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ON THE TYPE SPECIMENS OF *SALMO MACROSTOMA*, *ONCORHYNCHUS ISHIKAWAE* AND *O. RHODURUS*

SEIRÔ KIMURA

Department of Fisheries, Faculty of Agriculture, Kyushu University, Fukuoka City, 812, Japan

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Seirô Kimura (1990) On the type specimens of *Salmo macrostoma, Oncorhynchus ishikawae* and *O. rhodurus. Bull. Inst. Zool., Academia Sinica* 29 (3, Supplement): 1-16. It is concluded from examination of holotypes that the following scientific names apply to the *Oncorhynchus masou* complex: *Oncorhynchus masou masou* (Brevoort) for the anadromous masu salmon and land-locked Yamame, *O. masou ishikawai* Jordan and McGregor for the Amago and sea-run Satsuki salmon, and *O. masou* subsp. for the Biwa salmon.

Taxonomy and nomenclature of these salmon have been so much confused that the present author observed the type specimens of *Salmo macrostoma* Günther, *Oncorhynchus ishikawae* and *O. rhodurus* both named by Jordan and McGregor (1925). The three type specimens are each equivalent to the three holotypes, since they were used to provide the original descriptions and illustrations. After his observations, the author attained the following results. *S. macrostoma* is a synonym of *O. masou. O. ishikawae* has certain validity for the Amago and sea-run Satsuki salmon, but *O. rhodurus* which is currently used for Biwa salmon is a synonym of *O. ishikawae* or *O. masou.* Therefore, the Biwa salmon has no adequate name for present use. The morphological differences among these fishes are not always significant and the natural geographical distribution was clearly separated in the past. The author considers the differences among members of this taxon, *O. masou*, as subspecific.

Key words: Formosan Yamame, Masu salmon complex, Nomenclature, Type specimens.

The masu salmon complex in Japan is comprised of the anadromous masu salmon, its parr and land-locked form, the Yamame, *Oncorhynchus masou masou* (Brevoort), the Amago as well as its sea-run form, the Satsuki slamon, *O. masou ishikawai* Jordan and McGregor, and the lacustrine Biwa salmon, *O. masou* subsp. (Kimura, 1989). These forms are so alike in external morphology, meristic characters and life history that their taxonomy and nomenclature have been involved in much confusion. This undesirable state is partly caused by vagueness of their original descriptions and localities. In order to find a solution of the taxonomic problems of this masu salmon complex, it was necessary to re-examine the type specimens of *Salmo macrostoma* described by

Günther (1880), as well as *Oncorhynchus ishikawae* and *O. rhodurus* both described by Jordan and McGregor (1925) (Kimura, 1989). The present author had the opportunity to observe these type specimens in the summer of 1986, and now reports the following results concerning the taxonomy and nomenclature of this taxon.

TAXONOMIC CHARACTERS AND NOMENCLATURE OF THE MASU SALMON COMPLEX

According to Oshima (1957) and Kato (1973a, b; 1975; 1978a, b), the masu salmon and its land-locked form, the Yamame, are distinguished from the Amago including its sea-run form, the Satsuki salmon, and the parr of lacustrine Biwa salmon in never showing crimson spots on the body sides and in possession a distinctive scale structure. Scales of the masu salmon differ from those of the Amago and Biwa salmon in having a few ridges displayed in the exposed area of posterior field, but almost all ridges of the scale of Biwa salmon are continuous even in the exposed area (Kato, 1978a; Kawashima and Suzuki, 1968; Kobayashi, 1951, 1955; Oshima, 1934, 1957). Also, Kato (1978) recognized the scales of the Amago and its sea-run form have fewer ridges in the exposed area than those of the Biwa salmon, viz. the scales of the former show intermediate structure between the latter and masu salmon. Kato (1973a, b) reported that the crimson spots of Biwa salmon disappear completely when they descend into the lake, but the Amago and sea-run Satsuki salmon possess these beautiful spots throughout their lifetime. Furthermore, Kato (1973a, b) claimed that the Amago and Satsuki salmon differ from the Biwa salmon in having fewer pyloric caeca and more transverse scales. Geographical distribution of each subspecies was discussed by Oshima (1957) and Kimura (1989). According to these authors, the range of each subspecies had been scarcely over-lapped in nature.

