Rev. Biol. Trop. 49 Supl. 1: 29-37, 2001

A New Species of *Nezumia* (Gadiformes: Macrouridae) from Fieberling Guyot, Eastern North Pacific Ocean

Raymond R. Wilson, Jr.
Department of Biological Sciences, California State University, Long Beach, Long Beach, CA90840-3702, fax (562) 985-8878, email: rwilson1@csulb.edu

Received: 23-VI-2000 Corrected: 23-XI-2000 Accepted: 8-XII-2000

Abstract: A new species of the macrourine genus *Nezumia* is described from specimens collected from the crest of Fieberling Guyot in the eastern North Pacific Ocean. The new species is distinguishable from all other *Nezumia* species chiefly on the basis of a high number of pelvic fin rays, a relatively high number of first dorsal fin soft rays, a steep blunt snout lacking scales ventrally, a relatively weak suborbital ridge, and a moderately long, thin barbel. Although possibly endemic to the Baja California Seamount Province, the new species appears to lack close relatives among the other *Nezumia* species of the eastern North Pacific Ocean. It might have arrived there either from a disjunct Tethyan distribution, thus retaining close relatives among the Atlantic Ocean species of *Nezumia*, or by way of stepping-stone dispersal from the Indo-west Pacific Ocean.

Keywords: Biogeography, Grenadiers, Macrourids, *Malacocephalus*, Seamounts, Guyots

Nezumia is among the three most speciose genera of macrourine grenadiers with more than 46 described species worldwide (Cohen *et al.* 1990); however, only six species are reported from the eastern North Pacific Ocean (Iwamoto 1979). The typical habitat of *Nezumia* species is upper to middle continental slopes. A few are occasionally collected from slopes of volcanic islands, crests of submarine ridges, and isolated seamounts (Okamura et al. 1982, Sazonov 1985, Wilson *et al*. 1985, Wilson and Kaufmann 1987, Sazonov and Iwamoto 1992). Two decades ago the *Kaiyo Maru*, a research vessel of the Japan Fisheries Agency, sampled seamounts of the Fieberling-Guadalupe seamount chain (Batiza 1989) off Baja and southern California (Japan Fisheries Agency Report 1979). The two macrourids they collected from Fieberling Guyot (ca. 550 m crest depth) were reported as *Malacocephalus laevis* and as an undetermined species of *Nezumia* (listed as *Nezumia* sp.1). *M. laevis* was reported in extraordinarily high abundance whereas *Nezumia* sp. 1 was reported in moderate abundance. Subsequently, between 1990 and 1991, Fieberling Guyot was the focus of a coordinated study on the physical and biological oceanography of isolated seamounts. During this study submersible observations (Levin *et al*. 1994) confirmed that, collectively, macrourids were indeed very abundant on the crest of Fieberling Guyot. Additional sampling by K.L. Smith and party of the Scripps Institution of Oceanography provided several macrourid specimens for direct examination. Among

those specimens were *M. laevis* and one undescribed species of *Nezumia*, probably *Nezumia* sp.1. Due to an interest in the ichthyofauna of seamounts, it is my purpose in this paper to describe and name this new *Nezumia* species, officially adding it both to the ichthyofauna of the eastern North Pacific Ocean, as well as to that reported from seamounts worldwide (Kaufmann and Wilson 1991).

MATERIALS AND METHODS

Specimens of *Nezumia* were obtained from the crest of Fieberling Guyot using baited, free-vehicle traps as in Smith et al. (1979). Specimens were initially frozen, then ten were fixed in formalin and subsequently transferred to 55% isopropanol. Methods for making counts and measurements followed Iwamoto (1970). Counts of rays in both pelvic fins were made. Otherwise, counts were taken from the left side of the body whenever possible. Sagittae were removed from three of the above specimens and measured as in Wilson (1985).

Comparative eastern Pacific Ocean material examined: *Nezumia convergens* SIO72-184 3(180 to 203 mm total length); *Nezumia stelgidolepis* SIO62-188 13(315 to 400 mm total length) and SIO89-42 16(104 to 204 mm total length); *Nezumia pudens* CAS38310 1(405 mm total length), CAS38323 2(115 to 235 mm total length), SU22727 1(334+ mm total length); *Nezumia puchellus* CAS38323 3(198+ to 265 mm total length).

