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HAKES OF THE WORLD

(Family Merlucciidae)

AN ANNOTATED AND ILLUSTRATED CATALOGUE OF HAKE SPECIES KNOWN TO DATE

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by

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PREPARATION OF THIS DOCUMENT

This catalogue was prepared under the FAO Fisheries Department Regular Programme by the Species Identification and Data Programme in the Marine Resources Service of the Fishery Resources Division. It constitutes an update of the section on the family Merlucciidae of the FAO Species Catalogue, Vol. 10, Gadiform Fishes of the World (Order Gadiformes) published in 1990. The current edition is a translation into English of a Spanish version published in 2003.

The hake family Merlucciidae has been an important part of the fishing industry, as many of its species sustain a significant fishery. There is much existing literature on the biology and dynamics of its populations, however, the problem of species identification remains, owing to the difficulty of finding easily observable, stable characters that permit rigorous identification. These difficulties can become critical where species distributions overlap.

This document provides an identification key based on easily observable qualitative and meristic characters, which enable fast and precise diagnosis. Its objective is to make available to fishery professionals a reliable tool for species identification and thereby improve their gathering of statistical data. Given that many of the species are of great fishery value, a section on fisheries has been included.

The merlucciid material studied was acquired by the authors both fresh and frozen or obtained via museum collection exchanges.

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Hakes of the world (Family Merlucciidae). An annotated and illustrated catalogue of hake species known to date.

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ABSTRACT

This is a worldwide catalogue of the family Merlucciidae. Two subfamilies, Macruroninae and Merlucciinae, are recognized comprising four genera, ***Lyconodes***, ***Lyconus***, ***Macruronus*** and ***Merluccius***, and 18 species. The following subspecies are proposed: ***Macruronus novaezelandiae magellanicus*** Lönnberg, 1907; ***Merluccius albidus magnoculus*** Ginsburg, 1954, ***Merluccius australis polylepis*** Ginsburg, 1954 and ***Merluccius polli cadenati*** Doutre, 1960 and ***Merluccius merluccius smiridus*** Rafinesque, 1810. The possibility of one other subspecies, ***Merluccius merluccius lessepsianus***, represents the first record of ***Merluccius*** from the Red Sea. ***Merluccius paradoxus*** is first recorded from Madagascar.

In the introductory chapters, Merlucciidae systematics is debated, justifications for the proposed taxonomic organization are provided, and the characters used for the identifications are discussed.

Dichotomous keys are provided in the systematics chapter, enabling the identification of the hakes to the species level. Subfamilies and genera are also defined. The species are arranged in alphabetical order under each subfamily and genus to which they belong. The scientific name appears in bold at the head of each genus and species description, followed by the author, year of first description, and publication. Existing synonyms and FAO common names in English, French and Spanish are also provided. For each species there is an illustration followed by ten sections: description or diagnosis with differential characters; additional information; geographical distribution; habitat and biology; size; fisheries; fishery statistics; state of resources; local names, if any; and bibliographical references (author and year).

The review is completed by a series of colour plates showing details of different elements (heads, otoliths, hyomandibulars, urohyals) for a quick and efficient diagnosis of the genera and species of ***Lyconus***, ***Macruronus*** and ***Merluccius***.

ACKNOWLEDGEMENTS

We feel that our efforts have paid off, thanks to help from friends and colleagues from various institutions who did not hesitate to give up part of their time for us. We would like to thank them all, particularly to curators of collections of America and Europe who provided much material and supplied essential material and photographs to solve important and precise problems: Concepción Allué (Colecciones Biológicas de Referencia del Instituto de Ciencias del Mar, CMIMA-CSIC, de Barcelona, Spain); David Catania (California Academy of Sciences, Department of Ichthyology, California, USA); Guy Duhamel, Patrice Pruvost and Xavier Gregorio (Laboratoire d'Ichtyologie, Muséum national d'Histoire naturelle, Paris, France); Susan L. Jewett and Shirleen Smith (Smithsonian Institution, National Museum of Natural History, Washington, DC, USA); Phil Hastings (Scripps Institution of Oceanography, La Jolla, California, USA); Ricardo Bravo (Facultad de Ciencias del Mar, Universidad de Valparaiso, Chile); Germán Pequeño (Instituto de Zoología de la Universidad Austral de Chile, Valdivia, Chile); Sandra Mallol (Universidad de Girona, Spain); Dolores Garabana (Instituto de Investigaciones Marinas de Galicia, Spain); Anna Bozzano (Instituto de Ciencias del Mar de Barcelona, Spain); Kumbi Kilongo (Instituto das Pescas, Angola); Hector Plasencia, (Laboratorio de Ictiología de Mazatlán, Mexico); Martín Ehrlich (Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata, Argentina); A.E. Ruiz and R. Fondacaro (Cátedra de Zoología, Facultad de Ciencias Naturales U.N.P.S.J.B. Trelew, Argentina). We are indebted to Aldo Tomo, who helped us contact Santa Cruz Fisheries ship owner Jesús Pérez Costas, who made us happy by sending great quantities of fresh hake from all the Argentinian coast. Antoni Lombarte from the Instituto de Ciencias del Mar de Barcelona was kind enough to undertake otolith identification tests for hake specimens that originated from all latitudes. Thanks to Marta Ezpeleta and Rosa Cabanillas from the library and duplication service of the ICM (CMIMA-CSIC) for their help in obtaining references, and to Giulia Sciarappa Demuro for her help in some aspects of the project. Finally, our thanks to Elvira and Trinidad, who acquired specimens from different markets so that we could verify the validity of the keys presented here.

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1. INTRODUCTION

In this review the family Merlucciidae has been divided into 2 subfamilies (**Merlucciinae** and **Macruroninae**), which include four genera (Fig. 1) and 18 species. Amongst these species, commonly known as hake and grenadier, 13 are under the genus ***Merluccius*** and 2 in the genus ***Macruronus***. These fishes are of great fishery interest and generally have a high commercial value.

The genus ***Merluccius*** is geographically widely distributed, although certain discontinuities appear in equatorial latitudes or their surroundings (Fig 2). The genus is found in the Northern and Southern Hemispheres, on both sides of the Atlantic Ocean, throughout the eastern Pacific from a little north of the USA-Canadian border to Cape Horn, and off New Zealand; there are also periodic recordings of hakes in the western Pacific off Japan and in parts of the Indian Ocean south and southeast of Madagascar. Hakes are present along the European and African coast in the eastern Atlantic from the extreme north of the Scandinavian Peninsula and Iceland to the Cape of Good Hope; they are also found in the Mediterranean Sea, the southern part of the Black Sea, and are known from one isolated record in the Red Sea. On the western Atlantic coast of the Americas, hakes are found from Bell Island Canal (Newfoundland) in Canada to Cape Horn.

The genus ***Macruronus*** is less widely distributed and is only found in the Southern Hemisphere. They are found on each side of the Atlantic, with one record in the southern extremity of South Africa, but are more frequently encountered off the Argentinian coast. In the Pacific they are to be found off the coast of Chile, New Zealand, and to the south and east of Australia.

Hakes of the genus ***Merluccius*** constitute one of the most intensely exploited groups of demersal fish. They are primarily caught using bottom trawls, but also with gillnets and longlines. Some species, such as the Argentine hake, constitute targeted fisheries; others, such as the European and African hakes, are caught by multispecific fisheries, whilst in New Zealand they are accessory catches. Hake is a first-class fishery product; its quality and its subsequent commercial value differ significantly from one species to another. The excellent characteristics of the southern and European hakes give them a high market value if marketed whole and fresh. Other species of more inferior quality are gutted and filleted before being marketed and sold as diverse frozen products. Some species such as the North Pacific hake are difficult to market, owing to problems linked to their high level of parasites. Europe and Spain, in particular, constitute most of the world's hake market, with imports up to 700 000 tonnes per year.

The total catch of ***Merluccius*** reported to FAO at the end of the twentieth century (Fig. 3a), amounted to approximately 1 200 000 tonnes; that of ***Macruronus*** amounted to more than 700 000 tonnes. For ***Merluccius***, around two-thirds of world catch originates in the Atlantic Ocean (Fig. 3b), with the rest originating in the Pacific Ocean (Fig. 3c). ***Macruronus*** catches come almost entirely from the Pacific Ocean, except for around 137 000 tonnes caught in the Atlantic Ocean. ***Merluccius*** catches showed a strong increase at the beginning of the 1960s, reaching a maximum of just over 2 000 000 tonnes in 1973. Subsequent catches have fluctuated, showing a ten-year period when minimums registered in 1981, 1992, and 1999 amounted to almost 1 000 000 tonnes, and in 1986 and 1996 maximums reached almost 1 500 000 tonnes.

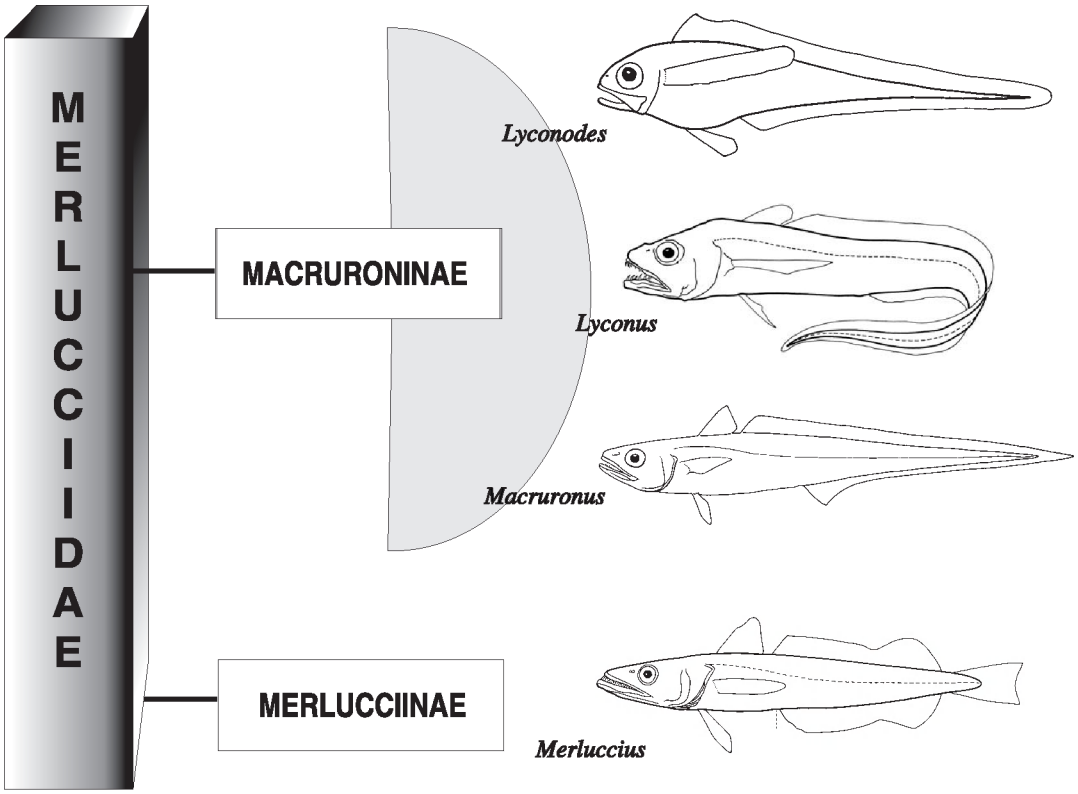


Fig. 1 Classification of the family Merlucciidae

It is estimated that today's hake fisheries offer no possibilities for expansion (Pitcher and Alheit, 1995). In most cases, overexploitation, to a greater or lesser extent, is to blame. Therefore, it is recommended that the present development strategy be modified in order to guarantee sustainability. It is, however, interesting to mention the resistance to fishing pressure shown by hake populations.

The family Merlucciidae as considered by Cohen *et al.* (1990) constitutes a problematic aggregation, and at present, there is no consensus concerning either its extension or its phylogenetic relations.

This lack of agreement affects the positioning and even the validity of some genera; as is the case for the inclusion or not of ***Lyconus*** in ***Macruronus*** and ***Lyconodes*** in ***Lyconus***, or whether special treatment should be given to some species or subspecies of the genera ***Merluccius*** and ***Macruronus***.

Numerous taxonomists have for a long time tried to include the species of ***Merluccius*** in a single dichotomous key. External morphological similarities of species have led to confusion, as experienced by Lozano Cabo (1965). In dealing with Atlantic hake, he states: *"Existing differences amongst these hake are not easy to determine, even for specialists, leading one to seriously question whether they are in fact, different species"*.

The situation becomes more complicated when economic interests come into play, as practically all the taxa of the genera ***Merluccius*** and ***Macruronus*** are objects of important fisheries, and processed and marketed. Statistical data generated with erroneous identifications complicate biological and fishery analyses.

For ***Merluccius***, experience has shown that general identification keys available to date are inadequate when differentiating two or more congeneric entities present in the same geographic area, as is the case with specimens from the eastern and western Atlantic coasts and from the southern and eastern Pacific. It is even more so when identifying specimens of unknown origin.

To overcome this, various authors have put forward local or regional identification solutions in didactic or practical terms for the given entities.

As a result, there is a need to find concrete and stable differential characters. These should be, as far as possible, easily observable in order to permit rapid identification in a commercial fishery. When these characters are not obvious, the taxonomist has to resort to other more cryptic ones, which are often difficult to verify at a glance; internal anatomical or even genetic characters are then used. In any case, only visible characters can be used in keys.

The hierarchy which we here propose follows criteria established by Nelson (1994): Class **Actinopterygii**; Subclass **Neopterygii**; Order **Gadiformes**. However, the rank attributed to lower levels, such as family (**Merlucciidae**), subfamilies (**Macruroninae** and **Merlucciinae**) as well as genera (***Lyconodes***, ***Lyconus***, ***Macruronus*** and ***Merluccius***), are based on the results obtained in the present study, regardless of other authors' opinions.

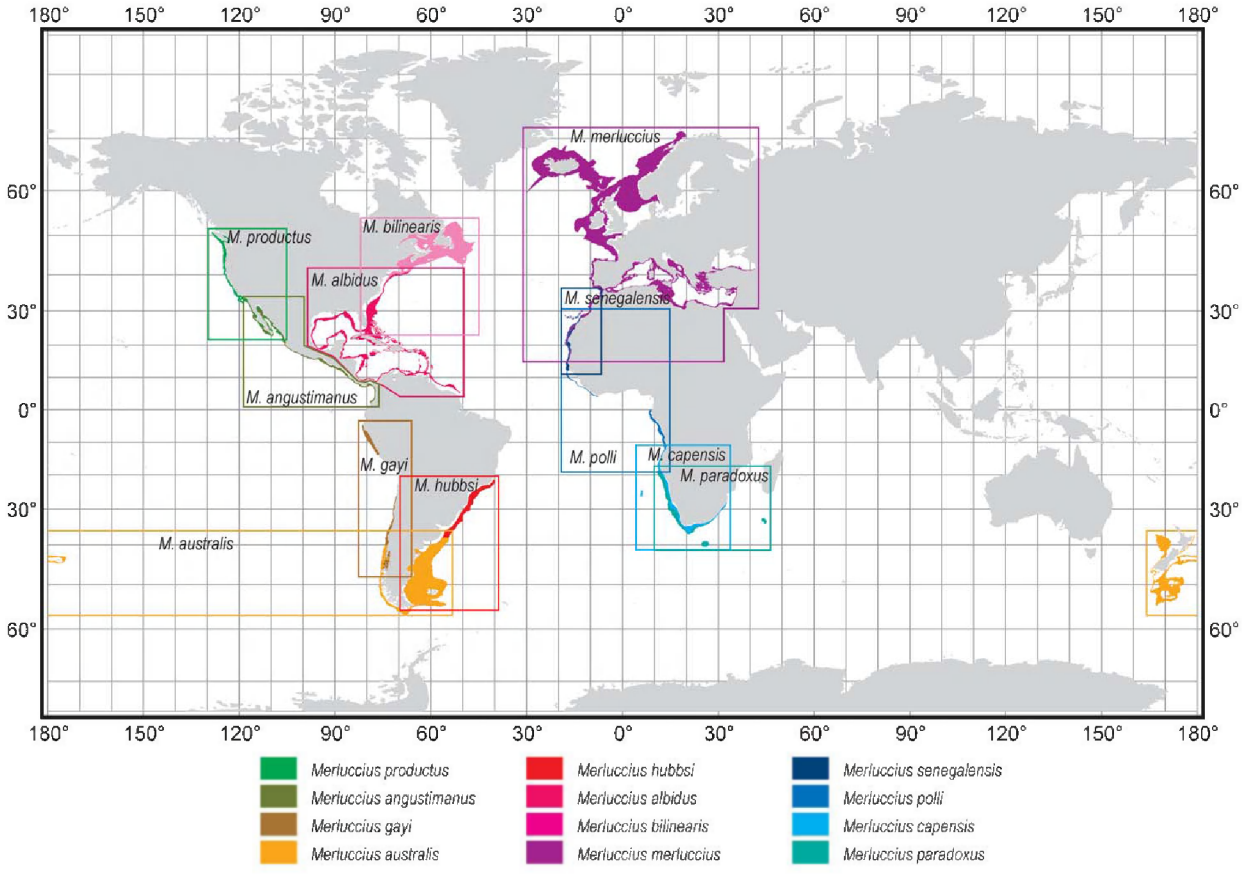
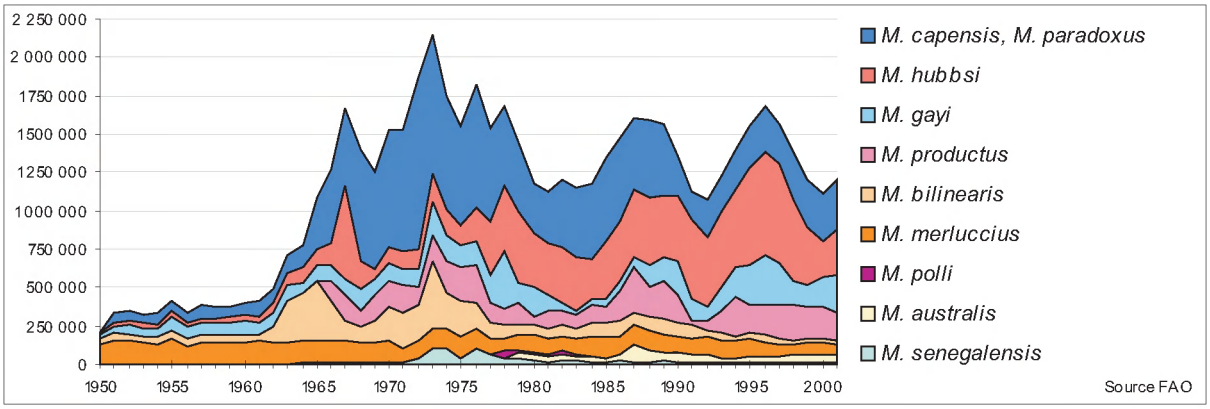
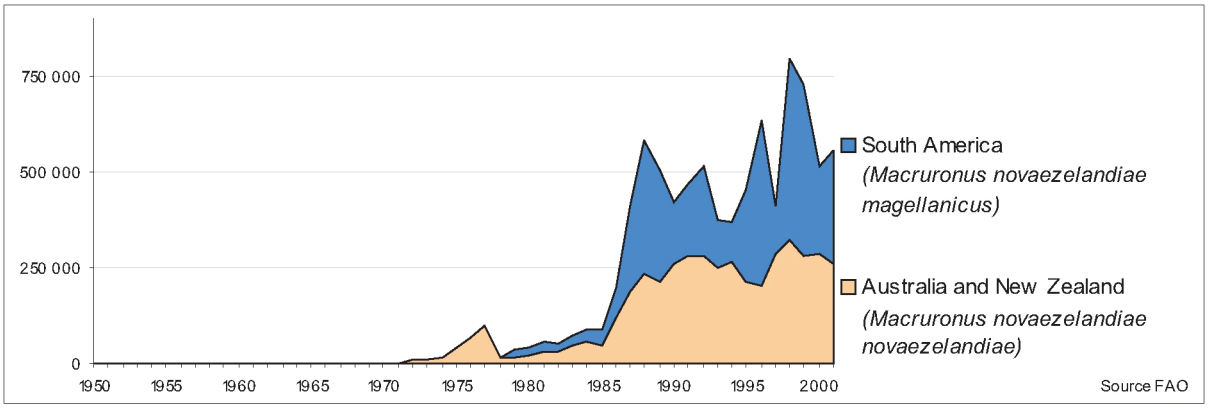


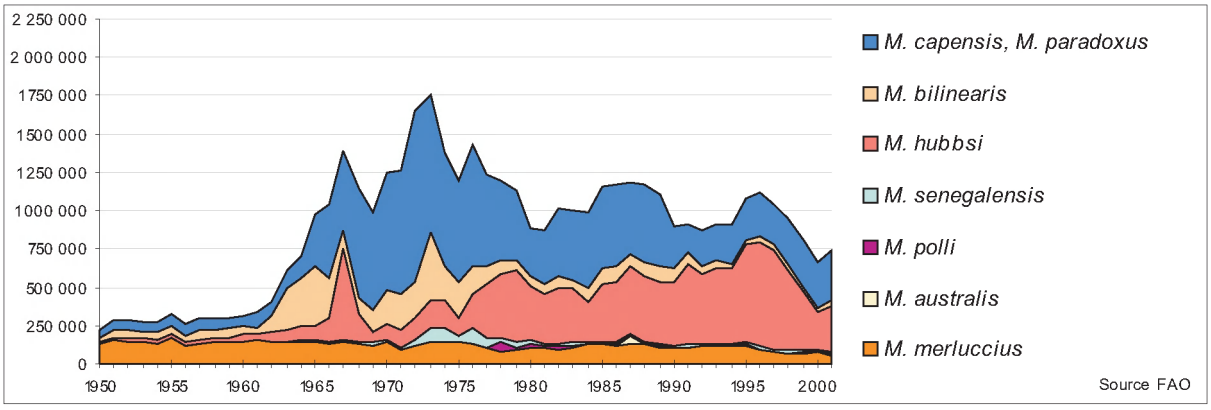
Fig. 2 Genus *Merluccius* geographical distribution



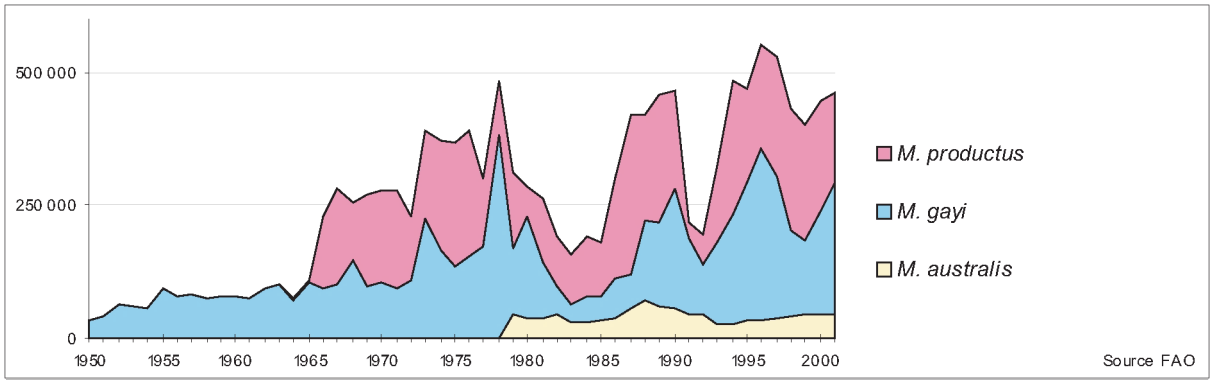
a) Hake (*Merluccius* spp.) world catches in tonnes



b) Blue grenadier (*Macruronus novazelandiae*) world catches in tonnes



c) Hake (*Merluccius* spp.) Atlantic Ocean catches in tonnes



d) Hake (*Merluccius* spp.) Pacific Ocean catches in tonnes

Fig. 3 Catch records of hakes (*Merluccius* spp.) and blue grenadier (*Macruronus novazaelandiae*)

Finally, seeing as the fundamental objective of this publication is to draw up a key which uses visible characters, some information are not presented: raw data, details of all analyses carried out, and the description of the numerous material examined. We only retained information that, to our mind, best illustrates qualitative and meristic differences found between the species we have dealt with. In order to make up for any lack of information, a subsection entitled "Supplementary information" has been included at the end of each diagnosis. The keys proposed here were also verified and used to classify samples without heeding to their original cataloguing or origin and then verifying the validity of the identifications.

1.1 Background

In order to understand the process that led to this study, it is necessary to refer back to the sources that provide the different concepts on the composition of the family Merlucciidae. Although briefly touched upon in the introduction, it will be expounded on below.

1.1.1 Merlucciidae Systematics

Merlucciidae, sensu, Adams, 1864. *Nat. Hist. Manual*, 1864:194, *in* Goode and Bean, 1896: 386; Gill,1872, *Smithsonian Miscellaneous Collections*, 3:25 (Merluciidae); Gill, 1884. *Proc. Acad. Nat. Sci. Phila.* 1884 (36): 172 (19 August); also in *The Century Dictionary* (1889-1891), vol. V:3719.

Inada *in* Cohen *et al.* (1990) following Inada (1989) criterion, included ***Merluccius*** Rafinesque, 1810; ***Macruronus*** Günther, 1873; ***Lyconus*** Günther,1887 and ***Steindachneria*** Goode and Bean, 1896 in the family Merlucciidae: the first three genera in the subfamily Merlucciinae and the fourth in Steindachneriinae. However, it must be pointed out that there is no existing consensus on the extent of the family Merlucciidae or whether it is a family as such, or simply a subfamily of the Gadidae. Even though all authors include in it the genus ***Merluccius***, there are different opinions as to where ***Macruronus***, ***Lyconus***, ***Lyconodes***, and ***Steindachneria*** belong.

Additional problems are whether to accept genus ***Lyconodes***, as well as recent dissension on the validity of ***Lyconus***.

Adams (1864) separated ***Merluccius*** from Gadidae and created for it the family Merlucciidae, which characters Gill (1884: 172-173) specified in the following way: *"Gadoidea with a moderate caudal region coniform behind and with the caudal rays procurrent forwards, the anus submedian, moderate suborbital bones, terminal mouth, subjugular ventral fins, dorsal double, a short anterior and long posterior one, a long anal corresponding to the second dorsal; ribs wide, approximated, and channelled before or with inflected sides, and paired excavated frontal bones with divergent crests continuous from the forked occipital crest."*

Günther (1887) included ***Merluccius*** in the Gadidae, ***Macruronus*** in Macrouridae, and created the family Lyconidae for ***Lyconus***. Goode and Bean (1896) accepted the families Lyconidae and Merlucciidae, but included ***Macruronus*** and ***Steindachneria*** in Macrouridae.

Gilchrist (1922) described ***Lyconodes***, a genus of controversial affinities but usually associated with ***Lyconus***, and included it in the subfamily Lyconinae under the Coryphaenoididae. Barnard (1925) acted in the same manner.

Svetovidov (1948), in his revision of Gadiformes, considers Merlucciinae as a subfamily of Gadidae together with Lotinae and Gadinae.

Norman (1966) was the first to consider ***Macruronus*** and ***Lyconus*** as Merlucciidae, but in a subfamily of its own (Macruroninae). Marshall (1966) and Cohen (1984) included them all in the family Merlucciidae made up of Merlucciinae (***Merluccius***), Macruroninae (***Macruronus***, ***Lyconus*** and ***Lyconodes***) and Steindachneriinae (***Steindachneria***). According to Marshall (1966) the three subfamilies have the following in common: terminal mouth, front vomerine teeth biserial, 7 branchiostegal rays, the upper of which rests on the epihyal, pectoral fins with narrow base and 12 to 16 rays, ventral fins with 7 to 9 rays, and no barbel. The Merlucciinae have, among other characters, a separate caudal fin, second dorsal and anal fin of similar length and height, less than 30 vertebrae in the caudal region of the vertebral column, and prominent lower jaw; the Macruroninae and Steindachneriinae have dorsal and anal fins confluent caudally, dorsal-fin rays much longer than those of the anal, more than 30 caudal vertebrae, lower and upper jaw of equal length, and both with a few very long teeth; ***Steindachneria*** (Steindachneriinae) is singular in having the anus located between the pelvic fins and clearly separated from the urogenital orifice, which is located just before the anal fin, and also for possessing a complex bioluminescent system.

Marshall and Cohen (1973), Fahay and Markle (1984), and Okamura (1989) separate ***Steindachneria*** into a family (Steindachneriidae) and put the rest of the aforementioned genera in Merlucciidae. Nolf and Steurbaut (1989) came to a similar conclusion by analysing otoliths, but included them, respectively, in Steindachneriinae and Merlucciinae, within the Gadidae.

Using osteological and ontogenetic characters, Fahay (1989) separated ***Steindachneria*** from Merlucciidae and related them to the Macruroidei. Markle (1989) spoke of three families: Steindachneriidae, as monotypic and under Macruroidei, whereas Merlucciidae, also monotypic, and Macruronidae (***Macruronus*** and ***Lyconus***) are grouped under Gadoidei.

Howes (1991) states "Presumed synapomorphies relating ***Macruronus*** and ***Merluccius*** are shown to be homoplastic. ***Macruronus***, ***Lyconus*** and possibly ***Lyconodes*** form a monophyletic group recognized as family Macruronidae; ***Merluccius*** is the sole member of Merlucciidae." Steindachneriidae would also be monotypic.

As can be seen, at present there is no consensus on the extent of the family Merlucciidae. An in-depth revision of all genera that could be part of it is necessary.

1.1.2 Character Analysis at the Genus Level

In order to classify genera, the criteria of Marshall and Cohen (1973), Fahey and Markle (1984), and Okamura (1989) have been adopted so that Merlucciidae is divided into 2 subfamilies: Merlucciinae and Macruroninae, whose affinity and differential characteristics can be seen in the adjoining identification key for subfamilies and genera.

In this way, Merlucciinae includes only the genus ***Merluccius***, while ***Lyconodes***, ***Lyconus***, and ***Macruronus*** constitute the Macruroninae. Among these, ***Lyconodes*** and ***Lyconus*** are closely linked, which leads to the possibility of them belonging to the same genus. However, owing to the lack of information, especially concerning ***Lyconodes***, we are inclined to respect the present dichotomy.

This is not the end of the difficulties to be sorted out. Various entities in ***Macruronus*** and ***Merluccius*** at the species and subspecies levels remain to be identified. Meristic characters that have been used up until now are highly variable and largely overlap between different species.

1.2 Characters Subject to Variability

The most common method used by taxonomists to group organisms into different taxa is to study anatomical, meristic, and morphometric characters in a comparative manner.

As mentioned in the background section, taxonomic knowledge of ***Merluccius*** has posed, and still poses, serious difficulties in separating its different entities into possible species or subspecies. This is due, among other things, to the fact that the characters used for comparison largely overlap. The same applies to ***Macruronus*** and, to a lesser extent, to the rest of the genera included in the Merlucciidae.

As for ***Merluccius*** and ***Macruronus***, it has to be said that in practice the vast majority of authors have used meristic characters, such as the number of fin rays, vertebrae, lateral-line scales, and number of gillrakers of the first arch. According to Ginsburg (1954), this is due to *"...the greatest divergence in proportional measurements in Merluccius seems to be shown by the smaller size groups. With growth, the extent of divergence appears to become lessened and perhaps disappears in some instances."* We therefore agree with Franca (1962), who states that metric characteristics are of no or of secondary value for a correct determination. Some meristic characters, however, said to be reliable for species identification (rays, vertebrae, scales and gillrakers) are subject to high variability in relation to trophic or clinal conditions. This renders them unsuitable, as they require the use of large numbers of observations to obtain different modal values of samples to compare; therefore, large overlap and ambiguities lead to permanent confusion.

Geographical latitude is often linked with variation in the number of vertebrae, which in part is true. In general, cold, temperate, or warm superficial waters are, respectively, related to high, medium, and low latitudes. However, deep waters, generally of lower and more uniform temperature, may rise to the surface in tropical or subtropical regions and influence the embryonic development of species spawning in the area, independent of their geographical latitude.

Jordan's Law (Jordan 1921) is generally accepted. It states that there is an inverse relation between the number of vertebrae and temperature, that is, the lower the water temperature, the higher the number of vertebrae, and vice versa. Interest was aroused a few years earlier with Jordan (1891, *in* Vega, 1987) and Heincke (1898) *in* Margalef, (1974), whereby the average number of vertebrae of individuals in a population was put forward as criteria to distinguish races in herrings and Labridae.