Besides the above subspecies, the Formosan Yamame, *O. masou formosanus* (Jordan and Oshima), has been discriminated from Japanese forms by having lower fin ray counts (Behnke, 1959; Behnke, et al., 1962; Watanabe and Lin, 1985).

Historical reviews of the nomenclature of the masu salmon complex is shown in Table 1.

Brevoort (1856) gave the name of *Salmo masou* to the anadromous masu salmon using a colored illustration (Pl. IX, 2) to serve as a description. This figure was drawn by an artist who had joined U.S. Expedition to China and Japan under the command of Admiral M. C. Perry. Although Brevoort (1856) described the morphology of it as *Salmo orientalis* Pallas, this specific name was found to be the synonym of *O. tschawytscha* (Walbaum) (Behnke *et al.*, 1962; Oshima, 1957). This illustration metioned above clearly shows external characters of the anadromous masu salmon. Another illustration of *Salmo* sp. (Pl. X, 1) of Brevoort (1856) may be considered as that of the smolt of the same salmon, since it has a black tipped dorsal and black margined caudal fins and dark parr marks. Hilgendorf (1876), Kitahara (1896) and Jordan and Snyder (1902) each made a mistake in the identification of the parr and land-locked form of this salmon. The former

Table 1. Outline of historical review of nomenclature of the masu salmon complex.

	Masu salmon & its land-locked form, Yamame *Oncorhynchus masou masou* (Brevoort)	Amago & its sea-run form, Satsuki Salmon *O. masou ishikawai* Jordan & McGregor	Biwa salmon *O. masou* subsp.
Brevoort (1856)	*Salmo masou*		
Hilgendorf (1876)	*O. Perryi* (Brev.?) *O. Yessoensis*		
Günther (1880)	*S. macrostoma*		
Kitahara (1896)	*O. perryi* Hilg.		
Jordan & Snyder (1902)	(Sea-run masu salmon) *O. masou* (Brev.) (Parr and land-locked form of masu salmon complex)		
	S.	*perryi*	Brev.
Kitahara (1904) Jordan (1905)	*S.*	*masou*	Brev.
Jordan, Tanaka & Synder (1913) Jordan & Thompson (1914)	*O.*	*masou*	(Brev.)
Jordan & Oshima (1919)	(Formosan Yamame) *S. formosanus*		
Jordan & McGregor (1925)	*O. kisutch* (Wal.) *O. macrostomus* (Günther) *O. ishikawae*	*O. ishikawae* *O. macrostomus* (Günther)	*O. rhodurus*
Tanaka (1929)	*O. kisutch* (Wal.)	or *O. milktschitsch* (Wal.)	
Oshima (1934, 1957) Okada & Nakamura (1948) Kobayashi (1951, 1955) Aoyagi (1957) Hikita (1962)	*O. masou* (Brev.)	*O. rhodurus* J. & McG.	

Table 1. (Continued)

Matsubara (1955)	*O. masou* var. *masou* (Brev.) (Yamame), *O. masou* var. *ishikawae* (J. & McG.)	*O. rhodurus* var. *macrostomus* (Günther)	*O. r.* var. *rhodurus* J. & McG.
Kimura & Nakamura (1961) Nakamura (1963) Ichthyol. Soc. of Japan (1981)	*O. masou* (Brev.)	*O. rhodurus* J. & McG.	
	Furthermore another species, *O. iwame* Ki. & Na., listed		
Behnke (1959)	*O. masou* (Brev.) (Formosan Yamame) (J. & Oshi.) *O. formosanum*		
Teng (1959)	(Formosan Yamame) *O. masou masou* (Brev.)		
Behnke et al. (1962)	*O. masou masou* (Brev.) (Formosan Yamame) *S.* spp. ? *O. masou* subsp.	*O. m. rhodurus* J. & McG.	
Miyadi et al. (1976)	*S. (O.) masou masou* (Brev.)	*S. (O.) masou macrostomus* Günther *S. (O.) masou macrostomus* Günther f. *iwame* Ki. & Na.	*S. (O.) masou macrostomus* Günther f. *ishikawai* J. & McG.
Araga & Ida (1984)	*O. masou masou* Brev.	*O. masou formosanus* Günther	*O. masou rhodurus* J. & McG.
Kato (1985)	*O. masou masou* (Brev.)	*O. masou ishikawae* J. & McG.	*O. masou rhodurus* J. & McG.
Watanabe & Lin (1985)	(Formosan Yamame) *O. masou formosanus* (J. & Oshi.)		
Kato (1988)	*O. masou* (Brev.)	*O. ishikawai* J. & McG.	*O. rhodurus* J. & McG.
Kimura (1989)	*O. masou masou* (Brev.)	*O. masou ishikawai* J. & McG.	*O. masou* subsp.

