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# **Bionomics and Sociology of Tancho or the Japanese Crane, *Grus japonensis*, I. Distribution, Habitat and Outline of Annual Cycle**

By

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(With 5 Text-figures and 3 Tables)

The cranes, Family Gruidae, are one of the most conspicuous groups among various wading birds by their large size and magnificent appearance. Unfortunately their populations are being threatened by gradual or rapid decreases throughout the world, due to their low reproductive potential and requirement for a large habitat space, both being incompatible with ever increasing human impact. The present studies on their biology, either to improve their rational protection or to understand their mode of life accurately.

All crane species so far studied show some common ethosocial traits: 1) Formation of permanent monogamic associations irrespective of breeding and non breeding seasons. 2) Occupation of a large territory by the pair in breeding season. 3) Participation of both sexes in brood rearing with little functional division of labour. 4) Possession of some peculiar behaviour patterns such as unison call and dancing at courtship. However, there still remain many aspects to be solved on their social structure.

The present study was undertaken to clarify the social life of the Japanese Crane, *Grus japonensis* (P.L.S. Müller), the bird symbolic for all Japanese peoples by the name Tancho (Red-crested), about 200 individuals of which are still resident in and near marshlands in eastern Hokkaido. We have elucidated its ecology, ethology and sociology through field observations from 1965 to 1972. In the present paper, which forms the first report of serial studies, geographical distribution, habitat conditions, and outline of annual cycle are described, leaving other etho-sociological aspects in subsequent papers.

## **1. Distribution**

Here the distribution of Tancho in and outside of Japan is briefly outlined, mainly through the bibliographical survey.

### 1.1. Past distribution in Japan

It is not clear when the Tancho settled in the Japan Archipelago, but some fragments of humerus of 3,000~3,800 years ago are recorded from *Kaitori Shell Mound*, Iwate Pref., northern Honshu (Kusama and Kaneko 1971). Similar pieces of bones, though not accurately identified with the species are also found from other shell mounds even in central Honshu. The studies of old scripts and paintings also suggest that the Tancho was probably not uncommon in Japan, mainly in eastern and northern Honshu during winter, and commonly bred even in southwestern Hokkaido.

Concerning Honshu, *Mannyoshu*, a colossal anthology of short poems (waka) edited from the 7. to the 8. century, includes 46 poems on *tazu*, the ancient Japanese name for the cranes (= *tsuru* in modern Japanese), (Higashi 1943). Although various large aquatic birds, storks, swans, herons and egrets would be involved under *tazu*, some of these poems seem to indicate the cranes and someones probably specify the Tancho, which has subsequently played a role nearly symbolic for the culture of Japan. Some scholars, e.g. Terashima (1713) and Kaibara (1715), gave short notes on the species in their iconographical encyclopedias. Many artists bequeathed the paintings of the Tancho on walls, sliding doors, folding screens, etc., during the 15.~19. centuries. Some of them would be drawn based upon the captive birds, but Hokusai, an outstanding artist, left a sketch of the Tancho in the Soshu-Umezawa scene (central Japan), of his serial landscape woodcuts (1823~1830). These facts suggest the occasional wintering of some individuals in central Japan till the late 19. century.

Concerning Hokkaido, before the invasion of Japanese immigrants started above 500 years ago, the island was inhabited by the aboriginal Ainu, who had maintained the life chiefly by hunting and food collecting. The Tancho must have lived in many marshlands scattering through the island (Fig. 1), for the species have been frequently cited in their mythes by the name *Sarurun-Kamui* (Marsh-God), as one of their gods, and appeared in some traditions, especially in Kushiro district.

Murashima (1688) recorded in his logbook a Tancho incubated and hand-reared by an Ainu woman in Ishikari (localities names cited below are given in Figs. 1 and 2). Some Ainus offering two Tanchos as a tribute to their subjugators in Fukuyama, the southern tip of Hokkaido, were drawn in a genre painting in the late 17. century. After the legend, they belonged to the western tribe, so that the cranes must have caught at the place not too remote from Fukuyama. Kaibara (1715) wrote that Tancho lived in Matsumae, southern Hokkaido.

Matsumae (1781) reported in his famous chronicle the occurrence of several kinds of cranes in Hokkaido, with special reference to the Tancho, noting a clansman of Matsumae Territory who hunted about 300 birds and observed courtships, nests, eggs, juveniles and breeding activities. At the same epoch, Hezutsu (1784) recorded that this species lived *in flock* at southern Hokkaido and salted birds were exported for sale. In the mid 19. century many cranes, may be the Tancho,

were observed in Kamikawa, central Hokkaido (Matsuura 1860), and two (a pair?) at Otanoshike (Mori 1857), both in summer. Therefore, it is inferred that the Tancho bred in southern and eastern Hokkaido until about 100 years ago. Furthermore, the occurrence of some locality names related with the crane along the southern coast suggests the presence or breeding of the Tancho in the coastal zone from Ishikari to Nemuro (cf. Inukai 1943).

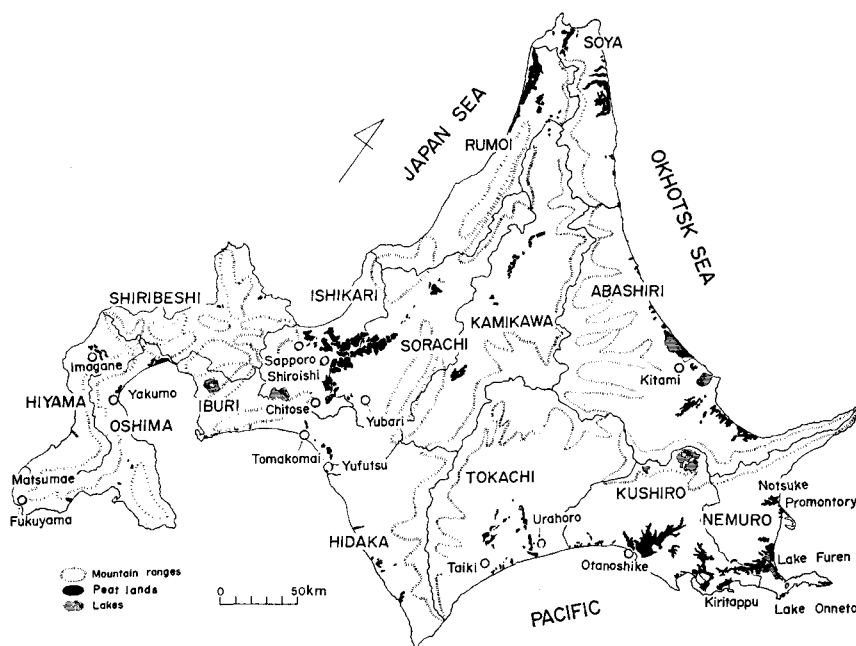


Fig. 1 Distribution of peat lands in Hokkaido, 1918~1928. (Prepared from Peat Land Map, Hokkaido Agricultural Experiment Station)

Nevertheless, a rapid decrease of population came by the Meiji Restoration, which invalidated the legal prohibition of the capture so far followed. Since the middle of the last century, the cranes became very uncommon in central and northern Honshu. On the other hand, in Hokkaido some seemed to survive still in the Ishikari Plain (chiefly in Chitose) and sometimes hunted in eastern Hokkaido (Akan). Blakiston and Pryer (1880, 1882) recorded specimens caught near Sapporo in January. As for the facts that several laws were declared to protect its breeding in Ishikari in early Meiji era (Inoue 1972), and a chick was brought by a cat was observed at Shiroishi near Sapporo in 1890 (Inukai 1943), it is certain that the species bred in west Hokkaido until 1890.

Up to the end of the 19. century one, may be Tancho, was seen near Osaka

(Higashi 1936), but the species were seldom observed in the Ishikari Plain as well as in Honshu, resulting in the assumption by some ornithologists on its extinction from Japan until the discovery of about 20 individuals in the Kushiro Marsh in 1924 (Saito 1926).

