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В сборнике опубликованы материалы IV Международной научной конференции «Биологическое разнообразие азиатских степей». В докладах рассмотрены итоги исследований и перспективы сохранения биологического разнообразия степных экосистем, островных и ленточных лесов и водно-болотных угодий степной зоны Евразии, охраны природных территорий и популяций видов особого природоохранного значения, формирования экологической сети и вклада вузов в изучение биоразнообразия, вопросы интеграции естественных наук и образования. Книга предназначена для ученых и практиков, работающих в области изучения и сохранения биологического разнообразия, преподавателей вузов, аспирантов, студентов, работников природоохранных учреждений.

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MIGRATION OF FIRST-YEAR STEPPE EAGLES (*Aquila nipalensis*) FROM NORTHERN KAZAKHSTAN AND IMPLICATIONS FOR CONSERVATION

*Миграция степного орла-первогодка (*Aquila nipalensis*) из Северного Казахстана и последствия для сохранения*

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Аннотация. Еуразия кеңістігіндегі далалық экожүйелердің кең антропогендік өзгерістері Орталық Азияны дүние жүзіндегі соңғы үлкен жайылымдық мекендеу орындарымен қалдырды. Дала қырандары (*Aquila nipalensis*) жаһандық масштабта, негізінен осы дала экожүйелерінде жойылып кету қаупі бар. Біз олардың көші-қонын және олардың орын ауыстырулары популяцияның тіршілікке қабілеттілігіне әсер етуі мүмкін қауіп-қатерлерге ұшырау дәрежесін түсіну үшін Солтүстік Қазақстанда ұшып шыққан бірінші жылдық дала қырандарының қоныс аударуын бағаладық. Біз көрген дала қырандарының көпшілігі Каспий теңізінің шығысында Араб түбегіндегі немесе солтүстік-шығыс Африкадағы қыстайтын жерлерге қоныс аударды, ал кейбіреулері Каспий теңізінен батысқа қоныс аударғанымен, біреуі Иранның оңтүстік-орталық бөлігінде және біреуі Оңтүстік Пәкістанда қыстады. Солтүстіктегі көші-қон жолдары негізінен оңтүстікке қарай жүрді. Жазғы лагерьлер мен қысқы лагерьлер арасындағы тұзу жолдың арақашықтығы орташа есеппен 3582 км (күз) және 3700 км (көктем) болса, нақты жүріп өткен жол орташа есеппен 7183 км (күз) және 9433 км (көктем) болды. Бұл дала қырандарының қозғалу жолдары олардың барлық қоныс аударатын және қыстайтын аймақтарында электр тогының соғуына, атуға және жабайы табиғаттың саудасына ұшыратады.

Түйінді сөздер. *Aquila nipalensis*, биотелеметрия, құстардың миграциясы, Таяу Шығыс, құстарды ату, далалық экожүйелер, жабайы табиғат саудасы.

Abstract Extensive anthropogenic alteration of steppe ecosystems throughout Eurasia leaves central Asia with some of the world's last remaining large expanses of grassland habitat. Steppe eagles (*Aquila nipalensis*) are globally endangered breed primarily in these steppe ecosystems. We evaluated migratory

movements of first year steppe eagles hatched in northern Kazakhstan, to understand their migration and the extent to which their movements expose them to threats that may impact population viability. Most steppe eagles we monitored migrated to the east of the Caspian Sea to wintering grounds on the Arabian Peninsula or northeastern Africa, although a few migrated to the west of the Caspian Sea, one wintered in southcentral Iran, and one in southern Pakistan. Northbound migration routes largely mirrored southbound routes. Straight-line distance between summering and wintering grounds averaged 3,582 km (fall) and 3,700 km (spring), and actual distance traveled averaged 7,183 km (fall) and 9,433 km (spring). Routes of travel of these steppe eagles expose them to potential electrocution, shooting, and wildlife trade across the extent of their migratory and wintering areas.

