

**First record of the Eucla cod,
Euclichthys polynemus McCulloch,
(Teleostei, Paracanthopterygii, Euclichthyidae)
from New Caledonia, southwest Pacific Ocean,
with notes on morphological characters**

Clive D. ROBERTS

&

Chris D. PAULIN

Museum of New Zealand
"Te Papa Tongarewa"
P.O. Box 467, Wellington
New Zealand

ABSTRACT

The Australasian Eucla cod, *Euclichthys polynemus* McCulloch, family Euclichthyidae, is described for the first time from the New Caledonian Exclusive Economic Zone where it appears to be restricted to seamount "B" (24°55'S, 168°21'E) on the northern Norfolk Ridge southeast of New Caledonia. The Eucla cod is superficially very similar to morid cods (family Moridae), but can be distinguished by a long filamentous pelvic fin with four to six distal elements, an unequally divided anal fin, and an asymmetrical caudal fin.

ROBERTS, C. D. & C. D. PAULIN, 1997. — First record of the Eucla cod, *Euclichthys polynemus* McCulloch, (Teleostei, Paracanthopterygii, Euclichthyidae) from New Caledonia, southwest Pacific Ocean, with notes on morphological characters. In: SÉRET, B. (ed.), Résultats des Campagnes MUSORSTOM, Volume 17. *Mém. Mus. natn. Hist. nat.*, **174** : 43-50. Paris ISBN 2-85653-500-3.

RÉSUMÉ

Premier signalement d'*Euclichthys polynemus* McCulloch (Teleostei, Paracanthopterygii, Euclichthyidae) de Nouvelle-Calédonie (Océan Pacifique Sud-Ouest), et remarques sur les caractères morphologiques de l'espèce

L'espèce Australo-asiatique, *Euclichthys polynemus* McCulloch, de la famille des Euclichthyidae, est décrite pour la première fois de la Zone Économique Exclusive de Nouvelle-Calédonie, où elle semble limitée au mont sous-marin "B" (24°55'S, 168°21'E), situé sur la partie nord de la Ride de Norfolk au sud-est de la Nouvelle-Calédonie. Ce poisson ressemble à un moridé (famille Moridae), mais s'en distingue par sa nageoire pelvienne formée de quatre-six rayons allongés et filamenteux, sa nageoire anale divisée inégalement, et sa nageoire caudale asymétrique.

INTRODUCTION

The Eucla cod is a rare benthopelagic fish found in deep slope waters of Australia and New Zealand (COHEN *et al.*, 1990). In general appearance it is a typical gadiform with an elongate tapering body covered with small cycloid scales, a large head, mouth and eye, fins without spines, and pelvic fins thoracic in position. The placement of *Euclichthys polynemus* in Gadiformes has never been questioned, but its family relationships remain enigmatic and controversial. Eucla cods are similar to morid cods in general body shape and appearance and the two have often been confused and thought to be closely related. However, several internal characters (e.g. COHEN, 1984) indicate they are only distantly related and, therefore, the morid cods of New Caledonia are reviewed separately (see PAULIN & ROBERTS, this volume).

Traditionally the Eucla cod has been considered to belong to the family Moridae (McCULLOCH, 1926: 174; SCOTT, 1962: 82; McCANN, 1972: 630) and is still often classified for convenience as a morid (LAST *et al.*, 1983: 232; PAXTON & HANLEY, 1989: 299). SVETOVIDOV (1969) showed that the Eucla cod is not a morid due to the absence of a connection between the swimbladder and auditory capsule, but its systematic position was considered unclear. PAULIN (1983: 88) noted that *E. polynemus* shared with *Melanonus gracilis* (Melanonidae) three distinct characters: olfactory lobes close to the brain, absence of a swimbladder-inner ear connection, and possession of five hypurals in the caudal skeleton. On the basis of these characters PAULIN (1983) suggested that Eucla cod occupied an evolutionary position between Moridae and Gadidae, and should be placed close to or within the family Melanonidae. It was subsequently placed in Melanonidae by MAY & MAXWELL (1986: 197), but has also been placed in the family Gadidae (AYLING & COX, 1982: 150), in its own family Euclichthyidae (COHEN, 1984: 264; HOWES, 1988: 23; PAULIN, 1990: 170), and classified as *incertae sedis* by FAHAY & MARKLE (1984: 266).

