Ecological connection between fish preference in the diet of Siberian cranes and their incubation period in tundra zone

Vladimirtseva, M.V., Bysykatova, I.P., Sleptsov, S.M.
Institute for Biological Problem for Cryolithozone
Siberian Branch of Russian Academy for Science
Russia, 677980, Republic Sakha (Yakutia), Yakutsk, Prospect Lenina 41
Sib-ykt@mal.ru

Summary

We researched the ecology of third in rarity crane species, Siberian crane, breeding in northern-eastern Siberian tundra. Nesting in places near great lakes, this crane appears to be an indicator for the global warming processes what affect lakes growth in the result of permafrost close situation to the surface in tundra. Researching shown these birds are presumably fish-eating during their incubation period coinciding in time with flooding season when fish comes on areas around great lakes. Such diet may be explained by the necessity of high-energetic food in incubating period as well as the particularity of this species as leaving plant resources around the nest point for period of the first days after chick hatching. This situation emphasizes tight connections in the vulnerable northern ecosystems. If the water level in tundra lakes starts to be higher own to the global warming all these links may be destructed.

Many literature references show Siberian crane like mostly vegetarian crane species[1,2,3,4]. Having special adaptation to foraging in water, such as long and massive beak with notches on its distal parts and partly webbed fingers, Siberian crane is considered also the most aquatic crane. Indeed the bulk of Siberian crane diet consists from subjects inhabiting water.

Typical habitats of this crane on the breeding ground in Siberian tundra are wetlands near or between great lakes, 10-15 and more kilometers across[5], the most low tundra zones covered with sedges, roots, rhizoids and sprouts what are plant items in Siberian crane diet.

K. Vorobyiov[2] describes Siberian crane as mainly plant-eater in the breeding period but still taking rodents in less degree at this time. When cranes just arrive to the breeding ground in tundra in the middle-late May, all ground covered with snow, and all water ice-bound. Frozen vegetation from the last year is very hard to access and rodents only may serve as food item for the cranes in this difficult time. The possibility of Siberian cranes to feed with rodents was confirmed yet in 1961[6] when the stomach contents of four killed on the breeding ground birds of the species were revised and bones and hair of Lemmus obensis, Microtis gregalis, M. oeconomus and M. hyperboreus were revealed.

We watched single Siberian cranes following presumably rodents on the higher and drier tundra areas. The season time, late August, did not let us to assume chicks of smaller birds could be the objects of this hunt. But, as we know, lemmings and voles are numerous enough no every year corresponding to their reproduction cycle.

In the snowy pre-nesting and post-migration hungry period we watched as two young Siberian cranes came very close to field camp for frozen pieces of fish *Coregonus peled Gm*. which were put near dwelling van. Such closing to human dwelling is absolutely no characteristically for this careful species. These watching were made in late May, 2005, year of late spring and low number of tundra rodents.

Young Siberian cranes stopped to visit this fish bite just when edges of lakes opened from ice, and small fish ninespine stickleback *Pungitius pungitius L.* came on flooded patches around lakes. We observed as cranes started catch these fish in shallow water.

These cases of only fish diet are explained by the absence of other food. But we also observed incubating pair of Siberian crane in the middle June, 2007, who prefer eat fish in despite of green plants abundance, contrary to the assertion of V. Flint and A. Kischinski[4,7] that the Siberian crane eats fish "rarely". So, the question why these Siberian cranes preferred fish instead of greed plants was raised.

Normally Siberian cranes incubation starts in the late May-early June but sometimes may late for one-two weeks own to severe tundra climate appearances, such as long snow storm. A chick hatching happen in 28-30 days, in the late June –early July. In despite of often two-egged clutches, Siberian cranes mostly have just one chick for not at all clear reasons.

We observed a pair of Siberian cranes on their individual breeding territory in 2007 and 2008, June and July. Corresponding to satellite data, a size of Siberian crane pair individual territory may occupy about 7,3 - 17 $km^{2(8)}$. The breeding territory we discussed has been known from 1996 when the both birds were banded and on the male was installed satellite transmitter here in August. Unfortunately, this male was killed in China on fall migration at the same year[9]. Next summer, 1997, the banded female leaded other male on this breeding territory. But in 2007 we revealed a new female instead of old one, smaller and slimmer, and without the band.

