 Courtship and display

6 Visiting probable nest-site

7 Agitated behaviour or anxiety calls from adults

8 Brood patch on adult examined in the hand

9 Nest-building or excavating of nest-hole

C. Confirmed breeding

10 Distraction-display or injury-feigning

11 Used nest or eggshells found (occupied or laid within period of survey)

12 Recently fledged young (nidicolous species) or downy young (nidifugous species)

13 Adults entering or leaving nest-site in circumstances indicating occupied nest (including high nests or nest holes, the contents of which cannot be seen) or adult seen incubating

14 Adult carrying a faecal sac or food for young

15 Nests containing eggs

16 Nests with young seen or heard

APPENDIX 6
WALKOVER FIELD SURVEY RESULTS

Table A6.1 Walkover Field Survey Results Undertaken Between 10th and 14th November 2018

Key: EN = Endangered, VU = Vulnerable; LC = Least Concern, N/A = not applicable, LR/nt = Low Risk Near Threatened, NL = not listed

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
Common raven	*Corvus corax*	LC	NL	vocalization	1 individual	N/A	Coniferous forest: pine plantation. Pomegranate present along the margins of track and cleared areas of pine plantation	Grazing, tree felling	41.820393	19.571359	157.7	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Coniferous forest: pine plantation. Pomegranate present along the margins of track and cleared areas of pine plantation	Tree felling	41.819796	19.569394	149.5	Habitat with potential to support wild boar, jackal, badger and perhaps roe deer
Eurasian badger	*Meles meles*	LC	EN	Faeces	1	Old	Maquis, arborescent matorral and	Grazing by cattle	41.823975	19.564974	177	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
							thermo-Mediterranean scrub					
Marten (probably a beech marten, also called stone marten)	Martes sp. Probably *Martes foina*	LC		Faeces (scat)	1	recent (approximately 1 week old)	Maquis, arborescent matorral and thermo-Mediterranean scrub		41.826155	19.562785	195.4	
Mantis sp	Uncertain, possibly *Iris oratoria*			Sighting	2 individuals	N/A	Regenerating agro-pastoral land		41.829591	19.558743	246.6	
Common raven	*Corvus corax*	LC	NL	Sighting	2 individuals	N/A	Maquis, arborescent matorral and thermo-Mediterranean scrub		41.829593	19.558759	244.4	2 individuals observed in flight, approximately 50m north from surveyors
Greylag goose	*Anser anser*	LC	NL	Sighting	8 individuals	N/A	Agro-pastoral land		41.829616	19.558749	240.7	8 individuals observed in flight, over 50m south of surveyors
Garden warbler	*Sylvia borin*	LC	LC	Sighting	2 individuals	N/A	Abandoned settlement and agro-pastoral land		41.830171	19.556792	260.4	1 individual observed perching in a tree

Common Name	**Scientific Name**	**IUCN (2018)**	**Nat. Red List**	**Observation Type**	**Number of Observations**	**Observation Age**	**Surrounding Habitat**	**Evidence of Threats**	**Latitude**	**Longitude**	**Altitude (m asl)**	**Field Notes**
Dung beetles	Unknown	N/A	N/A	Sighting	3 individuals	N/A	Transitionary scrubland - regenerating agro-pastoral land		41.830575	19.556078	259.3	
Yellowhammer	*Emberiza citrinella*	LC	NL	Sighting	5 individuals	N/A	Mediterranean evergreen *Quercus* forest		41.832702	19.552851	280.4	Observed perching in a tree before taking flight
Red fox	*Vulpes vulpes*	LC	NL	Prints	3	recent	Scrubland		41.83459	19.549976	296.5	
Viper sp	*Vipera sp.*	N/A		Sighting	1 individual	N/A	Regenerating agro-pastoral land / scrubland	Grazing	41.834927	19.548801	298.2	Individual observed basking
Eurasian jay	*Garrulus glandarius*	LC	NL	Vocalisation	1 individual	N/A	Regenerating agro-pastoral land / scrubland	Grazing	41.835448	19.547038	306.7	
Nose-horned viper	*Vipera ammodytes*	LC	LR/nt	Sighting	1 individual	N/A	Regenerating agro-pastoral land / thicket	Grazing	41.835466	19.546642	304.8	Individual observed basking
Carrion crow	*Corvus corone*	LC	NL	Vocalisation	1 individual	N/A	Mediterranean evergreen Quercus forest	N/A	41.835549	19.546171	310.2	
Common Kestrel	*Falco tinnunculus*	LC	VU	Sighting	1 individual	N/A	Edge of hill range over		41.835661	19.542144	332.1	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
							exposed rocks and scrub					
Unknown	Unknown	N/A	N/A	Large animal heard dislodging rocks whilst dispersing from the area. The animal was not sighted.	1 individual		Mediterranean evergreen Quercus forest		41.83658	19.540051	281	
Marten (probably a beech marten, also called stone marten)	Martes sp. Probably *Martes foina*			Scat		Recent	Mediterranean evergreen Quercus forest		41.836778	19.539724	307.7	
Common raven	*Corvus corax*	LC	NL	Sighting	2 individuals	N/A	Mediterranean evergreen Quercus forest		41.836778	19.539724	307.7	Breeding habitat for common raven. 2 individuals observed perching on a rock near cliff edge.
Wild boar	*Sus scrofa*	LC	LR/nt	Evidence of foraging activity	1 individual	Recent	Mediterranean evergreen Quercus forest		41.836922	19.539771	272.1	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
Red fox	*Vulpes vulpes*	LC	NL	Scat	1	old	Mediterranean evergreen Quercus forest		41.837044	19.53976	262.5	
lizard sp	Uncertain	N/A	N/A	Sighting	1 individual	N/A	Mediterranean evergreen Quercus forest		41.839089	19.537126	206	
lizard sp	Uncertain	N/A	N/A	Sighting	1 individual	N/A	Mediterranean evergreen Quercus forest		41.839683	19.536253	196.1	Lizard very dark brown-black in colour
Great tit	*Parus major*	LC	NL	Sighting	1 individual	N/A	Mediterranean evergreen Quercus forest		41.839715	19.536231	196.3	Individual observed perching in a tree
Red fox	*Vulpes vulpes*	LC	NL	Den	1	Appears to be in use	Mediterranean evergreen Quercus forest		41.840182	19.535909	228.6	
Bee hive	Uncertain	N/A	N/A	Sighting	1 hive	Active	Mediterranean evergreen Quercus forest		41.840361	19.535561	243.2	Natural beehive in a hole in exposed rock
lizard sp	Uncertain - to be confirmed	N/A	N/A	sighting	1 individual	N/A	Regenerating agropastoral land		41.834728	19.546886	297.6	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
Mantis sp	Uncertain, possibly *Iris oratoria*	N/A	N/A	Sighting	2 individuals	N/A	Regenerating agro-pastoral land / scrub		41.83482	19.547785	303.6	
Smooth snake	*Coronella austriaca*	LC	LR/nt	Sighting	1 individual	N/A	Coastal dune	Grazing and habitat loss	41.846013	19.518921	38	Individual observed basking
Wild boar	*Sus scrofa*	LC	LR/nt	Prints	Possibly several individuals	Many	Coastal dune	Grazing and habitat loss	41.846351	19.51912	44.2	
Grey wolf	*Canis lupus*	LC	LR/nt	Local knowledge report of the presence of grey wolves	Unknown		Within agropastoral land and surrounding habitat types		41.846373	19.519682	55.3	Interviewed a shepherd who stated that he has seen and heard grey wolves. He also mentioned wolf attacks on his livestock.
Golden jackal	*Canis aureus*	LC	VU	Local knowledge report of the presence of jackals	Many		Within the hill range and surrounding habitats		41.846262	19.519803	51.2	Interviewed a shepherd who confirmed presence of golden jackals
Great tit	*Parus major*	LC	NL	Sighting	1 individual		Sparse Mediterranean		41.846056	19.522015	94.2	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
							evergreen Quercus forest					
Grey wolf	*Canis lupus*	LC	LR/nt	Local knowledge report	Uncertain		Within the hill range and surrounding habitats		41.84859	19.519708	144.1	Local resident and plant collector stated that grey wolves are present in the area.
Carrion crow	*Corvus corone*	LC	LC	Sighting	1 individual	N/A	Sparse Mediterranean evergreen Quercus forest with exposed areas of scree		41.8501	19.517567	125.9	
Golden jackal	*Canis aureus*	LC	VU	Local knowledge report	Many		Golden jackals use habitats near the housing and beach		41.851958	19.515304	94.9	Report from a plant collector.
Grey wolf	*Canis lupus*	LC	LR/nt	Local knowledge report	Uncertain		Grey wolves occur in habitats within the hill range and surrounding landscapes		41.851958	19.515304	94.9	Report from a plant collector.

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
Red fox	*Vulpes vulpes*	LC	NL	Prints	5	New	Coastal dune	Grazing, erosion, disturbance associated with people	41.854421	19.505571	62.8	
Snake sp	Unknown	N/A	N/A	Prints	1 trail	New	Coastal dune in close proximity to dune wetland	Grazing, erosion, disturbance associated with people	41.854385	19.501105	37.4	
Red fox	*Vulpes vulpes*	LC	NL	Prints	11	New	Coastal dune in close proximity to dune wetland	Grazing, erosion, disturbance associated with people	41.854371	19.501115	37.4	
Frog sp	Unknown	N/A	N/A	Sighting - desiccated remains	1 individual	Old	Coastal dune near dune wetland	Grazing, erosion, disturbance associated with people	41.854831	19.496908	39.3	
Snake sp	Unknown	N/A	N/A	Prints	1 trail	New	Coastal dune	Grazing, erosion, disturbance associated with people	41.856473	19.495076	40.9	
European hare	*Lepus europaeus*	LC	NL	Prints	Many	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.841578	19.522365	38.7	

Common Name	**Scientific Name**	**IUCN (2018)**	**Nat. Red List**	**Observation Type**	**Number of Observations**	**Observation Age**	**Surrounding Habitat**	**Evidence of Threats**	**Latitude**	**Longitude**	**Altitude (m asl)**	**Field Notes**
Red fox	*Vulpes vulpes*	LC	NL	Prints	8	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.841292	19.520631	32	
Red fox	*Vulpes vulpes*	LC	NL	Prints	A trail	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.841656	19.519398	35.3	
Golden jackal	*Canis aureus*	LC	VU	Prints	Many and scattered	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.841961	19.51841	36	Prints indicate the presence of a family group
Golden jackal	*Canis aureus*	LC	VU	Prints	Many and scattered	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.84244	19.517471	36.2	Prints indicate the presence of a family group
Golden jackal	*Canis aureus*	LC	VU	prints	3 trails	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.842131	19.517757	35.6	Prints indicate at least 3 individuals have been active
Golden jackal	*Canis aureus*	LC	VU	prints	Many and scattered	New	Sand beach above the driftline	Disturbance associated with people	41.841973	19.517823	34	

Common Name	Scientific Name	IUCN (2018)	Nat. Red List	Observation Type	Number of Observations	Observation Age	Surrounding Habitat	Evidence of Threats	Latitude	Longitude	Altitude (m asl)	Field Notes
								and vehicle movement				
Golden jackal	*Canis aureus*	LC	VU	prints trails	4 trails	New	Sand beach above the driftline	Disturbance associated with people and vehicle movement	41.841743	19.517429	36.2	Prints indicate at the presence of 4 individuals
Red fox	*Vulpes vulpes*	LC	NL	Den	1	In use	Mediterranean evergreen Quercus forest		41.846025	19.526573	178.3	
Wild boar	*Sus scrofa*	LC	LR/nt	Foraging scrapes and stripping of the bark from the oak trees	3 separate areas	Recent	Mediterranean evergreen Quercus forest		41.844406	19.5277	196.3	
Wild boar	*Sus scrofa*	LC	LR/nt	Foraging scrapes and stripping of the bark from the oak trees	1 area	Recent	Mediterranean evergreen Quercus forest		41.844231	19.528032	195.9	
Carrion crow	*Corvus corone*	LC	LC	Sighting	1 individual	N/A	Mediterranean evergreen Quercus forest with exposed		41.840896	19.533763	237.1	Individual in flight

Common Name	**Scientific Name**	**IUCN (2018)**	**Nat. Red List**	**Observation Type**	**Number of Observations**	**Observation Age**	**Surrounding Habitat**	**Evidence of Threats**	**Latitude**	**Longitude**	**Altitude (m asl)**	**Field Notes**
							areas of scree and rocks					
Red fox	*Vulpes vulpes*	LC	NL	Den	1	Appears to be in use	Mediterranean evergreen Quercus forest		41.84027	19.534866	225.1	
Red fox	*Vulpes vulpes*	LC	NL	Prints	1 trail	New	Coastal dune	Disturbance associated with people and vehicle movement	41.837354	19.533289	47.9	

Figure A6-1 Field survey observations

APPENDIX 7

CANDIDATE PRIORITY BIODIVERSITY FEATURES AND CRITICAL HABITAT QUALIFYING FEATURES

Taxon Type	Species Scientific Name	Species Common Name	IUCN (2018) Status	National Red Book Status of Albania	Endemic Status	Migratory / Congregatory Status	Status under CITES	Status under Habitats Directive / Birds Directive	Other	EDGE Species	Habitat Of Occurrence
Plant	*Quercus robur* spp. *Scutariensis*	Skadar oak	Not evaluated	Not evaluated	Endemic to the Balkan peninsula	N/A	Not listed	Not listed		No	Forests
Plant	*Marsilea quadrifolia*	European waterclover	Least Concern	Endangered	Not endemic	N/A	Not listed	Not listed		No	Freshwater (=Inland waters); Wetlands (inland), Artificial/ Aquatic & Marine; It grows in still waters such as ponds, rice fields and ditches.
Plant	*Hydrocotile vulgaris*	Marsh pennywort	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Freshwater (=Inland waters); Wetlands (inland); H. vulgaris grows in carr, mires, fens, fen-meadows, swamps, marshes, in soakways and along spring-lines, and in dune-slacks and wet hollows in stabilised shingle, occasionally in deeper water. It is often, but not always, associated with peaty soils.
Plant	*Hidrocharis morsus-ranae*	European frogbit	Least Concern	Endangered	Not endemic	N/A	Not listed	Not listed		No	Freshwater (=Inland waters); Wetlands (inland), Artificial/ Aquatic & Marine; typically occurs in shallow, calcareous, mesotrophic or meso-eutrophic water in the sheltered bays of lakes or in ponds, canals and ditches.
Plant	*Anacamptis laxiflora*	Lax-flowered orchid	Not evaluated	Endangered	Not endemic	N/A	All orchids are included under Annex B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Not listed		No	
Plant	*Anacamptis palustris*		Least Concern	Endangered	Not endemic	N/A	All orchids are included under Annex B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	All orchids are included under Annex B of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)		No	Wetlands (inland); It is a perennial herbaceous plant (tuberous Geophyte) that inhabits humid pastures, wet meadows and swamps. It prefers calcareous soils and it needs a lot of light. Flowering occurs during spring.
Plant	*Pancratium maritimum L.*	Sea daffodil	Not evaluated	Endangered	Not endemic	N/A	Not listed	Not listed		No	

Plant	*Lycium europeum L.*		Not evaluated	Critically Endangered	Not endemic	N/A	Not listed	Not listed		No	
Plant	*Desmazeria marina (L.) Drude*		Not evaluated	Endangered	Not endemic	N/A	Not listed	Not listed		No	
Plant	*Ephedra distachya L.*	Sea grape	Least Concern	Endangered	Not endemic	N/A	Not listed	Not listed		No	Shrubland, Rocky areas (eg. inland cliffs, mountain peaks), Grassland, Desert, Marine Coastal/Supratidal; A dwarf shrub, found growing in a wide range of arid habitats including steppe communities, sandy areas (dunes or seaside), rocky ledges, gravelly plains, slopes. Tolerates areas where other plants are virtually non-existent
Plant	*Olea oleaster L.*		Not evaluated	Endangered	Not endemic	N/A	Not listed	Not listed		No	
Plant	*Laurus nobilis L.*	Bay Laurel	Least Concern	Endangered	Not endemic	N/A	Not listed	Not listed		No	Marine Coastal/Supratidal, Forest, Wetlands (inland), Shrubland; This plant is a dioecious evergreen large shrub or small tree found in a variety of lowland habitats such as woodland, scrub, sea cliffs, dunes, roadsides and river banks; It is always found in regions of warm climate and high rainfall and more frequently in humid microclimates such as canyons and valleys.
Plant	*Querqus robur (L.) subsp. scutariensis*		Not evaluated	Not evaluated	Endemic	N/A	Not listed	Not listed		No	
Plant	*Butomus umbellatus*	Flowering-rush	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; can grow as a terrestrial species on wet mud, emergent in shallow water or more or less permanently submerged in deep or fast-flowing water. It is most often found on nutrient-rich, calcareous clay substrates and will occur in a variety of water bodies such as rivers, lakes, streams, ditches (particularly those which serve as "wet fences") and canals.
Plant	*Cladium mariscus*	Great Fen-Sedge	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland); This species forms dense, extensive stands resembling and sometimes grading into beds of Phragmites australis. It occurs most often in strongly calcareous habitats such as fens but will also occur in acid habitats: it may be the case that it is more intolerant of nutrients than pH.
Plant	*Nuphar lutea*	Yellow Water-lily	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; N. lutea typically occurs in slow-flowing or standing, mesotrophic or eutrophic water bodies such as ponds, lakes, rivers and canals. It will also occur in oligotrophic conditions.
Plant	*Nymphaea alba*	European White Waterlily	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; occurs mostly in standing fresh water wetlands and lakes, ponds and canals.
Plant	*Nymphoides peltata O. Künze*	No common name	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; typically occurs in naturally eutrophic, calcareous, slow-flowing rivers and large ditches.
Plant	*Sagittaria sagittifolia L.*	Arrowhead	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; It grows in deep, mesotrophic to eutrophic, slow flowing or standing rivers, canals or ditches.
Plant	*Trapa natans L.*	Water Caltrop	Least Concern	Endangered	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; This plant is an annual floating-leaved plant that grows in stagnant waters, lakes, channels with weak currents, ponds and swamps. It primarily occurs in unpolluted nutrient-rich lowlands without too much

											calcium; it is important as a food source for birds and provides fish spawning habitat.
Plant	*Adiantum cappilus-veneris*		Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Rocky areas (eg. inland cliffs, mountain peaks), Wetlands (inland), Artificial/Aquatic & Marine, Artificial/Terrestrial, Forest; This species typically grows in shaded, permanently moist crevices on calcareous rock face (typically limestones) and cliffs, often beside streams or waterfalls or growing directly in seepages. In some areas, such as the Mediterranean, it will grow on non-calcareous rocks such as schists, sandstone grits and rhyolite.
Plant	*Baldellia ranunculoides*	Lesser Water-plantain	Near Threatened	Critically Endangered	Not endemic	N/A	Not listed	Not listed		No	Freshwater (=Inland waters); The species typically occurs along the margins of shallow meso-oligotrophic lakes, ponds, reservoirs and pools, on the shorelines of slow streams, in marshes, fens, brackish dune slacks and bog pools. It can also be found in more anthropogenic or disturbed habitats such as ditches, canals, flooded quarries, man-made dune wetlands, abandoned peat-drains and cuttings, fish ponds, and temporary flooded fields.
Plant	*Spirodela polyrhiza*	Greater Duckweed	Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; This species is found in fresh lentic waters in regions with warm summers. It occurs lakes, large dams, among reeds. The species occurs generally in mesotrophic to eutrophic lake and river waters
Plant	*Ulmus minor (synonym Ulmus campestris)*	Vulnerable	Data Deficient	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	
Plant	*Ulmus laevis*		Data Deficient	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Forest; The species is found within riparian deciduous forests, often in association with Ulmus minor and occasionally in oak mixed forests. Although the species prefers moist sites and can tolerate inundation it can also grow in moderately dry soils and steppe. The species can also tolerate the cold and acidic or calcareous soils
Plant	*Potamogeton gramineus*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Artificial/Aquatic & Marine, Wetlands (inland); will occur in most oligotrophic to mesotrophic water body types, from large lakes through ponds to temporary pools in fens and marshes as well as streams and even fairly large, fast-flowing rivers.
Plant	*Hippuris vulgaris*	No common name	Least Concern	Critically Endangered	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Aquatic & Marine; The species typically occurs in permanent rivers, ponds and lakes that are usually more than 1 m deep and have fairly deep beds of soft sediment rich in organic matter.
Plant	*Leucojum aestivum*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Grassland; It occurs in formations of Carex riparia, mostly characteristic of larger valleys and southern regions and is intolerant to dessication. It prefers wet meadows and marshy alder carrs of plains. L. aestivum grows on mineral or thin peaty substrates, often in areas almost permanently inundated by somewhat lime-rich water

Plant	*Groenlandia densa*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland); typically occurs in shallow, clear, base-rich water, including lakes and rivers, but more often streams, canals, ditches and ponds, particularly the headwaters of calcareous streams.
Plant	*Vallisneria spiralis*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Artificial/Aquatic & Marine, Wetlands (inland);typically occurs in mesotrophic to eutrophic slow-flowing or lentic lowland water bodies such as canals, ditches, rivers and occasionally lakes. It can be found in fresh or brackish water at depths of 0.2-3.5 m.
Plant	*Potamogeton nodosus Poiret*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland);will occur in most types of water body, from lake margins to ponds and even temporary pools, as well as streams and backwaters of larger rivers. It appears to tolerate nutrient enrichment and is most frequently found in mesotrophic to eutrophic calcareous waters. It will grow to a water depth of 2 metres.
Plant	*Rorippa amphibia*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland); typically occurs on the margins of mesotrophic to eutrophic water bodies, such as ponds, lakes and large lowland rivers.
Plant	*Persicaria amphibia*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland), Artificial/Terrestrial, Artificial/Aquatic & Marine; This species generally occurs in still or slow-flowing water, from which it will spread in a terrestrial form away from the water. It is most typical of mesotrophic to eutrophic water bodies, particularly lakes, canals and canalized lowland rivers.
Plant	*Lemna trisulca*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Wetlands (inland); will occur in most mesotrophic to eutrophic still or slow-flowing water bodies, and will also occur in backwaters in fast-flowing rivers. It is tolerant of shade and apparently also of hyper-eutrophication and will often occur where there are very few other aquatic plant species.
Plant	*Alnus glutinosa*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Forest; is species favours a moderate to cold climate and prefers damp or wet soils. It grows well in acidic soils and its growth is reduced under the alkaline or near-neutral conditions that are desirable for many other species. This species is commonly found in hilly regions, along the banks of streams and rivers, in damp marshy woods and riverside woodlands. It grows alongside spring-lines in oak woods and damp hollows or on wet slopes in high rainfall areas, away from the waterside. This species can also grow on poor quality soil due to nodules on the roots with nutrifying bacteria. The roots of this species can grow into open water as dense masses of hard, dark red cords which adds support to the banks.
Plant	*Salix pentandra*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Forest, Wetlands (inland); often found in bogs, wet meadows and flood plains
Plant	*Salix fragilis*	Crack willow	Not evaluated	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	
Plant	*Nymphoidetum peltata*		Least Concern	Vulnerable	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake; Wetlands (inland), Artificial/Aquatic & Marine; typically occurs in naturally eutrophic, calcareous, slow-flowing rivers and large ditches.
Plant	*Myriophyllo-Nupharetum lutei*		Not evaluated	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake
Plant	*Trapetum natantis*		Not evaluated	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake

Plant	*Leucojo-Fraxinetum angustifolia.*		Not evaluated	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake
Plant	*Potameto-Vallisnerietum*		Not evaluated	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake
Plant	*Phragmites australis*		Least Concern	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Shkodra Lake; Forest, Wetlands (inland), Artificial/Aquatic & Marine; will occur in most wetland habitats, from the margins of small ditches through river margins, ponds, lakes and reservoirs to vast expanses of reedmarsh, often in shallow water or growing out over deeper water. It can tolerate brackish conditions and variation in nutrient status from oligotrophic to highly eutrophic. It is capable of persisting for many years in sites which have ceased to be wetlands
Insect	*Cerambyx cerdo*	Great capricorn beetle	Vulnerable	Endangered	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	This species develops in fresh wood of broadleaf trees. In Central Europe, only trees of the genus Quercus (the oaks) are used, while in more southern parts of Europe it is also able to develop in Castanea (the chestnuts) and some other trees, including Ceratonia species. The Cerambyx longicorn inhabits large trees with sun-exposed stems, such as large, solitary oaks situated in fairly open landscape, or old pasture-woodlands
Fish	*Acipenser sturio*	Atlantic Sturgeon	Critically Endangered	Endangered	Not endemic	Migratory	listed on CITES Appendix II in 1975, and moved to Appendix I in 1983	CITES Appendix I		No	Marine Neritic, Wetlands (inland); Anadromous (spends at least part of its life in salt water and returns to rivers to breed).
Fish	*Acipenser naccarii*	Adriatic sturgeon	Critically Endangered	Endangered	Not endemic	Migratory	listed on CITES Appendix II in 1998.	listed in Annex 2 of the Council Directive 92/43/EEC. CITES Appendix II		No	Marine Neritic, Wetlands (inland); lives in large rivers where, in the past, reproduction occurred from May to July. It is a long-lived, anadromous species, living mainly in the rivers. It spawns in freshwater after a marine period of growth during which it remains near the shore (at the mouths of the rivers) at a depth of 10–40 m.
Fish	*Acipenser stellatus*	Stellate Sturgeon	Critically Endangered	Not evaluated	Not endemic	Migratory	listed on CITES Appendix II in 1997	CITES Appendix II		No	Marine Neritic, Wetlands (inland); anadromous species; found at sea, coastal and estuarine zones, where it forages on clayey sand bottoms, as well as intensively in middle and upper water layers. It spawns in strong-current habitats in the main course of large and deep rivers, on stone or gravel bottoms. It is also known to spawn on flooded river banks, on sand or sandy clay.
Fish	*Salmo marmoratus*	Marble trout	Least Concern	Endangered	Not endemic	Not migratory; Not congregatory	Not listed	Listed in the Annex II of the European Union Habitats Directive.		No	Wetlands (inland); The remaining population of Marble trout are found in headwaters of mountainous streams.
Fish	*Salmothymus obtusirostris*	No common name	Endangered	Vulnerable	Not endemic	N/A	Not listed	EU Habitats Directive Annex II animal and plant species of community interest whose conservation		No	Wetlands (inland); It lives in rivers of the karstic region

								requires the designation of special areas of conservation.			
Fish	*Chondrostoma scodrensis*		Extinct	Not evaluated	Not endemic	N/A	Not listed	Not listed		No	Formerly restricted to the Lake Skadar basin in Albania and Montenegro.
Fish	*Lampetra fluviatilis*	River Lamprey	Least Concern	Endangered	Not endemic	Migratory	Not listed	Not listed		No	Wetlands (inland), Marine Neritic; Adults live in coastal waters and estuaries and spawn in strong-current habitats of rivers and streams.
Fish	*Lampetra planeri*	Brook Lamprey	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	Wetlands (inland); Found in the lowland, piedmont and montane zone in clear, well oxygenated brooks. Ammocoetes live in detritus-rich sands or clay sediments.
Fish	*Alburnoides bipunctatus ohridanus*		Data Deficient	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	lakes, rivers and reservoirs
Fish	*Alburnus alburnus*		Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	Open waters of large lakes and medium to large rivers.
Fish	*Alosa fallax*	Twaite Shad	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex V		No	At sea, pelagic. Juveniles remain close to shore and estuaries. Migrates from sea to rivers, spawns in main river often only few kilometres above limit of brackish water. Spawning also reported from small rivers over gravel bottom.
Fish	*Anguilla anguilla*	European Eel	Critically Endangered	Not Evaluated	Not endemic	Migratory and congregatory	Not listed	CITES Annex II		No	found in a range of habitats from small streams to large rivers and lakes, and in estuaries, lagoons and coastal waters.
Fish	*Aristichtys nobili*		Data Deficient	Invasive	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	
Fish	*Chondrostoma nasus*	Nase	Least Concern	Low riskcd	Not endemic	migratory	Not listed	Bern Convention Annex 3		No	Moderate to fast-flowing large to medium sized rivers with rock or gravel bottom. Spawns in fast-flowing water on shallow gravel beds often in small tributaries
Fish	*Ctenopharyngodon idellus*		Low risk	Not Evaluated	Invasive	Not migratory; Not congregatory	Not listed	Not listed		No	
Fish	*Cyprinus carpio*	No common name	Vulnerable	Not Evaluated	Invasive	Migratory	Not listed	Not listed		No	Warm, deep, slow-flowing and still waters, such as lowland rivers and large, well vegetated lakes. Introduced in all types of water bodies
Fish	*Dicenthrarchus labrax*		Least Concern	Not Evaluated	Not endemic	Migratory	Not listed	Not listed		No	Coastal waters and estuaries.
Fish	*Gobio gobio*		Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	Nearly all types of riverine and lacustrine habitats with sand bottom.
Fish	*Gobitis taenia* spp *ohridana*		Not evaluated	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	
Fish	*Hypophthalmichthys molitrix*		Near Threatened	Not Evaluated	Invasive	Migratory	Not listed	Not listed		No	
Fish	*Mugil cephalus*	Flathead Mullet	Least Concern	Not Evaluated	Not endemic	Migratory	Not listed	Not listed		No	euryhaline, pelagic nearshore species
Fish	*Salaria fluviatilis*		Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	mainly a riverine species that can be found also in lakes. It likes rubble and gravel substrate with moderate to high current velocity

Fish	*Salmo Dentex*		Data Deficient	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	The species occurs in lakes and large rivers. It spawns on gravel bottom
Fish	*Pachychilon pictum*	Albanian Roach	Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Annex 3 of Bern Convention		No	Wetlands (inland); It is a small cyprinid living in rivers as well as in lakes.
Fish	*Petromyzon Marinus*		Least Concern	Vulnerable	Not endemic	Migratory	Not listed	Annex II		No	Adults migrate from the ocean or lake to spawning streams.
Fish	*Rhodeus amarus*		Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Annex II		No	Most abundant in still or slow-flowing water with dense aquatic vegetation and sand-silt bottom as lowland ponds, canals, slow-flowing rivers, backwaters and oxbows, where mussels are present.
Fish	*Leucos basak* (synonym *Rutilus basak*)		Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	lakes and rivers.
Fish	*Salmo trutta lacustris*		Least Concern	Vulnerable	Not endemic	Migratory	Not listed	Not listed		No	
Mammal	*Sciurus vulgaris*	Red Squirrel	Least Concern	Lower Risk/Near Threatened	Not endemic	Not migratory; Not congregatory	Not listed	Not listed	listed in appendix III of Bern Convention	No	Forest, Artificial/Terrestrial; It is most abundant in large tracts of coniferous forest and also occurs in deciduous woods, mixed forest, parks, gardens, and small stands of conifers. It is found in lowland to subalpine forests.
Mammal	*Glis glis*	Edible Doormouse	Least Concern	Lower Risk/Least Concern	Not endemic	Not migratory; Not congregatory	Not listed	Not listed	listed in appendix III of Bern Convention	No	Shrubland, Forest, Artificial/Terrestrial; typically found in mature deciduous and mixed woodland, where it frequents the canopy, although it also occurs in maquis and shrubland on rocky areas along the Mediterranean coast.
Mammal	*Rhinolophus ferrumequinum*	Greater Horseshoe Bat	Least Concern	Lower Risk/Conservation Dependent	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex IV	CMS Appendix II	No	Artificial/Terrestrial, Caves and Subterranean Habitats (non-aquatic), Grassland, Forest, Shrubland
Mammal	*Rhinolophus euryale*	Meditteranean Horseshoe Bat	Near Threatened	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex IV	CMS Appendix II	No	Caves and Subterranean Habitats (non-aquatic), Artificial/Terrestrial, Forest, Shrubland
Mammal	*Rhinolophus blasii*	Blasius's horseshoe bat	Least Concern	Lower Risk/Near Threatened	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex IV	CMS Appendix II	No	Forest, Savanna, Shrubland, Caves and Subterranean Habitats (non-aquatic), Desert
Mammal	*Myotis myotis*	Greater mouse-eared bat	Least Concern	Not Evaluated	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex IV	CMS Appendix II	No	Caves and Subterranean Habitats (non-aquatic), Forest, Shrubland, Artificial/Terrestrial
Mammal	*Lutra lutra*	Eurasian Otter	Near Threatened	Vulnerable	Not endemic	Not migratory; Not congregatory	Listed in Appendix I	Annex II and Annex IV	listed in appendix III of Bern Convention	No	Lives in a wide variety of aquatic habitats, including highland and lowland lakes, rivers, streams, marshes, swamp forests and coastal areas
Mammal	*Canis aureus*	Golden Jackal	Least Concern	Vulnerable	Not endemic	Not migratory; Not congregatory	Appendix III (India)	Annex V		No	Due to their tolerance of dry habitats and their omnivorous diet, the Golden Jackal can live in a wide variety of habitats. These range from the Sahel Desert to the evergreen forests of Myanmar and Thailand.
Mammal	*Ursus arctos*	Brown bear	Least Concern	Vulnerable	Not endemic	Not migratory; Not congregatory	Appendix III (India)	Annex II and Annex IV		No	Brown Bears occupy a great variety of habitats from dry Asian steppes to Arctic shrublands to temperate rain forests.
Mammal	*Sus scrofa*	Wild boar	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	It is found in a variety of habitats. In Europe, it prefers broadleaved forests and especially evergreen oak forests, but may also be found in more open habitats such as steppe, Mediterranean shrubland, and farmland, so long as there is water and tree cover nearby

Mammal	*Talpa stankovici subsp. montenegrina*	Balkan Mole	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	It occurs in a variety of open habitats including sandy beaches, pastures and arable land
Mammal	*Canis lupus*	Grey Wolf	Least Concern	LRnt	Not endemic	Not migratory; Not congregatory	CITES Appendix II except populations from Bhutan, India, Nepal and Pakistan, which are listed on Appendix I.	Habitats Directive (Annex II and IV),	Bern Convention (Appendix II)	No	Forest, Desert, Rocky areas (eg. inland cliffs, mountain peaks), Artificial/Terrestrial, Shrubland, Grassland, Wetlands (inland)
Mammal	*Myotis capaccinii*	Long fingered Bat	Vulnerable	Lower Risk/Conservation Dependent	Not endemic	Migratory and congregatory	Not listed	Annex II and Annex IV	CMS Appendix II	No	Wetlands (inland), Caves and Subterranean Habitats (non-aquatic), Shrubland; The Long-fingered Bat (Myotis capaccinii) depends strictly on aquatic habitats. It forages over wetlands and waterways (including artifical waterbodies, such as canals and reservoirs), also scrub
Amphibian	*Hyla arborea*	European Tree Frog	Near Threatened	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Appendix II of Bern Convention, Annex IV of Habitats Directive		No	Wetlands (inland), Artificial/Aquatic & Marine, Artificial/Terrestrial, Shrubland, Introduced vegetation, Grassland, Forest
Reptile	*Caretta caretta*	Loggerhead Sea Turtle	Vulnerable	Endangered	Not endemic	Migratory	Not listed	Annex II and Annex IV. CITES Appendix II		No	Marine, Nesting on sandy beaches
Reptile	*Emys orbicularis*	European Pond Turtle	Near Threatened	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex II of the EU Habitats Directive 92/43/EEC		No	Semi-aquatic - ponds, lakes, brooks, streams, rivers, drainage canals.
Reptile	*Testudo hermanni*	Hermann's Tortoise	Near Threatened	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	open patchy evergreen Mediterranean oak forest, but in its absence inhabits maquis, garigue, dune scrub and maritime grassland, as well as agricultural and railway edge
Reptile	*Testudo marginata*	Marginated Tortoise	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	Phrygana' and Macchia scrub, dense thorny scrub among rocky outcrops, but also a range of other vegetation types, from coastal dunes to olive groves, small-scale agricultural landscapes and damp areas.
Reptile	*Anguis fragilis / Anguis cephallonica*	Peloponnese Slow Worn	Near Threatened	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	
Reptile	*Pseudopus apodus*	European Glass Lizard	Not evaluated	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	pen country, such as short grassland or sparsely wooded hills
Reptile	*Mediodactylus kotschyi*	Kotschy's Gecko	Least Concern	Not listed	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	Artificial/Terrestrial, Shrubland, Rocky areas (eg. inland cliffs, mountain peaks)
Reptile	*Hemidactylus turcicus*	Meditteranean house gecko	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	It is extremely adaptable species. It is found in shrubland, rocky areas, salt marshes, coastal areas, cliffs, caves, on stone walls in agricultural areas and it is common in urban environments, including inside buildings.

