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A comparative study of two populations of the gadoid fish *Micromesistius australis* from the New Zealand and Patagonian-Falkland regions *, **

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ABSTRACT

Two populations of the gadoid fish *Micromesistius australis* NORMAN from the New Zealand and Patagonian-Falkland waters were compared and analyzed. Comparing the two populations, we recognized to be separable subspecifically the New Zealand one from the Patagonian-Falkland one. The subspecific name *Micromesistius australis pallidus* is here given to the New Zealand population and the subspecific name *Micromesistius australis australis* to the Patagonian-Falkland one.

INTRODUCTION

The purpose of this paper is to compare the two populations of *Micromesistius australis* NORMAN from the New Zealand and Patagonian-Falkland waters.

Micromesistius australis was first described by NORMAN (1937) based on the materials from the Patagonian-Falkland region. Thereafter, HART (1946) studied some biological aspects of this fish taken from the same region and SVETOVIDOV (1948) briefly treated the description and distribution of this fish in his revisional work on the order Gadiformes. Recently SHUNTOV (1971) reported this species from the New Zealand region, but he did not give the comparative discussion of this fish with the Patagonian-Falkland one.

As the result of our study, these two populations were recognized as two separate subspecies.

MATERIAIS AND METHODS

All the materials used in this study were obtained from the Patagonian-Falkland region between December, 1969 and January, 1970 and from the New Zealand region between

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December, 1970 and January, 1971 by R. V. Kaiyo Maru with otter trawl. Count and measurement were carried out with formalin fixed materials in accordance with the method of HUBBS and LAGLER (1947).

All the data used in the distribution and biology of both populations are based on the Kaiyo Maru Reports edited by HANAMURA (1971) and SAISHU (1972).

MICROMESISTIUS AUSTRALIS PALLIDUS SUBSP. NOV.

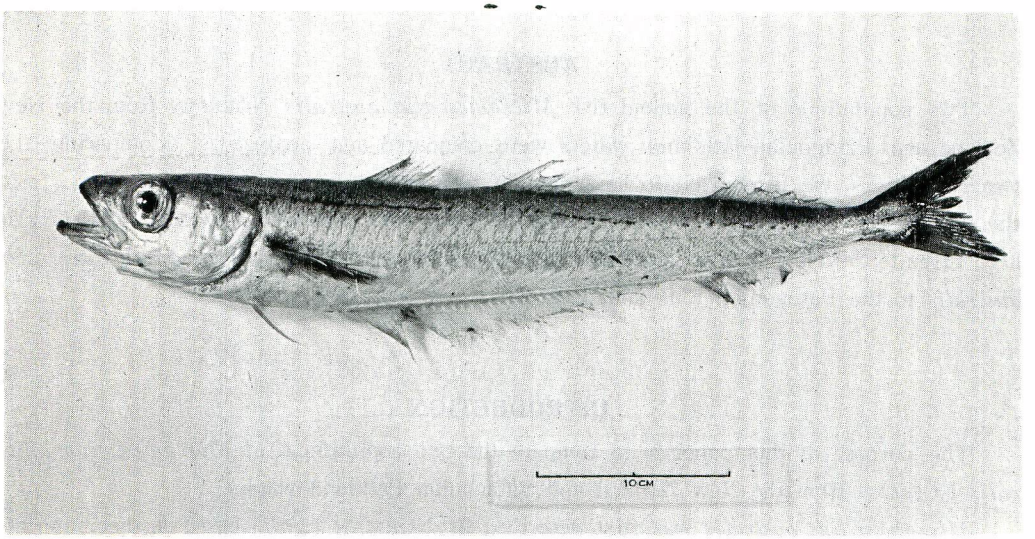

Fig. 1. *Micromesistius australis pallidus* subsp. nov.
368.2 mm in standard length, male. Collected on December 18, 1970 at 49°25.3′S, 173°22.2′E, 480 m in depth (Holotype, FAKU 43651). Scales are denuded almost completely.

Micromesistius australis - SHUNTOV, 1971, p. 429, Fig. 3, from Bounty Plateau and Campbell Plateau (distribution, hydrography).

Etymology: The subspecies name *pallidus* refers to its pale body color when it is kept in formalin. (Diagnosis : See DISCUSSION).

Holotype:

FAKU* 43651, 368.2 mm in standard length, male, December 18, 1970, 49°25.3′S, 173°22.2′E, 480 m in depth.

Paratypes:

Male - FAKU 43624～43629, 43631～43636, 341.8～383.3 mm, January 13, 1971, 51°58.0′S, 171°30.0′E, 530 m. FAKU 43644, 43650, 43652, 43952, 43954, 340.9～353.4 mm, December 18, 1970, 49°25.3′S, 173°22.2′E, 480 m. FAKU 43661, 43663, 43685, 359.0～365.3 mm, January 13, 1971, 52°00.0′S, 171°05.0′E, 475 m. FAKU 43683, 438.7 mm,

* FAKU is the abbreviation of the Department of Fisheries, Faculty of Agriculture, Kyoto University.

January 14, 1971, 51°04.0′S, 166°58.0′E, 500 m. FAKU 43738, 346.7 mm, January 11, 1971, 53°21.0′S, 169°55.0′E, 450 m. FAKU 43966, 427.4 mm, December 12, 1970, 47° 52.0′S, 179°09.0′E, 177～184 m. FAKU 44084, 271.3 mm, December 13, 1970, 48°14.0′S, 179°41.0′E, 340 m. FAKU 44157, 353.1 mm, January 7, 1971, 51°35.0′S, 169°58.0′E, 495 m. FAKU 44168, 267.4 mm, December 15, 1970, 48°01.8′S, 178°55.6′E, 305 m.

Female - FAKU 43630, 43637～43639, 302.6～369.2 mm, January 13, 1971, 51°58.0′S, 171°30.0′E, 530 m. FAKU 43643, 357.2 mm, December 18, 1970, 49°25.3′S, 173°22.2′E, 480 m. FAKU 43659, 43660, 379.9～396.3 mm, January 13, 1971, 52°00.0′S, 171°05.0′E, 475 m. FAKU 43686, 429.7 mm, January 14, 1971, 51°04.0′S, 166°58.0′E, 500 m. FAKU 43689, 43692, 43696, 343.2～371.8 mm, December 24, 1970, 49°55.5′S, 172°42.0′E, 511 m. FAKU 43730, 43732, 43733, 308.6～373.0 mm, January 11, 1971, 53°21.0′S, 169°55.0′E, 450 m. FAKU 43851, 395.5 mm, January 9, 1971, 53°05.2′S, 169°13.0′E, 480 m. FAKU 44085, 415.8 mm, December 13, 1970, 48°14.0′S, 179°41.0′E, 340 m. FAKU 44156, 423.2 mm, January 7, 1971, 51°31.8′S, 170°02.1′E, 530 m. FAKU 44164, 44174, 44176, 285.5～290.8 mm, December 15, 1970, 48°01.8′S, 178°55.6′E, 305 m.

Sex unknown - FAKU 43648, 43653, 43955, 194.2～289.1 mm, December 18, 1970, 49° 25.3′S, 173°22.2′E, 480 m. FAKU 43688, 212.1 mm, January 14, 1971, 51°04.0′S, 166° 58.0′E, 500 m. FAKU 43731, 225.2 mm, January 11, 1971, 53°21.0′S, 169°55.0′E, 450 m. FAKU 43915, 196.9 mm, December 23, 1970, 49°51.7′S, 172°08.8′E, 480 m. FAKU 44112, 44113, 197.7, 233.4 mm, December 13, 1970, 48°21.0′S, 179°32.0′E, 465～470 m, FAKU 44161, 280.1 mm, December 20, 1970, 49°03.0′S, 172°32.0′E, 470 m. FAKU 44163, 260.5 mm, December 15, 1970, 48°01.8′S, 178°55.6′E, 305 m.

DESCRIPTION OF HOLOTYPE

First dorsal fin rays 13; second dorsal fin rays 14; third dorsal fin rays 27; first anal fin rays 39; second anal fin rays 27; pectoral fin rays 22; pelvic fin rays 6; gill-rakers on first arch 8+40=48; branchiostegal rays 7.

Body depth at level of anus 16.8 in percent of standard length; body width 10.7; head length 23.1; snout length 7.6; upper jaw length 9.9; lower jaw length 13.4; diameter of eye 6.0; suborbital width 1.6; interorbital width 5.2; caudal peduncle length 11.7; caudal peduncle depth 4.5; tip of snout to first dorsal origin 33.5; tip of snout to second dorsal origin 49.2; tip of snout to third dorsal origin 72.2; tip of snout to first anal origin 33.9; tip of snout to second anal origin 72.4; tip of snout to pectoral insertion 23.3; tip of snout to pelvic insertion 22.4; tip of snout to anus 31.3; length of first dorsal (second ray) 12.5; length of second dorsal (second ray) 11.6; length of first anal (fifth ray) 10.0; length of second anal (sixth ray) 7.0; length of pectoral 15.9; length of pelvic 11.0; length of first dorsal base 9.0; length of second dorsal base 9.6; length of third dorsal base 16.9; length of first anal base 38.1; length of second anal base 17.6; space between first dorsal and second dorsal 7.6; space between

second dorsal and third dorsal 14.1; space between first anal and second anal 2.2.

Body elongate, somewhat compressed, highest at level of anus, its depth about 0.7 times length of head; dorsal contour almost straight behind origin of first dorsal; ventral contour almost straight behind anus. Caudal peduncle narrow in depth, about 1/4 depth of body. Head moderate, a little shorter than 1/4 length of body; upper and lower profile evenly curved; sensory pores obvious on head, 12 in preoperculo-mandibular canal, 9 in infraorbital canal, 3 in supraorbital canal and 1 in supraorbital commissure, foremost canals of supraorbital and mandibular obscure, mucous cavity on the skull closed in front. Interorbital flat, somewhat narrow, its width about 0.9 times length of diameter of eye. Snout moderate, slightly longer than eye. Eye large, about 0.6 times length of upper jaw. Nostrils small, a little in advance of anterior upper margin of eye, anterior nostril with rudimental tube, posterior one with a short flap anteriorly, situated close behind anterior one. Mouth rather large and oblique, maxillary reaching to slightly beyond margin of eye, a little shorter than half length of head, lower jaw projecting forward slightly before tip of upper jaw. No barbel on chin. Teeth on upper jaw biserial, inner one viliform and numerous, outer one depressible, conical and fewer; teeth on lower jaw uniserial, anteriorly one pair of teeth long and feeble, lateral teeth becoming long gradually, anterior one depressible, few depressible small teeth on vomer; no teeth on palatine. Gill-rakers long and slender. Scales deciduous, thin and small cycloid. Origin of first dorsal slightly behind level of anus; length of first dorsal base slightly shorter than that of second dorsal; seond dorsal situating a short distance behind first dorsal; space between second and third dorsal longer than base of second dorsal. Origin of first anal beginning slightly forward of first dorsal; base of second anal long, its length a little longer than 1/3 length of body; second anal opposite and similar to third dorsal in size and shape. Pectoral rather long, reaching below middle part of first dorsal. Pelvic long, extending beyond anus. Caudal fin with a small notch posteriorly. Lateral line almost straight, running parallel with dorsum above midline of body, extending from head to caudal fin base in form of continuous line for its entire length and forming supratemporal portion of the lateral line on head.

