1. INTRODUCTION

This catalogue covers all of the 103 lutjanid species presently known regardless of their current commercial importance. Aside from a taxonomic review (in press) of the 39 species of Lutjanus from the Indo-West Pacific by the present author in collaboration with F.H. Talbot, it is based primarily on information from literature, supplemented with examination of museum specimens. The catalogue is not intended as a definitive work on the classification, biology, and fisheries of lutjanid fishes, but rather as a state-of-the-art guide which will serve as a foundation for further work. Despite the commercial importance of many species, fisheries information is scarce for most areas. Separate catch statistics are lacking for most species and many areas report only "lumped" snapper landings. There are perhaps three major reasons for this paucity of information: (1) many of the species are similar in appearance and are therefore frequently confused; (2) also several species which are valid have previously been treated as synonyms; and (3) the nature of snapper fisheries is largely artisanal, and hence undocumented.

There are relatively few fisheries-oriented publications dealing exclusively with lutjanid fishes. Much of the literature consists of systematic papers or books with only brief comments related to fisheries. Therefore the information contained in the Interest to Fisheries sections in this catalogue is often rather sketchy. Most of the references given, particularly those for the Indo-West Pacific species, are recent works selected because of their comprehensive nature and inclusion of diagnostic colour illustrations. Two geographic regions, the eastern Pacific and eastern Atlantic Oceans, are poorly documented in recent literature, and up-to-date revisions are required. In order to avoid unnecessary cluttering of the text with numerous literature citations, every effort was made to restrict these to papers considered of specific relevance to the species in question. Many others, particularly those on systematics, anatomy, distribution, and the more general aspects of biology and fisheries, are included only in the bibliography. A number of older systematic works are still widely used for identification and diagnostic information. These include: Jordan & Swain (1885), and Jordan & Evermann (1896) for reviews of eastern Pacific and western Atlantic species; and Fowler (1931), and Weber & De Beaufort (1936) for treatment of the Indo-West Pacific species. Also, the impact of the French naturalists Cuvier & Valenciennes has been considerable. These authors described, mainly in their Histoire naturelle des Poissons (1828-1833), no less than 76 nominal lutjanid species. Another valuable contribution was made by the Dutch ichthyologist Pieter Bleeker, who described 38 nominal species. The 106 species described by these 19th century authors represent 35% of the 383 nominal species currently allocated to this family (see Section 3).

Colour illustrations were prepared by R. Swainston, M. Thompson, P. Lastrico and O. Lidonnici under the direct supervision of the author. Where possible, they are based on colour photographs of either live fishes taken underwater or of freshly dead specimens. Colour illustrations in the literature were also used for this purpose and in a few cases where no photographs existed, published colour notes were utilized. Black and white drawings were prepared mainly from systematic literature or museum specimens, by Swainston, but some were also adapted and redrawn by Thompson, Lidonnici and P. Lastrico. All distribution maps were drawn by Lastrico.

Acknowledgememts

The author wishes to express his thanks to all those who have contributed to the preparation of this catalogue. Particularly helpful were J.E. Randall, Bernice P. Bishop Museum (Honolulu) who made available specimens and photographs of lutjanid species from a wide area of the Indo-West Pacific and W.D. Anderson Jr., Grice Marine Biological Laboratory (Charleston, USA) for contributing valuable information on genera other than Lutjanus. A.D. Lewis (Ministry of Agriculture and Fisheries, Fiji), U. Raj (University of the South Pacific, Fiji) and A. Kerstitch (Tuscon, Arizona) provided valuable photographs of rare or poorly known species.

Special thanks are due to FAO and UNDP for their financial support, which provided opportunities for field visits to Indonesia and the Arabian peninsula, study visits to several European museums where important type specimens were examined, and visits to FAO HQ in Rome, in connection with the gathering of fisheries information and the preparation of this document for printing. The author also acknowledges the assistance of FAO personnel, in particular, the editor of the series, W. Fischer, the illustrators Messrs P. Lastrico and O. Lidonnici, Giulia Sciarappa-Demuro who word-processed the text and Gloria Soave who reviewed the bibliography.

