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Geese of Central Siberia (number, current state)

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Abstract. The studies were carried out on the territory of Central Siberia in the period 1980-2019. The research purpose is to assess the current state of geese in the region as an important biological resource. Data about geese number are fragmentary, and for some species and groups are absent. This problem is extremely weakly represented in English literature. Material includes previously published data and personal research of the authors. The observations were carried out at 91 points; additional of geese census in places of their stops - at 132 wetlands. The total duration of census on the flyways and in places where geese stopped in the daytime was more than 15 thous. hours, at night - 1422 hours. The total length of routes was more than 60 thous. km, of which land - 35.6 thous. km, with aviation use - 25.5 thous. km. 1035 collectible unites were collected and processed. The number of photo / videos files of geese were 13.1 thous. copies. As a result, the number of the northern geese populations was estimated at 1.72 million of individuals. "Southern" geese, including migratory geese, are small-numbered and make up no more than 1.5% of the total geese number in Central Siberia. In a certain sense, species and subspecies of geese, geographically related to the Altai-Sayan region, today represent the same relics of the Ice Age as reindeer, argali, and other animal species that live in the Sayans.

1. Introduction

9 species of geese live in Central Siberia, but the main population is the white-fronted goose (*Anser albifrons*) and the bean goose (*A. fabalis*). The largest breeding and molting areas of these birds in Eurasia are located in the northern part of the region, especially in Taimyr and the east of the Gydan Peninsula. At the same time, geese living in the south of Central Siberia (*A. fabalis middendorffii* Sever., 1873; *A. anser rubrirostris* Swin., 1871; *A. indicus*; *A. cygnoides*) are currently experiencing a serious impact of anthropogenic factors, which leads to fragmentation and reduction of habitats and reduction of their numbers. Most species, subspecies and subpopulations of "southern" geese are listed in the regions' Red Books [1-4].

The intensified economic development is going on not only in the south of Central Siberia, but also in Taimyr, and, as a result, the transformation of ecosystems of the Arctic and subarctic tundra. Against this background, the primary task for the scientific community, representatives of regional and federal authorities, as well as indigenous peoples of the North is to preserve the biological diversity of



the region and biological resources. The use of resources not only of deers, but also of massive species of geese of the northern territories serves as an important source of well-being for most farms and the indigenous population of the North of the region.

Research objective is to assess the current state of geese of Central Siberia as the most important biological resource of the region.

2. Central Siberia as a habitat for geese

The borders of Central Siberia on different schemes of physical-geographical zoning do not coincide, due to the greater contrast of nature within the country, its less clear boundaries and ambiguous interpretation of the actual data available to researchers [5-6]. The English literature term is used in this work - "Central Siberia", which, in our opinion, more accurately reflects the location of the research area as the intersection of two continental migratory flows of birds in Asia. The western and eastern borders coincide with the borders of Central Siberia [5], the southern one includes the northern part of the Ubsu-Nur basin, and the northern one - the coast of the Kara Sea.

Central Siberia is a cross-border territory with unique natural landscapes of taiga interfluvium and Altai-Sayan mountain country, relatively little affected by economic activity. The region under consideration is geographically located in the center of the Asian continent. Its length from north to south is 3140 km, from west to east - more than 1280 km.

3. Materials and methods

The material used in this publication includes both previously published data and personal research of the authors, performed in 1980-2019. In addition, departmental archival materials of the State Hunting Supervision are involved in the work. The information on bird encounters and prey received from respondents have been processed

Until 2006, surveys covered most of the wetlands in the south of Central Siberia and South Evenkia. When using aviation, one-time recording of geese was carried out throughout this territory. After identifying key areas, researches were conducted more often in the territory of Khakassia, in the Krasnoyarsk Territory, and in separate water bodies of Tuva. In 1994-2004 the work was performed in the basins of Syma, Tyma and Tugulan and on lake Burgunkuy (the Keti river basin), in 2005-2007 - in the basins of the Lower Baiha River (the Turukhan River basin), Big Kheta and Malaya Kheta, as well as on the coast of the Yenisei Gulf and in the flood plain of the river Taz. In June-August 2017, 2019 and in May-June 2019, point recordings of geese were carried out along the rivers Kheta, Maymecha, Khatanga.

