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DEER SPECIALIST GROUP NEWS

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Editorial

Dear DSG members,

The last two years have been a very challenging for many of us, personally and professionally. We hope that 2022 will finally allow a return to our activities, despite the challenging times arriving with a war that will surely affect the people and the biodiversity in those areas.

Entering the new quadrennium the DSG has set targets to update its website, establish, and maintain visibility of the Group and of its mission and goals in various social media platforms. These proposed targets contribute both to the Network and Communicate stages of the Species Conservation Cycle. Our new website (https://www.deerspecialistgroup.org) and social media presence (Instagram; IUCN/SSC Deer Specialist Group) would allow us to extend our network of collaborators and promote our goals, work, and achievements for the benefit of deer (including musk-deer and chevrotains). Please check if your contact details have been updated in our website and also in the IUCN portal (https://portals.iucn.org).

We are aware that your DSG work is done voluntarily, on top of your paid jobs, so your contribution is not taken for granted and we greatly appreciate it. However, we need a more proactive membership and we invite you to visit and send your contributions through our Instagram page, of news regarding your research species or any other information that you feel should be share with the membership and the general conservation community (dsg.iucn2020@gmail.com).

More targets for the upcoming quadrennium include re-assessments of the Red List status of several priority species, writing deer conservation translocation guidelines, better incorporate climate change into our plans, write action plans, and more. All of these have been selected so we can all continue to work together to improve and reinforce the DSG network, integrate deer biology knowledge, and be more effective in planning and implementing conservation and management work.

We also wish to acknowledge our supporting agency, DINABISE, the Environmental Minister in Uruguay for its research and contribution to the advancement of scientific knowledge on Neotropical deer species.

Finally, we want to thank all those who contributed to this edition of the Newsletter and invite all of you to submit manuscripts for the next issue by sending them to Dr. Patricia Black (black.patricia@gmail.com).

Our best wishes,
Susana and Noam
Susana González and Noam Werner, Co-Chairs, IUCN SSC Deer Specialist Group.

Free-ranging domestic caprines on the island of Rhodes (Greece): an additional threat to the conservation of the fallow deer population?

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Abstract

The *Dama dama dama* population of the island of Rhodes has an important conservation significance because of its unique genetic characters. Currently, many are the factors that threaten its survival. The aim of this paper is to study the spatio-temporal co-occurrence between fallow deer and unattended domestic caprines. The kilometric abundance index (KAI) was derived from spotlight counts with an average of 1.4 ± 1.3 fallow deer/km and 6.4 ± 8.5 caprines/km. The number of domestic caprines and deer per kilometer was negatively correlated ($P<0.05$) only in spring. Sheep and goats could have an impact on fallow deer during the fawning season. Further studies are needed on the interactions between wild and domestic ungulates and the monitoring of these populations is a crucial requirement for these studies. Livestock monitoring over time can act as a proxy indicator of the status of this deer population.

Key words: *Dama dama dama*, Domestic caprines, Kilometric abundance index

Resumen

La población *Dama dama dama* de la isla de Rhodes tiene un importante significado para la conservación debido a sus características genéticas únicas. Actualmente, muchos son los factores que amenazan su supervivencia. El objetivo de este trabajo es estudiar la co-ocurrencia espacio-temporal entre ciervos y caprinos domésticos asilvestrados. El índice de abundancia kilométrica (KAI) se derivó de conteos nocturnos con focos con un promedio de 1,4 ± 1,3 ciervos dama/km y 6,4 ± 8,5 caprinos/km. El número de caprino**s** y ciervos domésticos por kilómetro se correlacionó negativamente (P<0.05) solo en primavera. Las ovejas y las cabras podrían tener un impacto sobre los ciervos dama durante la época de cría. Se necesitan más estudios sobre las interacciones entre los ungulados salvajes y domésticos y el seguimiento de estas poblaciones es un requisito fundamental para estos estudios. El seguimiento del ganado a lo largo del tiempo puede actuar como un indicador indirecto del estado de esta población de ciervos.

Palabras clave: *Dama dama dama*, Caprinos domésticos, Índice de abundancia kilométrica

Introduction

The population of common fallow deer, *Dama dama dama* (L., 1758) on the island of Rhodes, Dodecanese (Greece), can be regarded as the oldest still surviving on any Mediterranean island. Its occurrence on Rhodes is documented since Neolithic times (6th millennium BC), and is of certain anthropochorous origin.

The latest techniques for investigating population genetics have shown that this population is of very ancient origin revealing, contrary to all expectations, genetic characters completely distinct from all other extant European populations (Masseti et al. 2008, Masseti and Vernesi 2015, Marchesini et al. 2020). A particularly surprising aspect that emerges is how genetically distant the Rhodian fallow deer is from its supposed ancestors of mainland Anatolia. MtDNA confirmed that this population was founded by a limited number of ancestors. Quite unexpectedly, the mtDNA of the descendants of these ancestors does not resemble the mtDNA of the extant fallow deer from Düzlercami, the Anatolian reserve reputed to be the world's last

native stronghold of this species. It thus emerges that in the current Rhodian population there are signatures of ancient mtDNA lineages now extinct amongst Asia Minor fallow deer. This fact makes the Rhodian fallow deer particularly important in terms of conservation and management strategies.

Today it is reputed this insular population does not exceed a few hundred in the wild. The fact that Rhodian fallow deer can be considered as already virtually extinct implies that all necessary actions aimed at its protection and conservation must be planned and implemented with the greatest caution, in order to avert the definitive disappearance of the last fallow deer of insular Asia Minor and, probably, one of the last representatives of the ancient wild populations of the species (Masseti et al. 2008, Masseti and Vernesi 2015). Currently, many are the factors that can threaten the survival of the Rhodian fallow deer. The main factor of risk is always illegal hunting or poaching (Theodoridis 2002). To this factor the changes made to the natural environment must also be added, including the increasing anthropic pressure due to touristic exploitation. Also, the major destructive fires which struck Rhodes during the last decades negatively affected the distribution of deer, both by reducing their number and by driving them out of the burnt forested areas (Masseti and Theodoridis 2002). Farmers traditionally, as reported by Chalahiris (2000) as far as the first half of the 20th century, and even today, come into conflict with deer due to presumed but not documented damages upon their crops, such as melons, watermelons and young olives trees (Papaioannou 2010). Currently relatively little is known about the Rhodian fallow deer, one of the few free-ranging populations of this species in Greece. As in much of the Mediterranean region, few data are available about the interaction between domestic and wild ungulates inhabiting the same areas, sharing space and resources. Grazing livestock have a great impact on forage quantity and quality, vegetation dynamics, community diversity and landscape (Hadjigeorgiou 2011). Some authors have argued that extant levels of livestock grazing may not adversely affect wildlife (Smith, 1992 cited in Saberwal 1996, Homewood et al. 2001); others strongly contest this view (e.g. Mishra and Rawat 1998, Young et al. 2005). The aim of this paper is to provide, for the first time, preliminary results on the spatio-temporal co-occurrence of common fallow deer and

unattended domestic caprines, namely goats and sheep, on Rhodes. Sheep and goat farming has been the main pastoral activity practised in Greece since ancient times and grazing, mainly of the indigenous vegetation, contributed on average up to 70% of the annual energetic requirements of these domestic ungulates in southern Aegean Islands such as Rhodes (Hadjigeorgiou, 2011). The physical characteristics, the infrastructure available, and the animal breeding traditions of these islands determine this high percentage value, which is significantly lower in other regions of Greece because goats and sheep are mostly fed indoors (Hadjigeorgiou, 2011). We hypothesize that an inverse correlation may exist between the presence of domestic ungulates and fallow deer in the same area and over the seasons. In particular the presence of sheep and goats could affect fallow deer in late spring and summer, during birth and breeding periods when energy requirements are greater and does look for suitable fawning habitats.

Material and methods

Rhodes is characterised by a Mediterranean climate, with a mean temperature ranging from 11.3 °C in January to 27.3 °C in August. Rainfall (700 mm per year) is concentrated from October to March. There is a perennial supply of fresh water, provided by the presence of several springs and water bodies. The fallow deer birth season spans from the last 10 days of May to the first 10 days of June (Braza et al. 1988, San José and Braza 1992), and the rut is in October, after a 5–6 months dry period (Masseti 2002).

From one year to another the flocks of sheep and goats are moved to different areas of the island in search of pastures not yet exploited. During the study period, livestock occurred mainly in the north-central part of the island and the survey was carried out in this area. Spotlight counts are suggested to be one of the most informative and logistically simple methods to study the relationships between deer and livestock (Lindeman and Forsyth 2008). Spotlight counts were carried out from October 2010 to September 2012 in the north-central part of the island, in cooperation with the Decentralised Aegean Administration, Directorate General of Forest and Agriculture of Piraeus, and the Department of Environmental Protection

of the Municipality of Rhodes.