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S. Ralston, National Marine Fisheries Service (Honolulu) was instrumental in procuring funds for the author's participation in a snapper workshop at Honolulu in May, 1985, where much valuable fisheries information appearing in this catalogue was obtained. The author is indebted to all the participants at this meeting. The papers which were presented will be ultimately published in a single volume (see Ralston & Polovina, and also individual papers in bibliography).

The author wishes to thank the Director, J. Bannister, and Board of Trustees of the Western Australian Museum for their continuing support of his research on lutjanid fishes. The study of this group was greatly facilitated by the loan of specimens and access to collections provided by curatorial staff including M.-L. Bauchot (Muséum d'Histoire Naturelle, Paris, France); M. Boeseman and M. van Oijen (Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands); W.N. Eschmeyer and T. Iwamoto (California Academy of Sciences, San Francisco, USA), P. Kaesbauer, formerly Naturhistorisches Museum, Vienna, Austria), W. Klausewitz, Natur-Museum Senckenberg, Frankfurt a/M, Federal Republic of Germany); R.J. McKay (Queensland Museum, Brisbane, Australia); H. Njissen, Instituut voor Taxonomische Zoölogie, Zoögisch Museum Amsterdam, the Netherlands); J.R. Paxton and D.F. Hoese (Australian Museum, Sydney, Australia); J.E. Randall (B.P. Bishop Museum, Honolulu, Hawaii, USA); D.E. Rosen and C.L. Smith (American Museum of Natural History, New York, USA); W.F. Smith-Vaniz (Academy of Natural Sciences, Philadelphia, USA); V.G. Springer (US National Museum of Natural History, Washington DC., USA); P.J.P. Whitehead (British Museum of Natural History, London, UK).

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1.1 Plan of the Catalogue

This catalogue is arranged alphabetically by genera and species. Each of the multispecies genera is introduced with general descriptive remarks, illustrations of diagnostic features, highlights on the biology, and relevance to fisheries. The information pertaining to each species is arranged by paragraphs, as follows: (1) scientific name, (2) synonymy, (3) FAO species names, (4) diagnostic features, (5) geographical distribution, (6) habitat and biology, (7) size, (8) interest to fisheries, (9) local species names, (10) literature, and (11) remarks.

(1) **Scientific name** : Reference is given to the original description of each species so no confusion will arise as to precise identification.

(2) **Synonymy:** Synonyms are listed (frequent misidentifications are discussed under (11) remarks).

(3) **FAO species names** : English, French and Spanish names for each species, to be used primarily within FAO, were selected on the basis of the following criteria: (i) each name must apply to one species only, in a worldwide context; (ii) the name should not lead to confusion with other groups. Wherever possible, the names selected were based on vernacular names (or parts of names) already in existence within the areas where the species is fished. FAO species names are, of course, not intended to replace local species names, but they are considered necessary to overcome the considerable confusion caused by the use of a single name for many different species, or several names for the same species.

(4) **Diagnostic features** : Distinctive characters of the species are given as an aid for identification, accompanied by pertinent illustrations. Species identifications should be attempted only after consultation of the illustrated key to genera and species.

(5) **Geographical distribution** : The entire known geographic range of the species is given in the text and shown on a small map. Shading encompasses actual locality records as well as areas of expected occurrence.

(6) **Habitat and biology** : General information concerning bottom type, depth range, food habits, behaviour and other biological aspects is given.

(7) **Size** : The maximum known, as well as the common total length are given. Total length is measured from the tip of the snout to the tip of the longest caudal rays. The size at first maturity is also given for some species.

(8) **Interest to fisheries:** This paragraph gives an account of the nature of the fishery and, where possible, its importance is qualitatively estimated. Data on utilization (fresh, dried, frozen, canned, etc.) are given where available. Here too, the quality and quantity of the information available vary considerably with the species.

