

NPAFC

Doc. 104

Rev. 1

Marine Life and Fishery of Masu Salmon

by

V.V. Tsiger

Pacific Research Institute of Fisheries
and Oceanography (TINRO)

submitted to the

North Pacific Anadromous Fish Commission

by

Russian Party

1994 October

THIS MAY BE CITED IN THE FOLLOWING MANNER: Tsiger, V.V.
Marine Life and Fishery of Masu Salmon. (NPAFC Doc. 104)
Pacific Research Institute of Fishery and Oceanography (TINRO) 1994.
Vladivostok, Russia 11pp.

(NPAFC)
(Doc.104)

MARINE LIFE AND FISHERY OF MASU SALMON

by
V.V.Tsiger

Abstract

The general plan of masu seasonal migrations from different origin areas is presented with help of published and own data analysis. Economic zones establishing and the lack of bilateral Russian-Japanese agreements except the opportunity of rational masu fishing. It's necessary to conduct the international researches of masu distribution in Japan Sea in winter-spring, scale structure analysis, tagging and genetics markers search also.

Marine life and fishery of masu salmon.

V.V. Tsiger

Pacific Research Institute of Fishery & Oceanography,

Vladivostok, 690600, Russia

(Submitted to annual meeting of NPAFC,

Vladivostok, October, 1994)

The anadromous form of masu salmon is distributed in Asian waters of Pacific ocean. Masu salmon run into rivers of Korean Peninsula, Primor'e, Hokkaido, Honshu, Sakhalin, South-Kuril Islands, Western Kamchatka and Amur River. This salmon rarely occurs on the western coast of Okhotsk Sea also (Machidori, Kato, 1984; Semenchenko, 1989).

Anadromous masu salmon reproduce in four countries of Pacific coast. The majority of sea-run masu salmon reproduces in rivers of Russia, the minority - in rivers of Japan, the smallest part - in rivers of North Korea. In rivers of South Korea masu salmon is the rarest (Machidori, Kato, 1984). There was no mention on masu salmon in the list of anadromous species of Southern Korea (Valencia, 1989).

Usually juvenile masu salmon spent one or two years in rivers until the seaward migration (Machidori, Kato, 1984; Tsygir, 1988). In the rivers of Western Kamchatka about 10% of juvenile live in rivers even 3 years (Kato, 1985; on Okazaki, 1989). Despite the variation of freshwater age in different regions, almost all masu salmon spent only one winter in the ocean (Machidori, Kato, 1984; Tsygir, 1988).

Some male masu salmon mature in rivers at the parr stage and do not migrate to ocean (Tsiger et al., 1994). Such mature male

parr are known through whole area of distribution of sea-run masu salmon: from Honshu and Korea in the south to Western Kamchatka in the north. Therefore, the sex ratio in smolt is inclined toward females through whole area of distribution of anadromous masu salmon (Machidori, Kato, 1984). In populations of Honshu Island sometimes 100% of male are matured as parr and only female are anadromous fish. So, the percentage of male smolt increases from 0% in the south region to more than 40% in the northern populations.

Despite of usually masu salmon live only one year in the sea, the body size of adults varies in different regions of reproductions. Large sized fish reproduce mainly in rivers of mainland coast (Primor'e, Amur River, North Korea), and in Honshu. Small sized fish spawn in some regions of Sakhalin and Hokkaido. Therefore size of fish as well as sex ratio can be used for determination of origin of masu salmon in the sea (Tanaka, 1965; Machidori, Kato, 1984).

The information on the marine migrations of masu salmon is limited. Almost all data on marine life of masu salmon were obtained and generalized mainly by Japanese scientists (Tanaka, 1965; Machidori, Kato, 1984; Kato, 1991). In general they may be described as follows.

The seaward migration of masu salmon smolt usually take place in spring and summer (from late April to June). Immature masu salmon in the Sea of Japan begin migrate northward when surface water temperature increases in summer. Immature fish from Pacific Ocean's side of Japanese Islands also shift northward moving to the Okhotsk Sea (Machidori, Kato, 1984).