The peculiarity of the south of Central Siberia is that in the spring the northern geese make a long (up to 45-50 days) stop in the strip between 51 and 56 ° north latitude before flying to the nesting sites. The distribution of migration flows and methods for studying migration are described by us in the previous paper [7]. To calculate the total migration flow, some of the points were distributed without reference to the places of geese concentration. Visual-optical and acoustic-optical observations were carried out at 91 points, additional counting of geese in places of their stops - at 132 water bodies. The total duration of recordings on the flight paths and in places where geese stopped in the daytime was more than 15 thousand hours, and at night (acoustic-optical observations) - 1422 hours.

In each of the most significant lands, we worked every year on the same dates: in April-May, in September-October, with the inclusion of dates of maximum concentration of birds, which according to long-term average data occur in May 9-15 (± 3 days) in spring and in October 7- 15 (± 3 days) - in the fall. To assess the success of nesting, broods from June to July were taken into account. At the same time, an additional search for geese molting places was carried out and birds were caught for tagging. The total length of the routes amounted to more than 60 thousand km, including land routes - 35.6 thousand km, using aviation - 25.5 thousand km.

To clarify the subspecies of geese, birds or their fragments (heads, wings, paws) were collected; 1035 samples were examined. In recent years, video and photographing geese in places of

concentration have occupied a large place in the study. The number of photographs / videos of individuals and accumulations of geese was 13.1 thousand copies.

4. Results and discussion

In Central Siberia, there is an extensive contact zone not only of the subspecies of the bean goose, the brant goose and the white-fronted goose, but also of large ecological and geographical groupings of geese that have flights and winters in various regions of Eurasia. Conventionally, they are divided into "European" and "Asian" geese with a very complex spatial structure. Current data on the number of geese are fragmentary, and for some species and groups are practically absent. They are extremely weakly represented in English literature. These materials will, to some extent, fill this gap (table 1).

Table 1. Resources of geese in Central Siberia after breeding and molting season, current state in 2019.

Species/subspecies/ subpopulation	Number, individuals	Abundance in the region south of 57 ° north latitude	
		on plain	in mountains
Krasnoyarsk Krai			
Geese of northern populations			
<i>Branta bernicla</i> (L.)	230000	0	0
<i>Branta nigricans</i> (Law.)**	75	0	0
<i>Branta leucopsis</i> (Bech.)	100	0	0
<i>Rufibrenta ruficollis</i> (Pall.)**	105000	100	0
<i>Anser albifrons</i> Scop.	1100000	300	0
<i>Anser erythropus</i> (L.)**	20000	0	0
<i>Anser fabalis rossicus</i> But.	195000	20000*	0
<i>Anser fabalis serrirostris</i> Swin.	19000	100	0
<i>Anser fabalis fabalis</i> Lath.	30000	150	0
<i>Anser fabalis middendorffii</i> Sev. (Evenk subpopulation)*	17500	100	0
Total	1716675	20750	0
«Southern» geese			
<i>Anser anser</i> (L.)*	150	150	0
<i>Eulabeia indica</i> (Lath.)**	15	0	15
<i>Cygnopsis cygnoides</i> (L.)**	10	10	0
<i>Anser fabalis middendorffii</i> Sev. (Sayan subpopulation)* *	350	0	350
Total	525	160	365
Republic of Khakassia			
<i>Anser anser</i> (L.)*	70	70	0
<i>Eulabeia indica</i> (Lath.)**	20	0	20
<i>Cygnopsis cygnoides</i> (L.)**	10	10	0
<i>Anser fabalis middendorffii</i> Sev. (Sayan subpopulation)*	100	0	100
Total	200	80	120
Republic of Tuva			
<i>Anser anser</i> (L.)	1500	1500	0
<i>Eulabeia indica</i> (Lath.)**	300	100	200
<i>Cygnopsis cygnoides</i> (L.)**	200	200	0
<i>Anser fabalis middendorffii</i> Sev. (Sayan subpopulation)*	1800	1500	300
Total	3800	3300	500
Total number, individuals	1721200	24290	985

%	100,0	1,41	0,056
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Note: * – geese listed in the Red data book of Krasnoyarsk Kray; ** – geese listed in the Red data book of the Russian Federation.

