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Distribution and Structure of *Parasalmo mykiss* Grouping in the Near-Kuril Waters of Pacific Ocean and Okhotsk Sea

by

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ABSTRACT

During the spring-summer period of 1996-2002, SakhNIRO scientists were counting numbers and estimating biological state of salmon from the genus *Oncorhynchus* in the near-Kuril waters of Pacific Ocean and Okhotsk Sea using drift fleet. Annually, beginning from the end of June, one more salmon species from the genus *Parasalmo* – "mikizha" occurred in the gillnet bycatch. A total of 838 individuals of this species were sampled for 7 years of observations; some of them had amputated fins as tags. In this paper we give the data on distribution, ecology, structure, and relative number of the *P. mykiss* grouping in the near-Kuril waters of Pacific Ocean and southern Okhotsk Sea.

INTRODUCTION

Salmon from the genus *Parasalmo* have amphipacific distribution, and they are represented by the complex of species including "mikizha" *(Parasalmo mykiss Walbaum*) as well. In Asia, *P. mykiss* spawn mainly in water bodies of the Kamchatka Peninsula. The river life period of *P. mykiss* is well studied (Savvaitova, Lebedev, 1966; Savvaitova, Maximov, 1967; Kuzischin et al., 1999; Pavlov et al., 2001; Chereshnev et al., 2002). Distribution and ecology of *P . mykiss* in the Pacific Ocean are described in papers of Myers et al. (1990), Myers et al. (1993), Ito et al. (1997), Welch et al. (1998), Fukuwaka et al. (2000), Fukuwaka et al. (2002) and Klovatch N.V. et al. (2002), but in the near-Kuril Pacific waters *P. mykiss* is still weakly studied. In 1996-2002, during studying a pre-spawning migration of salmon from the genus *Oncorhynchus* in the near-Kuril Pacific waters and Okhotsk Sea, a total of 838 *P. mykiss* individuals were sampled. This work is duration of studying anadromous *P. mykiss* in the period of its pre-spawning and feeding migration in the near-Kuril waters of the Pacific Ocean (Kovalenko et al., 2000).

MATERIAL AND METHODS

Materials have been collected during 1996-2002 in the exclusive economic zone (EEZ) of Russian Federation in the near-Kuril waters of the Pacific Ocean and Okhotsk Sea (Fig. 1). In the Pacific Ocean the counting works have been conducted since May 1-15 to August, and in 2001and 2002 – until August 31. In the Okhotsk Sea the count took place in August. Drift gillnets with 120-135 mm mesh being set in night hours in the layer of 0-10 m were used. From

2 to 5 drifter ships took part in these works. A catch per unit effort (CPUE) was calculated as a number of fish caught with one gillnet of 50 m length. In 1996-2002, a total of 838 individuals of *P. mykiss* have been caught in the Pacific Ocean and Okhotsk Sea and taken for a biological analysis.

When conducting biological analyses, we measured fork length, length of the body to the end of the scale covering, weight, and weight without guts, determined sex, gonadosomatic index (GSI), Clark's condition factor. Gonad weight was used as a criterion to divide fish for immature and maturating ones, as it was done by ?.Takagi (1961) for species from the genus *Oncorhynchus*. Fish, having gonad weight ? 10 (males) and ? 20 g (females), were related to the immature group, and fish with gonad weight > 10 (males) and >20 g (females) to the group of maturating fish. This division has a tentative character, and we intend to precise it during further investigations. The spawned fish were identified by the external form of gonads and the existence of a spawning mark on scales. The age was determined by scales using the methodical recommendations of D.S. Pavlov et al. (2001). We have determined the age of 403 individuals of *P. mykiss*.

RESULTS

Five species from the genus *Oncorhynchus* – pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), coho (*O. kisutch*), and chinook (*O. tschawytscha*) occur in the upper epipelagial of the near-Kuril Pacific waters in the spring-fall period of salmon aggregations. Since the late June, one more species of salmonids - "mikizha" (*Parasalmo mykiss*) appeared in catches.

Distribution

P. mykiss were absent in catches in May and major part of June. Only in late May 2002, one specimen was sampled in the extreme south-east of the near-Kuril waters at the surface sea temperature (SST) 5.4º? . First individuals of *P. mykiss* occurred in gillnets in the last days of June or in the first days of July south of 46º N at SST 5.5-7.8?? . In July and August as far as SST increasing up to 7-10º? , *P. mykiss* occurred throughout the area of the near-Kuril waters to 50º30 N inclusive. Evidently, *P. mykiss* enter the Okhotsk Sea not late than the end of July, because in early August we have fished them in the southern part of the sea. *P. mykiss* were not abundant in the study period, CPUE usually was 0.003-0.01, maximum 0.03 ind./net (Fig. 1). Fig. 2A shows that the major *P. mykiss* were sampled within SST of 7 to 11º? .

In late June and first decade of July, the *P. mykiss* grouping consisted only of maturing specimens; a ratio between males and females was 1:3. This ratio remained during July and August. Since the second decade of July with the water warming up to 7-8º? , immature

specimens began to appear in the south of the region, but their portion did not exceed 10% of the grouping abundance in this time period. In July and August the ratio between sexes among immature fish was stable and close to 1:1. With the water warming up to 8-12º? , the number of immature fish increased and reached 70% in the second half of August (Fig. 2B). Due to the fact that the water temperature was lower in the north of the region comparing to the south, in July the mature specimens dominated in the northern part, and immature ones concentrated in the south. In August the immature fish were found in the north of the region, nevertheless, the most dense aggregations they still form on the area located south of 47º N (Fig. 3).

Since the second half of July, the marked specimens appeared in the *P. mykiss* grouping. Marks were the amputated fins: as a rule, an adipose fin, rare an adipose fin together with pelvic, pectoral, or dorsal fins. A total of 122 such fish were sampled in 2001-2002 (Fig. 4, Table in the end of text). Marked fish occurred in catches in late July, but the majority of these fish were sampled in August, when their portion reached 70% of the *P. mykiss* capture.

Age structure and biological characteristic

Almost all *P. mykiss* specimens had scales with 2-3, rare 4 narrow (river) annual growth zone in the central part, and 1-3 wide (sea) annual growth zone in the periphery, the first of which included up to 40 sclerites. All these fish were related to the typical anadromous group. Only about 1% of fish had scales with the relatively narrow first sea (estuarine) zone of growth. The age structure of *P. mykiss* was presented by the following age groups: 2.1, 3.1, 4.1, 2.2, 3.2, 4.2, 2.3, 3.3 and 3.4. The portion of age class n.1 (2.1, 3.1, 4.1) constituted 42%, n.2 (2.2, 3.2, 4.2) – 53%, n.3 (2.3, 3.3) – about 4%, and n.4 – less than 1%.