There are other factors also linked to temperature that influence the variability in the number of vertebrae, for example: egg size, which is larger in colder waters (Marshall, 1953; Hempel and Blaxter, 1961 *in* Margalef 1974), photoperiod (Fowler, 1970), and salinity (the lower the salinity, the lower the number of vertebrae).

On the other hand, Jordan's Law, relative to the vertebrae of fishes is a particular case of a much wider phenomena of variation that affects not only the number of vertebrae, but also the fin rays, gillrakers, photophores and the number of scales on the lateral line (Hart, 1937; Tester, 1938; Tänning, 1951; Andreu *et al.*, 1952; Andreu, 1969; Margalef, 1974).

It should be pointed out that, the number of vertebrae is more important from the point of view of the *pleomerism rule*, in which Lindsey (1975) demonstrated in 118 fish families a positive correlation between the number of vertebrae and their maximum size.

However, various authors still use the number of rays, vertebrae, gillrakers, and lateral-line scales as differentiating species characters. It is important to note that although such parameters are occasionally useful in determination keys, they are merely of complementary value and should by no means be used as distinguishing criteria to characterize an entity at the species level.

In this respect, Angelescu *et al.* (1958), in their exhaustive work on Argentine hake (***Merluccius hubbsi***), conclude that meristic characteristics cannot be used as specific separation indices, but only as a subspecific value.

It is worth mentioning that when dealing with numerical values, such as number of scales, rays, vertebrae, or gillrakers, the mode should be preferred to the mean, as it relates to the frequency and therefore the possible normality of the character.

Leible (1974) revealed comparative problems when he made reference to the method of vertebral counts used by different authors. Some do not indicate whether the urostyle is included or not. Cadenat (1952), Maurin (1954), Doutre (1960) and Franca (1962) include it, while Gall (1952) *in* Arana (1970) does not.

The presence or absence of vomerine and palatine teeth in Merlucciidae has also contributed to the confusion. Thus, while Goode and Bean (1896), with the majority of authors, indicate the presence of teeth on the vomer and their absence on the palatine, Poll (1953: 209) wrongly indicates the presence of palatine teeth.

Confusion also occurs with the relative position of the ventral fins, one of the differentiating characters of the genera ***Merluccius*** and ***Macruronus***. For ***Merluccius***, ventral fins are inserted before the pectoral fins in a subjugular position, as indicated by Goode and Bean (1896), Belloc (1929), and Fowler (1936); others such as Lozano Cabo (1952), Poll (1953), and Angelescu (1958) consider them as being jugular. Inada (1981 b) and Inada in Cohen *et al.* (1990) say they are thoracic.

Authors' opinions differ with regard to certain internal characters of the Merlucciidae, as for example, the presence or absence of pyloric caeca in ***Merluccius***. Thus, Belloc (1929), Fowler (1936), and Lozano Rey (1960) indicate that they have one, whereas various modern authors (Inada, 1981b and Inada *in* Cohen *et al.*, 1990) do not mention them. In our case, the presence of a pyloric caecum in samples of different Euro-African and American species was observed.

Moreover, the problem is heightened when different authors assign to a single binomen all specimens coming from a given location. Errors are also made with direct transcription from one author to another, without prior verification.

With respect to this, for the present revision, data were taken directly from samples coming from different type localities, except for ***Macruronus capensis***, ***Lyconus pinnatus*** and ***Lyconodes argenteus***, for which we only had access to the existing literature.

Finally, key validity has been verified by identifying individuals without heeding their classification or provenance.

1.3 Diagnostic Features of the Family

Body fusiform, elongated, and rather compressed, especially in the caudal region. Caudal peduncle well differentiated (Fig. 4 and Plate I) or non-existing with union of the dorsal, caudal and anal fins (Fig. 5 and Plate I). Anal and urogenital openings adjoining. Head generally large, with a V-shaped ridge on the dorsum opening towards the front (Fig. 6). Scales cycloid and deciduous, without asperites. Lateral line present. Branchiostegal rays 7. Branchial openings wide. With or without pseudobranchs. Large, terminal, oblique mouth with lower jaw generally somewhat protruding, and without barbels. Strong sharply pointed teeth on premaxillary, lower jaw and vomer, but not on the palatines. One or 2 dorsal fins; when two are present, the first one is short based and the second long. A single anal fin similar in length to, or shorter than, the second dorsal fin. Pectoral insertion variable in position, with the first ray at the level of the centre of the eye or clearly below. Ventral fins with 7 to 10 rays, inserted slightly before pectoral fins (subjugular), at the same vertical (thoracic), or even slightly behind them. Caudal fin sometimes separated from dorsal and anal fins and sometimes attached. Except for the first dorsal ray, all rays are articulated and none are filiform. Swimbladder physoclistous. One or multiple pyloric caeca.

Demersal and benthopelagic fishes characteristic of cold or temperate waters, feeding on a large variety of prey. The family is made up of 2 subfamilies: **Macruroninae** and **Merlucciinae**, comprising 4 genera and 18 species

The abbreviations used in the description of each species are the following: **1D.**, first dorsal fin; **2D.**, second dorsal fin; **A.**, anal fin; **P.**, pectoral fin; **V.**, ventral or pelvic fin; **Gr.**, total number of gillrakers on the first gill arch; **L.L.**, number of scales on the lateral line; **TV.**, total number of vertebrae; **CV.**, number of cervical vertebrae; **CR.**, number of cervical ribs. For meristic values and biometric%ages, all observed ranges obtained by previous authors as well as those from the current study are provided and recorded as minimum and maximum values, and when available, the mode in brackets.

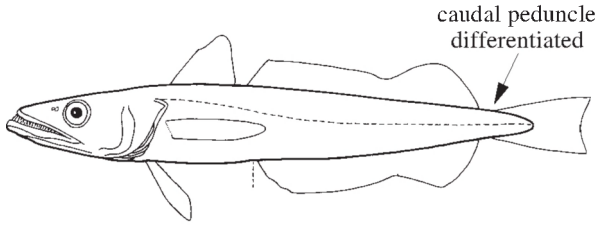


Fig. 4 ***Merluccius***

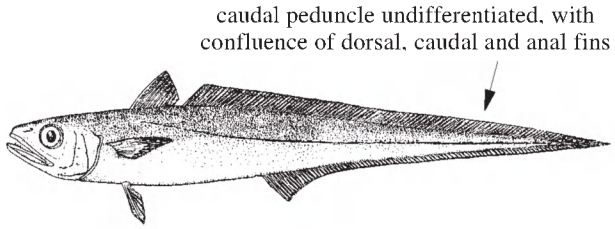


Fig. 5 ***Macruronus***

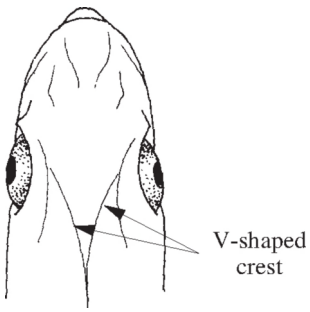


Fig. 6 Dorsal view of head

NEXT PAGE

2. SYSTEMATIC CATALOGUE

2.1 Key to Subfamilies, Genera and Species (except for *Merluccius*)

1a. Posterior part of the body ending in a peduncle with independent caudal fin. Two dorsal fins; second dorsal and anal similar in length and height. Ventral fins with 7 rays, their origin slightly before the base of pectoral fins. Single, unique pyloric caecum, well visible. No pseudobranchs . . . . . **subfamily: Merlucciinae (genus: *Merluccius*)**

1b. Posterior part of the body ending in a point, without a peduncle or independent caudal fin. One or 2 dorsal fins, if two are present, the second dorsal fin is longer and higher than the anal fin. Ventral fins with 8 to 10 rays, their origin at a vertical through the base of the pectoral fins or behind. Numerous long and thin pyloric caeca. With or without pseudobranchs. . **subfamily: Macruroninae → *2***

2a. No pseudobranchs. Two dorsal fins. Ventral fins with 8 rays . . . . . ***Macruronus* → *3***

2b. Pseudobranchs present. One or 2 dorsal fins. Ventral fins with 9 or 10 rays . . . . . **→ *4***

3a. Two rows of teeth on the upper jaw, and canine-like teeth on the anterior part of the premaxillaries . . . . . ***Macruronus novaezelandiae***

3b. A single row of teeth on the upper jaw and no canine-like teeth on the premaxillaries . . . . ***Macruronus capensis***

4a. One dorsal fin. Ventral fin with 9 rays, inserted in an abdominal position . . . . . ***Lyconodes argenteus***

4b. Two dorsal fins. Ventral fins with 9 or 10 rays, inserted in variable positions in relation to the pectoral fins. . . . . ***Lyconus* → *5***

5a. First dorsal with 9 or 10 rays. Pectoral fins with 13 or 14 rays . . . . . ***Lyconus brachycolus***

5b. First dorsal with 12 or 13 rays. Pectoral fins with 15 to 17 rays . . . . . ***Lyconus pinnatus***

2.2 Subfamily: Macruroninae Günther, 1873

Body elongated and compressed, tapering gradually from the occiput to the caudal extremity, which can even become filiform; no peduncle or caudal fin differentiated, as the caudal is joined to the anal and second dorsal, when 2 dorsal fins are present, or to the single dorsal. Head compressed, mouth terminal, oblique, lower jaw slightly or non prognathous. Nasal membrane completely covered in scales. One or 2 rows of teeth on the premaxillaries and a single row on the lower jaw; vomerine teeth in 1 or 2 rows; no teeth on palatines. One or 2 dorsal fins. When there are two, the first one has a short base while the second is very long. Anal fin single, long, but rather shorter than the second dorsal or single dorsal. Pectoral inserted in a high position. Ventral fins with 8 to 10 rays, inserted along the same vertical as the pectoral fins (thoracic) or behind them, but they are smaller. Various long, thin pyloric caeca. With or without pseudobranchs.

Comprises 3 genera (***Lyconodes***, ***Lyconus***, ***Macruronus***) and 5 species (***Lyconodes argenteus***, ***Lyconus brachycolus***, ***Lyconus pinnatus***, ***Macruronus capensis***, ***Macruronus novaezelandiae***). It is proposed that this last species be divided into 2 subspecies: ***M. n. novaezelandiae*** and ***M. n. magellanicus***.

Lyconodes Gilchrist, 1922

Fish. Mar. Biol. Surv. Un. S. Afr., (Spec. Rep.3): 59, pl. 10 Fig. 1 (type species: ***Lyconodes argenteus*** by monotypy).

Etymology: Similar to a wolf. The term comes from the Greek "lukonódes" (Aristotoles, *Historia Animalium*, 579b 15); it refers to the animal's colour and not its form.

Diagnostic Features: This problematic genus is monotypic and its description was based on a single specimen, which has since been lost; therefore, data were taken from the bibliography and simply transcribed and used for the accompanying illustration.

Lyconodes argenteus Gilchrist, 1922 **Fig. 7**

Lyconodes argenteus Gilchrist, 1922. *Fish. Mar. Biol. Surv. Un. S. Afr.*, (Spec Rep. 3): 59, pl. 10, Fig. 1 (type locality: west of Cape of Good Hope).

Synonyms: None.

FAO Names: None.

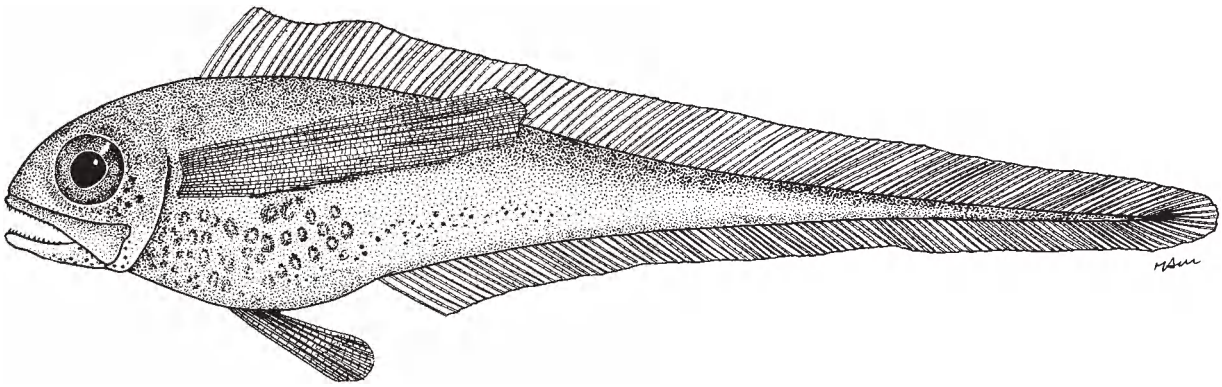


Fig. 7 ***Lyconodes argenteus***

Diagnostic Features: Body elongated and compressed, rather enlarged in the anterior third with caudal end tapering to a fine point. The single dorsal and anal fins confluent with the caudal fin. Branchial membranes joined; number of branchiostegal rays unknown. Mouth large, the posterior part of jaw, which is wide, extending beyond the posterior edge of the eye; premaxilliaries with a dozen teeth of different sizes and no anterior canines; lower jaw with small teeth and 4 canines on the posterior part. Presence of teeth on the vomer unknown. About 110 rays on the dorsal fin, origin situated slightly behind the base of the pectoral fins. The anal fin, with about 94 rays, is much shorter than the dorsal fin and has no anterior lobe. The pectoral fins, with 15 rays, are much longer than the ventral fins, extending far beyond the origin of the anal fin. The ventral fins, with 9 rays, are clearly inserted behind the base of the pectoral fins. Pseudobranchs present. Scales absent or deciduous. Dorsal side of body dark-coloured, belly lighter and silvery.

Additional Information: The different analyses carried out on the genera ***Lyconodes*** and ***Lyconus*** show an affinity index of 92.2%, inferring that they could be the same genus. ***Lyconodes*** Gilchrist, 1922 would then be a later synonym of ***Lyconus*** Günther, 1887. Among other characters, they both possess pseudobranchs. Lack of information has forced us to follow the present dichotomy, placing ***Lyconodes*** in the subfamily Macruroninae, family Merlucciidae. As it was impossible to examine a specimen of this species (the data are from the holotype, which has been lost), we have no choice but to use the original description, which mentions only 1 dorsal fin. However, we have doubts as to whether this is so. ***Lyconus*** possesses 2 nearly adjacent dorsal fins and a very small interdorsal space. According to Evseenko and Suntsov (1995), this space is imperceptible in some samples of ***Lyconus brachycolus*** measuring between 42 and 44 mm, and more easily visible in others measuring 79 mm in total length. Taking into account that ***Lyconodes*** was described using a single specimen measuring 45 mm, we suspect that Gilchrist (1922) inadvertently overlooked the presence of 2 dorsal fins. If this were the case, all Macruroninae would have 2 dorsal fins with the second confluent with the anal and the caudal.

Geographical Distribution: Type locality only: (west of Cape of Good Hope).

Habitat and Biology: Unknown. Species with a pelagic juvenile phase.

Size: The only known specimen measured 45 mm.

Interest to Fisheries: None.

Local Names: None.

Literature: Gilchrist (1922); Barnard (1925); Marshall (1966); Smith (1977) Cohen *in* Smith and Heemstra (1986); Howes (1991); Evseenko and Suntsov (1995).

Lyconus Günther, 1887

Challenger Rep. Zool., 22; 158 (type species: ***Lyconus pinnatus*** Günther, 1887, by monotypy).

Macruronus (*non* Günther 1873) Maul, 1951, *Bolm Mus. Munic. Funchal*, 5(12): 45-49, Fig. 11 (type locality: southeastern coast of Madeira).

Etymology: Alludes to the aspect of the head, which resembles a wolf by its dentition.

Diagnostic Features: Head and body compressed, caudal region filiform and tapering. Lateral line present, running midlaterally on the body, except slightly higher in the anterior part of the body. Second dorsal fin and anal fin confluent with the caudal. Scales cycloid and deciduous. Pseudobranchs present. Two dorsal fins very close together, with an interdorsal space difficult to discern. First ray of the first dorsal fin thin and shorter than the second but perfectly visible, and it has the structure of a spine. Anal fin without a developed anterior lobe. A single row of teeth on the premaxillaries, lower jaw, and vomer. No teeth on the palatine. Front part of branchiostegal membrane attached and joined to the isthmus. First branchial arch with 3-5 + 9-13 gillrakers.

Lyconus brachycolus Holt and Byrne, 1906 **Fig. 8**

Lyconus brachycolus Holt and Byrne, 1906. *Ann. Mag. Nat. Hist.*, 7(18): 423-426 (type locality: southwest of Ireland, 50° 21'N, 11° 39'W, depth 1 140 m).

Synonyms: ***Macruronus caninus*** Maul, 1951, *Bolm. Mus. Munic. Funchal.*, 5(12): 45-49, Fig. 11 (southeastern coast of Madeira). ***Macruronus brachycolus***: Coad, 1995, Encyclopedia of Canadian fishes.

FAO Names: None

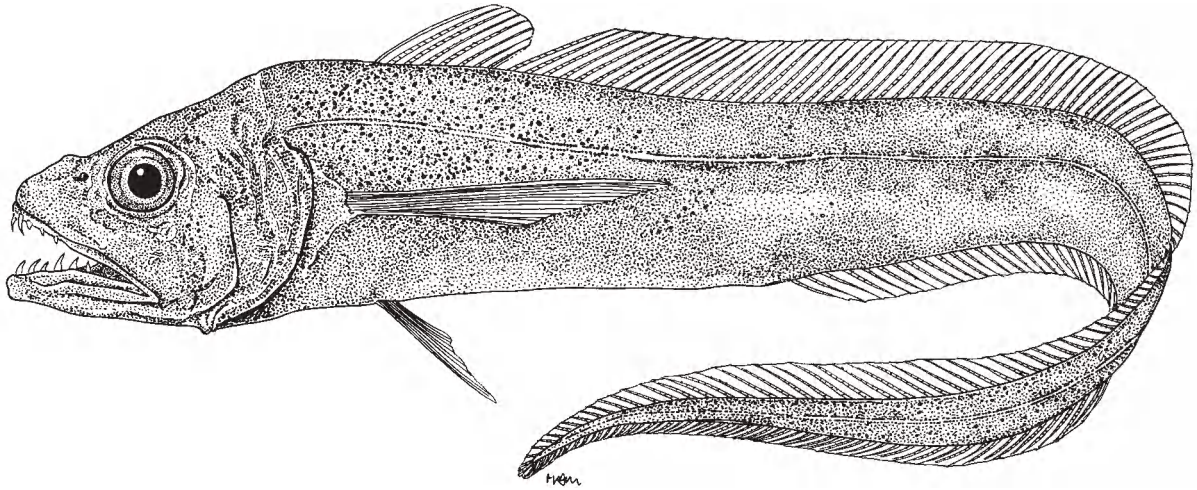


Fig. 8 ***Lyconus brachycolus***

Diagnostic Features: Head length included 5.5 to 6.4 times in standard length. Dorsal profile of head varies according to size: juveniles show an interorbital depression, which rises sharply to the occiput; whereas in adults the ascent is gradual from the snout to the insertion of the first dorsal fin. The mouth is large, terminal and oblique, the maxillary extends to the vertical line through the posterior margin of the eye. Teeth variable, but both the premaxillary and lower jaw are armed with a single row of teeth; 1 small tooth on the premaxillary at some distance from the symphysis, followed by 1 or 2 long teeth, one of which is fixed, again followed by a decreasing series of more than 10 articulated teeth. The lower jaw has 7 teeth, longer than those on the upper jaw, on the first half one of them is fixed, the others are articulated and increase in size from the symphysis to the first third, and then decrease in size. The number of vomer teeth varies, but normally 2 or 3 are present on each side in a single row. Eyes large, their diameter included between 3.2 and 4.8 times in head length. 3-5 + 9-12 gillrakers on the first branchial arch; gillrakers of juveniles are long, flattened, wide at the base, pointed, and with denticles on the internal side, whereas those found on adults are short and denticles are only situated on the apex. The first dorsal fin has 9 or 10 rays, its origin is located behind a vertical line through the base of the pectoral fins; the second dorsal fin has 105 to 111 rays. Pectoral fins have 13 or 14 rays. Origin of ventral fins situated behind pectoral fins; they are shorter than the latter and possess 8 or 9 rays. The anal fin, with 95 or 96 rays, is slightly smaller than the second dorsal fin. Abdominal vertebrae 17 or 18; caudal vertebrae 83. **Colour:** bright silver, turning brownish grey after preservation; a black median line between anus and abdomen.

Additional Information: Howes (1991), points out that ***Lyconus*** needs to be revised and places it in synonymy with ***Macruronus***. Here, on the contrary, ***Lyconus*** is seen as a valid genus, as among other characters, it possesses pseudobranchs (absent in ***Macruronus***); a single row of vomerine teeth (2 rows in ***Macruronus***); a single row of teeth on the premaxillaries (2 in ***M. novaezelandiae novaezelandiae*** and in ***M. novaezelandiae magellanicus*** and 1 in ***M. capensis***, although there are doubts on this as we could not examine any specimens); no lobe on anterior part of the anal fin (present in ***Macruronus***); dorsal fins are practically contiguous (not so close in ***Macruronus***). Nolf and Steurbaut (1989) point out the fact that the otoliths in ***Lyconus*** have a very generalized aspect and admit to the possibility of the genus being neotenic. This could explain the proximity of the 2 dorsal fins, which are almost contiguous. Evseenko and Suntsov (1995) highlight the pelagic character of the vital cycle, with juveniles living very far from the limits of the continental shelf. ***Macruronus*** lives practically on the continental shelf, and juveniles remain in shallow waters after a pelagic larval phase. The 210 rays Holt and Byrne (1906) attributed to ***L. brachycolus*** is probably erroneous.

Geographical Distribution: Rarely captured, only isolated references exist in the northwestern Atlantic (Canada), northeastern Atlantic (to the east of Ireland, southeast of Madeira and the coast of Sahara), and in the southeastern Atlantic.

Habitat and Biology: Juveniles are captured at a depth range from 150 to 700 m in deep ocean and far from the continental shelf and sea-mounts where the adults live.

Size: Maximum known length is of 52.5 cm.

Interest to Fisheries: None.

Local Names: None

Literature: Holt and Byrne (1906); Maul (1951); Marshall (1966); Svetovidov (1969); Svetovidov *in* Whitehead *et al.* (1973); Cohen (1984); Cohen *in* Smith and Heemstra (1986); Matallanas and Lloris (1987); Nolf and Steurbaut (1989); Eschmeyer (1990); Maurin *in* Quéro *et al.* (1990); Howes (1991); Coad, (1995); Evseenko and Suntsov (1995).

Lyconus pinnatus (Günther, 1887) Fig. 9

Lyconus pinnatus Günther, 1887. *Challenger Rep. Zool.*, 22: 158; (type species: ***Lyconus pinnatus*** Günther, 1887, by monotypy).

Synonyms: None.

FAO Names: None.

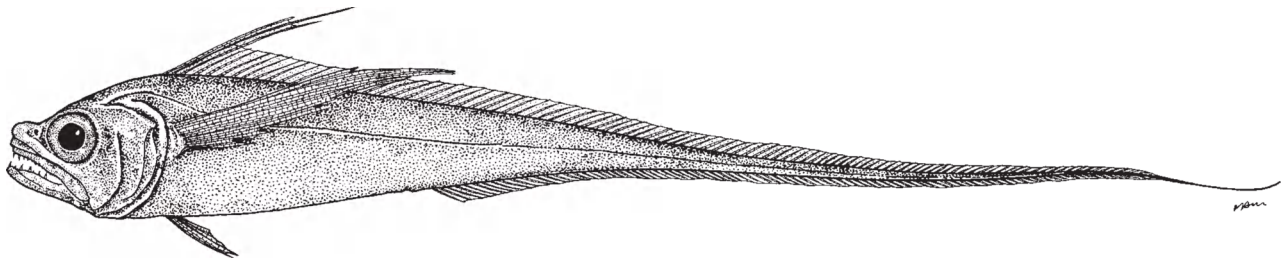


Fig. 9 ***Lyconus pinnatus***

Diagnostic Features: Head length included 7.1 to 8 times in standard length; in known individuals, dorsal profile of the head with an interorbital depression, then rising sharply to the occiput. Mouth large, terminal and oblique, maxillary reaches beyond the vertical line to the posterior part of the eye.The premaxillaries and lower jaw have a single row of teeth, and are scarce: the lower jaw of the holotype has 2 anterior canines and 3 smaller teeth behind them. Usually 1 to 3 teeth on the right and left side of the vomer. First branchial arch with 3-4 + 11-13 long, thin gillrakers, which do not change shape with age. Origin of first dorsal fin behind a vertical line through the base of the pectoral fins; 12 or 13 rays on the first dorsal fin while the second dorsal fin has about 124 rays. Pectoral fins with 15 to 17 rays. Ventral fins, which are shorter than the pectoral fins and in a thoracic position, have 9 or 10 rays. Anal fin, with about 109 rays, is slightly smaller than the second dorsal fin. Abdominal vertebrae 19 or 20 and caudal vertebrae 90. Live colour unknown.

Additional Information: See ***L. brachycolus***.

Geographical Distribution: Rarely captured. Isolated references in the southern Atlantic, Madagascar shelf, southern Australia, and to the east of New Zealand. Probably distributed around the Antarctic.

Habitat and Biology: As ***L. brachycolus***.

Size: Maximum length of rarely known samples, up to 60 cm.

Interest to Fisheries: None.

Local Names: None.

Literature: Günther (1887); Marshall (1966); Marshall (1973); Svetovidov *in* Whitehead *et al.* (1973); Fahay and Markle (1984); Cohen (1984); Cohen *in* Smith and Heemstra (1986); Matallanas and Lloris (1987); Cohen *et al.* (1990); Eschmeyer (1990); Howes (1991); Evseenko and Suntsov (1995).

Macruronus Günther, 1873

Trans. Proc. N.Z. Inst., v. 3 (1870),1871: 103 (replacement of the genus of the type species ***Coryphaenoides novae-zelandiae*** Hector, 1871, New Zealand, by original designation). ***Cynogadus*** Howes, 1991 (subgenus of ***Macruronus***) *Bull. Br. Mus. Nat. Hist. (Zool.)*, 5(1): 103.

Etymology: Generic name ***Macruronus*** from the Greek: *Makros* = large and *oura* = tail.

Diagnostic Features: Head and body compressed with tapering tail. Second dorsal, anal and caudal fins confluent. Scales cycloid and not very adherent. No pseudobranchs. Two dorsal fins, the first has a barely noticeable spine preceding a fully developed first ray. Anal fin shorter than the second dorsal fin and its anterior rays longer than the rest, forming a conspicuous lobe. One or 2 rows of teeth on the premaxillaries, a single row on the lower jaw. Teeth are large on the external row of the premaxillary and on the single row of the lower jaw; those of the inner row of the premaxillary, on species that have 2 rows, are very small and covered in buccal membrane making them barely noticeable; 2 rows of small, irregular, articulated teeth on the vomer. Front part of branchiostegal membranes attached and joined at the isthmus. Long, spear-shaped gillrakers, with 6-8 + 21-27 on the first branchial arch.

Macruronus capensis Davies, 1950

Fig. 10

Macruronus capensis Davies, 1950, *Ann. Mag. Nat. Hist.*,12(3): 512 (type locality: 50 miles northwest of Capetown, depth 426 m).

Synonyms: None.

FAO Names: En – Cape grenadier; **Fr** – Grenadier du Cap; **Sp** – Granadero del Cabo.

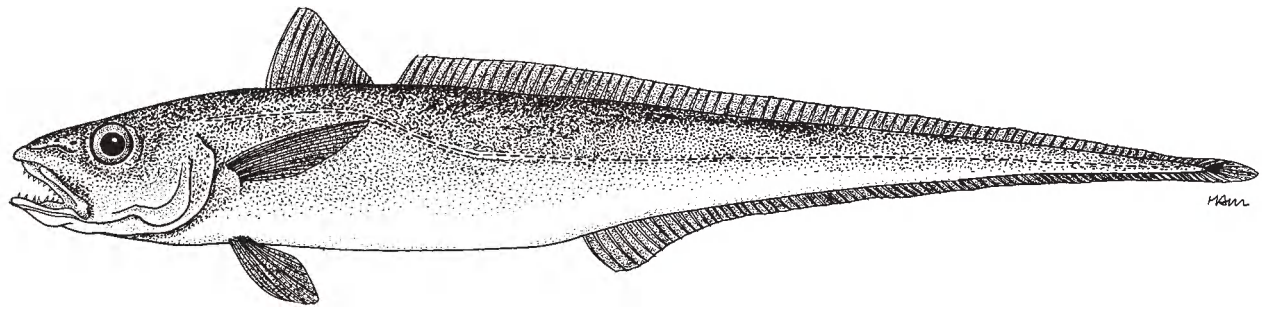


Fig. 10 ***Macruronus capensis***

Diagnostic Features: Body depth 6.3 to 7.8 times in total length. The lateral line runs along the middle of the body, except towards the anterior part where it runs near the dorsum. The head is contained 5.7 to 6.1 times into the total length. Mouth rather large, terminal and oblique, the maxillary reaches a vertical line through the posterior margin of the eye. Teeth strong but small, sharp, and curved, according to the original description of the species, and are in a single

row on the premaxillaries, the lower jaw, and the vomer; canine-like teeth absent on the anterior part of the premaxillaries. Eyes large, their diameter 3.8 to 4.6 times in head length. Branchial openings large. A total of 27 to 29 (6-7 + 21-23) gillrakers on the first branchial arch. The first dorsal fin, which has its origin behind a vertical line through the base of the pectoral fins, has a small anterior spine and 11 to 13 rays; the second dorsal has 88 to 98 rays. Pectoral fins are short, with 15 to 20 rays. Ventral fins with 8 rays, shorter than the pectoral fins and inserted in a thoracic position. Anal fin with 75 to 102 rays. **Colour:** blue, darker in the dorsal region, becoming lighter along the sides, the ventral region being almost white; all fins are dark-coloured.

Additional Information: It was not possible to examine a sample of this species. Davies (1950) based his description on a single specimen and placed it apart from ***Macruronus novaezelandiae*** and ***M. magellanicus*** as it possessed a small spine preceding the first dorsal fin. However this bone has been proven to be characteristic of the genus. Davies (1950) mistakenly believed that ***M. magellanicus*** lacked teeth on the premaxillary and that having 2 rows present was a character specific to ***M. novaezelandiae***. In this study we have seen that ***M. novaezelandiae*** as well as ***M. magellanicus*** have 2 rows of teeth on the premaxillaries; doubt remains on whether ***M. capensis*** possesses this character.

Geographical Distribution: Known only in the southeastern Atlantic (South Africa): Cape of Good Hope, Mossel Bay and Algoa Bay (Fig. 11).

Habitat and Biology: A supposedly bathypelagic species, which probably lives in rocky depths or in midwaters, to about 426 m depth.

Size: Maximum length about 100 cm.

Interest to Fisheries: None.

Local Names: SOUTH AFRICA: Bandstert, Strap-tail.

Literature: Davies (1950); Smith (1965); Cohen *in* Smith and Heemstra (1986); Inada *in* Cohen *et al.* (1990).

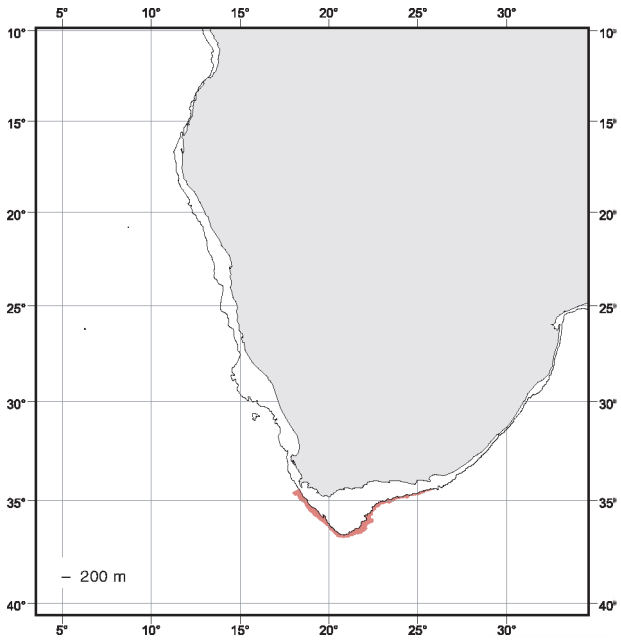


Fig. 11 ***Macruronus capensis***
Known distribution

Macruronus novaezelandiae (Hector, 1871) **Fig. 12**

Coryphaenoides novae-zelandiae Hector 1871, *Trans. Proc. N.Z. Inst.*, v. 3 (1870),1871: 103 (Port Nicholson, New Zealand).