Three transects were selected in the north-central part, along dirt roads and throughout cultivated areas and woodlands. The same proportion of each habitat type was surveyed. The transects were conducted once a month under similar weather conditions, and in the absence of rainfall and/or fog, using four-wheel drive vehicles at a average driving speed of 10 km/h. Spotlight counts began about 1 h after sunset, following the recommendations of Progulske and Duerre (1964) about standardised counts, and required approximately 4 h to be completed. On each route, one observer searched for deer, goats and sheep using 1,000,000 candle power spotlights and 10 × 40 binoculars at a maximum distance of 100 m from the moving vehicle. Another observer recorded the number of encountered animals. We attempted to maintain consistency among observers by having the same observer participate in all spotlight counts. The total sampling effort was 96 h per five transects (mean length 6.56 km; total length 19.5 km).

The Kilometric Index of Abundance is a common measure used in wildlife studies (Maillard et al. 2001) because it can provide qualitative and quantitative information about the presence of a species and its population trends over time (see Marchandeau et al., 2006). Following Vincent et al. (1991) and Whipple et al. (1994) the kilometric abundance index (hereafter KAI) was obtained as the average number of animals seen per kilometre surveyed in each month. The correlation between the number of fallow deer and the number of domestic caprines seen in each season per kilometre was tested using the Spearman's rank correlation coefficient calculated by means of R Statistical Software version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria, 2020). Threshold value for accepting correlations was set to $P < 0.05$.

Results

Spotlight counts led to an average of 1.4 ± 1.3 fallow deer/km and 6.4 ± 8.5 goats and sheep/km. The yearly ratio between deer and livestock was 1:4. However, livestock continuously moved from one pasture to another, and KAI values changed a lot throughout the

year, reaching the highest average values in summer (11.02) and autumn (6.87). The correlation coefficients between the number of fallow deer and the number of domestic caprines seen per kilometre in each season were not significant, except for the spring data set ($r = -0.48$, d.f. = 16, $P < 0.05$).

Discussion

A negative correlation was found in the course of the present study between the number of fallow deer and the number of domestic caprines during the fawning season. Livestock grazing during peak fawning season has been reported to reduce hiding cover and quantity and quality of forage for fawns and to affect the use of space of deer females looking for suitable fawning habitat (Smith and Coblentz 2010). Hence sheep and goats could have an unfavourable impact on the Rhodian fallow deer and represent an additional threat factor for the survival of the wild population. Not by chance in 2012, according to the South Aegean Veterinary Department, there were 50,366 domestic caprines on the island, most of which were goats. Domestic caprines are unattended and rarely graze on the spots that have been determined by the Municipality of Rhodes. For instance, livestock was observed in the Valley of the Butterflies (Figure 1), which is a fenced protected area of the Natura 2000 network (https://oikologicarodiaka.wordpress.com/2013/ 05/01/η-σιωπή-των-αμνών/).

Figure 1. The co-occurrence of free-ranging goats and fallow deer on the north-central part of the island of Rhodes (Dodecanese, Greece), (photo by Manolis Sarris).

During our research, the highest KAI values for livestock have been recorded during summer and autumn. These seasons are crucial for the life cycle of fallow deer as they respectively correspond to the breeding and reproductive periods, when the nutritional requirements are greater. Moreover, in these seasons drought and fires can contribute to reducing the available food resources. There are examples of strong conflicts in Mediterranean habitats (e.g. Acevedo et al., 2007) where free range livestock management is still a dominant economic activity, as in Greece. For instance, in Sardinia, extensive livestock husbandry is a traditional and still widespread form of land use; sheep and goats are brought onto hilly and mountain pastures, when pasture productivity is at its highest level and when lambing season starts, displacing mouflons to suboptimal areas like Mediterranean shrubs and forests (Ciuti et al., 2009). Hence the presence of livestock seems to influence not only feeding habits but also behavioural patterns of wild ungulates, increasing their stress levels as a result of habitat quality reduction (Chirichella et al. 2014; Horcajada-Sánchez et al. 2019; Mattiello et al. 2002).

In conclusion, it is necessary to continue studying the interactions between livestock and fallow

deer arising from the concomitant use of resources, analysing the use of the space and time in the same habitat over the seasons, and investigating the segregation or overlap at different spatio-temporal scales. Considering the negative correlation found in the course of the present study between the number of wild and domestic ungulates during the fawning season, it should be interesting to investigate if grazing by sheep and goats changes composition of vegetation of preferred deer habitats, and hence the habitat selection by does and fawns.

Monitoring of wild and domestic ungulates on the island of Rhodes is an indispensable requirement for the study of interspecific interactions between domestic and wild ungulates. We suggest that future monitoring programs should be planned using standardised protocols. Data should not be collected during the rutting and fawning period of fallow deer or when ungulates may be clumped in their distribution in relation to food availability. Results of domestic caprine monitoring could potentially serve as a proxy indicator of the status of the deer population. Data collected are necessary to conserve the Rhodian fallow deer that constitutes a veritable “cultural heritage”.

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Update on the global status of wild reindeer and caribou

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Abstract

Rangifer tarandus (wild reindeer or caribou) is an abundant and widely distributed member of the deer family across the circum-arctic tundra and boreal forests. *Rangifer* through its sheer numbers has a dominant role in arctic ecology and in the lives of Indigenous people. By 2016, the IUCN Red List classified the global status as *Vulnerable* based on an overall 40% decline over three generations. At national and regional scales, forest *Rangifer* are the most likely sub-species to be nationally or regionally recognised as at risk, but recently, migratory tundra *Rangifer* also have been recognized as at risk. Natural fluctuations accentuated by human activities are driving many declines and on the southern extent of *Rangifer* distribution, extractive industries have removed mature forests leaving *Rangifer* susceptible to incidental predation. Despite many declines being well-monitored and studied, recovery is slow or often stalled but recent changes to conservation planning, especially Indigenous initiatives and landscape management raise hopes for renewed and effective conservation.

Key words: *Rangifer tarandus,* current status, distribution

Resumen

Rangifer tarandus (reno salvaje o caribú) es un miembro abundante y ampliamente distribuido de la familia de los ciervos en la tundra circun ártica y los bosques boreales. *Rangifer* a través de su gran número tiene un papel dominante en la ecología ártica y en la vida de los pueblos indígenas. Para 2016, la Lista Roja de la UICN clasificó el estado global como Vulnerable en

función de una disminución general del 40% durante tres generaciones. A escala nacional y regional, los *Rangifer* de bosque son las subespecies con mayor probabilidad de ser reconocidas a nivel nacional o regional como en riesgo, pero recientemente, los *Rangifer* de tundra migratoria también han sido reconocidos como en riesgo. Las fluctuaciones naturales acentuadas por las actividades humanas están provocando muchas disminuciones y, en la extensión sur de la distribución de *Rangifer*, las industrias extractivas han eliminado los bosques maduros, dejando a *Rangifer* susceptible a la depredación incidental. A pesar de que muchas disminuciones están bien monitoreadas y estudiadas, la recuperación es lenta o, a menudo, se estanca, pero los cambios recientes en la planificación de la conservación, especialmente las iniciativas indígenas y la gestión del paisaje, generan esperanzas de una conservación renovada y efectiva.

Palabras clave: *Rangifer tarandus*, estado actual, distribución

Introduction

Rangifer tarandus is the member of the deer family supremely well adapted to the Arctic and sub-arctic continents and islands. The ability to digest the abundant lichens of boreal forests, migrate long distances (Fig, 1), and their social behavior allow continental wild reindeer (caribou in North America) to number in the millions. *Rangifer* adaptability is evident in the diversity of habitats at the sub-species level: montane *Rangifer* seasonally migrate between alpine meadows and forest valley bottoms, while other *Rangifer* remain year-round in boreal forests, others migrate between boreal forest winter ranges and summer on the tundra , and still other *Rangifer* migrate across sea-ice among Arctic Islands. The tundra *Rangifer* are known for spectacular migrations as hundreds of thousand individual *Rangifer* seasonally bring the tundra alive - their abundance gives them a dominant ecological role and has been fundamental to the lives of many Arctic people for thousands of years.

However, despite *Rangifer's* ecological diversity and abundance, their conservation status is changing. Our objective for this paper, is to update the status, numbers, and trends for circum-arctic *Rangifer* which we had previously reported in 2013 (Gunn and Russell 2013).