Age class n.1

The majority of fish (88%) of the age class n.1 were related to the group of immature fish; about 1/3 of them had marks as the amputated fins. The base of the age class was made by fish occurring in fresh waters for two years (72%); 25% of fish were at age 3.1+ , and only 3% at age 4.1+. A range and mean estimates of length and weight of the fish with different numbers of the fresh water growth zones (2.1 ? 3.1) practically were the same. Fish length and weight from this class ranged within 51-69 cm and 1.6-3.7 kg, averaged 60.8 cm and 2.48 kg (Fig. 5? and 5B). The mean length and weight of males and females were approximately equal – 61.3 cm, 2.5 kg for males and 60.2 cm, 2.5 kg for females. The majority of marked fish were longer and more massive than the unmarked ones, that partially caused a bimodal character of the length distribution for fish of the age class n.1 (modes 59 and 65 cm) (Fig. 5C and 5D). There were from 8 to 36 (average 22) wide “summer” sclerites in the second sea growth zone (in “plus”) on scales of fish from the considered class.

Age class n.2

The age class n.2 was formed by the maturing specimens, fish spawned in the year of capture, and immature fish; the portion of the first ones was 85, the second – 7, and the last - 8%. The majority of fish from this class occurred in fresh waters during 2 (42%) or 3 (54%) years. A portion of fish from the age group 4.2+ constituted only 4%. The length and weight of fish occurring in a sea for 2 years, ranged within 62-84 cm and 2.4-6.7 kg, averaged 71.7 cm and 4.21 kg (Fig. 5A and 5B). Males were larger than females: the mean length of males was 75.0 cm (70.4 for females), and mean weight was 4.7 kg (4.0 for females). As a rule, on scales of the maturing fish, there were from 3 to 16, rare 23-25 wide "summer" sclerites (average 9) in the third sea growth zone. The scales of only a small fish group (5%) had not any wide sclerites in the third sea growth zone. The scales of fish spawned in the year of capture were edged with a spawning mark, or the third sea growth zone of 4-6 wide sclerites.

Age class n.3

Specimens from the age class n.3 were less of all in the *P. mykiss* grouping. It was presented both by the maturing specimens and already spawned ones. The length of fish from this class ranged from 68 to 90 cm, averaged 77.8 cm, weight from 3.4 to 8.5 kg, averaged 5.23 kg (Fig. 5A and 5B). The size-weight indices for males were significantly higher than for females. The mean length of males was 83.9 cm (74.8 for females), and mean weight was 6.6 kg (4.6 for females). A half of fish from this age class had scales with 3-9 (average 6) wide sclerites in the forth sea growth zone; the rest fish had not any.

Fish from the age group n.4 occurred sporadically. This group was presented only by the spawned specimens.

Gonad characteristic

A gonad weight of *P. mykiss* ranged greatly – from 1 to 260 g for males and from 1 to 295 g for females. GSI varied within 0.03-4.48 and 0.05-4.61 for males and females, respectively. The smallest gonad weight was at immature specimens from the age class n.1. The weight of testes varied from 1 to 6 g, averaged 2.0 g; GSI from 0.03 to 0.23, averaged 0.08. The weight of ovaries was 1-8, averaged 4.5 g; GSI varied within 0.05-0.17, averaged 0.14. After two years of life in a sea, gonad weight increased insignificantly for immature fish. It was on the average 4.5 for males, and 11.0 g for females (Fig. 6); mean GSI were 0.13 and 0.43, respectively.

Gonads of the major maturing males were at different phases of stage III of maturity. As a rule, the weight of testes ranged within 11-150 g. GSI constituted 0.3-1.8, rare 2.4-3.5. The mean weight of testes of the maturing males from the age classes n.1 and n.2 were 41.6 and 44.9 g, respectively (Fig. 6), and the mean GSI by the same age classes were 1.74 and 0.98.

Almost all maturing females had gonads at different phases of stage III of maturity too. The mean weight of gonads for the maturing females from the age classes n.1 and n.2 were 35.6 and 71.9 ?, respectively (Fig. 6). GSI of females from the same age classes were 1.51 and 1.95. In addition, 3 sampled maturing females had gonads at IV stage of maturity. One of them was sampled in July 10 in the southern part of the region. The gonads of this fish contained large, homogeneous oocytes with the diameter of about 5.0 mm; gonad weight was 415 g, GSI - 17.6. The rest two fish were sampled in July 11 and 26 in the northern part of the region; gonad weight was 495-500 g, GSI – 17.0-17.9.

Among 440 individuals of *P. mykiss* sampled during 2000-2002 there were 17 spawned females and several males from the age classes n.2, n.3 and n.4. In gonads of these fish from 10 to 150 large residual eggs occurred among small oocytes of the next generation. There were almost no oocytes of the next generation at one of the females; gonad weight with residual eggs was only 2 g. The males, identified by the external form of gonads as already spawned, had white-pink gonads of 20-160 g weight. Nevertheless, there was no clearly expressed spawning mark on scales of these fish. All spawned specimens were sampled in the northern part of the region. The extreme eastern point, where the spawned *P. mykiss* female was sampled, had coordinates 50º22 N and 158º20 E (Fig. 3).

Individual condition factor

Due to the age and gonad state, *P. mykiss* were characterized by different condition. Individual condition factor ranged within 0.95-1.83. The immature fish from the age classes n.1 and n.2 were characterized by the least condition; the fish, which have spent 2 complete years in a sea, were less fat than those from the age class n.1. In the first case, the mean condition factors for immature males and females were 1.22 and 1.26, and in the second case - 1.17 and 1.14, respectively. The maturing fish from the age class n.1 were the fattest. In this group males had a mean condition factor 1.42, and females – 1.49. A tendency of declining in fatness with the age of fish has been noted for the maturing fish: in the age class n.2 the mean condition factors for males and females were 1.28 and 1.33, and in the age class n.3 - 1.24 and 1.23, respectively. The fish spawned in the year of capture also were less fat. The mean condition factor for these fish constituted 1.09.