When alive body color pale blackish silverly, darker on back, lighter on side, belly milky white; small numerous black spots on scales and fin membrane; iris gold, pupil blue-black; tip of both jaws and margin of caudal fin blackish. In formalin general color of body pale brownish.

DESCRIPTION OF PARATYPES

First dorsal fin rays 11～14 (average : 12.4); second dorsal fin rays 10～14 (11.9); third dorsal fin rays 23～27 (25.0); first anal fin rays 34～40 (37.5); second anal fin rays 22～29 (26.6); pectoral fin rays 20～23 (21.5); pelvic fin rays 6 (6); gill-rakers of upper limb on first arch 7～10 (8.1); gill-rakers of lower limb on first arch 30～40

(35.9); gill-rakers on first arch 38~48 (44.0); branchiostegal rays 7 (7); number of precaudal vertebrae 24~26 (25.2); number of caudal vertebrae 31~33 (31.9); number of total vertebrae 56~58 (57.1).

Body depth at level of anus in percent of standard length 12.6~19.2 (16.7); body width 8.2~11.1 (10.0); head length 22.6~25.5 (23.8); snout length 7.3~8.4 (7.8); upper jaw length 9.4~10.8 (10.1); lower jaw length 11.4~14.6 (13.6); diameter of eye 5.1~6.8 (6.2); suborbital width 1.3~1.9 (1.6); interorbital width 4.7~5.8 (5.3); caudal peduncle length 9.7~12.3 (11.2); caudal peduncle depth 3.9~5.0 (4.6); tip of snout to first dorsal origin 32.6~35.8 (34.2); tip of snout to second dorsal origin 46.5~51.8 (49.3); tip of snout to third dorsal origin 71.1~75.2 (73.0); tip of snout to first anal origin 32.4~36.4 (34.3); tip of snout to second anal origin 69.2~74.7 (72.0); tip of snout to pectoral insertion 23.2~26.1 (24.4); tip of snout to pelvic insertion 21.2~24.7 (23.1); tip of snout to anus 30.2~34.3 (32.5); length of first dorsal (second ray) 11.1~13.5 (12.4); length of second dorsal (second ray) 10.3~12.6 (11.7); length of third dorsal (fifth ray) 6.7~8.4 (7.5); length of first anal (fifth or sixth ray) 6.6~10.6 (9.2); length of second anal (fifth or sixth ray) 6.6~8.7 (7.4); length of pectoral 14.4~18.4 (16.6); length of pelvic (male) 8.8~12.7 (11.4); length of pelvic (female) 5.9~9.4 (7.7); length of firs tdorsal base 7.8~10.2 (9.0); length of second dorsal base 8.3~11.6 (9.8); length of third dorsal base 14.6~19.7 (16.8); length of first anal base 34.7~40.2 (37.5); length of second anal base 16.8~19.4 (18.3); space between first dorsal and second dorsal 4.9~7.9 (6.6); space between second dorsal and third dorsal 11.9~17.0 (14.3); space between first anal and second anal 0.9~2.7 (1.7).

Distribution:

This subspecies was recorded first from Bounty Plateau and Campbell Plateau by SHUNTOV (1971). The range of this subspecies caught by R. V. Kaiyo Maru is in the waters of Bounty Plateau, Pukaki Rise, Campbell Rise and Auckland Islands Shelf (Fig. 2). The vertical distribution of this subspecies is at depths between 180 m and 780 m (Fig. 3). They seem to be abundant around depth of 500 m at Pukaki Rise and Campbell Rise. According to the oceanographic data, they were taken from the region where bottom temperature ranges from 4.2 °C to 8.1 °C and bottom salinity ranges from 34.3‰ to 34.5 ‰ in December and January (Fig. 4). This fish probably lives predominantly at the calcareous ground about 7 °C in the bottom temperature. Small fishes are abundant in Bounty Plateau, middle size fishes are abundant in Pukaki Rise and Campbell Rise and large fishes are abundant in Auckland Islands Shelf (Fig. 5). The differences among the fork length frequencies by living depth are more remarkable than those among the fork length frequencies by living area. In the living depth above 400 m all the fishes are small, around 500 m the fishes are almost all middle size and below 600 m the fishes are larger (Fig. 6). The records of echo sounder suggest that the larval fishes inhabit about 20 m above the bottom.

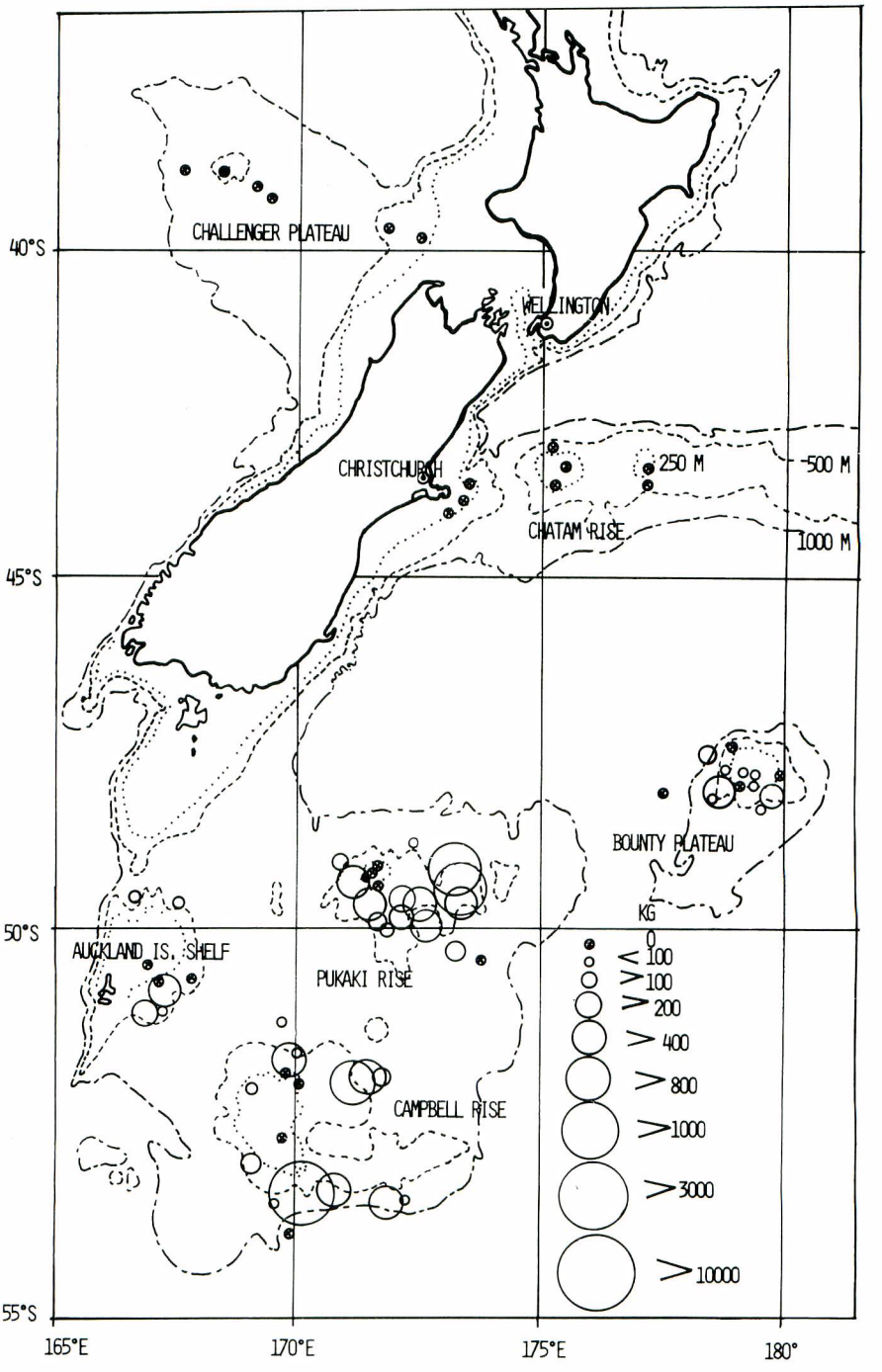

Fig. 2. Distribution of catch amount of *Micromesistius australis pallidus* caught by Kaiyo Maru during the New Zealand cruise between December 1970 and January 1971. Size of the catch amount is shown by weight (kg) per 30 minutes haul.