(9) **Local species names**: These are the names used locally for the various species. The present compilation is necessarily incomplete, since only a fraction of the local names used throughout the world is actually published. In many cases, local names are available only for species supporting documented fisheries. Apart from possible omissions due to limitations of literature available, some of the names included may be somewhat artificial (i.e. through transliteration of indigenous words into English). The local species name is preceded by the name of the country or geographic locality concerned (in capital letters).

(10) **Literature :** This includes references to important, usually well illustrated, publications relevant to the species, the emphasis being on identification. Additional references on biology and fisheries are included in the bibliography.

(11) **Remarks :** Important information concerning the species and not fitting in any of the previous paragraphs is given here. For instance, in some cases the scientific name used in the present catalogue, although nomenclaturally correct, is not the best known.

1.2 General Remarks on Lutjanids

The Lutjanidae is a family composed of 17 genera and 103 species of mostly reef-dwelling marine fishes collectively known as snappers. Some of their major morphological features have been discussed and illustrated by Johnson (1980). The family Lutianidae is divisible into four subfamilies: (1) the Etelinae containing five genera: Aphareus, Aprion, Etelis, Pristipomoides and Randallichthys; these are relatively elongate fishes with a lunate to deeply forked caudal fin, scaleless dorsal and anal fins, and generally with the last dorsal and anal fin rays produced (longer than penultimate rays); (2) the Apsilinae containing four genera: Apsilus, Lipocheilus, Paracaesio and Parapristipomoides; these are moderately elongate to moderately deep-bodied fishes with a lunate to deeply forked caudal fin, scaleless dorsal and anal fins, and generally with the last dorsal and anal fin rays not produced (shorter than penultimate ray); (3) the Paradicichthyinae containing two monotypic genera: Symphorus and Symphorichthys; these are relatively deep-bodied fishes with an emarginate or slightly forked caudal fin, scaly sheaths at the bases of the dorsal and anal fins, no teeth on the vomer, and some of the anterior dorsal and anal soft fin rays produced into filaments; (4) the Lutjaninae containing five monotypic genera: Hoplopagrus, Macolor, Ocyurus, Pinjalo and Rhomboplites, and the 65 known species of the genus Lutjanus; these are slender to deep-bodied fishes with a truncate to deeply forked caudal fin, scaly sheaths at the bases of the dorsal and anal fins, teeth present on the vomer, and without filamentous soft dorsal or anal fin rays.

On the basis of various internal characters including jaw musculature, skull morphology, and certain osteological features related to the axial and caudal skeletons, Johnson (1980) postulated that the Etelinae is the most primitive group, with the Apsilinae intermediate to Lutjaninae and Paradicichthyinae, which are considered to be the most advanced groups (Fig. 1). Johnson further hypotheslzed that the Paradicichthyinae are the primitive sister group of the Lutjaninae and of the closely related family Caesionidae. The caesionids, commonly known as fusiliers, have been historically treated as lutjanids, but they exhibit a unique specialization of the premaxillary bone in which the ascending process is a completely separate ossification. That family contains four genera, Caesio, Pterocaesio, Gymnocaesio and Dipterygonotus, which are highly adapted for plankton-feeding. The Caesionidae and Lutianidae constitute the superfamily Lutianoidea. Although both the Lutjanoidea and family Lutjanidae share a number of generalized percoid characters (see Johnson, 1980), no unique specialization has been found that characterizes either group.

