



The migration routes and important restsites of Whooper Swans satellite-tracked from northern Japan

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Introduction

Whooper Swans *Cygnus cygnus* are large birds of marshlands and lakes. They migrate long distances and stop over at several rest sites on their way. They need extensive marshes for existence, but their habitats have been decreasing and deteriorating worldwide in recent years. As a result, their population has decreased in East Asia (AWB & IWRB 1994).

There is a lack of information on the migration routes of Whooper Swans. Banding work has been conducted in Japan, but only fragmentary data have been collected on migration routes (Yamashina Institute for Ornithology 1991, 1992). There is little information on which to base effective conservation measures for swans.

Satellite tracking is an effective way to track moving objects over long distances, and has recently been used to show the migration routes and ecology of birds (Jouventin & Weimerskirch 1990, Nowak *et al.* 1990, Higuchi *et al.* 1991, 1992, 1994a, b). Satellite tracking data has been used for conservation of cranes (Higuchi *et al.* 1996).

We initially satellite-tracked Whooper Swans in 1991, but we could not successfully track them from their wintering site to their breeding grounds because all transmitters were broken by the swans (Higuchi *et al.* 1992). We satellite-tracked Whooper Swans again in 1994-1995 and some of the swans with transmitter were successfully tracked to their breeding grounds in

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Russia. This paper reports the migration routes and important stopover sites along the routes, and compares the migration routes between Whooper and Whistling *C. columbianus* Swans.

Study area and methods

Whooper Swans were captured on the Kominato sea coast (40.94° N, 140.98° E), northern Honshu, Japan in 1994 and 1995. Kominato is a well-known wintering site of Whooper Swans, and is designated as a national natural monument because of them. Recently, about 400-500 Whooper Swans winter at Kominato each year.

One transmitter was attached to each of 6 swans on February 21, 1994, and each of 9 swans on February 23, 1995. The transmitter was developed by the Nippon Telegraph and Telephone Corporation (NTT) and Toyo Communication Equipment Co., Ltd. (TOYOCOM). The transmitter used in 1994 (T-2050) was 60 x 40 x 30 mm in size with an antenna of 18 cm, and weighed 80 g. The transmitter used in 1995 (T-2050) was 70 x 34 x 23 mm in size with an antenna of 18 cm, and weighed 65 g. The transmitter was attached to the backs of swans with Teflon treated ribbon. The ribbon was put through the holes in the transmitter's flanges, and crossed at the swan's breast. Both ends of the ribbon were fixed with rivets.

All transmitters in 1994, and 7 of 9 transmitters in 1995, cycled at 6 hours active and 12 hours inactive, and the pulse interval was 60 seconds. The battery life was expected to be 6 months. The two remaining transmitters in 1995 cycled at 6 hours active and 42 hours inactive, and the pulse interval was 60 seconds. The battery life was expected to be one year.

Location data were received through computer communications and on disks sent from the CLS/Service Argos in France. Location classes ranged from 0 to 3. The higher the location class, the more accurate the location.

Keating *et al.* (1991) calculated the accuracy of LC 1, 2 and 3 data from PTTs designed for ungulates and wolves. Their one-standard-deviation accuracy results, compared to the accuracies reported by the CNES/Argos (1992) were, respectively, 1,188 m versus 1,000 m for LC 1, 903 m versus 350 m for LC 2, and 361 m versus 150 m for LC 3. In our analyses we assume an accuracy of 1 km for all data of LC 1 and above.

Location class 0 data were included to show the general migration route when the locations were considered appropriate from the nearest locations and elapsed time. They were, however, excluded from the analysis when more accurate locations were required.

Place names are based on ONC maps of the Defense Mapping Agency Aerospace Center.

Results and Discussion

Migration Routes

1. 1994 tracking

A total of 1,823 locations were obtained from February 21 to August 21. Of the 6 Whooper Swans, 3 were successfully tracked to their breeding grounds in Russia (Fig. 1). They migrated

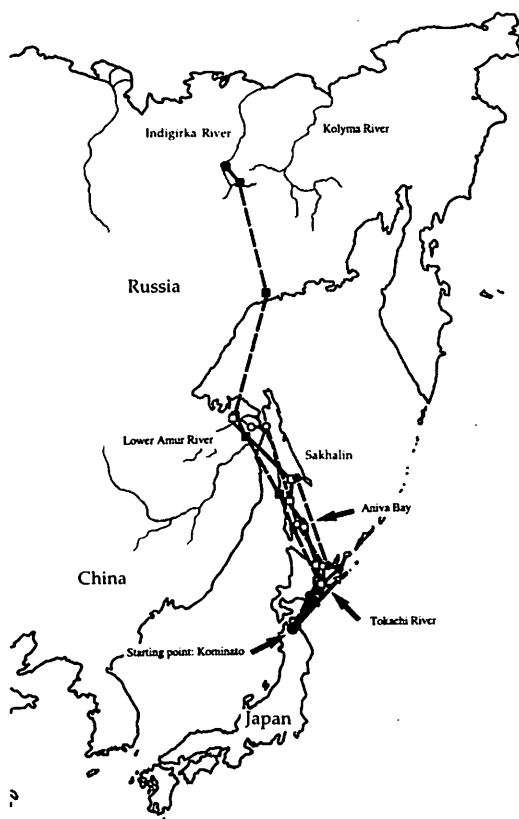


Fig. 1. Migration route of Whooper Swans satellite tracked from Kominato, northern Japan in 1994.