Some other records are cited as follows: *Hokkaido*. Kitami, September, 1926 and 1937; *Honshu*. Miyagi Pref., March, 1922; Ishikawa Pref., (Noto Peninsula) 1927; Niigata Pref., 1935; Fukushima Pref. (Oze), ca. 1930; Shiga Pref., May, 1943; Sado Island, 1947; Fukushima Pref., 1949 (cf. Austin and Kuroda 1953, OSJ 1958, Kiyosu 1965, Takatsukasa 1967).

On the other hand, the arrival of many individuals of *Grus monacha* Temminck and *G. vipio* Pallas in Kyushu, southern Japan, has been confirmed since more than 1,000 years ago, apparently coming from the continent via the Korean Peninsula. The occasional migration of the Tancho of the continental population mixed with those species is suggested by some records given by Blakiston and Pryer (1882), Blaauw (1897) and Iio (1940). The last record is an individual appeared in Izumi, southern Kyushu 1967~8 (Nishida 1969).

## 1.2. Past distribution outside of Japan

Although there is no accurated record, many birds must have wintered in the Korean Peninsula since fairly ancient ages. In 1880 wintering of a flock was confirmed in northern Korea and some ones were collected (Takatsukasa 1967). Even after the virtual disappearance of the Tancho from Japan since ca. 1910, it was often recorded and captured in Korea. Hundreds to thousands were found in winter in Pyongan Bukdo, Pyongan Namdo and Whanghae Do (northern Korea). In December, they stayed at the southernmost area of the Korea (Won 1974). Before the Korean War it was not uncommon in central and southern Korea (Austin 1948) but there is no definite record of breeding in Korea.

In China some specimens were collected at Haerhpín and Chichihaerh in 1925~6 (Mizuno 1934), Ryujuton in 1909~1911 (Enomoto 1914), and near Lü-shun (Kuroda 1915), the northeastern division of China (Manchuria). The species seemed to breed in the Sungali basin. Many ones were also found in fall and spring at Pei-tai-ho near Chin-huang-tao (Hemmingsen and Guildal 1968), in winter along the northern shore of the Yangtze (La Touche 1933), and as a straggler from Formosa in 1938 (Kiyosu 1965).

In the eastern part of U.S.S.R., marshes along the Amur and Ussuri have been recognized as their breeding areas, especially Lake Khanka and the Lefu River in the latter have well been known since the late 19. century (Shul'pin 1936, Vorobiev 1954). Some stragglers were recorded at Darasum, Lake Gagol in Tuva Autonomous Region, and Khaldzhakazhik pass (Dement'ev *et al.* 1969). Outside of the continent it was seen several times at the Lake Tokotan near Randomari, Saghalien, and a specimen was collected at the Moneron Island (U.S.S.R.) in 1935 (Takahashi 1937).

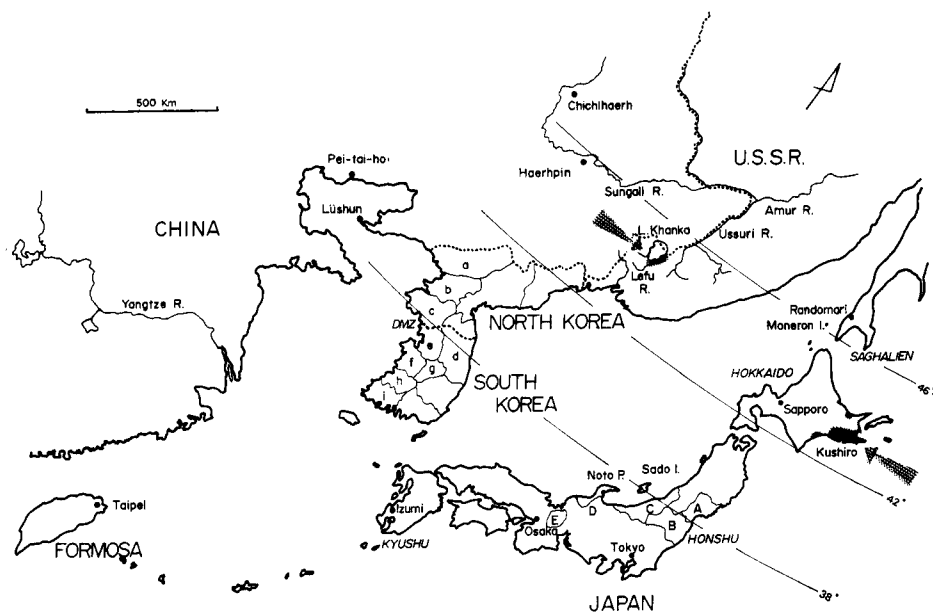


Fig. 2 Distribution of the Japanese Crane in and outside of Japan. A: Miyagi Prefecture, B: Fukushima P., C: Niigata P., D: Ishikawa P., E: Shiga P., a: Pyongan Bukdo, b: Pyongan Namdo, c: Whanghae Do, d: Kangwon Do, e: Kyonggi Do, f: Chungchong Namdo, g: Chungchong Bukdo, i: Cholla Namdo. Confirmed breeding areas shown by arrows. Localities cited by black circles.

### 1.3. Present distribution in Japan

Since the rediscovery of the Tancho in Kushiro, 1924, no particular survey was made until 1968. The population seemingly had not grown and the range had been restricted within Kushiro district. However, the number of the birds have increased since 1952 as the result of artificial feeding in winter.

Although some unofficial reports on its presence in Nemuro district were brought by the inhabitants since 1910~1920, the first record of a breeding pair was obtained in 1953 (Shu 1954). Later, some nests were recorded there (Saito 1960, Hatamiya 1970). Through aerial and surface surveys many other breeding pairs were found in 1972 not only in Kushiro but in Nemuro (Archibald, Masatomi and Kitagawa, unpublished).

The breeding areas (Fig. 3, Table 1), confirmed by these surveys, involve, *Tokachi*: Marshes and lakes near the Ootsu River mouth. *Kushiro*: the Kushiro Marsh and its adjacent lakes and lowlands, the Akkeshi Marshes involving the Bekanbeushi River areas, the Kiritappu Marsh and its neighbouring lakes. *Nemuro*: Marshes in the Nemuro Peninsula, Lake Furen, areas along the Nishibetsu and

Shibetsu Rivers. *Abashiri*: Lake Tofutsu, where a young pair settled in 1972 and is expected to breed in 1974.

Main wintering places are relatively restricted to several areas of Kushiro district: Akan Town and Tsurui Village with the environs. Winter flocks of about 40~80 birds, unstable in flock size, are formed around the feeding stations in the places. Out of these areas, only the following cases have been recorded: Several individuals in Yakumo, Oshima; western coast side, Hidaka ca. 1950; two sight records of flying cranes in and near Sapporo (about 1969~70, Abe and Tsunematsu person. comm.); a bird staying 20 days in Imagane, Hiyama, April, 1974; a few stragglers in Kyushu 1967~8, Fukui 1969, Shimane 1973, and Okayama 1973~4 (OSJ 1974).

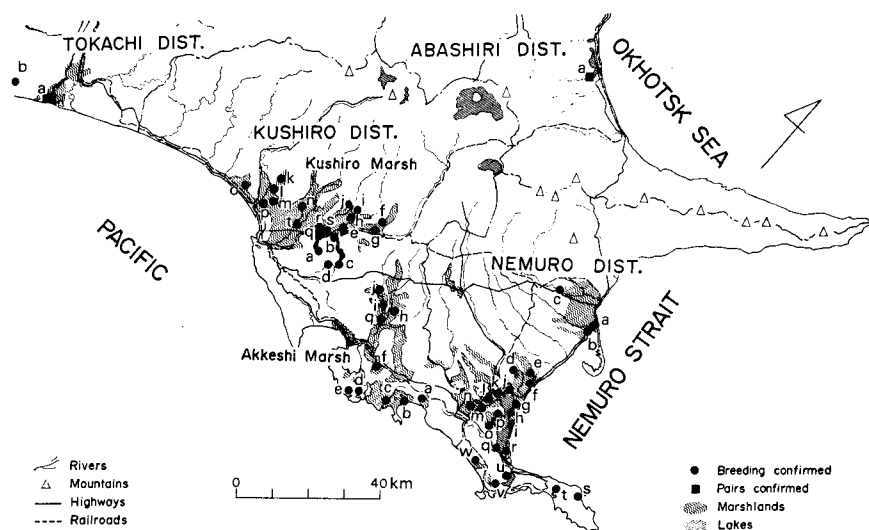


Fig. 3 Distribution of the pairs in breeding season in eastern Hokkaido: a~w, pairs and area codes (cf. Table 1).