The family Lutjanidae is mainly confined to tropical and subtropical marine waters, although three species of Indo-Pacific Lutjanus inhabit fresh water, and the juveniles of several species in this genus frequent brackish mangrove estuaries and the lower reaches of freshwater streams. The family is divisible into four discrete geographical faunas: (1) eastern Pacific, (2) Indo-West Pacific, (3) eastern Atlantic and (4) western Atlantic. NO species is found in more than a single region. However, there is a record of Lutjanus argentimaculatus from the Mediterranean coast of Lebanon, presumably having dispersed from the northern Red Sea via the Suez Canal. Many of the species, particularly members of Aphareus, Aprion, Etelis, Lutjanus, Macolor, Paracaesio, Pinjalo and Pristipomoides have broad distributions encompassing wide areas of the Indo-West Pacific region. Some of these species such as Lutjanus bohar, L. gibbus, L. kasmira, L. monostigma and L. rivulatus, as well as species of Etelis, Paracaesio and Pristipomoides are frequently associated with oceanic insular localities. Relatively few species have greatly restricted distributions and some of these may be more widespread, but because of their relatively deep habitat, they are seldom collected. Examples of localized species include Lutjanus adetii (New Caledonia and eastern Australia), L. ambiguus (southern Florida and Cuba), L. bitaeniatus (eastern Indonesia-northwestern Australia), L. coeruleolineatus (seas surrounding the Arabian Peninsula), L. dodecacanthoides (eastern Indonesia and the Philippines), L. goldiei (southern New Guinea), L. maxweberi (eastern Indonesia, the Philippines and New Guinea), L. notatus (Mauritius, Reunion, Madagascar, Natal and Mozambique), L. stellatus (southern Japan to Hong Kong), Paracaesio caeruleus (southern Japan), Parapristipomoides squamimaxillaris (Easter Island and Rapa), Pristipomoides freemani (Atlantic coast of Panama to Suriname), and P. macrophthalmus (Greater Antilles and Caribbean coast of Nicaragua and Panama). In addition, the five species of Lutjanus inhabiting the west African coast have relatively restricted distributions. The general distribution pattern of the four subfamilies of. Lutjanidae are indicated in Fig. 2.