Figure 1. Caribou in March migrating across a frozen lake (Petter Jacobsen, Dedats'eetsaa: Tłıç hǫ Research and Training Institute)

Methods

Our review relies on three technical information sources. First, the IUCN's global assessments of trends through its Red List. Second, countries assess their wildlife to determine if and at what level species are facing risks of extinction and those assessments largely follow the IUCN Red List approach. For example, Russia (2020) recently updated *Rangifer* status at the federal level while regional assessments are available through regional Red Books (I. Mizin pers. comm. 2018). National and regional assessments are based on regular inventories either through aerial counts or extrapolated from annual survival and productivity rates. The conservation unit is

individual herds (populations) or geographic areas. Third, the Circum-Arctic *Rangifer* Monitoring and Assessment (CARMA 2021) network maintains a multi-source database for 24 herds of migratory tundra *Rangifer*. The data are available on request and with the approval of individual data holders. Indigenous knowledge is increasingly included at the national levels and, additionally, CARMA works closely with co-management boards to include indigenous understanding of *Rangifer* trends.

Results

In 2016, the IUCN Red List assessment reported an overall 40% decline over three generations (about 25 years), in abundance of *Rangifer* globally, although trends vary regionally and differences in estimate precision and frequency of estimates add to uncertainties in measuring trends (Gunn et al. 2016, Uboni et al. 2016). The IUCN Red List's assessment as Vulnerable is a change from the previous assessment as Least Concern (Gunn et al. 2016). Since 2016, the overall decline has continued from 2.8 million individuals to 2.43 million individuals in 2021 (CARMA 2021).

Status assessments at the national scale list as at risk all forest (known as boreal in Canada), and mountain *Rangifer* (except in Alaska) based on long-term declines and population fragmentation. Canada's three ecotypes of mountain caribou are categorized from Special Concern to Endangered. Their numbers totalled 43,000-48,000 in 2014 and have declined 27-64% over three generations (COSEWIC 2014a). Norway's Mountain wild reindeer are fragmented into 23 populations from a former widespread distribution and are under consideration as Vulnerable. They currently number about 30,000 with a relatively stable trend (O. Strand pers. comm. 2021). In Russia, the three sub-species of wild reindeer are classified as Near Threatened to Critically Endangered based on 40% declines since 1990: current numbers total 10,500 in the European part of Russia and trends vary between regions (Russian Red Book 2020). The Alaskan Mountain caribou occur in 23 herds which overall have declined 50% since peak herd sizes in the mid-1990s and currently total 149,000 individuals (CARMA 2021).

Canada's boreal caribou are recognized as Threatened and currently numbered 25,000-30,000 although the difficulties of counting caribou in the boreal forests mean that estimated numbers are incomplete (COSEWIC 2014b).

On the Arctic Islands, trends are long-term but marked by irregular fluctuations in abundance with crashes during exceptionally severe winters followed by recoveries. On the Russian island of Severny, the sub-species *R. t. pearsoni* is classified as Near Threatened and numbers about 5,000 individuals (I. Mizan pers. comm.). On the Canadian Arctic Islands, Peary caribou were re-classified from Endangered to Threatened in 2015. They totalled 22,000 in 1987, declined to 5400 in 1996, recovered to 13,400 in 2015, but a collapse on Axel Heiberg Island reduced the overall total to 10,900 individuals by 2019 (Mallory et al. 2020, COSEWIC 2015). The recovery is geographically uneven as Peary caribou on the larger more southern island declined slowly over 20 years and then either did not recover or at a low rate (COSEWIC 2015). Hunting had reduced wild reindeer on the Svalbard Archipelago to the point of almost extirpation in the early 1900s, but then under protection from hunting, the wild reindeer recolonized their historic distribution and currently number about 22,000 with stable to increasing trends despite periodic die-offs (Moullec et al. 2019).

Migratory tundra *Rangifer* are the most numerous as the three sub-species are about 85% of all *Rangifer* individuals. In Canada, migratory tundra caribou numbered 730,000 individuals in 2020 but the two ecotypes were assessed in 2016 as Threatened and Endangered based on 40% - 86% declines since peak herd sizes in the 1990s. At the scale of individual herds, the extent of the declines is extreme: the much-studied George River herd declined 99% from a peak of about 823,000 caribou in 1993 to 5,500 in 2018 followed by a hint of recovery in 2020 (COSEWIC 2017, J. Taillon pers. comm.). From 2000-2020 Russian migratory tundra wild reindeer declined 51% from 1.3 million to 587,000 (Kharzinova et al. 2018; CARMA 2021). On the other hand, in Alaska, the three coastal migratory tundra herds that had declined since peak in herd sizes in the 1990s were by 2017 starting to recover and totalled 330,000 caribou. The herd that has different trends from neighboring herds is the Porcupine herd, which migrates between Alaska and Canada it has doubled in size since 2001 to reach 218,000 caribou

in 2017. Changes in survey methods between 2010 and 2019 hamper the ability to describe overall trends in Greenland's migratory tundra caribou and it is uncertain to what extent the current declines are natural fluctuations (Moshøj et al. 2011) or reflect a changing climate as the ice sheets melt.

Trends in abundance are typically assessed over three generations. This standardization has the disadvantage that it does not consider historic declines which can be gauged from people's recollections of historic distribution. In Canada, Boreal and Mountain caribou are only using about 40% of their historic annual ranges (COSEWIC 2014). In Russia, over 85% of *Rangifer* distribution has contracted to the north and west and become fragmented due to habitat loss (Syroechkovski 2000, Vasilchenko et al. 2020). By the early 1900s, forest Reindeer had disappeared from Finland until in 1950s, when a small area was re-colonized from neighbouring Russia (Panchenko et al. 2021). In Norway, the cumulative ranges of mountain *Rangifer* have contracted to about half the size of the historic range (Panzacchi et al. 2012).

Discussion

At the global scale, the historical trend continues with declining abundance and contracting distribution for most *Rangifer* populations in the seven circum-arctic countries with wild *Rangifer*. Limitations in measuring the declines stems from variability in the frequency of population estimates and uncertainties with accuracy and precision. Knowledge of the underlying causes of the declines is typically limited as factors interact and change during a decline.

The forest and mountain sub-species are most at risk as they are *Rangifer*'s southern global distribution, with the greatest overlap with human settlements and activities. Long-term declines over decades are driven by timber and hydrocarbon extractive industries which remove mature forests and replace them with early succession deciduous trees and shrubs better suited to moose and deer. In turn, moose and deer maintain higher wolf numbers and the combined effects of habitat loss, direct behavioral responses to roads, railways, oil wells, and incidental wolf predation drives the forest and mountain *Rangifer* into decline (Finnigan et

al. 2021, Vasilchenkoa et al. 2020, Nagy-Reis et al. 2021, Panchenko et al. 2021). The increased predation likely requires caribou to make trade-offs in habitat selection to reduce predator exposure but at the cost of foraging in lower quality habitats (Denryter et al. 2018).

In Russia, the combined effects of mining, roads, railways, and winter tourism have fragmented the remaining ranges of the Siberian Forest reindeer, *R. t. valentinae* (Vasilchenkoa et al. 2020). Similarly, in western Canada, the Central Mountain caribou (Endangered) are fragmented into remnant small populations. But despite awareness of declining caribou, the amount of industry impacted habitat jumped from 50 to 70% of the winter range over the last 30 years. With so few caribou remaining, at least one herd has stopped migrating to their much-disturbed winter ranges and are resident year-round, despite reduced survival in their summer range (Williams et al. 2021). Although industrial encroachment is typical across large areas of boreal forests, other factors play a role. In Canada's boreal forests in Labrador and in European Russia, illegal hunting is tipping the *Rangifer* into declines (Danilov et al., 2020, Schmeltzer et al. 2020).

While the role of changed habitat is clear for forest and mountain *Rangifer*, factors other than habitat fragmentation underly the quite different pattern of declines common to migratory tundra *Rangifer*, and some Arctic Island *Rangifer*. Their current declines are relatively synchronized as peak abundance was in the 1990s for most herds suggesting the increase, peak and initial declines were natural fluctuations from interactions between predation, weather, and forage. In a strongly seasonal environment, *Rangifer*, like other Arctic herbivores (e.g.: lemmings; Andreassen et al. 2020), naturally fluctuate in abundance (Zalatan et al. 2006, Bergerud et al. 2008, Bastille-Rousseau et al. 2013, Uboni et al. 2016). The fluctuations are at decadal timescales and somewhat regular although sample sizes limit describing periodicity: the duration of a single cycle is 40 - 70 years for 20 herds of migratory tundra caribou across North America, Greenland, and Alaska while the periodicity is 115–130 years for northern Eurasia (Baskin 2000).