Reptile	*Algyroides nigropunctatus*	Blue-throated Keeled Lizard	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	open woodlands, scrubland, hedges, bushes, on walls and in olive groves. In river valleys it can be found close to water on rocks and cliffs and urban areas.
Reptile	*Lacerta agilis*	Sand lizard	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	meadows, heathland, coastal dunes, grassland, steppe, subalpine and alpine meadows, shrubland, hedgerows, open woodland
Reptile	*Lacerta trilineala*	Balkan Green Lizard	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	bushy areas, sand dunes, boundary walls, orchards, and abandoned cultivated land. It can also be found close to streams and ditches
Reptile	*Lacerta viridis*	European Green Lizard	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	bushy vegetation at woodland and field edges, within open woodlands, forested areas and shrubland, hedgerows, and in overgrown areas and cultivated land including orchards
Reptile	*Podarcis melisellensis*	Dalmation wall lizard	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	dry open woodland, scrub, pastures and overgrown areas. It can be found on cliffs, rocks and stone walls
Reptile	*Podarcis muralis*	Common wall lizard	Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	ocky and scree areas, scrubland, deciduous and coniferous woodland, orchards, vineyards, fields, stone walls, and on buildings. It is often found in human settlements including large cities and villages and railway lines
Reptile	*Podarcis tauricus*	Balkan wall lizard	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	open areas of steppe, grassland, meadows, field edges, olive groves, traditionally cultivated land, rural gardens, sparsely vegetated sandy dunes and sometimes in open scrub.
Reptile	*Ablepharus kitaibelii*	European copper skink	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	dry areas including south facing slopes, meadows, scrubland and clearings in woodland (both deciduous and pine).
Reptile	*Eryx jaculus*	Javelin sand boa	Not evaluated	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	open dry steppes and semi-deserts. It appears to prefer clay and stony soils, and is more rarely it is encountered on stabilized sands and in vineyards and gardens
Reptile	*Dolichophis caspius / Coluber caspius*	Caspian whipsnake	Least Concern	Low risklc	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	dry areas of open scrubland (macchia) and woodland, steppe and other grassland, rocky hillsides, semi-desert, overgrown areas, vineyards, olive groves, rural gardens, stone walls and ruins.
Reptile	*Hierophis gemonensis / Coluber gemonensis*	Balkan whipsnake	Least Concern	Critically Endangered	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	dry, stony areas, scrubland, macchia, open woodland, vineyards, olive groves, generally overgrown areas, rural gardens and ruins
Reptile	*Coluber najadum / Platyceps najadum*	Dahl's whipsnake	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	stony semi-desert and wermuth steppe, among rocky outcrops and stones. Populations are found at the slopes of foothills and mountain covered with bush vegetation and woods, in thickets of xerophilous bushes, in juniper open woodlands, oak groves, border of forests. It has been recorded from open woodland, garrigue, overgrown areas, gullies, vineyards, gardens, stone walls and old buildings.
Reptile	*Coronella austriaca*	Smooth snake	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	moorland, rocky coastlines, open woodland (deciduous, coniferous and mixed) and scrubland, hedgerows, woodland edges, heathland, sandy coastal sites, rocky areas, screes, subalpine and open areas with sparse vegetation
Reptile	*Zamenis longissimus*	Aesculapian snake	Least Concern	Not listed	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	dry, open woodlands (deciduous, mixed and coniferous), woodland edges, forested ravines, scrubland and thickets, rocky outcrops, road embankments, moist meadows, field edges,

											traditionally cultivated land, tea plantations, stone walls and old buildings, parks and gardens
Reptile	*Elaphe quatuorlineata*	Fourlined snake	Near Threatened	Critically Endangered	Not endemic (med only)	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	hedgerows, close to woodland edges, in open woodland, rocky overgrown areas and traditionally cultivated land
Reptile	*Zamenis situla / Elaphe situla*	European ratsnake	Least Concern	Critically Endangered	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	scrubland, macchia, karst habitats, field edges, marshes, stream edges, vineyards, olive groves, on stone walls, and in rural gardens and buildings.
Reptile	*Natrix natrix*	Grass snake	Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	found in humid as well as dry areas with abundant vegetation. It can mostly be found close to water bodies, and is present in woodland (both deciduous and mixed), meadows, hedgerows, coastal areas, and suburban areas (especially gardens)
Reptile	*Natrix tessellata*	Dice snake	Least Concern	Not Evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	largely aquatic species associated with rivers, coasts, streams, lakes, ponds and the surrounding terrestrial habitat. It occurs in coastal areas
Reptile	*Telescopus fallax*	European cat snake	Least Concern	Low risklc	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	found amongst rocks in shrubby landscapes. It can also be found in open or degraded woodland, among old walls and ruins, on sandy beaches with plant cover
Reptile	*Xerotyphlops vermicularis*	European blind snake	Least Concern	Critically Endangered	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	associated with moist, sparsely vegetated, open areas. It is often found in grassy fields and slopes
Reptile	*Vipera ammodytes*	Nose-horned viper	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	associated with rocky areas but can be opportunistic in other habitats. It can be found in dry, often rocky habitats, including open woodland and scrub, sand dunes, hillsides, screes, stone walls, traditionally cultivated land, gardens and vineyards.
Reptile	*Vipera berus*	European adder	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	habitats including open heathland, woodland, moors, lake sides, alpine rocky slopes, and saline and sandy semi-deserts
Reptile	*Vipera ursinii*	Meadow viper	Vulnerable	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	primarily associated with open meadows and hillsides. Upland subspecies are generally found on well drained rocky hillsides, steppe and meadows, while the lowland forms are found in either steppe, or dry or damp meadows
Amphibian	*Salamandra atra*	Alpine salamander	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	found in cool, damp alpine meadows, stony pastures, dwarf heath and mixed, broadleaf and coniferous woodland
Amphibian	*Salamandra salamandra*	Fire salamander	Least Concern	Data Deficient	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	associated with wet cool deciduous, mixed, or rarely, coniferous forests with well shaded brooks and small rivers. Within the mountain forest belt, the species can be found in woodlands
Amphibian	*Triturus alpestris*	Alpine Newt	Least Concern	Data Deficient	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	aquatic species generally found close to water. It is widespread in both alpine and lowland habitats including wet, shaded coniferous, mixed and deciduous forests, sub alpine meadows and pastureland.
Amphibian	*Lissotriton vulgaris*	Smooth Newt	Least Concern	Low risklc	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	generally associated with woodland habitats, including deciduous, coniferous, mixed forests and dry forests and woodlands. This is an adaptable species also present in meadows, bushlands, parks, fruit gardens, many damp habitats and rural and urban areas. The species breeds in still and slow moving shallow waters and irrigation ditches

Amphibian	*Bombina variegata*	Yellow-bellied Toad	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex II and Annex IV		No	found in coniferous, deciduous and mixed forests, bushlands and meadows, floodplains and grasslands. At low elevations this species lives in deciduous forests, at higher altitudes it is more often found in coniferous forests and highland glades. The species uses many types of wetland. The breeding habitats are typically unshaded temporary pools within, or close to, woodland.
Amphibian	*Bufo bufo*	European toad	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	widespread and adaptable species present in coniferous, mixed and deciduous forests, groves, bushlands, meadows, arid areas, parks and gardens. It is usually in damp areas with dense vegetation, and large open areas are generally avoided.
Amphibian	*Bufo viridis*	European green toad	Least Concern	Low risknt	Not endemic	Congregatory	Not listed	Not listed	Bern Convention Annex II	No	lives in a wide range of forests, forest steppe, scrubland, grassland and alpine habitats. Animals may be present in modified areas including urban centres (e.g. Bucharest), city parks and gardens - and often benefits from disturbed habitats
Amphibian	*Hyla arborea*	European Tree Frog	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	generally associated with open, well-illuminated broad-leaved and mixed forests, bush and shrublands, meadows, gardens, vineyards, orchards, parks, lake shores and low riparian vegetation.
Amphibian	*Pelophylax kurtmuelleri / Rana balcanica*	Balkan water frog	Least Concern	Vulnerable	Not endemic (Greece and Albania only)	Not migratory; Not congregatory	Not listed	Not listed		No	a largely aquatic species, generally found in areas close to suitable open water wetland habitats. It breeds in various stagnant and slow-moving waterbodies
Amphibian	*Rana dalmatina*	Agile frog	Least Concern	Low risklc	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	found in glades and open sites within light deciduous woodland (oak, beech, hornbeam etc.), and less frequent in meadows and thickets
Amphibian	*Rana graeca*	Greek stream frog	Least Concern	Low risknt	Not endemic	Not migratory; Not congregatory	Not listed	Annex IV		No	a largely aquatic, montane species associated with cold small clear rivers, streams and springs often located in shady deciduous and mixed forest. It may also occur in moors and meadows, and around glacial pools in lakes.
Amphibian	*Rana temporaria*	Common frog	Least Concern	Low riskcd	Not endemic	Not migratory; Not congregatory	Not listed	Annex V		No	Many terrestrial (associated with woodland) and aquatic habitat types are used. Present in coniferous, mixed and deciduous forests, forested tundra and steppe, bush and shrublands, glades, grasslands, dry and wet meadows, marshes, fields, rural gardens, parks, and urban areas. Aquatic habitats include both temporary and permanent ponds, lakes and rivers
Mammal	*Tursiops truncates*	Bottlenoes dolphin	Least Concern	Not Evaluated	Not endemic		Appendix II	Annex II Habitats Directive. Appendix II CITES.		No	
Bird	*Turnix sylvatica*	*Common buttonquail*	Least Concern	Not evaluated	Not endemic.	Not migratory; Not congregatory	Not evaluated	EU Birds Directive Annex I.		No	found in scrub jungle in Asia, bushy savanna and grass-covered plains in sub-Saharan Africa
Bird	*Porzana pusilla*	Baillon's crake	Least Concern	Data Deficient	Not endemic.	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	CMS Appendix II. Bern Convention Appendix II.	No	It inhabits freshwater, brackish or saline marshy wetlands, both inland and coastal, permanent and temporary, with dense emergent and floating vegetation (especially reeds, rushes, sedges, tall dense grasses and Typha spp.)

Bird	*Merops apiaster*	European bee-eater	Least Concern	Endangered	Not Endemic	Migratory and congregatory	Not listed	Not listed	CMS Appendix II; Bern Convention Appendix II.	No	inhabits broad river valleys, pasture and cultivated land with shelter-belts and scattered trees, meadows, and practically any open and well-timbered country, such as cork-oak woods, olive groves, tamarisks, rice fields, cereal and root crops, and Mediterranean macchia scrub.
Bird	*Emberiza melanocephala*	Black-headed Bunting	Least Concern	Data Deficient	Not Endemic	Migratory	Not listed	Not listed		No	This species breeds in open rather dry terrain with scattered trees, shrubs and hedges. It favours low-intensity farmland with cornfields or vineyards or olive groves, but also more natural habitats such as mountain slopes with scrub vegetation
Bird	*Larus ridibundus*	Black-headed gull	Least Concern	Not evaluated	Not Endemic	Migratory and congregatory	Not evaluated	Annex II of the Birds Directive		No	The species chiefly breeds inland and shows a preference for shallow, calm (Snow and Perrins 1998), temporarily flooded wetland habitats (del Hoyo et al. 1996) with lush vegetation (Flint et al. 1984, del Hoyo et al. 1996).
Bird	*Podiceps nigricollis*	Black-necked grebe	Least Concern	Not evaluated	Not Endemic	Migratory and congregatory	Not listed	Not listed	Included in the Grebes Status Survey and Conservation Action Plan published in 1997	No	During the breeding season this species frequents permanent and temporary (Snow and Perrins 1998) small, shallow, highly eutrophic pools with lush vegetation, such as freshwater marshes and lakes (del Hoyo et al. 1992) with dispersed submergent vegetation and patches of reeds
Bird	*Limosa limosa*	Black-tailed godwit	Near Threatened	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II		No	In its breeding range it mostly inhabits areas with high but not dense grass and soft soil, occasionally using sandy areas; although other information suggests it may prefer short vegetation. Its preferred habitats include cattle pastures, hayfields, lowland wet grasslands, grassy marshland, raised bogs and moorland, lake margins and damp grassy depressions in steppes
Bird	*Gavia arctica*	Black-throated loon	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds directive Annex I	CMS Appendix II; Bern Convention Appendix II.	No	breeds on deep, productive, freshwater lakes or extensive pools with islets, peninsulas and other inaccessible nesting sites. Outside of the breeding season the species is most common on inshore waters along sheltered coasts, occasionally also frequenting large inland freshwater bodies such as natural lakes or barrages, lagoons and large rivers
Bird	*Himantopus himantopus*	Black-winged stilt	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds directive Annex I		No	The species typically breeds in shallow freshwater and brackish wetlands with sand, mud or clay substrates and open margins, islets or spits near water level. Suitable habitats include marshes and swamps, shallow lake edges, riverbeds, flooded fields, irrigated areas, sewage ponds and fish-ponds.
Bird	*Larus cachinnans*	Caspian gull	Least Concern	Endangered	Not endemic	Migratory and congregatory	Not listed	Annex II of the Birds Directive.	Covered under the African Eurasian Waterbird Agreement.	No	During the breeding season the species nests near lakes surrounded by reedbeds, reservoirs, rivers, and on grassy or shrubby river islands, also forming colonies on sea cliffs, rocky and sandy beaches, spits, sand-dunes, and salt-pans, and foraging in intertidal zones and in brackish coastal marshes
Bird	*Buteo buteo*	Common buzzard	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Not listed		No	inhabits a wide variety of habitats but requires at least some tree cover for nesting and roosting; ideal habitat appears to be forest edge, or mosaics of forest and open areas

Bird	*Larus canus*	Common gull	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	Annex II of the Birds Directive.	Covered under the African Eurasian Waterbird Agreement.	No	The species breeds along the coast and inland in a variety of sites not necessarily close to wetlands. On the coast it nests on grassy and rocky cliff-ledges, grassy slopes, inshore rocky islets, islands and stacks, and on sand and shingle beaches, banks and dunes amongst tide-wrack or flood debris. Inland the species nests on small islands in freshwater and saline lakes, shingle bars or small islets in streams or rivers, islets, artificial structures and shores of artificial waterbodies with short, sparse vegetation, and on bog marshes, meadows and grass or heather moorland near small pools or lakes.
Bird	*Gallunula chloropus*	Common moorhen	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II		No	The species inhabits freshwater wetlands, both still and moving, requiring easy access to open water and showing a preference for waters sheltered by woodland, bushes or tall emergent vegetation. Suitable habitats include slow-flowing rivers, oxbow lakes, streams, canals, ditches, lakes, reservoirs, sites with small open water surfaces such as pools and ponds only a few metres across, swamps, marshes, seasonally flooded sites
Bird	*Aythya ferina*	Common pochard	Vulnerable	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II.	CMS Appendix II	No	This species requires well-vegetated eutrophic to neutral swamps, marshes, lakes and slow-flowing rivers with areas of open water and abundant emergent fringing vegetation.
Bird	*Tringa totanus*	Common Redshank	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	The species is listed on Annex II (B) of the EU Birds Directive		No	The species breeds on coastal saltmarshes, inland wet grasslands with short swards (including cultivated meadows), grassy marshes, swampy heathlands and swampy moors. Non-breeding On passage the species may frequent inland flooded grasslands and the silty shores of rivers and lakes
Bird	*Actitis hypoleucos*	Common sandpiper	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed	The species is listed on Annex II of the Bern Convention	No	During the breeding season this species shows a preference for pebbly, sandy or rocky margins of fast-flowing rivers, as well as small ponds, pools and dams, clear freshwater lake shores, sheltered sea coasts with rocky or sandy beaches, tidal creeks and estuaries, and often forages in patches of dry meadow
Bird	*Tadorna tadorna*	Common shelduck	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed	CMS Appendix II. Bern Convention Appendix II.	No	The species shows a preference for saline habitats and frequents mudflats and muddy or sandy estuaries
Bird	*Gallinago gallinago*	Common snipe	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	The species is listed on Annex II (A) and III (B) of the EU Birds Directive		No	The species breeds in open fresh or brackish marshland with rich or tussocky vegetation, grassy or marshy edges of lakes and rivers, wet hay fields, swampy meadows and marshy tundra. Outside breeding season, generally occupies similar habitats, with more use of man-made habitats, e.g. sewage farms and rice fields, upper reaches of estuaries and coastal meadows.

Bird	*Sterna hirundo*	Common tern	Least Concern	Endangered	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.		No	breeds in a wide variety of habitats in coastal and inland areas from sea-level to heights of greater than 4,000 m. Including nesting on flat rock surfaces on inshore islands, open shingle and sandy beaches, dunes and spits, vegetated inter-dune areas, sandy, rocky, shell-strewn or well-vegetated islands in estuaries and coastal lagoons, saltmarshes, mainland peninsulas and grassy plateaus atop coastal cliffs. Inland it may nest in similar habitats including sand or shingle lakes shores, shingle banks in rivers, sandy, rocky, shell-strewn or well-vegetated islands in lakes and rivers, sand- or gravel-pits, marshes, ponds, grassy areas and patches of dredged soil
Bird	*Miliaria calandra*	Corn bunting	Least Concern	Not evaluated	Not endemic	Migratory	Not listed	Not listed		No	The species inhabits open rolling grasslands, both in natural steppe and in agricultural land. It tolerates scattered bushes, but avoids extensive bushy cover. In southern Europe it has a broader habitat array occupying several types of open country, including grasslands and steppes.
Bird	*Pelecanus crispus*	Dalmatian pelican	Near Threatened	Critically Endangered	Not endemic	Migratory and congregatory	Appendix I	EU Birds Directive Annex I.	CMS Appendix I and II. Bern Convention Appendix II.	No	It occurs mainly at inland, freshwater wetlands but also at coastal lagoons, river deltas and estuaries. Breeding It breeds on small islands in freshwater lakes or in dense aquatic vegetation such as reedbeds of Typha and Phragmites, often in hilly terrain.
Bird	*Calidris alpina*	Dunlin	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	Annex I of the EU Birds Directive	Annex II of the Bern Convention.	No	In the breeding season this species frequents moist boggy ground interspersed with surface water, such as tussock tundra and peat-hummock tundra in the arctic, as well as wet coastal grasslands, salt marshes and wet upland moorland. Non-breeding In the non-breeding season this species mainly prefer estuarine mudflats, but also frequent a wide variety of freshwater and brackish wetlands
Bird	*Fulica atra*	Eurasian coot	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III.		No	The species inhabits large, still or slow-flowing waters and shows a preference for shallow water with adjacent deeper water (e.g. > 2 m) for diving, and muddy substrates, marginal, emergent, floating or submergent vegetation
Bird	*Numenius arquata*	Eurasian curlew	Near Threatened	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I and II.		No	The species breeds on upland moors, peat bogs, swampy and dry heathlands, fens, open grassy or boggy areas in forests, damp grasslands, meadows, non-intensive farmland in river valleys, dune valleys and coastal marshlands. During the winter the species frequents muddy coasts, bays and estuaries with tidal mudflats and sandflats, rocky and sandy beaches with many pools, mangroves, saltmarshes, coastal meadows and pasture and muddy shores of coastal lagoons, inland lakes and rivers.
Bird	*Pica pica*	*Common magpie*	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not evaluated	EU Birds Directive Annex II.		No	Everywhere
Bird	*Haematopus ostralegus*	Eurasian oystercatcher	Near Threatened	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Listed on Annex II (B) of the EU Birds Directive		No	The species breeds on coastal saltmarshes, sand and shingle beaches, dunes, cliff-tops with short grass and occasionally rocky shores, as well as inland along the shores of lakes, reservoirs and rivers or on agricultural grass and cereal fields, often some distance from water

Bird	*Anas crecca*	Eurasian teal	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II.	No	preference for shallow permanent waters in the breeding season, especially those in the vicinity of woodlands with fairly dense herbaceous cover available nearby for nesting.
Bird	*Anas penelope / Mareca penolope*	Eurasian Wigeon	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II.	No	This species breeds in lowland freshwater marshes, slow-flowing large rivers and shallow lakes and lagoons with ample submerged, floating and emerging vegetation
Bird	*Scolopax rusticola*	Eurasian woodcock	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	listed on Annex II (A) and III (B) of the EU Birds Directive		No	Breeding For breeding the species requires extensive unfragmented areas of broadleaved deciduous or mixed broadleaved/coniferous forest containing a dense undergrowth of shrubs and ground cover
Bird	*Pluvialis apricaria*	European golden plover	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	listed on Annex I, II (B), III (B) of the EU Birds Directive	Annex III of the Bern Convention	No	The species breeds on humid moss, lichen and hummock tundra, low-lying marshes. It shows a preference for nesting on short vegetation less than 15 cm tall. Non-breeding, when on passage and in its winter quarters the species frequents freshwater wetlands, moist grasslands, pastures, agricultural land (e.g. stubble, ploughed or fallow fields)
Bird	*Anas Strepera*	Gadwall	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II.	No	inhabits highly productive and eutrophic freshwater marsh or lake habitats in open lowland grassland, showing a preference for sheltered, shallow, standing or slow-flowing waters with abundant emergent vegetation
Bird	*Anas querquedula*	Garganey	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II.	CMS Appendix II	No	In the breeding season this species frequents small, shallow ponds and lakes with abundant floating, emergent and fringing vegetation. Non-breeding During this season the species shows a preference for large freshwater or occasionally brackish lakes, again with abundant floating, emergent and fringing vegetation
Bird	*Plegadis falcinellus*	Glossy ibis	Least Concern	Endangered	Not endemic	Migratory and congregatory	Not listed	listed on Annex I of the EU Birds Directive	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species	No	The species feeds in very shallow water and nests in freshwater or brackish wetlands with tall dense stands of emergent vegetation (e.g. reeds or rushes) and low trees or bushes. It shows a preference for marshes at the edges of lakes and rivers, as well as lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and irrigated cultivation
Bird	*Aquila chrysaetos*	Golden Eagle	Least Concern	Endangered	Not endemic	Migratory	Not listed	listed on Annex I of the EU Birds Directive		No	occupies a wide range of flat or mountainous, largely open habitats, often above the tree line, from sea level to 4000m.
Bird	*Botaurus stellaris*	Eurasian bittern	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	listed on Annex I of the EU Birds Directive	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species	No	preference for quiet lowland marshes around lakes and rivers (less than 200 m above sea-level) with extensive dense young reedbeds

Bird	*Otis tarda*	Great Bustard	Vulnerable	Data Deficient	Not endemic.	Migratory	Not listed	EU Wild Birds Directive Annex I	CITES Appendix I and II, CMS Appendix I and II and CMS MoU for Middle European Populations in place since 2002. Bern Convention Annex II, Bonn Convention Annex I	No	Species has acclimated to agricultural landscapes. It occurs in open, flat or somewhat rolling landscapes, usually with a mixture of crops (cereals, vineyards, fodder plants, in some countries also with steppic grassland
Bird	*Phalacrocorax carbo*	Great cormorant	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed	listed under the African Eurasian Waterbird Agreement	No	The species frequents both coastal and inland habitats. It also inhabits fresh, brackish or saline inland wetlands including lakes, reservoirs, wide rivers, flood waters, deep marshes with open water, swamps and oxbow lakes, requiring trees, bushes, reedbeds or bare ground for nesting and avoiding overgrown, small, very shallow or very deep waters
Bird	*Egretta alba*	Great egret	Least Concern	Endangered	Not endemic	Migratory and congregatory	Not listed	listed on Annex I of the EU Birds Directive	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species	No	The species inhabits all kinds of inland and coastal wetlands although it is mainly found along the coast in the winter (e.g. in the Palearctic Region) or during droughts (e.g. in Australia). It frequents river margins, lakes shores, marshes, flood-plains, oxbows, streams, damp meadows
Bird	*Podiceps cristatus*	Great crested grebe	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed		No	species breeds on fresh or brackish waters with abundant emergent and submerged vegetation, showing a preference for non-acidic eutrophic waterbodies with flat or sloping banks and muddy or sandy substrates
Bird	*Tringa ochropus*	Green sandpiper	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed		No	During the breeding season this species inhabits damp areas in the vicinity of rivers, streams, swamps, ponds, lakes and bogs. Outside of the breeding season this species shows a preference for a wider variety of inland freshwater habitats such as marshes, lake edges, sewage farms, small dams and ponds, ditches, riverbanks
Bird	*Ardea cinerea*	Grey heron	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Not listed		No	This species is a generalist in its habitat use, although shallow water and relatively large prey are among the essential characteristics of its habitat
Bird	*Pluvialis squatarola*	Grey plover	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	listed on Annex II (B) of the EU Birds Directive.		No	Frequents intertidal mudflats, saltmarshes, sandflats and beaches of oceanic coastlines, bays and estuaries. During migration it may also be found inland on lakes, pools or grasslands
Bird	*Anser anser*	Greylag goose	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Directives Annex II.	CMS Appendix II	No	inhabits wetlands surrounded by fringing vegetation in open grassland
Bird	*Podiceps auratus*	Horned grebe	Vulnerable	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I.	Bern Convention Appendix II.	No	The species breeds on small, shallow fresh, brackish or slightly alkaline waters between 0.5 and 2 m deep and between 1 and 20 ha in area with rich floating, submergent and emergent vegetation
Bird	*Charadrius alexandrinus*	Kentish plover	Least Concern	Not evaluated	Not endemic	Migratory	Not evaluated	listed on Annex I of the	Annex II of the Bern Convention.	No	During all seasons the species is predominantly coastal and is usually found on sand, silt or dry mud surfaces

								EU Birds Directive			
Bird	*Alcedo atthis*	Common kingfisher	Least Concern	Not evaluated	Not endemic	Migratory	Not evaluated	EU Birds Directive Annex I.	Bern Convention Appendix II.	No	prefers still or gently flowing water with plenty of small fish, and with reeds, rushes or shrubs on the banks for perches. Streams, small rivers, canals and ditches are favoured to open waterbodies, but it also uses lakes, ponds and flooded gravel pits.
Bird	*Accipiter brevipes*	Levant sparrowhawk	Least Concern	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.		No	It inhabits woody plains, often near water, and usually ranges up to 1,000 m
Bird	*Ixobrychus minutus*	Little bittern	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I.	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species	No	The species is most common in freshwater marshes with beds of bulrushes Typha spp., reeds Phragmites spp. or other dense aquatic vegetation, preferably also with deciduous bushes and trees such as willow Salix spp.
Bird	*Egretta garzetta*	Little egret	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	Annex II of the Bern Convention	No	Habitats frequented include the margins of shallow lakes, rivers, streams and pools, open swamps and marshes, flooded meadows, flood-plains, lagoons, irrigation canals, aquaculture ponds, saltpans and rice fields (which are especially important in areas with few remaining natural wetland habitats). The species also occupies dry fields, inland savannas and cattle pastures
Bird	*Tachybaptus ruficollis*	Little grebe	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed	Bern Convention Appendix II	No	inhabits a wide range of small and shallow wetlands usually less than 1 m deep with rich vegetation (floating, submerged and emergent) and high densities of aquatic invertebrates, generally avoiding waters with large predatory fish. Suitable habitats include small lakes, ponds, the sheltered bays and vegetated shores of larger freshwater, alkaline or saline lakes and reservoirs, slow-flowing rivers
Bird	*Hydrocoloeus minutus*	Little gull	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I.	Listed under the African Eurasian Waterbird Agreement and on Appendix II of the Bern Convention.	No	The species breeds inland on shallow freshwater and brackish lakes, river basins, marshes and bogs, occasionally also at coastal lagoons. Non-breeding, on migration the species occurs at sea, along shores, and on reservoirs, lagoons and lakes
Bird	*Athene noctua*	*Little owl*	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Appendix II	Not listed	Bern Convention Appendix II	No	Found in a variety of semi-open habitats, ranging from parkland, orchards and cultivated fields with hedges to rocky, semi-desert regions and steppes
Bird	*Charadrius dubius*	Little ringed plover	Least Concern	Not evaluated	Not endemic	Migratory	Not listed	Not listed	listed on Annex II of the Bern Convention	No	preference for bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers
Bird	*Calidris minuta*	Little stint	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed	listed on Annex II of the Bern Convention	No	On migration this species is found along the muddy edges of small inland lakes, reservoirs, sewage farms, riverbanks and seasonal pools, as well as on coastal mudflats and seashores

Bird	*Sterna albifrons*	Little tern	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I.	The species is listed in Appendix II of the Convention on Migratory Species and is covered under the African Eurasian Waterbird Agreement. It is on Annex II of the Bern Convention.	No	shows a preference for islets surrounded by saline or fresh water where small fish can be caught without the need for extensive foraging flights
Bird	*Anas platyrhynchos*	Mallard duck	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II	No	occurs in almost every wetland type although it generally avoids fast-flowing, oligotrophic, deep, exposed, rough, rockbound waters and hard unvegetated areas such as rocky ground, sand dunes and artificial surfacing
Bird	*Tringa Stagnatilis*	Marsh Sandpiper	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Not listed		No	This species inhabits warm inland wetlands from open steppe to boreal forest, including shallow freshwater and brackish marshlands, grassy or marshy lake-edges, river valleys and flooded meadows.
Bird	*Ichthyaetus melanocephalus*	Meditteranean gull	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex I.	Appendix II of the Convention on Migratory Species, and is covered under the African Eurasian Waterbird Agreement. It is listed on Appendix II of the Bern Convention	No	breeds on the Mediterranean coast at lagoons, estuaries and sometimes coastal saltmarsh, often also breeding inland on large steppe lakes and marshes in open lowland areas. It nests near water on flood-lands, fields and grasslands
Bird	*Cygnus olor*	Mute swan	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II	CMS Appendix II	No	inhabits a variety of lowland freshwater wetlands such as shallow lakes, ponds, lagoons, marshes, reedbeds and slow-flowing rivers
Bird	*Nycticorax nycticorax*	Black-crowned night heron	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species, under which it is covered by the African-Eurasian Waterbird Agreement (AEWA).	No	It occupies the forested margins of shallow rivers, streams, lagoons, pools, ponds, lakes, marshes and mangroves and may feed on pastures, reservoirs, canals, aquaculture ponds. On migration the species may also frequent dry grasslands or marine coasts.

Bird	*Camprimulgus europaeus*	European nightjar	Least Concern	Low risklc	Not endemic	Migratory	Not listed	EU Birds Directive Annex I.	Bern Convention Appendix II	No	nests on bare or sparsely vegetated ground, often on free-draining soils. It uses mainly dry, open country including lowland heaths with scattered trees and bushes, commons and moorland, forest and woodland (especially glades, clearings and edges), recently felled woodland and young forestry plantations.
Bird	*Vanellus vanellus*	Northern lapwing	Near Threatened	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II	CMS Appendix II. Bern Convention Annex III	No	reference for breeding on wet natural grasslands, meadows and hay meadows with short swards. During the winter the species utilises large open pastures for roosting and forages on damp grassland, irrigated land, stubble and ploughed fields, riverbanks, lake shores, fresh and saline marshes, drainage ditches,and estuaries.
Bird	*Anas acuta*	Northern pintail	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II	No	preference for open lowland grassland, prairie or tundra habitats containing freshwater, brackish and saline wetlands with shallow water
Bird	*Anas clypeata*	Northern shoveler	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not evaluated	EU Birds Directive Annex II and III	CMS Appendix II	No	inhabits permanent shallow freshwater wetlands from sea level up to 2,900 m, preferred sites being those surrounded by dense stands of reeds or other emergent vegetation whilst being free of overhanging trees or fringing forest
Bird	*Ardea purpurea*	Purple heron	Least Concern	Endangered	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	Annex II of the Bern Convention and Annex II of the Convention on Migratory Species, under which it is covered by the African-Eurasian Waterbird Agreement	No	inhabits wetlands from sea level to 1,800m, showing a preference for dense, flooded, freshwater reedbeds (Phragmites spp.) in temperate areas. It also utilises lake shores, river margins, ditches, canals, brackish water lagoons
Bird	*Phalacrocorax pygmeus*	Pygmy cormorant	Least Concern	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	Annex I of the EU Birds Directive. Annex II of the Bern Convention and Annex I of the EU Birds Directive		No	reedbeds, transition zones between reedbeds and open waters, extensively grazed or mowed shores and wet meadows and, in winter, in coastal wetlands, along rivers, and sometimes on inland lakes
Bird	*Calidris canutus*	Red knot	Near Threatened	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Annex II (B) of the EU Birds Directive. CMS Appendix I		No	Outside of the breeding season the species is strictly coastal, frequenting tidal mudflats or sandflats, sandy beaches of sheltered coasts, rocky shelves, bays, lagoons and harbours, occasionally also oceanic beaches and saltmarshes
Bird	*Mergus serrator*	Red-breasted merganser	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex II.		No	he majority of the species winters at sea, frequenting both inshore and offshore waters, estuaries, bays and brackish lagoons but showing a preference for clear, shallow waters not affected by heavy wave action. It will also utilise large freshwater lakes on passage

Bird	*Netta rufina*	Red-crested pochard	Least Concern	Low riskcd	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex II.		No	inhabits inland deep fresh or brackish reed-fringed lakes, rivers, or saline and alkaline lagoons in open country, also occurring (less often) on estuaries, river deltas and other sheltered coastal habitats on passage or during the winter
Bird	*Podiceps grisegena*	Red-necked grebe	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. Bern Convention Appendix II.		No	frequents large inland lakes or shallow coastal areas with abundant fish stocks, often considerable distances from the shore, amongst islands in archipelagos or over drop-off zones. When foraging at sea the species shows a preference for sub-tidal locations down to a depth of 15 m with sand or gravel substrates, scattered rocks and patches of seaweed
Bird	*Gavia stellata*	Red-throated loon	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Annex II of the Convention on Migratory Species. Annex II of the Bern Convention, Annex I of the EU Birds Directive		No	Outside of the breeding season the species frequents inshore waters along sheltered coasts, occasionally occurring inland on lakes, pools, reservoirs and rivers
Bird	*Coracias garrulus*	European roller	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I. Bern Convention Appendix II. Bonn Convention Appendix I. CMS Appendix I & II		No	prefers lowland open countryside with patches of oak Quercus forest, mature pine Pinus woodland with heathery clearings, orchards, mixed farmland, river valleys, and plains with scattered thorny or leafy trees
Bird	*Calidris pugnax*	Ruff	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex I and II		No	During the non-breeding season the species occupies the muddy margins of brackish, saline and alkaline lakes, ponds, pools, rivers, marshes and food-plains, as well as freshly mown or grazed short-sward grasslands and wheat- or rice-fields, usually roosting at night in the shallow waters of lake shores. The species rarely utilises intertidal habitats but may frequent tidal mudflats and lagoons in India.
Bird	*Riparia riparia*	Sand martin	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Bern Convention Appendix II		No	nests colonially in newly eroded banks of rivers, streams, lakes, reservoirs and coastal cliffs. Quarries are important nesting sitesand birds may use other man-made habitats including road and railway cuttings and building work excavations
Bird	*Sterna sandvincensis*	Sandwich tern	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex I. Bern Convention Appendix II.		No	species frequents sandy or rocky beaches, mudflats fringed by mangroves, estuaries, harbours and bays, often feeding over inlets and at sea
Bird	*Otus scops*	*Eurasian scops*	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not listed	Not listed		No	wide variety of habitats

Bird	*Circaetus gallicus*	Short-toed snake eagle	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Annex I of the EU Birds Directive		No	uses a variety of habitats within warm temperate and tropical environments, and is recorded up to 2,300 m
Bird	*Numenius tenuirostris*	Slender-billed Curlew	Critically Endangered	Critically Endangered	Not endemic	Migratory and congregatory	Appendix I	Annex I of the EU Birds Directive. I.	CMS Appendix I and II.	No	On migration and in winter, a wide variety of habitats are used, including saltmarsh, steppe grassland, fishponds, saltpans, brackish lagoons, tidal mudflats, semi-desert, brackish wetlands and sandy farmland next to lagoons. Large coastal wetland complexes may be especially characteristic, and most records come from close to the sea. Artificial/Aquatic & Marine, Artificial/Terrestrial, Grassland, Wetlands (inland), Marine Coastal/Supratidal, Marine Intertidal; a wide variety of habitats are used, including saltmarsh, steppe grassland, fishponds, saltpans, brackish lagoons, tidal mudflats, semi-desert, brackish wetlands and sandy farmland next to lagoons. Large coastal wetland complexes may be especially characteristic, and most records come from close to the sea
Bird	*Larus genei*	Slender-billed gull	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Appendix II of the Convention on Migratory Species and on Appendix II of the Bern Convention. Listed on Annex I of the EU Birds Directive		No	species is almost entirely coastal outside of the breeding season, frequenting shallow inshore waters and salt-pans, although it generally avoids harbours
Bird	*Mergellus albellus*	Smew	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. Bern Convention Appendix II. EU Birds Directive Annex I.		No	The species overwinters on large freshwater lakes and reservoirs, ice-free rivers , brackish coastal lagoons, estuaries and sheltered coastal bays (although rarely on the open sea) , often resting and feeding on small bodies of water or small streams when on passage.
Bird	*Platalea leucorodia*	Eurasian spoonbill	Least Concern	Endangered	Not endemic	Migratory and congregatory	Appendix II	Appendix II of CITES, Annex I of the EU Birds Directive, Annex II of the Bern Convention, Annex II of the Convention on Migratory Species		No	The species shows a preference for extensive shallow wetlands with mud, clay or fine sand substrates, generally avoiding waters with rocky substrates, thick vegetation or swift currents . It inhabits either fresh, brackish or saline marshes, rivers, lakes, flooded areas and mangrove swamps, especially those with islands for nesting or dense emergent vegetation (e.g. reedbeds) and scattered trees or srubs (preferably willow Salix spp., oak Quercus spp. or poplar Populus spp.) . It may also frequent sheltered marine habitats during the winter such as deltas, estuaries, tidal creeks and coastal lagoons.
Bird	*Aquila clanga*	Greater spotted eagle	Vulnerable	Critically Endangered	Not endemic	Migratory and congregatory	Appendix II	EU Birds Directive Annex I.	CMS Appendix I and II.	No	occurs in lowland forests near wetlands, nesting in different types of (generally tall) trees, depending on local conditions

Bird	*Tringa erythropus*	Spotted redshank	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Annex II (B) of the EU Birds Directive and Annex II of the Bern Convention		No	species frequents a variety of freshwater and brackish wetlands such as sewage farms, irrigated rice fields, brackish lagoons, salt-marshes, salt-pans, sheltered muddy coastal shores and mudflats , marshes and marshy lake edges , small reservoirs, pools and flooded grasslands
Bird	*Ardeola ralloides*	Squacco heron	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Annex I of the EU Birds Directive, Annex II of the Bern Convention and Annex II of the Convention on Migratory Species		No	inhabits permanent or temporary wetlands showing a preference for fresh waters with abundant marsh vegetation, reedbeds, nearby bushes, trees and scrub . Habitats frequented include swampy plains, river valleys, deltas, lakes, ponds, canals and ditches although rice paddyfieldsare now the principle habitat throughout much of its range
Bird	*Burhinus oedicnemus*	Eurasian stone curlew	Least Concern	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex I. Bern Convention Appendix II.		No	The species inhabits lowland heath, semi-natural dry grassland, infertile agricultural grassland, steppe on poor soil, desert and extensive sand-dunes . It breeds on open, bare ground or areas with little vegetation , and has adapted to arable land but only where crops are short or have an open structure during the breeding season, such as maize, carrots, sugar beet and sunflowers
Bird	*Dendrocopos syriacus*	*Syrian woodpecker*	Least Concern	Not evaluated	Not endemic	Not migratory; Not congregatory	Not listed	EU Birds Directive Annex I	Bern Convention Appendix II	No	occurs in open country with wooded areas. It is often found in plantations of all kinds, including olive, pecan (Carya) and avocado in the south, and vineyards in central Europe, where it is also seen in roadside trees and groups of trees, mainly near habitations, as well as forest edges, parks and gardens
Bird	*Aythya fuligula*	Tufted duck	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	CMS Appendix II. EU Birds Directive Annex II and III.		No	The species breeds in lowland regions and shows a preference for eutrophic waters 3-5 m deep (avoiding lakes deeper than 15 m) with open water, islands for breeding and abundant marginal and emergent vegetation. It is common on large, freshwater lakes, ponds, reservoirs, gravel-pits and quiet stretches of wide slow-flowing rivers during this season
Bird	*Rallus aquaticus*	Water rail	Least Concern	Not evaluated	Not endemic	Migratory	Not listed	EU Birds Directive Annex II		No	The species requires muddy ground for foraging and shows a preference for shallow still or slow-flowing water 5-30 cm deep, surrounded by dense riparian, emergent, submergent or aquatic vegetation
Bird	*Circus aeruginosus*	Western marsh harrier	Least Concern	Vulnerable	Not endemic	Migratory and congregatory	Not listed	Annex I of the EU Birds Directive		No	inhabits extensive areas of dense marsh vegetation, in fresh or brackish water, generally in lowlands but up to 2,000 m
Bird	*Ciconia ciconia*	White stork	Least Concern	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	Annex I of the EU Birds Directive, Annex II of the Bern Convention and Annex II of the Convention on Migratory Species		No	The species inhabits open areas, generally avoiding regions with persistent cold, wet weather or large tracts of tall, dense vegetation such as reedbeds or forests, shallow marshes, lakesides , lagoons, flood-plains, rice-fields and arable land especially where there are scattered trees for roosting.

