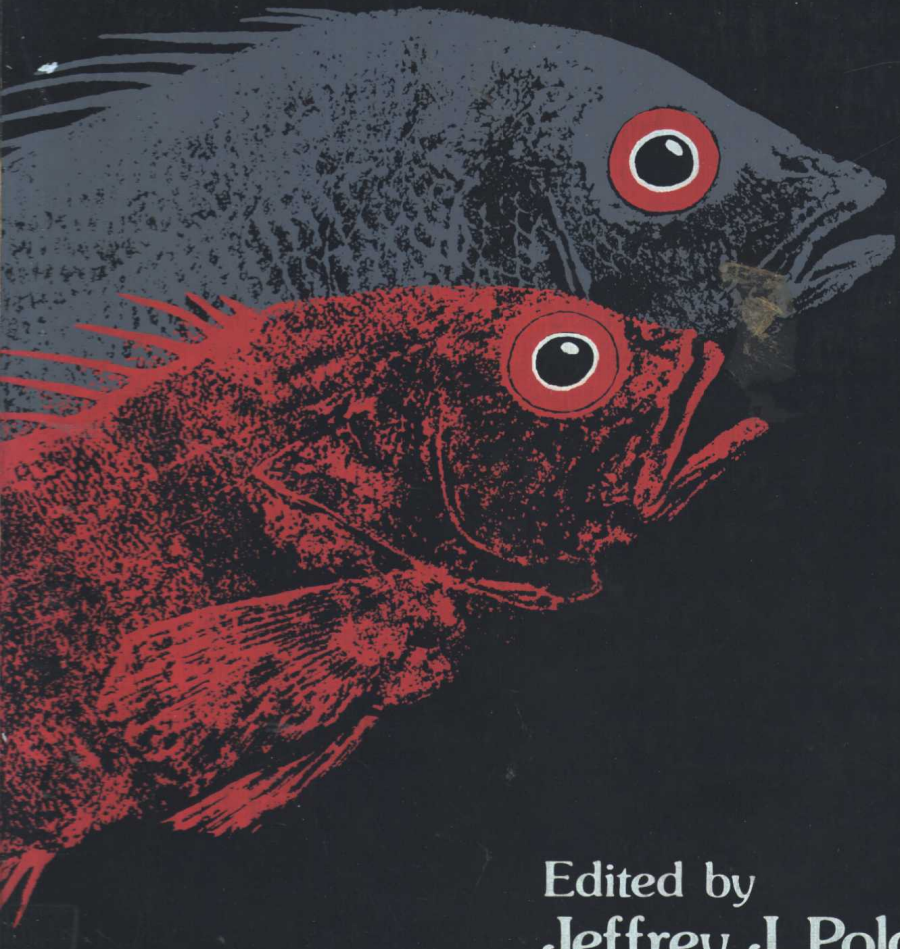
Tropical Snappers and Groupers: Biology and Fisheries Management



Edited by
Jeffrey J. Polovina
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Biology and Fisheries Management

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and Stephen Ralston

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About the Book and Editors

Snappers (Lutjanidae) and groupers (Serranidae) are among the most widely distributed fish taxa, yet most studies of these ecologically and commercially important families have been region-specific. This book presents an international perspective on snappers and groupers, including both research on their biology and discussions of fisheries management.

The first half of the book is devoted to biological reviews covering taxonomy, reproductive biology, early life history, growth, mortality, and community-trophic interactions. Surveys of the literature and extensive bibliographies provide a comprehensive perspective on current work on these two important fish groups.

Four more chapters examine assessment and management of fisheries for snappers and groupers in Australia, Hawaii and the Marianas, the southeastern United States, and the Gulf of Mexico and the Caribbean. They discuss historical trends within the fisheries, briefly describe methods of harvest, and evaluate and apply analytical methods to provide estimates of population and yield parameters. A final synthetic chapter takes a comparative approach to pursue general biological conclusions and explores future research needs.

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Preface

Snappers and groupers are important fishery resources throughout the tropical and subtropical regions of the world. These large apex predators are highly esteemed for their flavor and command high prices in virtually every society where they are found. Due in part to their non-migratory nature, geographic differences in species composition, and regional variation in methods of harvest, the literature concerning the biology and fisheries management of these fishes has been largely "region specific." This has been an unfortunate historical development. Clearly, much can be gained by comparing the experiences of researchers working on taxonomically similar resources that are harvested in differing localities.