The current declines, at least for migratory tundra *Rangifer* and some boreal or mountain *Rangifer*, are likely the result of natural fluctuations that integrate the numerical responses of predators and parasites, changes in forage quality, and stochastic events. As a decline

continues, lags in management (hunting and land use restriction) and the numerical response of predators may accelerate the rate of decline, even to below historical minimums. Avoiding extreme low numbers is essential as it minimizes the impact of stochastic events such as a hot dry summer, severe winter, or an outbreak of disease. Extreme low numbers may trigger Allee effects if the social density is too low to sustain collective behavior such as the return to a gregarious calving ground (Gunn et al. 2012). Low numbers increase the difficulty and length of recovery. For example, the Alaskan Fortymile herd declined from a peak of 260,000 in the 1920s to about 6,000 in the mid-1970s. Low calf survival meant it took about 15 years for the herd to double from the low numbers, despite restricted hunting and wolf control (Gronquist et al. 2005).

The most northerly of the Arctic Island *Rangifer* are in a third category of declines as they are characteristically irregular, and abrupt population crashes occur during winters with unusually severe foraging conditions followed by natural recovery, aided when the local Indigenous hunters restrict their take. For the Canadian Arctic Islands, the declines associated with severe winters are imposed on a long-term decline or, as in the case of Svalbard, a long-term recovery since historic over-hunting stopped (LeMoullec et al. 2019).

Whether declines are reversible with conservation and management actions is highly variable. Management actions such as reducing hunting can reverse declines, as for example Svalbard wild reindeer (LeMoullec et al. 2019). The reasons why some *Rangifer* are increasing, such as Alaskan coastal tundra herds and two of Greenland's west coast herds, are less clear. Even when herd size and factors affecting vital rates are monitored, describing the effectiveness of management actions is difficult (Strand et al. 2012).

The status assessments and Endangered Species Acts are a basis for governments to consult and plan but more is needed for effective conservation (Krause et al. 2021). Fortunately, changes are underway to shift the emphasis from a prescriptive to a cooperative approach among those who share an interest in *Rangifer* and their habitat. For example, cooperation has supported the linking of protected areas and forest management for the recovery of forest reindeer which seasonally migrate across the Russian-Finnish international border (Panchenko

et al. 2021). This international collaboration is part of a global effort to conserve migratory ungulates, including *Rangifer*, and to learn from each other through sharing data and experiences to map ungulate migrations (Kauffman et al. 2021).

The importance of migrations and free passage will only increase with a warmer climate as *Rangifer* can adapt to some level of habitat change if they can freely move across roads and other linear developments. The importance of migrations is that they are key to the abundance of *Rangifer* and, they depend on collective behavior and memory. Traditional seasonal ranges such as calving grounds have persisted for hundreds of years while the routes of seasonal migrations have persisted thousands of years (Gordon 2005, Miller et al. 2020). If *Rangifer* abundance is allowed to drop too low, and migration halts, the spatial and cultural memory of seasonal habitats under different environmental conditions is lost (Brakes et al. 2021).

In Norway, management is moving from expert-driven population-based management towards greater stakeholder involvement, and regional land use planning (Kaltenberg et al, 2012). Shifts in management and conservation are needed as the global decline documented through monitoring, research, management, and recovery planning are continuing (Krause et al. 2021). A key shift for conservation is collaboration with Indigenous people who, for thousands of years, depended on *Rangifer* and increasingly have a statuary role in monitoring and management.

In Canada, a National Boreal Caribou Knowledge Consortium (2021) is part of the federal action plan for boreal caribou about sharing, generating, and mobilizing boreal caribou knowledge among Indigenous peoples, governments, co-management boards, communities, industry, environmental non-governmental organizations, and academic researchers. Given the fundamental importance of free passage and habitat integrity for *Rangifer*, a focus on protected areas (Vasilchenko et al. 2020) as for example in Russia, on the Kola Peninsula, the establishment of the Lapland Nature Reserve helped to preserve the Western population of wild reindeer (Semenov-Tyan-Shansky, 1977). Protected areas where Indigenous people are taking the lead is a significant step forward (ICE 2018). In 2021 an Indigenous Protected and

Conserved Area in Nuhenéné, the traditional territory of the Athabasca Denesułiné is underway to protect important caribou wintering habitat in Canada.

The longer-term outlook for *Rangifer* will depend on the changes in climate which are especially significant in the Arctic. Climate and weather influence almost all aspects of *Rangifer* ecology including predation, parasitism, and forage quality and quantity. *Rangifer* live in a world buffeted by annual and unpredictable variations in weather, resulting in variations in forage availability (Caughley and Gunn 1993). A warmer climate adds both trends to the variable climate, and a change in the frequency of weather events (Chan et al. 2005) and will bring complex interactions between seasons (Loe et al. 2020). A warmer climate may increase biting fly harassment (Fig.2) as well as plant growth, for example. It is by no means clear how the positive effects (increased plant growth and a longer-snow-free season) will balance out the risks of, for example, intensified parasitism and periodic ice-restricted forage availability. A warmer climate will vary regionally across the Arctic and this regional variation will play against the already marked regional variation in the degree of human-influenced landscape. In Europe, human influences on the wild reindeer landscape are strong and will require a high degree of collaboration and communication to reach a balance for the wild reindeer to thrive (Linnell et al. 2020).

Figure 2. Insect harassment Bathurst caribou

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Investigation of snaring impact on large mammals reveals new record of Large-antlered Muntjac (*Muntiacus vuquangensis*) in Chu Yang Sin National Park, Vietnam

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Abstract

Presented are the preliminary findings from a project aiming to close critical knowledge gaps on threatened species' vulnerabilities to snaring and the drivers of snaring. The impact of snaring was investigated by working with local hunters to build a simulated snare fence in Chu Yang Sin National Park and using camera-traps to monitor animal interactions with the simulated snare locations. A primary focus of investigation was the Large-antlered muntjac (*Muntiacus vuquangensis*), a Critically Endangered Annamite Mountains endemic. Using 101 camera-traps, 35 simulated snare locations were monitored in a 268 m long snare fence over 47 days. One Large-antlered Muntjac fawn was detected. We discuss the importance of this finding in the context of conservation actions in the park.

Keywords: Large-antlered Muntjac, Chu Yang Sin, camera-traps, snares, hunter.

Resumen

Se presentan los hallazgos preliminares de un proyecto que tiene como objetivo cerrar las brechas críticas del conocimiento sobre las vulnerabilidades de las especies amenazadas por las trampas. El impacto de las trampas se investigó trabajando con cazadores locales para construir una cerca de trampas simulada en el Parque Nacional Chu Yang Sin y usando cámaras trampa para monitorear las interacciones de los animales con las ubicaciones de las trampas simuladas. Un foco principal de investigación fue el Muntiaco gigante (Muntiacus vuquangensis), una especie endémica de las Montañas Annamite en Peligro Crítico. Usando 101 cámaras trampa, se monitorearon 35 ubicaciones de trampas simuladas en una cerca de trampas de 268 m de largo durante 47 días. Se detectó un cervatillo muntjac de cuernos grandes. Discutimos la importancia de este hallazgo en el contexto de las acciones de conservación en el parque.

Palabras clave: Muntjac de grandes cuernos, Chu Yang Sin, cámaras trampa, trampas, cazador.

Introduction

The Large-antlered Muntjac (*Muntiacus vuquangensis*) is endemic to the Annamite mountain range, extending from Vietnam to Lao PDR and a small part of Cambodia. Listed as Critically Endangered in the IUCN Red List of Threatened Species, the species is under immense threatening pressure due to intensive development of commercial snaring and illegal wildlife trade (Timmins et al. 2016). Extensive camera trapping effort recorded the species in only a few localities, with very few detections at most. The newest locality detection is in Virachey National Park, the first confirmed field record of Large-antlered Muntjac in Cambodia (Cowan 2021). Lao PDR is the only country that is still known to hold large viable populations of Large-antlered Muntjac (Timmins et al. 2016). In Vietnam, records of Large-antlered Muntjac within the last decade are rare despite extensive camera-trapping in many areas of former range (Berger & Nguyen 2020, Timmins et al. 2016). In Chu Yang Sin National Park (NP), Dak Lak Province, the species was first photographed by camera trap, a male, in 2009 (Birdlife International 2010). Subsequent detections of the species in Vietnam, to the author's

knowledge, have been a small number of detections in Khe Nuoc Trong Nature Reserve, Quang Binh province in 2014 (Timmins et al. 2016), a single animal detected in Bidoup - Nui Ba National Park, Lam Dong province in 2017 (Dasgupta 2007, author's personal data) and Song Thanh National Park, Quang Nam province in 2018 (WWF 2018). All these records were verified from original camera trap photos seen by the author.