Currently, general consensus is that *Euclichthys polynemus* should be placed in its own family, Euclichthyidae, largely because it can not be placed in any other recognized gadiform family (COHEN, 1984) and has some unique morphological characters. Recent critical and rigorous studies of gadiform systematics (COHEN, 1989 and papers therein) have failed to resolve the relationships of *Euclichthys* which was classified by four independent studies as: close to the morids and rattails, a sister group of the macrourids, a macrouroid family, and among the gadoids. With good reason it was described by COHEN (1989: 2) as still a "problem genus".

As part of two cooperative fish research programmes Centre ORSTOM de Nouméa and the Museum of New Zealand "Te Papa Tongarewa" (formerly the National Museum of New Zealand), Eucla cods were observed and collected by the authors who participated in exploratory trawling on seamounts during R. V. "Alis" cruises BERYX 2 and 11. In addition, preserved specimens collected during an earlier ORSTOM research cruise off New Caledonia and held in the collection of ORSTOM in Muséum National d'Histoire Naturelle, Paris, were studied. This new material provides the basis for the present review and enables the rare Eucla cod to be described for the first time from the New Caledonian Exclusive Economic Zone.

METHODS

Counts and measurements follow the methods used by HUBBS & LAGLER (1964) and PAULIN (1989a). Precise counts of scale rows in longitudinal series from damaged specimens are difficult to make and these data are approximate; count of pelvic fin rays is the number of distal elements, it is unclear from the specimens examined whether the first ray is unbranched or branched basally. Morphometric data in the text are expressed as ranges and are given in mm, with percent standard length in parentheses. Vertebral counts include both ural centra. The synonymy includes valid name and Australian and New Zealand nomenclature, plus anatomical descriptions. Specimens examined are listed under the species account; nine specimens were X-rayed and these are denoted by an asterisk. Because morid cods are externally so similar in appearance to Eucla cod, Moridae are included at family level in the key to aid field identifications.

Institutional abbreviations follow the international standards fixed by LEVITON *et al.* (1985): NMNZ = Museum of New Zealand, Wellington (formerly the National Museum of New Zealand); MNHN = Muséum national d'Histoire naturelle, Paris. Eucla cods were collected off New Caledonia during three ORSTOM research cruises: CHALCAL 2 (see cruise report by RICHER DE FORGES *et al.*, 1987; and exploration summary by RICHER DE FORGES, 1990), BERYX 2 (GRANDPERRIN & LEHODEY, 1992), and BERYX 11 (GRANDPERRIN *et al.*, 1993).

SYSTEMATIC ACCOUNT

KEY TO EUCLA COD AND MORIDAE FROM NEW CALEDONIAN WATERS

- 1 Pelvic fin with 4-6 long filamentous elements; anal fin in two unequal parts, a short high anterior portion and a large low posterior portion, length of base of first portion about three times length of second; caudal fin asymmetrical, ventral lobe slightly produced **Euclichthyidae** (*Euclichthys polynemus*)
- 1' Pelvic fin with 5-6 rays, 0-2 long and filamentous; anal fin single or divided into two equal portions; caudal fin symmetrical..... **Moridae** (see PAULIN & ROBERTS, this volume)

Family **EUCLICHTHYIDAE**

DIAGNOSIS. — First neural spine free; no otophysic connection; caudal fin asymmetrical with four hypurals nearly fused to two (COHEN, 1984: 263). Cranial muscle *adductor arcus palatini* divided by a strong ligament running from the lateral ethmoid and palatine to the medial face of the hyomandibular (HOWES, 1988: 24).