from Kominato to their breeding sites via southeastern Hokkaido, northeastern Hokkaido, Sakhalin and the lower Amur River. Two individuals spent the summer on the lower Amur River, and an individual spent the summer on middle reaches of the Indigirka River. Their migration routes are described as follows.

ID 1288 was tracked from February 21 to June 12, and we received 368 locations. It was located for the last time in Kominato on March 15. Next, the swan was located at Oikamanae-numa Lake (42.57° - 42.58° N, 143.46° - 143.50° E) on the morning of March 17. The night of March 17, it arrived on the Tokachi River (42.74° - 42.90° N, 143.41° - 143.61° E) where it rested for 25 days, before being located at Abashiri Lake (43.88° - 43.93° N, 144.13° - 144.18° E) on the morning of April 11. It was located north of Svobodnoye (46.91° N, 143.37° E), southern

Table 1. Tracking period, tracking distance, and days needed for migration of six Whooper Swans that were successfully tracked to their breeding grounds.

| ID No. | Tracking period | Life of battery (day) | No. of locations obtained | Tracking distance (km) | Days needed for migration |
|--------|-----------------------|-----------------------|---------------------------|------------------------|---------------------------|
| 1288 | Feb.21 - Jun.13, 1994 | 113 | 368 | 1597.9 | 53 |
| 21416 | Feb.23 - Jul.25, 1994 | 153 | 765 | 3654.1 | 75 |
| 21417 | Feb.24 - Jun.23, 1994 | 120 | 238 | 1607.6 | 40 |
| 22907 | Feb.23 - May 24, 1995 | 91 | 122 | 2747.6 | 44 |
| 22908 | Feb.23 - Jun.21, 1995 | 119 | 297 | 3458.4 | 70 |
| 23393 | Feb.25 - Jun.21, 1995 | 117 | 135 | 3410.5 | 26 |
| 23394 | Feb.25 - Jun.17, 1995 | 113 | 60 | 3018.0 | 57 |
| 23395 | Feb.23 - Aug.09, 1995 | 168 | 515 | 3984.9 | 62 |

Sakhalin on April 13, and at central Aniva Bay (46.70°-46.78° N, 142.65°-142.77° E) on the morning of 14th, where it rested for 16 days. The night of May 1, it stayed at Buruny (48.08°-48.11° N, 142.55°-142.58° E), and N. Pogibi City (52.41°-52.44° N, 141.73°-141.78° E), central Sakhalin, on the night of the 5th. The swan left there and traveled to the lower Amur River (52.47°-52.53° N, 140.66°-140.80° E) on the night of May 9, where it was located until its PTT quit on June 13.

ID 21416 was tracked from February 23 to August 21, and we received 765 locations. It was located for the last time in Kominato on March 30. Next, the swan was located at the Oikamanaenuma Lake (42.61° N, 143.52° E) on the night of March 31. The afternoon of April 1, it stayed on the Tokachi River (42.79°-42.82° N, 143.51° - 143.60° E), and rested there for 10 days. The swan was located at Saroma Lake (44.10° N, 143.93° E) on the morning of April 12. It was located in central Aniva Bay (46.71°-46.74° N, 142.71°-142.75° E), southern Sakhalin, on the night of 12th, and moved to eastern Aniva Bay (46.51°-46.54° N, 143.29°-143.34° E) on the night of the 18th. The swan rested there for 13 days, and then flew to Aynskoye Lake (48.49°-48.56° N, 142.00°-142.05° E) on the afternoon of May 1, where it rested for 6 days. The swan was located at the Tatarskiy Strait (51.53°-51.54° N, 141.41°-141.42° E) on the afternoon of May 7, and at Uarke (52.48° N, 141.10° E) on the morning of the 9th. That day it flew to the lower Amur River (52.19° N, 140.24° E), where it rested for 20 days within the marsh (52.25°-52.29° N, 140.31°-140.40° E; and 53.13°-53.17° N, 140.41°-140.50° E; 53.06°-53.20° N, 139.50°-139.67° E). It was located at N. Okhotsk City (59.97°-60.02° N, 144.00°-144.16° E) on the night of May 30, and stayed there for 8 days before being located at the upper reaches of Indigirka River (62.84°-62.88° N, 144.33°-144.45° E) on June 6. Next, the swan was located at several places along the upper Indigirka River at (64.79°- 64.81° N, 144.84°-144.91° E) on June 9, (65.71°-65.76° N, 146.12°-146.26° E) on June 12, and a near Tyugyuren City (67.23°-67.33° N, 142.55°-142.56° E), middle reaches of Indigirka River, on June 14. The swan traveled to wetlands along that river (67.85°-67.92° N, 143.25°-143.52° E) on June 18, and the swan was located there until its PTT quit on July 25.