Feeding

A feeding spectrum of *P. mykiss* was rather limited – in major cases only squids and fish were found in their stomachs. Thus, of total 187 specimens having food in their stomachs, 182 individuals had food boluses containing fish and squids, 4 individuals – insects, and 1 individual – crustaceans. As a rule, fish were represented by juvenile Asian greenling (*Pleurogrammus*

azonus) 6-15 cm long; some stomachs contained up to 25-30 juveniles. Anchovy (*Engraulis japonicus*), lanternfishes (*Myctophidae sp.*) 7-9 cm long, and juvenile banded Irish lords (*Hemilepidotus gilberti*) 2.5-3.0 cm long were not frequent in stomachs. *Tarletonbeania crenularis* and *Gasterosteus ?culeatus* occurred sporadically in stomachs. In the southern part of the region, Pacific saury (*Cololabis saira*) 22-30 cm long were often found in the *P. mykiss* stomachs by 2-3 individuals. Squids with mantles 8-16 cm long occurred in stomachs by 1-3 individuals throughout the study region. Air insects were found in stomachs of 4 individuals of *P. mykiss*. Three of them were sampled in the north of the region approximately 60 nautical miles eastward from Paramushir Island. They had only insects in their stomachs. The fourth fish was sampled in the south of the region 100 nautical miles eastward from Iturup Island. In addition to insects, it had juvenile squid in its stomach.

DISCUSSION

During a sea life period, *P. mykiss* behave like a thermophilic species. It is known that in winter (November-March) the *P. mykiss* distribution is limited by the area of northeastern Pacific Ocean, where they live under SST 5-10º? . *P. mykiss* begin migrating westward to the shores of Asia in April. In May they reach 160º E, but only on the area located south of 45º N. In EEZ of Russian Federation (near-Kuril waters of Pacific Ocean) *P. mykiss* usually appear in late June and migrate to the north following the isotherm 6º? . In July they occur from the latitude of southern Kuril Islands to Southern Kamchatka, enter the Okhotsk Sea and southern Bering Sea (Myers et al., 1990; Myers et al., 1993; Welch et al., 1998).

A migratory flow of the maturing *P. mykiss* is characterized as feeding-spawning, as far as being distributed in the near-Kuril waters since the late June they are feeding in the ocean and Okhotsk Sea for two months, and only in September begin to enter the rivers of Kamchatka. Immature specimens begin to appear in the second half of July, and become dominants only in the second half of August. Thus, the maturing specimens move advanced the migratory flow, immature ones appear later at the higher SST, as it is observed for the Pacific salmon with a long sea life period, such as chinook, sockeye, and chum salmon.

The base of *P. mykiss* catches was formed by fish from the age classes n.1 and n.2 – 42 and 53%, respectively. A portion of fish from the age class n.3 was about 4%, and n.4 – less than 1%. The analogous age composition of *P. mykiss* was observed in the northern part of the Pacific Ocean in May-July of 1982-1990 (Myers et al., 1993).

Female domination among the maturing fish was probably connected with the net selectivity: mature males were larger than females and that is why they were worse captured

using the nets with 120-135 mm mesh. Analogous phenomenon we have observed in order to the chinook salmon (Kovalenko et al., 2000).

The ¾ part of small-sized (less than 66 cm) male and female *P. mykiss* were immature.

Among the large-sized fish (more than 66 cm), about a half of males and females were immature too. All these fish will return for wintering to the Pacific Ocean areas located far to the east of the Kuril Islands. The ¼ part of small-sized males and females, about a half of the large-sized males, and ¾ of large-sized females were related to the maturing group. Evidently, some part of them is reproductively connected with the rivers of Kamchatka. It is, first of all, large specimens distinguished for their high maturity. The maturing fish sampled from the Okhotsk Sea, perhaps, were locally originated too. Like specimens from the genus *Oncorhynchus* with a long sea period of life, the immature *P. mykiss* migrate later than the maturing fish. A great part of immature specimens captured in late June and August were marked by the amputation of some fins. In June, "mikizha" (*P. mykiss)* with the analogous marks have been captured far to the south-east of the near-Kuril Pacific waters (Myers et al., 1990; Fukuwaka et al., 2000; Fukuwaka et al., 2002).

By our data, *P. mykiss* is an active pelagic predator by the character of feeding during the sea life period. The base of its feeding is formed by epi- and mesopelagic fish and squids that prove the earlier observations (Chereshnev et al., 2002).

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Location and biological data for fin-clipped *P. mykiss* caught by Russian vesselsin summer of 2001-2002.

Ad: adipose fin, Do: dorsal fin, LV: left ventral fin, RV: right ventral fin, LP: left pectoral fin, RP:right pectoral fin