Otoliths: Sagittal otoliths were removed from three specimens collected in baited traps on Fieberling Guyot in 1990. These specimens ranged from 310+ to 393 mm of total length. Head lengths ranged between 71.6 and 75.7 mm (Table 1, specimens 1, 2, and 3). Length (anteroposterior axis), height (dorsoventral axis), and width (mediolateral axis) were measured. Lengths were 11.7 to 12.9 mm left sagittae (11.8 to 13.0 mm right), heights 6.8 to 7.5 mm left sagittae (6.1 to 7.4 mm right), widths 2.2 to 2.6 mm left sagittae (2.2 to 2.6 mm right), and mass 190-260 mg left sagittae.

Nezumia kensmithi new species
Blunt-nosed grenadier Fig. 1

Holotype: SIO92-108; a female of 346+ mm of total length, 108.7 mm preanal length, and 71.6 mm head length. Captured at 555 m depth on the summit of Fieberling Guyot, 32º27.82'N, 127º47.00'W, in a free-vehicle fish trap set by K.L. Smith and party, 5 October 1990, aboard the R/V *New Horizon.*

Paratypes: SIO92-108 3(310+ to 398 mm total length) (specimens were caught in the same trap as the holotype); SIO92-110 1(362 mm total length); SIO 93-186 5(285+ to 340 mm total length).

Diagnosis: A macrourine grenadier of the genus *Nezumia* as characterized by Iwamoto (1979) and Cohen et al. (1990) with 11-12 pelvic fin rays, 9-11 first dorsal fin soft rays, a steep, blunt snout naked on the venter, a relatively weak suborbital ridge, and a moderately long, thin barbel.

Description: Holotype counts (Table 1; column 1): First dorsal fin iI-10; P_1 21i, P_2 12/12i, scales below origin of first dorsal fin 9, scales below origin of second dorsal fin 9. Holotype measurements in % of head length: snout length 27.0, internasal width 18.2, barbel length 16.7, interorbital width 20.3, orbital diameter 29.6, suborbital width 13.6, ventral snout length 16.7, upper jaw length 39.5, length at preopercular orbital angle 40.2, postorbital length 50.1; measurement in % of preanal length: head length 65.9; measurement in % of total length: preanal length *ca*. 31.4. Paratype counts (Table 1, specimens of SIO92-108, SIO92-110, and SIO93-186, in columns 2 to 10, respectively): first dorsal fin (iI 9-11), P_1 (19-25), P_2 (11/12–12/12), scales below origin of first dorsal fin (8-9), scales below origin of second dorsal fin (8-9). Paratype measurements in % of head length determined from data in Table 1 (columns 2-10) were: snout length (25-29), barbel length (16-20), interorbital width (21-25), orbit diameter (27-31), suborbital width (12-16), ventral snout length (14-19), upper jaw length (34-39), length at preopercular orbital angle (38-47), postorbital

Fig. 1. Holotype of *Nezumia kensmithi,* SIO92-108.

length (45-50); measurement in % of preanal length: head length (61-74); measurement in % of total length: preanal length (25-32).

Head moderately compressed, ridges of head not prominent. Suborbital region nearly flat but with weakly developed suborbital ridge extending from preopercle posterior of orbit to just anterior of nares (Fig. 1). Area immediately below ridge scaled but becoming naked in narrow strip along ventral margin of lacrimal. Snout very blunt, nearly vertical in profile, not protruding much beyond mouth, naked below dorsal tip. Blunt scutes at tip and lateral angles, not prominent nor especially spinuous. Barbel not long nor especially thick, tapering to fine tip. Interopercle exposed posteriorly and ventrally with small patch of scales at posteroventral corner, but otherwise naked. Dorsal margin of opercle not forming prominent ridge, nor tab-like over pectoral shoulder. Posterior margin of opercle nearly straight from posterodorsal corner; lower third slightly concave, distal margin more-or-less triangular. Gill rakers on first arch much reduced, barely visible above gill arch in some specimens, 7 to 9 total on both limbs. Gill filaments well developed, their length about 0.85 in suborbital width in holotype. Body scales densely covered with slender, sharply pointed, erect spinules aligned mostly in convergent rows. Scales below origin of second dorsal fin with about 13 spinule rows in holotype, 6 to 7 spinules in longest rows. Head mostly covered with firmly-attached scales with reduced spinulation. Scales dorsal of suborbital ridge arranged in two rows with those along margin of orbit more columnar shaped. Scales ventral of ridge much smaller, not arranged in distinct rows. Mandible scaled, gill membranes naked. Small teeth in wide indistinct bands in upper and lower jaws. Outer row of enlarged, recurved teeth in upper jaw.