#### 1.4. Present distribution outside of Japan

Current records on the distribution in the continent are scarce. According to Leonovich (1965), Shibaev (1970) and Litvinenko (letter), the present extent of breeding areas and population size in the Maritime Territory seem to be much reduced than those mentioned by Dement'ev *et al.* (1969) and Vorobiev (1954). The breeding area definitely recorded is now only the eastern side of Lake Khanka. A small breeding activity is expected along the Sungali, but there is no authentic information from China (cf. Walkinshaw 1973).

The size of wintering flock in South Korea is reported after the Korean War as steadily reduced (Won 1967), represented by only a few sight records in Kangwon

Table 1. Distribution of pairs in breeding season during 1968~1973

District	area code	Locality (areas specially studied in Gothic)	Degree of habitat destruction	Confirmation of pairs					
				'68	'69	'70	'71	'72	'73
Abashiri (A) Nemuro (N)	A-a	Lake Tofutsu	o				(○)		
	N-a	Chashikotsu	o				(●)		○
	N-b	"	o						○
	N-c	Shibetsu River	+			○			
	N-d	Kanekin	+		(○)		(●)		○
	N-e	Barasan	+	○	(○)		(●)		○
	N-f	"	+						○
	N-g	Hashirikotan	o				○	●	○
	N-h	"	o					●	○
	N-i	"	o					●	○
	N-j	Ponyaushubetsu	o					●	○
	N-k	Yaushubetsu	o		○			●	○
	N-l	Furen River	o					●	○
	N-m	"	+					●	○
	N-n	"	+						○
	N-o	Kaigarakotan	o						○
	N-p	Yarimukashi	o					●	○
	N-q	Bettoga River	o	○					○
	N-r	Shunkunitai	o	○	○				○
N-s	Nokkamappu	o						○	
N-t	Suidonuma	o	○	○	●	○	●	○	
N-u	Onneto Lake	o	(○)					○	
N-v	Onnebetsu River	o						○	
N-w	Fureshima	o						○	
Kushiro (K) Akkeshi Marsh (KA)	KA-a	Ponporoto	+				(○)		
	KA-b	Kiritappu Marsh	+	(○)			(○)	●	
	KA-c	"	o	(○)					
	KA-d	Hichirippu	o	(○)					
	KA-e	Mochirippu	o	(○)			(●)		
	KA-f	Itoizawa	o					●	
	KA-g	Bekanbeushi	o					●	
	KA-h	"	o					●	
	KA-i	"	o					●	
	KA-j	Shimochanbetsu	o		●	○			
Kushiro Marsh (KK)	KK-a	Takkobu	o	(○)	●	●	●	●	○
	KK-b	Toro	o	(○)	●	●	●	●	○
	KK-c	Arekinai	+	(○)	●	●	●	●	
	KK-d	"	+					○	
	KK-e	Shirarutoro	o	(○)	●	●	●	●	
	KK-f	Osotsubetsu	o	(○)		●	●	●	
	KK-g	Gojukokoku	o			(●)			
	KK-h	Kottaro	o		●	●	●	●	
	KK-i	"	+			●	●	●	
	KK-j	Shimokuchoro	+	(○)		●	●	●	
	KK-k	Shimoninishibetsu	+	(○)	●	●	●	○	
	KK-l	Mino	≠			●			
	KK-m	Hokuto	≠	○			●	●	



Table 1. (Continued)

District	area code	Locality (areas specially studied in Gothic)	Degree of habitat destruction	Confirmation of pairs					
				'68	'69	'70	'71	'72	'73
	KK-n	Onnenai	+	(○)	●	(●)	(●)		
	KK-o	Otanoshike	‡	○	●	●	●	●	
	KK-p	Kushiro Marsh	+					●	
	KK-q	"	○				(●)	●	
	KK-r	"	○	(○)			●	●	
	KK-s	"	○					●	
Tokachi (T)	T-a	Ootsu River	○	(○)					
	T-b	Kimonto	○	○					

○: relatively intact, +: destruction presumed, ‡: being destructed, ●: pairs confirmed by Masatomi and Kitagawa (and Archibald in 1972), ○: those by others, ( ): breeding not confirmed.

Do (Fennel, quoted by Walkinshaw 1973) and Cholla Namdo (Won 1973). Several birds were found only near the Demilitarized Zone during the recent years (Won 1973, 1974). It was reported that numerous white cranes (Tancho?) wintered in North Korea, especially in Whanghae Do even after the War (Li 1965, Pak 1967) but without precise information.

## 2. Outline of human interference

As briefly sketched in 1.1. the Tancho has been more or less protected in Japan not only by laws but culturally as a symbol of longevity since old times, probably under the influence of Chinese belief. During the time of the Tokugawa Shogunate (17.~19. centuries), they were safely preserved in the sanctuaries established for the highest governors, where *Grus monacha* and *Grus vipio* were allowed to be hawked but the Tancho was placed under rigorous protection. Sometimes those who killed the Tancho in the preserved areas were sentenced to a grave of fence. In Hokkaido, however, no such protection had been executed so that many were hunted as described previously.

Meanwhile, as they had decreased in number, the first ordinance for the prohibition of crane hunting was issued by the local government in 1889. The marshes and the bogs in Sapporo, Chitose, Yufutsu, Yubari and Sorachi (cf. Fig. 1) were stipulated for the breeding habitats of the Tancho (cf. Inoue 1972). The extinction of the crane in central and southern Hokkaido at the beginning of this century may be attributed to the gradual expansion of paddy fields which have replaced the marshes and peat lands preferred by the Tancho.

In 1924 the population in the Kushiro Marsh was estimated to be less than 20 and a flock of 18 birds was observed at a place in the beginning of the 1920's (Saito 1926). Kuzu (1928) also presumed the presence of about 25 birds in Kushiro

according to the hearsay evidence from the inhabitants. Thereafter, the population size, somewhat assumed to be more than 30 (Sarashina 1936), might not fluctuate remarkably for about two decades. Thereafter it apparently increased mainly on account of the restraint of winter mortality because of the successful artificial feeding started in 1952. Since ca. 1960 the population of Hokkaido is regarded to be relatively stable, keeping the level of about 200.

After the confirmation of the Tancho's subsistence in Kushiro, a part of this habitat, about 1,200 ha, was assigned in 1925 as a sanctuary by the Ministry of the Agriculture and Forestry. Ten years later, a local breeding area, about 2,700 ha, and the cranes living in Kushiro were nominated for one of the natural monuments. Several years after the World War II it was raised to a higher rank, i.e. a special natural monument, which should receive more rigorous legal protection. In 1967 this crane was designated for a special natural monument irrespective of the areas and an enlarged sanctuary, about 5,000 ha, was independently kept as a natural monument, not only for the crane but for peculiar lowmoor vegetation.

The Tancho itself is now legally protected by several laws, but legal control on the conservation of habitat is still defective. Only a section of the Kushiro, not large enough considering the space required for the population, and the Kiritappu marshes including some breeding habitats have been designed as a natural monument. Moreover, several wildlife protection areas and prefectural parks cover some summer habitats.