Date	Location		Fork length (mm)	Body weight (g)	Sex	Gonad weight (g)	Clipped fin
25/07/01	45°00N	152°00E	590	2160	Female	1	**Ad**
04/08/01	46°35N	154°08E	645	2700	Female	2	**Ad**
04/08/01	46°35N	154°08E	640	2700	Male	1	**Ad**
05/08/01	46°35N	154°10E	645	2640	Male	1	**Ad**
05/08/01	46°35N	154°10E	640	2430	Male	1	**Ad**
05/08/01	46°35N	154°10E	620	2420	Female	2	**Ad**
07/08/01	46°35N	154°40E	650	2570	Male	1	**Ad, LV**
07/08/01	46°35N	154°40E	585	2060	Female	1	**Ad, LV**
07/08/01	46°35N	154°40E	615	2250	Female	1	**Ad**
07/08/01	46°35N	154°40E	620	2400	Male	1	**Ad**
07/08/01	46°35N	154°40E	635	2330	Male	1	**Ad**
08/08/01	46°35N	154°40E	655	2570	Female	2	**Ad**
08/08/01	46°35N	154°40E	600	2420	Female	2	**Ad, Do**
11/08/01	46°35N	154°40E	595	1950	Female	2	**Ad, Do, LV**
12/08/01	46°35N	154°05E	645	2640	Male	1	**Ad**
13/08/01	46°35N	154°08E	590	2020	Male	1	**Ad, Do, LV, LP, RP**
13/08/01	46°35N	154°08E	630	2650	Male	1	**Ad**
13/08/01	46°35N	154°08E	650	2740	Male	1	**Ad**
13/08/01	46°34N	154°17E	600	2250	Female	2	**Ad, LP**
14/08/01	46°30N	154°07E	605	2140	Male	1	**Ad**
16/08/01	47°09N	154°00E	630	2180	Female	3	**Ad**
17/08/01	46°22N	154°55E	630	2800	Male	2	**Ad, Do**
21/08/01	46°39N	154°34E	640	2940	Female	3	**Ad, Do**
21/08/01	45°33N	153°14E	645	2660	Male	2	**Ad**
21/08/01	45°33N	153°14E	610	2420	Female	3	**Ad**
21/08/01	45°33N	153°14E	610	2160	Female	3	**Ad**
21/08/01	45°33N	153°14E	640	2620	Female	2	**Ad**
21/08/01	45°33N	153°14E	640	1660	Male	2	**Ad**
21/08/01	45°33N	153°14E	635	2620	Female	3	**Ad**
21/08/01	45°33N	153°14E	640	2800	Female	4	**Ad**
21/08/01	45°33N	153°14E	660	3100	Male	2	**Ad**
21/08/01	45°33N	153°14E	790	5200	Male	70	**Ad**
23/08/01	46°45N	154°10E	680	3240	Male	1	**Ad**
23/08/01	46°45N	154°10E	680	3240	Male	1	**Ad**
23/08/01	46°45N	154°10E	660	2720	Male	1	**Ad, Do**
23/08/01	46°45N	154°10E	610	2570	Female	2	**Ad, Do**
23/08/01	46°45N	154°10E	670	3160	Male	2	**Ad, Do**
23/08/01	46°45N	154°10E	650	2660	Male	1	**Ad, Do, LV, RV**
23/08/01	46°45N	154°10E	620	2370	Female	2	**Ad, Do, LV, RV**
23/08/01	45°29N	153°10E	620	3000	Female	4	**Ad**
24/08/01	46°41N	154°11E	690	3100	Female	2	**Ad**
24/08/01	46°41N	154°11E	650	2400	Male	1	**Ad**
24/08/01	46°41N	154°11E	660	2800	Female	2	**Ad**
24/08/01	46°41N	154°11E	620	2350	Female	2	**Ad**
24/08/01	46°41N	154°11E	640	2500	Male	3	**Ad**
24/08/01	46°41N	154°11E	650	2700	Female	2	**Ad**

(continued)

Ad: adipose fin, Do: dorsal fin, LV: left ventral fin, RV: right ventral fin, LP: left pectoral fin, RP:right pectoral fin

Date	Location		Fork length (mm)	Body weight (g)	Sex	Gonad weight (g)	Clipped fin
25/08/01	46°20N	154°10E	660	2800	Male	3	**Ad**
25/08/01	46°20N	154°10E	630	2600	Male	3	**Ad**
25/08/01	46°20N	154°10E	645	2600	Female	5	**Ad**
25/08/01	46°20N	154°10E	650	2700	Male	4	**Ad**
26/08/01	46°21N	155°03E	650	3050	Female	4	**Ad, LV**
27/08/01	46°48N	153°32E	600	2140	Female	1	**Ad**
27/08/01	46°41N	152°52E	660	2750	Male	1	**Ad**
27/08/01	46°33N	154°13E	660	3160	Female	2	**Ad**
28/08/01	46°21N	155°31E	630	3200	Male	3	**Ad**
28/08/01	46°21N	155°31E	650	2750	Male	3	**Ad**
28/08/01	46°21N	155°31E	635	2600	Male	4	**Ad**
28/08/01	46°21N	155°31E	640	2900	Male	4	**Ad, LV, RV**
29/08/01	46°41N	153°48E	695	3710	Male	1	**Ad, LV**
29/08/01	46°41N	153°48E	640	2860	Female	4	**Ad, Do**
30/08/01	46°40N	153°45E	650	2630	Female	1	**Ad, Do**
22/07/02	49°59N	160°54E	750	4600	Female	38	**Ad**
22/07/02	49°59N	160°54E	730	4100	Female	42	**Ad**
23/07/02	49°55N	160°04E	790	5400	Female	40	**Ad**
27/07/02	46°00N	153°03E	630	2300	Male	2	**Ad**
28/07/02	46°04N	152°04E	810	4800	Male	2	**Ad**
28/07/02	46°04N	152°04E	620	2500	Male	2	**Ad**
28/07/02	46°04N	152°04E	640	2700	Female	6	**Ad**
28/07/02	46°04N	152°04E	600	2100	Male	2	**Ad**
28/07/02	46°04N	152°04E	760	4800	Female	56	**Ad**
04/08/02	46°34N	155°27E	640	2600	Male	2	**Ad**
04/08/02	46°34N	155°27E	610	2600	Male	3	**Ad**
04/08/02	46°34N	155°27E	620	2700	Male	2	**Ad**
04/08/02	46°34N	155°27E	750	4000	Male	5	**Ad**
04/08/02	46°34N	155°27E	640	2500	Male	3	**Ad**
04/08/02	46°34N	155°27E	580	2200	Female	3	**Ad**
05/08/02	46°31N	155°28E	545	2100	Male	1	**Ad**
09/08/02	46°41N	154°08E	590	2100	Male	2	**Ad**
10/08/02	46°42N	154°28E	650	2600	Male	2	**Ad**
11/08/02	46°42N	154°28E	740	4400	Female	32	**Ad, LV, RV**
13/08/02	46°20N	153°54E	780	5600	Female	50	**Ad**
13/08/02	46°20N	153°54E	650	2800	Male	2	**Ad**
14/08/02	50°10N	157°30E	795	6300	Female	54	**Ad**
14/08/02	50°10N	157°30E	610	2550	Male	1	**Ad**
17/08/02	46°12N	153°18E	580	2200	Male	2	**Ad**
17/08/02	46°12N	153°18E	630	2400	Male	2	**Ad**
18/08/02	46°21N	153°35E	660	2900	Male	2	**Ad**
24/08/02	46°22N	155°07E	620	2600	Male	3	**Ad**
24/08/02	46°22N	155°07E	810	5200	Male	6	**Ad**
24/08/02	46°22N	155°07E	650	2800	Male	2	**Ad**
24/08/02	46°22N	155°07E	670	3000	Male	1	**Ad**
24/08/02	46°22N	155°07E	680	3300	Male	1	**Ad**
24/08/02	46°22N	155°07E	600	2300	Male	1	**Ad**
24/08/02	46°22N	155°07E	660	3000	Male	1	**Ad**
25/08/02	46°34N	154°46E	670	3100	Male	1	**Ad**
25/08/02	47°30N	154°30E	850	6800	Male	220	**Ad, RV**

