Aquila (2014), Vol. **121**, p. 115–132

The Status of the Great Bustard *(Otis tarda tarda)* in Central Asia: from the Caspian Sea to the Altai

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ABSTRACT—Great Bustards were once familiar inhabitants of the steppe zones of Central Asia. Today, remnant populations are small and isolated, and the species is red-listed across this portion of its range. We review what is known about the historical status of the Great Bustard in Central Asia and the species' migratory patterns in this region. We also discuss factors, which led to sharp declines in these populations in the twentieth century. We observe a trend towards slight improvement in the status of Great Bustards in Central Asia at the turn of the 21st century. This leaves hope for their conservation if effective measures are taken across their breeding and wintering habitats.

Keywords: Central Asia; *Otis tarda tarda;* Kazakhstan; migration; conservation.

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Introduction

The Great Bustard *(Otis tarda)* originated in the steppe zones of Eurasia and North Africa. As European forests were felled for agriculture in the 16th through 18th centuries, the species expanded its range northward and westward and adopted cereal fields as habitat *(Isakov, 1974).* Since that time of maximum range expansion, the Great Bustard has suffered many regional extirpations *(Cramp & Simmons, 1980; Collar, 1985).* Today, the range of the species still stretches 10,000 km, from Manchuria to Portugal. However, across much of that range the remaining breeding populations (leks) are small and increasingly isolated. While the status of and threats facing European Great Bustards are relatively well studied *(Nagy, 2009),* populations and threats in Asia are less well documented. The goal of this paper is to review the status of populations of the Great Bustard in broader Central Asia, from the Caspian Sea to the Altai Mountains. We use primary and secondary literature from the region, which spans imperial expeditions, the socialist era, communications from contemporary researchers, and our own observations. This is a vast territory and a rich body of literature. This article is not meant to be exhaustive, but rather to describe the past and current status of eastern populations of the European subspecies of Great Bustard *(O. t. tarda)* in broad brushstrokes, to bring a wider understanding of these populations to English-speaking audiences. For simplicity and the comprehension of an international audience, we use present-day place names to describe locations.

Great Bustard during the pre-revolutionary era

Breeding Range

Populations of Great Bustards stretched across the steppe zone of Central Eurasia, southward from the edge of the boreal forest at approximately 54˚N *(Menzbir, 1895).* Early

Figure 1. Countries and provinces of Central Asia referred to in the text. Dashed-line divisions within China represent prefectures of Xinjiang Province.
1. ábra. A szövegben idézett országok és tartományok elhelyezkedése Közép-Ázsiában. A szaggatott vonallal jelölt területek a kínai Hszincsiang–Ujgur Autonóm Területen belüli igazgatási egységek.

writers describe the Great Bustard as numerous in some mesic steppe areas of southern Russia and northern Kazakhstan, with populations tapering off as aridity increased to the south and southwest *(Sushkin, 1908; Shnitnikov, 1949)*. To begin at the north of this territory, with the southern tier of Russian states, Great Bustards were noted as once numerous in western Orenburg Province, but already in decline in areas of greater human population by the mid-19th century *(Aksakov, 1852)*. In the Republic of Bashkortostan, Great Bustards were declining in numbers in the upper reaches of the Ural River in the late 19th century *(Menzbir, 1895)*. Bustards nested regularly in the southern steppes of Omsk Province, but began to decline in the vicinity of the city of Omsk in the late 19th century *(Nefedov, 2001; Nefedov & Kassal, 2005)*. The Great Bustard was less frequently sighted in Altai Krai and Altai Republic to the east *(Kashchenko, 1899; Sushkin, 1938; Irisova, 2000; Kuchin, 2004)*. The Altai Mountains form a natural border between the eastern populations of *O. t. tarda* and the eastern subspecies, *O. t. dybowskii*, in Mongolia.