The Okhotsk Sea is the main residence of R.0+ age juvenile masu salmon in summer (Machidori, Kato, 1984). In the Pacific Ocean in summer just a few immature masu salmon were caught (Machidori et al., 1978). Small amount of immature fish probably

does not leave Japan Sea in summer and remains in its northern part. However the abundance of juvenile masu there has been assumed to be low because of surface water temperature in the northern part of Tatarskiy Strait exceed 14 C. Usually there were no catches of immature masu salmon in waters of the Sea of Japan with such surface water temperature.

In autumn water temperature decreases and masu salmon leave the Okhotsk Sea moving southward. The main migration occurs along the Japanese Islands which are achieved in late October-December. On the basis of enzyme analyze and biological information (freshwater age and sex composition) T. Okazaki (1989) found that masu salmon migrated in inshore waters of Hokkaido is originated from different regions. Also it was concluded that masu salmon from the northern regions migrate further southward.

It's known that usually about 90-95% of sea-run adults from rivers of Japanese Islands are fish who spent 1 year in rivers. At the same time in the samples of masu salmon collected in waters near Hokkaido there were many fish who spent 2 winters in rivers. Consequently, many fish migrating near the Japanese Islands aren't originated from rivers of Japan. Fish which spent 3 winters in rivers were also revealed among migrated through the Japanese waters. Judging from the fact that fish with such long freshwater life are known from Western Kamchatka only, it was concluded that masu salmon from Western Kamchatka also migrates along the Japanese Islands (Okazaki, 1989).

Although size of masu salmon is small (25-40 cm) in autumn and winter, such fish already become the object of fishery. Season of pole and line fishery in coastal waters of Hokkaido begins in early November and reach a peak in December-January. While water temperature decreases, main area of fishery shifts to coastal waters of Honshu, where it reaches a peak in March (Machidori, Kato, 1984). As it was said earlier, fish from

different regions of reproduction migrate in coastal waters of Japanese Islands. Consequently, masu salmon from rivers of Russia are caught by Japanese fishermen beginning from autumn.

Marine fishery of masu salmon is separated on fishery in inshore and offshore waters. The inshore fishery usually is conducted within one mile of shore and until 100 m depth. It starts in late autumn and continue through winter and spring until summer (Tanaka, 1965; Machidori, Kato, 1984).

Except the southward migration of masu near Japanese Islands the migration along the Primor'e coast has been assumed (Machidori, Kato, 1984). Indeed, the researches conducted by TINRO revealed that from late autumn to early winter in inshore waters of Primor'e the small quantity of masu is caught. However water temperature near Primor'e decrease to 2 C in November, and to 0 C from January to March, which are the months of lowest water temperature in the Sea of Japan (Machidori, Kato, 1984). Probably in relation to this fact abundance of migrating along the Primor'e coast masu salmon is low against than along Japanese Islands.

In winter and early spring the 200-miles Economic zone (EZ) of Russia is almost not suitable for salmons because of low water temperature. Due this fact masu salmon are forced to move southward or eastward of Primor'e coast in winter. Therefore the majority of masu salmon from whole species' area in winter and early spring period of marine life distributed out off the EZ of Russia and inside EZs of others countries of the Sea of Japan (Japanese, North-Korean and South-Korean EZs).

The main places of wintering are located in central part of Japan Sea in the zone of Tsushima Current with surface water temperature 8-12 C (Tanaka, 1965; Birman, 1972; Machidori, Kato, 1984). The pink salmon also are occurred in this area (Tanaka, 1965; Birman, 1972). The minority of masu salmon is

distributed from Pacific Ocean side of Japan.

In the central part of the Sea of Japan masu salmon originated from different regions of reproduction is distributed. It has been corroborated from tagging and biological information. Tagged in the central part of Japan Sea fish were recovered in rivers of Primor'e, in coastal waters of Sakhalin and in coastal waters and rivers of Japan (Fukataki, 1970; Machidori, Kato, 1984). It is difficult to determine the origin of fish recovered in the sea, because of masu might to move further into rivers of Primor'e, Sakhalin or another places.

A significant part of fish from central part of Japan Sea shifts to Primor'e when water temperature increases in spring (Tanaka, 1965; Machidori, Kato, 1984). It's allows to say that those fish are originated from Primor'e rivers. Many fish caught near Western Kamchatka had hooks in their mouths. Those hooks are used in Japan Sea in longline fishery. It is evidenced that masu salmon from Western Kamchatka also is wintered in Japan Sea (Shimazaki, 1971). High percentage of male in waters near Honshu in area of 38-39 N in early March is evidenced on the presence of fish from northern areas of reproduction there.