(continued)

Ad: adipose fin, Do: dorsal fin, LV: left ventral fin, RV: right ventral fin, LP: left pectoral fin, RP:right pectoral fin

Date	Location	Fork length (mm)	Body weight (g)	Sex		Gonad weight (g)	Clipped fin
25/08/02	47°30N	154°30E	780	4900	Male	1	**Ad, Do**
25/08/02	47°30N	154°30E	840	6700	Female	50	**Ad**
25/08/02	47°30N	154°30E	780	5400	Female	105	**Ad**
25/08/02	47°30N	154°30E	590	1950	Female	2	**Ad**
25/08/02	47°30N	154°30E	585	2200	Male	1	**Ad**
26/08/02	46°22N	154°56E	660	3000	Male	2	**Ad**
26/08/02	46°22N	154°56E	650	2800	Male	2	**Ad**
26/08/02	46°22N	154°56E	640	2600	Male	2	**Ad**
26/08/02	47°02N	154°55E	610	2250	Female	4	**Ad**
26/08/02	47°02N	154°55E	635	2650	Female	3	**Ad**
27/08/02	46°35N	154°23E	650	2800	Male	2	**Ad**
27/08/02	46°35N	154°23E	700	3500	Male	2	**Ad**
27/08/02	47°20N	154°05E	650	3000	Male	1	**Ad**
28/08/02	46°29N	154°26E	640	2700	Male	1	**Ad**
29/08/02	46°34N	153°53E	630	2600	Male	1	**Ad**
29/08/02	46°34N	153°53E	810	7200	Male	160	**Ad**
29/08/02	46°34N	153°53E	650	2900	Male	2	**Ad**
29/08/02	46°34N	153°53E	680	3400	Male	1	**Ad**
29/08/02	46°34N	153°53E	640	2800	Male	2	**Ad**
30/08/02	46°31N	154°08E	640	2900	Male	2	**Ad**
30/08/02	46°30N	153°25E	640	2650	Female	3	**Ad**
30/08/02	46°30N	153°25E	830	5900	Male	1	**Ad**
30/08/02	46°30N	153°25E	620	2550	Female	3	**Ad, Do**
31/08/02	46°05N	152°35E	600	2450	Male	1	**Ad, Do**
31/08/02	46°05N	152°35E	645	3100	Female	3	**Ad, Do**
31/08/02	46°05N	152°35E	685	3200	Male	1	**Ad**

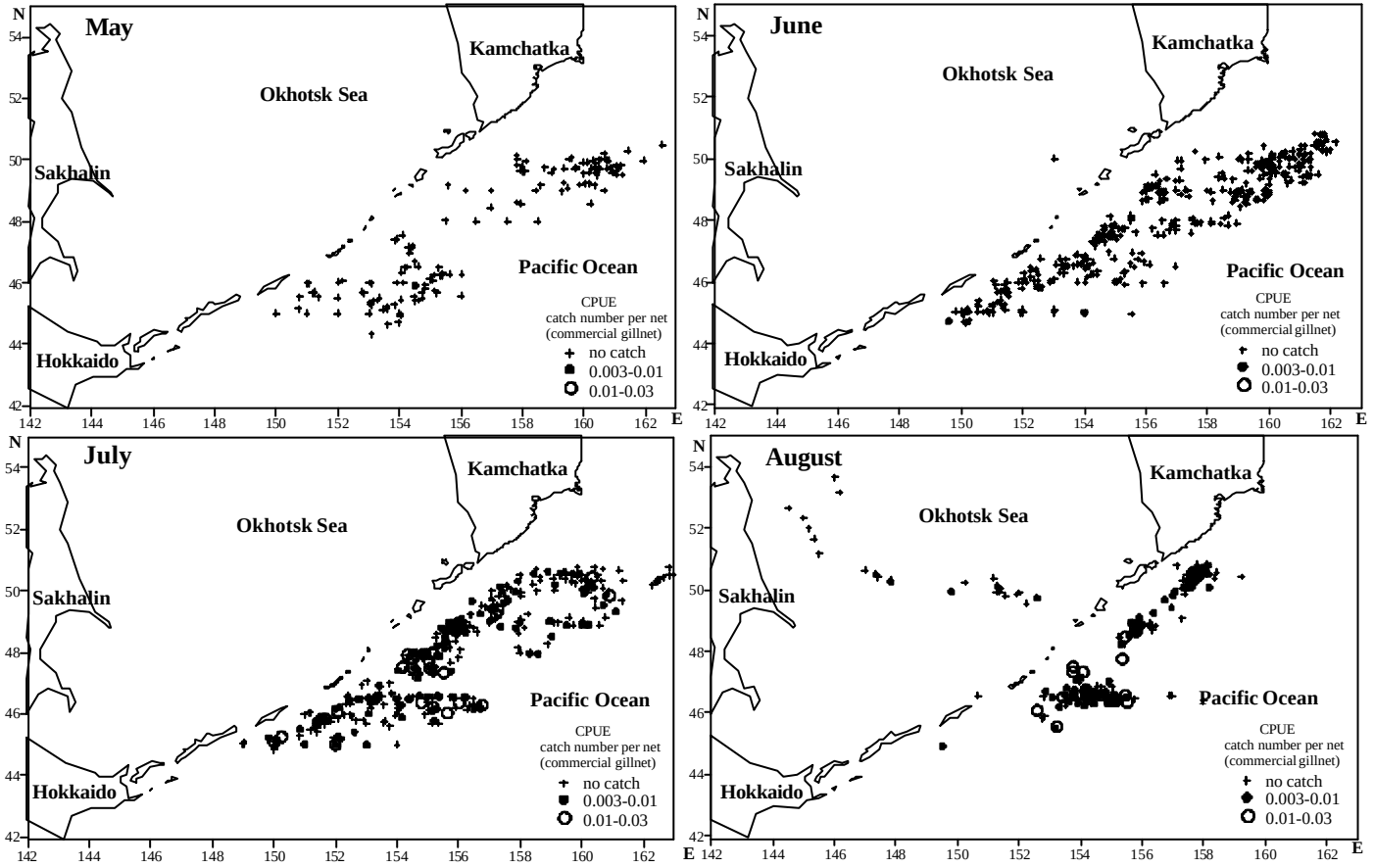

Fig. 1. Distribution of CPUE *P. mykiss* in May, June, July and August 1996-2002.