Abundant populations of Great Bustard inhabited modern-day West Kazakhstan, Aktobe, Kostanay, and East Kazakhstan provinces along the northern rim of Kazakhstan *(Plotnikov, 1905; Sushkin, 1908; Karamzin, 1917)*, eastward into the Alakol Depression *(Plotnikov, 1905)* and the foothills and floodplains of Dzhungaria, in the western Xinjiang Province of China *(Gao et al., 2008)*. In Karagandy Province of central Kazakhstan, Great Bustards bred in the northern, more mesic habitats and declined towards the south *(Afanas'ev & Sludskii, 1947)*. Populations breeding in semi-desert regions of Almaty Province in southeastern Kazakhstan, as well as in the foothills of the Karatau and Zailiskii Alatau in Almaty Province and Dzhungarskii Alatau in South Kazakhstan and Zhambyl provinces along the southern edge of Kazakhstan were also described as healthy *(Shevchenko, 1948; Shnitnikov, 1949)*.

Accounts of Great Bustards nesting in desert steppe further south and southwest are occasionally encountered. For example, observations of lone females with clutches are described in Mangystau and Kyzylorda Provinces of Kazakhstan, Navoiy and Jizzakh Provinces of Uzbekistan and even Turkmenistan's Ahal Province *(Zarudnyi, 1896; Zarudnyi, 1915; Zarudnyi & Bil'kevich, 1918)*. These are disputed as being non-local or vagrant individuals *(Dement'ev, 1952; Bogdanov, 1956; Gavrin, 1962)*, and no later such observations are available. These older accounts are also typically from foothill regions, as opposed to lowland desert.

To the east of Uzbekistan, in the Kyrgyz Tian Shan, Great Bustards regularly bred in Chuy and Osh provinces, and in north and eastern Ysyk Köl Valley. These sites include mountain steppes up to 3000 m elevation *(Severtsov, 1873; Yanushevich & Tyurin, 1959; Davletkeldiev, 2006)*. Great Bustards also bred abundantly in Khatlon Province of southwestern Tajikistan at around 1500 m *(Abdusalyamov, 1971)*. Given the breeding sites recorded for Great Bustards along the Panj River, these populations undoubtedly stretched into appropriate habitat in adjacent Kunduz and Takhar Provinces of Afghanistan.

To the west of the Caspian Sea, the Great Bustard bred in the Mugan steppes of the Tabriz region of northwest Iran, and in the Shirvan steppe of Azerbaijan *(Patrikeev, 2004; Barati et al., 2015)*. However, these leks were likely more interconnected with the broader Middle Eastern population extending through Turkey, Syria and Iraq *(Collar, 1985)*, than with the Central Asian population, and will not be treated here.

North of the Caucasus, the range of the Great Bustard stretched into the Precaspian steppes and Volga River Valley. Elders and early writers report the Great Bustard to have been numerous on the steppes of Kalmykia and to have nested in Astrakhan' Province *(Yakovlev, 1873; Bostanzhoglo, 1911; Bliznyuk, 2004; Ubushaev, 2013)*. To the north, the reader is referred to the well-developed literature on Volga River Great Bustard populations *(Oparina & Oparin, 2005; Antonchikov, 2006; Watzke, 2007a; Khrustov, 2009; Oparin et al., 2013)*, which today represent the healthiest Great Bustard populations outside of Spain *(Alonso & Palacín, 2010)*.

Migratory movements and wintering range

The migratory routes of Great Bustards in Central Asia have not been investigated through banding or telemetry. However, movements of Great Bustards breeding to the west, on the Lower Volga River, have been monitored, and some details are known about

the passage of Central Asian Great Bustards from the notes of naturalists. Using satellite telemetry, female Great Bustards nesting in Saratov Province of Russia were found to make a weeklong, 1100 km journey to overwinter in southeastern Ukraine *(Oparina et al., 2001; Watzke, 2007b)*. It is possible that Great Bustards breeding in West Kazakhstan Province also move southwest along this migratory path.