two authors considered them as *O. perryi* and the last one as *S. perryi*. However, this specific name had already been given to the Japanese huchen, Itô, *Hucho perryi* (Brevoort), as were later pointed by Kitahara (1904) and Jordan (1905).

The other members of the masu salmon complex which show a scattering of crimson spots on the body sides have not been recorded from Japan for many years. In 1925, Jordan and McGregor described three species with crimson spots, viz. the Amago, *O. macrostomus* (Günther), the smolt of Satsuki salmon, *O. ishikawae*, and the Biwa salmon, *O. rhodurus*. They neglected at all the anadromous masu salmon and its land-locked Yamame as the derivatives of the silver salmon, *O. kisutch* (Walbaum), and failed to notice crimson posts as an important taxonomic character in the masu salmon complex of Japan. Also, their localities are much confused. Moreover, specimens and localities of the parr and land-locked form of *O. masou masou* were mixed with types of each species identified and named by Jordan and McGregor (1925). After a time, their vague descriptions and confusing localities gave rise to considerable chaos in the classification of the masu salmon complex. This confusion remained until Kato (1985) published his excellent work (Table 1). However, Kato (1985) did not observe any specimen equivalent to the holotype of the currently recognized taxa as yet. Furthermore, Kimura and Nakamura (1961) reported the Iwame, *O. iwame*, as a new species, but later Kimura (1989) recognized this fish as a mutant of the Amago or Yamame based upon the results of hybridization experiments by Yamanouchi (1982) and Ida (1982).

MORPHOLOGICAL CHARACTERS OF THE TYPE SPECIMENS

There is no type specimen of *O. masou* (Brevoort). Measurements and counts, by the present author, of the type specimens of *S. macrostoma* Günther, *O. ishikawae* and *O. rhodurus* together with of *O. macrostomus* which have been described by Jordan and McGregor (1925) are shown in Table 2.

Type specimen of *Salmo macrostoma* Günther.

A single specimen of *S. macrostoma* Günther (Fig. 1A, Table 2) was obtained at Yokohama Market on May 14, 1879 when H. M. S. Challenger visited to Japan. This specimen is in the possession of the British Museum (Nat. Hist.) and is considered to be the holotype of the current systematics. This specimen is preserved in ethanol and 223.5 mm in standard length. Its viscera and the gills had been completely removed.

It is probably a mature male, because the head is somewhat modified and having remarkably pointed snout. But there is only found a slight degree of hooking of the jaws and snout. The mouth is large and oblique. The end of the upper jaw is projects beyond the posterior margin of the eye. Small but stout teeth are present on both jaws, head and shaft of the vomer, palatines and tongue. The surface of the basibranchial bone is entirely toothless. There are narrow spaces between the head of the vomer and palatines. Small cycloid scales cover the surface of the body. The ridges of the scale, except 8 or 9 near the focus, do not invade into the posterior field (Fig. 2).

The coloration of this specimen faded

Fig. 1A. The type specimen of *Salmo macrostoma* Günther, 223.5 mm SL, male, obtained at Yokohama Market on May 14, 1879. Possessed of Brit. Mus. (Nat. Hist.).