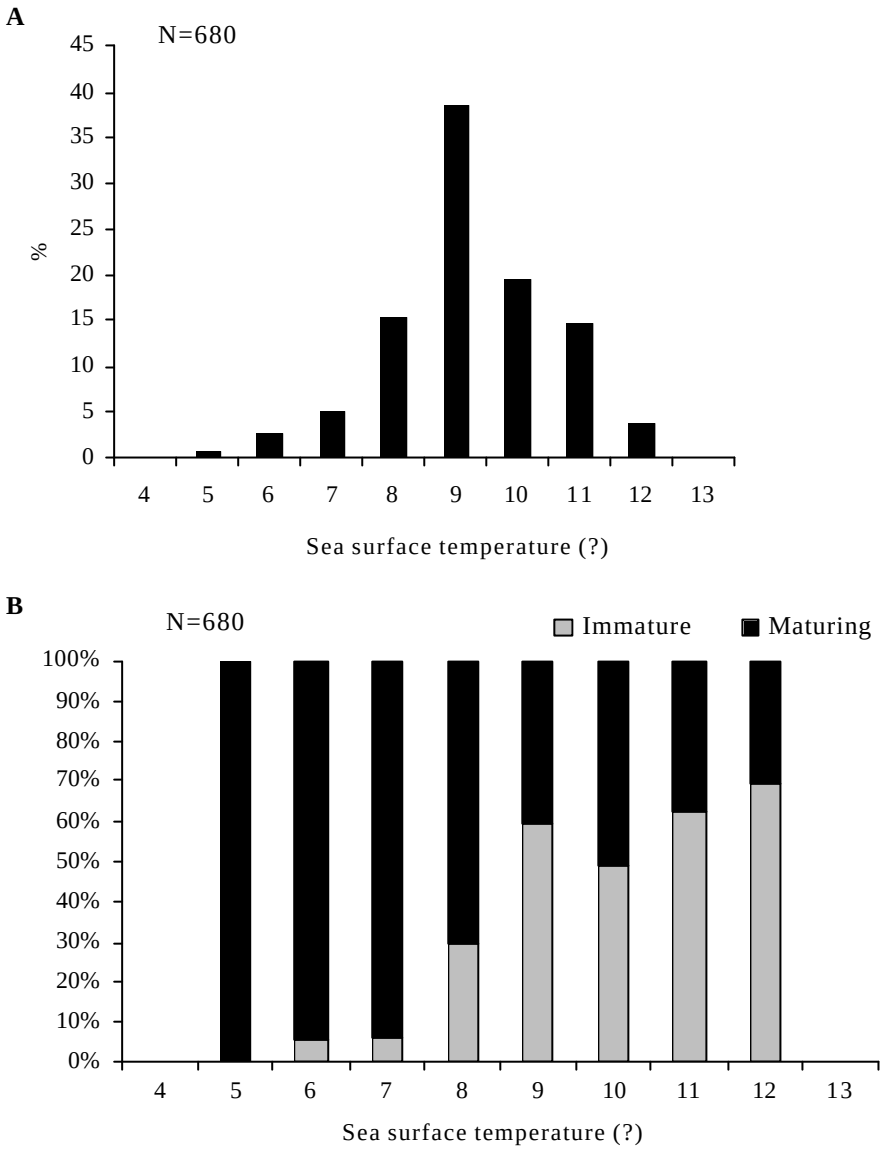

Fig. 2. Frequency distribution of *P. mykiss* (A) and ratio between maturing and immature fish (B), due to water temperature in 1996-2002