Fins of moderate size. First dorsal fin with two spines; first spine reduced, barely reaching above body margin; second spine long with filamentous tip and series of very short spines along anterior margin; dorsal soft rays 9 to 11 (10 in holotype). Second dorsal fin reduced as typical for macrourines. Pectoral fins of moderate length, extending posterior of anal fin insertion. Pelvic fins insert-

Fig. 2. A pair of sagittal otoliths from a *Nezumia kensmithi* (Table 1, column 3) of 73.0 mm head length. View is of the medial side for both. At left is the right sagitta with rostrum at top, rounded postrostrum at bottom, smooth ventral margin at left, and irregular dorsal margin at right. Dimensions of the left sagitta (at right) are: length 11.7 mm, height 6.81 mm, width 2.20 mm, and mass 190 mg.

ed slightly in advance of pectoral origin. Outer pelvic rays with filamentous tips extending posterior to anal fin insertion. Anus slightly less than half the distance from pelvic insertion to origin of anal fin. Periproct between pelvic fins, not extending anterior of pelvic fin insertion. Anterior dermal window of light organ small, more or less circular, posterior to pelvic fin insertion.

Otoliths (sagittae) relatively large as is typical for macrourids; well defined sulcus along anteroposterior axes. Ventral margins smooth, rounding slightly from anterior rostrum to posterior margin (Fig. 2). Dorsal margins more irregular. Lateral face slightly concave. Mean dimensional ratios (N=3 from left sagittae): sagitta length/head length 0.16 (range 0.16-0.17), sagitta height/sagitta length 0.57 (range 0.55-0.58), sagitta width/sagitta length 0.20 (range 0.19-0.22), and log sagitta mass/sagitta length 0.19 (range 0.19-0.20).

Freshly thawed specimens with posterior body, nape along interorbit, and snout slate brown; suborbital area gray. Mid-body bluish black beneath first dorsal fin and bluish along side of abdomen and ventrum. Gill membranes, periproct, lips and posterodorsal corner of opercle black. Paired fins black, first dorsal fin dusky with some gray. Anal fin dusky.

Etymology: Named for Dr. Kenneth L. Smith, Jr. who, throughout his distinguished research career in deep-sea biology, has contributed significantly to our knowledge of the ecology and behavior of deep-sea fishes, particularly macrourids, and to our general knowledge of the biology of Pacific Ocean seamounts, including Fieberling Guyot.

Comparisons: *N. kensmithi* can be distinguished from other macrourids of the eastern North Pacific Ocean having seven branchiostegal rays in the key of Iwamoto (1979). The few gill rakers present on the first arch of *N. kensmithi* (i.e., 7 to 9) causes it to key out to *N. convergens* in couplet 13a. However, *N. kensmithi* has more pelvic fin rays (11 to 12 versus 10 to 11), a much weaker suborbital ridge, scales below the ridge (naked in *N. convergens*), and is much less slender. Compared to the only remaining congener known in the eastern North Pacific Ocean, *N. pudens*, *N. kensmithi* has more pelvic fin rays (11 to 12 versus 10 to 11), a shorter and more slender barbel, longer gill filaments on the first gill arch, and is naked below the scutes on the anterior part of the snout (partially scaled in *N. pudens*). Among the other described species of *Nezumia* outside the eastern North Pacific Ocean, *N. kensmithi* would fall into group F in the key of Cohen et al. (1990) by having 12 rays in the pelvic fins. But it differs from all of the group F species

