Barashkova A., Smelansky I., Kirilyuk V., Naidenko S., Antonevich A., Gritsina M., Zhumabai Uulu K., Koshkin M., Battogtokh N., Otgonbayar B., Grachev A. & Lissovsky A. 2019. Distribution and status of the Pallas's cat in Central Asia and adjacent areas. Cat News Special Issue 13, 14–23. Supporting Online Material.

Recent studies of the manul

Not less than 30 projects especially devoted to the investigation of manul distribution, number, ecology and behaviour have been conducted in the region since 1990s (SOM T1, SOM F1).

SOM T1. Information on manul projects implemented in Central Asia and adjacent areas since 1990s.

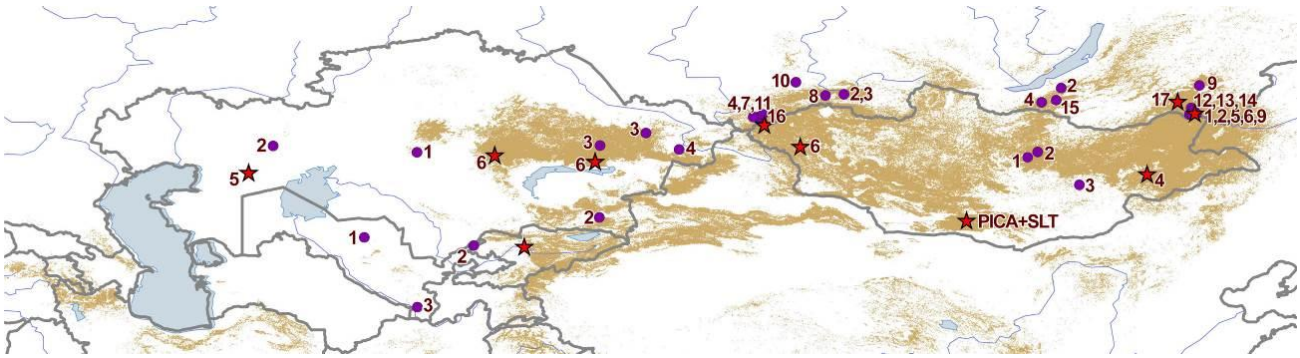
№	Period	Project name	Financing	Leader(s) / Organisation	Main achievements
Kazakhstan					
1	2009–2010	Clarifying conservation status of Pallas's cat in Kazakhstan	Rufford Foundation	Anna Barashkova / Sibecocenter	Reconnaissance research throughout Kazakhstan. Some data on past and modern Pallas's cat number and distribution and threats obtained. Spatial GIS database created. Educational posters on Pallas's cat distributed among local people (Barashkova 2010, 2011a; Barashkova et al. 2010a)
2	2011–2012	Creating a base for monitoring of Pallas's cat in Kazakhstan	Rufford Foundation, SWCCF, EARAZA Project	Anna Barashkova / Sibecocenter	First camera trap research in Kazakhstan (Aktobe and Almaty province). Analysis of distribution of manul in connection with distribution of main potential prey species and suitable habitats. Information on presence of manul in protected areas obtained (Barashkova & Smelansky 2012).
3	2013–2014	Pallas's cat in Kazakhstan: from investigation to conservation	Rufford Foundation	Anna Barashkova / Sibecocenter	Camera trap data on manul in eastern Kazakhstan obtained, data on threats updated (Barashkova et al. 2014).
4	2014–2016	Pallas's cat conservation status in the Zaissan Lake area - covering blanks	MbZSCF	Anna Barashkova / Sibecocenter	Presence of manul confirmed in most eastern Kazakhstan, in South Altai, and in low hills to the west of Zaissan Lake (Barashkova et al. 2015, 2016; Barashkova & Smelansky 2017).
5	2016–current	Study of distribution of felidae species on the Ustyurt plateau	ACBK, PICA	Ilya Smelansky / Sibecocenter	Camera trapping in western Kazakhstan, but no confirmation of presence of manul (Smelansky et al. 2017).
6	2017–2018	Pallas's cat in Kazakhstan: from investigation to conservation - Phase 2	Rufford Foundation	Anna Barashkova / Sibecocenter	Investigated new areas in the Central Kazakhstan (Karaganda province). Northern Balkhash Lake area was considered as place of great importance for the manul in Kazakhstan. Created a MaxEnt distribution model (Barashkova 2018).

