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MEMORANDUM OF UNDERSTANDING CONCERNING CONSERVATION, RESTORATION AND SUSTAINABLE USE OF THE SAIGA ANTELOPE

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THE SUSTAINABLE USE OF SAIGA ANTELOPES: PERSPECTIVES AND PROSPECTS

(Prepared by the Saiga Conservation Alliance on behalf of the CMS Secretariat)

Summary:

This draft report was prepared as a follow-up on the Joint CMS-CITES Technical Workshop under the Saiga MOU, which took place in April 2019 on the Isle of Vilm, Germany and produced a draft of the Medium-Term International Work Programme 2021-2025 for the Saiga Antelope. Measure 3.10 of the draft Work Programme calls for research to be undertaken on the feasibility, conditions and requirements for sustainable use of specific populations of Saiga Antelopes. In accordance with this measure, the present report provides a foundation for exploring the potential use of Saiga and defines the pre-conditions which need to be fulfilled to ensure that such use would be sustainable. All Saiga MOU Signatory States with extant populations of the Saiga Antelope have reviewed the report and provided their comments to the CMS Secretariat per email, which were included in the current version. Revision 1 was issued to correct translation mistakes in the Russian version of the document, as well as inconsistencies in the reference list, which were present in both language versions of the document.

Action requested:

- Review and endorse the document
- Use the report to inform decisions at the national and international levels to ensure the sustainability of Saiga use, if and when the use of the species becomes possible.

The Sustainable Use of Saiga Antelopes: Perspectives and Prospects

Photo: Valery Maleev

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Photo: Andrey Gilev

Executive Summary

0.1. Rationale for this report

The main international instrument for the conservation of the Saiga is the Memorandum of Understanding concerning the Conservation, Restoration and Sustainable Use of the Saiga Antelope (*Saiga spp*), the "saiga MOU". The long-term vision of the Saiga MOU, which all Range States and cooperating organizations have signed up to, is to restore Saiga populations to the point at which sustainable use can be envisioned.

This report was commissioned to provide a foundation for exploring the potential of sustainable use of the Saiga Antelope, and to define the pre-conditions which need to be fulfilled to ensure that such use would be sustainable in practice. It includes chapters on the theory of sustainable harvesting with application to Saiga, potential management structures for Saiga harvesting, population-specific considerations, a view from China as a major consumer nation and former Range State, and information on the international trade in Saiga products and its status under CITES. Throughout, we endeavour both to give detailed information specific to Saigas, but also to provide examples and lessons from other relevant species and geographies to provide the reader with ideas and concepts around sustainable wildlife use. Finally, we summarize the insights from the report and suggest ways forward.

Sustainable use, in the biological sense, is the use of a natural resource in such a way that it is maintained in the long term at a level that allows it to fulfil its role in the wider ecosystem. Sustainability more broadly has social, economic and ecological components; in order for the use of a natural resource to be sustainable, all three must be considered, because without one element the others will fail. This report focuses on consumptive use (i.e. hunting), as the most usual connotation of the term "sustainable use" in the Saiga context. However, sustainable use can be defined to include activities such as photo-tourism, or any other way of obtaining benefits from using Saigas in a non-consumptive way that does not threaten the population (and ideally enhances it).

The report was written collectively by experts from within the Saiga Range States and China, and by international experts. Authors have expertise in population dynamics, wildlife harvesting and wildlife trade. They also consulted with a wider group of colleagues, including individuals responsible for saiga conservation and management in Range State governments, members of academic institutions and NGOs. The intended audience for this report is all those interested in the conservation of Saigas around the world, from a range of organizations, but particularly those responsible for making decisions about Saiga management in Range State governments.

0.2. Insights from population theory and saiga ecology

Some key points from an examination of the literature on population theory and Saiga ecology, in respect to the potential for sustainable use, are:

Sustainable harvests allow long-term population stability, or growth, and may be achieved where harvests, plus other sources of loss from a population, do not exceed recruitment. The type of harvesting strategy used, the targeting of hunting on particular components of the population (by sex and age), and the timing of harvest, all have impacts on the amount of offtake that can be taken sustainably from a population.

Saigas are a highly productive species, capable of sustaining a high level of hunting mortality in good years, but they are vulnerable to weather-related fluctuations in recruitment, and to mass die-off events caused by *dzhuts* or by disease. *Rangifer tarandus*, *Caribou canadensis*, and *Alces alces* are three species with varying degrees of demographic similarity to Saigas, which are each subject to sustainable harvesting. In each case, harvest predominantly targets bulls and calves. The harvesting strategy involves ensuring that populations are only

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harvested if they are larger than a certain number. This allows sustainable harvest despite population fluctuations. Harvest quotas are calculated year-to-year.

Three mathematical models of Saiga harvesting exist in the published literature. These incorporate climatic stochasticity, but could be improved by incorporating disease, poaching, and sex-ratio bias. Furthermore, spatial data could be incorporated, to understand migration patterns and predict the effects of climate change into the future.

No harvest management can stand still; ongoing monitoring using appropriate methods must take place. This will ensure the incorporation of changing circumstances affecting Saiga ecology into annual harvest quotas as part of a broader adaptive management regime. Where monitoring produces inaccurate data, uncertainty should be explicitly incorporated into population models for sustainable harvest. The precautionary principle should be followed at all times.

0.3. Potential institutional structures for saiga harvesting

It is important to understand motivations for wildlife harvest, if a management regime is to be successful. Generally, motivations for wildlife hunting include: (1) subsistence hunting for food; (2) recreational and trophy hunting for pleasure; (3) commercial hunting for trade in wildlife products; (4) hunting for ecological management and scientific research; and (5) hunting as a consequence of human-wildlife conflict, to reduce the costs of wildlife for farmers.

Within these different reasons for hunting, wildlife may be managed to maximize: (1) profit; (2) volume of product; (3) social benefits; (4) conservation benefits. A combination of these goals is likely to be desired. Harvests are most likely to be sustainable, in the long-term, if financial, social, and biological considerations are met. To achieve such an outcome, both the state (at national and regional levels) and local communities, are likely to need to be involved, whether in co-management or not. The actual hunters may be: government operatives, for commercial or population management purposes; local people, for subsistence, commerce, or recreation; or international tourists, typically as trophy hunters.

Different case-studies for management of wildlife harvests are explored in our report, to illustrate the different combinations of motivations for hunting and institutional structures. These include cases where harvest has and has not been sustainable. In reference to saigas, motivations for harvest include access to horns for commercial trade, and to meat for local subsistence. Both activities are currently illegal. Sustainable harvests of saigas might permit rural development and provide revenue with which to reduce conflict with farmers. In particular, sustainable harvests may reduce poverty and increase employment within local communities, and so reduce poaching. Revenues may also be used for broader Saiga conservation actions and for vaccination and treatment of livestock, to avoid disease transmission between livestock and Saigas.

In principle, an offtake that represents a very low proportion of the population can be taken from even a small population without compromising sustainability, as shown in Section 2. This is particularly the case if the harvest is taken from a less reproductively valuable component of the population (e.g. adult males rather than adult females). The possibility for a certain level of hunting to be compatible with population growth is evidenced for Saigas by the fact that populations are currently growing, despite ongoing poaching removing an unknown proportion of the population. Therefore, if governments and local communities wanted to do it, biologically speaking a limited trophy or recreational harvest focused on males would not damage the recovery of Saiga populations so long as:

i) poaching was controlled so that the overall hunting mortality was at low levels,
ii) the sex ratio remained at levels allowing the maximum levels of fecundity,
iii) the effects of other biological factors such as disease, climate and barriers to movement were considered.

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There are precedents for such hunting systems being biologically sustainable over several years, including within Central Asia (see section 3). However, these examples relate to relatively sedentary species (therefore easier to monitor and control both the population and hunting) and without the Saiga's propensity for mass mortality. As well as the biological issues, the institutional, social and financial ramifications of legal hunting also need to be considered, and these are much less clear-cut. At present, governments are thinking in terms of large-scale hunts that take a substantial proportion of the population; enough to justify the considerable expense and effort of setting up the necessary institutions to manage that hunt in a secure and accountable way.

0.4. Population-specific considerations

In this section, we discuss in turn the status of Saigas in each Range State, and what this means for the potential for sustainable harvest in the near future. As wildlife management policy needs to be set at the national level, we focus at this level, but we also discuss the differences between individual populations and the potential management options for transboundary populations. Responsible institutions which currently contribute to Saiga management are generally state bodies, but NGOs are also involved in monitoring Saiga populations and contributing scientific and conservation expertise.

The general factors affecting Saigas are similar across the species' range; poaching, disease, infrastructure, weather and climate, and predation. However, each population has different circumstances, which affect whether it would be realistic to consider sustainable use at this time. The evidence laid out in Section 4 clearly shows that large-scale hunting cannot currently be contemplated for the Mongolian, Ustyurt and north-west Pre-Caspian populations. In the meantime, non-consumptive sustainable use (e.g. tourism) could be explored. With regard to the Ural population in Kazakhstan, the 2019 population of 217,000 would be large enough to sustain a meaningful level of offtake which could justify the expense of setting up hunting institutions. Sustainable use that provided benefits to people living within the population's range could improve prospects for co-habitation. The Betpak-Dala population is still substantially below the levels that it reached before the 2015 mass die-off but is recovering rapidly. It is conceivable that within the next five years it too could reach levels that would allow an economically feasible and biologically sustainable offtake. However, in both cases a set of pre-conditions needs to be met, including effective systems for hunting management, product traceability and stockpile management, before sustainable use would actually be possible.

0.5. Perspectives from China

In China, the Saiga became extinct in the mid-20th century due to land cover change and especially over-hunting. Future sustainable use of Saigas will rely on: Firstly, the establishment of self-sustaining populations of considerable size and healthy population structure (including a balanced sex ratio), in conservation breeding centres. Secondly, the establishment of free ranging populations in the former saiga range in China, for example, the Mt. Kalmaili nature reserve. To establish Saiga populations in China for conservation and restoration purposes, they need to be reintroduced from Range States. Thus, international cooperation on Saiga conservation is the first step. Probably when the saiga population in the wild in China increases to over 5,000, the Chinese Government may consider sustainable use as an option. Otherwise only the horns of those that have died naturally may be used, if safe for human consumption. It will also be important to consider the effects of trade in captive-bred Saigas on wild populations in China and the Range States, both in terms of the potential for stimulating or masking illegal harvests, and in terms of the effects on consumer demand (for example whether consumers have different preferences for wild or captive-bred individuals).

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0.6. CITES provisions for sustainable Saiga trade

All Saiga Range States have prohibited all commercial exports of Saiga specimens for over a decade, and consequently reported legal international trade in recent years has largely been between non-Range States in Asia. Much of it has been declared as originating from stockpiles comprising horns legally acquired before Range State export bans came into force. This trade has comprised only small volumes of horns and derivatives.

At the 18th meeting of the Conferences of Parties to CITES, Mongolia and the USA submitted a proposal to transfer *Saiga tatarica* from Appendix II to Appendix I of CITES. Parties agreed to an amended proposal whereby *Saiga tatarica* and *Saiga borealis* were maintained in Appendix II, with the following annotation for each species: "A zero export quota for wild specimens traded for commercial purposes". This new listing entered into force on 16 November 2019, and is legally binding upon CITES Parties. This amendment *de facto* bans the export for commercial purposes of all Saiga specimens of wild origin from Saiga Range States.

The amendment does not apply to the re-export of Saiga specimens, such as for example in the case of trade between non-Range States. Further exemptions from this listing are trade in specimens from captive-bred origin and trade in Saiga specimens for non-commercial purposes, for example hunting trophies. The export of specimens of captive-bred animals requires a CITES Certificate, issued by the Management Authority after verification. Changes to this listing require an amendment proposal from one or more CITES Parties to a meeting of the Conference of the Parties, that is supported by at least two thirds of the Parties present and having the right to vote.

Although Saiga Antelopes are not captive bred at a scale that would allow commercial offtake in the near future, any consideration of future trade in captive bred specimens of Saiga should consider the potential consequences for wild populations. This may include the effects of increased availability of Saiga products on market demand, or challenges for the implementation and enforcement of CITES (e.g. distinguishing horns of wild vs captive-bred origin, laundering of wild horns as captive bred specimens).

In addition, the CITES Secretariat is requested to consult with Saiga Range States and major trading and consumer states concerning their management of stockpiles of Saiga specimens; review processes and practices; and provide assistance in ensuring effective stockpile management and monitoring, including the development of inventories and strengthening stockpile security. Currently available information on stocks of Saiga specimens and their management in the different Range States, consumer and trading countries is incomplete and/or dated. This makes it difficult to ascertain the volumes of current legal stockpiles. Effective stockpile management and marking should enable authorities to clearly distinguish the different sources and origins of their stocks, and prevent illegal specimens being mixed with legal ones.

0.7. Main messages: biological considerations

There is substantial experience of setting harvesting rules for Saigas from Soviet times (section 3). These generally appeared to be successful, although there were issues with independent quotas being set by different Republics for the transboundary Ustyurt population, and concerns about overharvesting in some years and populations. There is also substantial experience of sustainable harvesting at relatively large scales for species that are somewhat similar to saigas (bearing in mind that saigas are biologically unique in a number of respects); also given in section 3. Population modelling has also explored sustainable harvesting rules for Saigas (section 2). All these sources of evidence suggest that a precautionary approach to setting a biologically sustainable harvest rule could involve:

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1) No mass-hunting of populations below 50 per cent of carrying capacity.
In recent years carrying capacity is likely to have changed substantially, due to changes in land use, barriers, climate change and forage productivity. These factors will continue to change and to affect the carrying capacity of Saiga habitat into the future. Therefore population-specific carrying capacities would need to be recalculated on a regular basis. However, a rough estimate of a population size below which mass harvesting should not be contemplated might be 200,000 individuals.

2) Harvesting to only take place in good years.
These would need to be defined, ideally with the use of a population model, but might include a summer/autumn juvenile to female ratio of around 1.2:1 and no evidence of major disease or poaching/illegal trade issues, favourable climate and a positive trend in the population compared to the previous year.

3) Harvest quotas to be calculated on an annual basis.
Although a population model would be useful back-up, there are robust approaches to setting quotas which are more suited to situations in which population estimates are uncertain and a precautionary approach is required. For example, the Potential Biological Removal approach set out in section 2 has proved very robust over years and for many different applications. Based on our biological knowledge of saigas and past experiences, a harvest quota of around 10 per cent of the pre-harvest population is likely to be sustainable given that rules 1) and 2) above have been applied.

4) Harvest composition to be biased towards the less productive components of the population
Adult females are the most productive components of any ungulate population. On the other hand, we know that harvests which are too male-biased can cause reproductive collapse in this species. It is hard to be selective when mass-harvesting but in general, saiga harvests should be biased towards young-of-the-year and males rather than reproductive females. However, the proportion of males in the post-harvest population should never go below 15 per cent.

5) Harvesting should only take place in autumn.
The best time to harvest both biologically and economically is when the young-of-the-year are old enough to be worthwhile to use, while not interfering with the reproductive cycle of the species. This means no harvest too close to the rut, or while females are pregnant, or calves are still dependent. The ideal time would be October, and this is when hunts took place in Soviet times.

6) Harvest quotas must be adjusted to reflect poaching rates
Total harvest numbers must include the number of saigas estimated to have been lost to poaching in a given year, in order that the total offtake does not exceed sustainable levels. Poaching rates can be estimated using data from anti-poaching patrols (e.g. using SMART technologies), from surveys of local residents, key informants, and by inference from population trends over time.

7) Adaptive management should be instituted.
Sustainable harvests can only be contemplated when backed up by rigorous and ongoing monitoring of the population's size, density, structure and vital rates, including disease surveillance and poaching monitoring. The information from this monitoring should be used in the following year's harvest quota calculations. If monitoring cannot be carried out in a given year, harvesting should not take place.

Abiding by these rules would produce a precautionary harvest system which would have a very low risk of leading to biological overharvesting.

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0.8. Main messages: social considerations

Evidence from around the world, including from previous Saiga harvests, shows that there is a range of feasible institutional structures for harvesting Saigas, depending on the government's management priorities. The types of harvesting these structures could support would include large-scale hunting for commercial purposes, smaller-scale hunting for local use only (meat and/or recreational), gathering of natural mortality horns, or hunting for trophies. The evidence does suggest a few key considerations for Saigas:

1) Local residents must feel positive towards saigas and sustainable use.

Use of a wide-ranging species in remote regions, such as Saigas, cannot be sustainable if local residents do not feel positive about the species and the harvesting regime. If they are not positive, then poaching and illegal trade will continue, and there will be no incentive to protect the species or its habitats (for example by limiting livestock numbers or leaving birth aggregations undisturbed, and not setting fire to grazing areas). Local administrations will come under pressure to approve activities that damage Saigas and their habitats (e.g. infrastructure sited in inappropriate locations, change of use of land from nature protection to grazing). Therefore, even if harvesting is carried out by national-level authorities, it is vitally important that local residents receive benefits, for example from employment in hunting organizations or permission to harvest saigas for their own consumption. It is also important that local and regional authorities are involved in Saiga management (including potentially photo-safari tourism).

2) Spatial structure must be accounted for.

Because of the wide-ranging and migratory nature of the species, unfairness can be introduced if only people within the areas where hunting takes place are able to benefit from that hunting. Therefore, some mechanism is needed that enables distribution of benefits to all those sharing saiga range. Many options are available to do this: One option might be to follow the model of Reindeer hunting in Norway, where each area's hunting association is provided with a quota. If a hunting association is in an area where Saigas are only present outside of the hunting season, they can trade their quota to an association within the Saiga's autumn range, or get permission to join the Saiga hunt wherever it takes place. Another option would be a benefit-sharing model, whereby the proceeds from hunting are shared between all the local authorities that host Saigas, pro rata according to the density of Saigas within their area divided by the amount of time spent there. This problem is likely to be much more acute for the very wide-ranging Betpak-Dala population than for the more constrained Ural population.

3) Cross-scale institutions will be required.

Models for hunting institutions around the world vary from very local and community-led to national-level and government-led. In the case of the Saiga, with its very large range, there has to be a major role for national-level (or at least Saiga population-level) authorities. This is unlike the case of the Torghar markhor project and more like the case of the USA's duck management approach. National authorities need to organize and fund monitoring, protection and quota-setting actions. Regional and local authorities need to carry out monitoring and protection on the ground and ensure compliance with hunting rules. Enforcement and controls would need to be strengthened and integrated across borders and between levels of national governments. The Saiga Range States already have hunting management structures of this type. However, it would be worthwhile for the Government of Kazakhstan to explore the potential of instituting a co-management regime, in which a range of stakeholder groups work together to manage hunting of Saigas. This has worked very well for Caribou management in Nunavut, Canada, and leads to more buy-in by local groups and residents, and therefore more compliance with rules and better outcomes. In the case of Saigas, local hunting associations would be particularly important to involve.

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0.9. Future perspectives

The newly instituted international regulations under CITES mean that it is currently not possible to export wild-sourced Saiga products such as horn (including products of natural mortality and live animals). In order to change the current CITES listing, a two-thirds majority will be required at a Conference of the Parties. To obtain this, Range States would need to prepare convincing non-detriment finding assessments and show that they have implemented appropriate safeguards (including effective population monitoring and adaptive management, stockpile management including marking and registration, strong enforcement). Therefore at least in the short to medium terms, it seems pointless to focus on horns for export as a major product from sustainable hunting. Instead, the main commodity from sustainable hunting is likely to be meat. Nonetheless if males are hunted or if natural mortality horns are gathered, there needs to be a system for disposing of, or stockpiling, horns in a secure way.

Given that saiga meat is most likely to be a locally-demanded product, this suggests that locally-organized or co-managed hunting for meat is likely to be both economically and socially the best model (given the caveats expressed above). However, there could be opportunities for improving the economic value from this product with high quality supply chain management and marketing. In Australia, there has been substantial investment in improving the value of kangaroo meat for local and national markets. Hides may also produce additional value.

Sport or trophy hunting has the advantage that it can provide relatively high levels of economic return for a very limited harvest, so it can be carried out sustainably even in small populations of conservation-dependent species. This has been demonstrated for markhor, and for very threatened populations such as the Mountain Nyala in Ethiopia. Therefore, in principle, small offtakes for sport or trophies could be biologically sustainable even for the smallest Saiga populations. However, the saiga is not, on first analysis, an excellent candidate for sport or trophy hunting. Firstly, its trophy is not of particularly high value, so the demand is likely to be low. Secondly, the remoteness and sparseness of the population, and its migratory nature, may make trophy hunting less logistically feasible. This means that the amount of money that could be obtained from sport or trophy hunting by tourists may be small. However, small-scale recreational hunting by local residents (as in Scandinavia) may be more feasible and may improve people's attitudes towards Saigas as a locally beneficial game species. More research would be needed before any conclusions could be drawn on the potential for trophy or recreational hunting; including attitude and willingness to pay surveys amongst potential hunters and local residents, and financial viability analyses.

0.10. Uncertainties and future research and policy needs

This report was compiled based on the best available information in the scientific literature, official reports and expert knowledge. However, it is not intended to give definitive answers to the questions surrounding sustainable use. Most importantly this is because decisions must be made by the governments and authorities responsible for saiga management. However, it is also because there are still substantial gaps in our knowledge that need to be filled in order to support any discussions about the future of sustainable use. These include:

1) The development of a comprehensive population dynamics model for each population, that can explore harvesting options.

This should include other drivers of Saiga population dynamics, including disease outbreaks and climate change, and may need to be spatially explicit. A management strategy evaluation (MSE) approach is likely to be useful, as is widely used to support sustainable fisheries management.

2) Exploration of the economic feasibility of different options for sustainable management.

This could include the exploration of financial models for harvesting, processing and sale of different Saiga products, as well as the costs and benefits of different institutional structures. There are no data available to explore these in this report, but visits to Australia and

Scandinavia to consult experts working in wildlife management (including the commercialization of wild meat products), and visits to small-scale recreational and trophy-hunting initiatives (such as in Pakistan and Tajikistan) would be worthwhile.

3) Consultation with local residents to understand their behaviour and perspectives.
This should include getting an understanding of the prevalence and drivers of Saiga poaching and consumption using modern indirect questioning methods. It should also include participatory exploration of local people's relationships with Saigas and preferences for receiving benefits from their presence (including alternative livelihood options as well as sustainable use). There is very extensive expertise on this topic within conservation science that can be drawn upon, and some work has been done on this for Saigas already.

4) Development of a plan for adaptive management at the population level.
This should draw on scientific evidence and include institutional as well as biological factors. So, for example, it could use a model to estimate population quotas, which change every year depending on circumstances. It would also require annual data collection to feed into the model, on threats and population dynamics. The plan would also include regular review of the institutional, social and economic functioning of Saiga management, and early warning triggers for intervention if, for example, there is a change in support for management (e.g. problems experienced by hunting associations). Help in setting up such a scheme could come from the waterfowl management authorities in the USA.

5) Deciding on a suitable legislative and regulatory structure
Governments would need to ensure that a suitable legislative and regulatory framework for managing sustainable hunting is in place, including stockpile management (see section 4.3 for a comprehensive assessment of the requirements). This could include an assessment of the requirements for institutional, administrative and enforcement capacity-building at national, regional and local levels. A consideration of the potential roles of different institutional structures for sustainable hunting (including state institutions at local, regional and national levels, private game management organisations, hunting associations, and wildlife management authorities) would also be useful.

6) Continued investment in ongoing monitoring of the system.
The monitoring and protection of saiga populations is getting better and more comprehensive, and more robust, over time. This will need to continue to improve in order to justify and support sustainable use. There should also be ongoing monitoring of social and governance aspects of the harvesting and trade systems, including equitable benefit sharing and local perceptions of saigas and of sustainable use, and of the effectiveness of trade controls.

7) Understanding and control of demand for saiga products
Saiga poaching for international trade will only be controlled when demand for illegal saiga products in consumer countries is controlled. Currently demand is high in some countries (e.g. Singapore), but there is very little knowledge about the level of demand in other countries, e.g. China. However, there are still large seizures and saiga products are still widely available online and in physical markets. There is also no understanding of how legal and illegal products might interact in consumer markets (e.g. would legal horn be seen as an inferior, superior or indistinguishable product). The potential for laundering and for demand either being reduced or exacerbated by legal products needs to be investigated.

8) Control of stockpiles in consumer countries
The lack of registration and control of stockpiles means that there is very little knowledge of how much new saiga horn is entering international trade. Unless the illegal horn trade is brought under control, poaching will continue to be a threat to all saiga populations. There will also be no prospect of a legal international horn trade under CITES. Unfortunately, this is

something that Range State governments have little control over, and instead governments of consumer countries must tackle, with the support of international NGOs.

8) Investigation of the potential for non-consumptive sustainable uses.
We were not able to assess the potential of other sustainable uses in this report. However,tourism in particular has potential. Tourism in general is being heavily promoted in some parts of the Saiga's range (e.g. Uzbekistan). Saiga-focussed international tourist trips have been piloted in both Kazakhstan and Russia. The infrastructure for international tourism is not fully developed in the Saiga range areas, and travel to see saigas may be challenging in some parts of the range. However, nature-based tourists are more likely to be prepared to accept rougher conditions in order to see rare and unusual species. There is the potential to link Saiga tourism to other attractions such as cultural sites and bird-watching. It can also generate and support local enterprises such as craft-making, guiding, and homestays.

0.11. Concluding remarks

In this report, we hope to have provided a comprehensive overview of the prospects for sustainable use of the Saiga Antelope via hunting. Given the very wide-ranging nature of the topics covered, this report can only provide brief coverage of each area. However, we hope that it gives a robust foundation for future discussions, which will support the conservation and restoration of this unique, special, and important species.

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List of abbreviations

ACBK - Association for the Conservation of Biodiversity of Kazakhstan

CAC - Communal Area Conservancies

CAMI - Central Asian Mammal Initiative

CFW - Committee for Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan.

CITES – The Convention on International Trade in Endangered Species of Wild Fauna and Flora

CMS - The Convention on Migratory Species

DSD - Department of Sustainable Development

FFI - Fauna & Flora International

FZS - Frankfurt Zoological Society

HTO - Hunters and Trappers Organization

IBM - Individual Based Model

IUCN - International Union for Conservation of Nature

MOU - Memorandum of Understanding concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope

MTIWP - Medium Term International Work Programme for the Saiga Antelope 2021-2025

NDF - Non-Detriment Finding

NGO - Non-Governmental Organization

NWMB - Nunavut Wildlife Management Board

PBR - Potential Biological Removal

SCA - Saiga Conservation Alliance

TCMA - Traditional Chinese Medicine Association

TCP - Torghar Conservation Programme

USFWS - The United States Fish and Wildlife Service

WCS Mongolia - Wildlife Conservation Society Mongolia

WMA - Wildlife Management Area

WWF - World Wildlife Fund

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1. Introduction

(Lead authors: E.J. Milner-Gulland, Saiga Conservation Alliance & University of Oxford and Steffen Zuther, FZS)

In this introductory section we set out the context for this report. This includes a brief outline of the saiga's status and trends and the international conservation actions for the species. We then focus in on the Memorandum of Understanding on Saiga Conservation, Restoration and Sustainable Use of Saiga Antelopes (*Saiga spp*.) under the Convention on Migratory Species (the Saiga MOU), as the major international agreement on the species. Finally, we discuss the rationale for preparing a report on sustainable use, within this context, and briefly outline its content and the process by which it was written.

1.1. Background to the report

Photo: Valery Maleev

The Saiga Antelope

The Saiga Antelope *Saiga spp.* a migratory or nomadic herding ungulate, is found in the semiarid rangelands of Eurasia; in Kazakhstan, Uzbekistan, the Russian Federation (henceforward Russia) and Mongolia. There are also semi-captive populations in Ukraine and China, both of which were Range States for the species in recent historical times (as recently as the 1950s, in the case of China; Cui et al. 2017). The Saiga is about the size of a domestic goat and is a sandy colour with a pale belly in the summer. In the winter it develops a heavy, creamy coloured coat. The males have horns which are an unusual translucent amber colour. The species' most striking feature is a protuberant nose, which swells further in rutting males.

Since its first scientific description by Pallas in 1767 (Figure.1.1), the Saiga has been difficult to classify. Macdonald (1984) places it with the Tibetan Antelope *Pantholops hodgsoni* in tribe Saigini of subfamily Caprinae, but states that it probably belongs with the Antilopinae. Gentry (1992) places it in tribe Antilopini of subfamily Antilopinae, and states that it is only remotely related to *Pantholops*.

There are two species recognized by international conventions; *S. tatarica*, in Kazakhstan, Uzbekistan and Russia, and *S. borealis* in Mongolia. Other authors, including IUCN, regard them as subspecies of *S. tatarica*, with *S.t. tatarica* in Russia, Kazakhstan and Uzbekistan, and *S.t. mongolica* in Mongolia. Both were probably present in China (Cui et al. 2017). In this report we will adhere to the taxonomy accepted by the Convention on Migratory Species (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), using two separate species, which are morphologically and genetically distinct from each other, with different sizes of head and horns (Lushchekina & Dulamtseren, 1997; Kholodova et al. 2006).

***Figure 1.1**. Plate showing* Saiga tatarica *from Pallas (1767), in which he described the species and gave it its Latin binomial.*

There are four populations of *S. tatarica*. Three of these are predominately in Kazakhstan, the fourth in the north-west Pre-Caspian region of Russia. The Kazakhstan populations currently make up more than 90 per cent of total numbers. The three populations primarily found in Kazakhstan are the Betpak-Dala population in central Kazakhstan (individuals of which occasionally cross into Russia), the Ural population which is found in north-west Kazakhstan and is transboundary with Russia, and the Ustyurt population in south-western Kazakhstan, transboundary with Uzbekistan.

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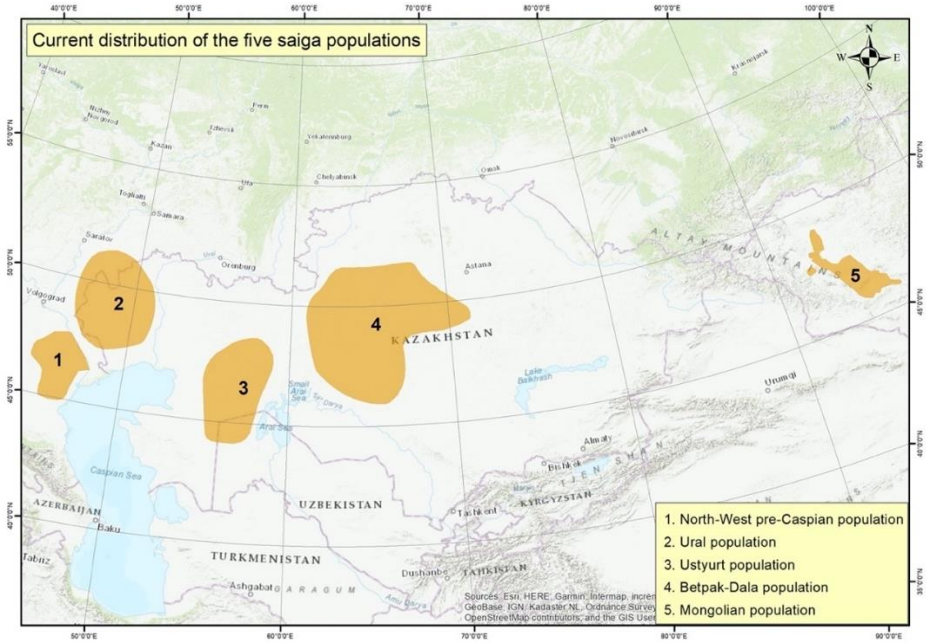

***Figure 1.2**. Distribution of the five Saiga populations. From the left, these are: (1) North-west Pre-Caspian population; (2) the Ural population; (3) the Ustyurt population; (4) the Betpak-Dala population; and (5) the Mongolian population. Figure provided by A. Salemgareyev.*

A brief overview of Saiga hunting

Since prehistoric times, Saiga have been hunted by humans for meat, hides and horns. Saiga are depicted in Neolithic cave paintings, while large-scale Saiga hunting structures from centuries ago are visible in satellite imagery of the Uzbekistan steppe (Yagodin & Amirov, 2014). Records of the use of Saiga horn for medicine can be traced back to Shennong's *Materia Medica* 2000 years ago, and it also appeared in the *Materia Medica* published in the 16th century (Cui et al. 2017). It was therefore subject to continuous exploitation from prehistoric times right up to the present day, for meat and hides for local use and for horns for Chinese traditional medicine, apparently without causing serious harm to the species. Saigas have also been an important part of the culture of the region from prehistoric times to the present day (see *Figure 1.3* for examples).

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Figure 1.3. *Top L-R.: A Saiga skull amulet from Uzbekistan Photo: A.Esipov. The White Old Man of the Steppe: Kalmykia.net. Pictograms of Saigas from Kazakhstan Photos: Steffen Zuther & Aline Kühl-Stenzel*

In the 19th and early 20th century, Saiga hunting was widespread within the Russian Empire, and large quantities of horn were exported to China, recorded in detail by officials in border forts such as Orenburg (presently on the Russia-West Kazakhstan border). This hunting led to drastic declines in the populations, such that by the time of the Soviet Union the species was very much depleted, down perhaps to a few thousand individuals in isolated groups (Box 1.1).

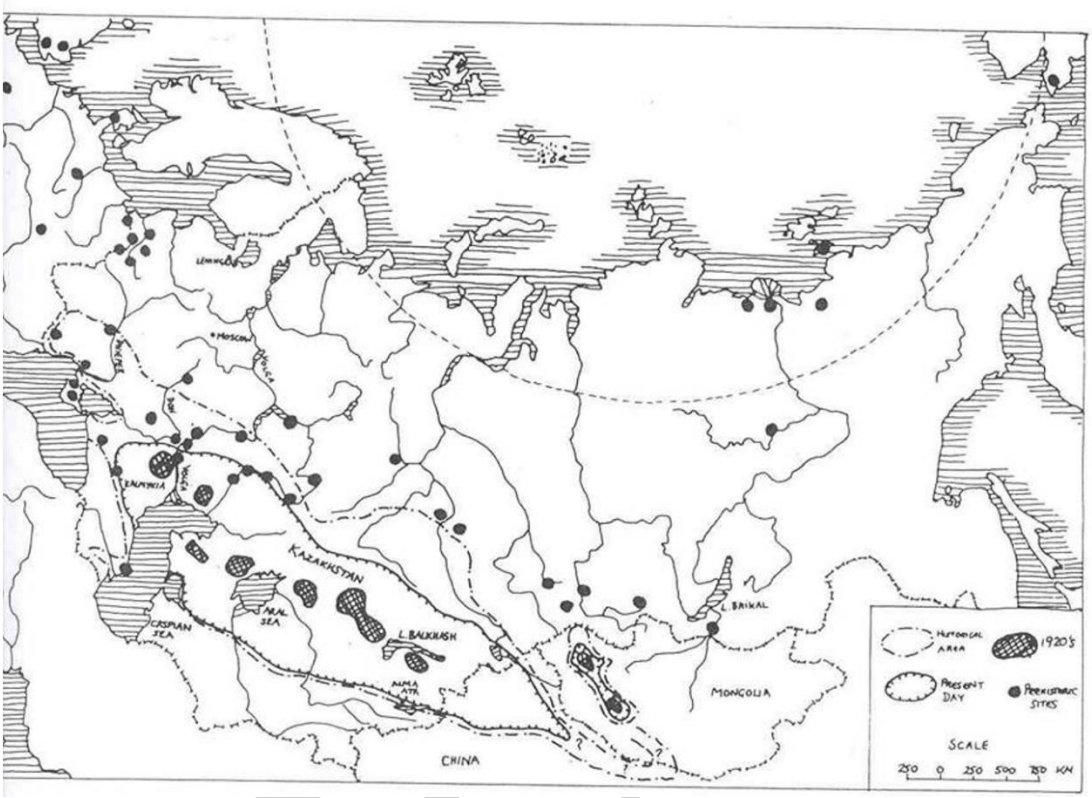

Figure 1.4. *Range of the Saiga Antelope from prehistoric times (black dots), to the historical (1600s) range (dot-dashed), to the 1920s (hatching) and the range in the 1990s, before the major post-Soviet decline. Redrawn from Bannikov et al. (1961).*

Box 1.1. *Quotes from contemporary authors highlighting the intense export-driven hunting for saigas in the 19th and 20th centuries.*

Pishchevich 1884: "in the lands of the Cossacks, there were so many Saigas that in places their herds covered the whole steppe."