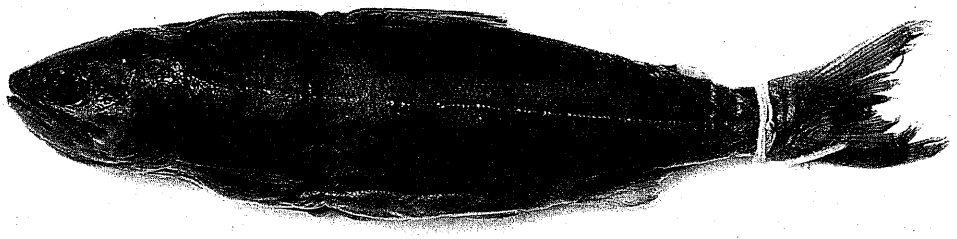

Fig. 1B. The type specimen of *Oncorhynchus ishikawae* Jordan and McGregor, 151.2 mm SL, male, collected from Lake Biwa. Now possessed of Field Mus.

Fig. 1C. The type specimen of *O. rhodurus* Jordan and McGregor, 446.0 mm SL, mature male, collected from Lake Hakone on Nov. 20, 1920. Now possessed of Field Mus.

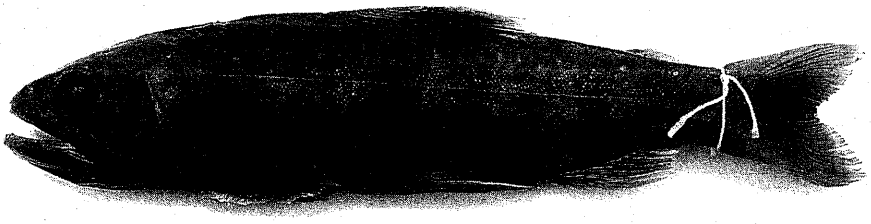

Fig. 1D. The specimen of *O. macrostomus* (Günther) recorded by Jordan and McGregor (1925), mature male, 129.9 mm SL, collected from Lake Biwa in 1920. Now possessed of Field Mus.

Table 2. Measurements and counts of the type specimens of *Salmo macrostoma*, *Oncorhynchus ishikawae*, *O. rhodurus*, and *O. macrostomus* recorded by Jordan and McGregor (1925).

	Type *Salmo macrostoma* Günther B.M. May 14, 1879	Specimen *Oncorhynchus ishikawae* J. & McG. F. M. C. No. 58682 & C. M. C. F. No. 7786	of *O. rhodurus* J. & McG. F. M. C. No. 59389 & C. M.C. F. No. 7794	(Not type spec.) *O. macrostomus* (Günther) F. M. C No. 58687 & C. M. C. F. No. 7791
In mm				
Total length	260	181.8	513.0	156.4
Standard length	223.5	151.2	446.0	129.9
Body depth	60.0	37.5	137.0	31.0
Head length	57.6	41.0	151.0	36.4
Snout length	17.2	9.7	–	8.2
Length of upper jaw	33.3	22.7	111.0	23.5
Diameter of eye	11.2	8.4	17.4	9.4
Interorbital space	15.8	11.0	49.0	10.1
Depth of caudal peduncle	20.0	12.9	46.6	13.5
In number				
Dorsal fin rays (branched ones + 1)	13	12	12	12
Anal fin rays (branched ones + 1)	14	12	13	12
Scales above lateral line	35	34	36	35
Scales	132	135	136	137
Scales below lateral line	–	27	33	27
Branchiostegal rays (left-right)	12–11	13–12	12–11	13–12
Gill rakers	–	9+12=21	7+11=18	6+12=18
Pyloric caeca	–	51*	42*	–
Vertebrae	64	65*	63*	–
Sexuality	Male	Male	Male	Male
Locality	Yokohama Market	Lake Biwa	Lake Hakone	Lake Biwa
Date	May 14, 1879		Nov. 20, 1923* Nov. 20, 1920	–

* After Jordan and McGregor (1925)

Fig. 2. Microphotograph of scale of the type specimen of *S. macrostoma* Günther.

considerably because of more than 110 years storage in alcohol. The head and body are pale brown, but guanine of the surface of scales remains. Under this silvery layer, traces of 8 or 9 parr marks are vaguely seen. Black spots on the dorsal part are almost faded out. Günther (1880) recorded neither crimson spots nor whitish traces of them. The present author did not observe any trace of crimson spots on the body sides.

Günther (1880) discriminated this specimen from *O. masou* (Brevoort) by its remarkably pointed snout, longer upper jaw and by wide oblique mouth.