The season of fishery in offshore waters of Japan Sea Japanese fishermen start to conduct in late February or early March. Masu and pink salmon are caught by longlines and gillnets. The main object of fishery is pink salmon as the most abundant species. However in the beginning of season the low abundance and small size of pink make masu salmon relatively important. Therefore, in March the fishermen concentrate their efforts on fishing for masu salmon (Tanaka, 1965; Machidori, Kato, 1984).

Until 1973 the catch of masu was not separated from catch of pink. And from 1973 the number of caught pink and masu is calculated separately if possibly and data on both species was represented to FAO (Machidori, Kato, 1984). Accordingly to these

data the catch of masu salmon in Japan Sea in 1973-1991 years was from 1.725 to 4.100 (on average 2.927) thousands tons (FAO, 1977-1991) or about 2 millions fish (Machidori, Kato, 1984). These figures are small against the chum and pink, but they are comparable with the marine catch of chinook and coho (FAO, 1977-1991). Southern and Northern Korea also are conducted salmon fishery in the Sea of Japan. There is no information on the masu salmon catch of those countries available.

Before 1977 (when 200-miles EZs were introduced) Japanese fishermen conducted fishery widely in the Sea of Japan and also in the coastal waters of Primor'ye (Tanaka, 1965; Machidori, Kato, 1984) where salmons migrate in spring. Introduction of 200-miles EZs decreased the area of Japanese fishery in the Sea of Japan mainly to the waters of Japanese EZ. Beside this, Japanese fishermen caught salmons in EZ of Northern Korea according to nongovernmental agreement and paid compensation (Valencia, 1989). There is almost no reproduction of pink salmon in Korea Peninsula and abundance of masu salmon much smaller than in rivers of Russia. Consequently, salmons distributed in the EZ of North Korea are originated mainly from Russia.

As it was already mentioned, in the places of fishery in the Sea of Japan and Pacific Ocean masu salmon originated from different regions are habitat. Consequently, fishermen caught masu salmon originated from mainland coast of Russia, Sakhalin, Japan and other regions. Judging from the fact that majority of masu salmon is reproduced in rivers of Russia, it can be concluded that significant part of fish caught in the Sea of Japan are originated from Russia.

The masu salmon populations of Middle and Northern Primor'ye are the most abundant. Before the War abundance of this species was higher than now. Some years the catch of masu was greater than pink salmon (on weight). In Northern Primor'ye in 1928-1943

years annual catch of masu varied from 600 to 1200 tons (on average 770 tons). In Tumnin River annual catch was about 100,000 fish, in Botchi, Koppi and Samarga rivers - about 30,000 fish per river. In more short rivers of Middle and Southern Primor'e 5,000-10,000 fish were caught. Relatively high abundance of masu salmon was also in Amur River where annual catch was 830 tons or about 300,000 fish (Semenchenko, 1989).

In 50-years the abundance of masu salmon was strongly decreased. Undoubtedly, the development of Japanese fishery in the Sea of Japan was one of the reasons of that. In 1957 the fishery of masu salmon was prohibited in Primor'e. However, abundance of masu salmon in rivers of Primor'e and, probably, in other regions continue to decrease. The marine fishery, unlawful fishery of adults in coastal waters and in rivers, and angling of juvenile in rivers inhibit the restoring of masu salmon stocks.

Next arrangements were offered for the improvement of masu salmon resources (Tsygir, 1993): 1) to formate international commission on regulation of fishery and reproduction of masu and pink salmon; 2) to work out the scientific program for percentage estimation of fish originated from different regions in mixed catches; 3) to regulate the fishery in offshore, coastal waters of the Sea of Japan and in rivers.

Despite of obviousness of these suggestions its realization is difficult. In the context of Convention on the conservation of Anadromous Stocks in the North Pacific ocean, signed in 1992, the masu salmon is mentioned. However really statements of this document are not distributed on this species, because region of Convention's application is the waters outside of the EZs, and marine migrations of masu salmon occur entirely inside the EZs of countries of the basin of Sea of Japan: Russia, Japan and North Korea. In Russian-Japanese agreement on fishery masu salmon does not mentioned as the object of fishery. So, achieved agreements

do not forbid marine fishery of masu salmon from rivers of Russia in the EZs of other countries (Kurmazov, Tsygir, 1993).