ID 21417 was tracked from February 24 to August 7, and we received 238 locations. It was located for the last time in Kominato on March 29. Next, the swan was located at the Oikamanaenuma Lake (42.56°-42.57° N, 143.49° E) on the morning of March 31. The afternoon of April 1 it arrived at the Tokachi River (42.81°-42.92° N, 143.40°-143.53° E), and rested there for 25 days before being located at Saroma Lake (44.19° N, 143.58° E) on the morning of April 26. It was located in eastern Aniva Bay (46.53°-46.54° N, 143.28°-143.32° E), southern Sakhalin, on the morning of April 28. On May 1 the swan was located in Buruny (48.06°-48.11° N, 142.54°-142.58° E), and west of Poronaysk (49.13° N, 143.04° E), central Sakhalin, on the morning of the 9th. The swan moved to the lower Amur River (52.91°-53.03° N, 139.46°-139.62° E) on May 10 where it was located until its PTT quit on June 23.

2. 1995 tracking

A total of 1,433 locations were obtained from February 23 to August 9. Of the 9 Whooper Swans, 5 were successfully tracked to their breeding grounds in Russia (Fig. 2). They migrated from Kominato to their breeding sites via southeastern Hokkaido, northeastern Hokkaido and Sakhalin. Two individuals summered on the north coast of the Okhotsk Sea, two individuals spent the summer on middle reaches of the Indigirka River, and an individual spent the summer on lower Kolyma River. Their migration routes are described as follows.

ID 22907 was tracked from February 23 to May 24, and we received 122 locations. It was located for the last time in Kominato on March 26. Next, the swan was located at Shizunai (42.40° - 42.41° N, 142.37° - 142.44° E) on the night of March 27, and rested there for 18-24 days. The night of April 20, it stayed on the Tokachi River (42.81° - 42.82° N, 143.52° - 143.54° E), and rested there for 11-17 days before being located at the Nevskoye Lake (49.62° N, 143.48° E), central Sakhalin, on the night of May 2. It was located in N. Pogibi (52.58° - 52.63° N, 141.83° - 141.84° E), northern Sakhalin, on the morning of May 6, and rested there for 11 days. The swan traveled to N.W. Motykleyka (59.81° - 59.83° N, 147.74° - 147.83° E) on May 18, and was located there until its PTT quit on May 24.

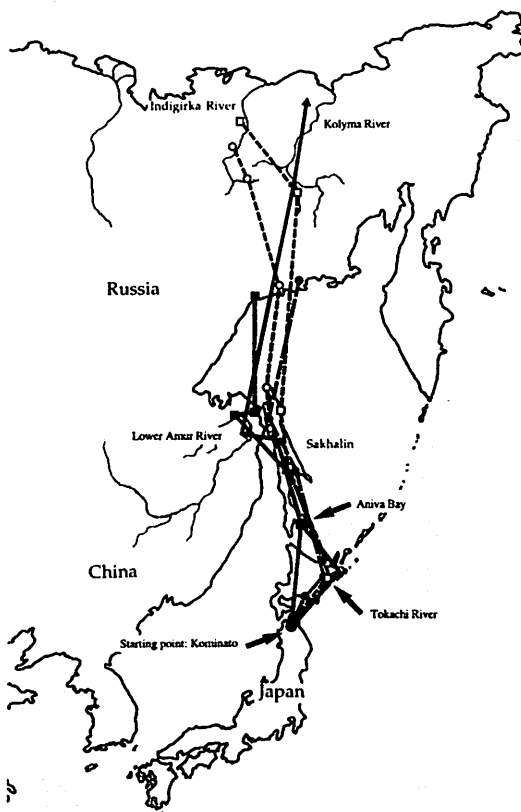


Fig. 2. Migration route of Whooper Swans satellite tracked from Kominato, northern Japan in 1995.

