The Nature Conservancy Mongolia

БАЙГАЛЬ ОРЧИН, НОГООН ХӨГЖИЛ, АЯЛАЛ ЖУУЛЧЛАЛЫН ЯАМ

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IDENTIFYING THE AREA FOR THE WORLD DATABASE OF KEY BIODIVERSITY AREAS THROUGH THE ECO-REGIONAL ASSESSMENTS

FINAL REPORT OF CONTRACT FOR PROFESSIONAL SERVICE - Prof/2020/005- ENSURE PROJECT

Funded by:
"ENSURING SUSTAINABILITY AND RESILIENCE OF GREEN LANDSCAPES IN MONGOLIA" PROJECT – UNDP/MET

Report by:
THE NATURE CONSERVANCY

Ulaanbaatar, Mongolia
April 30, 2021

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FINAL REPORT

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I. INTRODUCTION

The objective of the professional service contract with the "Ensuring Sustainability and Resilience of Green Landscapes in Mongolia" Project of the UNDP/MET is to identify the key biodiversity areas (KBAs) through the IUCN KBA standards (KBA Standards and Appeals Committee, 2020) using the ecoregional assessments (TNC 2011; 2013; 2017a; 2017b) for the target Aimags of the Project study area (see Figure 1), develop a package of database (including supporting GIS data and documentation), and to develop a package of proposals that could be incorporated into the World database of KBA (Key Biodiversity Areas).

The Mongolian database of KBA in target Aimags should include KBA identification analysis based on the national eco-regional assessments completed for region. The work includes the following tasks:

- **Assess the Global requirements** for integration of the national ERA (Ecoregional Assessments, ERAs) results for the Project study area (see Figure 1) target Aimags into the international Key Biodiversity Areas (KBA) database;
- Based on the assessment, **develop a set of proposals** to the Key Biodiversity Areas Secretariat that include a description of the key biodiversity areas in target Aimags and the justifications to include these areas to the World Database of Key Biodiversity Areas in accordance with the Global Standard for the Identification of Key Biodiversity Areas, IUCN 2016;
- **Collaborate with the Secretariat** of the World Database of Key Biodiversity Areas and organize online meetings;
- Provide **general guidance to MET** on how to register key priority areas (KBAs) in the World Database of Key Biodiversity Areas.

Identification of key biodiversity areas (KBA) for Mongolia will strengthen protection of the landscape-level conservation portfolio. It will also provide a valuable opportunity to relate systematic conservation plans to Key Biodiversity Areas. The lessons learned may strengthen conservation efforts around the globe by guiding the translation of other systematic landscape-level conservation plans into the global KBA network.

Timeline of contract deliverables:

October 22, 2020	- Inception Report submitted.
November 2, 2020	- Progress Report submitted.
December 28, 2020	- Progress Report resubmitted with revisions to address ENSURE expert comments.
March 1, 2021	- KBA proposals submitted.
March 17 – April 2, 2021	- Review by KBA review committee.
April 30, 2021	- Final report submitted.

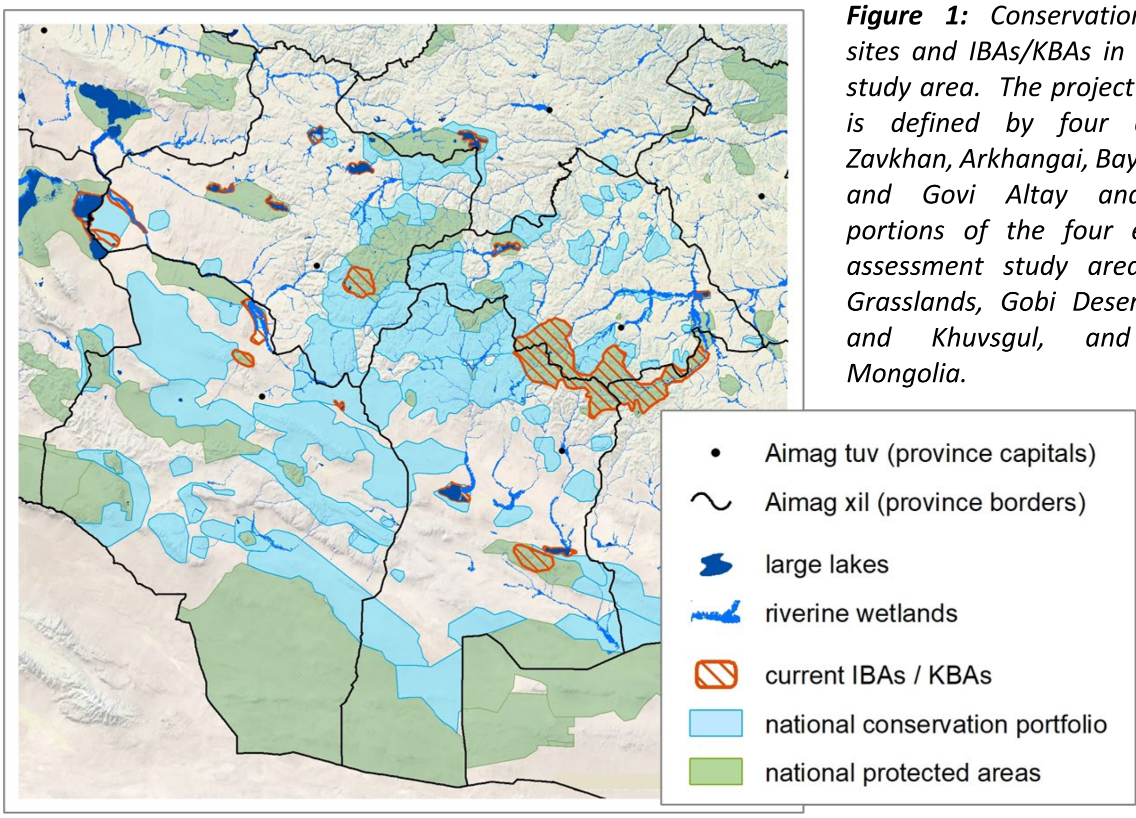


Figure 1: *Conservation portfolio sites and IBAs/KBAs in the project study area. The project study area is defined by four aimags of Zavkhan, Arkhangai, Bayan Hongor, and Govi Altay and includes portions of the four ecoregional assessment study areas: Eastern Grasslands, Gobi Desert, Khangai and Khuvsgul, and Western Mongolia.*

II. DEVELOPING KBA PROPOSALS FOR CONSERVATION PORTFOLIO SITES

A. BACKGROUND

We conducted a literature review of KBA guidance to identify criteria applicable to systematic landscape-level conservation plans, and specifically the ecoregional assessments developed in Mongolia (see Table 1 for list of publications). KBA criteria guide site designation are based on rarity and vulnerability of threatened species and ecosystems. Systematic conservation plans are also based on the distribution of species and ecosystems but identify priority conservation areas to meet landscape-level representation goals in a regional portfolio, or network, of conservation areas. Based on the initial literature review, we revised the workplan as described in the inception report.

Growing global resource demands are driving rapid development to new frontiers in developing countries that support important biological diversity. Effective mitigation will require integrating conservation and development planning at a landscape scale to proactively identify areas at risk of conversion and develop strategic plans to meet and maintain conservation goals in the face of projected cumulative impacts. Most development frontiers are in developing countries (Oakleaf et al., 2015) that face the combined problem of rapid development and limited biological data to plan effective mitigation. Both KBA designation and systematic conservation planning seek to address this challenge by identifying priority areas for conservation, but in different and complementary ways. The KBA approach is designed to identify individual sites that are globally important for biodiversity while the purpose of systematic conservation planning is to balance multiple objectives to guide conservation actions and strategies (Smith et al., 2018).

Systematic conservation planning is a transparent, data-driven process for identifying a set of places or areas that, together, represent the majority of native species habitats, natural communities and ecological systems found within the study area. To be effective, conservation efforts should consider distributions of habitats, threats and impacts at a regional- or landscape-level across biogeographic regions (Groves et al., 2002; Groves, 2003). A conservation portfolio of priority sites, the product of conservation planning, contains a set of areas selected to represent the full distribution and diversity of native species and ecosystems (e.g. Cameron et al., 2012; Goldstein et al., 2017). Systematic conservation planning generally involves first defining and mapping biodiversity elements, setting quantitative goals for their representation, and designing a portfolio of conservation sites that meets representation goals in a configuration that maximizes ecological condition while minimizing future threats and considering social and economic constraints.

In Mongolia, the national conservation portfolio was designed through six stages to identify sites that support native biodiversity and ecological processes representative of Mongolia's six major biogeographic regions: the Eastern Steppe, the Gobi desert, the Altai Mountains, the Great Lakes Basin, the Khovsgol basin, and the Khangai mountains. Portfolio design followed four criteria from systematic conservation planning principles (Margules and Pressey, 2000; Groves et al., 2002; Groves, 2003) – representation, ecological condition, efficiency, and connectivity. To meet the representation criterion, the portfolio composition must meet the 30% protection goal for all biodiversity elements, defined as terrestrial ecosystems, based on the Mongolian government commitment to protect 30% of all natural habitats (Master Plan for Protected Areas, 1998; Green Development Policy, 2014). To optimize for ecological condition, selected areas contain biodiversity elements that have the highest ecological integrity relative to the study area, as measured by an index of disturbance from cumulative anthropogenic impacts. To maximize efficiency, the portfolio contains the least area necessary to meet biodiversity goals, with some redundancy to withstand current and future threats. To maximize connectivity, where possible, portfolio sites are selected as large, contiguous areas, following the general principle that a nature reserve network consisting of fewer, larger contiguous sites is preferable to one consisting of many, smaller sites (Haddad et al., 2015; Crooks et al., 2017).

Stakeholder consultation with experts and implementing government agencies, national and local, was integral to the planning process. Advisory groups consisted of biologists and geographers from academia, government agencies, and conservation NGOs with expert knowledge of the study area and available data as well as officers in national and provincial (aimag) government agencies with knowledge and expertise in law, policy, and implementation strategy. The advisory groups reviewed all components and products of the assessments.

This landscape-level, stakeholder-driven planning approach has produced a national level mitigation framework to guide both the government policy commitment to protect 30% of all-natural lands and application of the mitigation hierarchy. The mitigation hierarchy is a critical tool to manage the impacts of development projects on biodiversity, requiring development projects to reduce adverse outcomes first through avoidance, then minimization, then remediation or restoration on-site, and finally by compensating for residual impacts through the use of offsets (McKenney and Kiesecker 2010; BBOP, 2012; Ekstrom et al., 2015; Bull et al., 2016). Mongolia's national mitigation framework has directed protection of 177,000 sq.km. in new national and local protected areas, and development of an offset design mechanism based on the conservation plans.

The KBA approach was developed with the goal of directing scarce resources to most important places globally with repeatable, quantitative thresholds. Criteria and thresholds were designed to allow consistent application globally, in a site-by-site manner, using local data and capacity that varies by region and taxonomic groups. KBAs are intended to inform expansion of PA networks and provide safeguards to minimize conflict for corporations and financial institutions (IUCN 2016).

The latest KBA standard, developed between 2004-2016, was revised to emphasize need for local and national consultation, correct documentation, and more comprehensive taxonomic, geographic, and ecological representation (IUCN 2016). This standard distinguishes between global and regional or national criteria and thresholds, and encourages countries to establish and apply national criteria. Summarized briefly, global KBA criteria cover species and ecosystems that are (A) threatened or (B) geographically restricted, e.g. endemic species; ecological integrity (C) to identify outstanding examples globally, meaning fully functional with all components and processes; biological processes (D), specifically migration and reproduction, e.g. migratory birds; and irreplaceability quantified (E). The full criteria are listed in Appendix A. Delineation guidance emphasizes a balance between ecological requirement and practical necessity.

The KBA approach is an effective means to identify individual sites with high confidence value to biodiversity conservation in global context. However, the KBA approach has limitations. The approach doesn't consider representation or connectivity in landscape context and doesn't engage stakeholders across agencies, and the area delineation rules are overly strict and, in many cases, globally didn't engage expert input, both which can cause errors (McGowan, 2018; Knight, 2007).

Effective conservation must define explicit, defensible objectives; guide actions; consider economic, political, and social constraints; and consider complementarity of sites at the landscape level, across sites (Brown, 2015; Game 2013). There is an opportunity to combine KBA and SCP, as recommended by Smith (2019), treating KBAs as high confidence, irreplaceable sites within landscape context of an SCP portfolio. McGowan (2020) recommend incorporating conservation of flagship (large, charismatic) species within SCP to improve both fund-raising and effectiveness.

Table 1: *The literature review included the following publications, with URL web links (full citations in references section).*

Beger et al., 2015. Integrating regional conservation priorities for multiple objectives into national policy. Nature communications, 6, p.8208.
Bennun et al., 2007. Clarifying the key biodiversity areas approach. BioScience, 57(8), pp.645-645.
Betts et al. 2019. A framework for evaluating the impact of the IUCN Red List of Threatened Species. Conservation Biology.
Brooks et al., 2016. Analysing biodiversity and conservation knowledge products to support regional environmental assessments. Scientific data, 3(1), pp.1-14.
Brown et al., 2015. Effective conservation requires clear objectives and prioritizing actions, not places or species. Proceedings of the National Academy of Sciences, 112(32), pp.E4342-E4342.
Di Marco et al., 2016. Quantifying the relative irreplaceability of important bird and biodiversity areas. Conservation Biology, 30(2), pp.392-402.
Donald et al., 2019. Important Bird and Biodiversity Areas (IBAs): the development and characteristics of a global inventory of key sites for biodiversity. Bird Conservation International, 29(2), pp.177-198.
Eken et al., 2004. Key biodiversity areas as site conservation targets. BioScience, 54(12), pp.1110-1118.
IUCN (2016). A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0.

KBA Standards and Appeals Committee (2020). Guidelines for using A Global Standard for the Identification of Key Biodiversity Areas. Version 1.1.

Keith, D.A., Ferrer-Paris, J.R., Nicholson, E. and Kingsford, R.T. (eds.) (2020). The IUCN Global Ecosystem Typology 2.0: Descriptive profiles for biomes and ecosystem functional groups.

Klein et al., 2015. Shortfalls in the global protected area network at representing marine biodiversity. Scientific reports, 5, p.17539.

Knight et al., 2007. Improving the key biodiversity areas approach for effective conservation planning. BioScience, 57(3), pp.256-261.

McGowan et al., 2020. Conservation prioritization can resolve the flagship species conundrum. Nature communications, 11(1), pp.1-7.

McGowan et al., 2018. An evaluation of marine important bird and biodiversity areas in the context of spatial conservation prioritization. Conservation Letters, 11(3), p.e12399.

Renwick et al., 2020. Taking a landscape approach to conservation goals: designing multi-objective landscapes. bioRxiv.

Smith et al., 2019. Synergies between the key biodiversity area and systematic conservation planning approaches. Conservation Letters, 12(1), p.e12625.

van Oudenhoven et al., 2016. Linking biodiversity and ecosystem service science to societal actors. International Journal of Biodiversity Science, Ecosystem Services & Management, 12:3, 155-159.

B. KBA PROPOSALS

We developed KBA proposals for four sites following a process as recommended by the KBA guidance (KBA Standards and Appeals Committee, 2020). First, through a scoping analysis, we identified ecoregions Dinerstein et al., 2017) in the four-aimag study area with potential for sites that could trigger Criterion C (Ecological Integrity) in terms of industrial human impact based on a global assessment of human modification (Kennedy et al., 2019). We then assessed each site for evidence to meet Criterion C and Criterion A1 (Threatened Species) as described below. The resulting proposed KBAs are shown in Figure2.

In the KBA Global Standard (IUCN, 2016), Criterion C is defined as: "*Site is one of ≤2 per ecoregion characterised by wholly intact ecological communities, comprising the composition and abundance of native species and their interactions" and e*cological integrity is defined as a condition that supports intact species assemblages and ecological processes in their natural state, relative to an appropriate historical benchmark, and characterised by contiguous natural habitat with minimal direct industrial anthropogenic disturbance. In the most recent guidance (KBA Standards and Appeals Committee, 2020) further clarifies that Criterion C identifies sites that contribute significantly to the global persistence of wholly *intact ecological communities* with supporting large-scale ecological processes.

Site assessment followed five steps:

- We reviewed **a national portfolio of conservation priority sites** that were identified through the ecoregional assessments. The portfolio was designed to meet goals for ecosystem representation and optimize for ecological integrity, connectivity, and efficiency, as described below (section C.i.).
- To compile **evidence of low human impact**, we identified portfolio sites with low human impact based on a spatial analysis of disturbance, as described below (section C.ii.) and shown in Figure 3.
- To compile **evidence of intact ecological communities**, we reviewed existing data and information regarding native species distributions, and specifically assemblages of wide-ranging animals that require large areas of intact habitat to persist.

- We selected **groups of adjacent portfolio sites and national protected areas** that form large contiguous areas and span a broad range of ecosystem types and ecological gradients, based on a national ecosystem classification described below (section C.iii.). This design follows the principle that conservation of large intact landscapes containing a range of habitat types and ecological gradients is an important strategy for maintaining broad-scale ecological processes and promotes resilience and adaptation to climate change. These areas are also designed to provide connectivity between existing protected areas.
- Though portfolio sites and protected areas generally occur in areas of low human disturbance, some borders lie near population centers and developed areas. Therefore, we **edited the borders** of each proposed KBA to exclude all population centers and areas of agricultural or industrial development including historic or active mine leases, and also exclude nearby areas of impact (see Figure 3).

Source datasets and supporting analysis:

i. **National portfolio of priority conservation sites** is a network of priority conservation areas identified through the ecoregional assessments and designed to meet goals for ecosystem representation and ecological integrity. The ecosystem representation goal is based on the Mongolian government commitment to protect 30% of all natural habitats defined by a mapped biophysical ecosystem classification, described below. Ecological integrity was assessed through an analysis of of spatial data representing human disturbance, also described below.

The national portfolio was developed through a series of landscape-level assessments completed across Mongolia between 2009-2017 that followed a stakeholder-driven planning process that engaged experts in science and policy, national and local governments, researchers at national universities and international organizations, and NGOs. The spatial planning approach was formally approved by the Mongolian Academy of Sciences in 2014 as the basis for landscape-level conservation planning (MAS 2014) and the national framework for implementing both the government protected area commitment and the mitigation hierarchy, specifically to determine areas to avoid development. This has led to protection of 177,000 km2 in new national and local protected areas, and development of an offset design mechanism based on the conservation plans. (TNC 2011; 2013; 2017a; 2017b; Heiner et al., 2019). For more details, see Appendix D.

Through expert review workshops conducted nationally and locally, the portfolio sites have been classified by urgency into three tiers, for recommended protection in three phases, Step I: 2016-2020, Step II: 2021-2025, and Step III: 2026-2030. The criteria for tiers/phases were:

- Threat of mining and infrastructure development.
- Vulnerability to climate change, e.g. due to limited distribution (e.g. desert wetlands)
- International significance according to international conventions such as RAMSAR sites, World Heritage site, UNESCO, WWF Global 200 ecoregions.
- Habitat for migratory species: Important seasonal habitat and connectivity of migratory species, particularly migratory birds.
- Benefit to conservation of internationally and nationally threatened species, including reintroduced species such as Przewalski's horse.
- Local support: site has been proposed as a local (provincial or county) protected area.
- Confidence of expert knowledge and research, i.e. sites that are well known and well studied.

The primary purpose of the proposed KBA designations is to strengthen protection of the portfolio.

Figure 2: *Terrestrial Ecoregions and Proposed KBAs in the four-aimag study area. Note: This map includes a correction to TEOW: a desert basin misclassified as Altai montane forest and forest steppe.*

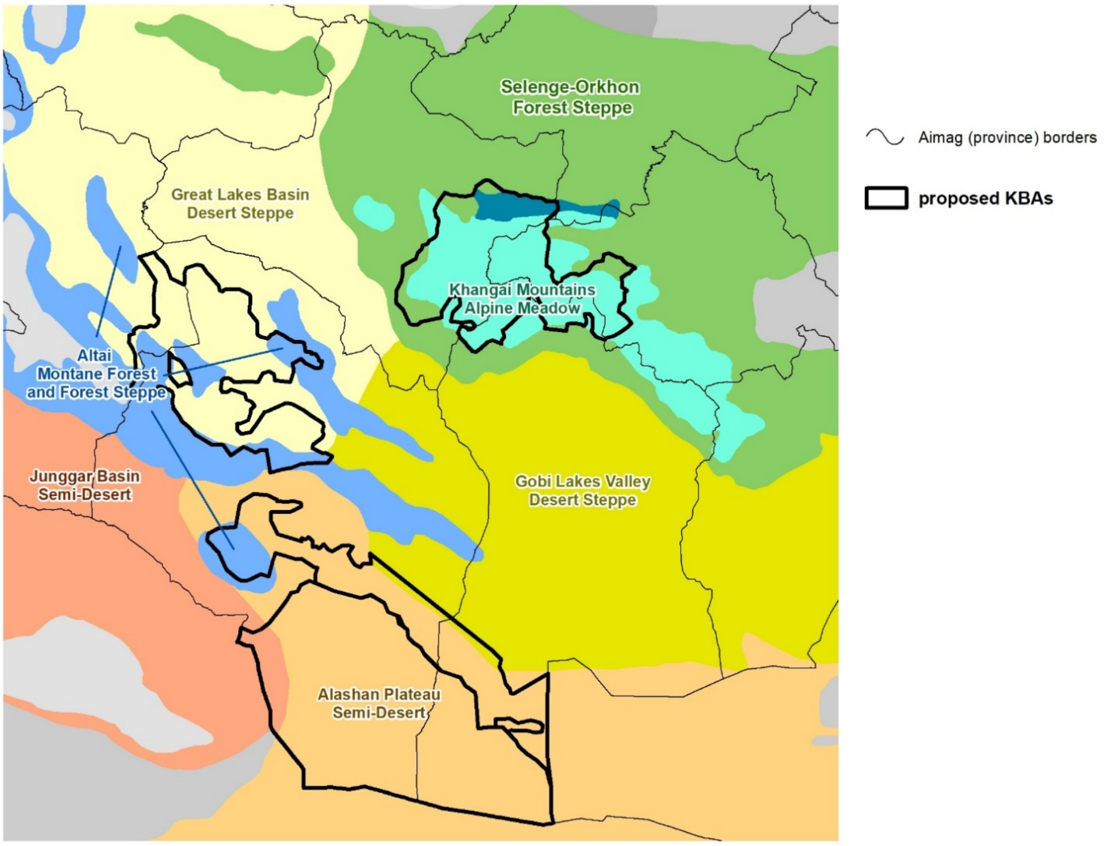
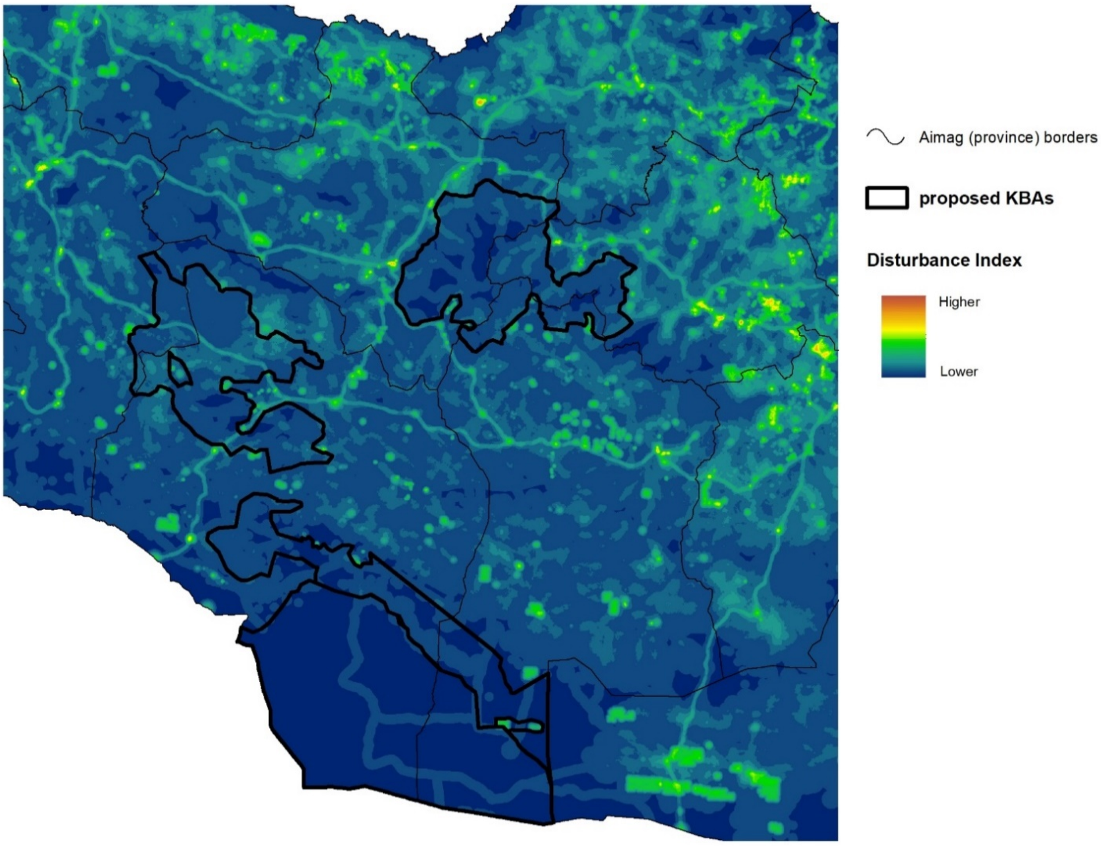


Figure 3: *Proposed KBAs and disturbance Index*



ii. **Disturbance analysis:** A key component of each ecoregional assessment was an index of disturbance that functions as a measure of ecological integrity. Method were iterative, developed in three phases of ecoregional assessments, and were revised and applied nationally for the MEGDT capacity building project mentioned previously (MEGDT, 2016). The spatial datasets are publicly available online in a national spatial data archive that includes the portfolio sites, ecosystem classifications and components, and the disturbance indexes and components (URL web link to spatial data archive). This national spatial data archive was compiled and made publicly available as part of a larger capacity building project directed by the MEGDT and funded by the European Bank for Reconstruction and Development (EBRD) through Contract No: C30074/EBSF-2012-08-107, "Capacity building for Mongolian Ministry of Environment Green Development, and Tourism (MEGDT) in relation to biodiversity and conservation in the southern Gobi Desert" (MEGDT, 2016).