Bird	*Lullula arborea*	Woodlark	Least Concern	Not evaluated	Not endemic	Migratory	Not listed	EU Birds Directive Annex I		No	inhabits a variety of open and semi-open habitats on well-drained soils, with a preference for acidic, sandy soils. It favours unmanaged or poorly managed habitats such as low-intensity or abandoned farmland, heathland, young forestry plantations, recently felled woodland, open woodland and scrub, orchards, steppes, woodland edges and clearings, wooded coastal dunes and parkland
Bird	*Lanius senator*	Woodchat shrike	Least Concern	Not evaluated	Not endemic	Migratory	Not listed	Bern Convention Appendix II.		No	requires shrub-like or arboreal cover, open ground offering rich supply of large insects, and perches with commanding view of area. It is commonly found in semi-open areas with bushes and well-spaced trees, such as open woodland, old orchards, olive (Olea) groves, gardens, and parks or hedgerows with large thorny bushes; in Greece it prefers open pine (Pinus) forest
Bird	*Motacilla flava*	Western yellow wagtail	Least Concern	Not evaluated	Not endemic	Migratory and congregatory	Not listed	Bern Convention Appendix II.		No	occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra.
Bird	*Microcarbo pygmaeus*	Pygmy cormorant	Least Concern	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	The species is listed on Appendix I of the Convention on Migratory Species, and is covered by the African Eurasian Waterbird Agreement. It is listed under Annex II of the Bern Convention and Annex I of the EU Birds Directive. It is currently listed within 182 Important Bird Areas in Europe. Within the EU it is currently listed within 189 Special Protection Areas		No	Forest, Wetlands (inland), Shrubland, Artificial/Aquatic & Marine, Marine Coastal/Supratidal; occurs in reedbeds, transition zones between reedbeds and open waters, extensively grazed or mowed shores and wet meadows and, in winter, in coastal wetlands, along rivers, and sometimes on inland lakes
Bird	*Pelecanus crispus*	Dalmatian pelican	Near Threatened	Critically Endangered	Not endemic	Migratory and congregatory	Appendix I	EU Birds Directive Annex I.	Bern Convention Appendix II. CMS Appendix I and II.	No	Marine Neritic, Wetlands (inland), Marine Coastal/Supratidal; It occurs mainly at inland, freshwater wetlands but also at coastal lagoons, river deltas and estuaries

Bird	*Anser erythropus*	Lesser White-fronted Goose	Vulnerable	Extinct	Not endemic	Migratory and congregatory	Not listed	Listed in Annex 1 of the EU Birds Directive. It is protected in most of its key range states.	CMS Appendix I and II and designated for Concerted Action (CMS Resolution 5.1). Listed in Table 1 Column A of the Action Plan under the African-Eurasian Migratory Waterbird Agreement (AEWA) and in Annex II 'Strictly protected species' of the Bern Convention.	No	Rocky areas (eg. inland cliffs, mountain peaks), Artificial/Terrestrial, Shrubland, Grassland, Wetlands (inland)
Bird	*Lullula arborea*	Wood lark	Least Concern	Not listed	Not endemic	Migratory		EU Birds Directive Annex I		No	Forest, Artificial/Terrestrial, Shrubland, Grassland
Bird	*Branta ruficollis*	Red-breasted goose	Vulnerable	Critically Endangered	Not endemic	Migratory and congregatory	Appendix II	Not listed	CMS Appendix I and II.	No	Wetlands (inland), Grassland, Artificial/Terrestrial, Marine Coastal/Supratidal; It breeds in tundra or scrubby 'wooded' tundra, in close proximity to rivers and gulley. It favours high and dry areas on steep river banks and precipices, low hills, rock outcrops and rocky islands. Less commonly it inhabits low islands in lowland areas. The distribution of geese from year to year depends a lot on differences in lake water levels.
Bird	*Oxyura leucocephala*	White-headed duck	Endangered	Critically Endangered	Not endemic	Migratory and congregatory	Appendix II	CITES Appendix II.	CMS Appendix I and II. The species is legally protected in many range countries, and occurs in a number of protected areas.	No	Wetlands (inland), Artificial/Aquatic & Marine, Marine Coastal/Supratidal; Habitats include saline inland lakes, coastal lakes and lagoons, and even the coastal waters of inland seas
Bird	*Marmaronetta angustirostris*	Marbled teal	Vulnerable	Not Evaluated	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	CMS Appendix I and II.	No	Wetlands (inland), Marine Coastal/Supratidal, Artificial/Aquatic & Marine; t is adapted to temporary, unpredictable, Mediterranean-type wetlands and breeds in fairly dry, steppe-like areas on shallow freshwater, brackish or alkaline ponds with well vegetated shorelines, and rich emergent and submergent vegetation. It also breeds on delta marshes where receding waters leave behind large areas of shallow water with abundant sedges and bulrushes. In addition it may use slow rivers and saline coastal lagoons, and man-made wetlands including fish-rearing ponds, small reservoirs and

											sewage farms. Although it favours brackish wetlands, it tends to avoid waters of high salinity.
Bird	*Aythya nyroca*	Ferruginous duck	Near Threatened	Critically Endangered	Not endemic	Migratory and congregatory	Not listed	EU Birds Directive Annex I.	Appendix III of the Bern Convention and on Appendices I and II of the Bonn Convention. CMS Appendix I and II.	No	Wetlands (inland), Artificial/Aquatic & Marine, Marine Coastal/Supratidal; it shows a strong preference for fresh standing water and is very rarely found on flowing streams or rivers. It requires shallow water 30-100 cm deep close to littoral vegetation for feeeding and generally avoids large open areas
Bird	*Gallinago media*	Great snipe	Near Threatened	Critically Endangered	Not enedemic	Migratory	Not listed	EU Birds Directive Annex I.	CMS Apendix II	No	Wetlands (inland), Grassland, Shrubland, Savanna, Artificial/Terrestrial; generally associated with moist to wet terrain, it is tolerant of wooded, and occasionally well-drained sites that adjoin bogs/fens or marshes
Reptile	*Chelonia mydas*	green turtle	Endangered	Not Listed	Not endemic	Full migrant	Appendix I	Annex II	Annex II of the SPAW Protocol to the Cartagena Convention. Appendices I and II of the Convention on Migratory Species	Yes - score 5.99	Marine Intertidal, Marine Neritic, Marine Oceanic, Marine Coastal/Supratidal

APPENDIX 8
HABITATS DIRECTIVE (ANNEX II) SPECIES

Table A8-1 Species of community interest identified under the EU Habitats Directive (Annex II) that occur or potentially occur within the area of analysis

Taxon Type	Common Name	Species Name	IUCN Status	National Red Book Status
Insect	Great capricorn beetle	*Cerambyx cerdo*	Vulnerable	Endangered
Fish	Adriatic sturgeon	*Acipenser naccarii*	Critically endangered	Endangered
	Twaite shad	*Alosa fallax*	Least concern	Vulnerable
		Petromyzon Marinus	Least concern	Vulnerable
		Rhodeus amarus	Least concern	Not Evaluated
Mammal	Greater horseshoe bat	*Rhinolophus ferrumequinum*	Least Concern	Lower Risk/Conservation Dependent
	Meditteranean horseshoe bat	*Rhinolophus euryale*	Near Threatened	Vulnerable
	Blasius's horseshoe bat	*Rhinolophus blasii*	Least Concern	Lower Risk/Near Threatened
	Greater mouse-eared bat	*Myotis myotis*	Least Concern	Not Evaluated
	Eurasian otter	*Lutra lutra*	Near Threatened	Vulnerable
	Brown bear	*Ursus arctos*	Least Concern	Vulnerable

Taxon Type	Common Name	Species Name	IUCN Status	National Red Book Status
	Long fingered bat	*Myotis capaccinii*	Vulnerable	Lower Risk/Conservation Dependent
Reptile	Loggerhead sea turtle	*Caretta caretta*	Vulnerable	Endangered
	European pond turtle	*Emys orbicularis*	Near threatened	Low risknt
	Hermann's tortoise	*Testudo hermanni*	Near threatened	Low risknt
	Marginated tortoise	*Testudo marginata*	Least concern	Low riskcd
	Fourlined snake	*Elaphe quatuorlineata*	Near threatened	Critically endangered
	European ratsnake	*Zamenis situla / Elaphe situla*	Least concern	Critically endangered
	Meadow viper	*Vipera ursinii*	Vulnerable	Low risknt
Amphibian	Yellow-bellied toad	*Bombina variegata*	Least concern	Low riskcd
		Bottlenoes Dolphin (Tursiops truncates)	Least concern	Not Evaluated

APPENDIX 9
IUCN RED LIST OF ECOSYSTEMS CATEGORIES AND CRITERIA VERSION 2.2

IUCN

Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria

Edited by Lucie M. Bland, David A. Keith, Rebecca M. Miller, Nicholas J. Murray and Jon Paul Rodríguez

Version 1.1

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

CEM

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Contributors to Version 1.1:
N.J. Murray, L.M. Bland, K.L. Boe, D.A. Keith, R.M. Miller, T.J. Regan, I. Zager

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Available from: IUCN (International Union for Conservation of Nature)
Global Ecosystem Management Programme
Commission on Ecosystem Management
Rue Mauverney 28
1196 Gland
Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org/resources/publications

These guidelines are also freely available online on https://portals.iucn.org/library/node/45794 and the IUCN Red List of Ecosystems website (www.iucnrle.org). The guidelines are conceived as a 'living document' and will be updated periodically. Please submit your comments and suggestions to www.iucnrle.org/work-with-us/contact-us. Numerous experts from around the world participated in the development of these guidelines. The complete list of contributors is located in Appendix 1.

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Executive Summary

The IUCN Red List of Ecosystems is a global framework for monitoring the status of ecosystems. It is part of the growing toolbox for assessing risks to biodiversity and aims to support conservation, resource use, and management decisions by identifying ecosystems most at risk of biodiversity loss. By targeting a level of biological organisation above species, the IUCN Red List of Ecosystems complements The IUCN Red List of Threatened Species™. The *IUCN Red List of Ecosystems Categories and Criteria* are designed to be: widely applicable across ecosystem types and geographical areas; transparent and scientifically rigorous; and easily understood by policy makers and the public.

The IUCN Red List of Ecosystems Categories and Criteria

The basis of the IUCN Red List of Ecosystems is the *IUCN Red List of Ecosystems Categories and Criteria*, a set of eight categories and five criteria that provide a consistent method for assessing the risk of ecosystem collapse. The eight categories of ecosystem risk are: Collapsed (CO), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE).

The IUCN Red List of Ecosystems protocol comprises five rule-based criteria (A-E) for assigning ecosystems to a risk category. Two of these criteria assess spatial symptoms of ecosystem collapse: declining distribution (A) and restricted distribution (B). Two criteria assess functional symptoms of ecosystem collapse: environmental degradation (C) and disruption of biotic processes and interactions (D). Multiple threats and symptoms can be integrated in a model of ecosystem dynamics to produce quantitative estimates of the risk of collapse (E). The Guidelines include comprehensive sections to support application of each of the five criteria, including information on relevant theory, thresholds and examples.

Application and documentation standards

The Guidelines assist correct implementation of the *IUCN Red List of Ecosystems Categories and Criteria* by providing information on the development of the protocol and a detailed overview of the scientific foundations supporting the categories and criteria. They define assessment units (ecosystem types); define ecosystem collapse; discuss the influence of scale; and explain the structure of the risk assessment protocol. The Guidelines also provide detailed definitions of the terms used in the *IUCN Red List of Ecosystems Categories and Criteria*.

The Guidelines aim to support the practical implementation of the *IUCN Red List of Ecosystems Categories and Criteria* from subnational to global areas of assessment. The Guidelines therefore outline the necessary steps to: define the assessment area; define the unit under assessment; apply the criteria; and prepare the assessment documentation for peer review and publication. All the steps are illustrated with examples spanning a wide range of ecosystem types, geographical localities and levels of data availability.

The future of the IUCN Red List of Ecosystems

The IUCN Red List of Ecosystems programme will assess the global status of the world’s terrestrial, marine, freshwater and subterranean ecosystems. In addition, the programme aims to support the development of national and regional Red Lists to inform conservation planning and sustainable development. For more information on the IUCN Red List of Ecosystems please consult the IUCN Red List of Ecosystems website (www.iucnrle.org).

Acknowledgements

IUCN gratefully acknowledges the dedication and efforts of the hundreds of scientists and practitioners who have contributed to the scientific development and practical testing of the *IUCN Red List of Ecosystems Categories and Criteria* since 2008. These experts have cumulatively participated in nearly 50 meetings and workshops in more than 20 countries around the world, as well as submitted comments and suggestions remotely. To all we are most indebted. Key contributors to this process are listed in Appendix 1.

The process to develop Red List criteria for ecosystems was launched with Resolution 4.020 at the Fourth IUCN World Conservation Congress in 2008, and consolidated with Resolution 5.055 adopted by the Fifth World Conservation Congress in 2012. This process culminated in the adoption of the *IUCN Red List of Ecosystems Categories and Criteria* by the IUCN Council in May 2014. Further information on the development of the IUCN Red List of Ecosystems is available in Section 1.2.

The work on the IUCN Red List of Ecosystems has been made possible through generous support from: Agence Française de Développement; Australian Research Council; Conoco-Philips; Embassy of the Netherlands in Brazil; European Commission; Gordon and Betty Moore Foundation; IUCN Netherlands National Committee; IUCN Secretariat; IUCN Commission on Ecosystem Management; MAVA Foundation; New South Wales Office of Environment and Heritage; and South Australian Department of Environment, Water and Natural Resources.

IUCN Red List of Ecosystems

Website www.iucnrle.org

Steering Committee

David A. Keith, Chair, Committee for Scientific Standards
Emily Nicholson
Angela Andrade
Edmund G. Barrow
Thomas M. Brooks
Rebecca M. Miller
Irene Zager

Staff

Cambridge, UK	Rebecca M. Miller, Red List of Ecosystems Senior Programme Coordinator
Caracas	Irene Zager, Scientific Officer
Washington D.C.	Kaia Boe, Social Science and Ecosystems Programme Officer
Nairobi	Edmund G. Barrow, Director, Global Ecosystem Management Programme

IUCN Commission on Ecosystem Management (2017-2020)

Website www.iucn.org/about/union/commissions/cem/

Steering Committee

Angela Andrade, Chair
Madhav Karki, Deputy Chair
Mike Jones, Chair's advisor
Bernal Herrera
Birguy Lamizana
Kelvin Passfield
Liette Vasseur

Red List of Ecosystems Thematic Group

David A. Keith, Lead
Emily Nicholson, Co-lead

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Acronyms

Acronym	*Definition*
AOO	Area of occupancy
ARD	Absolute rate of decline
CEM	IUCN Commission on Ecosystem Management
CO	Collapsed
CR	Critically Endangered
DD	Data Deficient
EN	Endangered
EOO	Extent of occurrence
GEMP	IUCN Global Ecosystem Management Programme
GSP	IUCN Global Species Programme
IUCN	International Union for Conservation of Nature
LC	Least Concern
NE	Not Evaluated
NT	Near Threatened
PRD	Proportional rate of decline
RLE	IUCN Red List of Ecosystems
RLTS	The IUCN Red List of Threatened Species™
SSC	IUCN Species Survival Commission
VU	Vulnerable

Glossary

Term	*Definition*
Area of assessment	Defines the implementation bounds of the assessment.
Area of occupancy	Area of occupancy (AOO) is a standardised measure of the area that is occupied by an ecosystem type.
Characteristic native biota	Biological features that define the identity of an ecosystem type and distinguish it from other ecosystem types and/or drive ecosystem dynamics and function, e.g. ecological processes, ecosystem engineers, trophic or structural dominants, functionally unique elements, species interactions.
Continuing decline	A gradual or episodic decline in distribution or ecological process that is likely to continue into the future, and is non-trivial in magnitude and its effect on the sustainability of characteristic native biota.
Ecosystem collapse	Collapse is a transformation of identity, a loss of defining features, and a replacement by a different ecosystem type.
Extent of occurrence	Extent of occurrence (EOO) is a standardised measure of the area within which all occurrences of an ecosystem type exist.
Ecosystem type	The unit of assessment.
Geographic distribution	The geographic distribution of an ecosystem type represents all spatial occurrences of an ecosystem type.
Grain size	The size of the spatial unit (e.g. grid cell, polygon segment) used to measure a distribution.
Location (Threat-defined location)	A geographically or ecologically distinct area in which a single threatening event can rapidly affect all occurrences of an ecosystem type.
Relative severity	The estimated magnitude of past or future environmental degradation or disruption to biotic processes, expressed as a percentage relative to a change large enough to cause ecosystem collapse.
Spatial extent	The total area of the geographic distribution of an ecosystem type estimated with a specified metric.
Temporal resolution	The units of time over which trends are measured.
Thematic scale	A measure of the similarity of features within and among ecosystem types. May be represented by the levels of a hierarchical classification.
Time frame	The total period over which ecosystem change is assessed.

1. Introduction

The IUCN Red List of Ecosystems was developed to promote a consistent global framework for monitoring the status of ecosystems (Keith et al., 2015). It is part of the growing toolbox for assessing risks to biodiversity and aims to support conservation, resource use and management decisions by identifying ecosystems most at risk of biodiversity loss. By targeting a level of biological organisation above species, the IUCN Red List of Ecosystems complements The IUCN Red List of Threatened Species™ (IUCN, 2015); together providing simultaneous assessment of broad- and fine-scale biodiversity. A combined approach is more likely to achieve the aim of comprehensive, effective and representative conservation outcomes and will improve the ability to monitor the status of biodiversity on Earth.

The basis of the IUCN Red List of Ecosystems is the *IUCN Red List of Ecosystems Categories and Criteria* (Appendix 2), a set of five criteria and associated thresholds that provide a repeatable, globally consistent method for classifying the risk of ecosystem collapse (Rodríguez et al., 2015; Keith et al., 2013). Ensuring accurate and comparable assessments for all ecosystem types included on the IUCN Red List of Ecosystems is a key challenge for the IUCN Red List of Ecosystems programme. These Guidelines provide the information required to meet this challenge.

The Guidelines assist users to correctly implement the *IUCN Red List of Ecosystems Categories and Criteria* by accompanying the assessor through the IUCN Red List of Ecosystems assessment process, from understanding the scientific foundations through to finalising assessments for publication. They provide information on the development of the protocol (Section 1) and a detailed overview of the scientific foundations that support the development of the categories and criteria (Sections 2 and 3). The Guidelines outline steps required to define the area and units of assessment, and the key ecosystem processes that will permit accurate application of the five criteria (Section 4). In addition, the Guidelines contain comprehensive sections on each of the five criteria, including information on relevant theory, thresholds and applications of each criterion (Section 5). Finally, the process of preparing an assessment for peer review and publication are described (Section 6).

1.1 Objectives of the IUCN Red List of Ecosystems

The primary goal of the IUCN Red List of Ecosystems (RLE) is to support conservation in resource use and management decisions by identifying ecosystems most at risk of biodiversity loss (Keith et al., 2013; Keith et al., 2015). By assessing relative risks of biodiversity loss at the ecosystem level, the RLE accounts for broad scale ecological processes and important dependencies and interactions among species (Keith et al., 2015). The IUCN Red List of Ecosystems also shines a light on common species, which define the identity of many ecosystems, are involved in key interactions with large numbers of co-occurring species, and can have major influences on ecosystem form and function (Gaston & Fuller, 2008). To achieve the primary goal of the RLE, listing categories and criteria were designed to be:

1. A standard method for assessing and comparing risks of ecosystem collapse.
2. Easily understood by policy makers and the public.
3. Transparent, objective and scientifically rigorous.
4. Applicable to terrestrial, marine, freshwater and subterranean systems.
5. Applicable to risk assessments of local to global areas.
6. Flexible to use data of varying quality and coverage.
7. Consistent with and complementary to The IUCN Red List of Threatened Species.

Although the primary goal of the RLE is focused on biodiversity conservation, the data associated with the RLE may inform a wide range of other activities, including the sustainable management of ecosystem services. Such applications will usually require additional tools to achieve effective planning outcomes (Keith et al., 2015).

1.2 Development of the IUCN Red List of Ecosystems

Although the desire to create a global Red List of Ecosystems (RLE) is not new within IUCN (Rodríguez et al., 2012a), the adoption of Resolution 4.020 on *Quantitative Thresholds for Categories and Criteria of Threatened Ecosystems* (Fourth World Conservation Congress, Barcelona, 2008) actively promoted the development of formal categories and criteria. The resolution requested IUCN to “initiate a consultation process for the development, implementation and monitoring of a global standard for the assessment of ecosystem status, applicable at local, regional and global levels.” Over the following four years, and with significant contributions from the scientific, government and conservation sectors, the IUCN Red List of Ecosystems Thematic Group of the Commission on Ecosystem Management (CEM) drafted an initial set of criteria (Version 1.0; Rodríguez et al., 2011). In subsequent years, the criteria were disseminated and tested globally across a suite of ecosystem types by a range of external partners and in collaboration with the IUCN Global Ecosystem Management Programme (GEMP).

One major output of the global consultation led by the CEM was a substantial advance in the scientific knowledge underpinning the RLE. The process resulted in a thorough review of the relevant literature on ecosystem structure and functioning, documentation of the theoretical basis for the RLE criteria, development of a model for ecosystem risk assessment, and application of this new model to 20 ecosystems worldwide (Keith et al., 2013). This revised set of *IUCN Red List of Ecosystems Categories and Criteria* (Keith et al., 2013) has been refined following further application of the criteria to case studies, now spanning many ecosystem types across all continents (Keith et al., 2015; Keith, 2015).

The Fifth World Conservation Congress (Jeju, 2012) adopted Resolution 5.055 on the *Consolidation of the IUCN Red List of Ecosystems*, which acknowledged the progress of the RLE development and requested the IUCN Council to “take the necessary steps for formal approval of the categories and criteria as an official IUCN data analysis protocol for use by the Members and any other stakeholder interested in ecosystem risk assessment”. Council examined the *IUCN Red List of Ecosystems Categories and Criteria* documentation and on 21 May 2014 adopted them as the official global standard for assessing the risk to ecosystems.

1.3 Governance of the IUCN Red List of Ecosystems

The Red List of Ecosystems is jointly coordinated by two IUCN bodies, the Commission on Ecosystem Management (CEM) and the Global Ecosystem Management Programme (GEMP). It is governed by two interacting committees with specific functions: (i) the Steering Committee, and (ii) a Committee for Scientific Standards. It is supported by the Red List of Ecosystems Thematic Group of the CEM, which is a group of volunteer experts that undertake diverse duties in support of the objectives of the RLE. The RLE Programme Unit—based in Cambridge, United Kingdom; Gland, Switzerland; and Nairobi, Kenya—administers the RLE and ensures global coordination of the experts involved in research, implementation and peer reviewing activities.

1.3.1 The Steering Committee

The RLE Steering Committee oversees the implementation of the *IUCN Red List of Ecosystems Categories and Criteria* at global and sub-global levels. The Steering Committee is composed of the Lead (and if applicable, the Co-lead) of the Red List of Ecosystems Thematic Group of the CEM (appointed by the Chair of the CEM), the Chair of the RLE Committee for Scientific Standards, the Chair of the CEM, the Director of the GEMP, the Head of the IUCN Science and Knowledge Unit, as well as additional members representing CEM, the IUCN Secretariat, and/or key RLE Partners appointed by the Chair of the CEM because of their specific technical or organisational expertise. The GEMP Director and the Head of the IUCN Science and Knowledge Unit represent the IUCN Secretariat.

The Steering Committee has the following functions:

1. Develop and manage the strategy and work plan for the implementation of the RLE worldwide, to achieve the goal of assessing all ecosystems at a global level by 2025.
2. Establish a mechanism for periodically updating global assessments.
3. Identify and approach potential sources of financial support for assessments and their dissemination.
4. Supervise a team of professional staff within the RLE Programme Unit, and build a network of volunteers to implement the RLE work plan both within the CEM and the IUCN Secretariat.
5. Actively engage the CEM in developing and peer reviewing assessments at the global and sub-global levels.
6. Develop training materials and guidelines in the three official IUCN languages to support assessments.
7. Recommend appointments to the RLE Committee for Scientific Standards.
8. Ensure that progress of the RLE is reported back to the IUCN Council and Secretariat senior management.
9. Ensure that progress and outcomes of the RLE are well communicated in the scientific literature and media.
10. Ensure the execution of the RLE work plan and maintain cooperation among collaborating organisations.
11. Actively engage with others involved in the development, testing, and applications of Knowledge Products mobilised by IUCN.

1.3.2 The Committee for Scientific Standards

The RLE Committee for Scientific Standards (CSS) is the principal scientific body that provides expertise in the development, application and review of all issues related to the RLE. The Committee consists of scientific experts with balanced expertise spanning a range of skills, including risk assessment, ecological modelling, remote sensing, ecosystem classification and mapping, decision theory, and ecology of terrestrial, freshwater, marine and subterranean ecosystems. The combined expertise of the members of the Committee for Scientific Standards covers the full diversity of ecosystem types and geographical regions.

Members of the Committee for Scientific Standards, including the Chair and Deputy Chair, are proposed by the RLE Steering Committee. The Chair of the CEM is ultimately responsible for appointing members to a maximum four-year term, which expires at the following session of the IUCN World Conservation Congress. One seat of the Committee for Scientific Standards is reserved for a representative of The IUCN Red List of Threatened Species designated by the Species Survival Commission (SSC) and the Global Species Programme (GSP).

The Committee for Scientific Standards promotes the application of high scientific standards to the implementation of the *IUCN Red List of Ecosystems Categories and Criteria*, and ensures that the intent of the categories and criteria is not compromised. The specific functions of the Committee for Scientific Standards are:

1. Develop and maintain technical guidelines in the three IUCN official languages to support the application of the *IUCN Red List of Ecosystems Categories and Criteria*, including details on implementation standards and data quality.
2. Provide scientific advice on the categories and criteria to the RLE Steering Committee and the Programme Unit.
3. Provide scientific advice and support to the Programme Unit on the development of databases, training materials and other resources.
4. Provide scientific advice on the design and implementation of systematic ecosystem risk assessment projects that could contribute to the global RLE.
5. Manage a peer review process of all classifications and maps of ecosystem types proposed for use in the global RLE.
6. Manage a peer review process for all assessments proposed for inclusion in the global RLE and, subject to the outcomes of the review process, submit recommendations to the Steering Committee on the inclusion or rejection of these assessments.
7. Critically review all applications of criterion E.
8. Provide scientific support and training for sub-global assessments of ecosystem types via the RLE Programme Unit and other RLE partners.
9. Promote and undertake research to improve ecosystem risk assessment methodologies underpinning the *IUCN Red List of Ecosystems Categories and Criteria*.
10. All formal decisions and recommendations of the RLE Committee for Scientific Standards are submitted to the Steering Committee for review and formal adoption.

1.4 Structure of the Guidelines

The *Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria* provide the information necessary to conduct a robust and repeatable ecosystem risk assessment suitable for inclusion on the RLE. Section 1 (Introduction) offers an overview of the motivation and history of the RLE, describing its general objectives and governing structure. Section 2 (Categories of the IUCN Red List of Ecosystems) presents the categories. Section 3 (Scientific Foundations) summarises the science underlying the categories and criteria, and presents the RLE risk assessment model. Section 4 (Assessment Process) guides assessors through a full assessment suitable for submission. The Criteria and Thresholds section (Section 5) outline the scientific theory underpinning each criterion, the estimation of variables for assessment, and the values of the thresholds for each category. Section 6 (Peer Review and Publication) describes the standards for evaluating the quality of a risk assessment. Throughout, a series of worked examples and cases studies are provided to assist assessors with the implementation of the categories and criteria.

A summary sheet of the current version of the *IUCN Red List of Ecosystems Categories and Criteria* is included as Appendix 2. More information on the IUCN Red List of Ecosystems, links to relevant documents, and summaries of case studies are available in multiple languages on the IUCN Red List of Ecosystems website (www.iucnrle.org).

2. Categories of the IUCN Red List of Ecosystems

The IUCN Red List of Ecosystems includes eight categories: Collapsed (CO), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE; Fig 1). The first six categories (CO, CR, EN, VU, NT and LC) are ordered in decreasing risk of collapse. The categories Data Deficient and Not Evaluated do not indicate a level of risk.

The categories Critically Endangered, Endangered and Vulnerable indicate threatened ecosystems and are defined by quantitative and qualitative criteria described in Section 5 and Appendix 2. These categories are nested, so that an ecosystem type meeting a criterion for Critically Endangered will also meet the criteria for Endangered and Vulnerable. The three threatened ecosystem categories are complemented by several qualitative categories that accommodate: (i) ecosystem types that almost meet the quantitative criteria for Vulnerable (Near Threatened); (ii) ecosystems that unambiguously meet none of the quantitative criteria (Least Concern); (iii) ecosystems for which too few data exist to apply any criterion (Data Deficient); (iv) ecosystems that have not yet been assessed (Not Evaluated). Following the precautionary principle (Precautionary Principle Project, 2005), the overall status of an ecosystem type is the highest risk category obtained through any criterion.

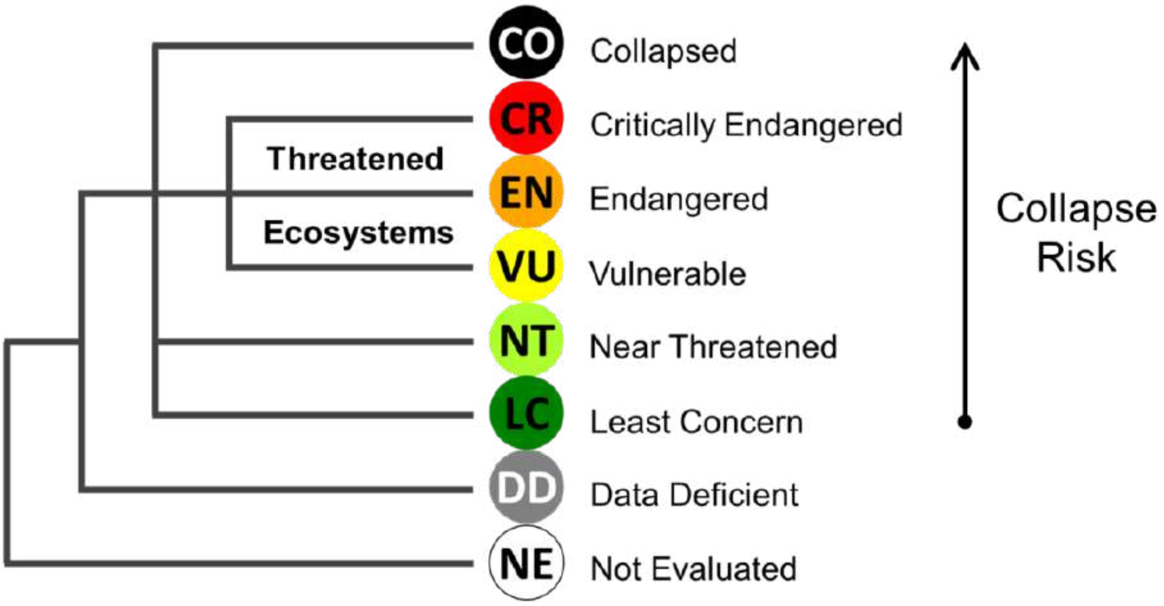


Figure 1. Structure of the IUCN Red List of Ecosystems categories.

Collapsed (CO)
An ecosystem is Collapsed when it is virtually certain (Table 3) that its defining biotic or abiotic features are lost from all occurrences, and the characteristic native biota are no longer sustained. Collapse may occur when most of the diagnostic components of the characteristic native biota are lost from the system, or when functional components (biota that perform key roles in ecosystem organisation) are greatly reduced in abundance and lose the ability to recruit.

Critically Endangered (CR)
An ecosystem is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered. It is therefore considered to be at an extremely high risk of collapse.

Endangered (EN)
An ecosystem is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered. It is therefore considered to be at a very high risk of collapse.

Vulnerable (VU)
An ecosystem is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable. It is therefore considered to be at a high risk of collapse.

Near Threatened (NT)
An ecosystem is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)
An ecosystem is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widely distributed and relatively undegraded ecosystems are included in this category.

Data Deficient (DD)
An ecosystem is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of collapse based on decline in distribution, disruption of ecological function or degradation of the physical environment. Data Deficient is not a category of threat, and does not imply any level of collapse risk. Listing of ecosystems in this category indicates that their situation has been reviewed, but that more information is required to determine their risk status.

Not Evaluated (NE)
An ecosystem is Not Evaluated when it is has not yet been evaluated against the criteria.

3. Scientific foundations

3.1 Ecosystem types: the units of assessment

The IUCN Red List of Ecosystems (RLE) protocol is a robust and generic risk assessment framework that can be applied to internally consistent classifications of ecosystem types. It has flexibility to assess risks to ecosystems that vary greatly in biological and environmental characteristics, scales of organisation, and amounts of available data. The clear definition and description of ecosystem types is therefore an essential first step to a RLE assessment.

Ecosystems are complexes of organisms and their associated physical environment within a specified area (Tansley, 1935). They have four essential elements: a biotic complex, an abiotic environment, the interactions within and between them, and a physical space in which these operate (Pickett and Cadenasso, 1995). Guidance on how to apply these concepts to define and describe suitable units for RLE assessment is given in section 4.2 Describing the unit of assessment.

3.1.1 Ecosystem typologies

The *IUCN Red List of Ecosystems Categories and Criteria* may be applied systematically to a set of ecosystem types within a specified area of assessment (global or sub-global) or to single ecosystem types. Standalone assessments of single ecosystem types can be useful diagnostic tools for ecosystem management (Keith et al., 2015). So long as the unit of assessment is clearly defined and delineated, standalone assessments are less reliant on a classification (typology) of ecosystem types than systematic assessments of multiple ecosystems. These systematic assessments require a typology to ensure consistent and comparable ecosystem risk assessments across the area of assessment. The classification may simply delineate units at a particular thematic scale, or may describe their relationships using hierarchies or nested arrangements that span a range of thematic scales (Rodríguez et al., 2011).

A number of jurisdictions have developed suitable typologies to support RLE assessments of national jurisdictions (Kontula & Raunio, 2009; Lindgaard & Henriksen, 2011; Driver et al., 2012). At the continental level, a RLE assessment of several hundred terrestrial ecosystem types for the Americas is based on an international classification framework for terrestrial vegetation (Faber-Langendoen et al., 2014; Rodríguez et al., 2012b). The thematic scale of ecosystem types in this assessment corresponds to the group and macrogroup levels in the International Vegetation Classification system (Faber-Langendoen et al., 2014), and is appropriate for global RLE assessments.

Sub-global assessments may be based on established national or regional ecosystem classifications, providing the units of assessment conform to the definition of ecosystem types (see 3.1 Ecosystem types: the units of assessment, above). These units should be justified as suitable proxies for ecological assemblages and should be cross-referenced to national, regional or global classification systems.

Development of a global ecosystem typology is currently underway (led by the RLE Committee for Scientific Standards and the CEM RLE Thematic Group). This work is guided by recent research on classifications of terrestrial vegetation (Faber-Langendoen et al., 2014) and marine environments (Gregr et al., 2012), and seeks to promote transparent and repeatable crosswalks among sub-global typologies meeting certain specifications (Section 4.1). In the interim, the IUCN Habitats Classification Scheme (www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3) provides a useful comparative framework for assessments of contrasting ecosystem types at a range of thematic scales.

Globally recognisable ecosystem types should not be confused with biogeographic or biophysical ecoregions (Spalding et al., 2007), or biomes (Allen & Hoekstra, 1990). Ecoregions and biomes are areas that share common macro-environmental or biogeographical features and contain complexes of contrasting, but co-occurring ecosystem types (Spalding et al., 2007). The potential heterogeneity of ecoregions and biomes makes them unsuitable for most RLE applications (Rodríguez et al., 2015; Keith et al., 2015; Keith et al., 2013). Other terms applied in conservation assessments –such as ecological communities, habitats, biotopes, and (largely in the terrestrial context) vegetation types – are regarded as operational synonyms of ecosystem type (Nicholson et al., 2009) providing they are adequately defined in accordance with the procedures described in the assessment process (Section 4.2).