Synonyms: ***Coryphaenoides tasmaniae*** Johnston, 1883, *Proc. R. Soc. Tasmania*: 143 (Kangaroo Bluff, Tasmania, Australia). ***Macruronus magellanicus*** Lönnberg, 1907, *Ergeb. Hamb. Magalh. Sammeir.*, 1, Fische: 15, Fig. 2 (Smyth Channel, Chile). ***Macruronus argentinae*** Lahille, 1915, *Anal. Mus. Nac. B. Aires*, 26: 22, p. v, Fig. 1.

FAO Names: En – Blue grenadier; **Fr** – Grenadier bleu; **Sp** – Merluza de cola.

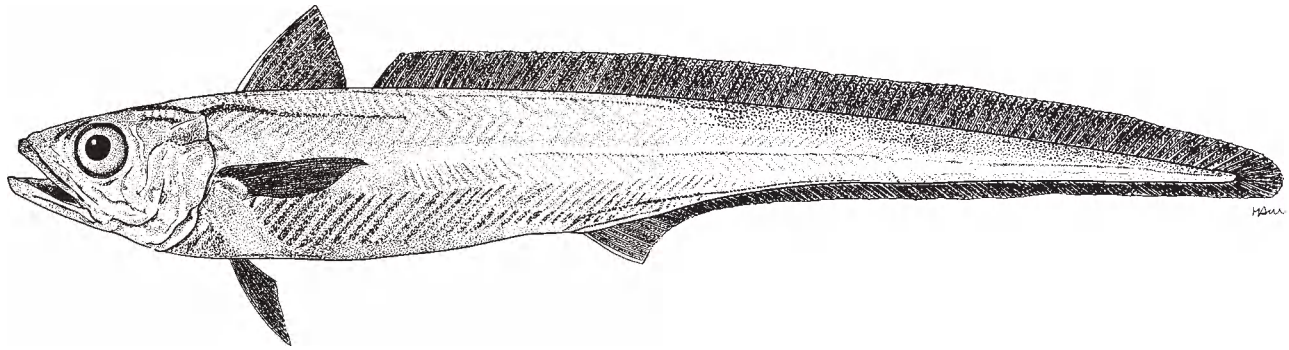


Fig. 12 ***Macruronus novaezelandiae***

Diagnostic Features: Body depth 6.7 to 8.5 times in total length; lateral line with 77 to 182 scales, running along the middle of the body except anteriorly where it runs near the dorsum. Head 4.8 to 6.6 times in total length. Mouth large, terminal and oblique, the maxillary extends to a vertical line through the posterior part of the eye. Two rows of teeth on the premaxillary, the inner row with very small, regularly disposed, articulated teeth; the outer row with larger canine-like teeth towards the front, followed by curved teeth, most of which are fixed. A single row of teeth on the lower jaw with a few small articulated teeth near the symphysis, followed by a canine, shorter and placed further back than on the premaxillary, with various long, arrow-shaped teeth, some being articulated. Two irregular rows of small articulated teeth on the vomer. Eye diameter 3.2 to 4.6 in head length. Large branchial openings. There are 27 to 35 gillrakers (6-8 + 21-27) on the first branchial arch. Two dorsal fins; the first, its origin behind a vertical line through the base of the pectoral fins, has a small spine and 10 to 13 rays; the second dorsal fin has 90 to 102 rays. Pectoral fins short, with 15 to 19 rays. Ventral fins, with 8 rays, are shorter than the pectoral fins and inserted slightly behind the latter. Anal fin with 83 to 95 rays. **Colour:** overall blue, darker in the dorsal region and becoming lighter along the sides, the ventral region being almost white; silvery surface with greenish tinges when animal is alive.

Additional Information: The results of the examination of specimens of ***Macruronus novaezelandiae*** (Hector, 1871) from the type locality and of others (***M. magellanicus*** Lönnberg,1907) captured in the Beagle Channel and Argentinian Sea, demonstrates that there are no significant differences that permit maintaining both binomials at the level of species.

The systematic value which diverse authors accredit to different meristic characters which are subject to a great deal of variability, such as number of vertebrae, gillrakers, fin rays and scales on the lateral line, is, to our mind, unjustified. Therefore, such characters have only been taken into account as indicative of the existence of different populations. Consequently, the following trinomena are proposed with their respective meristic formulas, where a degree of overlap can be noted.

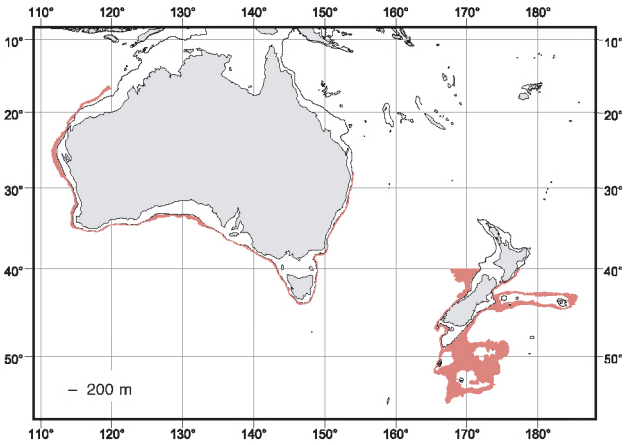
Macruronus novaezelandiae novaezelandiae (Hector, 1871)
(Australia, Tasmania and New Zealand)

1D. 10-12; **2D**. 96-102; **A**. 89-95; **P**. 15-18; **V**. 8; **Gr**. 6-7 + 21-24: 27-30

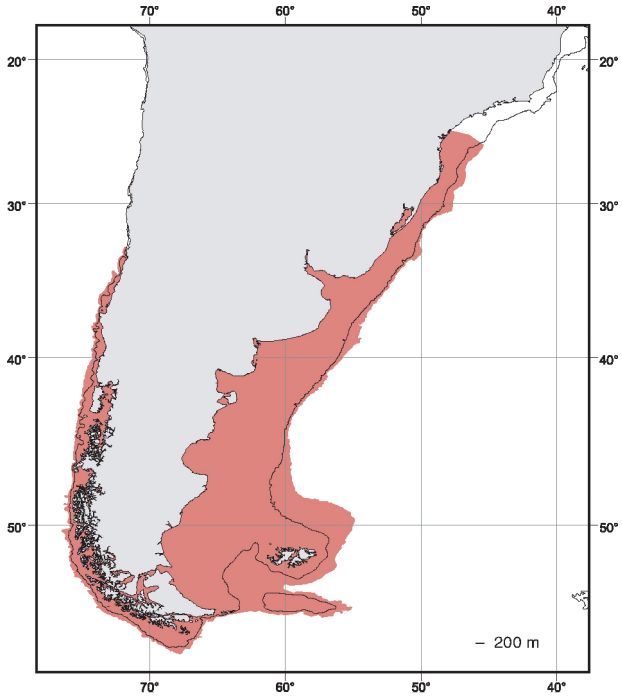
Macruronus novaezelandiae magellanicus Lönnberg, 1907
(Southern South America: Chile and Argentina)

1D. 10-13; **2D**. 90-102; **A**. 83-92; **P**. 17-19; **V**. 8; **Gr**. 7-8 + 23-27: 30-34

Geographical Distribution: Found in waters to the south of Australia, Tasmania and New Zealand (subspecies: ***Macruronus novaezelandiae novaezelandiae***) and on both sides of southern South America (subspecies: ***M. n. magellanicus***): in the southeastern Pacific (Chilean coast), from Valparaiso to the Straits of Magellan and Beagle Channel. It is also present in the southwestern Atlantic (Argentinian coast), from Beagle Channel to southern Brazil, following the isobaths from 200 to 800 m depth (Fig. 13).



a) ***Macruronus novaezelandiae novaezelandiae***



b) ***Macruronus novaezelandiae magellanicus***

Fig. 13 ***Macruronus novaezelandiae*** Known distribution

Habitat and Biology: The species is characteristic of cold or temperate waters, found between 200 and 800 m depths, and also present between 30 and 40 m. Juvenile specimens, and especially adults belonging to the American subspecies, have been caught with trammel nets and bottom trawls in the Beagle Channel from the coastal zone (0.5 m depth) to 110 m. It is voracious, generally feeding in similar proportions on fish (sardines, anchovies, myctophids) and crustaceans (Mysidacea, Euphausiacea, Amphipoda), as well as on cephalopods. The females are similar in size to males when they cannot be differentiated from the status of their gonads; the size of the liver is bigger in females. Spawning takes place in midwaters during the southern winter (June-August-September).

Size: The maximum established length is 120 cm; the common length from 50 to 100 cm.

Interest to Fisheries: Blue grenadier (***Macruronus novaezelandiae***) are caught by trawl in Australia, Tasmania, and above all, in New Zealand, where it is the main fishery. Japanese fleets began fishing in the 1970s, reaching maximum activity in the second half of the 1980s and the beginning of the 1990s; they were progressively taken over by local fleets. In the southwestern Pacific (Australia and New Zealand), Japanese and Russian trawlers began fishing in the 1970s, with catches amounting to 100 000 tonnes in 1977 and then dropping to less than 20 000 tonnes in 1978, which coincided with the declaration of the New Zealand EEZ. In the 1980s, catches grew steadily to 216 000 tonnes, mostly owing to New Zealand and Japanese catches; they remained between 177 000 and 213 000 tonnes during the first half of the 1990s, during which nearly all of the catches were progressively made by New Zealand fleets. In 1999, catches exceeded 300 000 tonnes, and a slight drop was recorded in 2000. In the southeastern Pacific off the South American coast, Chilean trawlers have been catching blue grenadier since the beginning of the 1970s. In recent years catches have fluctuated and reached a maximum of over 350 000 tonnes and a minimum of 70 000 to 80 000 tonnes. Blue grenadier is marketed filleted or frozen in blocks.

In the Atlantic, fishing started by the end of the 1970s with fleets from various countries. In the second half of the 1980s and particularly in the 1990s, Argentinian trawlers replaced these fleets. Atlantic catches were mostly made by Argentinian fleets (96 000 tonnes in 1998), and to a lesser extent by the Spanish (16 000 tonnes in 1998) and the Falkland Islanders (4 000 tonnes in 1998). However, different distant-water fleets maintained a high level of catch, such as the Bulgarians in the second half of the 1980s, and in particular, the Polish throughout the 1980s. In this region it is marketed frozen as well as fresh and is also used for fishmeal production.

Since 1995 annual catches of less than 25 tonnes have been recorded in the Antarctic region, as well as in the Atlantic area (carried out by the United Kingdom, Spain, South Africa, the Russian Federation, the Korean Republic, Chile, and Argentina) and in the Indian Ocean zone (carried out by South Africa, France and Australia).

Local Names: ARGENTINA: Argentino, Merluza de cola; AUSTRALIA: Blue grenadier; CHILE: Huaica, Huelca, Huilca, Merluza de cola de rata; FRANCE: Grenadier patagonienne, Merluche patagonienne; GERMANY: Langschwanz-Seehecht; JAPAN: Dekora, Hoki; NEW ZEALAND: Blue hake, Hoki, Whiptail; SPAIN: Merluza azul, Merluza de cola, Merluza hoki; UNITED STATES: New Zealand whiptail, Patagonian whiphake, Tailed hake.

Literature: Hector (1871); Günther (1873); Johnston (1883); Lönnberg (1907); Lahille (1915); Norman (1937); Fowler (1945); Hart (1946); Graham (1953); Ladiges *et al.* (1958); Angelescu and Gneri (1960); Ringuelet and Arámburu (1960); Marshall, (1966); Bellisio and López (1973); Marshall (1973); Svetovidov (1973); Stehmann, (1979); Torno and Tomo (1980); Ojeda (1983); Cohen (1984); Fahay and Markle (1984); Menni and López (1984); Menni *et al.* (1984); Pequeño (1984); Cohen (1986); Inada *in* Nakamura *et al.* (1986); Paxton *et al.* (1989); Pequeño (1989); Yamada *in* Amaoka *et al.* (1990); Inada *in* Cohen *et al.* (1990); Howes (1991); Lloris and Rucabado (1991); Andrews (1992); Wilkens and Dohse (1993); Gomon *et al.* (1994); López *et al.* (1996).

2.3 Subfamily: Merlucciinae Svetovidov, 1948

Body elongated and little compressed; caudal fin and penduncle well differentiated. Dorsal profile of the anterior part of the head flat, with wide and slightly depressed snout. Eye diameter smaller than interorbital distance, which in turn is smaller than the snout. Nasal orifices very close together, the anterior is rounded, the posterior is crescent-shaped and concave towards the front; the nasal membrane into which they open pointing towards snout. Mouth more or less oblique and moderately long; corner of mouth reaching below the anterior part of the eye or slightly behind; the maxillary extends to the posterior edge of the pupil or farther back. Lower jaw slightly protruding. Two rows of teeth on premaxillaries, on both lower jaws, and on vomer; teeth in external row fixed and small; internal row with longer inward-retracting teeth; 2 rows of teeth on vomer set as on the maxillary, only smaller. Branchial openings rather large, with branchiostegal membranes united anteriorly. First branchial arch (Fig. 14 and Plate VI) with well-developed, cushion-shaped gillrakers, clearly separated from the spiny tubercles. Gillrakers with a smooth external side and the

internal side with denticles; gillrakers on the upper part of the arch inserted on the epibranchial, the lower are inserted on the ceratobranchial, and possibly also on the hypobranchial. The Merlucciinae hyomandibular is complex with a prominent external blade that carries the anterior intermuscular proccess and the posterior preopercular process. This is of great diagnostic value. The urohyal is also used for diagnosis of different species in the group, although its degree of ossification, which increases with age, may slightly change its shape (Fig. 15 and Plates: V, VIII, X and XI). Two dorsal fins, the first high and triangular, the second less high and with a depression towards its middle. One anal fin opposed to the second dorsal and of a similar shape and size. A depression separates these 2 fins into two similar-length parts, although usually the posterior part has a few rays more than the anterior, as the last rays are thinner and closer together. Independent caudal fin with procurrent rays. Origin of pectoral fins on the lower half of flanks. Ventral fins with 7 rays and inserted in front of the pectoral fins (subjugular). Body completely covered in scales, including breast and base of pectoral fins; between 101 and 186 oblique rows of scales, from the upper anterior edge of the branchial openings to the end of the hypurals. Head scales smaller than those on body and arranged in a specific manner (Fig. 16a and Plate III); absent on jaws and ventral part of head; more scales on head in Euro-African hake species than in American hake species (Fig. 16a and b). Upper part of the head, including nasal membrane in Euro-African species, totally covered in scales; only tip end of the snout lacks scales in almost all species. Opercular and subopercular completely covered with scales. Scales on the preopercular and the interopercular, as well as on cheek and lacrimal vary from one species to another. Otoliths can be used to distinguish 2 groups, Euro-African, with plesiomorphic characters, and American, except for ***Merluccius albidus*** and ***Merluccius angustimanus*** with apomorphic characters (Fig. 17 and Plates:VII and XII). Single, short, conical pyloric caecum with wide base. Lacks pseudobranchs.

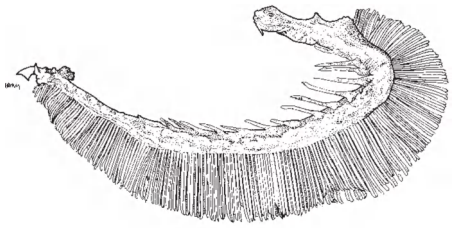
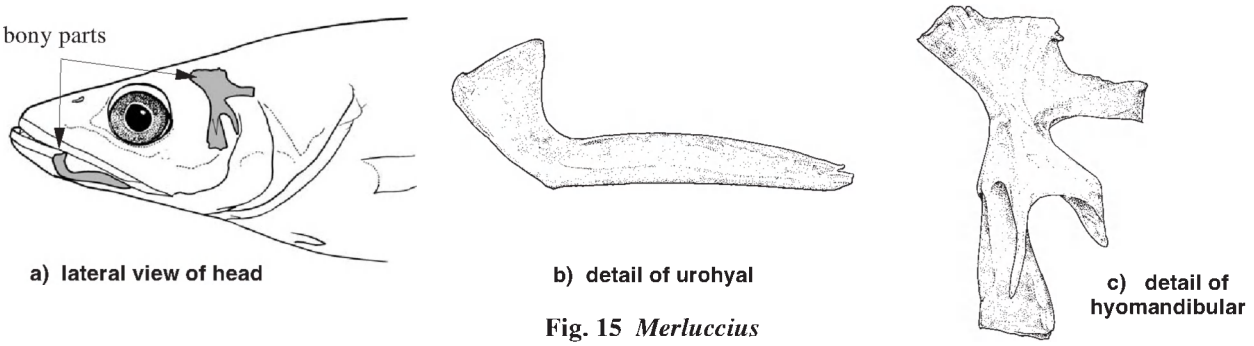


Fig. 14 First branchial arch

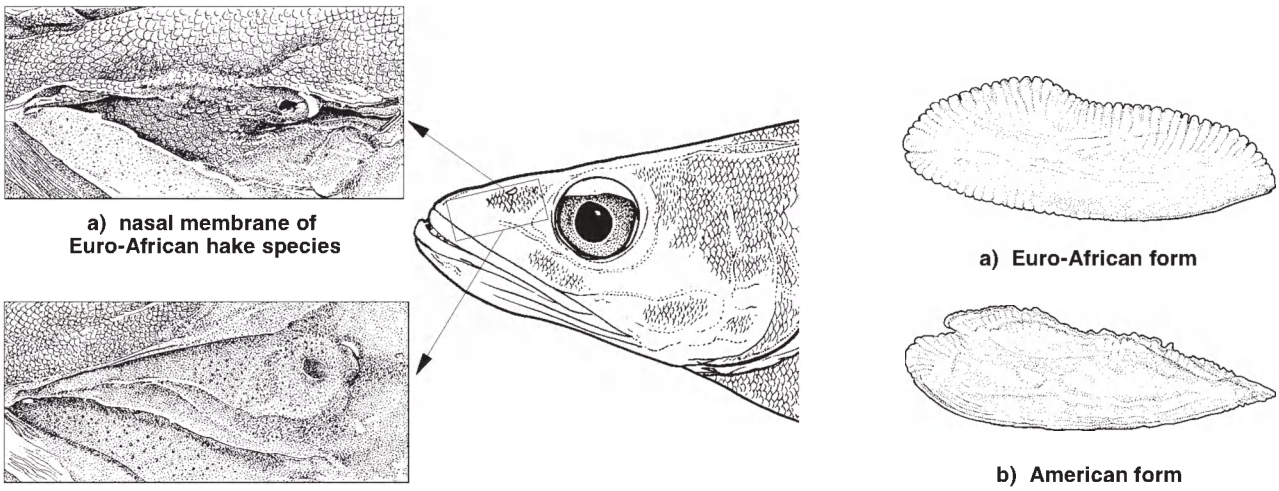
Species and subspecies of this subfamily are distributed throughout the eastern and western Atlantic, the Mediterranean, and the Red Sea; in the Indian Ocean (South Africa and Madagascar); in the western and eastern Pacific (eastern coast of Japan, New Zealand, and along the western American coast).

Includes a single genus: ***Merluccius***, which comprises 13 species.



a) lateral view of head **b) detail of urohyal** **c) detail of hyomandibular**

Fig. 15 *Merluccius*



a) nasal membrane of Euro-African hake species

b) nasal membrane of American hake species

Fig. 16 Head scales

a) Euro-African form

b) American form

Fig. 17 *Merluccius* otoliths (*sagitta*)

NEXT PAGE

2.4 Key to Species and Subspecies of Genus *Merluccius* (the figures in brackets indicate modal values)

A. Scales on nasal membrane and lower part of cheek. Posterior edge (*postrostrum*) of sagitta, generally blunt. **Euro-African forms** characteristic of the eastern *Atlantic, Mediterranean, Red Sea and southwestern Indian Ocean* . . . . . → ***1***

1a. Dark patch/mark, more or less widespread or very obvious in the submandibular fold. Scales on lower part of preopercular or interopercular . . . . . → ***2***

1b. No dark patch on the submandibular fold. No scales on lower part of interopercular . . . . . → ***4***

2a. Scales on lacrimal . . . . . → ***3***

2b. No scales on lacrimal. First branchial arch with a total of 12 (15) 21 gillrakers. Oral cavity and tongue blackish . . . . . ***Merluccius senegalensis***
(Eastern Atlantic: Morocco, Mauritania, Senegal)

3a. First branchial arch with a total of 8 (10) 12 gillrakers. Buccal cavity and tongue blackish. Posterior edge of caudal fin with a whitish stripe . . . . . ***Merluccius polli***
(Eastern Atlantic: Mauritania, Senegal, Angola, Namibia)

3b. First branchial arch with a total of 17 (19 or 20) 23 gillrakers. Buccal cavity and tongue greyish. Posterior edge of caudal fin of a uniform colour, no whitish stripe . . . . . ***Merluccius paradoxus***
(Eastern Atlantic: Namibia and western Indian Ocean: Madagascar)

4a. Scales on lacrimal. Scales on lower part of preopercular. First branchial arch with a total of 8 (10) 12 gillrakers . . . . . ***Merluccius merluccius***
(Eastern Atlantic: European coast, Morocco, Mediterranean, Red Sea)

4b. No scales on lacrimal. No scales on lower part of preopercular. First branchial arch with a total of 15 (19 or 20) 20 gillrakers . . . . . ***Merluccius capensis***
(Eastern Atlantic: from the south of Angola to Natal Province in the Indian Ocean)

B. No scales on the nasal membrane except some *Merluccius albidus* specimens where scales are present on the anterior part of the nasal membrane. No scales on lacrimal. No dark patch on on the submandibular fold. Posterior edge (*postrostrum*) of *sagitta*, generally pointed. **American forms** characteristic of the eastern Atlantic, eastern and western Pacific . . . . . → ***1***

1a. Scales on lower part of cheek and preopercular . . . . . → ***2***

1b. No scales on lower part of cheek, preopercular or interopercular . . . . . → ***5***

2a. Scales on lower part of interopercular. First branchial arch with a total of 8 (10) 11 gillrakers. Scales on body large, with 104 to 119 oblique series along the lateral line . . . . . ***Merluccius albidus***
(Western Atlantic: United States, Mexico, Venezuela, Guyana)

2b. No scales on lower part of interopercular. First branchial arch generally with 12 or more gillrakers. Scales on body rather small, with more than 120 oblique series along the lateral line . . . . . → ***3***

3a. Upper edge of opercular parallel to the lateral line. Oblique series of 133 to 144 scales along the lateral line. First branchial arch with a total of 12 (13-14) 15 gillrakers. Silvery grey colour with golden shine on back, silvery white on the belly . . . . . ***Merluccius hubbsi***
(Western Atlantic: Brazil, Uruguay, Argentina)

3b. Upper edge of opercular diverging down from origin and away from lateral line. Oblique series of 123 to 186 scales along lateral line . . . . . → ***4***

4a. Body robust. Upper cephalic profile straight, without any depression. Lateral line clearly separated from the dorsal profile. Eyes relatively small. Second dorsal fin with 39 (42 or 43) 45 rays. Anal fin with 40 (42 to 44) 46 rays. Oblique series of 144 to 186 scales along lateral line. First branchial arch with a total of 11 (13) 15 gillrakers. Gillrakers and their base with small melanophores . . . . . ***Merluccius australis***

(Japan, New Zealand, coasts of southern Chile and Argentina)

4b. Body slender. Upper cephalic profile with a depression before the eyes. Lateral line near the dorsal profile. Eyes large. Second dorsal fin with 37 (38) 38 rays. Anal fin with 37 (39) 39 rays. Oblique series of 123 to 126 scales along lateral line. First branchial arch with a total of 14 (14) 17 gillrakers. No melanophores on gillrakers or their base . . . . . ***Merluccius patagonicus***

(Southwestern Atlantic: Argentina)

5a. Small melanophores on gillrakers and their base . . . . . → ***6***

5b. No melanophores on gillrakers or their base . . . . . → ***7***

6a. Head short, between 3.4 and 4.0 times in standard length. Silvery grey colour on upper half, white on lower half. First branchial arch with a total of 15 (17 or 18) 22 gillrakers . . . . . ***Merluccius bilinearis***

(Western Atlantic: Canada and United States)

6b. Head long, between 2.9 and 3.8 times in standard length. Brownish blue on upper half, lower half with a yellow horizontal line. First branchial arch with a total of 17 (20 or 21) 25 gillrakers . . . . ***Merluccius gayi***

(Eastern Pacific: Chile and Peru)

7a. Head long, between 2.9 and 3.3 times in standard length. Scales on body rather long, with 121 to 134 oblique series of scales. First branchial arch with a total of 13 (16 or 17) 18 gillrakers . . . . . ***Merluccius angustimanus***

(Eastern Pacific: from Colombia to the Gulf of California)

7b. Head short, between 3.4 and 4.0 times in standard length. Scales on body small,with 144 to 166 oblique series. First branchial arch with a total of 18 (22) 23 gillrakers . . . . . ***Merluccius productus***

(Eastern Pacific: from Canada to southern Mexico)

Merluccius Rafinesque, 1810

Caratt. Gen. Spec. Sicil.: 25 (type: ***Merluccius smiridus*** Rafinesque, 1810, by monotypy).

Onus Rafinesque, 1810, *Ind. Ittiol. Sicil.*: 12 (type species: ***Onus riali*** Rafinesque, 1810; substitute for *Merluccius*). ***Merlangus*** Rafinesque, 1810, *ibid.*: 67 (type species: *Gadus merluccius* Linnaeus, 1758, substitute for *Onus*). ***Stomodon*** Mitchill, 1814, *Trans. Lit. Phil. Soc.*, 1: 7 (type species: *Stomodon bilinearis* Mitchill, 1814, by monotypy). ***Hydronus*** Minding, 1832, *Naturg. Fische*: 83 (type species: *Hydronus marlucius* Minding, 1832, by monotypy). ***Merlus*** Guichenot, 1848, *in* Gay. *Hist. Física polit. Chile, Zool.*, 2: 328 (type species: *Merlus gayi* Guichenot, 1848, by monotypy). ***Polydatus*** Gistel, 1848, *Naturg. Thierreichs*: 105 (type species: *Polydatus lucius* Gistel, 1848 (= *Gadus merluccius* Linnaeus, 1758, by monotypy). ***Merlucius*** Gronow, 1854, ed. Gray, *Cat. Fish.*: 129 (type species: *Merlucius lanatus* Gronow, 1854, by monotypy). ***Homalopomus*** Girard, 1856, *Proc. Acad. Nat. Sci. Philad.*: 132 (type species: *Homalopomus trowbridgii* Girard, 1856, by monotypy). ***Epicopus*** Günther, 1860, *Cat. Fish. Brit. Mus.*, 2: 232, 248 (type species: *Merlus gayi* Guichenot, 1848, substitute for *Merlus*). ***Trachinoides*** Borodin, 1934, *Bull. Vanderbilt mar. Mus.*, 1(4): 120 (type species: *Trachinoides maroccanus* Borodin, 1934, by monotypy). ***Huttonichthys*** Whitley, 1937, *Mem. Queensland Mus.*, 11(2): 122 (type species: *Gadus australis* Hutton, 1872, by monotypy).

Etymology: From the generic name ***Merlucci*(*us*)** + idae, from the Latin *maris lucius*: given by Belon (1553) (*De aquatibus*, p.121), which means "Sea pike".

Diagnostic Features: Same as for the subfamily.

Merluccius albidus (Mitchill, 1818) **Fig. 18**

Gadus albidus Mitchill, 1818, *J. Acad. Nat. Sci. Philad.*, 1: 409 (type locality: New York).

Synonyms: ***Merluccius vulgaris*** (*non* Fleming, 1828) Günther, 1862, *Catalogue of the fishes in the British Museum*, 4: 344. ***Merluccius bilinearis*** (*non* Mitchill, 1814): Norman, 1937, *Discovery Rep. Cambridge*, 16: 47. ***Merluccius magnoculus*** Ginsburg, 1954, *U.S. Fish Wildl. Serv., Fish. Bull.*, 96(56): 194 (Pensacola, Florida, depth 334 m).

FAO Names: En – Offshore silver hake; **Fr** – Merlu argenté du large; **Sp** – Merluza blanca de altura.

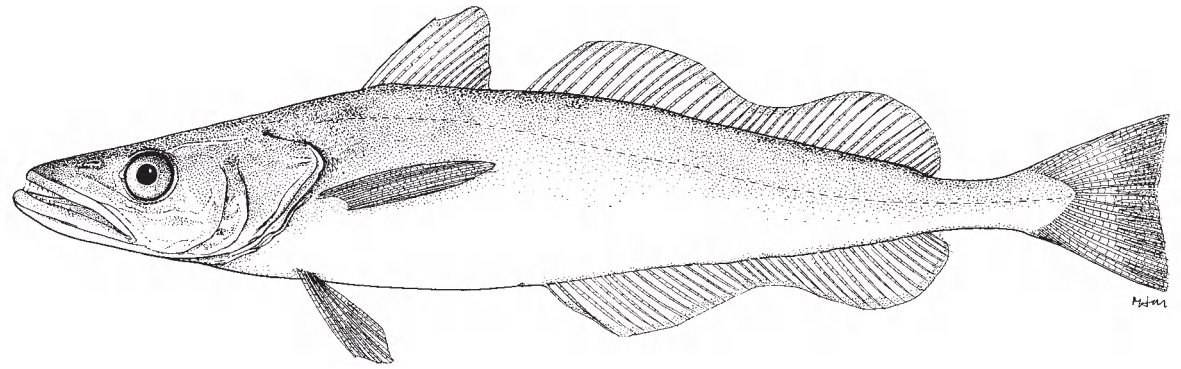


Fig. 18 ***Merluccius albidus***

Diagnostic Features: Scales on the lateral line 104 to 119. Head 26.8 to 31.7% of standard length and snout 31.0 to 37.2% of head length. No scales on nasal membranes in most specimens; no scales on lacrimal; scales on lower part of cheek, preopercular and interopercular. Eye diameter 17.1 to 27.7%, interorbital space 20.8 to 26.5% of head length. Lower jaw slightly protruding; strong and conspicuous teeth on premaxilliaries and mandibules; lower jaw slightly or not protruding. First branchial arch with 8 (10) 11 gillrakers: 1 to 3 on the upper limb and 7 to 9 on the lower limb.1D 11 (11-12) 13 rays; 2D 35 (38-39) 40 rays. A 35 (39-40) 41 rays. Pectoral fins with 12 (13-15) 16 rays, their length 16.9 to 22.3% of standard length, posterior end reaching the level of anal-fin origin. Ventral fins 13.8 to 20.6% of standard length. Posterior margin of caudal fin, truncate in young individuals and slightly concave in adults. A total of 51 to 55 vertebrae, 5 or 6 of them being cervical with 3 or 4 ribs. **Colour:** preserved specimens present a pale yellow, uniform colouring.

Additional Information: Ginsburg (1954) accepted the validity of ***M. albidus***, even though it was considered by other authors as a synonym of ***M. bilinearis***, and described a new species, ***M. magnoculus*** from Pensacola (Florida). Karnella (1972) and Inada (1981) relegate ***M. magnoculus*** to the synonymy of ***M. albidus***. Results of our analyses confirm differences which exist between ***M. albidus*** and ***M. bilinearis***, found on the Atlantic coast of the United States. They are easily distinguishable by their differing number of gillrakers (8 to 13 on the first arch to 15 to 22 on the second), and because ***M. albidus*** possesses scales on the lower part of the cheek, preopercular, and interopercular. If, however, ***M. magnoculus*** is considered a synonym of ***M. albidus***, we would find this species to have an inexplicable varying number of vertebrae, fin rays, and gillrakers. From our point of view, this shows the possible existence of a subspecies. Ginsburg (1954) himself points out that some ***M. albidus*** specimens possess a horizontal strip of scales on each side of the snout (supposedly referring to the lacrimal), while in our specimens they are lacking. Arai (1983) mentions ***M. albidus*** specimens in Suriname with a different number of cervical ribs than stated by Inada (1981b). In this study, specimens from the Gulf of Mexico have been observed as having few scales on the front part of the nasal membrane, whereas normally none are found in ***M. albidus*** specimens. All this as well as the differences in spawning periods makes the existence of a trinomen, ***Merluccius albidus magnoculus*** Ginsburg, 1954, plausible, and which we therefore propose for the hake population of the Gulf of Mexico.