In May of 1985 the Honolulu Laboratory of the Southwest Fisheries Center, National Marine Fisheries Service, sponsored a workshop which brought together researchers working on the biology and fisheries management of regional snapper and grouper stocks. Papers were presented that summarized our knowledge of these two groups, each written with the idea of developing a "resource specific" perspective on either their biology or fisheries management.

This book is the result of that workshop. The first nine chapters represent review papers that provide up-to-date summaries of our understanding of the biology of snappers and groupers. Included are papers dealing with taxonomy, early life history, reproductive biology, age and growth, mortality, and trophics. The next five chapters represent fisheries experience papers treating assessment, economic, and management aspects of snapper and grouper stocks. A final chapter synthesizes the main points and identifies critical information gaps. Regional coverage ranges from fisheries in the western Pacific Ocean to the Caribbean Sea. It is our hope that the results presented here will be of particular use in managing snapper and grouper fisheries to their fullest potential.

Many people contributed significantly to the completion of this volume. Izadore Barrett, Director of the Southwest Fisheries Center, and Richard S. Shomura, Director of the Honolulu Laboratory, provided the financial support and encouragement that we needed to see the project through. The talents of Elizabeth Young, Louise Lembeck, Virginia Ishida, Kathleen Repollo, and Gaylene Yoneda were used extensively in typing, editing, and preparing all the manuscripts for publication. Mary Lynne Godfrey technically edited each paper, Tom Weber prepared illustrations, and Josie Herr completed the layout for the book. Bill Walsh did a beautiful job preparing the cover gyotaku. We are particularly indebted to all these people for their dedicated work on this project. Lastly, we wish to thank each of the contributing authors for their patience and continued assistance as the volume approached completion.

Jeffrey J. Polovina
Stephen Ralston
Honolulu, Hawaii

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Fishery Management

1
Systematics of the Fishes of the Family Lutjanidae (Perciformes: Percoidei), the Snappers

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ABSTRACT

Seventeen genera and about 103 species are included in the snapper family (the Lutjanidae). Snappers are found throughout the world in tropical and subtropical seas, being largely confined to continental shelves and slopes and to corresponding depths around islands; some, however, enter estuaries and even fresh water. In this review descriptions of the family and subfamilies and keys to the genera and to the species of Pristipomoides and Paracaesio are furnished. In addition, descriptive information for genera and species, except those of Lutjanus, and geographic distributions are provided. In order to clarify the nomenclature, the status of numerous synonyms is presented.

INTRODUCTION

Fishes of the family Lutjanidae are found throughout the world in warm seas. Adults are mostly bottom-associated, feed chiefly on fishes and crustaceans, and occur from shallow inshore areas to depths of about 550 m. Some species enter estuaries and even fresh water. Early developmental stages are unknown for most species, but those stages that have been described are pelagic. The Lutjanidae include 17 genera and about 103 species. Herein I follow Johnson (1981) in excluding the Caesionidae from the Lutjanidae. Verilus and Symphysanodon, previously treated as members of the Lutjanidae by a number of

authors including Anderson (1967, 1970), are not members of that family (Johnson 1975). Allen (1985) presents a catalogue of lutjanid fishes. Some lutjanids reach sizes as great as 100 to 120 cm. Many are important to sport and/or commercial fishermen, and many are fine food fishes, although some are ciguatoxic in certain areas.

No synapomorphic character is known that distinguishes the Lutjanidae from other percoid families. Johnson (1981) treated the Lutjanidae as a natural group because of "the obvious intermediacy of the Apsilinae between the Etelinae and Lutjaninae."

Gill-raker counts are of those on the first gill arch and include rudiments. Counts of lateral-line scales are of tubed scales. Abbreviations used include: GMBL (Grice Marine Biological Laboratory, College of Charleston), SL (standard length), and USNM (National Museum of Natural History, Smithsonian Institution, Washington, D.C.).