Keywords: *Aquila nipalensis*, biotelemetry, bird migration, Middle East, shooting of birds, steppe ecosystems, wildlife trade

Аннотация. Обширное антропогенное изменение степных экосистем по всей Евразии оставило Центральную Азию с одними из последних оставшихся в мире больших пространств пастбищной среды обитания. Степные орлы (*Aquila nipalensis*) находятся под угрозой исчезновения в глобальном масштабе, главным образом в этих степных экосистемах. Мы оценили миграционные перемещения степных орлов-первогодков, вылупившихся в северном Казахстане, чтобы понять их миграцию и степень, в которой их перемещения подвергают их угрозам, которые могут повлиять на жизнеспособность популяции. Большинство степных орлов, за которыми мы наблюдали, мигрировали к востоку от Каспийского моря в места зимовки на Аравийском полуострове или в северо-восточной Африке, хотя некоторые мигрировали на запад от Каспийского моря, один зимовал в южно-центральной части Ирана и один в южном Пакистане. Маршруты миграции на север в значительной степени отражали маршруты на юг. Расстояние по прямой между летовками и зимовками в среднем составило 3582 км (осень) и 3700 км (весна), а фактическое пройденное расстояние составило в среднем 7183 км (осень) и 9433 км (весна). Пути перемещения этих степных орлов подвергают их потенциальному поражению электрическим током, отстрелу и торговле дикими животными на всем протяжении их миграционных и зимовочных районов.

Ключевые слова. *Aquila nipalensis*, биотелеметрия, миграция птиц, Ближний Восток, отстрел птиц, степные экосистемы, торговля дикими животными.

Introduction. Extensive anthropogenic alteration of steppe ecosystems throughout Eurasia leaves central Asia with some of the world's last remaining large expanses of grassland habitat [1]. Despite this, many of these steppe ecosystems are declining in size and quality [1]. These large remaining expanses of intact grassland habitats support unique fauna whose ecology and conservation are poorly known, and many of which are globally threatened or biome-restricted [22]. As such, there is substantial interest to understand basic natural history information about many of these species. Northern Kazakhstan contains some of the largest intact steppe ecosystems [17]. As a consequence, this area has become the sole remaining stronghold for populations of many grassland-obligate species and is a crucially important area for biodiversity conservation.

Steppe eagles (*Aquila nipalensis*) are globally endangered and fully migratory species that breed exclusively in the northern temperate zone from European Russia to eastern Mongolia [2,13]. As their name suggests, many phases of the life cycle of steppe eagles are closely associated with declining steppe habitats they inhabit. Steppe eagles also are unique among northern hemisphere eagles in that they nest almost exclusively on or very close to the ground [14]. Northern Kazakhstan is also a stronghold for steppe eagles, yet comparatively little has been published on this species or its movements from this region, and preliminary information suggests that birds from this region encounter many threats while on migration and during winter [13]. To address this information gap, we studied movements of first-year steppe eagles tagged in northern Kazakhstan. Here we report on migration of these birds, focusing on the (a) trajectory; (b) distance travelled; and (c) straight-line distance from summer to wintering areas.

Materials and Methods. We tagged nestling steppe eagles across a wide swath of northern

Kazakhstan. Habitat of this region is grassland, interspersed with trees that occur in riparian areas, along roadways, and in depressions that accumulate water [4,9]. Steppe eagles here nest predominantly on the ground and occasionally in small trees or on low structures [5]. These birds feed primarily on souslik (*Spermophilus spp.*), although a wide variety of small and medium size birds and mammals are taken during the breeding season [4,8].

Each bird was outfitted with an OrniTrack-30 solar powered GPS-GSM transmitter (Ornitela UAB, Vilnius, Lithuania). We attached transmitters to birds when they were $\geq 75\%$ of fledging age with a harness in a backpack configuration [10] made from Teflon ribbon (Bally Ribbon Mills, Bally, PA, USA). Devices weighed 30 g and were always less than 3% of the mass of the eagles. Each transmitter collected GPS data at 10-min to 1-hr intervals throughout the day (depending on battery voltage) and then transmitted those data via the mobile phone network twice per day when in coverage.

Because our research questions were very large scale, we only considered the last location on each day. For analysis purposes, we considered fall migration to occur during a “fall period” between when the bird left its natal nest and the end of the calendar year (31 December). Likewise, we considered spring migration to occur during a “spring period” between the start of the calendar year (01 January) and early summer (30 June).

To understand migratory trajectory of first-year eagles, we mapped the movements of all birds, separately considering the fall and spring periods. To understand straight-line distance from summer to wintering areas, we measured orthodrome distance between the starting and ending point of the fall and spring periods, using package Geosphere [8] in R [18]. Using the same method, we estimated distance travelled by measuring the cumulative day to day distance travelled during the fall and spring periods. To account for tag loss and mortality of birds, we only calculated distance for birds which had continuous data throughout the defined periods (fledging through the end of the year for autumn and January 1st to June 30 for spring). Finally, we used a Wilcoxon sign-rank test in R to test for differences between fall and spring periods in both straight-line distance and actual distance travelled.