Geographical Distribution: Western Atlantic: East coast of the United States from 40°N (Georges Bank, Long Island, Virginia, Florida), the Gulf of Mexico, and the Caribbean Sea to Suriname and French Guiana (5°N). ***M. albidus*** shares part of its geographical distribution (from Georges Bank to the coast of Virginia and perhaps to Florida) with ***M. bilinearis*** (Mitchill, 1814) (Fig. 19).

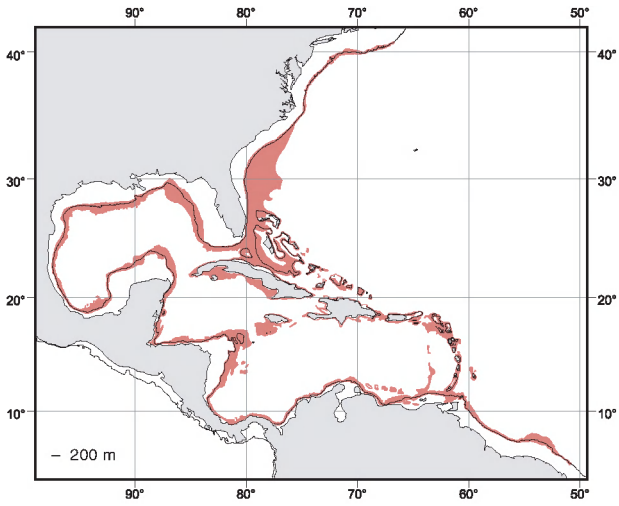


Fig. 19 ***Merluccius albidus***
Known distribution

Habitat and Biology: Offshore silver hake inhabit soft grounds between 92 and 1 170 m, but they are more commonly found between 160 and 640 m. Since catches are similar during night and day, it is considered that this species does not perform vertical circadian migrations. Depth segregation takes place from 550 m by size and sex, where only large females are caught. Juveniles feed primarily on crustaceans; as they become adults they prey on *Steindachneria argentea*, Myctophidae, Stomiatoidei, Macrouridae, Trichiuridae, and juveniles of their own species. Lifespan is unknown, though it is thought that males rarely exceed 3 years of age; many females live at least 5 years. Spawning occurs near the bottom in depths between 330 m and 550 m from April to July in New England and from late spring to early autumn in the Gulf of Mexico and the Carribean Sea. Fecundity is estimated at 340 000 eggs for a 68 cm standard length female.

Size: The largest recorded male and female measured 40 and 70 cm, respectively; common to 30 cm (males) and 45 cm (females).

Interest to Fisheries: Offshore silver hake (***Merluccius albidus***) are caught locally by fishing fleets from the United States and Cuba in the Gulf of Mexico. There are no fisheries targeting this species in the North Atlantic, however, they are caught in the bycatch of the silver hake (***Merluccius bilinearis***). No catches of this species reported to FAO.

Local Names: FRANCE: Merlu, Merlu argenté du large, Merlu blanc, Merlu du large; FRENCH GUIANA: Merlu; GERMANY: Seehecht; JAPAN: Ofushoa-heiku; MEXICO: Merluza; NICARAGUA: Merluza blanca; PORTUGAL: Pescada prateada do alto; SPAIN: Merluza, Merluza blanca, Merluza blanca de altura, Merluza norteamericana meridional; UNITED KINGDOM: Offshore hake, Offshore whiting; UNITED STATES: Offshore hake, Offshore silver hake, Offshore whiting; VENEZUELA: Merluza.

Literature: DeKay (1842); Günther (1862); Miranda Ribeiro (1903 and 1915); Ginsburg (1954); Karnella (1972); Inada (1981b); Arai *in* Uyeno *et al.* (1983); Inada *in* Cohen *et al.* (1990).

Merluccius angustimanus Garman, 1899 — Fig. 20

Merluccius angustimanus Garman, 1899, *Mem. Mus. Com. Zool.*, 24: 183 (type locality: Gulf of Panama).

Synonyms: ***Merluccius gayi*** (*non* Guichenot, 1848) Norman, 1937, *Discovery Rep.*, 14: 48. ***Merluccius angusticeps***: Hildebrand, 1946, *Bull. U.S. natn. Mus.*, 189: 159 (Peru). ***Merluccius hernandezi*** Mathews, 1985, *J. Nat. Hist.*, 19: 697-718 (Gulf of California).

FAO Names: En – Panama hake; **Fr** – Merlu du Panama; **Sp** – Merluza panameña.

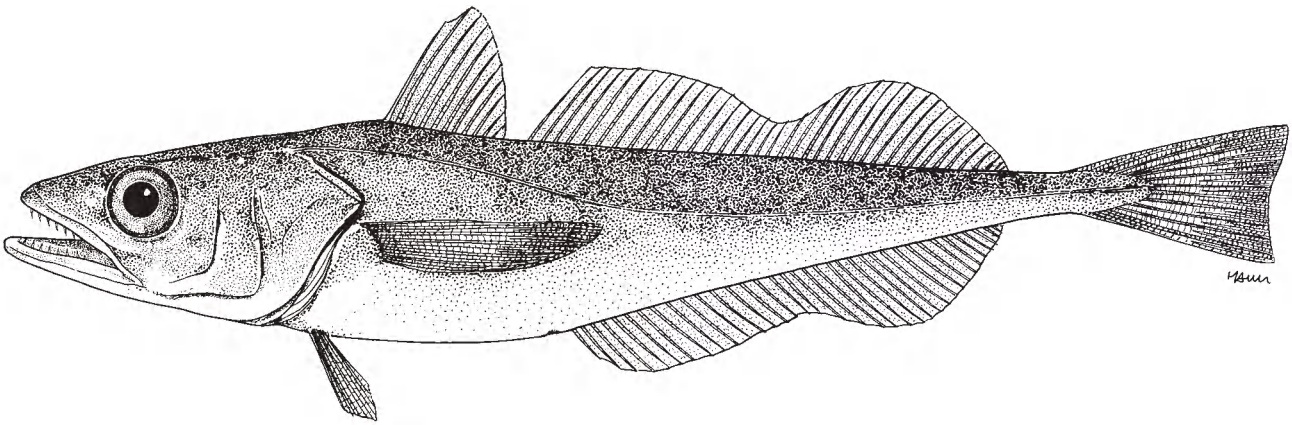


Fig. 20 ***Merluccius angustimanus***

Diagnostic Features: Scales along the lateral line 121 to 134. Head rather large, 30.1 to 33.5% of standard length. Snout 27.8 to 34.2% of head length. No scales on nasal membrane, lacrimal, lower part of cheek, preopercular, and interopercular. Eye diameter 19.7 to 24.6% and interorbital width 25.4 to 29.4% of head length. Lower jaw slightly protruding. Gillrakers on first branchial arch 13 (16-17) 18, 2 to 5 on the upper limb and 11 to 14 on the lower. 1D 10 (12) 13 rays; 2D 36 (37) 40 rays; A 36 (38) 40 rays. Pectoral fins with 14 (16-17) 17 rays, 20.3 to 24.2% of standard length, always extending far beyond the origin of anal fin. Ventral fin 11.0 to 15.8% of standard length. Caudal-fin margin truncate in juveniles and slightly concave in adults. Total number of vertebrae 49 to 52, 3 of which are cervical with 3 ribs. **Colour:** on small, preserved specimens, light grey with pale ventral region; large specimens brownish black.

Additional Information: To our mind, there are two problems with ***M. angustimanus*** which have not yet been resolved. First, its geographical distribution, and second, the validity of ***M. hernandezi*** Matthews, 1985.

As far as its geographical distribution is concerned, although Vrooman and Paloma (1977) as well as Ermakov (1983) remind us that Ahlstrom and Counts (1955) only found ***M. productus*** eggs and larvae and none belonging to ***M. angustimanus*** in California and Baja California, its presence is accepted in these latitudes. One of the specimens studied (**CAS** 117879), originating from the Gulf of California (Turtle Island: 27°4'N–112°W), has all the characteristics of ***M. angustimanus***. After studying geographic and bathymetric distributions of other ***Merluccius*** species, 2 or 3 species can be observed along all the ocean coast where they are normally found. This happens along the African Atlantic coast with ***M. merluccius*** and ***M. senegalensis***, and with the latter and ***M. polli***; and also ***M. capensis*** and ***M. paradoxus***. This also happens along the American Atlantic coast with ***M. bilinearis*** and ***M. albidus***, and ***M. hubbsi***, ***M. patagonicus*** and ***M. australis polylepis***. In all the examples mentioned, they usually occur in different depth ranges with a certain degree of overlap. ***M. productus*** is distributed in the eastern Pacific from Canada, the United States, and the Mexican coast, occurring deeper and separating from the coast as its distribution extends southwards to the Gulf of Teuantepec (16°N). ***M. angustimanus*** is distributed from Colombia, Panama, and Mexico to the Gulf of California, in deep to coastal waters. Although the two species are quite easily distinguishable, they have been mistakenly identified with another, owing to the fact that they share a broad distribution. ***M. angustimanus*** possesses fewer gillrakers (13 (16-17) 18) than ***M. productus*** (18 (22) 23), fewer rays on the second dorsal fin (36 (37) 40 *versus* 37 (40-42) 44), fewer scales along the lateral line (121-134 *versus* 144-166), and a larger head (30.1 to 33.5% of standard length *versus* 24.7 to 28.9%). This would partly validate Vrooman and Paloma's (1977) and Ermakov's (1983) viewpoints, as larvae and egg identification of any Merlucciidae species is intrinsically difficult, especially if taking into account the knowledge of both species being present when Ahlstrom and Counts put forward their contradicting results in 1955, along with possible fluctuations of the thermal front in the region.

The second issue to be resolved is ***M. hernandezi*** Mathews, 1985, which neither Inada *in* Cohen *et al.* (1990) nor Inada (1995) shed light on its validity or the naming of other binomen currently accepted in their region of origin (Gulf of California). Mathews separates ***M. hernandezi*** from ***M. angustimanus*** by the former having a relatively lower number of vertebrae as well as rays on the second dorsal and anal fins. ***M. hernandezi*** can grow to 107 cm total length whereas the maximum length of ***M. angustimanus*** is 40 cm. Due to high variability and overlap in meristic characters, such argumentation is not very consistent, especially in a region of periodic hydrographic fluctuation (El Niño-La Niña), where temperature plays an important role in embryonic development of eggs and larvae, giving rise to apparently isolated populations. Comparing meristic characters of ***M. angustimanus*** in Ginsburg (1954), Testaverde and Artunduage (1974), Inada (1981b) and Inada *in* Cohen *et al.* (1990) with those of ***M. hernandezi*** in Mathews (1985), there is much overlap in the number of gillrakers (13-18 *versus* 14-20), rays on the second dorsal fin (36-40 *versus* 36-42) and anal fins (36-40 *versus* 37-42), as well as scales along the lateral line (121-134 *versus* 130-139). As for the difference in size, the ***M. angustimanus*** specimen captured towards the interior of the Gulf of California (**CAS** 117879) measures 73 cm standard length; it has 4 + 13 = 17 gillrakers; 11 1D rays; 38 2D rays; 39 A rays. In relation to standard length: head length represents 33.5%; pectoral fins 20.5%, reaching the fourth anal-fin ray, and ventral fins 11.0%. In relation to head length: preorbital length represents 31.0% and eye diameter 14.2%. Therefore, after examining digitalized images of ***M. hernandezi*** paratypes, we propose ***M. hernandezi*** to become a synonym of ***M. angustimanus*** as it may constitute a part of ***M. angustimanus*** population.

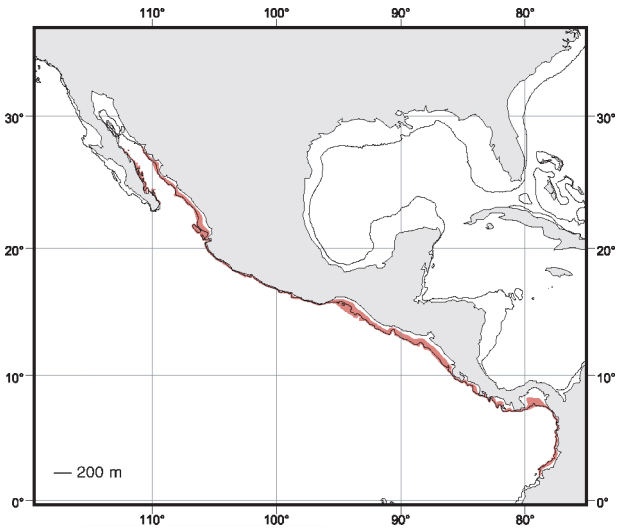


Fig. 21 ***Merluccius angustimanus***
Known distribution

Geographical Distribution: Eastern Pacific, from the Gulf of California (Turtle Island 27°04'N–112°W) to Ensenada de Tumaco (1°59.5'N–78°56.0'W) in Colombia (Fig. 21).

Habitat and Biology: The Panama hake is found in 80 to 500 m depths and also in midwaters of the open sea. Biological data on this species is sparse, possibly because it is not commercially exploited and most come from the southern part of the Gulf of California. It apparantly lives 7 years with a maximum recorded length of 39 cm. Minimum

length of first sexual maturity is 18 to 19 cm for both sexes, and spawning takes place from April to June, or later. If ***M. hernandezi*** from the northern part of the Gulf of California, and measuring as much as 107 cm, is a synonym of ***M. angustimanus***, the few biological data attributed to the Panama hake would need to be reconsidered.

Size: Maximum known length was 40 cm, common up to 32 cm, but one of the specimens studied measures 73 cm standard length. If ***M. hernandezi*** is accepted as a synonym of ***M. angustimanus*** its maximum length would be 107 cm.

Interest to Fisheries: This hake is only captured locally in small quantities in trawls; no catches reported to FAO.

Local Names: COLOMBIA: Merluza; FRANCE: Merlu Panaméen, Merlu du Panama; MEXICO: Merluza, Merluza bajacalifornia, Merluza panameña; NICARAGUA: Merluza panameña; PANAMA: Merluza; PORTUGAL: Pescada do Panamá; SPAIN: Merluza panameña; UNITED KINGDOM: Hake, Panama hake; UNITED STATES: Dwarf hake, Hake, Panama hake.

Literature: Garman (1899); Marini (1933); Norman (1937); Hildebrand (1946); Ginsburg (1954); Lozano Cabo (1965); Testaverde and Artunduage (1974); Vrooman and Paloma (1977); Inada (1981b); Ermakov (1973); Mathews (1985); Inada *in* Cohen *et al.* (1990); Inada (1995).

Merluccius australis (Hutton, 1872) **Fig. 22**

Gadus australis Hutton, 1872, *Fish. New Zeal.*, :45 (type locality: Cook Strait – New Zealand).

Synonyms: ***Merluccius gayi*** (*non* Guichenot, 1848): Günther, 1880, *Rept. Voy. Challenger*, 1(6): 22 (Gray Harbor, Straits of Magellan). ***Merluccius australis***: Norman, 1937 (*partim*), *Discovery Rept.*, 16: 48. ***Merlangius (Huttonichthys) australis***: Whitley, 1937, *Mem. Queensland Mus.*, 11(2): 122. ***Merluccius polylepis*** Ginsburg, 1954, *Fish. Bull.U.S.*, 96: 195, Fig. 2 (type locality: Castro, Chiloé, Chile). ***Merluccius gayi australis***: Mann, 1954, *Invest. Zool. Chil.*, 2(5): 81 (subantarctic to Talcahuano). ***Merluccius gayi hubbsi*** (*non* Marini, 1933): Mann, 1954, *Invest. Zool. Chil.*, 2(5): 81 (from Cape Horn to Puerto Montt). ***Merluccius gayi polylepis***: Angelescu *et al.*, 1958, *Sec. Mar.*, Buenos Aires: 155. ***Merluccius hubbsi*** (*non* Marini, 1933): Lloris and Rucabado, 1991.

FAO Names: En – Southern hake; **Fr** – Merlu austral; **Sp** – Merluza austral.

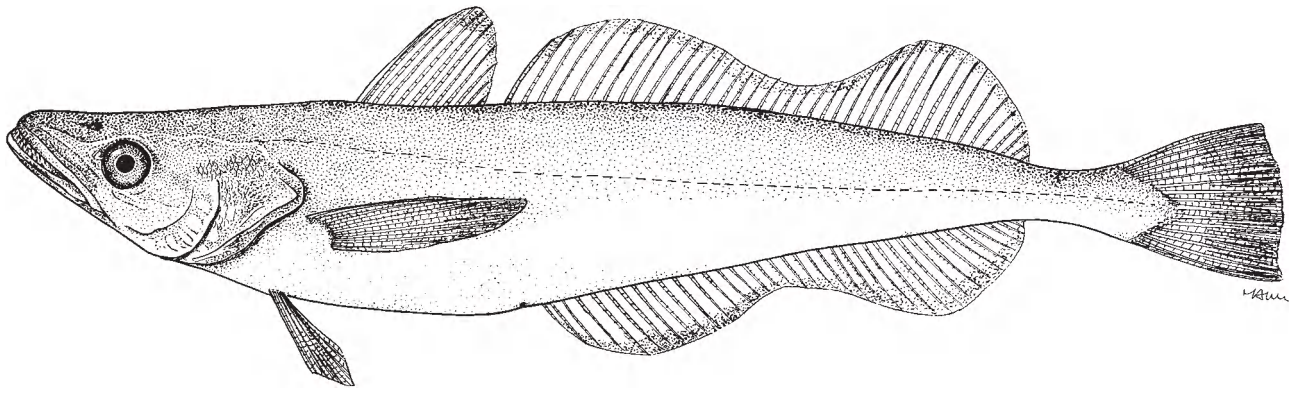


Fig. 22 ***Merluccius australis***

Diagnostic Features: Body robust. Lateral line clearly separated from the dorsal profile, with 144 to 186 scales. Head dorsal profile straight. Head length 24.9 to 28.3% of standard length, snout 33.2 to 39.0% of head length. No scales on nasal membrane, lacrimal, and lower part of interopercular; scales on lower part of cheek and preopercular. Eye diameter 13.8 to 21.9% and interorbital space 24.7 to 30.5% of head length. Lower jaw slightly protruding with large visible teeth, as those in the premaxilliaries. Gillrakers on first branchial arch 11 (13) 15, 2 to 4 on upper arm and 9 to 12 on the lower. 1D 10 (11) 13 rays; 2D 39 (42-43) 46 rays; A 40 (42-44) 46 rays. Pectoral fins with 13 (14) 16 rays, length 16.7 to 22.5% of standard length, reaching the origin of anal fin. Ventral fins 11.0 to 15.7% of standard length. Caudal-fin margin truncate in adults, convex in juveniles. Vertebrae 53 (56) 58, 5 or 6 of which are cervical, with 3 or 4 ribs. **Colour:** steel grey with tinges of blue on dorsum, lighter on sides and white on belly; dark fins. Gillrakers and their bases with small melanophores.

Additional Information: Based on specimens from New Zealand, Hutton (1872) described ***Gadus australis*** with 41 rays on the second dorsal and anal fins. Günther (1880) assigned specimens captured in the Magellan Straits to ***Merluccius gayi***, with 43 or 44 rays in 2D and 43 rays in the anal fin. Waite (1911) assigned 36 rays for both second dorsal and anal fins to ***M. australis*** from New Zealand. After studying three specimens from New Zealand, Norman (1937) compared them with Günther's (1880) specimen from the Magellan Strait, and finding no difference between them, identified them all as ***M. australis***, attributing to this species 36 to 43 rays in 2D and 36 to 42 rays in the anal fin.

Ginsburg (1954) considered specimens from the Chilean Pacific as different from those from New Zealand. Based on four specimens captured in Chiloé (Chile), he described ***M. polylepis*** having 43 to 45 rays in 2D and 42 to 45 rays in the anal fin, and 182 to 186 lateral-line scales. According to him, ***M. polylepis*** differs from ***M. australis*** in the number of rays on the 2D (43 to 45 in the former and 36 to 41 in the latter) and the anal-fin rays (42 to 45 in ***M. polylepis*** and 36 to 41 in ***M. australis***). Ginsburg also included the specimen from the Magellan Strait studied by Günther (1880) in ***M. polylepis***.

Inada (1981a and b) compared specimens of ***M. australis*** from New Zealand waters, with others from Chilean Patagonia and Argentina, which he believed to belong exclusively to ***M. polylepis***. After establishing that specimens from both regions have similar meristic and morphometric characters, he placed ***M. polylepis*** in the synonymy of ***M. australis***, while accepting that two populations exist.

In the present study, a paratype (**USNM** 157765) of ***M. polylepis*** from Puerto Montt (Chile) was studied as well as samples from the Chilean Pacific (46° 22'S–75° 27'W) and two specimens from the Beagle Channel (**IIPB** 92 and 93/1987, Ushuaia Bay, 54° 48.9'S – 68° 14.8'W, between 135 and 150 m depth). Meristic data of these specimens (13 to 15 gillrakers, 2D: 41-43 and A: 41-43) fit the original description of ***M. polylepis***.

The validity of ***M. australis*** was accepted after taking into account Ginsburg's (1954) meristic data of ***M. polylepis***, meristic and anatomical data from Inada (1981a and b) and Inada in Cohen *et al.* (1990), and our own data. Seeing as how the urohyal and the hyomandibular of Patagonian specimens are slightly different from those from New Zealand, two trinomena have been proposed: ***Merluccius australis australis*** for New Zealand waters, and ***M. australis polylepis*** for the southern coast of Chile, including Tierra del Fuego channels and southern Argentina.

Merluccius australis australis (Hutton, 1872)
(New Zealand)

1D. 10 (11) 13; **2D**. 39-45; **A**. 36-45; **P**. 13 (14) 15; **V**. 7; **Gr**. 11-14; **L.L.** 144-169

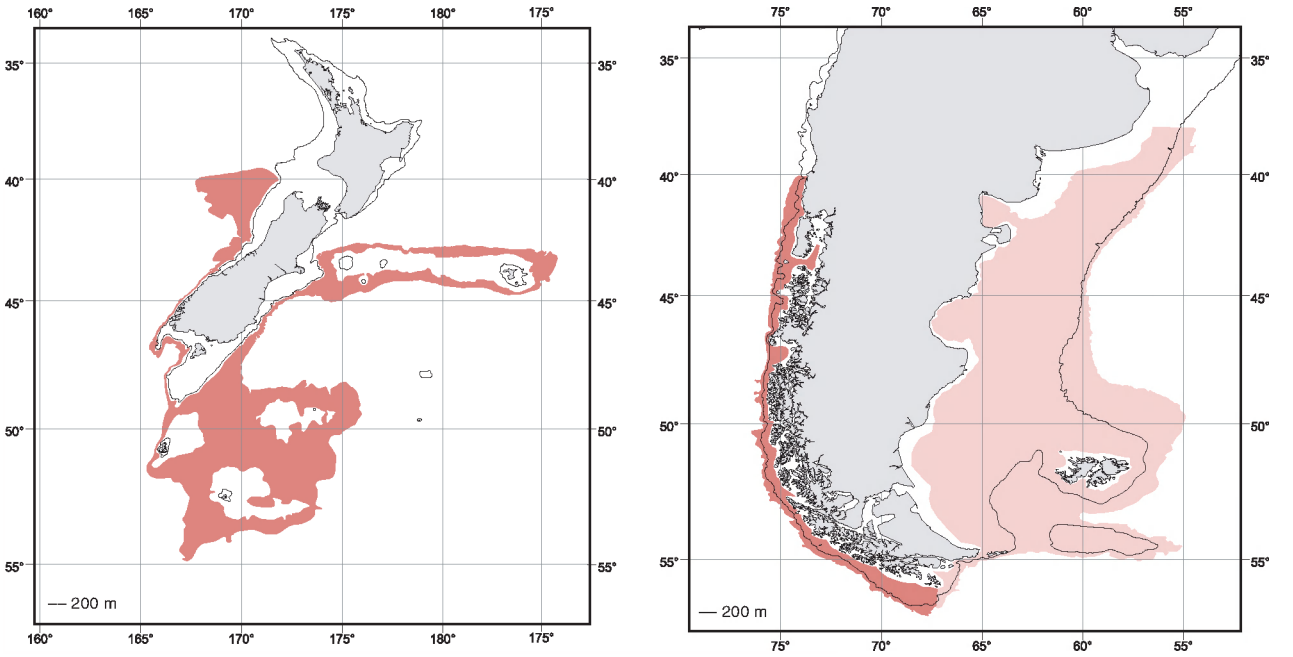
Merluccius australis polylepis Ginsburg, 1954
(southern coast of Chile, Magellan Strait, Beagle Channel and southern Argentina)

1D. 10 (11) 12; **2D**. 39-45; **A**. 38-45; **P**. 14; **V**. 7; **Gr**. 12-15; **L.L.** 174-186

Geographical Distribution: One can describe, with some precautions, the existence of 2 populations, one from New Zealand and another from the southern point of South America (Chile and Argentina). The New Zealand population (***M. australis australis***) is distributed south of the 40°S parallel (Challenger Plateau), bordering the islands and reaching Campbell Plateau and Chatham Rise. The South American population (***Merluccius australis polylepis***) can be found on the southeastern Pacific slope (Chile), from the Chiloé Island (40°S) to 57°S, including Diego Ramirez Island bordering Cape Horn, and reaching to the southwestern Atlantic slope (Argentina) (Fig. 23).

According to the present data, it is unkown whether the distribution of the species progresses northwards to around latitude 38°N and gradually moves away from the coast following the continental slope and under the influence of the Falklands Current.

Apart from regions already mentioned, Abe and Funabashi (1993) reported the first ***Merluccius australis*** specimen, measuring 79 cm, in the northwestern Pacific at 500 m from Japan (36° 23'N – 141° 02'E). As it was impossible to study that specimen, we have reservations on this recording, as it was caught very far from its distribution area. However, judging from the photographs, the head scales conform to those of the ***M. australis*** group.



a) *Merluccius australis australis* b) *Merluccius australis polylepis*

Fig. 23 ***Merluccius australis***
Known distribution and probable presence

Habitat and Biology: The New Zealand subspecies occurs south of 40°S and between 500 and 900 m, except on the Chatham Rise where it is found at 400 to 450 m. The species feeds mainly on fishes, primarily blue grenadier (***Macruronus novaezelandiae***), Macrouridae, and Myctophidae. Sexual maturity is attained at 6 years of age, or for males at 65 cm and females around 70 cm; at 10 years of age, all specimens are sexually mature, attaining up to 28 years, although few females surpass 23 years of age and males 21 years. The fact that three spawning areas are known and hake along the western coast are smaller than those along other areas of New Zealand, sheds doubt on the southern hake's identity (see additional information). Spawning takes place from August to September on the western coast of South Island, from September to November in the northern part of the Campbell Plateau, and between November and January on Chatham Rise.

There is little information on the biology of the Patagonian subspecies, especially around the southwestern Atlantic. It lives in sub-Antarctic waters drifting from the Chilean Pacific carried by the Cape Horn current, that becomes the Falkland current in the southwestern Atlantic. Along the Chilean coast it feeds mainly on demersal fishes such as blue grenadier (***Macruronus novaezelandiae magellanicus***), southern blue whiting (*Micromesistius australis*), and pink cusk-eel (*Genypterus blacodes*). Sexual maturity is reached at 65 cm in males and 72 cm in females; spawning takes place during a short but intense winter period of 3 to 4 months (July - September). Three reproduction areas have been pointed out, the main one is Guamblin Island (44° - 46°S), while Guafo Island to the north, and the area between 52° and 54°S are less important. Spawning areas are situated in fjords and canals. Given the females' large size, fecundity levels are rather high (estimated at 430 000 eggs); specimens smaller than 60 to 70 cm have a fecundity similar to that of ***M. gayi gayi***. It has the longest lifespan of the genus; maximum age recorded in males and females is 30 years, with females generally living longer, and are larger (to 155 cm total length), than males.

Size: Maximum recorded length 130 cm in New Zealand, 155 cm in Chile and Argentina; common length is 30 to 100 cm.

Interest to Fisheries: The geographical distribution of southern hake (***Merluccius australis***) overlaps in the Atlantic with that of the Argentine hake (***Merluccius hubbsi***), which also causes an overlap in fishery catches. However, the southern hake extends further south beyond Cape Horn and is also found along the Chilean coast. In New Zealand the southern hake (***Merluccius australis***) is a secondary fishery, as it is caught as bycatch with blue grenadier (***Macruronus novaezelandiae***).

In Argentina, the southern hake has constituted a target fishery since 1980, as well as a bycatch of other fisheries. It is fished by freezer factory-trawlers of more than 45 m length and other trawlers of smaller tonnage operating far from the coast as well as by fleets of small 25 m trawlers fishing near the coast. It is also caught around the Falkland Islands by fleets targeting Argentine hake (***Merluccius hubbsi***). In Chile in 1976, a Japanese factory trawler was the first to operate; afterwards, Chilean fleets continued to exploit this resource. In the mid-1980s, refrigeration was introduced, favouring the apparition of an artisanal fleet and other factory longliners also targeting this species. South American

catches, carried out exclusively by Chilean and Argentinian fleets (except for some catch carried out by the Republic of Korea, between 1987 and 1992), totalled a maximum of 110 993 tonnes in 1987. Since then, catches have decreased and are stable, between 3 000 and 4 000 tonnes in the Atlantic and around 25 000 tonnes in the Pacific. Owing to its excellent commercial characteristics, this species sells at a higher price than other hake species and is preferably marketed fresh and whole. It has also been marketed frozen and used for fishmeal. The New Zealand product is preferably marketed gutted, whole and frozen.

In New Zealand, Japanese trawlers began fishing in 1975, but in 1978 a TAC (Total Allowable Catch) system was introduced whereby fishing was reserved for New Zealand fleets and joint ventures with local fleets. Target fishing of this species also takes place in the sub-Antarctic area of New Zealand. New Zealand has been reporting catches since 1980, and in recent years, so have the Republic of Korea, Ukraine, the Russian Federation and Norway. Catches have gradually increased to more than 15 000 tonnes in annual catch for New Zealand and to around 20 000 tonnes in total annual catch. The New Zealand product is preferably marketed gutted, whole and frozen.

Local Names: CHILE: Maltona, Merluza austral, Merluza española; FRANCE: Merlu austral; JAPAN: Hitachi, Hitachi dara, Nyujiirando-heiku; NEW ZEALAND: Hake, Whiting; SPAIN: Merluza austral, Merluza del sur, Merluzón; UNITED KINGDOM: Chilean hake, Patagonian hake, Southern hake.

Literature: Hutton (1872); Günther (1880); Waite (1911); Norman (1937); Graham (1953); Ginsburg (1954); Mann (1954); Cousseau and Cotrina (1980); Gosztonyi (1981); Inada (1981a and b); Ayling and Cox (1982); Menni *et al.* (1984); Inada *et al.* (1986); Ojeda and Aguayo (1986); Csirke (1987); Inada *in* Cohen *et al.* (1990); Abe and Funabashi (1993); Balbontín and Bravo (1993); Aguayo (1995); Colman (1995); Cousseau and Perrotta (1998).

Merluccius bilinearis (Mitchill, 1814) **Fig. 24**

Stomodon bilinearis Mitchill, 1814, *Trans. Lit. Phil. Soc.*, 1: 7 (type locality: New York).

Synonyms: ***Merluccius vulgaris*** (*non* Fleming, 1828) Günther, 1862, *Catalogue of the fishes in the British Museum*, 4: 344. ***Merluccius bilinearis***: Gill, 1863, *Proc. Acad. Nat. Sci. Philad.*: 247 (Eastern North American coast, Virginia).

FAO Names: En – Silver hake; **Fr** – Merlu argenté; **Sp** – Merluza norteamericana.