The white-fronted goose *Anser albifrons* is the most numerous species in the northern part of the subzone of typical tundras of the region. Optimal habitats are located within Western and Central Taimyr, as well as in Eastern Gydan. The species is characterized by an uneven "hotspots" distribution at nesting. During molting it is distributed also uneven, but the largest place in Eurasia is formed in the delta of the river Pyasina [8]. Noticeable before flying off concentrations are characteristic of the Brekhov Islands located at the mouth of the Yenisei. The number of white-fronted geese in the tundra of Taimyr and East Gydan has a steady growth trend [9] and now, apparently, does not exceed 1.2 million individuals. At the same time, an extremely insignificant part of these birds flies through the most developed part of the Krasnoyarsk Territory, Khakassia, and Tuva (table 1, 2). In recent years, there has been a reduction in the abundance of birds of the *South Siberian, Kansk-Yenisei and Nizhneangarsk groupings*, representing less than a thousand individuals in total. In the period 2015-2019 the total number of white-fronted geese flying in the spring in the south of Central Siberia (including the Angara basin) did not exceed 2.0-3.5 thousand individuals. At the same time, in the Irkutsk region, the proportion of white-fronted geese was 15% of the total number of geese flying through this region [10].

Table 2. Species composition and distribution of geese on migration flyways in the south of Central Siberia

Species/subspecies/ subpopulation	Thous. individuals	On migration flyways, individuals					
		1	2	3	4	5	6
<i>Rufibrenta ruficollis</i> (Pall.)	0,50	200	0	0	60	180	60
<i>Anser anser</i> (L.)	2,1	300	1000	0	750	50	0
<i>Anser albifrons</i> Scop.	5,0	1340	0	0	210	1050	2400
<i>Anser erythropus</i> (L.)	0,2	100	0	0	15	15	70
<i>Anser fabalis</i> incl subspecies: <i>Anser fabalis rossicus</i> But.	30,0	0	0	0	20000	6000	4000
<i>Anser fabalis serrirostris</i> Swin.	19,0	0	0	0	500	5500	13000
<i>Anser fabalis middendorffii</i> Sev.	20	200	0	0	2000	5300	12500
<i>Anser fabalis fabalis</i> Lath.	30	24000	6000	0	0	0	0
<i>Eulabeia indica</i> (Lath.)	0,3	0	0	300	0	0	0
<i>Cygnopsis cygnoides</i> (L.)	0,2	0	0	0	190	10	0
Total	107,3	26140	7000	300	23725	18105	32030
%	100	24,4	6,5	0,28	22,1	16,9	29,9

Note. In the column «On migration flyways»: 1 – Kazakhstan-Central Siberian flyway; 2 – Ubsunur-Tarim; 3 – Ubsunur Gobi- Qinghai; 4 – East Tuva-Khubsugul-Chinese; 5 – Angara-Baikal-Gobi; 6 – Tunguska-Baikal-Angara-Khingán.

Black Goose is a polar arctic political species. Birds belonging to the nominative subspecies *Branta bernicla bernicla* L., 1758, which inhabit the islands of the Kara Sea and nest in a narrow strip along the coast of Taimyr, are widespread in the region [8]. The state of the population, as a whole, is stable, the average annual number varies, but at present it is about 230 thousand individuals.

As a result of comprehensive protection of the red-breasted goose, its number was stabilized. There is a sizeable growth (105 thousand individuals) and, as a result, the expansion of the range to the north and east. At present, the white-fronted goose, the tundra bean goose and the red-breasted goose are the three most common Taimyr species [11, 12]. In recent years, as a result of a sharp increase in the number of geese, its penetration has been observed in Western Taimyr, where it has recently been recorded at nesting (Rosenfeld S.B. - oral presentation).