№	Period	Project name	Financing	Leader(s) / Organisation	Main achievements
			Kyrgyzstan		
1	2017–2018	Clarifying conservation status of Pallas's cat in Kyrgyzstan	MbZSCF, PICA	Anna Barashkova, Maria Gritsina / PCWG	First special research of species distribution in Kyrgyzstan (interviews, camera trapping in western and central parts). The species presence confirmed for the first time in the western part of the country; data from interviews and camera trapping of other wildlife entered into national database on manul (Barashkova & Gritsina 2018).
			Mongolia		
1	2000–2001	Ecology and behavior of Pallas's cat in Mongolia	Ohio State University SOAR program and Alumni Society, Columbus Zoo and Aquarium, Cincinnati Zoo & Botanical Garden, Wild About Cats, Woodland Park Zoological Gardens, and Disney's Animal Kingdom	Meredith Brown & Bariushaa Munkhtsog / Cincinnati Zoo, Michigan State University & Mongolian Academy of Science	First study of ecology and behaviour, biomedical parameters of wild manuls in Mongolia (Altanbulag, Central Mongolia). Discovered that wild manuls are minimally exposed to *T. gondii* in natural habitat and are only infected with this parasite when brought into captivity (Brown et al. 2005). First investigation of home ranges of manuls in Mongolia (Munkhtsog et al. 2004).
2	2005–2007	Providing an ecological basis for the conservation of the Pallas's cat (PhD)	Leverhulme Trust, Panthera/Wildlife Conservation Society Kaplan Award, the Royal Zoological Society of Scotland, Royal Geographic Society, Small Cat Conservation Alliance, Dulverton Trust, Cincinnati Zoo and Botanical Gardens	Steve Ross	First comprehensive ecological study of manul. Home range size found to depend on year, season, sex, and habitat configuration. Data on habitat selection patterns, effects of competition and intra-species interactions, diet and feeding plasticity, mortality, seasonal body mass, reproduction and survival rates and other ecological traits obtained (Ross et al. 2010a, b, 2012).
3	2006	Evaluating the Impacts of Carnivore Hunting in the Grassland and Semi-Desert Steppes of Mongolia	Denver Zoological Foundation, Rufford Foundation, Trust for Mutual Understanding, Small Cat Conservation Alliance	James Murdoch / Wildlife Conservation Research Unit, University of Oxford	Preliminary data on home ranges, diet and other ecological traits of carnivore species inhabiting Ikh-Nart Nature Reserve. Impacts of carnivore hunting evaluated (Murdoch et al. 2006).
4	2018-current	Breeding and none breeding habitat occupancy and movement of Pallas' cat: implication for conservation of wild cat. Manul education programme	Rufford Foundation	Buyandelger Suuri & Otgonbayar Baatargal / Institute of General and Experimental Biology, Mongolian Academy of Sciences	Occupancy survey in Sukhbaatar aimak, eastern Mongolia, revealing that 69% of habitat occupancy are associated with rocky areas (Buyandelger 2018, unpub. data).

№	Period	Project name	Financing	Leader(s) / Organisation	Main achievements
5	2018–current	Pallas' cat distribution and habitat suitability in Western Mongolia	MUSE, Panthera, University of Lausanne	Ibra Edoardo Monti, Francesco Rovero (supervisor) / Green Initiative	Aim of study: identification of manul habitats using camera traps and DEM (digital terrain model) data to improve conservation. The project implemented as part of a snow leopard programme.
			Russia		
1	1992–1997	Manul research in Trans-Baikal Area (Zabaikalsky Krai)	Federal budget, private donors	Vadim Kiriliuk / Daursky Biosphere Reserve	Data on distribution and abundance, habitat preferences and diet in Russian Dauria obtained (Kirilyuk 1999; Kirilyuk & Puzansky 2000)
2	2004–2005	Save the manul: initial step.	GGF	Anna Barashkova / Sibecocenter	Special programme on manul research and conservation initiated. Website SaveManul http://savemanul.org created. Reviews of status of Pallas' cat in Russia and Kazakhstan, measures needed for conservation of the species prepared (Barashkova 2005). Information and organisational basis for long-term programme for study and conservation of manul in the wild created.
3	2005–2006	Monitoring of animal species listed in the Red Book of Russia in the Republic of Tuva: manul	Regional budget	Ubsunurskaya Kotlovina Biosphere Reserve, Tyva State University	Data on distribution and abundance of the manul and threats in Tyva Republic summarised; increase in both concluded (Anonymous 2006).
4	2006–2007	Pallas' s cat: investigation for saving (Clarifying conservation status in Russia)	PTES	Anna Barashkova / Sibecocenter	First special census of manul conducted in Republics of Altai and Buryatia, hot spots of the species in Russia identified (Naidenko et al. 2007, Barashkova et al. 2008, 2010b).
5	2006–2010	Radiotelemetry research in Daursky reserve		Vadim Kirilyuk / Daursky Biosphere Reserve	Preliminary data on habitat use, sizes of home ranges and dispersal of manul in Russia (Barashkova & Kirilyuk 2011; unpub. data).
6	2008–2010	Study of Pallas's cat ecology and behavior in wild	Explorers Club, Daursky Bioshpere Reserve	Alina Baranova & Aldar Dambain; V. Kirilyuk & T. Tkachuk (supervisors)	Data on maternal behaviour (activity patterns, home range, number and development of cubs) in Daursky reserve (Dambain et al. 2011)
7	2009–2010	Pallas's cat in Altai mountain area; update of conservation status	Panthera Foundation	Anna Barashkova / Sibecocenter	Repeated snow-tracking census in Altai Republic, number estimation, specifying threats and educational campaign (Barashkova et al. 2010b, Barashkova & Smelansky 2011).