It is also possible that West Kazakhstan populations move south along the western Caspian shore *(Belik, 1998)*. In Astrakhan' Province, Great Bustards were noted to have overwintered in "decent numbers" *(Yakovlev, 1873; Bostanzhoglo, 1911; Khlebnikov, 1930)* and in Stavropol' Krai, overwintering populations of up to 4000 were noted even as late as the 1970s *(Khokhlov et al., 2010)*. Great Bustard movements further south through Dagestan were once noted, probably ending at wintering grounds in Azerbaijan *(Karyakin, 2000; Patrikeev, 2004)*. Early writers also describe a migratory pathway along the eastern Caspian Sea as located close enough to the shore that hunters seeking ducks and coots also shot bustards *(Bostanzhoglo, 1911; Isakov & Vorob'ev, 1940)*. Throughout the rest of Kazakhstan, naturalists describe Great Bustards as moving in a roughly north-south direction *(Sushkin, 1908; Shnitnikov, 1949; Gavrin, 1962)*. An exception to this trend is for populations breeding in eastern Kazakhstan, which move in a southwest direction towards Uzbekistan along the foothills of the Tian Shan *(Shnitnikov, 1949; Gavrin, 1962; Berezovikov & Levinskii, 2005)*.

Migrants were reported as travelling throughout all of Uzbekistan *(Meklenburtsev, 1953)* and as overwintering in both Uzbekistan and Turkmenistan *(Isakov & Vorob'ev, 1940)*. Particularly large numbers were reported in two regions of Turkmenistan: in the lower reaches of the Atrek River in the southwest Balkan Province *(Rustamov, 1954)*, and in the foothills of the Kopet Dag in Ahal Province *(Isakov & Vorob'ev, 1940; Dement'ev, 1952)*. Some Great Bustards crossed the Kopet Dag to regularly overwinter in the Khorasan region of northeastern Iran *(Zarudnyi, 1903; Cornwallis, 1983)*.

The population of Great Bustards breeding in northwestern China is migratory, but its wintering grounds are unknown *(Gao et al., 2008)*. Given the migratory obstacle present in the form of the Himalayan massif, it is likely that these birds join the migratory pathway taken by Great Bustards breeding in adjacent eastern Kazakhstan. In Kyrgyzstan, Great Bustards overwintered in foothills in Osh and Jalalabad Provinces, and in Chuy River valley in Chuy Province *(Yanushevich & Tyurin, 1959)*. Great Bustards in Tajikistan overwintered in the Hisar Valley of the District of Republican Subordination to the north of breeding grounds in Khatlon Province *(Abdusalyamov, 1971)*. A single winter record is available from the Northwest Frontier Province of northern Pakistan, though if it is of the Asian subspecies *(O. t. dybowskii)* as reported, the journey it undertook must have been rather unusual *(Murray, 1889; Ripley, 1961)*.

In many regions of Central Asia, a handful of Great Bustards remained to overwinter nearer their breeding grounds *(Sushkin, 1908)*. In northern Kazakhstan and the steppe plateaus of Kyrgyzstan, these numbers increased in winters without snow cover *(Shnitnikov, 1949; Ryabov, 1949)*. Elders describe Great Bustards breeding in Omsk Province of Russia as nomadic rather than migratory, moving towards the Kazakhstan border in years when food reserves were insufficient *(Nefedov, 2013)*. Great Bustards breeding in the Karatau foothills (South Kazakhstan and Zhambyl provinces) are joined by additional overwintering

bustards, and move south only in more severe winters *(Shevchenko, 1948; Gubin & Vagner, 2009).*

Great Bustards were described as one of the earliest arriving and latest departing migrants to Kazakhstan. Arrival to breeding grounds typically occurred in April, while the bulk of fall migration occurred from October through November. However, both migrations are described in several texts as temporally variable and dependent on snow cover. *Gavrin (1962)* estimates that the spring journey lasted approximately one month. Incubation in southern Kazakhstan began at the end of April, while in northern Kazakhstan it started in mid-May *(Gavrin, 1962).*

Habitat

Great Bustards are described as using a wide variety of habitats in Central Asia. In addition to the region's iconic open, flat grasslands, Great Bustards were often observed in forest-steppe, mountain foothills and damp meadows *(Ivanov et al., 1951).* Overwintering spots in the south and southwest tended to be areas of greater vegetative growth in the desert steppe landscape (e.g. river valleys, foothills; *Ismagilov & Vasenko, 1950*). While Great Bustards occupied high-elevation steppe clearings in the south of their Central Asian range (e.g. Kyrgyzstan), they are not reported to have done so in the western Altai Mountains in the northeast of the European subspecies' range.