The population size has kept nearly the same level during recent one and half decades. But serious problems have currently been evoked for the ignorance of the habitat conservation: Reclamation of habitats by drainage of moors or marshes, clearing of trees from the hills surrounding the breeding areas, and riparian works ignoring marsh preservation. Such modifications may cause frequent overflows which disturb nesting and incubating activities at lowlands of the marshes in spring. Drainage, for instance, has also changed the water level and flora in the southern area of the Kushiro Marsh making it unsuitable for breeding. The riparian works now carried out in so many rivers of eastern Hokkaido. It must affect not only the water balance of neighbouring marshes but also directly the collapse of roosting places. These activities are just a modernized repetition of the destruction of breeding sites in the Ishikari Plain by agricultural development at the beginning of this century mentioned above, differing, however, by its drastic speed symbolizing the industrial era.

As a matter of fact, breeding areas situated in environs of the Kushiro Marsh lay themselves open to the danger of land development now in progress at their neighbourhood. Many summer habitats in Akkeshi, Hamanaka, and Nemuro are also included in the program of agricultural or other developments. For example, Otanoshike breeding site (cf. Fig. 3), where the Tancho's summer subsistence was first recorded in 1857 (Mori 1857) and valuable biological and ecological information was obtained during recent years, was nearly destroyed in 1972~1973 by the reclamation for its industrial use.

Moreover, the central roads with broad bases constructed through the Kushiro Marsh seems to have brought about the abnormal alternation of water level in its southwestern section, resulting in the predominance of thick reeds unsuitable for nesting. Careless field fires occasionally destroyed the habitats, burning off the nest materials and even nests and eggs.

Several Tanchos, 18 in the maximum, have fallen down to death every year through collisions with electric power lines running around the winter feeding stations. The coloured plastic plates or cylinders were attached to them at some points in 1971. This warning signal seems effective to some extent, because of a lower frequency of such accidents at the points concerned. Beside these unintentional persecutions, the increasing disturbance by careless anglers, sightseers, etc. of the breeding and wintering life of cranes must also be enumerated.

### 3. Habitat conditions

Hokkaido, situated at the northern end of the Japan Archipelago, can be conventionally divided in four natural regions, southern, central, northern, and eastern. The last one, including four administrative districts, covers the region east of the central backbone mountains stretching from north to south (Fig. 1). Furthermore, a part of the Kurile Volcanic Mountain range roughly divides lowlands of eastern Hokkaido into two parts, the south and the north (Figs. 1 and 3). At the present all cranes except a single pair are confirmed to the south area, the environmental conditions of which are briefly described in this section.

**3.1. Topographic conditions:** Vast low terraces of diluvial soil spread almost over the area. These hills or terraces were primarily covered with deciduous broad leaved trees, but now, especially in the eastern half, has mostly been replaced by the pasturages or cultivated fields. Many marshes or wetlands of alluvium or bog soil develop well at the basin of rivers, or around lakes, ponds, and along the coast. The major marshes extend at the southeastern coast of Tokachi District, in the Kushiro Plain, the Akkeshi area, the Bekanbeushi River basin and along the shore of Lake Furen and adjoining rivers (Fig. 3 and Table 1). Their brief physical aspects are as follows.

*Marshes in Tokachi:* Along the coast between Taiki and Urahoro, marshes and several lakes, some ones being brackish, lie in succession, showing varied aspects with coast vegetation on the benches (Fig. 1).

*Marshes in Kushiro Plain:* The Kushiro Marsh with low sand banks in rows along the southern coast occupies the most parts of Marshes in the Kushiro Plain. It was formed by the gradual sea regression since about three thousands years ago (Okazaki 1966). As the marsh inclines mildly towards south-east, many rivers meandering through the flat terrain flows with the same direction. They join to the Kushiro River flowing at the eastern edge of the marsh, or to the New Kushiro River (Figs. 3 and 4), an artificial canal running north to south at a little east of

the southern area of the marsh. Beside several semilunar ponds, the marsh involves three inland lakes, Takkobu, Toro, and Shirarutoro, all located near its northeastern border and contiguous for one another (Figs. 3 and 4, and Table 1).

The right bank of the canal turns toward northwest. This bank had been used as one of the leading roads till quite recently. More than the half of the southern area, mostly drained, has already been developed for agricultural and industrial purposes, and the suburb areas of Kushiro City are incessantly extending over the sand bank even into the peripheral lowlands. Contrarily, the northern area, a part of which was nominated as a natural monument, is very swampy and never more than 10 m above the sea level.

*Marshes in Akkeshi area:* The Kiritappu Marsh, one of Akkeshi Marshes, lying about 60 km east of Kushiro, is shaped like a fan opened to the ocean (Figs. 1 and 3, and Table 1). Many low sand banks stretch in parallel from northeast to southwest according to the sea regression, leaving some elongate ponds among them (Tanaka 1959a). The central area has been designated as a natural monument for valuable highmoor vegetation, but coastal parts connected with Kiritappu Island by a tombolo is used for grazing. Beyond the western hills there are two lakes located not so distant for each other and hemmed with fen vegetation. The ramified strips of wetlands lie between Kushiro and Kiritappu Marshes along the Bekanbeushi River and its tributaries (Fig. 3 and Table 1).

*Marshes in Nemuro:* The large brackish lake, Furen, lies at the base of the Nemuro Peninsula. It is closed by long sand banks, leaving a few openings to the Nemuro Strait. The Furen River, the largest among those emptying the lake, flows between low hills running from west to east (Fig. 3 and Table 1). The wetlands develop well along it and adjacent rivers. Many marshes are found sporadically along the rivers flowing down from west to east and around ponds lying between the Shibetsu River and Lake Furen (Fig. 3 and Table 1). Marshes also spread around the brackish Lake Onneto and other lakes or small rivers located in the Nemuro Peninsula (Fig. 3). A long shrimp like sand bank with some wetlands, the Notsuke Promontory, protrudes from the center of the eastern coast to the Nemuro Strait, embracing the bay inside (Figs. 1 and 3). Lake Furen and the bay are well known as the wintering or resting areas for water birds, especially swans and geese.

**3.2. Climatic conditions:** The eastern Hokkaido is climatically divided into three areas; inland areas, coastal areas facing the Okhotsk Sea, and those facing the Pacific or the Nemuro Strait. The climate of the last mentioned area, the habitat of the Tancho, is characterized by low air temperature throughout the year and lasting foggy days in summer. The seasonal wind blowing from the sea is accompanied with the dense fog produced by the warm Japan Current, which reduces both insolation and temperatures of air and soil especially at lowlands or riversides. Snowfall is usually less than 50 cm because of the reduced moisture of the winter wind blowing down from north-east across the central mountains. Thus the colder

inland air mass comes down to the Kushiro District, by which it is generally colder in Kushiro than in Nemuro, nevertheless both lie at similar latitude and coastal site. Mean temperature and rainfall in Kushiro City are 5.5°C and 1,112 mm.

**3.3 Vegetations:** General aspect of the lowlands in eastern Hokkaido is characterized by the development of lowmoor vegetation, dominated by reed-sedge or reed-alder associations. The marshes of the coastal areas in Tokachi consist almost of lowmoor vegetation e.g. *Phragmites communis*, *Carex omiana*, *Calamagrostis langsdorffii*, etc. Some coastal plants, *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Trifolium lupinaster* cover the neighbouring terraces admixed with small groups of *Betula platyphylla*, *B. ermanii*, *Alnus tinctoria* and so on.

The Kushiro Marsh is the largest peat land in Japan, about 23,000 ha. excluding alluvial soil area, left without any subversive human interference until recently. The lowmoor mainly composed of reeds and sedges occupies more than 95% of the total area. The highmoor is only fractional and local, and the rest is of transitional types.

The northern half of the marsh is covered with typical deep lowmoor dominated by reed *Phragmites communis* — sedges *Carex miyabei* or *C. thunbergii* community. *Phragmites* or *Carex* — *Alnus japonica* var. *arguta* associations are frequently found in the marginal zones. In north of Lake Takkobu (Figs. 3 and 4), the community of *P. communis*, *C. miyabei*, *C. augustinowiczii*, *C. aphanolepis*, *Equisetum palustre*, *Menyanthes trifoliata* spreads over partly covered with dense alder groves and numerous tonsure-like hummocks made of *C. augustinowiczii*, *C. caespitosa*, etc. In addition to the small lots of peripheral ones, well developed highmoor lies locally, consisting of *Sphagnum* sp., *E. nigrum*, *Ledum palustre* var. *yesoensis* and *Myrica gale*, with *Oxycoccus quadripetalus*, *Chamaedaphne calyculata*, *Eriophorum vaginatum*, etc. south of the lake Takkobu.