№	Period	Project name	Financing	Leader(s) / Organisation	Main achievements
8	2010–2011	Base for Pallas's cat populations monitoring in Tyva Republic and adjacent territories	Panthera Foundation	Anna Barashkova / Sibecocenter	Winter snow-tracking, density estimation, interviewing of locals, and hot spots evaluation in Tyva Republic (Barashkova 2011bc, 2012).
9	2010–2011, 2016	Estimation of number and main factors influencing population status of Pallas's cat in Zabaikalsky Krai	UNDP/GEF Project "Improving the coverage and management efficiency of protected areas in the steppe biome of Russia"	Vadim Kirilyuk / Daursky Biosphere Reserve	Repeatedly in 5-year period data on number and distribution, threats in Russian Dauria were obtained through snow-tracking census and interviewing (Kirilyuk & Barashkova 2011, 2016ab).
10	2012–2013	Wild Cats of South Siberia	Russian Geographic Society	Sayano-Shushensky Biosphere Reserve, Khakassky Nature Reserve	Unknown
11	2012–2014	Pallas's cat monitoring in Altai Republic	SWCCF, EARAZA Project, GGF, Altai Project, Biosphere Expedition	Anna Barashkova / Sibecocenter	Special camera trap research in Altai Republic (Barashkova & Smelansky 2016). Online database on small wild cats in Eurasia (http://wildcats.wildlifemonitoring.ru) created (Barashkova 2016).
12	2013–2014	Pallas's Cat conservation in Trans-Baikal Area	Russian Geographic Society	Vadim Kirilyuk / Daursky Biosphere Reserve, Severtsov Institute of Ecology and Evolution	Data on distribution, biology and threats of the Pallas's cat.
13	2014–2016	Ecological background and factor risk of pathogen infections in felines inhabiting extreme areas (Pallas's cat as example)	Russian Foundation for Basic Research	Sergey Naidenko / Severtsov Institute of Ecology and Evolution, Daursky Reserve	Seroprevalence to 15 pathogens estimated for Pallas's cat and sympatric domestic cats (Naidenko et al. 2014, Pavlova et al. 2015, 2016)
14	2015–2016	Comparative estimation of physiological indicators of infection resistance in felidae	Russian Foundation for Basic Research	Sergey Naidenko / Severtsov Institute of Ecology and Evolution, Daursky Reserve	The innate immune response in Pallas's cat was less than in domestic and Amur cats. Home range of Pallas's cat may be up to 450 km² (S. Naidenko, pers. comm.).

№	Period	Project name	Financing	Leader(s) / Organisation	Main achievements
15	2016–2017	Study of manul in the Altachei Wildlife Refuge, Buryatia Republic	Baikalsky Reserve (in the frames of scientific programme)	Eugenia Shelest / Baikalsky Reserve	Manul presence confirmed in the Altachei Wildlife Refuge and its vicinity (Shelest & Khidekel 2016, Shelest 2018).
16	2016–2018	Monitoring of the manul in Sailugem National Park and adjacent areas	PICA, SWCCF, Rufford Foundation, Sailughem NP	Anna Barashkova / Sibecocenter, Sailughem National Park	Started the monitoring of species in the Sailughem ridge using camera trapping.
17	2017–current	Study and conservation of snow leopard and other rare animals in Eastern Siberia	No data	Snow Leopard Fund - Irkutsk	Camera trap data on manul in Trans-Baikal area obtained.
			Uzbekistan		
1	2013–2015	Specification of the status of the Pallas's cat and sand cat in Central Kyzylkum desert (Uzbekistan)	MbZSCF	Maria Gritsina / Institute of Zoology, Academy of Science of Uzbekistan	Camera trapping and interview survey did not confirm the presence of the manul in Central Uzbekistan (outcrops of Central Kyzylkum Desert; Gritsina et al. 2015).
2	2015–2016	Specification of the status of the Pallas's cat (*Otocolobus manul*) in Uzbekistan	Rufford Foundation	Maria Gritsina / Institute of Zoology, Academy of Science of Uzbekistan	Camera trapping and interview survey did not confirm presence of manul in east of country. In western Tien Shan and western Gissar-Alai Mountains only C3 data obtained (Gritsina et al. 2016).
3	2016–2017	Specification of the status of the Pallas's cat (*Otocolobus manul)* in the south of Uzbekistan	PICA	Maria Gritsina / Institute of Zoology, Academy of Science of Uzbekistan	Camera trapping and interview survey did not confirm presence of manul in the south of country – in the spurs of Gissar-Alai Ridge (Gritsina et al. 2017).
			Range-wide		
1	2016–2019	Conservation of the Pallas's cat through capacity building, research, and global planning	Segre Foundation	Emma Nygren & David Barclay / PICA	First global strategy for Pallas's cat conservation developed with key species specialists; increased financing and field project support, education and global awareness. Camera trap data on manul summarised in collaboration with Snow Leopard Trust (PICA+SLT).



SOM F1. Map of projects (violet circles – completed, red stars – ongoing). Projects are numbered per country (№ in SOM T1).

