MEMOIR
SEARS FOUNDATION FOR MARINE RESEARCH

Number I

Fishes of the Western North Atlantic

PART TEN

Order Beloniformes
Needlefishes, Sauries, Halfbeaks, and Flyingfishes

BELONIDAE
SCOMBERESOCIDAE
HEMIRAMPHIDAE
EXOCOETIDAE
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>xi</td>
</tr>
<tr>
<td>Introduction</td>
<td>xiii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>xiii</td>
</tr>
<tr>
<td><strong>Order Beloniformes. By Bruce B. Collette and Katherine E. Bemis</strong></td>
<td>1</td>
</tr>
<tr>
<td>Key to the Western Atlantic Families of Beloniformes</td>
<td>4</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>4</td>
</tr>
<tr>
<td><strong>Family Belonidae. Needlefishes. By Bruce B. Collette and Katherine E. Bemis</strong></td>
<td>5</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Materials and Methods</td>
<td>6</td>
</tr>
<tr>
<td>Key to the Belonidae of the Western Atlantic</td>
<td>7</td>
</tr>
<tr>
<td>Genus Ablennes</td>
<td>8</td>
</tr>
<tr>
<td>Ablennes hians</td>
<td>8</td>
</tr>
<tr>
<td>Genus Platybelone</td>
<td>12</td>
</tr>
<tr>
<td>Platybelone argalus argalus</td>
<td>12</td>
</tr>
<tr>
<td>Genus Strongylura</td>
<td>18</td>
</tr>
<tr>
<td>Strongylura hubbsi</td>
<td>18</td>
</tr>
<tr>
<td>Strongylura marina</td>
<td>21</td>
</tr>
<tr>
<td>Strongylura notata</td>
<td>30</td>
</tr>
<tr>
<td>Strongylura notata notata</td>
<td>31</td>
</tr>
<tr>
<td>Strongylura notata forsythia</td>
<td>34</td>
</tr>
<tr>
<td>Strongylura timucu</td>
<td>37</td>
</tr>
<tr>
<td>Genus Tylosurus</td>
<td>42</td>
</tr>
<tr>
<td>Tylosurus acus acus</td>
<td>42</td>
</tr>
<tr>
<td>Tylosurus crocodilus crocodilus</td>
<td>48</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>54</td>
</tr>
<tr>
<td><strong>Family Scomberesocidae. Sauries. By Katherine E. Bemis and Bruce B. Collette</strong></td>
<td>79</td>
</tr>
<tr>
<td>Introduction</td>
<td>79</td>
</tr>
<tr>
<td>Materials and Methods</td>
<td>80</td>
</tr>
<tr>
<td>Key to the North Atlantic Sauries</td>
<td>80</td>
</tr>
<tr>
<td>Genus Scomberesox</td>
<td>80</td>
</tr>
<tr>
<td>Scomberesox saurus saurus</td>
<td>81</td>
</tr>
<tr>
<td>Scomberesox simulans</td>
<td>83</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>86</td>
</tr>
<tr>
<td><strong>Family Hemiramphidae. Halfbeaks. By Bruce B. Collette and Katherine E. Bemis</strong></td>
<td>89</td>
</tr>
<tr>
<td>Introduction</td>
<td>89</td>
</tr>
<tr>
<td>Materials and Methods</td>
<td>91</td>
</tr>
<tr>
<td>Key to the Hemiramphidae of the Western Atlantic</td>
<td>92</td>
</tr>
<tr>
<td>Genus Chriodorus</td>
<td>93</td>
</tr>
<tr>
<td>Chriodorus atherinoides</td>
<td>93</td>
</tr>
<tr>
<td>Genus Euleptorhamphus</td>
<td>96</td>
</tr>
<tr>
<td>Euleptorhamphus velox</td>
<td>96</td>
</tr>
<tr>
<td><strong>Family Exocoetidae. Flyingfishes. By Nikolay V. Parin, Ilia B. Shakhovskoy, Katherine E. Bemis, and Bruce B. Collette</strong></td>
<td>149</td>
</tr>
<tr>
<td>Introduction</td>
<td>149</td>
</tr>
<tr>
<td>Materials and Methods</td>
<td>150</td>
</tr>
<tr>
<td>Key to the Species of Exocoetidae in the Western Atlantic</td>
<td>151</td>
</tr>
<tr>
<td>Genus Cheilopogon</td>
<td>152</td>
</tr>
<tr>
<td>Cheilopogon cyanopterus</td>
<td>153</td>
</tr>
<tr>
<td>Cheilopogon exsiliens</td>
<td>160</td>
</tr>
<tr>
<td>Cheilopogon furcatus furcatus</td>
<td>165</td>
</tr>
<tr>
<td>Cheilopogon heterurus</td>
<td>170</td>
</tr>
<tr>
<td>Cheilopogon melanurus</td>
<td>176</td>
</tr>
<tr>
<td>Cheilopogon pinnatibarbatus</td>
<td>180</td>
</tr>
<tr>
<td>Genus Cypselurus</td>
<td>186</td>
</tr>
<tr>
<td>Cypselurus comatus</td>
<td>186</td>
</tr>
<tr>
<td>Genus Exocoetus</td>
<td>191</td>
</tr>
<tr>
<td>Exocoetus obtusirostris</td>
<td>191</td>
</tr>
<tr>
<td>Exocoetus volitans</td>
<td>196</td>
</tr>
<tr>
<td>Genus Hirundichthys</td>
<td>199</td>
</tr>
<tr>
<td>Hirundichthys affinis</td>
<td>199</td>
</tr>
<tr>
<td>Hirundichthys rufipinnis</td>
<td>206</td>
</tr>
<tr>
<td>Hirundichthys speculiger</td>
<td>209</td>
</tr>
<tr>
<td>Hirundichthys volador</td>
<td>214</td>
</tr>
<tr>
<td>Genus Parexocoetus</td>
<td>219</td>
</tr>
<tr>
<td>Parexocoetus hillianus</td>
<td>219</td>
</tr>
<tr>
<td>Genus Prognichthys</td>
<td>223</td>
</tr>
<tr>
<td>Prognichthys glaphyrae</td>
<td>224</td>
</tr>
<tr>
<td>Prognichthys occidentalis</td>
<td>228</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>232</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>241</td>
</tr>
</tbody>
</table>
Table of Contents