ID 22908 was tracked from February 23 to May 27, and we received 297 locations. It was located for the last time in Kominato on March 8. Next, the swan was located at the Lake Obuchi-numa (40.96° - 40.97° N, 141.37° - 141.39° E) on the night of March 9, and rested there for 5 days. It was located at Furen Lake (43.32° N, 145.35° E) on the night of March 14. It was located at Notsuke Peninsula (43.59° - 43.65° N, 145.05° - 145.32° E) on the night of the 18th, and stayed there for 23-26 days. On April 11, the swan was located at Abashiri Lake (43.91° - 43.93° N, 144.14° - 144.19° E), and rested there for 15-16 days. It was located near Polonysk City on the afternoon of April 28, S. Pogibi City (51.82° N, 141.82° E) on the 29th, and the northern end of Sakhalin (54.52° - 54.53° N, 142.59° - 142.62° E) on the 30th. Next, the swan was located in W. Motykleyka (59.57° -

59.60° N, 146.49°-146.53° E) on May 3, and rested there for 8 days. On the morning of May 13, it reached the upper Indigirka River (65.20°-65.37° N, 146.70°-146.85° E), and stayed there for 6 days. The swan traveled to wetlands along that river (67.91°-61.94° N, 145.58°-145.72° E) on May 21, and was located there until its PTT quit on May 27.

ID 23393 was tracked from February 25 to June 21, and we received 135 locations. It was located for the last time in Kominato on April 8. Next, the swan was located on the Tokachi River (42.74°-42.84° N, 143.49°-143.65° E) on the night of April 10, and rested there for 18-22 days. The swan was located in N. Polonysk City (49.57° N, 143.11° E) on the night of May 2, and located in Pil'tun Lake (52.83° N, 143.32° E) on the night of the 6th. On May 8, the swan was located on the upper Kolyma River (64.71°-64.72° N, 151.61°-151.70° E), and rested there for 2-4 days. It was located in wetlands along the Indigirka River (69.39°-69.79° N, 147.32°-147.96° E) on the afternoon of May 12, and was located there until its PTT quit on June 21.

ID 23394 was tracked from February 25 to June 17, and we received 60 locations. It was located for the last time in Kominato on March 29. Next, the swan was located in eastern Aniva Bay (46.53°-46.57° N, 142.24°-142.32° E) on the night of April 8, and rested there for 22-34 days. The swan was located in N.W. Polonysk City (49.55° N, 142.96° E) on the night of May 6, and in the lower Amur River (52.85°-52.95° N, 139.53°-139.72° E) on the afternoon of the 8th. The swan rested there for 32-34 days, and flew to the Amur River mouth on the afternoon of June 11 (53.08° N, 141.27° E). On June 17, the swan was located near Okhotsk City (59.24°-59.26° N, 142.60°-142.67° E), and the transmitter quit that night.

ID 23395 was tracked from February 23 to August 8, and we received 515 locations. It was located for the last time in Kominato on April 7. On the afternoon of April 9, the swan was located at Akkeshi Lake (42.99°-43.08° N, 144.86°-144.95° E), and flew to Furen Lake (43.32° N, 145.24° E) on the morning of April 11, and to Tokotan River (43.43° N, 145.24° E) that night. It was located in central Aniva Bay (46.60°-46.77° N, 142.69°-142.74° E) on the night of April 14, and moved to eastern Aniva Bay (46.66°-46.77° N, 143.31°-143.38° E) on the night of the 25th. The swan rested in Aniva Bay for 21 days, and flew to Starodubskoye (47.43° N, 142.73° E) on the afternoon of May 4. On the night of May 5, the swan was located at Molodezhnoye (51.04° N, 142.60°-142.62° E), and moved to Udyl Lake, lower Amur River (51.62°-51.92° N, 139.53°-139.80° E) on the morning of the 7th. The swan rested there for 22 days, and flew to the Amur River mouth (53.33° N, 141.21° E) on the morning of the 29th. It flew to N.E. Inya City (61.44° N, 146.90° E) on the night of May 30, and to the upper reaches of the Kolyma River (65.66°-65.75° N, 150.52°-150.73° E) on the night of the 31st. The swan stayed there for 7 days before being located on the middle reaches of Kolyma River (67.45° N, 152.02° E) on the morning of June 9. On the morning of June 10, the swan was located in wetlands along the Kolyma River (69.34°-69.44° N, 152.38°-152.76° E), where it was located until its PTT quit on August 9.

3. Summary migration route of Whooper Swans

The migration routes of Whooper Swans were similar between results in 1994 and 1995. They migrated from Kominato to southeastern Hokkaido, and rested there for a long time. They moved to Aniva Bay, Sakhalin, via northeastern Hokkaido, and also rested their for a long time. They went north along Sakhalin, and rested on the lower Amur River for a long time. Some individuals spent the summer there. They crossed the Okhotsk Sea, and moved to breeding areas.