66,500 pairs of horns passed through the Kyrgyzstan-Chinese border in 1855, only 2,000 in 1862. (Meyer 1865)

Morden (1927): "the mail carriers were held up and robbed so frequently [for Saiga horns] that the department had finally refused to take them."

Nazarov (1932): "Now the Saiga is on the verge of extinction, as it is mercilessly persecuted for the horns, which will fetch as much as forty or fifty guineas a pair"

Goodwin (1937) (after Harper,1945): "These animals are rather rigorously protected by the Soviet Government.

In the first decades of the Soviet Union, the species recovered rapidly thanks to border controls, the limitation of firearm possession by local people, the emptying of the steppe due to collectivization, and strong law enforcement. Once it had recovered to large numbers in the 1950s-60s, it was subject to a well organized hunting system, which was controlled by state institutions (Bekenov et al., 1998, Sokolov & Zhirnov, 1998). A certain percentage of all Saiga populations was hunted every year in autumn for their meat, horns and hides. Eating Saiga meat was very common throughout the distribution range. An annual aerial survey was used to establish the size of Saiga populations, in some years even twice a year, combined with ground observations to get a basis for the identification of hunting quotas. Up to about 400,000 animals were killed per hunting season. This system caused fluctuations in population size which were sometimes substantial but it was never a threat to the existence of any of the populations.

With the collapse of the Soviet Union, the strict hunting control system became dysfunctional. Illegal hunting began to gain momentum. The reasons for this were the absolute impoverishment of the rural population and the partial collapse of animal husbandry and the resulting food shortages. Saigas were present in very large numbers and this, alongside a steep price rise for Saiga horns and their meat, made them attractive targets. These factors, combined with a state monopoly on the use and international trade in certain huntable species, weakening border control mechanisms, loss of funding for wildlife management, and weak governance at all levels, lead to flourishing illegal trade. This meant a rapid and unchecked decline in saiga numbers.

From the mid-1990s until the mid-2000s, the species was very heavily exploited, predominately illegally, for horns for export for use in Traditional Chinese Medicine and for meat for relatively local sale and consumption. In that time, the global population of the species declined by more than 90 per cent in <10 years, causing it to jump from Near Threatened to Critically Endangered status on the IUCN Red List. This may be the most precipitous decline ever recorded for a mammal. Conservation actions kicked in from around 2005, after which the status of the species has generally improved.

Poaching is still a major threat to all saiga populations face today. The poachers are often local people aiming to get some extra income and food, but also organised poachers only killing male saiga to cut off their horns. The latter can kill many animals and seriously skew the sex ratio, potentially affecting the reproductive capacity of the population. All this poaching became attractive through a network of illegal traders selling the saiga horn to Asia. The construction of linear infrastructure across saiga habitat is a second, serious threat, limiting the Saiga distribution range and cutting animals off from important habitats, which are needed in the harsh climatic conditions they live in. Furthermore, diseases can wipe out significant portions of saiga populations, which was last observed in 2015, when 88 per cent of the Betpak-Dala population in Kazakhstan died in just a few weeks. While the first two threats can be influenced by humans, the last one seems to naturally occur without anthropogenic causes, apart from a potential impact of climate change.

More detail about saiga population dynamics and the threats faced by each population is set out in sections 2 and 4 of this report. Trends in Saiga populations, and the threats which the species and its individual populations face, are also described in detail in the various Overview Reports on Conservation Status and MOU implementation; the most recent of these is being prepared for the fourth meeting of the Signatories to the MOU concerning conservation, restoration and sustainable use of the Saiga Antelope, scheduled for 2021. All the Overview Reports published to date can be found on the CMS Saiga Memorandum of Understanding's website (https://www.cms.int/saiga/en).

The Saiga is currently still listed as Critically Endangered on the IUCN Red List, although in 2018 the species' status assessment was changed to reflect that it no longer meets the criteria

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for Critically Endangered (IUCN-SSC ASG 2018[1]). It will remain at Critically Endangered until 2023, however, because of the five-year lag period for down-listing which recognizes that these species are still in a precarious position and their status may worsen. Therefore, if the species still does not meet the criteria for Critically Endangered in 2023, it will be moved to the appropriate category at that point (currently assessed as Endangered based on observed, estimated and predicted declines of >50 per cent over ten years/ three generations). The Mongolian species has been separately assessed as Endangered on the same criteria. Both species are listed on Appendix II of the CMS and on Appendix II of CITES; see section 6.1.

The Saiga MOU: International cooperation on Saiga conservation

The main international instrument for the conservation of the Saiga is the Memorandum of Understanding concerning the Conservation, Restoration and Sustainable Use of the Saiga Antelope (*Saiga spp*)[2]. This MOU is an agreement between the Saiga Range States which was developed under CMS and it came into force in 2006 when the first 3 countries signed up on it. The MOU is legally non-binding and is now signed by all of the Range States. CITES cooperates with the CMS to support the implementation of the MOU. Coordination support for implementing the MOU is delegated by CMS to the Saiga Conservation Alliance and the Association for the Conservation of Biodiversity of Kazakhstan, by agreement of the Signatories. There are also Cooperating Organizations which signed up to engage with the MOU, provide input as needed and support the MOU implementation; these are predominately NGOs, and currently number nine organizations. As a former Range State, China is not a Signatory to the MOU, but is closely involved with the MOU and attends meetings as an observer.

The MOU has a Medium-Term International Work Programme (MTIWP), which aims to provide a road map to guide the implementation of conservation action for the Saiga Antelope, including sustainable use and trade[3]. The MTIWP is agreed by all the Signatories to the MOU every five years, with the next Meeting of the Signatories taking place in 2021, to agree the MTIWP for 2021-2025. The long-term vision of the current MTIWP is: *to restore Saiga populations to the point that sustainable use can again be envisioned*. Its overall goal is: *That all Saiga populations show an increasing trend or their decline is halted over the next five years.*

The MTIWP is divided into sections, which cover the priority areas requiring Saiga conservation actions. In the 2016-2020 MTIWP, the range-wide measures are grouped under: implementation of the MOU, anti-poaching, sustainable use and trade, work with local people, awareness, habitat and environmental factors, protected areas, monitoring, and captive breeding. The MTIWP has also population-specific measures, that list priority actions for each of the populations. Each action is rated according to its urgency and time needs: [*Urgency*: Urgent (crucial for preventing population extirpation). 2 - Important (necessary for stabilization of numbers). 3 - Useful (will contribute to population restoration). *Timescale*: A - Immediate (1-2 years). B - Medium-term (5 years)]

When the Signatories to the MOU meet to approve the next MTIWP, they review National Reports in which the Range States provide information on the status of their Saiga populations and the actions they undertook to support the MOU over the previous five years, reports on activities from Cooperating Organizations, and an Overview Report, which gives a summary of the status of the species and the implementation of the MTIWP based on information from the submitted reports and from other reliable sources. The Overview Report[4] is approved by

[1] http://www.iucnredlist.org/details/19832/0
[2] https://www.cms.int/saiga/en
[3] https://www.cms.int/saiga/sites/default/files/document/unep-cms_saiga%20mos3_mr_annex%205_mtiwp2016-2020_rev_eng_0.pdf
[4]https://www.cms.int/saiga/sites/default/files/document/Saiga%20MOS3_Overview_Report_of_Conservation_Status_Eng.pdf

the Signatories to the MOU and therefore acts as an officially agreed statement on the status of the species.

The drafting of each new MTIWP and Overview Report relies on the expert input from technical specialists. These specialists are drawn largely but not exclusively from national governments and the cooperating organizations. Between meetings of the Signatories, technical meetings can be held which cover key aspects of Saiga conservation such as monitoring or captive breeding. These meetings produce documentation which can be useful for the Parties to the MOU. Other sources of information include the online Saiga Resource Centre[5] and the publication *Saiga News*, which appears biannually in six languages[6].

The Saiga MOU is also closely linked to the Central Asian Mammals Initiative[7], CAMI, which aims to bring together and coordinate actions for wild mammal conservation within Central Asia, and was established under the auspices of CMS.

1.2. Rationale for this report

The long-term vision of the Saiga MOU, which all Range States and cooperating organizations have signed up to is to restore Saiga populations to the point at which sustainable use can be envisioned, and the title of the MOU mentions sustainable use. However, the subject of sustainable use has been consistently contentious at Meetings of the Signatories to the Saiga MOU, and among the experts who advise the Signatories. The difficulties of achieving international consensus about sustainable use being viable were brought into sharp focus at the 2019 Conference of the Parties to CITES (CoP18), where *Saiga tatarica* and *Saiga borealis* were proposed for up-listing from Appendix II (commercial international trade allowed under strictly controlled conditions) to Appendix I (no commercial international trade in wild-caught specimens allowed). Eventually, the two species were kept on Appendix II but with an annotation stating: "A zero export quota for wild specimens traded for commercial purposes". *De facto*, this means that international trade in both species has restrictions that are very similar as if they had been included in Appendix I. The discussions leading to this decision illustrated the differing positions among Parties to CITES around the role of trade within conservation of these species (e.g. Milner-Gulland, 2019, Shiilegdamba & Mezhnev, 2019).

Even before CITES COP18, there had been policy discussions and academic research about the sustainable use of the species (see sections 2-4). While sustainable use was not possible for many years after the species' drastic decline, the Government of Kazakhstan in particular has started to consider the possibility as its overall population recovered; reaching a size of more than 250,000 by 2014. While the mass die-off of the Betpak-Dala population provided a temporary reverse, Kazakhstan's Saiga were back to over 300,000 individuals in 2019. This significant number of animals, in combination with complaints by locals living in the area of the largest population about too many Saiga causing conflicts with their own land-use, has again fuelled discussions in Kazakhstan about setting up a sustainable use system. At an aggregate level, species with populations of this size should theoretically be able to sustain a relatively high level of harvest (see section 2).

The priority actions in the 2016-2020 MTIWP with regard to sustainable use and trade are focussed on trade controls and enforcement, and do not mention the potential for sustainable use as a conservation tool. However, the 2010-15 MTIWP included a recommendation on exploring the potential for sustainable trophy hunting as a conservation tool. The Joint CMS-CITES Technical Workshop under the Saiga MOU, which took place in April 2019, produced a draft of the 2021-2025 MTIWP for comments prior to the meeting of the Signatories in 2021.

[5] http://www.saigaresourcecentre.com
[6] https://www.saigaresourcecentre.com/content/saiga-news-magazine
[7] https://www.cms.int/cami/

The draft work plan proposes the following action (at Priority 2 B = Important/necessary for the stabilisation of numbers, Medium-term/5 years):

> *Initiate research on the feasibility, conditions and requirements for sustainable use of specific populations of Saiga Antelopes, taking into consideration all relevant factors including disease and mass mortality events, sustainable harvest levels, population thresholds, demographic structure of populations, socioeconomic aspects, compliance with CITES regulations (e.g. Non-Detriment Findings), capacity to monitor and control utilization and trade, and ability to identify and trace Saiga derivatives in trade.*

A thorough consideration of all factors influencing the feasibility of sustainable use is therefore both timely and beneficial for a number of reasons:

1) It is in line with the Mission and Goal of the Saiga MOU and its MTIWP;
2) There is evidence that, when properly managed, sustainable use can be beneficial for wildlife through generating income by consumptive or non-consumptive sustainable use of Saiga and thereby incentivising locals to preserve Saiga habitat, poach less or not at all and tolerate co-existence with large herds of Saiga and increasing funding for conservation actions, but also improving the attitudes about saiga conservation in the general public;
3) The history of Saiga population trends, with occasional catastrophic declines and serious losses in range area, calls for a harvesting system which is supported by scientific evidence, based on best available data, set up with the appropriate institutions, and properly enforced or complied with. This is in order to avoid negative consequences for Saiga conservation, whether for the population being harvested or for other populations of Saigas and for species sharing the Saiga's habitat;
4) Signatories of the MOU and cooperating organisations have differing perceptions about the need for, and level of, sustainable use, and the resulting discussions would benefit from a compilation of the evidence on this topic to support and guide decision-making processes and research prioritisation.

This report was commissioned to provide a basis for implementing the priority action of the draft 2021-2025 MTIWP, as quoted above. It includes chapters on the theory of sustainable harvesting with application to Saiga, potential management structures for Saiga harvesting, population-specific considerations, a view from China as a major consumer nation and former Range State, and information on the international trade in Saiga products and its status under CITES. Throughout, we endeavour both to give detailed information specific to Saigas, but also to provide examples and lessons from other relevant species and geographies to provide the reader with ideas and concepts around sustainable wildlife use. Finally, we summarize the insights from the report and suggest ways forward.

Sustainable use, in the biological sense, is the use of a natural resource in such a way that it is maintained in the long term at a level that allows it to fulfil its role in the wider ecosystem. Sustainability more broadly has social, economic and ecological components; in order for the use of a natural resource to be sustainable, all three must be considered, because without one element the others will fail. This report focusses on consumptive use (i.e. hunting), as the most usual connotation of the term "sustainable use" in the Saiga context. However, sustainable use can be defined to include activities such as photo-tourism, or any other way of obtaining benefits from using Saigas in a way that doesn't threaten the population (and ideally enhances it). Because photo-tourism is a very different form of use to hunting, with very different implications institutionally, economically and ecologically, we cannot cover it in this report. However, it is worth bearing in mind that Saiga-based tourism has been tried in several countries. It is still nascent and has potential; further investigation would be worthwhile.

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The report was written collectively by experts from within the Saiga Range States and China, and by international experts. Authors have expertise in population dynamics, wildlife harvesting and wildlife trade. They also consulted with a wider group of colleagues, including individuals responsible for Saiga conservation and management in Range State governments, members of academic institutions and NGOs. The intended audience for this report is all those interested in the conservation of Saigas around the world, from a range of organisations, but particularly those responsible for making decisions about saiga management in Range State governments.

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2. The theory of sustainable use, with application to Saigas

(Lead authors: Pietro Hughes, Saiga Conservation Alliance, and Albert Salemgareyev, Association for the Conservation of Biodiversity in Kazakhstan)

Population dynamics is a field in mathematical ecology, which considers the size and structure of populations, and the processes that drive population change. If a species is to be sustainably harvested, it is essential to understand its population dynamics. This section therefore first presents theory in population dynamics, before characterizing Saiga population dynamics. Following this, basic theory of sustainable harvests is discussed, alongside mathematical models for Saiga harvest, and real-world sustainable harvest practices. Finally, insights gathered through this chapter will be considered, to explore options for future harvest of Saiga.

2.1. Population dynamics - A brief overview

A population's dynamics may be determined by two factors: (1) the species' vital rates; and (2) any environmental events that influence these vital rates. A species' vital rates are its: birth rate, death rate, immigration rate, and emigration rate. In an open population, birth and immigration may increase population size, whilst death and emigration decrease population size. Recruitment into a population describes the number of individuals added per unit time; a population should increase if its birth rate and immigration rate exceed its death rate and emigration rate.

A critical idea in population dynamics is that populations show density-dependence: that population growth rate changes with population density (*Figure 2.1a*). The logistic equation (*Equation 2.1*) is a basic density-dependent model for population growth. Under the logistic equation, population growth follows an S-curve (*Figure 2.1b*).

Equation 2.1:

$$\frac{dN}{dt} = r\,N\,\frac{K-N}{K}$$

In *Equation 2.1*, the rate of change in population size, at time, *t*, is a function of the then population size (*N*), and the population's intrinsic rate of change (*r*). The resulting product is then multiplied by a term that includes carrying capacity (*K*). Intrinsic rate of change may be defined as the difference between *per capita* birth rate plus *per capita* immigration rate, and *per capita* death rate plus *per capita* emigration rate, at any single point in time. In turn, carrying capacity is defined as the maximum number of individuals a habitat can support indefinitely.

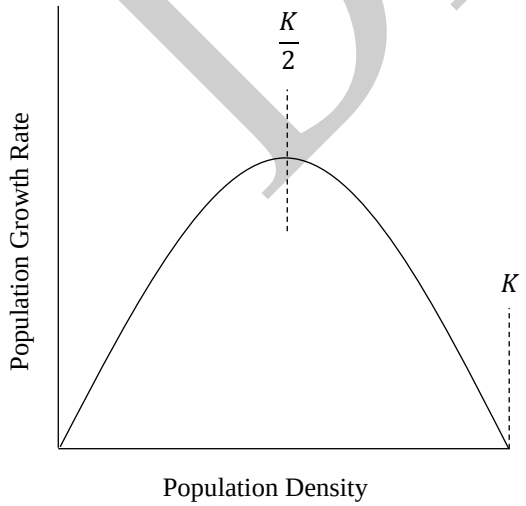

***Figure 2.1a**. Density-dependent population growth rate, under the logistic equation.*

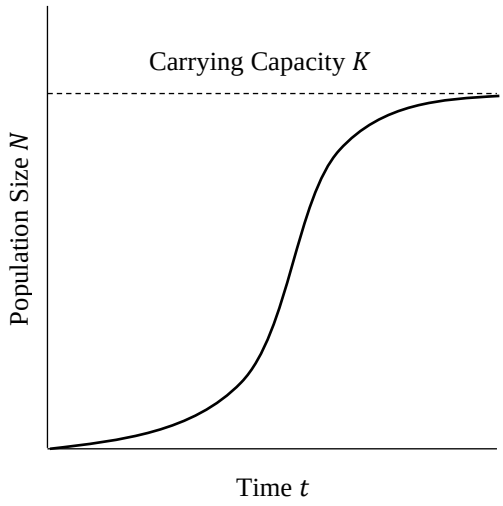

***Figure 2.1b.** Logistic population growth.*

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Basic population dynamics models assume logistic population growth. Species' vital rates are modelled to change with population density: *per capita* population growth rate is greatest at low population density, and lowest at high population density. At a population density of half that at carrying capacity, overall population growth should be greatest (*Figure 2.1a*).
The logistic model highlights the importance of a population's intrinsic rate of change (*r*) and carrying capacity (*K*). At low population densities, intrinsic rate of increase governs population dynamics, as a population grows to exploit available resources. Then, at high population densities, carrying capacity governs population dynamics: a habitat holds only finite resources, hence increasing competition for available resource causes population growth to slow.

The logistic model is a simplification of population dynamics in the real world. A smooth approach to carrying capacity is unlikely, for instance, where environmental stochasticity causes fluctuations in population size and recruitment. Extreme weather, or disease outbreaks, may cause precipitous declines in population size; now at low density, a population's high *per capita* growth rate allows recovery. Similarly, infrastructural development may cause habitat loss; reduced resource availability then causes reductions in carrying capacity. In all, environmental influences may render it difficult to establish curves as in *Figure 2.1a* and 2.*1b* for wild populations; it is often challenging to: (1) measure intrinsic population growth rate, (2) measure density-dependence in vital rates, and (3) estimate carrying capacity.

Thus, the logistic model serves as a valuable heuristic framework from which to understand population dynamics. In practice, however, logistic population growth may be difficult to observe, particularly on account of environmental factors.

2.2. Saiga population dynamics

Now that basic theory in population dynamics has been introduced, a brief overview of saiga population dynamics may be provided; this includes a discussion of their behaviour, vital rates, and ecology, to provide context for the later exploration of their sustainable harvest.

Migration behaviour

Currently, *Saiga spp.* exists in five populations, distributed through Russia, Kazakhstan, Uzbekistan, and Mongolia (*Figure 1.2*). Each of these populations show, to a greater or lesser extent, seasonal migrations – northward towards their summer range, and southward towards their winter range – in pursuit of favourable climatic conditions and more productive pasture.

Between populations, migrations differ in magnitude. For example, the North-west Pre-Caspian population is constrained to the south by the Caucasus mountains, and the Ural population to the south by the Caspian Sea. Historically, the Ustyurt population would undertake vast migrations – often reaching Turkmenistan on their southward journey – yet, with infrastructural barriers and population decline, few individuals now even reach Uzbekistan. The Betpak-Dala population shows the greatest seasonal migrations, and the largest range area. The Mongolian population, meanwhile, is better considered nomadic (for its seasonal movements are limited).

Reproductive behaviour and vital rates

Saiga population dynamics have been extensively studied (see Bekenov *et al*., 1998; Kühl, 2008; Sokolov & Zhirnov, 1998; and references therein). Primarily, the saiga is recognized for its high productivity; this is on account of females' early sexual maturity and high fecundity.

The mortality rate of individuals in their first year is approximately 50-60 per cent – where mortality is concentrated in the first month of life – and then declines to an average of 16 per cent from their second year onwards (Grachev & Bekenov, 1993; Tsapliuk, 1968; Sokolov & Zhirnov, 1998; Sludskii & Fadeev, 1977).

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Female saigas become sexually mature in their first year, typically live for at least four years, and may live up to twelve years. In their first year, over 90 per cent of females breed (on average), the majority of which produce a single offspring. Then, from their second year onwards, over 95 per cent of females breed (on average), the majority of which produce twins (Fadeev & Sludskii, 1982). Saiga fecundity shows density-dependence (Coulson *et al*., 2000), and also declines under adverse climatic conditions.

Male Saigas reach sexual maturity at 18-19 months (Grachev & Bekenov, 1983; Sokolov & Zhirnov, 1998; Zhirnov, 1982). Saigas are highly polygynous, hence mating rights are contested between males during an autumnal rut. A typical harem for a mature male consists of twelve females (Fadeev & Sludskii, 1982), though may vary between 10 and 50 females (Adolf, 1954; Bannikov *et al*., 1961). On account of the rut, male mortality during winter far exceeds female mortality. Consequently, the sex ratio is naturally biased against males, which comprise about 20-25 per cent of unhunted populations. However, providing that the proportion of adult males in a rutting herd exceeds 5 per cent, then female fecundity should remain high (Milner-Gulland *et al*., 2003).

Ultimately, the primary determinant of Saiga population growth is the high twinning percentage among adult females (Kühl, 2008; Sokolov & Zhirnov, 1998); this contributes to a short generation time, such that populations renew approximately every four years (Bekenov *et al*., 1998).

Ecological determinants of population dynamics

Saigas show frequent fluctuations in population size due to climatic stochasticity, and extreme fluctuations in population size due to mass die-off events, with rapid population growth in their aftermath. Mass die-offs occur either due to *dzhuts* or disease outbreaks.

Dzhuts describe extreme winter conditions. One use of the term describes the formation of ice-crusts on pastures; these are caused by heavy rain immediately followed by frost, usually in October. Each blade of grass becomes covered with ice, which Saigas ingest as they attempt to graze. Both the ingestion of ice, and starvation, cause individuals to die. Additionally, the word *dzhut* is used to describe heavy snowfalls, with a short thaw and then frost and ice, which buries forage beneath a layer of "reinforced concrete". Deep snow, covered with an ice crust, greatly limits Saigas' access to forage and makes movement difficult. Saiga may then die due to ingestion of ice, of hunger, and as a result of injury from the sharp ice crust. Dzuts are described by Sokolov & Zhirnov (1998) as one of the main factors governing the number of saigas in nature. From anecdotal records, *dzhuts* appear to occur about once every ten years (Milner-Gulland, 1994), and are typically preceded by spring or summer droughts (Bekenov *et al*., 1998). Particularly severe *dzhuts* may claim tens or even hundreds of thousands of lives. Males are disproportionately impacted; 50-70 per cent of those that participated in the rut may die (Fadeev & Sludkii, 1982).

Disease outbreaks have been responsible for recent saiga mass die-offs. In 2010, around 12,000 animals in the Ural population died due to bloat (a disease of livestock characterised by an accumulation of gas in the stomach – tympany). In 2015, over 200,000 individuals in Betpak-Dala population died due to pasteurellosis, caused by the *Pasteurella multocida* bacterium: this was about 62% of the global saiga population, and 88 per cent of the Betpak-Dala population (Kock *et al*., 2018). More recently, during the winter of 2016-2017, an outbreak of peste des petits ruminants (PPR) claimed 80 per cent of the Mongolian population (Pruvot *et al*., 2020). Such outbreaks do have historical precedent; mass die-offs to pasteurellosis also occurred through the 1980s, as did outbreaks of foot-and-mouth disease from 1950-1975 (Bekenov *et al*., 1998).

Further sources of saiga mortality include predation and illegal hunting. Grey Wolves (*Canis lupis*) are the dominant predator, though their offtake pales in comparison to that taken by

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poachers. Since the mid-1990s, poaching has driven Saiga population declines of over 90 per cent globally (Milner-Gulland *et al*., 2001a).

In all, Saigas are a migratory species, susceptible to mass die-off events, from which their high productivity permits recovery. *Dzhuts* and disease are the two main factors responsible for mass die-off. Poaching, meanwhile, is a continuous threat, responsible for drastic population declines. That female Saigas frequently produce twins ensures high productivity, which allows the species' populations to grow rapidly following declines.

2.3. Theory of sustainable harvesting

A sustainable harvest should, in the long term, either allow population growth or maintain a stable population size. On an annual basis, a population may be sustainably harvested if recruitment exceeds harvest plus other sources of loss (mortality and emigration) from the population.

It is important to understand density-dependence if sustainable harvests are to be successful. In particular, it is important to understand a population's density relative to that at carrying capacity. In *Figure 2.2*, two regions, numbered '1' and '2' are depicted; these respectively demarcate those regions where density is either below, or exceeds, that at which growth rate is greatest. Theoretically, it is at half carrying capacity ($\frac{K}{2}$) that population growth rate should be greatest though, in practice, this may vary. If a population's density falls within region '1', then harvest (which decreases population density) should decrease the population growth rate. If a population's density falls within region '2', then harvest should increase the population growth rate.

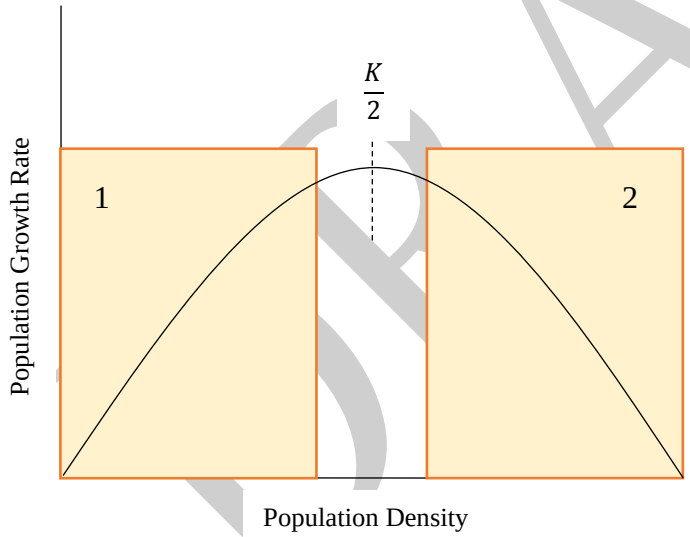

***Figure 2.2**. Density-dependent population growth rate, under the logistic equation*

A population that is harvested for the first time will always decrease in size. However, this does not mean that the harvest is unsustainable. Instead, the population may exhibit a density-dependent response, and either decrease or increase in growth rate. If harvest (plus other sources of loss) exceed this compensatory recruitment, then population size decreases. This is most likely to occur in region '1' of *Figure 2.2*, when the population size is below 50 per cent of carrying capacity. However, if harvest (plus other sources of loss) does not exceed this compensatory recruitment, then population size will stabilise. This is most likely to occur in region '2' of *Figure 2.2*, when the population size is at least 50 per cent of carrying capacity. Concomitantly, it may be possible to manipulate population density to increase yield of harvests. If a population is set at that density at which growth rate is greatest, then the largest

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harvestable surplus exists; this is known as the population size at which *Maximum Sustainable Yield* may be taken.

When harvesting from a population, different strategies exist, each with different implications. In *Table 2.1*, four of the simplest harvest strategies are presented: (1) a fixed number harvest; (2) a fixed proportion harvest; (3) a fixed effort harvest; and (4) a fixed escapement harvest.

***Table 2.1**. Strategies for harvest, their explanation, advantages, and disadvantages, including their effect on population stability.*

Strategy	Explanation	Advantages	Disadvantages
Fixed Number (for example, 5,000 individuals per year)	The same number of individuals is harvested from the population each year.	(1) This is a very simple strategy, which is easy to administer. (2) The same yield is harvested each year, which provides security of livelihood and economic certainty.	(1) Because the strategy does not account for stochastic fluctuations in population size (e.g. due to weather) a large harvest, in years of low population numbers, may cause population collapse. (2) To avoid population collapse, fixed harvests should be small, meaning that yields are then lower than from other strategies.
Fixed Proportion (for example, 10% of the population per year)	The same proportion of the total population is harvested each year.	(1) This is a very transparent strategy, which may be easily understood by managers and hunters. (2) Stochastic fluctuations in population are accounted for – hence high yields may be achieved in good years, and lower yields in poor years.	(1) Population size must be known prior to harvest, and this may be difficult to estimate accurately. (2) Varying yields are not conducive to economic and livelihood security.
Fixed Effort (for example, 500 hunters, or a 2-month season)	The same effort is expended in harvest each year (for example, the same number of hunters, or the same hunting season).	(1) Harvest should be proportional to population size – for the same amount of effort, more individuals may be harvested in good years than in bad years. (2) It is easier to monitor and control hunters than it is to monitor a population – for example, a hunting season may	(1) Hunters may be incentivised to pursue technological innovation (for example, better or larger vehicles), which allows greater harvest rates; this is effectively an increase in effort. (2) In a good year, it may be difficult to persuade hunters to limit their effort. (3) Varying yields are not conducive to

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		be established, and the number of hunters limited.	economic and livelihood security. (4) In not monitoring the population directly, it is possible that declines go unnoticed, and that a population collapse results.
Fixed Escapement (for example, no harvest if population falls below half carrying capacity)	The same numerical threshold for population size is chosen each year, beyond which a proportion of individuals in the population is harvested (this could be all of them).	(1) This is a transparent strategy, which may be easily understood by managers and hunters. (2) Stochastic fluctuations in population are accounted for – hence high yields may be achieved in good years, and lower yields in poor years – whilst a reserve of individuals are left to prevent population collapse.	(1) Population size must be known prior to harvest, and this may be difficult to estimate accurately. (2) Varying yields are not conducive to economic and livelihood security.

Different harvesting strategies produce different effects on population dynamics: ultimately, to ensure sustainability, a strategy should be chosen that ensures the population remains at a safe level. In practice, each of the four strategies specified in *Table 1* need not exist independently. It is possible that a combination of strategies provides the best prospects for sustainable harvest. For example, a fixed escapement threshold could be employed alongside a proportional harvest, once a population exceeds the threshold.

Two further considerations may ensure sustainability of harvest. First, it may be important to understand both the age and sex structure of a population. This creates scope for selective harvest, in targeting individuals of particular age - and sex-classes. Older individuals (which are likely to die shortly), and individuals unlikely to reproduce (such as males in a polygynous mating system), may be targeted to minimise the effect of harvest on recruitment. Second, the timing of harvest is important; harvest should not disturb either a breeding season, or females' gestation period, to maximise both fecundity and calving rates. Thus, selective harvest, taken away from the breeding period, may help elevate a population's recruitment, and therefore improve both population stability and future yields.

To summarise, sustainable harvests are those which allow long-term population stability or growth. In the short term, such harvests (plus other sources of loss) should not exceed recruitment; whether or not this occurs may depend on population density, and associated population growth rates. A number of further considerations may actively impact sustainable harvest: harvest strategy, selective harvest, and timing of harvest. These considerations – though an appropriate management regime – may improve both yields and sustainability of harvests.

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2.4. Models for Saiga harvesting

Three separate Saiga population models exist in the scientific literature. Each model attempts to recreate Saiga population dynamics as observed in the real world. A summary of these models' parameters is provided in Table *2*.2.

Table 2.2 *A summary of the population dynamics data which would be necessary to construct a population model, and information on each for saigas*

Population dynamics metrics	Parameter's level in saigas	Reference
Intrinsic rate of increase (r) – the highest rate at which a population is theoretically able to grow when all constraints are removed	High: in Kazakhstan, an (average) intrinsic rate of increase of 1.26 has been calculated. This means that a population may grow by 26% from one year to the next, in a good year, and when the population is small.	Kühl (2008)
Carrying capacity (K) – the greatest size that a saiga population could theoretically reach within a given area	High: Carrying capacity for Kazakhstan was estimated at 1,000,000 individuals in 1994. Carrying capacity is likely to have reduced in recent years, with infrastructural development and agricultural expansion into the Eurasian steppe.	Milner-Gulland (1994)
Variability in vital rates	High: Interannual variation in population growth rates renders it challenging to establish population growth rates and carrying capacity. This variability arises due to climatic stochasticity and disease outbreaks.	Bekenov *et al*. (1998); Kühl (2008)
Density-dependence – the shape of the population growth versus population density curve	This is challenging to estimate on account of fluctuations in population numbers, and the species' sensitivity to different climatic conditions. However, it has been found that Saiga show density-dependent fecundity; the proportion of females that produce only a single calf increases at high population densities, whilst the proportion of females twinning decreases at high population density.	Coulson *et al*. (2000)

The first model to have been published – Milner-Gulland (1994) – divides a Saiga population into age-classes by year, and sex-classes, and incorporates climatic stochasticity. Four sets of demographic parameters are used (for each age- and sex-class), corresponding to the type of climate experienced: a good or bad summer, and a good or bad winter. These climatic states are assigned randomly, according to their probability of occurrence, and the model is run over ten years. Through different runs, different harvesting strategies are applied – these are used to make management recommendations.

In Milner-Gulland (1994), a comparison is attempted between the model and real data, for Saiga harvests and population sizes in Kazakhstan from 1950 to 1989. This is important, to establish the accuracy of the model; however, inconsistencies in the data render the comparison unreliable (*Figure 2.3*). Nonetheless, the model would probably better represent the real world with incorporation of: (1) both poaching and legal harvests, (2) mass die-offs to disease, and (3) the effects of extreme female sex ratio bias on productivity.

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The same model constructed by Milner-Gulland (1994) was used for comparison of different harvest strategies in Milner-Gulland *et al*. (2001b); this second study will be considered in greater depth in Section 2.6.

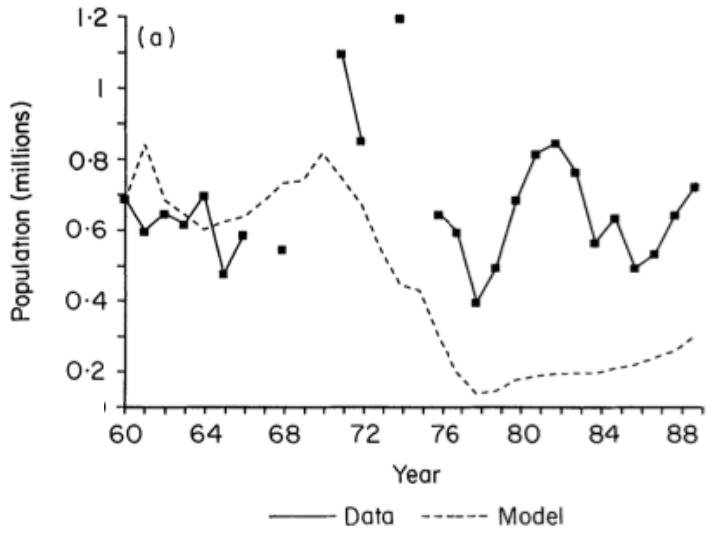

Figure 2.3. *A comparison of* S. tatarica *population size in Kazakhstan, between 1960 and 1989, with model output from Milner-Gulland (1994).*

Second, Milner-Gulland (1997) constructed a stochastic dynamic programming model, with climatic stochasticity incorporated. This model represents a demographic simplification of Milner-Gulland (1994), since the simulated population is split only into adult males, adult females, and juveniles. Demographic parameters for each class are affected only by climatic stochasticity. The model is then run to find an optimal long-term harvest strategy, which maximizes revenue. Milner-Gulland (1997) includes sensitivity analyses to assess the effects of poaching and extreme female bias in sex ratio, on an optimal harvesting strategy. This model thus assesses highly uncertain parameters as identified by Milner-Gulland (1994). However, given the demographic simplification made in this 1997 model, the 1994 model probably better represents the real world.

Finally, Rodnikova *et al*. (2018) report an individual-based model (IBM) for the North-west Pre-Caspian saiga population. This uses recent demographic and climatic data in an attempt to track the population's fluctuations between 1965 and 2015. A rough similarity between model and census data is produced (*Figure 2.4*); this model would be improved with inclusion of offtake to poaching, mass die-offs to disease, and demographic parameters of greater accuracy.