The type specimen of *Oncorhynchus ishikawae* Jordan and McGregor

The type specimen of *O. ishikawae* Jordan and McGregor (Fig. 1B Table 2, Field Mus. Cat. No. 58682, and Car. Mus. Cat. Fish. No. 7786) was collected by Dr. Y. Wakiya from Lake Biwa. No date of capture was recorded. This specimen, preserved in ethanol, was transferred to the control of the Field Museum of Natural History in Chicago from that of the Carnegie Museum in Pittsburgh on June 18, 1952. The description and illustration (Pl, VI, 1) found in Jordan and McGregor (1925) were based upon this specimen. Therefore, this may be equal to the holotype of current systematics. According to the original description, this is a young male specimen.

It is 151.2 mm in standard length without viscera and testes. The description and illustration of general morphology for this specimen by Jordan and McGregor (1925) are very accurate. Thus, it is not necessary to re-describe its characters of details. Sexual dimorphism is not developed. Small but stout canine teeth are on the jaws, tongue, palatines and head and shaft of the vomer. The surface of the basibranchial bone is entirely toothless. Spaces between the head of vomer and platines are nearly equal to the diameter of pupils. The scale structure of this specimen is shown in Fig. 3. Ten or more ridges form continuous circle, and almost of all others invade intermittently into exposed area of the scale.

The coloration of the body is dark brown and without remaining silvery

Fig. 3. Microphotograph of scale of the type specimen of *O. ishikawae* Jordan and McGregor.

guanine. Pigments are darker nearer the dorsal margin. Many discolored whitish traces of crimson spots are dotted on the flank above the lateral line. The tip of the dorsal fin is definitely dipped with black color. The posterior margin of the caudal fin shows a blackish tint. There are no black spots on the back, but 4 and 1 are shown on the base of dorsal and adipose fins, respectively.

Jordan and McGregor (1925) distinguished this specimen from *O. macrostomus* (Günther) and *O. rhodurus* by the black blotch at the tip of the dorsal fin.

The type specimen of *Oncorhynchus rhodurus* Jordan and McGregor

The type specimen of *O. rhodurus* Jordan and McGregor (Fig. 1C, Table 2, Field Mus. Cat. No. 59389 and Car. Mus. Cat. Fish. No. 7794) was collected from Lake Hakone (Lake Ashinoko) on November 20, 1920 and presented by Mr. H. K. Yamagishi. It is preserved in ethanol, 446.0 mm in standard length and fully mature male. This specimen was also transferred from the Carnegie Museum to the Field Museum in 1952. The original description and illustration (Pl. VII, 1) by Jordan and McGregor (1925) were based upon this specimen. This may be equal to the holotype of current taxonomy. The specimen was extremely distorted that it would be very difficult to give an accurate description and illustration.

As to the type specimen, secondary sexual characters of *Oncorhynchus* are typically shown. The depth of the body is rather high and the predorsal region rises towards the dorsal region with a moderate gradient and is evidently ri lged. The head is very large. Skeletal modification of the head elements is significant. The eyes are rather small. The mouth is very large. The snout is elongated and very pointed. The lower jaw is shorter than the upper one. The anterior part of the dentary curves towards upper jaw. Some large breeding teeth are developed at tip of the dentaries and the largest tooth fits into a small white hole which was observed just inside of a row of large breeding teeth on the premaxilla. The kype was not developed. The snout curves sharply downwards. Stout teeth are present on the jaws, tongue, palatines and head of the vomer, but teeth of vomerine shaft were not seen. These may have been in the palatal flesh. The surface of the basibranchial bone is entirely toothless. The exposed area of the scales are completely absorbed. And the scales stick so solidly under the skin that the present author failed to observe their structure.

The coloration of the type specimen is light brown, however, dorsal part is more or less darker. Black spots are scattered on the upper flanks. Neither parr marks nor whitish traces of crimson spots were observed on the body. The dorsal parts of the head and jaws are remarkably black and the inside of the mouth is blackish.

Jordan and McGregor (1925) distinguished this species from the others by the specific scale structure, which has many ridges invading into the exposed area.