Table 2. A list of the main areas visited by swans with transmitters in 1994 and 1995. Sites probably located on the fly are not shown. Location class 0 data are not included.

| ID No. | Locality | Approximate days of stay | Latitude | Longitude | Kind of use |
|--------------------------------------|----------------------------------|--------------------------|-------------------|-------------------|-------------|
| 1287 | Ominato | 1 | 41.25°-41.26° N | 141.11°-141.15° E | Resting |
| | Oibe River | 1 | 41.14° N | 141.36° E | Resting |
| | Obuchi-numa Lake | 4 | 40.94°-40.98° N | 141.30°-141.40° E | Resting |
| | Shizunai River | 2 | 42.48° N | 142.79°-142.80° E | Resting |
| | Samani | 1 | 42.15°-42.17° N | 142.89°-142.90° E | Resting |
| | Odaito | 1 | 43.68° N | 145.35° E | Resting |
| | Tofutsu Lake | 1 | 43.96° N | 144.43° E | Resting |
| | near Polonaysk City | 1+ | 49.30° N | 143.47° E | Resting |
| 1288 | Oikamanae-numa Lake | 1-2 | 42.57°-42.58° N | 143.46°-143.50° E | Resting |
| | Tokachi River | 25 | 42.74°-42.90° N | 143.41°-143.61° E | Resting |
| | Abashiri Lake | 2 | 43.88°-43.93° N | 144.13°-144.18° E | Resting |
| | Aniva Bay | 16 | 46.70°-46.78° N | 142.65°-142.77° E | Resting |
| | Svobodnoye | 1 | 46.91° N | 143.37° E | Resting |
| | Buruny | 4 | 48.08°-48.11° N | 142.55°-142.58° E | Resting |
| | N Pogibi City | 4 | 52.41°-52.44° N | 141.73°-141.78° E | Resting |
| | Amur River | 36+ | 52.47°-52.53° N | 140.66°-140.80° E | Summer |
| 21416 | Oikamanae-numa Lake | 1 | 42.61° N | 143.52° E | Resting |
| | Tokachi River | 10 | 42.79°-42.82° N | 143.51°-143.60° E | Resting |
| | Saroma Lake | 1 | 44.10° N | 143.93° E | Resting |
| | Aniva Bay | 13 | 46.51°-46.54° N | 143.29°-143.34° E | Resting |
| | Aniva Bay | 6 | 46.71°-46.74° N | 142.71°-142.75° E | Resting |
| | Aynskoye Lake | 6 | 48.49°-48.56° N | 142.00°-142.05° E | Resting |
| | Tatarskiy strait | 1 | 51.53°-51.54° N | 141.41°-141.42° E | Resting |
| | Uarke | 1 | 52.48° N | 141.10° E | Resting |
| | Amur River | 2 | 52.19° N | 140.24° E | Resting |
| | Amur River | 2 | 52.25°-52.29° N | 140.31°-140.40° E | Resting |
| | Amur River | 11 | 53.06°-53.20° N | 139.50°-139.67° E | Resting |
| | Amur River | 5 | 53.13°-53.17° N | 140.41°-140.50° E | Resting |
| | N Okhotsk City | 8 | 59.97°-60.02° N | 144.00°-144.16° E | Resting |
| | upper reachse of Indigirka River | 3 | 62.84°-62.88° N | 144.33°-144.45° E | Resting |
| | N Artyk City | 3 | 64.79°-64.81° N | 144.84°-144.91° E | Resting |
| | NW Sasyr City | 2 | 65.71°-65.76° N | 146.12°-146.26° E | Resting |
| near Tyugyuren City | 4 | 67.23°-67.33° N | 142.55°-142.56° E | Resting | |
| wetlands parallel to Indigirka River | 7+ | 67.85°-67.92° N | 143.25°-143.52° E | Breeding | |
| 21417 | Oikamanae-numa Lake | 1 | 42.56°-42.57° N | 143.49° E | Resting |
| | Tokachi River | 25 | 42.81°-42.92° N | 143.40°-143.53° E | Resting |
| | Saroma Lake | 2 | 44.19° N | 143.58° E | Resting |
| | Aniva Bay | 3 | 46.53°-46.54° N | 143.28°-143.32° E | Resting |