In all, existing saiga population models provide a number of lessons for the construction of future models. Primarily, it is clear that offtake to poaching, and mass die-offs to disease, both of which are important drivers of saiga population dynamics, are difficult to accurately incorporate. Similarly, no models incorporate data on female fecundity under extreme sex ratio bias; where the rut is composed of fewer than 5 per cent adult males, female fecundity rapidly declines (Milner-Gulland *et al*., 2003; *Figure 2.5*). So far, to address uncertainty, models have employed sensitivity analyses.

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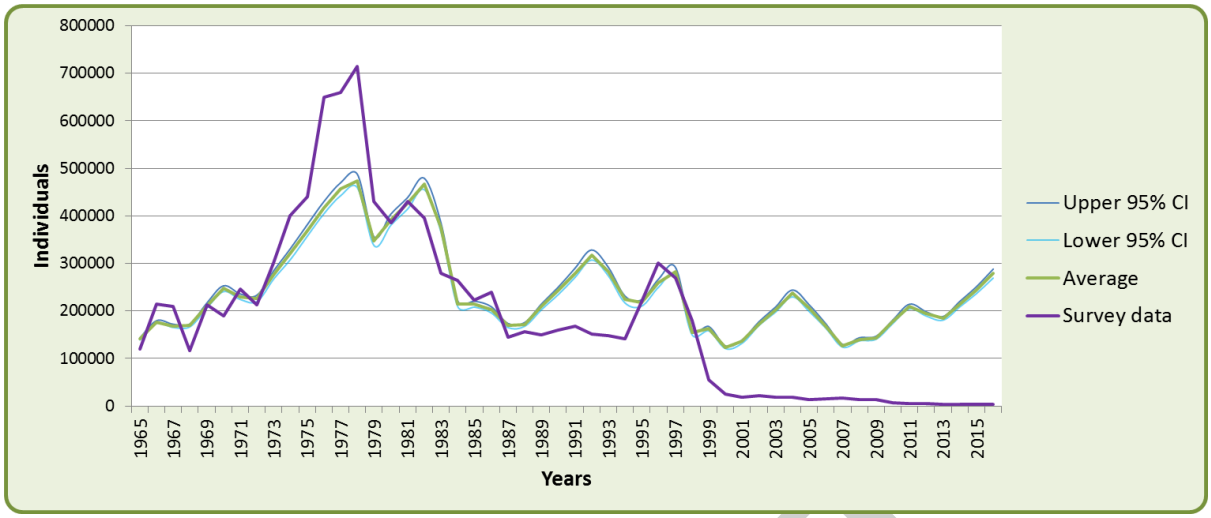

Figure 2.4. *Comparison of an individual based model (IBM) for population dynamics of the North-west Pre-Caspian Saiga population with survey data from 1965-2015. The green line shows the model output, with the upper 95% confidence interval in dark blue, and the lower 95% confidence interval in light blue. The violet line shows population size from survey data. Reproduced from Rodnikova et al. (2018).*

Moving forward, two options exist to address both data deficiency and uncertainty, in saiga population models. First, data collection should be pursued, to generate data to more accurately parameterise population models. Already, data exist as to the effects of extreme female sex ratio bias on productivity (Milner-Gulland *et al*., 2003), and on disease (Kock *et al*., 2018; Pruvot *et al*., 2020), though monitoring should continue in both regards. Where new data are required is with respect to vital and their density-dependence rates (beyond fecundity, for which density-dependence has been established by Coulson *et al*., 2000), and on the magnitude of poaching experienced by each population. Second, where data are difficult to accurately obtain, models may employ statistical methods which explicitly address parameter uncertainty (see Section 2.7). For example, with Bayesian estimation of parameter values, it may be possible to produce model outputs alongside a probabilistic estimate of output accuracy.

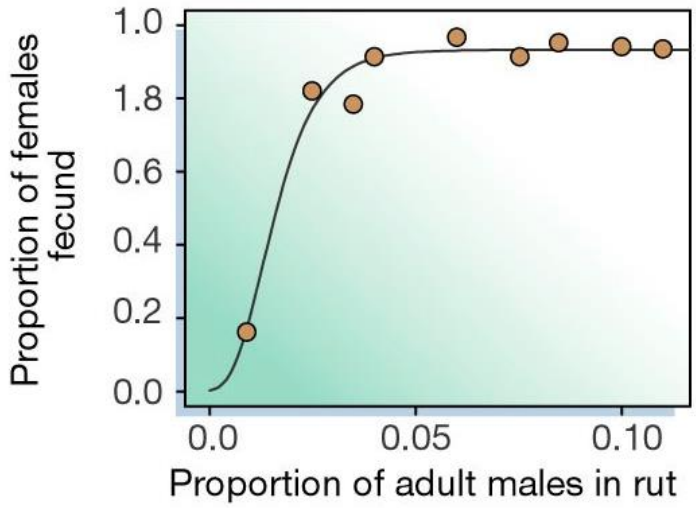

Figure 2.5*. Effect of extreme sex ratio bias on female fecundity: below a threshold of approximately 5% adult males in the rut, the proportion of fecund females declines rapidly. Reproduced from Milner-Gulland et al. (2003).*

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Finally, to better represent population dynamics, models should incorporate spatial data: for example, the relationship between population range and population size. This is available, given long-term collection of telemetry data from populations in Kazakhstan, and would be useful in informing the spatial distribution of harvests. Similarly, climate niche modelling may prove informative, both to estimate changes in carrying capacity, and for spatial management. Under climate change, and with infrastructural development, it is likely that the range and migratory patterns of Saigas will continue to shift (Singh & Milner-Gulland, 2011); if this effect can be predicted, then a pre-emptive modification of harvest management becomes possible.

To summarise, three mathematical models, which consider saiga population dynamics, have been published. However, these do not accurately represent population trends in the real world, in the absence of data on disease, poaching, and sex-ratio bias. Thus, to improve existing models, it is important to incorporate data on these factors, and employ statistical methods to address parameter uncertainty. Furthermore, with changes in climate and infrastructure into the future, it may prove valuable to construct spatially explicit models, so as to better understand spatial considerations for saiga harvest.

2.5. Examples of sustainable harvest in relevant species

Here, we explore real-world examples of successful sustainable harvest of Reindeer (*Rangifer tarandus*), Moose (*Alces alces*), and Elk (*Cervus canadensis*). These species are demographically somewhat similar to Saigas, enabling lessons to be drawn that may be relevant to sustainable Saiga harvests.

Reindeer

R. tarandus is a migratory species distributed across the northern regions of North America and Eurasia. Just as for Saigas, *R. tarandus* migrate northwards towards their summer range, and southwards towards their winter range.

With respect to population dynamics, *R. tarandus* share certain similarities with Saigas. Firstly, *R. tarandus* show high longevity: females frequently live up to a decade, with survival rates peaking at 94-95 per cent between two and seven years of age, then declining steadily (Messier *et al*., 1988). Furthermore, *R. tarandus* show pregnancy rates in mature females similar to those in saigas, at approximately 90 per cent (Bergerud *et al*., 2008). On account of polygyny, high calving rates persist even with sex ratio of 10 bulls / 100 cows (though calving dates then fall later into spring, hence calves are less able to survive the following winter; Holand *et al*., 2003). Finally, *R. tarandus* are susceptible to mass die-offs. These are driven typically by low forage availability in summer, followed by extreme weather events in winter (Bergerud, 1996). 'Lock pastures' – a term used to describe *dzhuts* in the *R. tarandus* literature – have been documented as causing die-offs in Canada, and on Svalbard (Miller & Gunn, 2003; Solberg *et al*., 2001). Where *R. tarandus* differ from saigas is with respect to twinning rates amongst adult females; twinning rates are exceptionally high in saigas, and much greater than those in *R. tarandus* (Godkin, 1986).

Hatter (2019) investigates the sustainable harvest of *R. tarandus* in British Columbia. A population model is constructed, with environmental variation in vital rates incorporated, and run over ten years. Different harvesting rates are simulated and assessed with respect to regional targets for: (1) maintaining bull/cow ratios at over 35 bulls/100 cows, and (2) maintaining a positive population growth rate. Under an annual, bulls-only harvest, sustainable offtake is calculated at 2 per cent for stable populations, 0–1 per cent for declining herds and 3–4 per cent for increasing herds. This corroborates earlier research conducted by Hegel (2015) and Environment Yukon (2016).

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Elk

C. canadensis is a migratory species distributed through North America. Small altitudinal migrations – rarely in excess of 100km, and of considerable fidelity – occur between higher altitudes in summer, and lower altitudes in winter (Boyce, 1991). With respect to population dynamics, *C. canadensis* show greater longevity and lower productivity than saigas. Adult survival rates are estimated to exceed 95 per cent (DeVore *et al*., 2018), whilst lifespan may reach thirteen years. Further, female *C. canadensis* rarely calve in their first year, and rarely produce twins even when sexually mature (DeVore *et al*., 2018).

Two population models for *C. canadensis* have been recently published. First, Lubow & Smith (2010) construct a best-fit model for a herd in Jackson, Wyoming, as compared to time-series data between 1980-2002. This best-fit model is thought to reliably predict the herd's population dynamics, with demographic parameters for: different sex- and age-classes (juveniles, <1 year; yearlings ≥1 and <2 years; and adult ≥2 years), and different climatic conditions. Management strategies could then be simulated: to achieve a governmental target for herd size of 11,029, the then-population of 15,680 required an annual harvest of mature females at 15.6 per cent.

Second, DeVore *et al*. (2018) report a population model for a small herd of *C. canadensis* in New Mexico. This model represents the female segment of the herd, for which annual adult survival, and calf recruitment rates, are calculated from survey data. Demographic and climatic stochasticity are also incorporated, such that the female segment of the herd is estimated – on average – to grow at 9 per cent annually. It is therefore suggested that a fixed proportion harvest at 8 per cent of cows annually might stabilize the herd.

In both Lubow & Smith (2010) and DeVore *et al*. (2018), an adaptive management regime is recommended, atop the fixed proportion harvest. Under adaptive management, harvest rate may be adjusted in accordance with annual survey data. This approach allows harvest rate to be increased in good years, and decreased in bad years, to improve both yield and population stability.

Moose

A. alces is a migratory species distributed through the northern forests of North America and Eurasia. Just as *C. canadensis*, *A. alces* undergo small altitudinal migrations between higher altitudes in summer, and lower altitudes in winter (Skonhoft & Olaussen, 2005).

With respect to population dynamics, *A. alces* show a greater longevity and lower productivity than *C. canadensis*. Female *A. alces* first calve at two to three years of age (Schwartz, 1998; Bowyer *et al*., 2003). Once sexually mature, pregnancy rates exceed 70 per cent: a single calf is most frequently produced (Poole, 2007), though females of excellent nutritional status may occasionally produce twins (Franzmann and Schwartz, 1985; Schwartz 1998; Bowyer *et al*., 2003). Cows then begin to decline in fecundity from 12-15 years (Ericsson *et al*., 2001). Male *A. alces*, meanwhile, become sexually mature as yearlings. However, on account of a polygynous mating system, it is unlikely that males reproduce until 7-11 years of age (Poole, 2007). Survivorship of adult moose exceeds 90% – though shows female bias on account of males' exertion during the rut (Bowyer *et al*., 2003). Quite rarely, *A. alces* may succumb to mass die-offs – these are caused by ticks, and the diseases they carry, and primarily affect calves (Samuel, 2004).

Harvest of *A. alces* has traditionally targeted bulls; from the 1970s onwards, various Canadian provinces, and Sweden, made it their objective to promote herd growth by reducing the adult female harvest, while maintaining or increasing adult bull and calf harvest (Poole, 2007; Sylvén, 2003). Nonetheless, minimum thresholds for bull/cow ratios, and calve/cow ratios, have also been stipulated. In British Columbia, the former threshold has been set at 30 bulls / 100 cows (MELP, 1996), though a higher ratio, of 50 bulls / 100 cows has been recommended

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for low density populations (Timmermann, 1992). A calf/cow ratio of 25 calves:100 cows (at 6–9 months of age; Bergerud, 1992) has been estimated to maintain a stable population in the absence of hunting, though this rises to 30–45 calves:100 cows in harvested populations (Hatter & Bergerud, 1991). As for *C. canadensis*, adaptive management, in harvest of *A. alces*, has been recommended (Sylvén *et al.*, 2003).

The literature on harvest of *A. alces* frequently considers the impact of predation. Empirical studies suggest that sustainable harvest rates (primarily on bulls) may range from 5% of the population in the presence of lightly hunted wolf and bear populations to 10% when predators are more heavily hunted (Gasaway *et al*., 1992; Hatter, 1998). In Norway, under the recolonization of *C. lupis*, it has been demonstrated that harvest rates need reducing: continuing to harvest at historical rates, established in the absence of *C. lupis*, would lead to declines in the *A. alces* population (Nilson *et al*., 2005).

With respect to harvest strategy, Saether *et al*. (2001) provide a comparison of fixed proportion and fixed escapement harvests, in an age-structured model of *A. alces*, with climatic stochasticity incorporated. Proportional harvest is found to give a smaller mean annual yield than fixed escapement harvest. The variance in the annual yield is, however, found to be larger for fixed escapement harvest than for proportional harvest. These differences increase when the survivorship of calves is low, when there is high climatic stochasticity, and when survivorship is strongly density-dependent. To ensure sustainability, particularly in areas of high predation, a fixed escapement strategy is strongly advised; a minimum population threshold, below which no harvest occurs, could be set to permit harvest only in a population's good years.

To summarize, the population dynamics and sustainable harvest of *R. tarandus*, *C. canadensis*, and *A. alces*, have been considered. These three species show varying degrees of similarity to Saigas: *R. tarandus* is perhaps most similar, whilst *C. canadensis* and *A. alces* show greater longevity and lower productivity. Regardless, a number of lessons may be drawn with respect to sustainable harvest. Most pertinently, a harvest quota that targets calves and adult males is most likely to maintain high population growth rates. Despite this, it is important that bull / cow ratios not fall too low, for this damages productivity: a target sex ratio, which safeguards against mass (male) mortality, should be established. Further, on account of population fluctuations, a fixed escapement harvest may be more sustainable than a fixed proportion harvest; should a population fall below a certain number, no harvest may be permitted. Finally, adaptive management appears advisable. This would allow identification of those years in which a population exceeds escapement threshold, and adjustment of harvest accordingly.

2.6. Options for sustainable harvest of Saigas

A number of insights for possible sustainable harvesting of saigas may be drawn from models of the species' population dynamics, and management of similar species' harvest:

(1) It is important to establish the position of each Saiga population relative to carrying capacity. For example, to achieve *Maximum Sustainable Yield*, a population may be managed to achieve greatest annual recruitment: theoretically, this occurs at around half carrying capacity (*Figure 2.2*). However, if population size should be below that for *Maximum Sustainable Yield*, harvests may decrease population growth rate: this endangers the population's long-term stability and reduces future yields. Conversely, if population size should exceed that for *Maximum Sustainable Yield*, harvests may increase population growth rate, and high yields may be possible in the long term, whilst maintaining population stability.
Key insight: A population should be kept at a size above half carrying capacity, for a sustainable high-yielding harvest to be achieved.

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(2) A selective harvest, by age- and sex-class, may help maintain high recruitment in populations. Already, this result has emerged from population dynamics models: Milner-Gulland (1994) suggests that adult males constitute 80 per cent of harvest, and that adult females, which contribute so significantly to saiga productivity, not be harvested. Further, this is as practiced in harvest of *R. tarandus*, *C. canadensis*, and *A. alces*, where both adult males and calves are targeted.
Key insight: Harvests should avoid adult females, and be biased towards males and younger individuals, to retain population productivity.

(3) If indeed males compose the majority of harvest, then a minimum threshold in bull / cow ratio is required, below which no further males be harvested. In Saigas, Milner-Gulland *et al*. (2003) demonstrate that adult males may compose as little as 5 per cent of rutting herds, and female fecundity remains high. In *R. tarandus*, 10 bulls / 100 cows appears the equivalent minimum threshold, below which calving rates collapse. Nonetheless, bull / cow ratios targeted in *R. tarandus* generally exceed 30 bulls / 100 cows, and a similar ratio is also targeted in *C. canadensis*. The importance of maintaining adult sex ratio above a minimum threshold – below which a reproductive collapse is likely – may be explained by a number of reasons. At 10 bulls / 100 cows, in *R. tarandus*, it requires greater time for all females to be fertilised, hence calving dates fall later in spring; calves then have less time to prepare for the following winter, and their survivorship diminishes. This has also been observed in saigas (Bekenov *et al*., 1998; Zhirnov, 1982). Furthermore, with very few adult males, it appears that young males may enter the rut prematurely; these males are then less likely to survive the winter, as compared to mature males. Lastly, males are disproportionately impacted by mass die-off events due to harsh winter conditions, both in *R. tarandus* and Saigas: in the aftermath of such events, it is necessary that a reserve of adult males exist to safeguard against reproductive collapse, and help accelerate population recovery.
Key insight: A safe threshold for population sex ratio must be established, below which no further males be harvested, to avoid reproductive collapse.

(4) In design of harvest strategies, a promising option appears a combination of fixed escapement threshold and proportional harvest (*Table 2.3*). Under such a strategy, harvests might occur only in good years, and take a proportion of the population above a threshold number. Harvests estimated in the literature have historically fallen at 20-30 per cent of population size (Fadeev & Shaad, 1978; Tikhonov, 1979; Zaikin & Zhirnov, 1989), though a 10 per cent rate appears more sustainable, particularly if harvest is male-biased (Milner-Gulland, 1994). A 10 per cent harvest falls well below estimates for average population growth rate in good years, which may reach 23 per cent (Kühl, 2008).
Key Insight: A combination of fixed escapement and proportional harvest strategies may be suitable, where escapement exceeds half carrying capacity, and a 10% proportional harvest is taken.

(5) There are various spatial considerations for harvest within and between Saiga populations. Here, it should be emphasised that each distinct Saiga population should be managed separately, on account of their differences in conservation status (see Section 4). For example, different populations experience different levels of poaching, and endure disease outbreaks independently. As part of an adaptive management regime, all populations need annual assessment of their age- and sex-class composition, abundance, disease status and poaching levels, for independent calculation of harvest quotas. In the case of transboundary populations, this will require collaborative action between the relevant countries.
Key insight: Population-specific harvesting regimes are needed.

(6) Accurate, precise, and well-designed annual population surveys are vital for sustainable harvest management. Additional ecological work would also help establish vital rates, and their density-dependence, relevant to each saiga population; in *A. alces*, different populations show different vital rates (Sylvén, 2003), and it is likely the same applies to saigas (given

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populations' differing ecological circumstances). Population dynamics models for saiga management should then include any demographic differences between populations, so as to best establish harvest quotas. Similarly, within each population, migratory patterns influence over harvest strategy. Given that Saigas show little fidelity in annual migration route, then aerial surveys, or tracking technologies, may be employed to locate herds.
Key insight: High quality and ongoing ecological monitoring, for each population of Saigas, should help ensure sustainable harvests.

(7) It is imperative that herds be promptly located so that harvests occur pre-rut, in early autumn. At this time, Saigas aggregate, prior to mating and migration: targeting aggregations facilitates harvest, and may therefore minimise stress. Any later than autumn, and harvests disturb mating, thereby reducing recruitment into the following year. Additionally, harvest in (around) October enables first-year individuals to be targeted; as shown for *A. alces*, this minimizes the mortality of adult females, and so enables a more sustainable harvest.
Key insight: Saigas should be harvested in autumn, to maximize sustainable yield.

Table 2.3. *Strategies for harvest, their suitability for saiga, and an evaluation in reference to population models.*

Strategy	Suitability for Saiga	Explanation	Reference
Fixed Number (for example, 5,000 individuals per year)	Unsuitable, unless set very low	If set to achieve high yields, this strategy would be likely to destabilise saiga populations, particularly in years of mass die-off. This is because harvest reduces the number of available individuals for reproduction, and thus impacts population recovery potential. However, if set at a very small proportion of carrying capacity, and if the population already exceeds 50% of carrying capacity, this strategy would be both simple and feasible to implement.	Milner-Gulland *et al*. (2001b)
Fixed Proportion (for example, 10% of the population per year)	Suitable	If set to a relatively small proportion of population size, this strategy provides consistent long-term yields. This result has been found for both moose and Saiga. If set relative to population growth rate, this strategy appears the least likely to cause long-term population declines. Given an intrinsic growth rate of approximately 20% for Saiga, then a proportional harvest of 10% might be suitable, so long as population size exceeds 50% of carrying capacity)	Saether *et al*. (2001); Milner-Gulland (1994); *Milner-*Gulland *et al*. (2001b)
Fixed Effort (for example, 500 hunters, or a 2-month season)	Unsuitable	This approach monitors wildlife populations indirectly, so would be incongruous with conservation efforts in Saiga, which include annual population surveys. In harvest of Moose in Sweden, it appears challenging to accurately	Sylvén (2003)

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		infer population trends from encounter rates between hunters and animals, particularly over large spatial scales.	
Fixed Escapement (for example, no harvest if population falls below half carrying capacity)	Suitable	This strategy provides highly variable annual yields in moose, on account of their high fluctuations in population. If an escapement threshold is set such that harvest occurs only in a population's good years, and not in a population's bad years, then this holds potential for long-term sustainability. However, it might be challenging to establish such a threshold, if population size is expected to change over the medium- to long-term: as in Saiga, which are recovering from substantial population declines, but are also likely to be affected by climate change and infrastructural; development.	Saether *et al*. (2001); Milner-Gulland (1994); *Milner*-Gulland *et al*. (2001b)

Further to *Table 2.3*, harvest strategies can be implemented in combination. For example, a particularly promising option for saigas would be a fixed escapement threshold with a proportional harvest. Under such a strategy, harvests might occur only in good years, and take a proportion of the population above a threshold number. Harvests estimated in the literature have historically represented about 20-30 per cent of population size (Fadeev & Shaad, 1978; Tikhonov, 1979; Zaikin & Zhirnov, 1989), though a 10 per cent rate appears more sustainable, particularly if harvest is male-biased (Milner-Gulland, 1994). A 10 per cent harvest falls well below estimates for average population growth rate in good years, which may reach 23% (Kühl, 2008). If we assume that *r*, the intrinsic growth rate, is around 30 per cent, then anything below 15 per cent should be comfortably sustainable **if** the population is above 50 per cent of K. It is important to ensure that the total harvest rate is calculated including other sources of mortality, such as poaching, however.

Table 2.4. *Summary recommendations for Saiga harvest, as taken from the literature; an explanation; and a reference*

Factor	Recommendation	Reference
Harvesting Strategy	A combination of proportional and fixed escapement harvest: proportions should be calculated relative to population growth rate, and escapement should allow harvest only in good years.	Milner-Gulland (1994)
Harvesting Rate	10% – a conservative estimate, lower than the population growth rates that may be attained in good years. It is important that harvest quotas consider offtake to predators and poachers.	Sokolov & Zhirnov, 1998; Kühl, 2008; Milner-Gulland (1994)
Selective Harvest	Male-biased; approximately 80% of harvested individuals should be males.	Milner-Gulland (1994)
Timing of Harvest	Early Autumn, pre-rut. This is when Saiga are highly aggregated, and when their reproductive cycle is not disturbed.	Sokolov & Zhirnov, 1998; Bekenov *et al*. (1998)

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2.7 Incorporating uncertainty into harvesting strategies

A number of uncertainties exist in the population dynamics literature on saigas, both with respect to vital rates, and with respect to environmental drivers of mortality. For example, the influence of predation (including of calves, by feral dogs, in areas of human settlement), poaching, disease outbreaks, and infrastructural development, are largely unknown. Although data collection may ameliorate uncertainty, in a species such as Saiga, with highly variable population dynamics, it is likely that some uncertainty will persist. To address such uncertainty in population models for Saiga harvest, two options exist:

i) use complex statistical methods to characterise uncertainty, then model its effects;
ii) develop robust rules of thumb that produce a sustainable harvest, even when a population's vital rates and abundance are inaccurately estimated.

When pursuing the first of these two approaches, population models include probability distributions for each demographic and environmental parameter. This is important, because parameters are frequently subject to measurement error, from which sustainable harvests may be overestimated. Memarzadeh *et al*. (2019) demonstrate this approach for fisheries worldwide. Here, it is found that fixed proportion harvests, designed to maximise either yield or revenue, perform poorly under extreme measurement error. Instead, under adaptive harvest management, where a fixed proportion harvest varies in accordance with both inter-annual population trends and the measurement error in these trends, populations are better able to recover and generate greater long-term revenue.

Use of complex statistical methods to incorporate uncertainty in population models represents a recent development in harvest management. The alternative approach, use of robust rules of thumb to produce a sustainable harvest, may be more practical for species such as Saigas, where intensive monitoring and complex modelling are currently unfeasible. In Milner-Gulland *et al*. (2001a), sensitivity analyses are employed to assess the sustainability of saiga harvest strategies, under inaccurate population estimates and unaccounted offtake to poaching; here, simple, rather than more complex strategies, were found to be more robust.

A very widely used approach for robust estimation of sustainable harvest was developed by Wade (1998). This method calculates a 'Potential Biological Removal (PBR)': the product of a minimum population estimate (the lower confidence bound of the estimated population size), N_{min}, half the intrinsic rate of increase, r, and a recovery factor F, between zero and one (*Equation 2.2*). This recovery factor quantifies risk that the manager may be prepared to accept, with one being the highest level of risk. The PBR is useful, because it is simple to calculate, and produces a precautionary approach to harvest where population estimates show great uncertainty. This approach is used in the USA and Europe to calculate sustainable cetacean bycatch; a maximum number of individuals is established beyond which bycatch could cause population declines. The PBR has also been tested in models of bushmeat hunting, and shown to be a simple, robust rule for harvesting under uncertainty (Milner-Gulland & Akçakaya, 2001).

***Equation 2.2*:** $$PBR = N_{Min}\ \frac{1}{2} R_{Max}\ F_R$$

Another possible rule-of-thumb, which has not been widely implemented, is the "rule of $\frac{3}{4}$" (Roughgarden & Smith, 1996). Rather than conduct annual population surveys, it is suggested that sustainable harvests be calculated from a population's carrying capacity and density-dependent function (see *Figure 2.1*). Thus, the "rule of $\frac{3}{4}$" advocates a harvest rate that maintains population size at 75 per cent of carrying capacity; this threshold both safeguards populations from collapse, and maintains high population growth rates, such that consistently high yields can be obtained. However, the "rule of $\frac{3}{4}$" is also risky: without adaptive management and population monitoring, it is quite possible that harvests will drive population

declines. This would probably apply to saigas, where substantial offtake to poaching, or adverse climatic conditions, could not be accounted for.

In all, the literature suggests that saiga harvest strategy be as simple as possible, and therefore robust to the many uncertainties that managers face. However, there exists potential for applying statistical approaches to saiga population models, to quantify an optimal harvest strategy; as such approaches improve into the future, so their potential for use in saiga management may increase also.

2.8. Summary

1. It is important to understand a species' population dynamics if it is to be sustainably harvested. The logistic model provides a heuristic framework from which to develop such an understanding.

2. Saigas are highly productive species, vulnerable to weather-related fluctuations in recruitment, and to mass die-off events caused by *dzhuts* or by disease.

3. Sustainable harvests allow long-term population stability, or growth, and may be achieved where harvests, plus other sources of loss from a population, do not exceed recruitment. Harvesting strategy, selective harvests, and timing of harvest, should each be considered to increase recruitment, and ensure stability of yields and populations.

4. *R. tarandus*, *C. canadensis*, and *A. alces* are three species with varying degrees of demographic similarity to Saigas and are each currently subject to a harvesting regime. In each case, harvest predominantly targets bulls and calves; a fixed escapement strategy allows sustainable harvest despite population fluctuations; and adaptive management allows calculation of harvest quota on a year-to-year basis.

5. Three mathematical models of Saiga harvesting exist in the published literature. These incorporate climatic stochasticity, but could be improved by incorporating disease, poaching, and sex-ratio bias. Furthermore, spatial data could be incorporated, to understand migratory patterns and predict the effects of climate change into the future.

6. For saigas, considerations for sustainable harvest are similar to those found for *R. tarandus*, *C. canadensis*, and *A. alces*.

7. It is important to estimate populations' position relative to carrying capacity and to collect data on vital rates and drivers of population loss. From here, population dynamics models – into which survey data are inputted for year-to-year calculation of sustainable harvest quotas – may use statistical methods to explicitly incorporate uncertainty, and so probabilistically identify an optimal management strategy.

8. No harvest management can stand still; ongoing monitoring using appropriate methods must take place. This will ensure the incorporation of changing environmental circumstances into annual harvest quotas as part of a broader adaptive management regime.

9. Where monitoring produces inaccurate data, uncertainty should be explicitly incorporated to population models for sustainable harvest. In cases of particular uncertainty, a Potential Biological Removal rate may instead be calculated. The precautionary principle should be followed at all times.

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3. A review of potential institutional arrangements for sustainable hunting, with application to Saigas.

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Having discussed Saiga population dynamics, and their implications for sustainable harvests (see Section 2), it is now possible to explore institutional arrangements for harvest. First, management practices used in sustainable hunting initiatives globally are described; these are primarily split between state- and community-management. Subsequently, various considerations for management of Saiga harvest are explored; these include different constraints and opportunities that harvest might address, and how harvests could be monitored to ensure sustainability.

3.1 Types of hunting

Globally, a great diversity of practice exists in wildlife harvests. A break-down of different hunting types is first provided, before discussion of case-studies in sustainable harvest management. Ultimately, these case-studies provide useful insights for saiga management.

People hunt wildlife for a range of reasons, including: (1) subsistence hunting; (2) recreational and trophy hunting; (3) commercial hunting for trade in wildlife products; (4) hunting for management purposes or research; and (5) hunting as a consequence of human-wildlife conflict.

Subsistence hunting is defined as: “the extraction of wild fauna by communities of individuals for self-consumption and local trade, without the influence of an external market to render it a lucrative activity” (Ramírez-Barajas & Calmé, 2015). Primarily, this is for food, though hunting may also be for clothing, shelter, tools, medicines, rituals, or decoration. Where meat or other products are gifted, bartered, or sold by subsistence hunters into local trade, their basic needs and those of their economic dependents must first have been satisfied. Only where an excess of a particular species has been harvested is it passed on.

Millions of people globally depend on the local extraction of animal produce to meet their nutritional requirements (Coad *et al*., 2019). Large mammals, predominantly ungulates, are preferred, as a substantial source of both meat and income (Milner-Gulland *et al*., 2003). However, intense extraction of any one particular species may have serious impacts on its conservation; in conjunction with habitat degradation, over-exploitative subsistence harvests may drive population declines (Peres, 2001). It is important, both for traditional livelihoods and for biodiversity, that subsistence harvests be sustainable.

Recreational hunting describes any harvests pursued for leisure; people may enjoy the skill required to hunt an animal, the pleasure of hunting for food, the opportunity to spend time in nature, or any social aspect of hunting. Strong traditions often exist in recreational hunting, particularly where a close cultural relationship exists between a society and game species.

Trophy hunting is an example of recreational hunting, in which a part of the hunted animal (the ‘trophy’) is kept and displayed. Typically, both impressive species, and impressive individuals within those, are favoured, such as those ungulates with the largest antlers or horns. In such cases, if the head and antlers or horns should be kept as a trophy, the carcass may be used as food.

Trophy hunting is a highly contentious practice (Batavia, 2018). Ethical issues exist with regards to killing animals for sport, and socio-political issues in cases of poor management, where international money derived from trophy hunting not benefit local people. Further, trophy hunting may negatively impact population dynamics, through altering age- and sex-structures, and removing those most genetically valuable individuals from a population

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(Loveridge *et al*., 2007). Where properly managed, however, trophy hunting provides an economic incentive for conservation and sustainable species management, and this has been recognised by the Conference of the Parties to CITES[8]. Trophy hunting may motivate private landowners to invest in conservation, and so reverse habitat loss (Leader-Williams *et al*., 2005). Further, trophy hunting may represent an effective alternative to photographic ecotourism, both in particularly remote areas without infrastructural development (Lindsey *et al*., 2007), and in generating greater revenue from a lower number of tourists (Di Minin *et al*., 2016). Trophy hunting of ungulates has been carried out in a number of Central Asian countries, with mixed results (Mallon, 2013).

Commercial hunting describes all hunting from which animals, or animal derivatives, are destined for sale in a market. A range of products – including either living or dead individuals, and their tissues (such as skin, horn, bones, and meat) – may be sold, nationally or internationally, to meet consumer demand for trophies, food, clothing, decorative items, pets, and traditional medicine (TRAFFIC, 2008). This trade may represent a highly lucrative enterprise. The illegal wildlife trade is currently one the world's largest illegitimate businesses, estimated to be worth US$20 billion annually, although this figure is highly uncertain (Sas-Rolfes *et al*., 2019). Where animal products are highly sought after, commercial hunting may place significant pressure on biodiversity. The financial value assigned to a particular species through commercial hunting may however provide an incentive for sustainable use, as a potential long-term revenue stream.

Harvest of animals for **management or research** may improve monitoring of species' populations; size, age- and sex-structure, and vital rates, including fertility and mortality. Further, the technological and biological foundations for breeding – either in captivity or semi-free conditions – may be established. Often, scientific use coincides with alternative motivations for harvest; for example, where scientists are able to accurately track commercial harvests, this may help ensure their sustainability. Invasive or over-abundance species may be harvested as a management measure, in order to reduce their impact on the wider ecosystem.

Finally, **human-wildlife conflict** may cause a species to be hunted, either pre-emptively or reactively. Three classic scenarios exist: (1) the hunting of predators, which may otherwise kill livestock; (2) the hunting of disease vectors (carriers), to reduce transmission into either livestock or humans; and (3) the hunting of competitor species, which reduce available resource to livestock. Hunting may be done informally or illegally, for example out of resentment for loss of income or livelihoods or out of fear, or formally by managers, in order to keep numbers down to a tolerable level.

It is important to separate the motivation for hunting (subsistence, recreation, trade, management, human-wildlife conflict) from: (1) the sustainability of that hunting, and (2) the legal position of that hunting. It is possible for harvests to be illegal and sustainable or legal and unsustainable (Sas-Rolfes *et al*., 2019). An unsustainable harvest may be legal (for example if the species is an invasive pest, or if laws poorly reflect a species' conservation status). A sustainable harvest may also be illegal (for example, for crop pests in a jurisdiction where no wild harvests are permitted).

Frequently, grey areas exist with respect to the legality of harvests. It may be possible that hunting is legal at the national level, but illegal with respect to local regulations. Similarly, trade in a species' derivatives may be legal at the national level, but illegal internationally. It is important to have clarity about the rules governing hunting, with good coordination between stakeholders, for effective management. A number of case-studies, each exemplifying a different approach to harvest management, will now be discussed.

[8] https://www.cites.org/sites/default/files/document/E-Res-17-09_0.pdf

3.2. Examples of hunting management

We choose these examples to highlight various potential models for hunting management of relevance to Saigas, with brief reflections on lessons learnt. We have biased our choice towards relatively successful models and those which might have some congruence with saiga hunting, because these give positive ideas for how hunting could be structured. However, we have also included less successful models and offer some reflections on why they failed.

State management of hunting in the former Soviet Union (USSR)

An example of state-run hunting, performed by government agencies, is that of Saigas in the former USSR through the latter half of the 20th century (Sokolov & Zhirnov, 1998; Lundervold, 2001; and references therein).

In Kazakhstan in the 1960s, specialized hunting organisations (promkhozes) were established regionally throughout the Saiga range. The promkhozes both hunted and protected Saigas. Hunting would (supposedly) occur in line with quotas established by the Kazakhstan Institute of Zoology, by age- and sex-class, from data collected during spring and autumn censuses. Data included: estimates of fertility, mortality and population growth; age- and sex structure; and the influence of natural limiting factors such as dzhuts. When protecting Saigas, promkhozes might: cull predators; patrol calving grounds; and apprehend poachers.