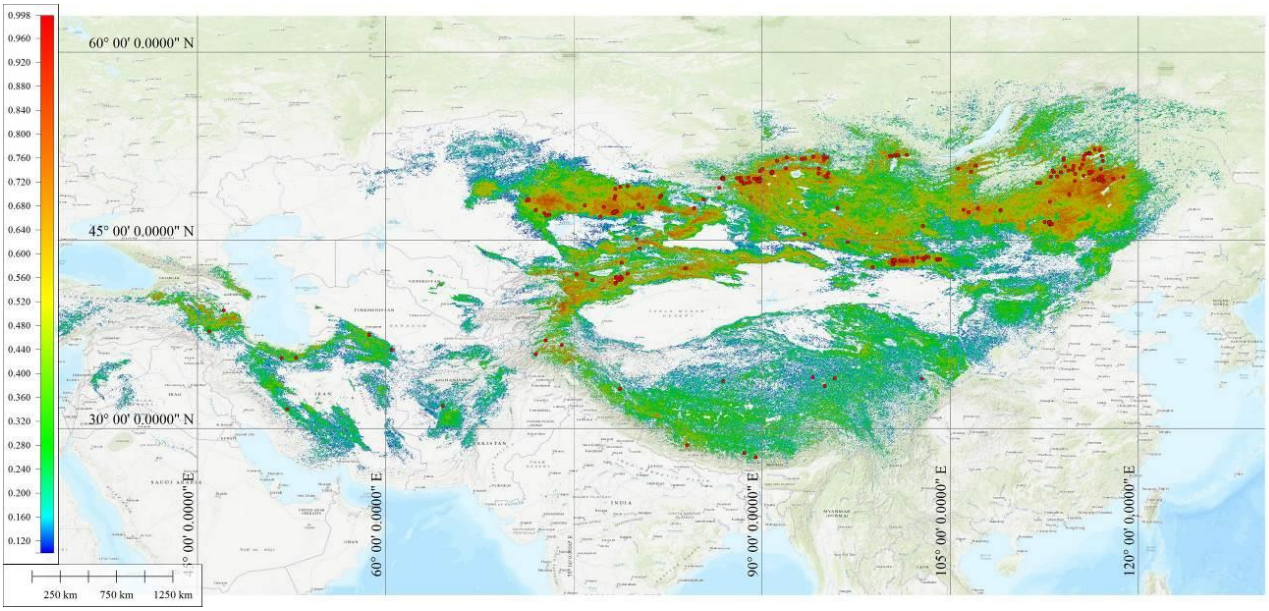
Methods: Mapping of potentially suitable habitats

Mapping of potentially suitable habitats for manul was performed using MaxEnt 3.3.3k (Phillips et al. 2006, Phillips & Dudik 2008) on the basis of analysis of three kinds of spatial data as well as a set of records with accurate geographical coordinates (data source described under Methods of the article). The major data set (377 records) represented observations mainly from Russian territory. Additional records (232) were taken from positive camera trap locations across Kazakhstan, Kyrgyzstan, Mongolia and Russia. The spatial distribution of the whole data set (609 records) was neither random nor homogenous. For example, two distribution patches in Altai Mountains and Trans-Baikal region in Russia were studied with incomparably higher density of observation efforts than other parts of the range. In order to smooth the distribution of the records, we covered all the manul range with a 50 x 50 km grid. After that, we selected randomly only one occurrence record per grid cell. Thus, the final dataset used in the analysis contained 398 records (SOM F2).

Since observation efforts in looking for the manul were not randomly distributed, using of random selection of background points for analysis may distort the results. Therefore, we prepared an additional layer for MaxEnt "bias file". We set the value 1 for each cell of this layer but the value 10 for the cells situated within 5 km buffer zones around all records and around locations of camera traps that did not register manul in the region.

The following environmental layers were used for modelling: (1) a remote survey from the Terra satellite's MODIS scanning system, 77 layers at a resolution of 500 m (http://glcfapp.glcf.umd.edu:8080/esdi/): 7 spectral bands for 11 subsequent months of 2004; (2) 19 "bioclimatic" variables hypothetically relevant to the distribution of biological objects (Hijmans et al. 2005; WorldClim data at a resolution of 30 minutes (>1 km); http://www.worldclim.org); (3) topographic data (altitude, slope gradient and curvature). All layers were converted to the same extent and grid cell of 0.02° in WGS84 longitude/latitude projection. Raster processing was done in Scanex Image Processor v.4.2.14. Mapping was performed using Mapinfo 11.0.

The resulted area of suitable habitats was obviously larger than the real confirmed manul distribution (SOM F2). We applied maximum training sensitivity plus specificity logistic threshold (Liu et al. 2013) and our expert data on the manul presence in the northern periphery (see Methods in Chapter 3) to remove extra territory (see Fig. 1 in Chapter 3). Resulted distribution was similar to our expert evaluation.



SOM F2. Spatial distribution of suitable habitats (red = well suited) for the manul from MaxEnt analysis. No threshold applied. Records used in the analyses are shown as red dots.

Historical distribution

Kazakhstan

Heptner & Sludskii (1972) and Sludskii (1973, 1982) reviewed the distribution of Pallas's cat in Kazakhstan. This detailed review represented the situation in the 1940 and 50s and was based mainly on fur trade data (i.e. number of harvested skins by province). The species was considered to be widely distributed from the Caspian Sea in the west to the Lake Markakol in the east and north from the Kazakh highlands to the republic's border on the south. These and other (Zaletaev 1976) authors reported the Pallas's cat as a rare species in western Kazakhstan namely occurring on Manghyshlak (now Manghystau) Peninsula, on cliffs of the Ustyurt plateau, in the middle Emba river and Mugodzhary hills. In the south the presence of the species was speculated to occur in small outcrops situated in the Kyzylkum Desert and the Karatau Mountains. In south-eastern Kazakhstan, it was rarely harvested in Chu-Ili Mountains, mountains of Trans-Ili Alatau (=Ile Alatau), Terskei Alatau, Dzungarian Alatau (also known as Jongar Alatau) and Ketmen ranges, Arganaty and Kzyl-Torgai erosion hills, and in the Saikan Mountains. In the north-east, the Pallas's cat was found in the South Altai, Tarbagatai, and Saur mountain ranges. The species was considered to be common in the Shynghystau range and relatively frequent in the central Kazakhstan highlands.