Besides the three type specimens listed above, the author also observed a specimen of *O. macrostomus* (Günther) (Fig. 1D, Table 2, Field Mus. Cat. No. 58687, Car. Mus. Cat. Fish. No. 7791), which was illustrated (Pl. VI, 2) by Jordan and McGregor (1925). This specimen was also transferred from

the Carnegie Museum to the Field Museum in 1952. It is preserved in ethanol with the viscera completely removed. It is a mature, male, 129.9 mm in standard length, and collected by Drs. D. S. Jordan and T. Kawamura from Lake Biwa. An accurate date of capture was not recorded. It is not a type specimen.

The general body form is similar to that of *O. ishikawae*, but differs from it in not showing a black blotch on the tip of dorsal fin. Many whitish traces of crimson spots are distributed on the body sides above and slightly below the lateral line. The eyes are larger and snout somewhat shorter and not so pointed. The teeth found on the elements of the mouth are similar to those of the type specimen of *O. ishikawae*. The basibranchial bone is toothless. Moreover, Jordan and McGregor (1925) illustrated another immature male specimen (Pl. VI, 3) which had no trace of crimson spots. The present author did not observe this specimen.

Jordan and McGregor (1925) distinguished these specimens from *O. rhodurus* by the marked difference in scale structure and from *O. ishikawae* by total absnece of black blotch on the tip of dorsal fin.

DISCUSSION

The type specimen of *S. macrostoma* Günther (Fig. 1A) does not show any whitish trace of crimson spots and has scales with only 8 or 9 continuous ridges in the exposed area (Fig. 2). Sometimes, old formalin and ethanol specimens of the Amago including Satsuki slamon, and parr of the Biwa salmon do not have any trace of crimson spots. However, the scale structure of this type specimen agrees well with that of both the masu salmon and the land-locked Yamame shown by Kato (1978a), Kobayashi (1951, 1955) and Oshima (1934, 1957). On the other hand, Günther (1880) distinguished this specimen from *S. masou* Brevoort by the remarkably pointed snout and wide mouth, but such features are good examples of sexual dimorphism also observed in the male specimens of the adult Yamame (Kimura, 1989). Therefore, *S. macrostoma* is apparently considered as a synonym of *O. masou* (Brevoort). It should not be used *macrostoma* and *macrostomus* as a specific or subspecific name for *Salmo* and *Oncorhynchus*.

O. ishikawae was given at the first time to the Amago (Table 1) which has scattering beautiful crimson spots on the body. The original description and illustration of this specimen are very accurate. The external morphology and meristic characters given by Jordan and McGregor (1925) as well as by the present author (Fig. 1B, Table 2) agree well with those of Amago and its sea-run form published by Kato (1973b, 1978a) (Table 3). The type specimen also resembles parr of the Biwa salmon, but differs in having more oblique scales above the lateral line (34) and most ridges of the scale invade intermittently into the exposed area (Table 3, Fig. 3). Such characters only apply to the Amago and Satsuki slamon (Kato, 1973b, 1978a). Although Jordan and McGregor (1925) distinguished *O. ishikawae* from both *O. macrostomus* and *O. rhodurus* in having a black blotch at the tip of dorsal fin, this feature appears on the smolt of the masu salmon (Ono, 1933) and of other salmonid fishes

Table 3. Taxonomic characters of the masu salmon complex.

	Land-locked Yamame *O. masou masou* N = 15	Amago and sea-run Satsuki salmon *O. masou ishikawai* N = 91	Biwa salmon *O. masou* subsp. N = 33
Crimson spots	None	Present	Present (only parr)
Pyloric caeca	32 – 48	32 – 58	46 – 77
Scales above l. l.	26 – 32	25 – 34	21 – 27
Scales below l. l.	24 – 29	25 – 37	21 – 29
Ridges in exposed area of scale	A few ones invade	Some ones invade and others intermittently	All ones invade
Authors	Kimura (1989)	Kato (1973b, 1978a)	

(Ishida, 1948). Such a feature should not be adopted in a taxonomical key. Thus, *O. ishikawae* has obvious validity for the Amago and its sea-run form, Satsuki salmon.

