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Homing of Lacustrine Charr in a Small Lake with a Few Inlet Creeks

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Anadromous Dolly Varden charr, *Salvelinus malma malma*, appear to return to spawn in the streams where they originated (Armstrong, 1974; Armstrong and Morrow, 1980), showing strong homing tendencies like other anadromous salmonid fishes. Lacustrine salmon in large lakes also show the same tendency (Frost, 1963; Hartman and Raleigh, 1964; Jahn, 1969; Hasler and Scholz, 1983). The life cycle of the landlocked Miyabe charr, *S. malma miyabei*, in Shikaribetsu Lake, Hokkaido, Japan, is similar to that of the anadromous Dolly Varden, from which the former were derived (Maekawa, 1984). However, it is unknown whether the Miyabe charr have homing tendencies in small lakes with a few streams.

In the present study, homing tendency was tested by using adult Miyabe charr, which have been found to spawn more than once in their lives and return to the lake after spawning (Maekawa, 1984).

Materials and methods

Shikaribetsu Lake is situated in a mountainous area at an elevation of about 800 m above sea level. The lake has four small inlet streams which flow permanently (Fig. 1). The length of Yambetsu, West and East creeks are about 6 km, 3 km and 500 m, respectively. The lake-run type of the Miyabe charr has been observed in these streams, but recently not in Kohan creek because

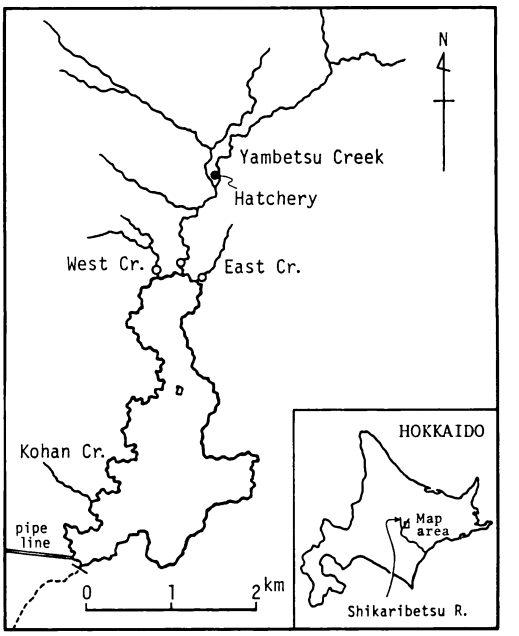

Fig. 1. Map of the Shikaribetsu Lake system showing four inlet streams. Circles (○) show location of weirs. Water has been flowing out to the Shikaribetsu River through the pipe line (=).

of a concrete dam near the mouth of the creek. Since the construction of the concrete dam in the outlet stream (Tomabetsu River) in 1955, water has been flowing out directly to the main stream, Shikaribetsu River, through a pipe line.

Lacustrine Miyabe charr, native to Shikaribetsu Lake, migrate up from the lake during fall and spawn in Yambetsu, West and East creeks. In the present study, adult fish which were reared in the hatchery after collection by a weir across Yambetsu creek near the mouth from August to October in 1981 and 1982 were anesthetized, tagged in June of 1982 and 1983, respectively, and

Table 1. Number of tagged fish and released sites.

Experimental group	Captured		No. tagged	Fork length (mm)		Released	
	Month	Site		Mean	Range	Month	Site
A	June, 1981	Yambetsu*	514	256	200–365	June, 1982	Lake
B	June, 1982	Yambetsu*	994	253	206–358	June, 1983	Lake
C	June, 1982	Lake	105	253	185–380	June, 1982	Lake
D	Sep., 1982	West Cr.	133	unrecorded		Sep., 1982	West Cr.

* Fish were reared in Hatchery until June of the next year after collection of mature eggs and sperm.

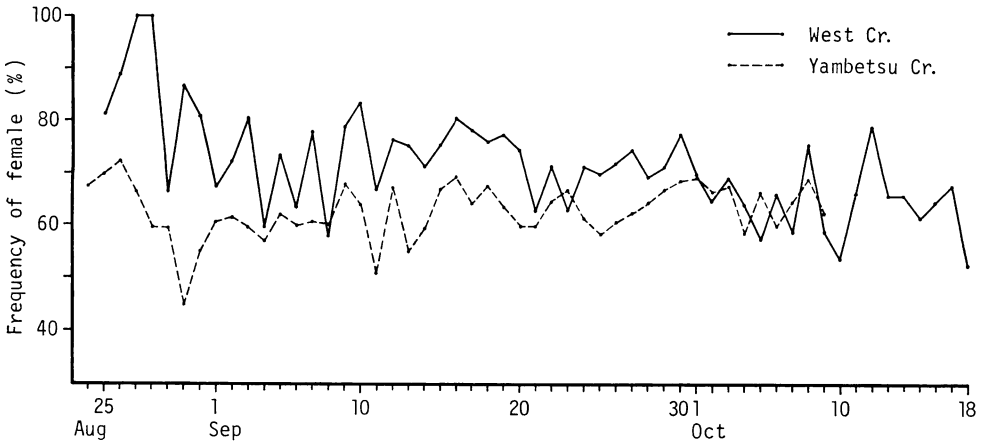

Fig. 2. Difference of sex ratio of up-migrating Miyabe charr among two inlet streams. The frequency is higher in West creek than Yambetsu creek.

then released into the lake (Table 1). Fish (body size unrecorded) collected by a weir across West creek during September of 1982 were also tagged and released there. Lake-living Miyabe charr, netted from a trap in the lake in June of 1982, were tagged and released there. For recapture, fish were taken from a weir across 2 creeks Yambetsu and West creeks, near the mouths, from August to October of 1982 and 1983, and also in East creek in 1982.