FAMILY LUTJANIDAE

Mouth terminal. Two nostrils on each side of snout. Maxilla slipping for most or all of its length under lachrymal when mouth closed. Supramaxilla absent. Premaxillae usually moderately protractile (fixed in Aphareus and Randallichthys). No bony suborbital stay. Subocular shelf on third infraorbital. Opercle with two small flat spines. Tubes in lateral-line simple; lateral line complete, not extending far onto caudal fin. Scales ctenoid; cheek and operculum scaly; maxilla with or without scales; snout, lachrymal, and lower jaw naked. Upper and lower jaws usually with more or less distinct canines (canines absent in Aphareus, Parapristipomoides, and Pinjalo; molariform teeth present in Hoplopagrus). Vomer and palatines usually with teeth. Pterygoids usually toothless (pterygoid teeth present in Ocyurus and Rhomboplites). Gill membranes separate, free from isthmus. Gill arches four, a slit behind fourth. Pseudobranchiae well developed. Branchiostegal rays seven. Body moderately elongate to deep. Dorsal fin single, spinous portion sometimes deeply incised; dorsal-fin rays IX to XII, 9 to 18. Anal-fin rays III,7 to 11. Pectoral-fin rays 14 to 19. Pelvic fins thoracic, I, 5; pelvic axillary process usually well-developed. Caudal fin truncate to deeply forked; principal caudal-fin rays 17 (9 + 8); procurrent caudal-fin rays 8 to 13 dorsally and ventrally; posteriormost ventral procurrent caudal-fin ray without a

spur (Johnson 1975). Vertebrae 24 (10 precaudal + 14 caudal). Epipleural ribs 7 to 13, first articulating with first vertebra. Pleural ribs usually 8 (in Apsilus fuscus 11 or 12), first articulating with third vertebra. Predorsal bones usually three (two in Aprion). First dorsal and first anal pterygiophore each supporting two supernumerary spines. Posteriormost two to seven complete pterygiophores of dorsal fin and posteriormost one to six complete pterygiophores of anal fin trisegmental (i.e., proximal and middle elements not fused). A crescent-shaped bony stay posterior to last complete dorsal and anal pterygiophore. Three epurals; two pairs of uroneurals; five hypurals (hypurals 1-2 and 3-4 frequently fused); one parhypural with well-developed hypurapophysis. Adductor mandibulae with or without separate upper division of A_1 (i.e., A_1') originating on subocular shelf.

The limits and relationships of the family Lutjanidae have been studied in detail recently by Johnson (1981). The preceding descriptive material is largely derived from Johnson's study. Four subfamilies (Etelinae, Apsilinae, Paradicichthyinae, and Lutjaninae) are currently recognized.

KEY TO THE GENERA OF LUTJANIDAE

1a. Dorsal and anal fins without scales. Dorsal-fin rays X,10 or 11 (rarely X,9) 2

1b. Soft dorsal and anal fins with scales or sheathed with scales basally. Dorsal-fin rays IX-XII,10-18 11

2a. Maxilla with scales 3

2b. Maxilla without scales 5

3a. Spinous portion of dorsal fin deeply incised at its junction with soft portion. Dorsal-fin rays X,11 (very infrequently X,10) . . . . . Etelis

3b. Spinous portion of dorsal fin not deeply incised at its junction with soft portion. Dorsal-fin rays X,10 4

4a. Ultimate soft ray of dorsal fin and anal fin shorter than penultimate soft ray . . . . . Paracaesio

4b. Ultimate soft ray of dorsal fin and anal fin about equal to or slightly longer than penultimate soft ray . . . . . Parapristipomoides

5a. Premaxillae essentially non-protractile, attached to snout at symphysis by a frenum 6

5b. Premaxillae protractile, not attached to snout by frenum 7

6a. Vomer without teeth. Teeth in jaws minute, no caniniform teeth. Pectoral fin somewhat shorter than head. Lateral surface of maxilla smooth . . . . . Aphareus

6b. Vomer with teeth. Jaws with some caniniform teeth. Pectoral fin about one-half to two-thirds length of head. Lateral surface of maxilla with a series of well-developed longitudinal ridges . . . Randallichthys

7a. Ultimate soft ray of dorsal fin and anal fin longer than penultimate soft ray 8

7b. Ultimate soft ray of dorsal fin and anal fin about equal to or shorter than penultimate soft ray 9

8a. Groove present on snout below nostrils. Pectoral fin less than one-half length of head . . . . . Aprion

8b. No groove on snout. Pectoral fin about two-thirds length of head to somewhat longer than head . . . . . Pristipomoides

9a. Upper lip with a median fleshy protrusion, well-developed in adults. Spines of dorsal and anal

fins strong, very robust in large adults . . . . . Lipocheilus

9b. Upper lip without a median fleshy protrusion 10

10a. Adductor mandibulae section A_1 with a well-developed anterodorsal extension. Ultimate dorsal and ultimate anal soft rays 86-113% length of respective penultimate soft rays. Atlantic . . . . . Apsilus

10b. Adductor mandibulae section A_1 without an anterodorsal extension. Ultimate dorsal and ultimate anal soft rays <90% length of respective penultimate soft rays. Indo-Pacific . . . . . Paracaesio