Unlike geese of northern populations, geese of the south of Central Siberia have a negative trend in numbers. East Eurasian Gray Goose *A. a. rubrirostris* inhabits the island steppes and forest-steppes of Central Siberia. The number of gray geese in the South Minusinskiy centre in 2002-2004 did not exceed 70–100 individuals. It is more common in the south of Tuva. To the north, there is a process of population decline and habitat reduction, mainly due to direct extermination of birds, increased anxiety levels, and degradation of the habitat in breeding and wintering sites. According to our data, as well as according to the testimonies of local residents and environmentalists, most likely, gray geese disappeared in the east of Tuva at the end of the 20th century. Only units were preserved in the Central Tuva, South Minusinsk and Kansk hollows.

In 2011–2015 Verkhne-Chulymsky and South Khakassia of the species habitats were at different stages of degradation. Nesting sites (clutches and broods found) are preserved even in the southern part of lake Beloe, in the area of lake Salbat and flood plain Seryozha (Chulym basin). Single pairs of geese breeding not every year were recorded in the Chulym basin: in flood plain complexes along the rivers Bely Iyus, Uryup, Verkhny Chulym. In northern Khakassia, no more than 20 pairs nest separately and not regularly; on the left bank of the Yenisei within the South Minusinsk hollow - no more than 10-15 pairs. The only before flying off concentration of gray geese of the Verkhne-Chulym group is currently being formed on lake Salbat, where in August - September 2014 260 individuals were counted, and in 2015 – 180. A similar concentration of up to 100 individuals was formed in the area of Lake Pataga (Uybat steppe) in the 1990s - early 2000s. After the water body had dried, it disappeared.

Currently (2017-2019) no more than 150-180 individuals live in the Krasnoyarsk Territory and in Khakassia. In the northern part of Central Asia and in the south of Siberia, wide gaps were formed not only between large geographical populations of gray geese, but also between separate groups within populations.

An analysis of *Anser fabalis* collection gatherings (n = 574 specimens) showed that *A.f. rossicus* prevails in the south of Central Siberia - 91%, share of *A.f. middendorffii* is 6% of the total sample size, *A.f. serratirostris* - 2% and *A. f. fabalis* - 1%. The current number of East Asian bean goose types in the region is critical. Almost all of them are listed in the regional Red Books or are candidates for inclusion in the second edition of the Red Book of the Russian Federation. As a result of fragmentation of the range, the number of *A.f. middendorffii* remains low. The Sayan subpopulation, numbering 1.5-2.0 thousand is particularly vulnerable. The number of geese in key habitats has decreased since 1980 by 1.5-2.0 times. The subspecies groups that live in Tuva in water bodies of the Togina hollow are more stable (up to 60% of birds are concentrated there). Along the northern macro slope of the Western Sayan and in the southwestern part of the Eastern Sayan, only some habitats of these geese in the basins of Amyl (30–50 pairs), Kazyr and Kizir (15–20 pairs) are preserved. In the upper reaches of the rivers Big and Small Abakan, as well as in basin the Monags river (the southern macro slope of the Western Sayan) inhabit no more than 100–150 taiga bean geese. Almost no geese remained in the western part and along the northwestern macro slope of the East Sayan and in the Kuznetsk Alatau.

According to the results of catching and tagging geese, we can talk about the presence of territorial ties of birds of this group with geese of eastern Tuva and northern part of Mongolia. In particular, in

2010 we caught an adult male taiga bean goose, tagged in the previous year during molting on Lake Erhel Nuur (49° 56' N, 99° 54' E) by ornithologists of the US-Mongolian expedition.

The number of the main flying type of *A.f. rossicus* (Tuvino-Minusinsk subpopulation) as early as in the 70s of the twentieth century was not less than 100 thousand individuals. Currently, it does not exceed 20.0 thousand (table 1).