The northern half of the interior, embosomed with the road running through the marsh, is covered almost with *Phragmites* and sedges, including small patches of the highmoor and alder groves. Several patches of the reed-sedge vegetation, sometimes sparsely wooded, remain in another mostly drained and cultivated half and in the southwestern area. The southeastern area of the marsh, now being mainly transformed into pastures, have primarily consisted of reed-sedge association, but owing to the drainage or grazing, *Dryopteris thelypteris*, *Lobelia sesselifolia*, *Osmunda cinnamomea*, *Myrica gale* var. *tomentosa*, *Sanguisorba tenuifolia*, etc. are dominant or frequent, besides the small patches of transitional and highmoors (c.f. Tanaka 1959, 1962, Ishizuka *et al.* 1963).

The hills surrounding the marsh seem to have been covered with big broad leaved trees such as *Ulmus japonica*, *Fraxinus mandshurica*, *Quercus crispula*, *Acer mono* var. *velutinum*, etc. But they have been almost cleared at the present, except for some copses chiefly consisting of *Q. crispula* and *Betula platyphylla* utilized to make charcoal. The conifers, *Abies sachalinensis* and *Larix leptolepis*, are being partly planted on the deforested hills. Some areas turned into meadows,

or are still left as clearings now luxuriantly covered with *Sasa amphitricha* involving scanty shrubs.

On the other hand, the Kiritappu Marsh (Figs. 1 and 3) is a typical highmoor covered with *Eriopharum vaginatum* — *Myrica gale* var. *tomentosa* association, admixed with *Carex lasiocarpa* var. *occultans*, *Sphagnum* sp., *E. nigrum*, etc., except transitional moors at periphery and grazing areas with ever-increasing aridity.

The greater portion of the Furen and Onneto lake shores (Figs. 1 and 3, and Table 1) and mouths of many rivers opening to these lakes are nearly dominated by a pure *P. communis* community, sometimes with various sedges, *Polygonum thunbergii*, etc. Certain salt marsh plants, *Triglochin maritimum*, *Salicornia herbacea*, *Glyceria ischyronaura*, etc. are found at the inside shores, lake mouths, and the Onnebetsu River mouth (Fig. 3 and Table 1). The lowmoor spreads along the Furen River (Fig. 3 and Table 1), involving developed highmoor in the center of the marsh, though its upper area has largely been drained for agriculture. On the terraces surrounding the Lake Furen, deciduous broad leaved forests develop and some forests of *Picea glehni*, either monospecific or occasionally with *Alnus japonica* var. *arguta*, are found on the sand banks. The groves of *P. glehni* stand near the shore of the Onneto, and mixed forests cover the neighbouring hills.

Salt marsh formation scatters through lowlands of the Notsuke Promontory (Figs. 1 and 3), in addition to dune plants on its sand banks and the coastal vegetation utilized for grazing.

**3.4. Conditions of breeding Territories:** The breeding territory of the Tancho is fallen under Type A listed by Hinde (1956), that is, all daily activities are executed within it. At least in spring it is equal to the range of all activities, involving feeding, nesting, and roosting places. Thus the presence of lakes, ponds, rivers, or marshy waters, with shallower portions for food-seeking, is prerequisite to establish the territory. But as these aquatic areas are necessary not for the Tanchos themselves but chiefly for animals preyed by them, a considerable part of aquatic area within the territory may be of little immediate utility for breeding activities of cranes.

The second principal may be the presence of safety place with nest materials, usually reeds, being more or less open, and something less watery to construct nests or to rear chicks. As the summer roost is not settled at definite places as in winter, it is difficult to point out the topographical conditions concerned. However the Tancho seems to have a tendency to spend night at the places not so far from water, and provided with a small cluster of shrubs. In addition to them, forests, roads, railways, bridges, or artificial environments involving farm houses, cultivated fields, pastures and others are often "inwillingly" included with in the activity range (Masatomi 1973).

The nesting sites are found at quite variable places. They are roughly assorted into three types in view of general aspects: A. Loose forest or grove, B.

Lowmoor covered with dense tall grass, and C. Relatively open lowland (Masatomi 1970), each provided with the following vegetation:

A. Alder-sedge association is typical. As an example, *A. japonica* var. *arguta* less than 3 m high, forming a sparse almost pure forest, with the undergrowth of *Carex miyabei*, *C. middendorffii*, *C. limosa*, *Eriophorum vaginatum*, *Myrica gale* var. *tomentosa*, *Sphagnum*, and occasionally *Phragmites*, etc., namely, a transitional moor often with many peculiar hummocks. Type A is less preferred than others, especially B.

B. Characterized chiefly by lowmoor, classified into several subtypes by reed density, various plant communities, and appearance of surrounding habitat, ranging from very swampy to less damp; B<sub>1</sub> Reed community. Nest sites exclusively covered with thick reeds. B<sub>2</sub> Reed-sedge or reed-grass associations. Reed density relative low, associated with various sedges such as *C. miyabei*, *C. thunbergii*, *C. lyngbyei*, *C. omiana*, and *Dryopteris thelypteris*, *Equisetum palustre*, or at times with *Sphagnum*, *M. gale* var. *tomentosa*, etc. B<sub>3</sub> Alder-dotted sites. Sparsely wooded, or closely embosomed with *A. japonica* groves. B<sub>4</sub> No shrubs within at least about two hundred meters from the nest.

C. Reed density is low (density index less than 10. cf. Masatomi 1970) on the whole, or small clusters of reed scattering in open low or wetlands. Consequently, the visibility more or less good and sedges, bogmoss, or dwarf shrubs rather prominent. Areas consisting of either lowmoor e.g. *Equisetum* — *Carex* association, or transitional moor e.g. *Carex* — *Sphagnum*. Some places with many submerged swales or pitfalls and others contrarily less moist.

As yet no pair nested in such open highmoor as *Sphagnum* — *Empetrum* — *Oxycoccus* associations has been recorded. But it was once reported that a pair tried to make their nest on the low moist spot near the cultivated field (Saito 1960). The habitat conditions of wintering area will be described later. The presence of water surface not freezing throughout the winter to seek food and to roost safely seems essential. Rivers or springs fulfilling these conditions are not abundant in the marshlands of eastern Hokkaido.

**3.5. Foods preferred:** As in other cranes the Tancho is omnivorous, feeding on both vegetable and animal foods. Few detail studies occur upon its food habit under natural conditions. The natural foods so far recorded are: *Vegetables*; parsley (Saito 1926, Kuzu 1928), some water plants and carrot (Saito 1926), pasture plants (Kuzu 1928), young buds of reed and inflorescence of *Potamogeton* (Kuzu 1928), acorn (Yamashina 1930), buckwheat (Masatomi unpub.), *Animals*; loaches (Saito 1926, Kuzu 1928), crucian carp (Inukai 1943), *Radix japonica*, sticklebacks, tadpoles, and frogs (Inukai 1970).

In winter the corns artificially offered must now constitute an important portion of the foods. However, the Tancho seems to prefer for animal foods than vegetable ones. No sure intake of leaves, stalks, roots, etc. of the plants predominant in the habitats, e.g. reeds, alders, and sedges was observed in our surveys

during the breeding season except *Oxyccoccus quadripetalus*, cabbage, and *Empetrum nigrum*.

The detailed dietary analysis is impossible. Being a special natural monument, even dead birds must be sent to Sapporo or Obihiro through legal steps. This makes impossible the examination of stomach content of the birds soon after deaths, caused by the accidents such as collision with the electric wires, etc. Although we attempted to take some samples from the water surface and soil substrate in several areas, where the Tanchos usually seek the food, but virtually no sufficient animals were obtained. Occasionally, the Tanchos swallowing some prey were observed but in most cases the kind of food was unidentified, because the observations must be made from the distance.