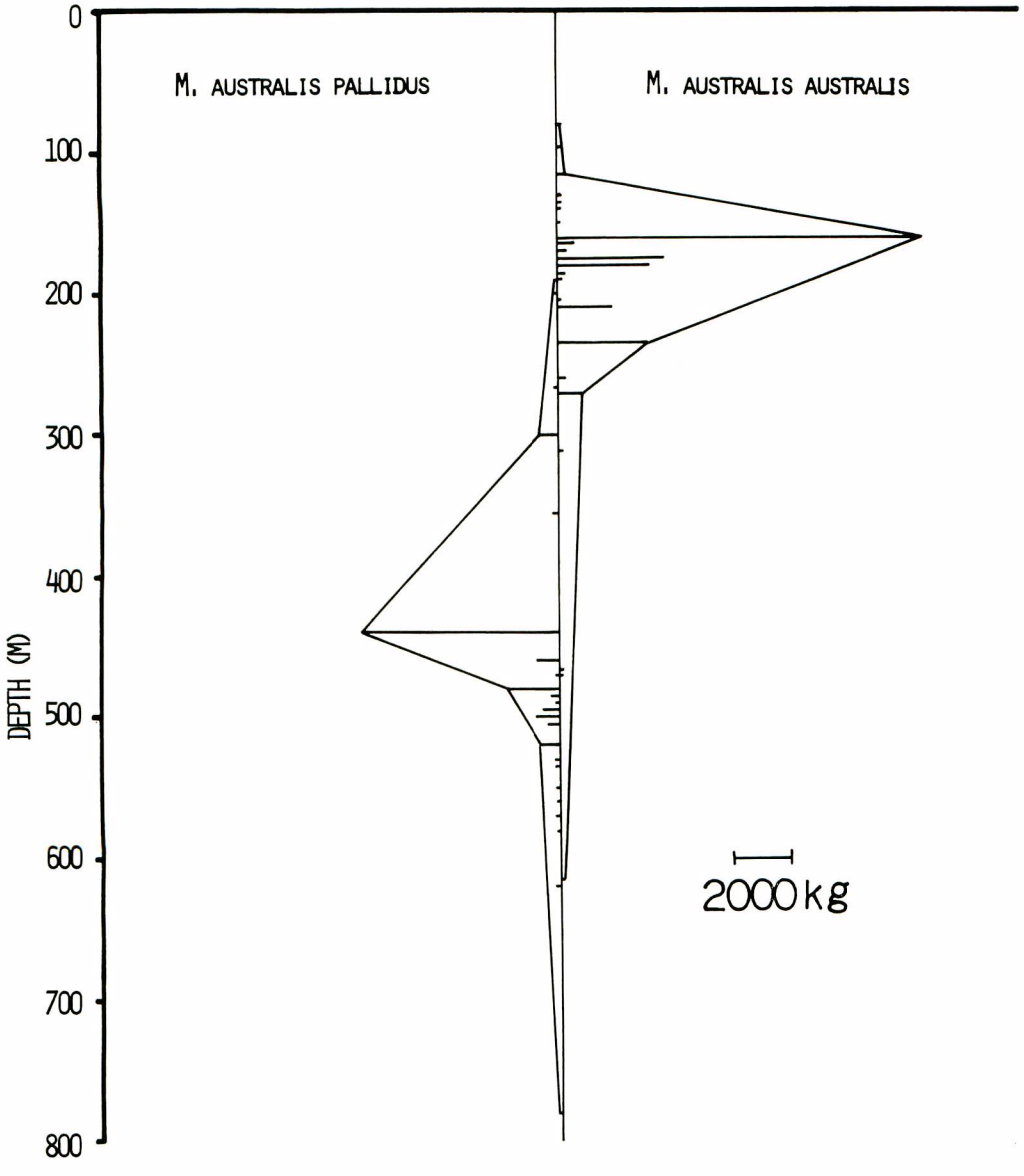

Fig. 3. Vertical distribution of catch amount of *Micromesistius australis* caught by Kaiyo Maru during the New Zealand cruise between December 1970 and January 1971 and the Patagonian-Falkland cruise between December 1969 and January 1970. Size of the catch amount is shown by weight (kg) per 30 minutes haul.

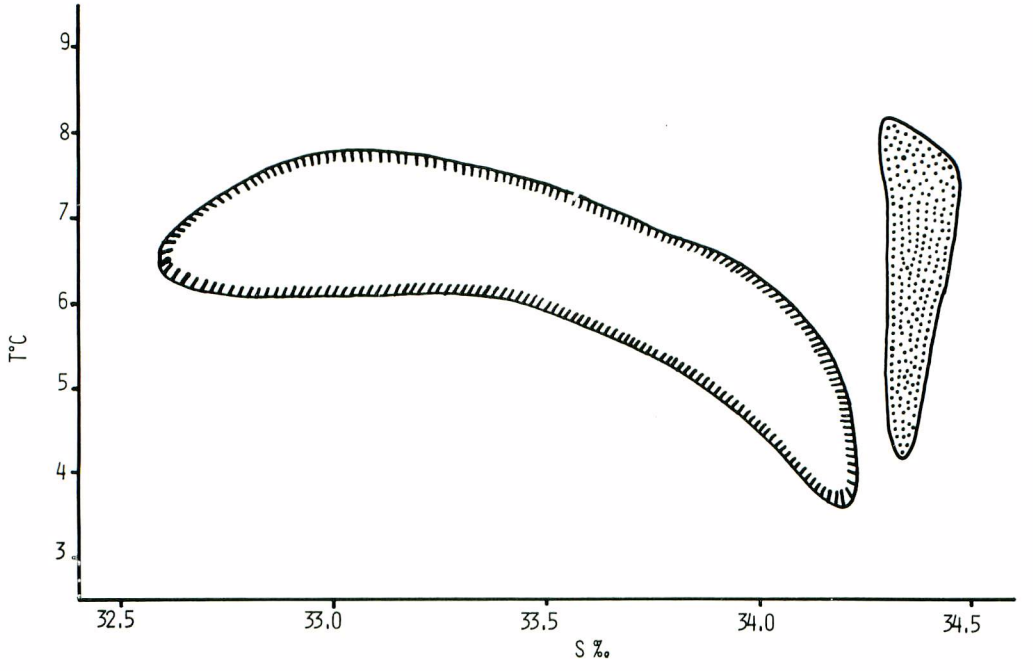

Fig. 4. Catch of *Micromesistius australis* in relation to the bottom temperature and salinity in the New Zealand and Patagonian-Falkland regions. Dotted area shows catch of *M. australis pallidus*. Area surrounded by shaded line shows catch of *M. australis australis*.

Biology:

All the gonads were immature in December and January. Judging from the gonad condition, spawning season should be in June or July. The fork length of the 1 st, 2 nd and 3 rd year classes are 130 mm, 220 mm and 290 mm respectively. Female is larger than male in older stage; the fork length of the 10 th year class is about 500 mm in female and 470 mm in male calculated from the method of the year ring of scale. The sex ratio changes as fish grows. In the fishes of about 300 mm in fork length almost all specimens were male, in those of 500 mm the sex ratio was equal, in those longer than 500 mm more than 90 percent were female. This may be caused by the result of most likely the difference of growth by sex, the sampling deviation, the geographic variation or the sex reversal. Stomach contents were as follows: small sized fishes (*Micromesistius*, Macrouridae, Moridae), salpas, euphausids and amphipods. Food component was very simple, with amphipods in abundance in this season. Specimens longer than 300 mm in fork length show sexual dimorphism in the length of the pelvic fin. The pelvic fin of female is short and does not reach the anus and that of male is long and reaches to the anus or beyond it (Fig. 7).

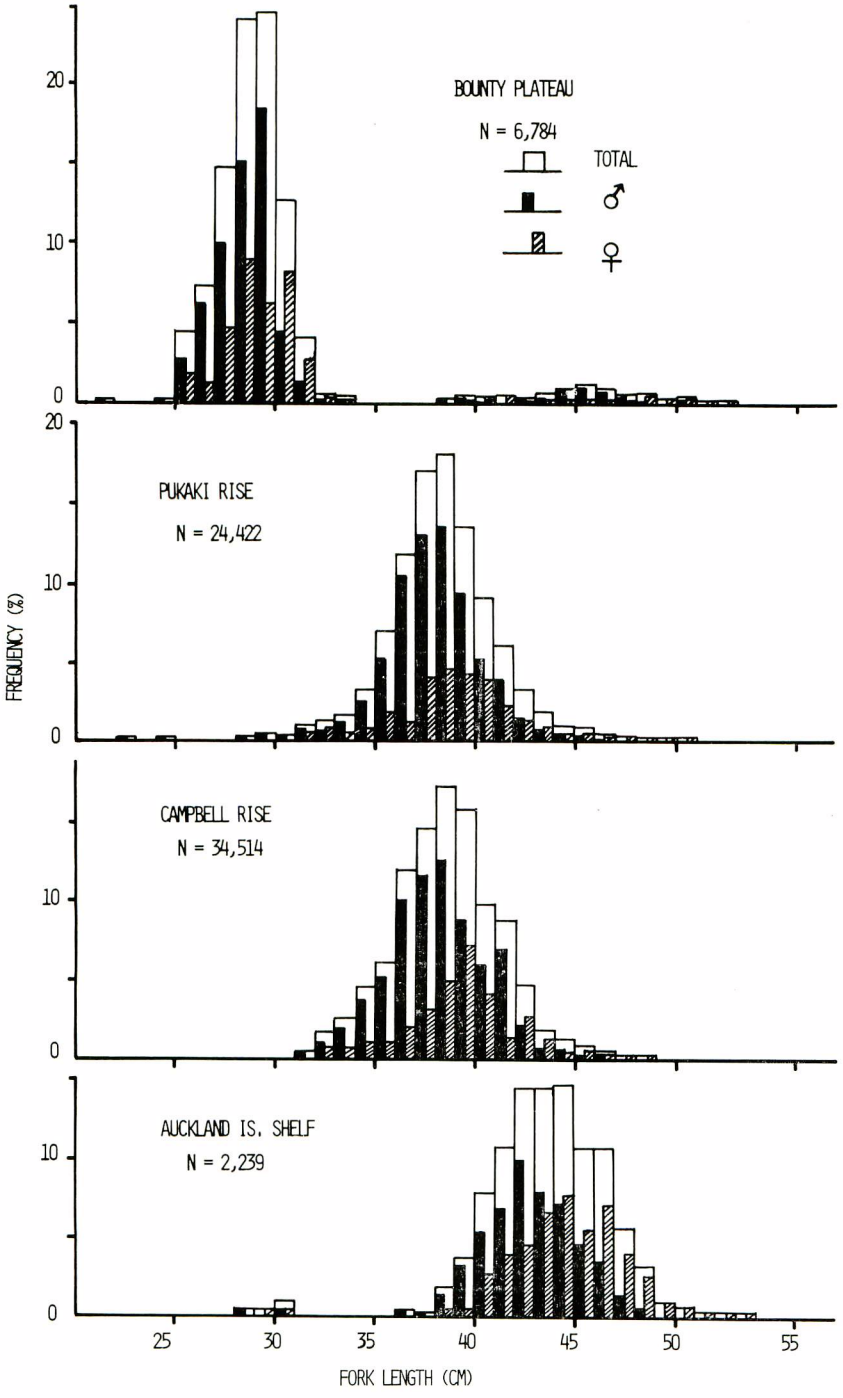

Fig. 5. Composition of fork length of *Micromesistius australis pallidus* taken from various areas in the New Zealand region.