Jordan and McGregor (1925) recorded *O. ishikawae* from Lake Hakone (Lake Ashinoko) the Shibu River, Kitakami River, Kiso River, Hamada (Shimane Pref.) Toyama Pref. Kumamoto Pref. and Uwajima (Ehime Pref.). According to Oshima (1957) and Kimura (1989), the anadromous masu salmon, its parr and land-locked form, *O. masou*, are distributed as a natural form in these rivers and districts, except Lake Hakone, Uwajima and the Kiso River.

Measurements and counts of the type specimen of *O. rhodurus* by the present author differ clearly from those of the Biwa salmon reported by Kato (1973b, 1978a) (Tables 2, 3). The type specimen of *O. rhodurus* has 42 caeca, 36 and 33 scales above and below the lateral line (Table 2), respectively. These numerical characters are distinctly out of the ranges of the Biwa salmon but are well within those of the Amago, its sea-run form and of the land-locked Yamame (Table 3). Certain members of the masu salmon complex are known to grow up to the size of the type specimen or larger even in lakes and in backwaters of the dams (Kato, 1975). Although the author pointed out that teeth on the vomerine shaft of the type specimen were not observed, such phenomena are often seen on the palate of the fully grown up and mature specimens of this taxon (Kimura, unpublished). Thus, *O. rhodurus* is with certainly considered as a synonym of *O. ishikawae* or *O. masou* (Brevoort). There is no known scientific name that can correctly be assighned to the Biwa salmon for present use. It will be necessary to give a name other than *rhodurus*.

Jordan and McGregor (1925) published photographs of the scale structure of *O. rhodurus* in Pl. VIII, Figs. 1 and 2. Fig. 1 is certainly the scale of the Biwa salmon, but possibly not of the type specimen, for exposed area of the scales

is not absorbed altogether. (As was already stated, the exposed area of scales of the type specimen are entirely absorbed.) In the Field Museum, the present author could not find and observe other designated para-types of *O. rhodurus* having the Similar scale structure to Pl VIII, Fig. 1. The scale shown in Pl. VIII, Fig. 2 has about 25 continuous ridges with the outer ones certainly vanishing in the exposed area which remained narrowly at its edge. Therefore, it is doubtful that Fig. 2 represents a scale of the Biwa salmon, but it could possibly be that of the Satsuki salmon. Jordan and McGregor (1925) also recorded this species from Lake Chuzenzi and Naoetsu, Echigo (Niigata Pref.). The Biwa salmon of the Chuzenzi were introduced from Lake Biwa (Kawashima and Suzuki, 1968). By nature, the Biwa salmon is restricted in Lake Biwa (Miyadi et al., 1976). Naoetsu is within the original ranges of the anadromous masu salmon (Oshima, 1957).

The specimen of *O. macrostomus* which was recorded and illustrated by Jordan and McGregor (1925) (Pl. VI, Fig. 2; Fig. 1D, Table 2 of this text) is apparently the same species to the *O. ishikawae*. They recorded also *O. macrostomus* from the Nagara River, Lake Biwa, Gifu, Lake Hakone (Pl. VI, Fig. 3), the Hiki River (Wakayama Pref.), Himeji (Hyogo Pref.), Kuma River (Kumamoto Pref.), Hamada (Shimane Pref.), Toyama Pref., Fukui Pref., Lake Kizaki, Echizen (Niigata Pref.) and Uwajima. According to Oshima (1957), this fish is distributed as a natural form in the Nagara and Hiki River, Lake Biwa, Lake Hakone, Uwajima, Hemeji and Gifu Prefecture, and other localities are in original ranges of the masu salmon and land-locked Yamame, *O. masou*.

The geographical distributions of valid members of the masu salmon complex were clearly separated (Oshima, 1957). However, the general morphology of the different forms is not always significant. Thus, the author considers that these differences may be of a subspecific level and the following names may be applied for the present

The masu salmon and land-locked Yamame ——*Oncorhynchus masou masou* (Brevoort)
The Amago and sea-run Satsuki salmon ——*O. masou ishikawai* Jordan and McGregor
The Biwa salmon ——*O. masou* subsp.