In the late 19th century, Menzbir observed Great Bustards nesting in fall-planted wheat in northwestern Central Asia, and Zarudnyi noted these birds nesting in unirrigated agricultural fields of Khatlon Province, Tajikistan *(Menzbir, 1895; Abdusalyamov, 1971). Shestoperov (1929)* described Great Bustards nesting in agricultural fields in Almaty Province of Kazakhstan in the 1920s. Thus, by the early 20th century, populations in very different areas of Central Asia were already described as using agricultural lands for breeding.

Socialist period

In the 20th century, the USSR embarked on massive development and landscape transformation projects which would have effects on Great Bustard habitat, reproduction, and mortality. Traditional pastoralism in Central Asia was collectivized and eventually herds were kept at fixed points rather than moving nomadically, resulting in pasture degradation in some areas. As part of Joseph Stalin's Great Plan for the Transformation of Nature, windbreaks were planted to an effort to prevent erosion and desiccation of farmland and temper Central Asia's harsh climate *(Brain, 2010).* Beginning in 1953, Nikita Khrushchev's Virgin Lands Campaign converted 42 million hectares of steppe lands in northern Kazakhstan and Western Siberia to wheat production *(Kamp, 2004).* This entailed the construction of irrigation infrastructure and the expansion of the paved road network, making travel through the region more efficient and Great Bustard populations easier for hunters to access. Zinc phosphide was applied to wheat grains as a rodenticide to combat outbreaks of the bubonic plague, which was suspected of decreasing populations of steppe birds including bustards through direct poisoning *(Ivanitskii & Shevchenko, 1992; Belik, 1998; Khokhlov et al., 2010).* When grain harvests were lower than expected in the 1960s, pesticide use was increased across the region. This included Granosan (ethylmercury chloride), which acts as an embryotoxin *(Kamp, 2004; Oparin et al., 2013).*

As concerns hunting of Great Bustards, in the first half of the century, *Ryabov (1940)* noted that hunters preferred to take larger individuals and described a sharp decline in the size of male Great Bustards. *Ryabov* also mentioned an increasing wariness of the species to cars, from which they were frequently hunted. *Meklenburtsev (1953)* described hunting and some limited market sales during the winter in Uzbekistan, and *Gavrin (1962)* wrote of large-scale hunting in Kazakhstan after World War II. At this time, the schedule of agricultural activity on cereal fields was also recognized as incompatible with Great Bustard reproduction *(Gavrin, 1962).* Populations in Kostanay Province of northern Kazakhstan were estimated to have declined by 60-100% due to these two factors in the period from the 1930s to the 1960s *(Ryabov, 1982).*

Great Bustards were also lost to severe winters during the late 1940s; *Sludskii (1956)* describes seeing only 1-3 individuals after such winters, over 2-3 months of surveys in regions of Central Kazakhstan where previously it was possible to observe Great Bustards in the hundreds. *Dement'ev (1952)* reported that the number of Great Bustards overwintering around the capital of Turkmenistan had strongly declined over the previous decade, and even more so when compared with the previous century.

In the mid-century, *Gavrin (1962)* summarized the status of the Great Bustard as shifting from that of a frequently observed species to a rarity over the previous thirty years. The Great Bustard could still be found across most steppe and semi-desert zones of Kazakhstan, according to Gavrin, but now only sporadically. Strongholds included Kostanay and Aktobe Provinces, Tengiz-Korgalzhin of Karagandy Province, and the Alakol' Depression in southern East Kazakhstan Province. A survey involving almost 2000 investigators and a territory of over 20 million ha found the Great Bustard to have disappeared from more than half of the 26 provinces surveyed *(Kandaurov, 1986).* This survey found Great Bustards to have disappeared completely from Tyumen, Kurgan, and Chelyabinsk Provinces and the Republic of Bashkortostan, though some reproduction was recorded in Orenburg Province. From this time onward, all literature on the species in Central Asia is marked by comments about its decline, rarity, and disappearances from regions in which it was once common *(Ryabov & Ivanova, 1971; Samusev, 1973; Gavrilov & Kapitonov, 1977).*

By the 1980s, the Great Bustard was listed in Category II of the Red List of the USSR due to catastrophic declines *(Ponomareva, 1985). Isakov (1982)* estimated that the population of Great Bustards in the USSR as a whole had decreased by 65% over 10 years. *Isakov* also estimated that less than 400 Great Bustards remained in Kazakhstan, specifically, 260 in the north Caspian region (this number includes Russian Astrakhan' and Kalmykia), 100 in west and central Kazakhstan, and 20 in eastern Kazakhstan.