In 1973, promkhozes were removed from control of the Kazakhstan Union of Hunting and Fisheries and transferred to the control of '*Kazglavokhot'*, a central administrative body. This formed part of the Kazakh hunting union, '*Okhotzooprom'*, which, in 1989, received exclusive legal rights for the commercial exploitation of saigas. This right-to-hunt, granted to the *Okhotzooprom*, arose to restrict private trade. It was instituted because, once border controls lifted between China and Kazakhstan in 1988, private co-operatives began to generate an unsustainable pressure on Saiga populations.

A similar management system existed in (what are now) the Russian Federation and Uzbekistan. This is a consequence of a uniform approach to management through the USSR, directed by the Interdepartmental Commission for the Conservation and Rational Use of Saiga. In Russia, the Department of Hunting and Wildlife Management oversaw *S. tatarica* harvest, with quotas calculated by the Russian Academy of Sciences. In Uzbekistan, the '*Uzbekrybolovohotsoyuz'* Council oversaw Saiga harvests, and the Uzbekistan Academy of Sciences established harvest quotas.

Additionally, in both Russia and Uzbekistan, specialized Saiga game management areas ('*gospromkhoz*') were established. These *gospromkhoz* were areas of Saiga range set aside for hunting, designed to improve yields and quality of product. The first *gospromkhoz* – the Astrakhan – was established in 1956, and the second – the Kalmykian – was established in 1977; both lay in the north-west Pre-Caspian region of Russia (Sokolov & Zhirnov, 1998). The Ustyurt *gospromkhoz* was also established in 1977, in Uzbekistan, and covered 1,380,000 hectares (Tsaplyuk, 1982). These *gospromkhoz* were only moderately successful, however.

Soviet management of Saigas is considered to have been of limited sustainability: although the species' numbers remained high overall, these declined compared to pre-Soviet populations. Declines may have been due to overhunting, be that on account of unrealistically high harvest quotas, or harvests (legal and illegal) exceeding annual quotas. Habitat loss, through conversion of Saiga range to agriculture and infrastructural development causing population fragmentation and mortality, are both also likely to have been responsible.

State management of hunting in the United Republic of Tanzania: Wildlife Management Areas

The United Republic of Tanzania has introduced a state-run hunting regime, targeted for recreational trophy-hunting by international tourists (Benjaminsen *et al.*, 2013; Baldus & Cauldwell, 2004; and references therein). All wildlife in the country is officially controlled by

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the Ministry of Tourism and Natural Resources, except for animals inside national parks, which are managed by the Tanzanian National Parks Authority. Thus, hunting is controlled by the Central State, and hunting quotas established by the Ministry of Tourism and Natural Resources. Hunting blocks are allocated by the State to private companies; allegations of corruption have been made against this process, since no bidding occurs, and companies owned by senior public officials are able to acquire a lease at little cost.

Local people appear to resent wildlife management as conducted by the Tanzanian Government. In the late 1990s, in response to pressure from international donors, Tanzania began to outline plans for creation of village-based WMAs. Yet from 2008, it has been illegal for local people to establish tourism operations without the express permission of the Ministry of Tourism and Natural Resources. Further, when WMAs were initially introduced, villagers were promised a phase-out of state-controlled trophy hunting, in favour of locally assigned quotas; this did not materialize, and the State retained control of hunting-generated revenue streams. Now, the State's Wildlife Protection Fund of the Wildlife Division collects and manages hunting fees; it is unclear whether these are successfully redistributed at the local level (Homewood et al. 2015).

The sustainability of trophy hunting in Tanzania has been questioned (Packer *et al*., 2011); harvest quotas established the Ministry of Tourism and Natural Resources are thought often to be too high. Nonetheless, conservation benefits are observed, in the persistence of wild areas, and large carnivores, across the landscape (Dickman *et al*., 2019).

Local governmental management of hunting in Scandinavia

In Scandinavia, hunting is also state-run, but via local governmental agencies (Reimers, 2007; Strand *et al*., 2012; Sylvén, 2003; and references therein). Both regional authorities and local hunting clubs are involved in regulatory decision-making.

For hunting of Moose (*A. alces*) in Sweden, two regulatory variants exist: either county administrators establish quotas within a local area, or local hunting clubs submit management plans for review by county administrators. Under the former, management areas are often far smaller than under the latter (tens of km^2 as compared to hundreds of km^2); the size of the area matters, because hunters' observations are used to monitor population status. The optimal size of an area, for accurate population estimates, appears between 300 km^2 and 3,000km^2 (Sylvén, 2003).

A. alces are particularly suited to local management in Sweden. This is because the species' seasonal migrations are small, and environmental conditions differ quite significantly over small distances; environmentally-related body mass variation and associated reproductive variation have been found, even between proximate populations (Sylvén, 2003).

For Reindeer (*R. tarandus*) in Norway, a similar system exists. A Wild Reindeer Board – one for each of 23 hunting districts (*Figure 3.1*) – represents the national government and consists of political appointees from municipalities overlapping the district. A local board also exists, to which are elected local landowners. Each year, the local board propose a harvest quota, which must be approved by the district's Wild Reindeer Board. Hunting permits may then be issued, for individual Reindeer by age- and sex- class, to licensed local or non-local hunters. These permits specify a district within which to hunt; though districts may be split further by private ownership, local management allows hunters to move freely through districts, and follow the highly mobile reindeer. Upon return from a hunt, it is necessary to provide specified animal parts (typically one side of the lower jaw) for verification of harvest levels, population monitoring, and research purposes.

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Generally, this governmental management has worked well, and harvests are considered sustainable. All stakeholders are involved in decision-making, whilst sufficient autonomy is afforded between hunting districts for diverse, local considerations to be accounted for.

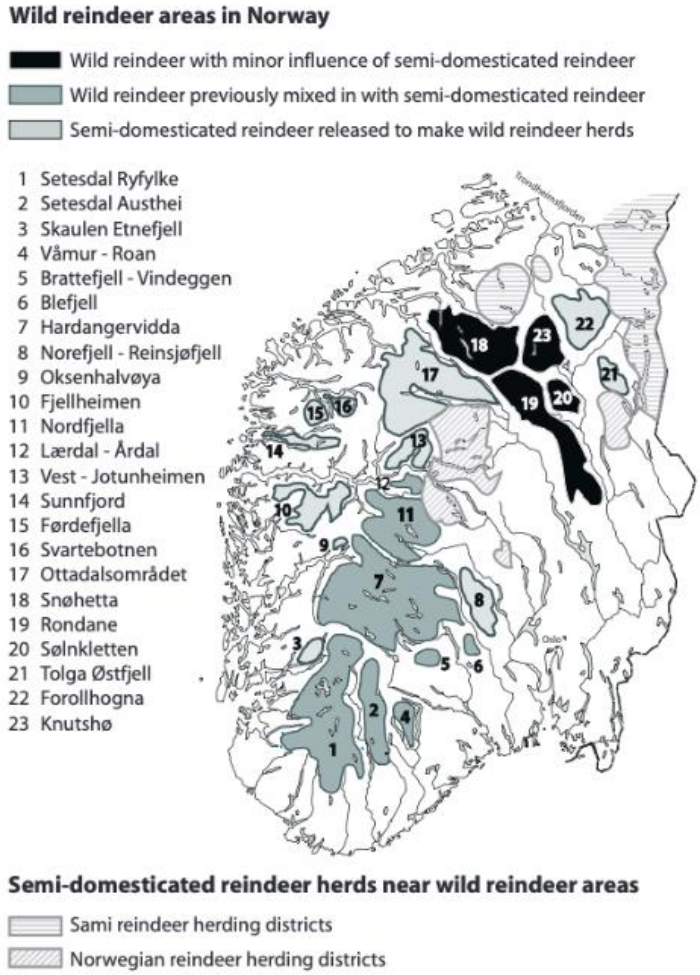

Figure 3.1. *Reindeer hunting districts in Norway, including the composition of herds, and ownership of districts. Sami Reindeer herds are managed by indigenous Sami communities, alongside the Wild Reindeer Board. Reproduced from Reimers (2007).*

Co-management of Reindeer harvest in Norway and Canada

Co-management of wildlife harvests is a cooperative approach between government and local communities. Through Scandinavia and Canada, co-management exists for Reindeer, between local government and indigenous societies.

In Norway, the Sàmi people practise Reindeer husbandry as part of an indigenous, nomadic lifestyle (Johnsen *et al*., 2017; and references therein). In 2007, a Reindeer Husbandry Act encouraged Sàmi self-governance within Reindeer herding districts (see *Figure 3.1*). Internal management plans were required from each herding district, for approval by local government, that specified an upper limit on Reindeer numbers. More recently, government targets for carcass weights, reindeer numbers and densities, have been established, following population models in the literature. In keeping with these targets, Sàmi herding districts have been required to develop further management plans; these may then be used as indicators of harvest sustainability, such that government sanctions can be introduced where targets are not met.

In Nunavut, Canada, co-management of Reindeer exists between the Inuit people and the regional government, across twelve separate Reindeer populations (Wheatley, 2003). Three separate organizations mediate this co-management: the Nunavut Wildlife Management Board (NWMB), the Hunters and Trappers Organization (HTO), and the Government of Nunavut's Department of Sustainable Development (DSD). The NWMB is the main instrument of wildlife management, to which government officials and local stakeholder representatives are appointed. The NWMB's mandate includes establishing quotas or non-quota limitations on harvesting (non-quota limitations include, for example, season duration and hunting methods), and approving management or conservation plans. Each of the 27 Inuit communities in Nunavut has an established HTO, with membership comprised of the Inuit beneficiaries of that community. Each HTO regulates its members' wildlife harvests, and reviews issues affecting wildlife about the community. Finally, the Government of Nunavut's DSD acts as the ultimate authority in *R. tarandus* decision-making; the Minister of Sustainable Development oversees this co-management process, and may intervene in matters of conservation, public health and safety, or Inuit harvesting rights.

This co-management, between indigenous people and local government, represents an evolution on the Scandinavian management of *A. alces* and *R. tarandus* by local government. Greater autonomy is afforded to traditionally self-governed people (the Sámi and Inuit), such that their livelihoods, and the persistence of *R. tarandus* populations, may continue to coincide. Thus, the incentives for sustainable harvests of *R. tarandus* are two-fold: (1) that traditional livelihoods depend upon it; and (2) for compliance with governmental regulation.

Local management of hunting in Namibia: Communal Area Conservancies (CAC)

The Namibian CAC model – established via governmental legislation in 1996 – allows local communities to group together and form 'conservancies'. These conservancies are legally-recognized, geographically-defined areas within which local people sustainably manage, and benefit from, wildlife (Weaver & Petersen, 2008). Typically, communal conservancy concessions are then granted by local communities to private tourism operators, which may then organize trophy hunting. The revenues flow back to the conservancies and are distributed to community members. For protected species, the Namibian Ministry of Environment and Tourism establishes sustainable offtake quotas, and issues hunting permits through each CAC. For all other species, CACs themselves set harvest quotas.

CACs regularly practise zoning; as multi-use areas, land-use may be allocated to infrastructural development, ecotourism, trophy hunting, subsistence agriculture, and subsistence hunting. This reduces conflict between each activity, protecting local peoples' livelihoods and the revenue streams generated by tourism. As of 2008, some 5,800 trophy hunters would visit Namibia annually, generating in excess of $70 million: at that time CACs occupied 14 per cent of Namibian landmass, and employed 13 per cent of its population. Concomitantly, poaching of wildlife has decreased and population trends in large, hunted species are increasing. The Namibian CAC model is widely considered the best example of successful, community-based wildlife management.

Local management of hunting in Pakistan: the Torghar Conservation Programme (TCP)

The Pakistani TCP represents an example of locally managed trophy hunting, conducted by international tourists (Bellon, 2008; Shackleton, 2001; and references therein). Founded in 1986, by the local Pashtun communities, the TCP was designed to save two species: Suleiman Markhor (*Capra falconeri jerdoni*), and Afghan Urial (*Ovis vignei cycloceros*). Hunting bans were initially imposed by the Pashtuns, until the Pakistani Government could grant export permits for both species. The TCP, and the Pakistani National Council for the Conservation of Wildlife, would together sell trophy hunting permits; between 1988 and 2006, these ranged in price from $15,000-$40,000 for Suleiman Markhor, and from $8,000 to $10,000 for Afghan Urial. Local people, as part of the Game Guard Programme, accompany

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hunters, and conduct wildlife surveys to inform quota-setting. Successful hunts are then reported to the National Council for the Conservation of Wildlife.

Generally, quotas have been highly conservative, with only a handful of individuals hunted each year. That permits fetch such high prices has allowed the continued success of the TCP – in preserving both local livelihoods and allowing recovery of both Suleiman Markhor and Afghan Urial The TCP project has generated significant benefits for about 400 local families. Income from trophy hunting and donor aid covers the salary of 82 game guards. Water towers, dams, and irrigation canals have also been funded, to ensure water supply during drought. Finally, a field hospital has been constructed, improving community access to healthcare.

Local management of hunting in Tajikistan: Ibex and Markhor[9]

This project involves community conservancies that were initiated by NGOs, communities and supporters in 2008, to conserve Ibex and Markhor through and sustainable use. Conservancies are in remote, poor areas where traditional lifestyles are largely dependent on natural resources and where poaching and overgrazing became serious problems under Soviet and post-Soviet regimes. The aim is to support sustainable community livelihoods in a way that promotes conservation of wild species and habitats. Eight conservancies are now functioning, with another six in development. They cover approximately 420,000ha and are managed by local traditional hunters.

Community members are involved in all aspects of wildlife management and hunting; population monitoring, anti-poaching efforts, homestays, harvests for food supply. To do so local people draw on local traditional knowledge blended with modern systematic knowledge. Conservancies relying on hunting provide locally significant livelihood benefits: Around 300 jobs are directly provided, with approximately 20,000 community members benefiting indirectly. The community-based management and associated trophy hunting programmes in Tajikistan have also led to increased populations of Ibex and Markhor. The benefits have led people to value wild species and landscapes, leading to lower livestock densities, improved sustainability of grazing practices, improved population monitoring and anti-poaching efforts, and more effective law enforcement.

Keys to success included: gaining active and committed engagement of local people, who are driven by livelihood incentives; partnerships (both among conservancies and with other supporters) and a focus on transparency.

Key challenges included: inadequate building of partnerships with government; weak and inadequately transparent local mechanisms for spending of funds generated by hunting; weak governance in Tajikistan, making it challenging for conservancies to operate with certainty around allocation of permits and financial flows; and competition with the much more powerful private hunting interests, not necessarily supportive of community management.

Adaptive management of U.S. waterfowl

Finally, the U.S. harvest of waterfowl represents an example of recreational hunting managed by both national government and state authorities. Crucially, adaptive management is implemented, whereby the U.S. Fish & Wildlife Service (USFWS) undertakes an annual cycle of monitoring, assessment, and decision-making, to improve sustainability of harvests. Data are collected from monitoring activities such as aerial surveys and hunter questionnaires, to provide information on harvest levels, population size, and habitat conditions. Conservative estimates for key population attributes are entered into population models, with climatic variation incorporated, in an attempt to predict the effects of different hunting quotas. Subsequently, proposals for hunting regulation are developed, and opened for public review.

[9] *CITES & Livelihoods case study 2019: Ibex and Markhor trophy hunting in Tajikistan https://cites.org/sites/default/files/eng/prog/Livelihoods/case_studies/Tajikistan_ibex%26markhor_long_revSept26.pdf*

The USFWS may then address public queries, before announcing a regulatory framework for each state; specifically, a designated number of hunting permits are assigned by lottery, which allow only a sustainable offtake from waterfowl populations.

***Table 3.1**. A summary of relevant hunting management regimes, as discussed in the main text*

Species / Group	Country / ies	Description	Reference
Saiga (*Saiga tatarica*)	USSR	State management at the (inter)national level, with hunting performed by governmental operatives.	Sokolov & Zhirnov (1998); Bekenov *et al*. (1998)
Various: mainly ungulates, elephants, and carnivores	Tanzania	State management at the national level. Trophy hunting performed by international tourists, with little economic benefit experienced by local communities.	Benjaminsen *et al.* (2013); Baldus & Cauldwell (2004)
Moose (*Alces alces*), Reindeer (*Rangifer tarandus*)	Sweden, Norway	State management, but at the local level: either private landowners, or private hunting clubs, may work with local authorities to ensure sustainable harvests. Recreational hunting performed by local people.	Reimers (2007); Strand *et al*. (2012); Sylvén (2003)
Reindeer / Caribou (*R. tarandus*)	Norway, Canada	A co-management approach, between local indigenous people and regional governments. Local people harvest *R. tarandus* for subsistence, but must do so sustainably, in keeping with governmental guidelines	Johnsen *et al*. (2017); Wheatley (2003)
Various: mainly ungulates and carnivores	Namibia	A community-run approach, with 'conservancies' recognized by the state, which assists also in calculation of harvest quotas for endangered species. Trophy hunting performed by international tourists, and subsistence hunting by local people.	Weaver & Petersen (2008)
Suleiman Markhor (*Capra falconeri jerdoni*), Afghan Urial (*Ovis vignei cycloceros*)	Pakistan	A community-run approach, with state involvement only in sale of hunting permits, provision of export permits, and assistance in wildlife protection. Trophy hunting performed by international tourists.	Bellon (2008); Shackleton (2001)
Asiatic Ibex (*Capra sibirica*) and markhor (*Capra falconeri*)	Tajikistan	A community-run approach, initiated by NGOs and managed by local hunters. Revenues raised from international trophy-hunting.	CITES (2019)
Waterfowl	USA	A state-run approach, with quotas calculated by the US Fish and Wildlife Service (USFWS) for each particular state, as part of an adaptive management initiative. Recreational hunting performed by licensed hunters.	USFWS (2018)

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To summarize, this section has explained the motivations for hunting – either for subsistence, commercially, recreationally, for management, or as a consequence of human-wildlife conflict – and outlined case-studies showing how hunting is managed globally. These case-studies demonstrate a diversity of structures by which harvests may be managed; broadly, either the state or local people may be responsible, or they may cooperate under co-management. Motivations for hunting, and management of harvests, then intersect; harvests may be performed by government operatives, for commercial purposes; by local people, for subsistence, commerce, or recreation; or by international tourists, typically as trophy hunters.

3.3 Possible structures for management of saiga harvesting

Section 3.2 has described a variety of case-studies in hunting management and highlighted a diversity of possible approaches. Following from this, the institutional and socio-political considerations for future harvest of Saiga can be explored. First, possible goals for sustainable harvests are outlined. Second, an overview of constraints and opportunities for management of Saiga harvests are presented. Finally, potential approaches for monitoring harvests are explored, to support effective regulation at the national level.

Goals for sustainable harvest

Theoretically, harvests may be structured against four separate objectives: (1) profit; (2) volume of product; (3) social benefits; (4) conservation benefits.

To maximize profits, single-operator management regimes may be most efficient. This is because harvests need not incur transactions costs, as when involving multiple private operators or local communities. Single operators can plan for long-term sustainability, which is likely to lead to higher population sizes and higher yields than competitively structured harvests (Clark 2010). Additionally, single-operator harvests achieve economies of scale; these are likely to span larger areas than any locally run regimes, and so target larger wildlife populations for which hunting and processing may occur more efficiently. Single-operator harvesting may be state run, or devolved to a hunting agency (as in the Soviet system).

To maximize the volume of product, it is also likely that single-operator systems outperform community-run operations. Again, this is because these are likely to span larger areas, with larger wildlife populations at their disposal. An overarching perspective on a wildlife population should allow harvest quotas to be more precisely tuned, to maximise product; adaptive management in the U.S. waterfowl harvest, for example, would be difficult to apply over small spatial scales, where populations are open to emigration and immigration. Single operators, such as nation states or their agencies, may also afford to invest in technical expertise where local communities could not. This should further improve monitoring, calculation of harvest quotas, and implementation of efficient practice, which, together, may increase volume of product. Last, it is likely that single-operator harvests may better fulfil a single function – for example, harvest of horn for trade, as in Soviet Saiga management – and so better target a desired product; in community-run harvests, some division between commercial hunting, trophy hunting, and subsistence hunting might instead be necessary to fulfil the objectives of different stakeholders within the community.

To maximize social benefits, a community-run harvest is likely to be preferable. Local people are able to manage a wildlife resource to extract maximum social value: as in the Namibian CAC model, communities may both extract meat for subsistence and generate revenue from ecotourism. Subsequently, communities may reinvest any profits from wildlife management; this is illustrated in the Pakistani TCP, where improved healthcare access was identified as an investment priority, and a community hospital so built.

Notwithstanding, state- and/or privately-run operations can still address societal needs; indeed, it is vital they do so, else they risk popular resentment (as observed in Tanzania), and non-compliance with harvest quotas. Such non-compliance may manifest as increased

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poaching, and conflict between wildlife and local communities. To avoid this, it is possible to pursue co-management, between local authorities and local communities: this is practised in both Canada and Scandinavia, for harvest of *R. tarandus*. Such co-management appears a successful middle-ground between community- and state-management. Both the technical expertise and capacity exist to implement sustainable harvests, while indigenous lifestyles are supported through ownership of the wildlife resource.

Finally, **to maximize conservation benefits**, it is important for management to operate on the same spatial scales as the biological population in question. This is because, where populations or stocks are managed in their entirety, local over-exploitation, with no regard for overarching population trends, may be avoided. A state-run operation, over larger areas, is likely to be effective for a wide-ranging migratory species; this is observed in U.S. waterfowl harvests, for which seasonal migrations align with management at the national scale. However, community-run operations do create incentives for wildlife conservation, as the revenue stream upon which long-term development may rely. Thus, for sedentary species, community harvests may be an effective conservation tool: this is observed in the Pakistani TCP and in hunting of markhor and ibex in Tajikistan.

In all, wildlife harvests may be managed to maximise: (1) profit; (2) volume of product; (3) social benefits; (4) conservation benefits. For each, either state- or locally-run harvests may be most suitable. The reality, however, is that a combination of goals is likely desirable, and that harvests are most likely sustainable, in the long-term, if financial, social, and biological considerations are met. To achieve such an outcome, both the state (at national and regional levels) and local communities, are likely to need to be involved, whether in co-management or not.

Additionally, all types of management regime can be prone to corruption, at all levels from local to international. This reduces the potential of hunting to contribute to any of the above goals. From our examples, perception of government corruption in management of wildlife harvests in Tanzania created resentment amongst local people, contributing to the underperformance of Wildlife Management Areas. In the end sustainability has ecological, financial and social components; all three are undermined by corruption. Transparency, accountability and legitimacy are required to combat this. It is also important that someone takes responsibility for the sustainability of the harvest; state-run conservation has a history of lack of accountability and therefore ineffectual management (e.g. National Parks that exist on paper but not in practice).

Constraints on saiga harvesting

Constraints on saiga harvest may be either ecological or socio-political. Ecological constraints include: environmental influences on population dynamics, such as climatic fluctuations and disease. Ecological constraints were discussed in Section 2, hence socio-political constraints are examined here.

Motivations for harvest of Saigas are an important consideration when structuring management regimes. Historically, Saigas have been harvested for two reasons: for their horns, and for their meat and hides. Harvest of horns has occurred for centuries, at commercial scales, either legally or illegally, to meet demand in Traditional Chinese Medicine (TCM). Through the 1990s, illegal commercial harvests contributed to a 95 per cent overall decline in saiga populations (Milner-Gulland et al., 2001). Today, despite it being illegal to trade saiga horn internationally, a commercial demand for use persists; an estimated 19 per cent of Chinese Singaporeans claim to use Saiga horn "most frequently" to treat heatiness (Doughty *et al*., 2019).

Harvest for meat and hide, meanwhile, has also been a longstanding tradition, and still occurs illegally today; this is for subsistence and trade within and between villages, as a cheaper

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alternative to domestic meat (Kühl *et al*., 2009; Hogg, 2014; Kor, 2015; Phillipson & Milner-Gulland, 2011). Any legal harvest of meat or horns could potentially be used to launder illegal harvests. A sustainable management regime would therefore need to consider any poaching, be it for horns or meat, as a constraint on harvest quotas.

Saigas have also been subject to trophy hunting conducted by international tourists. However, this appears an insignificant driver of harvests; between 1994 and 2005, legal exports of Saiga trophies numbered only 140 Saiga individuals (Von Meibom *et al*., 2010). This is because Saiga horn does not make an impressive trophy, hence is not particularly prized by trophy hunters. It is unlikely that a trophy hunting model such as the Pakistani TCP could be translated to Saigas, therefore.

Spatial influences on saiga harvest include: (1) the remoteness of their range areas; and (2) the species' seasonal migrations. In areas where poaching is prevalent, saigas avoid humans, and prefer to aggregate far from human settlements (Singh et al. 2010). This has implications for institutional harvest management: In remote areas, local management of harvests would be challenging given the absence of settlements; instead a state-run approach might be more practical.

Even where human settlements lie within a saiga population's autumnal range, as in the Ural population (Kazakhstan), community management may be challenging. This is particularly true where communities outside the population's autumnal range are precluded from saiga harvests. Under such circumstance, resentment may occur because of the unequal distribution of the costs and benefits of saiga presence. For this reason state involvement in harvests may be necessary. In harvest of *R. tarandus*, in Norway, both local and non-local people are permitted to hunt across hunting districts nationally. Revenues from harvests are then redistributed by the state, between hunting districts. Such benefit sharing – both in hunting opportunity, and revenues – might be applied to Saiga harvests. It would then be possible for all communities in any part of the Saiga's range to benefit from Saigas, and so support the management regime.

Opportunities for sustainable harvesting

Opportunities from sustainable hunting are both socio-economic and socio-biological. Socio-economic opportunities may derive from an involvement of local communities in harvest management, or national benefits from trade in Saiga derivatives. Socio-biological opportunities exist for the improved conservation of Saiga, including reductions in conflict with humans, and habitat improvement.

Already, the potential for local involvement in harvest of Saigas has been explored. To reiterate, local people may benefit from legal harvest of Saigas as a permissible traditional practice, and from access to cheap meat. Further, harvests – whether managed by local communities or the state – may create employment; this is important both for local livelihoods and the conservation of Saigas, since unemployment and poverty appear the primary drivers of poaching (Kühl *et al*., 2009; Phillipson & Milner-Gulland, 2011). Finally, sustainable harvests may create new revenue streams for the long-term development of rural communities.

With respect to socio-biological considerations, sustainable harvest of saigas may address the species' conflict with farmers and provide revenue streams with which to do so. It is believed that Saigas harbour disease and compete for water and pasture with livestock. Saigas are susceptible to both peste des petits ruminants (PPR) and foot-and-mouth disease and may transmit both to livestock. Though livestock are typically the initial host (Morgan et al., 2006), infection of Saigas may augment the severity and spatial scale of outbreak. Ongoing monitoring of domestic animals, and vaccination regimes, might both be funded with revenue generated from Saiga harvest. With respect to competition for water, it appears that Saiga often drink from artificial watering places (Bekenov et al., 1998); if local shepherds have

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reconditioned or created these watering places, potentially at considerable expense, this may cause friction.

Similarly, in regions of high livestock density, Saiga and livestock may graze rangelands together, such that forage becomes limiting. This is a particular issue for the Ural and Mongolia populations, where livestock and Saigas are confined to limited rangelands, particularly during winter. Elsewhere, in more extensive rangelands, this does not appear to be such an issue; the Betpak-Dala region, for example, is undergrazed (Kamp *et al*., 2011), whilst the North-west Pre-Caspian population of *S. tatarica* are documented as grazing a far greater breadth of vegetation than any livestock species (Petrishev, 1987). Nonetheless, it has been suggested that: (1) domestic pasture lands be patrolled to deter Saigas; and (2) that perennial fodder crops and artificial watering places be placed along the peripheries of agricultural areas for exclusive use by Saigas (Fadeev & Sludskii, 1982; Zhirnov, 1982; Zhirnov & Kalet, 1976). Whether either approach would work is unclear, though both could potentially be funded with revenues generated from saiga harvest.

Finally, sustainable harvests of Saigas might possibly allow any threats to the species to be addressed. The primary threat to Saigas, over the last two decades, has been poaching. Should communities establish ownership of wildlife or recognize the importance of sustainable harvests for their long-term development, then poaching may diminish. A secondary threat to Saigas is infrastructural development: individuals may die in irrigation canals, trenches dug for gas and oil pipelines, and wire fences placed beside roads, railways, and on national borders (Bekenov et al., 1998). Further, linear developments, such as railroads, highways, and pipelines, may prevent migration, thereby fragmenting populations and increasing susceptibility to extinction (Harris et al., 2009). Already, consultations have been pursued for mitigation of infrastructural impacts on Saigas, including passage through linear barriers (Olson, 2013). With harvest of Saigas, further (economic) incentives would be generated to reduce the impacts of infrastructural development; populations must remain sufficiently large for harvest to be feasible.

Monitoring of harvest

It is important to monitor wildlife harvests, to ensure their effective regulation. In Norwegian management of *R. tarandus*, a body-part is collected (often one side of the lower jaw) from each individual killed, and stored; from here, age and sex of individuals may be identified, such that harvest levels can be established, and population monitoring conducted. An adaptive management regime can then be established, as in the USFWS's management of waterfowl harvests.

Just as populations may be monitored, so may animal derivatives, destined for commercial trade. Typically, monitoring regimes track animal derivatives individually, from initial harvest to ultimate buyer. Such tracking may use numerical markings, unique to an individual piece, in reference to a time and location at which harvest occurred. Different marking techniques – for rhino horn – are outlined in Table 3.2; given that Saiga horns are far smaller than rhino horn, it is noted where size renders a marking technique unsuitable. We discuss marking further, in the context of stockpile management, in section 6.5.

To improve security in trade of animal derivatives, a Central Selling Organization (CSO) may be established; this is recommended for stockpiles of rhino horn (Biggs *et al*., 2013), and has also been explored for elephant ivory (Martin *et al*., 2012). Further, a CSO existed for *S. tatarica* in the 1980s, under the Department for the Protection of Wildlife of Kazakhstan. In principle, a CSO should collect all derivatives harvested at a national level, prior to redistribution for national or international sale. The CSO may then exist as the sole legal vendor of an animal derivative, and so as a checkpoint for monitoring legal harvest. Consequently, the CSO might manage monitoring databases, and ensure that numerical markings – applied shortly after harvest – align with those expected from both source and

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buyer. A similar system might be put in place for the control of trade in horn from natural mortality. It should be noted that, as commercial trade is currently banned for saigas, this is currently a hypothetical discussion, but more detail on how a CSO might implemented in Kazakhstan is given in section 4.3.

Table 3.2. *A summary of different marking techniques, as practised in monitoring stockpiles of rhino horn through Africa. These may be split into two categories: visible marking techniques (numbers one through five), and hidden marking techniques (numbers six and seven). Reproduced from Milledge (2005).*

Marking Technique	**Advantages**	**Disadvantages**
Engraving	- Markings applied directly to horn - Markings quick to apply	- It is difficult to engrave small horns - With time, engravings may become difficult to read
Tagging with: - rivets - wire/cord/cable ties - glue	- Attachments often durable (particularly rivets) and easy to apply (particularly glue)	- Rivets cannot be used on particularly small or poor-quality horn - Drilling may be expensive or impractical - Attachments may rust, loosen, or rot - Glue may quite easily come away
Marker Pen	- Markings applied directly to horn - Markings quick to apply - Markings cheap to apply	- Markings may rub off or become faint over time - It may be difficult to mark small horns with lengthy numbering systems
Digit Punches	- Markings applied directly to horn	- Requires a smooth surface, hence would not work on damaged horns - It may be difficult to mark small horns with lengthy numbering systems - Markings become faint over time
Labels	- Markings quick to apply - Markings cheap to apply	- Labels may be weak and likely to detach
Transponders	- These are small, wireless devices that may receive a signal, then emit a different signal in response. The emitted signal should be unique, allowing identification. - Transponders are easy to implant	- Transponders may be expensive to introduce for large amounts of horns - Readers are also expensive, and may need to be of the same manufacturer as the transponders, to ensure compatibility - High levels of international coordination necessary in recording transponder signals and identity of each horn
Ultraviolet Fluid	- Markings applied directly to horn - Markings quick to apply	- Imprecise application, so could not be used for numbering systems specific to an individual horn

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3.4. Summary

This section has outlined generic goals in wildlife harvest and related these to harvest of Saigas. Goals in wildlife harvest might include maximising: (1) profit; (2) volume of product; (3) social benefits; or (4) conservation benefits. Different systems of management may be better suited to meet different goals. In saigas, constraints on harvest management include: different stakeholders' motivations for harvest; the remoteness of the species' range area; and the species' seasonal migrations. Opportunities include: the potential to generate revenue streams that benefit of local communities, and creation of employment opportunities. Further, revenues may be reinvested to reduce human conflict with saigas, or to reduce threats which the species experiences (such as poaching and infrastructural development). Finally, there are effective systems available to monitor both harvests and Saiga derivatives, thereby improving opportunity for any future legal trade.

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4. Population-specific considerations.

In this section, we discuss in turn the status of saigas in each Range State, and what this means for the potential for sustainable harvest in the near future. As wildlife management policy needs to be set at the national level, we focus at this level, but we also discuss the differences between individual populations and the potential management options for transboundary populations. Responsible institutions which currently contribute to Saiga management are listed for each Range State in Table 4.1; the majority are state bodies, but NGOs are also involved in monitoring Saiga populations and contributing scientific and conservation expertise.

The general factors affecting saigas are similar across the species range: poaching, disease, infrastructure, weather and climate, predation. However, each population has different circumstances, which affect whether it would be realistic to consider sustainable use at this time.

4.1. Russia: The North-West Pre-Caspian population

(Lead Authors: Anna Lushchekina & Tatyana Karimov, Institute for Ecology & Evolution, Russian Academy of Sciences)

Russia's main Saiga population is the North-West Pre-Caspian population, which inhabits the territory of the Republic of Kalmykia and Astrakhan province. Russia also hosts small groups of Saigas within the transboundary Ural and Betpak-Dala populations, which are mostly found in Kazakhstan. Our review of the Betpak-Dala and Ural populations can be found in sections 4.4 and 4.5 respectively; here we focus on the North-West Pre-Caspian population. However, the Federal rules and management structures described below apply to any Saigas within the Russian Federation.

Review of population size, trends and demographic structure

The Saiga population of the North-Western Caspian is an independent (meaning, isolated from others) population that lives in Russia, inhabiting the south-western regions of the Astrakhan region (Limansky district) and the eastern regions of the Republic of Kalmykia (Yashkulsky and Chernozemelsky districts). The region within which the Saiga population of the north-western Caspian region currently lives is called “Chernye Zemli” (Black Lands) - here, due to strong winds in winter, snow cover is often absent and the land remains black (Karimova & Lushchekina, 2018).

The fate of the Saiga in this area has not been easy: its history is like a pendulum - it becomes an object of mass hunting; it is on the verge of extinction, as happened only a few decades ago; then again, numerous herds. In the figurative expression of one of the leading Russian Saiga experts, L.V. Zhirnov (1982), there are tens of thousands of Saigas “returned to life” during the migratory seasons.

As a result of overexploitation, the number of Saigas at the beginning of the 20th century was at a minimum, and by the 1920s only a few hundred saigas remained in the most remote part of the Republic of Kalmykia. The total number in the 1920s and 1930s was estimated by some scientists at about a thousand individuals. The population was essentially on the verge of extinction, but this did not happen - the Saiga, as a rare species, was given enhanced state protection, after which a new stage in its history began - the stage of recovery, which was very slow due to the extremely low initial abundance. It took about 20 years of full protection for the extremely rare species to become common again in this part of the range by 1940 (Sokolov & Zhirnov, 1998).