REMARKS. — Family interrelationships are poorly understood. Comprising one monotypic genus (SVETOVIDOV, 1969; COHEN, 1984; PAULIN, 1989b) for the Eucla cod which is benthopelagic at 200-1,000 m depth, found in deep subtropical-warm temperate Australasian waters, no commercial importance.

Genus **EUCLICHTHYS** McCulloch, 1926

Euclichthys McCulloch, 1926: 174 (masculine; type species *Euclichthys polynemus* McCulloch by original designation, also monotypic).

DIAGNOSIS. — As for family.

Euclichthys polynemus McCulloch, 1926

Fig. 1, Table 1

Euclichthys polynemus McCulloch, 1926: 174, plate 44, fig. 2 (original description, type locality off Eucla, Great Australian Bight, Australia).

Euclichthys polynemus: MUNRO, 1938: 62, fig. 439 (description). — SCOTT, 1962: 82, fig. (description). — McCANN, 1972: 630 (description, New Zealand). — AYLING & COX, 1982: 150, fig. (description). — LAST *et al.*, 1983: 232, fig. 21.3 (description). — COHEN, 1984: 263 & 264, fig. 137 (description, classification). — FAHAY & MARKLE, 1984: 266, Table 72 (description). — MAY & MAXWELL, 1986: 197, fig. (description). — HOWES, 1987: 628, fig. 2c (palatine articulation). — HOWES, 1988: 23, figs. 14-15 (cranial muscles and ligaments). — MARKLE, 1989: 82, figs. 11A, 16, 17A (pectoral and caudal skeleton, classification). — NOLF & STEUBAUT, 1989: 92, fig. 1B (otolith description, classification). — OKAMURA, 1989: 138, figs. 2B, 3C, 5 (cranium, vertebral region and luminous organ, classification). — PATTERSON & ROSEN, 1989: 16, figs. 6, 12A (caudal skeleton and dorsal gill arch). — PAULIN *et al.*, 1989: 121 (diagnosis, key). — PAXTON & HANLEY, 1989: 299 (synonymy). — COHEN *et al.*, 1990: 18, fig. 29 (description). — HOWES & CRIMMEN, 1990: 170, fig. 15D (basihyal and dorsohyals). — PAULIN, 1990: 170, fig. (description, New Zealand).

MATERIAL EXAMINED. — 13 specimens, 187.5-273.0 mm SL.

Norfolk Ridge. CHALCAL 2: stn CH7, 24°55.50'S, 168°21.10'E (seamount "B", southeast of New Caledonia), 494-590 m depth, bottom trawl, R. V. "Coriolis", 28 October 1986: 4 specimens, 209-273 mm SL (MNHN 1995-1001)*.

BERYX 2: stn 5, 24°56.05'S, 168°21.20'E (seamount "B", southeast of New Caledonia), 535-545 m depth, bottom trawl, R. V. "Alis", 24 October 1991: 3 specimens, 187.5-203 mm SL (NMNZ-P.27455)*. — Stn 19, 24°55.80'S, 168°22.30'E (seamount "B", southeast of New Caledonia), 550-700 m depth, bottom trawl, 30 October 1991: 2 specimens, 213-239 mm SL (NMNZ-P.27475)*.

BERYX 11: stn C3, 24°54.60'S, 168°21.60'E (seamount "B", southeast of New Caledonia), 502-610 m depth, bottom trawl, R. V. "Alis", 14 October 1992: 2 specimens, 230-243.5 mm SL (NMNZ-P.29408). — Stn C4, 24°50.75'S, 168°21.86'E (seamount "B", southeast of New Caledonia), 550-920 m depth, bottom trawl, 14 October 1992: 2 specimens, 212-243 mm SL (NMNZ-P.29228).