Genus Hemiramphus 98
   Hemiramphus balao 99
   Hemiramphus bermudensis 103
   Hemiramphus brasiliensis 105
Genus Hyporhamphus 109
   Hyporhamphus brederi 110
   Hyporhamphus collettei 112
   Hyporhamphus meeki 113
   Hyporhamphus mexicanus 117
   Hyporhamphus roberti 119
   Hyporhamphus roberti roberti 119
   Hyporhamphus roberti hildebrandi 122
   Hyporhamphus unifasciatus 124
Genus Oxyporhamphus 127
   Oxyporhamphus micropterus similis 127
Literature Cited 130

Family Exocoetidae. Flyingfishes.
By Nikolay V. Parin, Ilia B. Shakhoverkoy, Katherine E. Bemis, and Bruce B. Collette 149
   Introduction 149
   Materials and Methods 150
   Key to the Species of Exocoetidae in the Western Atlantic 151
Genus Cheilopogon 152
   Cheilopogon cyanopterus 153
   Cheilopogon exsiliens 160
   Cheilopogon furcatus furcatus 165
   Cheilopogon heterurus 170
   Cheilopogon melanurus 176
   Cheilopogon pinnatibarbatis 180
Genus Cypselurus 186
   Cypselurus comatus 186
Genus Exocoetus 191
   Exocoetus obtusirostris 191
   Exocoetus volitans 196
Genus Hirundichthys 199
   Hirundichthys affinis 199
   Hirundichthys rufipinnis 206
   Hirundichthys speculiger 209
   Hirundichthys volador 214
Genus Parexocoetus 219
   Parexocoetus hillianus 219
Genus Prognichthys 223
   Prognichthys glaphyrae 224
   Prognichthys occidentalis 228
Literature Cited 232