The faunal survey of the marshlands has not been carried out in detail, except several studies on insects (e.g. Iijima 1972~3, Naraoka 1972) birds (e.g. Hayashida and Hashimoto 1972) and fishes (Yamashiro 1969). The kinds of animal foods actually eaten (in Gothic) and those occurring in their habitats and presumably taken by the Tancho are listed in Table 2, but nothing is known on the actual proportion occupied by them.

Table 2. Animals actually or probably eaten by the Japanese Crane

Mollusca:	<b>Mud snail</b> ( <i>Cipangopaludian japonica</i> ), <i>Lymnaea</i> spp.,	Gastropoda spp.
Annelida:	Oligochaeta:	Gen. spp.
Arthropoda:	Arachnida:	Gen. spp.
	Crustacea:	Isopoda Gen. spp., Amphipoda ( <i>Anisogammarus kygi</i> )
	Insecta:	<b>Dragonflies</b> ( <i>Libellula quadrimaculata asahinai</i> , <i>Orthetrum japonicum japonicum</i> , etc.)
Pisces:	Agnatha:	<b>Lamprey</b> <i>Entosphenus reissneri</i>
	Osteichthyes:	<i>Barbatula toni</i> , <i>Misgurnus anguillicaudatus</i> , <i>Pungitius pungitius</i> , <i>Moroco perecnurus</i> , <i>Cyprinus carpio</i> , <i>Carassius auratus</i> , Salmonidae spp., <i>Chaenogobius</i> sp.
Amphibia:	<i>Rana chensinensis</i> , <i>Salamandrella keyserlingii</i> , <i>Hynobius retardatus</i>	
Aves:	<b>Chick of Mallard</b> ( <i>Anas platyrhynchos platyrhynchos</i> ), <b>Juveniles of Reed-warbler</b> ( <i>Acrocephalus</i> sp.)	
Mammalia:	<b>Small mammals</b> (mole or mouse)	

**3.6. Other animals living in and near habitats:** The Tancho is usually indifferent to other kinds of birds, such as most Passers, Anseres, Gressors and Pygopods living in marshlands. Grey heron, *Ardea cinerea jouyi* Clark, is rarely chased from feeding spots, the whooper swan, *Cygnus cygnus* (Linnaeus), is usually tolerate without any attack, but the chick of the *Anas* are rarely eaten and a fledgling of the reed-warbler, *Acrocephalus* was once swallowed (Takahashi person. comm.).

The eastern carrion crow, *Corvus corone orientalis* Eversmann, and the Japanese jungle-crow, *Corvus macrorhynchos japonensis* Bonaparte, frequently plunder eggs and chicks. The black kite, *Milvus migrans lineatus* (Gray), the Japanese



buzzard, *Buteo buteo japonicus* (Temm. and Schl.), and the eastern marsh harrier, *Circus aeruginosus spilonotus* Kaup behave occasionally similarly. The adult Tanchos can easily drive away these enemies. When a pair possesses early stage chicks, the parents frequently attack or chase these birds approaching the nest or the chicks. They also keep a watch or sometimes alarm for the white-tailed sea-eagle, *Haliaeetus albicilla* (Linnaeus), but we have not observed the eagle falling upon the crane. Yezo brown bear, *Ursus arctos yesoensis* Lydekker, red fox, *Vulpes vulpes schrencki* Kishida, racoon dog, *Nyctereutes procyonoides albus* Beard, Japanese mink, *Mustela sibirica itatsi* Temminck, mink, *Mustela vison* Schreber, and snakes, *Elaphe quadrivirgata* (Boie), *Elaphe climacophora* (Boie), inhabiting marshlands and the vicinity. Some of these animals and more plausibly feral cats and dogs may occasionally given nuisances to the Tanchos. But their influence is certainly inferior than the ever-increasing human interference (cf. Section 2).

#### 4. Location, topography and vegetation of observation sites

Observations of the behaviour were made at various areas but particularly at some selected sites. The location, topography and vegetation of these sites are outlined here in order to facilitate the understanding of descriptions given in the subsequent papers. Code number in Fig. 4 and Table 1, and observation period are given in parentheses. Northern, Eastern, Northeastern, etc. are abbreviated as N, E, NE.....

##### 4.1. Breeding sites:

a) *Takkobu* (KK-a, October 1968~July 1972): Situated at E periphery of Kushiro Marsh. Surrounded by low hills except W section facing the marsh. Divided into two sections by a highway at slightly E of the middle. E section and S piedmont mostly cultivated. The latter with several farm houses and the farmland of several ten square meters jutting into the marsh. SE corner fringed with many alders. W section including Lake Takkobu with a grove of many alders along the highway and small clumps sparsely along banks. The hem of the lake and S of the river forming flooded marshes with dense reeds and S side of W section partly highmoor. Patches of reeds clustering in W section.

b) *Toro* (KK-b, October 1968~July 1972): Located about 24 km N of Kushiro City. A narrow road running through in NW direction, dividing the site into small N section with a pond and large S section. E side of S section facing Lake Toro, bordered by a railway and a highway at the margin. The lake issuing a river into the site. A deep marsh at W part of S section, just like an Island, surrounded almost entirely by the meandering Kushiro River. Many alders growing along the river. S of *the island* with dense high reeds, N part with spare reeds, partly replaced by transitional moor. The other part outside *the island* forming open marsh with low vegetation. Several small ponds scattering between *the island* and the lake. Horses pasturing practiced around *the island*. Many alder

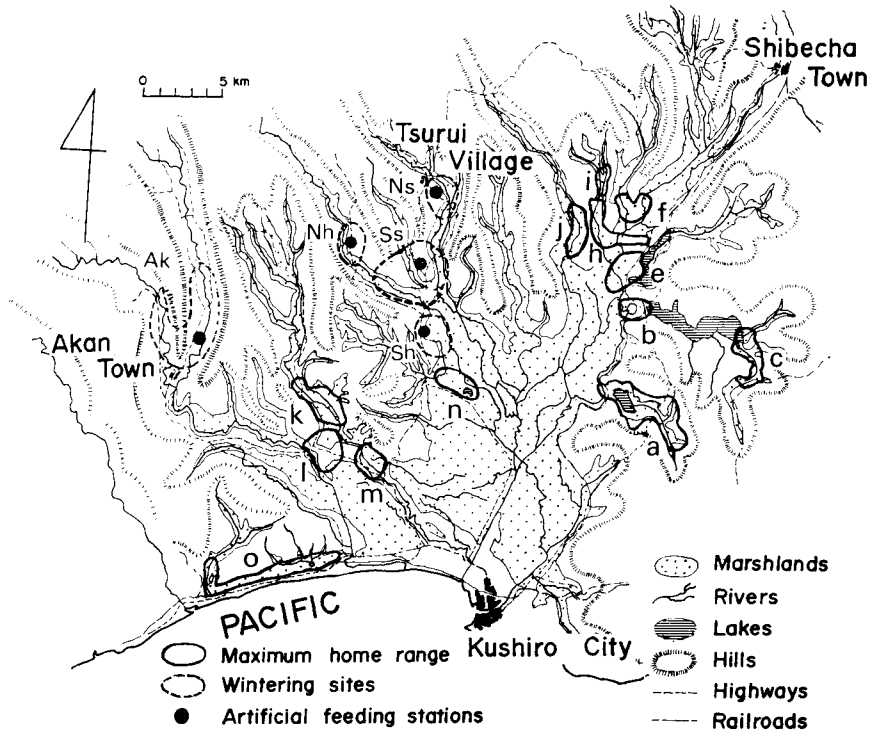


Fig. 4 Pairs, habitats and wintering areas observed in Kushiro Marsh: a~o: Pairs and habitat codes (cf. Tables 1 and 2), Ns: Nakasetsuri, Nh: Nakahororo, Ss: Shimosetsuri, Sh: Shimohororo, Ak: Akan.