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***Table 4.1**. A summary of institutions responsible for management of Saiga in each Range State.*

Country	**Hunting**	**Keeping and Breeding**	**Ownership of Body-parts and Derivatives**	**Domestic Trade in Body-parts and Derivatives**	**International Trade in Body-parts and Derivatives**	**Monitoring of Populations**	**Reporting and Control of Disease**	**Infrastructural Development**
Uzbekistan	State Committee on Ecology and Environmental Protection	State Committee on Ecology and Environmental Protection	State Committee on Ecology and Environmental Protection	State Committee on Ecology and Environmental Protection; Ministry of Internal Affairs	State Committee on Ecology and Environmental Protection; State Customs Committee	Academy of Sciences of the Republic of Uzbekistan	State Veterinary Committee	Uzbekneftegaz; State Joint Stock Railway Company; State Committee for Roads
Russia	Ministry of Natural Resources and Ecology; Designated regional authorities	Ministry of Natural Resources and Ecology; Ministry of Agriculture; Designated regional authorities	Ministry of Internal Affairs	Ministry of Internal Affairs	Ministry of Natural Resources and Ecology, Federal Customs Service; Federal Security Service	Ministry of Natural Resources and Ecology & associated institutions, Institute of Ecology and Evolution of the Russian Academy of Sciences, WWF Russia	Ministry of Agriculture; Designated regional authorities	Ministry of Natural Resources & Ecology; Federal Service for Environmental Supervision; Designated regional authorities
Mongolia	N/A	N/A	Ministry of Environment and Tourism	Ministry of Justice and Internal Affairs	State Customs General Administration	WWF Mongolia, WCS Mongolia	WWF Mongolia, WCS Mongolia	Ministry of Environment and Green Development
Kazakhstan	Ministry of Ecology, Geology and Natural Resources (Committee for Forestry and Wildlife)	Ministry of Ecology, Geology and Natural Resources (Committee for Forestry and Wildlife)	Ministry of Ecology, Geology and Natural Resources (Committee for Forestry and Wildlife)	Ministry of Finance, Ministry of Internal Affairs, Ministry of Ecology, Geology and Natural Resources	Ministry of Ecology, Geology and Natural Resources; State Customs Authorities	Association for the Conservation of the Biodiversity of Kazakhstan (ACBK)	Ministry of Agriculture (Committee for Veterinary Control and Surveillance); Ministry of Ecology, Geology and Natural Resources	Ministry of Industry and Infrastructure Development

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In the past at least 30 years, the state of the Saiga population inhabiting the north-western Caspian has raised serious concerns among specialists, because its numbers are still extremely low. So, if in the mid-1990s, the number of Saigas reached 260,000 individuals (not to mention the fact that in the middle of the twentieth century it was about 800,000 individuals; Bannikov *et al.,* 1961), then in 2000 it fell to 25,000 and, gradually decreasing, by 2016 reached 4,500 individuals (Karimova et al. 2020). By mid-2020, the Saiga population in the north-western Caspian region may be about 8,500 individuals, according to expert estimates.

Quantitative censuses (or rather, expert assessments) of the Saiga population began in the North-Western Caspian region in the 1950s (Sokolov & Zhirnov, 1998), which makes it possible to trace the dynamics of the species population over a long-term period (Fig. 4.1).

***Figure: 4.1**. Population dynamics of the Saiga inhabiting the north-west Pre-Caspian region. . Reproduced from Karimova et al. (2020)*

Along with the observed long-term decline in the number of Saiga, the area of its main habitat also decreased, from 60-70,000 km^2 to 2-3,000 km^2 (Karimova *et al*., 2020; Fig. 4.2), and a significant part of the population moved to a sedentary lifestyle, with only limited movements.

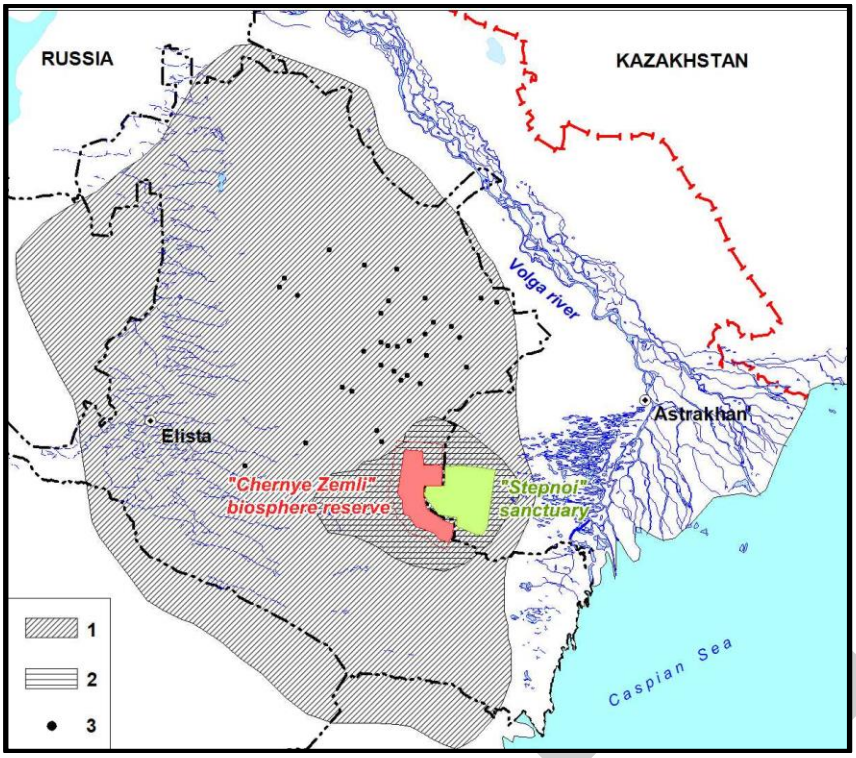

Figure: 4.2 *The area of the saiga population in the north-west Pre-Caspian region: 1 - the area during the years of high abundance (1950-60), 2 - the current area, 3 - the places of rare saiga encounters in recent years outside the main area. Figure provided by T. Karimova.*

So in recent years, small saiga herds make only small migrations, preferring to stay in protected areas all year round (the steppe section of the “Chernye Zemli” Reserve, Republic of Kalmykia, and the Stepnoi Reserve, Astrakhan district) or near them, on an area that is only 10.2 per cent of all optimal habitats in this region (Paltsyn, 2016). This area is relatively undisturbed and has sufficient forage resources.

The collapse of the Soviet Union and the subsequent economic crisis led in the early 1990s to saiga poaching taking on "industrial proportions". Sexually mature males were especially appreciated, whose horns are still in high demand abroad. As a result, there was a violation of the age and sex composition of the population, when the proportion of adult males in some years did not reach even 1 per cent (Milner-Gulland *et al*., 2003). In recent years, thanks to the measures taken to protect the Saiga and the resilience of the species, the situation has begun to improve, and the proportion of adult males in the population, according to expert estimates, has almost reached the level of periods of high abundance, at about 18 per cent. However, the shortage of sexually mature males in the population (less than 10 per cent), which occurred for a long time, led to a decrease in the reproductive rate and, consequently, to a decrease in its numbers (Karimova *et al*.; 2018; Karimova *et al*., 2020).

To determine the demographic structure of the population, studies are carried out annually in June-July, using expert knowledge to assess the qualitative composition of the population in the two protected areas where Saigas occur, by three sex and age groups; adult males, adult females and juveniles of the current year (see Table 4.2). Over the last few years, the demographic structure of the population has tended to improve (Bogun *et al*., 2018; Karimova *et al*., 2020). The number of juveniles per female is an indicator of the reproductive potential of the population and is estimated at 1.15. This compares favourably with the maximum value of this indicator (around 1.28), which was observed during the years with the most favourable conditions (for example in 1958). This indicator reaches its minimum value (0.31-0.34) in unfavourable years (for example, 1961).

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***Table 4.2**. Age and sex composition of Saigas in June-July 2014-2020 (%).*

Year	Males	Females	Juveniles
2014	5.7	76.2	18.1
2015	5.4	81.3	13.3
2016	8.1	43.9	48
2017	12.4	50.6	37
2018	16.6	44.7	38.7
2019	15.8	43.9	40.3
2020	18.5	37.9	43.6

Natural and anthropogenic factors that cause fluctuations in the Saiga population can act synergistically against the background of long-term changes in climatic conditions. It can be said with caution that trends in the livestock population coincide with the characteristic changes in climate which control both the productivity of the vegetation and the presence and number of watering places.

History of saiga hunting management

The management of the Saiga population of the North-west Pre-Caspian region in the mid-twentieth century was first carried out by hunting societies, who both shot animals and processed the harvested products. However, this form of organization had many drawbacks, including violation of harvest rules and the low quality of the harvested products. Later, the first specialized state hunting agency for Saigas in Russia was organized - the Astrakhan state industrial farm, and in 1977 the Kalmykian state industrial agency was created. In the early 1990s this agency conducted organized saiga hunting in the north-west Pre-Caspian region. Each state hunting agency had 1-2 reception points equipped with refrigerators, living quarters and utility rooms, workshops for processing animal carcasses, refrigerated trucks were used for storing and exporting meat. The creation of state industrial enterprises made it possible to conduct resource development more rationally. Brigades of professional hunters began to hunt saigas on these farms and were provided with weapons, vehicles and other necessary equipment. These farms were also entrusted with the functions of protection (ranger service), counting the population and monitoring its state, not only during the hunting period but all year round (Zhirnov, 1982; Sokolov & Zhirnov, 1998; Bliznyuk, 2009).

With the organization of state industrial farms, the quality of harvested products significantly improved, with the observance of harvesting rules along the entire supply chain, from population monitoring and harvesting to processing and selling products. In these conditions, it became possible to apply scientific recommendations on the timing, norms and composition of the animals harvested, which made it possible to use saiga resources more rationally. This experience has shown the effectiveness and appropriateness of this form of organization, under the control of the State Hunting Supervision Service of the Ministry of Agriculture / Main Directorate of Hunting and Wildlife Preservation. At the end of 1990, the Council of Ministers of the USSR adopted a proposal to create an Interdepartmental Commission for the Conservation and Rational Use of Saigas under the USSR State Committee for Nature Protection, entrusting it with the functions of developing recommendations for the conservation, reproduction and rational use of Saigas, establishing limits and timing of hunting, the volume of harvesting for their horns, as well as quotas for the export of Saiga products. The USSR State Committee for Nature Protection was instructed to develop, in agreement with the USSR Academy of Sciences, other interested ministries, departments and

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regions of the USSR, and to approve the Statute on this Commission, as well as its personnel. At that time, licences for the export of Saiga horns were to be issued by the USSR State Committee for Nature Protection on the basis of the recommendations of the Interdepartmental Commission for the Conservation and Rational Use of Saigas, in agreement with the governments of the union and autonomous republics where Saiga harvests took place (Sokolov & Zhirnov, 1998).

In connection with the collapse of the Soviet Union in the early 1990s and the transition of the economy to market conditions, as well as the transfer of land to private ownership, the system for the rational use of Saiga resources, built and fine-tuned over many years, was destroyed. Instead, the illegal extermination of the species by the local impoverished population, as well as by motorized poachers who specialize in illegal exploitation of males for the sake of expensive horns, increased many times over. As D. Mallon (2006) once said, "... the catastrophic decline in the Saiga population was caused by a deadly combination of economic collapse (crisis), poverty, severe exploitation for commercial purposes and the growing demand for horns used in traditional medicine. All this was facilitated by the abrupt transition to an unregulated market economy, the opening of borders and the weakening of the environmental protection system". Moreover, the threat to the survival of the species goes far beyond a simple decline in numbers - mainly males are hunted (for the sake of their horns), which led to an extremely asymmetric sex ratio among adults and put the species on the brink of reproductive collapse.

Current conservation status

The Saiga is included in the list of game species of the Russian Federation. However, given the status of its population in the north-west Pre-Caspian, hunting has been prohibited since the mid-1990s (Bukreeva, 2002; Bliznyuk, 2009). Illegal hunting and trafficking of Saiga and its derivatives are subject to a number of articles of the Criminal Code of the Russian Federation. Also, rules concerning the advertisement of Saiga products and derivatives, using the mass media or electronic or information and telecommunication networks including the internet, have been tightened. In 2019, the Government of the Russian Federation established a procedure for calculating damage from illegal hunting for criminal prosecution, according to which the rate for illegally hunting Saigas is 60,000 roubles (roughly $US800) per animal.

In 2015, the Saiga was included in the Red Book of the Republic of Kalmykia, and in 2019 in the Red Book of Astrakhan region. By order of the Ministry of Natural Resources and Ecology of the Russian Federation, in March 2020, the Saiga was included in the Red Book of the Russian Federation. In addition, the following strategic documents are relevant to Saigas: the Strategy for the Conservation of Rare and Endangered Species of Animals, Plants and Fungi in the Russian Federation until 2030; the action plan for the implementation of this Strategy; the strategy for the development of the hunting economy in the Russian Federation until 2030; the action plan for the implementation of this Strategy; Federal laws: "On hunting and on the conservation of hunting resources", "On veterinary medicine", "On the responsible treatment of animals", and "On the animal world".

One of the directions of the federal project "Conservation of biological diversity and development of ecological tourism" of the national project "Ecology" is the preservation and restoration of rare and endangered species of animals. This includes 11 priority animal species, including the Saiga. Documents defining the main direction of activities for the study, conservation, protection and restoration of the saiga population within the framework of the above federal project are the:

- Roadmap for the conservation and restoration of the Saiga;
- Strategy for Saiga conservation in the Russian Federation until 2030 and an Action Plan for its implementation;

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- The Action Plan for the Conservation of the Saiga Antelope in the Russian Federation until 2025, prepared in accordance with the Memorandum of Understanding on the Conservation, Restoration and Sustainable Use of the Saiga Antelope.

Aware of the difficult situation in which the Russian Federation's Saiga population has found itself in recent decades, particularly in the north-west Pre-Caspian, in 2018 WWF Russia declared this species, among eight other rare animal species, as a priority.

At present, the following institutions are engaged in the study, protection, conservation, and restoration of the saiga population in the north-west Pre-Caspian region:

At the Federal level: Ministry of Natural Resources and Environment of the Russian Federation; Federal Service for Environmental Supervision; Information and analytical centre for support of nature reserve management with the department for support and implementation of the Federal project "Conservation of biological diversity and development of ecological tourism"; State Natural Reserve "Chernye Zemli" including the "Mekletenisky" Reserve (Republic of Kalmykia); Scientific Research Institute for Environmental Protection (VNII Ekologii) (scientific, methodological, informational and analytical support for the fulfilment by the Russian Federation of its obligations under the Memorandum on Saiga Conservation under the Bonn Convention on the Conservation of Migratory Species of Wild Animals; scientific body CITES); Institute of Ecology and Evolution of the Russian Academy of Sciences (development of scientific foundations and recommendations for the conservation and management of saiga populations; scientific body of CITES).

At the regional level: Ministry of Natural Resources and Environmental Protection of the Republic of Kalmykia (exercises control, regulation and protection within public hunting grounds); Service for Nature Management and Environmental Protection of the Astrakhan Region (manages the Stepnoi Reserve, as well as control, regulation and protection within public hunting grounds); Stepnoi Reserve of the Astrakhan region. In addition, in the Limansky district of the Astrakhan region, in the Astrakhanskoye state hunting farm, there is a saiga breeding centre under the Service for Nature Management and Environmental Protection of the Astrakhan Region. It is currently the only state-run Saiga breeding centre.

At the NGO level: World Wildlife Fund (WWF Russia), Russian Geographical Society, Saiga Conservation Alliance.

Probable future trends

According to individual-based model of Saiga population dynamics in the North-west Pre-Caspian region published by Rodnikova *et al*. (2018) and described in Section 4.1, fluctuations in the population size are the species' adaptation to both ecological conditions - characterized by frequent catastrophic weather events (drought, high snow cover, *dzhut*, etc.) - and to hunting offtake. The restoration of the proportion of sexually mature males should lead to a gradual (but not rapid) increase in population size.

The Saiga population of the north-west Pre-Caspian has not yet been able to recover from its depression. However, protection measures taken in the last two to three years have led to a tendency towards a slight increase in the population size and an improvement in its sex and age structure. On this basis, it appears that the depression in this saiga population, which has lasted more than 20 years, is coming to an end. And although an increase in the saiga population is expected, it is still too early to say that it has been achieved, because juvenile mortality can be very high, sometimes reaching 50 per cent, or even 85 per cent, depending on climatic and anthropogenic factors (Bogun *et al*., 2018).

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Potential levels of sustainable hunting, currently and in the future

Unfortunately, now and in the near future, it is not possible to consider any hunting for Saigas in the North-west Pre-Caspian population. Due to a number of factors that negatively affect the population (climate change, poaching, anthropogenic transformation of habitats, pressure from predators, epizootics), it is not possible to predict when the population size will reach a level at which either commercial or sport hunting could be carried out.

However, if the number of Saigas ever grows to numbers that could sustain commercial harvests, the experience of sustainable saiga hunting, accumulated and applied during the time of the Soviet Union (Zhirnov, 1982; Sokolov & Zhurnov, 1998; Bliznyuk, 2009), will probably be considered. At that time, the population size was 500-800,000, and commercial hunting offtake in some years exceeded 100,000 individuals. In this case, the level of commercial hunting offtake should be associated with natural fluctuations in the population size, i.e. during periods of population growth, annual hunting rates should be at the growth rate, and during periods of population decline, hunting should be stopped completely or kept at a minimal level. Only a differentiated approach to the establishment of annual hunting quotas can ensure the long-term sustainable use of resources without undermining the population. In Soviet times (Zhirnov, 1982; Sokolov & Zhirnov, 1998), the following scheme of hunting rates was recommended:

- during periods of increasing numbers, it is possible to take up to 20-25 per cent from the population without damage to recruitment;
- during periods of depression in numbers, hunting must be completely closed or carried out in limited volumes, below 8-10 per cent of the pre-hunting number (assessed before 1 October).

Options for institutional arrangements for sustainable hunting

Currently, under the Federal project "Conservation of biological diversity and development of ecological tourism", a group of experts is working on the instructions of the Ministry of Natural Resources and Ecology of the Russian Federation to prepare a Strategy for the Saiga Conservation in the Russian Federation, including sections with the phrase "sustainable use of the Saiga Antelope" (Clauses 6.2.3. Ensuring the effectiveness of federal state supervision in the field of protection, reproduction and use of wildlife and their habitat, federal state hunting supervision, production hunting control outside specially protected natural areas; 6.6.1. Implementation of the obligations of the Russian Federation on the Memorandum of Understanding on the Conservation, Restoration and Sustainable Use of the Saiga Antelope under the CMS). Probably, after this strategy is formalized into an official state document for implementation, these points will become more concrete. However, based on the current situation with the saiga population in the north-west Pre-Caspian region (see above) and the status of the species in the Red Book, it is unlikely that the strategy will focus on any “sustainable hunting”.

On 19 March 2020, the Minister of Natural Resources and Ecology of the Russian Federation Dmitry Kobylkin, signed an order defining the general process for submitting data on wildlife to the Ministry of Natural Resources of Russia, including hunting resources. The document is aimed at improving the quality and reliability of monitoring information submitted to the Ministry, which, in turn, is used to organize the rational use of hunting resources, as well as to increase the transparency of the process of establishing and approving quotas for the extraction of hunting resources. Thus, with the proper execution of this order by all responsible and interested persons and organizations (and there are quite a few in this country; individual owners of hunting grounds, regional bodies that control resources on publicly available hunting grounds, directorates of federal and regional special protected natural areas), an effective strategy for managing sustainable hunting could be possible. But for now, despite all the measures taken for the conservation and sustainable use of hunting resources, and the saiga population of the north-west Pre-Caspian region in particular, a radical change in the State's current position on the issue of saiga overexploitation would be required:

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First, we need an inventory of the population - in addition to counting numbers, an assessment of the age and sex structure and reproductive capabilities of the species is needed over its entire range, including information on the current state of the natural environment. Secondly, there is a need for the systematic creation of appropriate protected areas and rest zones on their migration routes. Thirdly, there is a need for the organization in the regions of a special environmental unit with targeted funding and specific powers to address offenses concerning the use of wildlife resources.

Beneficiaries: Who might benefit and how might the revenues be used?

Of all the uses of wildlife, recreational hunting tourism is the most economically viable, if not lucrative. In theory, hunting can provide an opportunity to generate extremely high incomes with minimal removal of individual game animals - usually aging males. Thus, hunting tourism could give a significant impetus to the economic and social development of remote underdeveloped rural and border areas. If conducted properly and transparently, hunting tourism could have a positive impact on wildlife, its habitats, and the populations that live nearby and to some extent protect and manage wild animals. However, every step in the development of hunting tourism must be done in the right way if such tourism is to fulfil its role as a tool for positive management and as a powerful incentive. Hunting can generate income for conservation and, at the same time, for the economic and social improvement of the local population, who use land inhabited by wild animals, and bear direct and indirect costs of living with wildlife. In theory, activities that generate income from wildlife can contribute to increased welfare while conserving biodiversity and other conservation goals. Unfortunately, this approach may not work for the Saiga because this species is not very attractive for trophy hunting.

With an increase in the population of the saiga in the north-west Pre-Caspian region to a level that allows the sustainable hunting of some individuals, it would be possible to organize commercial hunting with the subsequent sale of the products. Given the existence within the country and abroad of practically unlimited demand for horns, meat and other Saiga products, this seems realistic and promising. In addition to its direct social significance (the earnings of the population employed in legal hunting create an interest in preserving the resource and reduce incentives for poaching), replenishment of the budgets of different levels of government via taxes makes it possible to channel part of these funds towards protection of Saigas and/or compensation for the damage caused by Saigas to agriculture.

Summary

Saiga numbers in the north-west Pre-Caspian region have remained extremely low over the past 20 years, and the size of the local population currently does not exceed 8,500 individuals. In parallel to the decrease in the numbers of saigas, the range of the species has also decreased, and a significant part of the population has switched to a sedentary lifestyle in the protected areas of the Chernye Zemli ecoregion. The shortage of mature males (less than 10 per cent) over a long time has led to a reduction in population growth and, consequently, to a decrease in the saiga numbers.

Although the Saiga is included in the list of game species, hunting of Saiga in the north-west Pre-Caspian region (and throughout Russia as well) has been banned since the mid-1990s because of the threatened status of the species. Due to its low numbers and its upward trend in population size being so recent, the Saiga has been included in the Red Book of the Russian Federation and the Red Books of the constituent entities of the country. This, together with the provisions of the legislation of the Russian Federation, implies that no hunting of Saigas can be allowed in the north-west Pre-Caspian and other regions of Russia in the near future. Poaching and illegal trade in the saiga and its derivates fall under the provisions of a number of articles of the Criminal Code of the Russian Federation, and according to the Russian legislation, the horns seized at Customs checkpoints should be subject to specialised

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examination and subsequent destruction. In 2019, the relevant state authorities agreed to provide confiscated horns for research purposes.

Improving the quality of Saiga habitats through the creation of additional water holes and pasture condition improvement, mitigation of the negative impacts that are typical of all Saiga populations (linear infrastructure disrupting seasonal movement and migration routes, climate change, especially drought, anthropogenic transformation of habitats, epizootics, etc.), and enhancing protection of the Saiga population in the north-west Pre-Caspian region will contribute to increasing the proportion of mature males, which, in turn, will result in an increase in the overall population size.

4.2. Mongolian population

(Lead authors: Buyanaa Chimeddorj, WWF-Mongolia, Bayarbaatar Buuveibaatar, WCS-Mongolia)

Review of population size, trends and demographic structure

Trends in the population of the Mongolian Saiga in the past were largely based on partial surveys or anecdotal evidence; this has resulted in large fluctuations in estimates of the total population size (Dash et al., 1977; Sokolov et al., 1978; Sokolov et al., 1992; Sokolov & Zhirnov, 1998). During the 1970-1990s, point estimates of the population varied between 200 and 1,300 individuals (Lushchekina et al., 1999). Since the late 1990s, regular population monitoring has begun using systematic transect surveys across its entire range. However, the methods used in these surveys provided only a measure of relative abundance, with no corresponding measure of uncertainty, precluding statistical comparisons (Chimeddorj et al., 2009). During this period, the Saiga population has plummeted to approximately 800 individuals as a consequence of harsh winters in 2001 and 2002.

The use of long-distance driving transects following the protocol for distance sampling and analysis was piloted in the Shargiin Gobi in 2006 and 2007 and the monitoring team estimated approximately 6,000 Saiga in the 4,678 km^2 survey region (Young et al. 2010). Range-wide population monitoring using the distance sampling line transect approaches has been in place since 2011 (Buuveibaatar 2015), with multiple surveys in 2012, 2017 and 2018 (Figure 4.3). Thanks to conservation measures and favourable climatic conditions, the Saiga population in Mongolia has been recovering over the last decade and reached to 14,000 individuals in 2014. Unfortunately, at the end of 2016, the Saiga population was once more severely reduced, to about 5,000 by the end of March 2017, due to an outbreak of Peste des Petits Ruminants virus (or goat plague). Currently, the Saiga population in Mongolia is still in an alarming condition and, regrettably, showing a declining trend. The latest population survey in October 2019 estimated about 5,074 animals across its entire range in Mongolia (Figure 4.3).

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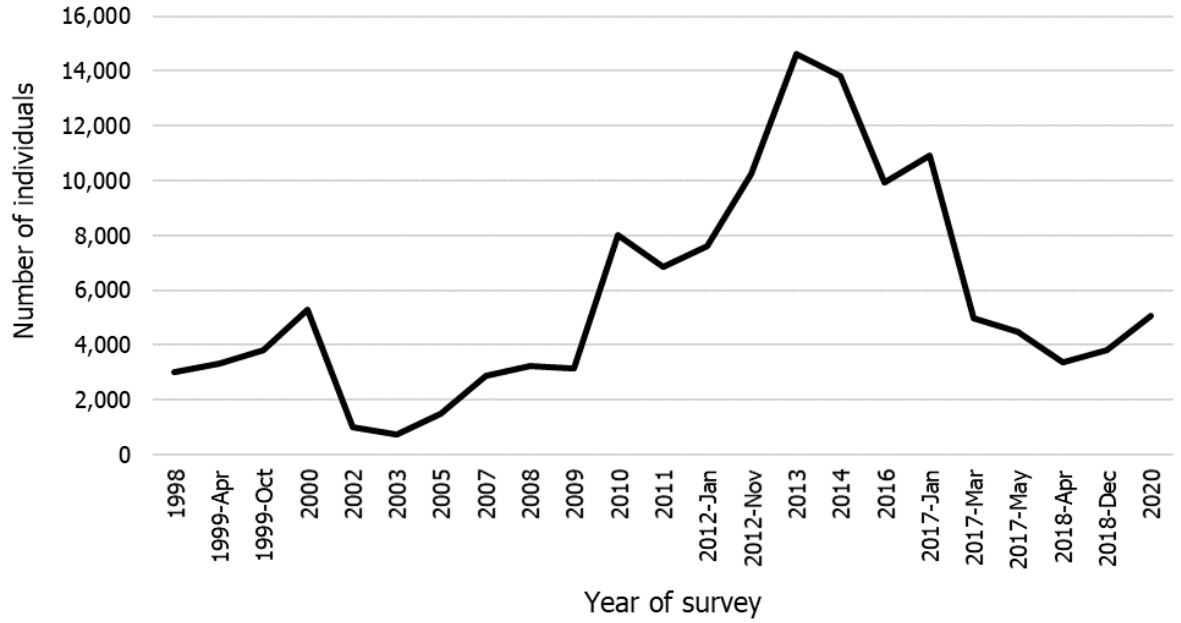

***Figure 4.3**. Population dynamics of the Mongolian Saiga, 1998-2020.*

The Mongolian subspecies of Saiga (as defined by IUCN) is categorized as Endangered on the IUCN Red List (Mallon, 2008), and is now only found in Mongolia. The Mongolian subspecies is ecologically, phenotypically and behaviourally distinct from the nominate subspecies, which is currently classified as Critically Endangered, in accordance with the overall species-level classification (Bannikov et al., 1961; Kholodova et al., 2006). In addition, the Mongolian Saiga is also listed in the CITES and CMS appendices, under the species name *Saiga borealis* (see section 6.1). At the national level, Saigas are protected by the Mongolian Law on Fauna. Hunting has been prohibited since 1930, and this species is protected as Very Rare under Law on Fauna of Mongolia (MNE 1996 and 2012). In addition, the species is listed in the Mongolian red books of 1987, 1997 and 2013 (Shagdarsuren et al. 1987; Shiirevdamba et al. 1997, Shiirevdamba et al. 2013). Two nature reserves (Sharga and Mankhan) have been designated to conserve saiga, and approximately 24 per cent of the species' range in Mongolia occurs within these protected areas (Clark et al. 2006). The population of Mongolian saigas could have the potential to recover quickly from population declines due to hunting and natural extremes, given the high adult female fecundity and twinning rate, and high first year survival of calves (Buuveibaatar et al., 2013).

Potential levels of sustainable hunting, currently and in the future

There is no practice of sustainable hunting of saiga in Mongolia, as the population size is relatively small in comparison to the other subspecies. Thus, even low levels of hunting could have a large impact on the small population of Mongolian saigas (Lkhagvasuren et al. 2001). Moreover, illegal hunting for the horns of males, used in traditional medicines, still occurs (Lkhagvasuren 2007). Increasing numbers of livestock are also believed to be driving declines in population size through habitat degradation due to overgrazing and probable competition for pasture and water resources (Clark et al. 2006; Berger et al. 2013). Domestic dogs (*Canis familiaris*) have negative impacts on Saiga particularly during harsh winters (Buuveibaatar et al. 2009). In recent years, infrastructure developments such as mines and paved roads appear to be a new threat. Given the persistent and emerging new threats, it is unlikely that the Mongolian saiga population will reach a level that permits sustainable hunting in the near future. In addition, Mongolia considers that hunting the Mongolian Saiga Antelope would open a potential side door for exporting saiga horn and thus further induce poaching on saiga. Under such pressure, the fate of the Mongolian Saiga would be in jeopardy because of a collapsing

gene pool combined with extreme climatic condition and habitat pressure. Therefore, we do not discuss potential institutional arrangements or beneficiaries of sustainable hunting here.

4.3. Overall assessment for the Kazakhstan populations

(Lead authors: Albert Salemgareyev, ACBK, and Steffen Zuther, FZS; contribution Sergey Sklyarenko, ACBK, and Stephanie Ward, FZS)

Here we give a summary overview of the situation for Saiga management in Kazakhstan, past, present and future. Detailed information by population is given in the next section.

Saiga management

During the time of the Soviet Union, the Moscow Institute of Hunting Industry trained specialists in the field of hunting and widllife management. For this reason, there was no separate institution in Kazakhstan. This was the reason why, after the collapse of the Soviet Union, there was a vacuum in knowledge about animal management. Only as late as 2003 was a working group tasked with drafting a new Wildlife Protection, Reproduction and Use Act[10], which was recognized and adopted in 2004 with 36 implementing regulations.

With the collapse of the Soviet Union in the early 1990s, illegal hunting began to gain momentum. The reason for this was the absolute impoverishment of the rural population, the partial collapse of animal husbandry, and the resulting food shortages. Saigas were prevalent in very large numbers and this, alongside a steep price rise for Saiga horns and their meat, made them attractive targets. These factors coupled with a state monopoly on the use and international trade in certain huntable species, alongside weakening border control mechanisms, meant a rapid and unchecked decline in Saiga numbers.

Currently, the Saiga in Kazakhstan is not listed as an endangered species in the national Red Data Book, but it has equivalent status following a decree to ban hunting of Saiga. However, it is still regarded as a huntable species. Saiga protection from poaching is carried out mainly by rangers from the "Okhotzooprom State Enterprise", which acts under the Committee of Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources of Kazakhstan. Okhotzooprom has regional branches in each of the saiga range areas.

Population status

Ural: The Ural population has shown a very promising development in recent years and the positive trend in the population size is likely to persist in the near future at least. Currently, the population size is higher than in many years of the Soviet era and the sex ratios allow for high reproduction. Significant levels of poaching are countered by intensive patrolling by wildlife rangers. In this very positive situation, it will be possible to hunt up to 10 per cent of the population, targeting predominantly males and young-of-the-year, preferably in autumn (October). This quantity of animals available for hunting would justify the investment required to set up the proper hunting system with all necessary infrastructure and safeguards, whilst ensuring a sufficient return from the hunting. As conflicts with local people have been reported already, it is recommended to let local communities benefit from co-existing with saiga by allowing them to hunt Saiga for their own use and/or give them a certain share of the revenues. Hunting areas should also be involved in the new sustainable hunting system, while a state organization like "Okhotzooprom" could be in charge of the large-scale offtake of several thousand animals. But before starting such hunting, legal regulations in Kazakhstan need to be adopted, appropriate procedures for sustainable use developed and control mechanisms including marking horns put in place, which will take some time. Therefore, hunting cannot be started now, but in the near future. For international trade, further preconditions to eliminate the danger of misuse need to be fulfilled before putting a proposal to CITES to enable exports according to CITES rules (see section 6).

[10] http://adilet.zan.kz/rus/archive/docs/Z040000593_/09.07.2004

Betpak-Dala: A very positive population trend has been characteristic of the Betpak-Dala population since 2015, when a mass die-off wiped out about 88 per cent of the population. A healthy population structure allows for high reproduction, which is the precondition for the fast growth observed in the saiga numbers. Several conservation measures are in place including numerous ranger groups, Protected Areas, NGO activities and others. This gives hope that the positive trend will continue into the future, but mass die-offs might happen again, posing a serious threat to this population. Therefore, it is recommended to let the population recover to levels higher than 300,000 animals, before the question of sustainable use should be discussed. Currently, only preparatory steps towards hunting should be made. Once sustainable use is possible, it will be necessary to involve different stakeholders in the hunting system and let them benefit from the saiga hunt, especially local communities and hunting areas, in order to secure their support for saiga conservation.

Ustyurt: The Ustyurt saiga population has recovered in recent years from an historical low in 2015, which was likely caused by the construction of new linear infrastructure. The population is growing slowly and it is largely restricted to the area north of a new railway, significantly limiting its range. As natural resource use and other human impacts are intense in the area, the future of the Ustyurt population remains insecure, although the population structure is improving and numbers growing thanks to intense conservation work. As the population is still far from its size 25-30 years ago, it is currently not possible to start any sustainable use of the Ustyurt population. Several years of continued growth are needed, before this idea can again be reviewed and its feasibility assessed. To make this happen, conservation efforts have to be continued for the years to come, especially regarding protection from poaching and mitigation of impacts from linear infrastructure and industrial use.

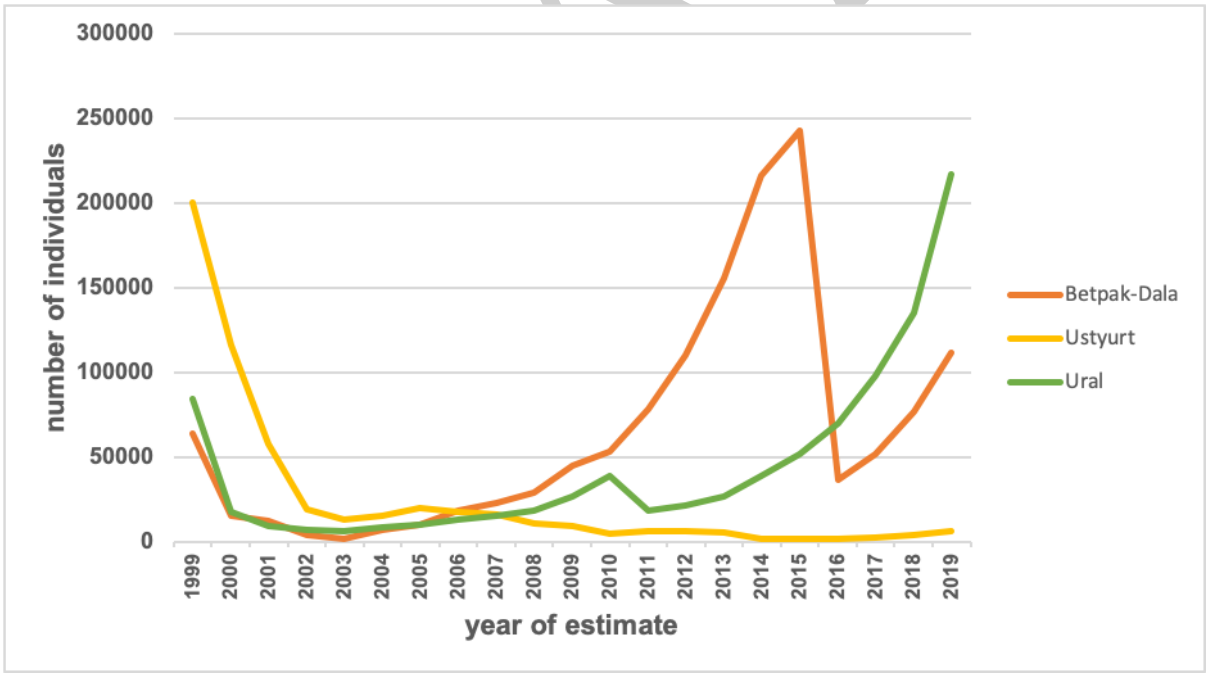

Figure 4.4. *Population trends over time for each of the three Saiga populations in Kazakhstan. (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007).*

Options for institutional arrangements for sustainable hunting

For sustainable hunting of Saiga in Kazakhstan, attainment of all goals mentioned in section 3.3 are applicable: (1) profit; (2) volume of product; (3) social benefits; (4) conservation benefits. It will be important to: create revenues from saiga hunting for various stakeholders; produce a significant number and diversity of saiga products; involve local people living in the

Saiga range in hunting to avoid human-wildlife conflicts; and most importantly conserve Saiga and other species sharing the same habitat to preserve healthy wildlife populations and ecosystems. Such a combination of various goals requires the involvement and commitment of various interested institutions and communities in a sustainable Saiga hunting system.