Uzbekistan

Heptner & Sludskii (1972) and Ishunin (1961) reported the presence of manul in south-eastern Uzbekistan in the upper Surkhandarya River valley near Saryassiya and in south-western spurs of the Ghissar Range, Baisuntau and Kughitangtau Mountains near Shirabad. They suggested that the species also inhabits the northern and western foothills of Zeravshan and Turkestan Ranges, namely Aktau, Karatau, Malguzar, and Nuratau Mountains, but no confirmed records existed. They speculated that the species inhabits the outcrop massifs of Bukantau, Tamdytau, and Kuljuktau situated in the Kyzylkum desert between Amudarya and Syrdarya rivers, and also in the Sultanuizdag Mountains east of the Amudarya Delta. Mitropolsky (1979) and Lesnyak et al. (1984) reported occasional skins brought to Bukhara for the fur industry from the area of Shirabad and Saryassiya and from the outcrops of the mountains near the Kyzylkum Desert. The Pallas's cat was also reported from the Karakalpakstan part of the Ustyurt Plateau: from both cliffs (*chink*s) and inselbergs of the southern and western Ustyurt as well as from the Kaplankyr cliffs (Heptner 1956,

Ishunin 1961, Sapzhenkov 1961, Heptner & Sludskii 1972, Lesnyak et al. 1984). With the exception of the Central Kyzylkum Desert, these areas are situated along international borders with Turkmenistan, Kazakhstan, Tajikistan, and Afghanistan. Mitropolsky (2005) reported the capture of a Pallas's cat by hunting dogs in the Keles River valley (foothills of the Western Tien Shan) in 1980, but no evidence of this finding has been preserved.

Population number

SOM T2. Estimations of Pallas's cat population numbers for several specific provinces (sub-regions) in the region published since 2000.

Area / sub-region	Area of estimation (km^2)	Population number	Density (ind./100 km^2)	Basic data came from	Year	Reference
Dauria (Trans-Baikal Territory, Russia and adjacent part of Mongolian Dauria)	63,500	2,400–3,000	3.8–4.7	Expert estimation	Late 1990s	Kirilyuk & Puzansky 2000
Dauria (Trans-Baikal Territory, Russia)	58,000	13,750	23.7	Snow-tracking, expert estimation	2010	Kirilyuk & Barashkova 2011a
Dauria (Trans-Baikal Territory, Russia)	58,000	4,000–5,000	6.9–8.6	Snow-tracking, expert estimation	2016	Kirilyuk & Barashkova 2016a
Buryatia Republic, Russia	1,500	200–280	13.3–18.7	Snow-tracking, expert estimation	2007	Barashkova et al. 2008
Kosh-Agach District of Altai Republic, Russia	3,500	650–680	18.6–19.4	Snow-tracking, expert estimation	2009	Barashkova & Smelansky 2011
Tyva Republic, Russia	27,000	2,200	8.2	Snow-tracking, survey, expert estimation	2006	Anonymous 2006
Tyva Republic, Russia	37,000	4,300–5,800	11.6–15.7	Snow-tracking, survey, expert estimation	2011	Barashkova 2011c, 2012

Habitats of minor types

In addition to the two main types of habitats that are discussed in the habitat section (a-type and b-type; SOM F3.1– 3.3) of the article, we recognise five more minor types (c–g) in the region. These habitat types are not rare throughout the whole region, but manul occupies them only in the eastern part of the region:

(c) Flat or gently rolling hill plains (SOM F3.4) covered with grassy steppe vegetation, lacking rocks (crevasses), but shelters provided by burrows of marmots, corsac foxes, or badgers, or humans (ruined and abandoned structures, abandoned agricultural machinery, etc.);
(d) Large clearings and forest edges in pine and/or larch woodlands (SOM F3.5), covered with steppe-like grasslands, located on river terraces or on slopes and low mountains;
(e) High-mountain areas with permafrost (SOM F 3.6), covered with cryophytic steppe, *Cobresia* grasslands, or various montane tundra types, often located on steep slopes and sharp ridges but also on rolling hills of highland plateaus;
(f) Sand dunes landscapes (SOM F3.7) with sparse vegetation of sand desert or psammophytic steppe located on watersheds or large terraces of rivers or lakes;
(g) Flat bottoms of wide valleys covered with steppe shrubs and wetland shrubs (SOM F3.8).

Occurrence records of the (c) type are typical for the easternmost part of the manul range, including the Daurian steppe in Russia, Mongolia, and China (Kirilyuk & Puzansky 2000, Kirilyuk 2012, Kirilyuk & Barashkova 2011, Barashkova et al. 2017). To the west, such habitats remain common, but the manul, as far as we know, does not occupy them. In some regions, the species uses this habitat type even if highly degraded due to heavy overgrazing (even down to bare soil), as long as prey remains sufficiently abundant (SOM F4.1–4.4).

Habitats of the (d) type are used by manul mainly in the forest-steppe region of Trans-Baikal area – in Buryatia (Barashkova et al. 2008, Medvedev 2007, 2010) and occasionally in Dauria (Barashkova et al. 2017), and probably in northern Mongolia (Litvinov & Bazardorzh 1992). Shnitnikov (1934) referred to anonymous reports of manul inhabiting the spruce woodlands of Ile Alatau Mountains, but there is no recent confirmation. We assume that the reference does not apply to forest habitats as such, but rather to the altitude level of spruce, where the landscape pattern includes not only forest but also steppe grassland on southern slopes, and canyons with rocks and scree.