3.1.2 The influence of scale

The RLE risk assessment protocol was designed to be flexible for application at multiple spatial scales and with a range of data types (Rodríguez et al., 2015; Keith et al., 2015; Keith et al., 2013). However, there are practical limits to the spatial, temporal and thematic scales of units that can be assessed, and within these limits the assessment outcomes are sensitive to scale. Assessments of units that are too broadly or narrowly defined, or failure to implement methods or standardisation procedures (Section 5) could lead to scale mismatches, incomparable assessments across scales, or invalid assessment outcomes (Keith et al., 2013). A range of measures in the RLE protocol address the influence of scale:

1. Research is underway to support the interpretation of the RLE criteria for assessments of different geographic areas. The categories and criteria were primarily designed for assessments at the global level, but are applicable to sub-global assessments (Section 3.1.1). Many of these sub-global assessments will work within ecologically arbitrary boundaries (e.g. national borders), and therefore will consider only parts of the global distribution of some ecosystem types. Methods for interpreting and scaling threat categories or their thresholds to account for these scenarios are currently under investigation.

2. A growing number of national and subnational assessments provide guidance on appropriate thematic scales (classification level or strength; Hermoso et al., 2013) for ecosystem risk assessments (Table 1). The ecosystem typologies provide examples of ecosystem classifications designed to support different regulatory frameworks and

conservation planning applications among jurisdictions. The development of a global typology will provide further guidance on the thematic scale of assessments for the global RLE.

3. Standard scales for assessing geographical distribution: the grain size (e.g. pixel resolution) at which an ecosystem distribution is mapped can greatly affect the estimate of distribution size. To maintain consistency with the fixed thresholds for assessing distribution size (criterion B), distributions are measured at a standard grain size (10x10 km grid) for estimating AOO and a standard geometric method (minimum convex polygon) for estimating EOO. This generalising process is sufficiently broad to accommodate processes relevant to persistence in a wide range of ecosystem types (Section 5.2). A range of tools are made available to assist with upscaling and downscaling distribution data, and completing assessments under criteria A and B (Section 5).

4. Standard time frames for assessment: temporally, ecosystems may develop, persist and change over time frames that vary from hours to millennia. They appear stable at some temporal scales, while undergoing trends or fluctuations at others (Wiens, 1989; Carpenter & Turner, 2001). The categories assess ecosystem change over standard time frames that represent trends over present, future and historical time scales. Present and future time frames are set at 50 years to balance the need to diagnose trends with reasonable certainty (requiring long time frames) with the need for timely responses to adverse trends. Historical time frames are included to accommodate the effects of ecological lags in assessments (Section 5).

Table 1. Examples of ecosystem typologies and similar classifications supporting national ecosystem risk assessments for various conservation planning and regulatory applications (adapted from Keith et al., 2015).

Jurisdiction	*Application*	*Assessment unit*	*Reference*
European Union	Habitats Directive 92/43/EEC (European Commission)	Habitat type. 'Plant and animal communities as the characterising elements of the biotic environment, together with abiotic factors operating together at a particular scale.'	Council of the European Commission (1992)
Germany	Red List of biotopes (Federal Environment Agency)	Biotope. 'Habitat of a community of fauna and flora living in the wild.'	Riecken et al. (2009); Riecken et al. (2006)
Finland	Red List of habitat types (Finnish Environment Institute)	Habitat type. 'Spatially definable land or aquatic areas with characteristic environmental conditions and biota which are similar between these areas but differ from areas of other habitat types.'	Kontula & Raunio (2009)
Norway	Red List of ecosystems and habitat types (Norwegian Biodiversity Information Centre)	Habitat type. 'A homogeneous environment, including all plant and animal life and environmental factors that operate there.'	Lindgaard & Henriksen (2011)
Venezuela	National Red List of ecosystems (Provita)	Major vegetation types for national assessment; satellite-derived land types for subnational assessments.	Rodríguez et al. (2010)
Canada	State threatened species and ecosystems legislation (Manitoba Conservation and Water Stewardship Department)	Ecosystem. 'A dynamic complex of plant, animal and microorganism communities and their nonliving environment interacting as a functional unit.'	Government of Manitoba (2014)
Australia	Lists of threatened ecological communities at national and state levels (Federal Department of Environment, state environment agencies)	Ecological community. 'An assemblage of native species that inhabits a particular area in nature.'	Commonwealth of Australia (2000); Keith (2009); Nicholson et al. (2015)
South Africa	National biodiversity legislation (South African National Biodiversity Institute)	Ecosystem. 'A dynamic complex of animal, plant and micro-organism communities and their nonliving environment interacting as a functional unit.'	Republic of South Africa (2004); Driver et al. (2012)

3.2 Ecosystem collapse

To achieve a robust application of the *IUCN Red List of Ecosystems Categories and Criteria*, assessors must synthesise diverse causes, mechanisms and pathways of ecosystem decline within the generic risk assessment framework. To estimate risk—the probability of an adverse outcome over a specified time frame—it is necessary to define the endpoint of ecosystem decline, the point at which an ecosystem is considered collapsed. The definition of the endpoint to ecosystem decline must be sufficiently discrete to permit an assessment of risk, but sufficiently general to encompass the broad range of contexts in which risk assessments are needed. The RLE protocol has two elements to deal with this trade-off: (i) a definition of ecosystem collapse as the endpoint to ecosystem decline; (ii) a risk assessment model that identifies the multiple pathways to ecosystem collapse and forms the basis for the criteria.

Within the *IUCN Red List of Ecosystems Categories and Criteria*, “an ecosystem is Collapsed when it is virtually certain (Table 3) that its defining biotic or abiotic features are lost from all occurrences, and the characteristic native biota are no longer sustained. Collapse may occur when most of the diagnostic components of the characteristic native biota are lost from the system, or when functional components (biota that perform key roles in ecosystem organisation) are greatly reduced in abundance and lose the ability to recruit.”

3.2.1 Defining ecosystem collapse

Unlike species, ecosystems do not disappear; rather they transform into novel ecosystems with different characteristic biota and mechanisms of organisation (Hobbs et al., 2006; Keith et al., 2015; Keith et al., 2013). Many characteristic features may disappear long before the last characteristic species disappears from the last ecosystem occurrence (assemblage extinction; Gaston & Fuller, 2008). The novel systems may retain some of the characteristic biota of the collapsed systems that they replace, but the abundance of those species, their interactions or ecological functions are altered. Acknowledging the contrasts with species extinction, the concept of ecosystem collapse is defined as the transition beyond a bounded threshold in one or more variables that define the identity of the ecosystem. Collapse is a transformation of identity, a loss of defining features, and/or replacement by a different ecosystem. An ecosystem is collapsed when all occurrences lose defining biotic or abiotic features, no longer sustain the characteristic native biota, and have moved outside their natural range of spatial and temporal variability in composition, structure and/or function. This can be illustrated by the familiar ‘marble’ model of state and transition theory (Fig. 2) and by key examples such as the Aral Sea (Box 1). Ecosystem collapse may in theory be reversible—given a long time frame, or via the reintroduction of characteristic biota and/or the restoration of ecosystem function—but in many systems recovery will not be possible.

Transitions to collapse may be gradual, sudden, linear, non-linear, deterministic or highly stochastic. These include regime shifts (Scheffer et al., 2001), but also other types of transitions that may not involve reinforcing feedbacks. The dominant dynamic in an ecosystem will depend on abiotic or external influences (e.g. weather patterns or human disturbance), internal biotic processes (e.g. competition, predation, or epidemics), historical legacies (e.g. climatic history, extinction debts or exploitation), and spatial context (e.g.

whereabouts, size and dispersion of distribution). An ecosystem may thus be driven to collapse by different threatening processes and through multiple pathways. Trophic cascades (Estes et al., 2011), loss of foundation species (Diamond, 2007), environmental degradation (UNEP, 2001), and climatic forcing (Grebmeier et al., 2006) are common pathways to ecosystem collapse. Symptoms of collapse may differ depending on the characteristics of the ecosystem, the nature of threatening processes, and the pathways of decline that these generate. The RLE protocol has flexibility to allow thresholds of collapse to be expressed in appropriate terms for very different kinds of ecosystems.

The definition of ecosystem collapse may be clearest for ecosystems that have already collapsed and for which time series data exist for relevant variables. It will often be possible to infer characteristics of collapse from occurrences within the ecosystem distribution where defining features have been lost, even if the majority of the ecosystem remains extant. Major changes in functionally similar ecosystems can also provide guidance for defining the symptoms of collapse in systems of interest. This can provide a basis for defining the spatial and functional symptoms of ecosystem collapse.

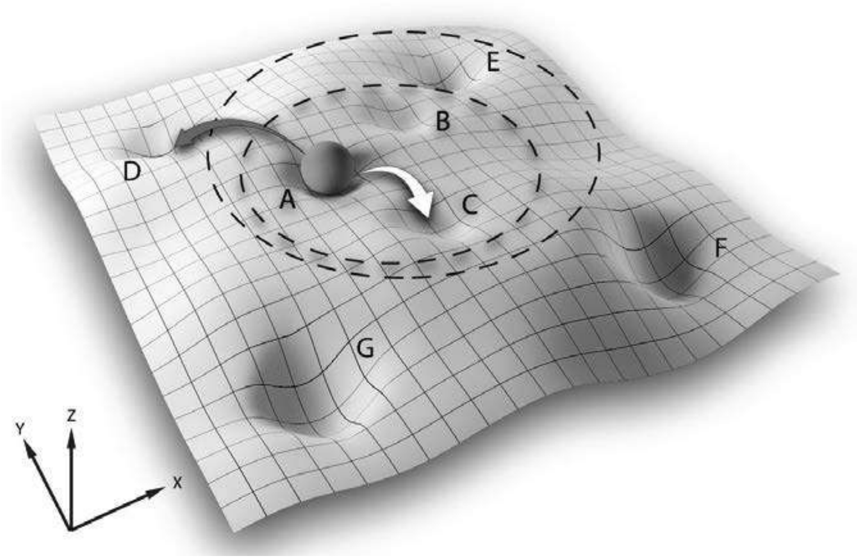


Figure 2. Generalised schematic illustrating the interpretation of ecosystem collapse in a state and transition framework (Keith et al., 2015). States A-G are defined by two state variables represented on the X and Y axes. The vertical axis (Z) represents potential for change. The two broken lines represent alternative interpretations of ecosystem collapse. For the inner line, transitions between states A, B and C (e.g. white arrow) represent natural variability without loss of key defining features, while transitions across broken lines (e.g. grey arrow) to states D, E, F and G represent collapse and replacement by novel ecosystems. Progression along different pathways of collapse is assessed with variables X and Y, or other ecosystem-specific diagnostic variables that reflect the loss of characteristic native biota and function. The outer broken line represents an alternative interpretation of ecosystem collapse in which state E is included within natural variation of the ecosystem type.

Box 1. Ecosystem collapse in the Aral Sea

The Aral Sea – the world's fourth largest continental water body – is fed by two major rivers, the Syr Dar'ya and Amu Dar'ya (Aladin & Plotnikov, 1993). Its characteristic native biota includes freshwater fish (20 species), a unique invertebrate fauna (>150 species) and shoreline reed beds, which provide habitat for waterbirds, including migratory species (Keith et al., 2013). Hydrologically, the sea was approximately stable during 1911-1960, with inflows balancing net evaporation (Micklin & Aladin, 2008). Intensification of water extraction to support expansion of irrigated agriculture lead to shrinkage and salinisation of the sea. By 2005, only 28 aquatic species (including fish and invertebrates) were recorded, reed beds had dried and disappeared, the sea had contracted to a fraction of its former volume and surface area, and salinity had increased tenfold (Micklin & Aladin, 2008).

Consistent with the definition of ecosystem collapse, these changes suggest the Aral Sea has undergone a transformation of identity, lost many of its defining features (aquatic biota, reed beds, waterbirds, hydrological balance and brackish hydrochemistry) and has been replaced by novel ecosystems (saline lakes and desert plains). Under this interpretation, collapse occurred before the volume and surface area of standing water declined to zero. Although the exact point of ecosystem collapse is uncertain, time series data for several variables are suitable for defining a functional reference state (prior to onset of change from 1960) and a bounded threshold of collapse, assuming this occurred sometime between 1976 and 1989 when most biota disappeared (Keith et al., 2013).

The choice of available variables for assessing the status of the ecosystem will depend on how closely they represent the ecosystem's defining features, the quantity and quality of the data, and the sensitivity of alternative variables to ecological change. Of those listed above, fish species richness and abundance may be the most proximal biotic variable to the features that define the identity of the Aral Sea ecosystem. Sea volume may be a reasonable abiotic proxy, because volume is functionally linked with salinity, which in turn mediates persistence of the characteristic freshwater/brackish aquatic fauna. Sea surface area is less directly related to these features and processes, but can be readily estimated by remote sensing and may be useful for assessment when data are unavailable for other variables.

Collapse of the Aral Sea ecosystem may or may not be reversible. While it may be possible to restore the hydrological regime over a small part of the former sea (Micklin & Aladin, 2008), some components of the characteristic biota are apparently extinct (e.g. the Aral salmon, *Salmo trutta aralensis*), preventing reconstruction of the pre-collapse ecosystem. Image: © NASA

3.2.2 Uncertainties in the endpoints for risk assessment

Risk assessment relies on the definition of an adverse outcome, typically a discrete endpoint or event that affects the asset under evaluation. The implementation of risk assessment confronts uncertainties in two key areas: the definition of the asset itself, and the definition of the endpoint. The boundary which delineates an ecosystem type may be uncertain due to imperfect knowledge of natural variability within the ecosystem, continuous patterns of variability with other ecosystems, and changes in ecosystem classification through time, as well as uncertainties associated with mapping distributions (Keith et al., 2013). Defining ecosystem collapse is also subject to uncertainty which can affect the estimation of spatial and functional symptoms of collapse (Fig. 3). All applications the *IUCN Red List of Ecosystems Categories and Criteria* should consider these sources of uncertainty and discuss them in the assessment documentation. Examples of how uncertainties can be dealt with through the assessment process are described below, acknowledging that uncertainties in spatial and functional systems are often related.

Uncertainty in spatial symptoms

During decline, an ecosystem may transition to collapsed state(s) in some parts of its distribution before others. In areas where these transitions have occurred, the ecosystem may be described as ‘locally collapsed’. Spatially, an ecosystem is considered collapsed when all extant occurrences of the ecosystem have collapsed (i.e. area of occupancy = 0 10x10 km grid cells and extent of occurrence = 0 km^2). To quantify past declines in distribution and declines in function, assessors must identify where the ecosystem type is currently extant, and where it was previously extant (within the time frame of assessment) and is now in a collapsed state. Similarly, to quantify future declines in distribution and function, assessors must project the area in which the ecosystem will collapse during the future time frame of the assessment. All of these estimations and projections involve uncertainties. Epistemic uncertainty (i.e. uncertainty due to a lack of knowledge, as opposed to inherent uncertainty due to variability in the system) exists due to a range of measurement and classification errors:

1. Thematic uncertainties caused by decisions relating to the threshold at which an ecosystem type is considered to have moved outside of its natural bounds of variability, and must then be considered a different ecosystem type (Payet et al., 2013).

2. Measurement error due to imperfect measurements or mapping techniques resulting in area estimates that are not precisely repeatable and randomly fluctuate (Elith et al., 2002; Olofsson et al., 2014; Fuller et al., 2003).

3. Systematic error due to mapping methods that consistently produce biased area estimates (Congalton & Green, 2008).

4. Classification errors that result in misclassification of pixels in a distribution map, generally termed omission or commission errors (Congalton & Green, 2008; Foody, 2011).

5. Errors of scale where the grain size at which an ecosystem is mapped results in area estimates that are dependent on the scale at which they are mapped (Hartley & Kunin, 2003; Gaston & Fuller, 2009).

Uncertainty in functional symptoms

A collapsed ecosystem may be replaced by a novel ecosystem with strongly contrasting features. When grasslands replace forests, the change in vegetation structure is readily detected by a range of proximal and remotely sensed methods. In other cases, ecosystems may lose defining features and collapse, but the novel system may resemble the antecedent one, making symptoms of collapse more difficult to detect. Burns et al. (2015) describe an example of a forest ecosystem characterised by biota associated with large old trees. When densities of large old trees fall below a critical level, characteristic native biota is lost from the system. This includes birds and mammals that nest or shelter in tree hollows, and invertebrates that live under loose bark and in deep leaf litter beds. After such transitions, the novel ecosystem still retains a forest structure, albeit one characterised by smaller trees and lacking biota associated with large trees. Similarly, Barrett & Yates (2015) described collapse of a species-rich shrubland as the elimination of groups of plant species eliminated by a soil-borne disease. The novel ecosystem replacing the antecedent one was a structurally similar, but compositionally and functionally different shrubland. These and other examples illustrate uncertainties in delineating extant and collapsed states, which depend on the features of the antecedent ecosystem, the pathway of collapse, and the features of the novel ecosystem. Sources of uncertainty include:

1. Definition of reference ecosystem states, and the natural variability within those.

2. Definition of collapsed ecosystem states, which represent critical deviations from natural variability. Transition points from original to novel ecosystems are inherently uncertain but can be estimated within plausible bounds (Fig. 3). The first value represents no doubt that the ecosystem has collapsed, whereas the second is a plausible value based on observations or inferences.

3. Variation in collapsed states caused by different threatening processes. Catastrophic threats may cause total functional and spatial collapse of the ecosystem. Other threats, such as environmental degradation or the spread of invasive species may cause different functional changes in characteristic biota. These different pathways of collapse should be reflected in the documentation (as part of the definition of collapse; see Section 4.2.7 and Section 5).

4. Uncertainty in the measurement of variables representing ecosystem function and collapse. As with spatial variables, measurement error in functional variables may affect the assessment of ecosystem collapse through random errors or systematic bias.

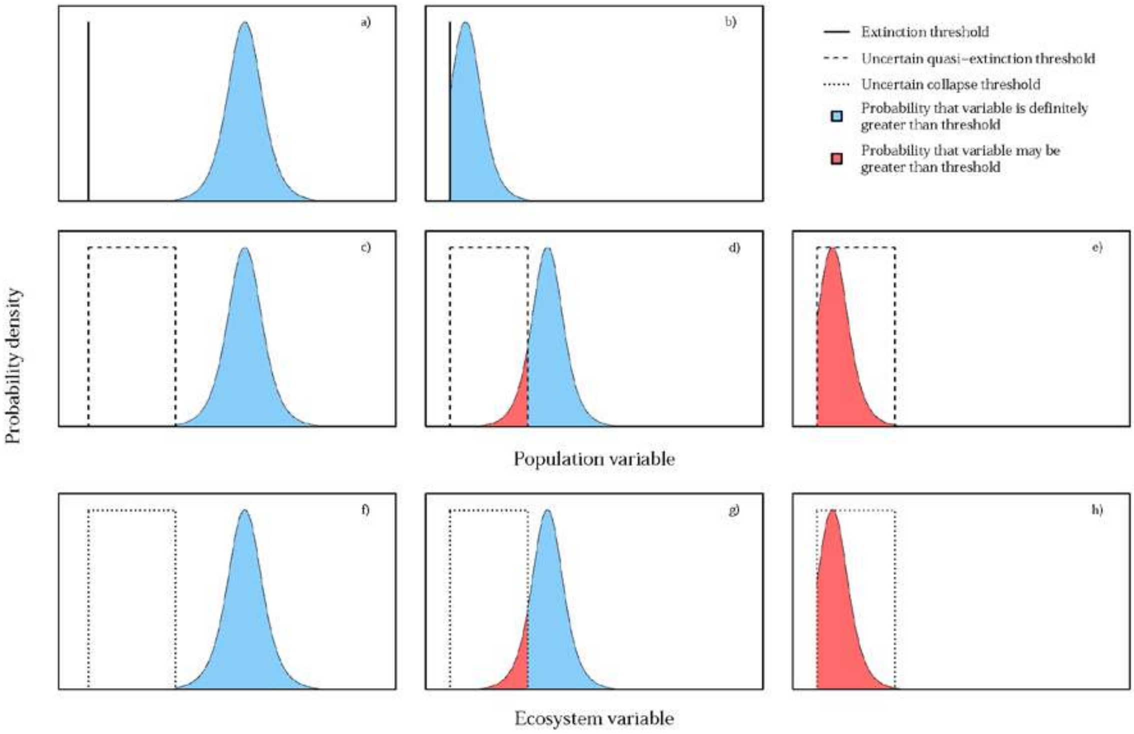


Figure 3. Probability density functions for the population and ecosystem variables that measure proximity to the thresholds that define species extinction (a, b), species quasi-extinction (c-e), and ecosystem collapse (f-h). For species, the population threshold that defines extinction is known with certainty (e.g. zero abundance, described by the vertical line in (a) and (b)). In practice, Population Viability Analyses are calibrated on a quasi-extinction threshold higher than the extinction threshold, to account for prediction and management uncertainty. A lower bound on the value of extinction (zero abundance), and a putative upper bound for the value of quasi-extinction can be depicted as a dashed box (c-e). For ecosystems (f-h) the x-axis could represent key features or processes (e.g. spatial distribution, number of species, water quality). The bounded definition of collapse is analogous to the definition of quasi-extinction in species. The width of the dashed box represents uncertainty in the collapse definition. The blue area represents the probability that the ecosystem is definitely extant, whereas the red area represents the probability that the ecosystem may be extant (adapted from Keith et al., 2013).

3.3 Risk assessment protocol

The RLE protocol comprises five rule-based criteria for assessing risks to ecosystems. Risks to ecosystems may be caused by a variety of threatening processes that are expressed through different symptoms of ecosystem collapse (Keith, 2015). The RLE protocol groups symptoms of ecosystem collapse into four major types and identifies the corresponding mechanisms that link the symptoms to the risk that an ecosystem will lose its defining features (Fig. 4). Two of the four mechanisms produce distributional symptoms: (A) declines in distribution, which reduce carrying capacity for dependent biota; and (B) restricted distribution, which predisposes the system to spatially explicit threats. Two other mechanisms produce functional symptoms: (C) degradation of the abiotic environment, reducing habitat quality or abiotic niche diversity for component biota; and (D) disruption of biotic processes and interactions, resulting, for example, in the loss of mutualisms, biotic niche diversity, or exclusion of some component biota by others. Interactions between two or more of these four contrasting mechanisms may produce additional symptoms of transition towards ecosystem collapse. Multiple mechanisms and their interactions may be integrated into a simulation model of ecosystem dynamics to produce quantitative estimates of the risk of collapse (E). These five groups of symptoms form the basis of the RLE criteria. An ecosystem type under assessment should be evaluated using all of the criteria for which data are available. The overall risk status of the ecosystem type is assigned as the highest category of risk obtained through any criterion.

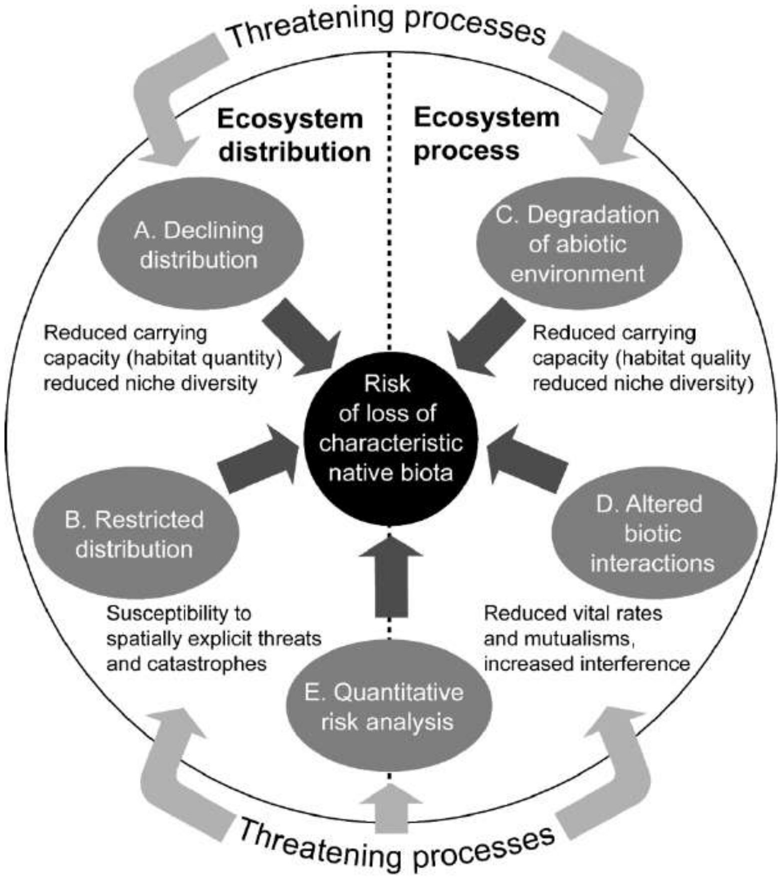


Figure 4. Mechanisms of ecosystem collapse and symptoms of collapse risk (source: Keith et al., 2013).

3.3.1 Time frames

The criteria assess declines over four specified time frames: the historical past, the recent past, any 50-year period including the recent past, present and future, and the future (Fig. 5). The ‘recent past’ time frame encompasses the past 50 years, which is sufficiently recent to capture current trends but long enough to distinguish directional change from natural variability. The RLE protocol assumes that declines over this time frame are indicative of future risk irrespective of cause.

Assessment of future declines requires predictions of changes over the next 50 years or any 50-year period including the present and future (Fig. 5). Past declines may provide a basis for such predictions, but other information may support predictions and inferences about rates of future decline even when the ecosystem is currently stable. Such predictions require a defensible assumption about the pattern of future change (e.g. accelerating, constant, decelerating). Plausible alternative models of change should be explored where appropriate, but a constant proportional rate of decline is often a reasonable default assumption (Section 5).

Assessments of historical declines are essential for ecosystems containing biota with long generation lengths and slow population turnover (Mace et al., 2008). They are also essential for foundation species with short generation lengths which may have suffered extensive historical declines (e.g. oyster reefs: Kirby, 2004; Beck et al., 2011). Even where future rates of decline abate, historical reductions in distribution or function may predispose an ecosystem to additional threats and reduce its ability to absorb adverse changes (Folke et al., 2004). Historical declines are assessed relative to ecosystem status at a notional reference date of 1750, corresponding approximately to the earliest onset of industrial-scale exploitation of ecosystems. In parts of the world where industrial-scale exploitation of ecosystems commenced earlier or later than 1750, it is justifiable to assess historical declines with a different baseline. Distribution models with environmental predictors may be used to estimate historical declines based on the difference between the current state of an ecosystem and its expected state in the absence of industrial-scale anthropogenic effects. Such approaches are most useful in regions where landscape-scale change did not occur before the industrial era.

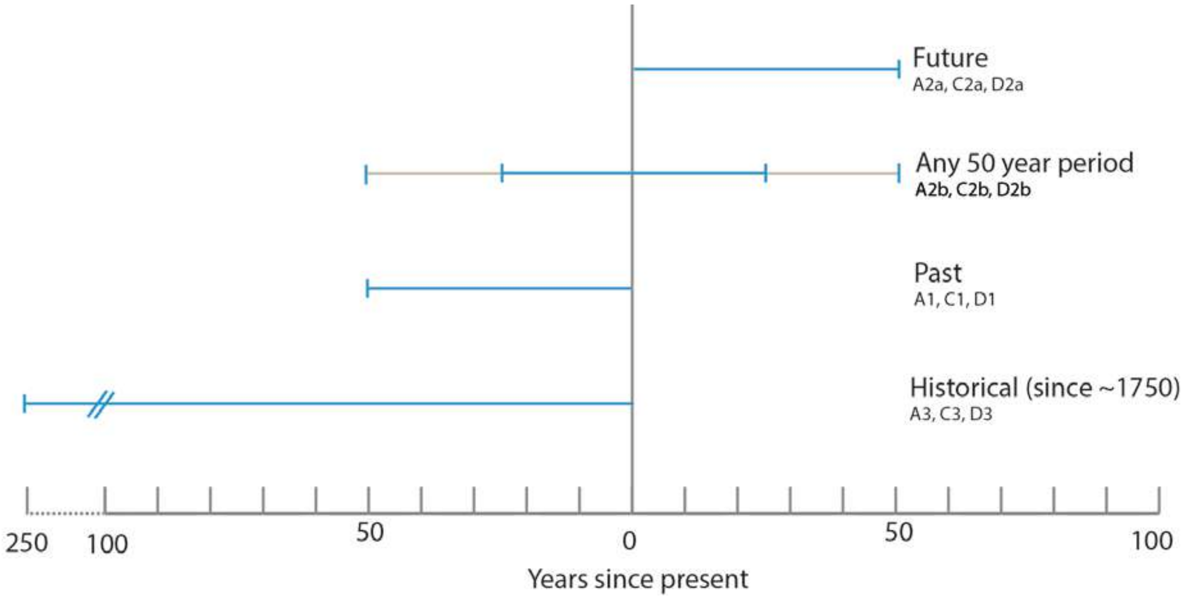


Figure 5. Time frames for assessment of change under criteria A, C, and D (adapted from Keith et al., 2013).

3.3.2 Decline thresholds

The ordinal categories of risk (Section 3) are delimited by thresholds defined in the *IUCN Red List of Ecosystems Categories and Criteria* (Appendix 2). The rationale for the criteria and ordinal categories is grounded in theory (Keith et al., 2013). However, the threshold values that delimit categories are based partly on theoretical considerations and partly on utilitarian considerations (Keith et al., 2015). Theory provides a qualitative basis for ordered thresholds for decline, but offers limited guidance for setting their absolute values. The purpose of these decision thresholds is to rank ecosystems in informative ordinal categories of risk, rather than estimate precise probabilities of collapse. Consequently, for criteria A, C, and D, threshold values were set at relatively even intervals for current and future declines in ecosystem distribution or function (Vulnerable: 30%, Endangered: 50%, Critically Endangered: 80%). The range of thresholds between 0 and 100% seeks to achieve an informative rather than highly skewed ranking of ecosystems among categories. The lowest threshold for a threatened ecosystem type (30%) recognises that evidence of an appreciable decline in ecosystem distribution or function is necessary to support listing in a threatened category. These thresholds are consistent with thresholds for population reduction in The IUCN Red List of Threatened Species (IUCN, 2001, 2012). Thresholds for historical declines are higher (A3, C3, D3; 50%, 70%, 90%) because times frames for assessment are longer.

Declines within 5-10% of thresholds for the Vulnerable category may warrant listing as Near Threatened, although there are no quantitative thresholds for this category (Section 3). For example, an ecosystem type with an extent of occurrence of 50,000 to 55,000 km^2 that qualifies for at least one of the three subcriteria of criterion B could qualify for listing as Near Threatened. An ecosystem type with a decline in an abiotic variable of 20% to 30% relative severity and 100% extent could qualify as Near Threatened under subcriteria C1 or C2.

3.3.3 Standards of evidence and dealing with uncertainty

Achieving a robust and repeatable assessment for an ecosystem type requires extensive data, often from disparate sources. The categories and criteria were specifically designed to allow the inclusion of various data types from a range of sources, but it is the onus of the assessor to critically evaluate whether data quantity and quality are sufficient to support determinate outcome of an assessment. For guidance on this evaluation, assessors are referred to the principles adopted by the Intergovernmental Panel on Climate Change for consistent treatment of uncertainty (Mastrandrea et al., 2010). In summary, key principles include:

1. Evaluating the type (Table 2), amount, quality, and consistency of evidence (summary descriptors: “limited,” “medium,” or “robust”);

2. Evaluating the degree of agreement between different sources of evidence (summary descriptors: “low,” “medium,” or “high”);

3. Providing a traceable account describing the evaluation of evidence and agreement;

4. Evaluating the likelihood (Table 3) of alternative categories as outcomes of an assessment;

5. Communicating the uncertainty in the outcomes of an assessment by reporting the most likely category and as well as categories that represent plausible upper and lower bounds of the assessment outcome (Section 4.4.1).

The standard of evidence for the RLE must be sufficient to support inferences that:

1. Some categories (LC, NT, VU, EN or CR) are ‘very unlikely’ outcomes of assessment (i.e. probability <10%, Table 3). If no category is a very unlikely outcome of assessment, then the status should be assigned as Data Deficient (DD);

2. The plausible bounds of assessment outcomes include all categories necessary to ensure that collectively they are ‘very likely’ to encompass the true status (i.e. probability >90%, Table 3). If all categories (LC-CR) are within the plausible bounds, then the status should be assigned as Data Deficient (DD);

3. The best overall status (i.e. categorisation of an ecosystem) is more likely than any alternative categorisation and within the plausible bounds; and

4. All categorisations of overall status in the Collapsed category (CO) are ‘virtually certain’ (i.e. >99% certain, Table 3). Where this is not the case and CO is the most likely category, the best overall status should be assigned to CR, and CO reported as the upper bound of the assessment outcome.

Table 2. Descriptors for types of evidence (IUCN, 2001, 2012) will typically support inferences during an assessment. These apply to quantitative variables (such as rates of change in distribution) and binary inferences (such as whether or not there is a continuing decline in distribution).

Descriptor	*Explanation*
Observed	Information that is directly based on well-documented records of all known occurrences of the ecosystem (IUCN Standards and Petitions Subcommittee, 2016).
Estimated	Information that is based on calculations that may include statistical assumptions about sampling, or biological assumptions about the relationship between an observed variable and the variable of interest (e.g. relationship between an index of abundance and the number of mature individuals; IUCN Standards and Petitions Subcommittee, 2016). These assumptions should be stated and justified in the assessment documentation. Estimation may also involve interpolation in time to calculate the variable of interest for a particular time step (e.g. a 50-year reduction in distribution based on observations of distribution 40 and 60 years ago).
Inferred	Information that is based on indirect evidence and on variables that are indirectly related to the variable of interest, but in the same general type of units (IUCN Standards and Petitions Subcommittee, 2016). Inferred values rely on more assumptions than estimated values. For example, inferring disruption of biotic interactions from catch statistics not only requires statistical assumptions (e.g. random sampling) and biological assumptions (about the relationship of the harvested section of the population to the total population), but also assumptions about trends in effort, efficiency, and the spatial and temporal distribution of harvest in relation to the population. Inference may also involve extrapolating an observed or estimated quantity from known ecosystem occurrences to calculate the same quantity for other occurrences. Whether there are enough data to make such an inference will depend on how large the known occurrences are as a proportion of the whole distribution, and the applicability of threats and trends observed in the known occurrences to the rest of the ecosystem.
Projected	Same as estimated, but the variable of interest is extrapolated in time towards the future (IUCN Standards and Petitions Subcommittee, 2016). Projected variables require a discussion of the method of extrapolation (e.g. justification of the statistical assumptions or the ecosystem model used) as well as the extrapolation of current or potential threats into the future, including their rates of change.

Table 3. Calibrated language for describing quantified uncertainty (source: Mastrandrea et al., 2010). It can be used to express a probabilistic estimate of a quantity, a binary inference or an assessment outcome (e.g. a magnitude of change in distribution, whether or not there has been a change, whether the status of an ecosystem is within a given range). Likelihood may be based on statistical or modelling analyses, elicitation of expert views, or other quantitative analyses. The categories defined in this table can be considered to have "fuzzy" boundaries (Kauffman & Gupta, 1991).

Term	*Likelihood of outcome (probability)*
Virtually certain	99–100%
Very likely	90–100%
Likely	66–100%
More likely than not	50–100%
About as likely as not	33–66%
Unlikely	0–33%
Very unlikely	0–10%
Exceptionally unlikely	0–1%

3.3.4 Making the most of quantitative data and expert knowledge

The Red List criteria require calculations based on quantitative estimates of variables such as areas and rates of change in biotic and abiotic features of ecosystems. Quantitative estimates of these variables are ideally based on systematic measurements acquired in a sampling design that permits valid statistical inferences across the geographic range of the ecosystem type under evaluation. In reality, relevant and useful evidence on ecosystem status includes a range of incomplete, patchy and subjective observations.

Scientific judgements are required to decide which pieces of information meet the standard of evidence required to support an inference about the status of an ecosystem. For example, a particular forest ecosystem may never have been mapped at an appropriate resolution to quantify the proportional change in its distribution over the past 50 years, as required to assess criterion A1. Despite the lack of formal data, experts are unanimous in their opinion, based on anecdotal observations, that at least 50% of the ecosystem distribution has been converted to pasture in the past 50 years. The high degree of certainty about the rate of decline should inform a Red List assessment – the status of the forest ecosystem is likely to be at least Endangered and is very unlikely to be Least Concern. Qualitative expert knowledge may also add value to quantitative measurements. For example, data from repeat surveys of fish in a marine reef ecosystem may indicate a 32% decline in abundance over the past 50 years, but experts are unanimous that surveys are limited to the most exploited reefs and, based on anecdotal observations, that fish abundance has remained "approximately stable" on many unexploited reefs. If fish abundance was assumed to decline by 0-20% on these unexploited reefs (a worst-case interpretation of "approximately stable"), the overall average decline across all reefs is estimated to decline by 15-25%. In this case, Least Concern or Near Threatened may be more likely status than Vulnerable, despite the estimate based on formal data.

Both examples above show how expert knowledge can improve inferences about Red List status compared to assessments based exclusively on measurements. However, expert opinion is notoriously unreliable, subject to various social biases, influenced by a range of experiential and behavioural factors and expert performance is very difficult to predict (Burgman 2015). Use of expert opinion to estimate quantities required for Red List assessment must therefore be subject to standards and procedures that reduce the risks of errors and bias. The recommended standards and their rationale are given in Table 4.