DIAGNOSIS. — As for family. *Euclichthys polynemus* differs from all morid cods, with which it is superficially most similar, by lacking a horizontal diaphragm within the posterior chamber of the swim bladder (PAULIN, 1988), no swim bladder-auditory capsule connection (SVETOVIDOV, 1969), *adductor arcus palatini* muscle divided by a strong ligament (HOWES, 1988), and only a single sulcus groove on the otoliths. Field characters which enable the Eucla cod to be distinguished from morid cods include the long filamentous pelvic fins comprised of four to six distal elements, the unequally divided anal fin, and the asymmetrical caudal fin.

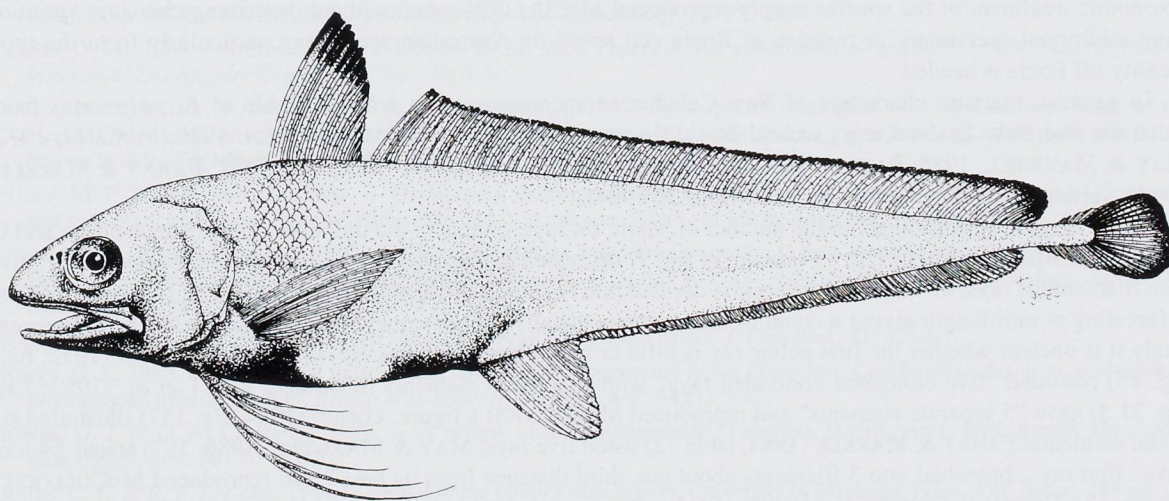
DESCRIPTION. — Body elongate, narrow and compressed posteriorly, greatest depth at origin of first dorsal fin, thereafter tapering to a narrow caudal peduncle. Snout rounded, its length less than diameter of the eye. Teeth small villiform, none on vomer. First dorsal fin short, high, first ray minute, fin separated from second by a short space. Anal fin long with a short high anterior portion, followed by a long, low posterior portion with fin rays increasing in length posteriorly. Pelvic fins comprising four (COHEN, 1990), five ($n = 1$) or six ($n = 12$) long filamentous distal elements reaching beyond anus. Caudal fin rounded, asymmetrical with a longer lower lobe.

Measurements (in mm, % SL in parenthesis). Standard length 187.5-273.0; head length 36.9-59.5 (19.6-21.7), head width 16.5-25.6 (7.5-10.3); body depth at origin of first dorsal fin 28.0-52.1 (14.9-19.2); caudal peduncle depth 3.4-4.8 (1.5-1.9); orbit diameter 10.8-17.4 (5.5-6.3); interorbital width 7.1-10.6 (3.0-4.1); snout length 9.1-15.1 (4.8-6.1); maxilla length 21.4-35.5 (10.5-13.0); length of pectoral fin 26.4-43.5 (12.5-16.3); length of pelvic fin 44.0-88.0 (22.5-32.3); length of longest ray of first dorsal fin 28.3-38.5 (12.7-15.5), length of longest ray of second dorsal fin 15.1-22.8 (7.3-9.4); length of longest ray of anal fin 19.5-28.7 (8.9-11.7); predorsal length 42.1-72.6 (22.4-32.2); preanal length 77.5-104.5 (35.2-42.4).