In relation to this fact it's necessary to conclude a principally new agreement between the countries of the Sea of Japan basin which will be valid inside the EZs. Signing of such document likely is not possible in near future, but study of marine life of masu salmon should be helpful to that. In this connection the next joint international investigations are offered.

1) Study of distribution of masu salmon in the Japan Sea in winter and spring; 2) scale sampling from commercial sea fishery; 3) scale sampling from inshore fishery; 4) scale analyze of masu salmon from different areas of reproduction and marine catches; 5) tagging of adult fish in Japan Sea in spring; 6) genetic studies to search for criteria of stocks determination.

Investigations in these directions will be allow to got new information on marine life of masu salmon, to estimate the split of the catch and will be the basis for regulation of marine fishery of masu salmon. The fishermen of different countries of basin of the Japan Sea basin must be interested in conservation of masu salmon resources in Russian waters, because decreasing of masu salmon resources in Russia will lead to decreasing their catches of this species.

References

- Birman, I.B. 1972. Some problems on biology of masu salmon. -
Izvestiya TINRO, 82: 234-247. (In Russian)
- FAO. 1977 yearbook of fishery statistics. vol. 44.
- FAO. 1991 yearbook of fishery statistics. vol. 58.
- Fukataki, H. 1970. Further notes on migration of the masu salmon, *Oncorhynchus mason* (Brevoort), in the Japan Sea as

- determined by tagging.- Bull. Jpn. Sea Reg. Fish. Res. Lab., 22: 1-14.
- Kato, F. 1991. Life history of masu and amago salmon (*Oncorhynchus masou* and *Oncorhynchus rhodurus*) - in book: "Pacific salmon life histories", edited by C. Croot & L. Margolis, Canada, UBC Press, Vancouver, p. 447-520.
- Kurmazov, A.A. and V.V. Tsygir. 1993. The necessity of international cooperation for rational utilization of masu salmon resource.- Bull. Far-East. Branch, Russian Academy Sci., 1: 13-17.
- Machidori, S. and F. Kato. 1984. Spawning populations and marine life of masu salmon.- Bull. NIP, N 43,- 138 pp.
- Machidori, S., S. Okazaki and J. Ogasawara. 1978. Masu salmon found in offshore waters in the northwestern North Pacific Ocean.- Bull. Far Seas Fish. Res. Lab., 16: 1-7.
- Okazaki, T. 1989. Populational structure of masu salmon during wintering migration along the coastal waters of northern Japan. - *Physiol. Ecol. Japan, Spec. Vol. 1*: 359-369.
- Shimazaki, K. 1971. Notes on biological characteristics and migration of the masu salmon, *Oncorhynchus masou* (Brevoort), in the offshore areas of the west coast of the Kamchatka Peninsula.- Bull. Fac. Fish., Hokkaido Univ. 22(1): 37-46.
- Semenchenko, A.Yu. 1989. Primor'e masu salmon.- Vladivostok: DVO AN SSSR, 192 p. (in Russian)
- Tanaka, S. 1965. A review of the biological information on masu salmon (*Oncorhynchus masou*).- Bull. Intern. North Pacific Fish. Comm., 16: 75-135.
- Tsiger, V.V., V.I. Skirin, N.I. Krupyanko, K.A. Kashkin and A.Yu. Semenchenko. 1994. Life history forms of male masu salmon in South-Primor'e, Russia. - *Canadian Journal of Fisheries and Aquatic Sciences*, 51(1): 197 - 208.
- Tsygir, V.V. 1988. Age of masu salmon.- *Vopr. Ikhtiologii*, 28(2):

248-258. (in Russian)

Tsygir, V.V. 1993. Marine migrations and fishery of masu salmon. - Rybn. khozjaistvo, 2: 25-26. (In Russian)

Valencia, M.J. 1989. International Conference on the sea of Japan. Transnational ocean resource management issues and options for cooperation. A report of the conference held at the Hotel Niigata, Japan, 11-14 October 1988. East-West Environment and Policy Institute, Occasional paper N 10, 239 pp.