Index 241
Order Beloniformes

BRUCE B. COLLETTE and KATHERINE E. BEMIS
Family Belonidae
NEEDLEFISHES

BRUCE B. COLLETTE and KATHERINE E. BEMIS
Figure 2.2. Atlantic distribution of Flat Needlefish, *Ablennes hians*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 2, Family Belonidae Needlefishes, Page 11.
Figure 2.4. Atlantic distribution of Keeltail Needlefish, *Platybelone argalus*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 2, Family Belonidae Needlefishes, Page 15.
Figure 2.6. General distribution of three freshwater Beloniformes: Maya Needlefish, Strongylura hubbsi, El Petén Halfbeak, Hyporhamphus mexicanus, and Breder's Halfbeak, Hyporhamphus brederi; based on specimens examined by B. B. Collette. Map by W. E. Bemis.

Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Iliya B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 2, Family Belonidae Needlefishes, Page 20.
Figure 2.8. Distribution of Atlantic Needlefish, *Strongylura marina*, and Timucu, *Strongylura timucu*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 2, Family Belonidae Needlefishes, Page 30.
Figure 2.10. Distribution of Redfin Needlefish, *Strongylura notata notata* and *S. notata forsythia*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
*Fishes of the Western North Atlantic, Part 10*
Chapter 2, Family Belonidae Needlefishes, Page 36.
Figure 2.13. Atlantic distribution of Atlantic Agujon, *Tylosurus acus*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*

Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy

Fishes of the Western North Atlantic, Part 10

Chapter 2, Family Belonidae Needlefishes, Page 48.
Figure 2.15. Atlantic distribution of Houndfish, *Tylosurus crocodilus*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 2, Family Belonidae Needlefishes, Page 54.
Fishes of the Western North Atlantic • Order Beloniformes

Introduction

Scomberesocidae is the sister group of the Belonidae, which together form the superfamily Scomberesocoidea. All members of Scomberesocoidea share three derived characters: presence of a premaxillary canal, upper jaw at least slightly elongate, and interdigitation of bony processes from each side of the lower jaw (Collette et al. 1984; also E. M. G. Kokkelmans, "The functional morphology and phylogenetic implications of lower jaw structure of the Scomberesocoidea," unpublished manuscript). Analyses of the pharyngeal jaw apparatus support the concept that sauries are most closely related to needlefishes (Aschliman et al. 2005). Scomberesocidae is defined by one derived character: the dorsal and anal fins are followed by a series of four to seven finlets. Other diagnostic characters include: third pair of upper pharyngeal bones separate, fourth upper pharyngeal bone usually present, and scales on the body are relatively small. There are no spines in the fins. The dorsal, with 14–18 rays, including the finlets, and anal fins, with 16–21 rays, including the finlets, are posterior in position; the pelvic fins, with 6 soft rays, are abdominal in position; pectoral fins are short, with 8–15 rays. The caudal fin is deeply forked and symmetrical, similar to a mackerel tail. The lateral line, when present, runs along the ventral margin of the body. Gill raker counts by Parin (1968) are clearly for lower first arch gill rakers and we presume the same is true for Hubbs and Wisner (1980), although this was not stated. Maximum observed size of the two large species, Cololabis saira and Scomberesox saurus, is 350–400 mm SL; maximum observed size of the two dwarf species is 68 mm SL for C. adocoetus and 126 mm SL for S. simulans (Hubbs and Wisner 1980).

Hubbs and Wisner (1980) placed the four species of sauries in four monotypic genera: Scomberesox and its dwarf derivative Nanichthys, and Cololabis and its dwarf derivative Elassichthys. Rather than recognize four monotypic genera, we recognize two evolutionary lines in the family by considering Nanichthys a synonym of Scomberesox and Elassichthys a synonym of Cololabis (Collette et al. 1984). Both species of Scomberesox develop an elongate beak in comparison to Cololabis; the snout increases in length in S. simulans throughout its life span and in S. saurus until a length of about 200 mm SL. The two dwarf species Cololabis adocoetus and Scomberesox simulans differ convergently from the two larger species, C. saira and S. saurus, in being much smaller, losing one ovary and the swim bladder, and in having fewer vertebrae, branchiostegal rays, pectoral fin rays, and gill rakers.