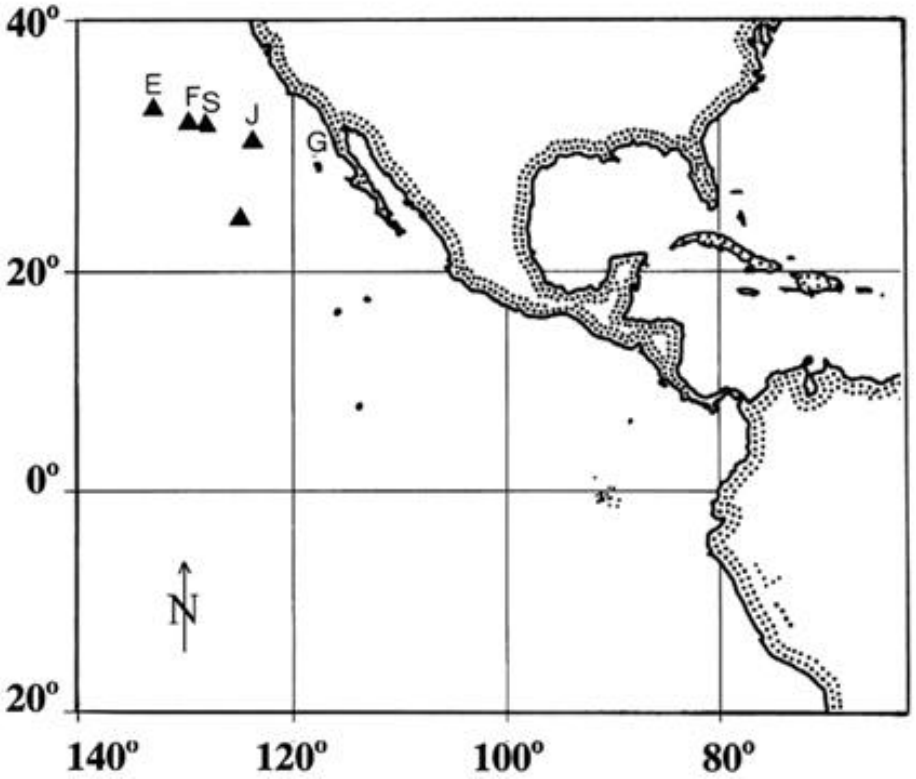

Fig. 3. Probable distribution of *Nezumia kensmithi* among seamounts of theBaja California Seamount Province based on the reported collections of *Nezumia* sp. 1 by the *Kaiyo Maru*, and specimens obtained from Fieberling Guyot. Named seamounts are as follows: E = Erben Tablemount, F = Fieberling Guyot (type location for *N. kensmithi*) S = Stoddard Seamount, J = Jasper Seamount. G is Guadalupe Island included only for reference, has no reports of *N. kensmithi.*

in having a very blunt snout and naked venter. Other species of *Nezumia* with such blunt snouts and naked venters have fewer (8-10) pelvic fin rays.

The sagittae of *N. kensmithi* are typical of relatively shallow-dwelling macrourids as illustrated by Wilson (1985) in being relatively thin without any apparent doming. The shape more closely resembles *Coryphaenoides acrolepis* sagittae than sagittae of the *Nezumia* species studied by Wilson (1985). The similarity is also apparent in the dimensional ratios, especially with regard to log sagitta mass/sagitta length and sagitta height/sagitta length. Moreover, at 16 to 17% of head length the sagittae of *N. kensmithi* are considerably larger than sagittae of other Pacific Ocean macrourids that have been studied. For example, the notoriously large sagittae of *C. acrolepis* average about 12% of head length (Wilson 1985). Wilson (1985) and Lombarte and Lleonart (1993) have shown that among grenadiers and hakes, species with the shallowest distributions have the largest sagittae, and species with the deepest distributions have the smallest sagittae. One explanation for the unusually large sagittae of *N. kensmithi* might be that the adult fish essentially remain on or near the shallow crest of the guyot, rather than seeking deeper water with increasing size. Individuals therefore spend perhaps all of their adult life spans at relatively shallow depths over the seamount.