Meristics. Frequency distributions of selected meristic characters are given in Table 1. First dorsal fin rays 1 + 12-15; second dorsal fin rays 78-88; anal fin rays 14-17 + 75-88 = 94-103; pectoral fin rays 18-22; pelvic fin ray distal elements 5-6; total caudal fin rays 39-44; gill rakers 5-6 + 15-18; oblique scale rows in longitudinal series 130-150; vertebrae 68-73.

TABLE 1. — Frequency distributions of selected meristic characters of *Euclichthys polynemus* McCulloch, 1926, from New Caledonia. Count includes 2 ural centra of vertebrae.

2nd dorsal fin rays	78	79	80	81	82	83	84	85	86	87	88
	1	-	-	2	2	-	1	1	3	-	3
1st + 2nd anal fin rays	94	95	96	97	98	99	100	101	102	103	
	1	-	-	-	3	-	4	1	-	2	
Caudal fin rays	39	40	41	42	43	44					
	1	4	3	3	-	2					
Vertebrae	68	69	70	71	72	73					
	3	1	2	1	1	1					

FIG. 1. — *Euclichthys polynemus* McCulloch, 1926, specimen of 213 mm SL (NMNZ-P.27475), BERYX 2, stn 19, 24°54.2'S, 168°21.7'E (seamount "B", southeast of New Caledonia), bottom trawl at 510-519 m depth, R. V. "Alis", 30 October 1991. Drawn by Helen Casey.

Coloration (from fresh and frozen specimens). Head and body silvery white, more silvery laterally and white on mid portion of abdomen. Lips, throat, branchiostegals, anterior abdomen and region around anus deep bluish black. First dorsal fin black with a prominent white spot medially, tips of second dorsal fin black. Anal fin dusky brown. Pectoral fin pale.

Coloration (from preserved specimens). Head and body pale pinkish to yellowish tan, lower sides of head and operculum silvery. Lips, throat and branchiostegals black, becoming bluish towards abdomen. Region around anus bluish black; base of first part of anal fin pale. First dorsal fin bluish black basally, white medially and black on distal third; second dorsal with black margin; anal fin rays faint brownish black. Pectoral fin pale.

DISTRIBUTION. — Known from specimens taken on Seamount "B" (24°55'S, 168°21'E), southeast of New Caledonia, at 494-920 m depth; also known from New Zealand waters north of the Chatham Rise, at 250-920 m depth, and southern Australian waters from Queensland to Western Australia and off the Northwest Shelf, at 250-820 m depth (MAY & MAXWELL, 1986: 197; PAXTON & HANLEY, 1989: 299; PAULIN, 1990: 170; this study).

Given the wide distribution of *Eucla* cod in Australasian waters and its benthopelagic life style, it is surprising that *E. polynemus* has only been taken from one locality (seamount "B") in New Caledonian waters. This restricted distribution appears to be real because the fish fauna of neighbouring seamounts has been explored by the same vessels using the same sampling gear in similar habitats without capturing *Eucla* cod (e.g., see RICHER DE FORGES, 1990, and cruise reports by RICHER DE FORGES *et al.*, 1987; GRANDPERRIN & LEHODEY, 1992; GRANDPERRIN *et al.*, 1993). PAULIN & ROBERTS (1997) record the morid *Tripterophycis svetovidovi* as also confined to seamount "B".

Intriguing differences in fish faunal composition, dominant benthos and substratum type as well as differences in topographic and hydrographic characteristics have been observed between adjacent seamounts in this area southeast of New Caledonia (e.g., RICHER DE FORGES, 1987; LEHODEY *et al.*, 1993; pers. obs.). These differences are not yet fully documented and are far from being understood. Further survey of the biotic and abiotic characteristics of these rich Norfolk Ridge seamounts is required.