Results and discussion

In Yambetsu creek, the charr presumably began to migrate up into the stream from the middle of August, based on direct observation and fish collection. However, in West creek, the fish began to move up into the creek from early September.

Total number of fish captured was about 35,000 during the two years. Of the 1,746 fish released, 181, or 10.3%, were observed subsequently (Table 2). Low recovery of the tagged fish may be partly due to various conditions in addition to the high mortality after first spawning (Maekawa *et al.*, in preparation) and mortality from tagging. The first condition is that many tagged fish had already moved upstream during the period of early August to the beginning of the present capture. We observed several tagged fish in a tributary of the Yambetsu and in an outlet of the hatchery. The second possibility is that some Miyabe charr do not mature every year. Forty-two fish of Group A (Table 1), which were recovered in 1983, spawned in 1981, showing that some fish mature every other year. The third possibility is that the ratio of mature to immature fish was unknown in Group C because we could not examine the fish adequately.

If fish which originate from each creek were distributed at random in the lake except for the spawning season and Group C fish were sampled at random, then we can suppose that the number of fish in Group C that migrate into the parental creek should be directly proportional to the ratio of the number of fish captured in the creek to the

Table 2. Homing of tagged fish. A, B, C, and D show experimental group in Table 1.

Captured		Total no. captured	No. recovered			
Month	Site		A	B	C	D
Aug., Sep. and Oct., 1982	Yambetsu Cr.	11,628	39	0	19	0
Aug., Sep. and Oct., 1982	West and East Cr.	1,698	2	0	2	0
Aug., Sep. and Oct., 1983	Yambetsu Cr.	18,604	40	64	3	1
Aug., Sep. and Oct., 1983	West Cr.	3,507	0	1	2	8

total number of fish captured in a year. In 1982, the ratio of number of tagged fish of Group C to the total number of captured fish was 0.16% in Yambetsu creek, and 0.11% in West creek, showing no significant differences among them ($p \fallingdotseq 1$, by Exact Test). In 1983, only 5 fish were recovered. Limited data, however, showed that the ratio was higher in West creek than in Yambetsu creek. Therefore, it is reasonable to accept our supposition mentioned above.

In 1982, 39 fish, or 0.33% (no. of tagged fish recovered/total no. of fish captured $\times 100$), were recovered in Yambetsu creek in Group A, which were tagged at Yambetsu creek, and 2 fish, or 0.11%, in West creek, showing no significant differences between locations ($\chi^2=3.06$, $0.05<p<0.1$). However, there is a possibility that the ratio is higher in Yambetsu creek than in other creeks. In 1983, 104 fish, or 0.56%, were recovered in Yambetsu creek from Groups A and B, and only one fish, or 0.02%, was recovered in West creek, showing a significant difference between locations ($\chi^2=17.37$, $p<0.001$). Conversely, of the 9 fish recovered from Group D (tagged at West creek), 8, or 0.22%, were found in West creek, and only one fish, or 0.005%, in Yambetsu creek, showing a significant difference ($p \fallingdotseq 0.001$, by Exact Test). These results demonstrate a strong preference of the Miyabe charr for a particular creek.

On September 11, 1983, 25 fish collected from West creek were released at a tributary of Yambetsu creek. Seven of these fish were recovered in West creek during September and October, suggesting searching and homing behaviour. These homing tendencies are suggested strongly by the difference of sex ratio of fish which up-migrated to Yambetsu and West creeks (Fig. 2). The frequency of female in 1983 was significantly higher in West creek than in Yambetsu creek. This appears to reflect that the populations are separated from each other to a certain degree during breeding.

From the data during 2 years in Yambetsu creek, about 97% ($143/147 \times 100$) of the charr returning as spawners homed to their parent creek, but homing ratio of juveniles cannot be known since we used adult charr in the present study. The olfactory identification of the home stream by salmon is learned rapidly during the transformation from parr to smolt (cf. Hara, 1975; Halser and Scholz, 1983). If it can be applied to the present case, then when or where will the Miyabe charr (of which the smolt are hardly observed in a stream [Maekawa, 1977]) be imprinted? It is known that most of the young Miyabe charr migrated into the Lake from July to November with a peak in October. Therefore, timing of the upward-migration of adult charr coincides with the downward-migration of the young charr. Nordeng (1977) proposed, according to his pheromone hypothesis, that homeward navigation is an inherited response to population-specific pheromone trails released from descending smolt. Study of juvenile Miyabe charr will clarify the problem.

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然別湖産オショロコマの母川回帰

前川光司

1982 年と 1983 年に，然別湖産オショロコマ（ミヤベイワナ）が多回産卵することを利用して，タッグ装着による母川回帰性を調べた．前年に遡上した同じ河川に翌年再び遡上する個体の比率は極めて高かった．また，湖中で捕獲し標識後湖に再放流した個体の各河川への遡上率は，各河川の総遡上数の比率とほぼ比例していた．このことから，このオショロコマは然別湖水系内で母川回帰することが示唆された．

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