Historically, Okhotzooprom had exclusive rights to hunting and the commercial exploitation of saiga, until the hunting ban stopped this role in 1999. Since then, the organization has developed into a pure wildlife ranger service. However, when thinking about commercial hunting of Saiga, people in Kazakhstan would still see Okhotzooprom as the responsible organization from the side of the state. Therefore, they would probably be in the best position to organize and conduct commercial hunting for a large number of animals in early autumn, as they already have a lot of the required equipment, vehicles and people for such large scale hunting.

As the products of hunting are not only interesting for the domestic market in Kazakhstan, we recommend the creation of an agency which is solely responsible for selling Saiga (and potentially other species') products on the international market. This agency would ensure the export procedures were in line with CITES regulations and would organize and manage the harvest of horns using an efficient marking technique. It would be controlled by the wildlife authority (the Committee of Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources of Kazakhstan). Another option is to assign this function to an existing organization; in both cases, the question of monopolization arises, which usually causes many objections, especially when declaring a monopoly on newly commercialized species. This should be the subject of a separate discussion taking into account all factors.
Other entities interested in saiga hunting are hunting areas, of which there are several hundred in Kazakhstan, some of which are in the Saiga range. One of their tasks is to protect wildlife from poaching, which includes Saiga. Therefore, the hunting entities who lease those areas will want to gain some benefit from the sustainable use of Saiga. This could be achieved in two ways: (1) granting them hunting licenses, so that they can organize recreational hunting, potentially for trophies; (2) giving them a certain share of the monetary revenue from the sale of Saiga products. Potentially a combination of both might be possible. As such a scheme would provide incentives to efficiently protect saiga, benefits for the conservation of the species could be created.

To involve local communities in Saiga hunting seems possible, but difficult to control. A solution could be that local people can obtain a hunting licence from local hunting areas for a reduced fee, in order to get cheap meat for subsistence. They could also get it for free and give the horn and hide to the hunting area, so that they can sell it further to the saiga trade agency in Kazakhstan. But any hunting by local people should be in accordance with the designated hunting period in early autumn and other rules put in place for the commercial hunting of Saiga. All this should be in line with the aforementioned mandatory creation of a mechanism for handling and marking of horn using modern technologies to allow tracking their trade and movement.

Another option entirely could be to create a specific organization for monitoring, population management and use of wildlife, and give it the right to extract Saigas and to market commercial products. This approach exists for sturgeon fish species (Article 11-1 of the Law of the Republic of Kazakhstan No. 73-VI of June 15, 2017).

Beneficiaries: Who might benefit and how might the revenues be used?
The revenues from saiga hunting will go to the state, except for revenues created through recreational hunting organized by privately-leased hunting areas. It is important that this money is used wisely by the authorities in Kazakhstan, in order to achieve the goals of the sustainable saiga hunting system and not intentionally or inadvertently damage the saiga population.

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In order to achieve the conservation goals of the sustainable Saiga hunting system, the greatest share of the revenues could be used to fund conservation work. In the case of the Ural population, this will mostly be for anti-poaching work by Okhotzooprom. Salaries, equipment and patrolling costs could be covered with money from sales of Saiga products. A share of it would be well spent to fund awareness-raising and educational work on a local level, with community initiatives and NGOs applying for the funds to deliver such work.
Following the considerations highlighted in section 3, it will be necessary to create benefits for the local communities around the saiga range in order to gain their support for saiga conservation, help them tolerate the antelopes' presence on the same pastures as their livestock, and prevent them from becoming poachers. Sharing the revenues from the sustainable use of saiga would help to achieve these goals. For instance, a certain share of the funds could be distributed among communities in the Saiga range to allow them to develop local infrastructure or initiatives that are of benefit to them collectively. This does not necessarily need to apply equally to all communities but could be done through a simple grant-making procedure where selections are made based on certain criteria which have been co-created together with the communities. The share of hunting revenues for communities would then be distributed among successful applicants. However, there can be no direct payments to the local population in the form of allowances, as this would raise the question of why this is not done for all other hunted species.

As outlined above, hunting areas need to be considered as potential beneficiaries of saiga hunting, as they are also responsible for protecting them from poaching. Therefore, they should have the right to organize recreational hunting within the limits described above and the ability to obtain hunting licences from the State. A certain percentage of the hunting revenues from the state could also be channeled to the hunting areas to support their patrolling work. All of these approaches require discussions with key stakeholders, careful economic calculations and an analysis of all possible consequences of decisions.

Ustyurt-specific considerations: There are only a few hunting areas active in the Ustyurt and in order to participate in the sustainable harvesting of saiga and receive a share of monetary revenues from hunting, they would also need to be involved in the required anti-poaching measures. Community conservation initiatives have been set up in some villages with the aim of controlling poaching towards sustainable use (under the association Tabigi Orta). Due to its transboundary character, any use of the Ustyurt Saiga population has to be coordinated with authorities in Uzbekistan. Uncoordinated harvest of saiga could easily lead to overhunting or skewed sex ratios, leading to decreased reproduction. In the Ustyurt population range there are almost no human settlements, thus reducing the share to be given to local communities. But as poaching in the Ustyurt population is often conducted by people from local villages, these local people should be the first to benefit from sustainable saiga use, in order to decrease the poaching pressure. However, all this has to be reassessed when the population size reaches higher numbers and when saigas might also have reoccupied former habitats.

Betpak-Dala-specific considerations: Once the population reaches a size which would allow offtake, the institutional arrangements would follow those instituted for the Ural population, where sustainable use will most probably begin first. A significant difference to the other two populations in Kazakhstan is the presence of Protected Areas. Their role in a commercial hunting system has to be identified. Either they are completely excluded and saigas are protected from any hunting within these territories, or they open for a certain period to allow commercial hunting for a state organization such as "Okhotzooprom". Both options seem realistic, although in some parts of the year a large proportion of the Betpak-Dala population is located within protected areas. As numerous hunting areas exist within the Saiga range, they should also be sufficiently involved in a future sustainable use system. Protected areas should also get support from the state-owned revenues in the same way that "Okhotzooprom"

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does. Although it is a vast area, there are numerous communities, which should somehow benefit from saiga hunting in a similar way to those in the vicinity of the Ural population.

Preconditions for sustainable hunting

These preconditions only currently apply to the Ural population, as that is the only one that could withstand hunting at present. However, the systems required to put a hunting system in place need to be done at the national level.

A number of preparatory steps need to be taken to start using saiga resources, as regulations and logistics for the use of saiga resources are currently lacking. These are:

1) To conduct a stakeholder analysis (e.g. costs, benefits and risks of involving different stakeholders) to inform development of a system of sustainable harvesting and processing. Extensive stakeholder involvement will be essential from the beginning and on an ongoing basis to avoid a failure of the system and collapse of Saiga Antelope populations;
2) To develop procedures and mechanisms and establish the necessary infrastructure for the use of Saiga, their parts and derivatives. These will include standards for receiving and processing material, procedures for collecting saiga parts in cases of natural mortality, alongside the correct handling of such naturally occurring derivatives. Any Saiga products would need to be included in a national register, supervised by a specialized wildlife protection organization. Additionally, procedures must be developed that make use of international experience and standards of tagging and tracking derivatives along the storage and trade chain;
3) To establish strict market and shipment controls as strong safeguards against poaching and illegal trade, including relevant Standard Operating Procedures for registration of stockpiles, forensic labelling of parts and products, and legal registration of manufacturers and traders. Inter-agency collaboration, chains of custody and data collection and management should be improved.
4) The Government of Kazakhstan will need to consult with all other Range States before proposing officially to resume international trade in any Saiga Antelope products to enable Range States' governments to prepare pre-emptive communications and other actions.
5) To define and approve standards for agreeing the number of saigas needed to maintain a sustainable population, taking into account habitat conditions, forage base and livestock presence;
6) To expand monitoring of Saiga populations, with the study of all limiting factors (poaching, linear infrastructure, diseases, etc.), with the involvement of relevant organisations;
7) To continue to strengthen Saiga protection.

In view of possible errors in previous models of population dynamics, the recommendation is to improve the previous models by taking into account recently collected data and new research results, therefore providing the responsible authorities in Kazakhstan with a potential sustainable harvesting strategy for the future. To improve the population models, in addition to the improved annual aerial census (spring), additional monitoring surveys should be conducted during autumn (to determine breeding success), as well as continued seasonal ground monitoring of annual calving sites (sex ratio, twins), determination of saiga survival, and recording of rutting aggregations using UAV or ground-based techniques. Each Saiga population should be considered separately, and catastrophic events such as the recent mass mortality of saigas and climatic conditions should be taken more strictly into account when developing future population models.

4.4. Betpak-Dala population: detailed assessment

(Lead authors: Albert Salemgareyev, ACBK, and Steffen Zuther, FZS; contribution Sergey Sklyarenko, ACBK, and Stephanie Ward, FZS)

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Review of population size, trends and demographic structure

The Betpak-Dala Saiga population in Central Kazakhstan has historically been the biggest population not only in Kazakhstan but globally, occupying the largest distribution range. Its size varied quite significantly with a maximum of about half a million animals, but in the 1970s up to one million Saiga were counted (Bekenov, 1998).

Table 4.3. *Population estimates and number of Saiga killed commercially for the three saiga populations in Kazakhstan during 1999-2020 (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007/Zhirnov et al. 1998).*

Year	Population estimate	Number hunted	Source
1980	400,000	100,000	Institute of Zoology, KZ
1981	470,000	130,000	Institute of Zoology, KZ
1982	480,000	150,000	Institute of Zoology, KZ
1983	440,000	135,000	Institute of Zoology, KZ
1984	340,000	70,000	Institute of Zoology, KZ
1985	400,000	100,000	Institute of Zoology, KZ
1986	250,000	40,000	Institute of Zoology, KZ
1987	300,000	70,000	Institute of Zoology, KZ
1988	368,000	30,000	Institute of Zoology, KZ
1989	323,000	57,000	Institute of Zoology, KZ
1990	361,000	51,000	Institute of Zoology, KZ
1991	357,000	57,000	Institute of Zoology, KZ
1992	375,000	60,000	Institute of Zoology, KZ
1993	510,000	28,000	Institute of Zoology, KZ
1994	282,000	13,000	Institute of Zoology, KZ
1995	212,000	9,000	Institute of Zoology, KZ
1996	248,000	9,000	Institute of Zoology, KZ
1997	*Not conducted*	3,100	
1998	60,000	Ban	Institute of Zoology, KZ
1999	64,000	Ban	Institute of Zoology, KZ
2000	15,000	Ban	Institute of Zoology, KZ
2001	12,000	Ban	Institute of Zoology, KZ
2002	4,000	Ban	Institute of Zoology, KZ
2003	1,800	Ban	Grachev & Bekenov 2007
2004	6,900	Ban	Grachev & Bekenov 2007
2005	9,943	Ban	Grachev & Bekenov 2007
2006	18,600	Ban	Institute of Zoology / CFW
2007	22,800	Ban	Institute of Zoology / CFW
2008	29,252	Ban	Institute of Zoology / CFW
2009	45,196	Ban	Institute of Zoology /ACBK/ CFW
2010	53,441	Ban	Institute of Zoology /ACBK/ CFW
2011	78,019	Ban	Institute of Zoology /ACBK/ CFW
2012	110,000	Ban	Institute of Zoology /ACBK/ CFW
2013	155,200	Ban	Institute of Zoology / CFW
2014	216,000	Ban	ACBK/ CFW
2015	242,500	Ban	ACBK/ CFW
2016	36,200	Ban	ACBK/ CFW
2017	51,700	Ban	Institute of Zoology / CFW
2018	76,400	Ban	ACBK/ CFW
2019	111,500	Ban	ACBK/ CFW
2020	*Not conducted*	Ban	

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In the 1990s, along with the beginning of a decline in Saiga numbers, its range also decreased (Grachev & Bekenov, 1993). After the unusually snowy winter of 1993/94, the Betpak-Dala population decreased by almost half from 510,000 to 270,000; in the same years, poaching sharply increased, leading to a continued decline in following years. By the beginning of the 2000s, the number of animals reached an absolute minimum with an estimated 2,000 Saiga left in 2003, which amounts to a loss of more than 99 per cent of this population since 1993.

Owing to intensifying conservation efforts from both government and NGOs, the population managed to slowly recover. This growth continued until 2015 with 242,500 animals counted in April during the aerial census. In May of that year a mass die-off due to an infection with the bacteria *Pasteurella multocida* lead to the loss of more than 200,000 saiga, equal to 88% of the population (Kock et al. 2018). As this die-off happened at calving areas, mostly females were affected. The remaining males were still subject to poaching. In the following year, a population size of only 36,200 animals was estimated. Since then, the population has continued to grow at the rates seen prior to the die-off and the 2019 estimate was 111,500 Saiga.

As the Betpak-Dala population has shown reliable growth for many years now after the catastrophic decline in the ten years following 1993, we assume that this growth will continue. The occupied range is large enough to offer room for many more Saigas. The density of human settlements is not high and is significantly lower than, for instance, in the Ural population range. Therefore, competition with livestock for pastures is less likely to impact the Betpak-Dala population size in the years to come.

From 2013 to 2018 the observed proportion of males in herds of the Betpak-Dala population varied between 5.4 and 27.5 per cent (mostly 12-14 per cent), females between 41.3 and 64.3 per cent , and yearlings between 29.7 and 36.8 per cent. The situation is better than in other populations, although the percentage of males has not yet reached previous levels, potentially as a consequence of quite intense poaching in this population. During the rutting period in 2019, the ratio of sexually mature males to females, according to the results of ground surveys, averaged 1:10 (2017 - 1:22, 2018 - 1:11).

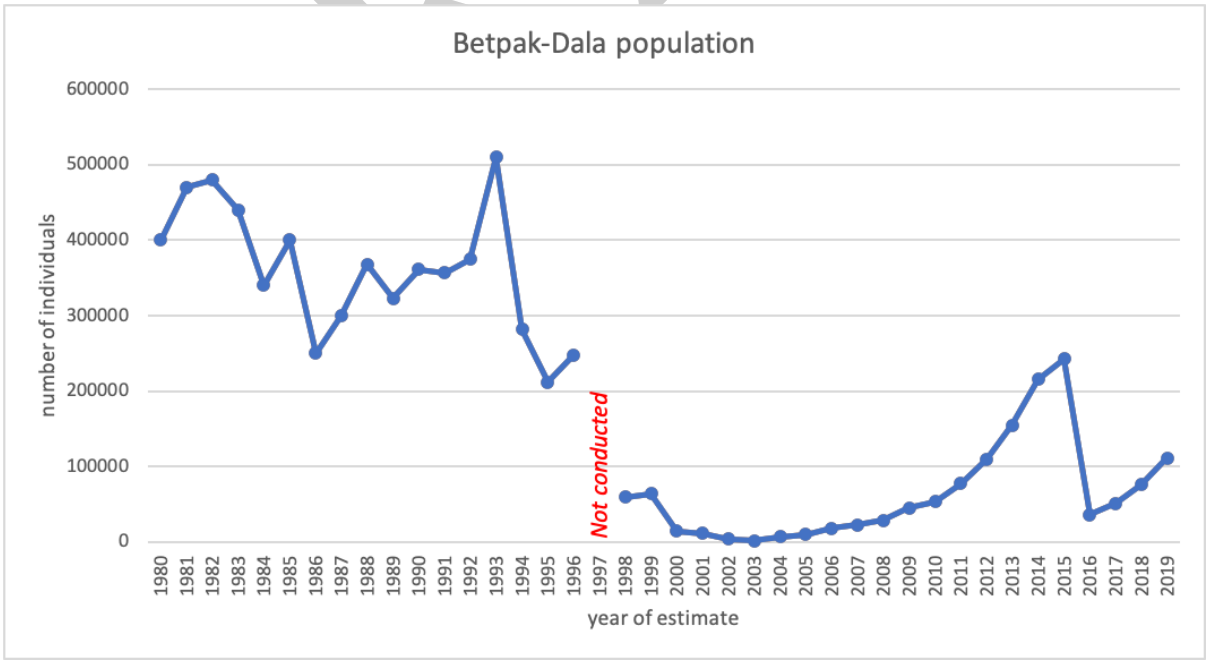

Figure 4.5. *Population estimates of the Betpak-Dala Saiga population during 1980-2020. (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007).*

Current conservation status

The vast range of the Betpak-Dala saiga population is patrolled by many groups of rangers from "Okhotzooprom" State Enterprise, who are based at several places throughout the range. Regional branches of the Committee of Forestry and Wildlife provide additional resources and control the performance of Okhotzooprom. There are several Protected Areas, which contribute to saiga protection. The most important ones are Irgiz-Turgai state nature reserve (national designation: *reservat*), Altyn Dala state nature reserve, and Korgalzhyn state nature reserve, which all contain important summer pastures, calving areas and even rutting places. In addition, Central Kazakhstan is well covered with hunting areas, which are obliged to prevent the poaching of saiga and to conduct their own patrols. Nonetheless, the level of poaching is significant, although some cases remain undetected.

In May 2015, an outbreak of hemorrhagic septicemia caused by the bacteria *Pasteurella multocida* led to a mass die-off of catastrophic scale (Kock et al. 2018). This has been a serious drawback for all conservation efforts for this population and led to a changed strategic approach for both the government and NGOs, including a lot of activities on disease research and monitoring. In the following years the population seemed to recover quickly despite continued poaching. But the population size remains far smaller than the levels recorded regularly in Soviet times and cannot therefore be regarded as restored.

Likely future trends

The Betpak-Dala population is currently in the process of recovery after the mass die-off of 2015. In the 1980s, when the population was prosperous and was regularly hunted, its numbers fluctuated between 250,000 and 480,000. It will take several more years to reach such levels again, given the current population growth rate. It is very likely that this Saiga population will continue to grow, however. It has shown a rather stable growth rate since 2003 and managed to start a quick recovery after the mass die-off in 2015. We assume this will most probably continue. At the same time, a lot of conservation mechanisms are in place. Although instances of poaching are still high, these measures ensure the impact is bearable at the population level. The observed sex ratio also allows for normal reproduction, as observed during calving in recent years (ACBK, unpublished).

How long this growth will continue is unclear. There is sufficient habitat of good quality available to provide forage to more saigas, but a disease outbreak could happen again anytime, if the environmental conditions trigger it, which would rapidly decrease the Betpak-Dala population size. This needs to be taken into account in any planning of a sustainable use strategy.

Potential levels of sustainable hunting

Currently, the Betpak-Dala saiga population shows stable growth and is recovering well from the mass die-off in 2015. Its current size is far from previous levels of up to half a million or more, counted during Soviet times. The offtake through commercial hunting in 1979-1993 varied between 28,000 and 150,000 animals per year, producing the largest contribution to Saiga offtake in Kazakhstan. Such hunting levels seem extremely high compared to the population size. Taking into account the considerations expressed here, it is advisable to hunt fewer animals once the population size has reached former levels, especially to mitigate the threat of extinction due to mass die-off events.

As soon as the population reaches levels of 300,000-400,000 animals, its dynamics should again be evaluated in order to carefully determine a possible hunting quota. The rather conservative recommendation of 10 per cent offtake made in section 3 might be acceptable, but a lower ratio could also be a good start, in order to assess the consequences of hunting on the population. Given the current population size, sustainable use of the Betpak-Dala population should only be considered possible in a few years - not immediately.

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4.5. The Ural population: Detailed assessment

(Lead authors: Albert Salemgareyev, ACBK, and Steffen Zuther, FZS; contribution Sergey Sklyarenko, ACBK, and Stephanie Ward, FZS)

Population size, trends and demographic structure

During the Soviet era, the Ural population size varied between 50,000 and 150,000 individuals, with a sudden rise in numbers up to 300,000 animals towards the beginning of the 1990s (Bekenov, 1998). Except for this anomalous high number, it has always been the smallest Saiga population in Kazakhstan. After 1994 it suffered a serious population crash, falling to 17,500 individuals by the end of the century. The population continued to decline to around 6,500 in 2003. A slow recovery was observed in the following years, which ended suddenly in 2010 due to a mass die-off causing around 12,000 animals to die. Fortunately, the population recovered quickly from this setback and has kept growing from 2011 until today. According to an aerial census in spring 2019, the Ural Saiga population is currently the largest Saiga population globally, with a total of 217,000 individuals. These numbers eclipse the previously larger Betpak-Dala population, which was significantly reduced through its own mass die-off in 2015. According to direct observations from rangers, the Ural population continues to grow, even outnumbering the population size observed during Soviet time.

Table 4.4. *Population estimates and number of Saiga killed commercially for the Ural populations in Kazakhstan in 1980-2020 (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007/Zhirnov et al., 1998).*

Year	Population estimate	Number hunted	Source
1980	120,000	20,000	Institute of Zoology, KZ
1981	160,000	33,000	Institute of Zoology, KZ
1982	180,000	40,000	Institute of Zoology, KZ
1983	150,000	30,000	Institute of Zoology, KZ
1984	40,000	3,000	Institute of Zoology, KZ
1985	50,000	7,000	Institute of Zoology, KZ
1986	70,000	7,000	Institute of Zoology, KZ
1987	100,000	10,000	Institute of Zoology, KZ
1988	90,000	10,000	Institute of Zoology, KZ
1989	135,000	14,000	Institute of Zoology, KZ
1990	138,000	15,000	Institute of Zoology, KZ
1991	236,000	24,000	Institute of Zoology, KZ
1992	298,000	33,000	Institute of Zoology, KZ
1993	250,000	21,000	Institute of Zoology, KZ
1994	274,000	11,000	Institute of Zoology, KZ
1995	*Not conducted*	12,000	
1996	*Not conducted*	15,000	
1997	*Not conducted*	9,100	
1998	104,000	3,600	Institute of Zoology, KZ
1999	84,000	Ban	Institute of Zoology, KZ
2000	17,500	Ban	Institute of Zoology, KZ
2001	9,300	Ban	Institute of Zoology, KZ
2002	6,800	Ban	Institute of Zoology, KZ
2003	6,500	Ban	Grachev & Bekenov 2007
2004	8,800	Ban	Grachev & Bekenov 2007
2005	10,052	Ban	Grachev & Bekenov 2007
2006	12,850	Ban	Institute of Zoology / CFW
2007	15,600	Ban	Institute of Zoology / CFW
2008	18,322	Ban	Institute of Zoology / CFW
2009	26,624	Ban	Institute of Zoology /ACBK/ CFW

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2010	39,058	Ban	Institute of Zoology /ACBK/ CFW
2011	17,948	Ban	Institute of Zoology /ACBK/ CFW
2012	21,000	Ban	Institute of Zoology /ACBK/ CFW
2013	26,400	Ban	Institute of Zoology / CFW
2014	39,000	Ban	ACBK/ CFW
2015	51,700	Ban	ACBK/ CFW
2016	70,200	Ban	ACBK/ CFW
2017	98,200	Ban	Institute of Zoology / CFW
2018	135,000	Ban	ACBK/ CFW
2019	217,000	Ban	ACBK/ CFW
2020	*Not conducted*	Ban	

This shows that the Ural population can be seriously affected in bad years with unfavourable weather and habitat conditions or disease outbreaks but can also swiftly recover from such events to grow to previous numbers and even exceed them, given good conditions. The positive population trend in recent years comes with an extension of the distribution range, as saiga reoccupies its former habitats. In particular, this can be observed at the eastern edge of the range and in the south and south-west of Lake Aralsor.

Observations during the last decade always showed that the percentage of males in the population was sufficient to keep up a high reproduction rate, indeed this has been proven by the positive growth in the population size. The most recent observations, from June and September 2019, identified 20.2 per cent males (both adult and juveniles) in a total of 3,776 animals (according to ACBK monitoring data). During the census in April 2019, a large group of about 2000 males was observed. Probably there were more that were not within the counting strip. However, among the males, non-reproductive yearlings dominated.

Although the level of poaching has also increased with an increasing population size, overall the status of the Ural population is very positive. But history shows us that mass die-offs can change this situation rapidly.

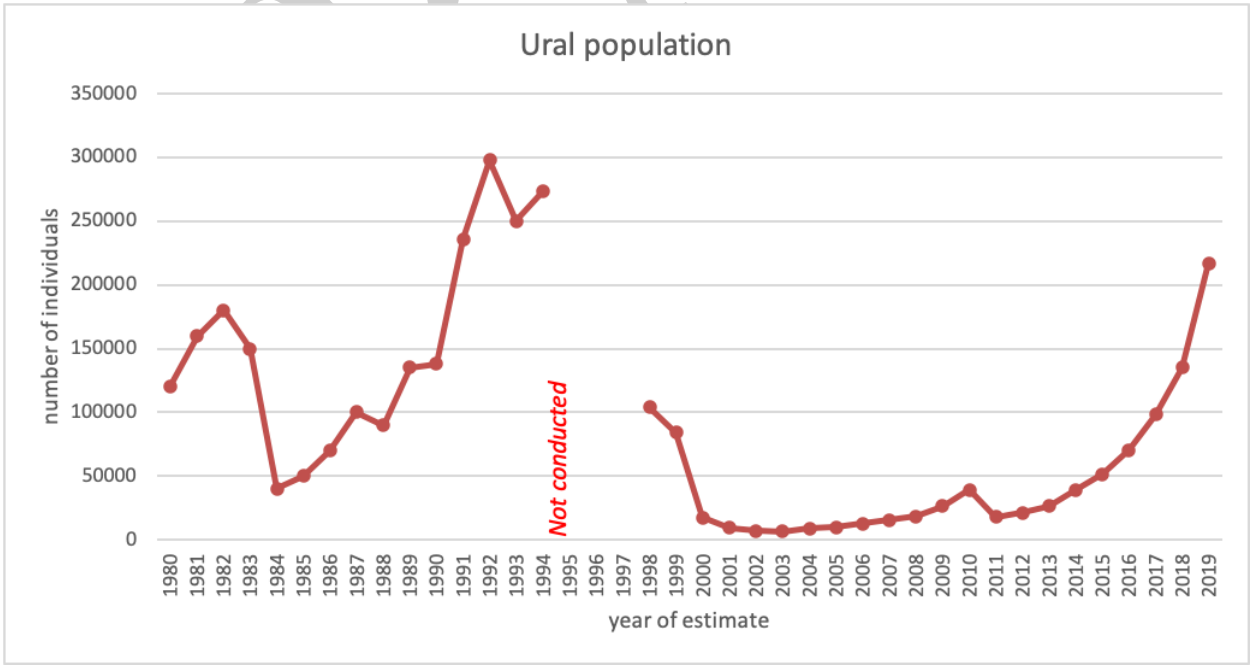

Figure 4.6. *Population estimates of the Ural Saiga population during 1980-2020. (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007).*

Current conservation status

The Okhotzooprom office in Uralsk is responsible for patrolling the Ural Saiga population range. Regular detentions of poachers in the Ural range in recent years show the success of this investment by the government. In addition, there are officers of the regional branch of the Committee of Forestry and Wildlife, who have a clear directive both to protect saigas and to oversee Okhotzooprom's wildlife rangers. There are no protected areas within the Ural Saiga population's range in Western Kazakhstan (although there are several protected areas on the Russian side of the border, where some Saigas go, particularly in the summer). To date, the Ural population has reached a size comparable to Soviet times and can therefore be seen as a conservation success.

Likely future trends

The Ural Saiga population has grown considerably in recent years and shown a positive trend in population size since 2003 apart from the mass die-off in 2010. Currently, it is not only the largest population in Kazakhstan, but globally. This population can be regarded as recovered from the massive decline in the ten years after 1994. This positive development gives reason for the prognosis that population growth will continue in years to come. This assumption is supported by the fact that the carrying capacity of its range is not yet reached and not all of its former range, as described in literature, reoccupied. Furthermore, the sex ratio seems to allow for good reproduction. A population size larger than the one observed in 1992 (298,000 individuals) seems possible.

Potential levels of sustainable hunting

During Soviet times, commercial Saiga hunting took place in the Ural population, which is probably the reason for the varying population numbers outlined above, which did not reach today's levels until the end of the Soviet Union. Nonetheless, between 1979 and 1993, 3,000 to 40,000 Ural Saiga were killed annually for their meat, hide and horns (Zhirnov et al., 1998).

To date, the Ural Saiga population is the only population which we can regard as restored. Efforts to protect it from poaching will continue, which is a precondition for a large population. Its size will also give it the resilience needed to survive the kind of mass die-off events we have seen in the past. With more than 211,500 individuals, it is now larger than it was during any year it was hunted legally. Consequently, it seems feasible to start hunting this population in its current size and condition. Local people from the Ural Saiga range are beginning to request that the population be managed somehow, because their experience is that there are too many Saigas which are having an impact on livestock grazing pastures in the area, competing for water and forage. Yields of hay are also negatively impacted by the many grazing Saigas.

Concerning potential levels of sustainable hunting the considerations from chapter 2 should be taken into account. Following the recommendations made, up to 10 per cent of the population could be hunted without causing negative impacts on the population, with predominantly males being hunted (80 per cent of individuals). With observed growth rates of not less than 30 per cent annually during the last years, this level of off-take seems to be a very conservative approach. That means for the Ural population size of 2019 that 21,150 animals could have been taken from the population without adversely affecting population growth.

4.6. The Ustyurt population (Kazakhstan): Detailed assessment

(Lead authors: Albert Salemgareyev, ACBK, and Steffen Zuther, FZS; contribution Sergey Sklyarenko, ACBK, and Stephanie Ward, FZS)

Review of population size, trends and demographic structure

Between 1988 and 1990, with about 200,000 individuals, the Saiga population of the Ustyurt plateau was estimated to be the second largest population in Kazakhstan, after Betpak-Dala,

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(Bekenov, 1998). At the beginning of the 1990s it even numbered more than 250,000! However, it was more or less stable throughout 1980 until 1999. After this period of stability, it experienced a similar decline as the other two populations, but slightly later - around the year 2000. At first, the numbers did not drop as low as for other populations; about 12,800 individuals were counted in 2003, making it Kazakhstan's largest population that year. But while other populations started to recover around then, the Ustyurt population size stayed roughly at the same level and then resumed its decline around 2007.

Table 4.5. *Population estimates and number of killed commercially for the Ustyurt population in Kazakhstan in 1980-2020 (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007/Zhirnov et al., 1998).*

Year	Population estimate	Number hunted	Source
1980	170,000	30,000	Institute of Zoology, KZ
1981	190,000	30,000	Institute of Zoology, KZ
1982	190,000	33,000	Institute of Zoology, KZ
1983	180,000	40,000	Institute of Zoology, KZ
1984	190,000	50,000	Institute of Zoology, KZ
1985	190,000	50,000	Institute of Zoology, KZ
1986	150,000	40,000	Institute of Zoology, KZ
1987	140,000	20,000	Institute of Zoology, KZ
1988	207,000	23,000	Institute of Zoology, KZ
1989	265,000	39,000	Institute of Zoology, KZ
1990	202,000	29,000	Institute of Zoology, KZ
1991	232,000	31,000	Institute of Zoology, KZ
1992	254,000	15,000	Institute of Zoology, KZ
1993	216,000	13,000	Institute of Zoology, KZ
1994	254,000	13,000	Institute of Zoology, KZ
1995	*Not conducted*	8,000	
1996	107,000	6,000	Institute of Zoology, KZ
1997	*Not conducted*	600	
1998	246,000	3,700	Institute of Zoology, KZ
1999	200,000	Ban	Institute of Zoology, KZ
2000	116,000	Ban	Institute of Zoology, KZ
2001	58,000	Ban	Institute of Zoology, KZ
2002	19,100	Ban	Institute of Zoology, KZ
2003	12,800	Ban	Grachev & Bekenov 2007
2004	15,000	Ban	Grachev & Bekenov 2007
2005	19,621	Ban	Grachev & Bekenov 2007
2006	17,810	Ban	Institute of Zoology / CFW
2007	16,400	Ban	Institute of Zoology / CFW
2008	10,383	Ban	Institute of Zoology / CFW
2009	9,223	Ban	Institute of Zoology /ACBK/ CFW
2010	4,900	Ban	Institute of Zoology /ACBK/ CFW
2011	6,121	Ban	Institute of Zoology /ACBK/ CFW
2012	6,500	Ban	Institute of Zoology /ACBK/ CFW
2013	5,400	Ban	Institute of Zoology / CFW
2014	1,700	Ban	ACBK/ CFW
2015	1,270	Ban	ACBK/ CFW
2016	1,900	Ban	ACBK/ CFW
2017	2,700	Ban	Institute of Zoology / CFW
2018	3,700	Ban	ACBK/ CFW

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2019	5,900	Ban	ACBK/ CFW
2020	*Not conducted*	Ban	

Currently, the Ustyurt population is the smallest of the three Saiga populations in Kazakhstan, with as few as 5,900 individuals estimated in 2019. Since 2015 the population has been recovering from an extreme low level of 1,270 animals. This current positive trend gives hope that this Saiga population will survive, but it is still very fragile. Conservation efforts need to continue and even be intensified to allow the Ustyurt population to recover towards a stable population size.

Recent surveys in the Ustyurt suggest that the mature male to female ratio was 1:18.6, i.e. 5.4 per cent mature males (1,158 saiga observed) in 2018 (ACBK unpublished). This is a low number compared to 2–27 per cent sexually mature males and 9–38 per cent young males observed in Kazakhstan during 1966–1980 (Fadeev & Sludskii, 1982), but it allows for normal reproduction. A higher number still, 15.6 per cent of sexually mature males, was reported for Ustyurt in 1990 (4,897 animals counted; Bekenov et al., 1998). In 2019, 231 herds in the Ustyurt population (5397 animals split into groups of 2–300) were counted from vehicles, showing 12.6 per cent sexually mature males, which possibly indicates an increasing trend in the proportion of males in the population.

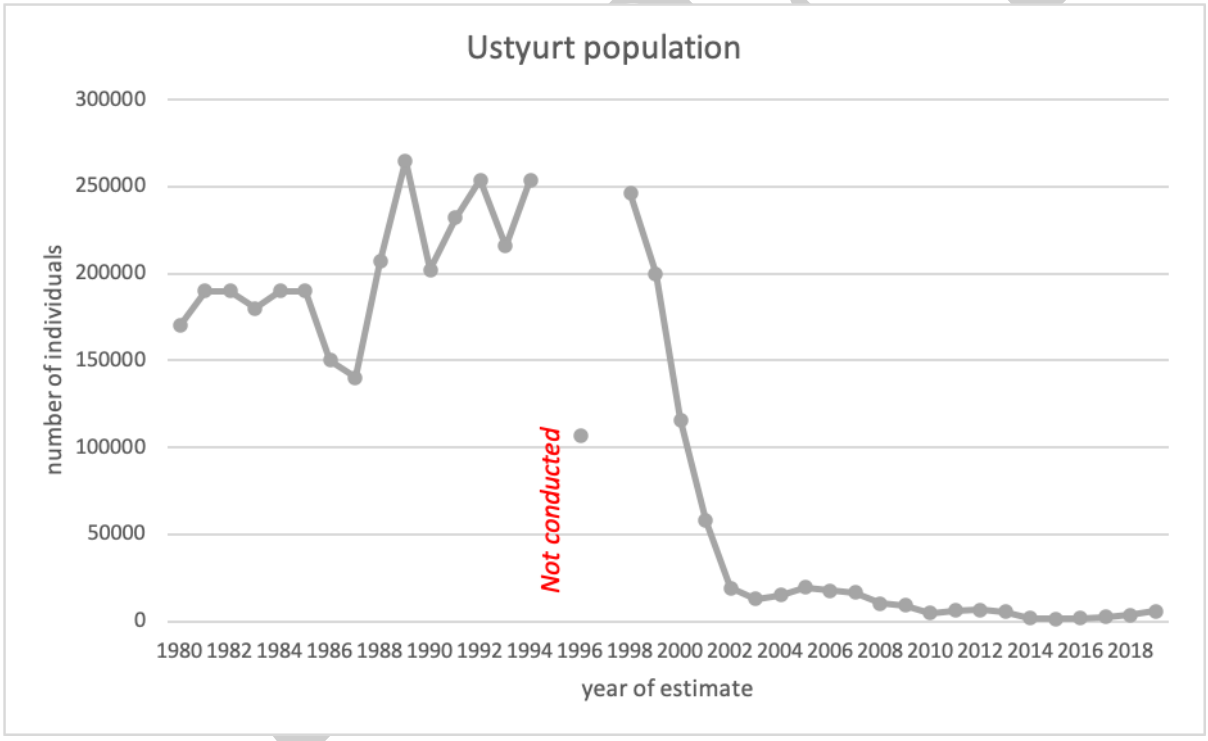

***Figure 4.7**. Population estimates of the Ustyurt Saiga population during 1980-2020. (Source: Institute of Zoology /ACBK/ CFW, Grachev & Bekenov 2007).*

Current conservation status

As there are only few hunting areas at the Ustyurt Saiga range and no protected areas, the protection from poaching is almost exclusively the task of Okhotzooprom rangers. The number of rangers was reduced a few years ago, when the number of Saiga was extremely low. This makes effective protection difficult, and partly NGOs are stepping in to help.