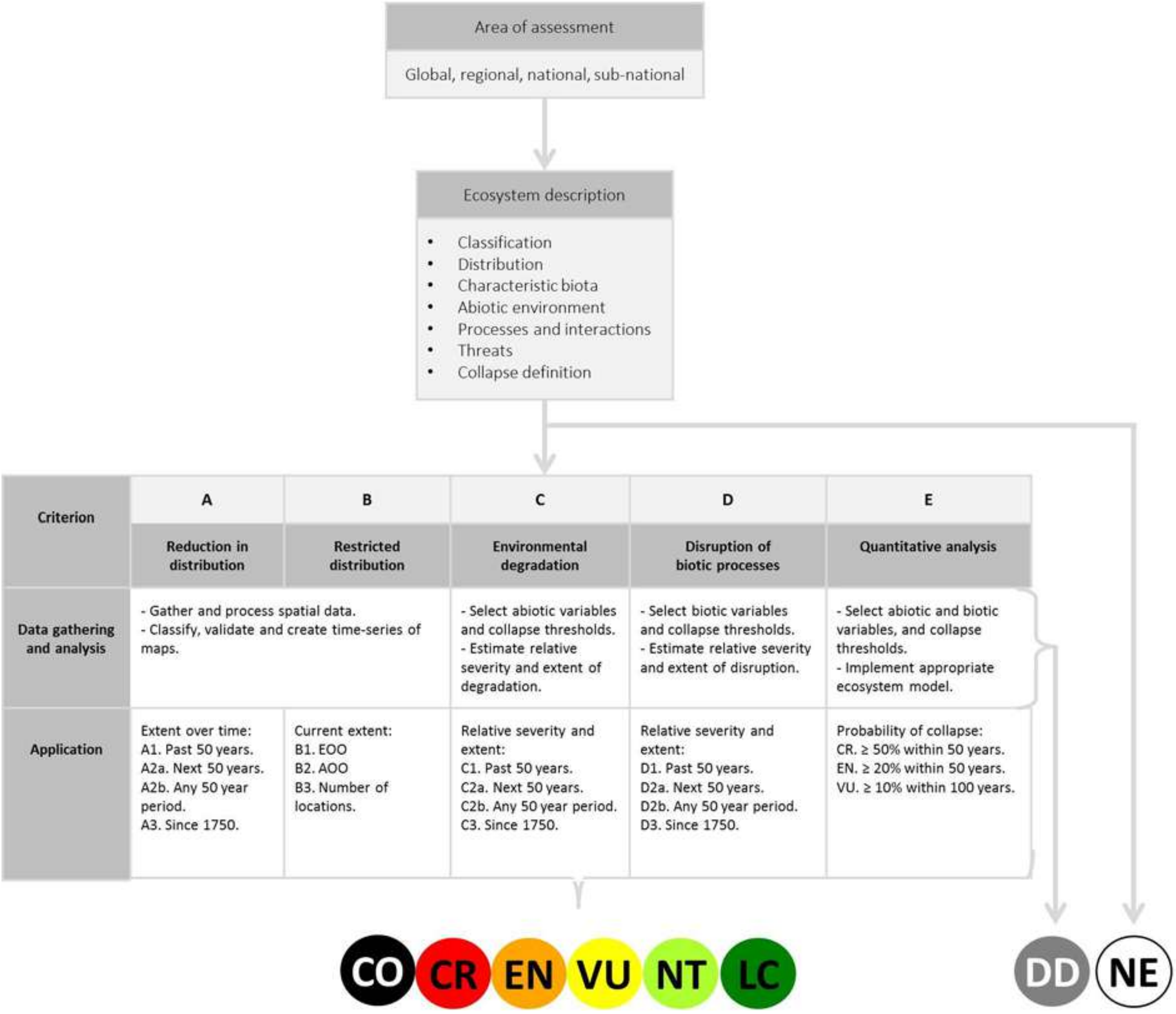
Table 4. Recommended standards and procedures for expert elicitation and handling uncertainty (based on Burgman 2015).

Step	*Recommended approach*	*Rationale*
Selecting experts	People who are: i) reasonably familiar with the ecosystem type, the area in which it occurs, and the processes that affect it; and ii) frequently seek feedback and consider uncertainty in their advice. Seek diversity and avoid homogeneity in selecting expert groups.	Expertise declines dramatically outside an individual's specialisation or experience. Basic familiarity is relevant but expert performance appears independent of experience and standing. Experts who seek frequent feedback on their judgements, subdue overconfidence and consider uncertainty perform well.
Number of experts	A minimum of three. More is better.	Estimated values averaged across multiple experts outperform individual estimates, including those by the most experienced experts.
Information provided to experts	Available data and qualitative observations relevant to the quantity being estimated, including sources, contextual information including definitions of terms and details of sampling design and methods. Inform experts of the elicitation process (steps 1-3) and the qualities associated with high performance* (see Burgman 2015).	Provides a common base of information on which to base an estimate. Raises awareness of cognitive factors associated with accurate expert estimates and reduces linguistic uncertainties.
Elicitation step 1	Each expert is asked to estimate a required quantity (e.g. decline in distribution over past 50 years) independently of (i.e. without conferring with) others. Four values are required for each estimate in the following order: i) a plausible upper bound ii) a plausible lower bound; iii) a best estimate; iv) the probability that the true value lies between the upper and lower bound.	Independent estimates for each expert avoids social elicitation biases associated with dominant personalities, seniority, perceptions of peers, etc.
Elicitation step 2	Experts are provided with all estimates without names of those who made them. In plenary, they are given an opportunity to discuss the reasons considered in coming	Exchange of ideas and factors relevant for consideration, additional data and observations, supports more informed estimates.

Step	*Recommended approach*	*Rationale*
	to an estimate	
Elicitation step 3	Each expert is given the opportunity to revise their estimates from step 1 independently of other experts, in the light of discussion in step 2	Reduces social biases, while incorporating additional information.
Synthesis	The best estimates are averaged across all experts. Upper and lower bounds are converted to 90% confidence interval, assuming a probability distribution and transformation that are appropriate to the quantity estimated (Speirs-Bridge et al. (2010), and averaged across assessors.	Central tendency of multiple independent estimates is more likely to be close to the true values than any other expert estimate. Upper and lower bounds based on means exclude extreme outlying values.
Assessment against Red List criterion	The Red List status is calculated for the best estimate, upper and lower bounds, producing a bounded estimate of the threat category for that criterion	Uncertainty (represented by upper and lower bounds) is propagated transparently through the assessment, allowing reporting of the best estimate of threat category, as well as plausibly optimistic and pessimistic categories, given the available information.

4. Assessment process

Assessing an ecosystem type against the *IUCN Red List of Ecosystems Categories and Criteria* is a sequential process. All components must be completed before submission of the assessment (Fig. 6).



Criterion	A	B	C	D	E
	Reduction in distribution	Restricted distribution	Environmental degradation	Disruption of biotic processes	Quantitative analysis
Data gathering and analysis	- Gather and process spatial data. - Classify, validate and create time-series of maps.		- Select abiotic variables and collapse thresholds. - Estimate relative severity and extent of degradation.	- Select biotic variables and collapse thresholds. - Estimate relative severity and extent of disruption.	- Select abiotic and biotic variables, and collapse thresholds. - Implement appropriate ecosystem model.
Application	Extent over time: A1. Past 50 years. A2a. Next 50 years. A2b. Any 50 year period. A3. Since 1750.	Current extent: B1. EOO B2. AOO B3. Number of locations.	Relative severity and extent: C1. Past 50 years. C2a. Next 50 years. C2b. Any 50 year period. C3. Since 1750.	Relative severity and extent: D1. Past 50 years. D2a. Next 50 years. D2b. Any 50 year period. D3. Since 1750.	Probability of collapse: CR. ≥ 50% within 50 years. EN. ≥ 20% within 50 years. VU. ≥ 10% within 100 years.

Figure 6. Process for assessing the risk of collapse of an ecosystem type.

4.1 Area of assessment

Red List of Ecosystems (RLE) assessments may be undertaken within different geographic areas. Global assessments consider all occurrences of an ecosystem type throughout the world. This is essential for the set of broadly defined ecosystem types that will form the global RLE, and for informing international biodiversity targets and conservation strategies. Sub-global assessments are possible: they are typically defined by political (continental, national or state assessments) or ecoregional boundaries (ocean basins or catchments). Many sub-global lists of ecosystems already exist, such as lists of threatened ecosystems for Germany (Blab et al., 1995), Western Australia (DEC, 2007), Finland (Kontula & Raunio, 2009), Venezuela (Rodríguez et al., 2010), Austria (Essl & Egger, 2010), Norway (Lindgaard & Henriksen, 2011), South Africa (Driver et al., 2012), New Zealand (Holdaway et al., 2012) and El Salvador (Crespin & Simonetti, 2015), although only the latter used Version 2.0 of the *IUCN Red List of Ecosystems Categories and Criteria*.

For assessments of sub-global areas, it will usually be appropriate to assess ecosystem types of finer thematic resolution than those for global assessments, as sub-global assessments will usually require finer detail to support land and water use decision-making. For example, a national RLE may have a larger number of more finely divided assessment ecosystem types for a given area, compared to a global-level RLE assessment.

The same ecosystem type may be assigned to different risk categories in sub-global and global assessments. Differences in status depend on the distribution of threatening processes across the range of the ecosystem type in relation to the boundaries of the sub-global assessment. Although regional guidelines for applying the *IUCN Red List of Ecosystems Categories and Criteria* have not yet been developed, some general rules apply:

1. Comprehensive description of the assessment unit (ecosystem type) is still required. The area of assessment (e.g. political boundaries) must be clearly defined and supported with maps or other spatial data.

2. No modifications of the categories or criteria A, C, D or E are required when making sub-global assessments of ecosystems. Therefore, all thresholds, time frames, definitions and data requirements remain unchanged for sub-global applications of the RLE.

3. Application of subcriterion B1 and its thresholds remains unchanged (Section 5.2). A minimum convex polygon that encloses all occurrences of an ecosystem type is applied, regardless of whether the edges cross the bounds of the area of assessment. No holes or cutting of the minimum convex polygon are permitted, regardless of the bounds of the area of assessment.

4. When the area of assessment is similar to or smaller than the EOO or AOO thresholds for the Vulnerable category, listing of ecosystem types under criterion B will depend solely on meeting the subcriteria. Research to support specific guidelines and tools for applying criterion B in small assessment areas is currently in progress.

4.2 Describing the unit of assessment

To ensure repeatable application of the *IUCN Red List of Ecosystems Categories and Criteria*, detailed description and definition of the assessment units is an essential component of the assessment process. The description and assessment is based on a comprehensive compilation of all available information about the ecosystem type under consideration. The description of an ecosystem type must provide contextual information on its classification; clearly describe four elements that define the ecosystem type (characteristic native biota; abiotic environment; key processes and interactions; and spatial distribution); and describe the threats and collapsed states.

Assessors should use the description template for ecosystem types (Table 5) and justify why the unit selected for assessment is recognised as a separate ecosystem type from adjacent or similar ecosystem types. What are the key features that distinguish the focal ecosystem type from other ecosystem types? Information supporting the description of the ecosystem type should be included in the assessment documentation, and will be assessed by peer review. It is expected that all submissions to the global RLE will include relevant supporting information including a fully populated reference list, maps, geographic coordinates, exemplar photographs and any other information that will facilitate repeatability of the assessment. These submissions will be openly accessible on the IUCN Red List of Ecosystems website (www.iucnrle.org).

Table 5. Description template for ecosystem types.

Elements	*Description*
Classification	Cross-references to relevant ecological classifications: a. Source classification. b. IUCN Habitats Classification Scheme. c. Ecoregional classifications.
Spatial distribution	Describe distribution and extent: a. Accurate spatial distribution data. b. Estimates of area. c. Time series, projections (past, present, future).
Characteristic native biota	Identify defining biotic features: a. Diagnostic native taxa and their relative abundance in comparison to other ecosystem types. b. Functional components of characteristic biota and their roles in the focal system compared to others. c. Limits of spatial and temporal variability in the ecosystem biota. d. Exemplar photographs.
Abiotic environment	Identify defining abiotic features: a. Text descriptions and citations for characteristic states or values of abiotic variables. b. Graphical descriptions of abiotic variables. c. Exemplar photographs.
Processes and interactions: – among biota – between biota and environment	Describe key ecosystem drivers: a. Text descriptions and citations. b. Conceptual model. c. Exemplar photographs.
Threats	Describe major threats and impacts on ecosystem functioning: a. Text descriptions and citations. b. Diagnosis based on IUCN Threats Classification Scheme. c. Exemplar photographs.
Collapse definition	Describe ecosystem-specific collapsed state(s) and threshold(s).

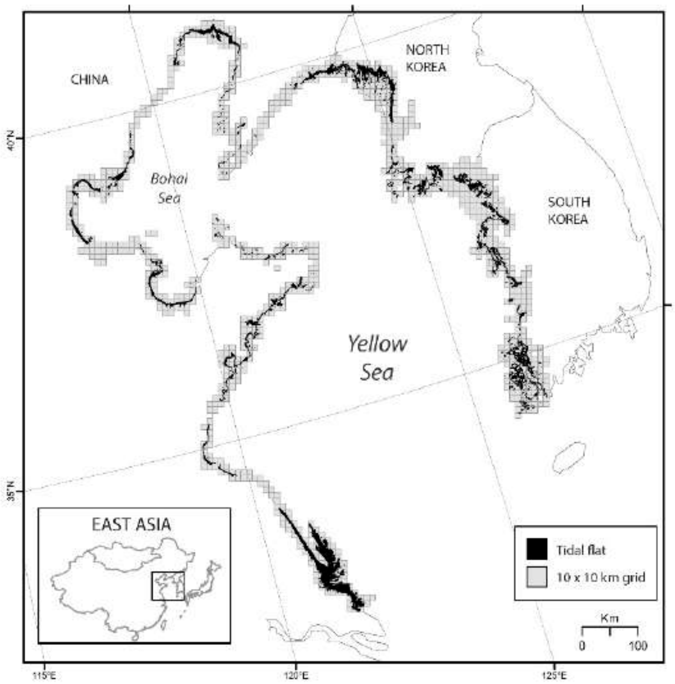
4.2.1 Classification

Ecosystem types should be cross-referenced to any relevant ecosystem classifications, including source classifications (such as vegetation classifications for terrestrial systems), ecoregional classifications, and the IUCN Habitats Classification Scheme (www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3). Further guidance is available for the use of the IUCN Habitats Classification Scheme. Cross-referencing with the global RLE typology will be required when it becomes available (3.1.1 Ecosystem typologies).

4.2.2 Spatial distribution

Information on the spatial distribution of an ecosystem type is best represented by maps or inventories of localities. They can be derived from remote sensing, biophysical distribution models, field observations or a combination of all three (Box 2). The spatial features of some ecosystems (such as pelagic environments) are inherently dynamic over relatively short time frames, so spatial distributions can only be described at very coarse levels of resolution. Given the diversity of methods and maps available, an important aspect of the description is to justify why a particular spatial dataset is an adequate representation of the ecosystem distribution. Further information on clearly describing the spatial distribution of an ecosystem type is provided in Sections 5.1 and 5.2. Assessors are encouraged to deposit the ecosystem map in a suitable online repository.

Box 2. Distribution map of the Yellow Sea tidal flat ecosystem.



The distribution of the Yellow Sea tidal flat ecosystem was mapped by applying a peer-reviewed remote sensing classification method to Landsat Archive satellite imagery (Murray et al., 2012; Murray et al., 2014; Murray & Fuller, 2015). The classified map has an overall accuracy of >94% when assessed using a confusion matrix, a widely implemented method for assessing the accuracy of classified maps (Murray et al., 2014; Congalton & Green, 2008). Estimates of the area of the ecosystem type for criterion A are derived from the distribution of the ecosystem (black), whereas the area of occupancy (AOO) is determined by counting the number of 10x10 km cells in which >1 km^2 of the ecosystem type occurs (Murray et al., 2015).

4.2.3 Characteristic native biota

The concept of characteristic native biota is central to ecosystem risk assessment and is therefore an important component of their description (Box 3). The characteristic native biota include the genes, populations, species, assemblages of species and their key interactions that: (i) compositionally distinguish an ecosystem type from others (diagnostic components); and (ii) are central in driving ecosystem dynamics and function, such as ecosystem engineers, trophic or structural dominants, or functionally unique elements (functional components). The diagnostic components of characteristic native biota should demonstrate a level a compositional uniqueness and identify functionally important elements. In general, the description need not include exhaustive species inventories.

Characteristic native biota are crucial in the diagnosis of ecosystem collapse because they define part of the 'identity' of the ecosystem type. Thus, the loss of characteristic native biota or processes in which they play a functional role signals a transformation of identity, collapse of the ecosystem type and replacement by a novel system.

Characteristic native biota may be defined in terms of taxonomy or functional traits (e.g. guild composition, trait spectra, structural features such as architecture of trees or corals) and excludes exotic species and uncommon or vagrant species that contribute little to ecosystem function. Examples of characteristic native biota include species that are endemic or near-endemic to the ecosystem type, predators that structure the animal communities, tree species that create microclimates in their canopies or at ground level, reef-building corals and oysters that promote niche diversity for cohabiting fish and macro-invertebrates, nurse plants and those that provide sites for predator avoidance, burrowing animals, guilds of nitrogen fixers, key dispersal agents responsible for movement of biota or resources, peat-forming plants, detritivore guilds, and flammable plants that promote recurring fires.

Box 3. Describing characteristic native biota (adapted from Appendix S2 in Keith et al., 2013).

Raised Bogs, Germany
This ecosystem type is characterised by vegetation dominated by peat mosses (e.g. *Sphagnum magellanicum, Sphagnum fuscum*) and insectivorous plants like sundew (*Drosera* sp.). The dominance by peat mosses together with geomorphic and hydrological processes distinguishes raised bogs from other ecosystem types. Other typical species for raised bogs in Germany are the vascular plants bog-rosemary (*Andromeda polifolia*) and cranberry (*Vaccinium oxycoccos*), the butterfly species *Boloria aquilonaris* (Cranberry Fritillary), the moth *Carsia sororiata* (Manchester Treble-Bar) and the ground beetle *Agonum ericeti* (Blab et al., 1995).

Great Lakes Alvar, North America
This ecosystem type is characterised by a variable physiognomy, from open perennial (rarely annual) grassland or shrubland and nonvascular pavement (5-25% herb and or shrub cover) to dense grassland or shrubland (>25%) with scattered evergreen needleleaf (more rarely broad-leaf deciduous) trees (Reschke et al., 1999; Catling & Brownell, 1995). Species composition contains a mix of tallgrass prairie graminoids and forbs and sub-boreal to boreal shrubs and trees. Key dominants and differentials include the perennials *Schizachyrium scoparium, Sporobolus heterolepis*, *Danthonia spicata* and *Deschampsia caespitosa*; less commonly with *Sporobolus neglectus, Sporobolus vaginiflorus*, and *Panicum philadelphicum*. Key shrubs, when present, are *Juniperus communis*, *J. horizontalis, Dasiphora fruticosa* ssp. *floribunda and Rhus aromatica*. Trees, when present, include *Thuja occidentalis, Picea glauca, Pinus banksiana*, and *Abies balsamea* (in more northern sites) and *Juniperus virginiana, Quercus macrocarpa* or *Quercus muehlenbergii* (more southern sites).

Giant Kelp Forests, Alaska
Alaskan kelp forests are structurally and functionally diverse assemblages. They are characterised by species of brown algae in the Order Laminariales including *Nereocystis luetkeana, Laminaria groenlandica, Alaria fistulosa, Agarum fimbriatum* and *Thalassiophyllum* sp. (Steneck et al., 2002). These create a complex and dynamic layered forest architecture up to 15 m tall that provides substrate, shelter and foraging resource for a diverse fauna assemblage of epibenthic invertebrate herbivores and pelagic vertebrate predators (Steneck & Watling, 1982; Estes et al., 2009). Characteristic invertebrates include urchins, *Strongylocentrotus franciscanus*, *S. purpuratus* and *S. droebachiensis,* limpets, and starfish, *Solaster* spp. Fish, including the Pacific cod (*Gadus*

macrocephalus) and rock greenling (*Hexagrammos lagocephalus*, are important predators that depend directly or indirectly on the ecosystem (Reisewitz et al., 2006). Characteristic mesopredators include sea otters, (*Enhydra lutris*), harbour seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*) and northern fur seals (*Callhorinus ursinus*). Steller's sea cow (*Hydrodamalis gigas*), now extinct, was a functionally unique herbivorous member of the vertebrate assemblage (Domning, 1972). Large pelagic predators are also important components of the ecosystem, including killer whales (*Orcinus orca*) and over 15 species of great whales including sperm (*Physeter macrocephalus*) and fin whales (*Balaenoptera physalus*). Kelp forests are generally separated geographically by continental land masses or deep sea. The Alaskan kelp forests are continuous with those of California, but differ compositionally in their more diverse assemblage of macroalgae, including *Macrocystis pyrifera*.

Shallow under-ice benthic invertebrate communities, Antarctica (source: Clark et al., 2015)
Under-ice communities are typically composed of a mix of sessile suspension feeders and mobile macro-invertebrates, elements of which are reminiscent of deep-sea fauna but occur at depths as shallow as a few metres. Sessile fauna include Porifera (Demospongia, Hexactinellida, Calcaria), Gorgonaria, Pennatularia, Alcyonaria, Stolonifera, Hydrozoa, Actiniaria, Bryozoa, Brachiopoda, Polychaeta, and both solitary and colonial Ascidiacea (Dayton, 1990; Gili et al., 2006). Dominance of some sessile taxa is known to occur at local scales, such as by sponges (Dayton, 1979, McClintock et al., 2005) and ascidians (pers. obs). Fauna with fragile skeletons are distinctly abundant, which is thought to be due to the lack of durophagous (skeleton crushing) predators (Aronson & Blake, 2001) but may also relate to low wave energy in ice-protected coasts. Mobile invertebrates occur with these sessile fauna or can dominate in some areas. Commonly occurring taxa include Echinodermata (Echinoidea, Asteroidea, Ophiuroidea, Holothurioidea) and Peracarida (Amphipoda, Isopoda, Tanaidacea, Mysidacea, Cumacea) both of which are very successful in Antarctica and can exhibit high abundances or dominance of particular species. Other common mobile epifauna include Pycnogonida, Ostracoda, Caridea, Teleostei, Prosobranchia, Opisthobranchia, Polyplacophora, Bivalvia and Nemertinea (Dayton, 1990; Gili et al., 2006). Many of these are symbionts and use sessile invertebrates as habitat, including specialised predators such as nudibranches, asteroids, and gastropods. Some fauna such as the pycnogonids display gigantism, where individuals grow to much larger sizes than related taxa in non-polar regions (Chapelle & Peck, 1999).

4.2.4 Abiotic environment

Descriptions should identify salient abiotic features that influence the distribution or function of an ecosystem type, define its natural range of variability, sustain its characteristic native biota, and differentiate it from other systems. For terrestrial ecosystems, salient abiotic features may include substrates, soils and landforms, as well as ranges of key climatic variables, while those of freshwater and marine ecosystems may include key aspects of water regimes, light regimes, tides, currents, climatic factors and physical and chemical properties of the water column (Box 4).

Box 4. Describing the abiotic environment (adapted from Appendix S2 in Keith et al., 2013)

Gnarled Mossy Cloud Forest, Lord Howe Island, Australia (source: Auld & Leishman, 2015)
The Lord Howe Island Gnarled Mossy Cloud Forest occurs on the summit plateau and ridgetops of two mountains on Lord Howe Island. The climate is temperate, and sea level parts of the island have a mean annual temperature of 19.2°C, ranging from 17°C–25°C in summer to 14°C–18°C in winter (Mueller-Dombois & Fosberg, 1998). At sea level, average annual rainfall is 1,717 mm, with a maximum of 2,886 mm and a minimum of 998 mm (Mueller-Dombois & Fosberg, 1998). Temperature decreases with altitude in the southern mountains (0.9°C for every 100 m rise in altitude; Simmons et al., 2012). Cloud forests on Pacific islands typically occur between 800 and 900 m a.s.l. (Meyer, 2011), and on Lord Howe Island, the Gnarled Mossy Cloud Forest ecosystem occurs from 750 to 875 m a.s.l. The annual rainfall in Gnarled Mossy Cloud Forest is thought to be much higher than at sea level (although this has not been quantified) and spread throughout the year (DECC, 2007). The two southern mountains (Mounts Gower and Lidgbird) obtain significant moisture from both rainfall and direct canopy interception of cloud water (horizontal precipitation or cloud stripping), and their peaks are often shrouded in cloud (Auld & Hutton, 2004). Cloud forests are characterised by increased rainfall and cooler temperatures than forest with no cloud (Jarvis & Mulligan, 2011), and this is thought to also apply to the Gnarled Mossy Cloud Forest ecosystem (Auld & Leishman, 2015).

Yellow Sea Tidal Flats, East Asia (source: Murray et al., 2015)
The Yellow Sea is a shallow (mean depth c. 45 m), semi-enclosed sea with surrounding geography varying from mountain ranges in South Korea to low-elevation coastal plains across much of the northern and western regions (Healy et al., 2002; MacKinnon et al., 2012). As such, tidal flats in the Yellow Sea are among the largest on Earth; in areas with high tidal amplitude (macrotidal, >4 m) they may attain a width of nearly 20 km when exposed at low tide (Healy et al., 2002). A key feature of the Yellow Sea tidal flats is the seasonal switching from an erosion- to accretion-dominated system in some areas, depending on the occurrence of the monsoon season (Wang & Zhu, 1994). The ecosystem is dependent on the continuing operation of a suite of coastal processes that are focused on sediment transport and dynamics. Sediments are transported to tidal flats by coastal and tidal currents, where the deposition process is influenced by factors such as sediment texture and size, occurrence of vegetation, wave dynamics, rainfall and the composition of the benthic community, which facilitates local bioturbation, biodeposition and biotransportation (Wang et al., 2012). Storms, wind and wave action cause seaward erosion of tidal flats, and compaction and subsidence reduce their elevation, so sediment trapping and replenishment are required to offset these processes and maintain tidal flat extent. However, a feature that distinguishes tidal flats in the Yellow Sea from adjacent regions is that the tidal flat ecosystem is largely erosion-dominated, requiring ongoing sediment replenishment and transport to persist (Healy et al., 2002). Therefore, disruption of sediment provision via reduced supply from sources such as rivers, and interruption of sediment transport and deposition mechanisms are considered the primary processes that lead to degradation of the ecosystem (Wang et al., 2012).

4.2.5 Processes and interactions

A qualitative understanding of ecosystem dynamics is essential for assessing risks related to functional declines. Generic mechanisms of ecosystem dynamics can often be inferred from related systems if the ecosystem type under assessment lacks direct studies. For example, pelagic marine systems are typically dominated by trophic interactions in which elements of the main trophic levels are known, even if particular predator-prey relationships are not (Estes et al., 2009). Tree and grass dynamics in savannahs across the world are influenced by fire regimes, herbivores and rainfall, although their relative roles may vary among savannah types (Lehmann et al., 2014). All descriptions of ecosystem types should include a narrative account of ecosystem dynamics that addresses key ecological processes defining the identity and behaviour of the ecosystem type and the threats that may cause their loss or disruption.

A conceptual model of key ecosystem dynamics is required for each ecosystem type as part of its assessment. A conceptual model is a diagram of key ecosystem processes and threats, and serves four purposes. First, the creation of a conceptual model compels assessors to think through and clarify their assumptions and understanding of ecosystem processes. Second, the conceptual model provides a basis for conducting the risk assessment, by informing selection of relevant variables for assessing criteria C and D (5.3.3 Application). Third, the conceptual model is a communication tool that effectively summarises key features of an ecosystem type for risk managers, conservation practitioners, peer reviewers and the wider community. Finally, the conceptual model is useful for underpinning the development of a quantitative model for criterion E.

Two types of conceptual models are particularly useful for RLE assessments: cause-effect models and state-and-transition models (Box 5). Cause-effect models depict the interaction and dependencies among model components, such as characteristic biota, the abiotic environment and threats (Box 5a). State-and-transition models depict switches between ecosystem states due to changes in the abiotic environment or ecosystem processes (Box 5b). For example, changes in the average water level determine transitions between the degraded hypersaline and unhealthy hypersaline states in the Coorong lagoon (Appendix S2 in Keith et al., 2013; Lester & Fairweather, 2011; Lester & Fairweather, 2009).

A standard visual repertoire can help develop consistent cause-effect models (Fig. 7). Characteristic biota are represented by green hexagons, the elements of the abiotic environment by blue hexagons, biotic processes by green ovals, abiotic processes by blue ovals, and threats by red rectangles. Positive, negative and hypothesised relationships can be represented by appropriate symbols. The use of arrows accompanied by plus and minus signs is discouraged. Distinct ecosystem components functioning together should form part of a compartment. For example, the Gonakier forest in Senegal (Appendix S2 in Keith et al., 2013) can be described by two faunal and floral compartments, driven by abiotic processes that are influenced by threats (Box 5c).

General guidelines for developing conceptual models for RLE assessments include:

1. Conceptual models of ecosystem types should be complete, unambiguous and easy to understand. They should be consistent with the narrative description of ecosystem processes and functions, and should not introduce elements which have not been described in the narrative. They should focus on processes especially relevant to the application of criteria C and D, and to the definition of the collapsed state of the ecosystem type.

2. Overly complex conceptual models should be avoided, so models will typically include fewer details than the narrative text. Assessors are encouraged to think carefully about the level of complexity and hierarchical organisation of the conceptual model, revisiting the purpose of developing conceptual model described above if necessary. Overall, the least complex model covering all ecosystem processes will be the most appropriate (typically fewer than 12 elements).

3. The inclusion of processes relevant to other ecosystem types (but not to the ecosystem type of interest) is discouraged.

4. Repetition of components and relationships should be avoided.

5. Assessors are encouraged to use the IUCN Threats Classification Scheme to select appropriate threats for their system. The inclusion of generic drivers such as human population growth or economic factors is not recommended.

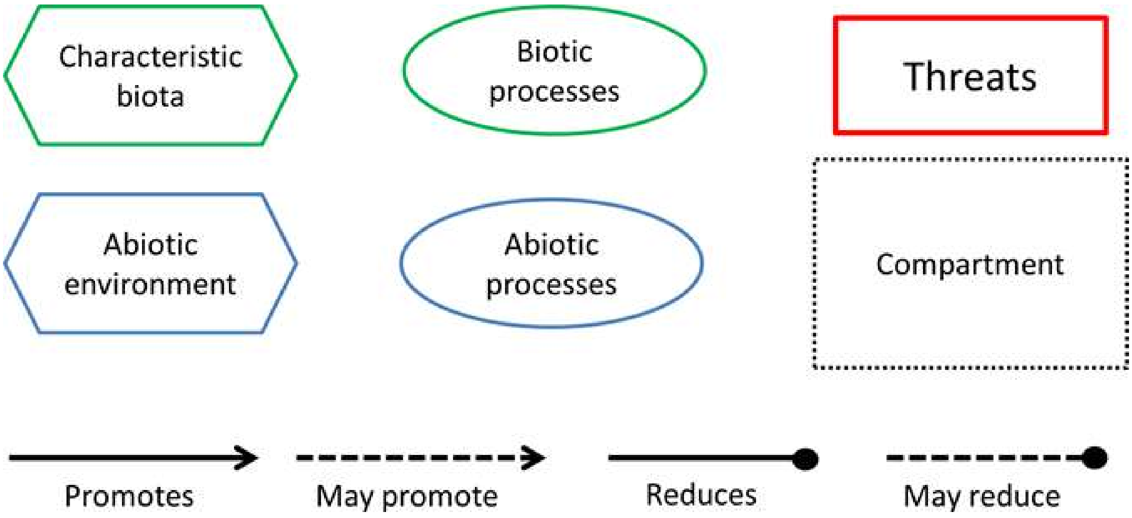
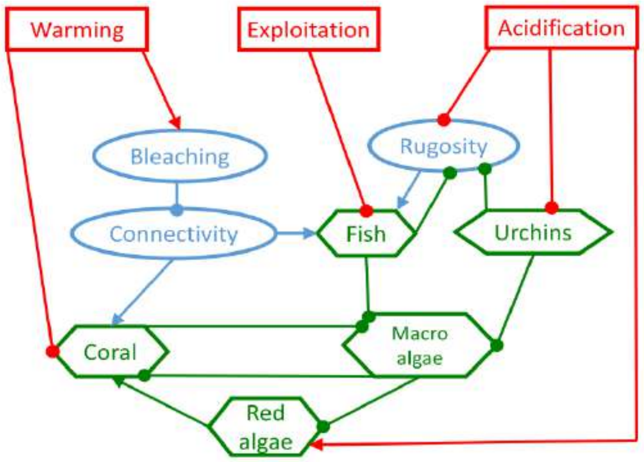


Figure 7. A common visual repertoire for cause-effect models.

Development of the conceptual model may reveal uncertainties in the understanding of ecosystem processes. It may be necessary to draft two or more alternative conceptual model to represent this uncertainty. Refining the model multiple times may help to explore and refine ecosystem processes and clarify the layout of the model. An effort should be made to reach a consensus conceptual model for the ecosystem type, using the narrative text to highlight the greatest sources of uncertainty. When assessing criterion E, it may be useful to include a second, more complex model to describe selected indicators and modelled relationships among components. Tools to assist in construction of conceptual models are in development, including a computer programme to support the development of internally consistent conceptual models. The programme will allow users to save and retrieve conceptual models for a range of ecosystems, use a common visual repertoire and evaluate the effects of threats on ecosystem processes.

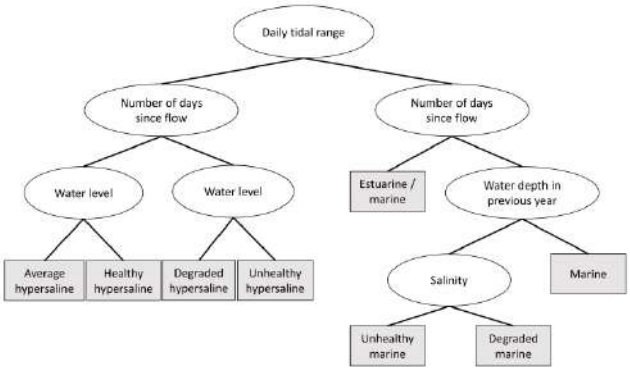
Box 5. Conceptual models representing processes and interactions

(A) Cause-effect model



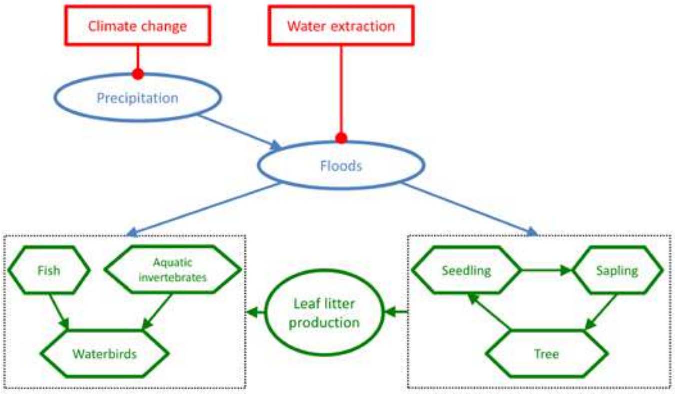
Cause-effect model of a Caribbean coral reef (Appendix S2 in Keith et al., 2013). Warming, pollution, exploitation and acidification are direct threats. Bleaching, rugosity and connectivity are key ecosystem processes. The system alters between coral and algae-dominated patches.

(B) State-and-transition model



State-and-transition model of the Coorong lagoon in Australia (adapted from Appendix S2 in Keith et al., 2013). Average salinity determines shifts between the unhealthy marine and degraded marine states.

(C) Cause-effect model with compartments



Cause-effect model of the Gonakier forest in Senegal (Appendix S2 in Keith et al., 2013).). The model is composed of two compartments. Forest regeneration depends on floods, and contributes to leaf litter production. Leaf litter production in turn provides nutrients for the aquatic fauna.

4.2.6 Threats

Accompanying the description of an ecosystem type should be a full review of threatening processes that cause ecosystem change. Describing the threats to an ecosystem type requires two elements: (i) a brief description and explanation of the primary threats causing ecosystem change; (ii) identification of threats with reference to the Threats Classification Scheme, used in The IUCN Red List of Threatened Species (IUCN, 2015). When combined, the description of threatening processes and stresses, the threat classification under the IUCN Threats Classification Scheme, and the conceptual model for an ecosystem type will assist in identifying collapsed states and key variables for assessing change in abiotic and biotic function. The framework below (drivers, threats and stresses) outlines how threats affect ecosystems.

Background

Consistent terms for drivers, threats and stresses are needed for ecosystem assessment (Table 6). A direct threat for one ecosystem type or organism can be an indirect threat for another or pose no threat to other organisms. For example, unsustainable fishing will directly threaten target and by-catch species and may also have indirect effects (negative or positive) on species that prey upon, compete with or are preyed upon by targeted species. This complexity of effects requires careful consideration and definition of threats for each ecosystem type.

Table 6. Definitions of threats, drivers and stresses (Salafsky et al., 2008).

Term	*Definition*	*Synonyms*
Driver	The ultimate factors, usually social, economic, political, institutional, or cultural that enable or otherwise add to the occurrence or persistence of proximate direct threats. There is typically a chain of drivers behind any given direct threat.	Contributing factors, underlying factors, root causes, indirect threat, pressures
Threat	Direct threats are the proximate activities or processes that have impacted, are impacting, or may impact the status of the ecosystem being assessed (e.g., unsustainable fishing or logging). Threats can be past (historical), ongoing, and/or likely to occur in the future. Natural phenomena are also regarded as direct threats in some situations.	Direct threats, sources of stress, pressures, proximate pressures, stressors
Stress	Stresses are the effects on ecosystem features that are impaired directly by threats (e.g. reduced abundance of keystone species, fragmentation of habitat). A stress is not a threat in and of itself, but rather a degraded condition or symptom of the target that results from a direct threat. The RLE risk protocol aims to quantify these symptoms to assess declines towards collapsed states.	Symptoms, key degraded attributes.

