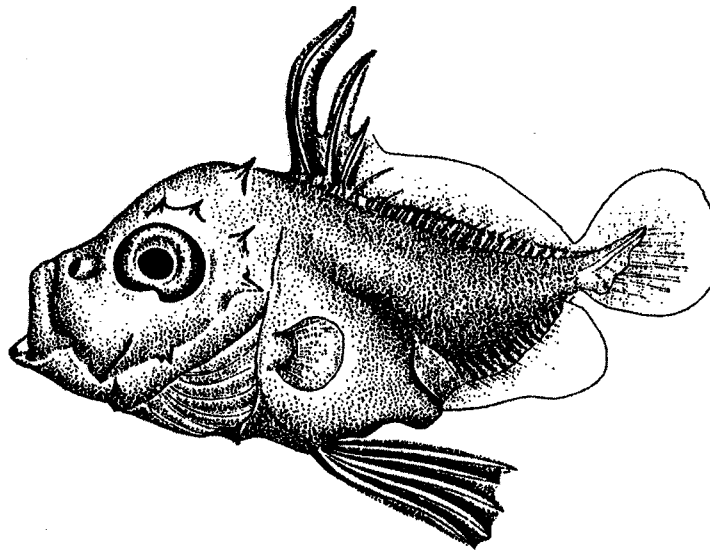




PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE STAGES  
OF ZEIFORM FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC  
BY

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It will be a chapters entitled Zeiformes, Cyttidae, Grammicolepididae, Oreosomatidae, Parazenidae, Zeidae, and Zeniontidae in "The early life history stages of fishes of the western central North Atlantic".

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**ZEIFORMES: Families Parazenidae, Zeniontidae  
Zeidae, Oreosomatidae, & Grammicolepidae**

**By J. G. Ditty**

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The Zeiformes are a group of small to medium size (usually 20 to 60-cm SL), generally deep-bodied and highly compressed benthopelagic fishes with stout dorsal spines, small pectoral fins, and a slender caudal peduncle. Eyes are located near the dorsal profile and spiny scutes or large bony plates are found along the bases of the dorsal and anal fins, and on the breast and belly. Most species are rare in the western central North Atlantic (WCNA) and reside in mid- to deep oceanic waters over the outer continental shelf or slope. For example, only two specimens of *Pseudocyttus maculatus* have been caught in the WCNA, one off Iceland and the other off Suriname (Post & Jonsson 1996). The literature on zeiform fishes is scattered and inadequate, and the biology of individual species is poorly known (Tighe & Keene 1984). As currently recognized (Tyler et al. 2003), the Zeiformes contain six families with most families containing few genera or species. Heemstra (2003) lists the following species as occurring in our area: Parazenidae with one species *Parazen pacificus* Kamohara 1935, Zeniontidae with one species *Zenion hololepis* Goode & Bean 1896, Zeidae with two species *Cyttopsis*

*rosea* (Lowe 1843) and *Zenopsis conchifera* (Lowe 1850), Oreosomatidae with two species *Allocyttus verricosus* (Gilchrist 1906) and *Pseudocyttus maculatus* Gilchrist 1906, and Grammicolepidae with two species *Grammicolepis brachiusculus* Poey 1873 and *Xenolepidichthys dalgleishi* Gilchrist 1922. All but the Cyttidae are found in the coverage area. Another family, the Caproidae, formerly considered a zeiform has been removed from the order and placed in the Perciformes.

Zeiforms are characterized by having unbranched rays in the dorsal, anal, and pectoral fins and all regional genera, except *Cyttopsis*, have a locking mechanism between the first-two or three dorsal spines. Pelvic fins are inserted either below or in front of the pectoral fins, except in the zeniontids, where the pelvics are slightly behind the pectoral fins, and in *Parazen*, where the pelvics are inserted midway between the pectoral and anal fins (Tyler et al. 2003). Only parazenids have more than three upper and three lower secondary caudal rays. Parazenids and zeids both lack a pelvic spine (Tyler et al. 2003). Grammicolepidids have dorso-ventrally elongate, linear scales rather than the

cycloid or ctenoid scales found in other zeiform families. *Zenopsis* lacks scales (Karrer & John 1998). Morphometric data suggest an undescribed species of *Parazen* in the western Atlantic (Kotlyar 2001). Because of their extreme rarity I have listed a few synonyms in Table Zeiformes 1 and five additional species for the meristic characters in the Table Zeiformes 2 as they may eventually be found in our area. Geographic distributions and habitat characteristics are listed in Table Zeiformes 3.