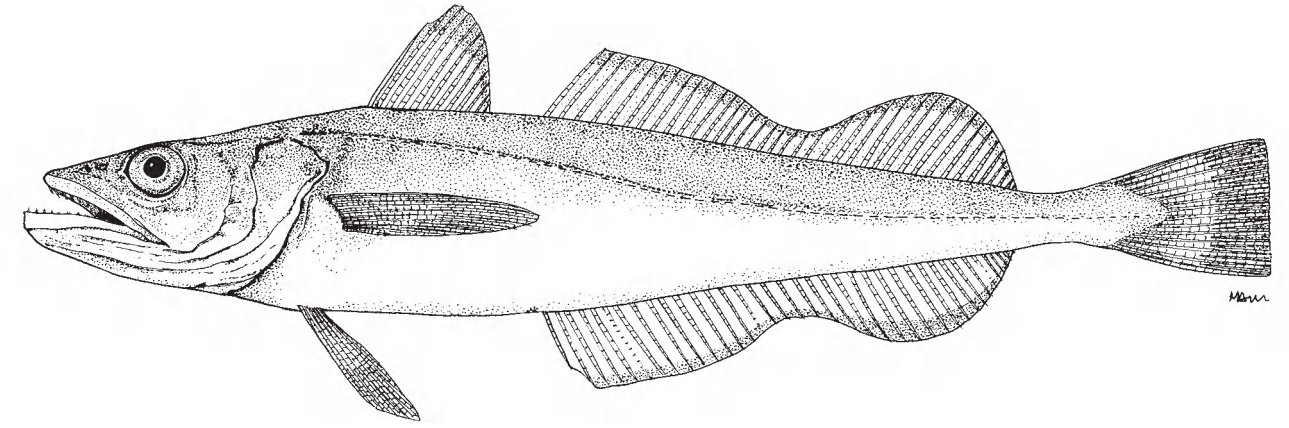


Fig. 24 ***Merluccius bilinearis***

Diagnostic Features: Scales along the lateral line 101 to 130. Head 24.4 to 27.4% of standard length and snout 31.2 to 35.1% of head length. No scales on nasal membrane, lacrimal, lower part of cheek, preopercular and interopercular. Eye diameter 16.4 to 23.8% and interorbital width 24.0 to 29.8% of head length. Lower jaw slightly protruding. Gillrakers on the first branchial arch 15 (17-18) 22, 2 to 6 on the upper arm and 11 to 17 on the lower arm. 1D 11 (12) 14 rays; 2D 37 (40) 42 rays; A 37 (41) 42 rays. Pectoral fins with 13 (14-15) 17 rays, length 18.1 to 24.1% of standard length, in juveniles reaching beyond anal-fin origin. Ventral fins 14.0 to 19.6% of standard length. Caudal-fin margin truncate in juveniles and slightly concave in adults. Vertebrae 53 to 57, 6 of which are cervical with 4 ribs. **Colour:** in preserved specimens silvery grey, dorsum slightly darker. Gillrakers and their base with dark conspicuous spots (melanophores).

Additional Information: Miranda Ribeiro (1903-1915) widened the distribution of ***Merluccius bilinearis*** in the western Atlantic, recording them from Belle Island in North America to Rio de Janeiro in South America without even considering ***M. albidus*** (Mitchill 1818) and ***M. hubbsi*** for description. Differences from ***M. albidus***, which are also found along the American coast, are described under ***M. albidus***.

Geographical Distribution: Atlantic coast of Canada and the United States from Belle Isle Strait (52°N) to the Bahamas (24°N); most common from southern Newfoundland to South Carolina (Fig. 25).

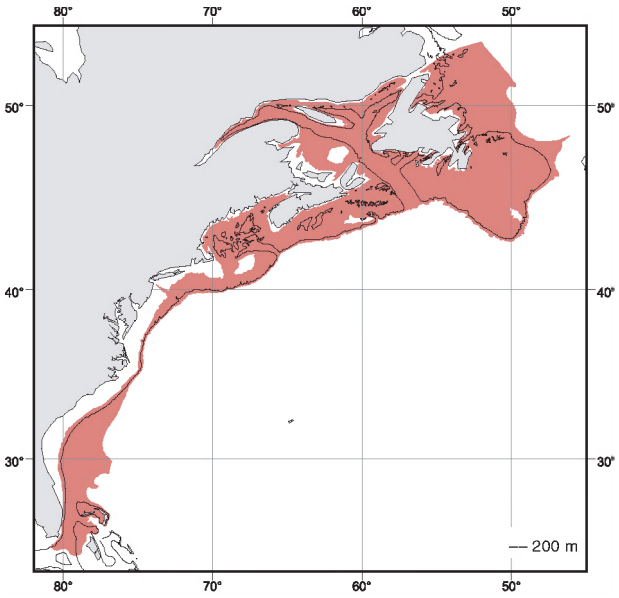


Fig. 25 ***Merluccius bilinearis***
Known distribution

Habitat and Biology: The silver hake is one of the most important species on the continental shelf and the North American continental slope, both as predator as well as prey. Demersal, it can be found between 55 and 914 m depth. There are two populations: one to the north, from the Gulf of Maine to the northern part of Georges Bank, characterized by a slower growth than the southern population, and another which occurs from the southern part of George Bank to the southernmost point of the species' distribution. During winter and spring most adults are found on the continental edge and slope, mainly gathering on the Scotian Shelf, the Gulf of Maine, and the slope from Sable Island Bank to Cape Hatteras. In summer and autumn, they migrate to shallower waters. Juveniles show a similar seasonal distribution pattern to the adults, only gathering in shallower waters. The smallest specimens feed mostly on crustaceans to the age of six, when they then feed on fishes (clupeids, *Scomber scombrus*, *Urophycis chuss*, *Gadus morhua*); they also show cannibalistic habits. There is a positive correlation between the abundance of *Scomber scombrus* and the recruitment of silver hake in the area. The first sexual maturity is similar in males and females, between 2 and 3 years (29 to 33 cm length) on Georges Bank and 1 to 2 years (females 26 to 27 cm length; males 23 to 24 cm length) on the Scotian Shelf. Recent studies have shown a drop in age and size at first maturity. Variations occur in spawning and takes place, according to area and population, from May to November. Spawning occurs in June – July in the mid-Atlantic region; July – August in the Gulf of Maine and to the north of Georges Bank, and August – September on the Scotian Shelf. Little is known about the species' fertility but it is believed to be as high as that of other species of the genus. Females grow faster, live longer, and are larger than males; maximum size of females is 76 cm and live up to 15 years of age. Maximum size and age of males are 41 cm and 9 years of age. In the last few years silver hake from the United States waters rarely exceed 6 years of age.

Size: Maximum recorded length is 76 cm; common to 37 cm (males) and 65 cm (females).

Interest to Fisheries: The silver hake fishery is one of the largest and oldest fisheries in the world. It is mainly concentrated off the coast of Nova Scotia, Gulf of Maine and Georges Bank. It is one of the most abundant demersal species in the region, and after the intense fishing pressure of the 1960s and 1970s exerted by the Soviet Union, the species is now exploited by the United States, Canada and Cuba. Up until the 1940s, when trawl fleets and low-temperature preservation were introduced, United States fishermen had fished this species near the coast since the middle of the nineteenth century, the artisanal fleets using nets and traps, and the recreational vessels using hooks. In the 1950s the use of trawls in the fishing area increased, and annual catches totalled over 50 000 tonnes. From 1960, foreign fleets with 500 to 1 000 GRT (Gross Registered Tonnage) trawlers joined local fleets and contributed to an increase in fishing effort that until then had been exerted by local fleets with trawlers of less than 300 GRT. In 1950, owing to intense fishing pressure from foreign fleets, the ICNAF (International Commision for the North Atlantic Fisheries) was created, bringing restrictions and technical measures to achieve rational fishing exploitation. As a result, foreign fleets decreased and the United States fleet grew in number and capacity. Today the resource is also exploited by Canada, Cuba and the Russian Federation under joint ventures. Silver hake is of great commercial interest and is mostly marketed fresh in the Russian Federation. It is also marketed frozen, gutted, whole or in fillets, and was occasionally used for fishmeal in the past.

At the beginning of the twentieth century, United States fleets caught around 3 000 tonnes per year, but by 1951 catches totalled over 50 000 tonnes, this level was maintained throughout the 1950s. In the 1970s the Soviet Union fleets joined the fisheries, thus contributing to a large increase in fishing effort, their annual catch twice totalling over 350 000 tonnes. Shortly after both occasions, a rapid decline in annual catch to under 100 000 tonnes was recorded. In the 1980s, and particularly in the 1990s, catches slowly and steadily declined to about 30 000 tonnes.

NEXT PAGE

Local Names: CANADA and UNITED STATES: Atlantic hake, Hake, New England hake, Silver hake, Whiting; CROATIA: Ugotica; DENMARK: Kulmule; FINLAND: Hopekummelituska; FRANCE: Merlan, Merlu argenté; GERMANY: Nordamerikanischer Seehecht, Silberhecht; ICELAND: Lysingur; ITALY: Nasello atlantico; NORWAY: Lysing; POLAND: Morszczuk srebrzysty; PORTUGAL: Pescada prateada; SPAIN: Merluza, Merluza atlántica, Merluza norteamericana.

Literature: Mitchill (1814); Günther (1862); Gill (1863 and 1872); Jordan and Evermann (1898); Miranda Ribeiro (1903 and 1915); Marini (1933); Ginsburg (1954); Inada (1981); Báez and Gómez-Larrañeta (1989); Inada *in* Cohen *et al.* (1990); Bolles and Begg (2000).

Merluccius capensis Castelnau, 1861 — Fig. 26

Merluccius capensis Castelnau, 1861, *Mém. Poiss. Afr. Austr.*: 68-69 (type locality: South Africa).

Synonyms: ***Gadus merluccius*** (*non* Linnaeus, 1758): Pappe, 1854: 30 (Cape of Good Hope). ***Merluccius vulgaris*** (*non* Fleming, 1828): Gruvel, 1913: 14 *in* Maurin (1990), South Africa. ***Merlucius capensis***: Gruvel, 1913: 153 *in* Maurin (1990), South Africa. ***Merluccius capensis capensis***: Franca, 1960, *Mem. Junta Invest. Ultram.*, 2(18): 3 (Farta Bay, Angola, to Agulhas Bank, and Natal). ***Merluccius merluccius capensis***: Franca, 1962, *Mem. Junta Invest. Ultram.*, 2(36): 25 (taxonomy). ***Merlucius merluccius capensis***: Lozano Cabo, 1965, *Publ. Téc. Junta Estud. Pesca*, 4: 20 (from Farta Bay to Capetown). ***Merluccius merlucius capensis***: Franca, 1971: 5 and 11 (Angola, southwest Africa, South Africa).

FAO Names: En – Shallow water Cape hake; **Fr** – Merlu côtier du Cap; **Sp** – Merluza del Cabo.

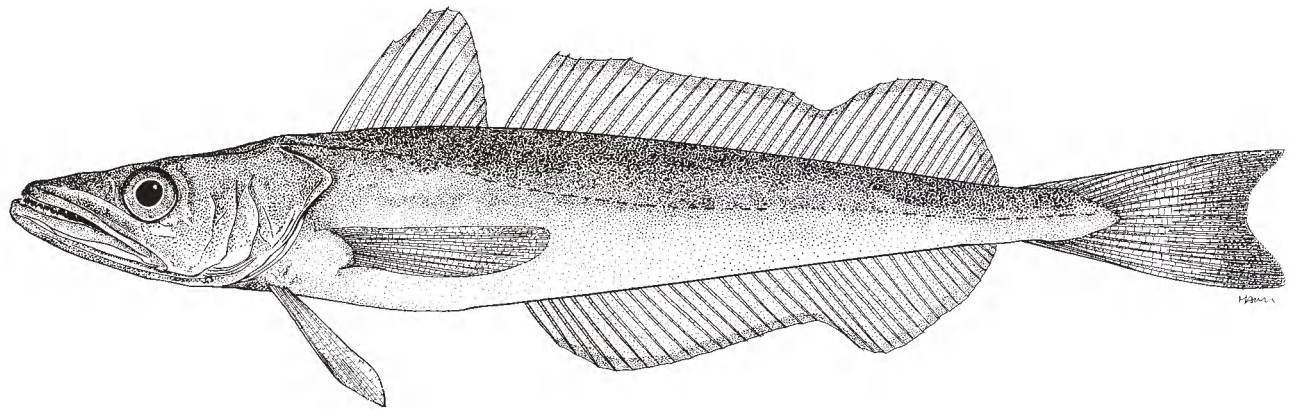


Fig. 26 ***Merluccius capensis***

Diagnostic Features: Scales along the lateral line 120 to 153. Head 27.3 to 30.2% of standard length and snout 31.9 to 36.5% of head length. Scales on nasal membrane and lower part of cheek; no scales on lacrimal, lower part of preopercular and interopercular. Eye diameter 17.0 to 24.6% and interorbital space 24.1 to 28.6% of head length. Lower jaw rather prominent; strong teeth on jaw, premaxilliary and vomer. Gillrakers on first branchial arch 15 (19-20) 20, 3 to 6 on upper limb and 11 to 15 on lower. 1D 9 (11) 12 rays; 2D 37 (39) 43 rays; A 36 (39) 41 rays. Pectoral fins with 14 (15) 16 rays, length 17.2 to 19.9% of standard length and reaching beyond the origin of anal fin. Ventral fins 14.2 to 17.1% of standard length. Posterior margin of caudal fin truncate or slightly concave. Number of vertebrae 48 (51-52) 53, 6 of which are cervical with 4 ribs. **Colour:** lead grey, darker on dorsum than on sides; whitish belly; greyish fins. No submandibular mark.

Additional Information: Different studies have shown similarities between ***M. capensis***, ***M. merluccius*** and ***M. senegalensis***. Similarities of these three species concern meristic, morphometric, and qualitative characters, amongst others (allozymes, Roldan *et al.*, 1999). With ***M. capensis*** and ***M. senegalensis***, the *sagitta*, especially the sulcus (sulcus acusticus), are very similar, although the *sagitta* of the latter species is rather more curved and more fragile than that of ***M. capensis***. ***M. merluccius*** is different from the other two species in having fewer gillrakers (8-11, as opposed to 13-21 in ***M. senegalensis*** and 15-20 in ***M. capensis***); ***M. senegalensis*** shows a black mark on the submandibular fold that is lacking in ***M. merluccius*** and ***M. capensis***. In the same way as ***M. paradoxus***, they differ in their scale distribution pattern on the head.

Geographical Distribution: Southeastern Atlantic, from Farta Bay near Benguela (12° 30'S) on the Namibian coast to the Cape of Good Hope; around the Agulhas Bank into the Indian Ocean to Natal at Cape Saint Lucia (32°E). To the north towards Benguela, its distribution area overlaps with that of the Benguela hake (***M. polli***) and partially, in deep areas, with the South African deepwater Cape hake (***M. paradoxus***). Also found on the Valdivia Bank between 228 and 283 m depth (Fig. 27).

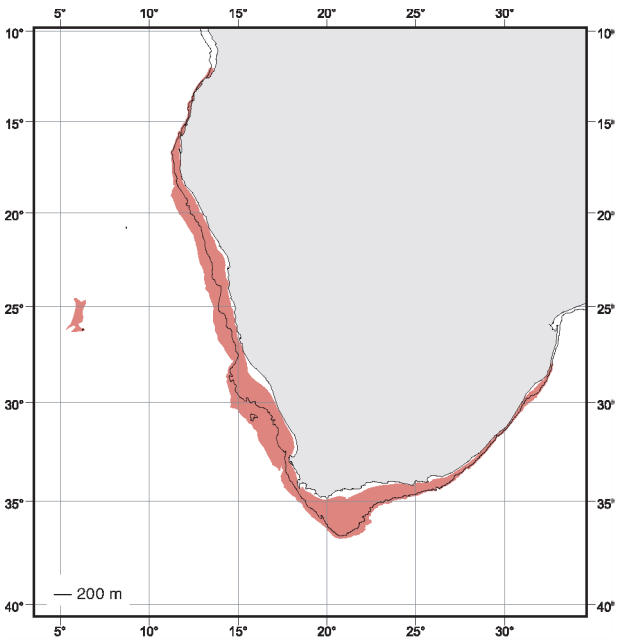


Fig. 27 ***Merluccius capensis***
Known distribution

Habitat and Biology: Demersal and benthopelagic species which migrate seasonally and vertically (demersal during the day and nectonic during the night). Bathymetric distribution ranges between 50 and 500 m, but it is more frequently found between 50 and 400 m, overlapping with ***M. paradoxus*** between 200 and 400 m depth. Juveniles usually gather to the north of Walvis Bay (between Palgrave Point and Cape Cross) and feed mainly on pelagic crustaceans and myctophids. Adults are euryphagous and prey mainly on myctophids, horse mackerels, small sardines, macrourids, and fish of their own genus. Male sexual maturity is attained between 28 and 67 cm. According to Ritzhaupt (1969) and Botha (1971), ***M. capensis*** growth in comparison to ***M. paradoxus*** is more rapid, estimating it at 6 to 8 cm in 8 years; Botha (1971) points out that ***M. paradoxus*** grows steadily up to 6 years of age, slowing down thereafter. Spawning apparently takes place all year round, although there is controversy on this. According to Jones (1967) and Jones and Van Eck (1967), peak spawning in the Capetown region is between August and September (end of winter and beginning of southern spring). Pshenichnyy and Assarov (1969) believe the spawning period to extend from September to February (spring and end of the southern summer). The species is believed to live up to 11 years.

Size: Maximum known length 120 cm; common from 40 to 60 cm.

Interest to Fisheries: Like other hakes, shallow water Cape hake (***Merluccius capensis***) and deepwater Cape hake (***Merluccius paradoxus***) are caught using trawls operating on the bottom during the day and lifting away from bottom at night. In the southeastern Atlantic (FAO statistic area 47), the shallow water Cape hake is distributed along three coastal states (Angola, Namibia and South Africa), and fishery management differ in each of them. Shallow water Cape hake (***Merluccius capensis***) dominated Namibian catches and still dominates South African catches. Deepwater Cape hake (***Merluccius paradoxus***) is increasingly present in Namibian catches and dominates in those carried out on the western South African coast.

Given their similarity, catch reports of shallow water Cape hake (***Merluccius capensis***) combine this species with deepwater Cape hake (***Merluccius paradoxus***). South African trawlers began fishing in the 1920s. In 1962, foreign fleets joined South African, Namibian and Angolan fisheries and caught both species. Catches showed a marked increase during 1964-1972, reaching a total of 1 100 000 tonnes in 1975, forcing in 1972 the International Commission for South Eastern Atlantic Fisheries (ICSEAF) to introduce fishery management measures. This increase was a result of the activity of the Soviet Union fleet (655 000 tonnes) and to a lesser extent the Spanish fleets (130 000 tonnes), South Africa (118 000 tonnes), Japan (54 700 tonnes), Cuba (48 000 tonnes), and other countries. After this maximum, the catch dropped to a minimum of nearly 300 000 tonnes in 1981. Catches recovered to about 500 000 tonnes around 1985 and decreased again to 200 000 tonnes before Namibian independence. Namibian and South African fleet catches showed a slow recovery begining from there on.

Resource management changed in 1977 with the declaration of a 200 mile EEZ for South Africa and its waters as well as for Namibia in 1990 after its independence. A large part of the fishing effort corresponding to foreign fleets was removed. While foreign fleet fishing was reduced drastically, TACs were introduced, which helped the recovery of resources at the end of the 1990s. The main reason for the delay in the resources responding to a reduction in fishing mortality was a result of anoxic conditions in 1993 and 1994, which led to very poor recruitment in hake populations.

Shallow water Cape hake is a high-quality product. It is marketed fresh, whole or in fillets, gutted and frozen in blocks, with or without skin. Most catches are exported to Europe, mainly to Spain.

Local Names: ANGOLA: Marmota, Pescada, Pescada do reino, Pescada branca do Cabo, Pescada do África do Sul, Pescada do Cabo; FINLAND: Kapinkummelilurska; FRANCE: Merlu blanc du cap, Merlu côtier du Cap, Merlu du Cap, Merluche; GERMANY: Kaphecht; ITALY: Nasello del capo; NAMIBIA: Hake, Stokvis, Vlakwater stokvis; NETHERLANDS: Zuidafrikaanseheek; POLAND: Morszczuk kapski; PORTUGAL: Marmota, Pescada, Pescada do reino, Pescada branca do Cabo, Pescada do África do Sul; SOUTH AFRICA: Cape hake, Shallow water hake, Stockfish, Vlakwater stokvis; SPAIN: Merluza del Cabo, Cabezudo, Carioca, Pijota, Pitillos (juveniles); UNITED KINGDOM: Cape hake, Shallow water Cape hake; UNITED STATES: Cape hake, Hake, Shallow water hake, South African whiting, Stockfish, Whiting.

Literature: Pappe (1854); Castelnau (1861); Hickling (1927); Belloc (1928); Marini (1933); Norman (1935); Poll (1953); Franca (1962); Maurin (1963 and 1965); Lozano Cabo (1965); Jones 1967); Jones and Van Eck (1967); Pshenichnyy and Assorov (1969); Van Eck (1969); Botha(1971); Quéro (1973); Macpherson (1980); Inada (1981b and c); Lloris (1981 and 1982); Bianchi (1986); Botha (1986); Cohen (1986); Lloris (1986); Olivar *et al.* (1988); Punt and Leslie (1991); Inada *in* Cohen *et al.* (1990); Maurin (1990); Bianchi *et al.* (1993); Roldán *et al.* (1999).

Merluccius gayi (Guichenot, 1848) **Fig. 28**

Merlus gayi Guichenot, 1848, *En: Gay, Hist. Fisica polit. Chil Zool.*, 2: 328 (type locality: Chilean coast).

Synonyms: ***Merluccius gayi***: Kaup, 1858, *Arch. Naturg.*, 24(1): 87 (bibliography). ***Merluccius gayi gayi***: Ginsburg, 1954, *Fish. Bull.*, 96(56): 202 (coast of Chile). ***Merluccius gayi peruanus*** Ginsburg, 1954, *Fish. Bull.*, 96(56): 202 (type locality: Paita and Callao, Peru).

FAO Names: En – South Pacific hake; **Fr** – Merlu du Pacifique sud; **Sp** – Merluza del Pacífico sur.

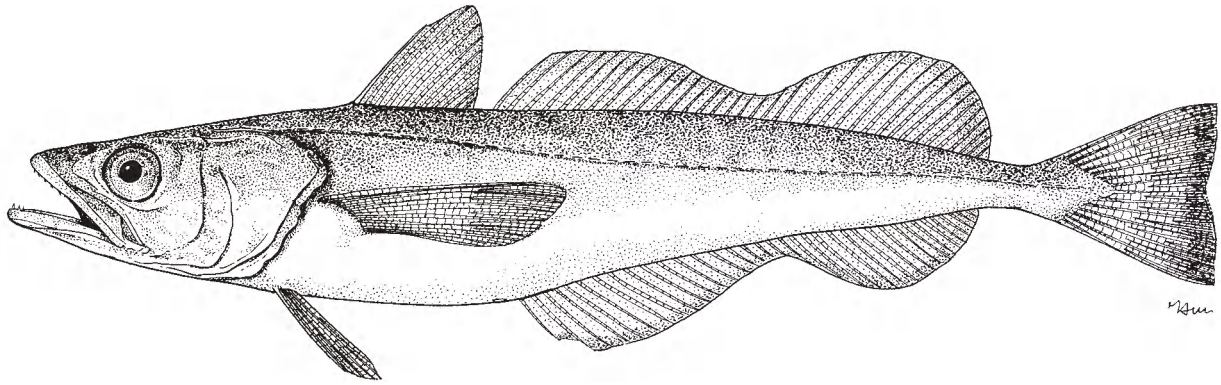


Fig. 28 ***Merluccius gayi***

Diagnostic Features: Scales along the lateral line 106 to 144. Head 26.0 to 33.5% of standard length, snout 29.3 to 34.1% of head length. No scales on nasal membrane, lacrimal, lower part of cheek, preopercular, and interopercular. Eye diameter 16.9 to 22% and interorbital width 24.3 to 28.3% of head length. Gillrakers on first branchial arch 17 (20-21) 25, 3 to 6 on the upper limb and 13 to 19 on the lower. 1D 10 (10) 13 rays; 2D 34 (38-39) 42 rays. Pectoral fins with 15 (16) 18 rays, length 19.0 to 23.5% of standard length, its tip always reaching beyond anal-fin origin. Ventral fins 12.3 to 15.5% of standard length. Posterior caudal-fin margin usually concave. Vertebrae 48 to 53, 5 or 6 of them cervical with 3 or 4 ribs. **Colour:** grey-black on upper part of the body especially head and fins; middle part of sides with a horizontal orange stripe, belly always whitish. Gillrakers and their base with small melanophores.

Additional Information: Ginsburg (1938, *in* Leibe, 1979) considered that two populations, represented by adequate samples, have subspecific value when one or more characters overlap by 15 to 25%. Based on this criteria, Ginsburg (1954) divided ***Merluccius gayi*** into 2 subspecies, ***M. gayi gayi*** and ***M. gayi peruanus***, living in Chilean and Peruvian waters, respectively. For there to be subspecific value, Mayr (1969) uses the 75% rule whereby a population is accepted as a valid subspecies if 75% of its individuals differ from all (= 97%) individuals of a previously valid subspecies. In ***M. gayi*** samples from Chile and Peru, Leibe (1979) proved that even in the number of anal-fin rays, the best diagnostic character between these 2 subspecies, only 60% of Chilean specimen differ from those of Peru. If we take into account that at least 1 300 km separate these populations, as well as being isolated for reproduction, they could be considered as different species, regardless of the overlapping meristic and morphometric characters. It is difficult to decide whether

they should be considered as subspecies or allopatric species. We follow the criterion of Mayr (1969), who recommends to consider the dubious allopatric populations as subspecies. Therefore, in theory, we accept with reservations the validity of the 2 subspecies, ***M. gayi gayi*** (Guichenot, 1848) and ***M. gayi peruanus*** (Ginsburg 1954), because if meristic characters (vertebrae, gillrakers and fin rays) are taken into account, ***M. gayi peruanus*** would resemble ***M. angustimanus*** more than ***M. gayi gayi***. This shows once more that such differences are due to clinal variations influenced by the environment. It is worth pointing out that there is a marked colour difference between the upper and lower part of the body, similar to that observed in species with pelagic behaviour; this is possibly related with the anoxic environment of its habitat.

Merluccius gayi gayi (Guichenot, 1848)
(Chilean population)

1D. 10 (10) 13; **2D**. 34 (39) 42; **A**. 35 (39) 42; **P**. 15 (16) 18; **V**. 7; **Gr**. 18 (21) 25; **L.L**. 108-144; **TV**. 49-53; **CV**. 6; **CC**. 4

Merluccius gayi peruanus Ginsburg, 1954
(Peruvian population)

1D. 10 (10) 13; **2D**. 36 (38) 40; **A**. 36 (38) 39; **P**. 15 (16) 18; **V**. 7; **Gr**. 17 (20) 23; **L.L**. 106-141; **TV**. 48-53; **CV**. 5; **CC**. 3

Geographical Distribution: Two populations present off the South American Pacific coast between Peru and Chile, with a 1 300 km separation. In the north of Peru ***Merluccius gayi peruanus*** is distributed between Puntas Parióas (4° 40'S) and Tambo de Mora (13° 56'S); the largest concentrations are found between 6° and 9°S. ***M. gayi gayi*** is distributed between Chañaral (26° 21'S) and the Chonos Archipelago (45° 10'S), although some samples were studied from further south (46° 22'S – 75° 27'W), largely concentrated between Coquimbo (29°S) and Arauco (47°S); to the south of 42°S, it shares part of its distribution area with ***M. polylepis*** Ginsburg, 1954 (Fig. 29).

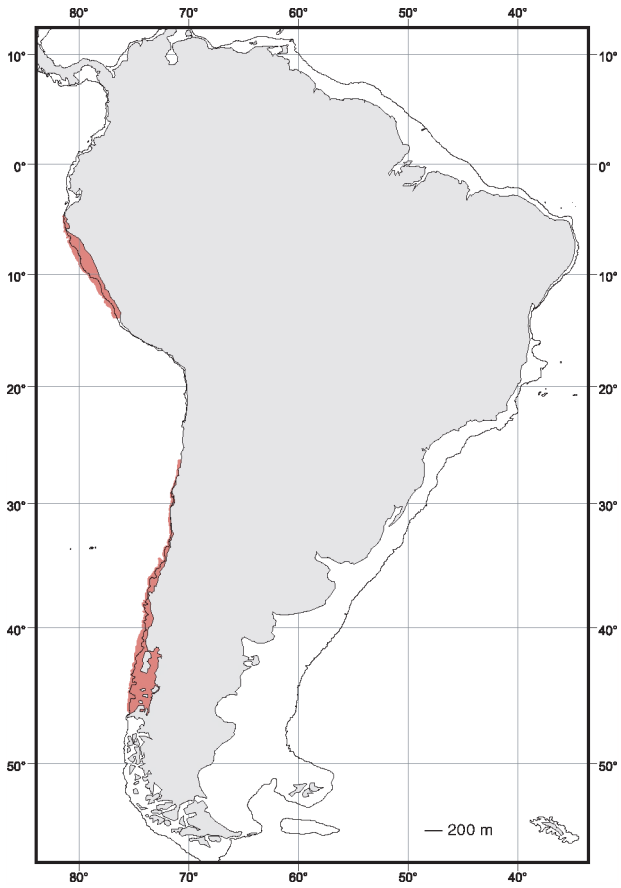


Fig. 29 ***Merluccius gayi***
Known distribution

Habitat and Biology: The South Pacific hake lives in the Chilean-Peruvian countercurrent (Günther Current) characterized by low oxygen level and temperatures of 6° to 12°C. The Chilean subspecies is largely concentrated between 35° and 36°S and between 38° and 41°S, forming dense groups near the bottom between dawn and dusk and dispersing during the night between 50 and 150 m depth. During the summer they are found between the 10 and 50 m isobaths; in autumn they migrate to depths of approximately 300 m at the boundary between the continental edge and the slope. In winter and spring they move towards the coast at around 170 to 190 m depth. Spawning occurs at the end of the winter and during the southern spring and constitutes the most important latitudinal migration towards the north; in summer/autumn it returns south where prey are more abundant. Diet is not very well known but is generally made up of crustaceans (Euphausiacea and others) and fish (*Clupea bentincki* and *Engraulis ringens*), including their own species. Male gonad development begins when a total length of 30 to 34 cm or 2 years of age is attained. In females this process takes place at 35 to 39 cm (3 years of age).The subspecies spawns throughout its distribution area as well as on the coast and 90 miles offshore, with two main areas: the most important between 32° 15'S and 34° 45'S, and the second between 35° 15'S and 37° 15'S. In central Chile sexual maturity in females is attained at 37.9 cm, with the main spawning period from August to November and the second between December and February of the following year; average batch fecundity is of 143.397 ± 16.905 ooctyes per female. Maximum age for males 9 years, and 12 for females.

The Peruvian subspecies' habitat is determined by the southern branch of the Cromwell Current, which flows from north to south between 100 and 500 m depth and is characterized by a high oxygen level and high temperature. The current's southern limit is between 12° and 14°S in summer/autumn and between 6° and 8° S in winter/spring; however, during the

El Niño Southern Oscillation (ENSO), the current can exceed 18°S. This subspecies can resist temperatures between 10° and 22°C and low oxygen concentration. There is a latitudinal distribution by size: in the largest concentration areas, average size is 40 cm and 4 years of age; large specimens are usually found south of 6°S and move south when they detect the ENSO. Basic diet of specimens under 30 cm consists of crustaceans, particularly Euphausiacea; larger specimens feed mostly on sardines (*Sardinops sagax sagax*) and other fish (*Ctenosciaena peruviana*, *Engraulis ringens*, *Anchoa nasus* and others); consumption of the Peruvian anchoveta (*E. ringens*) increases when hake move south, where the anchoveta is more abundant; specimens measuring 50 cm and over (5 years of age onwards) have cannibalistic habits, making up 30 percent of the species' natural mortality rate. Sexual maturity is attained at 27.3 cm in males and 29.9 cm in females; spawning is fragmented; fecundity in females between 40 and 70 cm in length ranges between 78 000 and 174 000 ooctyes per female. Spawning occurs all year round with a maximum during the southern winter (August/September) and another, less important, in summer.

Size: Maximum length: Chilean population 87 cm; Peruvian population 68 cm (males) and 115 cm (females). Common to 50 cm for both subspecies.

Interest to Fisheries: The South Pacific hake has been commercially exploited by Chilean fleets since 1940. Towards the mid-1950s, with the activity of European fleets, new technologies were introduced and a drastic drop in catch took place in 1969. Since then fishing has been carried out exclusively by local fleets with around 10 trawlers, some of them being rather large, and also a fleet of numerous artisanal longliners of less than 50 GRT.