11a. Vomer without teeth. Dorsal-fin rays X,14-18. Some of anterior dorsal soft rays produced as filaments (at least in juveniles) 12

11b. Vomer with teeth. Dorsal-fin rays IX-XII,10-16. None of anterior dorsal soft rays produced as filaments 13

12a. Anterior profile quite steep (see Plate 1.2f). Upper and lower pharyngeals enlarged and bearing large molariform teeth . . . . . Symphorichthys

12b. Anterior profile sloping more gently (see Plate 1.3a and 1.3b). Upper and lower pharyngeals not particularly enlarged, not bearing molariform teeth . . . . . Symphorus

13a. Pterygoid teeth present 14

13b. Pterygoid teeth absent 15

14a. Dorsal-fin rays XII,11 (rarely XII,10 or XII,12) . . . . . Rhomboplites

14b. Dorsal-fin rays X,12 or 13 (rarely with IX or XI spines or 14 soft rays) . . . . . Ocyurus

15a. Teeth in jaws and on vomer molariform. Anterior nostril opening through a tube above upper lip . . . . . Hoplopagrus
15b. Teeth conical. Anterior nostril not opening through a tube above upper lip 16

16a. First gill arch with 60 or more gill rakers on lower limb . . . . . Macolor
16b. First gill arch with 20 or fewer gill rakers on lower limb 17

17a. Mouth rather small, somewhat upturned. Teeth in jaws small . . . . . Pinjalo
17b. Mouth larger, usually not upturned. Some caniniform teeth in jaws . . . . . Lutjanus

SUBFAMILY ETELINAE

Nostrils on each side close together; posterior flap of anterior nostril, when reflected, typically reaching anterior border of posterior nostril. Vomerine teeth present (except in Aphareus). Body moderately elongate. Dorsal and anal fins scaleless. Dorsal-fin rays X,11 (infrequently X,10). Anal-fin rays III,8 or 9 (very infrequently III,7). Anterior dorsal and anterior anal soft rays not produced into filaments. Ultimate soft ray of dorsal fin and anal fin produced, longer than penultimate soft ray (except in Randallichthys where ultimate soft ray about equal to penultimate). Caudal fin lunate to deeply forked. Procurrent caudal-fin rays 10 to 13 dorsally, 9 to 13 ventrally. Interorbital region flattened. Configuration of predorsal bones, anterior neural spines, and anterior dorsal pterygiophores (using the symbolization of Ahlstrom et al. 1976) usually 0/0+0/2/1+1/ (Aprion with 0/0/2/1+1/). Posteriormost four to seven complete pterygiophores of dorsal fin and posteriormost three to six complete pterygiophores of anal fin trisegmental. Adductor mandibulae typically simple, section A_1 with anterodorsal extension only in Pristipomoides and Aprion; division A_1' absent. (See Johnson 1981.)

Five genera: Etelis, Randallichthys, Aphareus, Pristipomoides, and Aprion.

GENUS ETELIS CUVIER, 1828

Maxilla with scales, but without a series of longitudinal bony ridges on lateral surface. Premaxillae protractile. Dorsal fin continuous, but spinous portion of fin deeply incised at its junction with soft portion. Pectoral fin fairly long; in specimens more than about 160 mm SL, length of pectoral fin about 80 to 90% of head length. Dorsal-fin rays X,11 (very infrequently X,10). Anal-fin rays III,8. Pectoral-fin rays 15 to 17 (usually 16). Species of Etelis are reddish dorsally and dorsolaterally, paler ventrolaterally and ventrally. Four species. Type species Etelis carbunculus. Anderson and Fourmanoir (1975) relegated Erythrobussothen Parr, 1933, to the synonymy of Etelis. (See Anderson 1981.)

Species of Etelis (Plate 1.1a)

Etelis carbunculus Cuvier, 1828. Gill rakers 5 to 8 + 11 to 14--total 17 to 22. Lateral-line scales 48 to 50. Length of pelvic fin 18 to 20% SL. Length of upper lobe of caudal fin 26 to 30% SL. Jaws each with several enlarged needlelike canine teeth. Widespread in the Indo-Pacific. Etelis marshi (Jenkins, 1903) is a junior synonym of E. carbunculus.

Etelis coruscans Valenciennes, 1862. Gill rakers 8 to 10 + 15 to 18--total 23 to 28. Lateral-line scales 47 to 50. Length of pelvic fin usually 21 to 23% SL. Length of upper lobe of caudal fin 33 to 75% SL. Widespread in the Indo-Pacific.