| | | | | | |
|-------|--------------------------------------|-------|-----------------|-------------------|---------------------|
| | Buruny | 8 | 48.06°-48.11° N | 142.54°-142.58° E | Resting |
| | near Polonysk City | 1 | 49.13° | 143.04° | Resting |
| | Amur River | 39+ | 52.91°-53.03° N | 139.46°-139.62° E | Summer |
| 21418 | Obuchi-numa Lake | 2 | 40.96°-40.97° N | 141.36°-141.39° E | Resting |
| | Furen Lake | ? | 43.21°-43.34° N | 145.30°-145.55° E | Resting |
| 22906 | Mukawa | 1 | 42.55° N | 141.96° E | Resting |
| | Kushiro Mire | 2 | 43.14°-43.16° N | 144.50°-144.53° E | Resting |
| | Pereval' naya | 25+ | 47.92°-48.02° N | 142.48°-142.57° E | Resting |
| 22907 | Shizunai | 18-24 | 42.40°-42.41° N | 142.37°-142.44° E | Resting |
| | Tokachi River | 11-17 | 42.81°-42.82° N | 143.52°-143.54° E | Resting |
| | Nevskoye Lake | 4 | 49.62° N | 143.48° E | Resting |
| | N Pogibi | 11 | 52.58°-52.63° N | 141.83°-141.84° E | Resting |
| | NW Motykleyka | 6+ | 59.81°-59.83° N | 147.74°-147.83° E | Breeding |
| 22908 | Obuchi-numa Lake | 5 | 40.96°-40.97° N | 141.37°-141.39° E | Resting |
| | Furen Lake | 4 | 43.32° N | 145.35° E | Resting |
| | Notsuke peninsula | 23-26 | 43.59°-43.65° N | 145.05°-145.32° E | Resting |
| | Abashiri Lake | 15-19 | 43.91°-43.93° N | 144.14°-144.19° E | Resting |
| | near Polonaysk Lake | 1 | | | Resting |
| | S Pogibi City | 1-2 | 51.82° N | 141.82° E | Resting |
| | northern end of Sakhalin | 3 | 54.52°-54.53° N | 142.59°-142.62° E | Resting |
| | W Motykleyka | 10 | 59.57°-59.60° N | 146.49°-146.53° E | Resting |
| | upper part of Indigirka River | 6 | 65.20°-65.37° N | 146.70°-146.85° E | Resting |
| | wetlands parallel to Indigirka River | 6+ | 67.91°-61.94° N | 145.58°-145.72° E | Breeding |
| 23393 | Tokachi River | 18-22 | 42.74°-42.84° N | 143.49°-143.65° E | Resting |
| | N Polonysk City | 1-8 | 49.57° N | 143.11° E | Resting |
| | Pil' tun Lake | 2 | 52.83° N | 143.32° E | Resting |
| | upper part of Kolyma River | 2-4 | 64.71°-64.72° N | 151.61°-151.70° E | Resting |
| | wetlands parallel to Indigirka River | 45+ | 69.39°-69.79° N | 147.32°-147.96° E | Breeding |
| 23394 | Aniva Bay | 22-34 | 46.53°-46.57° N | 142.24°-142.32° E | Resting |
| | NW Polonysk City | 2-6 | 49.55° N | 142.96° E | Resting |
| | Amur River | 32-34 | 52.85°-52.95° N | 139.53°-139.72° E | Resting |
| | mouth of Amur River | 1-6 | 53.08° N | 141.27° E | Resting |
| | near Okhotsk City | 1+ | 59.24°-59.26° N | 142.60°-142.67° E | Resting or Breeding |
| 23395 | Akkeshi Lake | 2 | 42.99°-43.08° N | 144.86°-144.95° E | Resting |
| | Furen Lake | 1 | 43.32° N | 145.24° E | Resting |
| | Tokotan River | 3 | 43.43° N | 145.24° E | Resting |
| | Aniva Bay | 11 | 46.60°-46.77° N | 142.69°-142.74° E | Resting |
| | Aniva Bay | 10 | 46.66°-46.77° N | 143.31°-143.38° E | Resting |
| | Starodubskoye | 1 | 47.43° N | 142.73° E | Resting |
| | Molodezhnoye | 2 | 51.04° N | 142.60°-142.62° E | Resting |
| | "Udyl Lake, lower Amur River" | 22 | 51.62°-51.92° N | 139.53°-139.80° E | Resting |
| | mouth of Amur River | 1 | 53.33° N | 141.21° E | Resting |
| | NE Inya City | 1 | 61.44° N | 146.90° E | Resting |
| | upper reaches of Kolyma River | 7 | 65.66°-65.75° N | 150.52°-150.73° E | Resting |
| | middle reachse of Kolyma River | 1 | 67.45° N | 152.02° E | Resting |
| | wetland parallel to Kolyma River | 60+ | 69.34°-69.44° N | 152.38°-152.76° E | Breeding |
| 23396 | Obuchi-numa | 6 | 40.93°-40.96° N | 141.36°-141.38° E | Resting |
| | Fukikoshi | 2 | 41.04°-41.06° N | 141.23°-141.30° E | Resting |
| | Samani | 11 | 42.13°-42.14° N | 142.93° E | Resting |
| | Tokachi River | 14+ | 42.73°-42.81° N | 143.52°-143.63° E | Resting |

Important Areas for Swans

Table 2 shows a list of areas visited by the swans equipped with transmitters. All these areas are important for the swans, and we can evaluate the importance of each area based on the length of stay and the number of swans which visited them. Tokachi River, Aniva Bay and lower Amur River were the most important stopover areas for swans which wintered at Kominato. The swans' stopover periods at each site are shown in Fig 3. Migration and conservation information for these areas are given below.

1. Tokachi River

Five of 8 successfully tracked swans rested there, and total 6 swans rested there. They spent from 10 to 24 days each. Swans rested mainly around Ikusota Pond, where about 200 swans have been recorded roosting together and foraging in the Tokachi River during migration (Tokachi Chapter, Wild Bird Society of Japan 1986). This area is also an important stopover site for migratory Bean Geese *Anser fabalis*, each spring and autumn 200-550 individuals rest there (Tokachi Chapter, Wild Bird Society of Japan 1986).