The reason for the poor condition of the Ustyurt population is that it faces several serious threats, which are more intense than for other populations. High levels of poaching, fueled by rural unemployment, poverty, high demand for Saiga horn in China and South-east Asia and

local demand for meat, can be observed at similar levels elsewhere, yet habitat fragmentation through linear infrastructure and habitat loss through natural resource extraction are a particularly serious threat in the Ustyurt Saiga range. Since 2008 a barbed wire fence along the Kazakh-Uzbek frontier has been limiting migration movements of Saiga across the border. Following recommendations from ACBK/FFI/FZS/CMS, Kazakhstan's border security agency included passages for saiga at regular intervals in a substantial section of the fence which are designed to allow Saiga to cross it.

Yet another very serious threat emerged in 2015 – a newly built railway across the Ustyurt plateau in Kazakhstan, cutting the previous distribution area of the Ustyurt population into two parts and preventing saiga from migrating south during winter, thus shortening the migration distance by approximately 50 per cent. As a consequence, much of the Ustyurt saiga population does not migrate to Uzbekistan any more, but stays the whole year in Kazakhstan (but see section 4.7; saigas in Uzbekistan).

Likely future trends

It is very difficult to predict the future development of this saiga population, as there are so many factors influencing it, and even a small change in conditions can have a large impact on a population of such small size. Nonetheless, the positive developments in recent years may continue as conservation efforts are also continued, and even extended. Whilst there may be growth in the next few years, it will be at a lower rate than the other populations and the population could face setbacks in difficult years. Given the complex range of factors present in this population, it is unclear whether it can ever reach the population size seen in Soviet times. Even with continued reproductive success and reduced poaching, much of the previous habitat has been lost for the Ustyurt Saiga. Therefore an estimate of ten years for population recovery may be too generous given the constraints of the carrying capacity of the landscape.

Potential levels of sustainable hunting

In the 1980s, up to 50,000 animals from the Ustyurt Saiga population were commercially hunted every year, but at that time the population was healthy, had a better habitat and was relatively undisturbed (Zhirnov et al., 1998). With a population of about 6,000 animals, which is equal to 3 per cent of its former population size, it is not even possible to think about starting to hunt this population. The Ustyurt Saiga population needs effective and long-term protection and should be excluded from any planning for a system of sustainable use of saiga in Kazakhstan. Only if it reaches population levels comparable to the historical size can recommendations be made on how this population can be used, based on a careful review of its development in previous years.

4.7. The Ustyurt population in Uzbekistan

(Lead author: Elena Bykova, Institute of Zoology, Uzbekistan)

An overview of population size, trends, and demographic structure.

Saigas can be found in Uzbekistan on the Ustyurt plateau (where most of Uzbekistan's Saiga population migrates from the adjacent territories of Kazakhstan), in the eastern and southern Aral Sea region, and on the former bottom of the Aral Sea. In the past, parts of the population migrated further south through Uzbekistan to Turkmenistan. The Saiga is included in the Red Data Book of Uzbekistan with status 1 (Critically Endangered). It is protected by the Saigachy Complex Landscape Reserve, with an area of 848,100 hectares.

The number of animals migrating south from Kazakhstan into Uzbekistan changes annually depending on weather conditions, and in the past was between 30 and 50 per cent of the total number of individuals in the Ustyurt population. The maximum number of Saigas in Uzbekistan was observed during the Soviet period from 1986 to 1990. (Table 4.6). Usually the census data did not fully correspond to real numbers, since the census did not try to determine the real number of Saigas and was carried out before the mass migration into Uzbekistan (the

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end of October) in order to determine the hunting quota. However, these data to some extent reflect trends in the Saiga population, indicating its decline over the 10-year period of pre-hunting surveys, which stopped in the early 1990s (Table 4.6). The Saiga has been hunted since 1976. The last hunting was conducted in 2000 (Table 4.7). Licensed hunting in the 1970s averaged 6-9 thousand animals per year (10 per cent adult male, 50 per cent adult female and 40 per cent young saigas of both sexes), the maximum was up to 10,000-12,000. At the same time, poaching was about 10 per cent of legal hunting (Ishunin, 1987). Uzbekistan sold cheap saiga meat on the internal market (1 rouble per kilo) and gathered Saiga horns for sale on the international market. Data about sales of Saiga horns are inaccessible.

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***Table 4.6**. Pre-hunting Saiga population census in Uzbekistan, 1982-1991 (according to aerial surveys by the Glavokhota (State Hunting Agency) of the Ministry of Agriculture of the USSR (after the reorganization in 1988 - the State Biocontrol of the State Committee for Nature Protection)*

Year	Number of individuals
1982	34,000
1983	34,000
1984	50,000
1985	40,000
1986	65,000
1987	60,000
1988	65,000
1989	45,000
1990	80,000
1991	10,000

***Table 4.7.** The number of saigas hunted in Uzbekistan in 1976-1985 (after Ishunin, 1987), 1990 and 2000 (after Goncharov, 2007)*

Year	Harvested Saigas, individuals
1976	156 (pilot hunting)
1977	1,439
1978	2,000
1979	3,900
1980	5,500
1981	5,430
1982	6,534
1983	9,235
1994	5,593
1985	12,626
1990	7,100
2000	490

Since 1990, the number of Saigas in Uzbekistan has been steadily decreasing. In 2004-2008, according to vehicle surveys, numbers ranged from 5,000-5,638 animals (high-snow winters in 2004-2005 and 2008-2009) to 3000 individuals (low-snow winters in 2005-06 and 2006 -07; Bykova et al., 2006; Bykova, Esipov, 2009; Bykova et al., 2010). According to the data from participatory monitoring with motorcycles in 2012, 2014-2018, in the north-eastern part of the Karakalpak Ustyurt, which is most visited by Saigas (now within the Saigachy reserve), the number of Saigas decreased constantly over time. So, in May 2012, there were 244-317 Saiga individuals (20-26 animals / 1000 sq. km), and in May 2014 - 60 (4.9 animals / 1,000 sq. km), in May 2015 - only 37 (2.13 animals / 1,000 sq. km), and in May 2016 - 49 individuals (4.0 animals / 1,000 sq. km). In September 2012, there were 12 Saigas (0.98 animals / 1,000 sq. km), and in September 2014 not a single animal was found, just like in February 2015, when the maximum number of migrants from north could be expected. In February 2016, the number of Saigas recorded was 37. (3.0 / 1,000 sq. km) (Bykova et al., 2016, 2017; Figure. 4.8).

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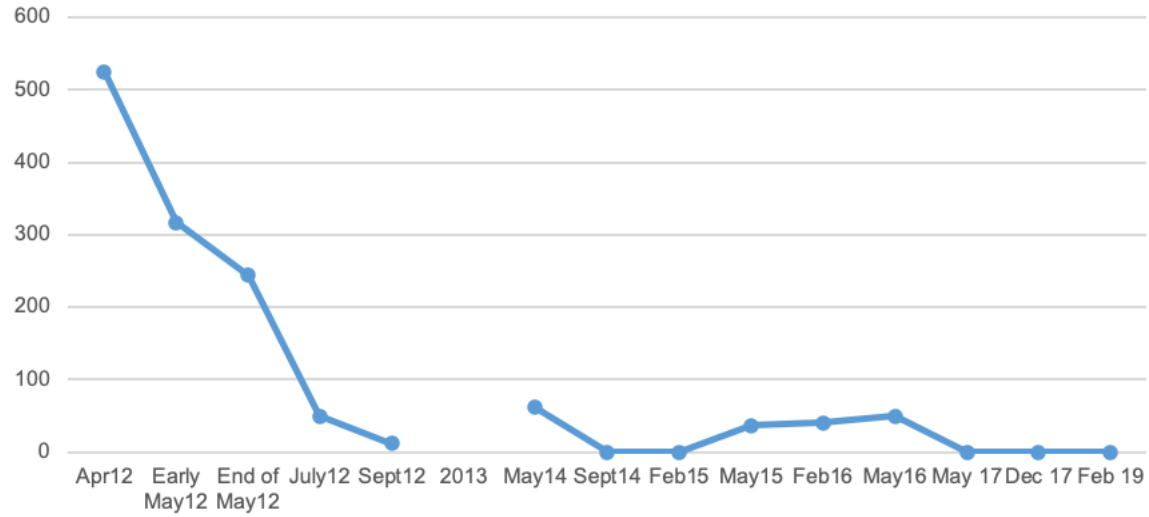

Figure 4.8. *Dynamics of the Saiga population on the Ustyurt plateau in Uzbekistan according to transect counts in 2012 and 2014-2019.*

In 2017 and 2018 only single Saiga tracks and droppings were found on the permanent transects. However, in January 2020, during camera trap monitoring carried out by the CADI project team in the Saigachy Reserve, 20-25 Saigas were recorded at one of the sites. The total number of Saigas in this area was 35 individuals (Gritsyna et al., in press).

During the same period in Kazakhstan, the Committee for Forestry and Wildlife (CFW) of the Ministry of Ecology, Geology and Natural Resources of Kazakhstan (formerly the Ministry of Agriculture) and the Kazakhstan Association for the Conservation of Biodiversity (ACBK) and other partners conducted and aerial census which showed a general trend of a decrease in the number of the Ustyurt population in the period from 2005 to 2015 (Figure. 4.8). Since 2016, there has been an increasing trend in the number of Saigas (Baydavletov et al, 2018; Zuther, 2018, 2019), which is probably due to several factors: improved protection of the population in Kazakhstan, a general decrease in the level of poaching due to a decrease in the profitability of this illegal business due to the critically low number of saigas in Ustyurt; relatively favourable weather conditions. See section 4.3 for more details.

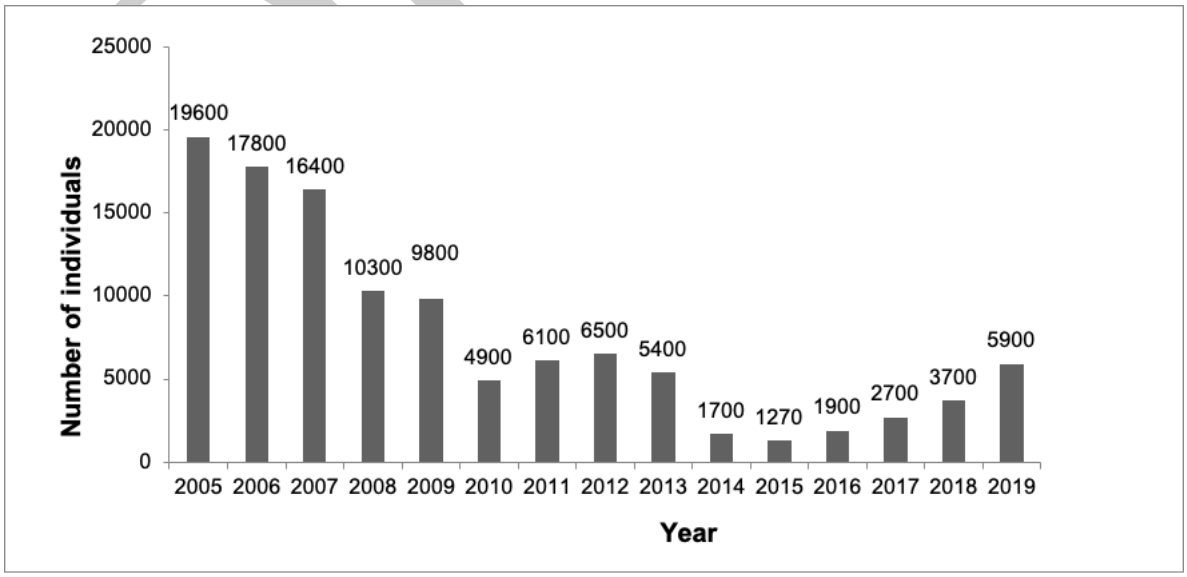

Figure. 4.9*. Dynamics of the Ustyurt population, 2005-2019 (according to data from aerial census of CFW of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan)*

However, in Uzbekistan, the number of Saigas continues to remain at a very low level, although protection on the Ustyurt plateau, where the main saiga range is located, is well established. In addition to traditional threats, the primary of which remains poaching by local residents, the Ustyurt population is also affected by the border fence built in Kazakhstan in 2012 and the section of the Beineu-Shalkar railway in Kazakhstan, which started functioning in 2017, overlapping traditional migratory routes. In 2016, changes were made to the design of the border fence (Olson, 2013) - migration passages were opened at 125 sections of the 150 km border facility. Single animals overcome the above obstacles, but fully-fledged migration has not been observed in recent years (Bykova et al., 2016). However, data from winter 2019/2020 indicate that a small number of Saigas nevertheless crossed the state border, crossing the border fence, and spent the winter in Uzbekistan (Gritsyna et al., in press). This is evidenced by the data obtained from the staff of the Saigachy Reserve, who discovered fresh tracks and droppings of Saigas near the passages in the border fence (Alisher Abdurakhmanov, pers.comm), as well as the results of observations of ACBK employees that Saiga tracks were found in seven places along the border fence[11]. Some of the animals remained in the Saigachy reserve, taking part in calving in April/May 2020 (Mardonova et al., in press).

Other threats to Saigas in Uzbekistan include habitat degradation and fragmentation due to human activity, low pasture pressure by wild ungulates and progressive aridification. Potential threats include disease, the impact of the oil and gas industry and the possible impact of road infrastructure (e.g Kungrad-Beineu section of highway A380 during and after reconstruction).

In general, there are currently around 150-200 Saigas in Uzbekistan, including migrants from Kazakhstan, resident groups in the southern Aral Sea region and on the former bottom of the Aral Sea. Uzbekistan has all the prerequisites for the restoration of this species, provided that the fight against poaching continues, there is further improvement of territorial protection (creation of a protected area on the drained bottom of the Aral Sea in the Muynak region), mitigation of the impact of road-transport infrastructure, and strengthening of transboundary cooperation and work with local residents.

Possible levels of sustainable hunting at present and in the future.

As the Ustyurt Saiga population is still critically low and affected by a number of threats, it is too early to consider the possibility of sustainable hunting in the near future. But it is very timely to start studying the possibilities for sustainable hunting, considering the transboundary context of this population and the lessons from the past. After a critical decline in the 1920s, the species completely disappeared from the territory of Uzbekistan and did not reoccur here until the mid-1950s. In the mid-1970s, when the Saiga population had recovered and was estimated to be around 60,000 to 80,000 individuals in Uzbekistan, legal state hunting was opened. Despite the regulation of Saiga hunting, to which the annual pre-hunting surveys were directed in order to determine annual hunting quotas, even then there were negative trends in the Saiga population (see above). This was because of inconsistency in actions between Kazakhstan and Uzbekistan, so that the Ustyurt population was exploited twice during the autumn hunting season - first in Kazakhstan, then in Uzbekistan. Each country determined its own quotas, not taking into account that of the neighbouring country.

Options for institutional mechanisms for sustainable hunting.

Currently, according to the existing legislation, hunting for Saigas in Uzbekistan is prohibited. Illegal hunting of saigas carries civil and criminal liability (for citizens of Uzbekistan - 50 minimum wages, for foreign citizens - US$5,000). However, in general, Uzbekistan has a legislative and institutional framework for hunting wild animals. Hunting is regulated by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated 20.10.2014 N 290 "On the regulation of the use of biological resources and on the procedure for passing

[11] https://www.facebook.com/ACBK.kz/

permitting procedures in the field of nature management"; Order of the Chairman of the State Committee of the Republic of Uzbekistan for Nature Protection "On approval of the rules of hunting and fishing in the territory of the Republic of Uzbekistan" No. 1569 dated May 2, 2006; as well as the Law of the Republic of Uzbekistan "On hunting and hunting economy" No. 627 dated 09.07.2020 (date of entry into force: 10.10.2020)[12].

Beneficiaries: who can benefit and how the profit can be used.

Local people can potentially benefit from sustainable saiga hunting, as generating income from sustainable use would be a very strong motivation for saiga conservation. The most popular types of hunting in Uzbekistan are sport and recreational hunting, which is conducted for the main hunting species according to quotas issued annually by the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection after agreement and approval by the Academy of Sciences of the Republic of Uzbekistan.

Trophy hunting in Uzbekistan is very poorly developed. However, this type of hunting is also included in the legislation (by the Law of the Republic of Uzbekistan "On hunting and hunting economy" No. 627 dated 09.07.2020), and even prioritized in comparison with sports and recreational hunting (Law of the Republic of Uzbekistan "On hunting and hunting economy" No. 627 of 09.07.2020). The hunting season in Uzbekistan is limited seasonally (for most species it runs from 1 September to 31 January), but hunting for trophy animals is allowed all year round.

Some experience of trophy hunting already exists in Uzbekistan, but it is rather negative, since it was carried out by separate groups of people pursuing only their own benefit, without taking into account the population status of trophy species (often threatened ones) and the interests of local communities. In the case of the Saiga, it is necessary to investigate the real consumer demand for trophies from this species. It may not be as high as the demand for horns from other ungulate species (such as Mountain Ibex and sheep). Alternatives to hunting such as ecotourism and safari tourism (watching wild animals in nature) can generate high incomes to local people, tourist enterprises and the government. These should be considered. The development of tourism in Uzbekistan is currently a high priority area (Law of the Republic of Uzbekistan "On Tourism, dated June 21, 2019, https://lex.uz/docs/4834921).

As the demand for Saiga horns for TCM appears still to be high (judging from continued poaching of the species throughout its range, and from surveys of consumers such as Doughty et al. 2019), Uzbekistan could in principle benefit from sustainable Saiga use in the future. However, smugglers use various tricks to pass off illegally obtained Saiga horns as legal products. A new trend is the proposals from the citizens of mainland China and Hong Kong Special Administrative Region to establish animal breeding centres in Uzbekistan (none was approved). The fear is that this would give them a legal basis for the export of contraband horns under the guise of horns of animals bred in captivity (see section 6 for the international legal position). There is already a negative experience of such a "business" in Uzbekistan, related to the Central Asian Tortoise *Testudo horsfieldii*. Therefore, in the long term, when the Saiga population recovers to a sustainable commercial level, it is possible to think about lifting the moratorium on horn trade and legalizing the controlled removal of older animals or collection from natural mortality for the international sale of horns without harming the population. However, this practice may not be resumed soon, and only under the condition of serious protection, effective control of illegal hunting and trade at all stages of the trade chain, and coordination of actions between the Range States and the consuming countries.

5. Perspectives from China

(Lead author Jiang Zhigang)

[12] https://cis-legislation.com/document.fwx?rgn=126271.

5.1. The status of saigas in China

In China, the Saiga became extinct in the mid-20th century due to land cover change and especially over-hunting (Cui et al. 2017). Saiga has been listed as Category I State Protected Wild Animal Species since 1989. The Saiga is also listed as Regionally Extinct in the 2020 National Threatened Species - Biodiversity List assessment (Jiang, 2020). The Wuwei Endangered Wildlife Breeding Centre (WEWBC, Now Gansu Endangered Animal Research Center) was established in Gansu Province in 1987 by the former Ministry of Forestry (now the National Forestry and Grassland Administration), and its captive breeding population of Saiga was established with introductions from San Diego Zoo, USA and Berlin Zoo, Germany in 1989 and 1990. However, the population grew only slowly during the initial period of establishment. For their part, subsequent attempts to introduce Saiga from Kazakhstan (1991) and Russia (1997) to Xinjiang failed, largely due to high mortality resulting from the stress of long-distance transportation. Only two Saiga from a herd of 21 coming from Kazakhstan survived the translocation in 1991 and both later died. Of a herd of 30 Saiga relocated from Russia to Xinjiang, only one survived the long-distance movement and it was later sent to WEWBC in 1997 (Wang *et al*., 2001).

The Saiga population in WEWBC has not recruited any new blood into the population in the two decades since that time. From the initial 11 Saigas that arrived in 1989-90, the Saiga population in WEWBC began to increase more substantially in the new millennium and the population size reached over 130 in 2013. However, the population then crashed; first it declined due to bad weather in the winter of 2014, then a disease broke out and drastically reduced the Saiga population to only 20 individuals in 2018 (Jiang et al., 2020). The population thus returned to its original size from the beginning of the reintroduction programme and it is impossible to foresee how long the population will need to recover, in part because of its low genetic diversity.

5.2. Perspectives on future sustainable use

Future sustainable use of Saigas will rely on: Firstly, the establishment of self-sustaining populations of considerable size and healthy population structure (including a balanced sex ratio), in conservation breeding centres. Secondly, the establishment of free ranging populations in the former saiga range in China, for example, the Mount Kalmaili Nature Reserve (Jiang et al., 2020).

To establish Saiga populations in China for conservation and restoration purposes, they need to be reintroduced from range countries. Thus, international cooperation on Saiga conservation is the first step. Probably when the Saiga population in the wild in China increases to over 5,000, the Chinese Government may consider sustainable use as an option. Otherwise only the horns of those that have died naturally due to non-disease causes may be used, when the horns have been proved to be safe for human consumption. It will also be important to consider the effects of trade in captive-bred Saigas on wild populations in China and the Range States, both in terms of the potential for stimulating or masking illegal harvests, and in terms of the effects on consumer demand (for example whether consumers have different preferences for wild or captive-bred individuals).

The Traditional Chinese Medicine Association (TCMA) has participated in many international meetings concerning Saiga management and sustainable use, and the TCMA is actively looking for founder stock to reintroduce to China in order to establish a new breeding population.

6. CITES provisions for sustainable trade in Saiga specimens

(Lead author: Stephanie von Meibom, TRAFFIC)

6.1 Current status of Saiga Antelopes under CITES

CMS and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) signed an Memorandum of Understanding in 2002 to strengthen their co-operation, to exchange information, co-ordinate their respective programmes of work of mutual interest and to promote shared goals (CMS, 2002) and have co-operated on Saiga conservation since then, including the participation on meetings, organizing joint events and establishing Joint Action Plans and Work Programmes.

The CITES-CMS Joint Work Programme 2016-2020 identifies Saiga Antelopes as one of their target species for joint actions and focuses on supporting the implementation of the Medium-Term International Work Programme for the Saiga Antelope (2016-2020), that was developed in support of the Memorandum of Understanding concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope (Saiga spp.) and its Saiga Action Plan1. While all five Saiga Range States (Kazakhstan, Mongolia, Russia, Turkmenistan and Uzbekistan) are Signatories of the Saiga MOU, important consumer and trading countries such as China, Malaysia and Singapore are not a Party to CMS and have not signed the MOU. However, China, as a historic Range State of Saigas, has been closely engaged and participated in Saiga-related meetings (CMS, 2020).

Similar to CMS, the nomenclature adopted by the 183 CITES Parties recognizes two separate species of Saiga: *Saiga borealis*, endemic to Mongolia and *Saiga tatarica* comprising all other populations. *Saiga borealis* was included in CITES Appendix I in 1975 as *Saiga borealis mongolica* but was removed from the Appendices in 1979. In 1995, *Saiga tatarica* was listed in Appendix II. At that time, the Mongolian population was considered a subspecies of *Saiga tatarica* and included in that listing, but the subsequent adoption of Wilson and Reeder (2005) as the CITES Standard Taxonomic Reference for mammals, including Saiga, resulted in the splitting of this taxon into *S. borealis* and *S. tatarica*, a division enshrined in CMS and CITES taxonomy until a new reference is adopted.

Subsequently, all populations of Saiga spp. have thus been included in CITES Appendix II since 1995, and international trade in Saiga specimens became regulated under the provisions of CITES. This listing concerns all specimens, including dead or alive, all parts and derivatives, and from wild or captive bred origin. As a result, international trade in Saiga specimens was allowed provided that the designated CITES Management Authority of the exporting CITES Party had issues a CITES export permit pursuant to Article IV of the Convention. This Article includes a provisions that (i) the such export should will not be detrimental to the survival of the species – a so-called Non-Detriment Finding that needs to be made by the Scientific Authority of the exporting Party – and (ii) that the specimens to be exported were legally acquired – a so-called Legal Acquisition Finding.

At the 18th meeting of the Conferences of Parties to CITES, Mongolia and the USA submitted a proposal to transfer *Saiga tartarica* from Appendix II to Appendix I of CITES. Although not the intention of the proponents, this would have resulted in a split-listing with *Saiga tartarica* included in Appendix I and *Saiga borealis* remaining in Appendix II, with the consequent implementation challenges this entails. Parties therefore agreed instead to an amended proposal whereby *Saiga tatarica* and *Saiga borealis* were maintained in Appendix II, with for each species the following annotation: “A zero export quota for wild specimens traded for commercial purposes”. This new listing entered into force on 16 November 2019, and is legally binding upon CITES Parties.

This amendment *de facto* bans the export for commercial purposes of all Saiga specimens of wild origin from Saiga Range States. The amendment does not apply to the re-export of Saiga specimens, such as for example in the case of trade between non-Range States. Further exemptions from this listing are trade in specimens from captive bred origin (i.e. specimens meeting the definition of bred in captivity under CITES, see section 6.4) and trade in Saiga specimens for non-commercial purposes, for example hunting trophies (as such trade is

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considered non-commercial). Changes to this listing require an amendment proposal from one or more CITES Parties to a meeting of the Conference of the Parties, that is supported by at least two thirds of the Parties present and having the right to vote.

In addition to the listing of the species in Appendix II, CITES Parties adopted Decisions related to Saigas at each of the recent meetings of the Conferences of the Parties (CoP). The latest Decisions are Decisions 18.270-274, adopted at CITES COP18 in August 2019. These direct, among others, Range States and important consumer and trading countries to implement the Medium-Term International Work Programme (MTIWP) for the Saiga Antelope for 2016-2020 and for 2021-2025 (see section 1.2), and encourage the Range States to establish internal market controls for saiga parts, (including registration of stockpiles, labelling of parts and products, and registration of manufacturers and traders).

In addition, the CITES Secretariat is requested to consult with Saiga Range States and major trading and consumer states concerning their management of stockpiles of Saiga specimens; review processes and practices; and provide assistance in ensuring effective stockpile management and monitoring, including the development of inventories and strengthening stockpile security.

There are several CITES Resolutions that are relevant to the sustainable use of Saiga Antelopes, including Resolution Conf. 17.9 on *Trade in hunting trophies of species listed in Appendix I or II;* Conf. 16.6 (Rev. CoP18) on *CITES and livelihoods*; Conf. 16.7 (Rev. CoP17) on *Non-detriment findings*; and Conf. 13.2 (Rev. CoP14) on *Sustainable use of biodiversity: Addis Ababa Principles and Guidelines*.

There is also Resolution Conf. 13.3 *on Cooperation and synergy with the Convention on the Conservation of Migratory Species of Wild Animals (CMS).*

It should be noted that CITES Decisions and Resolutions are technically not legally binding on CITES Parties. However, CITES Parties have over the years developed significant compliance mechanisms on the basis of Parties failing to meet recommendations in certain Resolutions.

6.2 International trade in Saiga

All Saiga Range States have prohibited all commercial exports of Saiga specimens for over a decade, and consequently reported legal international trade in recent years has largely been between non-Range States in Asia and much of it has been declared as originating from stockpiles comprising horns legally acquired before Range State export bans came into force (CITES, 2018b).

According to an analysis of information reported to the CITES trade database between 2007 and 2016, the main trading countries/territories are China, Hong Kong SAR, Indonesia, Japan, Malaysia, Singapore and Viet Nam (CITES, 2018b), where the most commonly used Saiga horn products include bottled ‘fresh’ saiga water, shavings, bottled ‘supermarket’ Saiga water, tablets (CITES, 2018b). In addition, Saiga products are also found as decorations, e.g. beads or pendants that are sold in both physical and online markets in China and Singapore for example (Doughty et al. 2019; Lam, 2018).

According to the CITES trade data analysis for the years 2007 to 2016, legal international trade in horns and derivatives appears to have declined over the last decade, while trade in saiga-containing medicine as a finished product has increased between Asian non-Range States (CITES, 2018a). The vast majority of reported trade in saiga parts and derivatives during this period comprised *Saiga tatarica* and 95 per cent of the reported trade in horns, medicines and derivatives were wild-sourced according to exporter reported data while according to importer reported data, half were wild-sourced and most of the remainder pre-

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Convention (50 and 47 per cent , respectively). Both exporters and importers reported a decline in trade in derivatives and horns, with trade in medicine increasing. In total, 1798 horns were reported in trade according to the exporter reported data. The main trade routes were from China to Japan (74 per cent all trade reported by exporters), followed by China to Singapore (17 per cent). Re-exports comprised wild-sourced and pre-Convention horns for commercial purposes, almost all of which were re-exported by Singapore (95 per cent) to Hong Kong SAR (93 per cent) and Japan (7 per cent) (CITES 2018a).

Although poaching levels have been reported to be declining in some areas, there are still regular reports of poaching incidents and reported seizures of saiga horns. These provide evidence for ongoing poaching and illegal trade and demonstrate that the trafficking of poached saigas between Range States and consumer states is mainly to meet demand for saiga horns. In the period 2016-2020, Kazakhstan reported 297 arrests involving saiga offences and the seizure of 6001 horns and 2109 carcasses. Russia reported for the same time period 9 poaching incidents involving 8 Saiga specimens and 20 cases of Saiga horn seizures comprising a total of 4295 horns seized. Between December 2016 and July 2017, at least 3 cases of illegal saiga horns trade occurred and 82 Saiga horns were seized in Uzbekistan. A number of incidents of saiga horn trade have been detected in Mongolia, however the rate decreased from 14 cases (102 Saiga parts) between 2011 to 2015 to only 4 cases (46 Saiga parts) in the period 2016-2020 (all figures from CMS Overview Report, 2020).

Plakhov (2018) reported on numerous seizures and poaching incidents in Kazakhstan involving Saiga with details on border posts and trade routes. Based on information from governmental sources as well as media reports this report estimated that between 2011 and 2018 around 13,000 horns and 1,500 carcases were seized either inside Kazakhstan or at the border to China. According to this report, Saiga horns are mainly smuggled in trucks that cross the border between Range States such as Russia or Kazakhstan into China. However, illegal transportation via non-Range States, such as via Kyrgyzstan to China are also reported (also by CITES, 2013).

There have been also reports of seizures that involved considerably large amounts of horns. One seizure of this type was made in October 2019, when the National Security Committee of Kazakhstan seized 1,118 kg of Saiga horns destined for export and detained 18 members of a criminal group associated with this seizure (Kazinform, 2019). Two equally large seizures were both made by the Chinese border police of the Xinjiang Autonomous Region. One took place in September 2013 when 4,470 antelope horns were seized and the other one in October 2015 with 5,300 Saiga horn seized. Both consignments came from Kyrgyzstan, a non-Range State, suggesting that the horns originated from elsewhere, most likely from Kazakhstan (CMS, 2013; Saiga News, 2013; Saiga Resource Centre, 2018).

The annual illegal trade reports for the years 2015 – 2017 that are submitted to the CITES Secretariat indicate that several CITES Parties seized predominately small quantities of medicines containing - or claiming to contain - Saiga Antelope. These reported seizures have occurred mostly at airports. Only two seizures in the report for 2015 to 2017 referred to small numbers of horns, and one seizure to six poached Saiga Antelopes. A total of 160 cases were reported, the vast majority by non-Range States (CITES, 2018a). During the same period (2015-2017), seizure records contained in the WorldWISE database of the United Nations Office on Drugs and Crime (UNODC) document additional 59 seizure cases by: Austria (2); Germany (5); Netherlands (16); and the USA (36). Again, most cases comprised pharmaceutical products/medicines (CITES, 2018a).

6.3. Non-detriment Findings (NDFs) for species listed in CITES Appendices

Article IV 2a) of CITES states that in order to grant an export permit for trade in specimens of species included in Appendix II, one of the requirements is that "*a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that*

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species". This advice given by the Scientific Authority is called a non-detriment finding or NDF. The making of Non-Detriment Findings is one of the key tasks of CITES Scientific Authorities and a cornerstone of the Convention. The background to NDFs and non-binding guidance are contained in Resolution Conf. 16.7 (rev. CoP17) on non-detriment findings.

When making NDFs, Scientific Authorities may evaluate parameters such as species distribution and habitats, population status and trends, harvest practices, as well as volumes and impact of trade in target species. For some of these aspects to be considered, there may be uncertain or limited information available and thus, making a NDF process is comparable to a risk assessment, where decisions will be made based on weighing up the proposed levels of export against possible conservation risks for the target species. They result in a recommendation to the CITES Management Authority of the exporting Party. In general, this assessment can result in a positive NDF (a precondition for the issuance of a CITES export permit), a conditional NDF (certain limitations to be respected for the specimens to be exported, or certain measures to be implemented before export can take place), or a negative NDF. A negative advice can be revisited later, e.g. as precautionary trade management and conservation measures are put in place, levels of export are revised, the population recovers, or more information becomes available.

The making of NDFs varies considerably. This is partly explained by the fact that there are different analytical requirements for different groups of animals and plants. NDF risk assessments can easily be made for the export of low numbers of a common species but may require significant research in case exports concern proportionally high numbers, (more or less) rare species, or a combination thereof.

CITES Parties have agreed on non-binding guidance for how NDFs can be undertaken. Considerable efforts have been made by Parties, IGOs, and the CITES Secretariat over the years to develop general and taxon-specific guidance for making NDFs. There are now a number of NDF-specific references that have been written to help CITES Parties to develop NDFs. These include as standard references the IUCN Guidance for CITES Scientific Authorities (Rosser and Haywood, 2002) and the outputs from the International Expert Workshop on Non-Detriment Findings, Cancun, Mexico (CITES, 2009).

Examples of species-specific guidelines include:

- CITES Non-detriment Findings for Timber: A nine-step process to support CITES Scientific Authorities making science-based non-detriment findings (NDFs) for timber/tree species listed in CITES Appendix II Version 3.0. 2018
- CITES Non-Detriment Findings Guidance for Perennial Plants: A nine-step process. Version 3.0, 2016.
- Non-Detriment Findings and Trade Management for Tortoises and Freshwater Turtles - a guide for CITES Scientific and Management Authorities. Prepared by IUCN SSC's Tortoise & Freshwater Turtle Specialist Group, 2015
- CITES Non-Detriment Findings Guidance for Shark Species - 2nd revised version. A Framework to assist Authorities in making Non-detriment Findings (NDFs) for species listed in CITES Appendix II. 2015.
- Framework for CITES non-detriment findings for hunting trophies with a focus on Argali *Ovis ammon*. 2013.

In 2020 and pursuant to Decision 18.132, the CITES Secretariat has been undertaking an inventory and review of all relevant materials and guidance for the making of non-detriment findings (NDFs) that are available to Parties and on the CITES website to identified potential gaps and needs and with the aim to generate updated and improved guidance where needed (CITES, 2020).

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Resolution Conf. 16.7 (Rev. CoP17) emphasize that an NDF is the result of a science-based assessment that verifies whether a proposed export is detrimental to the survival of that species or not; that takes into account the role of the species in the ecosystems in which it occurs, the intrinsic biological risks, harvest impacts, and trade impacts identified for the species concerned and that may include, but are not limited to, consideration of:

A. species biology and life-history characteristics;
B. species range (historical and current);
C. population structure, status and trends (in the harvested area, nationally and internationally);
D. threats;
E. historical and current species-specific levels and patterns of harvest and mortality (e.g. age, sex) from all sources combined;
F. management measures currently in place and proposed, including adaptive management strategies and consideration of levels of compliance;
G. population monitoring; and
H. conservation status.