In the masu salmon complex, one of the most famous forms is the Formosan Yamame, a land-locked native salmon in the subtropical highland reaches of the Tachia River flowing out the Taiwan Strait (Jordan and Oshima, 1919). This salmon was thought to be an example of a glacial relict isolated in Taiwan and respresents the southernmost limit of nature distribution of the salmonid fish in the world today (Kano, 1940). Behnke (1959), Behnke *et al.* (1962), Oshima (1957), Teng (1959) and Yogi and Nakamura (1938) studied the morhology and ecology of this subtropical salmon and stated that it is related to the the masu salmon but not both the Amago and Biwa salmon. Every author except Oshima (1957) noticed that this salmon is having fewer fin ray counts than those of the Japanese forms. In addition, Yogi and Nakamura (1938) pointed out that its body height is higher than Japanese form and caeca number of the Formosan Yamame counted by Teng (1959) is higher than those of Kyushu Island shown by Kimura (1989). At the present time, the author agrees with Behnke et al. (1962) and Watanabe and Lin (1985) who have recognized the

Formosan Yamame as a distinct subspecies, *O. masou formosanus* (Jordan and Oshima).

CONCLUSIONS

After examining the type specimens of *Salmo macrostoma* named by Günther (1880), *Oncorhynchus ishikawai* and *O. rhodurus* both described by Jordan and McGregor (1925), the following conclusions are reached.

The type specimen of *S. macrostoma* can not be discriminated from *O. masou* (Brevoort). Characters used to describe *S. macrostoma* such as pointed snout and wide mouth are merely dimorphic features of mature male residents of the anadromous masu salmon and land-locked Yamame, *O. masou*. The scale structure of *S. macrostoma* agrees well with of *O. masou*. *macrostoma* is obviously a synonym of *masou*.

The original description and illustration of *O. ishikawae* are very accurate. It was the first scientific name given to the Pacific salmon having crimson spots on the body. Jordan and McGregor (1925) distinguished this fish by having a black blotch at tip of the dorsal fin, but such a character can occur generally in smolts of other salmonid fishes. Many whitish traces of crimson spots, numerical counts and scale structure of the type specimen agree completely with those of Amago and sea-run Satsuki salmon. Therefore, *ishikawae* has its valid application for these fish.

On the other hand, *O. rhodurus* which is now used for the Biwa salmon is a synonym of *O. ishikawae* or *O. masou* because its numerical features, such as caeca count and number of oblique scales, differ from those of the Biwa salmon. It follows that the Biwa salmon has no adequate scientific name for present use.

The morphological differences among the masu salmon complex are not always significant and the geographical distribution had clearly separated in the past. Morphological differences are considered as subspecific. The following scientific names for the Japanese members are suggested at present.

Oncorhynchus masou masou (Brevoort) for the anadromous masu salmon and land-locked Yamame.

O. masou ishikawai Jordan and McGregor for the Amago and sea-run Satsuki salmon.

O. masou subsp. for the Biwa salmon.

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三種鮭魚 (*Salmo macrostoma, Oncorhynchus ishikawae, O. rhodurus*) 之模式標本

木 村 清 朗

由基本型模式標本之檢視結果證實櫻鮭複合種包括如下之三種不同學名：代表溯河性及陸封性之 *Oncorhynchus masou masou* (Brevoort)，代表 Amago 及洄游性五月鮭之 *O. masou ishikawai* 以及代表琵琶鱒之 *O. masou* 亞種。當詳細檢查此三種鮭魚之模式標本後，益發使作者對彼等之分類及命名滋生困惑。由於它們均具備原始之描述及圖說，上述之三個模式標本經證實是分別爲三個基本型模式相同的。依作者之觀察結果，確定 *S. macrostoma* 爲 *O. masou* 之同種異名。至於 *O. ishikawae* 用在 Amago 及洄海洋之五月鮭則居較高之可信度。過去用以代表琵琶鮭之 *O. rhodurus* 則爲 *O. ishikawae* 或 *O. masou* 之同種異名。因此眞正的琵琶鮭目前尙無適當的名字給與。上述的這些鮭基本上並無顯著的形態差異，然以往的記錄在在顯示地理隔離的現象。爲此作者深信 *O. masou* 成員間的差異僅止於亞種的範圍。