Nesting behavior of new female was apparently inexperience, look like it was its first breeding. Normally Siberian crane male and female change one another on their nest in equal time, every 88.35 min averagely. But in this case the male had to sit much longer during its shift because female stayed out of nest sometimes for 3-4 hours.

The cranes nest was situated in a kilometer of a large lake and between several small ponds inhabited with fish. Own to the spring high water level fish from the lake and ponds came on flooded areas of the Siberian crane breeding territory. Water level on the lowest areas of the breeding area was about 50-60 cm. In some years with especially snowy winters, the spring water level continues to rise after cranes laid their clutches, so they have to add vegetation material to their nests making it higher and dryer[10].

After its shift on the nest, a crane had a possibility to catch fish on flooded patches in diameter of 5-50 m from the nest, sometimes up to 3-5 m (fig. 1). For the period 114.11 min averagely when one from mates incubated on the nest, male fed itself with plant items just 9.3 % of this time, female 10.1%. The male spent 2.7% of the total observation time on feeding the vegetation, female - 4.9%. The main feeding behavior was to track down, catching and eating fish.

We detected the fish species as peled and pike *Esox lucius L.* on the base of the lake's ichthyofauna data and fish appearances. Before eating large fish, cranes treated it with strong hits of their beaks cutting it for smaller pieces. The treatment and eating of large fish took on average 10 minutes, middle fish - 1.5 minutes.

The male was more skilled at fish catching. One day he caught four large fish, the female - two large and one middle fish. In addition, the both birds caught dozens of small fish ninespine stickleback and possible fry of large fish. Tables 1 and 2 show the number of those fish, the capture of which it was possible to clearly see and determine the time of its eating by cranes.

After eating a large fish Siberian crane carefully cleaned its beak, first dipping it in water, then wiping it off the grass or by foot. A crane did not bring caught fish to its mate sitting on the nest. When looking for fish 49.7% of the total amount of free time brooding male, and 39.4% female wandered along the shore of the lake, stopping at every step and making a probe movement (2-4 cm above the water surface), with speed as 1 step per 2 seconds.

Cranes were presumably fish-eating during their incubation, but observations in the middle-late July - early August 2000 for the three pairs of Siberian cranes, each with a well visible chick, showed almost completely vegetarian diet, adult birds as well as their chicks. Most of the daylight hours Siberian cranes with chicks spent in slow enough movements associated with feeding the shoots of sedge and submerged parts of the plant, underwater roots and rhizoids, within their individual territories[11].

Our observation for Siberian cranes on transit stop in Momoge Nature Reserve in northern-eastern China, middle October-early November, 2007, also showed feeding just vegetation items, underwater parts of semi-water plant, *Scirpus maritimus.*

But why the diet of incubating birds consisted almost exclusively from animal food if they had unlimited access to plant resources?

To answer this question, we should look in the structure of Siberian cranes individual territories which they use when incubate their clutches, raise their chicks or spend summer time if for some reason have no any chick. The visual observations of territorial pairs of Siberian Crane as well as satellite data[8] provide a basis for detection of "nesting" and "feeding" areas in their individual territories. The nesting area includes the nest. There is a food supply for the chick in its first days after hatching, as well as for its parents, who must remain close to their slow-moving chick. Especially noticeable such separation for the nesting and feeding areas during the incubation period when the bird is replaced by a partner on the nest almost immediately flies off to feed far from the nest, for about 500-1000 m or more. However, the bird does not leave the nesting area when going to feed animals objects, such as fish, coming in flooded areas around the lakes after the spring floods. It is possible that this mechanism works intentionally to keep crane's plant feeding resources in nesting area for hard period of their chick first days.

Analysis of the vegetation distribution in the nesting and feeding areas at the pair individual territory showed that plant resources for breeding zone quantitatively and qualitatively superior to feeding: a large portion of the surface is covered by herbaceous vegetation represented mainly sedges used in food Siberian Crane, while the six sites used in the feeding area, occupying from 50 to 200 m^2 and this type of vegetation occupied only 40-50% of their territory**.** In the rest of the space grew moss and shrubs. As individual territory of this pair is under constant surveillance, the birds are accustomed to human presence. This allowed to observe the nesting behavior of birds from a distance of about 1 km long and to conduct detailed investigation of their breeding site. But the other Siberian cranes pairs immediately left the nest with a similar approach of human beings, so such detailed studies of vegetation in their territories have no been conducted.