Distribution: *N. kensmithi* is presently confirmed only on Fieberling Guyot in the eastern North Pacific Ocean. Fieberling is the penultimate seaward guyot of the Fieber-

TABLE 1.
Selected measurements and counts from holotype (column 1) and nine paratypes (columns 2 – 10) of Nezumia kensmithi.

Specimen	1	2	3	4	5	6	7	8	9	10
Measurement (mm)										
TL	346+	393	310+	398	362	285+	310	340	340	339
HL	71.6	75.7	73.0	81.5	72.4	69.3	65.9	68.2	59.2	58.3
SNL	19.4	19.4	19.3	20.5	18.0	18.0	17.5	18.1	16.5	17.0
VSL	12.0	13.0	12.7	12.5	11.0	14.6	8.8	12.0	11.4	11.3
PAL	108.7	115.8	119.0	116.7	98.0	107.8	97.9	107.2	91.9	85.9
IO	14.6	16.5	16.0	17.1	14.2	17.0	14.3	15.7	13.7	13.5
OD	21.2	23.4	20.7	22.6	20.5	18.6	18.2	18.3	17.0	16.5
SOW	9.8	10.1	10.0	10.7	9.0	11.3	9.3	10.9	8.6	8.3
POL	35.9	36.8	35.7	38.7	35.5	34.9	31.9	34.4	28.7	27.2
POA	28.8	35.6	31.3	31.4	28.3	28.9	26.8	25.9	22.4	22.5
UJL	28.3	27.9	23.3	28.5	27.6	27.2	23.1	25.6	20.4	20.6
BL	12.1	15.0	14.1	n.d.	12.5	13.4	12.9	12.5	9.5	7.5
BD	61.6	64.0	60.2	60.9	53.9	52.8	55.1	56.8	47.9	43.4
Counts										
D_1 rays	iI+10	iI+11	iI+11	iI+10	iI+10	iI+10	iI+10	iI+11	iI+9	iI+11
P_1 rays	21	21	23	19	23	25	22	23	23	24
P_2 rays	12/12	12/12	12/12	12/12	11/12	11/12	11/12	11/12	12/12	12/12
Scales D_1	9	9	8	9	9	9	8	9	9	9
Scales D_2	9	9	8	9	8	9	9	9	9	8

TL = total length, HL = head length, SNL = snout length, VSL = ventral snout length, PAL = preanal length, IO = interorbital width, OD = orbit diameter, SOW = suborbital width, POL = post-orbital length, POA = length at preopercular orbital angle, UJL = upper jaw length, BL = barbel length, BD = body depth at first dorsal fin origin, D_1 = first dorsal fin, P_1 = pectoral fin rays, P_2 = pelvic fin rays, Scales D_1 = scale rows below origin of first dorsal fin, Scales D_2 = scale rows below origin of second dorsal fin.

ling-Guadalupe seamount chain (Batiza 1989), lying about 900 km WSW of San Diego, California, U.S.A. (Fig. 3). The distribution of *Nezumia* sp. 1, presumably *N. kensmithi*, as reported by researchers of the *Kaiyo Maru* extendsto other seamounts in the Baja California Seamount Province of which the Fieberling-Guadalupe seamounts represent but a few. *Nezumia* sp. 1 was reported on Erben Tablemount (32°52'N, 132°30'W), the ultimate seaward guyot of the Fieberling-Guadalupe chain, Stoddard Seamount (31°45'N, 126°15'W), Jasper Seamount (30°25'N, 112°45'W), and an unnamed seamount lying at 350 m crest depth at 23°05'N, 124°55'W (Japan Agency Report 1979).