2. Aniva Bay

Five of 8 successfully tracked swans rested there, from 2 to 34 days each. Swans rested

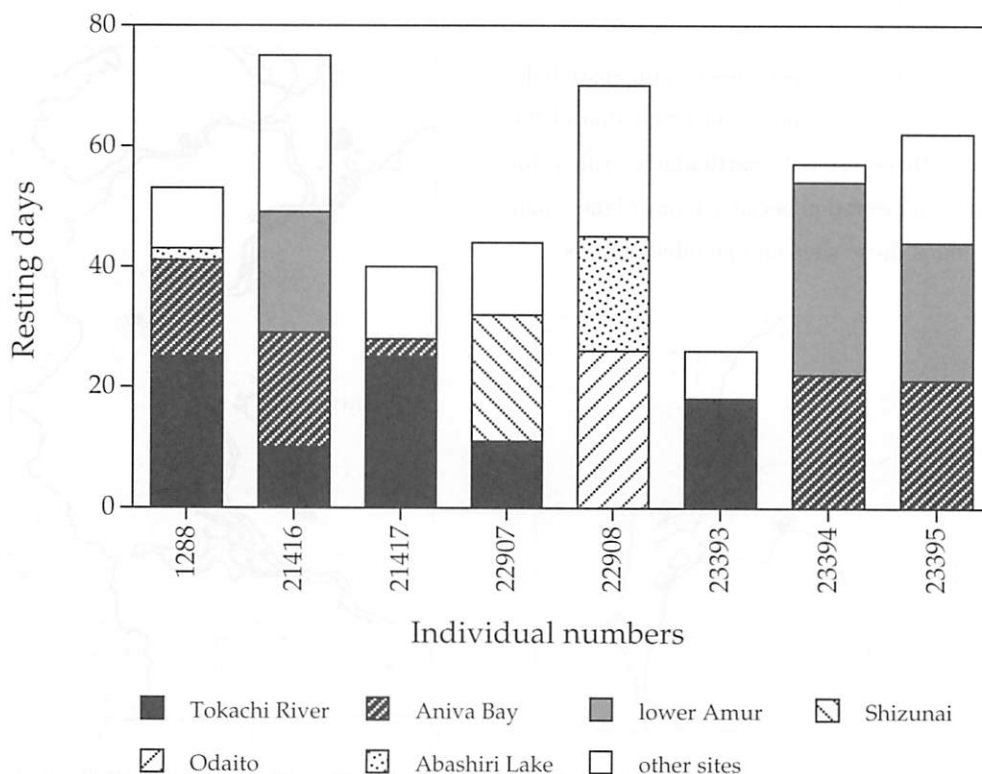


Fig. 3. The resting days at each resting site of the eight successfully tracked Whooper Swans. IDs 1288 and 21417 spent the summer on the lower Amur.

mainly on the north and east sides of the bay (Fig. 4). Both Whooper Swans and Whistling Swans rest in this area, with 1,000-6,000 swans being recorded there in the spring (Ostapenko 1990, Nechaev 1991).

3. Lower Amur River

Five of 8 successfully tracked swans rested or spent the summer there for 20 to 40 days each, and two tracked swans spent the summer. The lower Amur River and its tributaries create a wetland complex which reaches from 51.25° N, 139.0° E to 53.75° N, 141.0° E. It is an area of lakes and marshes with little official protection. However, a portion of the area south of Bogorodskoye City is protected as a hunting preserve for indigenous people, and was visited by two tracked swans. The northern end of the wetland was used by three swans, where they visited marshes along the Amur and one of its tributaries, and in lakes to the west of the river (Fig 5).

There are two primary conservation concerns for the wetland. Pollution from industrial cities upstream is likely to be a problem for waterfowl, and may account for the apparent rarity of Osprey *Pandion haliaeetus* along the lower Amur River. The second concern is an observed reduction of water flow due to dams on large tributaries of the middle and upper Amur River. The southern (upstream area) of the marsh is beginning to desiccate, with several small lakes having already disappeared (V. Koulikov & B. Voronov per. com.).

All of the stopover sites identified are links in the migration chain, but protection of the above three areas is particularly critical for swan conservation because many of the swans rested at these sites for extended periods.

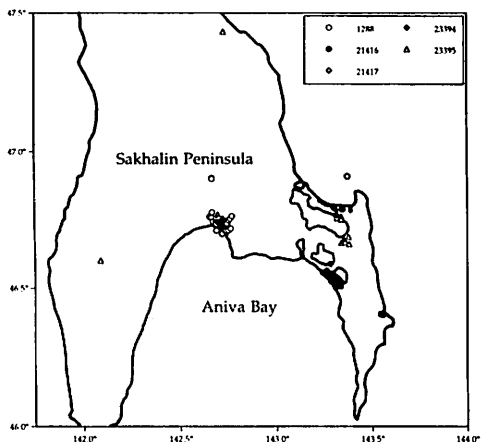


Fig. 4. The locations of Whooper Swans in Aniva Bay. Symbols show ID number of transmitter.