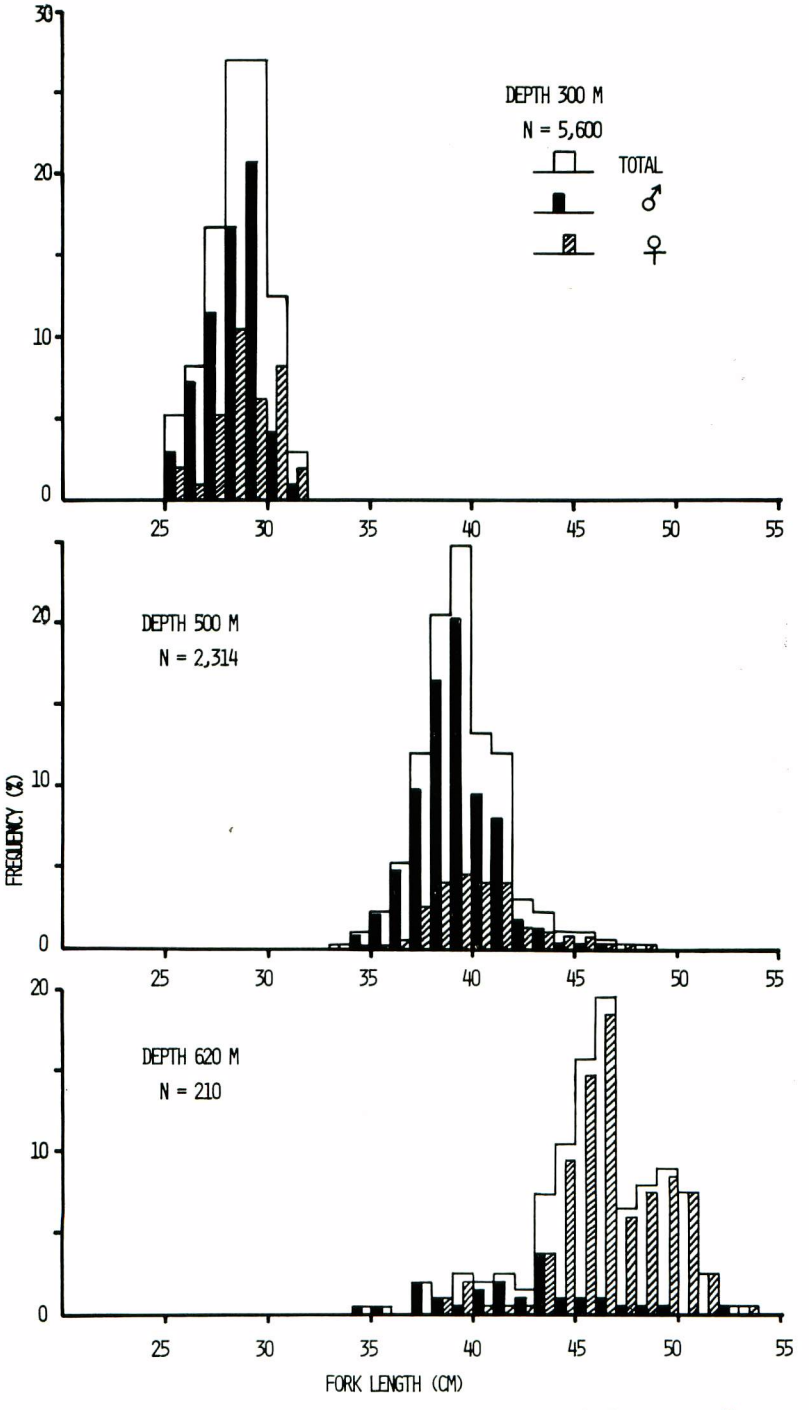

Fig. 6. Composition of fork length of *Micromesistius australis pallidus* taken from various depths in the New Zealand region.

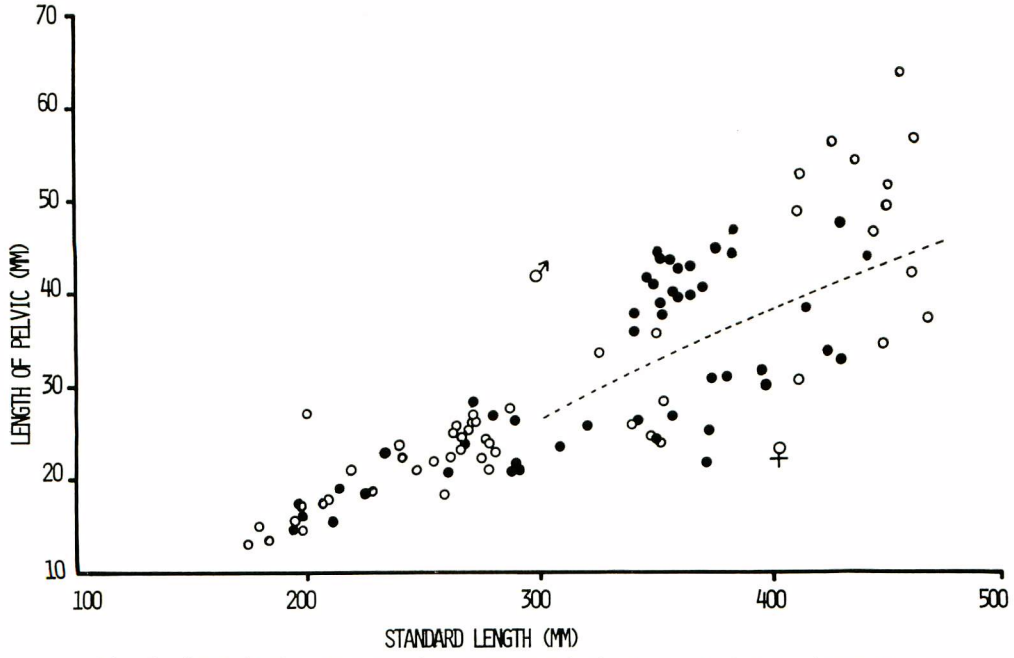

Fig. 7. Length of pelvic in relation to standard length of both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*). Those plots above broken line are male and those below broken line are female.

Commercial value:

This fish is not used commercially until recently, but at present this fish is caught commercially by fishing boats around New Zealand.

MICROMESISTIUS AUSTRALIS AUSTRALIS NORMAN

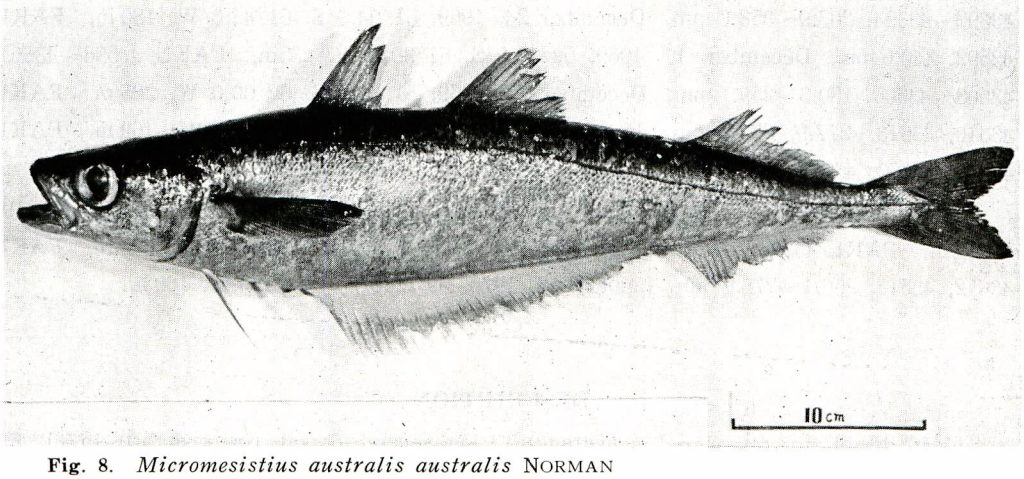

Fig. 8. *Micromesistius australis australis* NORMAN
449.4 mm in standard length, male. Collected on January 13, 1970 at 50°00.0′S, 60°00.0′W, 169 m in depth (FAKU 43607). Scales remain completely.

Micromesistius australis NORMAN, 1937, p. 51, Fig. 22, off Patagonia and Falkland Islands (original description). — FOWLER, 1945, p. 34, 1 Fig., off Patagonia and Falkland Islands (list). — HART, 1946, p. 320, off Patagonia and Falkland Islands (biology, fisheries). — SVETOVIDOV, 1948, p. 227, Table 67, Argentine Patagonia and around the Falkland Islands (classification, description, osteology). — RINGUELET and ARAMBURU, 1960, p. 57, Argentine (list).

Materials examined:

Male - FAKU 42763, 436.0 mm in standard length, January 13, 1970, 49°15.0′S, 61°00.0′W, 172 m depth. FAKU 42860, 265.8 mm, December 20, 1969, 54°15.0′S, 62°14.0′W, 470 m. FAKU 42896, 348.0 mm, December 17, 1969, 52°41.0′S, 60°28.0W, 250～270m. FAKU 42961, 424.0 mm, December 16, 1969, 52°30.3′S, 58°25.5′W, 198～203m. FAKU 43082, 453.0 mm, December 16, 1969, 52°31.0′S, 58°21.0′W, 305 m. FAKU 43210, 43211, 450.0, 462.0 mm, December 19, 1969, 54°15.5′S, 65°27.0′W, 95 m. FAKU 43312, 43315, 43316, 263.4～352.0 mm, December 20, 1969, 54°09.8′S, 63°28.0′W, 250～280 m. FAKU 43395, 264.1 mm, December 24, 1969, 51°04.0′S, 61°42.0′W, 180 m. FAKU 43590, 43606～43609, 43611, 43614, 43615, 43617, 268.1～455.5 mm, January 13, 1970, 50°00.0′S, 60°00.0′W, 169 m. FAKU 43591, 43593, 412.1, 413.6 mm, December 17, 1969, 52°13.0′S, 61°30.0′W, 235 m. FAKU 43594. 43595, 43597, 43602, 200.5～246.1 mm, December 25, 1969, 51°42.8′S, 62°00.0′W, 205 m.

Female - FAKU 42861, 262.3 mm, December 20, 1969, 54°15.0′S, 62°14.0′W, 470 m. FAKU 42888, 352.0 mm, December 17, 1969, 54°41.0′S, 60°28.0′W, 250～270 m. FAKU 42962, 42963, 42965, 42966, 42968, 228.8～447.0 mm, December 16, 1969, 52°30.3′S, 58°25.5′W, 198～203 m. FAKU 43256, 348.0 mm, December 20, 1969, 54°17.0′S, 61°30.0′W, 212 m. FAKU 43314, 277.0 mm, December 19, 1969, 51°04.0′S, 61°42.0′W, 180 m. FAKU 43392～43394, 207.9～353.0 mm, December 24, 1969, 51°04.0′S, 61°42.0′W, 180 m. FAKU 43592, 340.6 mm, December 17, 1969, 52°13.0′S, 61°30.0′W, 235m. FAKU 43598～43601, 43603～43605, 180.3～259.1 mm, December 25, 1969, 51°42.8′S, 62°00.0′W, 205 m. FAKU 43610, 43613, 277.9, 281.8 mm, January 13, 1970, 50°00.0′S, 60°00.0′W, 169 m. FAKU 44259, 44260, 461.4, 466.1 mm, January 11, 1970, 48°00.0′S, 60°00.0′W, 598 m.

Sex unknown - FAKU 42967, 412.0 mm, December 16, 1969, 52°30.3′S, 58°25.5′W, 198～203 m. FAKU 43596, 195.4 mm, December 25, 1969, 51°42.8′S, 62°00.0′W, 205 m. FAKU 43612, 43616, 266.1～278.0 mm, January 13, 1970, 59°00.0′S, 60°00.0′W, 169 m.