The study was conducted to help close critical knowledge gaps on threatened species' vulnerabilities to snaring, hunters' methodology for setting up snares, and the setters' motivations, that will aid in design of effective enforcement strategies. In particular, the study aims to answer three questions: firstly, the capture probability by snares for different species in the Annamites; secondly, which factors hunters use to select snaring locations, at scales from the landscape where the snares would be set to the exact location where the snares would be set up; finally, the economic gains of and motivations for snaring.

Chu Yang Sin NP is located in southeast Dak Lak Province in Southern Vietnam with an area of 590 km^2. It covers part of a still extensively forested landscape in the Southern Annamites and is connected to several other protected areas such as Bidoup – Nui Ba NP on the south. Chu Yang Sin NP is one of a few areas in Vietnam that still potentially holds a population of Large-antlered Muntjac; even though there have been no further records since 2009; there also had been no appropriate survey effort in the intervening period. Suitable habitat and its connection with large, protected forest areas helped increase the survival opportunity for the population in the park. Therefore, Chu Yang Sin NP is a potential site for the study, especially on Large-antlered Muntjac.

Figure 1. Large-antlered Muntjac fawn recorded in Chu Yang Sin National Park

Material and Methods

The field site was selected based on a reconnaissance survey in August 2020, conducted by the lead author, which aimed to identify areas in the NP with positive signs of large mammals, especially signs potentially indicating Large-antlered Muntjac. These signs were assessed largely based on the footprint types (i.e., species), age and size. The area chosen had a higher frequency of fresh muntjac footprints of different sizes compared with other parts of the area surveyed as well as the presence of Eurasian Wild Pig *Sus scrofa*, Sambar *Cervus unicolor,* and Mainland Serow *Capricornis sumatraensis* signs. Following this, in December 2020, we engaged with local communities to identify five experienced hunters with whom to work, to understand their snaring methods. At the field site, we worked with each hunter independently, to emulate a real hunting trip to set up snares. The hunters were asked to act as they normally would, as if

setting real snares, made all the decisions (except for the selection of the general study area) and chose how and exactly where to set up snares. In the final step the hunters were asked to come to a consensus as to where to place a single snare fence, which is their favoured method of snaring. The only difference from a real hunting trip was that no actual snares were set, so as to ensure that there was no danger of any animal being caught or injured. From 16 to 18 December the hunters constructed a typical snare fence and camera-traps were set up to monitor animals moving through simulated snare locations in the fence and along the fence. In total, 101 camera-traps were set up along 268 m of snare fence with two cameras monitoring each of 35 snare locations; the remaining cameras were set to monitor the area between the snares along the fence. The camera-traps were set to ensure that it was clear which animals 'encountered' the snares, and, very specifically, of the animals that encountered the snares, which ones put their foot within the simulated snare noose. The camera-traps were left for 47 nights in the forest; every camera was switched on, on 18 December 2020, and all retrieved on 3 February 2021. For logistical and cost reasons the camera-traps could not be left in the forest for a longer period, although typically hunters would leave snares active for a longer period.

Results and Discussions

There were 4,747 working camera trap nights between 18 December 2020 and 3 February 2021. We recorded one Large-antlered Muntjac fawn (still with a spotted coat) on three occasions: 9, 24, and 25 January 2021 (Fig. 1), recorded by 15 different camera-trap units. It was unusual to see a spotted fawn not in association with a female. The fawn was identified by its distinctive short and broad tail, a diagnostic characteristic of Large-antlered Muntjac (Fig. 1). The photos and videos were also shared with R.J. Timmins, who corroborated the identification.

At least 16 other mammals, including two detections of the Northern Red Muntjac (*Muntiacus vaginalis*), and 10 bird species were recorded.

Although 101 camera-traps were used, the area of forest covered was very small, only 268 m of snare fence. In addition, animals moving outside the ca. 5m perimeter of the fence would not

be detected by the camera-traps. It is probable that this area is smaller than the typical home range of an individual muntjac. Therefore, the camera-traps should have a high detection rate of any muntjac individuals within this area, but it would be unlikely that many individual muntjacs would be detected. This assumes that muntjacs are generally solitary and that male home ranges are largely exclusive from each other but overlap with females, and that female home ranges overlap to some extent. According to the hunters, the snare fence construction often causes a lot of disturbance to the wildlife living in the area surrounding the snare fence, and it would take at least one month for the muntjacs to get familiar with the snare fence. The first time that camera-traps recorded Large-antlered Muntjac was on 9 January 2020, 23 nights after the snare fence was completed on 18 December 2020. No adult Large-antlered Muntjac were certainly detected, although one video with the fawn also shows eyeshine from what was most probably its mother; adults may be more wary in general, and in particular to the new fence, than was the fawn. If the snares had been real, the fawn would have been captured. The detections of the Large-antlered Muntjac and other species are only the first result from our ongoing analysis based on the camera trapping reported here, which will be published at a later stage. The survey's small spatial extent and brevity prevents speculation about broader Large-antlered Muntjac status in Chu Yang Sin NP, but it is very encouraging to detect the species with so little effort, and even more so that the species still breeds there.

The August reconnaissance survey and discussions with hunters and other local community members suggested that snaring is more common in the periphery of the NP than in the remote interior. It has been challenging for the law enforcement team to detect the snares. Night hunting with headtorches, civet traps, and hunting with dogs, which are also common in many other protected areas of the Annamites (Timmins et al. 1998), are also common throughout most of Chu Yang Sin NP. The December journey to the camera-trap site revealed two separate snare fences and one unidentified muntjac carcass in a snare. As well as Large-antlered Muntjac, other species presumed sensitive to snaring such as Greater Hog Badger (*Arctonyx collaris*) were detected, suggesting that snaring levels have not yet reached the intensity and density experienced by many areas of Large-antlered Muntjac range. Future

conservation management at the site would however benefit from further data on the status of Large-antlered Muntjac and other species of potential conservation priority at the site, which would require more comprehensive surveys using camera-trapping and other methods.

More widely, Southeast Asian tropical forest is under immense pressure from a snaring crisis, which is creating a silent forest syndrome (Gray et al. 2018). Chu Yang Sin NP is not an exception, and its wildlife is also threatened by this simple but highly effective hunting technique. Current models for controlling the snaring issue have not proven very effective (Gray et al. 2017) and conservation management of the Large-antlered Muntjac population in Chu Yang Sin NP will be challenging. The situation urges for more resources to support *in situ* enforcement activities, as well as integrated applied research to devise effective solutions for Chu Yang Sin NP in particular, and Southeast Asia in general.

Acknowledgments

We would like to express our gratitude to the Department of Agriculture and Rural Development of Dak Lak Province for supporting our project and granting permission for fieldwork. We are also grateful to Mr Do Van Lam, Mr Dang Hung Phi, the ranger station 5, especially Mr Nguyen Viet Hang, Mr Nguyen of Chu Yang Sin NP and Mr Ket, vice head of Cho village for assisting the field survey. A special thanks to Joel Berger, Hannah O'Kelly and Robert Timmins for your mentoring and advising effort. Finally, we deeply thank Robert Timmins, Will Duckworth and Le Trong Trai for help reviewing the document.

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Distribution and population size of Persian Fallow Deer in Iran from 2009–2021

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The Persian Fallow Deer (*Dama mesopotamica*) occurs in Iran and some of the basic information on this species, including distribution and population size, is outdated. It is important to update these kinds of data so that wildlife managers can plan effective conservation strategies for these animals. I therefore conducted a Farsi gray literature search for the Persian Fallow Deer's (equivalent Farsi words are گوزن زرد ایرانی and گوزن زرد) latest distribution and population size in Iran using the Google web search engine to access and compile all relevant material confirmed and disseminated by provincial offices of Iran's Department of the Environment (DOE), which is the governmental organization responsible for conserving Iran's fauna and flora. I used the search terms: "common species name" + "population size (تعداد جمعیت/اندازه جمعیت)" + "latest (تازه ترین/جدیدترین/به روز ترین/اخرین)", and "common species name" + "distribution (پراکندگی/پراکنش)" + "latest (تازه ترین/جدیدترین/به روز ترین/اخرین)" for this species. I then compared these data with those of DOE in 2009 to show the difference between their population size in 2009 and 2021 (Table 1). This table comes from a book chapter to be published (David, Dolev, Parchizadeh, et al., in press).