Description of threats

A summary of the main threats currently affecting or likely to affect the ecosystem type is required supporting information for all ecosystem types. The description provides a brief explanation of the major threats (past, present and future), the drivers of those threats, and the resultant stresses or symptoms of the ecosystem. Identifying stresses is highly informative for defining collapsed states and assessing criteria C and D. The geographic extent of threats should also be described. Assessors can base their description on regional and/or national threats classifications, but these cannot be used directly within the IUCN Threats Classification Scheme. In cases where a national threats classification must be used, assessors should report both the national designation and the IUCN Threats Classification Scheme. Graphs, figures and exemplary photographs are encouraged to illustrate the impact of threats on the characteristic native biota, physical environment and interactions among them. An example of threats description is provided in Box 6.

Threats Classification Scheme

The RLE adopts the IUCN Threats Classification Scheme (www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme) for consistency with The IUCN Red List of Threatened Species. The Threats Classification Scheme is hierarchical, consisting of three levels with increasing detail, and contains 12 main threat categories. For a RLE assessment, the description of threats to an ecosystem type must correspond with threats from the IUCN Threats Classification Scheme. Coding for the major threats affecting an ecosystem type is required as supporting information for all ecosystem types except where there are no known threats to those assigned to the Data Deficient or Least Concern categories. Assessors should diagnose and record threats to the lowest possible level in the Threats Classification Scheme.

Coding of timing, scope and severity for each major threat is not required but can be provided. If assessors decide to also record minor threats (threats affecting only a very small proportion of the distribution), then it is essential that the timing, scope and severity be described for all of the threats recorded. This will allow major and minor threats to be clearly identified for the ecosystem type and assist higher level analyses of the RLE. Guidance for using the IUCN Threat Impact Scoring System is available on the IUCN Red List of Threatened Species website (www.iucnredlist.org). The Threat Impact Scoring System for the RLE is currently under review, so use of the current Threat Impact Scoring System is not required within a RLE assessment at this stage.

Although recording stresses from the IUCN Stresses Classification Scheme for each threat selected is not required, this is highly recommended supporting information for an assessment. This information is useful for demonstrating how threats are impacting ecosystem types listed on the RLE, and may provide useful guidance for policy makers to address ultimate causes. It is possible to record multiple stresses, simply by selecting threat code.

Box 6. Describing threats

The *Coolibah - Black Box Woodlands of south-eastern Australia* is a flood-dependent woodland ecosystem type affected by five main threats (Appendix S2 in Keith et al., 2013; NSW Scientific Committee, 2004). Expansion and intensification of agricultural land use has replaced large areas of woodland with crops and pastures in recent decades (Keith et al., 2009). Furthermore, extraction of water from rivers for irrigation has altered flood regimes and their spatial extent, reducing opportunities for reproduction and dispersal of characteristic flora and fauna (Thoms & Sheldon, 2000; Thoms, 2003; Kingsford & Thomas, 1995; Kingsford & Johnson, 1998; Kingsford & Auld, 2005). Future climate change may also affect the spatial and temporal availability of water in the system. Invasive plants have spread with agricultural intensification and are reducing the diversity and abundance of native biota. Additionally, invasion of the mat-forming forb *Phyla canescens* reduces the diversity of native ground layer plants (Taylor & Ganf, 2005). This species has spread rapidly in response to altered water regimes and persistent heavy livestock grazing (Earl, 2003). Finally, overgrazing by feral goats, rabbits and domestic livestock has altered the composition and structure of the woodland vegetation, through selective consumption of palatable native ground layer plants and seedlings of trees and shrubs (Reid et al., 2011; Robertson & Rowling, 2000). These effects are most marked beneath trees and around watering points where livestock concentrate their activities.

The threats affecting this ecosystem type correspond with five threats (underlined) and their hierarchical categories in the IUCN Threats Classification Scheme:

- 2. Agriculture & Aquaculture:
    - 2.1 Annual & Perennial Non-Timber Crops:
        - 2.1.3 Agro-industry Farming;
    - 2.3 Livestock Farming & Ranching:
        - 2.3.3 Agro-industry Grazing, Ranching or Farming
- 7. Natural System Modifications:
    - 7.2 Dams & Water Management/Use:
        - 7.2.3 Abstraction of Surface Water (agricultural use)
- 8. Invasive & Other Problematic Species, Genes & Diseases:
    - 8.1 Invasive Non-Native/Alien Species/Diseases:
        - 8.1.2 Named Species – *Phyla canescens*
- 11. Climate change & severe weather
    - 11.2 Droughts

The description of threats and stresses underpinned the selection of variables for assessing criteria C and D and clarified their link to collapse of this ecosystem type. Under criteria A and B, the ecosystem type was “assumed to have collapsed when its mapped distribution has declined to zero as a consequence of clearing for agriculture”. Because flood regimes are fundamental to ecosystem dynamics and water extraction for irrigation is a major threat, median daily river flow was identified as a suitable variable for assessing environmental degradation under criterion C.

4.2.7 Describing collapsed states

Ecosystem collapse is a key concept in the RLE (Section 3.2) and underpins the application of the *IUCN Red List of Ecosystems Categories and Criteria*. Assessors should describe the collapsed state(s) of an ecosystem, based on the information summarised in the description of the ecosystem type and the conceptual model. If multiple states of collapse are possible (e.g. due to different threats), all of these should be described with similar levels of detail. Descriptions should focus on the key defining features of the ecosystem type. Collapse thresholds for the application of criteria A and B are typically defined as 100% loss of spatial distribution of the ecosystem type (i.e. 100% decline under criterion A; EOO = 0 km^2 and/or AOO = no 10x10 km grid cells occupied under criterion B). Choosing a different collapse threshold for criterion A or B must be thoroughly justified. Collapse thresholds for the application of criteria C, D, and E should be identified as part of the assessment of those criteria (5.3.3 Application). Assessors are encouraged to provide examples of locally collapsed occurrences of the ecosystem type to support their descriptions of collapsed states.

Box 7. Defining ecosystem collapse

The *Mountain Ash Forest of south-eastern Australia* is a unique ecosystem dominated by the world's tallest flowering plant species (*Eucalyptus regnans*). Mountain ash supports a wide range of plant species and a rich array of native mammals and birds, including the Endangered Leadbeater's possum and the Vulnerable yellow-bellied glider (Lindenmayer, 2009). The availability of old-growth forest and natural tree hollows is a critical factor in the survival of cavity-dwelling animals (Keith et al., 2013; Burns et al., 2015).

Ecosystem collapse is considered to occur under any of the following (Burns et al., 2015):

1. 100% of the area where the ecosystem currently occurs is no longer bioclimatically suitable (criterion C).
2. The abundance of hollow-bearing trees drops below one per hectare averaged across the entire ecosystem distribution (subcriterion D2 and criterion E).
3. Less than 1% of old-growth forest remains in the ecosystem (subcriteria D1 and D3).

4.3 Evaluating the criteria

Each ecosystem type must be assessed against all of the RLE criteria so far as the available data permit. To assist this purpose, Section 5 provides detailed information on how to gather data, perform an assessment, consider data quality and uncertainty, and document an assessment outcome. At the onset of an assessment, all ecosystem types are considered Not Evaluated (NE) for all criteria (Fig. 8). The next step is to determine whether adequate data exist for application of the criteria, which requires data searches of the scientific literature, unpublished reports, expert opinion, historical accounts, past and present maps, satellite imagery or any other source of relevant data. If no adequate data exists to assess any of the criteria, the assessment outcome is Data Deficient (DD; Fig. 8).

Following this initial assessment of data, assessors must systematically evaluate all of the IUCN Red List of Ecosystems criteria. If an assessor chooses not to apply a criterion, the risk assessment outcome for this criterion is Not Evaluated. If a reasonable search effort indicates that adequate data are not available to assess under a criterion, the risk assessment outcome for this criterion is Data Deficient (DD). The difference between Not Evaluated and Data Deficient is that reporting Not Evaluated for any criterion implies that no attempt was made to obtain relevant data and assess the ecosystem type under that criterion. If a decent attempt was made, but data were not available or inadequate, then Data Deficient should be used. The search effort for appropriate data should be briefly described in documentation.

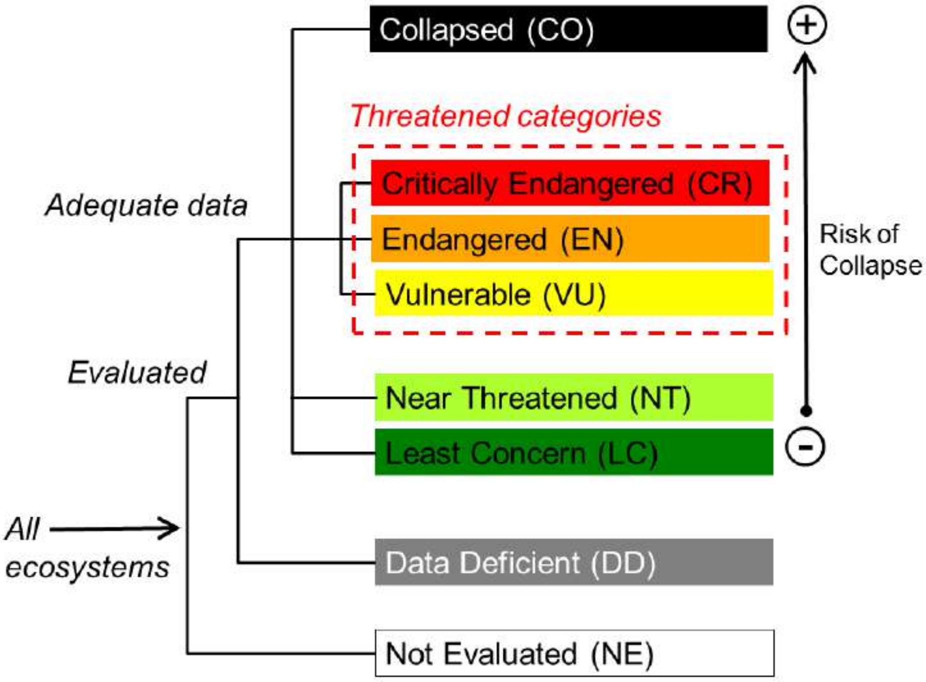


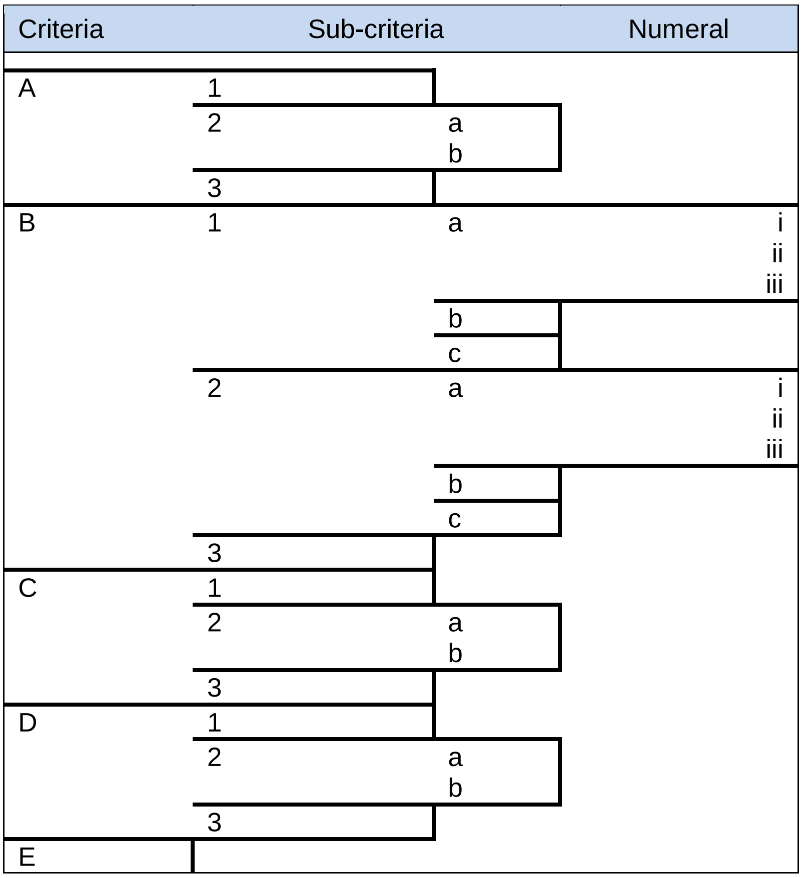
Figure 8. Process of evaluating the IUCN Red List of Ecosystems criteria.

4.4 Assessment outcome

A summary table for each ecosystem type reports the assessment outcome for all criteria (and subcriteria) as well as the overall status (Box 8). There are a total of 20 subcriteria in the *IUCN Red List of Ecosystems Categories and Criteria*, each of which can be assigned one of the eight risk categories (Fig. 1, Fig. 9). The results for all subcriteria under criteria A, B, C, and D, as well as which method was used to assess the subcriteria (i,ii or iii), must be reported during the assessment process.

Some ecosystem types will be Data Deficient or Not Evaluated for some of the subcriteria; this must be included in the summary table (Box 8). If all subcriteria are Data Deficient, the overall outcome of the assessment is Data Deficient. If all subcriteria are Not Evaluated, the overall outcome of the assessment is Not Evaluated. If all subcriteria are either Not Evaluated or Data Deficient, the overall outcome of the assessment is Data Deficient.

Following the precautionary principle and to ensure that the most severe symptoms of risk determine the assessment outcome, the highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem. The main method currently used for representing uncertainty in ecosystem assessment is to use bounded estimates (4.4.1 Dealing with uncertainty). The lower bound of the overall status is the highest lower bound across any of the subcriteria that return the same category as the overall status. The upper bound of the overall status is the highest upper bound across any of the subcriteria that return the same category as the overall status. For example, if an ecosystem type qualifies for EN (plausible bounds EN-CR) under criterion B, EN (plausible bounds VU-CR) under criterion D, and lower categories under other criteria (e.g. NT under criterion A, LC under criterion C, and DD under criterion E), then its overall status will be EN (plausible bounds VU-CR).



Criteria	Sub-criteria		Numeral
A	1		
	2	a	
		b	
	3		
B	1	a	i
			ii
			iii
		b	
		c	
	2	a	i
			ii
			iii
		b	
		c	
	3		
C	1		
	2	a	
		b	
	3		
D	1		
	2	a	
		b	
	3		
E			

Figure 9. The IUCN Red List of Ecosystems protocol comprises a total of five rule-based criteria (A-E) and 20 subcriteria for assigning ecosystems to a risk category.

Box 8. Assessment outcome (adapted from Appendix S2 in Keith et al., 2013)

Caribbean Coral Reefs

Caribbean coral reefs are primarily fringing reefs and bank barrier reefs separated from island and mainland shorelines by reef flats, shallow waters or slightly deeper lagoons (Alevizon, 2010). Due to the difficulties of remotely measuring the distribution of live coral and mosaic marine ecosystems, the ecosystem is listed as DD under all subcriteria of criterion A. The ecosystem is assessed as LC under all subcriteria of criterion B due to its large extent of occurrence, area of occupancy and number of threat-defined locations. The data for criterion C are currently under review; at the time of writing, the ecosystem is assessed as NE under all subcriteria of criterion C. Data on coral cover and reef rugosity both lead to similar estimates for subcriterion D1: EN (plausible range VU – CR). No projections are available for future disruptions to biotic interactions, so the ecosystem is listed as DD under D2. The ecosystem is listed as EN under subcriterion D3 based on historical data. No quantitative analysis has been carried out to assess criterion E, so the status is NE under criterion E. The most appropriate overall risk status of Caribbean coral reefs is determined to be EN (plausible range EN – CR).

Criterion	A	B	C	D	E	Overall
Subcriterion 1	**DD** A1	**LC** B1a,b,c	**NE** C1	**EN**(VU-CR) D1	**NE** E	**EN**(EN-CR)D1,D3*
Subcriterion 2	**DD** A2a,b	**LC** B2a,b,c	**NE** C2a,b	**DD** D2a,b		
Subcriterion 3	**DD** A3	**LC** B3	**NE** C3	**EN** D3		

** Overall status should specify best estimate, plausible lower and upper bounds and all criteria and full subcriteria that support the overall status (other examples: VU (VU-CR) B1ai,iii, B3, D2a; CR(CR-CR) A2a, B2bii, C1b)*

Coastal Sandstone Upland Swamps of south-eastern Australia

The Coastal Sandstone Upland Swamps of south-eastern Australia are treeless bogs that form relatively abrupt boundaries with surrounding eucalypt-dominated forests and woodlands that occupy more freely draining soils (Keith & Myerscough, 1993). They are strongly associated with high rainfall and moisture. Interactions between hydrological processes and fire regimes are crucial to the development of upland swamps and maintenance of their diverse and characteristic biota. To assess potential future decline due to climate change, Keith et al. (2013) used a range of plausible bioclimatic distribution models to predict its distribution under future climate scenarios. Based on these models and scenarios, the distribution of the ecosystem was projected to decline by 58-90% (median 74%) over the next 50 years. The most appropriate status of the ecosystem was therefore determined to be EN (plausible range EN – CR) under subcriterion A2. The same distribution models used to assess future change in distribution were also used to assess trends in climatic suitability under criterion C. From 1983 to 2009, the summed abundance of woody re-sprouters declined by a mean of 37% at 72% of sampled sites. These are just below the severity and extent thresholds, respectively, for VU under criterion D1, assuming that zero abundance of re-sprouters marks the point of ecosystem collapse. No data are available prior to 1983, but if current declines were initiated prior to that time, they may exceed the threshold for Vulnerable status. The status of the ecosystem type is likely to be NT (plausible range NT – VU) under subcriterion D1. The most appropriate overall risk status of the Coastal Sandstone Upland Swamps of South-Eastern Australia is EN (plausible range EN – CR).

Criterion	A	B	C	D	E	Overall
Subcriterion 1	**LC** A1	**EN** B1b,c	**LC** C1	**NT**(NT-VU) D1	**DD** E	**EN**(EN-CR) A2a, C2a
Subcriterion 2	**EN**(EN-CR)A2a	**EN** B2b,c	**EN**(EN-CR)C2a	**DD** D2a,b		
Subcriterion 3	**LC** A3	**LC** B3	**DD** C3	**DD** D3		

4.4.1 Dealing with uncertainty

Uncertainty in any information used to evaluate the criteria should be propagated through the assessment and reported as part of the outcome. Reporting both the most likely risk category and other plausible categories, given the uncertainties in the data, is more useful than simply reporting the most likely category. The simplest means of characterising uncertainty is through bounded estimates. Bounded estimates represent a range of plausible alternative values for a measure. They can take into account uncertainty in thresholds describing collapsed states (Fig. 3 and Box 1), mapped estimates of change in distribution (Box 9), and estimates of variables for measuring relative severity in criteria C and D (Boxes 11 and 12). The upper and lower bounds of an estimate may be propagated through an assessment by repeating the same analysis for the best estimate, and the lower and upper bounds. For example, if the decline in an ecosystem type's distribution is estimated to be between 75-85% in the last 50 years, it could plausibly be either Endangered (decline between 50-80% based on the lower bound) or Critically Endangered (≥80% based on the best estimate and upper bound) under subcriterion A1. Dealing with uncertainty in ecosystem risk assessment draws largely on the experiences of The IUCN Red List of Threatened Species (Newton, 2010; Regan & Colyvan, 2000; Akcakaya et al., 2000).

4.5 Documentation

All assessments must be accompanied by documentation and supporting information, which should undergo peer review by appropriate experts (6. Peer review and publication), and must be readily available when the assessment is completed (see the IUCN Red List of Ecosystems website for examples: www.iucnrle.org). All required fields in the online RLE database should also be completed (see the IUCN Red List of Ecosystems website). The documentation must include the following sections:

1. Summary. A brief abstract (~200 words) that describes the complete assessment in summarised form, including the area of assessment, the focal ecosystem type and its defining features, threatening processes and the assessment outcome.

2. Ecosystem description. A complete description of the ecosystem type, including the elements listed in Table 5.

3. Risk assessment. This section must include specific information on the application and outcome of each criterion e.g. inferences, statistical analyses and spatial analyses. It should also include a discussion of assumptions, limitations or further data required. Further guidance is available in Section 5.

4. References. A complete reference list showing the sources of information used for the assessment must be provided.

5. Criteria and thresholds

The IUCN Red List of Ecosystems (RLE) risk assessment model includes five criteria for assessing the risk of ecosystem collapse (Table 6). This section outlines the theory, thresholds and subcriteria relevant for the application of each criterion. A summary table of the current *IUCN Red List of Ecosystems Categories and Criteria* is provided in Appendix 2.

Table 6. Purpose of the IUCN Red List of Ecosystems criteria.

	Criterion	*Purpose*
A	Reduction in geographic distribution	Identifies ecosystems that are undergoing declines in area, most commonly due to threats resulting in ecosystem loss and fragmentation.
B	Restricted geographic distribution	Identifies ecosystems with small distributions that are susceptible to spatially explicit threats and catastrophes.
C	Environmental degradation	Identifies ecosystems that are undergoing environmental degradation.
D	Disruption of biotic processes or interactions	Identifies ecosystems that are undergoing loss or disruption of key biotic processes or interactions.
E	Quantitative analysis that estimates the probability of ecosystem collapse	Allows for an integrated evaluation of multiple threats, symptoms, and their interactions.

5.1 Criterion A. Reduction in geographic distribution

5.1.1 Theory

A decline in geographic distribution—defined as all spatial occurrences of an ecosystem type—influences its risk of collapse by: (i) reducing the ability of an ecosystem to sustain its characteristic native biota; and (ii) predisposing it to additional threats (Keith et al., 2013). The loss of characteristic native biota due to a declining distribution typically occurs through a combination of reduced carrying capacity, niche diversity, spatial partitioning of resources, and increased susceptibility to competition, predation and threats (MacArthur & Wilson, 1967; Shi et al., 2010; Harpole & Tilman, 2007; Hanski, 1998; McKnight et al., 2007). The rate of decline in an ecosystem distribution indicates its trajectory towards collapse, with ecosystem collapse typically occurring when no spatial occurrences of the ecosystem type remain (extent of distribution collapses to zero).

5.1.2 Thresholds and subcriteria

An ecosystem may be listed under criterion A if it meets the thresholds for any of four subcriteria (A1, A2a, A2b or A3), quantified as a reduction in geographic distribution over the following time frames:

Subcriterion	*Time frame*	CR	EN	VU
A1	Past (over the past 50 years)	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years)	≥ 80%	≥ 50%	≥ 30%
A2b	Any 50 year period (including the past, present and future)	≥ 80%	≥ 50%	≥ 30%
A3	Historical (since approximately 1750)	≥ 90%	≥ 70%	≥ 50%

5.1.3 Application

Data requirements

The rate of decline in distribution is typically estimated from time-series data appropriate for the focal ecosystem type. Ecosystem maps — such as those derived from remote sensing classifications, distribution models, field observations, or historical data — are a principal data source for assessing criterion A. When more than one source of data is available, such as different vegetation maps or estimates produced with different methods, assessors should first critically evaluate the efficacy of the alternatives as representations of the distribution of the ecosystem type. If more than one data source is suitable, assessors can calculate estimates of area from each data source, and explore the sensitivity of ecosystem status to this data uncertainty (Section 4.4.1 Dealing with Uncertainty). The net reduction in geographic distribution will then form an interval of estimates generated from each data source.

Remote sensing is a common approach for mapping distributions of many terrestrial and marine ecosystems that have interpretable signatures from different sources of remote sensing data (e.g. Fig. 10). Where regional or local data sets are lacking, global data sets, such as those available for forests (Hansen et al., 2013), mangroves (Giri et al., 2011), water cover (Pekel et al., 2016), and coral reefs (Andréfouët et al., 2006) may be suitable templates for superimposing appropriate classifications of ecosystem types.

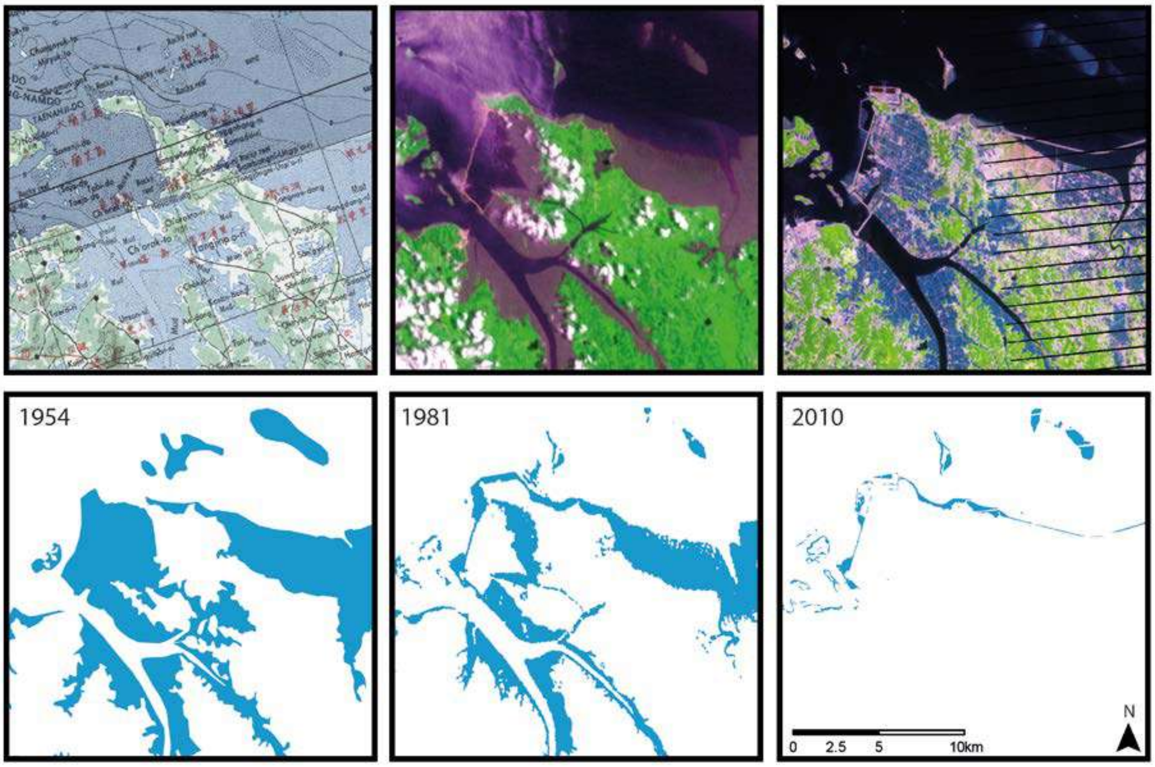


Figure 10. Time series maps of an ecosystem distribution inform the risk of ecosystem collapse. Here, historical topographic maps (1954) and Landsat Archive satellite imagery (1981, 2010) allowed a standardised time-series of the area of the Yellow Sea tidal flat ecosystem to be developed for assessment under criterion A (Murray et al., 2014; Murray et al., 2015; Murray et al., 2012).

In some cases, spatial proxies for ecosystem distributions may be used, such as field observations of organism assemblages, keystone species, climate, substrate, topography, bathymetry, ocean currents, flood regimes, water cover, aquifers or some synthesis of these that can be justified as valid representations of the distribution of ecosystem biota or its niche space. For example, maps of physical factors such as sea floor characteristics, ocean currents, water temperatures and water chemistry may be appropriate for marine ecosystems. In some subterranean, freshwater and marine ecosystems, trends in the depth dimension may be appropriate proxies of declines in distribution, so long as they reflect trends in carrying capacity and niche diversity for characteristic biota (Keith et al., 2013).

Spatial distribution models offer an additional opportunity to formally select and combine the most suitable set of spatial proxies to predict ecosystem distributions. For example, Clark et al. (2015) used bathymetric spatial data and remote sensing data on sea ice concentration to model the distribution of suitable light conditions for under-ice marine benthic invertebrate communities in Antarctica. Models are especially useful for projecting time series of ecosystem distributions into the future for assessing criterion A2. Keith et al. (2014) modelled the distribution of a mire ecosystem under future climate scenarios using a map of present day mires developed from satellite imagery, in combination with hydrologically-based climate, substrate and terrain predictor variables. In both studies, a mechanistic understanding of the relationship between occurrence of the ecosystem and limiting environmental factors was central to developing an adequate ecosystem map.

Methods

To apply criterion A, at least two comparable estimates of the geographic distribution of the ecosystem type at different points in time are required. It is beyond the scope of these guidelines to provide detailed information on the acquisition, classification and accuracy assessment of spatial data. Nevertheless, it is assumed that spatial data used for assessments under criterion A are suitable for the purpose in being: (i) consistent and comparable across time periods (unbiased); (ii) sufficiently accurate (Congalton & Green, 2008); and (iii) of a suitable grain size for the ecosystem type being assessed (Murray et al., 2017). Although assessments can be completed with just two data points (see below), efforts should be made to ensure appropriate power in a suitable statistical model of ecosystem change and that all model assumptions are addressed in the analysis. Good practices in data processing and analysis (Olofsson et al., 2014; Olofsson et al., 2013; Fuller et al., 2003) should be employed to minimise bias in estimates of areal change over a time-series of spatial data.

Subcriterion A1 may be directly assessed if data are available for 50 years ago and the present. However, it is rare for the raw data to be available for precisely the time frames required by an assessment of criterion A. More typically, assessors must use methods of interpolation, extrapolation, or prediction to calculate estimates of distribution change over the last 50 years (A1), the next 50 years (A2), and/or since 1750 (A3). This will involve assumptions about the nature or pattern of change (see below), as well as the quality of the data (Alaniz et al., 2016), which must be explained and justified in the documentation.

To assist calculations, a spreadsheet tool is available on the IUCN Red List of Ecosystems website (www.iucnrle.org). Several tools for assisting in this step are in development and will become available on the website in the future.

Assumptions

Whether inferences are made from time series of satellite images or from other data sources, two important aspects will fundamentally influence assessments: (i) assumptions about the rate of decline; and (ii) the number of points in the time series. When the rate of decline is estimated from two observations (e.g. maps) over a specified time frame, assessors should use information about the causes and context of the decline to deduce the likely trajectory of decline (Fig. 11).

Although criterion A can be applied acceptably with only two data points, more data enables a more certain diagnosis of the shape of the trajectory, allows the fitting of alternative models, and hence will result in more accurate interpolation, extrapolation or prediction to the full time frames required by criterion A. Selection of candidate models should always be informed by the causes and context of the decline and assessors should ensure that the assumptions of the model are adequately met. At least two plausible alternative scenarios should be explored and all sources of uncertainty in spatial data and decisions about assessment time frames should be clearly described and justified (e.g. Alaniz et al 2016).

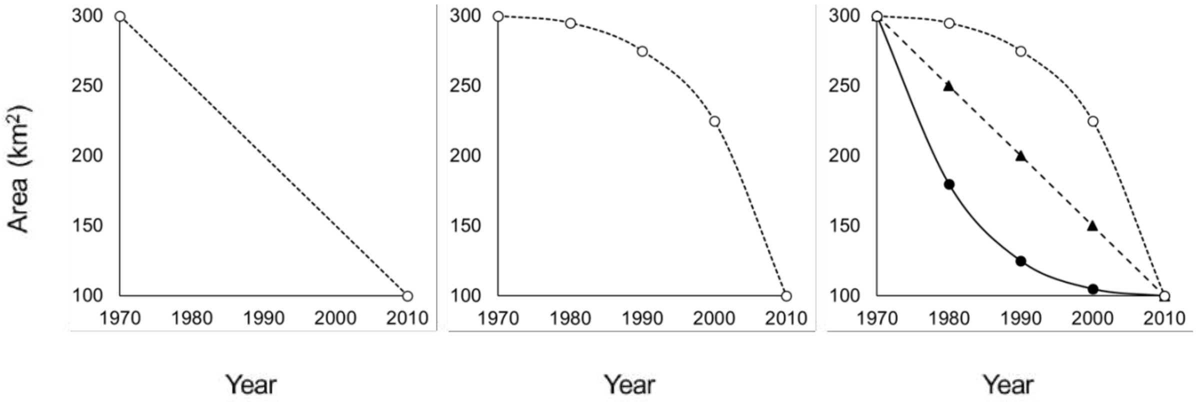


Figure 11. All distribution size trajectories in this figure have the same endpoints: 300 km^2 in 1970 and 100 km^2 in 2010. A simple interpolation between the two extremes assumes linear decline (left panel). Addition of intermediate distribution size estimates could reveal that the decline is not linear (middle panel). Different ecosystem types could also exhibit contrasting trajectories with identical endpoints: future projections of distribution considering these trajectories would clearly differ (right panel).

Figure 12 illustrates two alternative scenarios of decline for a model ecosystem type based on Coolibah – Black Box Woodland, an ecosystem on a semi-arid floodplain in eastern Australia (Keith et al., 2009). As a first scenario (ARD), a constant area is lost each year, producing a linear pattern of decline (Figure 12). An alternative scenario (PRD), where the rate of decline is proportional, a constant fraction of the remaining distribution is lost each year and the area lost reduces over time (Fig. 12). These scenarios may be modelled using exponential (PRD) and linear (ARD) functions, as defined by Keith et al. (2009):

Proportional rate of decline:

$$PRD = 100 \times \left(1 - \left(\frac{Area_{t2}}{Area_{t1}}\right)^{\frac{1}{(Year_{t2} - Year_{t1})}}\right)$$

Absolute rate of decline:

$$ARD = \frac{Area_{t2} - Area_{t1}}{Year_{t2} - Year_{t1}}$$

The predicted changes of these alternative models become more different the further they are extrapolated into the future. In the absence of any other information, examining rates of decline as proportional (PRD) or absolute (ARD) permits an assessment of ecosystem status under these two relatively optimistic and pessimistic scenarios (Box 9). However, a longer time series of observations — together with an understanding of the drivers of change, the regulatory context, regional variability in land suitability, and the extent of protected tenures across the distribution of the ecosystem — can help to select more realistic models (Keith et al., 2009). More realistic models will produce narrower bounds of uncertainty on the estimated change in distribution. For example, ecosystems in the early stages of large-scale exploitation may be more likely to exhibit linear patterns of decline (ARD) than those in an advanced stage of decline, where the area lost over time will eventually reduce to zero with diminishing area (Puyravaud, 2003).

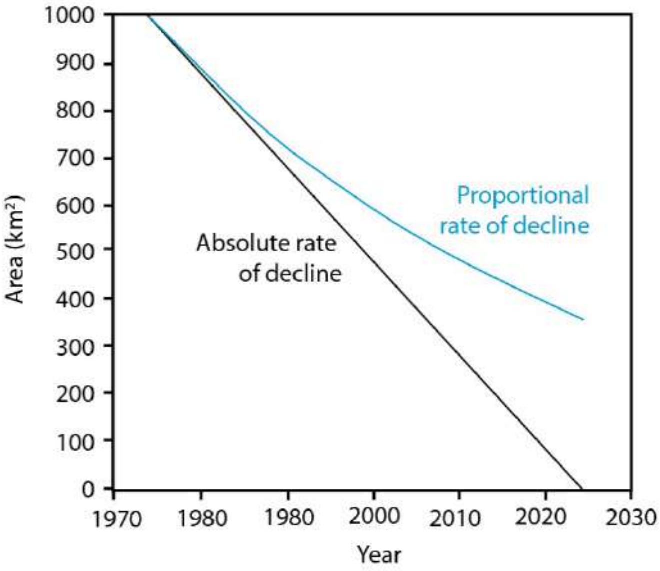


Figure 12. Alternative scenarios for decline in distribution of a model ecosystem (Keith et al., 2009; Keith et al., 2013). The figure shows an ecosystem with an initial area (1974) of 1,000 km^2. It declined at rate of 2% per year during the following 50 years, but the outcome was substantially different if the decline was proportional (PRD) or absolute (ARD). In a PRD, the decline is a fraction of the previous year's remaining area (0.02 × last year's area), whereas in an ARD the area subtracted each year is a constant fraction of the area of the ecosystem at the beginning of the decline (0.02 × 1000 = 20 km^2/year). Under a PRD scenario, this ecosystem would be considered Endangered under A2b (50% decline over any 50 year period including the present and future), while under an ARD scenario if would have disappeared by 2024, and be assessed as Collapsed.

Box 9. Proportional and absolute rate of decline (criterion A)

Sierra de Perijá is the mountain range that separates north-western Venezuela from north-eastern Colombia. The humid forests in the Venezuelan side of Perijá are threatened by the expansion of large-scale commercial agriculture, primarily of a tuber, the arrowleaf elephant ear (*Xanthosoma saggittifolium*). Using Landsat satellite images, it was estimated that in 1986 the humid forests of the watersheds of the Guasare, Socuy and Cachirí rivers occupied 328 km^2, while in 2001 they had decreased to 198 km^2. These two estimates allow assessment of ecosystem status under subcriterion A2b, using 1986-2001 to first estimate an observed rate of change over 15 years, and then extrapolating projected losses to 2036 (Portillo 2014).

The forests in 2001 occupied 198 km^2 or 60.4% of their area in 1986, thus declining at a mean proportional rate of 3.3% per year. The next step is considering how this rate may change over time to project losses at 2036. Assuming a proportional rate of decline (PRD) between 2001 and 2036 results in a total decline of 81.5% between 1986 and 2036. Assuming an absolute rate of decline (ARD) it is predicted to decline by 100% by 2024. Therefore, under criterion A2b PRD leads to a classification of Critically Endangered (≥80% decline over any 50 year period including the present and future), while ARD leads to a classification of at least Critically Endangered (≥80% decline over any 50 year period including the present and future), although it seems unlikely to collapse entirely if fragments of forest remain in less accessible mountain terrain. In conclusion, the ecosystem is considered Critically Endangered (CR) under subcriterion A2b (Portillo 2014). Information on the most likely shape of decline can help determine which of these two plausible categories should be reported as the best estimate.

Documentation

Assessors should: (i) cite data repositories for time-series maps of ecosystem distributions used in the assessment (see the IUCN Red List of Ecosystems website for a list of preferred spatial data repositories: www.iucnrle.org); (ii) provide full bibliographic references; (iii) justify why the spatial data used are an adequate representation of distribution of the focal ecosystem type; (iv) justify assumptions and alternative scenarios used to interpolate, extrapolate or predict changes in distribution from the available data; (v) explain the methods of calculation including the assumed threshold of collapse. In addition, assessors are encouraged to describe the source of the spatial data (such as satellite sensor type) and its spatial resolution (grain size), and comment on the accuracy of all classified maps.