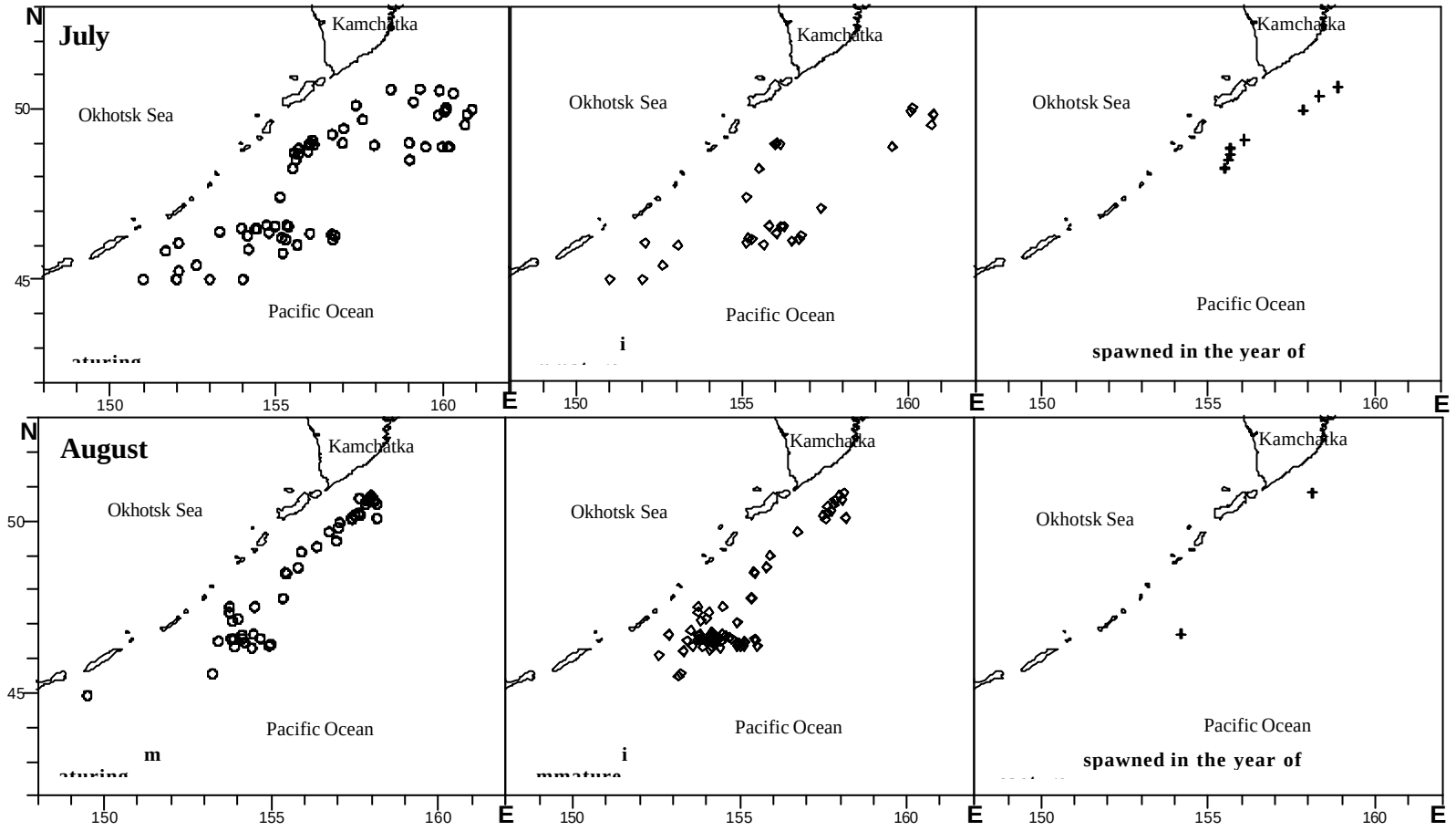

Fig. 3. Location of captures of the maturing, immature *P. mykiss*, and those spawned in the year of capture, occurred in July (above) and in August (below) 2001-2002

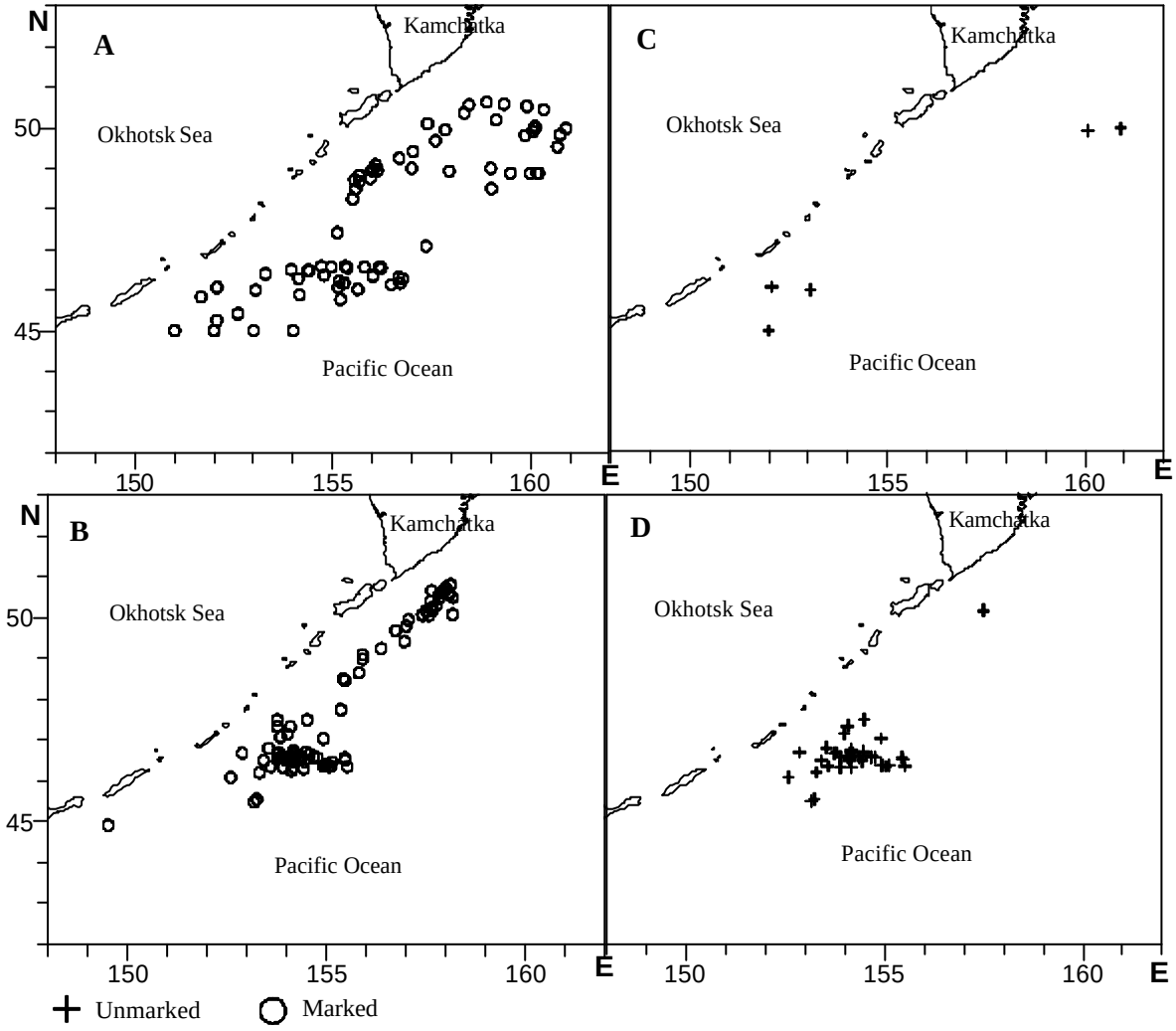

Fig. 4. Distribution of unmarked *P. mykiss* in July (A) and August (B), and marked fish in July (C) and August (D), 2001-2002