DESCRIPTION

First dorsal fin rays 11～13 (average: 12.1); second dorsal fin rays 10～15 (12.7); third dorsal fin rays 22～27 (25.0); first anal fin rays 33～41 (36.6); second anal fin rays 23～30 (26.3); pectoral fin rays 20～23 (21.0); pelvic fin rays 6 (6); gill-rakers

of upper limb on first arch 6～9 (8.0); gill-rakers of lower limb on first arch 31～38 (35.3); total gill-rakers on first arch 38～47 (43.3); branchiostegal rays 7 (7); number of precaudal vertebrae 24～26 (24.9); number of caudal vertebrae 30～32 (30.7); number of total vertebrae 54～57 (55.6).

Body depth at level of anus in percent of standard length 12.1～19.0 (16.2); body width 8.2～11.2 (9.5); head length 19.1～25.6 (23.2); snout length 6.9～8.1 (7.5); upper jaw length 9.1～10.3 (9.7); lower jaw length 11.3～14.0 (13.1); diameter of eye 5.2～6.7 (6.0); suborbital width 1.4～1.8 (1.6); interorbital width 4.4～6.0 (5.3); caudal peduncle length 10.1～13.3 (11.8); caudal peduncle depth 3.9～6.3 (4.7); tip of snout to first dorsal origin 31.8～36.1 (34.1); tip of snout to second dorsal origin 42.8～51.8 (48.7); tip of snout to third dorsal origin 69.6～77.0 (72.2); tip of snout to first anal origin 31.2～37.2 (34.1); tip of snout to second anal origin 64.0～73.8 (71.0); tip of snout to pectoral insertion 22.5～26.8 (24.4); tip of snout to pelvic insertion 20.8～27.0 (23.3); tip of snout to anus 29.4～35.7 (32.2); length of first dorsal 10.9～14.0 (12.0); length of second dorsal 10.6～13.4 (11.5); length of third dorsal 6.1～9.3 (7.7); length of first anal 6.9～10.9 (9.0); length of second anal 5.9～8.3 (7.4); length of pectoral 14.2～19.3 (16.5); length of pelvic (male) 8.6～14.0 (10.8); length of pelvic (female) 6.9～9.3 (8.0); length of first dorsal base 7.3～10.2 (8.5); length of second dorsal base 8.0～12.9 (10.0); length of third dorsal base 16.1～20.0 (17.6); length of first anal base 34.1～39.5 (36.7); length of second anal base 16.8～20.5 (19.0); space between first dorsal and second dorsal 5.4～8.6 (6.6); space between second dorsal and third dorsal 11.5～18.6 (13.9); space between first anal and second anal 0.7～3.6 (2.1).

Body elongate, somewhat compressed, highest at level of anus, its depth about 0.7 times length of head; dorsal contour almost straight behind origin of first dorsal; ventral contour almost straight behind anus. Caudal peduncle narrow in depth, about 0.3 times depth of body. Head moderate a little more than 1/4 length of body; upper and lower profile evenly curved; sensory pores obvious on head, about 11 or 12 in preoperculo-mandibular canal, about 8 in infraorbital canal, 2 in nasal component of supraorbital canal, about 4 in posttemporal component of cephalic lateralis and 1 in supraorbital commissure. Interorbital flat and somewhat narrow, its width about 0.9 times length of diameter of eye. Snout moderate, slightly longer than eye; its length about 1.3 times length of diameter of eye. Eye rather large in size, about 0.6 times in length of upper jaw. Nostrils small, a little in advance of anterior upper margin of eye, anterior nostril with rudimental tube, posterior one with a short flap anteriorly, both closely situated. Mouth rather large and oblique, maxillary reaching to slightly beyond anterior margin of eye, a little shorter than half length of head; lower jaw projecting forward slightly before tip of upper jaw. No barbel on tip of lower jaw. Teeth on upper jaw biserial, inner one fine viliform and numerous, outer one depressible backward, a little larger and sparse; teeth on lower jaw uniserial, long, sparse and depressible backward, few depressible small teeth on vomer, no teeth on palatine. Gill-rakers long and slender. Scales cycloid, thin and deciduous. Origin of first

dorsal slightly behind at level of anus; length of first dorsal base slightly longer than that of second dorsal; second dorsal a little backward first dorsal; space between second and third dorsal longer than base of second dorsal. Origin of first anal situated slightly forward that of first dorsal; base of second anal long, its length a little longer than 1/3 length of body; second anal opposite and similar to dorsal fin in size and shape. Pectoral rather long, reaching level of middle part of first dorsal or somewhat beyond it. Pelvic long, extending beyond anus in male, but short, not reaching anus in female (secondary sexual dimorphic character). Caudal fin concave posteriorly. Lateral line almost straight, running parallel with dorsal contour.

Live color of body dark brown dorsally, silvery white ventrally. Dorsals light brown. Caudal dark brown with black margin. Pectorals dark brown. Pelvic and anals whitish. Iris gold yellow, pupil blue-black. Tip of both jaws blackish. Numerous fine spots on epidermis and fin membrane. Scales of body easily deciduous, revealing light blue body color. In formalin general color of body brownish.

Distribution:

This fish is abundant in the Patagonian-Falkland region. The known range of this subspecies is the Atlantic Ocean off the east coast of South America from about 45°S to almost 55°S and around the Falkland Islands (Fig. 9). Recently this fish was known from the South Georgia, South Shetland and South Orkney Islands (MERRET, 1953; SUBNIKOV, PERMITIN and VOZNJAK, 1969; KOCK, 1975) and from the Scotia Sea (MIKHEEV, 1967; BASALAEV and PETUCHOV, 1969; SUBNIKOV, PERMITIN and VOZNJAK, 1969). The vertical distribution of this subspecies is at depths between 80 m and 614 m. They seem to be abundant in depth of about 200 m around the Falkland Islands (Fig. 3). Oceanographic data indicate that the habitat of this subspecies is in between 3.8° C and 7.3° C bottom temperature and between 32.6 ‰ and 34.3 ‰ bottom salinity in December and January (Fig. 4).

Biology:

Weight of gonad were incleasing rapidly above almost 400 mm in fork length both male and female. All the gonads were in the stage after spawning in December and January. The fork length of the 1 st, 2 nd, 3 rd and 4 th year classes are 130 mm, 210 mm, 290 mm and 370 mm respectively calculated from the method of the year ring of otolith. Biological minimum size is guessed about 400 mm both in male and female. Spawning season should be in spring or early summer of Southern hemisphere as HART (1946) guessed on the change of the ponderal index. Large fishes are abundant in northern region and small fishes are abundant in southern region estimated from the body length frequencies. In the northern region, body length frequencies of male and female are different and female attains larger size than male does (Fig. 10). Fork length frequencies by living depth are

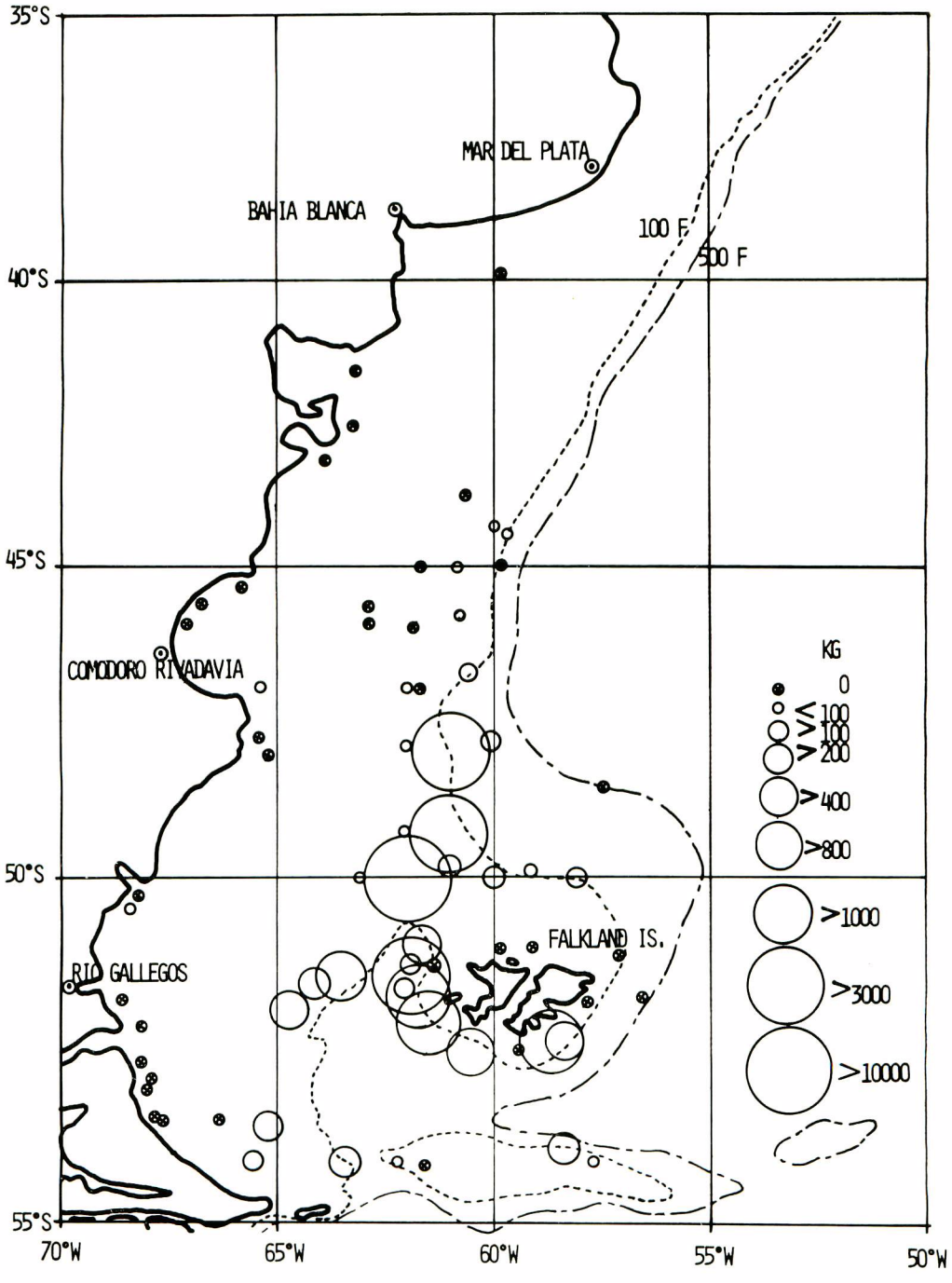

Fig. 9. Distribution of catch amount of *Micromesistius australis australis* caught by Kaiyo Maru during the Patagonian-Falkland cruise between December 1969 and January 1970. Size of the catch amount is shown by weight (kg) per 30 minutes haul.