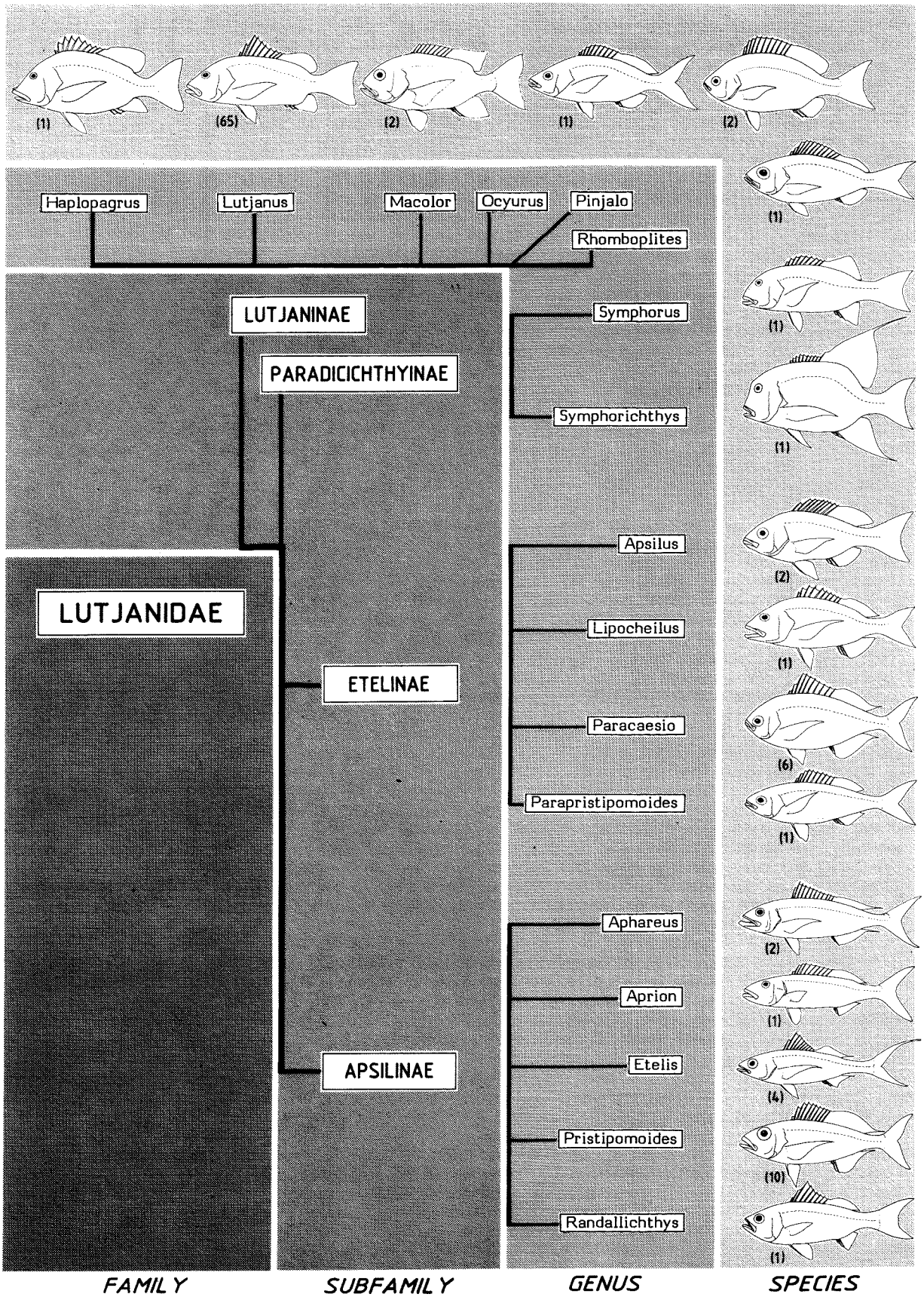


Fig. 1 Every genus is illustrated by one typical representative. The number of species in each genus is given in parenthesis