The disturbance index was derived from available spatial data representing sources of anthropogenic impacts that include population centers, roads and railways, mines and supporting infrastructure, and livestock grazing. The result functions as a generalized measure of ecological condition and competing economic values such as high livestock use, and is an an indicator of ecological integrity, or departure from historic or natural conditions. Three of this region's wide-ranging and threatened species, Asiatic wild ass (or Mongolian khulan), Goitered gazelle, and Mongolian gazelle, have been found to avoid human activities as modeled by this disturbance index (Buuveibaatar et al., 2016; Nandintsetseg et al., 2019). For more details, see Appendix E.

iii. **Ecosystem classification:** Another key component of each ecoregional assessment was a mapped terrestrial ecosystem classification. Methods were developed and improved iteratively through the three phases of ecoregional assessments: Eastern Grasslands, Gobi Desert, and West/Central Mongolia. Source data and methods are described in detail for each phase: Gobi Desert (Appendix F), Khangai, Khuvsgul, and Western Mongolia (Appendix G), and the Eastern Grassland Ecoregion Assessment Report (TNC, 2011). The spatial datasets are publicly available online in a national spatial data archive that includes the portfolio sites, ecosystem classifications and components, and the disturbance indexes and components (MEGDT, 2016; URL web link to spatial data archive).

Each mapped classification is a spatial model organized as a hierarchy of regional biogeographic zones (Dash, 2007), ecosystem types based on vegetation structure and geomorphology, and landforms (Heiner et al., 2015). This approach to to defining and mapping ecosystems for conservation planning is based on a classification framework developed for ecological systems across the United States and Latin America (Comer et al., 2003) and has been applied widely in regional conservation plans across terrestrial, freshwater, and marine realms (Groves et al., 2002; Groves, 2003). This framework was developed to support landscape-level conservation and management decisions, and specifically to address a critical need for ecological classification that is 1) practical to map at a regional level with available GIS data and 2) represents key ecological processes and patterns that produce and sustain habitat and ecosystem services. Within this framework, ecological systems are defined as groups of biological communities occurring in similar physical environments and influenced by similar ecological processes. As such, this approach considers multiple scales of organization, environmental patterns, and processes that influence habitat structure and function, and produces classification units that are practical to map and identify in the field (Comer et al., 2003). For more details, see Appendices F and G.

<u>KBA proposal for Khangai Mountains, Mongolia:</u> site description and other supporting information for the KBA proposal form KBAproposal_Khangai Mountains_Mongolia.xlsx.

Area - 24,593 sq.km.

<u>Global and Ecoregional Context</u>: Most of the proposed KBA (77% or 19,030 sq.km.) spans the western half of the Khangai Mountains Alpine Meadow ecoregion (TEOW cite). This ecoregion is relatively intact and unmodified relative to its biome, Montane Grasslands & Shrublands. According to a global study of human modification (Kennedy et al., 2019), globally almost half (52%) of the biome has experienced human modification, while only 25% of the ecoregion is classified as modified. The proposed KBA also contains small portions of the neighboring Khangai Mountains Conifer Forests (2,043 sq.km.) and surrounding Selenge-Orkhon Forest Steppe (3,516 sq.km.) ecoregions.

<u>Landscape context and ecosystem-level representation</u>: The proposed KBA is defined by four portfolio sites and parts of a fifth (TNC, 2017; Heiner et al, 2019) is designed to provide landscape connectivity among four national protected areas that include one existing IBA/KBA (see Figure 4). Spanning an elevation range from 1800 meters in the northern river valleys to 3900 meters at the peak of Otgontenger Mountain, the area contains a range of ecosystems types and broad ecological gradients. The landscape is dominated by alpine steppe and mountain steppe, with meadows and riverine wetlands in the valleys and boreal forest on the northern mountain slopes (see Figure 5). This area contains headwaters of two of Mongolia's largest rivers, the Selenge River that drains north into Lake Baikhal and the Yenisey Basin, and the Zavkhan River that runs west into the arid endorheic Great Lakes Basin, forming desert wetland complexes that include three Important Bird Areas.

<u>Basis for meeting Criterion C, Ecological Integrity</u>: *site holds wholly intact ecological communities with supporting large-scale ecological processes and so contribute significantly to the global persistence of biodiversity at the ecosystem level.*

1. **Evidence of low human impact**: Based on analysis of spatial data for a range of human impacts, the proposed KBA spans a large (24,593 sq.km.), contiguous area with no historic industrial development and no population centers. Current human land use is traditional nomadic pastoralism, though at the lowest levels in Central Mongolia, and other human impacts are limited to dirt tracks.
2. **Evidence of intact ecological communities**: The area supports an assemblage of native species that require large areas of intact habitat to persist, including several wide-ranging species, as follows.
    - Snow leopard (Panthera uncia; VU): Snow leopard have been recorded in Otgontenger SPA (Nyambayar and Tseweenmyadag, 2009) and the area is classified as current range with probable occupied habitat (McCarthy et al., 2016).
    - Argali (Ovis ammon) – Harris, Wingard, and Lhagvasuren 2010.
    - Siberian Ibex (Capra sibirica) – Batsaikhan et al., 2010.
    - Red Deer (Cervus elaphus) core area – MAS, 2010.
    - Roe Deer (Capreolus capreolus) core area – MAS, 2010.
    - Siberian Marmot (Marmota sibirica; EN) – Batsaikhan et al., 2010. Though not wide-ranging, this has been extirpated from other mountain ranges and its persistence is an indicator of ecological integrity and limited human impacts.

Figure 4: *Khangai Mountains proposed KBA, conservation portfolio sites, National PAs, and existing IBAs/KBAs*

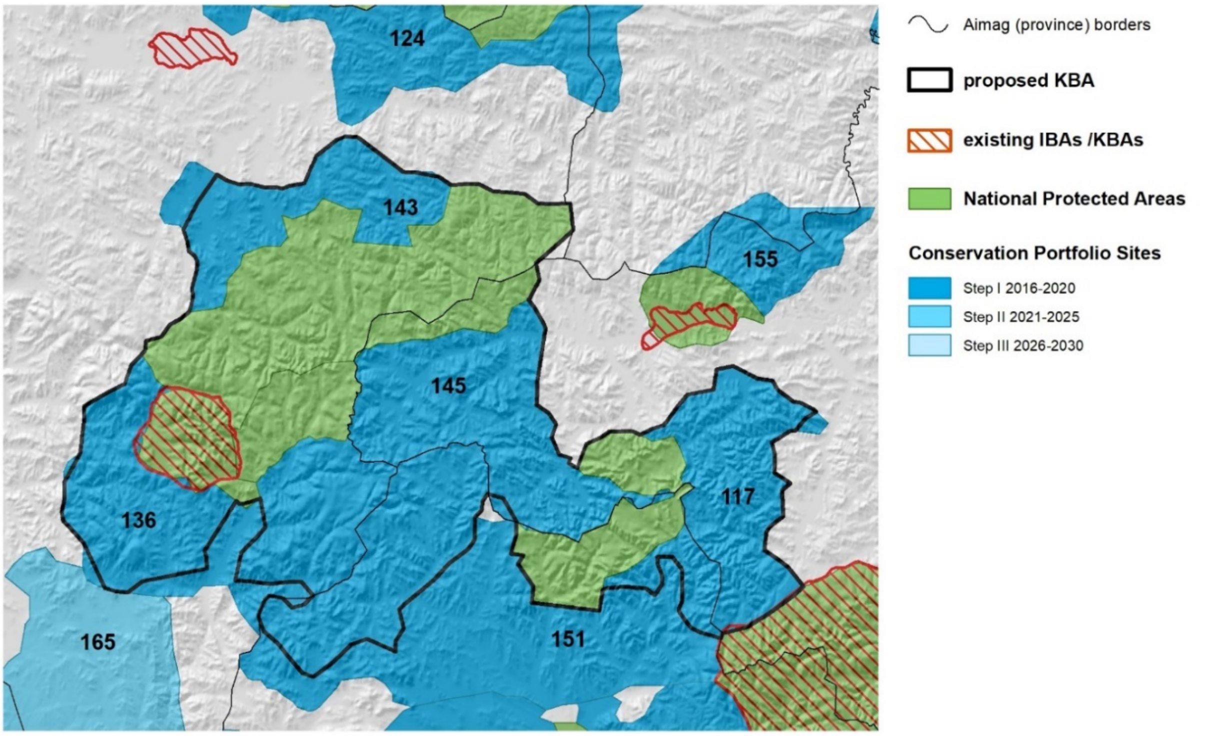
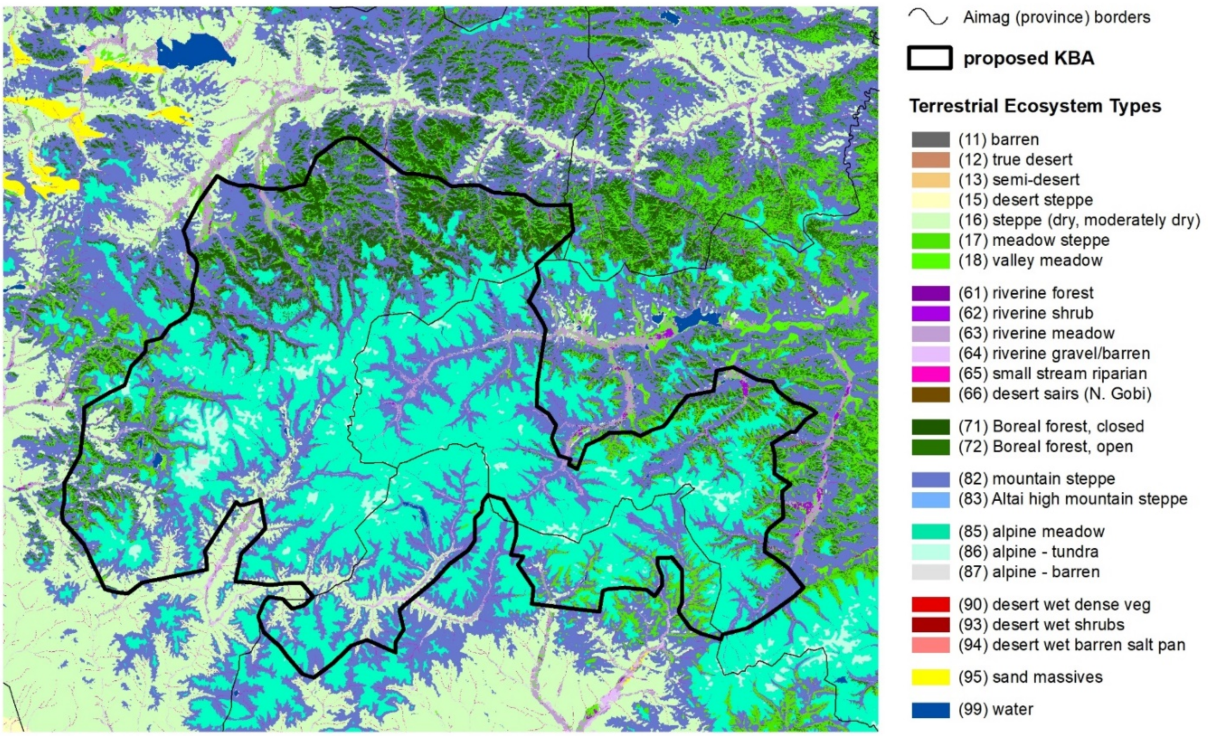


Figure 5: *Terrestrial ecosystems in the Khangai Mountains proposed KBA*



Khangai Mountains KBA: species listed for conservation concern

Listed species, all designations	21
Globally threatened (IUCN Red List)	6
Nationally threatened (National Red List)	6

color legend
globally endangered (CR or EN)
globally vulnerable (VU)
nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	**LISTING**					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global Red List (IUCN)**	**National Red List (ZSL)**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	core	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Худэр	Musk deer	Moschus moschiferus	VU	EN	LoF R, VR	Red Book	CITES	suitable	MAS
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	3.
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	distribution	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	breeding	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

HSM = habitat suitability models from TNC (2017)

MAS = Forest ungulate population assessment in Mongolia (MAS, 2010)

3. McCarthy et al., 2016

<u>Site composition:</u>

Portfolio sites (all Step I: 2016-2020 of protected areas expansion plan):

- Тарвагатайн нуруу өргөтгөл (Tarvagatain urgutgul, id#143)
- Отгонтэнгэр өргөтгөл (Otgontengeriin urgutgul, id#136)
- Тэрх - Унтаа Ямаат (Terh - Untaa Yamaat, id#145)
- Ангархай - Будуун Гичгэнэ (Angarhai - Buduun Gichgene, id#117)
- Хангайн өвөр (Hangain uvur, id#151)

Protected areas:

- Тарвагатайн нуруу Байгалийн цогцолборт газар (Tarvagatai nuruu NCP)
- Отгонтэнгэр уул Дархан цаазат газар (Otgontenger uul SPA) - (IBA/KBA MN022 Otgontenger Mountain).
- Ноён хангай Байгалийн цогцолборт газар (Noyon Xangai NCP)
- Заг Байдрагийн голын эхэн сав Байгалийн цогцолборт газар (Zag Baidragiin goliin ekhen sav NCP)

<u>IBA/KBA MN022 Otgontenger Mountain SPA</u> (reproduced from Nyambayar and Tseveenmyadag, 2009):

Importance for birds: Globally Threatened species include White-throated Bushchat (Saxicola insignis; VU). The site supports assemblages of species restricted to the Eurasian steppe and desert, Eurasian high montane biomes and boreal forest (taiga) biomes. The site also supports Mongolian Accentor (Prunella koslowi), whose breeding range defines the Mongolian Mountains Secondary Area. Bar-headed Geese Anser indicus breed, moult and occur in high numbers during migration. Mallard (Anas platyrhynchos) and Common Goldeneye (Bucephala clangula) also congregate in large numbers. Populations of all three species reach at least 1% of their flyway populations. *Importance for other fauna and flora*: Rare species of mammal include Argali (Ovis ammon; NT), Siberian Ibex (Capra sibirica), Snow Leopard (Panthera uncia; EN) and Siberian Marmot (Marmota sibirica; EN).

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<u>KBA proposal for South Great Lakes Basin, Mongolia:</u> site description and other supporting information for the KBA proposal form KBAproposal_South Great Lakes Basin_Mongolia.xlsx.

Area - 3,744 sq.km.

<u>Global and Ecoregional Context</u>: Most of the proposed KBA (73% area or 17,413 sq.km.) spans the southern end of the Great Lakes Basin Desert Steppe ecoregion (TEOW cite). This ecoregion is relatively intact and unmodified relative to its biome, Deserts and Xeric Shrublands, according to a global study of human modification (Kennedy et al., 2019). Globally, 30% of the biome has experienced human modification, while only 9% of the ecoregion is classified as modified. The proposed KBA also contains parts of mountain ranges at the southeastern end of in the Altai Montane Forest and Forest Steppe ecoregion (27% area or 6,331 sq.km.).

<u>Landscape context and ecosystem-level representation</u>: The proposed KBA is defined by three portfolio sites and parts of a fourth (TNC, 2017a; 2017b; Heiner et al, 2019) and is designed to provide landscape connectivity among four national protected areas (see Figure 6). Covering an elevation range from 960 meters in the Shargiin Tsagaan Lake basin to 4200 meters at the peak of Sutai Khairhan Mountain, the area represents a range of ecosystems types and broad ecological gradients. The site spans two large desert basins lying between three mountain ranges - Sutai khairkhan to the west, Khasagt khairkhan to the east, and Khar Azargin nuruu to the south. The basins form several large desert wetland complexes of salt pans and dense shrubs that provide productive habitat and scarce surface water. The landscape is dominated by semi-desert and desert steppe at lower elevations, with dry steppe, mountain steppe, and alpine steppe moving higher into the mountains (see Figure 7).

<u>Basis for meeting Criterion A1a, Threatened Species</u>: *site regularly holds >=0.5% of the global population size AND >=5 reproductive units of a CR or EN species.*
Trigger species: Saiga (Saiga tartarica), CR. Saiga occur in five populations globally, one in Russia, three in Kazakhstan, and one in Mongolia. Mongolian Saiga are a genetically distinct subspecies, Saiga tartarica mongolica. Globally, Saiga populations have suffered four disease outbreaks since 2010 including a mass mortality event that killed 200,000 in Kazakhstan in May, 2015 and another event in 2017 that killed an estimated 54% of the Mongolian population (IUCN, 2018).

In Mongolia, Saiga occur in two subpopulations, a larger population in Shargyn Gobi and Khuisiin Gobi and a smaller population in Mankhan/Durgun Steppe (Milner-Gulland et al., 2001; IUCN, 2018). The proposed KBA contains most of the range of the larger Shargyn Gobi - Khuisiin Gobi subpopulation (Berger et al., 2008). Given that the Mongolian population of ca 5,000 is more that 4% of the global population of ca 125,000 (IUCN, 2018), it can be estimated that the population in this area is greater than 0.5% of the global population size and triggers Criterion A1a.

In the proposal form (KBAproposal_South Great Lakes Basin_Mongolia.xlsx), we list the following estimates of the *number of mature individuals* based on the IUCN Red List Assessment (IUCN, 2018).

Global: min to max 123,450 to 124,200 and best 123,450.

Site: min to max 2,200 – 2,250 and best 2,200, with minimum 250 reproductive units, roughly estimated as 1/8 of the number of mature individuals at the site.

Basis for meeting Criterion C, Ecological Integrity: *site holds wholly intact ecological communities with supporting large-scale ecological processes and so contribute significantly to the global persistence of biodiversity at the ecosystem level.*

1. **Evidence of low human impact**: Based on analysis of spatial data for a range of human impacts, the proposed KBA spans a large (24,593 sq.km.), contiguous area with no historic industrial development and no population centers. Current human land use is traditional nomadic pastoralism. Other human impacts are limited to dirt tracks and two road corridors.

2. **Evidence of intact ecological communities**: The area supports an assemblage of native wide-ranging species that require large areas of intact habitat to persist, as follows.
   - Snow leopard (Panthera uncia; VU): Most of the area is Snow leopard range, and the Khasagt Khairkhan mountain range is classified as definitive occupied habitat (McCarthy et al., 2016).
   - Saiga antelope (Saiga tartarica mongolica) – Milner-Gulland et al., 2001; Berger et al., 2008.
   - Black-tailed gazelle (Gazella subgutturosa) – Batsaikhan et al., 2010.
   - Mongolian gazelle (Procapra gutturosa) – Batsaikhan et al., 2010.
   - Siberian Ibex (Capra sibirica) – Batsaikhan et al., 2010.

Site composition

Portfolio sites (all Step I 2016-2020 of protected areas expansion plan):

- Сутай хайрхан (Sutai hairhan, id#193)
- Баян Цагааны нуруу (Bayan tsagaanii nuruu, id#182)
- Хүйсийн говь (Huisiin govi, id#198)
- parts of Шаргын хоолой (Shargiin hooloi, id#200)

Protected areas:

- Сутай уул Байгалийн нөөц газар (Sutai uul NR)
- Шарга Байгалийн нөөц газар (Sharga NR)
- Хар Азаргын нуруу Байгалийн нөөц газар (Khar Azargin nuruu NR)
- Хасагт хайрхан Дархан цаазат газар (Khasagt khairkhan SPA)

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Heiner, M., Galbadrakh, D., Batsaikhan, N., Bayarjargal, Y., Oakleaf, J., Tsogtsaikhan, B., Evans, J. and Kiesecker, J., 2019. Making space: Putting landscape-level mitigation into practice in Mongolia. Conservation Science and Practice, 1(10), p.e110. https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/csp2.110

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Figure 6: *South Great Lakes Basin proposed KBA, conservation portfolio sites, National PAs, and existing IBAs/KBAs*

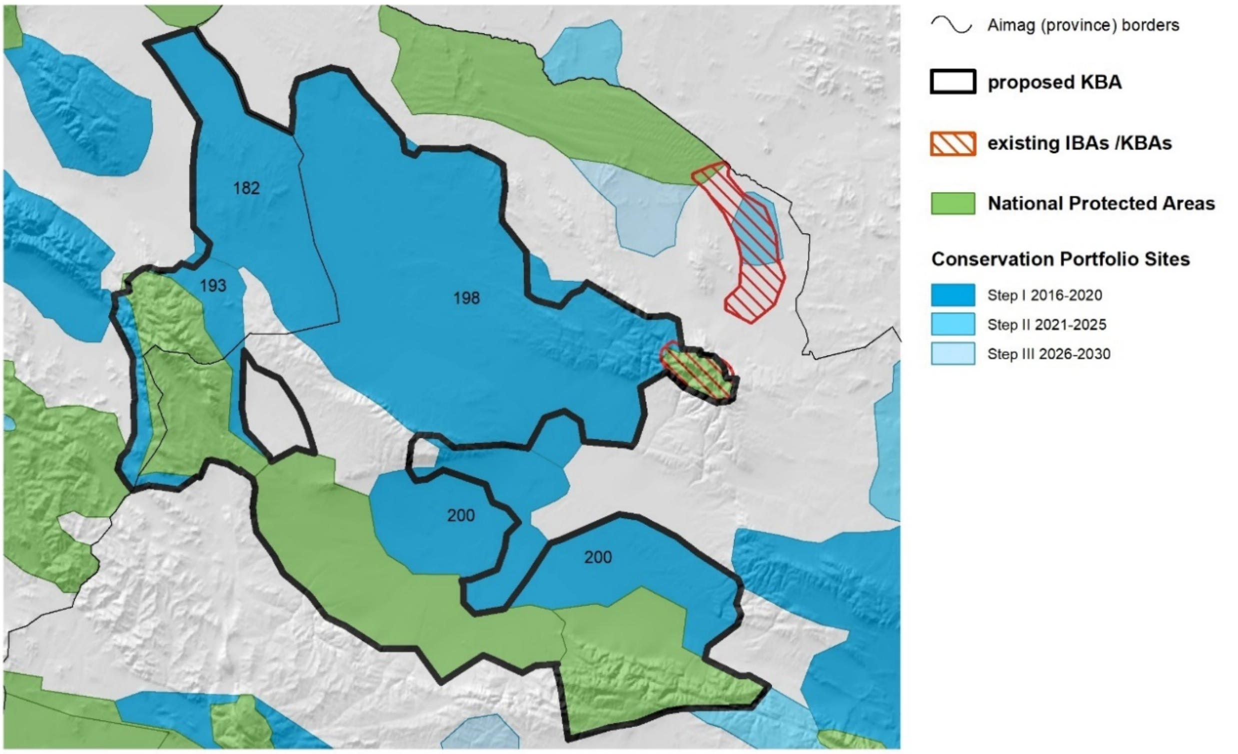
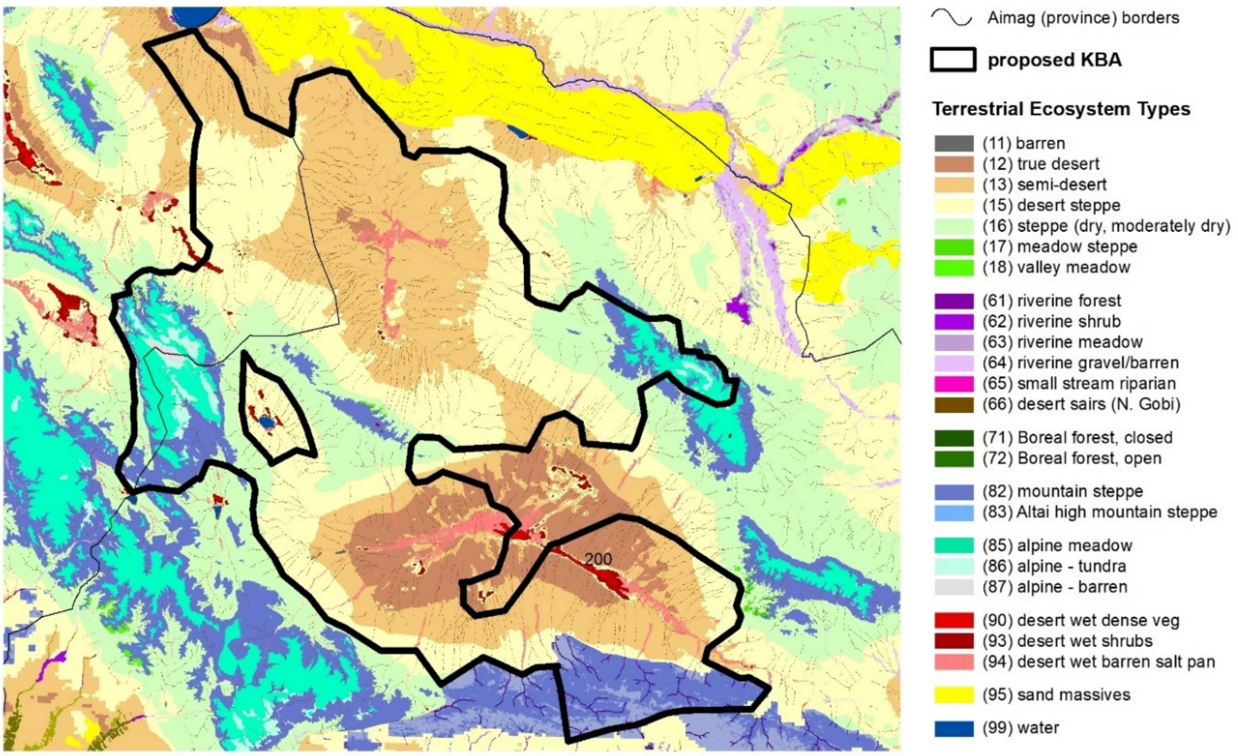


Figure 7: *Terrestrial ecosystems in the South Great Lakes Basin proposed KBA. Source: TNC (2017a,; 2017b).*



South Gobi Lakes Basin KBA: species listed for conservation concern

Listed species, all designations	14
Globally threatened (IUCN Red List)	6
Nationally threatened (National Red List)	5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	
Mongolian common name	**English common name**	**Scientific name**	**Global Red List (IUCN)**	**National Red List (ZSL)**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	4.
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	3.
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	high productivity	HSM
Монгол бөхөн	Saiga antelope	Saiga borealis	CR	EN	LoF R, VR	Red Book	CITES	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	denning	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM

HSM = habitat suitability models from TNC (2017)

3. McCarthy et al., 2016

4. Harris et al., 2010

<u>KBA proposal for Edrengiin Nuruu, Mongolia:</u> site description and other supporting information for the KBA proposal form KBAproposal_Edrengiin Nuruu_Mongolia.xlsx.

Area - 19,104 sq.km.

<u>Global and Ecoregional Context</u>: Most of the proposed KBA (87% area or 15,066 sq.km.) spans the northwestern end of the Alashan Plateau Semi-Desert (TEOW cite) in the Mongolian Trans-Altai Gobi Desert. This ecoregion is relatively intact and unmodified relative to its biome, Deserts and Xeric Shrublands. According to a global study of human modification (Kennedy et al., 2019), globally 30% of the biome has experienced human modification, while only 18% of the ecoregion is classified as modified. Note that most of this development has occurred in the part of the ecoregion that lies south of Mongolia in the Chinese provinces of Gansu and Inner Mongolia. The proposed KBA also contains a small section of the Gobi Lakes Valley Desert Steppe ecoregion (7% area or 1,432 sq.km.) and the Aj Bogd mountain range that is the southernmost section of in the Altai Montane Forest and Forest Steppe ecoregion (14% area or 2,606 sq.km.).