In Peru, coastal trawler fleets as well as distant-water fleets of trawlers intensively exploited the local population of ***Merluccius gayi*** since 1970, exporting nearly all their catch. After this period of intense activity, a collapse in the fishery ensued in 1980, followed by a slight recovery before yet another decline in catch. After the last decline, exploitation was only carried out by local fleets.

Catches of ***Merluccius gayi*** reported to FAO are almost entirely caught by Chilean and Peruvian fleets operating along their respective coast, although at certain periods foreign fleets also exploited the resources. In the late 1970s the Cuban fleet captured between 30 000 and 40 000 tonnes; in 1973 the Soviet Union and in 1990 the Russian Federation fleets caught about 40 000 tonnes. Total maximum catch reported in 1978 amounted to over 380 000 tonnes, over 300 000 tonnes of which taken by Peru. The Peruvian catch has fluctuated since 1970, with annual catches ranging between the above-mentioned catch in 1978 and a minimum just over 5 000 tonnes in 1983. The Chilean catch has been steadier, in the range from 120 000 to 130 000 tonnes, with some peaks, as in 1978 and 2001, and the annual catch in the 1970s and 1980s ranged from 25 000 to 30 000 tonnes.

South Pacific hake is preferably marketed frozen, although in the past it has also been used for fishmeal when it was caught in the pelagic fisheries.

Local Names: CHILE: Maltona, Merluza, Merluza común, Pescada; DENMARK: Kulmule; FINLAND: Perunkummelituska; FRANCE: Merlu du Chili, Merlu du Pacifique sud; GERMANY: Chilenischer Seehecht, Seehecht; GREECE: Bakaliáros; ICELAND: Lysingur; ITALY: Nasello dei Chile; JAPAN: Chiri-heiku; NETHERLANDS: Chileense heek; PERU: Huaycuya, Merlango, Merluza, Peje-palo, Pescada, Pescadilla; POLAND: Morszczuk chilijski; PORTUGAL: Pescada chilena, Pescada do Chile; SPAIN: Merluza, Merluza chilena, Merluza común chilena, Peje palo, Pescada; UNITED KINGDOM: Chilean hake, Pacific hake, Silver hake, South Pacific hake; UNITED STATES: Chilean hake, Chilean whiting, English hake, Hake, Peruvian hake, Peruvian whiting, Whiting; YUGOSLAVIA: Oslic.

Literature: Guichenot (1848); Kaup (1858); Günther (1860); Cunningham (1871); Fowler (1945); Ginsburg (1954); Poulsen (1957); de Buen (1958); López 1963); Del Solar (1965); Mayr (1969); Arana (1970); Martínez and Leible (1974a and 1974b); Boerema (1977); Leible (1979); Inada (1981b and c); Inada *in* Cohen *et al.* (1990); Alarcón and Arancibia (1993); Espino, Castillo and Fernández (1995).

Merluccius hubbsi Marini, 1933 — **Fig. 30**

Merluccius hubbsi Marini, 1933, *Rev. Physis*, 11: 322 (type locality: province of Buenos Aires, Patagonian coast).

Synonyms: ***Meluccius gayi*** (*non* Guichenot, 1848): Cunningham, 1971, *Trans. Linn. Soc. Londo*n, 27: 472 (eastern entrance of the Strait of Magellan). ***Merluccius bilinearis*** (*non* Mitchell, 1814): Miranda Ribeiro, 1915, *Arch. Mus. Nac.*: 1-2, Fig. , (from North America to Río de Janeiro). ***Merluccius gayi hubbsi***: Mann, 1954, *Invest. Zool. Chil.*, 2(5): 83 (Patagonia). ***Merluccius merluccius hubbsi***: Angelescu *et al.*, 1958, *Sec. Mar., Buenos Aires*: 164 (biology and taxonomy).

FAO Names: En – Argentine hake; **Fr** – Merlu d'Argentine; **Sp** – Merluza argentina.

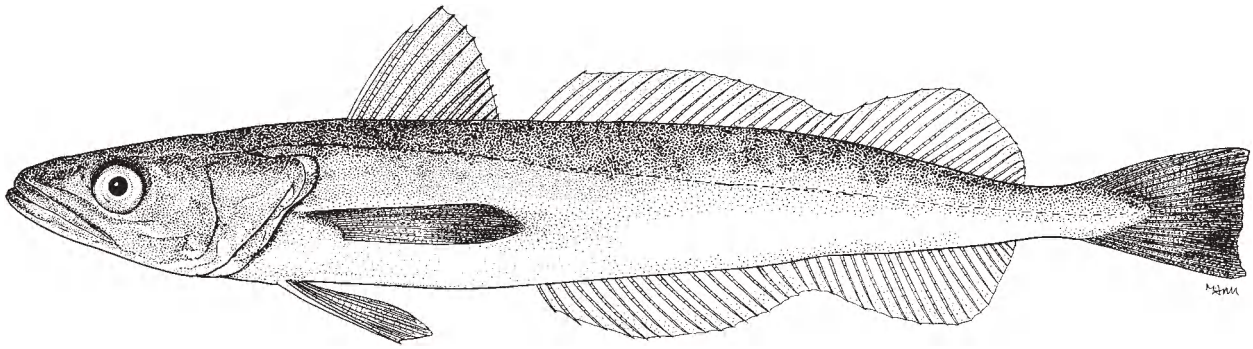


Fig. 30 ***Merluccius hubbsi***

Diagnostic Features: Scales along lateral line 133 to 144. Head 24.4 to 28.0% of standard length. Snout 31.0 to 35.1%, eye diameter 16.8 to 22.5%, and interorbital 24.0 to 28.2% of head length. No scales on nasal membrane, lacrimal, and lower part of interopercular; scales on lower part of cheek and preopercular. Lower jaw very slightly prominent. Gillrakers on first branchial arch 12 (13-14) 15, 2 to 4 on the upper arm and 10 or 11 on the lower. 1D 10 (12) 12 rays; 2D 36 (38) 38 rays; A 38 38-(39) 41 rays. Pectoral fins with 14 (15) 15 rays, length 15.1 to 21.2% of standard length; pectoral-fin rays do not normally reach the anal-fin origin. Ventral fins 11.3 to 16.1% of standard length. Posterior margin of caudal fin usually truncate in adults, sometimes convex in juveniles. Vertebrae 50 to 53, 5 or 6 of them cervical with 3 or 4 ribs. **Colour:** greyish on dorsal region and silvery white on belly.

Additional Information: According to Inada (1981b), ***M. hubbsi*** has 3 or 4 cervical ribs although on page 91, Fig. 42 only 3 are indicated. The material examined by Inada (page 49, Table 15) comes from an area situated south of parallel 43°S and west of 59°W, where according to our data, ***Merluccius patagonicus*** are also present.

Geographical Distribution: Southwestern Atlantic, from parallel 21°30'S to 49°S. To the south and east of the Argentinian coast, ***M. hubbsi*** overlaps with ***M. patagonicus***, and to a lesser extent, with ***M. australis polylepis*** near Beagle Channel and the eastern coast of Tierra del Fuego. Two of the specimens studied (**MNHN** 1999-0376 and **MNHN** 1999-0377) were caught between 262 and 248 m off Rio de Janeiro (21°35'S – 40°06.16'W). Seret and Andreata (1992) note that another specimen caught at 785 and 750 m depth (21°31.42'S – 40°06.83'W) was assigned to this species, establishing the northernmost record of ***M. hubbsi*** (Fig. 31)

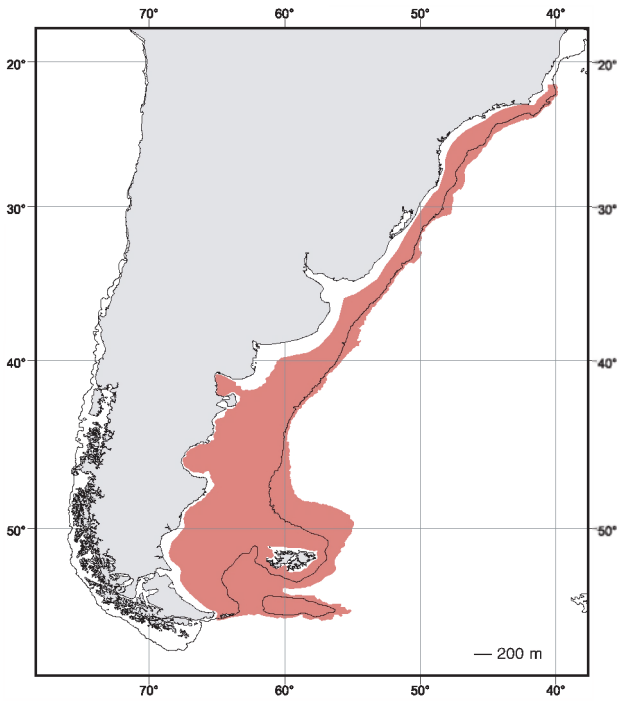


Fig. 31 ***Merluccius hubbsi***
Known distribution

Habitat and Biology: Argentine hake undertakes migrations associated with high-production oceanic fronts in the area betweeen 34° and 44°S; it migrates north from the continental shelf to deeper waters in summer/autumn and returns at the beginning of spring. Larvae feed almost entirely on copepods; larger fish feed mainly on Argentinian squid (*Illex argentinus*), small anchovy, Myctophidae (*Gymnoscopelus* spp., *Myctophum* spp. and *Lampanyctus* spp.), as well as fish of their own species. The species carries out daily vertical migrations in relation to feeding. In the common Argentinian-Uruguayan fishing area, first sexual maturity is reached at 34 cm in females and 30 to 39 cm in males; in the Isla Escondida area, sizes are 30 cm for females and 39 cm for males. Spawning occurs partially and successively at various times and in different areas, which leads us to believe the existence of various reproductive groups, although it is unknown to what degree they mix. Egg laying takes place in different areas all year long, mainly concentrating in the south (42°S and 44°S) during the summer and to the north of 39°S in autumn and winter. Isla Escondida is another main springtime spawning area.

Biological data referenced to Argentinian or "bonaerense" hake should be dealt with cautiously, so as not to confuse it with ***M. patagonicus***, and to a lesser extent, with ***M. australis polylepis***.

Size: Maximum recorded length is 95 cm; males common to 50 cm, females to 60 cm.

Interest to Fisheries: Demersal resources, and in particular hake, constitute the main fishery production of the South American Atlantic coast. Argentine hake (***Merluccius hubbsi***) is the principal target fishery in the Rio de La Plata area as well as on the Patagonian Shelf; despite the decrease in recorded catches in the last few years, it remains the main species in terms of landing. It is worth mentioning, however, that catches of southern hake (***Merluccius australis***) have probably been recorded as Argentine hake.

Argentine hake is an important constituent in the fisheries of Argentina and Uruguay. Argentinian trawlers began fishing in 1950 and continued to develop during the 1960s, with the addition of Uruguayan trawlers and foreign fleets. In the mid-1970s, following the creation of joint Spanish-Argentinian companies new technologies were introduced and the Spanish market started to develop. This resulted in a notable increase in production where the Argentinian fleet catches dominated. Fishing continued to develop to the end of the 1990s, reaching 680 000 tonnes in 1997; thereafter, catches declined drastically to less than 300 000 tonnes in 2000 and 2001.

This species, along with southern hake (***Merluccius australis***), has been caught in the Falkland Islands since 1970, where a fishing protection area was set up in 1986 and extended in 1990 in order to avoid overexploitation of resources. Argentine hake is marketed fresh in Argentina and Uruguay, and is exported frozen whole and gutted or in fillets primarily to the European Union and the United States.

Local Names: ARGENTINA: Merluza argentina, Merluza bonaerense, Merluza común; JAPAN: Aruzenchin-heiku; SPAIN: Merluza, Merluza Argentina, Merluza hubbsi; UNITED KINGDOM: Argentine hake.

Literature: Angelescu *et al.* (1958); Miranda Ribeiro (1903 and 1915); Fowler (1945); Ginsburg (1954); Rojo (1976); Inada (1981); Menni *et al.* (1984); Inada et al. (1986); Podestá (1989); Inada *in* Cohen *et al.* (1990); Séret and Andreatta (1992); Ehrlich and Ciechomski (1995); Ruíz and Fondacaro (1997); Cousseau and Perrotta (1998).

Merluccius merluccius (Linnaeus, 1758) **Fig. 32**

Gadus merluccius Linnaeus, 1758, *Syst. Nat.*, ed. X: 254 (type locality: 'Habitat in Oceano').

Synonyms: ***Gadus ruber*** Lacépède, 1803, *Hist. Nat. Poiss.*, 5: 671, & 673 (Scotland, Fécamp, Dieppe, Boulogne). ***Merluccius smiridus*** Rafinesque, 1810, *Caratt. Gen. Spec. Sicil.*: 25 (Sicily). ***Onus riali*** Rafinesque, 1810, *Ind. Ittiol. Sicil.*: 12 (Sicily). ***Merluccius esculentus*** Risso, 1826, *Hist. Nat. Eur. Mérid.*, 3: 220 (Nice). ***Merluccius vulgaris*** Fleming, 1828, *Hist. Brit. Anim.*: 195 (southeastern coast of England and Ireland). ***Hidronus marlucius*** Minding, 1832, *Naturg. Fische*: 84 (North Sea, Mediterranean). ***Merlucius sinuatus*** Swainson, 1838, *Nat. Hist. Fishes*, 1: 319, Fig. 73 (Mediterranean). ***Merlucius ambiguus*** Lowe, 1840, Proc. Zool. Soc. London, 8: 37 (Madeira). ***Merlucius lanatus*** Gronow, 1854, ed. Gray, *Cat. Fish.*: 130 (Mari Gallico, Mediterranean). ***Merluccius argentatus*** Günther, 1862, *Cat. Fish., Brit. Mus.*, 4: 346 (Iceland). ***Merluccius linnei*** Malm, 1877, *Göteb. Bohsul. Fauna*: 489 (Göteborg, Vinga). ***Onus guttatus*** Collet, 1890, *Bull. Soc. Zool. Fr.*, 15: 105 (Fayal, Azores). ***Trachinoides maroccanus*** Borodin, 1934, *Bull. Vanderbilt mar. Mus.*, 1(4): 120 (Casablanca).

FAO Names: En – European hake; **Fr** – Merlu européen; **Sp** – Merluza europea.

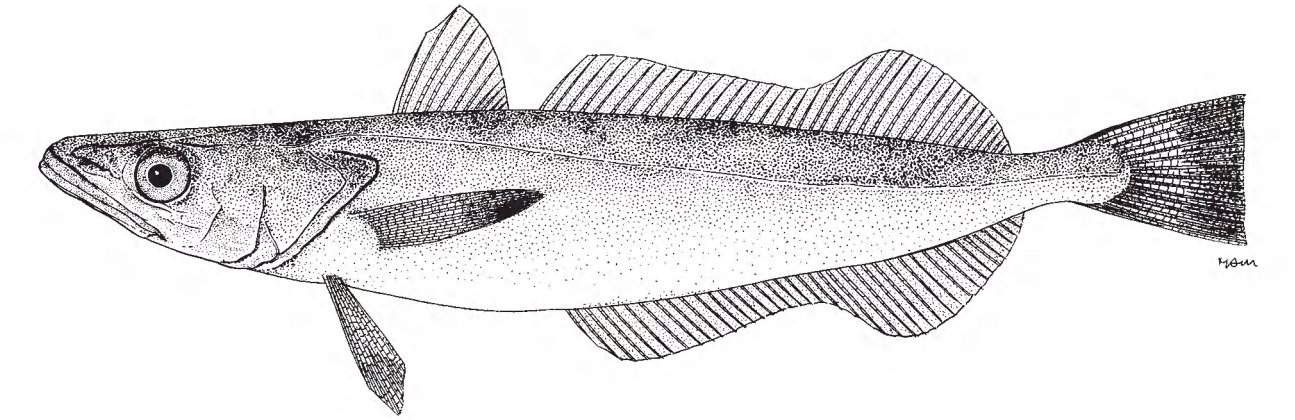


Fig. 32 ***Merluccius merluccius***

Diagnostic Features: Scales along lateral line 127 to 156. Head 25.1 to 30.5% of standard length. Snout 30.2 to 34.5% of head length, eye diameter 16.0 to 21.0%, and interorbital 21.5 to 28.4%. Scales on nasal membrane, lacrimal, lower part of cheek, and preopercular; no scales on lower part of interopercular. Gillrakers on first branchial arch 8 (10) 12, 1 to 3 on upper arm and 7 to 9 on the lower. 1D 8 (10) 11 rays; 2D 35 (38-39) 40 rays; A 36 (38) 40 rays. Pectoral fins with 10 (14) 15 rays, length 14.1 to 18.7% of standard length, tips of pectoral fins reaching to level of anal-fin origin in small fish (less than 20 cm standard length). Ventral fins 14.0 to 19.1% standard length. Posterior caudal-fin margin usually truncate, becoming progressively concave with growth. Vertebrae 49 (51-52) 54, 5 or 6 being cervical with 3 or 4 ribs. **Colour:** dark silvery grey on back, lighter on the sides, white on belly; rainbow-hued on some specimen. No submandibular mark.

Additional Information: Part of the material used by Inada (1981b), attributed to the trinomen ***Merluccius merluccius smiridus*** (set out in Table 2, page 10), correspond to nine specimens from a Tunis (Mediterranean) market. The other part (USNM 219331, 219332 and 219333) originated from the Atlantic, as the longitudes and latitudes indicated correspond to a series of geographical points west of San Vicente Cape (Portugal).

Maybe this is the reason why the entity labelled by the trinomen ***Merluccius merluccius smiridus*** Rafinesque, 1810 possesses characters specific to both Atlantic and Mediterranean subspecies.

Two, possibly three, subspecies can be distinguished in the western Mediterranean:

Merluccius merluccius merluccius (Linnaeus, 1758)
(European Atlantic, Bay of Biscay, Portugal, north of Morocco and southwestern Mediterranean)

Pectoral fins larger than ventral fins

1D. 9 (10) 11; **2D**. 35 (38-39) 40; A. 36 (38) 40; **P**. 10 (14) 15; **V**. 7; **Gr**. 8 (10) 12; **L.L.** 127-156; **TV**. 49 (51-52) 52; **CV**. 6; **CC**. 4

Merluccius merluccius smiridus Rafinesque, 1810
(northwestern Mediterranean)

Pectoral and ventral fins of equal size

1D. 8 (10) 11; **2D**. 35 (38-39) 40; **A**. 36 (38) 40; **P**. 10 (14) 15; **V**. 7; **Gr**. 8 (10) 12; **L.L.** 133-143; **TV**. 49 (51-52)-54; **CV**. 6; **CC**. 4

One of the specimens examined (**MNHN** 1966-0435) coming from the Red Sea (20°00'N – 39° 00'E), is the first record of ***Merluccius*** in this sea; thus it would be antilessepsian. The trinomen ***Merluccius merluccius lessepsianus*** is therefore proposed here, despite there being only one specimen, as it is the only one with pectoral fins smaller than the ventral fins.

Geographical Distribution: Eastern Atlantic, from the coast of Norway and Iceland to the Mauritanean coast (Cape Blanc, 21°N), where it is quite rare. There are 3 specimens (**MNHN** 1956 0019) from the Azores in the Muséum National d'Histoire Naturelle de Paris, which we have not examined. The species shares its distribution area along the coast of Morocco with ***M. senegalensis*** (Fig. 33).

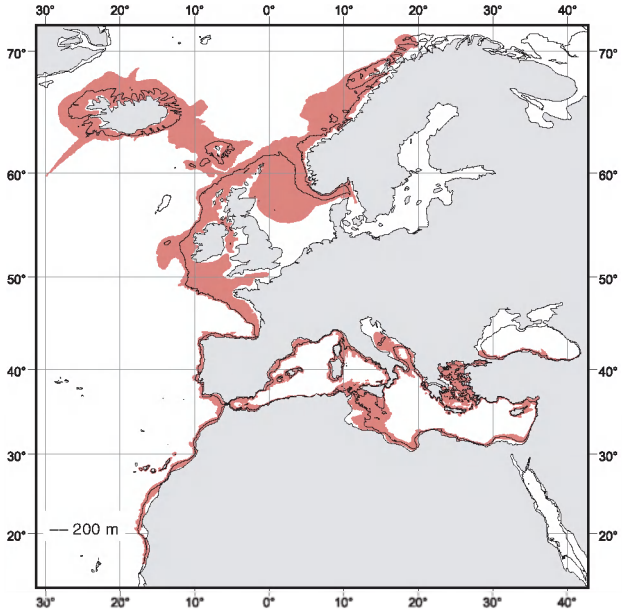


Fig. 33 ***Merluccius merluccius***
Known distribution

Habitat and Biology: A demersal and benthopelagic species. Lives on muddy or mud-sand grounds on the continental shelf and slope, in depths between 50 and 370 m, although it can also be found in depths of 30 m as well as 1 075 m. In the north and northeast of the Iberian Peninsula (Galicia and Bay of Biscay), ***M. merluccius*** feeds on crustaceans and fish. Specimens smaller than 15 cm feed mainly on euphausiacids, which are present in 85% of stomachs. Larger specimens gradually feed more on fish, mainly blue whiting (*Micromesistius poutassou*), which are present in all stomachs of specimen more than 50 cm in length. In the Mediterranean and especially in the Adriatic, juveniles of 13-cm length consume mainly Amphipoda, Mysidae, *Pomatoschistus*, and decapods of the genus *Processa*; adults feed mainly on clupeiforms. In Atlantic

populations, age/size relation to sexual maturity is 57 cm and seven years for females, 40 cm and five years for males. In the Mediterranean females reach maturity at 36 to 40 cm and males at 26 to 27 cm. The spawning period is long and varies according to population; four or five spawnings occur without an ovary resting period, with approximately 20% of the ooctyes per emission. Small ooctyes remain after the last emission and degenerate when the ovary enters the resting period. In the Mediterranean, spawning fluctuates between December and June; from February to May in the Bay of Biscay; from April to July in Iceland; and from May to August to the west of the British Isles. In the western Mediterranean, there are two recruitments per year, in the spring and in autumn at between 50 and 250 m depths, with relatively stable oceanographic conditions. Fecundity is estimated at between 2 and 7 million ooctyes per female.

Size: Maximum recorded length in the Atlantic is 140 cm and 15 kg, rarely exceeds 100 cm and 10 kg; minimum size in Mediterranean 89 cm and 6 kg, common up to 60 cm.

Interest to Fisheries: European hake has been a traditionally important food for the population of western Europe. It is primarily caught with trawls but also with longlines, both techniques being the most commonly used for this species. Also used are bottom-set gillnets and Danish seines. European hake is a target species for many European fisheries, as well as an important component of multispecific fisheries carried out by all coastal countries, from North Africa to Iceland, with the main fisheries in northern and western Scotland, west and southern Ireland, Bay of Biscay, and the coasts of Spain, Portugal and Morocco.

European northern Atlantic populations are generally exploited by fleets with large-sized vessels, allowing them to reach distant fishing grounds situated on the continental margin and depths of over 200 m. Ships exploiting southern European populations are usually smaller and operate on the narrow continental shelf and return to the harbour daily.

On western African fishing grounds, from the Strait of Gibraltar to Senegal, large foreign fleets have traditionally operated together with fleets of coastal countries. At the beginning of the twentieth century, Spanish sailing trawlers along with artisanal gillnetters and longliners caught hake in these fishing grounds. After 1910, these fleets became more numerous and motorized. Later, Portuguese, Soviet Union and Polish fleets joined the fisheries. Hake is caught as target species and as a bycatch of other trawl fisheries targeting cephalopods and shrimp, as well as by gillnets. Before the EEZ declaration in the 1970s, catch regulations were rather loose and fishing was generally operated through bilateral agreements. After the EEZ declaration, foreign fleet restrictions were slowly introduced, and by 2000, European fleets no longer operated in Moroccan fishing grounds. In Morocco hake is caught by traditional trawlers and multipurpose vessels using trawls, purse seiners and longlines, which in the last few decades, developed at the same time that foreign fleets decreased during the period 1981-1983.

In the Mediterranean, hake is mainly caught with trawls, and to a lesser extent, with longlines and gillnets; in this multispecific trawl fishery, hake is one of the target species.

Since 1950 in the northeast Atlantic, catches have been dominated by Spanish, French, and Portuguese fleets. In the Mediterranean catches are made by Euopean Union countries. In the eastern central Atlantic up until 2 000, most catches were made by Spanish and Moroccan fleets. The largest catches come from the northeast Atlantic, where catches registered a maximum of 160 000 tonnes before a steady decline, reaching under 40 000 tonnes in 2001. Catches in the Mediterranean and Black Sea progressively increased, reaching around 50 000 tonnes in 1985, and then dropped by half ten years later. After various years of annual catches totalling between 10 000 and 14 000 tonnes, eastern central Atlantic catches have decreased, recording a recent drop to 5 000 tonnes.

European hake, for its quality, is almost entirely marketed fresh, whole or filleted, to specialized restaurants or retail markets.

Local Names: DENMARK: Kulmule; FINLAND: Kummeli; FRANCE: Brochet de mer, Merlu, Merluche, Merluchón; GERMANY: Hechtdorsch, Seehecht; ICELAND: Lysingur; NETHERLANDS: Stockvisch heek; NORWAY: Lysing; POLAND: Morszczuk; PORTUGAL: Marmota, Pescada, Pescadinha; SPAIN: Carioca, Merluza, Pescada, Pescadilla; SWEDEN: Kummel; UNITED KINGDOM: Hake.

Literature: Linnaeus (1758); Lacépède (1803); Rafinesque (1810); Risso (1826); Fleming (1828); Minding (1832); Swainson (1838); Lowe (1840); Gronow (1854); Pappe (1854); Günther (1862); Malm (1877); Vaillant (1888); Marini (1933); Borodin (1934); Hart (1948); Cadenat (1950); Maurin (1952); Maurin (1954a and b); Franca (1952); Letaconnoux (1953); Franca (1956a and b); Angelescu *et al.* (1958); Doutre (1960); Lozano Cabo (1960); Franca (1962); Lozano Cabo (1965); Maurin (1965 and 1968); Larrañeta (1970); Froglia (1973); Inada (1981b); Sarano (1984); González *et al.* (1985); Orsi Relini *et al.* (1989); Inada *in* Cohen *et al.* (1990); Casey and Pereiro (1995); Ramos and Fernández (1995); Recasens *et al.* (1998).

Merluccius paradoxus Franca, 1960 — Fig. 34

Merluccius capensis paradoxus Franca, 1960, *Mem. Junta Invest. Ultram.*, 2nd ser., 18: 57-101 (Southwest Afr., 27° 37'S-29° 51.7'S).

Synonyms: *Merluccius capensis* (*non* Castelnau, 1861): Franca, 1956: 49-68 (Southwest Afr.). *Merluccius merluccius paradoxus*: Franca, 1962: 7-48 (taxonomy). *Merlucius merlucius paradoxus*: Franca, 1971: 1-18 (Kunene). *Merlucius paradoxus*: Quéro, 1973: 117-123 (from Cape Frío to Port Elizabeth).

FAO Names: En – Deepwater Cape hake; **Fr** – Merlu du large du Cap; **Sp** – Merluza de altura del Cabo.

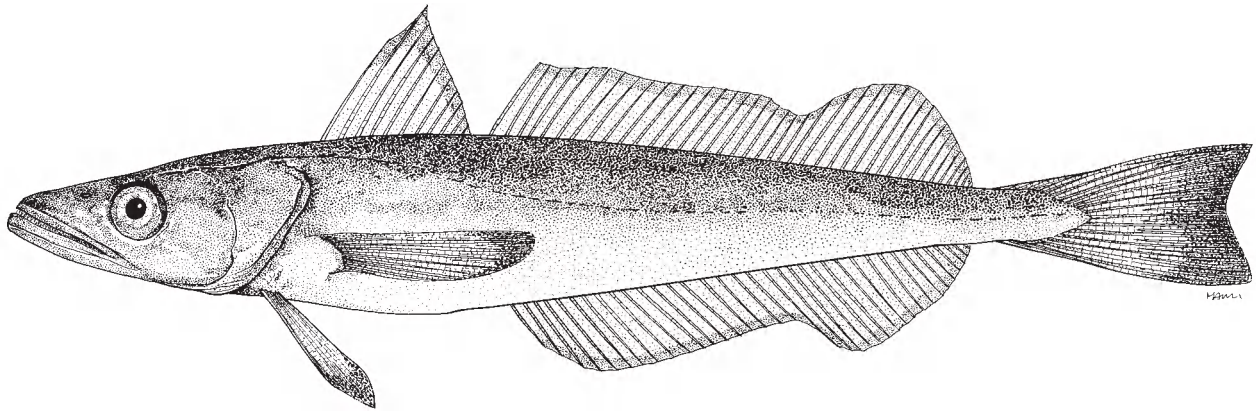


Fig. 34 *Merluccius paradoxus*

Diagnostic Features: Scales along the lateral line 121 to 143. Head 26.0 to 28.6% of standard length. Snout 30.6 to 35.3%, eye diameter 18.7 to 21.4%, and interorbital 22.5 to 28.0% of head length. Scales on nasal membrane, lacrimal, lower part of cheek, preopercular, and interopercular. Lower jaw slightly protruding with small teeth as on premaxilliary. Gillrakers on first branchial arch 17 (19-20) 23, 4 to 7 on the upper arm and 13 to 18 on the lower. 1D 9 (11) 12 rays; 2D 37 (40) 42 rays; A 38 (39-41) 42 rays. Pectoral fins with 14 (15) 16 rays, length 19.1 to 23.6% of standard length; tips always reaching beyond the origin of anal fin. Posterior margin of caudal fin slightly convex. Vertebrae 54 (56) 58, 6 of which are cervical with 4 ribs. **Colour:** dark grey on dorsum, lighter on sides; light grey on belly. Black mark on submandibular, of varing size and form. Melanophores on gillrakers and their base. Mouth cavity and tongue greyish.

Additional Information: *Merluccius* species presenting the largest scaled areas on head. The dorsal and lateral parts of the head completely covered with scales, as well as the membrane of the front tip of the snout, under which slides the ascending process of the premaxillaries. Only a small part of the head situated between the posterior nasal orifice and orbit is without scales. Lacrimal, cheek, preopercular, subopercular, and interopercular completely covered by scales. Scales on *M. polli* are very similar to *M. paradoxus* except on the front tip of the snout, which lacks them. Despite sharing a large distribution area, it differs from *M. capensis* in having scales on the lacrimal, preopercular, and interopercular, and in having a submandibular mark.

Geographical Distribution: Eastern Atlantic, from Cape Frio (18°S) to the south of Agulhas Bank in the Indian Ocean, to East London; also recorded on the Madagascar Ridge (33°S-44°E). One of the specimens examined (**MNHN** 1988 1410), 41.5 cm total length and 36.6 cm standard length, was caught at 605 m depth southwest of Madagascar (22° 17'S-43° 03'E), a first recording in this locality (Fig. 35).

Habitat and Biology: Demersal species living in muddy depths on the continental shelf and slope at 200 to 850 m depths, although most commonly found below 400 m. Feeds mainly on fish, crustaceans (Mysidacea, Euphausiacea), and cephalopods (squids); juveniles feed mostly on Euphausiacea. Reproduction is not very well known, but probably takes place between September and November.

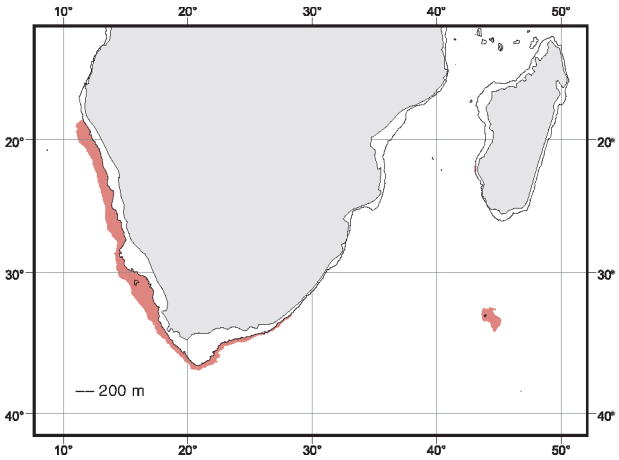


Fig. 35 *Merluccius paradoxus*
Known distribution

Size: Maximum recorded length, 82 cm (females) and 53 cm (males); commonly 40 to 60 cm.

Interest ot Fisheries: See ***Merluccius capensis***.