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Table 1. Distribution and population size of Persian Fallow Deer in Iran from 2009–2021 (number 1 above each location name represents wild, and number 2 denotes large fenced area/semi-wild).

Name of province	Name of habitat	Geographic location of habitat	Area of habitat (Hectare)	Number of individuals in 2009 (Reference number)	Number of individuals in 2021 (Last update – Reference number)
Fars	Miankotal Enclosure in the Arjan and Parishan Protected Area[2]	29˚32′–29˚37′ N, 51˚52′–51˚60′ E	400	62 (1)	39 (19 January – 2)
Khuzestan	Dez Wildlife Refuge[1]	31˚34′–32˚12′ N, 48˚22′–48˚46′ E	70	21 (1)	20 (6 April – 3)
Khuzestan	Karkheh Wildlife Refuge[1]	31˚34′–32˚20′ N, 48˚9′–48˚37′ E	300	270 (1)	6 (6 April – 3)
Yazd	Bagh-e-Shadi Protected Area[1]	29˚42′–29˚52′ N, 54˚5′–54˚15′ E	200	8 (1)	25 (17 April – 4, 5)
West Azerbaijan	Ashk Island in Uromiyeh National Park[1]	37˚20′ N, 45˚28′ E	2,610	288 (1)	29 (28 April – 6, 7)
Mazandaran	Dasht-e-Naz Wildlife Refuge[1]	36˚48′ N, 53˚10′ E	55	33 (1)	51 (4 May – 8, 9)
Ilam	Tunel-e-Reno Enclosure in Mansht and Ghalarang Protected Area[2]	33˚34′–33˚49′ N, 46˚20′–46˚39′ E	10	12 (1)	52 (14 May – 10, 11)
Fars	Arsenjan Enclosure in Khalil Beig Jungle[2]	Not available	300	Not available	55 (9 June – 12, 13)
West Azerbaijan	Rashakan Enclosure in Uromiyeh National Park[2]	Not available	6	Not available	5 (18 July – 14, 15)
Gilan	Lavandevil Enclosure in Lavandevil Wildlife Refuge[2]	38˚18′–38˚24′ N, 48˚51′–48˚53′ E	14	9 (1)	Not available
Kohgiluyeh and Boyer-Ahmad	Tang-e Putak in Dena Protected Area[2]	30˚52′–31˚14′ N, 51˚9′–51˚37′ E	15	16 (1)	Not available
Kurdistan	Bijar Protected Area[1]	33˚34′–33˚49′ N, 47˚18′–47˚51′ E	14	4 (1)	Not available
Mazandaran	Semeskandeh Wildlife Refuge[1]	36˚32′ N, 52˚7′ E	Not available	2 (1)	Not available
Total	–	–	–	**725**	**282**

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Results of 20 years Bukhara deer restoration

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The Bukhara deer was previously considered as one of the vulnerable red deer subspecies of *Cervus elaphus bactrianus.* Due to a nomenclature change (IUCN Red List revision) it is now considered to be one of the three subspecies of *Cervus hanglu, i.e. C.h.bactrianus.* From 2000 to2002 it had been under a real threat of extinction. It numbered no more than 350 animals in total in all 10 populations throughout its range in Central Asia, and was completely extinct in the most important part of its historical area. In accordance with the MOU and Action Plan on Bukhara deer conservation and restoration (CMS), signed in 2002, and in the frame of WWF projects since 1999, a set of important activities ensured population growth in natural habitats, natural habitat restoration and reintroduction in suitable sites within the historical area.

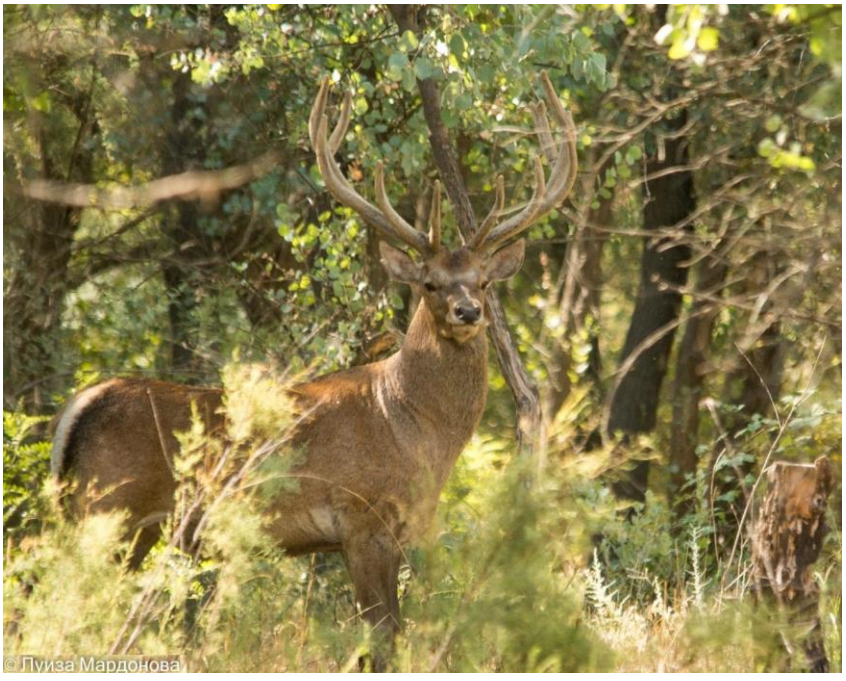


Figure 1. *Bukhara deer photo — Luiza Mardonova, Uzbekistan, Zarafshan, 2016*

Table 1. Population trends of Bukhara deer

	Year	Map code	1999	2010	2015	2018	2019	
							free-ranging	captive
KAZ	Karatchingil/ surroundings	Kz1	80	350	400	700	715[1]	
	Turkestan (Syrdarya)	Kz2	0	18 (+22 in pens)	49 (+54 in pens)	71 (+85 in pens)	75[1]	83[1]
	Ily-Balhash	Kz3				5	5[1]	12[1]
	Middle Ily (private)	Kz4					40[1]	
	Subtotal		***80***	***390***	***800***	***>900***	***835***	***95***
TAJ	Tigrovaja Balka	Tj1		>150		350	>350 (386[2)]	
	Romit	Tj2				18		25[2]
	Dashti-Dzum	Tj3				8-10?	8-10[2]?	
	Other territories	Tj4				50?	50[2]?	
	Zarafshan (upper reaches)	Tj5		60-65		*40-50*	*60-150[3]*	
	Subtotal		***?***	***210***	***400***	***>500***	***550***	***25***
TKM	Middle reaches of Amudarya (7 sites)	Tm1	30	60-70		112	120[4]	
	Djazguzer (Amudarya upper reaches)	Tm2 (Uz5)	~20	~50	130?	~50-100?	130[5]	
	Subtotal		***50***	***120***	***80?***	***~200***	***~250***	
UZB	Badai-Tuagai NR / Lower Amudarya BR	Uz1	~100	517+30 in pens		1350- *nat. report (or2112**)*	*1500 - 1857[6]*	*18[6]*
	Kyzylkumskii NR	Uz2	76	~130		120-150	140-150[6]	
	Other territories	Uz3	~50	~140-180		200	~200[6]	
	Zarafshan (reintroduction)	Uz4	9	~30-32 (+22 in pens)		100 (+24 in pens**) +** *60-150*	100[6]**+** *60-150[3]*	24[6]
	Subtotal		***~190***	***~900***	***1500***	***>2000***	***~2000 - 2200***	***42***
TOTAL			**~350**	**1620**	**2780**	**3400-3500**	**~3735-3900**	**162**

[1] – data of census completed in 2019 by the specialists of the Institute of Zoology, Kazakhstan, and by the staff of the Karatchingil game management enterprise

[2] - data from the State Department of Specially Protected Natural Territories (SDSPNT) of the Republic of Tajikistan