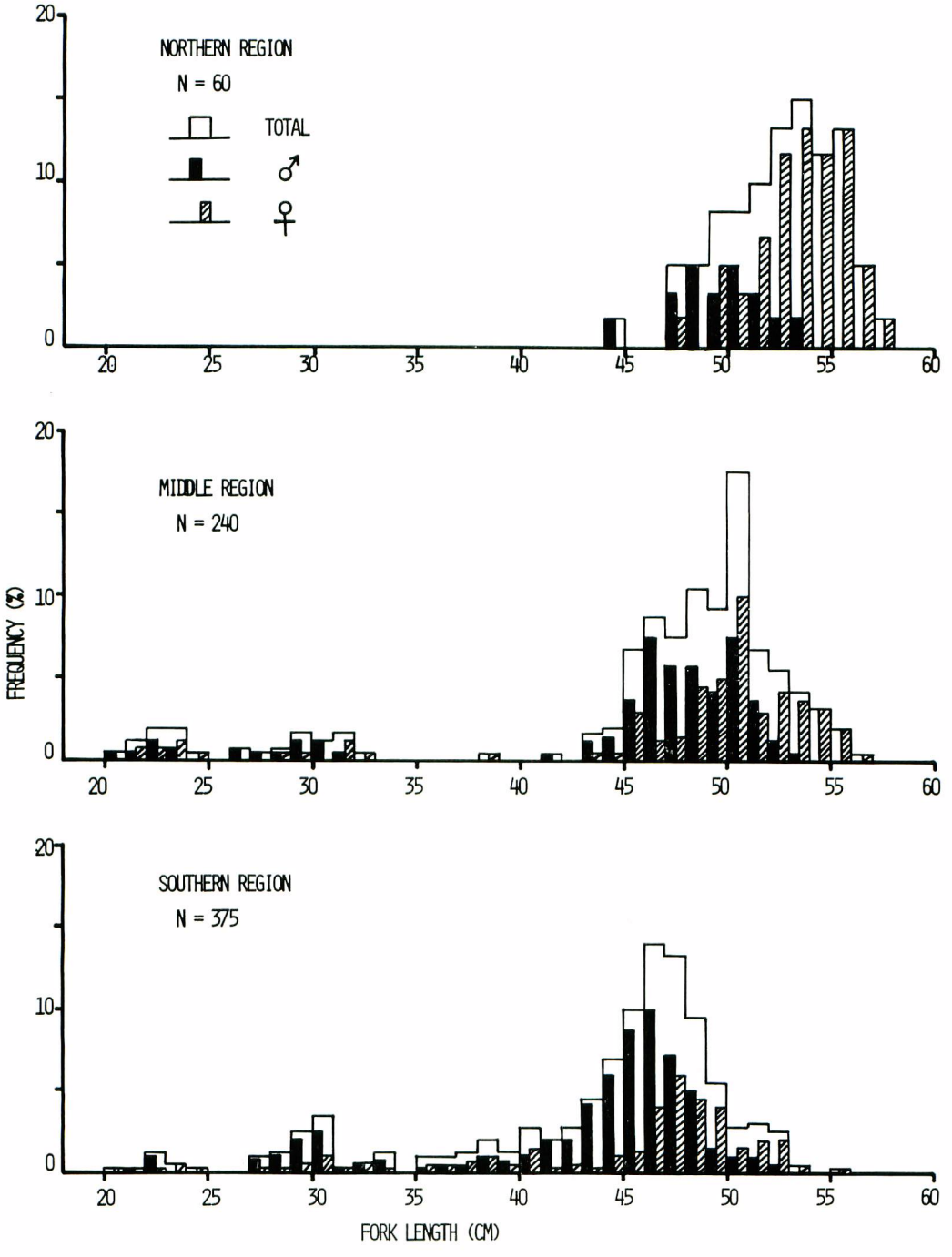

Fig. 10. Composition of fork length of *Micromesisitus australis australis* taken from various areas in the Patagonian-Falkland region.

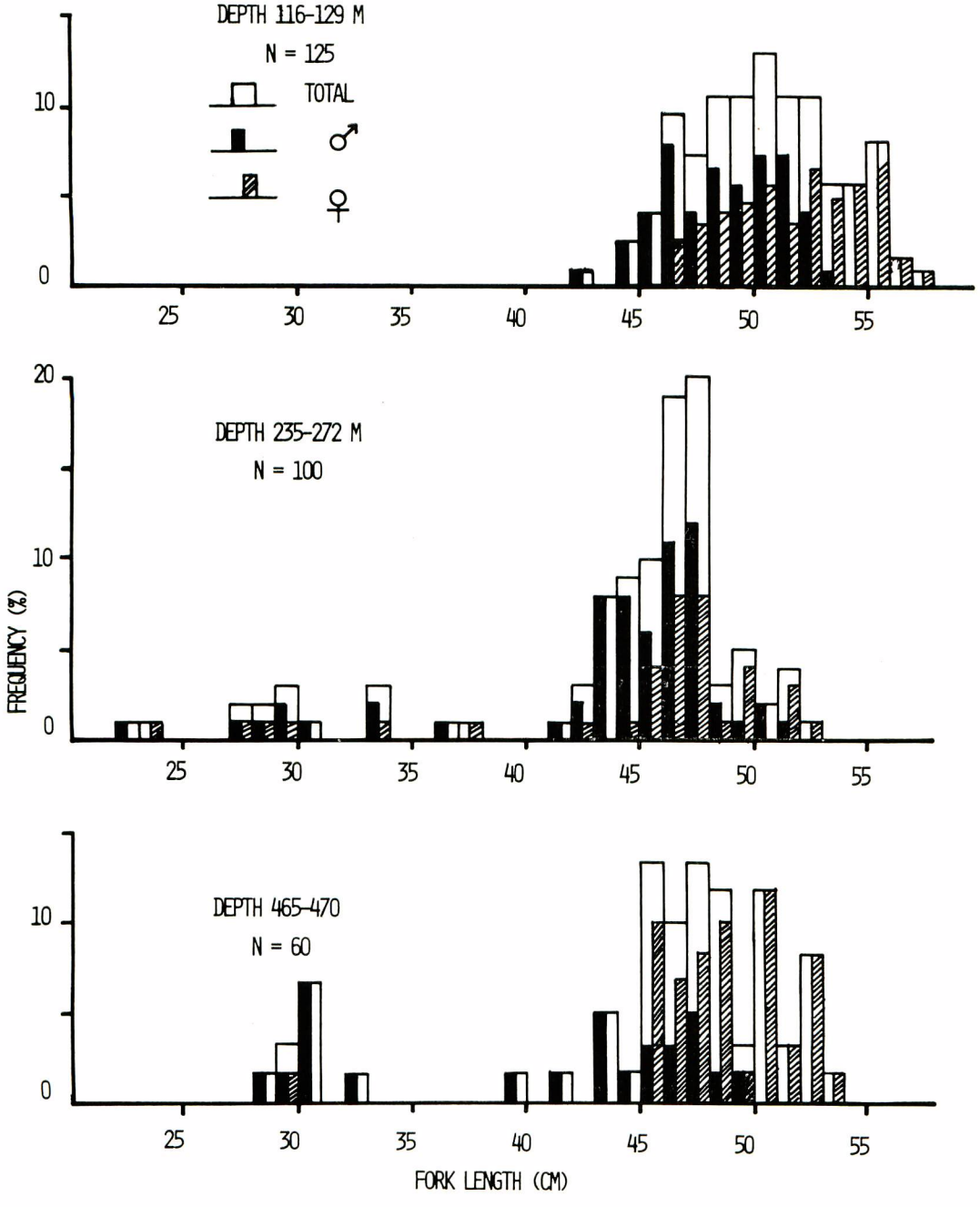

Fig. 11. Composition of fork length of *Micromesistius australis australis* taken from various depths in the Patagonian-Falkland region.

shown in Fig. 11. Large fishes are abundant in shallow water and smaller fishes are abundant in deeper water, although the differences among these fork length frequencies by living depth are not clear. This fish feeds chiefly on euphausids and amphipods and occasionally feeds on copepods, decapod molluscas, octopods and small fishes (Gonostomatidae, Englauridae and so on). Food component changes as this fish grows. Above the fork length about 400 mm it feeds still chiefly on euphausids, amphipods and copepods but partly on small fishes, octopods and decapod molluscas. Large fishes show sexual dimorphism in the length of pelvic fin as *Micromesistius australis pallidus* shows (Fig. 7).

Commercial value:

There is presently no commercial fisheries of this fish. This fish is the most hopefull species from the viewpoint of catch amount in the Patagonian-Falkland waters. Kamaboko (Japanene fish cake) forming capability of this fish is moderate (OKADA and SUZUKI, 1971).

DISCUSSION

We examined 34 proportional characters of each population and plotted graphically each character with standard length. We recognized slight proportional differences in the graphs of eight characters, such as the head length, the snout length, the upper jaw length, the lower jaw length, the diameter of eye, the length of first dorsal base, the length of third dorsal base and the length of second anal base (Appendix Figs. 1~8). The head is relatively smaller in the Patagonian-Falkland population than the New Zealand one (Appendix Fig. 1). In the head length the fishes of each population smaller than about 300 mm in standard length could not be separable clearly. However, those larger than about 300 mm could be easily recognized by the differences of the head-standard length relation between two populations. In the snout length, the upper jaw length, the lower jaw length and the diameter of eye, the difference between each population is hardly separable but these characters are all slightly smaller in the Patagonian-Falkland population than the New Zealand one (Appendix Figs. 2~5). In the length of first dorsal base and the length of third dorsal base, the fishes of each population smaller than about 300 mm in standard length could not be separable clearly. In those larger than about 300 mm, however, the difference between each population could be easily recognized. The length of first dorsal base are relatively smaller in the Patagonian-Falkland population than the New Zealand one but the length of third dorsal base are relatively larger in the Patagonian-Falkland population than the New Zealand one (Appendix Figs. 6, 7). The length of second anal base is relatively larger in the Patagonian-Falkland population than the New Zealand one. But the difference between each population is not clear, especially in the fishes larger than about 400 mm in standard length (Appendix Fig. 8).

We also examined 14 meristic characters of each population. The ranges of all these

characters between each population are overlapped each other. The mean values of six characters, such as the number of second dorsal fin rays, the number of first anal fin rays, the number of lower gill-rakers, the number of total gill-rakers, the number of caudal vertebrae and the number of total vertebrae show considerable difference between each population. The mean values of the other six characters, however, show little difference between each population. The mean value of the number of second dorsal fin rays is higher in the Patagonian-Falkland population than the New Zealand one. The numbers of pelvic fin rays and branchiostegal rays are fixed in both populations. The mean values of

Table 1. Comparison of 14 meristic characters of both subspecies from the New Zealand and Patagonian-Falkland regions. Those characters attached with asterisk show considerable differences between two subspecies.