DISCUSSION

N. kensmithi does not appear closely related to any *Nezumia* species of the eastern Pacific Ocean based on morphological similarity. Its steep blunt snout and naked venter render it superficially close to the Atlantic Ocean species *Nezumia atlantica* and *Nezumia africana*, an observation enticing speculation that *N. kensmithi* might be a product of a disjunct Tethyan distribution. Conversely, there is evidence of possible origination in the Indo-west Pacific Ocean via the eastern South Pacific Ocean. Wilson and Kaufmann (1987) reported that the ichthyofauna of seamounts with crests at moderate depths (e.g., 200 to 2000 m) is typically composed of nearly equal parts of widespread species and species abundant on the nearest continental slope (i.e., provincial species). The other demersal fishes reported from the crest of Fieberling (Japan Agency Report 1979) included the hagfish *Eptatretus deani*, the catshark *Apristurus brunneus*, the squaloid *Etmopterus* sp. (*E.* cf. *granulosus*?), the scorpaenids *Sebastolobus altivelis* and *Sebastes* sp., and *M. laevis.* While *E. deani, A. brunneus, S. altivelis*, and *Sebastes* sp. are certainly eastern Pacific (provincial) species of the California slope, *Etmopterus* sp. and *M. laevis* are little known from the California slope. Both are apparently widespread in mid- to low-latitude seas except in the eastern North Pacific Ocean and thus would appear to represent the "widespread" category of Wilson and Kaufmann (1987). But the "widespread" category of Wilson and Kaufmann (1987) applied to species widespread throughout the major ocean region in which the seamounts occurred as well as beyond it. The distributions of *Etmopterus* sp. and *M. laevis* are probably substantially greater outside the ocean region (eastern North Pacific) of Fieberling Guyot than within it. On this relatively fine distinction the two might be referable instead to the "exotic" category of Wilson and Kaufmann (1987). This category comprised the smallest fraction of the fauna pool (< 4% of species) of the major seamount groups that had been studied. However, very little of the data reviewed by Wilson and Kaufmann (1987) came from seamounts in the eastern North Pacific Ocean near the latitude of Fieberling or lower, so their somewhat artificial categories might not be directly extendable to species of the Baja California Seamount Province. The conventional interpretation would be to regard the two widespread species as extralimital to the eastern North Pacific Ocean.

The two most abundant and probably most widespread fishes collected from Fieberling Guyot (*M. laevis* and *Etmopterus* sp.) are possibly extralimital in the eastern North Pacific Ocean from a chiefly Indo-west Pacific Ocean distribution. The third most abundant species collected there by the *Kaiyo Maru*, *Nezumia* sp. 1 (= *N. kensmithi*) might be endemic to the Baja California Seamount Province, but there are no closely-related congeners reported from the eastern North Pacific Ocean. The abundant demersal fishes of Fieberling Guyot reflect a larger pattern of dominance of mid- to low-latitude seamounts in the central and eastern Pacific oceans by species also abundant in the Indo-west Pacific Ocean (Hubbs 1959, Wilson et al. 1985,

Wilson and Kaufmann 1987). The pattern as it applies to Fieberling Guyot is similar to that Parin et al. (1997) detailed for some eastern South Pacific Ocean seamounts. Namely, the evident "intrusion" of Indo-west Pacific Ocean species into the eastern Pacific Ocean possibly by way of seamount "stepping stones." The probable occurrence of *N. kensmithi* on seamounts south of Fieberling (Fig. 3) suggests that it too might be derived from the Indo-west Pacific/eastern South Pacific Ocean fauna, having arrived in the eastern North Pacific Ocean via "seamount stepping stones." A phylogenetic analysis of the genus *Nezumia* might allow rejection of one of these two hypotheses on the origin of *N. kensmithi* in the eastern North Pacific Ocean. Namely, an origin resulting from a disjunct Tethyan distribution retaining close relatives among the Atlantic Ocean species of *Nezumia*, or one resulting from stepping-stone dispersal from the Indo-west Pacific Ocean.

ACKNOWLEDGEMENTS

I thank K. L. Smith, Jr. and R. J. Baldwin, Scripps Institution of Oceanography (SIO), for the specimens they collected on Fieberling Guyot in 1990 and 1991, and H. J. Walker, C. Klepaldo, and P. Ajtai for examining some of the specimens which helped expedite this paper. I also thank T. Iwamoto, California Academy of Sciences, Department of Ichthyology, for encouraging me to finish this paper for inclusion in the present volume, and for the loan of comparative materials.