woods spreading at W, S and SE of the site, expanding toward Kushiro Marsh.

c) *Arekinai* (KK-c, March 1969~July 1972): At SE of Lake Toro, 8 km E from KK-b. Fringed by hills except NW facing the lake. By a ridge extending toward the lake shore from E hills, the site divided in N marsh with the Omoshironbetsu River and S marsh with the Arekinai River: Both emptying into the lake, E end between the river mouths being shallow. W side of S marsh with scattering alders along the river. A pasture adjoining near SW hills with a low vegetation in contrast to other parts. A small, virtually abandoned road at slightly SE of the lake shore in S marsh.

d) *Kottaro* (KK-h, March 1969~July 1972): Situated about 6 km NW of Lake Toro, laying between two N-S ridges protruding toward Kushiro Marsh. The site expanding at times to SE beyond E hill, nearly to Kayanuma at NE periphery of Kushiro Marsh. C (central) section of the site occupied by a typical swamp with numerous small pitfalls characteristic of lowmoor. The Kottaro river and its

Table 3. The habitat conditions of the pairs observed in breeding season

Pair and habitat code	Locality	Sedentary (S) or removal in winter (W)	Artificially fed or not in winter	Main type of nesting site	Approx. size of maximum home range (sq. km)
KK-a	Takkobu	S	+	B	4
KK-b	Toro	W	-	B, C	1
KK-c	Arekinai	S?	+	B	2
KK-e	Shirarutoro	W?	+	B, C	2-3
KK-f	Osotsubetsu	S?	+	B	2
KK-h	Kottaro	W	-	A, B, C	2.5-7
KK-i	Kottaro	W	-	C	1
KK-j	Shimokuchoro	W	-(+)	C	2.5-3
KK-k	Shimoninishibetsu	W	-(+)	B	3
KK-l	Mino	W	-(+)	B	2.5
KK-m	Hokuto	W	-	B, C	1.5-2
KK-n	Onnenai	W	-	B	2.5
KK-o	Otanoshike	W	-	B, C	7

tributaries penetrating until joining with the Kushiro River, demarcating E border of the site. Water level high in N section. N dominated by *Menyanthes trifoliata* and S section by reeds. A small pond abutting on E hill and a charcoal burning shed at the opposite side. N section bordered by alder groves beyond which another pair occasionally occupied the head area (KK-i) of the river.

e) *Shirarutoro* (KK-e, March 1969~July 1972): Lying near Lake Shirarutoro, in NE part of Kushiro Marsh. Linked with KK-h at NW side and separated from KK-b by hills. A railway passing through the site from N to S, crossing small intricated SW side of the lake. S shore of the lake fringed with deep reed marshes while W section provided with relatively open moorland.

f) *Kuchoro* (KK-j, March 1969~July 1972): Nearly surrounded by hills except SW linked with Kushiro Marsh and being adjacent to KK-h beyond E ridge. NE section covered with very thick alder groves and W section mostly cultivated. The Kuchoro River flowing N to S through the site but now straight and wide by recent change. SE section bordered with steep gradient of hills. It consisting of lowmoor, partly bog moss developed with pitfalls and dotted dwarf alder. Reed density and height not so high. One or two farmers at W plateau appointed as feeders in fall. Draining and pasturing especially in NW section being in progress.

g) *Shimoninishibetsu* (KK-k, March 1969~July 1972): Located about 16 km NW of Kushiro City, surrounded by hills except S facing Kushiro Marsh. A river meandering at E side, making a pond on the way. A road running along W hillside with two or three houses along it. For several drains, W and S sections not swampy, mostly occupied by reeds but with a plenty of well developed hummocks or tssucks specially at S. Alder woods growing along the river and making groves in N section. S margin hedged by roads and farmlands. Recently a half of S section entirely destroyed to make pasture fields.

h) *Otanoshike* (KK-o, October 1968~July 1972): A long strip of lowmoor at SW corner of Kushiro Marsh, 7 km in length but less than 1 km in width, located between low hills and the Pacific coast. W extremity hooking N-wards. Snatchy lines formed with several low ridges running through from W to E, scattering among them wetlands and several ponds. Patches of reeds sparse in central part while dominant in W-hook. Water level relatively low in the rest, especially in NE section adjoining hills where cattle grazing practiced. Groves and thickets developing along foots of hills where several shallow streams making small sloughs.

The site is out of sanctuary. Seven to eight years ago some constructions were built at E section for filth-treating equipment. Currently more than a half of the site was reclaimed to establish factories.

i) Other areas: In addition to those mentioned above, fragmentary observations on activities of some pairs were made in the following areas.

*Hokuto* (KK-m, 1968~1972): About 10 km NW of Kushiro City. Open except N bordered with hills. Rivers and a highway running through it, with studded farm houses and cultivated fields.

Many parts being reclaimed or drained to make pasture fields so that the site is dotted with patches of wetlands around ponds, streams and springs.

*Onnenai* (KK-n, 1969~1972): Spreading in WC part of Kushiro Marsh. No artificial construction except an abandoned highway lying at its S border. Involving narrow zigzag rivers, a large pond adjoining with well-developed highmoor covered with *Sphagnum* and *Oxycoccus* vegetation, consisting of reed marshes mixed with alders forming groves, but mostly dwarf ones.

*Osotsubetsu* (KK-f, 1969~1972): Located N of Kayanuma Railway station. One of low marshes embraced by fairly dense alder groves or hills in NE margin of Kushiro Marsh. Involving rivers, many hummocks, without any artificial constructions.

*Lake Furen* (N-g~r, 1969~1972): At the base of Nemuro Peninsula fringing Lake Furen, a large brackish tidal lake connected with sea at base of the peninsula. Lake periphery roughly divided into three zones: Outermost zone composed of thick alders, middle representing marshes dominated by reeds, and innermost one being shore fringed by reeds only along riverside. Very inconvenient to make precise observation from land.

**4.2. Wintering sites:** In late autumn most pairs leave the breeding sites and form flocks at wintering sites, where artificial feeding stations are settled: Stations are financially supported by Educational Committee of Hokkaido and managed by voluntary inhabitants.

a) *Akan* (Ak, October 1964~April 1972): Located near Akan Town, ca. 30 km apart from Kushiro City. Surrounded by high hills and one ridge dividing the site into E and W sections. In each section rivers meandering from S to N (Akan River and Shitakara River) and highways running through. Along high-

ways, houses scattered over. The site mostly utilized for farmland from May to October, while covered with snow during winter. Feeding station near the highway alongside Akan River, ca. 4 km apart from Akan Town. A farm house adjoined to the station being used as vegetable field and partly as corn field.

b) *Shimosetsuri* (Ss, October 1968~April 1972): Situated at N section of Kushiro Marsh, 20 km apart from Kushiro City. Two ridges protruding toward Kushiro Marsh, embraced by rivers from SW to E, as follows: R. Hororo — SW ridge — R. Ashibetsu — E ridge — R. Setsuri. S to N houses scattering along highway. The land used mostly as meadow or cultivated field. A primary school and a farm house adjacent to the station. The station used as meadow during summer. On the contrary in winter about a half of the station is used as the ground for exercise of cows.

c) *Shimohororo* (Sh, October 1968~April 1972): Located at NW margin of Kushiro Marsh. E side fringed with many alders, while W side surrounded by hills. About 1.3 km E from the station, the Hororo River meandering NW to SE through Kushiro Marsh. A highway running through the site S to N at the base of W hills. A farm house adjacent to the station. The site used as meadow or pasture land during summer.

d) *Nakahororo* (Nh, October 1968~April 1972): Located near Nakahororo Village. Lying between E and W ridges, 7 km apart from Sh. At E base of W ridge the Hororo River forming a deep and wide valley. The river flowing into NW margin of Kushiro Marsh. A highway running through SN. Houses are dense in N along the road, while sparser in S. Feeding station situated on the plateau E of valley. A farm house adjacent to it. The site used as meadow, partly as corn field. A road running just near the station.

e) *Nakasetsuri* (Ns, October 1968~April 1972): Located about 4 km N of Sh, near Tsurui Village. Representing an end of the lowland penetrating into the hills ranging N margin of Kushiro Marsh. The Setsuri River flowing at E of village. Feeding station lying on W edge of the river. A farm house adjacent to it. The site used as pasture field.