5.2 Criterion B. Restricted geographic distribution

5.2.1 Theory

The size of the geographic distribution of an ecosystem influences its risk of collapse when confronted with a spatially explicit threat or catastrophe (Keith et al., 2013). In general, ecosystems that are widely distributed or exist across multiple independent patches are at lower risk from catastrophes, disturbance events or any other threats that exhibit a degree of spatial contagion (e.g. invasions, pollution, fire, forestry operations, and hydrological or regional climate change). The primary role of criterion B is to identify ecosystems whose distribution is so restricted that they are at risk of collapse from the chance occurrence of single or few interacting threatening events (Rodríguez et al., 2015). Criterion B also includes an approximation for an estimate of occupied habitat for component biota, which is positively related to population viability irrespective of exposure to catastrophic events.

5.2.2 Thresholds and subcriteria

An ecosystem may be listed under criterion B if it meets the thresholds for either of three subcriteria (B1, B2 and B3), which indicate restricted geographic distribution as follows:

Subcriterion	*Measure of geographic distribution*	CR	EN	VU
B1	Extent of a minimum convex polygon (km^2) enclosing all occurrences (extent of occurrence, EOO) is: **AND** at least one of the following (a-c): (a) An observed or inferred continuing decline in **ANY OF**: i. a measure of spatial extent appropriate to the ecosystem; **OR** ii. a measure of environmental quality appropriate to the characteristic biota of the ecosystem; **OR** iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. (b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.	≤ 2,000	≤ 20,000	≤ 50,000
	(c) Ecosystem exists at:	1 threat-defined location	≤ 5 threat-defined locations	≤ 10 threat-defined locations
B2	The number of 10×10 km grid cells occupied (area of occupancy, AOO) are: **AND** at least one of a-c above (same as for B1).	≤ 2	≤ 20	≤ 50
B3	A very small number of threat-defined locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of Collapse or becoming Critically Endangered (CR) within a very short time period (B3 can only lead to a listing as Vulnerable, VU).			VU

5.2.3 Application

Data requirements

The geographic distribution of an ecosystem type is assessed under criterion B with two standardised metrics: the extent of occurrence (EOO) and the area of occupancy (AOO) (Gaston & Fuller, 2009; Keith et al., 2013). In addition, assessment of criterion B requires a qualitative evaluation of whether continuing declines in spatial extent, environmental quality, or increasing disruption of biotic interactions are occurring or likely to occur as a result of threats. Lastly, it requires an estimate of the number of threat-defined locations at which an ecosystem occurs. Thus, accurate maps of the current distribution of an ecosystem, information about the direction of current trends, and an understanding of the threats influencing the ecosystem are needed (Keith et al., 2013). For further information on data sources and the requirements of distribution maps for application in the RLE, refer to Section 5.1.3.

In some cases, spatial data may be insufficient to estimate EOO or AOO, but there is evidence that a small number of plausible threatening events may cause an ecosystem to become Critically Endangered or Collapsed within the near future. Such ecosystems may be eligible for listing as Vulnerable under criterion B3 if they occupy few threat-defined locations relative to the extent of threatening events. Distribution maps, locality records or expert knowledge are required to determine the number of threat-defined locations in which an ecosystem occurs.

Methods

Assessing spatial metrics for criteria B1 and B2

The two standardised measures of ecosystem distribution represent conceptually different aspects of geographic range size for both species (Gaston, 1994; Gaston & Fuller, 2009) and ecosystems (Keith et al., 2013; Murray et al., 2017). The EOO (subcriterion B1) measures the spread of risk over a contiguous area that encloses all occurrences using a minimum convex polygon. In contrast, the AOO (subcriterion B2) measures the spread of risk among occupied patches through a count of occupied grid cells (Keith et al., 2013).

AOO and EOO have been shown to perform better than other spatial distribution metrics (such as mean patch area, core area) for predicting the risk of ecosystem collapse in landscapes subject to stochastic threats (Murray et al., 2017). These measurement protocols are appropriate for all assessment units, including ecosystem types with depth dimensions or particular distribution patterns, such as linearly occurring ecosystem types.

Ensuring standardized application of these methods is critical for objective measurement of the size of a spatial distribution. Therefore, in no cases should AOO or EOO be measured in ways that do not comply with the methods specified below:

1. Extent of occurrence (EOO). The EOO of an ecosystem is measured by determining the area (km^2) of a minimum convex polygon – the smallest polygon that encompasses all known occurrences of a focal ecosystem in which no internal angle exceeds 180 degrees – fitted to an ecosystem distribution. The minimum convex polygon (also known as a convex hull) must not exclude any areas, discontinuities or disjunctions, regardless of whether the ecosystem can occur in those areas or not. Regions such as oceans (for terrestrial ecosystems), land (for coastal or marine ecosystems), or areas outside the study area (such as in a different country) must remain included within the minimum convex polygon to ensure that this standardised method is comparable across ecosystem types. In addition, these features contribute to spreading risks across the distribution of the ecosystem by making different parts of its distribution more spatially independent.

2. Area of occupancy (AOO). Measures of AOO are highly sensitive to the grain size (pixel resolution) at which the AOO is estimated (Nicholson et al., 2009), so all measures of AOO of an ecosystem type must be standardised to a common spatial grain (Keith et al., in review). The AOO of an ecosystem defined in the RLE is determined by counting the number of 10×10 km grid cells that contain the ecosystem. This relatively large grain size is applied for four reasons: (i) ecosystem boundaries are inherently vague (Regan et al., 2002), so it is easier to determine that an ecosystem occurrence falls within a larger grid cell than a smaller one; (ii) larger cells may be required to diagnose the presence of ecosystems characterised by processes that operate over large spatial scales, or possess diagnostic features that are sparse, cryptic, clustered or mobile (e.g. pelagic or artesian systems); (iii) larger cells allow AOO estimation even when high resolution distribution data are limited; and (iv) simulation studies have indicated that larger cells better predict risk in the face of real-world threat events than finer scale cells (Keith et al. *in review*). A global 10×10 km gridded dataset suitable for this purpose is available via a public data repository in raster and vector formats (Murray, 2017). Some ecosystem distributions comprise a highly skewed distribution of patch sizes. In these cases large numbers of small patches contribute a negligible risk-spreading effect to that of larger patches and a correction may be applied by excluding from the AOO those grid cells that contain patches of the ecosystem type that account for less than 1% of the grid cell area (i.e. <1km^2 of the focal ecosystem type, Box 10). Research is in progress to support guidance on when to apply this correction.

Several spatial tools are in development to assist in measuring the EOO and AOO of an ecosystem type. These will become available on the IUCN Red List of Ecosystems website (www.iucnrle.org).

Assessing subcriteria B1 and B2

To be eligible for listing under subcriteria B1 or B2, an ecosystem must meet the EOO or AOO thresholds that delineate threat categories, as well as at least one of three subcriteria that address various forms of decline. These subcriteria distinguish restricted ecosystems at appreciable risk of collapse from those that persist over long time scales within small stable ranges (Keith et al., 2013). Only qualitative evidence of continuing decline is required to invoke the subcriteria, but relatively high standards of evidence should be applied.

Subcriteria B1a and B2a address continuing declines in ecosystem distribution, abiotic environment or biotic processes. To invoke this subcriterion, the declines must: (i) reduce the ability of an ecosystem to sustain its characteristic native biota; (ii) be non-trivial in magnitude; and (iii) be more likely than not to continue into the future (Table 3). Episodic or intermittent declines qualify as continuing, so long as they are recurring and uncompensated by increases of comparable magnitude. Downward phases of cyclical changes or fluctuations do not qualify as continuing declines. These requirements imply an understanding of the causes of decline to support a correct inference.

Subcriteria B1b and B2b do not require evidence of past or current declines, but may be invoked by future declines inferred from serious and imminent threats. For these subcriteria, assessors, must: (i) identify one or more specific threatening processes; (ii) present convincing and generally agreed evidence that such threats are very likely (Table 3) to cause continuing declines within the next two decades. These requirements imply an understanding of how the threats affect the defining features of the ecosystem and the timing of their effects. Speculation about generic threats with uncertain impacts or onset is discouraged. Relevant evidence includes observations of similar threats in the past or on similar ecosystems, as well as accumulated knowledge about the behaviour and nature of the threat itself.

Subcriteria B1c and B2c require an estimate of the number of threat-defined locations that are occupied relative to the extent of serious plausible threats. A threat-defined location is defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all occurrences of an ecosystem type. Note that in the context of RLE assessment, a threat-defined location is not necessarily the same as a locality or site of occurrence; rather, a threat-defined location is defined entirely by the spatial extent of the most serious plausible threats (this is consistent with the definition of locations for The IUCN Red List of Threatened Species). The size of the threat-defined location depends on the area covered by the threatening event and may include part of one or many separate patches of the ecosystem. Where an ecosystem type is affected by more than one threatening event, threat-defined locations should be defined by considering the most serious plausible threat (IUCN, 2012). Where an ecosystem type is not affected by any threatening events, the number of threat-defined locations cannot be estimated and the subcriteria that refer to the number of locations will not be met. Box 11 contains further guidance and examples to support the interpretation of the threat-defined location concept.

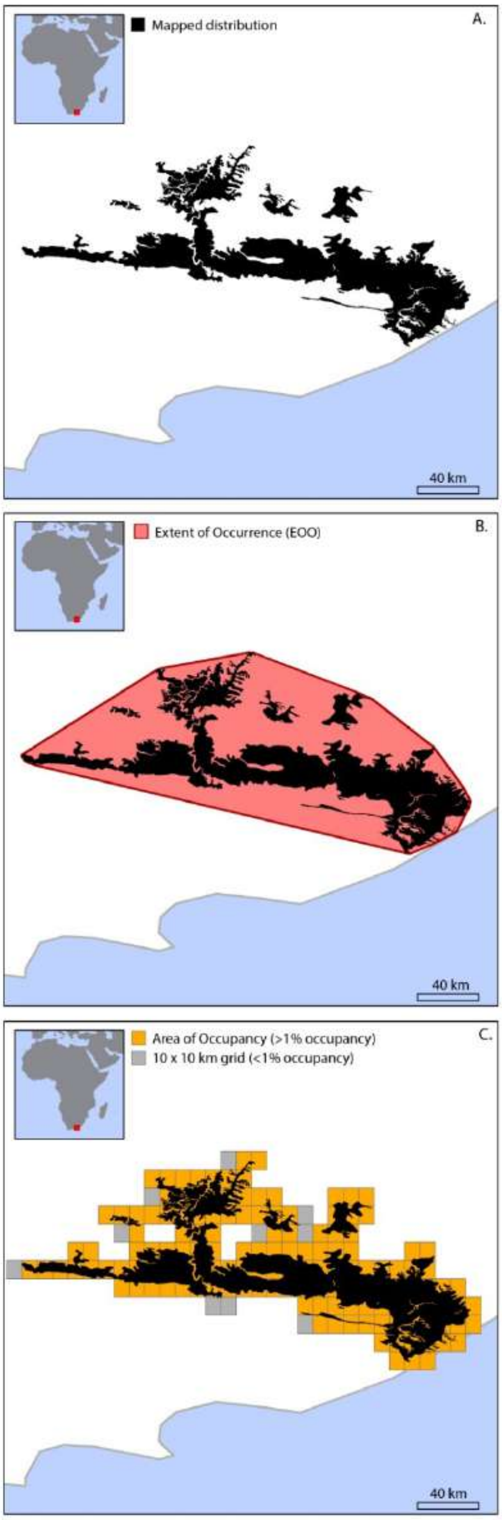
Assessing subcriterion B3

Subcriterion B3 requires only qualitative information on the distribution of an ecosystem and threats to its persistence. To compensate for this type of evidence (cf. quantitative estimates in other criteria), a higher standard of qualitative evidence is required and the highest category that can be invoked by subcriterion B3 is Vulnerable. Subcriterion B3 comprises two parts which must both be met for an ecosystem type to qualify for Vulnerable status. First, the ecosystem type must have a very restricted distribution, generally with fewer than five threat-defined locations (Box 11). Second, the ecosystem type must be facing severe threats (human activities or stochastic events) within a very short time period in an uncertain future and thus capable of collapse or becoming Critically Endangered within a very short time period. In other words, the impact of the threat is very likely (Table 3) to occur in the near future and its consequences are severe. Assessors have some flexibility to interpret the ‘very short time period’, but this generally means within the next two decades.

Documentation

For each assessment of an ecosystem type, assessors should: (i) provide the current maps of ecosystem distributions (similar to those in Box 10) that were used to estimate the EOO and AOO and to determine the number of threat-defined locations; (ii) provide full bibliographic references; (iii) justify why the spatial data used is an adequate representation of distribution of the focal ecosystem type (if not already done so for criterion A); (iv) explain why a correction to AOO was justified if one was applied; (v) justify inferences about continuing declines, and threats that may lead to continuing declines within the next 20 years; (vi) justify estimates of the number of threat-defined locations through reference to the most serious plausible threats and their spatial characteristics (Box 11). As with assessments under criterion A, description of the source of the spatial data (such as satellite sensor type), the accuracy of all mapped data, and the spatial resolution (grain size) of all data used in an assessment is strongly encouraged. Deposition of spatial data used for AOO and EOO into an appropriate data repository is encouraged and should be referenced in the documentation supporting the assessment.

Box 10. The extent of occurrence (EOO) and area of occupancy (AOO) of an ecosystem (criterion B)



The distribution of the Great Fish Thicket, South Africa (Mucina & Rutherford, 2006), is depicted by a raster dataset with a spatial resolution of 30x30 m (A). As mapped, the area of the Great Fish Thicket ecosystem type is 6,763.4 km^2.

A minimum convex polygon—the smallest polygon that encompasses all known occurrences of the ecosystem type in which no internal angle exceeds 180 degrees—is applied to estimate the extent of occurrence (EOO) for assessment under criterion B1 (B). The area of the minimum convex polygon is 18,359.2 km^2, meeting the initial requirements for an Endangered classification under criterion B1.

To estimate the area of occupancy (AOO) for assessment under criterion B2, the number of cells covered by the ecosystem type is required (C). The standardised measurement of AOO ensures that distribution data mapped at varying resolutions is generalised to a common 10x10 km grid, allowing consistent comparisons across ecosystem types. First, a 10x10 km grid is applied to the ecosystem type, indicating that 155 10x10 km grid cells intersect the distribution map (shown in orange and grey). Second, when the number of cells that contain very small patches (<1km^2) that negligibly contribute to risk spreading are excluded (shown in grey), the AOO is measured as 145 grid cells (shown in orange). This AOO is greater than the thresholds for classification in a threatened category under B2.

Finally, to be eligible for listing in a threatened category under criterion B, qualitative evidence of continuing decline is also required. In this case, the Great Fish Thicket ecosystem type does not meet any of the additional subcriteria, and is thus assigned an overall classification of Least Concern.

Box 11. Determining the number of threat-defined locations (criterion B) (adapted from Appendix S2 in Keith et al., 2013)

Coolibah - Black Box Woodland of south-eastern Australia
In its mature state, Coolibah – Black Box Woodland has an open structure with widely scattered trees, a variable cover of shrubs and grassy ground layer. The characteristic vertebrate fauna includes diverse assemblages of woodland and wetland bird species, many of which depend on tree hollows, other features of large trees or standing water for breeding and foraging (NSW Scientific Committee, 2004). The most serious plausible threats are land clearing and changes to water regimes. Spatial patterns of land clearing show a high degree of contagion, with the best predictor of future clearing being the proximity of a patch to land parcels already cleared of native vegetation. A broad interpretation of threat-defined locations under subcriterion B3 identifies three jurisdictional zones with different regulatory controls on land clearing: the leasehold Western Division of New South Wales; the freehold Central Division of New South Wales; and Queensland; this results in an estimate of three threat-defined locations as defined by land clearing. A more narrow interpretation of threat-defined locations based on neighbourhoods of contagion would produce an estimate of more than five. Small protected areas are excluded from these threat-defined locations, as they are not threatened by land clearing. These areas were assessed by considering the next most serious plausible threat: changes to water regimes. As protected areas are located in at least two different sub-catchments with different water management infrastructure, there are at least two further threat-defined locations. Hence the most precautionary interpretation produces an estimate of five threat-defined locations, although it is likely that there are more. Based on current rates of depletion due to land clearing (subcriterion A1) and current rates of environmental degradation due to changes in water regime (subcriterion C1), the ecosystem is unlikely to collapse or become Critically Endangered within the near future (c. 20 years). The ecosystem type therefore does not meet subcriterion B3, so the status of the ecosystem type is Least Concern under this subcriterion.

Cape Flats Sand Fynbos of South Africa
Cape Flats Sand Fynbos is a species-rich, dense, moderately tall shrubland with scattered emergent shrubs (Rebelo et al., 2006). The ecosystem type is an edaphically determined species assemblage restricted to Tertiary acid, deep grey regic sands at low elevations (20–200 m) on flat to undulating terrain. Cape Flats Sand Fynbos is restricted to the Western Cape province of South Africa, almost entirely within the limits of the City of Cape Town. The most severe threat to the ecosystem type is habitat destruction associated with urban development (Rebelo et al., 2006; Wood et al., 1994). Occurrences that are currently within proclaimed reserves are protected from this threat, although these stands are threatened by invasion of exotic plants (Rebelo et al., 2006). As the entire distribution of the ecosystem type is within the City of Cape Town, the unproclaimed remnant vegetation is subject to the same development pressures, regulatory regimes and planning authority. The distribution is therefore interpreted as two semi-independent threat-defined locations; one outside protected areas (threatened by habitat destruction and invasive plants) and one within protected areas (threatened by invasive plants, but not habitat destruction). Given the severe and immediate nature of the threats, the ecosystem type is prone to the effects of human activity or stochastic events such that it is capable of collapse or becoming Critically Endangered within a very short time period. The status of the ecosystem type is thus Vulnerable under subcriterion B3.

5.3 Criterion C. Environmental degradation

5.3.1 Theory

The RLE risk model defines two criteria for assessing declines in ecosystem functions or processes. Two criteria are needed to assess abiotic (environmental) and biotic degradation because the causes, effects and mechanisms of functional decline differ fundamentally between them (Keith et al., 2013). Abiotic degradation is the deterioration of the physical, non-living attributes that have a defining role in ecological processes and/or the distribution of an ecosystem type. Abiotic degradation reduces the capacity of an ecosystem to sustain its characteristic biota. For example, declines in limiting resources (niche dimension) reduce species diversity in a range of terrestrial, freshwater and marine ecosystems (Harpole & Tilman, 2007).

5.3.2 Thresholds and subcriteria

An ecosystem may be listed under criterion C if it meets the thresholds for any of four subcriteria (C1, C2a, C2b, or C3), which express different levels of environmental degradation over the following time frames:

Subcriterion	*Time frame*		Relative severity (%)		
C1	The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
C2	C2a. The next 50 years, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; **OR** C2b. Any 50-year period including the past, present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
C3	Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 90	≥ 70	≥ 50
		≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		

5.3.3 Application

Data requirements

To assess criterion C it is necessary to select suitable abiotic variables that represent defining features of the ecosystem type. This choice is based on a number of considerations:

1. There must be plausible evidence of a causal relationship between the process of environmental degradation and the loss of characteristic native biota. For example, an assessment of wetland degradation based on change in water quality would require evidence that declines in water quality are associated with loss of wetland biota, either through direct observation or inference from comparable ecosystem types. A carefully developed conceptual model can highlight key environmental processes and the transitions between healthy and collapsed states to be assessed in criterion C (Section 4.2.3).

2. Assessing abiotic degradation requires suitable scalar variables for estimating the severity of degradation, as well as suitable spatial variables for estimating the extent of degradation. The characteristics of the ecosystem and its threats will determine which variables are relevant. Variables with direct and clear cause-effect relationships and the greatest sensitivity to loss of characteristic native biota will be the most suitable.

3. The choice of a variable representing abiotic degradation should enable direct inferences about threshold values of the variable that define ecosystem collapse (Fig. 3).

4. Applying generic indices across functionally contrasting ecosystems is unlikely to assess degradation accurately if key processes differ among these ecosystems. The choice of abiotic variable should be underpinned by the ecology of a particular ecosystem (Table 7). If alternative variables representing different degradation processes are available, they should be examined independently and the one producing the greatest rate of decline should be used to assess status or the outcomes should contribute to a bounded estimate of the status.

5. Aggregation of multiple variables into a single index for assessment under criterion C can be problematic and is discouraged. Aggregation relies on statistical assumptions which may be unwarranted, especially in data-poor ecosystems. Aggregation can also confound different mechanisms of environmental degradation, making the index less sensitive than individual variables due to averaging effects. Assessors should therefore avoid aggregating variables when they are uncertain about ecosystem dynamics and the assumptions underpinning the aggregation. In these cases, the best effort should be made to select a variable that is relevant to ecosystem processes and sensitive to environmental degradation. The use of aggregated indices should be supported by critical evaluation of ecological and mathematical assumptions. A clear link between the change in index value and proximity to collapse must be demonstrated.

6. If the interaction between two or more variables is considered important, it is preferable to develop robust, expert-based rules to define states that are a combination of the variables, rather than use an index. For example, a severely degraded example of an ecosystem type might require two variables to have crossed a given threshold or be between two stated values, while moderate degradation may require either one to have crossed the threshold or both to be between a different set

of values. Using a rule-based method requires the assessor to explicitly state and understand how the variables can be combined. In many indices these relationships are submerged, poorly understood, and have unintended effects on index values.

7. Estimating the extent of abiotic degradation can be based on expert-derived estimates, inferences or spatial data. For example, data on levels of water extraction and surface area for each wetland were combined to assess the relative severity of environmental degradation over the entire area of the swamps, marshes and lakes of the Murray-Darling Basin (Keith et al., 2013).

Table 7. Examples of variables potentially suitable for assessing the severity of environmental degradation under criterion C.

Environmental degradation	*Variables*
Desertification of rangelands	Proportional cover of bare ground, soil density, soil compaction indices, remote sensing indices of change (Zhao et al., 2005; Ludwig et al., 2007).
Eutrophication of soils, freshwater streams or lakes	Levels of dissolved or soil nitrogen, phosphorus, cations, oxygen, turbidity, bioassay (Carpenter, 2003).
Dehumidification of cloud forests	Cloud cover, cloud altitude (Pounds et al., 1999).
Deforestation by acid rain	Rain water chemistry (Likens, 1992).
Homogenisation of microhabitats	Diversity of micro-terrain features, spatial variance in inundation depth and duration (Cabezas et al., 2009).
Changed water regime or hydroperiod	Field-based monitoring of stream flow volume, or piezometric water table depth; remote sensing of spatial extent of surface water, frequency and depth of inundation (Mac Nally et al., 2011).
Salinisation of soils or wetlands	Field monitoring of salinity of soils or groundwater, remote sensing of ground surface albedo (Metternicht & Zinck, 2003).
Sedimentation of streams, coral reefs	Sediment accumulation rates, sediment load of streams, discharge, turbidity of water column, frequency and intensity of sediment plume spectral signatures (Rogers, 1990).
Structural simplification of benthic marine ecosystems	Microrelief, abundance of benthic debris, trawling frequency and spatial pattern (Watling & Norse, 1998).
Sea level rise	Acoustic monitoring of sea level, extent of tidal inundation (Hannah & Bell, 2012).
Retreat of ice masses	Remote sensing of sea ice extent (Hong & Shin, 2010).

Methods

The key concept for assessing functional declines in either abiotic or biotic variables is relative severity. Relative severity is essential for comparing risks among ecosystems undergoing different types of degradation. Relative severity describes the proportional change observed in an environmental variable scaled between two values: one describing the initial state of the system (0%), and one describing a collapsed state (100%). Thus, if an ecosystem type undergoes degradation with a relative severity of 50% over an assessment time frame, this implies that that it has transformed half way to a collapsed state. Information on relative severity is combined with information on the proportion of the ecosystem affected (extent) to determine the risk category under criterion C. Assessors may either estimate the extent of degradation that exceeds a threshold level of severity or estimate the average severity of degradation across the entire ecosystem distribution (100% of extent; Fig. 13).

Ecosystems are listed as CR if environmental change is both extremely severe (≥80% relative severity) and extensive (across ≥80% of the distribution). Ecosystems may be eligible for listing in lower threat categories if they are undergoing very severe but localised degradation or less severe degradation over extensive areas (Fig. 13). Ecosystems that fail to meet the thresholds for the Vulnerable category may be assigned to the Near Threatened category. For example, an ecosystem undergoing >80% decline in environmental quality over 20-30% of its distribution, or >30% decline over 70-80% of its distribution could qualify as Near Threatened.

In the simplest case, relative severity may be calculated by range-standardising the raw values of the abiotic variable between its initial value and its collapse value. Assessors must: (i) estimate the value of the abiotic variable initial state (at the beginning of the assessment time frame); (ii) estimate the expected value in a collapsed state; (iii) measure or estimate the present or future value of the variable (i.e. at the end of the assessment time frame). Note that the calculated relative severity can be negative if the condition of the ecosystem has improved.

The following equations rescale an abiotic variable to a proportional change towards collapse suitable for assessing criterion C:

$$\text{Relative severity (\%)} = (\text{Observed or predicted decline} / \text{Maximum decline}) \times 100$$

where

$$\text{Observed or predicted decline} = \text{Initial value} - \text{Present or future value}$$

and

$$\text{Maximum decline} = \text{Initial value} - \text{Collapse value}$$

Next, assessors determine the extent of the degradation as a proportion of the total distribution of the ecosystem. With these two quantities assessors assign a risk category using the described thresholds.

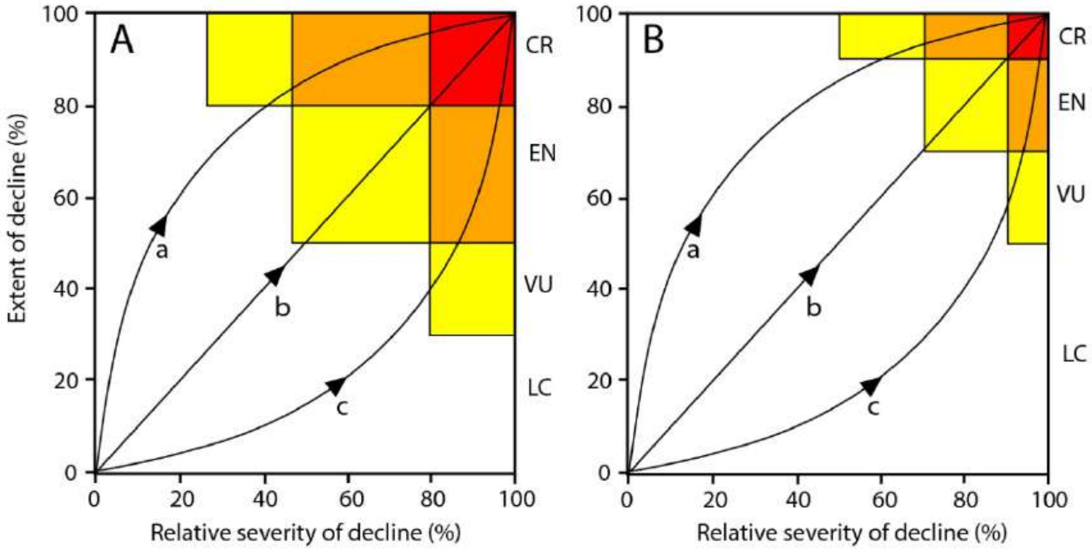


Figure 13. Contrasting pathways of environmental or biotic degradation and their corresponding risk classifications under criteria C1, C2, D1, D2 (A) or C3, D3 (B): (a) initially widespread and relatively benign degradation, which increases in severity, (b) severity and extent of degradation increase at similar rates, (c) localised but severe degradation, later becoming more widespread.

Box 12. Assessing environmental degradation (criterion C) (adapted from Appendix S2 in Keith et al., 2013)

Flooding is a key ecological process that sustains the *Gonakier Forests for the Senegal River Floodplain* in Senegal-Mauritania (Keith et al., 2013). As floods occur only during the wet season months, the maximum annual river height was assumed to be indicative of the river's capacity to flood each year. River height data were available for 100 years from 1904 to 2003. To assess criterion C, mean annual maximum river height across four gauging stations was used as a proxy for environmental degradation. River flows declined sharply, reaching a minimum during the late 1970s and 1980s. Floods of 2,500 m^3/s, which are needed for floodplain inundation, would be very unlikely to occur based on river flows observed during 1986-1989. Extreme rates of tree mortality were observed between the mid-1970s and the mid-1980s, corresponding to the lowest maximum river heights (473±27 cm) observed during the 100 years of records.

Based on these observations, the collapse threshold was defined as the mean maximum river height for a 50-year period falling below 450-500 cm, causing extensive tree mortality. To calculate the relative severity of hydrological decline, the time series was divided into the reference period (1904-1953) and the present period (1954-2003). Since the collapse threshold is an interval, relative severity was estimated for the lower and upper bounds of the interval.

For the lower bound (450 mm), relative severity is:

(Observed decline) / (Maximum decline) × 100 = (712-619) / (712-450) × 100 = 35%

For the higher bound (500 mm), relative severity is

(Observed decline / Maximum decline) × 100 = (712-619) / (712-500) × 100 = 44%

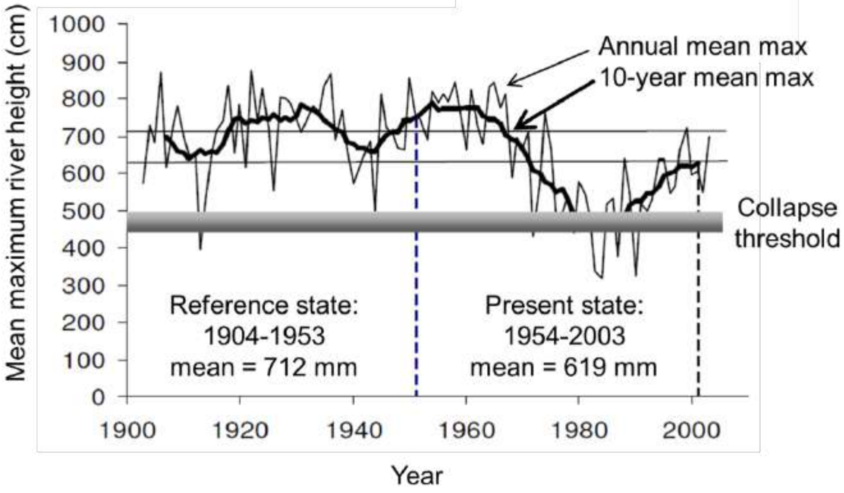


Figure 14. River height in the Gonakier forest.

Since hydrological decline affects the entire ecosystem, it was assumed that the extent of the threat was >80%, thus leading to the conclusion that the ecosystem is Vulnerable according criterion C1 (degradation with relative severity ≥30% over an extent ≥80% in the last 50 years).

Assumptions

Determining an initial and a collapsed value for the abiotic variable relies on assumptions about collapsed states of the ecosystem type. Such uncertainty in the collapse point can be represented with bounded thresholds of the values of the variable. The calculation of relative severity can be repeated with both values, providing a lower and upper estimate for the risk category (Box 12). Similarly, uncertainty in the extent of degradation can be assessed with the use of upper and lower estimates. The use of bounded values yields an estimate of the extent and severity of abiotic degradation while clearly expressing uncertainty.

Similar to the declines of extent required for assessing under criterion A, the application of criterion C assumes a functional form of decline. The simplest case illustrated above applies when there is a linear relationship between the assessment variable and the trajectory towards a collapsed state. Other scenarios are possible, for example, where collapse proceeds more slowly or more rapidly than indicated by changes in the assessment variable. In such cases a suitable transformation of the assessment variable should be used in the calculation of relative severity (Fig. 15).

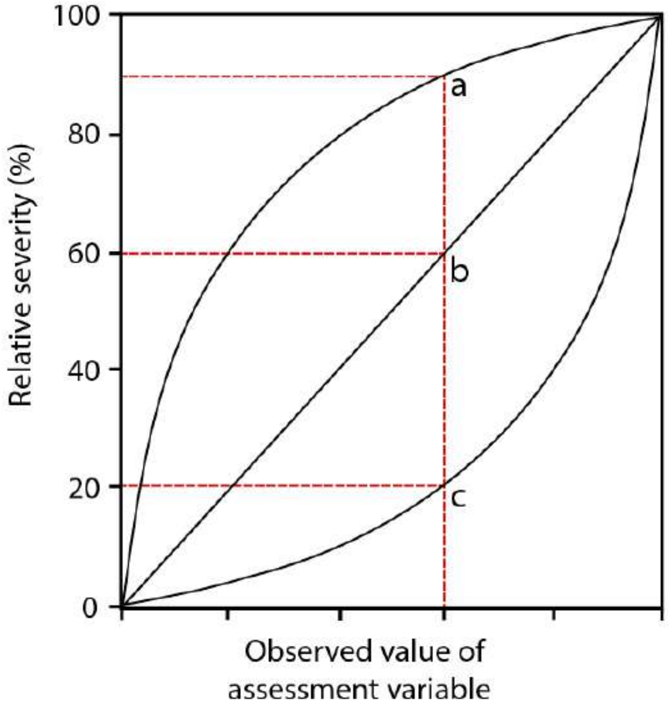


Figure 15. An observed value for a variable assessing degradation can be mapped to different values of relative severity depending on the functional form considered. The red line indicates an observed value which can be mapped to a relative severity of 20%, 60%, or 90% depending on the functional form. This corresponds to a risk category of LC, EN, or CR if the degradation occurs over ≥80% of the ecosystem type.

Determining whether the degradation is constant, accelerating, or decelerating can be informed by time-series data. Assessors should evaluate whether the available data are sufficiently representative to characterise the shape of the decline in the abiotic variable, ideally through appropriate statistical methods (Di Fonzo et al., 2013; Connors et al., 2014). Where time-series data are unavailable, it may be possible to infer changes in degradation using expert elicitation or space-for-time substitution with appropriate reference sites (Pickett, 1989). To overcome uncertainty due to this assumption, sensitivity analyses that include estimates produced from multiple shapes of decline can provide a bounded estimate for the risk assessment outcome.

Documentation

Assessors should document: (i) the selection of the abiotic variable with respect to the conceptual model of ecosystem dynamics; (ii) the setting of a bounded collapse threshold for the abiotic variable; (iii) the calculation of relative severity; (iv) the estimation of the extent of degradation; (v) assumptions and appropriate sensitivity analyses (e.g. regarding the collapse definition or shape of decline); (vi) the final risk categories and plausible bounds. Temporal variation in degradation is best shown in a graph that depicts changes in the variable over time, and includes any interpolation or extrapolation to match the relevant time frame.

5.4 Criterion D. Disruption of biotic processes and interactions

5.4.1 Theory

The persistence of biota within ecosystems depends on biotic processes and interactions. This includes: competitive, predatory, facilitatory, mutualistic, trophic and pathogenic processes; mobile links (e.g. seasonal migration); and species invasions. Biodiversity loss reduces the capacity of ecosystems to capture resources, produce biomass, decompose organic matter and recycle carbon, water and nutrients, and also reduces the stability of these functions through time (Cardinale et al., 2012). The identity of organisms within a system controls its functioning as key taxa make disproportionate contributions to ecosystem functions. The diversity of organisms is also important, because niche partitioning and positive species interactions promote complementary contributions to ecosystem functions.

Feedback interactions are crucial for an ecosystem type to absorb environmental change while maintaining characteristic biota and processes. Conversely, significant disruptions to biotic processes and interactions can cause collapse, regime shifts and re-organisation into novel ecosystems (Thébault & Loreau, 2005). Disruption of interactions through trophic cascades is one of five major threats to biodiversity (Diamond, 1989), although non-trophic interactions also play important roles (Fontaine et al., 2005; Goudard & Loreau, 2008). Certain ecosystem types may be especially sensitive to disruption of biotic processes and interactions, such as systems with strong top-down trophic regulation, with many mutualistic or facilitation interactions that are strongly dependent on mobile links, and where positive feedbacks operate between the biota and disturbance regimes.

5.4.2 Thresholds and subcriteria

An ecosystem may be listed under criterion D if it meets the thresholds for any of four subcriteria (D1, D2a, D2b, or D3), which express different levels of biotic disruption over the following time frames:

Subcriterion	*Time frame*		Relative severity (%)		
D1	The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
D2	D2a. The next 50 years, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; **OR** D2b. Any 50-year period including the past, present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 80	≥ 50	≥ 30
		≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
D3	Since 1750 based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	Extent (%)	≥ 90	≥ 70	≥ 50
		≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		

5.4.3 Application

Data requirements

Assessment of criterion D addresses the same data requirements as criterion C, except suitable biotic variables are used. Conceptual models provide a useful framework for selecting biotic variables linked to key ecosystem processes. A broad set of variables are potentially useful for quantifying biotic processes and associated functional declines. This includes changes in species richness, composition and dominance; relative abundance of species functional types, guilds or alien species; measures of interaction diversity; changes in identity and frequency of species movements; measures of niche diversity and structural complexity (Table 8).

Table 8. Examples of biotic variables potentially suitable for assessing the severity of disruption to biotic interactions under criterion D.

Variable	*Role in ecosystem resilience and function*	*Example*
Species richness (the number of species within a taxonomic group per unit area).	Ecological processes decline at an accelerating rate with loss of species (Cardinale et al., 2011). Species richness is related indirectly to ecosystem function and resilience through its correlations with functional diversity, redundancy and complementarity.	Response of species diversity of grasses and relative abundance to varying levels of grazing in grassland (Walker et al., 1999).