<u>Landscape context and ecosystem-level representation</u>: The proposed KBA is defined by seven conservation portfolio sites (TNC, 2017; Heiner et al, 2019) and is designed to provide landscape connectivity between Mongolia's two largest National protected areas, Ikh Gobi A Strictly Protected Area and Gobi Gurvan Saikhan National Conservation Park (see Figure 8). The proposed border roughly delineates the valley between the northeast border of Ikh Gobi A SPA and the Gobi Altai Mountains, stretching from Aj Bogd and Eej Khairkhan 350 km southwest to the Nogoon Tsav Valley and the western border of Gobi Gurvan Saikhan NCP. Covering an elevation range from 695 meters in the Nogoon Tsav Valley to 3800 meters at the peak of Ikh Ovoo mountain in the Aj Bogd range, this area covers a range of desert ecosystems types. A series of lakes and endorheic wet depressions lie along the bottom of the valley. Two of the largest are Ozero Buur nuur and Dzahuy Nuur. These desert wetland complexes of salt pans and dense shrubs provide productive habitat and scarce surface water. The upland landscape is dominated by semi-desert and true desert, with areas of dry steppe and mountain steppe in the pediments and valleys of the mountain ranges (see Figure 9).

<u>Basis for meeting Criterion C, Ecological Integrity</u>: *site holds wholly intact ecological communities with supporting large-scale ecological processes and so contribute significantly to the global persistence of biodiversity at the ecosystem level.*

1. **Evidence of low human impact**: Based on analysis of spatial data for a range of human impacts, the proposed KBA spans a large (19,104 sq.km.), contiguous area with no historic industrial development and no population centers. Current human land use is traditional nomadic pastoralism. Other human impacts are limited to dirt tracks.
2. **Evidence of intact ecological communities**: The area supports an assemblage of native species that require large areas of intact habitat to persist, including several wide-ranging species, as follows.
    - Snow leopard (Panthera uncia; VU): Most of the area is Snow leopard range, and it contains four distinct areas classified as definitive occupied habitat (McCarthy et al., 2016).
    - Mongolian khulan (Equus hemionus). The Mongolian Gobi region holds >80% of the global population and >70% of the breeding range, and its conservation depends on maintaining connectivity and movement across its range in southern Mongolia (Kaczensky et al. 2021).

- Black-tailed gazelle (Gazella subgutturosa) – Batsaikhan et al., 2010.
- Mongolian gazelle (Procapra gutturosa) – Batsaikhan et al., 2010.
- Argali (Ovis ammon) – Harris, Wingard, and Lhagvasuren 2010.
- Siberian Ibex (Capra sibirica) – (Batsaikhan et al., 2010)
- The Nogoon Tsav valley in Shine Jinst soum of Nomingiin govi has been identified as a national hotspot for reptile diversity and contains seven species of reptiles including two (Gobi naked-toed gecko / Cyrtopodion elongatus and Tatary sand boa / Eryx tataricus) listed in the Mongolian Red Book (Munkhbayar and Munkhbaatar, 2012).

Site composition:

Portfolio sites and in the protected areas expansion plan:

- Төхөмийн хоолой, Их Таянгий (Tuhumiin hooloi, Ih Tayangiin nuruu; id#91): Step I 2016-2020
- Аж Богд (Aj Bogd; id#105): Step II 2021-2025
- Лха хайрхан (Lha Hairhan; id#83): Step II 2021-2025
- Тооройн хоолой (Tooroin hooloi; id#113): Step II 2021-2025
- Ээж хайрхан өргөтгөл (Eej Hairhan urgutgul; id#103): Step I 2016-2020
- Эдрэнгийн нуруу (Edrengiin nuruu; id#115): Step I 2016-2020
- Номингийн говь (Nomingiin govi; id#111): Step I 2016-2020

Protected areas:

- Ээж хайрхан Дурсгалт газар (Eej Khairkhan Monument)

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***Figure 8:** Edrengiin Nuruu proposed KBA, conservation portfolio sites, National PAs, and existing IBAs/KBAs*

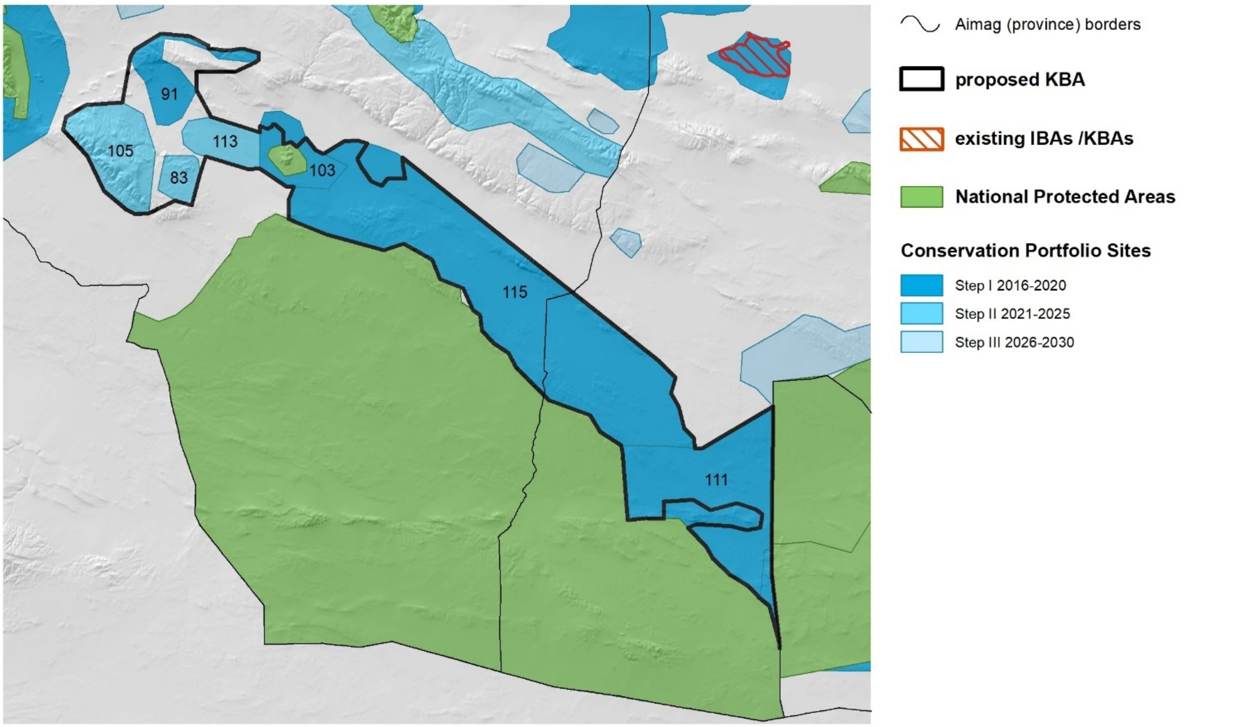
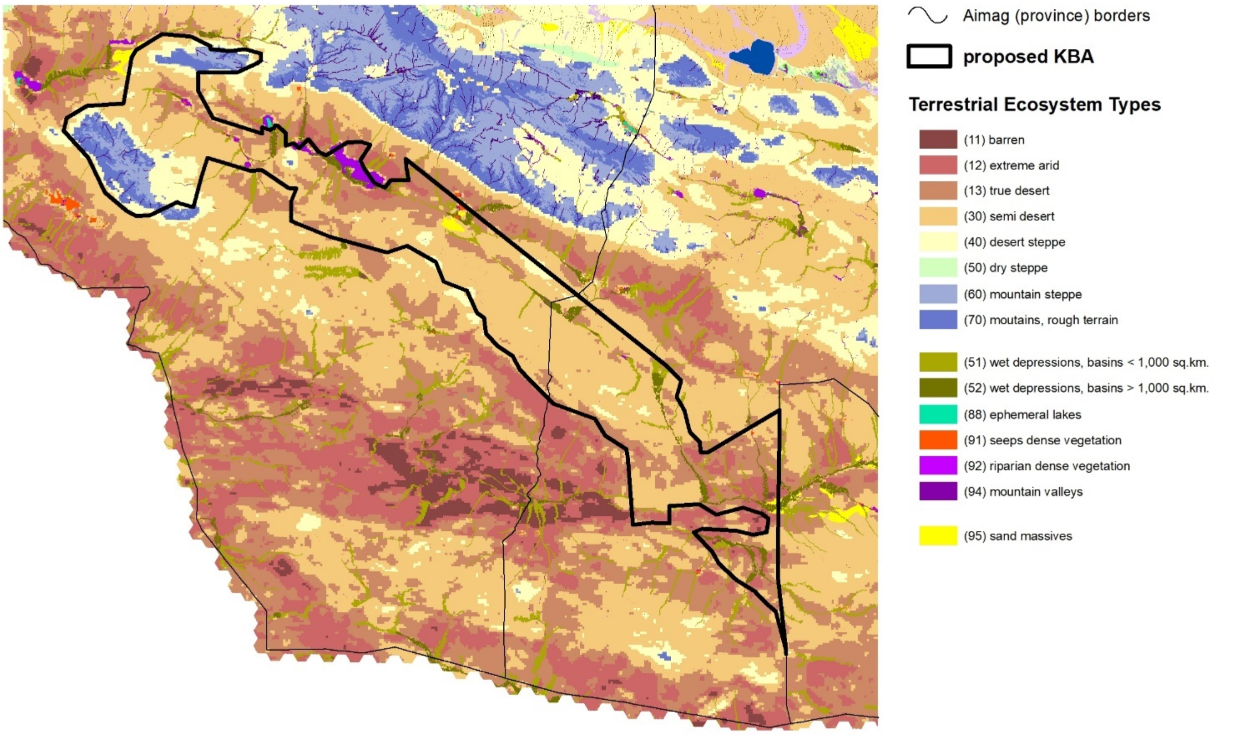


***Figure 9:** Terrestrial ecosystems in the Edrengiin Nuruu proposed KBA*



Edrengiin Nuruu KBA species listed for conservation concern

Listed species, all designations	23
Globally threatened (IUCN Red List)	8
Nationally threatened (National Red List)	5

color legend
- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global Red List (IUCN)**	**National Red List (ZSL)**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	3.
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	high productivity	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Соотон алагдаага	Long-eared jerboa	Euchoreutes naso	EN	VU	--	--	--	suitable	HSM
Өөхөн сүүлт атигдаахай	Thick-tailed pygmy jerboa	Salpingotus crassicauda	VU	dd	--	--	--	suitable	HSM
Бор шишүүхэй	Grey hamster	Cricetulus migratorius	NT	dd	--	--	--	suitable	HSM
Хулан	Asiatic wild ass - current	Equus hemionus	VU	EN	--	--	--	suitable	HSM
Говийн махир хуруут гүрвэл	Gobi naked-toed gecko	Cyrtopodion elongatus	ne	VU	--	--	--	suitable	HSM
Нохой гүрвэл	Przewalski’s wonder gecko	Teratoscincus przewalskii	ne	NT	--	--	--	suitable	HSM
Замба гүрвэл	Mongolian agama	Laudakia stoliczkana	ne	NT	--	--	--	suitable	HSM
Тэмээн сүүл могой	Tatar sand boa	Eryx tataricus	ne	NT	--	--	--	suitable	HSM
Нарийхан могой	Slender racer	Coluber spinalis	ne	NT	--	--	--	suitable	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM
Загийн боршувуу	Saxaul Sparrow	Passer ammodendri	LC	NT	--	--	--	nesting	HSM
Нөмрөг тас	Cinereous Vulture	Aegypius monachus	NT	?	--	--	--	nesting	HSM

HSM = habitat suitability models from TNC (2013; 2017).

3. McCarthy et al., 2016.

KBA proposal for Great Gobi A (Ikh Gobi A) Strictly Protected Area, Mongolia:

(This document contains the site description and other supporting information for the KBA proposal form KBAproposal_Great Gobi A_Mongolia.xlsx).

Area - 46,333 sq.km.

Global and Ecoregional Context: Most of the proposed KBA (94% area or 43,476 sq.km.) lies in the northwestern end of the Alashan Plateau Semi-Desert (TEOW cite) in the Mongolian Trans-Altai Gobi Desert. This ecoregion is relatively intact and unmodified relative to its biome, Deserts and Xeric Shrublands. According to a global study of human modification (Kennedy et al., 2019), globally 30% of the biome has experienced human modification, while only 18% of the ecoregion is classified as modified. Note that most of this development has occurred in the part of the ecoregion that lies south of Mongolia in the Chinese provinces of Gansu and Inner Mongolia. The proposed KBA also contains a small section of the Junggar Basin Semi-Desert ecoregion (6% area or 2,855 sq.km.).

Landscape context and ecosystem-level representation: The proposed KBA is defined by the borders of Ikh Gobi A Strictly Protected Area (see Figure 10). Covering an elevation range from 530 meters in the Dzagta Yihe Sayr basin to 2680 meters at the peak of Atas Bogd Uul, the area represents a range of desert ecosystem types. Sayrs (dry stream beds with shallow ground water) and a few small desert oases provide unique habitat and critical surface water. The landscape is dominated by nearly barren true desert in the basins and semi desert in the low mountain ranges (see Figure 11).

Basis for meeting Criterion A1a, Threatened Species: *site regularly holds >=0.5% of the global population size AND >=5 reproductive units of a CR or EN species.*

Trigger species: Bactrian camel (Camelus ferus), CR.

Wild Bactrian camel occur in four subpopulations in China and Mongolia, with half the global population in Mongolia and in the Ikh Gobi SPA (Hare et al., 2008). Therefore, it can be estimated that the population in this area is greater than 0.5% of the global population size and triggers Criterion A1a.

population size and triggers Criterion A1a.

In the proposal form (KBAproposal_South Great Lakes Basin_Mongolia.xlsx), we list the following estimates of the species *range* based on the IUCN Red List Assessment and range map provided as a GIS shapefile (Hare et al., 2008).

Global: min to max 93,069 (extant) to 207,948 (extant and probably extant) sq.km. and best 93,069 sq.km..

Site: min to max 12,044 (extant) – 42,297 (extant and probably extant) sq.km. and best 12,044, with minimum 35 reproductive units, roughly estimated as 10% of the Mongolian population of 350 individuals.

Basis for meeting Criterion C, Ecological Integrity: *site holds wholly intact ecological communities with supporting large-scale ecological processes and so contribute significantly to the global persistence of biodiversity at the ecosystem level.*

1. **Evidence of low human impact**: Based on analysis of spatial data for a range of human impacts, the proposed KBA spans a large (46,333 sq.km.), contiguous area with no historic industrial

development and no population centers. Because this is a strictly protected area and because it is dominated by arid desert with minimal productive forage, human impacts are nearly absent and limited to a few dirt tracks.

2. **Evidence of intact ecological communities**: The area supports an assemblage of native species that require large areas of intact habitat to persist, including several wide-ranging species, as follows.
    a. Snow leopard (Panthera uncia; VU): the area contains two distinct areas classified as definitive occupied habitat (McCarthy et al., 2016).
    b. Mongolian khulan (Equus hemionus). The Mongolian Gobi region holds >80% of the global population and >70% of the breeding range, and its conservation depends on maintaining connectivity and movement across its range in southern Mongolia (Kaczensky et al. 2021).
    - Black-tailed gazelle (Gazella subgutturosa) – Batsaikhan et al., 2010.
    c. Argali (Ovis ammon) – Harris, Wingard, and Lhagvasuren 2010.

Siberian Ibex (Capra sibirica) – Batsaikhan et al., 2010.

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Figure 10: *Ikh Gobi A SPA proposed KBA, conservation portfolio sites, National PAs, and existing IBAs/KBAs*

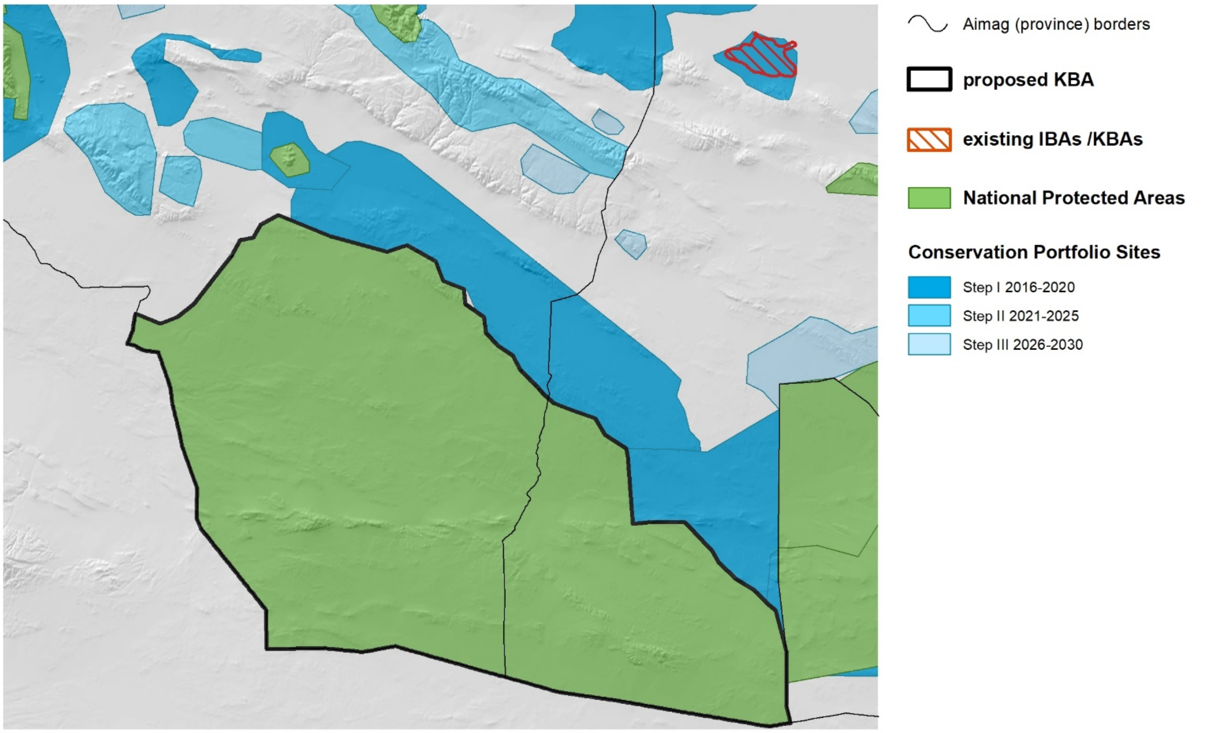
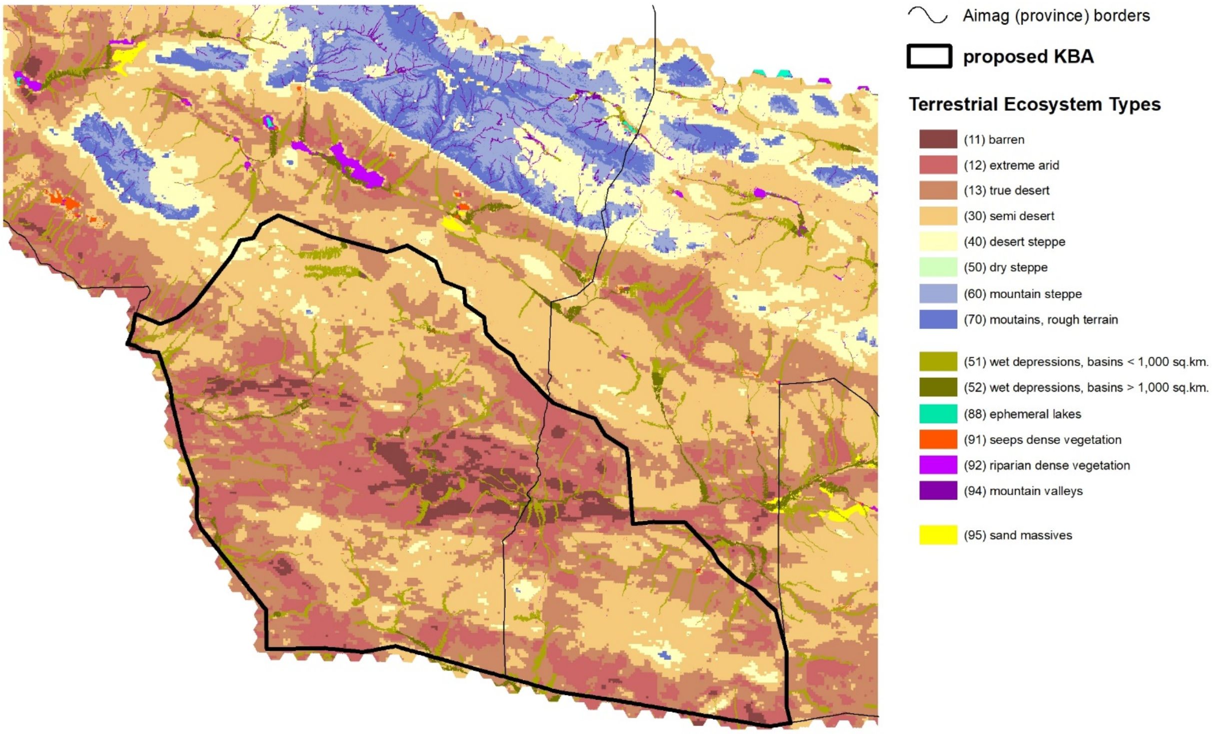


Figure 11: *Terrestrial ecosystems in the Ikh Gobi A SPA proposed KBA*



C. KBA PROPOSAL REVIEW

After completing and submitting the proposals, we reviewed them with the KBA Programme and experts from TNC and the ENSURE scientific review committee, as follows.

TNC global science: Dr. Joseph Kiesecker, Lead Scientist, Global Protect Team

ENSURE scientific review committee:

1. Dr. Z.Batjargal
2. Dr. B.Oyungerel
3. B.Chimed-Ochir
4. A.Bayasgalan

Global KBA Programme (two meetings):

1. KBA Secretariat Head - Dr.Andrew Plumptre *
2. KBA Standard and Appeals Committee Chair - Dr. Charlotte Boyd *
3. KBA Technical Working Group Co-chair - Dr. Penny Langhammer
4. KBA Asia Region Focal Point - Mike Crosby

* Provided additional written review and comments.

Summary of comments from the Global KBA Programme:

KBA Criterion C is new. Previous versions of the KBA criteria did not include a criterion for identifying sites based on ecological integrity. The KBA proposals described here are the first to be submitted based on Criterion C. The KBA Standards and Appeals Committee is studying how to apply this criterion in practice, and will hold a series of webinars and workshops during 2021 that are designed to collect input from regional planning teams in Australia, Canada, Mongolia, Myanmar, the Congo Basin, and the Falkland Islands. The TNC Mongolia team will participate in the workshops. Formal review of the Mongolian proposals by the Global KBA Programme will likely occur after the workshop input Criterion C is reviewed and the guidance is revised.

To provide ecoregional context, proposals should document that each focal ecoregion was assessed as a whole to identify 1-2 best sites. In particular, the Alashan Plateau ecoregion should be assessed to determine which areas are still intact (using global spatial indices of human modification or human footprint) and the locations of the most intact sites. For sites that overlap neighboring ecoregions, explain and justify, specifically regarding the proposed South Great Lakes Basin site. Consider whether the two adjacent proposed sites Edregiin Nuruu and Ikh Gobi A SPA be combined as one site? See notes about manageability.

Regional historical benchmarks are an essential element. To id sites that are ecologically intact, i.e. still support the native species composition and function, it's necessary to establish a benchmark for species composition. The idea is that this benchmark should precede major industrial human impacts and so allow comparison between the current fauna and flora with the fauna and flora characteristic of the ecosystems before significant industrial human impacts. This benchmark may vary by biogeographic region (e.g., different for Africa, Europe, Asia, the Americas, Australia).

Choosing benchmarks can be challenging, especially in dynamic ecosystems or ecosystems that have seen a long history of significant human impacts. The guidance around benchmarks is a work in progress. The guidance recognizes that most ecosystems are dynamic and substantial fluctuations in the abundance/densities of some species may occur naturally. Some clarifying questions to help set a benchmark: What extinctions have occurred since a given benchmark? What was the ecological role of those extinct species? Is reintroduction possible or likely to succeed? When were the major pulses in development that have led to significant transformations of natural landscapes (e.g., perhaps a significant intensification of livestock management or expansion of agriculture or mining)? Are there any key species missing or at much lower densities, for example?

In Mongolia, possible global extinctions and local extinctions to consider are Przewalski's horse (Equus ferus; King et al., 2016), Dhole (Cuon alpinus; Kamler et al., 2015), wild Bactrian camel (Camelus ferus), Saiga tatarica (note that the IUCN has not resolved whether Saiga tatarica ssp. tatarica and Saiga tatarica ssp. mongolica are distinct species; IUCN, 2018). The cases of Przewalski's horse and wild camel should consider that reintroduction would face the problem of interbreeding with domestic horse and domestic camel, and that domestic horse and domestic camel are likely performing similar ecological roles.

The choice of indicator species should assess multiple taxa, not just mammals. Indicator species are species sensitive to broad-scale ecological processes, area-demanding species, species that are sensitive to human impact, and/or species that indicate ecological condition.

In delineating KBAs, proposals should consider manageability of the site, i.e. whether the site is manageable in terms of size, administration, and legal jurisdictions. The aim of delineation is to maximize effective management, but KBA confirmation does not include or imply any specific management prescriptions. KBA confirmation is a validation of biodiversity values and defines the site as critical habitat requiring Net Positive Impact of any development according to the Equator Principles for risk management adopted by 116 financial institutions in 37 countries.

The work in Canada regarding Criterion C and a National KBA standard may be relevant to Mongolia because Canada also contains large intact landscapes.

Notes for all proposals, all criteria:

Guidance encourages consideration of multiple criteria to better establish the resilience of sites and interplay between ecological factors, and also to guide future management. For example, a large site identified under Criterion C may include smaller areas that are especially important for globally threatened or geographically concentrated species or ecosystems – applying the other KBA criteria will help to identify those sites.

For proposed KBAs that overlap with existing KBAs, there are two options: 1) revise the proposed border to lie adjacent to existing KBA, and 2) propose enlarge the existing KBA following consultation and agreement with the KBA partner who identified it originally.

III. RECOMMENDATIONS

Because ERA portfolio design is based on ecosystem representation and ecological integrity, the most promising pathways for future KBA proposals are Criterion A2 (Threatened Ecosystems) and Criterion C (Ecological Integrity).

Recommendations for developing proposals to meet Criterion C (see comments above in section II.D.)

Proposal development should start by considering these framing questions:

1. Have you assessed the ecoregion as a whole and tried to select the best 1 or 2 sites?
2. What is the evidence of minimal human impact? Guidance encourages use/development of national-level disturbance analysis such as the one here and described in section II.C.ii. This is available online through MEGDT (2016): URL web link to spatial data archive.
3. What is the evidence that the species composition is complete (with reference to a specific baseline date)?
4. What is the evidence that the species are at functional densities such that they can play their ecological roles in the KBA?

Other key considerations are the identification of regional historical benchmarks, selection of indicator species, and consideration of site management in delineating borders, as discussed above in section II.D.