Scomberesox inhabits the Atlantic, Pacific, and Indian oceans; Cololabis is restricted to the Pacific Ocean. Sauries spend most of their life in warm homogeneous surface layers of the open sea, far from shallow continental shelf waters. They live close to the surface, so close that in English waters, where Atlantic Saury are plentiful in summer, few are caught in nets as deep as 2 m. Atlantic Saury are one of the most abundant epipelagic planktivores inhabiting the open part of the Atlantic Ocean, feeding mainly on copepods, euphausiids, and amphipods.

Family Scomberesocidae
SAURIES

KATHERINE E. BEMIS and BRUCE B. COLLETTE

© 2019 Peabody Museum of Natural History, Yale University. All rights reserved. Yale University provides access to these materials for noncommercial personal, educational and research purposes only. These maps may not be reproduced, distributed, or archived, in whole or in part, in any form without the written permission of the Yale Peabody Museum of Natural History.
Figure 3.2. Atlantic distribution of Atlantic Saury, *Scomberesox saurus*, based on specimens examined by Hubbs and Wisner (1980). Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 3, Family Scomberesocidae Sauries, Page 83.
Figure 3.4. Atlantic distribution of Atlantic Dwarf Saury, *Scomberesox simulans*, based on specimens examined by Hubbs and Wisner (1980). Map by W. E. Bemis.
Fishes of the Western North Atlantic • Order Beloniformes

Arrhamphus, Chriodorus, Melapedalion, and Oxyporhamphus have very short or no beaks. Euleptorhamphus and Oxyporhamphus contain two offshore species each. Hemiramphus (with 10 species) is a widespread marine genus. Rhynchorhamphus (with 4 species) has fimbriate nasal papillae and is confined to Indo-West Pacific marine waters. Hyporhamphus, the most speciose genus, includes two subgenera: Hyporhamphus with 25 species is widespread and Reporhamphus with 11 species occurs only in the Indo-West Pacific. Some Hyporhamphus species are marine, some estuarine, and some freshwater. All genera are characterized by particular lateral line characters (Parin and Astakhov 1982).

We include Oxyporhamphus in the family Hemiramphidae, not the Exocoetidae (Collette 1966; Parin et al. 1980; Collette et al. 1984; Lovejoy et al. 2004; Lewallen et al. 2011). In external morphology, Oxyporhamphus, with short jaws and elongate pectoral fins, resembles the true flyingfishes. Because of this, Oxyporhamphus was at one time placed in the family Exocoetidae (Nichols and Breder 1928; Hubbs 1933; and others) and has been so placed once again by Silas et al. (1997). This similarity is a condition not so much of close relationship as of parallel development of the ability to glide in flight over the water. In most of the anatomical characters (presence of forked parapophyses, direct connection of the basioccipital and cleithrum, incomplete fusion of the frontals and parietals, failure of interradial foramina in the pectoral fin skeleton to close, and nonprojection of the swim bladder into the haemal canal [Parin 1961]), and also from the evidence of ontogeny, there is...
Figure 4.2. Distribution of Hardhead Halfbeak, *Chriodorus atherinoides*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.
Figure 4.4. Distribution of Atlantic Ribbon Halfbeak, *Euleptorhamphus velox*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.
Figure 4.6. Distribution of Balao, *Hemiramphus balao*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*

Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy

*Fishes of the Western North Atlantic*, Part 10

Chapter 4, Family Hemiramphidae Halfbeaks, Page 102.
Figure 4.8. Distribution of Bermuda Ballyhoo, *Hemiramphus bermudensis*, and Redtail Ballyhoo, *Hemiramphus brasiliensis*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*

Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy

Fishes of the Western North Atlantic, Part 10

Chapter 4, Family Hemiramphidae Halfbeaks, Page 104.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 4, Family Hemiramphidae Halfbeaks, Page 113.
Figure 4.16. Distribution of Pajarito, *Hyporhamphus roberti roberti* and *H. roberti hildebrandi*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 4, Family Hemiramphidae Halfbeaks, Page 123.
Figure 4.19. Distribution of Atlantic Bigwing Halfbeak, *Oxyporhamphus micropterus similis*, based on specimens examined by B. B. Collette. Map by W. E. Bemis.

Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 4, Family Hemiramphidae Halfbeaks, Page 129.
Introduction

The Exocoetidae, the flyingfishes, is one of six families of the order Beloniformes. It is the sister group of the Hemiramphidae, the halfbeaks, forming the superfamily Exocoetoidea (Collette et al. 1984). Flyingfishes lack the elongate lower jaw (except for juveniles of *Fodiator*) present in most halfbeaks and can be distinguished from the needlefishes (Belonidae) and sauries (Scomberesocidae), which have both jaws elongate.

The Exocoetidae contains seven genera and about 65–70 species (Shakhovskoy and Collette, in press). Flyingfishes are small- to medium-sized (to 480 mm total length) with elongate, broadly cylindrical (round or elliptical in cross section) bodies, flattened ventrally in some species. The head is short, snout usually blunt (produced only in *Fodiator*), and shorter than the eye in all western Atlantic species. Flyingfishes have a small mouth and very small or no jaw teeth, but have well-developed pharyngeal teeth. The upper pharyngeal bones of the third gill arches are close together, but not fused into a single plate. There are no spines in the fins. The dorsal and anal fins are set equally far back on the body, their bases are short and opposed. The caudal fin is deeply forked, its lower lobe longer than the upper. The pectoral fins insert high on the body, are strikingly long, and always extend beyond the origin of the dorsal fin in adults. The pelvic fins are abdominal in position, and greatly enlarged in many, but not all, species. The lateral line is low on the body, and provides diagnostic characters for the genera as described by Parin and Astakhov (1982). The large cycloid scales are easily shed. The swim bladder is large, extending posteriorly beyond the body cavity. Adult flyingfishes are usually dark above and pale below. The dark colors are typically iridescent blue or green in life; the dorsal fin in some species has black pigment, and the pectoral fins in some species have a pale crossband and outer margin.

Otolith and tagging studies suggest that flyingfishes are short lived, with individuals usually living no more than 1.5 years. All species are oviparous. The eggs of some species are buoyant and float on the surface, whereas the eggs of other species have specialized filaments to attach to floating debris and seaweed. Juveniles (to about 100–150 mm SL) differ in appearance from adults, having shorter pectoral fins, a higher dorsal fin, and a conspicuous single or paired chin barbel in many species. Color patterns of juvenile flyingfishes are highly variable, and they often have spots and bars not found in adults.

Exocoetids are well known for leaping out of the water and gliding through the air to escape predators below the surface (see the amazing photographs of flyingfishes in Howell [2014]). The two-winged flyingfishes use enlarged pectoral fins, whereas the four-wing flyingfishes have enlarged pelvic as well as pectoral fins that allow them to glide relatively longer distances. Fins are not flapped during flight, but rather erected quickly as the fish leaves the water and held perpendicular to the body during the glide; the fish is propelled into the air by a strong thrust of the caudal fin (Davenport 1994, 2003).

Flyingfishes inhabit the surface of open oceans as well as neritic and inshore areas and are abundant in most tropical seas. Many species of flyingfishes school in large groups, but do not undertake extensive migrations. Flyingfishes are important components of pelagic food webs and serve as prey species for dolphinfishes, tunas, billfishes, sharks, cetaceans, and pelagic seabirds (Perrin et al. 1973; Richard and Barbeau 1994; Andrew et al. 1995; Vaske et al. 2005; Alonso et al. 2014; Herzing and Elliser 2014). Little specific information is known about the diet of western Atlantic species of flyingfishes, which predominantly...
Figure 5.2. Atlantic distribution of Margined Flyingfish, *Cheilopogon cyanopterus*, based on Parin and Belyanina (1996). Map by W. E. Bemis.

Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 158.
Figure 5.4. Distribution of Bandwing Flyingfish, *Cheilopogon exsiliens*, based on Parin and Belyanina (1996). Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*

Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy

*Fishes of the Western North Atlantic, Part 10*

Chapter 5, Family Exocoetidae Flyingfishes, page 164.
Figure 5.6. Distribution of Spotfin Flyingfish, *Cheilopogon furcatus furcatus*, based on Parin and Belyanina (1998). Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 168
Figure 5.11. Distribution of Bennett’s Flyingfish, *Cheilopogon pinnatibarbus*, based on specimens identified by N. V. Parin and I. B. Shakhovskoy, as well as data from the scientific literature. Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 185.
Figure 5.13. Distribution of Clearwing Flyingfish, *Cypselurus comatus*, based on specimens identified by N. V. Parin and I. B. Shakhovskoy, as well as data from the scientific literature. Map by W. E. Bemis.
Figure 5.15. Distribution of Oceanic Two-wing Flyingfish, *Exocoetus obtusirostris*, based on Parin and Shakhovskoy (2000). Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 195.
Figure 5.17. Atlantic distribution of Tropical Two-wing Flyingfish, *Exocoetus volitans*, based on Parin and Shakhovskoy (2000). Map by W. E. Bemis.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 198.
Figure 5.19. Distribution of Fourwing Flyingfish, *Hirundichthys affinis*, based on Shakhovskoy and Parin (2013b). Map by W. E. Bemis.

*Order Beloniformes*: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 205.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*

Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy

*Fishes of the Western North Atlantic, Part 10*

Chapter 5, Family Exocoetidae Flyingfishes, page 208.
Figure 5.23. Atlantic distribution of Mirrorwing Flying-fish, *Hirundichthys speculiger*, based on Shakhovskoy and Parin (2013a). Map by W. E. Bemis.

Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 214.
Figure 5.26. Distribution of Atlantic Sailfin Flyingfish, *Parexocoetus hillianus*, based on specimens identified by N. V. Parin and I. B. Shakhovskoy. Map by W. E. Bemis.

Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 223.

*Order Beloniformes: Needlefishes, Sauries, Halfbeaks, and Flyingfishes*
Edited by Bruce B. Collette, Katherine E. Bemis, Nicolay V. Parin, and Ilia B. Shakhovskoy
Fishes of the Western North Atlantic, Part 10
Chapter 5, Family Exocoetidae Flyingfishes, page 228.
Publications of the Sears Foundation for Marine Research, Yale University

The Sears Foundation for Marine Research at Yale University was established in 1937 by Albert E. Parr, director of Yale's Bingham Oceanographic Laboratory, through a gift from Henry Sears, to promote research and publication in marine sciences. The Foundation’s Memoirs, inaugurated in 1948, remain important references. In 1959 the Bingham Oceanographic Collection was incorporated into the Yale Peabody Museum of Natural History.

Distributed by Yale University Press
www.yalebooks.com | yalebooks.co.uk

MEMOIR I

Fishes of the Western North Atlantic

Part One
Lancelets, Cyclostomes, Sharks

Part Two
Sawfishes, Guitarfishes, Skates and Rays, Chimaeroids

Part Three
Soft-rayed Bony Fishes: Orders Acipenseroidae, Lepisosteidae, and Isospondyli
Sturgeons, Gar, Tarpon, Ladyfish, Bonefish, Salmon, Char, Anchovies, Herring, Shad, Smelt, Capelin, et al.

Part Four
Soft-rayed Bony Fishes: Orders Isospondyli and Ginglymodiformes
Argentinoids, Stomioids, Pickerels, Bathylaconids, Giganturids

Part Five
Orders Iniomi and Lyomeri
Lizardfishes, Other Iniomi, Deepsea Gulpers

Part Six
Orders Heteromi (Notacanthiformes), Berycomorphi (Beryciformes), Xenoberyces (Stephanoberyciformes), Anacanthini (Gadiformes)
Halosauriforms, Killifishes, Squirrelfishes and Other Beryciforms, Stephanoberyciforms, Grenadiers

Part Seven
Order Iniomi (Myctophiformes)
Neoscopelids, Lanternfishes, and Atlantic Mesopelagic Zoogeography

Part Eight
Order Gasterosteiformes
Pipefishes and Seahorses

Part Nine, Volume One
Orders Anguilliformes and Saccopharyngiformes

Part Nine, Volume Two
Leptocephali

Part Ten
Order Beloniformes
Needlefishes, Sauries, Halfbeaks, and Flyingfishes

MEMOIR II

The Elementary Chemical Composition of Marine Organisms
by A. P. Vinogradov