The Great Bustard is red-listed across the Central Asian states and in adjacent provinces and republics of the Russian Federation *(Table 1).* As for the wintering grounds, after the late 1970s Great Bustards were no longer observed in northeast Iran *(Tareh, 2000; Rabiee & Moghaddas, 2008; Barati et al., 2015).* They were only rarely spotted as migrants or overwintering birds in Uzbekistan and Turkmenistan *(Kashkarov & Ostapenko, 1978; Meklenburtsev, 1990; Saparmuradov, 2003).*

Country	Listing category	Year of listing	Source
Azerbaijan	Endangered – "Rare wintering species"	1989	*Patrikeev, 2004*
China	VU [1]	2009	*Ding & He, 2009*
Kazakhstan	1 –"Species under threat of extinction"	2006	*Mityaev & Yashchenko, 2006*
Kyrgyzstan	III – "Critically endangered"	2006	*Davletkeldiev, 2006*
Russia			
National level	3 – "Rare subspecies" [2]	2001	*Gabuzov, 2001*
Republic of Dagestan	I – "Rare species, whose number is quickly decreasing"	2009	*Abdurakhmanov, 2009*
Stavropol' Krai	II – "Decreasing in population"	2002	*Khokhlov & Il'yukh, 2002*
Kalmyk Republic	1 – "Rare species"	2013	*Ubushaev, 2013*
Astrakhan' Province	3 – "Rare species, whose number is decreasing"	2004	*Rusanov, 2004*
Volgograd	1 – "Rare species, under threat of extinction"	2008	*Chernobai et al., 2011*
Saratov Province	5 – "Subspecies which is reestablishing itself, the condition of which does not call for concern, but which is not appropriate for commercial use and whose population requires continued monitoring"	2006	*Khrustov & Khrustov, 2006*
Samara Province	4/D – "Rare species with tendency to increase in number" [3]	2008	*Shaposhnikov et al., 2009*
Orenburg Province	"Very rare, sporadically nesting"	1998	*Gavlyuk & Yudichev, 1998*
Republic of Bashkortostan	1 – "Rare, disappearing from the territory"	2007	*Il'ichev, 2007*
Chelyabinsk Province	I – "Species under danger of extinction"	2005	*Zakharov & Ryabitsev, 2005*
Tyumen Province	"Likely extinct"	2004	*Bogdanov et al., 2004*
Omsk Province	0 – "Likely extinct"	2005	*Nefedov & Kassal, 2005*
Novosibirsk Province	0 – "Disappeared from territory in the 20th century"	2008	*Yurlov, 2008*
Altai Krai	1 – "Extremely rare species, almost extinct"	2006	*Irisova, 2006*
Altai Republic	1 – "Extremely rare species, almost extinct"	2006	*Irisova, 2008*
Tajikistan	1 – "Under threat of extinction"	1988	*Abdusalyamov, 1988*
Turkmenistan	I* – "Disappearing species under threat of extinction"	1999	*Rustamov & Sopyev, 1994; Atamuradov, 1999*
Uzbekistan	1(CR) –"On the verge of complete extinction"	2009	*Kreitsberg-Mukhina, 2009*

Table 1. Red List status of the Great Bustard in range states of Central Eurasia. Listings at the provincial level are included for Russia, and provinces are listed from west to east.
[1] Protected National Class I (highest); listing considers *O. t. tarda* and *O. t. dybowskii* jointly; [2] listing considers only *O. t. tarda;* [3] equivalent to Russian national category V – "populations re-establishing".
1. tábla. A túzok vörös listás besorolása a közép-eurázsiai elterjedési területén belüli országokban. Oroszország esetében a tartományok is szerepelnek nyugattól keletre történő felsorolási sorrendben.
[1] Országosan védett I (highest); beleértve az *O. t. tarda* és *O. t. dybowskii* alfajokat; [2] csak az *O. t. tarda* alfaj*;* [3] megfelel az orosz nemzeti V. kategóriának („újra megtelepülő populációk").