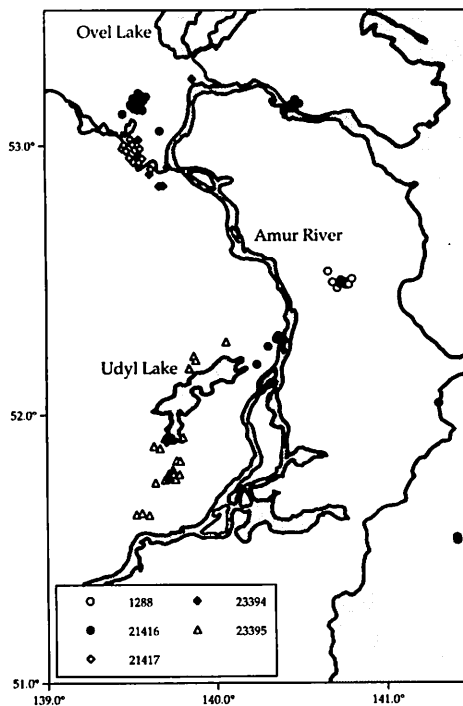


Fig. 5. The locations of Whooper Swans on the lower Amur River. Each number shows ID number of transmitter.

Comparison of the migration route between Whooper and Whistling Swans

Whooper Swans migrate from Kominato to southeastern Hokkaido, and rested there for a long time. They move to Sakhalin via northeastern Hokkaido, and go north along Sakhalin. They cross the Okhotsk Sea and move to breeding areas. The migration routes of Whistling Swans from Sakhalin to breeding areas (Higuchi *et al.* 1992) are similar to that of Whooper Swans. However, the migration routes from Honshu to Sakhalin are different. Whistling Swans migrate from Honshu to Sakhalin via the Japan Sea coast of Hokkaido (Yamashina Institute for Ornithology 1996). On the other hand, Whooper Swans migrate from Honshu to Sakhalin via the Pacific Ocean coast of Hokkaido.

However, the migration routes of Whooper and Whistling Swans from Sakhalin to their breeding areas are similar, and there is a small difference in migration pattern. Five of 8 tracked Whooper Swans rested at Aniva Bay from 2 to 34 days each. But only 1 of 4 tracked Whistling Swans rested there for 5 days. Aniva Bay is an important rest-site for Whooper Swans rather than Whistling Swans. The lower Amur River is an important rest-site for both swan species. Five of 8 tracked Whooper Swans rested or spent the summer there for 20 to 40 days, and 2 of 4 Whistling Swans for more than 10 days each.

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オオハクチョウの渡り経路と重要な中継地

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青森県小湊において、1994年2月に、6羽のオオハクチョウに人工衛星用の送信機を装着してオオハクチョウの渡り経路を明らかにする調査を行なった。1995年2月には、さらに9羽のオオハクチョウに人工衛星用の送信機を装着して調査を行なった。

1994年は3羽、1995年は5羽のオオハクチョウについて渡りの経路を完全に明らかにすることに成功した。1994年、1995年両年とも、オオハクチョウは青森県を飛び立ったあと、十勝川中流域、風蓮湖などの北海道南東部で休息し、網走湖、サロマ湖などの北海道北東部の湖沼を經由してサハリンのアニワ湾に入り、サハリンを北上することが明らかになった。そして、アムール川下流域、オホーツク海北部沿岸、インディギルカ川中流域、コリマ川下流域で夏を過ごした。

渡りの中継地に滞在する日数と利用する個体数からオオハクチョウにとって重要な中継地が、十勝川中流域、サハリンのアニワ湾、アムール川下流域であることが示された。繁殖地まで追跡をできたオオハクチョウ8羽のうち5羽が十勝川中流、アニワ湾を利用し、4羽がアムール川下流を利用した。

Higuchi *et al* (1991) のコハクチョウの追跡結果と今回明らかにできたオオハクチョウの渡り経路を比較すると、サハリンから北の経路はかわりないが、コハクチョウが北海道の日本海側を通過してサハリンに入るのに対して、オオハクチョウは北海道の太平洋側を通過して十勝川中流などの北海道南東部で休息し、網走湖などの北海道北東部を經由してサハリンに入る点で渡り経路に違いが見られた。また、コハクチョウがあまりアニワ湾を利用しないのに対して、オオハクチョウはアニワ湾に長期間滞在する点にも差が見られた。

キーワード：衛星追跡、オオハクチョウ、重要な中継地、渡り経路