Recommendations for developing proposals to meet Criterion A2 (Threatened Ecosystems)

The KBA global standard defines criterion A2 as "*site holds a) >=5% global extent of a CR or EN, or >=10% of a VU ecosystem type.*" The ecosystem typology, global distribution, and threatened status (CR, EN, VU) are determined by the IUCN Red List of Ecosystems (RLE; Bland et al., 2017). This KBA criterion may apply to many portfolio sites given that Mongolia supports intact but globally threatened grassland ecosystem types and the portfolio design was based on ecosystems. The KBA designation process will involve three steps. First, aligning national ecosystem maps with the global typology as discussed below; second, analysis to designate ecosystem types as globally threatened for the IUCN RLE; and third, designation of sites in Mongolia as KBAs based on ecosystem composition. The first and second steps could be completed as a national assessment of all ecosystems following a process similar to that developed recently for Myanmar (Murray et al., 2020). The RLE criteria for designating an ecosystem type as globally threatened are (A) geographic distribution reduced, (B) geographic distribution restricted, (C) environmental degradation (abiotic), (D) biotic processes/interactions disturbed, and/or (E) quantitative analysis of collapse probability (Bland et al., 2017).

The IUCN RLE is relatively new, with relatively few designations globally (Bland et al. 2017; Keith et al., 2013; 2015; Rodríguez et al., 2015). The RLE guidance describes two options for typology or definition of ecosystem types. The first option (Bland et al., 2017) refers to the macrogroup/group level of the International Vegetation Classification (Faber-Langendoen et al., 2014). The International Vegetation Classification (IVC) is organized in a hierarchy of levels from formation, division, macrogroup/group, and alliance/association. The second option, published in December 2020 and still in development, offers a new global ecosystem typology that provides alternative approaches to defining and mapping ecosystem types (Keith et al., 2020).

Specific recommendations:

1. Align Mongolian ecosystems to a global typology, either International Vegetation Classification (Faber-Langendoen et al., 2014) or the latest IUCN global ecosystem typology (Keith et al., 2020).
   a. The ecosystem classification developed nationally for the ecoregional assessments (TNC 2011; 2013; 2017a; 2017b; Heiner et al., 2015) is available online (URL web link to spatial data archive; MEGDT, 2016) and should align readily with both approaches to global typology. It is based on NatureServe Ecological Systems approach (Comer et al., 2003) that corresponds closely to the International Vegetation Classification macrogroup/group level (Faber-Langendoen et al., 2014). According to the current KBA guidelines, levels 4 (biogeographic ecotype) and 5 (global ecosystem type) of the 2020 IUCN RLE typology (Keith et al., 2020) are the relevant levels for KBA identification (KBA Standards and Appeals Committee, 2020).
   b. The national ecosystem classification published by Vostokova and Gunin (2005) is also available. It defines and maps over 80 ecosystem types across Mongolia. The classification approach is different from the IVC so may require significant documentation and review to reclassify and align with the global typology. WWF reclassified this map to define ecosystems for the national gap assessment (Chimed-Ochir et al., 2010). That reclassification may be a useful reference for cross-referencing the Vostokova and Gunin ecosystems to the global typology levels 4 (biogeographic ecotype) and 5 (global ecosystem type).
2. Designate ecosystem types as globally threatened per IUCN Red List for Ecosystems. This will involve, for each ecosystem type:
   a. Assess global distribution and status. Estimating reduction in distribution due to conversions and degradation will likely require a global dataset representing human modification (e.g. Kennedy et al., 2019).
   b. Demonstrate global status as threatened
   c. Propose RLE designation, review by IUCN committee, and revision.

   Specifically, this could designate Mongolian grassland ecosystems/*macrogroups* as threatened based on RLE criteria (A) geographic distribution reduced, (C) environmental degradation (abiotic), and/or (D) biotic processes/interactions disturbed. This would involve analysis of global human modification (HM, Kennedy et al.2019) of IVC grassland Divisions (Dixon et al., 2014), and would support assessment of grassland divisions as threatened per RLE criteria and designation of Mongolian steppe and semi-desert ecosystems as globally threatened. Key supporting literature:

   - Hoekstra et al. (2005) globally, grasslands are the least protected, most converted biome.
   - Gobi-Steppe global significance (Batsaikhan et al., 2014)
   - other literature re global conversion of grasslands and aridlands (Mortimore et al., 2009; Durant et al., 2012; Reynolds et al., 2007; Safriel et al., 2005)
   - Dixon et al. (2014) Distribution mapping of world grassland types
3. Propose KBAs in Mongolia:
   a. analysis of sites as a proportion of global distribution
   b. develop proposals to meet Criterion A2

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IV. APPENDICES

Appendix A: Summary of global Key Biodiversity Area Criteria

Appendix B: Summary of global IBA criteria

Appendix C: PORTFOLIO SITE REPORTS: Portfolio sites supporting high numbers of species classified as threatened by global or national red lists (IUCN, ZSL).

Appendix D: National mitigation framework and landscape-level conservation planning

Appendix E: Disturbance index

Appendix F: Khangai and Khuvsgul Regions Terrestrial Ecosystem Classification and Spatial Model

Appendix G: Gobi Desert Region Terrestrial Ecosystem Classification and Spatial Model

Appendix H: Stakeholder engagement and consultation

Appendix A: Summary of global Key Biodiversity Area Criteria

From IUCN (2016). A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0 . First edition. Gland, Switzerland: IUCN.

A. Threatened Biodiversity

A1. Threatened species: *Site regularly holds one or more of the following:*

- *a) ≥0.5% of the global population size AND ≥5 reproductive units of a CR or EN species;*
- *b) ≥1% of the global population size AND ≥10 reproductive units of a VU species;*
- *c) ≥0.1% of the global population size AND ≥5 reproductive units of a species assessed as CR or EN due only to population size reduction in the past or present;*
- *d) ≥0.2% of the global population size AND ≥10 reproductive units of a species assessed as VU due only to population size reduction in the past or present;*
- *e) Effectively the entire global population size of a CR or EN species.*

A2. Threatened ecosystem types: *Site holds one or more of the following:*

- *a) ≥5% of the global extent of a globally CR or EN ecosystem type;*
- *b) ≥10% of the global extent of a globally VU ecosystem type.*

B. GEOGRAPHICALLY RESTRICTED BIODIVERSITY

B1: Individual geographically restricted species: *Site regularly holds ≥10% of the global population size AND ≥10 reproductive units of a species.*

B2: Co-occurring geographically restricted species: *Site regularly holds ≥1% of the global population size of each of a number of restricted-range species in a taxonomic group, determined as either ≥2 species OR 0.02% of the global number of species in the taxonomic group, whichever is larger.*

B3: Geographically restricted assemblages: *Site regularly holds one or more of the following:*

- *a) ≥0.5% of the global population size of each of a number of ecoregion-restricted species within a taxonomic group, determined as either ≥5 species OR 10% of the species restricted to the ecoregion, whichever is larger;*
- *b) ≥5 reproductive units of ≥5 bioregion-restricted species OR 30% of the bioregion-restricted species known from the country, whichever is larger, within a taxonomic group;*
- *c) Part of the globally most important 5% of occupied habitat for each of ≥5 species within a taxonomic group.*

B4: Geographically restricted ecosystem types: *Site holds ≥20% of the global extent of an ecosystem type.*

C. ECOLOGICAL INTEGRITY: *Site is one of ≤2 per ecoregion characterised by wholly intact ecological communities, comprising the composition and abundance of native species and their interactions.*

D. BIOLOGICAL PROCESSES

D1: Demographic aggregations: *Site predictably holds one or more of the following:*

- *a) An aggregation representing ≥1% of the global population size of a species, over a season, and during one or more key stages of its life cycle;*
- *b) A number of mature individuals that ranks the site among the largest 10 aggregations known for the species.*

D2: Ecological refugia: *Site supports ≥10% of the global population size of one or more species during periods of environmental stress, for which historical evidence shows that it has served as a refugium in the past and for which there is evidence to suggest it would continue to do so in the foreseeable future.*

D3: Recruitment sources: *Site predictably produces propagules, larvae, or juveniles that maintain ≥10% of the global population size of a species.*

E. IRREPLACEABILITY THROUGH QUANTITATIVE ANALYSIS: *Site has a level of irreplaceability of ≥0.90 (on a 0–1 scale), measured by quantitative spatial analysis, and is characterized by the regular presence of species with ≥10 reproductive units known to occur (or ≥ 5 units for EN or CR species).*

Appendix B: Summary of global IBA criteria

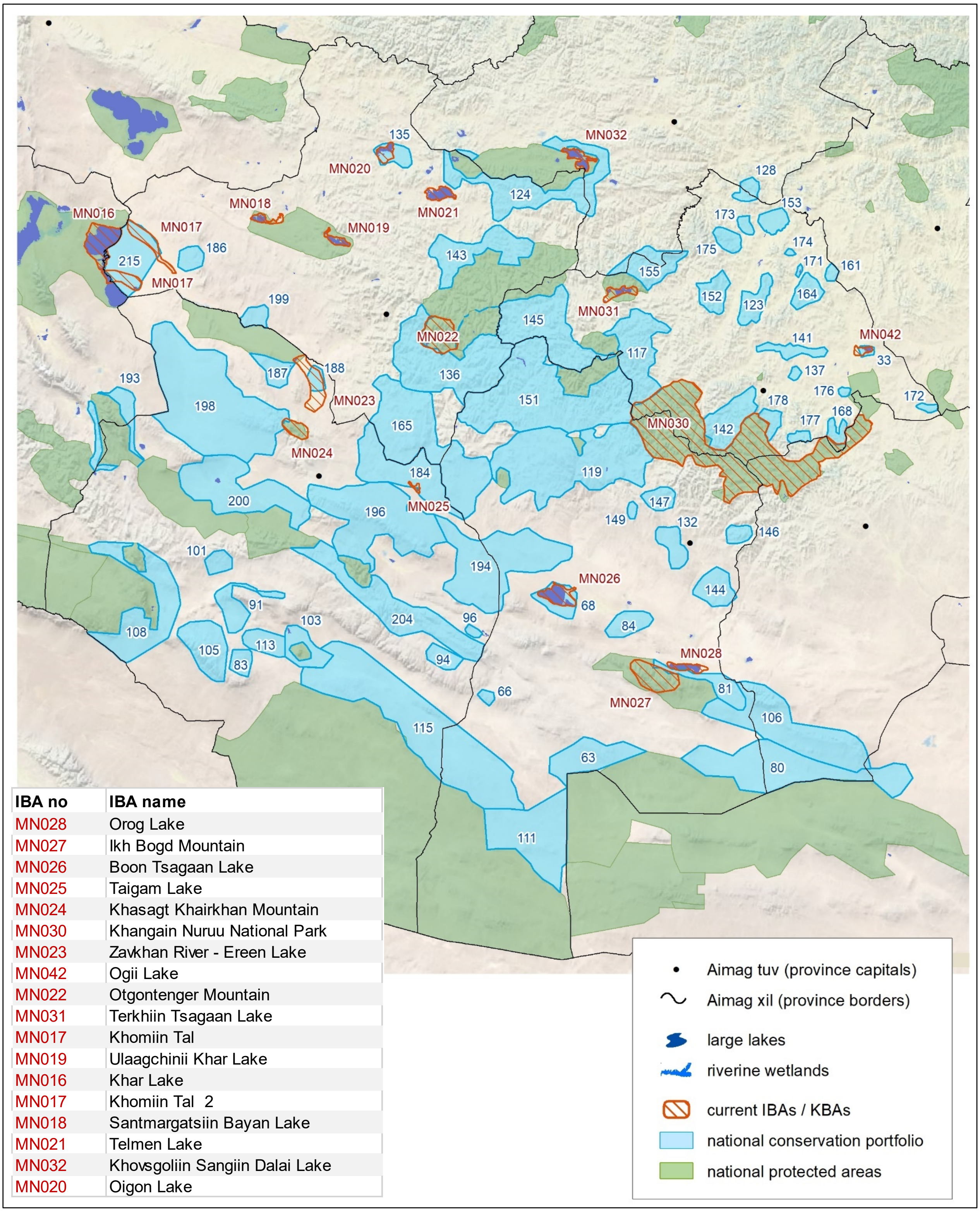
From Nyambayar, B. and Tseveenmyadag, N. eds. (2009) *Directory of Important Bird Areas in Mongolia: Key Sites for Conservation*. Ulaanbaatar: Wildlife Science and Conservation Center, Institute of Biology and BirdLife International.

Category	Criterion	Notes
A1. Globally Threatened species	The site is known or thought regularly to hold significant numbers of a Globally Threatened bird species.	The site qualifies if it is known or thought to hold a population of a bird species categorised as Critical, Endangered or Vulnerable.
A2. Restricted-range species	The site is known or thought to hold a significant component of a group of bird species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA).	The site qualifies if it forms one of a set selected to ensure that, as far as possible, all restricted-range bird species of an EBA or SA are present in significant numbers within at least one site and, preferably, more.
A3. Biome-restricted assemblages	The site is known or thought to hold a significant component of the group of bird species whose distributions are largely or wholly confined to one biome.	The site qualifies if it forms one of a set selected to ensure that, as far as possible, all biome-restricted bird species are adequately represented.
A4. Congregations	(i) The site is known or thought to hold, on a regular basis, 1% or more of a biogeographic population of a congregatory waterbird species.	This applies to waterfowl species as defined in Wetlands International (2002). Thresholds are set based on the population estimates given in Wetlands International (2002) for the relevant flyway population (i.e. Central Asia-South Asia or East Asia).
or	(ii) The site is known or thought to hold, on a regular basis, 1% or more of the global population of a congregatory seabird or terrestrial species.	This applies to terrestrial species and those seabird species not covered in Wetlands International (2002). Thresholds are set by estimating 1% of the global population.
or	(iii) The site is known or thought to hold, on a regular basis, at least 20,000 waterbirds, or at least 10,000 pairs of seabird, of one or more species.	This is the Ramsar criterion for waterbirds, the use of which is discouraged wherever data are good enough to permit the use of (i) or (ii).
or	(iv) The site is known or thought to be a 'bottleneck site', where at least 20,000 raptors (Accipitriformes and Falconiformes) or cranes (Gruidae) pass regularly during spring and/or autumn migration.	Thresholds are set regionally or inter-regionally as appropriate (in Asia, a site qualifies if a combined total of _ 20,000 migrating individuals of all raptor or crane species pass through it in a single migration season).

Appendix C: PORTFOLIO SITE REPORTS: Portfolio sites supporting high numbers of species classified as threatened by global or national red lists (IUCN, ZSL).

Each site report lists the species either a) occurring in the site according to survey records, or b) with suitable habitat in the site according to range maps and biophysical habitat suitability models. Each report also lists species designations in the Mongolia Law of Fauna, the Mongolian Red Book, the Convention of Migratory Species, or the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Map of portfolio sites and existing IBAs/KBAs



Site Number	33		
Site Name	Өгийн нуур	Ugii nuur	
area (sq.km.)	116		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			6
Globally threatened (IUCN Red List)			5
Nationally threatened (National Red List)			2

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	iba - survey	HSM
Цагаан тогоруу	Siberian Crane	Grus leucogeranus	CR	CR	--	--	--	iba - survey	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Реликт цахлай	Relict Gull	Larus relictus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	iba - survey	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM

Site Number	117	
Site Name	Ангархай - Будуун Гичгэнэ	Angarhai - Buduun Gichgene
area (sq.km.)	2,597	
Proposed PA desingation	Step I 2016-2020	
Listed species, all designations		21
Globally threatened (IUCN Red List)		6
Nationally threatened (National Red List)		6

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	distribution	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	range	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Хүдэр	Musk deer	Moschus moschiferus	VU	EN	LoF R, VR	Red Book	CITES	suitable	MAS
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	survey
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	distribution	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

Site Number	142	
Site Name	Тамирын голын эх	Tamiriin goliin eh
area (sq.km.)	1,529	
Proposed PA desingation	Step I 2016-2020	
Listed species, all designations		18
Globally threatened (IUCN Red List)		4
Nationally threatened (National Red List)		5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	distribution	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Худэр	Musk deer	Moschus moschiferus	VU	EN	LoF R, VR	Red Book	CITES	suitable	MAS
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	distribution	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

Site Number	145		
Site Name	Тэрх - Унтаа Ямаат	Terh - Untaa Yamaat	
area (sq.km.)	3,639		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			15
Globally threatened (IUCN Red List)			5
Nationally threatened (National Red List)			2

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	range	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	Panthera
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	range	HSM

Site Number	152	
Site Name	Хатавч - Дашлунгийн булуу у	Hatavch - Dashlungiin Buluu uul
area (sq.km.)	748	
Proposed PA desingation	Step III 2026-2030	
Listed species, all designations		18
Globally threatened (IUCN Red List)		4
Nationally threatened (National Red List)		5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	distribution	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	core	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	range	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

Site Number	173		
Site Name	Мухар Хужирт	Muhar Hujirt	
area (sq.km.)	187		
Proposed PA desingation	Step II 2021-2025		
Listed species, all designations			17
Globally threatened (IUCN Red List)			4
Nationally threatened (National Red List)			5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	core	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	core	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	range	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	range	HSM

Site Number	63		
Site Name	Баян булгийн тал	Bayan bulgiin tal	
area (sq.km.)	1,863		
Proposed PA desingation	Step III 2026-2030		
Listed species, all designations			20
Globally threatened (IUCN Red List)			7
Nationally threatened (National Red List)			4

color legend
globally endangered (CR or EN)
globally vulnerable (VU)
nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	Panthera
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	suitable	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Соотон алагдаага	Long-eared jerboa	Euchoreutes naso	EN	VU	--	--	--	suitable	HSM
Өөхөн сүүлт атигдаахай	Thick-tailed pygmy jerboa	Salpingotus crassicauda	VU	dd	--	--	--	suitable	HSM
Козловын атигдаахай	Kozlov’s pygmy jerboa	Salpingotus kozlovi	NT	dd	--	--	--	suitable	HSM
Говийн махир хуруут гүрвэл	Gobi naked-toed gecko	Cyrtopodion elongatus	ne	VU	--	--	--	suitable	HSM
Нохой гүрвэл	Przewalski’s wonder gecko	Teratoscincus przewalskii	ne	NT	--	--	--	suitable	HSM
Замба гүрвэл	Mongolian agama	Laudakia stoliczkana	ne	NT	--	--	--	suitable	HSM
Тэмээн сүүл могой	Tatar sand boa	Eryx tataricus	ne	NT	--	--	--	suitable	HSM
Нарийхан могой	Slender racer	Coluber spinalis	ne	NT	--	--	--	suitable	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM
Загийн боршувуу	Saxaul Sparrow	Passer ammodendri	LC	NT	--	--	--	nesting	HSM
Нөмрөг тас	Cinereous Vulture	Aegypius monachus	NT	?	--	--	--	nesting	HSM

Site Number	84		
Site Name	Нарийн хар нуруу	Nariin Har nuruu	
area (sq.km.)	735		
Proposed PA desingation	Step III 2026-2030		
Listed species, all designations			17
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			3

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	survey
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	suitable	HSM
Алшаа зурам	Alashan ground squirrel	Spermophilus alashanicus	lc	EN	--	--	--	suitable	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Өөхөн сүүлт атигдаахай	Thick-tailed pygmy jerboa	Salpingotus crassicauda	VU	dd	--	--	--	suitable	HSM
Нарийхан могой	Slender racer	Coluber spinalis	ne	NT	--	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM

Site Number	111		
Site Name	Номингийн говь	Nomingiin govi	
area (sq.km.)	4,132		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			18
Globally threatened (IUCN Red List)			7
Nationally threatened (National Red List)			3

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	survey
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	high productivity	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Соотон алагдаага	Long-eared jerboa	Euchoreutes naso	EN	VU	--	--	--	suitable	HSM
Өөхөн сүүлт атигдаахай	Thick-tailed pygmy jerboa	Salpingotus crassicauda	VU	dd	--	--	--	suitable	HSM
Козловын атигдаахай	Kozlov's pygmy jerboa	Salpingotus kozlovi	NT	dd	--	--	--	suitable	HSM
Хулан	Asiatic wild ass - current	Equus hemionus	VU	EN	--	--	--	suitable	HSM
Говийн махир хуруут гүрвэл	Gobi naked-toed gecko	Cyrtopodion elongatus	ne	VU	--	--	--	suitable	HSM
Нохой гүрвэл	Przewalski's wonder gecko	Teratoscincus przewalskii	ne	NT	--	--	--	suitable	HSM
Замба гүрвэл	Mongolian agama	Laudakia stoliczkana	ne	NT	--	--	--	suitable	HSM
Тэмээн сүүл могой	Tatar sand boa	Eryx tataricus	ne	NT	--	--	--	suitable	HSM
Нарийхан могой	Slender racer	Coluber spinalis	ne	NT	--	--	--	suitable	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Загийн боршувуу	Saxaul Sparrow	Passer ammodendri	LC	NT	--	--	--	nesting	HSM

Site Number	68		
Site Name	Бөөн Цагаан нуур	Buun Tsagaan nuur	
area (sq.km.)	886		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			15
Globally threatened (IUCN Red List)			7
Nationally threatened (National Red List)			4

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Еренхий Нэр	**Англи еренхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	iba - survey	HSM
Монгол бөхөн	Saiga antelope	Saiga borealis	CR	EN	LoF R, VR	Red Book	CITES	iba - survey	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	range	HSM
Алшаа зурам	Alashan ground squirrel	Spermophilus alashanicus	lc	EN	--	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	iba - survey	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	iba - survey	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Реликт цахлай	Relict Gull	Larus relictus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM

Site Number	119		
Site Name	Байдраг	Baidrag	
area (sq.km.)	7,370		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			12
Globally threatened (IUCN Red List)			5
Nationally threatened (National Red List)			2

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	survey
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas’s Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM

Site Number	194		
Site Name	Улаан шалын хоолой	Ulaan shaliin hooloi	
area (sq.km.)	5,371		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			14
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			1

color legend
- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	survey
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	denning	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM

Site Number	108		
Site Name	Говийн Их Б өргөтгөл	Goviin Ih B urgutugul	
area (sq.km.)	7,268		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			25
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			7

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	possible	survey
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	range	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Давжаа алагдаага	Small five-toed jerboa	Allactaga elater	lc	EN	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Соотон алагдаага	Long-eared jerboa	Euchoreutes naso	EN	VU	--	--	--	suitable	HSM
Козловын атигдаахай	Kozlov's pygmy jerboa	Salpingotus kozlovi	NT	dd	--	--	--	suitable	HSM
Зүүнгарын даахай	Mongolian three-toed jerboa	Stylodipus sungorus	EN	EN	--	--	--	suitable	HSM
Бор шишүүхэй	Grey hamster	Cricetulus migratorius	NT	dd	--	--	--	suitable	HSM
Сухайн чичүүл	Tamarisk gerbil	Meriones tamariscinus	lc	EN	--	--	--	suitable	HSM
Хулан	Asiatic wild ass - current	Equus hemionus	VU	EN	--	--	--	suitable	HSM
Говийн махир хуруут гүрвэл	Gobi naked-toed gecko	Cyrtopodion elongatus	ne	VU	--	--	--	suitable	HSM
Нохой гүрвэл	Przewalski's wonder gecko	Teratoscincus przewalskii	ne	NT	--	--	--	suitable	HSM
Замба гүрвэл	Mongolian agama	Laudakia stoliczkana	ne	NT	--	--	--	suitable	HSM
Тэмээн сүүл могой	Tatar sand boa	Eryx tataricus	ne	NT	--	--	--	suitable	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM
Загийн боршувуу	Saxaul Sparrow	Passer ammodendri	LC	NT	--	--	--	nesting	HSM
Нөмрөг тас	Cinereous Vulture	Aegypius monachus	NT	?	--	--	--	nesting	HSM

Site Number	115		
Site Name	Эдрэнгийн нуруу	Edrengiin nuruu	
area (sq.km.)	9,643		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			21
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	survey
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	suitable	HSM
Говийн алагдаага	Gobi jerboa	Allactaga bullata	NT	dd	--	--	--	suitable	HSM
Таван-хуруут атигдаахай	Five-toed pygmy jerboa	Cardiocranius paradoxus	VU	dd	--	--	--	suitable	HSM
Соотон алагдаага	Long-eared jerboa	Euchoreutes naso	EN	VU	--	--	--	suitable	HSM
Өөхөн сүүлт атигдаахай	Thick-tailed pygmy jerboa	Salpingotus crassicauda	VU	dd	--	--	--	suitable	HSM
Хулан	Asiatic wild ass - current	Equus hemionus	VU	EN	--	--	--	suitable	HSM
Говийн махир хуруут гүрвэл	Gobi naked-toed gecko	Cyrtopodion elongatus	ne	VU	--	--	--	suitable	HSM
Нохой гүрвэл	Przewalski's wonder gecko	Teratoscincus przewalskii	ne	NT	--	--	--	suitable	HSM
Замба гүрвэл	Mongolian agama	Laudakia stoliczkana	ne	NT	--	--	--	suitable	HSM
Тэмээн сүүл могой	Tatar sand boa	Eryx tataricus	ne	NT	--	--	--	suitable	HSM
Нарийхан могой	Slender racer	Coluber spinalis	ne	NT	--	--	--	suitable	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	nesting	HSM
Загийн боршувуу	Saxaul Sparrow	Passer ammodendri	LC	NT	--	--	--	nesting	HSM
Нөмрөг тас	Cinereous Vulture	Aegypius monachus	NT	?	--	--	--	nesting	HSM

Site Number	184		
Site Name	Гуулингийн тал	Guulingiin tal	
area (sq.km.)	2,877		
Proposed PA desingation	Step II 2021-2025		
Listed species, all designations			14
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			2

color legend
globally endangered (CR or EN)
globally vulnerable (VU)
nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	range	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Реликт цахлай	Relict Gull	Larus relictus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	iba - survey	HSM

Site Number	188		
Site Name	Завхан гол	Zavhan gol	
area (sq.km.)	295		
Proposed PA desingation	Step II 2021-2025		
Listed species, all designations			11
Globally threatened (IUCN Red List)			5
Nationally threatened (National Red List)			2

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	range	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	iba - survey	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM

Site Number	196		
Site Name	Хантайширын нуруу	Hantaishiriin nuruu	
area (sq.km.)	5,679		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			13
Globally threatened (IUCN Red List)			6
Nationally threatened (National Red List)			4

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	Англи ерөнхий нэр	Зүйлийн шинжлэх ухааны нэр	LISTING					type of habitat or occurrence	data source
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	distribution	MAS
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цоохор ирвэс	Snow leopard	Panthera uncia	VU	EN	LoF R, VR	Red Book	CITES	definitive	survey
Монгол бөхөн	Saiga antelope	Saiga borealis	CR	EN	LoF R, VR	Red Book	CITES	suitable	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	denning	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	core	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM

Site Number	124		
Site Name	Булнайн нуруу	Bulnain nuruu	
area (sq.km.)	7,088		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			20
Globally threatened (IUCN Red List)			4
Nationally threatened (National Red List)			7