REMARKS. — Meristic and morphometric characters of *Euclichthys polynemus* have not been well described previously and, therefore, there are little data available on character variation. In the original description McCULLOCH (1926) had 28 specimens, but only described characters from the holotype. Most subsequent taxonomic treatment of the species simply reproduced McCULLOCH's data without describing character variation from additional specimens. A revision of *Eucla* cod based on Australian specimens particularly from the type locality off *Eucla* is needed.

In general, meristic characters of New Caledonian specimens agree with available of *E. polynemus* from Australia and New Zealand, e.g., second dorsal fin rays 78-88, cf. 74-88 (McCULLOCH, 1926; McCANN, 1972; MAY & MAXWELL, 1986; PAULIN, 1990); caudal fin rays 39-44, cf. 34-41 (McCANN, 1972; FAHAY & MARKLE, 1984); vertebrae 68-73, cf. 70 (FAHAY & MARKLE, 1984).

There is some confusion about the number of pelvic fin rays; counts in the literature range from 4-6 rays and 0-3 branches. McCULLOCH (1926: 174, plate 44 fig. 2) described the pelvic fin as narrow based, composed of "five free filamentous rays, of which the anterior is divided into two" and illustrated the holotype with five rays, the first bifurcating at mid-length giving a count of six elements distally. In subsequent descriptions including the present study it is unclear whether the first pelvic ray is bifid or trifid (branching basally) or single: McCANN (1972: 632, fig. 15) recorded "five elongated undivided rays" with five distal elements illustrated; LAST *et al.* (1983: 232, fig. 21.3) gave "5 separate elements" and reproduced McCULLOCH's figure; COHEN (1984, fig. 137) illustrated six distal elements; FAHAY & MARKLE (1984, table 72) listed five rays; MAY & MAXWELL (1986: 197) stated "4 long rays...first ray ...branched into 3 filaments about one-third distance from its base" and reproduced McCULLOCH's figure; and COHEN *in* COHEN *et al.* (1990: 18, fig. 29) recorded "4 long, completely separate filamentous rays" and illustrated four distal elements. The present count of 5-6 pelvic fin ray elements is, nevertheless, within the published variation of 4-6.

Only count of total anal fin rays appears to differ from previous descriptions, viz.: 94-103, cf. 92 (McCULLOCH, 1926 and subsequently repeated by FAHAY & MARKLE, 1984, and MAY & MAXWELL, 1986). Two *Eucla* cod described from the Three Kings Ridge, northern New Zealand EEZ, have been reported with 90-94 total anal fin rays (PAULIN, 1990).

Due to the absence of character variation in published counts of anal fin rays, it is difficult to assess the significance of the higher range of counts found in New Caledonian specimens. Therefore, a conservative approach is taken and this difference is here attributed to the very low sample size from Australian waters. It is expected that further investigation of character variation in Australian specimens will show an overlapping range in anal fin ray count with those from New Caledonia. Clearly, further work involving detailed character description and analysis is needed to help resolve euclichthyid systematic problems at both the species and family level.

ACKNOWLEDGEMENTS

We are grateful to Bernard SÉRET for the opportunity to study the New Caledonian specimens held in ORSTOM, Paris. We thank Helen CASEY (Museum of New Zealand) for her careful artwork in preparing the illustration, Trevor WILLIS (Museum of New Zealand) for preparing radiographs. Funding for visits by the authors to ORSTOM, Nouméa, was provided by the Ministry of Foreign Affairs, Paris, assisted by the French Embassy, Wellington and ORSTOM Nouméa - this support is gratefully acknowledged. René GRANDPERRIN, Jacques RIVATON and Michel KULBICKI (ORSTOM Nouméa) kindly gave us much friendly assistance during our visits to New Caledonia. Also, we thank captain Michel LE BOULCH, second captain Hervé LE HOUARNO, the officers and crew of R. V. "Alis" for their help in collecting Eucla cod and other deep water fishes during exploratory trawling operations off New Caledonia. Jean-Claude STAHL (Museum of New Zealand) provided the French "Résumé". The paper benefited from critical comments given by an anonymous referee.