## 5. Outline of annual cycle

Although the full account of annual cycle of the Tancho would be described only after the ethological details of each phase, here its outline is briefly presented, first of all, as a framework to subsequent papers.

The annual cycle of the Tancho in eastern Hokkaido is schematically presented in Fig. 5. In winter most birds aggregate in areas around several artificial feeding stations (cf. 4.2.) through about five months or more (cf. Fig. 5). During another half of a year, contrarily, they widely disperse in pairs or small flocks over the marshes of eastern Hokkaido (cf. Fig. 3), located within a radius of 150 km from the wintering places. Breeding habitats to which cranes shift in spring consist of marshes, lakes, ponds or rivers, pasture fields, and alder groves as given in Section

4. Some of the activity ranges are embosomed by hills or bordered with cultivated lands.

The annual life of the crane can be divided into three Phases according to their activities and related environmental changes.

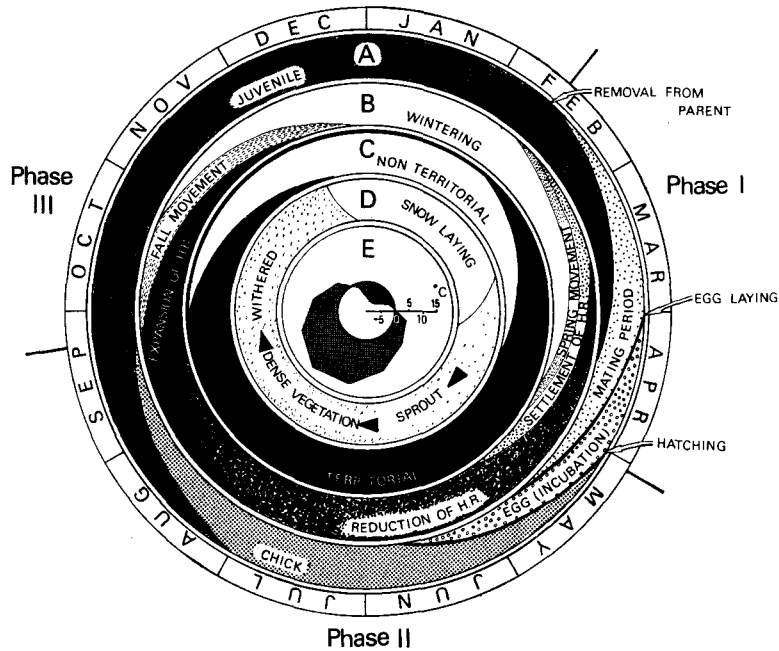


Fig. 5 Annual cycle of the Japanese Crane shown schematically. A: Development of young, B: Change of activity range, C: Social pattern, D: Environmental change, E: Average monthly temperature.

**Phase I** (Pairing-incubation phase): Each pair establishes a large A-type territory of 1~7 sq. km and eagerly participates in conspicuous courtship display or dance. The male and the female begin to copulate about one month before egg laying, generally made during early April to mid May. Both sexes start to build their nest on the small hummock construction of the fen only a few days or a week before laying. It looks like a low frustrum of a cone, 1~2 m in diameter and about 5~50 cm above the surrounding water, and is mainly made of dry reeds.

Clutch size is two and rarely one. There are two types of egg distinguished by colour, one is pale bluish or almost white without any spots, and the other pale yellowish or olive brown with many spots of reddish-brown, yellowish gray, etc. Incubation begins with the laying of the first egg and the second one is laid a few days later. As a rule attentive periods of both sexes are in half during daytime,

but the female usually remains on the nest at night. Incubation of parents lasts 30~35 days and chicks stay in the nest several days after hatching.

**Phase II** (Brood caring phase): Although the chicks is capable of picking up food by themselves even on the day of hatching, parents often give them food from bill to bill until early winter. One of the mates alternately guards their chick, standing near the latter, while the other is searching about food at a distance. In the evening the chick crawls under the wings of the female sitting on the ground for about two months after hatching.

The daily activity range of the family is very small in the early stage of chick, but their territory seems still to be as large as that of incubation period. Actual territorial defence such as attacks on, or chases to the intruders is chiefly practiced by the male, though the female also takes part in the defences, sharing with unison calls or other threatening activities. Chicks generally become volant at about three months old and thus the activity range of the family is rapidly extended.

**Phase III** (Wintering phase): Pairs or families leave their breeding territories mainly from September to November, moving to the wintering areas in knots, though earliest birds appear there in late August. On their way to the areas they often land to rest or to take food, and sometimes settle a temporal domicile by rivers, ponds or corn fields. Making each a small feeding territory generally around the corn fields, the pairs and especially the families arrived at the wintering places first tend to scatter in the area. But by freezing of the ground and for the requirement for corns they gradually concentrate on several restricted places centering around the artificial feeding stations.

Thus two or three large flocks of 40 to 80 cranes, together with some smaller ones, are annually formed in December. Including roosts and feeding places, activity range of each flock more or less covers a couple of kilometer wide. They usually move in pair, family or small flock in daytime, but often leave their roost in the mid-morning and fly back after dusk in relatively large formations in mid-winter. Most of them roost communally in unfrozen shallow rivers, but it is recognized that some families prefer to keep their own isolated roosting points. Removal of members among large flocks seems to be not infrequent in fall and spring, but less in winter.

The winter flocks fundamentally are composed of a temporal feeding and roosting assembly of pairs or families and begin to break down by snatchy take off of the pairs to the breeding areas in February. Prior to this dissolution, parents drive away their young-of-the-last-year with vigorous attacks, or remove the area leaving the young. Consequently there remain some flocks which consist of the juveniles and sometimes of a few unpaired subadults or even matured ones at the feeding station in early April.

During April to June they move to the marshes and wander there either solitarily or in pairs or small groups, frequently making troubles with the territory owners. However, it must be mentioned that a few pairs stay in regular areas throughout the year for a long time, maintaining territories even in winter without

adjoining the winter flocks.

The Tancho may mature at 3~4 years and is exclusively monogamous. Pair bond is probably perpetual, but neither its details nor their ecological span are yet confirmed due to the lack of banding or precise individual recognition.

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### Summary

As a first report of our serial work on the bionomics and sociology of the Japanese Crane, *Grus japonensis* (P.L.S. Müller), or Tancho, geographical distribution, habitat conditions and an outline of annual cycle are presented.

1). The gradual decrease of the Tancho in and outside of Japan is traced through a bibliographical survey. About 200 individuals remaining in eastern Hokkaido form now the unique authentically confirmed breeding population, though the breeding at the eastern shore of Lake Khanka, in the Maritime Province, U.S.S.R. is still probable.

2). The ever-increasing human interference to the life of the Tancho is regarded as the most serious factor for its survival in eastern Hokkaido, operating through the contraction of marshlands suitable for breeding.

3). Habitat conditions for breeding sites are described. Within the general preference for marshland, the habitats variable as to topography and vegetations are recognized. Generally, and especially in breeding season, the Tancho seems to prefer animal foods than vegetables. Some foods actually taken are recorded together with probable foods, but nothing is still known on the details of dietary composition under natural conditions. The Tancho is relatively indifferent to other large co-habitants except for the frequent nuisance given by crows.



4). The annual cycle is divided into three phases: Phase I, From mating to hatching. Living in pairs and dispersing over marshlands. Each pair occupying a large territory. Lasting ca. three months (March~May). Phase II, Brood caring. As in I but accompanied with their chicks. Lasting ca. four months (June~September). Phase III, Wintering. Leaving the territories and forming flocks at wintering sites. Lasting ca. five months (October~February). Although most pairs exhibit the cycle I-II-III, it is noteworthy that some pairs show I-II, without participating in winter flocks.

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