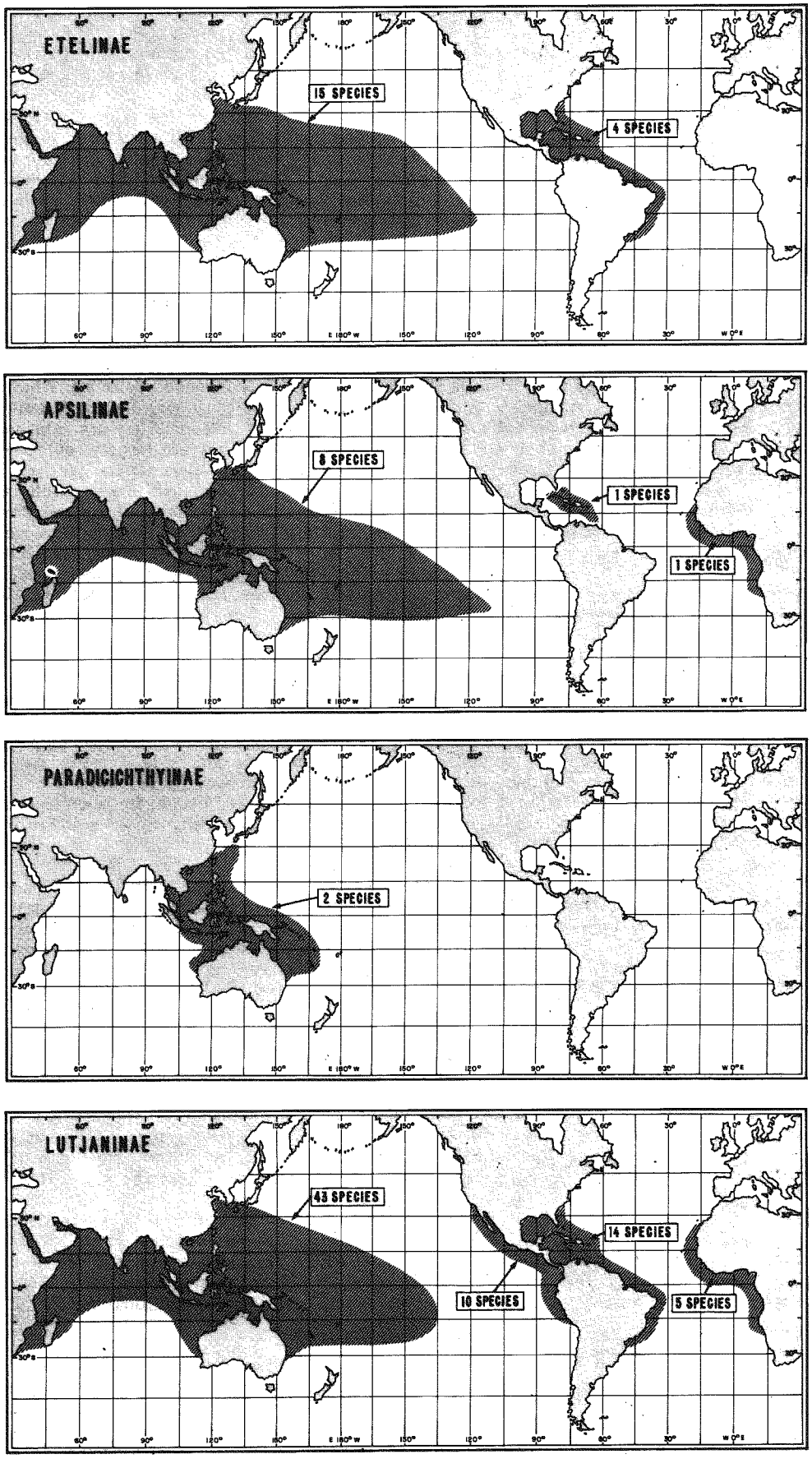


Fig. 2 General distribution pattern by subfamilies in the family Lutjanidae.

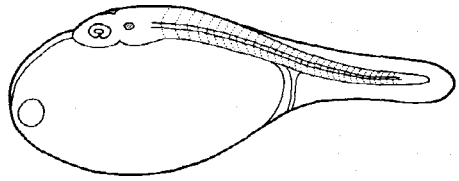
Lutjanids are dioecious (separate sexes) and display little or no sexual dimorphism in structure or colour pattern. The reproductive pattern is that of gonochorism: following sexual differentiation, the sex remains constant throughout the life cycle. On the average, lutjanids reach first maturity at about 43 to 51% of the maximum total length, with males maturing at a slightly smaller size than females. Based on larval abundance, two types of seasonal reproductive patterns are common among the family: (1) a protracted summer season, and (2) a more or less continuous pattern with peak activity in the spring and fall. Lutjanids are batch-spawners with individual females generally spawning several times each season. There have been few sightings of the actual spawning act, but the general pattern is probably similar to that reported for captive Lutjanus kasmira in Japan by Suzuki & Kioki (1979). Group spawning of 10 or more fish occurred in the evening or at night during August with water temperatures ranging from 22.2 to 25.2ºC. Males initiated courtship by pecking and rubbing against the body of a female. Eventually other fish joined the activities and initiated a spiral ascent, releasing gametes just below the surface. The pelagic eggs of lutjanids are generally spherical with diameters ranging between 0.65 to 3.02 mm, although the eggs of most species are less than 0.85 mm. They are characterized by a single, small oil droplet which provides buoyancy during the pelagic stage. Incubation times generally range from 17 to 27 hours depending on the species and temperature. Newly hatched larvae are sparsely pigmented, have a large yolk sac, unpigmented eyes, no mouth, and very limited swimming capabilities. The yolk reserves last for about 3 or 4 days. Perhaps the most striking feature of the larvae is the development of pronounced head spination and elongated pelvic and dorsal spines (Fig. 3). Lutjanine larvae, particularly those of Lutjanus, are most common relatively close to shore, in waters over the continental shelf or in large coral reef lagoons. They are relatively rare in the more offshore areas at the edge of the shelf and in oceanic waters where they are largely replaced bv the larvae of various etelines such as Etelis and Pristipomoides. Experimental plankton tows off the northern Great Barrier Reef indicate that the lutjanid larvae constitute as much as 4 to 8% of the total fish larvae catch. Evidence from several studies indicates that the larvae are largely absent from surface waters during the day and migrate upward at night. Settlement and concurrent metamorphosis generally occurs at total lengths ranging between about 12 and 20 mm or after an estimated pelagic stage of 25 to 47 days. The maximum lifespan of snappers has been estimated between 4 and 21 years, based on studies of growth rings or bony structures such as otoliths and vertebrae. In general, the larger species have longer lifespans, perhaps in the range of 15 to 20 years. Most snappers dwell in shallow to intermediate depths (to 100 m), although the majority of etelines and some apsilines are largely confined to deep water (100 to 500 m).