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	Англи ерөнхий нэр	Зүйлийн шинжлэх ухааны нэр	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Голын минж	Eurasian beaver	Castor fiber	NT	EN	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	suitable	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Голын халиу	European otter	Lutra lutra	NT	DD	LoF R, VR	Red Book	CITES	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	iba - survey	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	iba - survey	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	breeding	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

Site Number	135		
Site Name	Ойгон нуур	Oigon nuur	
area (sq.km.)	563		
Proposed PA desingation	Step II 2021-2025		
Listed species, all designations			13
Globally threatened (IUCN Red List)			4
Nationally threatened (National Red List)			3

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	feeding	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	feeding	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	feeding	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	suitable	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	range	HSM
Идлэг шонхор	Saker Falcon	Falco cherrug	EN	VU	--	--	--	iba - survey	HSM

Site Number	143	
Site Name	Тарвагатайн нуруу өргөтгөл	Tarvagatain urgutgul
area (sq.km.)	2,310	
Proposed PA desingation	Step I 2016-2020	
Listed species, all designations		18
Globally threatened (IUCN Red List)		4
Nationally threatened (National Red List)		5

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING					**type of habitat or occurrence**	**data source**
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**		
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Халиун буга	Red deer	Cervus elaphus	LC	CR	--	--	--	core	MAS
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	core	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Ойн булга	Sable	Martes zibellina	LC	VU	--	Red Book	--	core	HSM
Зэгсний гахай	Wild boar	Sus scrofa	LC	NT	--	Red Book	--	distribution	MAS
Модны мэлхий	Japanese Tree Toad	Hyla japonica	?	VU	--	--	--	suitable	HSM
Усны могой	Grass (ringed) Snake	Natrix natrix	0	0	LoF R, VR	--	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	breeding	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	breeding	HSM

Site Number	165		
Site Name	Шилуустэй	Shiluustei	
area (sq.km.)	5,861		
Proposed PA desingation	Step II 2021-2025		
Listed species, all designations			17
Globally threatened (IUCN Red List)			5
Nationally threatened (National Red List)			4

color legend
- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regional**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Янгир	Siberian ibex	Capra sibirica	LC	NT	--	Red Book	CITES	suitable	HSM
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Нохой зээх	Wolverine	Gulo gulo	LC	LC	--	--	--	range	HSM
Монгол тарвага	Mongolian marmot	Marmota sibirica	EN	EN	--	--	--	suitable	HSM
Аргаль	Argali	Ovis ammon	NT	EN	LoF R, VR	Red Book	CMS/CITES	surveyed	cite
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	low productivity	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Өгөөлэй шунгуулай	White-throated Bushchat	Saxicola insignis	NT	VU	LoF R, VR	--	CMS	breeding	HSM
Алтайн хойлог	Altai Snowcock	Tetraogallus altaicus	LC	NT	LoF R, VR	Red Book	--	nesting	HSM
Нугын сойр	Black-bilied Capercaillie	Tetrao parvirostris	--	--	LoF R, VR	--	CMS	range	HSM

Site Number	215		
Site Name	Хомын тал	Homiin tal	
area (sq.km.)	2,174		
Proposed PA desingation	Step I 2016-2020		
Listed species, all designations			16
Globally threatened (IUCN Red List)			8
Nationally threatened (National Red List)			4

color legend

- globally endangered (CR or EN)
- globally vulnerable (VU)
- nationally threatened (CR, EN, VU)

Зүйлийн Ерөнхий Нэр	**Англи ерөнхий нэр**	**Зүйлийн шинжлэх ухааны нэр**	LISTING						
Mongolian common name	**English common name**	**Scientific name**	**Global**	**Regiona l**	**Law on Fauna**	**Mongolian Red book**	**CMS, CITES**	**type of habitat or occurrence**	**data source**
Хар сүүлт зээр	Black-tailed gazelle	Gazella subgutturosa	VU	VU	--	--	--	suitable	HSM
Цагаан зээр	Mongolian gazelle	Procapra gutturosa	LC	EN	--	--	--	iba - survey	HSM
Монгол бөхөн	Saiga antelope	Saiga borealis	CR	EN	LoF R, VR	Red Book	CITES	iba - survey	HSM
Эрээн хүрнэ	Marbled polecat	Vormela peregusna	LC	DD	LoF R, VR	Red Book	--	suitable	HSM
Хошуу галуу	Swan Goose	Anser cygnoides	VU	--	--	--	CMS	breeding	HSM
Хээрийн галуу	Bar-headed Goose	Anser indicus	--	--	--	--	--	breeding	HSM
Жороо тоодог	Houbara Bustard	Chlamydotis macqueeni	VU	VU	LoF R, VR	--	CMS/CITES	nesting	HSM
Хархираа тогоруу	Common Crane	Grus grus	--	--	--	--	CMS/CITES	breeding	HSM
Ооч ёл	Lammergeier	Gypaetus barbatus	NT	VU	--	Red Book	CMS/CITES	nesting	HSM
Цагаан сүүлт бүргэд	White-tailed Eagle	Haliaeetus albicilla	LC	NT	LoF R, VR	Red Book	CITES	nesting	HSM
Усны нөмрөг бүргэд	Pallas's Fish-eagle	Haliaeetus leucoryphus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Реликт цахлай	Relict Gull	Larus relictus	VU	EN	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хонин тоодог	Great Bustard	Otis tarda	VU	VU	LoF R, VR	--	CMS/CITES	suitable	HSM
Цагаан толгойт ямаан сүүл	White-headed Duck	Oxyura leucocephala	EN	EN	LoF R, VR	Red Book	CMS/CITES	nesting	HSM
Борцгор хотон	Dalmatian pelican	Pelecanus crispus	NT	CR	LoF R, VR	Red Book	CMS/CITES	iba - survey	HSM
Хулан жороо	Mongolian Ground-jay	Podoces hendersoni	LC	VU	--	Red Book	--	nesting	HSM

Appendix D: National mitigation framework and landscape-level conservation planning

Parts of the following are reproduced from: Heiner, M., Galbadrakh, D., Batsaikhan, N., Bayarjargal, Y., Oakleaf, J., Tsogtsaikhan, B., Evans, J. and Kiesecker, J., 2019. Making space: Putting landscape-level mitigation into practice in Mongolia. Conservation Science and Practice, 1(10), p.e110. https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/csp2.110

Landscape-level mitigation

The most significant anthropogenic drivers of biodiversity decline are impacts associated with development are (Newbold et al., 2015). An estimated 20% of the world's remaining natural lands are at risk of fragmentation from mining, energy, agriculture, and urban expansion (Oakleaf et al., 2015). Arresting further declines will require the implementation of environmental conservation principles that reduce biodiversity losses associated with economic development.

A key gap in current environmental policy and practice is the absence of established biodiversity conservation goals, or limits to biodiversity loss, established at a regional- or landscape-level, and approaches to achieve such targets. Unfortunately, environmental impact assessments (EIAs) are typically conducted on a project-by-project basis that does not consider the landscape context, or regional biogeography and cumulative impacts of multiple projects. Effective mitigation will require integrating conservation and development planning at a landscape scale to proactively identify areas at risk of conversion and develop strategic plans to meet and maintain conservation goals in the face of projected cumulative impacts.

The mitigation hierarchy is a critical tool to manage the impacts of development projects on biodiversity, requiring proponents of development projects to reduce adverse outcomes first through avoidance, then minimization, then remediation or restoration on-site, and finally by compensating for residual impacts through the use of offsets (McKenney and Kiesecker 2010; BBOP, 2012; Ekstrom et al., 2015; Bull et al., 2016). However, mitigation efforts often skip the first, critical step in the mitigation hierarchy, avoidance (Clare et al., 2011; Villarroya et al., 2014; Phalan et al., 2018).

If development proceeds and offsets are used to manage residual impacts, there is a tradeoff between locating offsets close to impact and directing offsets to sites that have regional conservation significance (Kiesecker et al. 2009). Biodiversity offset investments must also minimize uncertainty and conflicts with future development and other threats to ensure the duration and permanence of offset gains (Bull et al., 2013; Gardner et al., 2013). These problems may be partially addressed by directing offsets to areas identified as conservation priorities by a stakeholder- and data-driven landscape plan. It is important to ensure that ecological equivalence of impacts and offsets are measured and used to guide offset design, but many methods for measuring biodiversity exist and are not applied consistently (McKenney and Kiesecker, 2010; Quertier and Lavorel, 2011; Bull et al., 2013; Gardner et al., 2013) and data requirements vary. Most development frontiers are in developing countries (Oakleaf et al., 2015) that face the combined problem of rapid development and limited biological data to plan effective mitigation.

Here we present an example of a landscape-level mitigation framework that addresses these challenges in Mongolia, a data-scarce landscape with globally significant biodiversity values facing rapid development. This framework serves as a mechanism to apply the mitigation hierarchy to meet the government goal of protecting 30% of all natural habitats (Master Plan for Protected Areas, 1998; Green Development Policy, 2014) in a manner that maximizes biodiversity conservation. The framework is based on a stakeholder driven, landscape-level conservation plan developed following systematic conservation planning methods (Margules and Pressey, 2000; Groves et al., 2002) adapted for landscape-level mitigation (Kiesecker et al., 2010).

Study area

Mongolia's Gobi-Steppe System is part of the largest steppe region in the world that supports its historic wildlife assemblage, including long distance wildlife migrations (Batsaikhan et al., 2014), as well as traditional nomadic pastoralism. Globally, temperate grasslands such as those found in Mongolia are the most converted and least protected biome on the planet (Hoekstra et al., 2015). Parts of the Mongolia have been identified as among the world's largest and most intact (least converted) remaining wild areas (Allan et al., 2017; Kennedy et al., 2019). Mongolia currently supports the world's largest remaining populations of Asiatic wild ass (*Equus hemionus*), Goitered gazelle *(Gazella subgutturosa*), wild Bactrian camel (*Camelus ferus*), Siberian ibex (*Capra sibirica*), Gobi bear (*Ursus arctos gobiensis*), and Mongolian gazelle (*Procapra gutturosa*) (Kaczensky et al., 2015; Mallon, 2008a; Mallon, 2008b; Clark et al., 2006).

However, the wildlife and pastoral livelihoods of this area are threatened by rapid growth of mining and related infrastructure (Suzuki et al., 2013; Batsaikhan et al., 2014). In 2012, 14% of Mongolia's surface area was leased for mineral extraction or exploration (Ministry of Mineral Resources and Energy of Mongolia, 2012). In 1998, in anticipation of growth in the mining sector, the Mongolian government established a goal of designating 30% of the country's land as national and local protected areas (Master Plan for Protected Areas, 1998; Green Development Policy, 2014). As of 2008, Mongolia had designated 74 national protected areas covering about 217,000 km^2 or 14% of the country (MNET, 2008).

Methods and Results

Our methods are based on systematic conservation planning standards described by Groves (2003) and adapted for landscape-level mitigation planning (Kiesecker et al., 2010) to guide avoidance and offset implementation (Figure 1). Systematic conservation planning is a transparent, data-driven process for identifying a set of places or areas that, together, represent the majority of native species habitats, natural communities and ecological systems found within the study area. To be effective, conservation efforts should consider distributions of habitats, threats and impacts at a regional- or landscape-level across biogeographic regions (Groves et al., 2002; Groves, 2003). A conservation portfolio of priority sites**,** the product of conservation planning, contains a set of areas selected to represent the full distribution and diversity of native species and ecosystems (e.g. Cameron et al., 2012; Goldstein et al., 2017).

Through a series of four regional assessments, we identified a portfolio of sites that support native biodiversity and ecological processes representative of each region (see Figure 2), based on four criteria from systematic conservation planning principles (Margules and Pressey, 2000; Groves et al., 2002; Groves, 2003) – representation, ecological condition, efficiency, and connectivity. To meet the representation criterion, the portfolio composition must meet the 30% protection goal for all biodiversity elements, defined here as terrestrial ecosystems. To optimize for ecological condition, selected areas contain biodiversity elements that have the highest ecological integrity relative to the study area, as measured by an index of disturbance from cumulative anthropogenic impacts. To maximize efficiency, the portfolio contains the least area necessary to meet biodiversity goals, with some redundancy to withstand current and future threats. To maximize connectivity, where possible, portfolio sites are selected as large, contiguous areas, following the general principle that a nature reserve network consisting of fewer, larger contiguous sites is preferable to one consisting of many, smaller sites (Haddad et al., 2015; Crooks et al., 2017).

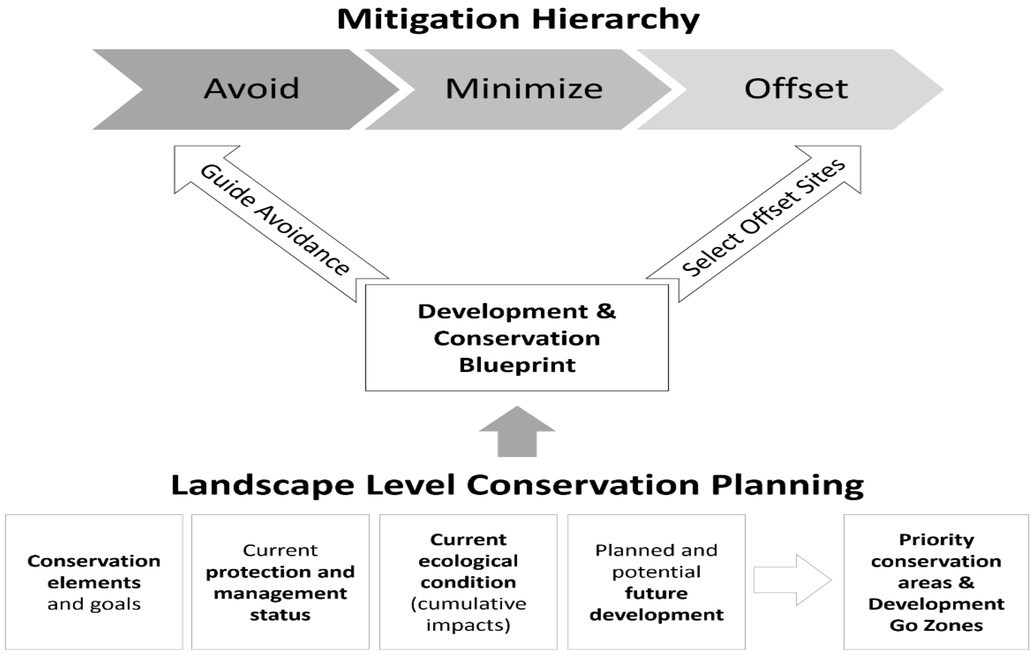


Figure 1: Steps in the landscape-level conservation planning process and application of the results to implement the mitigation hierarchy, specifically a) identification of areas where development should be avoided, and b) siting and design of biodiversity offsets. Adapted from Saenz et al. (2013).

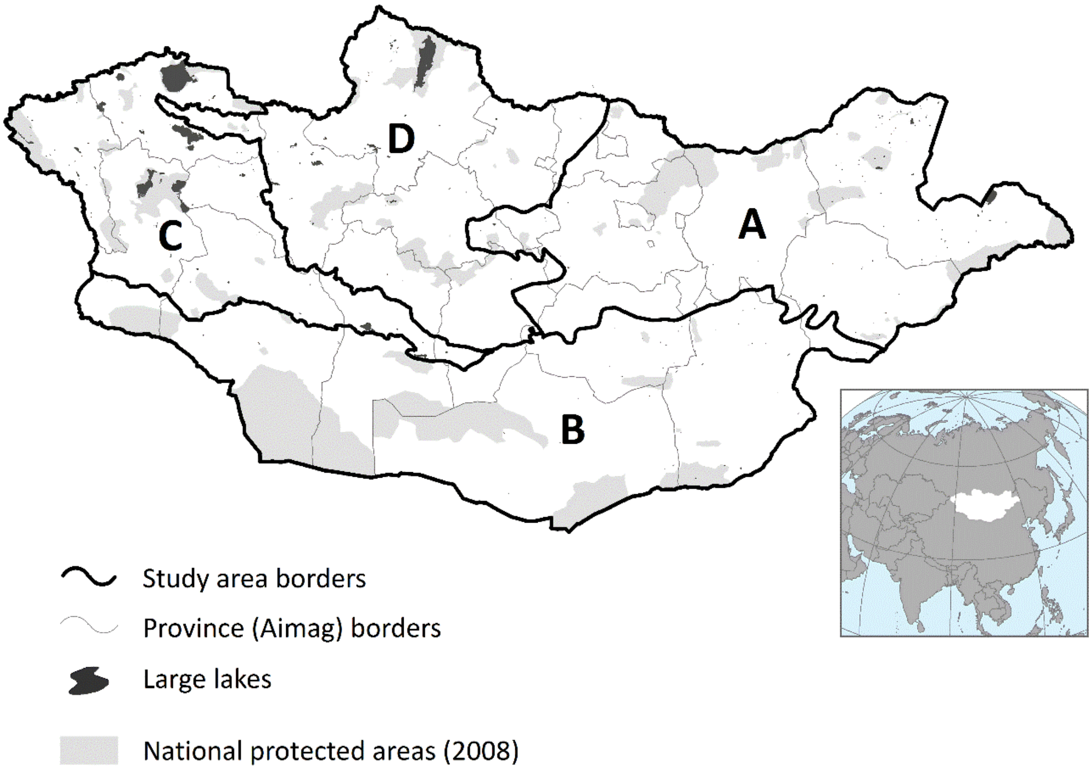


Figure 2: This map shows the biogeographic study areas of the four landscape-level conservation plans that are the basis for the national mitigation framework. (A) The Eastern Grasslands is the Mongolian portion of three WWF Global Ecoregions (Olson et al., 2001): Mongolian-Manchurian Grasslands, Daurian Forest Steppe, and Trans-Baikal Boreal Forest. The boundaries of the other three study areas follow biogeographic regions delineated by Dash (2007) and Chimed-Ochir et al. (2010): (B) the Mongolian Gobi Desert, (C) the Mongol Altai Mountains and Northern Altai Gobi, and (D) Khovsgol and Khangai.

We designed the portfolio following four steps described below. We chose and developed these methods to address the scope and scale of conservation planning across the study area with available data. Because the process depends on existing data that is coarse and incomplete, expert review was an essential component throughout the process.

Step 1: **Assemble a working group.** We convened experts and stakeholders to advise and review the planning process. This advisory group consisted of biologists and geographers from academia, government agencies, and conservation NGOs with expert knowledge of the study area and available data as well as officers in national and provincial (aimag) government agencies with knowledge and expertise in law, policy, and implementation strategy (see Supporting Information section 1). The advisory group reviewed all components and products of the assessment.

Step 2: **Identify existing priority conservation areas.** We identified a set of existing priority conservation areas that are either 1) current national protected areas, i.e. strictly-protected areas, national parks, national monuments, and nature reserves; or 2) Important Bird Areas (Nyambayar and Tseveenmyadag, 2009) that were identified through a systematic selection process and are the Mongolian component of the world database of Key Biodiversity Areas (KBAs) (Donald et al., 2019). These areas form the foundation or starting point for portfolio design.

Step 3: **Site selection for ecosystem representation**. We identified a set of areas that, in combination with National-level PAs and existing priority areas, meets representation goals for biodiversity elements in a configuration that optimizes for ecological condition, efficiency and connectivity (spatial contagion). This analysis involved selecting a set of representative biodiversity elements and mapping their distribution, developing a spatial metric of ecological condition, and site selection analysis.

To define biodiversity elements and map their distribution, we developed a terrestrial ecosystems classification and spatial model organized as a hierarchy of regional biogeographic zones (Dash, 2007), ecosystem types based on vegetation structure and geomorphology, and landforms (Heiner et al., 2015). This approach to ecosystem classification for conservation planning has been applied widely in regional conservation plans across terrestrial, freshwater, and marine realms (Groves et al., 2002; Groves, 2003). We set representation goals as 30% of the distribution of each ecosystem type across each of the four study areas, based on the national protection goal. To assess the distribution of threatened species, we identified nationally listed rare and endangered animals; developed spatial models of potential habitat based on range maps, literature, and existing survey data; and measured representation in the portfolio post-hoc.

To guide site selection, we calculated a metric of ecological condition derived from spatial data representing sources of anthropogenic impacts that include population centers, roads and railways, mines and supporting infrastructure, and livestock grazing (see Supporting Information section 2). The result is an index of disturbance from cumulative impacts that functions as a generalized measure of ecological condition and competing economic values such as high livestock use. In site selection, this index directs selection to sites with least degradation and conversion from historic natural conditions and has the effect of excluding highly converted areas such as population centers and active mine leases. Three of this region's wide-ranging and threatened species, Asiatic wild ass (or Mongolian khulan), Goitered gazelle, and Mongolian gazelle, have been found to avoid human activities as modeled by this disturbance index (Buuveibaatar et al., 2016; Nandintsetseg et al., 2019).

To conduct site selection analysis, we used MARXAN (Ball et al., 2009), a software package developed for spatial conservation planning that conducts site selection to meet user-defined representation goals for biodiversity elements while minimizing user-defined planning unit cost. In this case, planning unit cost was derived from the disturbance index so the more disturbed planning units had higher cost values. The MARXAN cost function includes a connectivity component that provides a cost savings for sites that share a boundary. We constructed a spatial analysis framework that divides each study area into approximately 10,550 planning units or cells of uniform shape (hexagons) and size (50 km^2). We then populated this framework to identify existing priority conservation areas (step 2 above), and for each cell calculated composition (area) of ecosystem types and the mean disturbance index value. We set MARXAN parameters following a sensitivity analysis as recommended by Game and Grantham (2008).

Step 4: **Re-design to minimize conflict with planned mineral development**. In each assessment, the initial site selection included areas that were leased for mineral exploration. Recognizing that in Mongolia there are a range of options to meet representation goals and that most stakeholders did not want to retire or convert existing exploration leases, we redesigned the initial portfolio to minimize conflict with exploration leases. Within the set of conflict areas, we identified cells with critical conservation significance based on several criteria including optimacity and rarity, as described below – and designated these as areas where development should be avoided. We replaced the remaining conflict areas with sites of similar composition and condition outside existing leases. The result is a redesigned portfolio that avoids mining leases except in areas of critical conservation significance. Existing national protected areas were unaffected by this redesign because national protected areas prohibit mining exploration and mining leases.

Optimacity (Wilhere et al., 2008) is a measure of the relative contribution of each cell to an optimal MARXAN solution independent of the representation goals. The rarity metric calculation is a modification of the Relative Biodiversity Index (Schill and Raber 2009) that removes the influence of cell size and standardizes the distribution and range of values. A rarity value is calculated for each ecosystem type within each cell as the area of the ecosystem type relative to its total area across the study area, and the cell rarity metric is the maximum rarity value in the cell. In general, the cells with the highest rarity metric contained rare wetland ecosystems including water bodies, oases, and wet depressions.

To redesign portfolio conflict areas, we identified areas of critical conservation significance as cells either with the sum of the optimacity and maximum rarity values (rescaled from 0 to 1) in the upper 30th percentile. We designated cells meeting either of these criteria as areas where development should be avoided. We replaced the remaining cells with sites of similar composition and condition outside existing leases.

Four regional conservation plans that have been replicated across Mongolia and have directed designation of new national and local protected areas based on the portfolio. The first, completed in 2011 for the Eastern Mongolian Grasslands (TNC, 2011), led to designation of 39 new protected areas covering 60,200 km^2, including 21 National Protected Areas (19,300 km^2). After completion of the Gobi Desert regional planning framework in 2013 (TNC, 2013), 68,800 km^2 of new protected areas were designated based on the portfolio. With the establishment of these new protected areas, 160 exploration and application leases have been retired (MMRE, 2012; MRPAM, 2019). Planning for the remaining regions of western (Mongol Altai Mountains and Northern Altai Gobi) and northern (Khovsgol and Khangai) Mongolia was completed in 2017 (TNC, 2017a; b), and led to protection of an additional 48,500 km^2 of new protected areas. In total, approximately 177,000 km^2 of new protected areas have been established based on the national conservation portfolio and planning process (see Figure 3).

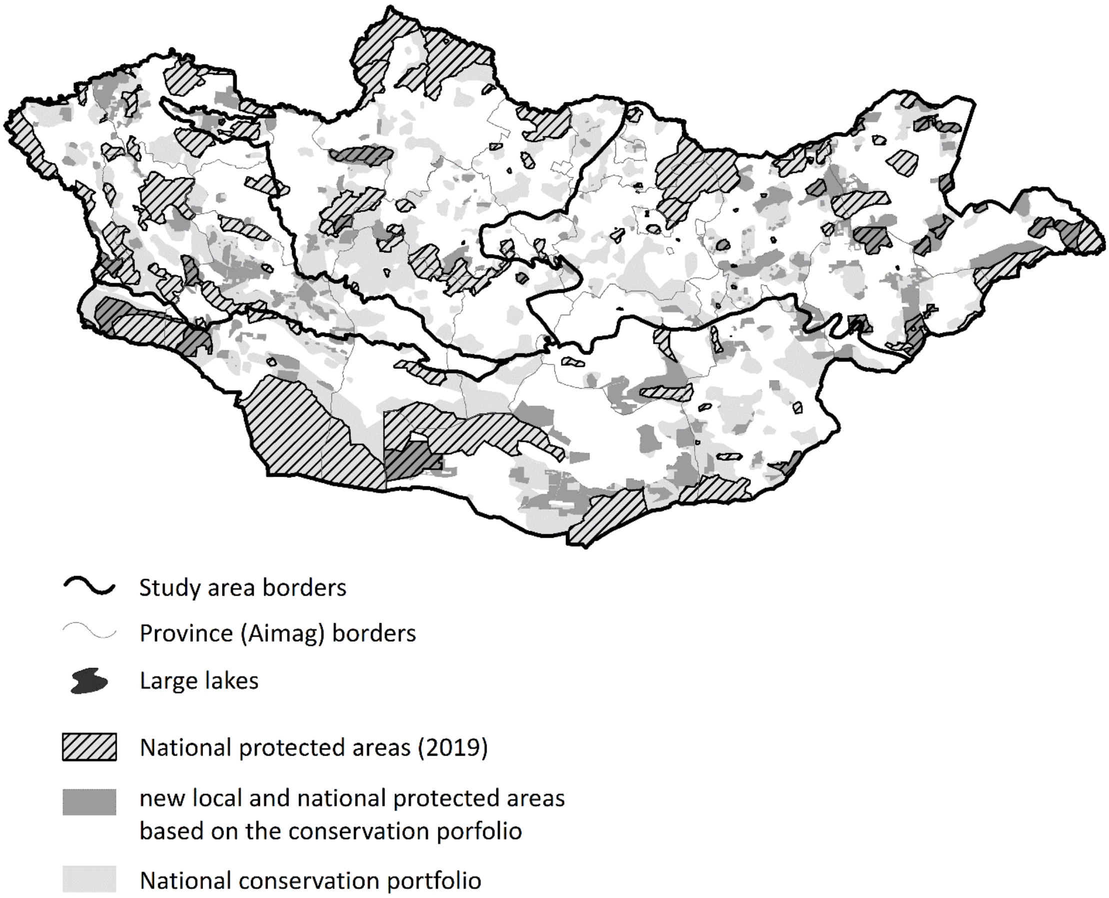


Figure 3: National conservation portfolio and portion in new protected areas. Since 2010, approximately 177,700 sq.km. of new protected areas have been established based on the national conservation portfolio and planning process.