Post-Independence

By the time of the dissolution of the Soviet Union, the Great Bustard was almost extinct in Central Asia *(Gubin, 2007).* Changes stemming from the dissolution reduced the rate of their decline and resulted in slight levels of recovery in some areas. Loss of soil fertility and

the transition from a planned to market economy brought about the abandonment of large areas of farmland in the former Soviet states in the 1990s (e.g. 23% of agricultural lands in Russia; *Kamp et al., 2009; Kurganova et al., 2013*). During this time, the use of agricultural chemicals also dropped dramatically (by 90% in Kazakhstan; *Gintzburger et al., 2005*). Both of these changes likely favourably affected the reproductive success of Great Bustards in Central Asia. However, these decades also witnessed high levels of poaching.

The status of the Great Bustard in Central Asia is such that from the 1990s through today, sightings of individual or small groups of Great Bustards, on the breeding or wintering grounds, continue to be noteworthy enough for publication. Areas where the Great Bustard continues to lek in Kazakhstan, albeit in small numbers, include the Alakol' Depression on the border between East Kazakhstan and Almaty provinces *(Berezovikov & Levinskii, 2003)*, the Turgai region of Kostanay Province (*Bragin, 2004; Kessler*, surveys in 2006), the Karatau foothills of South Kazakhstan Province (*Gubin & Vagner, 2005; Kessler*, surveys in 2006), and Tengiz-Korgalzhin region of Karagandy and Akmola provinces (2-3 females; *Mityaev & Yashchenko, 2006*). The work of an artificial incubation facility in Saratov Province of Russia, which releases chicks hatched from wild-collected Great Bustard eggs *(Khrustov, 2009)*, has been attributed as having breathed new life into populations of Great Bustard in adjacent West Kazakhstan and Aktobe Provinces (*Gubin, 1996; Kessler*, surveys in 2006).

In Russia, approximately 100-120 individuals breed in both Samara and Orenburg Provinces *(Gavlyuk & Yudichev, 1998; Shaposhnikov et al., 2009)*. To the east, in Omsk Province, along the border with North Kazakhstan Province, a handful of Great Bustard sightings have occurred since the turn of the century. These are the first observations in Omsk in 40 years, and the breeding of 5-7 females was recorded in 2004 *(Nefedov & Kassal, 2005; Nefedov, 2013)*. However, this population was later decimated, apparently by the hunting of humans and free-ranging dogs *(Nefedov, 2013)*. There have also been a few sightings of Great Bustards in Chelyabinsk Province, to the north of Kostanay Province of Kazakhstan *(Zakharov & Ryabitsev, 2005)*.

Gao *et al.* (2008) describe four non-connected populations remaining in Xinjiang Province of northwest China, specifically, in Tarbagatai and Ili Prefectures adjacent to Kazakhstan, and areas east of Ulungur Lake and south of the Altai Mountains in Altai Prefecture, which is adjacent to Mongolia. The estimates for Great Bustards in this region are 1600-2400 individuals, however, this number was obtained by multiplying the available habitat by density observed on surveys *(Gao et al., 1994; Gao et al., 2008)*. As the Great Bustard has a lek breeding system, and is known to aggregate in higher-quality areas *(Pinto et al., 2005)*, this number may be an overestimate.

At the same time that slight improvements were observed on the breeding grounds, an increase in the number of Great Bustards at migratory staging points and wintering grounds was also noted.

The number of Great Bustards staging and even overwintering in the Alakol' Depression has increased *(Berezovikov & Levinskii, 2004)*. In one snowless winter, approximately 200 Great Bustards overwintered in this region *(Berezovikov & Levinskii, 2012)*. There has also been a small uptick in the number of migrating and overwintering birds in Almaty Province. While groups of less than 10 were recorded in the 1970s and 1980s, a group of

120 individuals was sighted in 2002 *(Zhuiko & Belyalov, 2002)*. The Karatau foothills of South Kazakhstan Province continue to attract overwintering birds (maximum count of 171 birds; *Gubin & Vagner, 2005; Sklyarenko & Vagner, 2005; Kessler,* surveys in 2006), which sometimes move into nearby regions of Uzbekistan, including Toshkent and Jizzakh provinces *(Kreitsberg-Mukhina, 2003).*