[3] – experts' evaluation, data from surveys of border guards

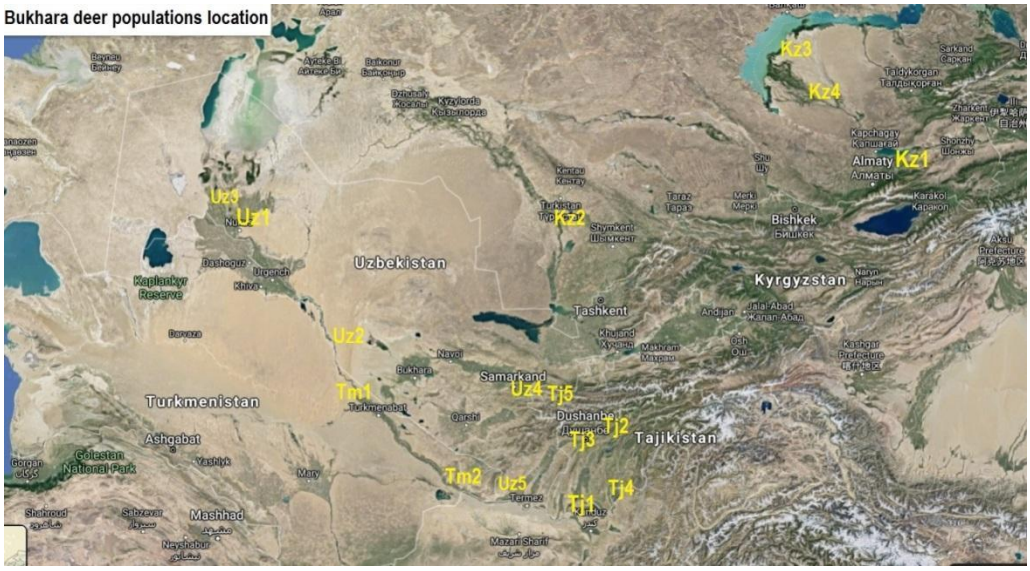
[4] – official National Report; surveys of the staff of the Amu-Daria nature reserve;

[5] - official National Report; experts' estimations

[6] - official National Report; census completed by national specialists and the staff of the reserves

[7] - *2112** – results of* census *in* 2019: Daniel CORNELIS, Valéry GOND, and Régis PELTIER (CIRAD), with participation of Elena KAN (KRASS), 8 January 2020. Mission report Estimation of Bukhara red deer (*Cervus hanglu bactrianus*) population in Lower Amudarya State Biosphere Reserve.

60-150 - (Tadjikistan, Uzbekistan) - transboundary group in Zarafshan river valley, , counted by experts of both countries.



The implemented activities resulted in significant growth of all populations, which allows the species to be considered as *Least Concern.*

In Tajikistan continuous population growth is registered in the major natural population in Tigrovaja balka (southern Tajikistan, bordering with Afghanistan) – according to the latest census there are 386 deer there. In Central Tajikistan in Ramit nature reserve the BD population had been completely eliminated during the 1990s – while previously it had been permanently used as a resource of animals for reintroduction (e.g. in Karatchingil, Kazakhstan; Badai-tugai, Uzbekistan, etc.). In 2017 a new enclosure was built, and 10 BD were translocated from Tigrovaja balka. As a result of natural reproduction, the number of BD in Ramit was 18 animals in 2019; according to the latest information there are already 33 deer in summer 2021.

In Uzbekistan the total number of BD already exceeds 2000: *1500 -1857 according to the data of the official national report* on deer in the Lower-Amudaria biosphere reservat (in 2112, according to *Cornelis et al, 2020*), -–anyway, substantially more than the carrying capacity of the habitats. 120-150 deer live in Kyzylkumskii zapovednik (middle Amudaria), while about 200 BD live in upper Amudaria, on the border with Afghanistan and Turkmenistan. The reintroduced population in the middle and upper reaches of the Zarafshan river, Zarafshan National Nature Park, is about 100 animals with 24 deer in pens for future releases; there is also a transboundary group of 60-150 BD, migrating from Uzbekistan to Tajikistan.

The State Agency for nature conservation, with the support of various international organizations (Michael Succow Foundation, WWF) started preparation of deer translocation from Badai-Tugai – core area of Lower-Amudaria biosphere reservat -- to a number of suitable riparian forest sites within the limits of the species' historical area in Uzbekistan and -- to various populations in Kazakhstan – e.g. Ile-Balkhash reserve, Syrdaria-Turkistan Nature Park. A preliminary agreement on that has already been achieved with Uzbek and Kazakh authorities. The potential for BD population development in these areas is very high.

In Kazakhstan development of the reintroduced population in the riparian forests of middle Syrdaria is on-going. There are 75 deer in a free-ranging population in the Syrdaria-Turkistan nature park and its surroundings and 83 in the system of pens, for future releases. It is planned to translocate deer from

the pens to far-away spots of riparian forests of Syrdaria, to advance BD population development for all of the Syrdaria valley. On the basis of private activities, a group of deer was established in 2013 in the game management entity Tasmuryn (middle reaches of the Ily river) and there are now about 40 BD. The major BD population in Kazakhstan – Karatchingil and its surroundings – already exceeds 700 animals.

In the framework of the Tiger reintroduction Programme in the Ily-Balkhash region (Memorandum between WWF and the Government of Kazakhstan, signed in 2017), WWF has prepared enclosures for deer adaptation, and in December 2018 the first 5 deer were translocated from the Syrdaria pens to Ile-Balkhash reserve. They were released to nature in 2019, and 2 females were equipped with satellite collars. Females kept close to the pens for the first few months, but, in the middle of winter, together with one of the males, they moved 100 kilometers away from the enclosure. At the beginning of 2020, 13 more females and 1 male from the Karatchingil were translocated for adaptation to the enclosures of the Ile-Balkhash reserve. In 2021 an important group of deer was translocated from Karatchingil to Ili-Balhash, and 61 deer were released, which is a record number for one year. Camera traps were set up in the release zone, to observe the released deer. In addition, 9 deer were equipped with satellite collars to better monitor the deer population. The restoration of the population of Bukhara deer in the Ile-Balkhash reserve is proceeding successfully; the deer have adapted well. According to preliminary estimates, taking into account the current calvings in the wild, there are almost 100 deer. Additional deliveries of significant numbers of animals are planned in subsequent years, and this capture level in Karatchingil will not lead to a decrease of this population, but only to the intensification of reproduction.

In Turkmenistan, according to the latest data there are about 120 deer in total in riparian forest spots of the Amudarijinskii nature reserve. An exact census of the sub-populations in the upper reaches of Amudaria in Uzbekistan and Turkmenistan was never conducted as the populations inhabit territories between engineering systems of state borders and access to these territories

is difficult. Some periodic expert estimates suggest that they number about 130 animals, which are stable or even show slight growth.

The data currently available on the population status in Afghanistan is very fragmented. A wildlife survey carried out by the WCS in December 2007 in the riparian forests of the Pianj River in the deer's historical range in Kunduz and Takhar provinces, failed to find any indication that the species was present. A special survey in 2013 detected deer presence in the Darqad - the northernmost district of Takhar Province in northern Afghanistan, which borders the major habitat of Bukhara deer in Tajikistan. Very recently, the National Environment Protection Agency (NEPA) in Afghanistan has declared Darqad a protected area.

In conclusion, by the end of 2019, the total number of BD within the species area in Central Asia exceeds 3500-3800 animals.

The expert workshop under the Bukhara Deer MOU was jointly organized by the CMS Secretariat and the International Academy for Nature Conservation of the Federal Agency for Nature Conservation, Germany, with funding from the BMU, in November 2000. This meeting was initially planned as the second Meeting of the Signatory States to the MOU (MOS2), but could not take place due to the pandemic and was carried out online with participation of national and international experts and officials of the range countries. A set of key documents were prepared: the Overview Report, the draft Work Programme for Bukhara Deer 2021-2026 and the new National Reporting Format. The drafts of these documents were prepared by WWF Russia analysing submitted national reports, consultations with regional experts and government representatives.

The marsh deer returns to the Chacoan Impenetrable

In January of this year a large former member began its return to El Impenetrable: the marsh deer (*Blastocerus dichotomus*). Brisa and Alfonso are the first pair to be reintroduced to El Impenetrable National Park, Chaco, Argentina, where the species has been extinct for many years. More individuals will continue to arrive for the project.

Figure 1. Ciervo de los Pantanos en Portal Carambola del Parque Iberá-535 @ Matías Rebak - Fundación Rewilding Argentina

The first explorers who sailed the Teuco River during the eighteenth and nineteenth centuries described this beautiful deer species as abundant. However, game hunting, habitat loss for forestry and agroindustry, and cattle-imported diseases drove the Marsh Deer extinct in the region about a century ago.

Brisa and Alfonso come from Iberá Park, Corrientes, where the ecological restoration through rewilding has helped many species augment their numbers, including the Marsh Deer, which now numbers some ten thousand individuals.