For further discussion of outcomes and applications to guide mitigation, including avoidance decisions, offset design and implementation, aggregated offsets, and directing offsets to protected areas, as well limitations of this study and outstanding issue, see [*Heiner et al., 2019*]*.*

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Appendix E: Disturbance index

Parts of the following are reproduced from:
The Nature Conservancy. (2016). Annex D: Connectivity Report. In Contract No: C30074/EBSF-2012-08-107, Capacity building for Mongolian Ministry of Environment and Green Development (MEGDT) in relation to biodiversity and conservation in the southern Gobi Desert. Ulaanbaatar. https://tnc.app.box.com/s/zpdldhezvqrjpqz9c3t0wsrxwoc88mke

To measure cumulative human impacts as an indirect indicator of ecological integrity, or departure from historic or natural conditions, we calculated an index of disturbance derived from available spatial data representing sources of anthropogenic impacts that include population centers, roads and railways, mines and supporting infrastructure, and livestock grazing (see Supporting Information section 2). The result is an index of disturbance from cumulative impacts that functions as a generalized measure of ecological condition and competing economic values such as high livestock use.

In site selection, this index directs selection to sites with undisturbed ecosystems, i.e. those least degraded and converted from historic natural conditions, and minimizes selection of areas with competing economic values, such as areas heavily grazed by livestock, and has the effect of excluding highly converted areas such as population centers and active mine leases. As such, this index functions as a generalized, coarse-scale measure of the relative cost of conservation effort and investment. Three of this region's wide-ranging and threatened species, Asiatic wild ass (or Mongolian khulan), Goitered gazelle, and Mongolian gazelle, have been found to avoid human activities as modeled by this disturbance index (Buuveibaatar et al., 2016; Nandintsetseg et al., 2019).

Disturbance Factors

- Population centers and associated areas of impact: areas around population centers (Aimag centers, Soum centers, border crossings) are typically overgrazed (Fernandez-Gimenez, 2001), and hunting (Wingard and Zahler, 2006) and predation and harassment by dogs (Young et al., 2011) are common.
- Transportation (roads and railways: Roads have multiple negative impacts on wildlife habitat and habitat use (Trombulak and Frissell, 2000). In the study area, most roads are simply dirt tracks and routes constantly shift. However, drivers use some routes more frequently than others, and several road corridors are designated as highways. The GIS linework for roads (MORT 2016) is incomplete, and intended to represent frequently-used routes of vehicle traffic.
- Mines and supporting infrastructure: Aside from the site-level impacts, impacts to vegetation and groundwater can extend far from the mine footprint (pit and infrastructure). Water extraction for mining operations causes drawdown of near-surface groundwater in the local cone of depression, and potentially over large distances depending on groundwater hydrology (Walton, 2010). This can affect wells, springs and vegetation productivity, reducing water and forage availability, and impacting groundwater dependent systems such as oases, elm stands and Saxaul forests. Mine operations and high traffic on mining roads also create large amounts of dust that can travel far and affect vegetation growth (Walton 2010). The impacts and movement of dust are well studied (e.g. http://www.roaddustinstitute.org/; http://www.dirtandgravel.psu.edu/Research/research.html).
- Agricultural land use
- Livestock grazing intensity: Livestock grazing can affect plant species composition (Fernandez-Gimenez and Allen-Diaz, 2001) and may impact availability and quality of habitat for wildlife, through exclusion and competition (Wingard et al., 2011; Yoshihara et al., 2008; Campos-Arceiz et al., 2004), or by reducing palatable species (Gana Wingard pers comm.). Olson et al. (2011) found that Mongolian gazelle avoid areas near herder households, and high densities of herder households may create barriers to movement and limit access to forage. Hunting (Wingard and Zahler, 2006) and predation or harassment by feral dogs (Young et al., 2011; Buuveibaatar et al., 2009) also likely increase with proximity to and density of herder households.

Calculation of the National disturbance index. This table lists the disturbance factors, source data, GIS measurements and the steps followed to calculate the disturbance index. All source datasets were projected to WGS_1984_UTM_Zone_48N (WKID: 32648) and converted to raster format (425m resolution) with a single national extent, (6413 cells x 3197 rows).

The disturbance index is derived from available GIS data for sources and types of current human disturbance, and is a measure of cumulative human impacts and an indicator of ecological integrity or departure from historic or natural conditions. The components are described on the following page.

1. **transportation**
    - a. primary roads (MORT 2016) and railways (ALAGaC 2014)
        - *inverse of Euclidean distance to 3km*
    - b. all transportation: primary and local roads (MORT 2016) and railways
        - *focal sum of length within 5 km radius**
    - c. index* = a. + b.
2. **population centers**
    - a. urban (ALAGaC 2014)
        - i. urban residential, non-residential, industry
            - *[inverse of Euclidean distance to 5km] + [focal sum of area within 5 km radius*]*
        - ii. urban all
            - *[inverse of Euclidean distance to 5km] + [focal sum of area within 5 km radius*]*
    - b. border crossings
        - *inverse of Euclidean distance to 10km*
    - c. nighttime lights (NOAA 2011) *
    - d. index* = maximum value of a., b. and c.
3. **active mineral and energy leases**
    - a. active lease areas, mining and petroleum, April 2015 (MRA 2015)
        - *inverse of Euclidean distance to 5km*
4. **agriculture** (ALAGaC 2014)
    - a. high-intensity: cropland and vegetable
        - *inverse of Euclidean distance to 3km*
    - b. cropland: cropland, vegetable and wheat
        - *inverse of Euclidean distance to 3km*
    - c. all agriculture: cropland, vegetable, wheat and hay
        - *inverse of Euclidean distance to 3km*
    - d. index* = a. + b. + c.
5. **herder household locations (**CPR 2010)
    - converted to raster: each 450m cell can contain only one household, to partially correct for sampling bias and duplicate records.
    - a. winter and spring:
        - *focal sum of count within 5 km radius **
    - b. summer and autumn
        - *focal sum of count within 10 km radius **
    - c. index* = a. + b.
6. **cumulative disturbance index**
    - a. sum of five factors = 1c. + 2e. + 3a. + 4d. + 5c.
    - b. maximum value of population centers, mineral/petroleum leases and all other factors
        - index = max of 2e., 3a. and 6a.

* values rescaled by dividing each value by maximum value to produce a range of values from 0 to 1 (max).

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Appendix F: Khangai and Khuvsgul Regions Terrestrial Ecosystem Classification and Spatial Model

Parts of the following are reproduced from:
The Nature Conservancy Mongolia Country Program. (2017a). Identifying conservation priorities in the face of future development: applying development by design in the Khangai and Khuvsgul. The Nature Conservancy. Ulaanbaatar. Available online: https://tnc.box.com/s/ympw8nfjnaycwqci187rt5g22urp5rsz

A key component of landscape-level planning is a mapped classification of major habitat types, or ecosystems, to represent the range of natural habitats and function as a surrogate for biodiversity. To map ecosystems across the study area, we developed a spatial model by comparing the distribution of plant communities and major vegetation types as shown in maps and described in literature with patterns of above-ground biomass, elevation and topography derived from remote sensing. The resulting mapped classification is organized as a hierarchy of 1) biogeographic regions, 2) terrestrial ecosystem types based on vegetation, elevation and geomorphology, and 3) landforms. We chose methods and source datasets to fit the challenge of developing a mapped classification that is accurate at a consistent spatial scale across the large 600,000 km^2 study area and captures the range of major habitat types and environmental gradients. This provides a map to support landscape-level conservation planning and a first-iteration spatial model framework that can support field surveys and future model revisions, with other applications to land use planning, research, surveys and monitoring. A key advantage of a data-driven GIS modeling approach is that the source data and model can be iteratively revised as new field data becomes available, and initial results can guide spatial sampling of survey design to inform revisions.

Our approach to defining and mapping ecosystems is based on a classification framework developed for ecological systems across the United States and Latin America (Comer et al., 2003). This framework was developed to support landscape-level conservation and management decisions, and specifically to address a critical need for ecological classification that is 1) practical to map at a regional level with available GIS data and 2) represents key ecological processes and patterns that produce and sustain habitat and ecosystem services. Within this framework, ecological systems are defined as groups of biological communities occurring in similar physical environments and influenced by similar ecological processes. Classifications are organized by biogeographic regions (e.g. ecoregions) and four categories of spatial pattern or patch type: matrix, large patch, small patch and linear. Matrix-forming systems such as steppe types or boreal forest typically dominate uplands and form extensive cover as a heterogeneous mosaic of plant communities. Patch- forming and linear systems such as sand massives and riparian wetlands are formed by distinct biotic and abiotic factors and typically nested within matrix-forming system types. As such, this approach considers multiple scales of organization, environmental patterns and processes that influence habitat structure and function, and produces classification units that are practical to map and identify in the field (Comer et al., 2003).

In Mongolia, there is a need for a regional-level mapped classification of vegetation and physical habitat that is accurate at a coarse but consistent spatial scale and based on transparent, well-documented methods and source data. Since the 1970s, extensive field surveys by joint Mongolian-Russian expeditions have produced several national and regional maps of vegetation and ecosystems (e.g. Vostokova and Gunin, 2005; Yunatov et al., 1979) at map scales of 1:1 to 1:2 million. The applications of these maps are limited by the coarse spatial scale that under-represents riverine wetlands and other groundwater-dependent systems that have high value as habitat and water sources for wildlife, livestock and people. In recent years, several advances in remote sensing products and tools have enabled vegetation mapping and landscape classification at a finer spatial scale with quantitative analytical methods. These include Landsat TM (NASA, 2011) for multi-spectral image classification, the Normalized Difference Vegetation Index (NDVI) (e.g. MODIS 13Q1 – NASA LP DAAC 2013) to measure above-ground biomass at a range of spatial and temporal scales, and digital elevation models (DEMs) (e.g. SRTM; Jarvis et al., 2008; Lehner et al., 2008) for measuring elevation and modeling topography, landforms and surface hydrology.

For a study area this large, a Landsat-based multi-spectral image classification is not feasible in terms of time and computer processing required and because it requires a large dataset of field training data well-distributed across the study area. Therefore, we defined a simple thematic classification of major ecosystem types and developed a spatial model based on regionally available datasets measuring elevation, above-ground biomass and topography. The thematic classification is based on vegetation and habitat classifications described in literature and maps, primarily a national ecosystem map developed by WWF (Chimed-Ochir et al., 2010), as well as Vostokova and Gunin (2005); Tuvshintogtokh (2014); Beket (2009); Dash (2009); Zemmerich et al., (2010) and Hilbig (1995). The spatial model is based on biophysical thresholds and environmental factors described in the literature (Beket 2009; Zemmerich et al., 2010) and derived from a spatial analysis of regional and national maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin 2005; Dash 2009; Lhagvasure 2014).

Terrestrial ecosystem classification structure

The terrestrial ecosystem classification is organized as a hierarchy of biogeographic zones, terrestrial ecosystems based on vegetation structure and biophysical setting, and landforms. This classification defines 182 types, or unique combinations of biogeographic zone, ecosystem type, and landform. Source datasets and methods are summarized in Table 1. Biogeographic regions and modeled ecosystem types are mapped in Figure 1 and listed in Table 2.

Tier I: Biogeographic zones

Biogeographic zones represent broad, regional patterns of climate, physiography and related variation in species and genetics. For most ecosystem types distributed across the study area, stratification by biogeographic zone captures regional differences in species composition and environmental patterns, and ensures that site selection will include multiple occurrences that are geographically distributed across the study area. This geographic redundancy provides some insurance against local extinctions caused by disturbance events such as climate extremes, disease and/or invasive species. To define and map biogeographic zones for this study, we chose four Landscape-ecological zones delineated by Dash (2007) and published by Chimed-Ochir et al., (2010): the Mongol Altai Mountains, the North Altai Gobi (aka Great Lakes Depression), the Khangai region and the Khovsgol region (see Figure 1).

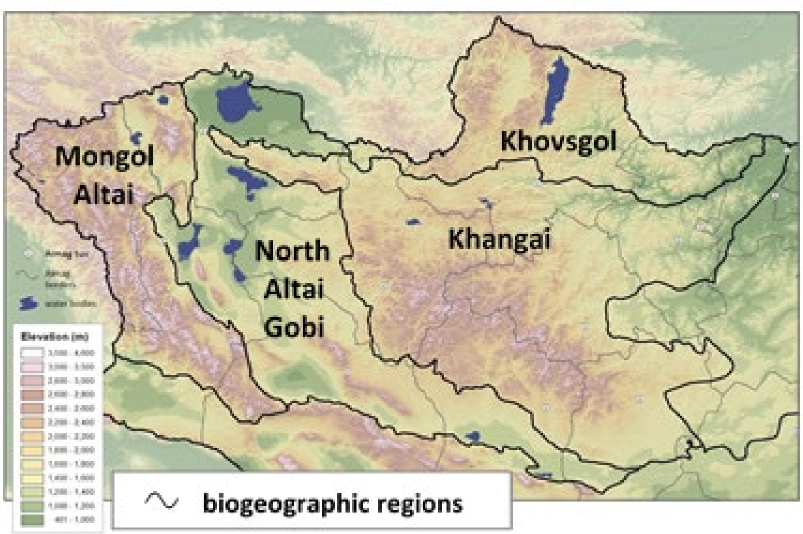


Figure 1: Biogeographic zones chosen for the ecosystem classification are the landscape-ecological regions defined by Dash (2007) and published in the WWF National Gap Assessment (Chimed-Ochir et al., 2010).

Tier II: Terrestrial ecosystems

Ecosystems are generally defined as a biotic component (vegetation) and abiotic component (physical environmental features and processes) and occur at distinct spatial scales and in patterns driven by the underlying physical processes. The thematic classification and the spatial model define and map ecosystems at two levels, or spatial scales. First, matrix-forming types, such as boreal forest and mountain steppe, are broadly distributed as a patchy mosaic of plant communities and are mapped here according to coarse-scale patterns of elevation, vegetation structure and topography. Second, patch-forming types, such as riverine wetlands and sand massives, form distinct patches and are mapped here at a relatively fine scale based on topography, surface hydrology and land cover maps. Source datasets and methods are described in Table 1 and the result is mapped in Figure 2.

Matrix-forming systems cover most of the land area and follow broad patterns of climate and precipitation. These include boreal forest, six major steppe types, semi-desert and true desert. The predictive variables are elevation, forest percent cover and above-ground biomass. All have been mapped and measured globally with remote sensing. Elevation, derived from a digital elevation model (SRTM, Jarvis et al., 2008, Lehner et al., 2008), is a predictor or proxy for climate gradients and major vegetation zones that are well described in the literature (Beket, 2009; Zemmerich et al., 2010; Hilbig, 1995 and Tuvshintogtokh, 2014). Forest percent cover (Hansen et al., 2013) and above-ground biomass derived from a vegetation index (NDVI - MODIS 13Q1, NASA 2013) are predictors or proxies for vegetation structure and site productivity. NDVI has been used widely to measure spatial and temporal patterns of vegetation structure and productivity for a range of applications to vegetation science and animal ecology (Pettorelli et al., 2011; Pettorelli et al., 2005; Williamson et al., 2012). To write model rules, we identified thresholds of elevation, forest percent cover and above-ground biomass based on literature (Beket 2009; Zemmerich et al., 2010) and a spatial analysis of regional and national maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin 2005; Dash 2009; Lhagvasure 2014).

Patch forming ecosystems include four wetland types mapped with DEM-derived wetland model (Smith et al., 2008), water bodies mapped with Landsat TM imagery (Hansen et al., 2013) and sand massives mapped by digitizing large sand features in 1:200,000 landcover maps (U.S.S.R. Military Topographic Map Administration, 1952). The DEM-derived wetland model delineates wetlands according to local topography and surface hydrology. In temperate regions with perennial streams and rivers, the wetland model delineates riverine wetlands including large river floodplains and small stream riparian areas. In desert regions, the wetland model delineates large wet depressions and smaller dry river beds (sayrs) with near-surface groundwater. The riverine floodplain ecosystem type typically supports a mix of forest, shrubs, meadows and gravel bars that are mapped as sub-types according to above-ground biomass. Similarly, the desert wet depression ecosystem type is a mix of dense tall woody vegetation, meadows and barren salt pans that are also mapped as sub-types according to above-ground biomass. More detailed descriptions of the ecology and plant communities of each ecosystem are in section 2.0.

The floodplain and riverine wetland delineation has been developed for all of Mongolia. This delineation is the basis for proposed designation of river protection zones to implement the water protection law (Mongolian Law on Water 2007), as described in a report and recommendations produced by WWF for the Ministry of Environment and Green Development (WWF Mongolia and TNC Mongolia, 2014). The spatial model result is currently being tested and revised to inform local land use planning and protection (WWF Mongolia 2015).

Tier III: Landforms

Matrix-forming ecosystem types - including boreal forest, steppe types, and semi-desert - occupy nearly 90% of the study area as a heterogeneous, patchy mosaic of plant communities formed by topography, disturbance regimes and successional cycles. Patterns of plant species composition within these matrix-forming ecosystems generally follow topographic environmental gradients. To capture this ecological, environmental and genetic diversity, we stratified these widespread steppe ecosystem types by landforms. We defined and mapped landforms according to a cluster analysis of a two topographic indices, the compound topographic index (Gessler et al., 1995; Moore et al., 1991) and slope-transformed aspect (Stage 1976), that represent variation in soil properties, water balance and microclimate (see Figure 3).

DISCUSSION

In the face of rapid development of natural resources, landscape-level biogeographic information is a critical reference for guiding protection, management and mitigation actions. The mapped ecosystem classification described here demonstrates a method for defining and mapping ecosystems across a large region in a relatively short time frame based on limited survey data and globally-available datasets. This type of spatial model can be developed and updated relatively quickly, and the results are appropriate to support landscape-level conservation planning and inform regional land use planning, research, surveys and monitoring.

The model is based on relationships between spatial distribution of ecosystems and environmental gradients, and does not consider interactions between factors. Many multivariate methods exist for future iterations, including Classification and Regression Tree (CART) analysis and cluster analysis (e.g., hierarchical agglomerative clustering, fuzzy C-means clustering). However, these methods require field data well-distributed across the study area.

A key assumption underpinning the spatial model design is that it is possible to accurately distinguish major vegetation types and structure with 12-year mean growing season NDVI (MODIS 13Q1, NASA LP DAAC 2013) as a proxy for vegetation structure, in combination with elevation and topography as proxies for water balance and other factors that influence the distribution of vegetation and ecosystems. Many tools and methods exist for analyzing and mapping vegetation with NDVI. Williamson et al. (2012) found that time-integrated NDVI (NDVI-I) is sensitive to spatial variation in shrub canopy cover, and differences between shrublands and grasslands, and therefore holds promise for future model improvements.

Ecological classification is an iterative process. Additional field validation is a critical next step to test and revise the model using a combination of methods and datasets, including 1) field surveys, 2) research plots established by long-term rangeland studies, and 3) fine-scale vegetation maps developed for smaller areas within the study area. The current model results can guide the spatial sampling design of field surveys that will inform future revisions.

Table 1: Terrestrial Ecosystem Classification: Source datasets and mapping methods. The ecosystem classification is organized as a hierarchy of (i) biogeographic zones, (ii) ecosystem types based on vegetation structure and biophysical setting and (iii) landforms. The result is 182 ecosystem types, or unique combinations of biogeographic zone, ecosystem type and (iii) landforms.

i. **Biogeographic Regions** (Dash, 2007; Chimed-Ochir et al., 2010). See Figure 1.

Mongol Altai Mountains
North Altai Gobi (aka Great Lakes Depression)
Khovsgol
Khangai

ii. **Ecosystem Types**. See Figure 2.

Matrix-forming systems follow broad patterns of climate and precipitation. GIS datasets re-sampled to 250m resolution to fit NDVI (MODIS 13Q1).

alpine barren alpine tundra alpine meadow high mountain steppe (Altai) mountain steppe boreal forest meadow steppe valley meadow steppe (dry steppe) desert steppe semi-desert true desert	• elevation: SRTM (Jarvis et al., 2008; Lehner et al., 2008). Elevation thresholds derived from literature (Beket 2009; Zemmerich et al., 2010) and maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin, 2005; Dash, 2009). • NDVI: 13 year (2000-2012) mean, growing season (April - September), MODIS 13Q1 (NASA LP DAAC, 2013). NDVI thresholds derived from maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin 2005; Dash 2009) and analysis of vegetation data (Heiner et al., 2015) collected von Wehrden et al. (2006a, 2006b, 2006c, 2009) and Wesche et al. (2005) in the Gobi Desert. • forest percent cover from Landsat TM 2000-2012 (Hansen et al., 2013).

Patch-forming systems follow finer-scale pattern of soil moisture, drainage and microclimate. GIS datasets re-sampled to 85m resolution to fit DEM (3 arc-second SRTM projected to UTM 48 North).

Floodplains and riverine wetlands	
riverine forest riverine shrub riverine meadow dry river bed small stream riparian	• DEM-derived topographic model (Smith et al., YEAR). • forest percent cover from Landsat TM 2000-2012 (Hansen et al., 2013). • NDVI: 13 year (2000-2012) mean, growing season (April - September), MODIS 13Q1 (NASA LP DAAC 2013). NDVI thresholds derived from maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin 2005; Dash 2009).
Wet depressions: in the desert, dry river beds or salty depressions with shallow water table following broad drainage patterns. Desert dense vegetation: large patches of closely-spaced tall shrubs and trees, typically near oases, including Tamarisk, Populus, Elm and Saxaul.	
desert dense vegetation desert wet shrubs desert wet barren salt pan desert sayrs (N. Altai Gobi)	• DEM-derived topographic model (Smith et al., 2008). • forest percent cover from Landsat TM 2000-2012 (Hansen et al., 2013). • NDVI: 13 year (2000-2012) mean, growing season (April - September), MODIS 13Q1 (NASA LP DAAC, 2013). NDVI thresholds derived from maps of vegetation and ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin 2005; Dash 2009).
sand massives	• digitized manually from 1:200k topographic maps
water bodies	• forest percent cover from Landsat TM 2000-2012 (Hansen et al., 2013).

(continued on next page)

Table 1: Terrestrial Ecosystem Classification: Source datasets and mapping methods. (continued)

iii. Landforms capture finer-scale variation in plant communities following patterns of soil moisture and microclimate. They are used here to stratify matrix-forming ecosystem types. See Figure 3.

steep, N-facing steep, S-facing gentle slope, N-facing gentle slope, S-facing upland, flat depression water tracks	mapped by cluster analysis of two DEM-derived topographic indices at 3-arc second (78m) resolution: • Compound topographic index (Gessler et al., 1995; Moore et al., 1991) • Slope-transformed aspect (Stage, 1976)

Table 2: Terrestrial Ecosystem Classification: area distribution of the ecosystem types across the study area and by bio-geographic zone.

Ecosystem type	Study area total (4 regions)		Mongol Altai Mountains		North Altai Gobi		Khangai		Khovsgol	
	km²	%	km²	%	km²	%	km²	%	km²	%
Matrix-forming types										
alpine barren	2,311	0.4	1,851	3	331	0.2	13	0.0	117	0.2
alpine tundra	7,444	1	2,823	4	1,662	1	1,140	0.4	1,818	2
alpine meadow	42,573	7	3,962	6	9,846	5	21,216	8	7,548	10
high mountain steppe (Altai)	18,652	3	18,652	26						
mountain steppe	120,767	19	16,925	24	10,408	5	76,355	28	17,079	22
boreal forest										
forest closed	24,315	4	293	0.4	4	0.00	13,345	5	10,673	14
forest open	35,529	6	633	1	47	0.02	19,814	7	15,035	20
meadow steppe	56,379	9	1,037	1			42,777	16	12,566	16
valley meadow	10,250	2	104	0.1	1,045	1	7,959	3	1,142	1
steppe	113,237	18	7,001	10	34,006	17	67,602	25	4,628	6
desert steppe	77,965	13	11,451	16	62,289	31	4,225	2		
semi-desert	43,450	7	1,026	1	40,833	20	1,591	1		
true desert	4,108	1			4,108	2				
Patch-forming types										
riverine floodplains / wetlands										
riverine forest	1,644	0.3	196	0.3	490	0.2	426	0.2	532	1
riverine shrub	6,140	1	693	1	1,769	1	2,768	1	910	1
riverine meadow	10,294	2	826	1	2,791	1	5,916	2	762	1
barren gravel/beach	8,509	1	1,207	2	5,844	3	1,441	1	17	0.02
small stream riparian	4,465	1	771	1			2,934	1	760	1
desert wet depressions										
desert dense veg	167	0.03	8	0.01	159	0.1				
desert wet shrubs	469	0.1			469	0.2				
barren salt pan	1,020	0.2			1,020	1				
desert sairs	2,607	0.4			2,607	1				
sand massives	17,135	3	264	0.4	15,346	8	1,525	1		
water bodies	12,904	2	1,163	2	7,657	4	1,061	0.4	3,022	4
Total area	**622,333**	**100**	**70,886**	**100**	**202,729**	**100**	**272,109**	**100**	**76,609**	**100**
Percent of study area	100 %		11 %		33 %		44 %		12 %	