Results. We tagged 20 steppe eagles in the Kostanay and Aktobe Oblasts of northern Kazakhstan during late June and early July 2018. From these, we were able to record 15 migratory movements during the fall period and 12 in the spring period. Other birds died or transmitters failed or were removed before the end of the defined periods.

Migratory trajectories

Fall migration of steppe eagles followed one of three general pathways (Fig. 1). The majority of birds (11 out of 15 tracked) travelled in a general south-west trajectory until reaching the eastern shores of the Caspian Sea. Upon reaching this leading line, birds followed the coastline and then continued southbound through Iran. Two others initiated migration in a westward direction from their natal areas, traveling into Russia. Of these two, one wintered in southwest Russia and the other continued southward along the western coast of the Caspian Sea, eventually converging with the pathways of the birds that used the eastern side of the waterbody. Finally, two birds travelled directly south from nesting areas, through eastern Iran. One of those birds followed the coastline of the Persian Gulf, eventually following a similar pathway as the other more westerly migrants. Ultimately, one eagle remained in Iran for the winter, one wintered in Pakistan, two in Saudi Arabia, two in Yemen, and eight crossed Bab al-Mandab Strait, with migration ending in northeastern Africa.



Figure 1 – Map of southbound migration trajectories of 15 first-year steppe eagles tagged at natal nests in northern Kazakhstan during summer 2018. Data shown are from the time of tagging to 31 December 2018 (referred to as the “fall period” in the main text). See text for details on tagging and transmitter funct

Spring migration of steppe eagles generally followed a reverse trajectory (Fig. 2). All the birds in Africa travelled north along the western edge of the Red Sea. Some of these crossed to the Arabian Peninsula at the mouths of the Gulfs of Suez and Aqaba, others turned east at the northernmost extent of the Gulf of Suez. From there, birds travelled northeast to the Caspian Sea and then travelled either the east or west of the sea to northwestern Kazakhstan. Only one of the four birds that wintered in Saudi-Arabia or Yemen survived and returned north, traveling east of the Caspian Sea. Finally, the bird that wintered in Pakistan travelled northwest through Afghanistan and then north to central Kazakhstan.



Figure 2 – Map of northbound migration trajectories of 12 first-year steppe eagles tagged at natal nests in northern Kazakhstan during summer 2018. Data shown are from 01 January 2019 to 30 June 2019 (referred to as the “spring period” in the main text). See text for details on tagging and transmitter function.

Distance travelled

Straight-line distance travelled by first year steppe eagles was similar between spring and fall migration ($p = 0.65$, $W = 100$), averaging about 3,750 km but ranging from 630 to 5,100 km (Table 1). Mean actual distance travelled was ~1,300 km less in fall than in spring (Table 1), and in eight of

Table 1 – Straight-line distance between summer and wintering grounds, and actual distance travelled for steppe eagles tagged in summer 2018 in northern Kazakhstan and tracked on migration through the (a) fall and (b) spring periods. Fall period was from tagging to 31 December 2018, spring

period was 01 January – 30 June 2019. Shown are only birds for which data was collected during the entire period.

(a) Fall period

	n	Distance (km; $\bar{x} \pm SD$)	Range (km)
Straight-line distance	15	3,835 \pm 1,137	1,293 – 4,879
Actual distance travelled	15	8,154 \pm 2,482	3,929 – 11,573

(b) Spring period

	n	Distance (km; $\bar{x} \pm SD$)	Range (km)
Straight-line distance	12	3,685 \pm 1,357	627 – 5,103
Actual distance travelled	12	9,433 \pm 2,938	3,992 – 12,662

12 cases where actual distance travelled was longer in spring than in fall. Despite this, because of substantial variation around that mean, we did not detect a statistical difference in this parameter ($p = 0.18$, $W = 62$). Maximum actual distance travelled by any single bird was <10% different between fall and spring (11,573 vs 12,662 km, respectively), and minimum distance was even more similar (both \sim 3,900 km).

Discussion. Migratory movements of steppe eagles from Kazakhstan are poorly known. Thus, the migratory connectivity and movement pathways of eagles we show here are important information for the conservation of this rapidly declining species. The wintering areas of this species also highlight the potential for threats that they may encounter.