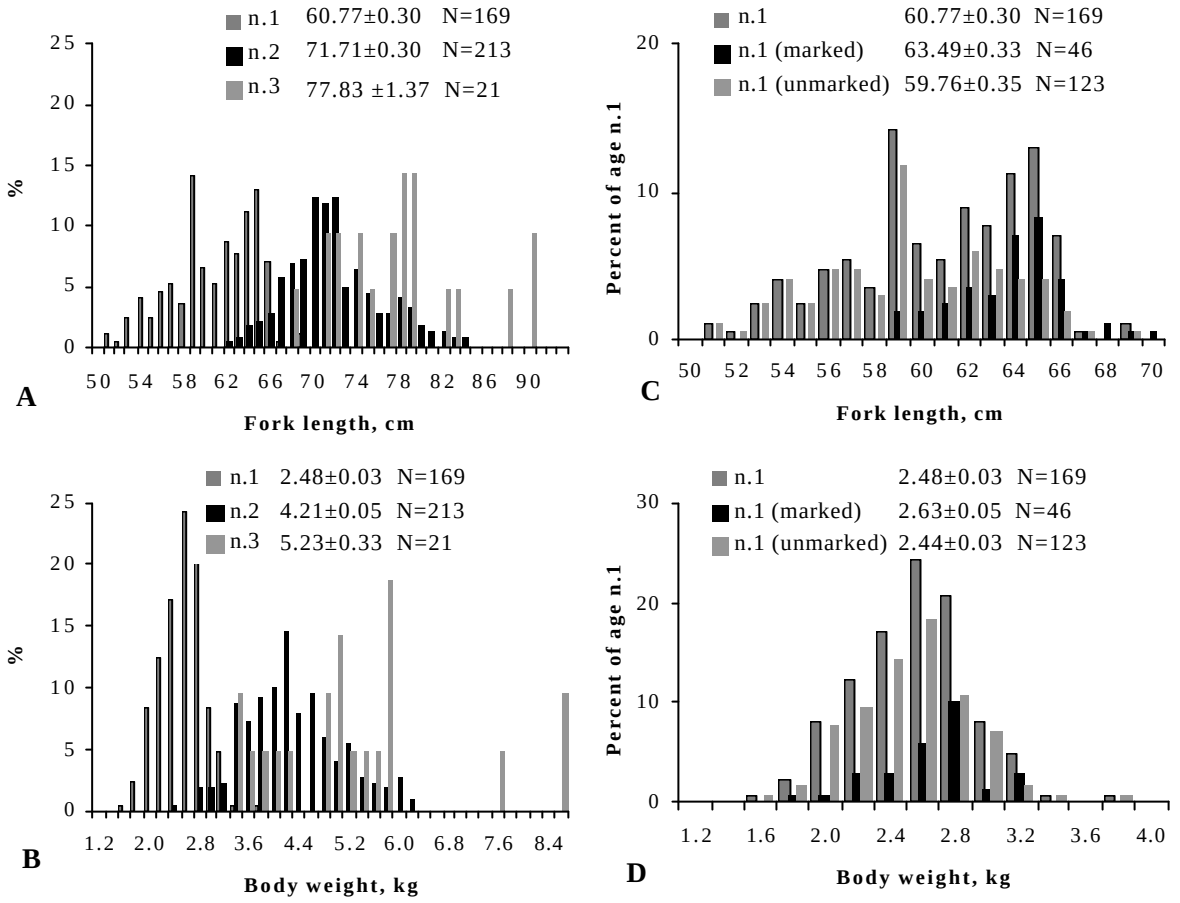

Fig. 5. Length and weight composition of *P. mykiss* due to the duration of the sea life period (A,B), and size and weight composition of marked and unmarked *P. mykiss* from the age class n.1 (C,D)

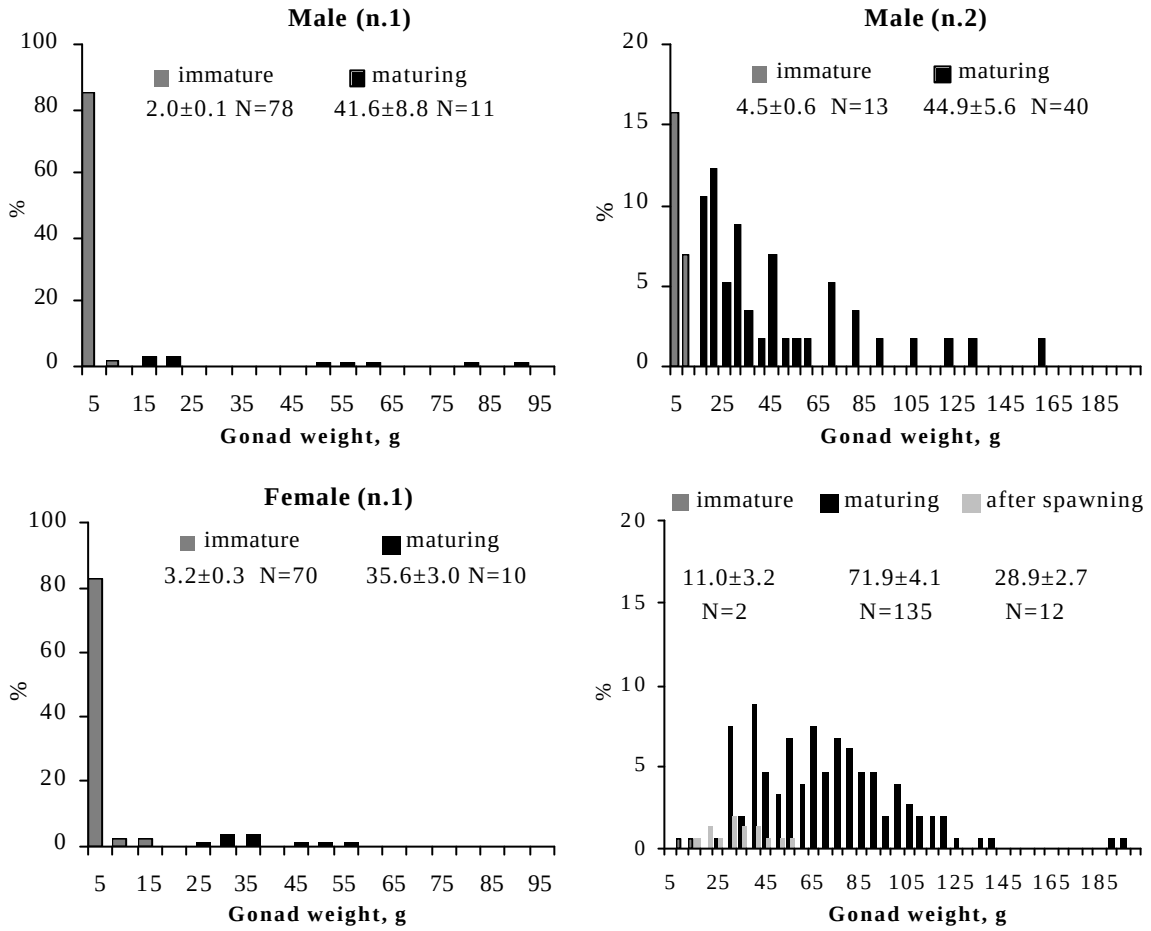

Fig. 6. Distribution of the *P. mykiss* gonad weight from the age classes n. 1 and n. 2 (males), and n. 1, n. 2 and n. 3 (females)