Snappers are active predators feeding mainly at night on a variety of items, although fishes are dominant in the diet of most species. Other common foods include crabs, shrimps, various other crustaceans, gastropods, cephalopods, and planktonic organisms, particularly urochordates. Plankton is particularly important in the diet of eteline and apsiline genera such as Pristipomoides and Paracaesio, and of the lutjanines Ocyurus, Pinjalo and Rhomboplites. Generally, the larger, deep-bodied snappers feed on fishes and large invertebrates on or near the surface of the reef. They are usually equipped with large canine teeth, adapted for seizing and holding their prey. Snappers having a relatively slender, fusiform body shape and often a forked caudal fin, such as some members of the genera Ocyurus, Paracaesio, Pristipomoides, and Rhomboplites, consume a significant amount of plankton, and have a weaker dentition with fewer enlarged canines in the jaws.

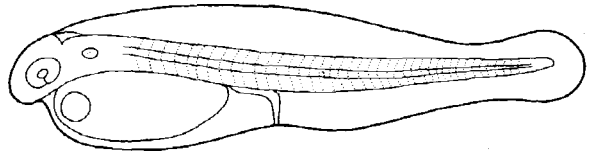
Although snappers seldom constitute the main focus of major commercial fisheries, they are an important component of the local artisanal catch throughout their geographic range. Because of their solitary habits and territorial behaviour, the larger species are not caught in huge quantities, but nevertheless are popular eating fishes frequently sold at markets. They are captured by a variety of methods which include handlines, traps, various types of nets, and trawling gear. Because of their widespread distribution, encompassing numerous national boundaries, and the largely artisanal nature of their fisheries, there are limited catch statistics for this group.

The catch of snappers for 1983 reported to FAO totalled 131 452 metric tons, of which roughly 57 000 were taken in the western central Pacific (Fishing Area 71), 28 000 in the western central Atlantic (Fishing Area 31), 13 000 in the eastern central Atlantic (Fishing Area 34), 11 720 in the southwestern Atlantic (Fishing Area 41), 9 000 in the northwestern Pacific (Fishing Area 61), 6 000 in the eastern central Pacific (Fishing Area 77), 4 000 in the western Indian Ocean (Fishing Area 51) and 3 000 in the eastern Indian Ocean (Fishing Area 52). Separate statistics were reported only for the following species: Lutjanus argentimaculatus: 9 814 metric tons (Fishing Areas 51 and 71); Lutianus purpureus: 7 531 metric tons in Fishing Areas 31 and 41; Lutjanus campechanus: 5 514 metric tons in Fishing Area 31; Ocyurus chrysurus: 5 178 metric tons in Fishing Areas 31 and 41; Lutjanus argentiventris: 3 632 metric tons in Fishing Area 77; and Lutjanus synagris: 2 261 metric tons in Fishing Area 31. Combined statistics for the genus Lutianus (excluding the above species) totalled 41 077 metric tons from Fishing Areas 71 (24 470 metric tons), 34 (13 094 metric tons), 57 (2 010 metric tons), 51 (613 metric tons) and 77 (389 metric tons). Finally the total catch of unidentified lutjanids (exclusive of the above categories) was 56 445 metric tons from Fishing Areas 51 (25 729 metric tons), 31 (11 382 metric tons), 61 (8 666 metric tons), 41 (3 610 metric tons), 51 (3 376 metric tons), 77 (1 988 metric tons), 57 (886 metric tons) and 87 (800 metric tons) (FAO,1984).