Young have been illustrated or described for only four of a probable 10-11 western North Atlantic species. Larvae of most taxa are laterally compressed and have a heavily pigmented (except the caudal peduncle) deep-body that becomes relatively less so with growth. Larvae have precocious pelvic fins, and dorsal spines develop more rapidly than do the rays. Eyes are generally large and round, the mouth is oblique, and the gut reaches mid-body. Zeiform larvae have few, relatively weak spines or no head spination, and all species but *Parazen pacificus* have fewer than 18 total caudal fin rays. Young *Grammicolepis brachiusculus* have irregular black blotches on the body, five black bars along the anal fin, and black spots on the tail. *Xenolepidichthys dalgleishi*

possess long filamentous extensions on some dorsal spines and the first anal spine becomes relatively shorter with growth (Okuyama 1988). Young *Oreosoma atlanticum* have large conical protuberances or transformed scales on various parts of the body (Abe and Kaji 1972). In *Zenopsis conchifer*, the anteriormost dorsal spines are precocious, filamentous, and elongate (Weiss et al. 1987). Only grammicolepidids have a 'prejuvenile' phase that can remain pelagic up to 100-mm or more SL (Tighe & Keene 1984; Tyler et al. 2003) and one grammicolepidid (*Pseudocyttus maculatus*) can reportedly remain pelagic for as much as six years before settling (Smith et al. 2002).

Zeiform larvae could be confused with those of some of the Beryciformes (anomalopids and trachichthyids) and the carangid, *Alectis*, which also have a deep, heavily pigmented body and precocious pelvic fins. However, *Alectis* has well-developed preopercular spination, a median supraoccipital crest, and 24 myomeres. Anomalopids have prominent head spination and fewer total dorsal and anal fin elements than do zeiforms. The 'acronurus' stage of some Acanthuridae, which also have vertically elongate scales and precocious dorsal and pelvic fin spines, could be confused with some grammicolepidids.

Acanthurids, however, have a precocious anal spine (and all spines are serrate), moderate to heavy head spination, and <25

total vertebrae. Two species accounts are provided plus available illustrations of young stages in Fig. Zeiformes 1.

Table Zeiformes 1. Some synonyms for western central North Atlantic zeiform fishes (from Eschmeyer 1998)

| Family                    | Synonyms  | Valid name  |
|---------------------------|---|---|
| Grammicolepididae         | <i>Xenolepidichthys americanus</i> <sup>1</sup>   | <i>Dramattus americanus</i>                       |
| Oreosomatidae             | <i>Cyttosoma verrucosum</i>                       | <i>Allocyttus verrucosus</i>                      |
| Parazenidae               | <i>Zeus roseus</i>                                | <i>Cyttopsis rosea</i> (sometimes <i>roseus</i> ) |
| Zeidae                    | <i>Zeus ocellatus</i> , <i>Zenopsis ocellatus</i> | <i>Zenopsis conchifer</i>                         |
| Zeniontidae               | <i>Cyttus hololepis</i><br><i>C. leptolepis</i>   | <i>Zenion hololepis</i><br><i>Z. leptolepis</i>   |
| <b>Corrected spelling</b> | <i>Zenion japonicus</i>                           | <i>Z. japonicum</i>                               |

<sup>1</sup> Shimizu (in Uyeno et al. 1983) considers *Xenolepidichthys americanus* Nichols & Firth 1939 valid in the genus *Dramattus*, but Karrer (1986) places *X. americanus* in synonymy of *Grammicolepis branchiusculus*

Table 2. Meristic data for zeiform fishes known to occur in the western north Atlantic. "NA" = not available.