Variable	*Role in ecosystem resilience and function*	*Example*
Species composition and dominance.	Shifts in dominance and community structure are symptoms of change in ecosystem behaviour and identity.	Shift in diet of top predators (killer whales) due to overfishing effects on seals, caused decline of sea otters, reduced predation of kelp-feeding urchins, causing their populations to explode with consequent collapse of giant kelp, structural dominants of the benthos (Estes et al., 2009) (Box 13).
Abundance of key species (ecosystem engineers, keystone predators and herbivores, dominant competitors, structural dominants, transformer invasive species).	Invasions of certain alien species may alter ecosystem behaviour and identity, and make habitat unsuitable for persistence of some native biota. Transformer alien species are distinguished from benign invasions that do not greatly influence ecosystem function and dynamics	Invasion of crazy ants simplifies forest structure, reduces faunal diversity and native ecosystem engineers (Green et al., 2011). Invasion of arid Australian shrublands and grasslands by Buffel Grass makes them more fire prone and less favourable for persistence of native plant species (Clarke et al., 2005; Miller et al., 2010).
Functional diversity (number and evenness of types).	High diversity of species functional types (e.g. resource use types, disturbance response types) promotes coexistence through resource partitioning, niche diversification and mutualisms (Allen et al., 2005). Mechanisms similar to functional complementarity.	High diversity of plant-derived resources sustains composition, diversity and function of soil biota (Eisenhauer et al., 2011). Fire regimes promote coexistence of multiple plant functional types (Keith et al., 2007).
Functional redundancy (number of taxa per type; within- and cross-scale redundancy; see Allen et al., 2005).	Functionally equivalent minor species may substitute for loss or decline of dominants if many species perform similar functional roles (functional redundancy). Low species richness may be associated with low resilience and high risks to ecosystem function under environmental change (Allen et al., 2005; Walker et al., 1999).	Response of bird communities to varying levels of land use intensity (Fischer et al., 2007).
Functional complementarity (dissimilarity between types or species).	Functional complementarity between species (e.g. in resource use, body size, stature, trophic status, phenology) enhances coexistence through niche partitioning and maintenance of ecosystem processes (Cardinale et al., 2007).	High functional complementarity within both plant and pollinator assemblages promotes recruitment of more diverse plant communities (Fontaine et al., 2005).
Interaction diversity (interaction frequencies and dominance, properties of network matrices).	Interactions shape the organisation of ecosystems, mediate evolution and persistence of participating species and influence ecosystem-level functions, e.g. productivity (Thompson, 1997).	Overgrazing reduced diversity of pollination interactions (Vázquez & Simberloff, 2003).

Variable	*Role in ecosystem resilience and function*	*Example*
Trophic diversity (number of trophic levels, interactions within levels, food web structure).	Compensatory effects of predation and resource competition maintain coexistence of inferior competitors and prey. Loss or reduction of some interactions (e.g. by overexploitation of top predators) may precipitate trophic cascades via competitive elimination or overabundance of generalist predators.	Diverse carnivore assemblages (i.e. varied behaviour traits and densities) promote coexistence of plant species (Calcagno et al., 2011), decline of primary prey precipitates diet shifts and phase shifts (Springer et al., 2003).
Spatial flux of organisms (rate, timing, frequency and duration of species movements between ecosystems).	Spatial exchanges among local systems in heterogeneous landscapes provide spatial insurance for ecosystem function (Loreau et al., 2003). Exchanges may involve resources, genes or involvement in processes (Lundberg & Moberg, 2003).	Herbivorous fish and invertebrates migrate into reefs from seagrass beds and mangroves, reducing algal abundance on reefs and maintaining suitable substrates for larval establishment of corals after disturbance (Moberg & Folke, 1999).
Structural complexity (e.g. complexity indices, number and cover of vertical strata in forests, reefs, remote sensing indices).	Simplified architecture reduces niche diversity, providing suitable habitats for fewer species, greater exposure to predators or greater competition for resources (due to reduced partitioning).	Structurally complex coral reefs support greater fish diversity (Arias-González et al., 2012), structurally complex woodlands support greater bird diversity (Huth & Possingham, 2011).

Methods

The evaluation of criterion D follows the same procedure as with criterion C, but focuses on biotic variables rather than abiotic variables. Again, relative severity is calculated by range-standardising the raw values of the biotic variable between its initial value and its collapse value (Section 2). Assessors must: (i) estimate the value of the biotic variable in an initial state; (ii) estimate the expected value in a collapsed state; (iii) measure or estimate the present or future value of the variable. These three quantities are then used to rescale the biotic variable to a proportional change towards collapse (Section 5.3.3). Next, assessors must determine the extent of the disruption as a proportion of the total distribution of the ecosystem. With these two quantities assessors proceed to assign a risk category using the described thresholds. Similarly to criterion C, the use of generic indices is discouraged (Section 5.3.3).

Assumptions

Assumptions in the application of criterion D are similar to assumptions for criterion C. Again, determining an initial and a collapsed value for the biotic variable relies on assumptions about initial and collapsed states of the ecosystem (Section 2.2). As in the application of criterion A and C, application of criterion D relies on an assumption about the functional form of decline. In all cases, the decisions made in relation to assumptions must be explicitly discussed in the documentation.

Documentation

Assessors should document: (i) the selection of the biotic variable with respect to the conceptual model of ecosystem dynamics; (ii) the setting of a bounded collapse threshold for the biotic variable; (iii) the calculation of relative severity; (iv) the estimation of the extent of disruption; (v) assumptions and appropriate sensitivity analyses (regarding the definition of collapse or the assumed shape of decline); (vi) the final risk categories and plausible bounds. Temporal variation in biotic disruption is best shown in a graph depicting changes in the variable over time, and includes any interpolation or extrapolation to match the relevant time frame (Box 13).

Box 13. Assessing disruption of biotic processes (criterion D)

Alaskan Giant Kelp Forests are structurally and functionally diverse assemblages, characterised by species of brown algae in the Order Laminariales. These create complex and dynamic layered forest architecture up to 15 m tall that provides substrate, shelter and foraging resources for a diverse fauna assemblage of epibenthic invertebrate herbivores and pelagic vertebrate predators.

The most serious disruption to biotic interactions occurs through trophic cascades involving sea otters, their predators (killer whales) and their prey (urchins, which consume kelp). Given that densities of kelp are inversely related to densities of urchins, and that phase shifts between forests and urchin barrens are related to a threshold abundance of otters (Estes et al., 2010), any of these variables is potentially suitable for assessing criterion D. Although data are available on population changes in great whales and pinnipeds (alternative prey for killer whales), these were not used because: (i) data on more proximal response variables are available; (ii) the causal relationship linking great whales and pinnipeds with otter abundance via killer whale predation is less certain than the link between otters, urchins and kelp.

Survey data for kelp stipe densities were available between 1987 and 2000 from seven islands (Estes et al., 2009). It was assumed that the seven islands, scattered across the Aleutian chain, were representative of the full distribution of the ecosystem. Ecosystem collapse occurs when kelp density is close to zero across all sites, consistent with kelp replacement by urchin barrens throughout the distribution. Rates of change in kelp density were calculated for each island assuming an exponential model. A weighted average across all sites indicated that kelp densities declined on average by 49.2% between 1987 and 2000. Allowing for some decline prior to 1987 or after 2000 suggests that the decline in kelp density over the past 50 years was at least 50% across the full ecosystem extent.

Aerial survey data for sea otters were available for 55 islands along the Aleutian chain between 1959 and 2000 (Doroff et al., 2003). Ecosystem collapse occurs when otter populations reach zero across all sites. The total population was estimated to be 55,000–74,000 prior to decline in the mid-1980s. By 2000 there were a total of 3,924–13,580 animals based on extrapolation from the aerial survey (Doroff et al., 2003). The lower and upper bounds of otter population decline are:

$$100 \times (55000 - 13580) / 55000 = 75.3\%$$

$$\text{and } 100 \times (74000 - 3924) / 74000 = 94.7\%$$

Evidence from trends in kelp density and sea otter sightings suggest a decline in biotic function of 50-95% relative severity across 100% of the ecosystem extent. The upper bound of this range may overestimate the severity of decline because: (i) the surveys may have underestimated the population due to detectability issues (Doroff et al., 2003); (ii) the calculations assume that otter and kelp populations have not recovered since 2000, in spite of qualitative evidence for some recovery. The most likely status of the ecosystem under criterion D1 is Endangered, although a status of Critically Endangered is possible. No projections are currently available for any of the biotic variables. The status of the ecosystem is Data Deficient under criterion D2.

The otter population in 1750 was comparable or slightly larger than its peak in the mid-1980s (Doroff et al., 2003). Based on this assumption, the decline in otter populations throughout the distribution of the kelp forest was 75-95% since 1750. The status of the ecosystem type under criterion D3 is therefore Endangered (plausible range Endangered – Critically Endangered). Thus, the Alaskan giant kelp forests ecosystem type is listed as Endangered (plausible range Endangered – Critically Endangered).

5.5 Criterion E. Quantitative risk analysis

5.5.1 Theory

Criterion E serves two purposes. First it can be used to list an ecosystem type by implementing models that integrate multiple mechanisms of decline and their interactions into the risk assessment (as described below). Second, it provides an anchor for risk assessment and an overarching framework for the other criteria, as its analogue does in Red List criteria for species. Criterion E specifies the level of risk that corresponds to each category of threat, by defining the probability of collapse and the specified time frame for Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) ecosystem types.

5.5.2 Thresholds

An ecosystem may be listed under Criterion E if it meets the thresholds for the criterion, a quantitative analysis that estimates the probability of ecosystem collapse to be:

CR	≥ 50% within 50 years
EN	≥ 20% within 50 years
VU	≥ 10% within 100 years

5.5.3 Application

Methods

The probability of ecosystem collapse can be estimated with stochastic simulation models incorporating key ecosystem processes. The models should:

1. Produce estimates of an ecosystem variable for which a threshold of collapse has been estimated.
2. Produce quantitative estimates of risks of ecosystem collapse over a 50-100 year time frame.
3. Incorporate stochasticity in key processes that determine ecosystem properties.
4. Be applied with scenarios that represent plausible future scenarios of ecosystem dynamics.

A wide range of models can be used to apply criterion E. We provide broad recommendations for the application of criterion E in the form of nine steps to ensure that models are based on sound assumptions, scientifically credible and transparent (Fig. 16).

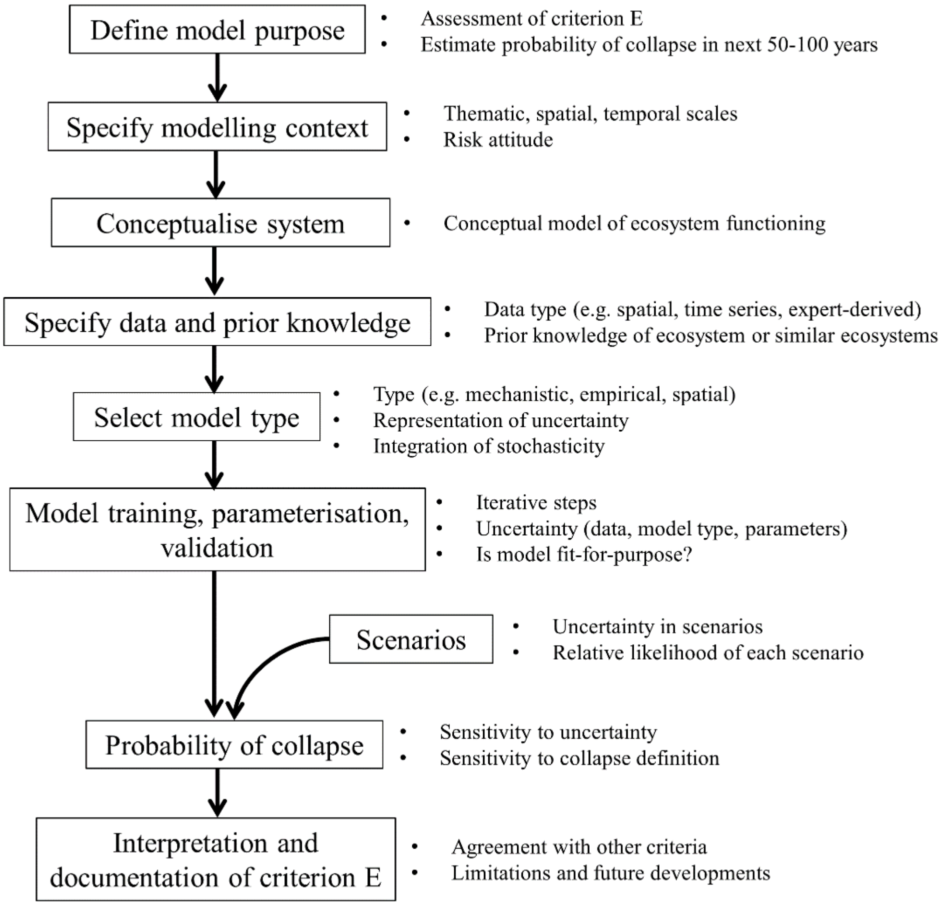


Figure 16. Nine steps to apply criterion E.

1. *Define model purpose*
   Models for criterion E should provide an adequate prediction of the risk of collapse over a period of 50-100 years. If the model used for criterion E is being adapted from a model with different objectives (e.g. providing guidance for management and decision-making), it may be necessary to modify its objectives and implementation. Although other objectives may be important in model-building, models for criterion E will be reviewed based on the quality of their predictions for the purpose of the RLE assessment.

2. *Specify modelling context*
   Ecosystems are inherently scale-dependent, so the thematic, spatial and temporal scales of ecosystem processes may affect model-building and predictions. Adequately defining the boundaries of the ecosystem under assessment is crucial – external forcing and external outputs should be clearly labelled as such. The model should aim to spatially represent all occurrences of the ecosystem; if not, adequate inferences should be made to assess the representativeness of final predictions. The time frame of predictions for criterion E is 50-100 years, which is longer than other subcriteria (A2a, A2b, C2a, C2b, D2a, D2b) and may therefore require a different understanding of future threats.

Modelling may involve decisions relying on the risk attitude of the assessor, i.e. the relative costs of under or overestimating the risk of collapse. A precautionary but realistic risk attitude is advocated when implementing criterion E. Such decisions should be thoroughly documented within the criterion E documentation, and if possible underpinned by quantitative measures of risk aversion.

3. *Conceptualise system*
Models for criterion E should rely on a sound understanding of ecosystem dynamics and function, underpinned by data and relevant inferences from similar ecosystems. Conceptual models can help identify key ecosystem processes and variables indicating collapse. The conceptual model may depict cause-and-effect relationships or transitions among reference and collapsed ecosystem states. The conceptual model used for criterion E may differ from the general conceptual model used in the ecosystem description (Section 6.2.3), as it may depict more complex relationships and include measurable variables. Deciding on an appropriate level of abstraction for key processes is a key component of conceptualisation and should consider the model purpose, context, required resolution of output and effort required for model building. A critical component of assessment under criterion E is the explicit definition of collapse as it relates to the conceptual model of ecosystem dynamics and measured variables (Section 3.2).

4. *Specify data and prior knowledge*
Applying criterion E requires the levels of key ecosystem variables to be predicted over specified time frames. These variables can represent spatial distribution (as in criteria A and B), abiotic environment (criterion C), and/or biotic interactions (criterion D). Suitable variables can be selected by following the processes outlined in the *Application* sections relevant to each criterion. The data may be quantitative measurements (e.g. spatial data, time series) or expert-derived. At this stage the degree of spatial and temporal aggregation of data and predictions may be revised, to match ecosystem dynamics to the modelling context. For example, it may be appropriate to aggregate daily or monthly data to yearly time steps. In data-poor situations, it may be possible to infer processes and data from similar ecosystems (Maxwell et al., 2015). This should be clearly indicated and discussed within the model documentation.

5. *Select model type*
A diverse range of simulation models of ecosystem dynamics allow the probability of ecosystem collapse to be estimated directly. Selection of an appropriate model type will depend on: (i) ecosystem dynamics; (ii) data availability; (iii) representation of uncertainty; and (iv) integration of stochasticity. Some models may be more appropriate to represent specific ecosystems and their dynamics (e.g. hydrologic models for wetlands, global vegetation models for forests). The type of input data may also constrain model choice (e.g. some model types may be unable to handle missing data or expert-derived data). Models should be chosen or adapted so that appropriate uncertainty and sensitivity analyses can be conducted. Ideally, model uncertainty should be addressed by implementing multiple models representing alternative interpretations of ecosystem dynamics. Finally, ecosystem dynamics rely

on stochastic processes, so models should be chosen or adapted so as to integrate stochasticity (see Coorong Lagoon case study in Appendix S2 in Keith et al., 2013).

Candidate model types for the application of criterion E include:

- state-and-transition models (Lester and Fairweather, 2009, Rumpff et al., 2011, Maxwell et al., 2015).
- mass-balance models (e.g. Ecopath, Models of Intermediate Complexity) (Christensen and Walters, 2004, Plagányi et al., 2014).
- bifurcation plots (Holdo et al., 2013).
- network theory (e.g. Community Viability Analysis) (de Visser et al., 2011).
- dynamic Global Vegetation Models (Scholze et al., 2006).
- dynamic species distribution and population models (Midgley et al., 2010, Keith et al., 2008).
- spatial models (e.g. cellular automata) (Soares-Filho et al., 2002).
- general ecosystem models (e.g. the Madingley model) (Harfoot et al., 2014).

6. *Model training, parameterisation, validation*

Models should follow best practice recommendations for each model type, and should be appropriately trained, parameterised and/or validated. For example, the data-derived state-and-transition model of the Coorong Lagoon was validated through multiple pathways, so that neither states nor transitions were determined a priori (Lester & Fairweather, 2011). For some models full validation may not be possible; in these cases model performance can be evaluated with relevant performance indicators, e.g. satisfactory reproduction of observed behaviour, absence of correlation in model residuals (Jakeman et al., 2006). Model training, parameterisation and validation may occur in iterative steps that should be thoroughly documented. It may be appropriate to assess the effects of data uncertainty, parameter uncertainty and model uncertainty through sensitivity analyses. Overall, assessors should demonstrate that the model is fit for purpose for application in criterion E.

7. *Scenarios*

Future scenarios representing likely threats and changes to ecosystem dynamics should be identified. It is important to recognise that concepts and data underpinning scenarios may be subject to high levels of uncertainty, the effects of which may be difficult to track in large models (e.g. climate change projections; Kujala et al., 2013). Often, the relative likelihood of each future scenario will not be known (Peterson et al., 2003), so the final likelihood of collapse may be expressed as a range of values rather than a single estimate.

8. *Probability of collapse*

The estimate of the probability of collapse may be a single value, but in most cases in may be expressed as a range of values representing uncertainty in model-building. Sensitivity analyses of the probability of collapse may be done relevant to: (i) data, model and parameters uncertainty; (ii) scenario uncertainty; and (iii) other forms of uncertainty that may affect modelling outcomes, e.g. the choice of variables to assess ecosystem collapse. A sensitivity analysis on the threshold of collapse should be conducted in all models, as the final outcome for criterion E may be particularly sensitive to the definition of collapse. In simulations of the Mountain Ash forest (Burns et al., 2015), for example, the collapse threshold would need to decrease from an average of one hollow-bearing tree per hectare to 0.7 to change the risk assessment outcome.

9. *Interpretation*
   Criterion E provides an overarching framework for the application of the other criteria, and includes ecosystem dynamics that may not be captured by other criteria. It may therefore be useful to compare the outcome for criterion E with the outcomes of other criteria and provide insights into possible reasons for differences in assessment outcomes.

Documentation

A greater level of documentation is required for criterion E than for other criteria, given the scientific nature of modelling and the effects of uncertainty. It is recommended that assessors publish their models in the peer-reviewed literature and place their materials (data, code) in data repositories to allow full scrutiny of models and their outcomes. Within the RLE peer review, risk assessment and modelling experts will review models against strict criteria and may request additional analyses. Specific guidance and examples of the application of criterion E are currently under development, and will be made available on the IUCN Red List of Ecosystems website (www.iucnrle.org).

Box 14. Developing a quantitative model of ecosystem dynamics (criterion E)

The probability of ecosystem collapse has been estimated for the Coorong Lagoon of South Australia, through the adaptation of an empirically derived state-and-transition model (Appendix S2 in Keith et al., 2013; Lester & Fairweather, 2011). Ecosystem collapse occurred when half of the modelled years occurred either in degraded ecosystem states or in a period of recovery following the occurrence of degraded states.

The quantitative assessment of the likelihood of ecosystem collapse in the Coorong was undertaken with a chain-of-models (Lester & Fairweather, 2011). Downscaled simulations from multiple global climate models were applied to hydrologic models for the Murray-Darling Basin to estimate a time series of flows. Six scenarios were investigated to quantify the likelihood of ecological collapse in the Coorong based on three climate projections for 2030 and two extraction levels (i.e. with, and without current infrastructure and extraction). All scenarios were run for a period of 114 years (Lester & Fairweather, 2009). Given that each scenario should be interpreted as 114 years of possible variability due to climatic fluctuations, the proportion of years occurring in degraded or recovery states provides an assessment of the stochasticity within the system.

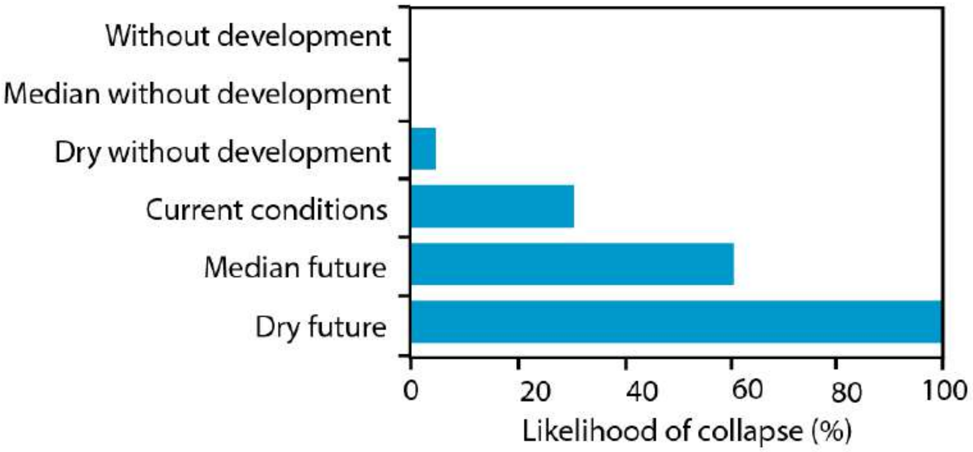


Figure 17. Likelihood of collapse of the Coorong Lagoon under six scenarios of climate change and water extraction. The three climate scenarios are: historical sequence since 1895; the median future climate projection based on three climate change scenarios from 15 global climate models; and a dry future climate projection based on the 10th percentile of the same models.

Of the six scenarios investigated, ecological collapse occurred in four. Water extraction will not cease in the Murray-Darling Basin, so the ‘without development’ scenarios can be discounted from the overall calculation of risk of collapse. The likelihood of ecological collapse ranges from 30% to 100% across three scenarios representing current levels of development. The Coorong Lagoon is thus listed as Critically Endangered (plausible range Endangered – Critically Endangered) under criterion E.

6. Peer review and publication

The IUCN Red List of Ecosystems Committee for Scientific Standards will coordinate independent peer reviews of risk assessments for the global IUCN Red List of Ecosystems. Reviews of sub-global assessments will be the responsibility of project managers, though they are encouraged to seek advice from the Committee for Scientific Standards. Assessments will be reviewed by at least two experts: one with expertise in the ecology of the ecosystem type under assessment, and another familiar with the *IUCN Red List of Ecosystems Categories and Criteria*.

The review criteria include:

1. Whether the ecosystem type is consistent with the conceptual definition of an ecosystem, and hence a valid unit for assessment using the IUCN Red List of Ecosystems criteria.

2. Whether documentation includes or references an adequate description of the ecosystem type. This includes crosswalks to relevant classifications, an account of key ecological processes and threats, a graphical conceptual model, and a quantitative evaluation of each criterion for which data exist.

3. Whether all accessible data and information relevant to IUCN Red List of Ecosystems assessment of the ecosystem type have been addressed.

4. Whether the quality of underlying data has been evaluated and found to be adequate.

5. Whether definitions and concepts in the Guidelines have been correctly interpreted and applied.

6. Whether methods and calculations have been validly applied, and whether alternative methods are more suitable.

7. Whether estimates of variables for past, present, future, and collapsed states are complete and supported by evidence.

8. Whether inferences related to the IUCN Red List of Ecosystems criteria are justified and transparently communicated.

9. Whether uncertainties have been adequately incorporated in the assessment.

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Appendix 1. List of contributors

Name	*Organisation*	*Country*
Kaisu Aapala	Finnish Environment Institute	Finland
Alfonso Alonso	Smithsonian Conservation Biology Institute	USA
Marianne Asmüssen	Instituto Venezolano de Investigaciones Científicas	Venezuela
Steven Bachman	Royal Botanic Gardens, Kew	UK
Jonathan Baillie	Zoological Society of London	UK
Edmund G. Barrow	IUCN	Kenya / Ireland
Alberto Bassett	University of Lecce	Italy
John Benson	Royal Botanic Gardens and Domain Trust	Australia
Melanie J. Bishop	Macquarie University	Australia
Lucie M. Bland	University of Melbourne	Australia
Kaia Boe	IUCN	Switzerland
Ronald Bonifacio	South Australian Department of Environment and Natural Resources	Australia
Tim Boucher	The Nature Conservancy	USA
Thomas M. Brooks	IUCN	Switzerland
Claire Brown	UNEP-WCMC	UK
Neil Burgess	UNEP-WCMC	UK
Mark A. Burgman	University of Melbourne	Australia
Ben Collen	Zoological Society of London	UK
Patrick Comer	NatureServe	USA
Francisco A. Comín	Pyrenean Institute of Ecology-CSIC	Spain
Franz Essl	Environment Agency	Austria
Don Faber-Langendoen	NatureServe	USA
Peter G. Fairweather	Flinders University	Australia
Ariany García Rawlins	Provita	Venezuela
Robert J. Holdaway	Landcare Research	New Zealand
Michael Jennings	University of Idaho	USA
David A. Keith	University of New South Wales	Australia
Richard T. Kingsford	University of New South Wales	Australia
Tytti Kontula	Finnish Environment Institute	Finland
Rebecca E. Lester	Deakin University	Australia
Ralph Mac Nally	Monash University	Australia
Michael A. McCarthy	University of Melbourne	Australia
Rebecca M. Miller	IUCN	UK
Justin Moat	Royal Botanic Gardens, Kew	UK

Name	*Organisation*	*Country*
Nicholas J. Murray	University of New South Wales	Australia
Emily Nicholson	Deakin University	Australia
María A. (Tina) Oliveira-Miranda	Provita	Venezuela
Phil Pisanu	South Australian Department of Environment and Natural Resources	Australia
Brigitte Poulin	Tour du Valat Research Center	France
Tracey J. Regan	Arthur Rylah Institute	Australia
Belinda Reyers	Council for Scientific and Industrial Research	South Africa
Uwe Riecken	German Federal Agency for Nature Conservation	Germany
Jon Paul Rodríguez	Instituto Venezolano de Investigaciones Científicas	Venezuela
Kathryn M. Rodríguez-Clark	Instituto Venezolano de Investigaciones Científicas	Venezuela
Mark D. Spalding	The Nature Conservancy and University of Cambridge	UK
Andrew Taber	The Wildlife Trust	USA
Irene Zager	Provita	Venezuela
Sergio Zambrano-Martínez	Instituto Venezolano de Investigaciones Científicas	Venezuela
Carlos Zambrana-Torrelio	EcoHealth Alliance	USA
Tara Zamin	Monash University	Australia

Appendix 2. IUCN Red List of Ecosystems Criteria, Version 2.2

A. Reduction in geographic distribution over **ANY** of the following time periods:

	A1. the past 50 years	**A2a**. the next 50 years	**A2b**. any 50 year period including the past, present and future	**A3**. since 1750
CR	≥ 80%	≥ 80%	≥ 80%	≥ 90%
EN	≥ 50%	≥ 50%	≥ 50%	≥ 70%
VU	≥ 30%	≥ 30%	≥ 30%	≥ 50%

B. Restricted geographic distribution indicated by **ANY OF** B1, B2 or B3:

B1. Extent of a minimum convex polygon enclosing all occurrences (extent of occurrence, EOO) is no larger than:

CR	2,000 km^2	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at 1 threat-defined location
EN	20,000 km^2	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at ≤ 5 threat-defined locations
VU	50,000 km^2	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at ≤ 10 threat-defined locations

B2. The number of 10 × 10 km grid cells occupied (area of occupancy, AOO) is no more than:

CR	2	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at 1 threat-defined location
EN	20	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at ≤ 5 threat-defined locations
VU	50	**AND** at least one of the following (a-c):	**(a)** An observed or inferred continuing decline in **ANY OF**: **i.** a measure of spatial extent appropriate to the ecosystem; **OR** **ii.** a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR** **iii.** a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem. **(b)** Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years. **(c)** Ecosystem exists at ≤ 10 threat-defined locations

B3. The number of threat-defined locations is:

VU	Very small (generally fewer than 5 threat-defined locations) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of Collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).

C. Environmental degradation over **ANY** of the following time periods:

C1. The past 50 years, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	**CR**	**EN**	**VU**
≥ 50	**EN**	**VU**	
≥ 30	**VU**		

C2a. The next 50 years, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; **OR**

C2b. Any 50-year period including the past, present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	**CR**	**EN**	**VU**
≥ 50	**EN**	**VU**	
≥ 30	**VU**		

C3. Since 1750, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 90	≥ 70	≥ 50
≥ 90	**CR**	**EN**	**VU**
≥ 70	**EN**	**VU**	
≥ 50	**VU**		

D. Disruption of biotic processes or interactions over **ANY** of the following time periods:

D1. The past 50 years, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

D2a. The next 50 years, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table; **OR**

D2b. Any 50-year period including the past, present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 80	≥ 50	≥ 30
≥ 80	CR	EN	VU
≥ 50	EN	VU	
≥ 30	VU		

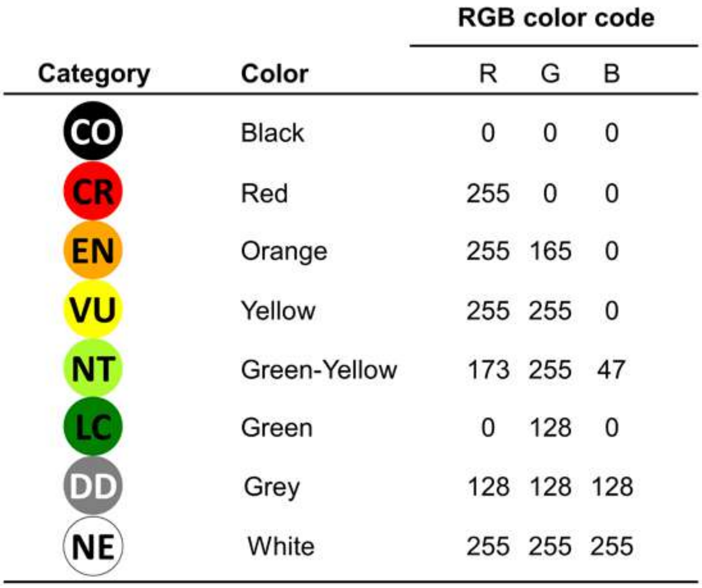
D3. Since 1750, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:

	Relative severity (%)		
Extent (%)	≥ 90	≥ 70	≥ 50
≥ 90	CR	EN	VU
≥ 70	EN	VU	
≥ 50	VU		

E. Quantitative analysis that estimates the probability of ecosystem collapse to be:

CR	≥ 50% within 50 years
EN	≥ 20% within 50 years
VU	≥ 10% within 100 years

Appendix 3. Colour codes



Category	Color	RGB color code		
		R	G	B
CO	Black	0	0	0
CR	Red	255	0	0
EN	Orange	255	165	0
VU	Yellow	255	255	0
NT	Green-Yellow	173	255	47
LC	Green	0	128	0
DD	Grey	128	128	128
NE	White	255	255	255

Appendix 4. Revision history

Version Number	*Revisions*	*Date*
1.0	Guidelines v1.0 launched	27/10/2016
1.1	Updated guidelines to include new research published between v1.0 and v1.1 New section: 3.3.4 Making the most of quantitative data and expert knowledge New Fig. 8 and Fig. 9 Incorporated recent research on performance of range size measures Change of language from 'location' to 'threat-defined location' to avoid ambiguity with locality	16/06/2017

INTERNATIONAL UNION
FOR CONSERVATION OF NATURE

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland, Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org

APPENDIX 10
PROPOSED BIODIVERSITY MITIGATION MEASURES

Table 10-1 Suggested Additional Biodiversity Mitigation Measures

Project-related Impacts	Avoidance Measures	Mitigation and Management Measures
Pre-Construction and Construction		
Habitat clearance	• Avoid habitat clearance in zone 1a of the Buna River Protected Landscape • Avoid the use of herbicides to clear vegetation	• Areas to be cleared will be delineated and vegetation removal will be restricted to these designated areas. • Vegetation clearance works will be restricted to daylight hours to minimise the risk of collision with fauna. • Preservation and translocation of soil seed bank as part of site rehabilitation / revegetation where possible • Vegetation clearance will be undertaken in a progressive and sensitive manner to enable fauna to move away from the area of works and dispense into surrounding habitats • Pre-clearance survey to check for the presence of priority flora. • An ecologist will be on call during habitat clearance to provide assistance / advice regarding any biodiversity issues if required. • Environmental awareness and training (toolbox talk) to all personnel (employees and contractors)
Noise and vibration		• Regular vehicle / machinery maintenance to minimise noise and vibration. • Retain natural barriers, particularly near the Buna River Protected Landscape (i.e. retention of the hanging wall, bunds and trees).
Invasive species transfer and pest immigration	• The development and implementation of organic waste management procedures to avoid attracting pests	• An invasive species prevention protocol will be implemented to prevent the introduction and transfer of invasive species. This will include the avoidance of affected areas by staff and vehicles where possible. A record will be kept of all affected areas • To be communicated through induction and training to drivers and other relevant personnel (employees and contractors).

Project-related Impacts	Avoidance Measures	Mitigation and Management Measures
Wildlife-vehicle collision		• Vehicle operation to be restricted to daylight hours. Permission to be sought to drive after dusk. • Enforcement of restricted speed limits • Minimisation of planned heavy vehicle / plant use within the Buna River Protected Landscape • Driver training and signage • Restricted access to Project roads (where appropriate) to authorised people only • The development and adherence of an Injured Wildlife Protocol
Spills: hydrocarbon, other hazardous materials (i.e. paint, solvents etc.)	• The development and implementation of a Standard Operating Procedure for Hazardous Materials Management	• Regular maintenance of vehicles / machinery • Staff training in spill events management. • The development and implementation of a Standard Operating Procedure for Hazardous Materials Management
Artificial lighting	• Avoid using artificial lighting where possible, particularly in the Buna River Protected Landscape	• Use of capped / directional artificial lighting to focus lighting away from sensitive areas. • Retain of natural barriers to minimise light spill particularly in the Buna River Protected Landscape (i.e. woodland canopy, earth bund etc.)
Dust		• Regular watering during the dry season in areas of biodiversity sensitivity. • Use of geotextiles to cover exposed topsoil prior to the establishment of vegetation in areas of biodiversity sensitivity.
Transfer of pathogens to and from wildlife	• Avoid contact with wildlife • Adhere to hygiene procedures	• Raise awareness of the risks of disease transmission, general hygiene procedures, the management of road kill and waste management procedures. To be communicated through induction and training to all personnel (employees and contractors).
Suspended sediments		• Install sediment traps if required
Emissions (NOx, SOx, CO) from vehicle and machinery use		• Regular maintenance of vehicles / machinery • Use of catalytic converters / low emission engines
Bushfires		• Bushfire controls including a Project ban on open-burning of waste

Project-related Impacts	Avoidance Measures	Mitigation and Management Measures
		• Specific emergency response procedures developed for managing bushfires • Establishment of fire breaks where required
Exploitation of natural resources and poaching		• Prohibit hunting and natural resource collection by the project personnel and contractors when at work. To be communicated through induction and training to all personnel (employees and contractors). • Consultation and collaboration with protected area managers to ensure potential projected-related indirect impacts to the Buna River Protected Landscape are adequately mitigated; • Consultation with local authorities to minimise the impacts of in-migration on natural resource exploitation (including the collection of timber, non-timber products and hunting).
Operation		
Habitat clearance		• Progressive habitat restoration along the margins of the right of way.
Noise and vibration from traffic vehicles and human disturbance		• Use of artificial sound barriers if present. • Consider installing artificial sound barriers
Invasive species transfer and pest in-migration	• Adhere to SOP06: organic waste management procedures to avoid attracting pests	• Actively monitor and eradicate invasive vascular plant species along the right of way
Wildlife-vehicle collisions		• Enforcement of restricted speed limits, particularly in the Buna River Protected Landscape, communicated through signage • Monitor wildlife-vehicle collisions
Artificial lighting	• Avoid using artificial lighting where possible, particularly in the Buna River Protected Landscape	• Use of capped / directional lighting to focus lighting away from sensitive areas. • Retain natural barriers to minimise light spill artificial light, particularly near the Buna River Protected Landscape (i.e. woodland canopy, earth bund etc.).
Dust		• Use of geotextiles to cover exposed topsoil prior to the establishment of vegetation in areas of biodiversity sensitivity.

Project-related Impacts	**Avoidance Measures**	**Mitigation and Management Measures**
		• Progressive habitat restoration along the margins of the right of way.
Suspended sediments		• Installation of an effective draining system to minimise the risk of suspended sediment loading and runoff. • Maintenance of sediment traps / erosion controls
Bushfires		• Specific emergency response procedures developed for managing bushfires • Maintenance of fire breaks where required
Unsustainable exploitation of natural resources, hunting and poaching		• Collaboration with protected area managers to ensure indirect impacts to the Buna River Protected Landscape are adequately mitigated; • Consultation with local authorities to minimise the impacts of in-migration on natural resource exploitation (including the collection of timber, non-timber products and hunting). • Prohibit hunting and natural resource collection by the road maintenance personnel and contractors when at work. To be communicated through induction and training to all personnel (employees and contractors).