REFERENCES

- AYLING, T. & G. J. COX, 1982. — *Collins guide to the sea fishes of New Zealand*. Collins, Auckland, 343 pp.
- COHEN, D. M., 1984. — Gadiformes: Overview. In: MOSER, H. G. *et al.* (eds) *Ontogeny and systematics of Fishes*. Special Publication No. 1, American Society of Ichthyology and Herpetology, pp. 259-264.
- COHEN, D. M., 1989. — Introduction. In: COHEN, D. M. (ed.), *Papers on the systematics of gadiform fishes. Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 1-3.
- COHEN, D. M., INADA, T., IWAMOTO, T. & N. SCIALABBA, 1990. — FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. *FAO Fish. Synop.*, **125** (10): 1-442.
- FAHAY, M. P. & D. F. MARKLE, 1984. — Gadiformes: development and relationships. In: MOSER, H. G. *et al.* (eds) *Ontogeny and systematics of Fishes*. Special Publication No. 1, American Society of Ichthyology and Herpetology, pp. 265-283.
- GRANDPERRIN, R. & P. LEHODEY, 1992. — Campagne BERYX 2 de pêche au chalut de fond sur trois monts sous-marins du Sud-Est de la Zone Économique de Nouvelle-Calédonie (N. O. « Alis », 22-31 octobre 1991). *Rapp. Missions*, ORSTOM Nouméa, Sciences de la Mer, Biol. Mar., **11**: 1-40.
- HOWES, G. J., 1987. — The palatine bone and its association in gadoid fishes. *J. Fish Biol.*, **31**: 625-637.
- HOWES, G. J., 1988. — The cranial muscles and ligaments of macrouroid fishes (Teleostei: Gadiformes); function, ecology and phylogenetic inferences. *Bull. British Mus. (Nat. Hist.)*, Zool. Ser., **54** (1): 1-62.
- HOWES, G. J. & O. A. CRIMMEN, 1990. — A review of the Bathygadidae (Teleostei: Gadiformes). *Bull. British Mus. (Nat. Hist.)*, Zool. Ser., **56** (2): 155-203.
- HUBBS, C. L. & K. F. LAGLER, 1964. — *Fishes of the Great Lakes region*. University of Michigan Press, Ann Arbor, 213 pp.
- LAST, P. R., SCOTT, E. O. G. & F. H. TALBOT, 1983. — *Fishes of Tasmania*. Tasmanian Fisheries Development Authority, Hobart, 563 pp.
- LEHODEY, P., RICHER DE FORGES, B., NAUGES, C., GRANDPERRIN, R. & J. RIVATON, 1993. — Campagne BERYX 11 de pêche au chalut sur six monts sous-marins du Sud-Est de la Zone Économique de Nouvelle-Calédonie (N. O. « Alis », 13 au 23 octobre 1992). *Rapp. Missions*, ORSTOM Nouméa, Sciences de la Mer, Biol. Mar., **22**: 1-93.
- LEVITON, A. E., GIBBS, Jr, R. H., HEAL, E & C. E. DAWSON, 1985. — Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985: 802-832.
- MAY, J. L. & J. G. H. MAXWELL, 1986. — *Trawl fish from temperate waters of Australia*. CSIRO Division of Fisheries Research, Hobart, 492 pp.
- MARKLE, D. F., 1989. — Aspects of character homology and phylogeny of the Gadiformes. In: COHEN, D. M. (ed.), *Papers on the systematics of gadiform fishes. Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 59-88.
- MCCANN, C., 1972. — Additions to the deep-sea fishes of New Zealand. *N. Z. J. Mar. Freshwater Res.*, **6**: 619-640.
- MCCULLOCH, A. R., 1926. — Report on some fishes obtained by the F.I.S. "Endeavour" on the coasts of Queensland, New South Wales, Victoria, Tasmania, South and South-Western Australia. Part 5. Biological results of the fishing experiments carried out by F.I.S. "Endeavour" 1909-14, **5** (4): 157-216.