Local Names: ANGOLA: Marmota, Pescada; DENMARK: Kulmule; FRANCE: Merlu du large du Cap, Merlu profond; GERMANY: Seehecht; NAMIBIA: Diepwater stokvis, Hake, Stokvis; POLAND: Morszczuk atlantycki; PORTUGAL: Marmota, Pescada, Pescada do sudoeste africano; SOUTH AFRICA: Deepwater hake, Diepwater stokvis; SPAIN: Merluza de altura del Cabo, Merluza de cantil; UNITED KINGDOM: Deep water hake, Deep-water Cape hake.

Literature: Pappe (1854); Franca (1962); Lozano Cabo (1965); Inada (1981b); Franca (1971); Lloris (1981 and 1982); Bianchi (1986); Lloris (1986); Inada *in* Cohen *et al.* (1990); Bianchi *et al.* (1999).

Merluccius patagonicus Lloris and Matallanas, 2003 **Fig. 36**

Synonyms: Very probably mixed up with ***Merluccius hubbsi*** Marini, 1933 and also perhaps with ***M. australis*** (Hutton, 1872).

FAO Names: En – Patagonian hake; **Fr** – Merlu de Patagonie; **Sp** – Merluza patagónica.

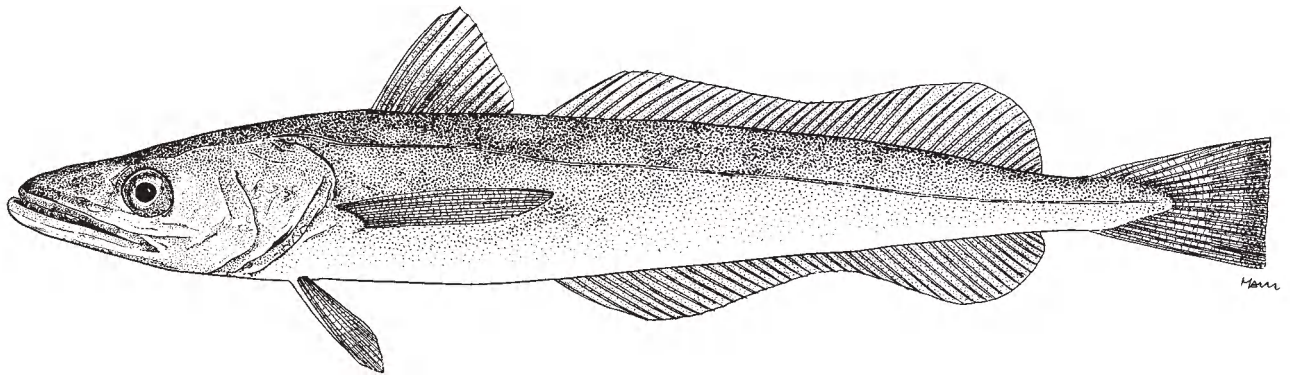


Fig. 36 ***Merluccius patagonicus***

Diagnostic Features: Scales along the lateral line123 to 126. Head 26.8 to 28.8% of standard length (28.8% on the holotype); snout 30.6 to 33.3% of head length (33.3% on the holotype). No scales on nasal membrane, lacrimal, and lower part of interopercular; scales on lower part of cheek and preopercular. Eye diameter 17.9% of head length on the holotype (14.1 to 20.2% on the paratypes) and interorbital 24.7% on the holotype (21.1 to 26.7% on the paratypes). Lower jaw protruding, with large visible teeth as on the premaxillaries. First branchial arch of the holotype with 14 gillrakers (14, 15 and 17 on paratypes): 3 or 4 on the upper part and 9 to 13 on the lower. 1D 11 rays on the holotype and 10 (11) 13 on the paratypes; 2D 38 rays on holotype (36 to 38 on paratypes); A 39 rays on holotype (37 to 38 on paratypes). Pectoral fins with 14 or 15 rays; length 15.6% of standard length on the holotype (15.2 to 16.8% on paratypes); in males and small specimens, fins reach origin of anal fin, but not on adult females. Ventral fins 11.7% of standard length on the holotype (10.7 to 13.0% on paratypes). Posterior margin of caudal fin truncate or slightly convex. **Colour:** brownish grey, darker on dorsum, light on sides, whitish on belly. Small melanophores on gillrakers and their base.

Additional Information: For this study, 160 specimens were captured between 45° and 49°S in the Argentinian Sea. The majority corresponded to the typical ***Merluccius hubbsi*** pattern. Five of them, caught at 95 m depth (45° 30'S – 65° 30'W), however, possessed clear differential characters. All of them with a free opercular edge separation diverging away from lateral line; otolith, hyomandibular, and urohyal differ from those of ***M. hubbsi*** and ***M. australis*** (Plates: VIII and IX, X, XI, XII – Fig. J), also differentiated by meristic character range (second dorsal and anal rays, and lateral line).

The specimen considered as a holotype (measuring 61 cm total length and 56.2 cm standard length) is kept at the Instituto de Ciencias del Mar (CMIMA-CSIC) in Barcelona, catalogue number **IIPB** 500/2001. **IIPB** 501, 502, and 504/2001 are considered paratypes; measurements, hyomandibular, and urohyal of the fifth specimen only have been retained.

Etymology: The name ***Merluccius patagonicus*** is derived from the marine goegraphical region from where the species comes (Patagonia Argentina)

Geographical Distribution: Latitude near Comodoro Rivadavia on the Argentinian Atlantic coast, 95 m deep.

Habitat and Biology: Unknown.

Size: Maximum length on specimen studied 77 cm (female) total length and 71 cm standard length; the smaller specimens 29.7 cm total length and 27 standard length.

Interest to Fisheries: Unknown up until now for having been mixed up with ***M. hubbsi*** and/or ***M. australis***.

Local Names: None.

Literature: Lloris and Matallanas (2003).

Merluccius polli Cadenat, 1950 **Fig. 37**

Merluccius polli Cadenat, 1950, *Cong. Pêche pêcher. Un. Franç. d'outre Mer.*, 129 (type locality: near Congo River mouth, 6°S).

Synonyms: ***Merluccius cadenati*** Doutre, 1960, *Rev. Trav. Inst. scient. Tech. Pêche*, 24(4): 517 (from Cape Blanc to Cape Roxo). ***Merluccius merluccius polli***: Franca, 1962, *Mem. Junta Invest. Ultram.*, 2(36): 25 (taxonomy). ***Merluccius merluccius cadenati***: Franca, 1962, *Mem. Junta Invest. Ultram.*, 2(36): 25 (taxonomy). ***Merlucius merluccius polli***: Lozano Cabo, 1965, *Publ. Téc. Junta Estud. Pesca*, 4: 20 (from Port Gentil to Benguela). ***Merlucius merluccius cadenati***: Lozano Cabo, 1965, *Publ. Téc. Junta Estud. Pesca*, 4: 18 (from Cape Blanc to Cape Roxo).

FAO Names: En – Benguela hake; **Fr** – Merlu d'Afrique tropicale; **Sp** – Merluza de Benguela.

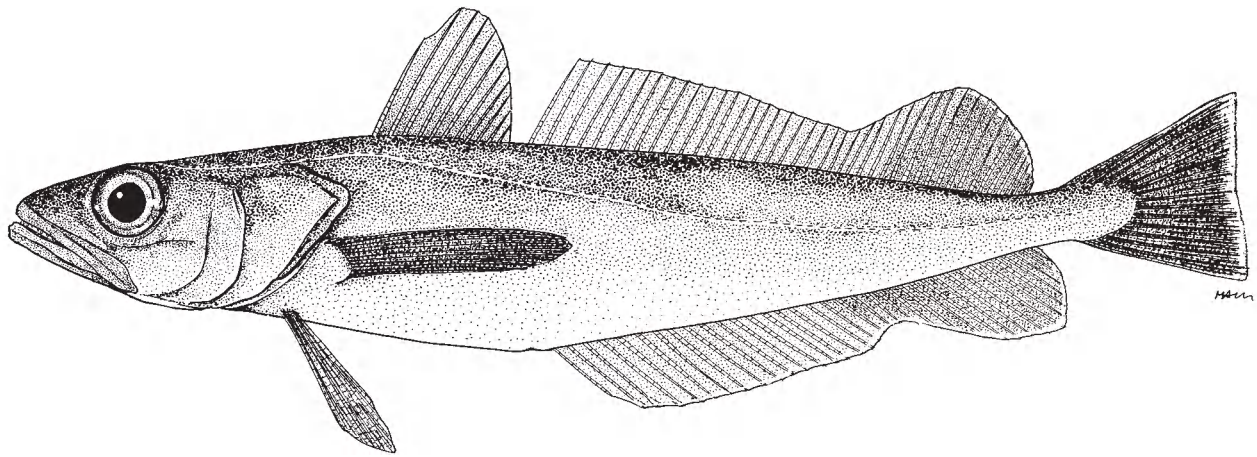


Fig. 37 ***Merluccius polli***

Diagnostic Features: Scales along the lateral line 98 to 127. Head length 24.8 to 29.1% of standard length. Snout 30.2 to 35.9% of head length. Scales on nasal membrane, lacrimal, lower part of cheek, preopercular, and interopercular. Eye diameter 16.4 to 21.8%, interorbital 24.1 to 28.0% of head length. Head large, lower jaw very slightly or not prominent. Teeth small on lower jaw and premaxillaries. Gillrakers on first branchial arch 8 (10) 12: 1 to 3 on upper part and 7 to 9 on the lower. 1D 7 (11) 12; 2D 36 (38-39) 41; A 36 (38) 42. Pectoral fins with 14 (15) 17 rays, length 17.7 to 21.8% of standard length and reaching origin of anal fin. Ventral fins 13.0 to 16.7% of standard length. Posterior margin of caudal fin generally truncate, but sometimes concave. Vertebrae 52 (54-56) 57, 5 cervical with 3 ribs. **Colour:** generally blackish, darker on dorsum; caudal fin white-edged. Mouth cavity and tongue blackish. Black continuous mark on submandibular fold.

Additional Information: Seeing that differences were found between ***Merluccius polli*** Cadenat, 1950 and ***M. cadenati*** Doutre, 1960 in the otolith (*sagitta*), hyomandibular, urohyal, and certain meristic values, as well as a 500 km gap between the two geographic distributions (from Liberia, 05° 07'N, to Port Gentil, 0° 15'S), two subspecies have been proposed:

Merluccius polli polli Cadenat, 1950
(from Port Gentil, Angola to the north of Namibia)

1D. 10 (11) 12; **2D**. 36 (38) 41; **A**. 36 (38) 42; **P**. 14 (15) 17; **V**. 7; **Gr**. 8 (10) 11; **L.L.** 98-127; **TV**. 53 (54) 57; **CV**. 5; **CC**. 3

Merluccius polli cadenati Doutre, 1960
(from Mauritania, Senegal, Gambia, Guinea-Bissau, Sierra Leone, and Liberia)

1D. 7 (11) 12; **2D**. 36 (39) 41; **A**. 36-40; **P**. 15-16; **V**. 7; **Gr**. 9 (10) 12; **L.L.** 110; **TV**. 52 (56) 57; **CV**. 5; **CC**. 3.

Geographical Distribution: General distribution in the eastern Atlantic ranges from a point between Cape Barbas and Cape Blanc in Mauritania, through Senegal, Gambia, Guinea-Bissau, and Liberia (05° 07'), all the way to to Namibia. To the north it overlaps with ***M. senegalensis***, and to the south with ***M. capensis*** and ***M. paradoxus***. The subspecies proposed in this catalogue, ***M. polli cadenati***, is distributed from Cape Barbas (aprox. 22°30'N) to Liberia (05° 07'N). After a 500 km break from Liberia to Port Gentil (0° 15' S), ***M. polli polli*** is found in Angola and to the north of Namibia (18° 30'S – 11° 26' E). Maurin (1963) reported catches of ***M. polli cadenati*** between Cape Juby and Cape Bojador at over 500 m depths, which is slightly more north of its usual distribution (Fig. 38).

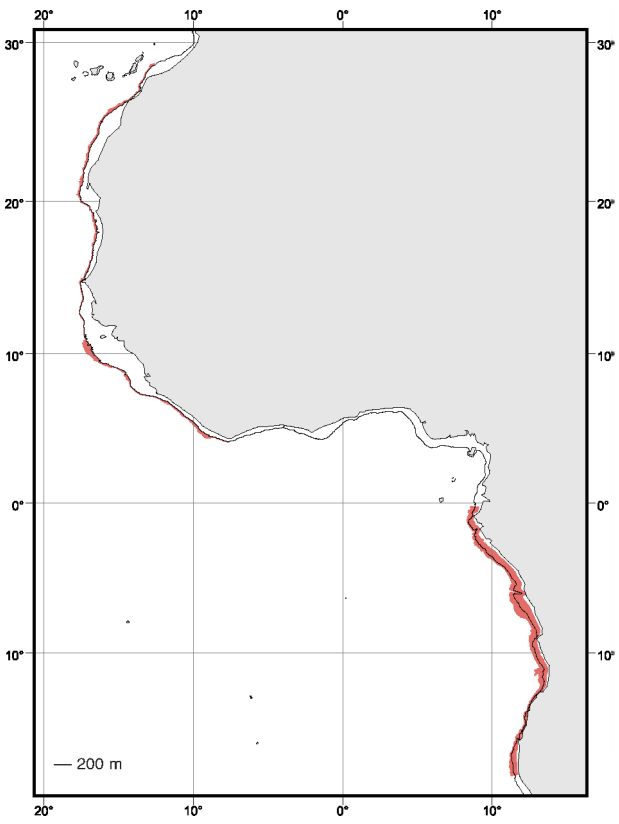


Fig. 38 ***Merluccius polli***
Known distributions

Habitat and Biology: Demersal species, generally found on the continental shelf and slope between a depth of 50 and 910 m. ***M. polli cadenati*** is found between 132 and 910 m, and can probably reach 1 000 m in Senegal and Gambia; ***M. polli polli*** is caught between a depth of 50 and 550 m. Feeds mainly on small fish, as well as squids, and natantia crustaceans.

Size: Maximum recorded length 80 cm; according to depth, commonly 16 to 42 cm.

Interest to Fisheries: Benguela hake (***Merluccius polli***) has been exploited in Angola and northern Namibia, although it is of little commercial interest. It is difficult to separate ***Merluccius polli*** and ***M. senegalensis*** catches. With regard to their exploitation and commercialization, Benguela hake is treated together with Senegalese hake (***M. senegalensis***) in the northern part of its distribution area and together with shallow water Cape hake (***M. capensis***) in the south. (See corresponding paragraphs for further information on respective fisheries.)

Local Names: ANGOLA: Marmota, Pescada, Pescada de Angola; CAPE VERDE: Pescada de Angola, Pescada africana, Pescada angolense; FRANCE: Merlu d'Afrique tropicale, Merluche; NAMIBIA: Benguela Seehecht, Hake, Stokvis; POLAND: Morszczuk angolanski; PORTUGAL: Marmota, Pescada de Angola; SENEGAL: Merlu; SPAIN: Merluza, Merluza de Angola, Merluza de Benguela, Merluza negra; UNITED KINGDOM: Benguela hake, Hake.

Literature: Hart (1948); Franca (1962); Maurin (1963); Lozano Cabo (1965); Pshenichnyy (1979); Inada (1981b); Bianchi (1986); Lloris (1986); Inada *in* Cohen *et al.* (1990), Bianchi *et al.* (1993); López Abellán and Ariz Tellería (1993).

Merluccius productus (Ayres, 1855) **Fig. 39**

Merlangus productus Ayres, 1855, *Proc. Cal. Acad. Sci.*, 1: 64 (type locality: San Francisco).

Synonyms: ***Homalopomus trowbridgii*** Girard, 1856, *Proc. Acad. Nat. Sci. Philad.*: 132 (Astoria, Oregon). ***Gadus productus*** Günther, 1862, *Cat. Fish. Brit. Mus.*, 4: 338 (coast of California). ***Merluccius productus*** Gill, 1863, *Proc. Acad. Nat. Sci. Philad.*: 247 (bibliography).

FAO Names: En – North Pacific hake; **Fr** – Merlu du Pacifique nord; **Sp** – Merluza del Pacífico norte.

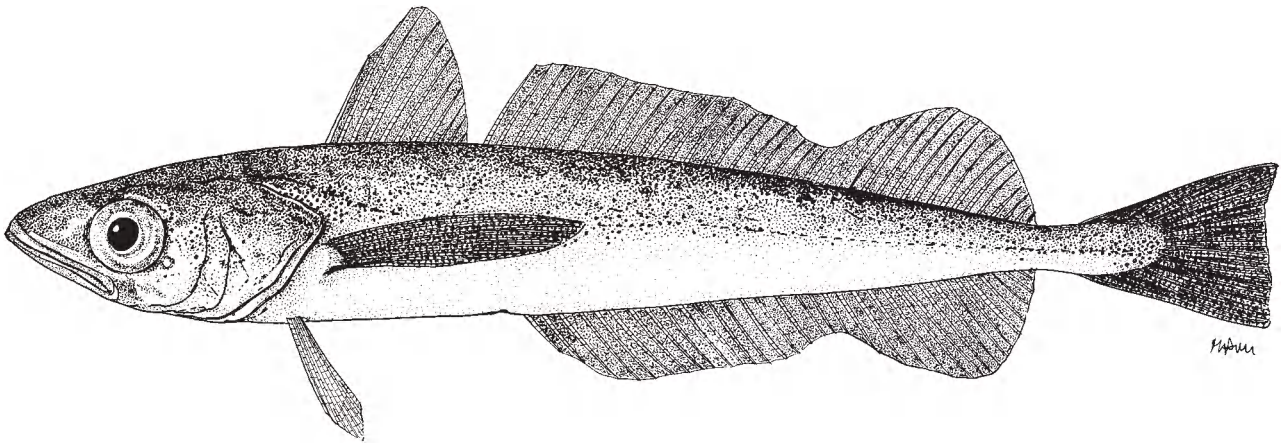


Fig. 39 ***Merluccius productus***

Diagnostic Features: Scales along the lateral line 144 to 166. Head 24.7 to 28.9% of standard length. Snout 31.1 to 35.4%, eye diameter 16.1 to 22.6%, and interorbital width 24.0 to 28.8% of head length. No scales on nasal membrane, lacrimal, lower part of cheek, preopercular, and interopercular. Gillrakers on first branchial arch 18 (22) 23, 3 to 6 on upper arm and 14 to 17 on lower. 1D 10 (11) 13 rays; 2D 37 (40-42) 44 rays; A 39 (41) 44 rays. Pectoral fins with 14 (16) 17 rays, length 17.4 to 21.9% of standard length and usually reaching beyond the origin of anal fin. Ventral fins 10.4 to 13.9% of standard length. Caudal-fin margin slightly concave. Vertebrae 50 to 55, 5 cervical with 3 ribs. **Colour:** silvery grey on back and whitish on belly.

Additional Information: Different populations have been described with meristic values and size variations, as noted below. North Pacific hake shares part of its distribution area with ***M. angustimanus*** (for differences see notes on the latter). Examples of differential characters are head length in comparison to standard length, number of gillrakers, scales along the lateral line, and hyomandibular and urohyal geometry.

Geographical Distribution: Eastern Pacific: Canada, United States and part of the Gulf of California, Mexico, up to 16°N (Gulf of Tehuantepec). To the south it shares its distribution area with Panama hake (***M. angustimanus***). Amongst the examined samples, one specimen (**MNHN** 0000-4954) coming from Mazatlan (Mexico) stands out, with a standard length of 424 mm, 22 (5+17) gillrakers, and head 27.9% of standard length (Fig. 40).

Habitat and Biology: North Pacific hake lives in association with the California Current, migrating to northern and shallower waters in autumn and winter. Feeds on crustaceans and fish: basic food for larvae and juveniles are copepods and euphausiacids, respectively. Adults feed on

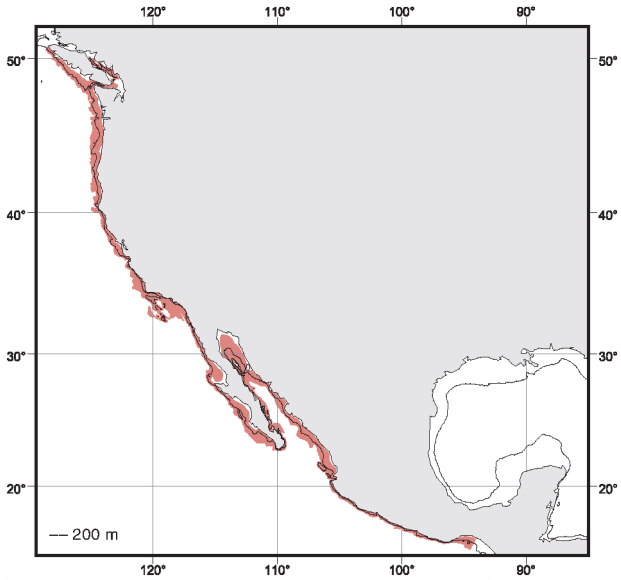


Fig. 40 ***Merluccius productus***
Known distribution

euphausiacids, pandalids, and fish, especially herring; large specimens have cannibalistic habits. Growth is fast, attaining 26 cm by the second summer and 34 by the third; individuals can live up to 20 years, but commonly not more than 12. There is a dwarf population present mainly south of 28° 45'N, where most specimens reach sexual maturity at 2 years of age and over 22 cm. Another oceanic population, distributed north of 28° 44'N, reaches sexual maturity at 3 or 4 years and at 35 to 45 cm. Both populations live in the high seas, sometimes mixing at the limits of their respective distribution areas except during reproduction. The dwarf population reproduces between 25° and 28°N, 10 to 20 miles from the Baja Californian peninsular coast, between April and February; the population of larger-sized fish reproduces between 30° and 34°N, 100 to 200 miles from the Californian coast, with a peak in March. Little is known about reproductive aggregations; spawning seems to take place at 130 to 150 m depth, eggs float up to 40-60 m depth. The populations migrate north after reproduction, the larger the fish the farther north it reaches. Males, which are smaller than females, reach Canada later and begin their return to the spawning areas before them.

Size: Maximum recorded length 91 cm; common to 60 cm.

Interest to Fisheries: North Pacific hake (***Merluccius productus***) is the most abundant commercial species off the coast of California, Oregon, and Washington in the United States, and off British Columbia in Canada, where it is caught by pelagic trawlers. Fisheries evolved with the arrival of foreign fleets in 1966, with a rapid increase in fishing effort. Before the arrival of foreign fleets, the fisheries were local and coastal, and the small catches were used for fishmeal production. Soviet Union factory trawlers of around 85 m length were the first to arrive, and by 1970 other foreign fleets followed suit. In the 1980s, joint ventures with foreign countries were set up and sophisticated methods of detection were introduced, giving rise to an increase of local fleets of pelagic trawlers of around 25 m length. Development of this fishery faced difficulties as the product was subject to the alterations by myxozoa parasites, which induced muscular softening and proteolysis; this could only be avoided by rapid refrigeration or the use of enzyme inhibitors. At the end of the 1980s, only local fleets exploited the resources, as foreign fleets did not have access to fishing quotas. In the United States the catch was used for fishmeal and pet food, while the Soviet Union catch was gutted, filleted, and frozen, thus avoiding the softening of the flesh, which occurs 2 to 4 hours after being caught.

Annual catch evolution of this species has been irregular. Since the arrival of the Soviet Union fleet in 1966, catches increased from being insignificant to totalling over 150 000 tonnes and remaining relatively constant. In the 1980s local fleets, especially from the United States, gradually monopolized exploitation, and in 1987 the maximum catch totalled almost 300 000 tonnes. Foreign fleet activity gradually decreased until it ceased in 1990. A minimum of 35 000 tonnes was recorded in 1991, recovering in later years to around 200 000 tonnes, caught almost exclusively by the United States.

Local Names: DENMARK: Kulmule; FINLAND: Kaliforninkummeliturska; FRANCE: Merlu du Pacifique nord; GERMANY: Nordpazifischer seehecht, Pazifikhecht, Seehecht; GREECE: Bakaliaro; ITALY: Nasello dei Pacífico; NORWAY: Kalifornisk, Lysing; PORTUGAL: Pescada do Pacífico, Pescada do Pacífico norte; SPAIN: Merluza, Merluza del Pacífico norte, Merluza norteña, Merluza pacífica norteamericana; SWEDEN: Kalifornisk kummel; TURKEY: Pasifik berlami; UNITED STATES: North Pacific hake, Pacific hake, Whiting.

Literature: Ayres (1855); Girard (1856); Günther (1862); Gill (1863); Kner (1865); Schmeltz (1869); Marini (1933); Roedel (1948); Ginsburg (1954); Lozano Cabo (1965); Hart (1973); Vrooman and Paloma (1977); Inada (1981b); Ermakov (1983); Inada *in* Cohen *et al.* (1990); Inada, (1995); Methot and Dorn (1995).

Merluccius senegalensis Cadenat, 1950 **Fig. 41**

Merluccius senegalensis Cadenat, 1950, *Congr. Pêches Pêcher. Un. Franç. d'outre-mer*: 127-130 (type locality: "near the Cape Verde Island").

Synonyms: ***Merluccius merluccius*** (*non* Linnaeus, 1758): Belloc, 1937: 341-346 (Cape Verde, Senegal). ***Merluccius merluccius senegalensis***: Franca, 1962: 25, 42 (taxonomy). ***Merluccius merluccius senegalensis***: Lozano Cabo, 1965: 18 (from Cape Cantín to Cape Roxo). ***Merluccius senegalensis***: Maurin, 1968: 34-36 (from north Morocco to Mauritania).

FAO Names: En – Senegalese hake; **Fr** – Merlu du Sénégal; **Sp** – Merluza del Senegal.

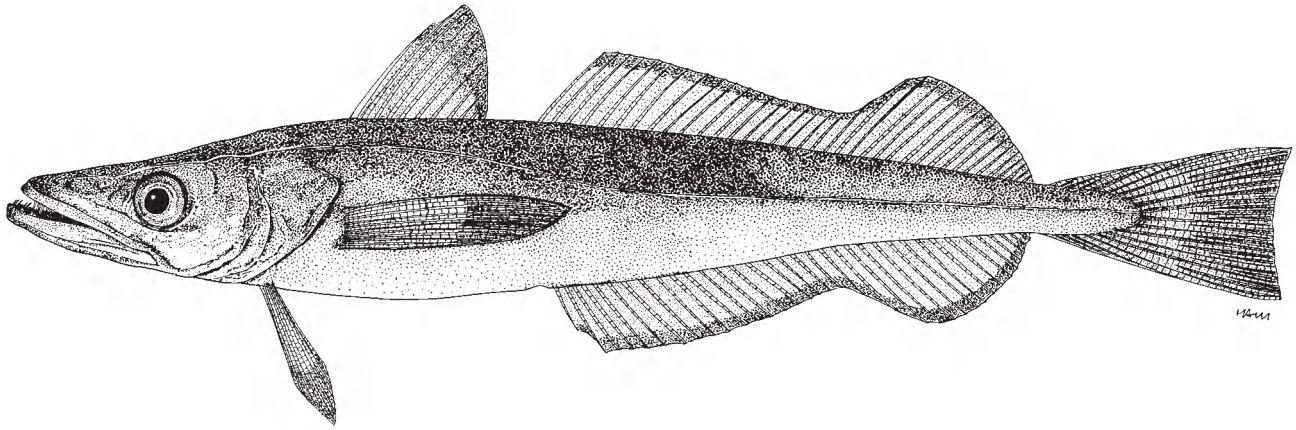


Fig. 41 ***Merluccius senegalensis***

Diagnostic Features: Scales along the lateral line 124 to 155. Head 24.9 to 27.7% of standard length. Snout 30.2 to 34.1%, eye diameter 17.1 to 20.8%, and interopercular 27.0 to 31.0% in head length. Scales on nasal membrane, lower part of cheek, preopercular, and interopercular; no scales on lacrimal. Lower jaw very prominent, with a clear prognathism; mouth rather oblique. Gillrakers on first branchial arch 12 (15) 21, 3 or 4 on the upper arm and 10 to 17 on the lower. 1D 7 (11) 12 rays; 2D 37 (40) 43 rays; A 36 (38-39) 40 rays. Pectoral fins with 12 (15) 17 rays, length 16.5 to 21.3% of standard length, reaching origin of anal fin. Ventral fins 13.1 to 16.9% of standard length. Posterior margin of caudal fin usually truncate, slightly concave in specimens over 40 cm. Vertebrae 51 (54) 56, 6 cervical with 4 ribs. **Colour:** dark grey, blackish on dorsum and lighter on belly. Mouth cavity and tongue blackish. A split black mark on the submandibular fold.

Additional Information: Dendrograms of similarity and the analysis of allozymes show certain affinities between ***Merluccius senegalensis***, ***M. merluccius***, and ***M. capensis***, as already noted in the respective sections of each species. ***M. senegalensis***, as well as the rest of the species in the genus, shares its distribution area with other ***Merluccius*** species, in this case with ***M. polli cadenati***. The two are easily distinguished, as among other characters, ***M. senegalensis*** has more gillrakers (12 to 21, as opposed to 9 to 12 for ***M. polli cadenati***), the lower jaw prognathous, and lacks scales on the lacrimal.

Geographical Distribution: Eastern Atlantic, from Cape Cantin, Morocco (32° 32'N) to Cape Roxo, Senegal (12° 25'N). To the north, up to Cape Blanc, its distribution area overlaps with that of the European hake (***M. merluccius***), and from Cape Barbas (aprox. 22° 30'N) to Cape Roxo (12° 25'N), with that of the Benguela hake (***Merluccius polli***). Already mentioned here with the proposed subspecies ***M. polli cadenati***. Its distributional limit varies throughout the year, moving further south from October to April and back again in August. Its relative abundance allows it to be situated in the optimum zone of distribution between Cape Barbas and Cape Timiris (Fig. 42).

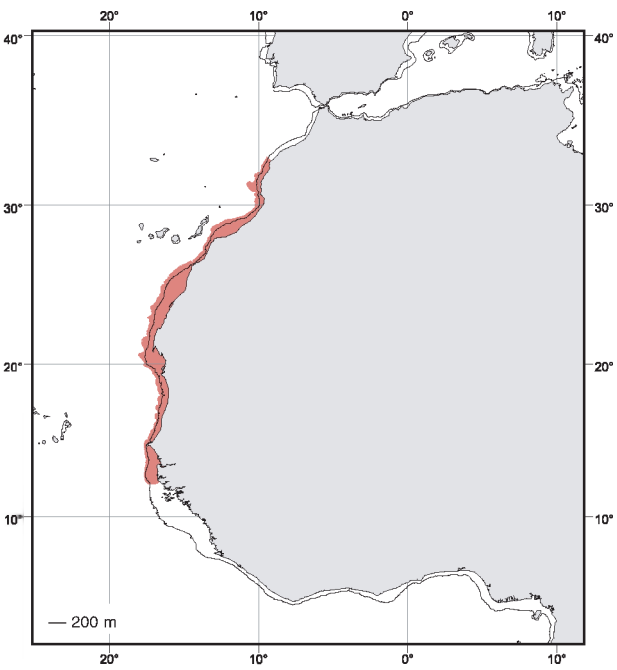


Fig. 42 ***Merluccius senegalensis***
Known distribution

Habitat and Biology: A demersal and bathypelagic species, lives preferentially over mud or sandy-mud bottoms in 18 to 800 m depths, although it is most abundant on the upper and lower part of the continental slope between 100 and 600 m. Feeds on fish (*Synagrops microlepis*, *Chlorophthalmus agassizi*, *Trachurus trecae*, Scombridae, Macrouridae, Myctophidae, and other Merlucciidae), crustaceans (*Munida iris*, *Parapenaeus longirostris*, *Plesionika edwardsi*, and *Plesionika heterocarpus*), and cephalopods. Growth characteristics are not very well known; males seem to reach first sexual maturity between 22 and 28 cm. Spawning occurs in northern areas from January to March, according to Doutre (1960), and from October to March, according to López Abellán and Ariz Tellería (1993), coinciding with the southern migration; females are more abundant than males. The fecundity of a female of 57.5 cm (TL), a weight of 1 kg, and with ovaries of 87 g was found with around 78 600 ooctyes.

Size: Maximum recorded length 87 cm (females) and 78 cm (males); common up to 65 cm.