According to the latest data [13], the number of *Anser fabalis* in East Asia is 157–194 thousand individuals including of *A.f. middendorffii*. We believe that, in general, these figures are underestimated, since only in the area of lake East Dotinghu, about 18.0 thousand taiga bean geese were recorded (Rosenfeld S.B. - oral presentation) in January 2018. Probably, geese wintering in Western China, Central Asia and partially in India were also not included in the records. In our estimation, taking into account territorial ties and the number of geese along the flight paths, from 15 to 30 thousand *A. f. fabalis* inhabiting the Yenisei-Ob, Yenisei-Taz interfluves, as well as the western parts of the Putorana, Syverm plateau and some other parts of the right bank of the Yenisei can winter there.

In addition, 30 thousand *A.f. rossicus* migrate from the tundra of Western Siberia and Taimyr to winter in the eastern part of China. 19 thousand geese of the *A.f. serrirostris* subspecies fly there from the tundra of East Taimyr and Khatanga-Lena interfluves. That is also true for a subpopulation of Siberian taiga *A.f. middendorffii*, inhabiting Evenkia and Zaaangarye, as well as the western part of Yakutia and the north of the Irkutsk region, with a total number of 15.0-17.0 thousand individuals. 1.5-2.0 thousand geese living in the Altai-Sayan Ecoregion migrate in the same direction. Thus, about 70.0 thousand bean geese or 36.1% of all Asian geese of this species fly to the East Asian wintering grounds. The total number of all species migrating along the selected migration routes, including the Angara-Baikal sector, will be 107.3 thousand individuals or 6.2% of the geese of Central Siberia (table 2).

Other nesting species of the “southern” geese are represented by the bar headed goose *Eulabeia indica* and the Chinese goose *Cygnopsis cygnoides*. The number of the first, which participated in the epizootics of bird flu, decreased in some areas by 4–5 times. At present, their total number in Tuva, according to our estimation, does not exceed 200–300 individuals.

A stable group of the Chinese goose exists in the middle and lower reaches of the river Tes Khem, which is probably connected with Mongolian populations, where this species is quite widespread. According to our estimates, from 50 to 300 of these birds lived in the south of Central Siberia in the early 2000. Currently within the floodplain complex of the river Tes Hem inhabits no more than 200 geese. The number of Chinese goose to the north of the Western Sayan is probably no more than one to two dozen individuals.

5. Conclusion

Changes in the Arctic communities, according to A. A. Tishkov et al. [14], which have cascading, cumulative and synergetic effects, also influence the formation of biota trends, which, obviously, also affect the change in the number of different species of geese. In addition, the bean goose groups wintering in the western part of Eurasia, mainly in Europe, are more stable. In general, the resources of the geese of the North of Central Siberia are significant and are not less than 1.7 million individuals.

At the same time, the “southern” geese, including migratory ones, are few in number. In addition to the genesis of flyways and, as a consequence, the extremely uneven distribution of birds along migration flows, anthropogenic factors influence the number of geese. More than 95% of the population and the majority of hunters live in the south of the region. Direct seizure of an already relatively small number of geese, economic development of the territory, and in recent years a significant recreational load lead to the formation of wide disjunctions not only between large geographical populations of geese (Central Asian, Siberian-Kazakh and Amur-Chinese), but between separate groups within populations. Birds in most exclaves are in critical condition.

In a certain sense, the species and subspecies of geese, geographically related to the Altai-Sayan region, represent today the same relics of the Ice Age as the reindeer, argali, willow and rock

ptarmigans, dotterel and several others. In addition, the number of geese in the south of Central Siberia is affected by the proximity to the Ubsu-Nursky acting focus of influenza A virus [15]. After the introduction of a ban on the killing “southern” geese and their inclusion into the Red Books of a number of constituent entities of the Russian Federation, their decline stopped. These measures positively affect the state of the bean goose but practically do not affect the number of gray goose. There is no doubt that in order to save this species it is necessary to take more radical measures such as including the gray goose inhabiting the Asian part into the Red Book of the Russian Federation.

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