Figure 2: Terrestrial Ecosystems

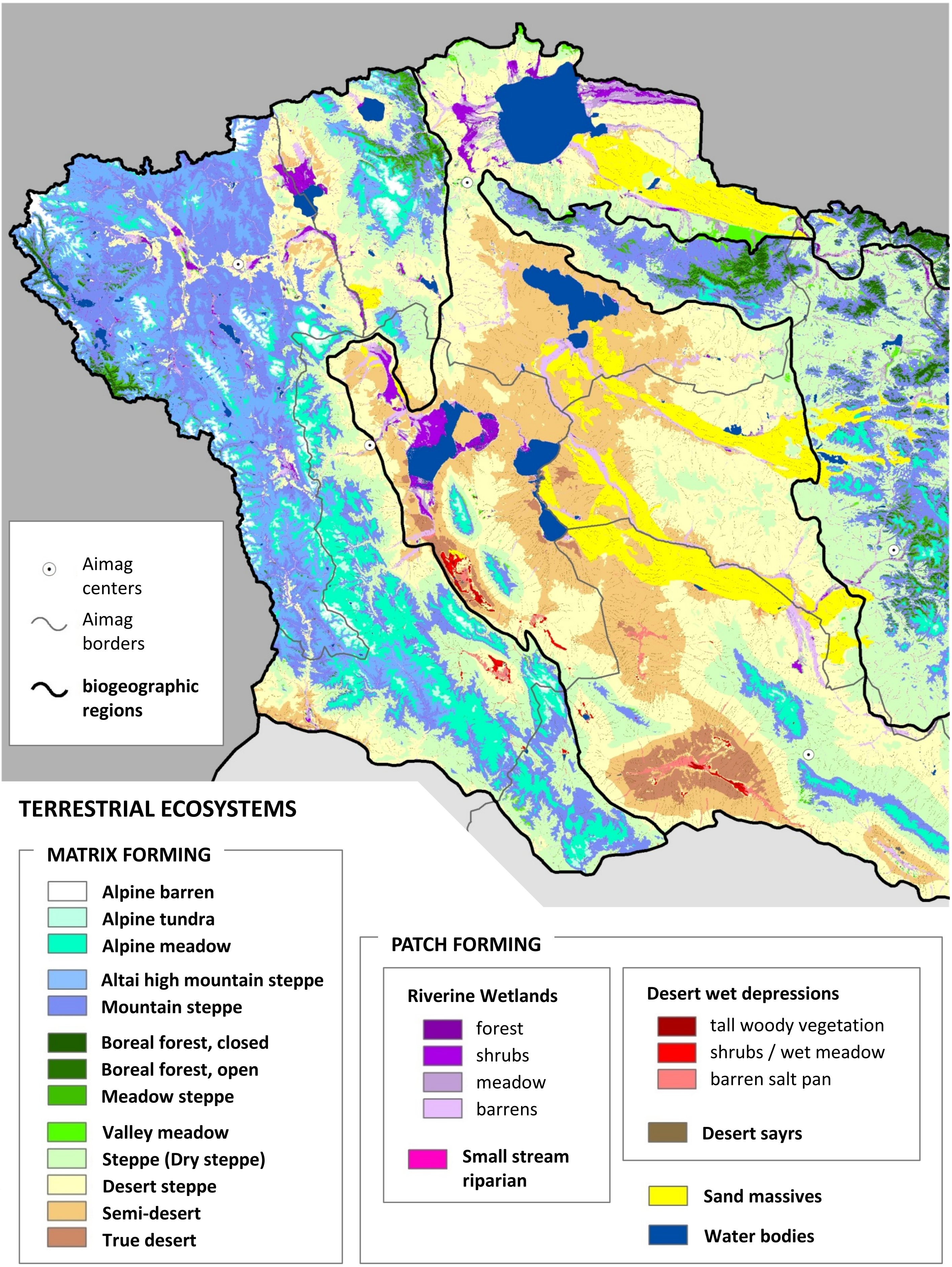


Figure 2: Terrestrial Ecosystems (continued)

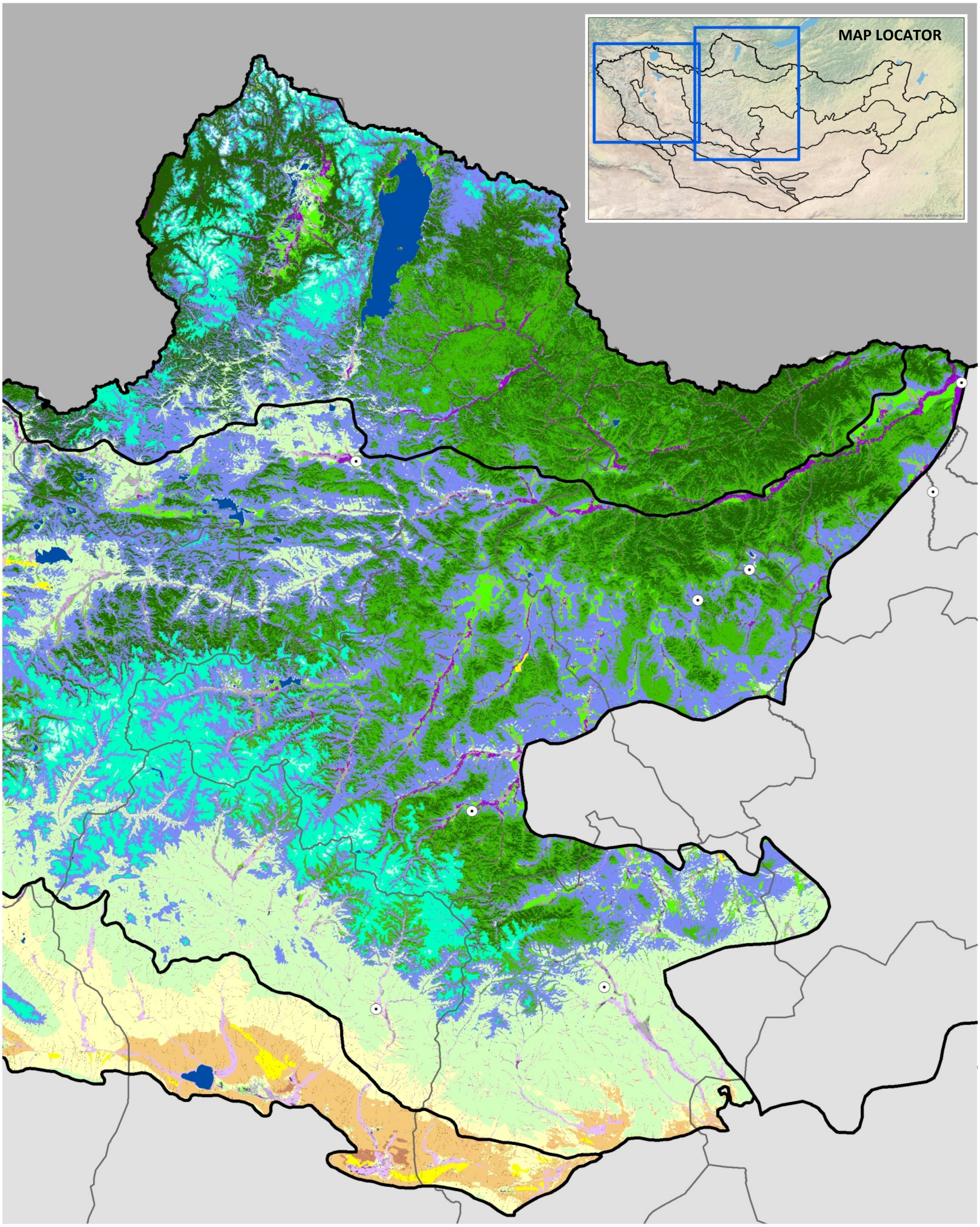
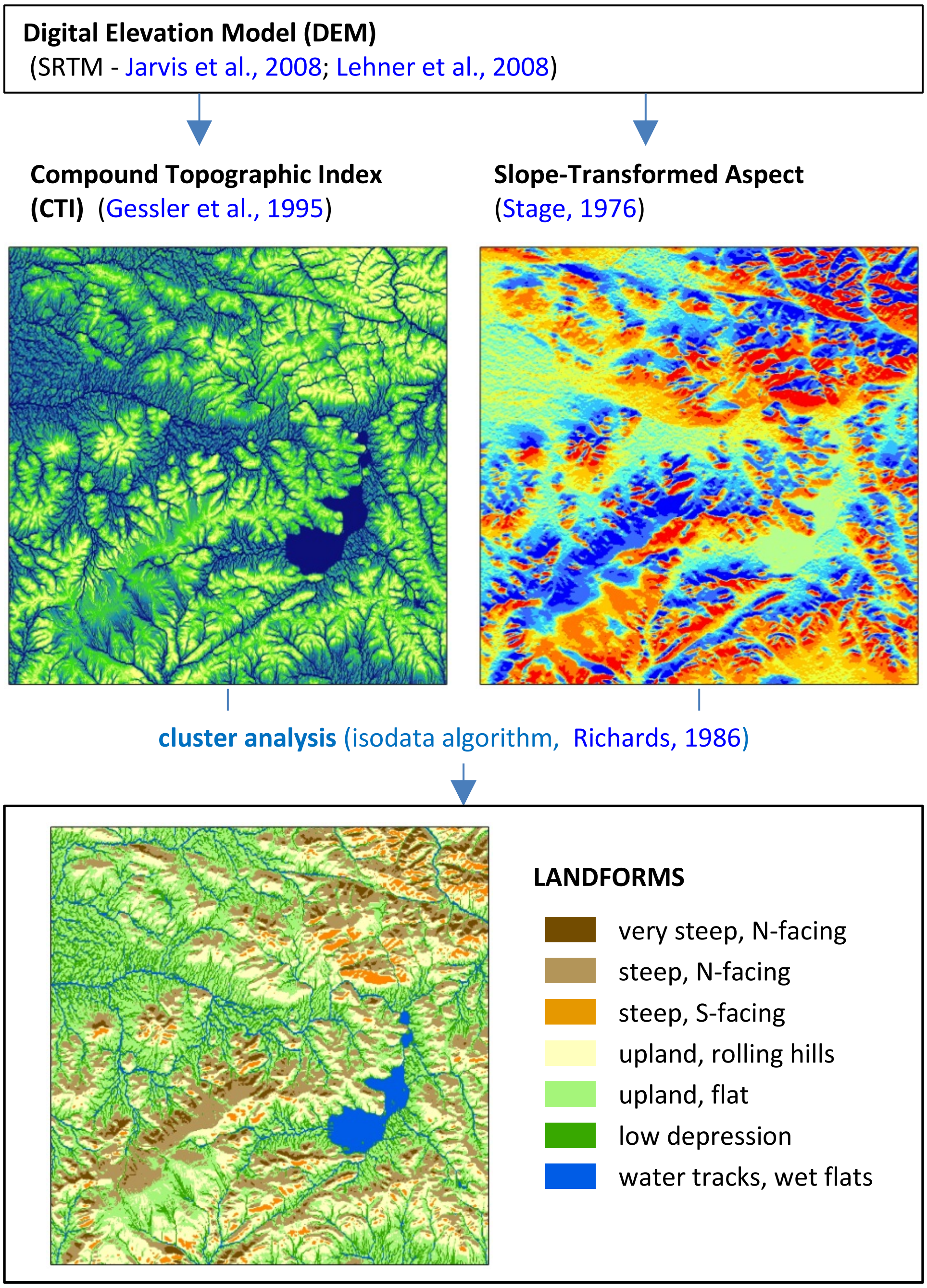


Figure 3: Landform classification based on cluster analysis of two DEM-derived topographic indices. The result defines and maps 7 landform types characteristic of the study area.



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Дэлхийн Байгаль Хамгаалах Сангийн Монгол дахь Хөтөлбөрийн Газар ба Де Нэйчэ Консерванси Монгол. 2014. Усны сан бүхий газрын байгалийн хилийг зурагласан ажлын тайлан (зөвлөх үйлчилгээний ажлын хэсгийн тайлан, № БОНХЯ/2014/К7)

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Дэлхийн Байгаль Хамгаалах Сангийн Монгол дахь Хөтөлбөрийн Газар. 2015. Гол, нуурын эрэг орчмын ус намгархаг газар, татмын байгалийн хилийг зурагласан үр дүнг баталгаажуулж, засварласан ажлын тайлан (Сав газар: Хэрлэн гол, Онон гол, Улз гол, Хар нуур-Ховд гол, Хяргас нуур-Завхан гол, Увс нуур-Тэсийн гол, Хүйсийн говь-Цэцэг нуур).

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Appendix G: Gobi Desert Region Terrestrial Ecosystem Classification and Spatial Model

Parts of the following are reproduced from:
The Nature Conservancy Mongolia Country Program. (2013). Identifying conservation priorities in the face of future development: Applying development by design in the Mongolian Gobi Desert. The Nature Conservancy. Ulanbaatar. Available online: https://www.nature.org/media/smart-development/development-by-design-gobi-english.pdf

The terrestrial ecosystem classification is organized as a hierarchy of biogeographic zones, terrestrial ecosystems based on vegetation and geomorphology, and landforms. This classification defines 193 types (Tables 1 and 2). Several vegetation maps have been developed using Landsat 5 TM images for National Protected Areas in the Gobi study area (Wesche et al. 2005, von Wehrden and Wesche 2006, von Wehrden et al. 2006, 2009). However, given the goal of developing a single consistent map of habitat and vegetation across the large study area over a short time frame, a Landsat-based approach was not feasible. Instead, we used a combination of datasets and methods. To map steppe and desert at a coarse scale, we classified satellite imagery (MODIS 13A3 NDVI at 1km resolution; NASA 2012) based on field surveys of plant communities. To map patch-forming systems including dense vegetation around oases, dry riparian areas and ephemeral water bodies at a fine scale, we combined a DEM-derived hydrologic model (78m resolution) with several remote sensing indices (Landsat 5 TM at 30 m resolution).

Tier I: Biogeographic zones

Biogeographic zones represent broad, regional patterns of climate, physiography and related variation in species and genetics. For most ecosystem types distributed across the study area, stratification by biogeographic zone captures regional differences in species composition and environmental patterns, and ensures that site selection will include multiple occurrences that are geographically distributed across the study area. This geographic redundancy provides some insurance against local extinctions caused by disturbance events such as climate extremes, disease and/or invasive species. To define and map biogeographic zones for this study, we chose the four ecoregions delineated by the National Gap Assessment (Chimed-Ochir et al. 2010): Eastern Gobi, Gobi-Altai, Southern Gobi-Altai and the Dzungarian Gobi (Figure 1). To capture the unique biogeography of the Trans-Altai Gobi in southwestern Mongolia (N. Batsaikhan pers. comm.), we further divided the Southern Gobi-Altai ecoregion based on the Trans-Altai Gobi Landscape-Ecological zone delineated by Vostokova and Gunin (2005).

Tier II: Terrestrial ecosystems

Ecosystems are generally defined as a biotic component (vegetation) and abiotic component (physical environmental features and processes) and occur at distinct spatial scales and in patterns driven by the underlying physical processes. We defined and mapped ecosystems at two levels, or spatial scales. First, matrix-forming types, such as desert steppe, are broadly distributed and mapped here according to coarse-scale patterns of annual productivity, elevation and precipitation. Second, patch-forming types, such as oases or wet depressions, form distinct patches and are mapped here at a relatively fine scale based on topography, surface hydrology and satellite imagery. For each ecosystem type, we identified the source data and mapping method (Table 1) and then determined the distribution of each ecosystem type by biogeographic zone (Table 2, Figure 7). Appendix 1 lists the ecological descriptions of the ecosystems types.

Matrix-forming systems cover most of the land area and follow broad patterns of climate and precipitation. These include desert, semi-desert, desert steppe, dry steppe and mountain steppe as described in existing literature (Hilbig 1995, von Wehrden et al. 2006, von Wehrden et al. 2007, Wesche et al. 2005). In the Gobi region, precipitation, vegetation productivity, and the spatial pattern of plant communities are highly correlated (von Wehrden and Wesche 2007). Based on this strong relationship, we developed a predictive model of the distribution of general steppe and desert types based on annual productivity, annual precipitation, and elevation of 1,145 survey records of diagnostic plant communities collected by von Wehrden et al. (2009) and Wesche et al. (2005). In this case, productivity is represented by the 11-year (2000-2011) mean Normalized Difference Vegetation Index (NDVI) during the growing season (June through September), derived from MODIS satellite imagery (MODIS 13A3, NASA 2012). The precipitation values are 50 year monthly averages from WorldClim (Hijmans et al. 2005). Based on the results (Figure 5), we chose NDVI thresholds to map the predicted distribution of the following matrix-forming vegetation types:

barren: virtually no vegetation

extreme arid desert: diagnostic species is Iljinia

true desert: characteristic desert shrubs, Haloxylon and Rheaumaria, dominate.

semi-desert: grasses appear, mixed with desert shrubs.

steppe and desert wetland vegetation: Stipa grasses dominate, desert shrubs disappear. To further distinguish three steppe types (desert-, dry- and mountain-) and large patches of dense wetland vegetation, we developed a set of decision rules based on annual NDVI, elevation and annual precipitation (Hijmans et al. 2005).

Patch-forming systems include five general types and sets of mapping methods, described below. All of these are groundwater-dependent systems that have disproportionately high biological value for wildlife, livestock and people, with sparse and patchy distribution following groundwater hydrology. These systems support high species diversity and provide critical habitat, particularly for small mammals, reptiles and birds, and provide valuable forage for large desert mammals.

i. *Wet depressions*: dry river beds or salty depressions with shallow water table following broad drainage patterns. These areas typically support distinct vegetation types including Saxaul (*Haloxylon ammodendron*) forests and Siberian elm (*Ulmus pumila*) and contain physically diverse soil types due to near-surface groundwater and hydrology. Because of the relatively high productivity and structural diversity of vegetation and soils, these areas also often support high diversity of small mammals and reptiles (N.Batsaikhan pers. comm.). We mapped these features using a GIS topographic model that delineates potential riverine wetlands based on regional flow accumulation and local topography of the stream channel, as derived from a digital elevation model (Lehner et al. 2008) at 3-second (77m) resolution.

ii. *Dense vegetation*: large patches of closely-spaced tall shrubs and trees, typically near oases, including Tamarisk (*Tamarix ramosissima*), *Populus diversifolia*, Elm and Saxaul. We mapped these features with a vegetation index derived from satellite imagery. First, we compiled and processed 54 Landsat 5 TM satellite scenes to cover the study area (NASA 2011). The acquisition date for most scenes was between June 15 and September 28, 2011. For six scenes, the best available image was acquired in 2010. Pre-processing included an atmospheric correction algorithm, tasseled cap transformation (ERDAS 1999) and calculation of the Soil-Adjusted Total Vegetation Index (SATVI; Marsett et al 2006). The SATVI was developed specifically to measure biomass of aridlands vegetation. Dense vegetation in an arid desert setting produces distinct high SATVI values (Figure 6). We classified areas with high SATVI values as dense vegetation. Finally, we separated the result by likely water source or hydrology into patches occurring in either a) dry stream beds and wet depressions (described above), or b) spring-fed seeps (remainder).

iii. *Ephemeral water bodies*: we digitized the boundaries and point locations of water bodies through manual interpretation of the 2011 Landsat 5 TM satellite imagery described above. The tasseled cap transformation produces a 3-band image that improves the contrast between bare ground, water, and vegetation. The resulting image is useful for classification and manual interpretation of landscape features. Using the transformed images, we digitized over 1,200 water bodies on-screen at 1:200,000. Because precipitation was relatively high during the summer of 2011, many ephemeral water bodies had surface water and were more visible in the Landsat imagery.

iv. *Sand massives:* large areas of sand dunes that we digitized manually from 1:200,000 topographic maps. The unique hydrology of sand dunes often creates small wetlands that support distinct plant communities and habitat with high species diversity.

v. *Mountain valleys:* mapped as valley bottoms, per the landform classification (described below), in mountain steppe or rugged mountain vegetation, per the matrix-forming ecosystem classification.

Tier III: Landforms

Five matrix-forming ecosystem types – extreme arid desert, true desert, semi-desert, desert steppe and dry steppe – occupy over 80% of the study area as a heterogeneous, patchy matrix of plant communities formed by topography, disturbance regimes and successional cycles. Patterns of plant species composition within these matrix-forming ecosystems generally follow topographic environmental gradients. To capture this ecological, environmental and genetic diversity, we stratified these widespread steppe ecosystem types by landforms. We defined and mapped landforms according to a cluster analysis of a topographic soil moisture index (Moore et al. 1991), insolation (Rich et al. 1995) and terrain ruggedness (Sappington et al. 2007) (Table 2, Figure 8).

Figure 5: Vegetation classification based on productivity and the distribution of plant communities.
This box plot shows the distribution of plant community survey records (n=1,145; von Werden et al. 2006 and Wesche et al. 2005) across the range of 11-year mean NDVI values (MODIS 13A3, NASA 2012). Based on the distribution of several diagnostic plant communities, we classified 11-year mean NDVI to map general vegetation types.

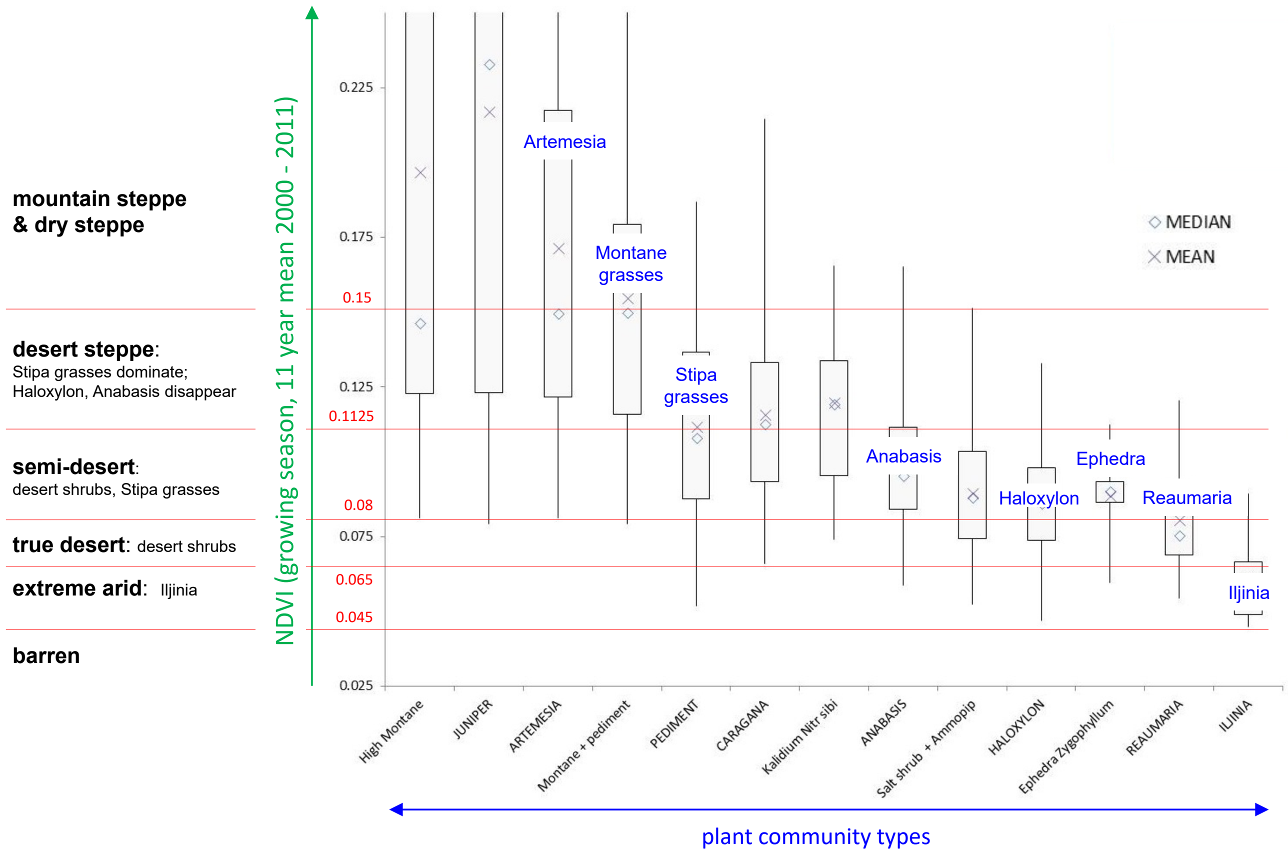


Figure 6: The Soil-Adjusted Total Vegetation Index (SATVI), derived from Landsat 5 TM imagery (NASA 2011), was designed for mapping aridlands vegetation. We classified SATVI to map patches of dense vegetation that typically occur around oases and areas with near-surface groundwater. SATVI may also be used to measure biomass, and biomass changes in response to groundwater changes, as described in Appendix 6.

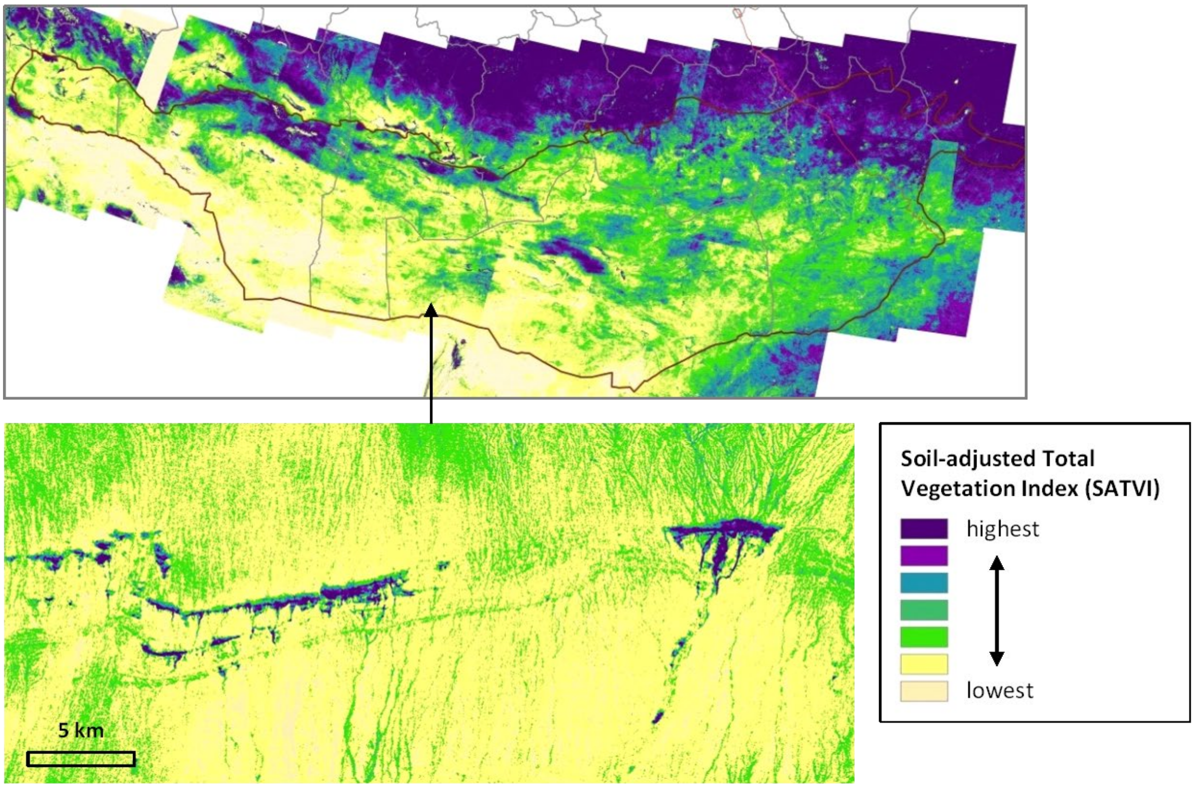


Table 1: Terrestrial Ecosystem Classification: Source datasets and mapping methods. The ecosystem classification is organized as a hierarchy of (i) biogeographic zones, (ii) ecosystem types based on vegetation and (iii) landforms. The result is 193 unique types.

i. Biogeographic Regions (WWF National Gap Assessment - Chimed-Ochir et al. 2010)

Djungarian Gobi
Gobi-Altay
Southern Gobi
Eastern Gobi
Trans-Altai Gobi - Dr. N. Batsaikhan pers. comm. Digitized from Vostokova EA & Gunin PD (2005).

ii. Ecosystem Types

Matrix-forming systems follow broad patterns of climate and precipitation.

barren extreme arid * true desert * semi desert * desert steppe * dry steppe * mountain steppe mountains rough terrain	• 1,400 vegetation survey records of plant community types (von Wehrden et al. 2009, Wesche et al. 2005) to classify NDVI according to vegetation types. • NDVI: satellite imagery (1 km resolution) measuring vegetation biomass during the growing season (June – September), covering 11 years (2000-2011; MODIS 13A3, NASA 2012). • annual precipitation (50 year mean – Hijmans et al. 2005)

Patch-forming systems follow finer-scale pattern of soil moisture, drainage and microclimate.