Interest to Fisheries: Senegalese hake under 40 m in length are caught by trawlers targetting this species, as well as by smaller longliners and gillnetters. It is also captured as a bycatch of fisheries targetting cephalopods and shrimp. It shares its distribution area in the north with European hake (southern Morocco) and in the south with Benguela hake (Mauritania and Senegal). This leads to catches quite often being mixed up, especially with Benguela hake. The eastern central Atlantic fishery began at the beginning of the twentieth century, with sailing trawlers from southern Spanish coast exploiting north African fishing grounds. This fleet gradually became motorized, vessels became larger, and their fishing range extended further south (Mauritania and Senegal). By the end of the 1960s, Portuguese, Polish, and USSR fleets, amongst others, were exploiting the resource, and they continued to do so, using large trawlers of up to 2 000 GRT, until the 1970s. After the EEZ declaration, and in 1986 with the fishing agreement between Morocco and the European Union, European fleets were gradually reduced in the Moroccan EEZ. By 2000 only local fleets exploited the area. This species is marketed fresh or frozen.

Eastern central Atlantic catches also include Benguela hake (***M. polli***), owing to overlapping of fisheries and identification problems. Catches reported to FAO show a peak period between 1973 and 1977 with around 100 000 tonnes annually resulting from USSR-fleet activity, and to a lesser extent, Spanish fleets. From 1977 a drastic drop is recorded owing to an abrupt decrease in the USSR fleet; a certain stability is regained at the end of the 1980s, with annual catches of around 20 000 tonnes taken out by Spanish fleets.

Local Names: DENMARK: Kulmule; FRANCE: Merlu du Sénégal, Merlu noir; GERMANY: Seehecht; MOROCCO: Colin; POLAND: Morszczuk senegalski; PORTUGAL: Pescada negra; SPAIN: Merluza del Senegal; UNITED KINGDOM: Black hake, Senegalese hake.

Literature: Doutre (1960); Franca (1962); Maurin (1963); Lozano Cabo (1965); Inada (1981b and c); Inada *in* Cohen *et al.* (1990); López Abellán and J. Aríz Tellería (1993); Lloris and Rucabado (1998).

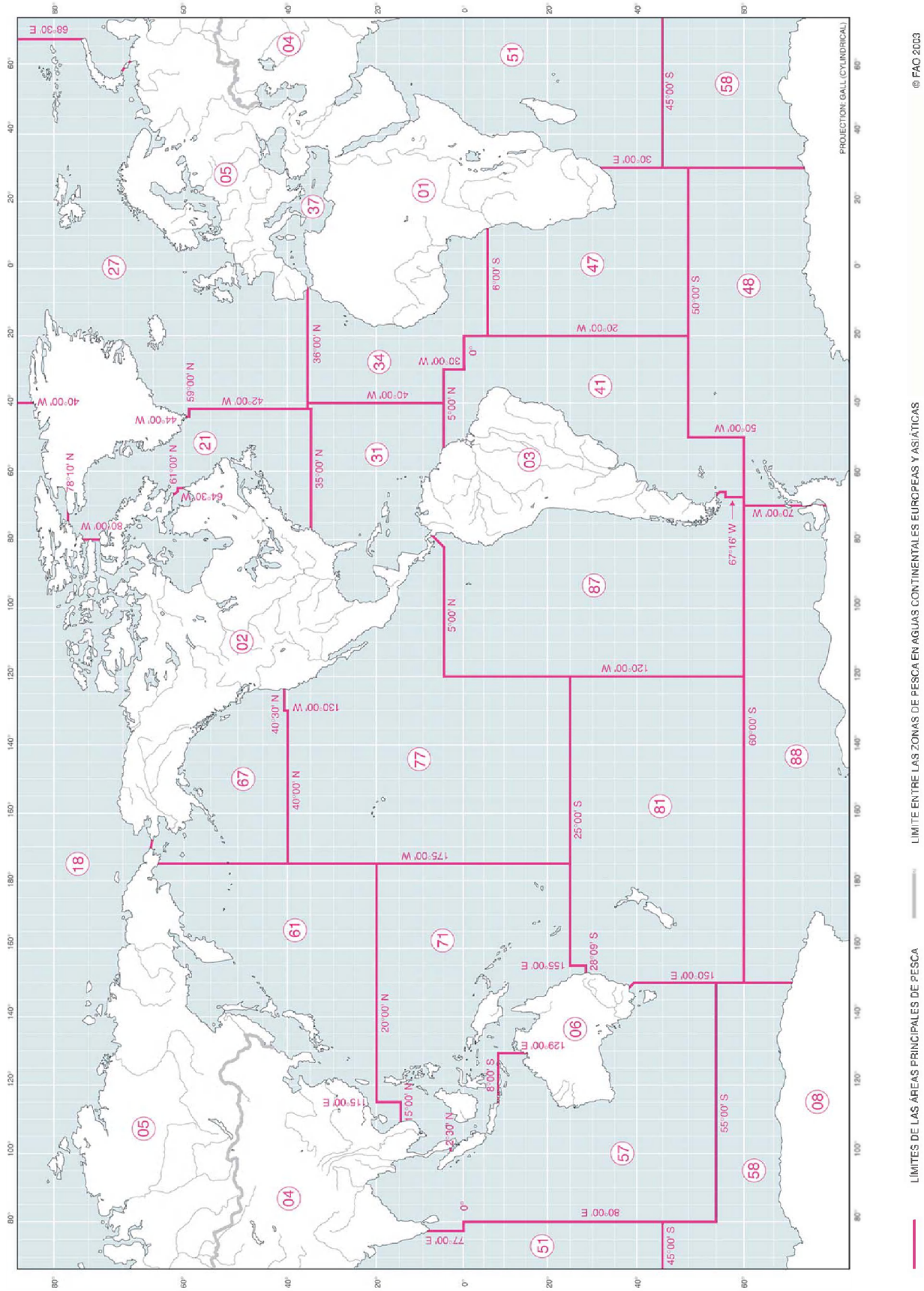
3. LIST OF SPECIES BY MAJOR FISHING AREAS

Listed in the below Table are species present in this catalogue and different FAO statistical areas, showing the distribution area of each species in thousand nautical square miles.

SPECIES	Page	GEOGRAPHICAL DISTRIBUTION																		
		MAJOR FISHING AREA FOR STATISTICAL PURPOSES																		
		18	21	27	31	34	37	41	47	48	51	57	58	61	67	77	81	87	88	Total area
Lyconodes argenteus	9								•											
Lyconus brachycolus	10	•	•	•	•	•		•	•											
Lyconus pinnatus	11					•			•	○	•	•	○				•		○	
Macruronus capensis	12								•											
Macruronus novaezelandiae	13							51				35					65	92		243
Merluccius albidus	20		10		404															414
Merluccius angustimanus	21															81		4		86
Merluccius australis	23								386					•			204	44		634
Merluccius bilinearis	27		392		95															487
Merluccius capensis	29								147		4									151
Merluccius gayi	31																	97		97
Merluccius hubbsi	34							509												509
Merluccius merluccius	36			593		63	344													1000
Merluccius paradoxus	40								85		6									91
Merluccius patagonicus	42							•												
Merluccius polli	43					34			27											61
Merluccius productus	45														27	91				118
Merluccius senegalensis	47					76														76

• Known distribution ○ Probable distribution

MAJOR FISHING AREAS FOR STATISTICAL PURPOSES



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5. INDEX OF SCIENTIFIC AND VERNACULAR NAMES

Explanation of the System

Italics	:	Valid scientific names (genera and species)
Italics	:	Synonyms (genera and species), subspecies
ROMAN	:	Family names
ROMAN	:	Scientific names of divisions, orders, suborders and subfamilies, classes, subclasses
Roman	:	FAO names, vernacular and local

A

B

C

D

E

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K

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6. COLOUR PLATES

PLATE I

General appearance of two Merlucciidae representatives: ***Macruronus*** (subfamily: Macruroninae) and ***Merluccius*** (subfamily: Merlucciinae).

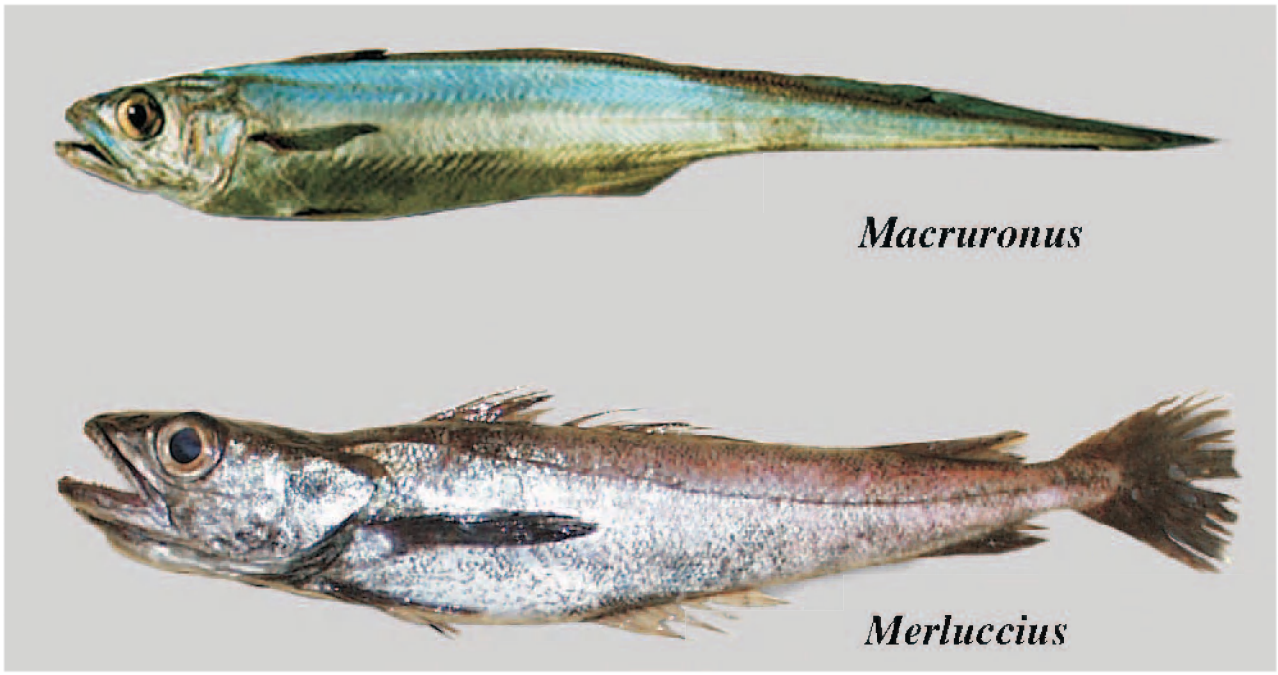


PLATE II

Details of two heads and general appearance of ***Lyconus brachycolus*** Holt and Byrne, 1906. Juvenile (**A, B**) and adult (**C**).

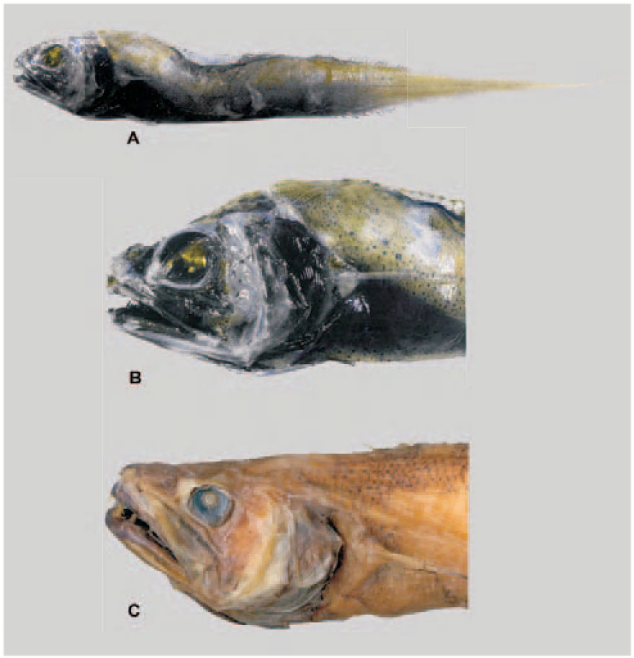


PLATE III

Details of ***Merluccius merluccius*** head, showing scale distribution, presence or absence of which has diagnostic value: **1)** Nasal membrane; **2)** Lacrimal; **3)** Lower part of cheek; **4)** Lower part of preopercular; **5)** Lower part of interopercular. Scales always present on **OP** (opercular) and **SO** (subopercular).

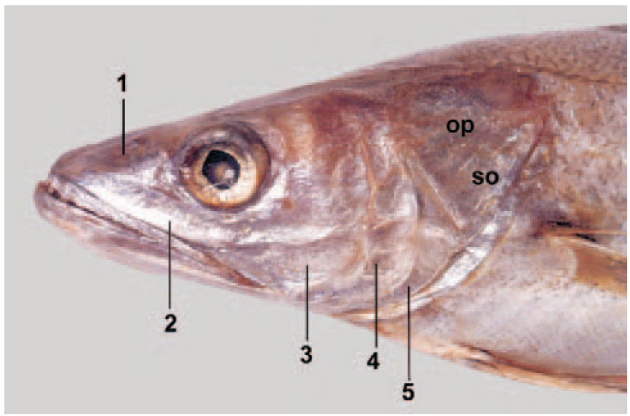


PLATE IV

Magnified details of the nasal membrane of genus ***Merluccius***, showing anterior nasal orifice (circular) and posterior orifice (semicircular). **A)** with scales, characteristic of all species with a Euro-African distribution. **B)** No scales, characteristic of all American species.

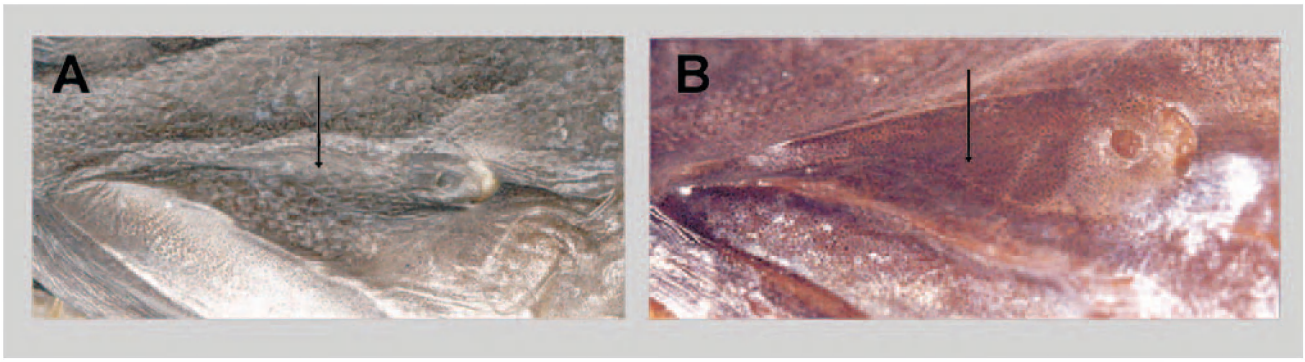


PLATE V

Details of ***Merluccius*** head, showing aproximate position of hyomandibular and urohyal.

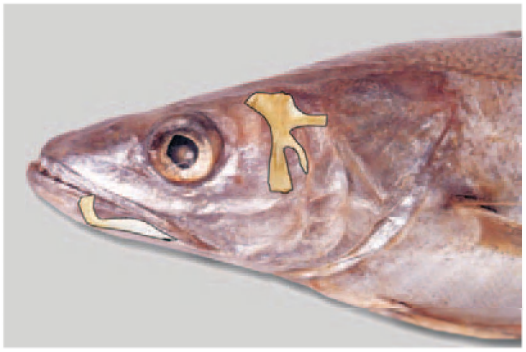


PLATE VI

Details of a ***Merluccius*** branchial arch and its different parts: **1)** Epibranchial; **2)** Ceratobranchial; **3)** Hypobranchial; **4)** Gillrakers; **5)** Gill filaments.

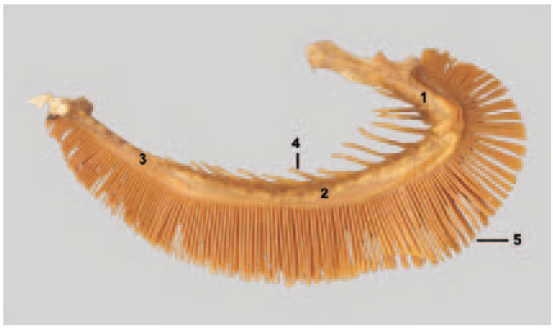


PLATE VII

Details of two otoliths (*sagitta*) of **A)** ***Merluccius capensis*** and **B)** ***Merluccius patagonicus***, showing postrostrum shape (blunt and sharp, respectively).

PLATE VIII

Magnified detail of the different hyomandibular parts (***Merluccius patagonicus***), taken from a specimen from the Argentine Sea.

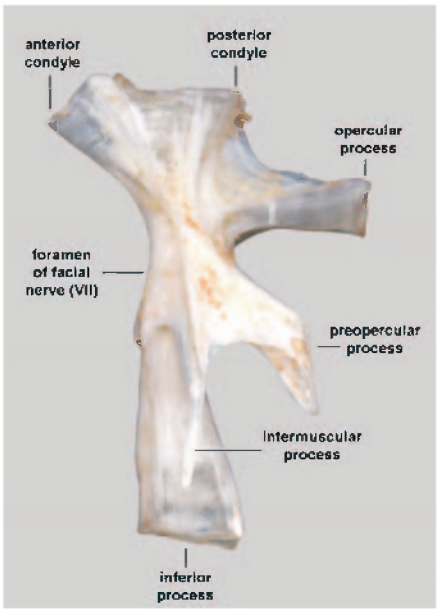


PLATE IX

Series of heads of species and subspecies of genus *Merluccius* showing different details of their general shape and the distribution of scales: **A)** *M. merluccius*; **B)** *M. senegalensis*; **C)** *M. polli cadenati*; **D)** *M. polli polli;* **E)** *M. capensis*; **F)** *M. paradoxus*; **G)** *M. bilinearis*; **H)** *M. albidus*; **I)** *M. hubbsi*; **J)** *M. patagonicus*; **K)** *M. productus*; **L)** *M. angustimanus*; **M)** *M. gayi*; **N)** *M. australis polylepis*; **O)** *M. australis australis*.

PLATE X

Series of hyomandibular bones from different *Merluccius* species and subsepcies showing diagnostic details: **A)** *M. merluccius*; **B)** *M. senegalensis*; **C)** *M. polli cadenati*; **D)** *M. polli polli*; **E)** *M. capensis*; **F)** *M. paradoxus*; **G)** *M. bilinearis*; **H)** *M. albidus*; **I)** *M. hubbsi*; **J)** *M. patagonicus*; **K)** *M. productus*; **L)** *M. angustimanus*; **M)** *M. gayi*; **N)** *M. australis polylepis*.

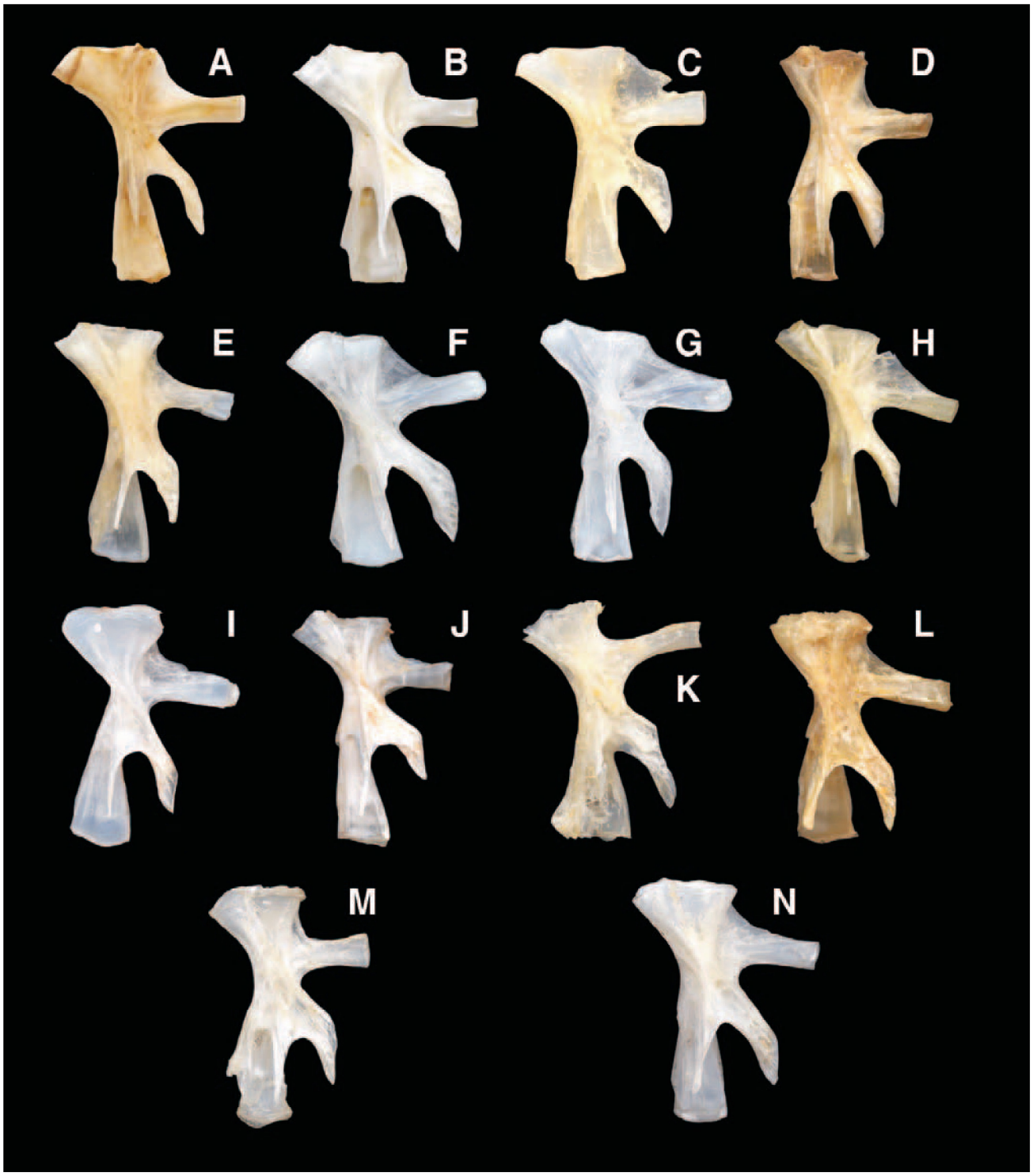


PLATE XI

Series of urohyal bones from different *Merluccius* species and subspecies showing differential details: **A)** *M. merluccius*; **B)** *M. senegalensis*; **C)** *M. polli cadenati*; **D)** *M. polli polli*; **E)** *M. capensis*; **F)** *M. paradoxus*; **G)** *M. bilinearis*; **H)** *M. albidus*; **I)** *M. hubbsi*; **J)** *M. patagonicus*; **K)** *M. productus*; **L)** *M. angustimanus*; **M)** *M. gayi*; **N)** *M. australis polylepis*.

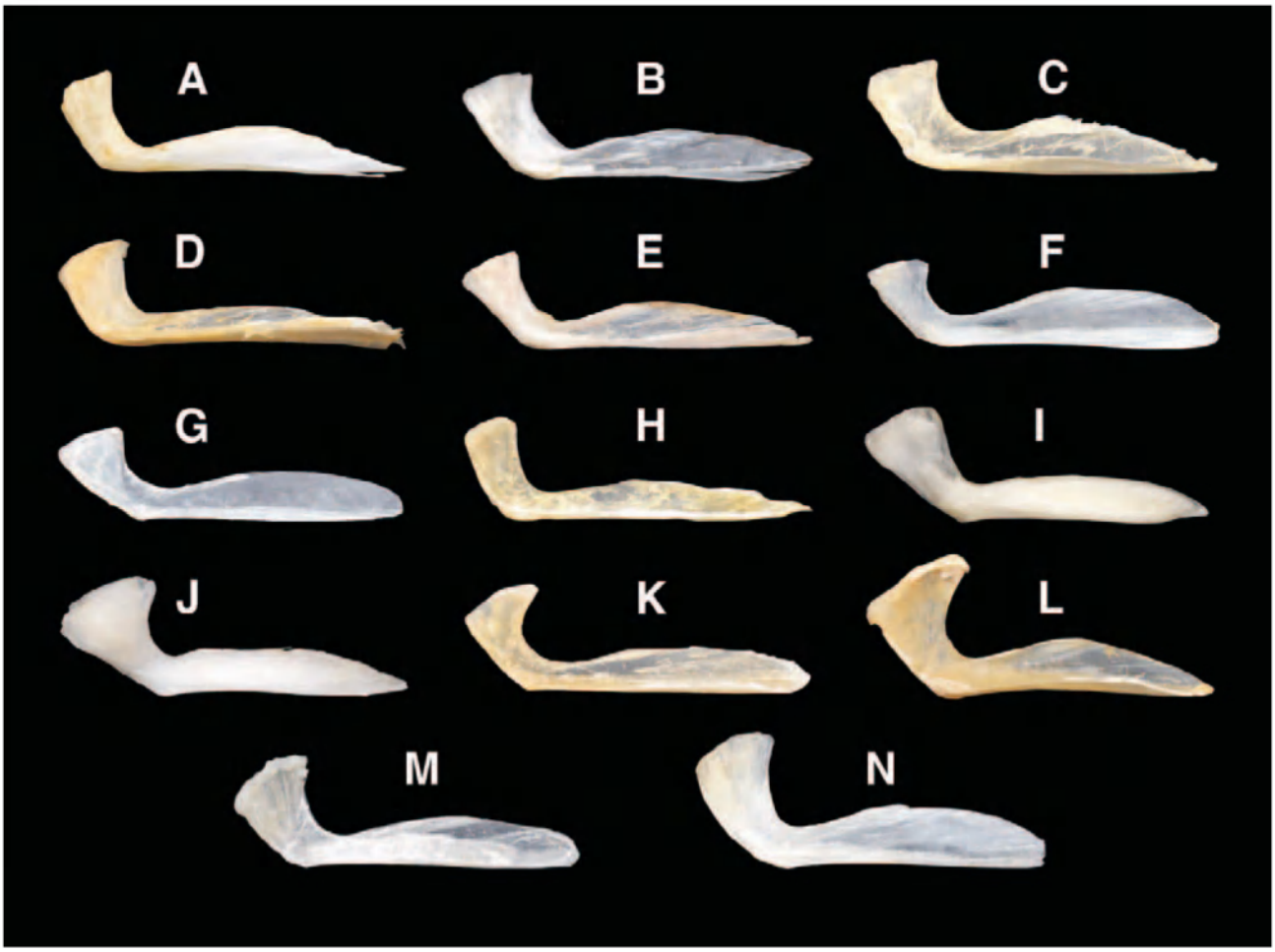
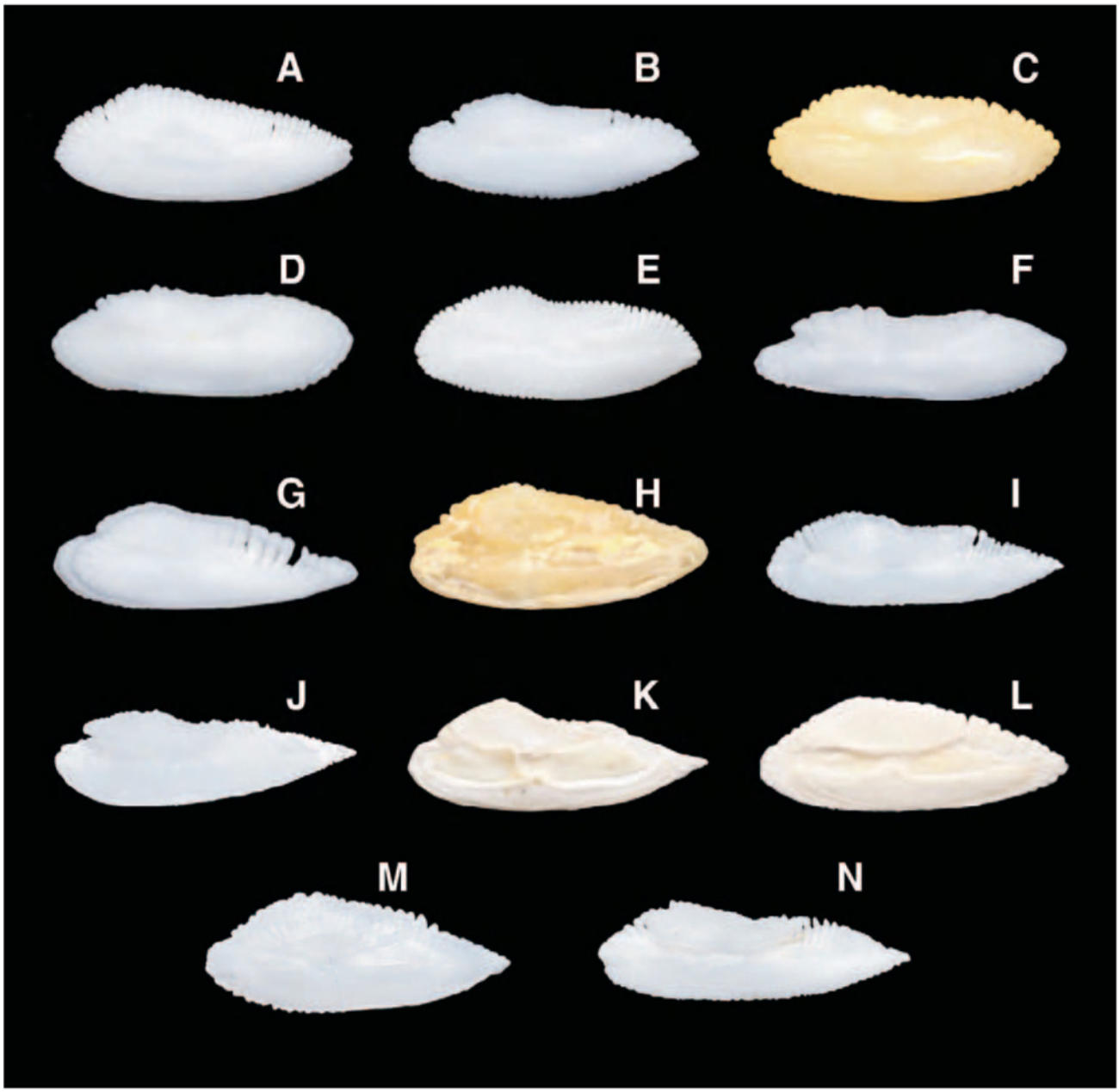


PLATE XII

Series of otoliths (*sagitta*) from different ***Merluccius*** species and subspecies showing differential details, especially the distribution of crests and profiles, as well as *postrostrum* geometry. **A)** ***M. merluccius*****; B)** ***M. senegalensis*****; C)** ***M. polli cadenati***; **D)** ***M. polli polli***; **E)** ***M. capensis***; **F)** ***M. paradoxus***; **G)** ***M. bilinearis***; **H)** ***M. albidus***; **I)** ***M. hubbsi*****; J)** ***M. patagonicus***; **K)** ***M. productus***; **L)** ***M. angustimanus***; **M)** ***M. gayi***; **N)** ***M. australis polylepis***.



This is a worldwide catalogue of the family Merlucciidae. Two subfamilies, Macruroninae and Merlucciinae, are recognized comprising four genera, *Lyconodes, Lyconus, Macruronus* and *Merluccius,* and 18 species. The following subspecies are proposed: *Macruronus novaezelandiae magellanicus* Lönnberg, 1907; *Merluccius albidus magnoculus* Ginsburg, 1954; *Merluccius australis polylepis* Ginsburg, 1954; *Merluccius polli cadenati* Doutre, 1960 and *Merluccius merluccius smiridus* Rafinesque, 1810. The possibility of one other subspecies, *Merluccius merluccius lessepsianus*, represents the first record of *Merluccius* from the Red Sea. *Merluccius paradoxus* is first recorded from Madagascar. In the introductory chapters, Merlucciidae systematics is debated, justifications for the proposed taxonomic organization are provided, and the characters used for the identifications are discussed. Dichotomous keys are provided in the systematics chapter, enabling the identification of the hakes to the species level. Subfamilies and genera are also defined. Species accounts include an illustration of each species, scientific and vernacular names, and information on habitat, biology, fisheries, size, relevant literature and distribution maps. The review is completed by a series of colour plates showing details of different anatomic elements for a quick and efficient diagnosis of the genera and species of *Lyconus, Macruronus* and *Merluccius.*

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