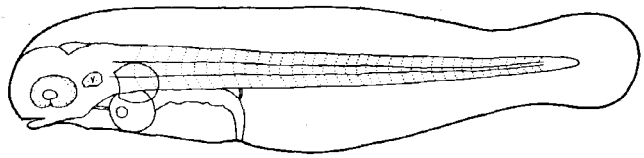
The larger species, especially those in the genus Lutjanus, are much sought after by recreational anglers, particularly in the Caribbean region and off the east coast of Australia. Although highly esteemed as food, several species are sometimes implicated in cases of human fish poisoning (ciguatera), including Lutjanus bohar, L. fulvus, L. gibbus, L. monostigma and Symphorus nematophorus of the Indo-West Pacific, and Lutjanus buccanella, L. cyanopterus, L. jocu, and L. vivanus of the western Atlantic. It is believed that Lutjanus and other predatory fishes accumulate the responsible toxin by feeding on herbivorous fishes that eat a dinoflagellate found on dead coral or benthic algae.



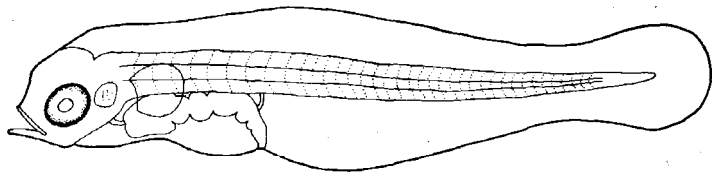
a. Lutjanus kasmira, newly hatched, 1.83 mm total length



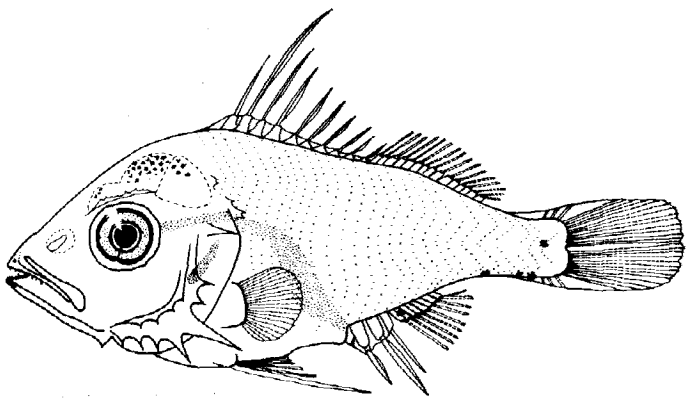
b. Lutjanus kasmira, 12 hours, 3.0 mm total length



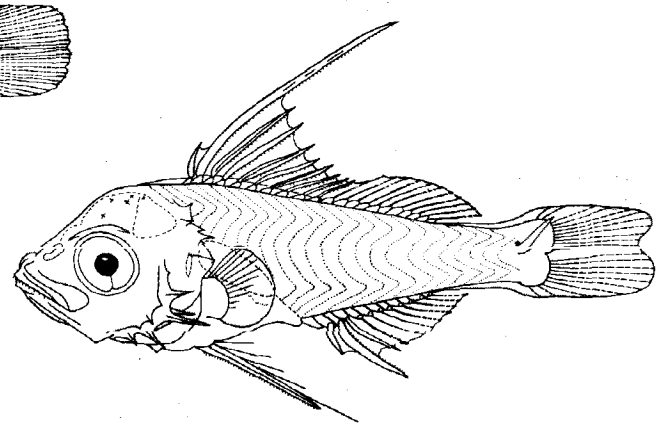
c. Lutjanus kasmira, 24 hours, 3.2 mm total length



d. Lutjanus kasmira, 72 hours, 3.2 mm total length



e. Lutjanus sp., about 7.7 mm total length



f. Aprion virescens, 7.1 mm total length

Fig.3 Examples of larval stages of Indo-West Pacific snappers
a-d from Suzuki & Hioki, 1979; e. from Leis & Rennis, 1983; f. from Leis, in press