The (e) type is typically connected to high mountains in Southern Siberia, like Altai and Sayan, highlands of Tibet and Tien Shan (Heptner & Sludskii 1972, Medvedev 2010, Barashkova & Smelansky 2011, Toropova 2006, Barashkova 2017). Probably this type is more important as transit habitat for cats moving between other habitats.

It is extremely uncommon for manul to occupy the (f) type. The only presence in such habitat has been documented in a limited area at the border between Tyva (Russia) and Mongolia (Barashkova 2012, Kuksin 2018). It can probably also be found in Mongolia. Further to the west, this type of habitat is broadly occupied by Asiatic wildcat, a species that is not found in Tyva and Mongolia.

The (g) type is known to be occupied in the east and northeast of the regional range, in Dauria, Buryatia, and Tyva (Russia), and northern Mongolia.

The (c) and (g) types play an important role particularly in Dauria, where manul often uses grassy steppes and steppe shrubs on low hill slopes and valley bottoms instead of rocky habitats on hilltops and in narrow ravines (Kirilyuk & Barashkova 2011).

3.1. Type (a). Desert steppe in Ayirtau Hills at average altitude 800 m, Central Kazakhstan Uplands, Karaganda Province, Kazakhstan (Photos I. Smelansky & A. Barashkova).


3.2. Type (a). True steppe in Adon Chelon Hills at average altitude 900 m, Dauria, Russia (Photos left I. Smelansky, right V. Kirilyuk).


3.3. Type (b). Montane dry steppe in the Taldura R. Valley at approximately 2,200-2,500 m altitude, North Chuya Ridge, Altai, Russia (Photos left I. Smelansky, right A. Barashkova)


3.4. Type (c). True grassy steppe on the terraces of the Borzya R. valley, Dauria, Russia. One of old abandoned pillboxes that manuls commonly use as shelters in the habitats of such type (Photos left Ilya Smelansky, right V. Kirilyuk).


3.5. Type (d). Pine forest contacting with meadow steppe, Buryatia, Russia (Photos left A. Barashkova, right courtesy presented by Yu. Kelberg).

3.6. Type (e). Mountain tundra at approximately 3,700 m altitude, Terskey Alatau, Kazakhstan/Kyrgyzstan border (Photo A. Grachev).

3.7. Type (f). Sand dunes covered with psammophythic dry and desert steppe along the Tes-Khem R. valley in Uvs Nuur Depression, Tyva, Russia. Track of manul on sand in the site (Photo A. Barashkova).

3.8. Type (g). Flat bottom of wide valley covered with large grass, steppe shrubs and wetland shrubs in Dauria, Russia (Photo A. Barashkova).

SOM F3. Common and occasional types of manul habitats in Central Asia and adjacent areas. For the habitat type definitions see the text above.

Prey

4.1. Mongolian pika *Ochotona pallasii* (Photo I. Smelansky).

4.2. Kazakh pika *Ochotona opaca* (Photo A. Lissovsky).

4.3. Flat-headed mountain vole *Alticola strelzowi* (Photo A. Barashkova)

4.4. Brandt's vole *Lasiopodomys brandti* (Photo B. Otgonbayar)

SOM F4. Some of the most important prey species for manul in the Central Asia and adjacent areas.

Conservation in protected areas

SOM T3. Representation of potential manul habitats and actual manul presence within protected areas in Russia and Kazakhstan (other countries not assessed so far).
Manul presence after 2000 means contemporary C1–C3 records of the species inside the protected area and/or its buffer zone.
PA portion – portion of the protected area occupied by (appropriate) manul habitats.
PAS portion – portion of the national predicted suitable area PAS located inside the protected area.
BR – Biosphere Reserve, NR – Strict Nature Reserve, NP – National Park, FWS – Federal Wildlife Sanctuary (Russia only), NaP – Nature Park, RWS – Regional (Provincial) Wildlife Sanctuary (Russia only), RZ – Reserve Zone (Kazakhstan only), WS – Wildlife Sanctuary (Kazakhstan only).