Wet depressions: dry river beds or salty depressions with shallow water table following broad drainage patterns	
small basins (drainage area < 1,000 km^2)	• DEM-derived topographic model at 3-arc second (78m) resolution.
large basins (drainage area > 1,000 km^2)	
Dense vegetation: large patches of closely-spaced tall shrubs and trees, typically near oases, including Tamarisk, *Populus*, Elm and Saxaul	
seeps: spring-fed	• Soil-adjusted total vegetation index (SATVI) from Landsat 5 TM satellite imagery (July - September 2010 and 2011).
riparian: shallow water table	
ephemeral water bodies	• digitized manually from Landsat 5 TM satellite imagery
sand massives	• digitized manually from 1:200k topographic maps
mountain valleys	

iii. Landforms capture finer-scale variation in plant communities following patterns of soil moisture and microclimate. They are used here to stratify five matrix-forming ecosystem types (* labeled above).

rough steep N-facing rough steep S-facing hills N-facing hills S-facing upland low flat depression valleys water tracks	mapped by cluster analysis of three DEM-derived topographic indices at 3-arc second (78m) resolution: • Topographic moisture index (CTI; Moore et al. 1991) • Insolation (SolarFlux; Rich et al. 1995) • Terrain ruggedness (VRM; Sappington et al. 2007)

Table 2: Terrestrial Ecosystem Classification: area distribution. This table lists the area distribution of the ecosystem types across the study area and by bio-geographic zone.

	Study area	Dzungarian Gobi		Southern Gobi-Altay		Trans-Altai Gobi		Gobi-Altay		Eastern Gobi	
	km²	km²	%	km²	%	km²	%	km²	%	km²	%
Matrix-forming types											
barren	2,909	201	1	161	0.2	2,451	5	95	0.1		
extreme arid	19,931	803	3	4,749	5	13,332	25	823	1	224	0.1
true desert	50,427	2,919	10	22,306	22	18,147	34	5,110	6	1,943	1
semi desert	176,610	13,522	48	57,254	56	14,302	27	27,714	33	63,816	26
desert steppe	128,654	5,691	20	5,428	5	697	1	22,599	27	94,238	38
dry steppe	57,186							24	0.0	57,163	23
mountain steppe	13,057	495	2	89	0.1	3	0.0	12,470	15		
steep mountains	10,803	600	2	375	0.4	18	0.0	9,810	12		
Patch-forming types											
wet depressions, small basins	23,524	1,018	4	5,492	5	2,811	5	2,066	2	12,138	5
wet depressions, large basins	9,145	1,114	4	1,459	1	703	1	653	1	5,216	2
dense vegetation – seeps	1,024	19	0.1	394	0.4	94	0.2	206	0.2	311	0.1
dense vegetation – dry river beds	6,913	1,118	4	739	1	12	0	866	1	4,178	2
ephemeral waterbodies	323	7	0.0	21	0.0	3	0.0	64	0.1	228	0.1
sand massives	11,953	373	1	3,147	3	90	0.2	689	1	7,654	3
mountain valleys	1,104	38	0.1	5	0.0			1,062	1		
Total area	513,544	27,917	100	101,619	100	52,664	100	84,249	100	247,109	100
Percent of study area	100 %	5 %		20 %		10 %		16 %		48 %	

Figure 7a: Terrestrial Ecosystem Classification, Western Gobi

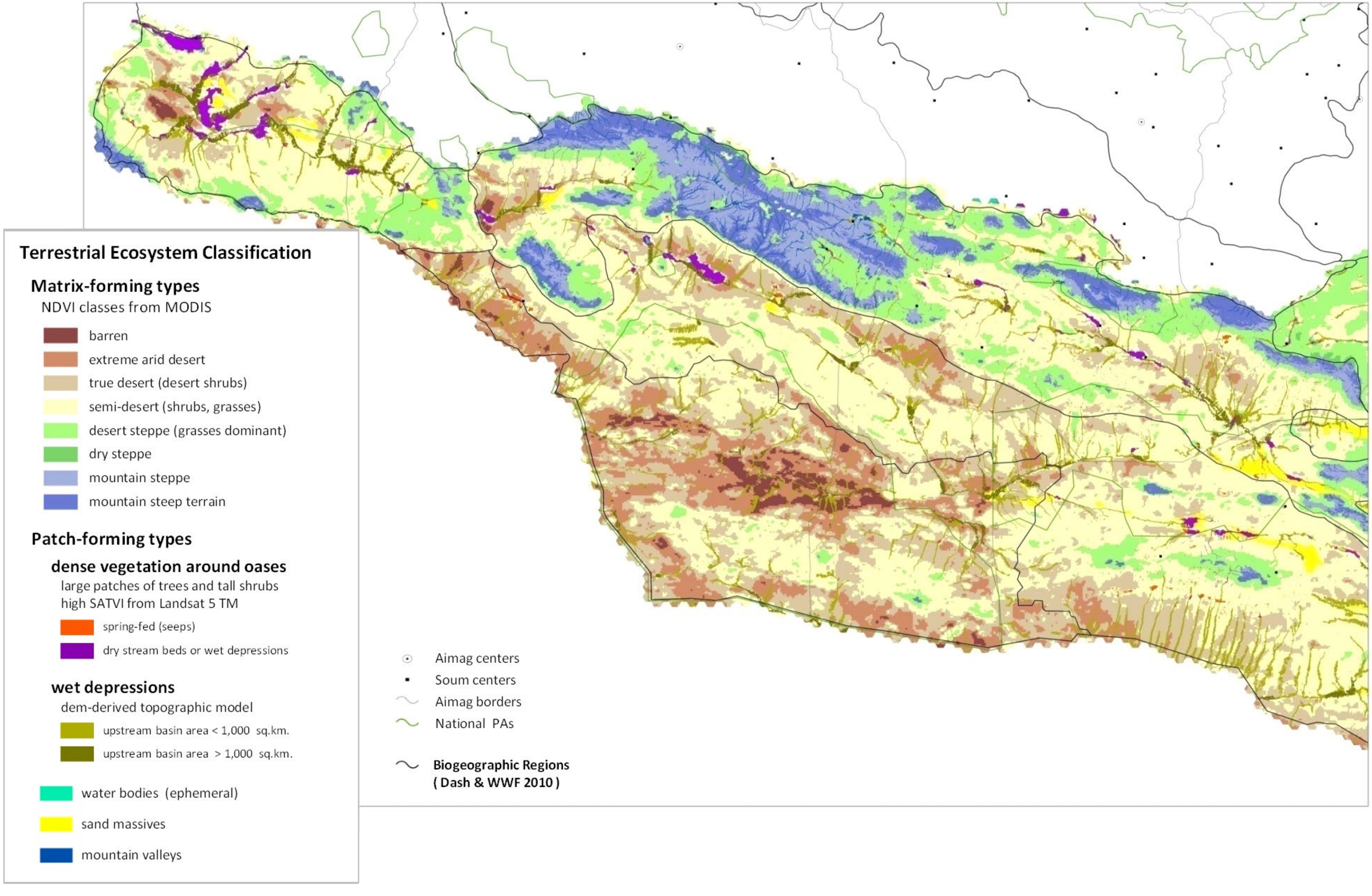


Figure 7b: Terrestrial Ecosystem Classification, Eastern Gobi.

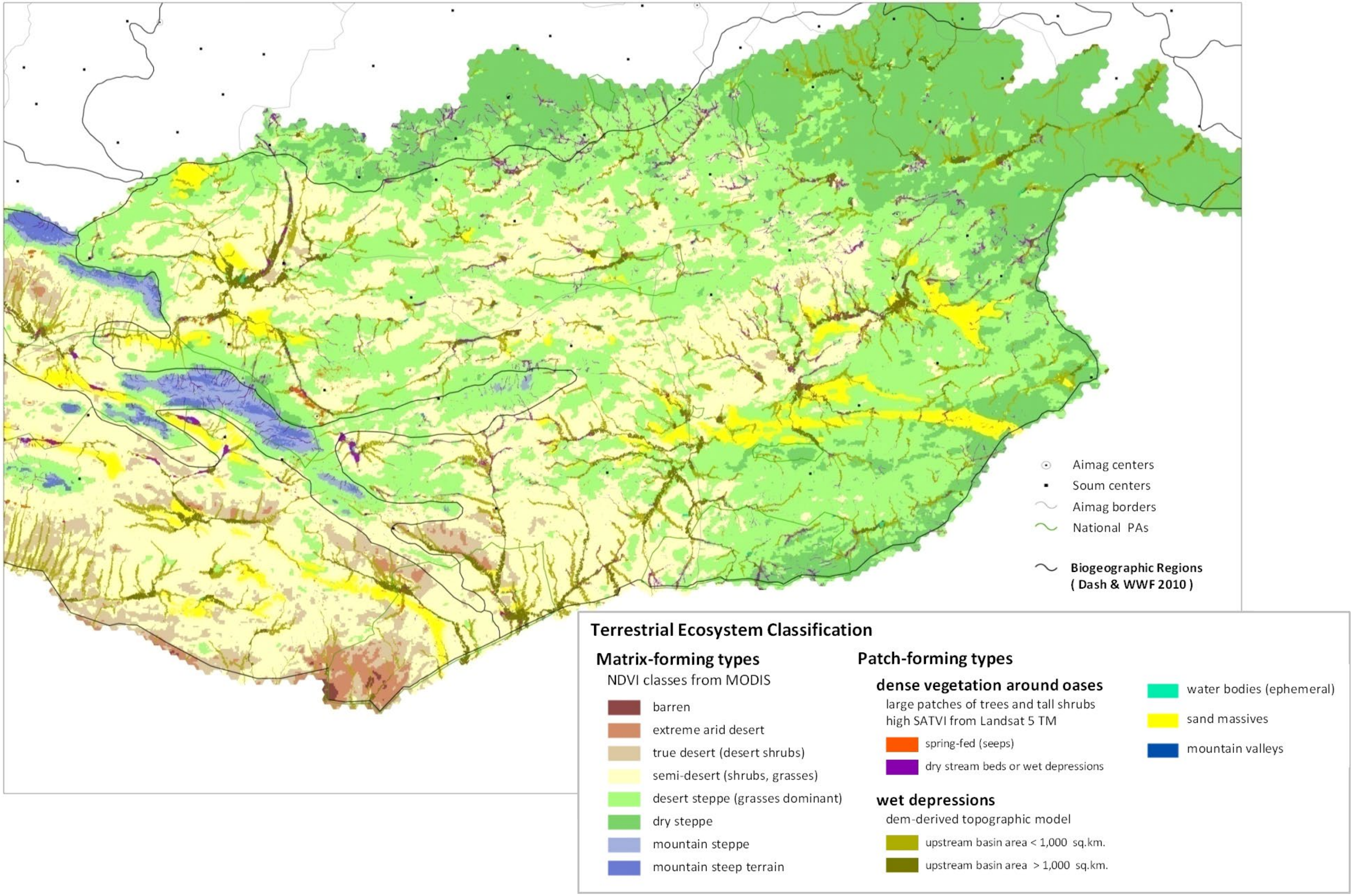


Figure 7c: Terrestrial Ecosystem Classification - detail showing patch-forming ecosystem types. The classification approach, mapping methods and source data are described in section 2.2.1. Ecosystem types are described in Appendix 1.

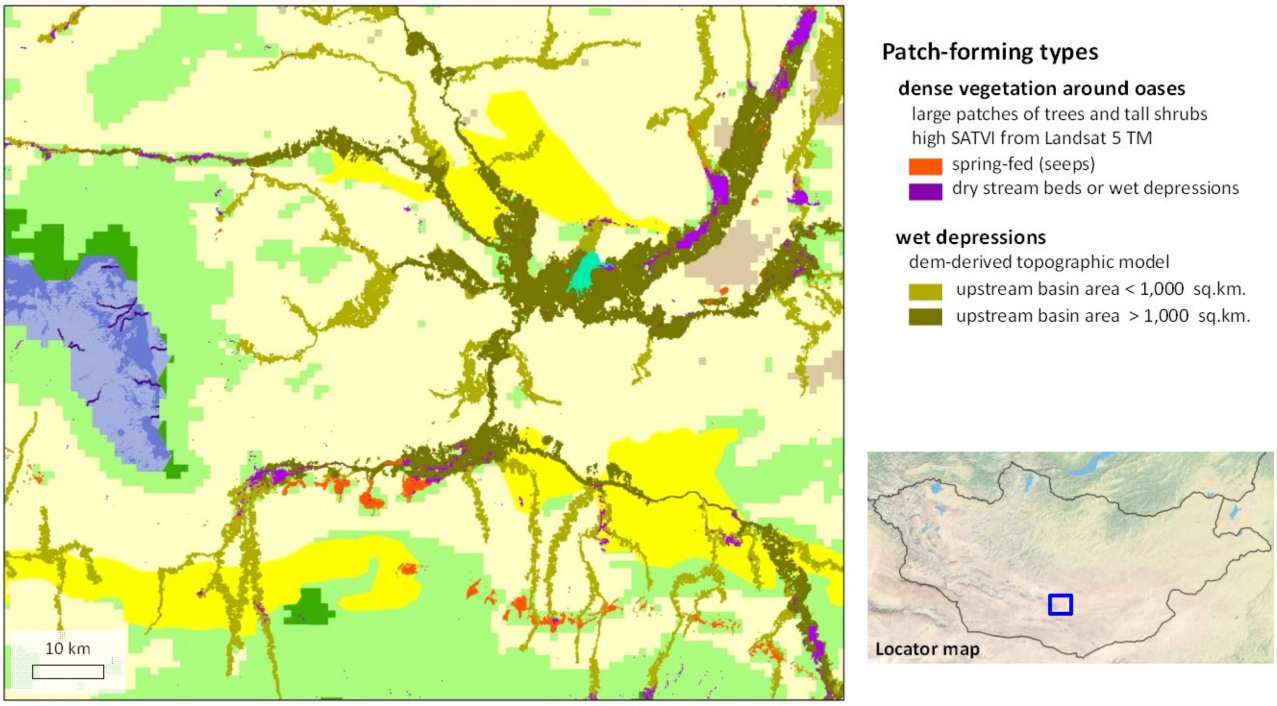
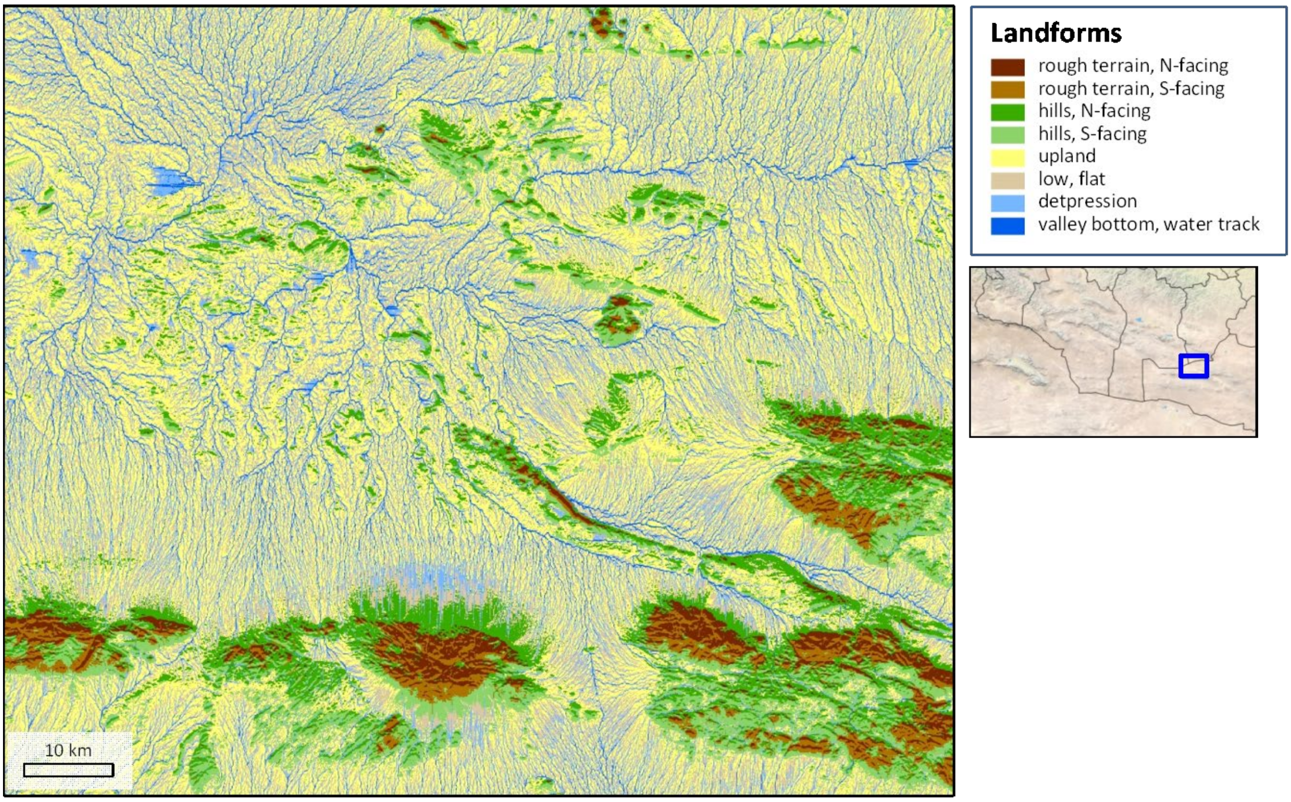


Figure 8: Landform classification based on cluster analysis of three DEM-derived topographic indices. The result defines and maps 8 landform types characteristic of the Gobi region. We used this 1) to stratify matrix-forming ecosystem types and 2) in the focal species distribution models.



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Appendix F: Stakeholder engagement and consultation

This document describes the process of stakeholder engagement and consultation for the Mongolian Gobi Desert conservation plan. This process was replicated in the landscape-level conservation plans developed for the Khangai and Khuvsgul regions, and also the Mongol Altai Mountains, Great Lakes Depression, and Lakes Valley, documented in detail in the assessment reports for the Khangai and Khuvsgul regions, available online: https://tnc.box.com/s/ympw8nfjnaycwqci187rt5g22urp5rsz,
and for the Mongol Altai Mountains, Great Lakes Depression, and Lakes Valley, available online: https://tnc.box.com/s/8mac7zz1r5xxp3ekz8rhoiuqhkkwdkqo

Parts of the following are reproduced from:
The Nature Conservancy Mongolia Country Program. (2013). Identifying conservation priorities in the face of future development: Applying development by design in the Mongolian Gobi Desert. The Nature Conservancy. Ulanbaatar. Available online: https://www.nature.org/media/smart-development/development-by-design-gobi-english.pdf

On October 24, 2011, the joint order A-358/235/282/120 was passed by the Minister for Nature, Environment and Tourism; Minister for Mineral Resources and Energy; Minister for Road, Transportation, Construction, and Urban Development; and Director for National Development and Innovation Committee to form a working group to establish a Development by Design approach for the South Gobi region of Mongolia. Following the joint order, the process of stakeholder engagement and consultation began with an assessment of experts and stakeholders at the national level and in the region. Based on this assessment, two working groups were formed to advise and review the planning process and implementation. The science advisory group consisted of biologists and geographers from academia, government agencies, and conservation NGOs with expert knowledge of the study area and available data. The policy working group consisted of officers in national and provincial (aimag) government agencies with knowledge and expertise in law, policy, and implementation strategy. The stakeholder consultation effort was managed by a full time stakeholder relations coordinator.

The names and affiliations of the working group members have been published previously in the report for Mongolian Gobi Desert Regional Conservation Plan (Heiner et al., 2013), available online:
https://www.nature.org/media/smart-development/development-by-design-gobi-english.pdf

Advisory working groups and Provincial Stakeholders: members designated by Minister's Order and schedule of activities
Working group leader: D. Enkhbat, Director, Department of Environment and Natural Resources, Ministry of Environment and Tourism (MNET).
Secretary: G. Erdenebayasgalan, Senior officer, Department of Environment and Natural Resources, MNET.

Science advisory working group established by Minister's Order
R. Gankhuyag, Head, Administration of Land Affairs and Urban Development, Department of Land Affairs, Construction, Geodesy and Cartography, MRTCUD.
D. Dash, Scientific-secretary of Geo-ecological Institute, MAS.
L. Amgalan, Scientist, Mammal laboratory, Biological Institute, MAS.
N. Tseveenmyadag, Head, Ornithological Laboratory, Biological Institute, MAS.
A. Khaulenbek, Scientist, Geo-ecological Institute, MAS.
D. Zumberelmaa, Scientist, Botanical Institute, MAS.
B. Oyungerel, Scientist, Geographical Institute, MAS.
S. Amgalanbaatar, Scientist, Mammal laboratory, Biological Institute, MAS.
O. Batkhishig, Head, Soil Laboratory, Geographic Institute, MAS.
S. Tsedendash, Head, Pastoral and fodder studies department, Animal Husbandry Research Institute
G. Davaa, Head, Water studies division, Meteorological Institute.
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M. Munkhbaatar, Head, Zoology and Ecology faculty, School of Natural Science, Mongolian State University of Education.

Ya. Gombosuren, Professor, School of Mining Engineering, Science and Technology University of Mongolia.

M. Altanbagana, Head, Environmental Policy Division, National Development Institute.

R. Battumur, Ground water researcher.

B. Lkhagvasuren, Director, WWF-Mongolia.

D. Sanjmyatav, GIS specialist, WWF-Mongolia.

L. Bolor-Erdene, Specialist, Mercy Corps-Mongolia.

L. Ochirkhuyag, GIS specialist, WCS.

Sabine Schmidt, Director, New Zealand Natural Institute-Mongolia.

J. Oyunsuvd, Environmental manager, Oyu Tolgoi project.

Yu. Bayarjargal, Project Manager, Development by Design for Southern Gobi Eco-regions project, TNC/Mongolia.

G. Munkhzul, Stakeholder Relations Coordinator, Development by Design for Southern Gobi Eco- regions project, TNC/Mongolia.

Science advisory working group meetings

1. October 7, 2011: Kick off meeting and first working group session. Establish Terms of Reference.
2. February 17, 2012: Establish study area and focal biodiversity elements.
3. March 20, 2012: Review data development workplan.
4. June, 07, 2012: Midterm review meeting: progress report, review data processing and analysis.
5. October 5, 2012: Review draft results of ecoregional assessment.
6. January 9, 2013: Review conservation portfolio and designated additional sites based on expert knowledge.
7. March 13-21, 2013 (three meetings): Form editorial committee, review and edit draft ERA report.

Policy advisory working group established by Minister's Order

B. Dolgor, Senior Advisor to the Prime Minister of Mongolia.

D. Myagmarsuren, Advisor, Standing Committee on Environment, Food and Agriculture, Parliament of Mongolia.

P. Zorigtbaatar, Senior Officer, Cabinet Secretariat, Government of Mongolia.

Ts. Banzragch, Director, Sustainable Development and Strategic Planning Department, MNET.

D. Munkhbaatar, Deputy Director, Urban Development and Land Relations Policy Department, Ministry of Road, Transportation, Construction and Urban Development.

Ch. Tsogtbaatar, Deputy Director, Mining and Heavy Industry Policy Department, Ministry of Mineral Resources and Energy (MMRE).

N. Boldkhuu, Deputy Director, Oil Policy Department, MMRE.

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T. Zuunnast, Senior officer, Mining and Heavy Industry Policy Department, MMRE.

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D. Munkhzorig, Manager of Health, Safety and Environment, Energy Resources LLC.
L. Baigal, Executive Director, Responsible Mining Initiative for Sustainable Development .
Ts. Tuyatsetseg, Deputy Director, Association of Environmental Lawyers.
D. Galbadrakh, Conservation Director, TNC/Mongolia.

Policy advisory working group meetings

1. October 7, 2011: Kick off meeting and first working group session. Establish Terms of Reference.
2. November 7, 2011: review policy and legal framework necessary for implementing mitigation hierarchy.
3. June 07, 2012: Midterm review meeting: progress report, discuss implementation mechanism including offsets.
4. March, 12, 2013: Progress report: draft results, final review process.

Provincial (Aimag) stakeholder outreach

Government representatives from Department of Nature, Environment and Tourism, Department of Land Affair, Constructions and Urban Development,s and Department of Policy Implementation of the seven Aimags in the study area were invited to all the major meetings in Ulaanbaatar. The seven Aimags are: Khovd, Gobi-Altay, Bayankhongor, Omnogovi, Ovorkhangai, Dundgovi, Dornogovi.

The project team travelled to four Aimags for stakeholder engagement meetings to introduce the project goals and discuss cooperation to integrate the ecoregional assessment into Aimag land use planning.

- Dornogobi Aimag, March 26-29, 2012 (Development Investment Conference)
- Dundgobi Aimag, April 24, 2012 Department of Nature, Environment and Tourism, and the Land Affairs, Construction and Urban Development Office. 43 participants including the governors, vice-governors and officials from the province soums.
- Umnugobi Aimag, April 27, 2012 39 participants including the specialists and the nature inspectors of the Department of Nature, Environment and Tourism, and the Land Affairs, Construction and Urban Development.
- Gobi-Altay Aimag, November, 2012 54 attendances for the meeting, including the staff of ANET, rangers, environmental inspectors, and the staff of Land Administration of the province.

Capacity building: The project team organized two GIS trainings for Aimag land use planning staff, which were attended by staff from all seven Aimags.

- Beijing, China, 18-22 December, 2011, at ESRI GIS training center.
- Ulaanbaatar, 19-21 September, 2012, at NUM Geology and Geography School.

National capacity building: The spatial datasets produced by all four assessments are publicly available online in a national spatial data archive that includes the portfolio sites, biophysical ecosystem classifications and components, and the disturbance indexes and components. URL:
https://tnc.app.box.com/s/zpdldhezvqrjpqz9c3t0wsrxwoc88mke

This national spatial data archive was compiled and made publicly available as part of a larger capacity building project directed by the MEGDT and funded by the EBRD through Contract No: C30074/EBSF-2012-08-107, “Capacity building for Mongolian Ministry of Environment Green Development, and Tourism (MEGDT) in relation to biodiversity and conservation in the southern Gobi Desert." This project included the following major tasks:

A. Development of a Mitigation Design Tool (see Supporting Information section 4)
B. Landscape modeling and connectivity analysis: Modeling habitat connectivity of a nomadic migrant facing rapid infrastructure development: Khulan habitat connectivity in the Southeast Gobi Region, Mongolia.
C. Training to support assessment of regional soil conditions in the mineralized zones of the Gobi Desert.
D. Assessment of alternatives and logistical constraints on regional traffic.

Reports are available online:
https://www.conservationgateway.org/ConservationByGeography/AsiaPacific/mongolia/Pages/southerngobi-ebrd.aspx

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