Etelis oculatus (Valenciennes, 1828). Gill rakers 7 to 11 + 14 to 18--total 23 to 28. Lateral-line scales 47 to 50. Length of pelvic fin 18 to 21% SL. Length of upper lobe of caudal fin 27 to >40% SL. Western Atlantic. Anderson and Fourmanoir (1975) showed that Erythrobussothen gracilis Parr, 1933, is a junior synonym of Etelis oculatus.

Etelis radiosus Anderson, 1981. Gill rakers 12 to 15 + 20 to 22--total 33 to 36. Lateral-line scales 50 or 51. Length of pelvic fin 17 to 18% SL. Length of upper lobe of caudal fin 31 to 34% SL. Tropical Indo-Pacific.

GENUS RANDALLICHTHYS ANDERSON, KAMI, AND JOHNSON 1977 (PLATE 1.1b)

Maxilla without scales, but with a well-developed series of longitudinal bony ridges on lateral surface. Premaxillae not protractile, fixed by a frenum. Gill openings extending anterior to orbit. Dorsal fin continuous, indented just anterior to junction of spinous and soft portions, but not as deeply incised as in Etelis. Pectoral fin short, about one-half to two-thirds length of head. Dorsal-fin rays X,11. Anal-fin rays III,9. Pectoral-fin rays 16 or 17. Gill rakers 5 to 9 + 14 to 16--total 19 to 23. Lateral-line scales 48 or 49. Ground color rosy to dull orange. The single species, Randallichthys filamentosus (Fourmanoir, 1970), is widespread in the central and western Pacific and may be antiequatorial in distribution (Randall 1982). Etelis filamentosus Fourmanoir, 1970, and E. nudimaxillaris Yoshino and Araga, 1975, are synonyms of R. filamentosus.

GENUS APHAREUS CUVIER, 1830

Maxilla without scales; no well-developed series of longitudinal bony ridges on lateral surface of maxilla. Premaxillae not protractile, fixed by a frenum. Gill openings extending far anterior to orbit. Dorsal fin continuous, not deeply incised near junction of spinous and soft portions. Pectoral fin somewhat shorter than head. Dorsal-fin rays X,11 (infrequently X,10). Anal-fin rays III,8. Pectoral-fin rays 15 or 16. Lateral-line scales 69 to 75. Two species. Type species Aphareus furca.

Species of Aphareus (Plate 1.1c)

Aphareus furca[1] (Lacepède, 1801). Gill rakers 6 to 10 + 16 to 18--total 22 to 27. Color steel blue. Widely distributed in the Indo-Pacific.

Aphareus rutilans Cuvier, 1830. Gill rakers 16 to 19 + 32 to 35--total 49 to 52. Head and body brick red or pink dorsally; inside of mouth, gill chamber, and gills shining silver. Widely distributed in the Indo-Pacific.

GENUS PRISTIPOMOIDES BLEEKER, 1852

Maxilla without scales; no well-developed series of longitudinal bony ridges on lateral surface of maxilla. Premaxillae protractile. Gill openings not extending far anterior to orbit. Dorsal fin continuous, not deeply incised near junction of spinous and soft portions. Pectoral fin fairly long, about two-thirds length of head to somewhat longer than head. Dorsal-fin rays X,11 (rarely X,10). Anal-fin rays III,8 (rarely III,7 or III,9). Pectoral-fin rays 15 to 17. Eleven species. Type species Pristipomoides typus. Tropidinius Gill, 1868, a junior synonym of Apsilus Valenciennes, 1830, has been used incorrectly as the generic name for some species of Pristipomoides.

Key to the Species of Pristipomoides

1a. Western Atlantic species 2
1b. Indo-Pacific species 4

2a. Depth of body at origin of dorsal fin 3.5-4.2 times in SL (23.9-28.2% SL). Total number of gill rakers 28-32. Lateral-line scales 49-51 . . . . . P. freemani
2b. Depth of body at origin of dorsal fin 2.5-3.2 times in SL (31.1-40.5% SL). Total number of gill rakers 19-28. Lateral-line scales 48-57 3

3a. Lateral-line scales 48-52. Total number of gill rakers 24-28 . . . . . P. aquilonaris
3b. Lateral-line scales 54-57. Total number of gill rakers 19-25 . . . P. macrophthalmus

4a. Lateral-line scales 48-50 5
4b. Lateral-line scales 57-71 6

5a. No golden bands on snout and cheek; longitudinal vermiculations on dorsum of head. Suborbital narrow--8.4 times in length of head at 150 mm SL, 7.3 at 250 mm,