- MUNRO, I. R. S., 1938. — Handbook of Australian fishes, No. 15. *Fish. Newsletter*, **16** (9): 61-64.
- NOLF, D. & E. STEURBAUT, 1989. — Evidence from otoliths for establishing relationships within Gadiformes. In: COHEN, D. M. (ed.), Papers on the systematics of gadiform fishes. *Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 89-112.
- OKAMURA, O., 1989. — Relationships of the Suborder Macrouroidei and related groups, with comments on Merlucciidae and Steindachneria. In: COHEN, D. M. (ed.), Papers on the systematics of gadiform fishes. *Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 129-142.
- PATTERSON, C. & D. E. ROSEN, 1989. — The Paracanthopterygii revisited: order and disorder. In: COHEN, D. M. (ed.), Papers on the systematics of gadiform fishes. *Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 5-36.
- PAULIN, C. D., 1983. — A revision of the family Moridae (Pisces: Anacanthini) within the New Zealand region. *Rec. Nat. Mus. N.Z.*, **2**: 81-126.
- PAULIN, C. D., 1988. — Swimbladder structure in morid cods (Pisces: Gadiformes). *Copeia*, 1988: 450-454.
- PAULIN, C. D., 1989a. — Review of the morid genera *Gadella*, *Physiculus*, and *Salilota* (Teleostei: Gadiformes) with description of seven new species. *N.Z. J. Zool.*, **19**: 93-133.
- PAULIN, C. D., 1989b. — Moridae: Overview. In: COHEN, D. M. (ed.), Papers on the systematics of gadiform fishes. *Natural History Museum of Los Angeles County, Sci. Ser.*, **32**: 243-250.
- PAULIN, C. D., 1990. — Euclichthyidae. In: AMAOKA, K., MATSUURA, K., INADA, T., TAKEDA, M., HATANAKA, H. & K. OKADA (eds), *Fishes collected by the R/V "Shinkai Maru" around New Zealand*. Japan Marine Fishery Resource Research Center, Tokyo, p. 170.
- PAULIN, C. D., STEWART, A.L., ROBERTS, C. D. & P. J. McMILLAN, 1989. — New Zealand fish, a complete guide. *Nat. Mus. N. Z. Misc. Ser.*, **19**: 1-279.
- PAULIN, C. D. & C. D. ROBERTS, 1997. — Review of the morid cods (Teleostei, Paracanthopterygii, Moridae) of New Caledonia, southwest Pacific Ocean, with description of a new species of *Gadella*. In: SÉRET, B. (ed.), Résultats des Campagnes MUSORSTOM, Volume 17. *Mém. Mus. natn. Hist. nat.*, **174**: 17-41.
- PAXTON, J. R. & J. E. HANLEY, 1989. — Moridae (224). In: PAXTON, J. R., HOESE, D. F., ALLEN, G. R. & J. E. HANLEY, *Zoological Catalogue of Australia, Vol. 7, Pisces: Petromyzontidae to Carangidae*. Australian Biological Resources Study, Canberra, pp. 298-303.
- RICHER DE FORGES, B., GRANDPERRIN, R. & P. LABOUTE, 1987. — La campagne CHALCAL 2 sur les guyots de la ride de Norfolk (N. O. « Coriolis », 26 octobre-1 novembre 1986). *Rapp. Missions, ORSTOM Nouméa, Sciences de la Mer, Biol. Mar.*, **42**: 1-41.
- RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. Exploration for bathyal fauna in the New Caledonian economic zone. In: CROSNIER, A. (ed.), Résultats des Campagnes MUSORSTOM, Volume 6. *Mém. Mus. natn. Hist. nat.*, (A), **145**: 9-54.
- SCOTT, T. D., 1962. — *The marine and freshwater fishes of South Australia*. Government Printer, Adelaide, 338 pp.
- SVETOVIDOV, A. N., 1969. — [On the taxonomic position of the genus *Euclichthys* (Pisces, Gadiformes)]. *Zool. Zhurn.*, **48**: 1824-1831. (In Russian with English summary).