Siberian cranes adapted to living in tundra, and, to be more precise, to live among tundra lakes, shapes of which can change within one season as well as during many-years periods[12]. This crane species have to count with constantly changing tundra climate conditions.

Incubation coincides with intensive snow-melting period connected with water level rising what is dangerous for the cranes clutches in their nests. It is very responsible time for cranes who should constantly, daily and nightly, watch if their nest became too wet, and immediately start bring additional vegetation to fix the situation. But also, it is the time of fish abundance, rich time, when the cranes may catch fish actually near their nest. It should be reasonable to eat high energetic high food as tundra fat fish in this hard and difficult time for cranes. And, also, it is good way to save plant resources close to nest for the time, when it is necessary to be with just-hatched chick. Cranes still eat plants in lesser quantities during their incubation, but, also, far from the nest. While chick grows, water level is lowering consequently, so, vegetation food starts to be mainly source of food for Siberian cranes to the late July-August.

So, accessible fish helps cranes to count with difficult flooding conditions as source of energetic food in incubation period, and to save their plant resources for first days of their chick live.

At least, this true for the present, but global climate warming may lead to tundra lakes growing and to disappearing of zone where Siberian cranes construct their nests and incubate their clutches. The tundra ecosystem, in despite of its severe climate condition, is very fragile in its inner connections between organisms.

Literature cited

1. Sludski A.A. 1959. About the distribution and biology of Siberian cranes. In "Ornithology", No Edition of Moscow Government University. Moscow. Pp. 159—162.
2. Vorobyov K.A. 1963. Birds of Yakutia. Yakutsk. Pp. 1-336
3. Meine Curt D., Archibald George W. 1996. The Cranes: Status Survey and Conservation Action Plan. IUCN/SSC Crane Specialist Group, IUCN, Gland, Switzerland, and Cambridge, U.K. 88-103.
4. Flint, V.Ye., and Kischinski, A.A. 1975. Siberian crane in Yakutia. Zoological journal. Moscow. Vol. 54. No 8. Pp. 1197-1212.
5. Germogenov N.I. 2002. Present condition of cranes in Yakutia researching and protection. Cranes of Eurasia (distribution, number, biology). Moscow. Pp. 106-111
6. Uspenski, S.M., Beme, R.L., Priklonski, S.G., Vekhov, V.N. 1962. Birds of Yakutia Northeast. In "Ornithology". Edition of Moscow Government University, Moscow. No. 5. Pp. 64-86.
7. Flint, V.Ye., 1987. Family crane. Birds of USSR. Galiiformes, Gruiformes. Leningrad. Science. 527 pp.
8. Germogenov, N.I., Pshennikov, A.Ye., Kanai, Yu. 2009. About territorial conservatism of Siberian crane (Grus leucogeranus). Zoological journal. Vol. 88. No 7. Moscow. Pp. 860-870.
9. Germogenov, N.I. et al. 2007. Banding and monitoring of Siberian Cranes in Yakutia. China Crane News. China Crane and Waterbird Specialist Group. Felburn. Vol. 11. No 1. P. 26-35.
10. Vladimirtseva, M., and Sleptsov, S. 2009. Base ethological aspects in Siberian crane (GRUS LEUCOGERANUS) and Lesser Sandhill crane (GRUS CANADENSIS CANADENSIS) in their incubation periods. Zoological journal. Moscow. Vol. 88- 2. P. 221-227.
11. Vladimirtseva, M. 2002. Data on behavior and time budget of Siberian crane and Sandhill crane in Yakutia. Cranes of Eurasia (distribution, number, biology). Moscow. Pp. 234-238
12. Pshennikov, A.Ye., and Germogenov, N.I. 2000. Fluctuation and effect of weather factors to Siberian crane reproductive area and its population number dynamics. I International Ornithological Conference "Present problems of ornithology in Siberia and Central Asia". Ulan-Ude. Pp. 180 – 182.

Acknowledgements We thanks chief of Nature Protection Committee in Allaikhovski District of Republic Sakha, Stryukova T.G. for providing with the transport (motor boat) to point of research.

Author Contributions: The main surveys were hold by Vladimirtseva M.V. The part of observation was made by Bysykatova I.P. and Sleptsov S.M. These two last authors contributed equally to this work

Author Information: Reprints and permissions information is available at www.nature.com/reprints. Correspondence and requests for materials should be addressed to sib-ykt@mail.ru.