There has also been an increase in the number of Great Bustards observed on passage through Uzbekistan and Turkmenistan *(Kreitsberg-Mukhina, 2003; Saparmuradov, 2003)*. In Turkmenistan, the number of overwintering individuals is estimated at several dozen *(Rustamov & Sopyev, 1994)*, after an absence of approximately a decade *(Saparmuradov, 2003).* One Great Bustard was even noted in northeastern Iran in 2008; overwintering birds arriving from Central Asia had not been recorded in that region since 1971 *(Rabiee & Moghaddas, 2008).* To the west, however, breeding populations in Azerbaijan are extinct, and migrants and wintering birds occur there only rarely *(Patrikeev, 2004).*

An estimate of the current population of the Great Bustard in Central Asia is difficult to produce. Surveying efforts are incomplete and most red book listings do not provide population estimates. In 1998, regional experts estimated the number of Great Bustards remaining in Kazakhstan to be 100-500, and the number in Central Asia as a whole (including northwest China) to be 2000-3500 *(Smelanskii, 1998; Chan & Goroshko, 1998)*. Since that time, the number may have increased slightly, but probably does not exceed 4000 individuals.

Threats and conservation measures

Recent observations leave room for hope for the persistence of Central Asian Great Bustards. However, noted increases have been slight, the region is changing rapidly, and the species is still very vulnerable. To conserve these populations, poaching and low reproductive rates must be addressed immediately. Climate change and genetic isolation are also long-term challenges.

Hunting from automobiles played an important role in the sharp declines in Great Bustard populations in Central Asia in the mid- and late 20th century, after the expansion of the paved road network *(Ryabov, 1949).* Continuing into the 21st century, illegal hunting is still cited in virtually all publications as a major threat to the survival of Great Bustards in Central Asia *(Sklyarenko, 2004).* The liquidation of some anti-poaching units, the climate of lawlessness and chaos following the collapse of the Soviet Union, and the improved availability of long-range, automatic rifles are cited as factors in the increase in illegal hunting *(Berezovikov & Levinskii, 2005; Khokhlov et al., 2010)*. Additionally, sport hunting of Great Bustards came into fashion amongst the upper class, who travel from urban areas to more easily accessible flocks. Groups of such hunters use high-clearance jeeps and optical equipment to better target overwintering bustards in Almaty Province *(Berezovikov & Levinskii, 2005).* Hunting of Great Bustards at overwintering grounds in southern Kazakhstan and northern Uzbekistan is described as a particular problem, perhaps because of the proximity of capital cities. Such poaching removed, for example, up to 30% of overwintering Great Bustards in East Kazakhstan in 2012 *(Berezovikov & Levinskii, 2012)*, and eliminated a flock of 200 Great Bustards in Uzbekistan *(Kreitsberg-Mukhina, 2003).* Hunting at breeding grounds also occurs, decreasing lek populations and disrupting reproductive activity (*Kessler,* surveys in 2006).

Effective anti-poaching measures should be undertaken at sites where Great Bustards consistently breed and overwinter. As migratory stopovers are unpredictable and some overwintering spots are used only during severe winters, flexibility will be required in protecting individuals at these locations. One possibility is the development of mobile, quick-response teams, which assist local inspectors in monitoring areas where Great Bustards are newly reported. Public information campaigns should be undertaken to inspire pride in the conservation of this iconic steppe species. Such campaigns will be necessary at both the local and national level, given the role of urban sport hunters.