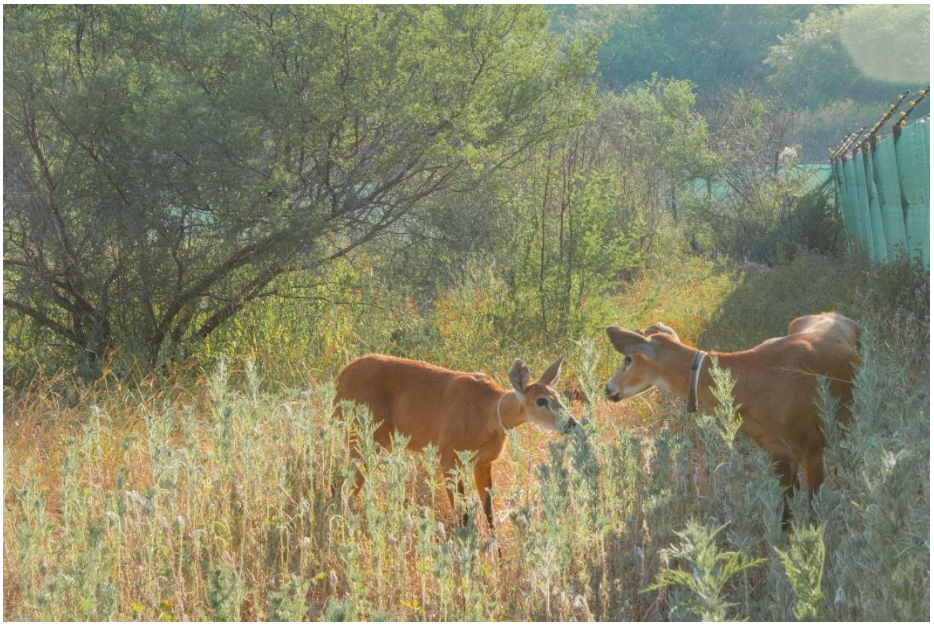


Figure 2. Brisa y Alfonso - Ciervo de los Pantanos - Parque Nacional El Impenetrable © Sebastián Navajas - Fundación Rewilding Argentina

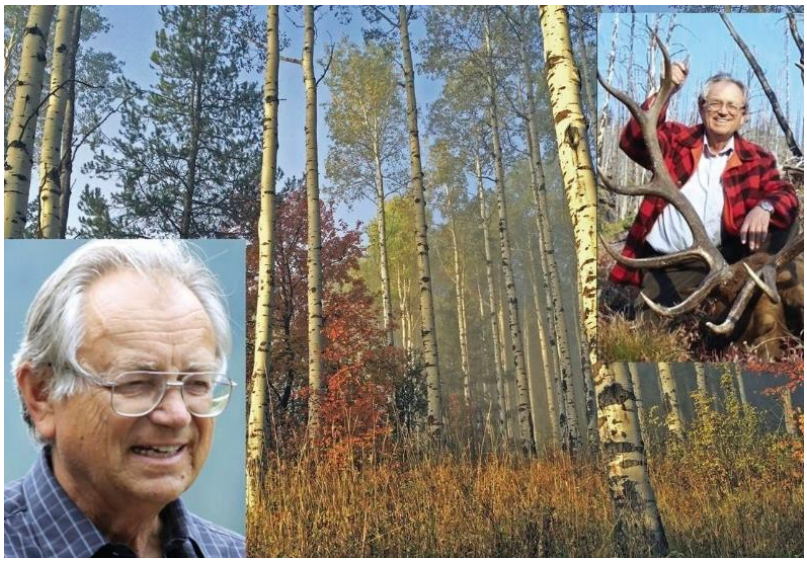
With Brisa and Alfonso, the Marsh Deer begins to fulfill its ecological role again in El Impenetrable, thus contributing to the ecosystem's good health and functioning. Further, its charisma will boost local development in the neighboring communities, which are already training in—and in some cases already beginning—ecotourism ventures related to wildlife-viewing.

This project is the result of the joint efforts of the Government of Chaco, the National Parks Administration, and Fundación Rewilding Argentina.

Obituary

A tribute to Professor Dr. Valerius Geist 1938 - 2021

Contributed by Jo Anne Smith-Flueck



The deer world lost a stellar pioneering researcher since our last Deer Specialist Group newsletter. Professor Doctor Valerius Geist (1938-2021), the famed professor, scientist, and prolific writer on ungulates and wild canid species, passed away on July 6, 2021 at the age of 83 in Port Alberni, British Columbia.

Dr. Geist was a giant and pioneer in the field of large mammal ecology and behavioral evolution. One of his greatest lifetime accomplishments involved defining the core principles that have made wildlife management unique in North America, for which he is now considered the Father of the *North American Model of Wildlife Conservation*.*

Valerius, held an honors B.Sc. in zoology (1960), and a Ph.D. in zoology (1967), both from the University of British Columbia. His doctoral thesis, “On the behavior and evolution of American Mountain Sheep”, was supervised by famed Canadian ecologist, Ian McTaggart-Cowan (1910-2010). He then completed his postdoctoral studies at the Max Planck Institute for Behavioral

Physiology in Germany (1967-1968) under the legendary Konrad Lorenz, the founding father of the field of ethology and a 1973 laureate for The Nobel Prize in Physiology or Medicine.

Since 1977, Dr. Geist taught at the University of Calgary, where he was a founding member and first Program Director of Environmental Science in the Faculty of Environmental Design. Later, he became Associate Dean and retired as Professor Emeritus in 1994. For the remaining years of his life, he resided on Vancouver Island, B.C.

Valerius authored and co-authored countless scientific papers, policy reports, commentaries and 23 books, including "Deer of the World: Their Evolution, Behavior and Ecology" (1998, Stackpole). This book, with more than 1,300 scientific references, is widely considered to be the authoritative reference for deer researchers, scientists, hunters, game managers and wildlife watchers.

Glancing through various obituaries, dozens of positive adjectives were used to describe his astounding qualities. This was one of my favorite: "He was graced with huge personality; passionate, intense, massive intellect, big of heart. He commanded a very firm handshake and incredible hugs. His smile would light up a room and welcome anyone in it." Yes, Valerius – or Val as we better knew him – was definitely passionate about the life path he had chosen. And for that we are graced with all the magnificent works he has added to our field of deer biology.

Jim Heffelfinger, a wildlife science coordinator for Arizona's Game and Fish Department (USA) and mule deer expert and researcher at the University of Arizona best expressed my own thoughts on this titan. He wrote, "Geist was a visionary who brilliantly sorted through ecological relationships to form theories about how things came to be and how they worked. Not all of his theories were supported by data, but they all made us think deeply. When a theory was later disproved, Val was gracious and accepting, and genuinely excited that we had more information about that topic to know his theory wasn't valid."

This very manner was exactly how he approached his work as part of the Huemul Task Force, a worldwide group of scientists organized under the auspices of the IUCN Deer Specialist Group to evaluate the conservation status of the highly endangered Patagonian huemul, a deer indigenous to South America's southern cone. Valerius, as one of the more active participants of this scientific committee during my time as chair, had his insatiable curiosity piqued by the many unknowns surrounding the ecology and evolution of this unfortunate animal. The mysterious huemul whet his keen appetite for discovery and knowledge. With enthusiasm, Val encouraged us to ponder and dive deeper, to look for plausible theories, even new paradigms. He was a master at that. Beyond the Huemul Task Force, Val continued to interact with a group of us that had branched off of this nucleus, those of whom in his style had caught the inquisitive investigative bug. We strived together to evaluate the ultimate causes behind the species' demise with the determination to then formulate the most appropriate and efficacious conservation tools. In similar ways, Val has influenced an entire army of younger conservation scientists and wildlife managers. As for the huemul's demise, he never tired to work with us on this conundrum as his final days drew near, unbeknownst to any of us in the group that he was terminally ill.

Val was born February 2, 1938 in Mykolaiv (also known as Nikolaev), in southern Ukraine, what was then the Soviet Union. Ironically, this past month on March 11th, several hospitals in his birth town were bombed by the Russian army. I couldn't help but think that had Val's hospital been blown up in 1938, we might never have had the blessing of his brilliance. Instead, Val had to flee the USSR when a small child, after his father was killed fighting in WWII, to live in Germany and Austria before finally settling in Canada in 1953 with his mother. In 1961 he would marry his life partner, Renate (1937-2014), also a talented biologist, whom he spoke very fondly about. He is survived by 3 children (Rosemarie, Karl and Harold), 5 grandchildren and 2 great grandkids.

Our hearts go out to everyone who had the pleasure of knowing Val. Legendary characters like him may come across our paths once in a lifetime, if we are even that lucky. He leaves behind a world immeasurably richer for him having been a part of it. May you RIP dear Val!

*When the Wildlife Society and Boone and Crockett Club published a 60-page technical report in 2012 (https://wildlife.org/wp-content/uploads/2014/05/North-American-model-of-Wildlife-Conservation.pdf) on “The Model,” its authors noted that Geist refined it to seven key principles by 1995.

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