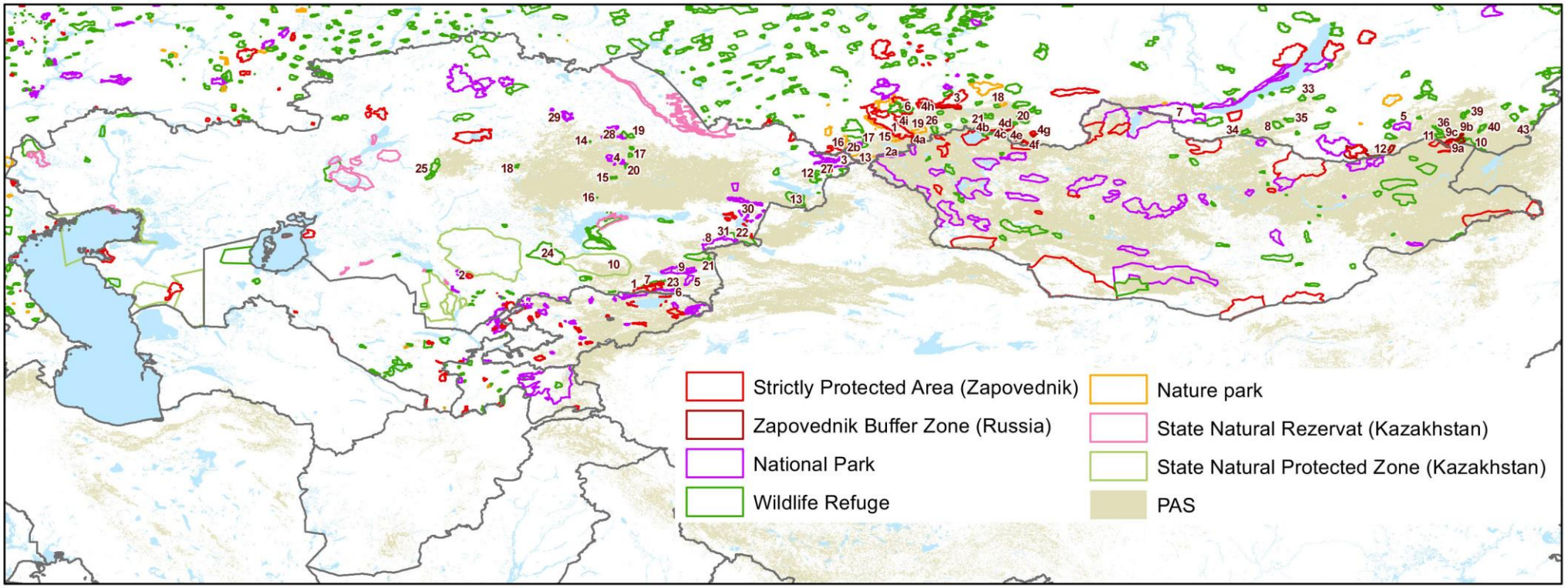
№	Protected area, site, type	Protected area size*, km^2	IUCN category	Manul presence after 2000	PA portion*, %	National PAS portion*, %
	Russia: Federal Protected Areas					
1	Altaisky BR	8,712.1	Ia	C1	7.5	0.23
2a	Sailyugemsky NP: Argut site	807.3	II	C1	57.2	0.26
2b	Sailyugemsky NP: Sailyugemsky and Ulandryk sites	376.5	II	C1	92.9	0.20
3	Sayano-Shushensky BR	3,903.7	Ia	C1	2.4	0.05
4a	Ubsunurskaya Kotlovina BR: Mongun-Taiga site	158.9 (1,015.1)	Ia	C1	64.8 (87.8)	0.06 (0.51)

4b	Ubsunurskaya Kotlovina BR: Uvs Nuur site	44.9 (130.4)	Ia	C2	70.2 (77.2)	0.02 (0.06)
4c	Ubsunurskaya Kotlovina BR: Oruku-Shynaa site	287.5 (638.4)	Ia	C3	77.0 (88.6)	0.13 (0.32)
4d	Ubsunurskaya Kotlovina BR: Aryskannyg site	150.0 (264.6)	Ia	C2	17.5 (53.2)	0.02 (0.08)
4e	Ubsunurskaya Kotlovina BR: Yamaalyg site	8.0 (54.5)	Ia	C1	91.3 (99.6)	<0.01 (0.03)
4f	Ubsunurskaya Kotlovina BR: Tsugeer Els site	49.0 (506.9)	Ia	C1	95.9 (85.5)	0.03 (0.25)
4g	Ubsunurskaya Kotlovina BR: Ular site	180 (405.4)	Ia	No data	63.7 (44.6)	0.07 (0.10)
4h	Ubsunurskaya Kotlovina BR: Khan-Deer site	1,129.2 (2,302.5)	Ia	No data	8.0 (14.1)	0.05 (0.19)
4i	Ubsunurskaya Kotlovina BR: Kara-Khol site	1224.5	Ia	No data	10.6	0.07
5	Alkhanai NP	1,382.3	II	No data**	20.9	0.17
6	Pozarym FWS	2537.4	IV	No data	1.3	0.02
7	Tunkinsky NP	11,836.6	II	C1	10.8	0.73
8	Altacheisky FWS	783.7	IV	C1	47.4	0.21
9a	Daursky BR: Toreisky, Imalkinsky, Chikhalan, Ereldzhi, and Kuku-Khodan sites	426.7 (1620.0)	Ia	C1	30.0 (70.7)	0.07 (0.65)
9b	Daursky BR: three sites at Adon-Chelon area	43.4 (155.5)	Ia	C1	100 (100)	0.03 (0.09)
9c	Daursky BR: Lesostepnoy site	3.0 (45.6)	Ia	C1	100 (97.1)	<0.01 (0.03)
10	Dzerens' valley FWS	2,138.4	IV	C1	93.4	1.14
11	Tsasucheisky Bor FWS	578.7	IV	C1	31.1	0.06
12	Sokhondinsky BR: buffer zone	(3,180.5)	Ia	C1	(39.3)	(0.71)
	Total for Federal PAs:	**36,779.6 (46,618.4)**			**21.4 (28.0)**	**4.49 (7.13)**
	Russia: Regional Protected Areas					
13	Ukok Quiet Zone NaP	2,542.0	V	No data**	60.1	0.87
14	Uch-Enmek NaP	811.2	V	No data	6.1	0.03
15	Ak-Cholushpa: NaP Kalbakaya site	789.5	V	C3	73.0	0.33
16	Belukha NaP	1,312.7	V	No data	28.1	0.21
17	Shavlinsky RWS	2,466.0	IV	C1	33.7	0.47
18	Tyva NaP: Taiga site	233.0	V	C3	10.7	0.01
19	Tyva NaP: Shui site	980.0	V	C1	68.2	0.38
20	Balgazynsky RWS	1500.0	IV	C3	48.2	0.41
21	Kaksky RWS	600.0	IV	C3	46.9	0.16
22	Ondumsky RWS	470.0	IV	C1	3.2	<0.01
23	Chaa-Kholsky RWS	200.0	IV	C3	41.5	0.05
24	Sut-Kholsky RWS	100.0	IV	No data	52.0	0.03
25	Chagytaisky RWS	53.5	IV	No data	37.4	0.01
26	Ayangatinsky RWS	510.0	IV	No data	80.9	0.24
27	Eerbeksky RWS	290.0	IV	C3	7.5	0.01
28	Khudaksky RWS	500.0	IV	No data	6.3	0.02
29	Sheminsky RWS	250.0	IV	No data	20.8	0.03
30	Durgensky RWS	350.7	IV	No data	10.8	0.02
31	Gagulskaya Kotlovina RWS	246.3	IV	No data	8.7	0.01
32	Tapsinsky RWS	1090.0	IV	No data	5.0	0.03