Subspecies / Characters	*Micromesistius australis pallidus*				*Micromesistius australis australis*			
	N	Range	Mean	S. D.	N	Range	Mean	S. D.
Number of first dorsal fin rays	57	11~14	12.379	0.744	53	11~13	12.132	0.651
Number of second dorsal fin rays*	57	10~14	11.913	0.995	53	10~15	12.679	1.122
Number of third dorsal fin rays	57	23~27	25.000	1.169	53	22~27	24.962	1.142
Number of first anal fin rays*	57	34~40	37.482	1.453	53	33~41	36.641	1.653
Number of second anal fin rays	57	22~29	26.614	1.472	53	23~30	26.339	1.357
Number of pectoral fin rays	57	20~23	21.465	0.598	53	20~23	20.962	0.758
Number of pelvic fin rays	57	6	6	—	53	6	6	—
Number of Gill-rakers of upper limb on first arch	57	7~10	8.068	0.556	54	6~9	8.000	0.588
Number of Gill-rakers of lower limb on first arch*	57	30~40	35.931	1.908	54	31~38	35.264	1.711
Number of Gill-rakers on first arch*	57	38~48	43.965	2.051	54	38~47	43.301	2.052
Number of precaudal vertebrae	9	24~26	25.222	—	20	24~26	24.900	—
Number of caudal vertebrae*	9	31~33	31.889	—	20	30~32	30.700	—
Number of total vertebrae*	9	56~58	57.111	—	20	54~57	55.600	—
Number of branchiostegal rays	57	7	7	—	53	7	7	—

the other eleven characters are lower in the Patagonian-Falkland population than the New Zealand one (Table 1).

As mentioned above, of 34 proportional characters compared with standard length between two populations we recognized eight considerable differencies of each character (Appendix Figs. 1~8) and of 14 meristic characters we recognized six considerable differencies (Table 1) although they are all slight. We consider that these differences of each character between two populations have not attained specific level yet but that these characters are in subspecific level.

There are some differences of biological aspects such as distribution pattern and growth rate between two population which suggest subspecific difference of two populations.

We also examined three specimens* from Chile, but we could not find out any significant difference in these specimens with the Patagonian-Falkland and New Zealand populations because of the inadequate number of the Chilean specimens. Although we do not have adequate knowledge on the Chilean population, we distinguish the New Zealand population from the Patagonian-Falkland one subspecifically. As the differences between both subspecies are slight, we consider that the formation of subspecies might be in an early stage. Both subspecies are found in the subantarctic wateres. New Zealand and Patagonian-Falkland is geographically, separated far from each other so that the subspecies formation might be carried out independently in each environment through the rather short evolutional time scale. Further study on the Chilean population based on the adequate materials is highly desirable in order to understand the evolutional process of these subspecies. Forthcoming systematic work on the fishes of the genus *Micromesistius* is necessany to learn the direction of dispersal and the speciation or subspeciation.

ACKNOWLEDGEMENTS

The data reported here were obtained by cooperation of our colleagues on board the R. V. Kaiyo Maru during the cruise of 1969 to the Patagonian-Falkland region and 1970 to the New Zealand region.

We are very grateful to the captain Tetsuo JINNO and his crews, the chief scientist of the Patagonian-Falkland cruise, Dr. Nobuhiko HANAMURA and the chief scientist of the New Zealand cruise, Dr. Kozo SAISHU in obtaining the materials and data. We wish to express our appreciation to Dr. Ikuo IKEDA of the Far Seas Fisheries Research Laboratory, Drs. Kozo SAISHU and Hideo OOTAKI of the Seikai Regional Fisheries Research Laboratory, Prof. Tamotsu IWAI of the Kyoto University and Mr. Susumu KATO of the U. S. National Marine Fisheries Service, Tiburon Fisheries Laboratory for their invaluable suggestions and criticisms in reading the manuscript.

* These specimens were obtained by R. V. Kaiyo Maru with otter trawl at 46°06.5′S, 75°25.2′W at a depth of 190 m, on January 22, 1969. The standard length ranged from 349.0 mm to 386.0 mm.

Dr. Osame TABETA of the Shimonoseki University of Fisheries kindly offered us the Chilean specimens. Dr. Toshikatsu ASAI of the Nara Medical College and Mr. Masaru TAGAWA of the Seikai Regional Fisheries Research Laboratory kindly offered us the photographs of the Patagonian-Falkland and New Zealand specimens. Mr. Atila E. GOSZTONYI of the Instituto de Investigaciones Biofisicas (Argentina) and Mr. John MORELAND of the New Zealand National Museum of Wellington helped us in obtaining the references of both regions. We wish to express our sincere appreciation to them.

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ニュージーランドおよびパタゴニア・フォークランド海域から得られたタラ科魚類 *Micromesistius australis* の比較研究

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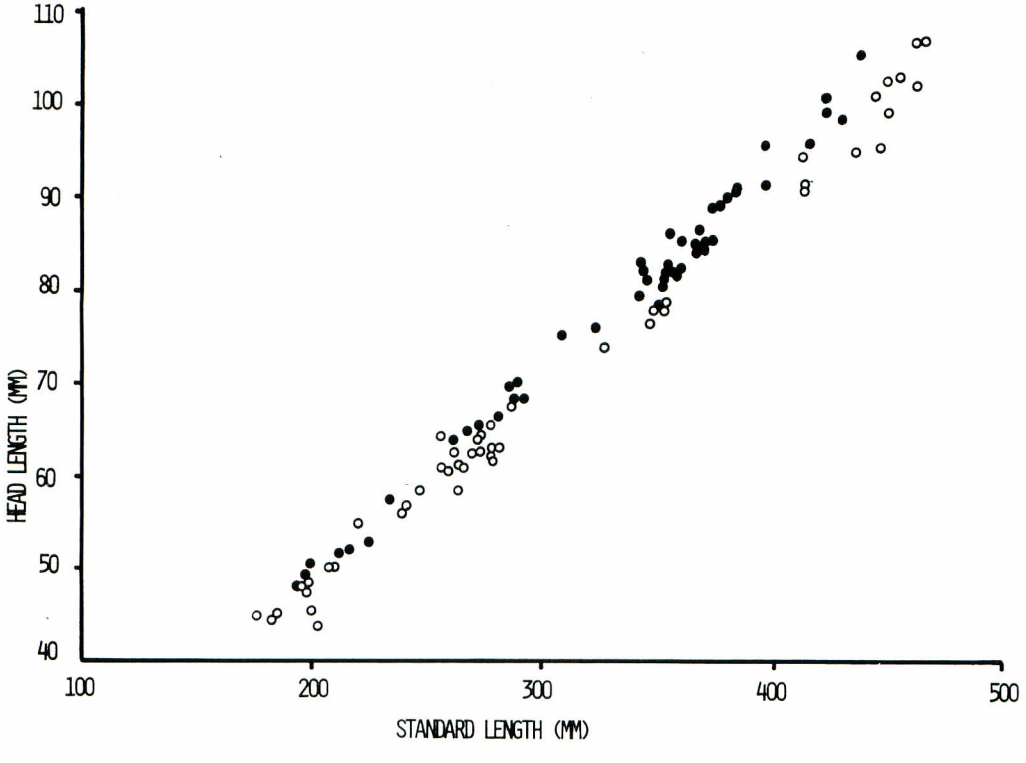
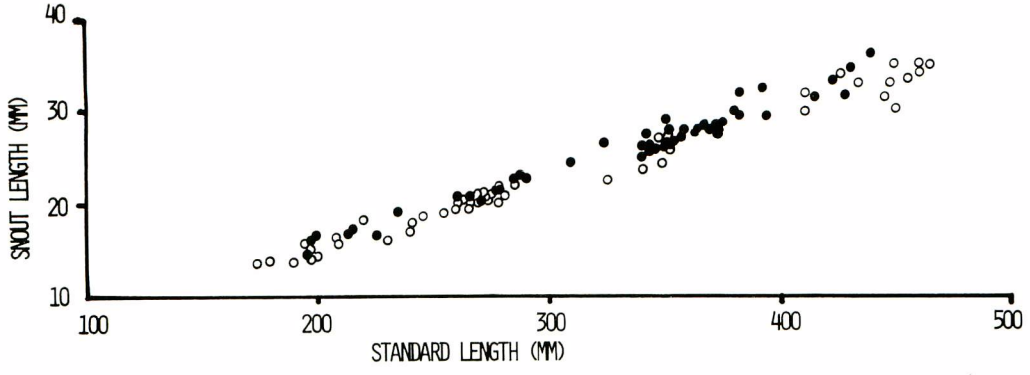
要約

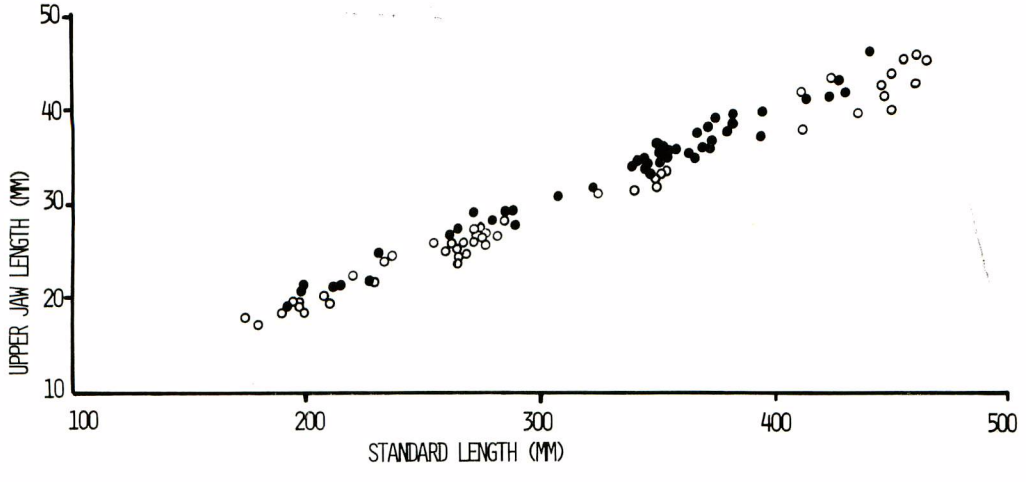
水産庁漁業調査船開洋丸によるパタゴニア・フォークランド海域調査（1969～1970年）とニュージーランド海域調査（1970～1971年）によって多数の通称ミナミダラ，*Micromesistius australis* NORMAN が採集された。両者の形態（34の計測的形質および14の計数的形質）と生態を比較検討した結果，両者は亜種レベルの分化に達していると考えられるに至った。そこで筆者らはパタゴニア・フォークランド海域のものに *Micromesistius australis australis* NORMAN なる亜種名を，ニュージーランド海域のものに新たに *Micromesistius australis pallidus* なる亜種名を与えた。