In addition to reducing adult mortality, it will be necessary to increase reproductive success to conserve Great Bustards in Central Asia. Losses of eggs and chicks to predators have always been high for this ground-nesting species *(Ryabov, 1949)*. As many Great Bustards nest on agricultural lands, clutch loss now also occurs due to crushing by agricultural machinery. Agricultural work may also indirectly cause clutch loss by flushing incubating females, whose eggs or chicks are then more easily spotted by predators. Agriculture presents additional issues for Great Bustard reproduction in the form of chemical use and irrigation. While agricultural chemical use decreased in the last decades of the 20th century *(Gintzburger et al., 2005)*, it is likely to rise again as local economies and trade infrastructure improve. Pesticides destroy the protein-rich summer food base of Great Bustards and their fast-growing chicks *(Hellmich, 1992; Bravo et al., 2012)*, and also increase parasite loads *(Lemus et al., 2011)*. Irrigation systems in Xinjiang Province of China are reported to flood bustard nests *(Chan & Goroshko, 1998)*. To establish plans for agricultural activity that will allow both Great Bustards and farmers to flourish, it will be necessary to develop a dialogue with farmers at bustard breeding sites. The harsh climate and short growing season of Central Asia must be taken into account, and as in Europe, financial subsidies and incentives may be required. Where bustards are breeding on virgin steppe, establishment of protected areas should be considered.

When making long-term conservation plans for breeding populations, genetic isolation and climate change must be considered. The remaining breeding populations of Great Bustard in Central Asia are small (some consisting of only two or three breeding females), and often separated by hundreds of kilometres from other breeding populations. A landscape genetic approach should be undertaken when prioritizing breeding populations for conservation action, as some leks may be small, but are critically located to facilitate gene flow in the metapopulation.

Niche modelling to forecast the suitability of future Central Asian climates to breeding Great Bustards should also be undertaken and considered when prioritizing conservation work. Considering that the Great Bustard is particularly sensitive to high temperatures *(Alonso et al., 2009)*, Great Bustard populations may shift northwards. Communication between conservation stakeholders in Kazakhstan and Russia should be maintained. The frequency of steppe fires, which already cause loss of clutches and chicks *(Chan & Goroshko, 1998)*, may be further increased if soils dry.

Finally, much remains to be understood about Great Bustard populations in Central Asia, including the location of remnant breeding locations and routes of migration. An ideal first step would be to undertake synchronized breeding surveys throughout the former breeding range of the species to identify active leks, particularly in Kazakhstan. However,

such an undertaking will be challenging, given the large extent of potentially suitable habitat and the wary nature of this species. Many hunters in Central Asia possess a deep understanding of the natural environment of their home region. The distribution of a survey through regional hunting groups concerning Great Bustard observations would be a good first step to both collect information about this species at the national level and develop dialogue with a group of stakeholders key to the species' survival.

Acknowledgements

We are grateful for the support of colleagues who assisted in field and archival research. *E.* and *T. Bragin, M. Brombacher, B. Gubin, T. Katzner, S. Sklyarenko* and *D. Zhandaeva* provided advice and logistical support in Kazakhstan. *O. Belyalov, F. Bidashko, V. Khrokov, A. Salemgareev, I. Vagner* and *I. Verbenkina* proved knowledgeable and patient in field surveys for the rare Great Bustards of Kazakhstan. The Altai Project provided funding and logistical support to investigate Great Bustard populations in Altai Republic, and *J. Castner* and *N. Malkov* gave helpful advice in this regard. *N. Formozov* facilitated archival research in Moscow. We are thankful also to the many hunters, birdwatchers, and ornithologists who have shared their personal observations of Great Bustards in Central Asia. Funding was received from the Frank M. Chapman Memorial Fund of the American Museum of Natural History and the Association for Conservation of Biodiversity in Kazakhstan for fieldwork in Kazakhstan. An IREX International Advanced Research Opportunities Program Fellowship and US National Science Foundation Pre-Doctoral Fellowship supported *A. Kessler* while she pursued field and archival research in Russia and Kazakhstan.

KIVONAT—A túzok egykor a közép-ázsiai sztyepp területek ismert lakója volt. Ma a maradványpopulációk aprók és elszigeteltek, a faj szerepel valamennyi vörös listán elterjedési területén belül. A dolgozatban áttekintjük, mi az, ami ismert a faj történelmi helyzetéről Közép-Ázsiában, valamint a régión belüli vonulásáról. Azokat a tényezőket is felsoroljuk, melyek az állomány meredek hanyatlásához vezettek ebben a populációban a huszadik században. Egy enyhe javulás figyelhető meg a faj helyzetében Közép-Ázsiában a 21. század fordulóján. Ez reményt ad a faj megőrzésére, amennyiben hatékony védelmi intézkedések valósulnak meg a költő- és telelőhelyeken egyaránt.

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