The guidelines describe a nine-step process that can be summarized as follows:

- Steps 1-3 involve the evaluation of whether a detailed, science-based NDF is needed for the species and specimens concerned. An early decision (shortcut to Step 9) can be made in some cases.
- Steps 4 and 5 involve the evaluation of conservation concerns and potential biological risks. Assessments at these steps set the context of risk that the harvest, trade and management should be considered against.
- Steps 6 and 7 involve the evaluation of harvest impacts, and trade impacts relevant to the species concerned.
- Step 8 involves the evaluation of whether the management measures in place are sufficiently rigorous to mitigate the concerns, risks, and impacts identified in steps 4-7.
- Step 9 involves the making of an NDF or other advice to the Management Authority based on the outcomes of Steps 1-8.

Resolution Conf. 16.7 (Rev. CoP17) also highlights the need for transparency and information-sharing about NDFs made by requesting Parties - "to provide to the Secretariat for publication on the CITES website, where they exist, written records of the science-based rationales and scientific information used for non-detriment finding assessments, where possible“.

Under the current listing, exports of Saiga specimens of wild origin from the Range States is only allowed for non-commercial purposes. The export of saiga trophies from Range States would generally be considered non-commercial. The export of such trophies would, however, still require the Scientific Authority of the exporting country to advise that the export will not be detrimental to the survival of that species through the making of a positive non-detriment finding. The making of a NDF could benefit from experience or guidance made with regard to other trophy species, such as the Argali or the Markhor even though the species differ in their biology, geographical range and trophy value (Parry-Jones, 2013).

6.4. Captive breeding provisions under CITES

Rather than being taken directly from the wild, animals traded under CITES are increasingly sourced from captive breeding facilities. During the early years of the Convention, the majority of animals in international trade were taken from the wild. Since then, there has been a significant change and, today, international trade in animals that are considered from “captive-produced sources” is widespread (Harfoot et al. 2018).

Article VII, paragraph 5 of the Convention provides that:

> *Where a Management Authority of the State of export is satisfied that any specimen of an animal species was bred in captivity (…), a certificate by that Management Authority to that effect shall be accepted in lieu of any of the permits or certificates required under the provisions of Article III, IV or V.*

The export of specimens of captive-bred animals requires a CITES Certificate, issued by the Management Authority after verification. Obviously, for specimens of captive bred animals, there are no requirements to undertake a non-detriment finding because they are not extracted from the wild.

However, as the proportion of trade in captive-bred animals increased, a number of Resolutions and Decisions were adopted by the Parties to regulate and define the terms and conditions for such production and trade. Important in that regard are CITES Resolution Conf. 10.16 (Rev.) on *Specimens of animal species bred in captivity* that defines the relevant terminology and outlines the conditions under which trade in captive-bred animals is permitted and CITES Resolution Conf. 12.3 (Rev. CoP18) on *Permits and certificates* that defines the various source codes for animals that were kept and /or produced in a captive environment (see details in Box 6.1).

Box 6.1. *Terms relevant to captive breeding*

The most relevant source codes and definitions used in CITES reporting are (Lyons, 2017 and Resolution Conf. 12.3 (Rev. CoP18):
W: Wild - Specimens taken from the wild
R: Ranched specimens: specimens of animals reared in a controlled environment, taken as eggs or juveniles from the wild, where they would otherwise have had a very low probability of surviving to adulthood)

C: Animals bred in captivity (in accordance with Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof, exported under the provisions of Article VII, paragraph 5.

F: Animals born in captivity (F1 or subsequent generations) that do not fulfil the definition of 'bred in captivity' in Resolution Conf. 10.16 (Rev.), as well as parts and derivatives thereof.

Resolution Conf. 10.16 (Rev.) then further defines:

a) "first-generation offspring (F1)" are specimens produced in a controlled environment from parents at least one of which was conceived in or taken from the wild;
b) "offspring of second generation (F2) or subsequent generation (F3, F4, etc.)" are specimens produced in a controlled environment from parents that were also produced in a controlled environment;
c) the "breeding stock" of an operation means the ensemble of the animals in the operation that are used for reproduction; and
d) "a controlled environment" is an environment that is manipulated for the purpose of producing animals of a particular species, that has boundaries designed to prevent animals, eggs or gametes of the species from entering or leaving the controlled environment, and the general characteristics of which may include but are not limited to: artificial housing; waste removal; health care; protection from predators; and artificially supplied food;

Resolution 10.16 (Rev.) also defines the conditions applying for trade in specimens 'bred in captivity':
a) the definition provided below shall apply to the specimens bred in captivity of species included in Appendix I, II or III, whether or not they were bred for commercial purposes; and

b) the term 'bred in captivity' shall be interpreted to refer only to specimens, as defined in Article I, paragraph (b), of the Convention, born or otherwise produced in a controlled environment, and shall apply only if:

i) the parents mated or gametes were otherwise transferred in a controlled environment, if reproduction is sexual, or the parents were in a controlled environment when development of the offspring began, if reproduction is asexual; and

ii) the breeding stock, to the satisfaction of the competent government authorities of the exporting country:

A. was established in accordance with the provisions of CITES and relevant national laws and in a manner not detrimental to the survival of the species in the wild;

B. is maintained without the introduction of specimens from the wild, except for the occasional addition of animals, eggs or gametes, in accordance with the provisions of CITES and relevant national laws and in a manner not detrimental to the survival of the species in the wild as advised by the Scientific Authority:

1. to prevent or alleviate deleterious inbreeding, with the magnitude of such addition determined by the need for new genetic material; or

2. to dispose of confiscated animals in accordance with Resolution Conf. 17.81; or

3. exceptionally, for use as breeding stock; and

C. 1. has produced offspring of second generation (F2) or subsequent generation (F3, F4, etc.) in a controlled environment; or 2. is managed in a manner that has been demonstrated to be capable of reliably producing second-generation offspring in a controlled environment.

Saiga Antelopes in captivity – the current situation

In August 2017, the Saiga Conservation Alliance and San Diego Zoo Global hosted the first Saiga Conservation Captive Breeding Workshop in Moscow, bringing together captive breeding experts to discuss the status of captive saiga populations and the potential of captive breeding for conservation. Saiga conservationists from Russia, Kazakhstan, Mongolia, China, Uzbekistan, the USA, and the United Kingdom attended. This meeting concluded that captive breeding can assist with the overall conservation of the Saiga, "through breeding for release, education, scientific study and awareness-raising" (San Diego Zoo Global and Saiga Conservation Alliance, 2017).

Several zoos have attempted to keep Saigas but very few have done so successfully. The most likely cause of death has been disease or trauma (Enderby 2017). In addition, inbreeding in some of these captive populations has resulted in low genetic diversity which, together with harsh winter conditions and severe disease, has led to large fluctuations in population sizes (Cui et al., 2017). Nevertheless, there have been some recent advances in the captive breeding of saiga, and consideration of the role that captive breeding can play in the conservation of the species, for example through re-introductions (Karimov et al., 2018).

There are currently nine known captive breeding centres in the world (not including zoos) that keep Saiga and an estimated 750-800 Saiga held in these facilities (San Diego Zoo Global and Saiga Conservation Alliance, 2017, Saiga News, 2019). Six of these occur in the current range of Saiga, two in the Ukraine and one in China:

- 117 animals in four facilities in Russia
- 20 animals at two facilities in Kazakhstan
- 20 animals at the Wuwei Breeding Centre in Gansu, China in early 2018 (down from a population of around 130 in 2013 due to disease and bad weather conditions)
- 600 animals at the Askania Nova centre in the Ukraine
- 34 animals in the newly established centre in the Kherson Province of Ukraine.

While there have been reports of offspring being born in some of these facilities, it is unclear how many specimens are currently kept in captivity that would meet the definition of "captive-bred" as defined by the relevant CITES provisions (i.e. F2 generation and subsequent

generations). F1 generation offspring that are born in captivity from wild caught animals would generally not qualify as “captive bred” and are likely to be considered “ranched” or “captive born” under CITES (see definitions in Box 6.1). Consequently, such specimens would not be considered exempt from the provisions of Article IV and in this case would require the prior issuance of an export permit, based on a positive NDF.

Although Saiga Antelopes are not captive bred at a scale that would allow commercial offtake in the near future, any consideration of future trade in captive bred specimens of Saiga should consider the potential consequences or impact on wild populations. For example, effects of increased availability of saiga products on market demand and if challenges might arise for the implementation and enforcement of CITES (e.g. distinguishing horns of wild vs captive-bred origin, laundering of wild horns as captive bred specimens) (CMS, 2020).

6.5. Saiga horn stockpiles and their management

Stockpiles of saiga horns

Saiga Range States such as Russia and Kazakhstan, as well as consumer states such as Singapore and China, have reported on the existence of stockpiles in the past. These stockpiles may consist of Saiga horns that originate directly from dead animals, from confiscations or from other sources (e.g. commercial trade) and/ or from specimens that were important prior to the listing of Saiga into the CITES Appendices. However, available information on stocks of Saiga specimens and their management in the different Range States, consumer and trading countries is incomplete and/or dated:

China conducted surveys to evaluate the total volume of Saiga horn held in stockpiles within the country (von Meibom, 2010). One survey was conducted in 1994 and estimated the total stock of saiga horn held in China at 155,500 kg. A second nationwide survey was undertaken by the Department of National Forestry Bureau Protection for the period 2005–2006 and revealed that the total volume of Saiga horns in China was 55,000 kg by the end of August 2006 (von Meibom, 2010). In 2015, China reported that there were also privately owned stockpiles, but they were not required to be legally registered and therefore the volume was not known (Saiga News, 2019).

The Hong Kong SAR reported in 2006 a stockpile of 37,600 kg of Saiga horns of which 21,700 kg had been imported before 1995 (CITES, 2007).

A 2016 study of Singapore’s international trade in Saiga revealed that considerable quantities of horns, reportedly from stockpiles, were still being exported to the Hong Kong SAR, China and Malaysia (Theng et al., 2017) and based on CITES trade data from 1995–2015 Singapore was the largest (re-)exporter of Saiga horns (Theng & Krishnasamy, 2017). In 2006, Singapore reported a horn stockpile of around 33,000 tonnes, which had fallen to an estimated less than 20,000 tonnes by 2015 (CMS, 2015) (CMS, 2015).

The Malaysian authorities maintain a database of registered dealers through a licensing system. However, the number of dealers permitted to trade in Saiga and the volume of stockpile of Saiga horns and derivatives is unknown (Gomez & Krishnasamy, 2019).

In 2010, Kazakhstan and Russia had no official stockpiles of Saiga horns (von Meibom et al., 2010).

In recent years, the CITES Secretariat has consulted Saiga Range States as well as important consumer and trading countries to report on their stockpile management practices and any challenges they encounter, however, there is little up to date information available on the volumes of these stocks and their management. In the past, CITES Parties have expressed concerns regarding how to manage effectively existing stockpiles of saiga parts and

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derivatives, and suggested that relevant Parties might require assistance to ensure effective stockpile management (CITES, 2019). Accordingly, CITES Parties adopted Decision 8.270 and 8.271 at COP18 in August 2019 that encourages Range States to establish internal market controls for saiga parts, including registration of stockpiles, labelling and registration of manufacturers and traders, and directs the CITES Secretariat to consult Saiga Range States and major trading and consumer States concerning their management of stockpiles of saiga specimens, review processes and practices, and provide assistance in ensuring effective stockpile management and monitoring.

The lack of up-to-date information on stocks of saiga specimens being held in the Range States and in transit and consumer countries makes it difficult to ascertain the volumes of current legal stockpiles. Effective stockpile management and marking should enable authorities to clearly distinguish the different sources and origins of their stocks, and prevent illegal specimens being mixed with legal ones.

Stockpile management in CITES – examples from other species

For some years, the subject of stockpiles and the need to effectively manage them has received increased attention under CITES. At CITES COP 17 and COP18, CITES Parties adopted Decision 17.170 (Rev. CoP18) that directs the Standing Committee to review the existing provisions agreed by the Parties concerning controls on stocks of specimens of CITES-listed species. While these deal primarily with the management of stockpiles of species listed in Appendix I such as elephants, rhinoceros and pangolins, they are also relevant for the management of nationally-held stocks of Saiga horn. There is also Decision 18.270 that encourages Saiga Range States to establish internal market controls for Saiga parts, including registration of stockpiles, labelling of parts and products, and registration of manufacturers and traders, and report such information to the CITES Secretariat.

In 2019, TRAFFIC published guidance on how to deal with stockpiles of CITES-listed wildlife products. The document sets out the steps needed for adequate management of stockpiles, including undertaking effective stock inventories, designating the appropriate agencies to manage all aspects of stockpile management and their roles and responsibilities, the development and operational roll-out of stockpile management systems. It also contains a Checklist to Assess the Status of Stockpile Management at the National Level, that is of particular importance for Saiga range and consumer countries.

According to the guidelines published by TRAFFIC in 2019, effectively managed stockpiles:

- Are legally supported through legislation, regulations and standard operating procedures;
- Unambiguously establish accountable management structures and governance regimes at all levels;
- Clearly delineate the roles and responsibilities of individuals along the administrative and physical chains of custody under a range of likely circumstances for all stocks;
- Provide detailed guidance on all procedures associated with the management of targeted stocks from first acquisition through secure storage to safe disposal or final destruction;
- Result in up-to-date, immediately retrievable, records of all items held in the stockpile, including their unique markings, provenance and other relevant information whenever consolidated summarized data are required.

Marking and labelling of specimens

One important prerequisite for effective stockpile management is the need for stock inventories. In fact, stock-taking, which results in the marking and registration of each individual piece of stock (i.e. an inventory), constitutes one of the most fundamental processes in the system. All specimens of stocks which are part of a stockpile management system

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should be marked individually so that each individual piece has a unique identity that is recorded when it becomes part of the inventory record for the particular wildlife commodity in question.

There are examples of marking systems that have been agreed under CITES, for example, with respect to ivory stocks Resolution Conf. 10.10 (Rev. CoP17). Trade in elephant specimens recommends that whole tusks of any size, and cut pieces of ivory that are both 20 cm or more in length and one kilogram or more in weight, be marked by means of punch-dies, indelible ink, or other form of permanent marking, using the following formula: *country-of-origin two-letter ISO code, the last two digits of the year / the serial number for the year / and the weight in kilograms (e.g. KE 00/127/14)*.

Under this system, tusk marked VN/17/285/13 would indicate a piece of ivory that was the 285th item registered in the Viet Nam national stockpile database in 2017 with a weight of 13 kg. Likewise, an ivory tusk that was marked KH/17/285/13 would indicate the same thing except that the particular tusk was in Cambodia (Milliken & Compton, 2019).

There are currently no legal obligations for CITES Parties to label or mark Saiga horns, however the Decision adopted at CoP18 in 2019 encourages the Range States of the Saiga Antelope to establish internal market controls for Saiga parts, including registration of stockpiles, labelling of parts and products, and registration of manufacturers and traders, and to report such information to the CITES Secretariat. The implementation of these measures such as marking of horns and registration of stockpiles would greatly help to ensure that illegally sourced products do not enter the trade chain or get mixed with legal trade in horns.

Other implementation issues

Species identification

While *Saiga tatarica* and *Saiga borealis* show morphological differences, products in trade - including their horns - cannot be differentiated by non-experts (IUCN & TRAFFIC, 2019). However, species identification is of importance, for example to establish the legality of existing stockpiles or the origin of seized specimens. Studies have shown that DNA barcoding technology is an effective tool to differentiate horns of *Saiga tatarica* from *Saiga borealis* (Chen, et al., 2015). However, it needs to be explored if these technologies can be applied in practice in a cost-effective to support enforcement efforts.

Disposal of confiscated specimens

The disposal of illegally traded and confiscated specimens of CITES-listed species is becoming increasingly important as many CITES Parties step up their efforts and more specimens are confiscated. This also applies to saiga, where CITES Parties such as China and Kazakhstan have reported large seizures of Saiga horn in recent years (see section 6.2). At its 17th meeting, the Conference of the Parties adopted Resolution Conf. 17.8 on *Disposal of illegally traded and confiscated specimens of CITES-listed species*. The Resolution contains recommendations to Parties on available disposal options of live and dead specimens. Important considerations in this regard are whether or not confiscated specimens of Appendix II species may be allowed to be sold, how to avoid illegally-sourced and traded specimens entering commercial trade, how to manage stocks of confiscated specimens, and if considered, how to dispose of these, e.g. through burning events such as those happened in Kazakhstan in 2018 (Saiga Conservation Alliance, 2018).

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7. Conclusions: Perspectives on, and prospects for, sustainable use of the Saiga Antelope

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This report has covered a wide range of topics, from the theory of sustainable use through institutions for harvesting, to the prerequisites for and current status of, international trade in the species. It has also drawn on relevant examples of other species and sustainable harvesting regimes. Importantly, the report does not just take a generic perspective; we focus on the circumstances of individual populations within particular countries. This is important because the circumstances of Saigas differ quite markedly between countries. Our general recommendations follow.

7.1 Prospects for sustainable use by population

In principle, an offtake which represents a very low proportion of the population can be taken from even a small population without compromising sustainability, as shown in Section 2. This is particularly the case if the harvest was taken from a less reproductively valuable component of the population (e.g. adult males rather than adult females). The possibility for a certain level of hunting to be compatible with population growth is evidenced for Saigas by the fact that populations are currently growing, despite ongoing poaching removing an unknown proportion of the population. Therefore, if governments and local communities wanted to do it, biologically speaking a limited trophy or recreational harvest focused on males would not damage the recovery of Saiga populations so long as: i) poaching was controlled so that the overall hunting mortality was at low levels, ii) the sex ratio remained above safe levels, and iii) the effects of other biological factors such as disease, climate and barriers to movement were considered. There are precedents for such hunting systems being biologically sustainable over several years, including within Central Asia (see section 3). However, these examples relate to relatively sedentary species (therefore easier to monitor and control both the population and hunting) and without the saiga's propensity for mass mortality.

As well as the biological issues, the institutional, social and financial ramifications of legal hunting also need to be considered, and these are much less clear-cut. At present, governments are thinking in terms of large-scale hunts that take a substantial proportion of the population; enough to justify the considerable expense and effort of setting up the necessary institutions to manage that hunt in a secure and accountable way. The evidence laid out in Section 4 clearly shows that large-scale hunting cannot currently be contemplated for the Mongolian, Ustyurt and north-west Pre-Caspian populations. These three populations are all small and depleted. They are at risk from various threats which include disease and poor pasture for the Mongolian population, poaching and linear infrastructure for the Ustyurt population, and poaching and habitat degradation for the north-west Pre-Caspian population. These populations require ongoing stringent conservation and close monitoring; consumptive sustainable use can potentially be revisited in future. In the meantime, non-consumptive sustainable use (e.g. tourism) could be explored.

With regard to the Ural population in Kazakhstan, the 2019 population of 217,000 would be large enough to sustain a meaningful level of offtake which could justify the expense of setting up hunting institutions. This population lives in a relatively constrained area and has limited migratory movements. It is also increasingly seen negatively by local pastoralists and farmers, as a species which competes with livestock for food and water, and which carries diseases. Given this context, sustainable use that provided benefits to people living within the population's range could improve prospects for co-habitation.

The Betpak-Dala population, at 111,500 in 2019, is still substantially below the levels that it reached before the 2015 mass die-off (242,500). Howeve,r it is recovering rapidly. It is conceivable that within the next 5 years it too could reach levels that would allow an economically feasible and biologically sustainable offtake. Although the issues of conflict with

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local residents are less acute than in the Ural region, sustainable hunting could in principle provide much-needed revenues, employment and other benefits to the Betpak-Dala region.

7.2. Biological criteria for large-scale consumptive use

There is substantial experience of setting harvesting rules for saigas in Soviet times (section 3). These generally appeared to be successful, although there were issues with independent quotas being set by different Republics for the transboundary Ustyurt population, and concerns about overharvesting in some years and populations. There is also substantial experience of sustainable harvesting at relatively large scales for species that are somewhat similar to saigas (bearing in mind that Saigas are biologically unique in a number of respects); also given in section 3. Population modelling has also explored sustainable harvesting rules for saigas (section 2). All these sources of evidence suggest that a precautionary approach to setting a biologically sustainable harvest rule could involve:

1) No harvesting of populations below 50 per cent of Carrying Capacity (K).

In recent years carrying capacity is likely to have changed substantially, due to changes in land use, barriers, climate change and forage productivity. These factors will continue to change and to affect the carrying capacity of Saiga habitat into the future. Therefore population-specific carrying capacities would need to be recalculated regularly. However, a rough estimate of a population size below which mass harvesting should not be contemplated might be 200,000 individuals.

2) Harvesting to only take place in good years.

These would need to be defined, ideally with the use of a population model, but might include a summer/autumn juvenile to female ratio of around 1.2:1 and no evidence of major disease or poaching/illegal trade issues, favourable climate and a positive trend in the population compared to the previous year.

3) Harvest quotas to be calculated on an annual basis.

Although a population model would be useful back-up, there are robust approaches to setting quotas which are more suited to situations in which population estimates are uncertain and a precautionary approach is required. For example, the Potential Biological Removal approach set out in section 2 has proved very robust over years and for many different applications. Based on our biological knowledge of saigas and past experiences, a harvest quota of around 10 per cent of the pre-harvest population is likely to be sustainable given that rules 1) and 2) above have been applied.

4) Harvest composition to be biased towards the less productive components of the population

Adult females are the most productive components of any ungulate population. On the other hand, we know that harvests which are too male-biased can cause reproductive collapse in this species. It is hard to be selective when mass-harvesting but in general, saiga harvests should be biased towards young-of-the-year and males rather than reproductive females. However, the proportion of males in the post-harvest population should never go below 15 per cent.

5) Harvesting should only take place in autumn.

The best time to harvest both biologically and economically is when the young-of-the-year are old enough to be worthwhile to use, while not interfering with the reproductive cycle of the species. This means no harvest too close to the rut, or while females are pregnant, or calves are still dependent. The ideal time would be October, and this is when hunts took place in Soviet times.

6) Harvest quotas must be adjusted to reflect poaching rates

Total harvest numbers must include the number of saigas estimated to have been lost to poaching in a given year, in order that the total offtake does not exceed sustainable levels.

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Poaching rates can be estimated using data from anti-poaching patrols (e.g. using SMART technologies), from surveys of local residents, key informants, and by inference from population trends over time.

7) Adaptive management should be instituted.
Sustainable harvests can only be contemplated when backed up by rigorous and ongoing monitoring of the population's size, density, structure and vital rates, including disease surveillance and poaching monitoring. The information from this monitoring should be used in the following year's harvest quota calculations. If monitoring cannot be carried out in a given year, harvesting should not take place.

Abiding by these rules would produce a precautionary harvest system which would have a very low risk of leading to biological overharvesting.

7.3. Institutional criteria for sustainable harvesting
Evidence from around the world, including from previous saiga harvests, show that there is a range of feasible institutional structures for harvesting saigas, depending on the government's management priorities. The types of harvesting these structures could support would include large-scale hunting for commercial purposes, smaller-scale hunting for local use only (meat and/or recreational), gathering of natural mortality horns, or hunting for trophies. The evidence does suggest a few key considerations for saigas:

1) Local residents must feel positive towards sustainable use.
Use of a wide-ranging species in remote regions, such as saigas, cannot be sustainable if local residents do not feel positive about the species and the harvesting regime. If they are not positive, then poaching and illegal trade will continue, and there will be no incentive to protect the species or its habitats (for example by limiting livestock numbers or leaving birth aggregations undisturbed, not setting fire to grazing areas). Local administrations will come under pressure to approve activities that damage saigas and their habitats (e.g. infrastructure sited in inappropriate locations, change of use of land from nature protection to grazing). Therefore, even if harvesting is carried out by national-level authorities, it is vitally important that local residents receive benefits, for example from employment in hunting organizations or permission to harvest saigas for their own consumption. It is also important that local and regional authorities are involved in saiga management (including potentially photo-safari tourism).

2) Spatial structure must be accounted for.
Because of the wide-ranging and migratory nature of the species, unfairness can be introduced if only people within the areas where hunting takes place are able to benefit from that hunting. Therefore, some mechanism is needed that enables distribution of benefits to all those sharing Saiga range. Many options are available to do this: One option might be to follow the model of reindeer hunting in Norway, where each area's hunting association is provided with a quota. If a hunting association is in an area where Saigas are only present outside of the hunting season, they can trade their quota to an association within the saiga's autumn range or get permission to join the saiga hunt wherever it takes place. Another option would be a benefit-sharing model, whereby the proceeds from hunting are shared between all the local authorities which host Saigas, pro rata according to the density of saigas within their area divided by the amount of time spent there. This problem is likely to be much more acute for the very wide-ranging Betpak-Dala population than for the more constrained and nomadic Ural population.

3) Cross-scale institutions will be required.
Models for hunting institutions around the world vary from very local and community-led to national-level and government-led. In the case of the Saiga, with its very large range, there has to be a major role for national-level (or at least saiga population-level) authorities. This is

unlike the case of the Torghar markhor project and more like the case of the USA's duck management approach. National authorities need to organize and fund monitoring, protection and quota-setting actions. Regional and local authorities need to carry out monitoring and protection on the ground and ensure compliance with hunting rules. Enforcement and controls would need to be strengthened and integrated across borders and between levels of national governments. The Saiga Range States already have hunting management structures of this type. However, it would be worthwhile for the Government of Kazakhstan to explore the potential of instituting a co-management regime, in which a range of stakeholder groups work together to manage hunting of saigas. This has worked very well for caribou management in Nunavut, Canada, and leads to more buy-in by local groups and residents, and therefore more compliance with rules and better outcomes. In the case of Saigas, local hunting associations would be particularly important to involve.

7.4 Types of hunting

The newly instituted international regulations under CITES mean that it is currently not possible to export wild-sourced saiga products such as horn (including products of natural mortality and live animals). In order to change the current CITES listing, a two-thirds majority will be required at a Conference of the Parties. To obtain this, Range States would need to prepare convincing non-detriment finding assessments and show that they have implemented appropriate safeguards (including effective population monitoring and adaptive management, stockpile management including marking and registration, strong enforcement). In the current climate it will be challenging to get these accepted. Therefore at least in the short to medium terms, it seems pointless to focus on horns for export as a major product from sustainable hunting. Instead, the main commodity from sustainable hunting is likely to be meat. Nonetheless if males are hunted or if natural mortality horns are gathered, there needs to be a system for disposing of, or stockpiling, horns in a secure way.

Given that Saiga meat is most likely to be a product subject to local demand, this suggests that locally organized or co-managed hunting for meat is likely to be both economically and socially the best model (given the caveats expressed above). However, there could be opportunities for improving the economic value from this product with high quality supply chain management and marketing. In Australia, there has been substantial investment in improving the value of kangaroo meat for local and national markets, for example (Spiegel & Wynn 2014). Hides may also produce additional value.

Sport or trophy hunting has the advantage that it can provide relatively high levels of economic return for a very limited harvest, so it can be carried out sustainably even in small populations of conservation-dependent species. This has been demonstrated for markhor, and for very threatened populations like the mountain nyala in Ethiopia (Atickem et al. 2011, Bunnefeld et al. 2013). Therefore, in principle, small offtakes for sport or trophies could be biologically sustainable even for the smallest saiga populations. However, the saiga is not, on first analysis, an excellent candidate for sport or trophy hunting. Firstly, its trophy is not of particularly high value so the demand is likely to be low. Secondly, the remoteness and sparseness of the population, and its migratory nature, may make trophy hunting less logistically feasible for a number of reasons. This means that the amount of money that could be obtained from sport or trophy hunting by tourists may be small. However, small-scale recreational hunting by local residents (as in Scandinavia) may be more feasible and may improve people's attitudes towards Saigas as a locally beneficial game species. More research would be needed before any conclusions could be drawn on the potential for trophy or recreational hunting; including attitude and willingness to pay surveys amongst potential hunters and local residents, and financial viability analyses.

7.5. Uncertainties and future research and policy needs

This report was compiled based on the best available information in the scientific literature, official reports and expert knowledge. However, it is not intended to give definitive answers to

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the questions surrounding sustainable use. Most importantly this is because decisions must be made by the governments and authorities responsible for Saiga management. However, it is also because there are still substantial gaps in our knowledge that need to be filled in order to support any discussions about the future of sustainable use. These include:

1) The development of a comprehensive population dynamics model for each population that can explore harvesting options.
This should include other drivers of saiga population dynamics, including disease outbreaks and climate change, and may need to be spatially explicit. A Management Strategy Evaluation approach is likely to be useful, as is widely used to support sustainable fisheries management (Bunnefeld et al. 2011).

2) Exploration of the economic feasibility of different options for sustainable management.
This could include the exploration of financial models for harvesting, processing and sale of different saiga products, as well as the costs and benefits of different institutional structures. There are no data available to explore these in this report, but visits to Australia and Scandinavia to consult with experts working in wildlife management (including the commercialisation of wild meat products), and visits to small-scale recreational and trophy-hunting initiatives (such as in Pakistan and Tajikistan) would be worthwhile.

3) Consultation with local residents to understand their behaviours and perspectives.
This should include getting an understanding of the prevalence and drivers of saiga hunting and consumption using modern indirect questioning methods (e.g. Nuno & St John 2015). It should also include participatory exploration of local people's relationships with saigas and preferences for receiving benefits from their presence (including alternative livelihood options as well as sustainable use). There is very extensive expertise on this topic within conservation science that can be drawn upon (e.g. Wilkie et al. 2016, Travers et al. 2019), and some work has been done on this for saigas already (e.g. Hogg 2014, Kor 2015, Dhanda 2015).

4) Development of a plan for adaptive management at the population level.
This should draw on scientific evidence and include institutional as well as biological factors. So, for example it could use a model to estimate population quotas, which change every year depending on circumstances. It would also require annual data collection to feed into the model, on threats and population dynamics. The plan would also include regular review of the institutional, social and economic functioning of saiga management, and early warning triggers for intervention if, for example, there is a change in support for management (e.g. problems experienced by hunting associations). Help in setting up such a scheme could come from the waterfowl management authorities in the USA (e.g. Nichols et al. 2007).

5) Deciding on a suitable legislative and regulatory structure
Governments would need to ensure that a suitable legislative and regulatory framework for managing sustainable hunting is in place, including stockpile management (see section 6.5 for a comprehensive assessment of the requirements). This could include an assessment of the requirements for institutional and administrative and enforcement capacity-building at national, regional and local levels. A consideration of the potential roles of different institutional structures for sustainable hunting (including state institutions at local, regional and national levels, private game management organizations, hunting associations, and wildlife management authorities) would also be useful.

6) Continued investment in population monitoring and protection.
The monitoring and protection of Saiga populations are becoming better and more comprehensive, and more robust, over time. This will need to continue to improve in order to justify and support sustainable use.

7) Understanding and control of demand for saiga products

Saiga poaching for international trade will only be controlled when demand for illegal Saiga products in consumer countries is controlled. Currently demand is high in some countries (e.g. Singapore: Doughty et al. 2019), but there is very little knowledge about the level of demand in other countries, e.g. China (other than that there are still large seizures and saiga products are still widely available online and in physical markets). There is also no understanding of how legal and illegal products might interact in consumer markets (e.g. would legal horn be seen as an inferior, superior or indistinguishable product; cf Dutton et al. 2011). The potential for laundering and for demand either being reduced or exacerbated by legal products needs to be investigated (Hinsley & 't Sas Rolfes, in press).

8) Control of stockpiles in consumer countries

The lack of registration and control of stockpiles means that there is very little knowledge of how much new saiga horn is entering international trade. Unless the illegal horn trade is brought under control, poaching will continue to be a threat to all saiga populations. There will also be no prospect of a legal international horn trade under CITES. Unfortunately, this is something that Range State governments have little control over, and instead governments of consumer countries must tackle, with the support of international NGOs.

8) Investigation of the potential for non-consumptive sustainable uses.

We were not able to assess the potential of other sustainable uses in this report. However, tourism in particular has potential. Tourism in general is being heavily promoted in some parts of the saiga's range (e.g. Uzbekistan). Saiga-focussed international tourist trips have been piloted in both Kazakhstan and Russia. The infrastructure for international tourism is not fully developed in the saiga range areas, and travel to see saigas may be challenging in some parts of the range. However, nature-based tourists are more likely to be prepared to accept rougher conditions in order to see rare and unusual species. There is the potential to link saiga tourism to other attractions such as cultural sites and bird-watching. It can also generate and support local enterprises such as craft-making, guiding, and homestays.

7.6. Concluding remarks

In this report, we hope to have provided a comprehensive overview of the prospects for sustainable use of the Saiga Antelope via hunting. Given the very wide-ranging nature of the topics covered, this report can only provide brief coverage of each area. However, we hope that it gives a robust foundation for future discussions, which will support the conservation and restoration of this unique, special, and important species.

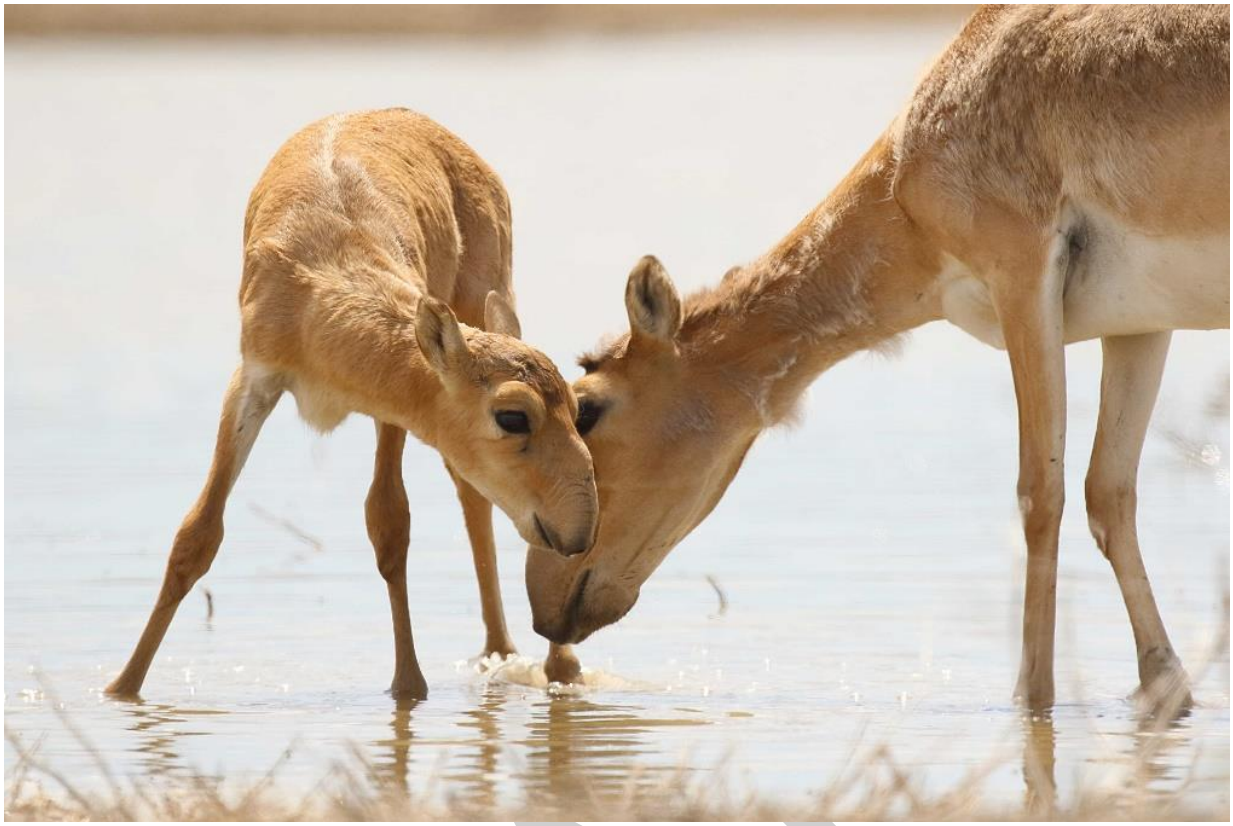

Photo: Andrey Gilev

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