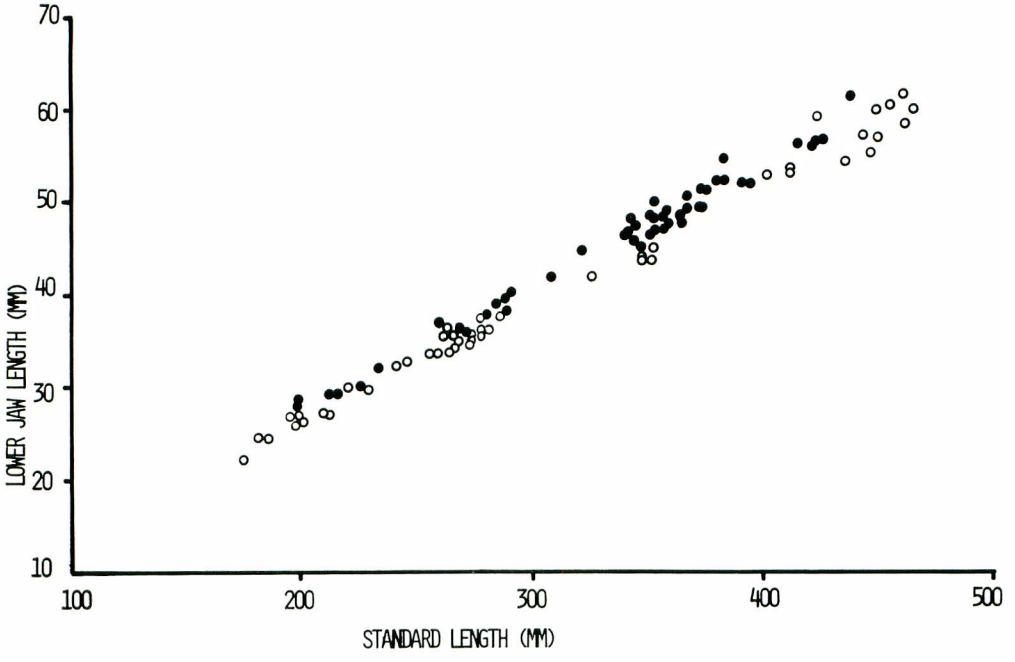
Appendix Fig. 1. Relations between head length and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



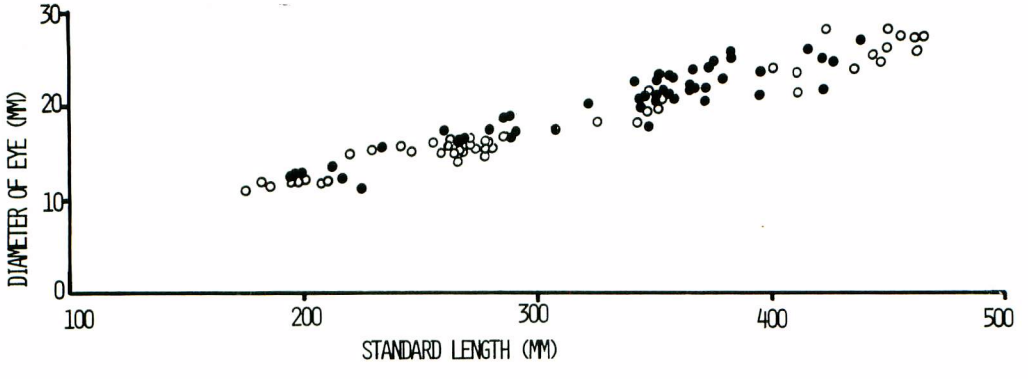
Appendix Fig. 2. Relations between snout length and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



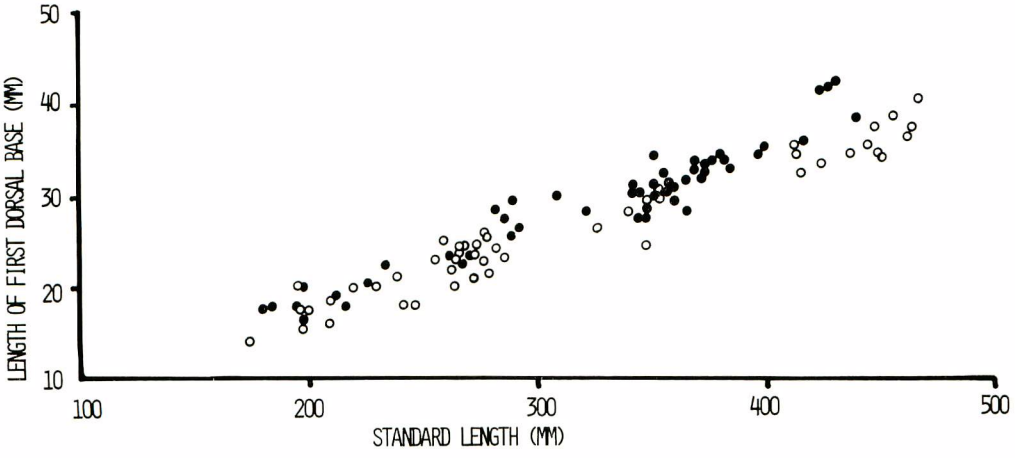
Appendix Fig. 3. Relations between upper jaw length and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



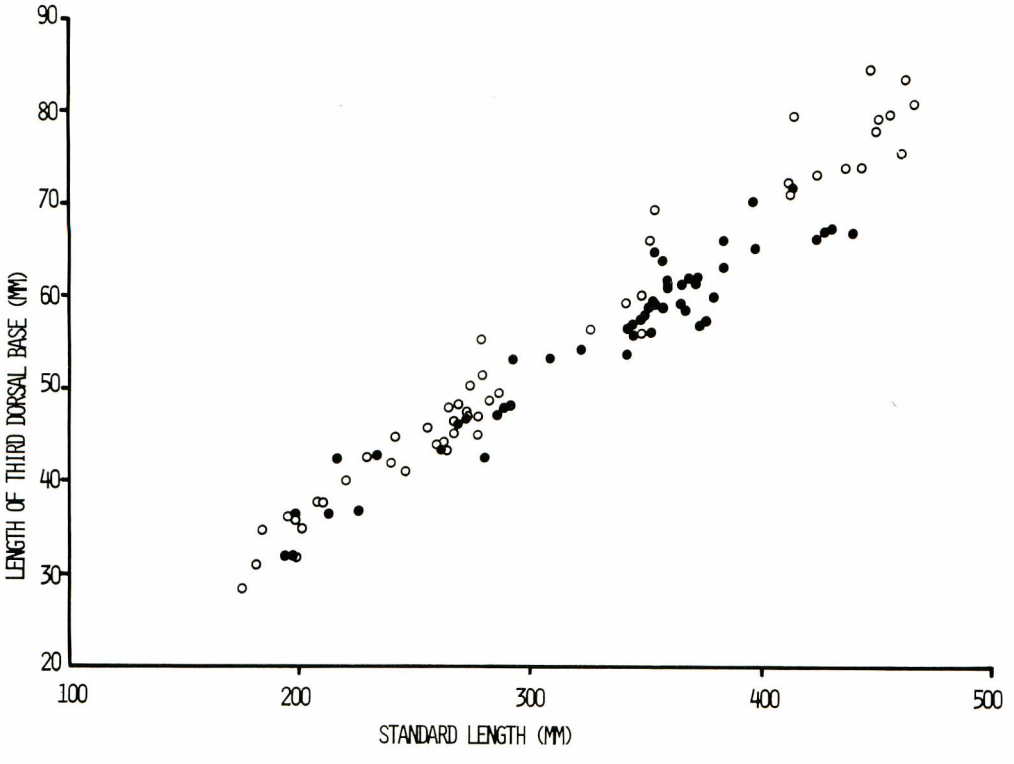
Appendix Fig. 4. Relations between lower jaw length and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



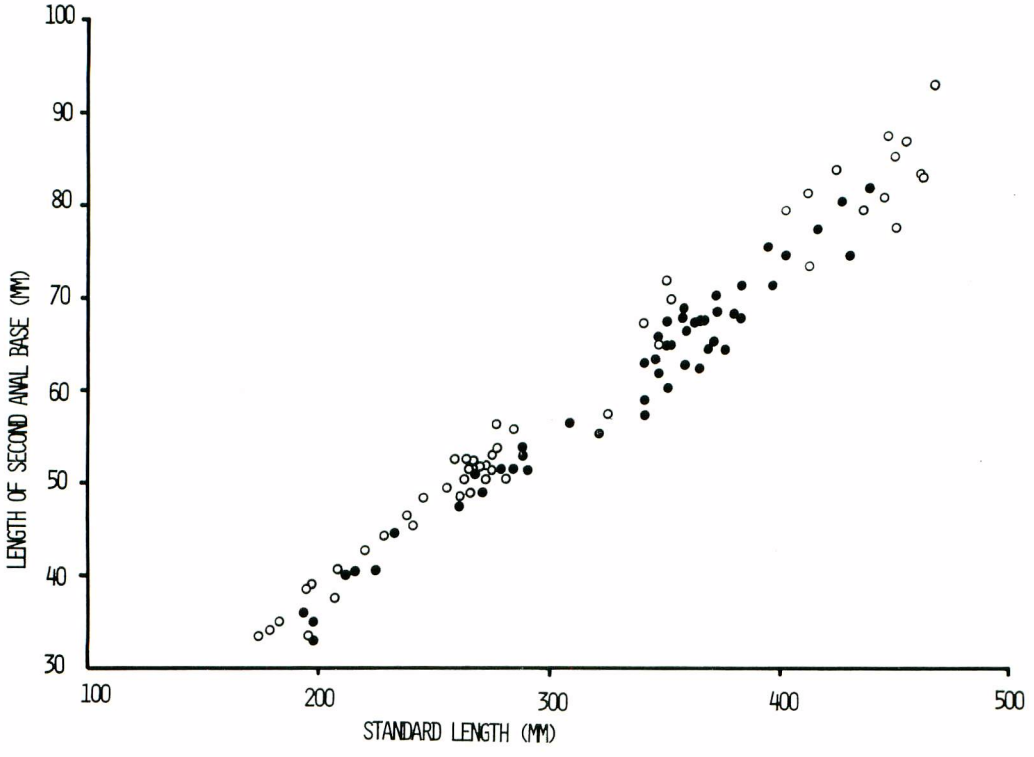
Appendix Fig. 5. Relations between diameter of eye and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



Appendix Fig. 6. Relations between length of first dorsal base and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesistius australis australis*).



Appendix Fig. 7. Relations between length of third dorsal base and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micromesistius australis pallidus*, ○ *Micromesitsius australis australis*).



Appendix Fig. 8. Relations between length of second anal base and standard length in both subspecies in the New Zealand and Patagonian-Falkland regions (● *Micro mesistius australis pallidus*, ○ *Micromesistius australis australis*).