RESUMEN

Se describe una nueva especie de *Nezumia* del Pacífico Norte que parece endémica de la bioprovincia *Seamount* de Baja California, donde podría estar desde tiempos del mar de Tetis o haber llegado posteriormente desde el Pacìfico Indo-occidental.

REFERENCES

Batiza, R. 1989. Seamounts and seamount chains of the eastern Pacific, p. 289-306. *In* E. L. Winterer, D. M. Hussong & R. W. Decker (eds.). The Geology of North America Vol. N: The Eastern Pacific Ocean and Hawaii. Geological Society of America, Boulder, Colorado. 563 p.

Cohen, D.M., T. Inada, T. Iwamoto & N. Scialabba. 1990. Gadiform Fishes of the World. FAO Species Catalogue Vol. 10, Rome, Italy. 442 p.

Hubbs, C.L. 1959. Initial discoveries of fish faunas on seamounts and offshore banks in the eastern Pacific. Pac. Sci. 13: 311-316.

Iwamoto, T. 1970. Macrourid fishes of the Gulf of Guinea. Stud. Trop. Oceanogr. (Miami) 4: 316-431.

Iwamoto, T. 1979. Eastern Pacific macrourine grenadiers with seven branchiostegal rays (Pisces: Macrouridae). Proc. Calif. Acad. Sci. 42: 135-179.

Japan Fisheries Agency. 1979. Report of the survey of the research vessel *Kaiyo Maru*, FY1978: Survey of the eastern Pacific seamounts.167 p. (In Japanese).

Kaufmann, R.S. & R. R. Wilson, Jr. 1991. A summary and bibliography of seamount biota. SIO Ref. Series 91-8. La Jolla, California. 79 p.

Levin, L.A., E.L. Leithold, T.F. Gross, C.L. Huggett & C. DiBacco. 1994. Contrasting effects of substrate mobility on infaunal assemblages inhabiting high-energy settings on Fieberling Guyot. J. Mar. Res. 52: 489-522.

Lombarte, A. & J. Lleonart. 1993. Otolith size changes related with body growth, habitat depth and temperature. Environ. Biol. Fish. 37: 297-306.

Okamura, O., K. Amaaoka & F. Mitani. 1982. *Fishes of the Kyushu-Palau Ridge and Tosca Bay*. Japan Fish. Res. Conserv. Assoc., Tokyo. 435 p.

Parin, N. V., A. N. Mironov & K. N. Nesis. 1997. The Nazca and Sala-y-Gomez submarine ridges: An outpost of the Indo-West Pacific fauna in the Eastern Pacific. Advan. Mar. Biol. 32: 47-242.

Sazonov, Y. I. 1985. Two new macrourid species (Gadiformes) from northern Pacific seamounts. Vorp. Ikth. 5: 719-727.

Sazonov, Y. I. & T. Iwamoto. 1992. Grenadiers (Pisces:Gadiformes) of the Nazca and Sala-Y-Gomez Ridges, southeastern Pacific. Proc. Cal. Acad. Sci. 48: 27-95.

Smith, K.L., G.A. White, M.B. Laver, R.R. McConnaughey & J.P. Meador. 1979. Free vehicle capture of abyssopelagic animals. Deep-Sea Res. 26: 57-64.

Wilson, R.R., Jr. 1985. Depth-related changes in sagitta morphology in six macrourid fishes of the Pacific and Atlantic Oceans. Copeia 1985: 1011-1017.

Wilson, R.R., Jr. & R.S. Kaufmann. 1987. Seamount biota and biogeography, p. 355-377, *In* B. H. Keating, P. Fryer, R. Batiza & G. W. Boehlert (eds.). Seamounts, Islands and Atolls. Geophy. Monogr. 43, American Geophysical Union, Washington, D.C. 405 p.

Wilson, R. R., Jr., K. L. Smith, Jr. & R. H. Rosenblatt. 1985. Megafauna associated with bathyal seamounts in the central North Pacific Ocean. Deep-Sea Res. 32: 1243-1254.