33	Angirsky RWS	403.8	IV	C3	21.0	0.05
34	Borgoysky RWS	421.8	IV	C2	95.4	0.23
35	Tugnuisky RWS	393.6	IV	C2	96.5	0.22
36	Aginskaya Steppe RWS	457.6	IV	C1	93.4	0.24
37	Argaleisky RWS	109.7	IV	No data	49.3	0.03
38	Gornaya Steppe RWS	52.7	IV	C2	64.1	0.02
39	Semenovsky RWS	476.2	IV	No data	56.5	0.15
40	Oldondinsky RWS	514.0	IV	C1	92.4	0.27
41	Borzinsky RWS	604.3	IV	No data	2.0	<0.01
42	Akshinsky RWS	665.4	IV	No data	20	0.08
43	Sredneargunsky RWS	2013.9	IV	No data	16.9	0.19
	Total for Regional PAs:	**21407.8**			**39.5**	**4.83**
	Total for Russia (12 Federal PAs and 31 Provincial PAs):	**58,187.4 (66,026.2)**			**28.1 (31.8)**	**9.32 (11.96)**
	Kazakhstan					
1	Almaty NR	717.0	Ia	C3	43.6	0.09
2	Karatau NR	343.0	Ia	No data	4.8	<0.01
3	Katon-Karagai NP	6,434.8	II	C1	5.2	0.10
4	Karkaraly NP	1121.2	II	C2	68.2	0.16
5	Charyn NP	1270.5	II	C1	65.0	0.18
6	Kolsai Kolderi NP	1,610.5	II	No data	53.5	0.26
7	Ile Alatau NP	1,986.7	II	No data	30.1	0.18
8	Jongar Alatau NP	3,560.2	II	C1	21.2	0.25
9	Altyn-Emel NP	3,076.5	II	C3	46.8	0.43
10	Jusandala RZ	27,775.0	Ib	C3	37.0	2.49
11	South-Kazakhstan RZ	62,580.0	Ib	No data	0.1	0.03
12	Ontustik-Altai WS	1,971.8	IV	C1	33.2	0.19
13	Tarbagatai WS	2,400.0	IV	C1	96.2	0.87
14	Belagash WS	15.0	IV	No data	59.4	<0.01
15	Kyzylaray WS	182.0	IV	No data	93.2	0.06
16	Bektauata WS	5.0	IV	C3	100.0	<0.01
17	Kuvsky WS	335.0	IV	No data	59.3	0.06
18	Karaagash WS	68.0	IV	No data	86.5	0.02
19	Kyzyltau WS	600.0	IV	No data	51.8	0.13
20	Beldeutas WS	466.6	IV	No data	69.6	0.03
21	Verhnekoksuisky WS	2,400.0	IV	No data	35.8	0.28
22	Toktinsky WS	1,870.0	IV	C3	72.3	0.47
23	Almaty WS	5,424.0	IV	C3	55.0	0.59
24	Andasai WS	10,000.0	IV	No data	1.2	0.03
25	Ulytau WS	193.0	IV	No data	62.2	0.04
26	Urochische Karakunuz WS	30.7	IV	No data	34.8	<0.01
27	Markakol NR	1,029.7	Ia	No data**	4.2	0.01
28	Bayanaul NP	684.5	II	No data**	47.6	0.09
29	Buyratau NP	889.7	II	No data**	22.0	0.06
30	Tarbagatai NP	1,435.50	II	No data**	25.3	0.13
31	Lepsinsky WS	2,580.00	IV	No data**	1.9	<0.01
	Total for Kazakhstan	**143,055.84**			**16.2**	**7.2**

* Data in parentheses represent the habitat area or percentage of potential habitat for the manul in the PA given together with its buffer zone (if any exist).

** Old (before 2000) C3 records are known: in Russia – from Alkhanai NP and Ukok Quiet Zone NaP, in Kazakhstan – from modern area of Markakol NR, Bayanaul NP, Buyratau NP, Tarbagatai NP, and Lepsinsky WS.



SOM F5. Map of protected areas on the background of predicted area of suitability for the manul (Numbers refer to № in SOM T3).

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