Migration of other species of eagles shows age-related and seasonal patterns, yet this preliminary evaluation of movements may show different patterns. For example, after their first year, golden eagles in eastern North America spend more time during fall migration than during spring migration, but first year birds show similar durations of movement [15]. It is therefore interesting that our data suggest the possibility that spring migration of some of these steppe eagles appeared covered a longer distance than the fall movements. If correct, this could suggest that these spring movements may have also taken a longer time than the fall movements (see also [17]). This could be because of differences in speed of migration or possibly because eagles were traveling to more distant areas in spring (a situation complicated since we did not attempt to determine the formal start or end of migration; [15]). Additional research is needed to understand if this pattern holds with a larger sample of eagles and as the birds age.

The migratory movements of steppe eagles expose them to a large number of potential threats. Electrocution is a substantial threat for steppe eagles, both on migration in western Kazakhstan [11] and when on wintering grounds on the Arabian Peninsula [21]. These are both rapidly developing areas, and with development typically comes additional electrical infrastructure, highlighting the potential for future conflict for this species. An additional threat to steppe eagles comes from recreational hunting and capture for sale in markets. Although known to be widespread throughout the Mediterranean [12] and Black Sea [20] regions, there is increasing evidence of widespread hunting and capture of birds for sale in the Middle East [13,16,19]. The movements of these birds from Kazakhstan expose them to all these threats during both migration and wintering periods.

Steppe eagles are rapidly declining and of considerable conservation concern. These declines likely are linked to the rapid changes in the steppe ecosystems they occupy during summer months. However, their migration pathways and wintering areas expose them to a large number of potential threats that are also likely influential to the trajectory of these populations. Our work thus highlights the importance to conservation of improved understanding of the movement, behavior, and ecology of this endangered species.

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УГРОЗЫ ФАУНЕ ПТИЦ ВОДНО-БОЛОТНЫХ УГОДИЙ ДЕЛЬТЫ РЕКИ ИЛЕ И ЮЖНОГО ПРИБАЛХАШЬЯ

Threats to water birds of the Ile river delta and the southern Balkhash coast

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Аннотация. Қазақстанның жазық аймағындағы сулы-батпақты алқаптар біздің елімізге тән құстардың бірқатар түрлерінің тіршілік етуі үшін қажетті жағдай болып табылады. Әсіресе, миграция кезінде ары қарай ұшу үшін тоқтап, энергия қорларын жинауда маңызды рөл атқарады. Дала көлдерінің сипаттамаларына су деңгейінің циклдік ауытқуы жатады. Табиғи флуктуацияға судың деңгейі мен сапасын өзгертетін адам қызметінің теріс әсері қосылады. Мақалада Іле өзенінің атырауындағы су деңгейінің күрт өзгеруі теріс әсер еткен құс түрлерінің топтары қарастырылады.

Түйінді сөздер: құстар, сулы- батпақты алқаптар, негізгі орнитологиялық территориялар, Рамсар алқаптары, Іле өзенінің атырауы.

Аннотация. Водно-болотные угодья в равнинной зоне Казахстана являются необходимым условием для выживания целого ряда видов птиц, характерных для нашей страны. Особую роль они играют в период миграций для остановки и накопления энергетических запасов для дальнейших перелётов. К характеристикам степных озёр относятся циклические колебания уровня воды. К природным флуктуациям добавляется негативное влияние человеческой деятельности, изменяющее уровень и качество воды. В статье рассматриваются группы видов птиц, на которые негативно влияет резкая смена уровня воды в дельте реки Иле.

Ключевые слова: птицы, водно-болотные угодья, ключевые орнитологические территории, Рамсарские угодья, дельта реки Иле.

Abstract. Wetlands in the flat area of Kazakhstan are a necessary condition for the survival of a number of bird species that are native of our country. They play a special role during migrations to stop and accumulate energy reserves for further flights. The characteristics of steppe lakes include cyclic fluctuations in the water level. Added to natural fluctuations is the negative impact of human activities that affect the level and quality of water. The article deals with groups of bird species that are negatively affected by a sharp change in the water level in the Ile River Delta.

Keywords: birds, wetlands, Important Bird Areas, Ramsar Sites, Ile River Delta.

На огромной территории равнинного Казахстана расположилось несколько природных зон, самые крупные из которых: лесостепь, степь и пустынная. Во всех этих