| Species                         | Dorsal elements |              | Total elements |                     | Pectoral  | Pelvic | Total vertebrae        | BR  | Total gill rakers <sup>1</sup> | Caudal rays | Epurals | Source  |
|---------------------------------|-----------------|--------------|----------------|---------------------|-----------|--------|------------------------|-----|--------------------------------|-------------|---------|---|
|                                 | Spines          | Rays         | Dorsal         | Anal                |           |        | Precaudal+Caudal       |     |                                |             |         |   |
| <b>Grammicolepididae</b>        |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>Daramatus</i>                |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>americanus</i> <sup>2</sup>  | VII             | 32-33        | 39-40          | II,34               | 15        | I,6    | 10+26-27=36-37         | 7   | NA                             | 1+15+1      | NA      | Nichols & Firth 1939  |
| <i>Grammicolepis</i>            |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>brachiusculus</i>            | VII(VI)         | 32-34(28-35) | 38-40          | II-III,33-35(28-36) | 14-15     | I,6(7) | 11+32-35=44(43-46)     | 7   | NA                             | 1+15+1      | 1       | Myers 1937; Machida 1984;<br>Tyler et al. 2003                                    |
| <i>Xenolepidichthys</i>         |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>dalgelishi</i>               | VI(V)           | 27-31        | 32-35(36)      | II,27-29            | 14(15)    | I,6(7) | 10+26-28=37(36-38)     | 7   | NA                             | 1+15+1      | 2       | Machida 1984;<br>Tyler et al. 2003  |
| <b>Oreosomatidae</b>            |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>Alloctytus</i>               |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>verrucosus</i>               | VI(VII)         | 29-33(34)    | 35-40          | II(III),27-32       | 20(18-20) | I,6    | 13(14)+23-25=37(36-38) | 7   | 25                             | 2+13+2      | 2       | Gilchrist 1908; Welander et al. 1957; Kobayashi et al. 1968;<br>Tyler et al. 2003 |
| <i>Oreosoma</i>                 |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>atlanticum</i>               | VII(VI-VIII)    | 29-31        | 35-38          | II-III,28-30        | 20(19-21) | I,6(7) | 13-14+24-25=38-39      | 7   | NA                             | 2+13+2      | 2       | Tyler et al. 2003   |
| <i>Pseudocytus</i>              |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>maculatus</i>                | V(V-VII)        | 34-36        | 39-41          | II(III),31-34       | 20(19-22) | I,5-6  | 14-15+27-28=41-42      | 6-7 | 23-25                          | 2-3+13+2-3  | 2       | Gilchrist 1908; Post & Jonsson 1996; Tyler et al. 2003                            |
| <b>Parazenidae</b>              |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>Parazen</i>                  |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>pacificus</i>                | VI-VIII         | 30-32        | 37-40          | I,32-33             | 15-16     | 0,7    | 12+22=34               | 7   | 7-8                            | 7-8+13+7-8  | 2       | Mead 1957; Kotylar 2001;<br>Tyler et al. 2003                                     |
| <b>Zeidae</b>                   |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>Zenopsis</i>                 |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>conchifer</i>                | X(VIII-X)       | 24-27        | 33-36          | III,24-26           | 12(13)    | 0,6    | 14-15+20-21=35(34-36)  | NA  | 24                             | 1+13+1      | 1       | Tyler et al. 2003<br>Machida 1984;  |
| <i>Cyttopsis</i>                | VII(VIII)       | 27-30        | 34-37          | I(II),28-30         | 14(13-15) | 0,9    | 11+21=32               | 7   | 11-12                          | 3-4+13+3-4  | 2       | Tyler et al. 2003   |
| <b>Zeniontidae</b>              |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>Zenion</i>                   |                 |              |                |                     |           |        |                        |     |                                |             |         |   |
| <i>hololepis</i>                | VI(VII)         | 26-31        | 32-38          | II,23-29            | 16(16-18) | I,6    | 11+16=27               | 8   | 18-20                          | 2-3+13+2-3  | 2       | Tyler et al. 2003   |
| <i>leptolepis</i> <sup>2</sup>  | VI(VII)         | 27-31        | 33-37          | II,22-31            | 16(16-18) | I,6    | 11+16=27               | 8   | NA                             | 2-3+13+2-3  | 2       | Gilchrist & von Bonde 1924  |
| <i>japonicum</i> <sup>2</sup>   | VI-VII          | 23-28        | 30-35          | I,23-24             | 15-17     | I,5-6  | 11+16=27               | 8   | NA                             | NA          | 2       | Kamohara 1934; Machida 1984   |
| <i>longipinnis</i> <sup>2</sup> | VI              | 28-29        | 34-35          | I,25-26             | NA        | NA     | 11+16=27               | 8   | NA                             | NA          | 2       | Uyeno et al. 1983   |

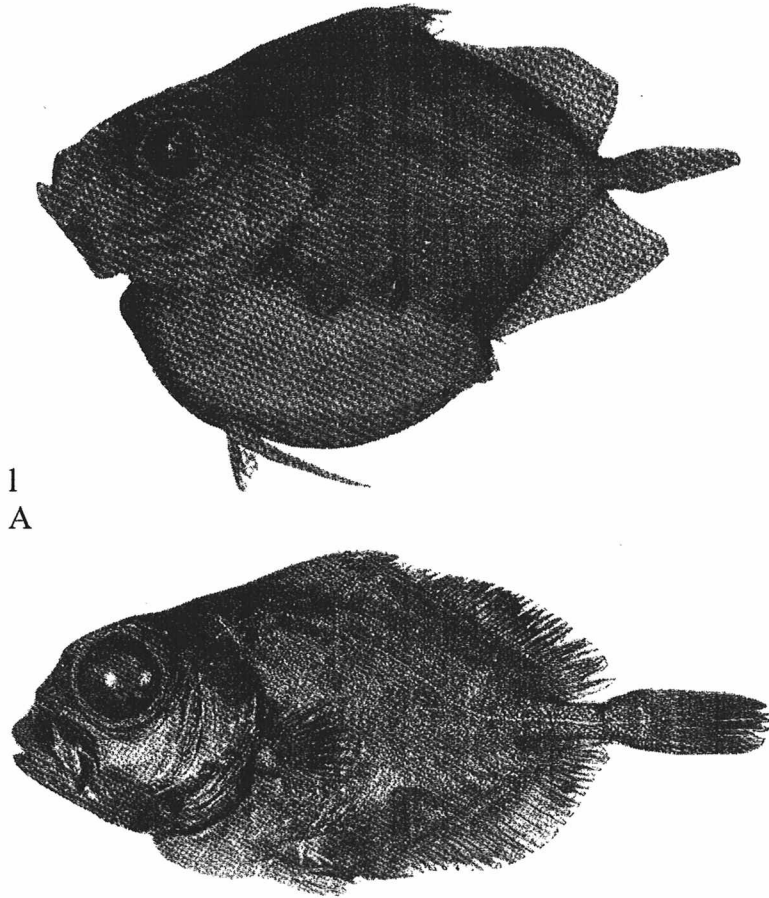
<sup>1</sup> Counts do not include rudiments<sup>2</sup> Unlikely or very rare in coverage area

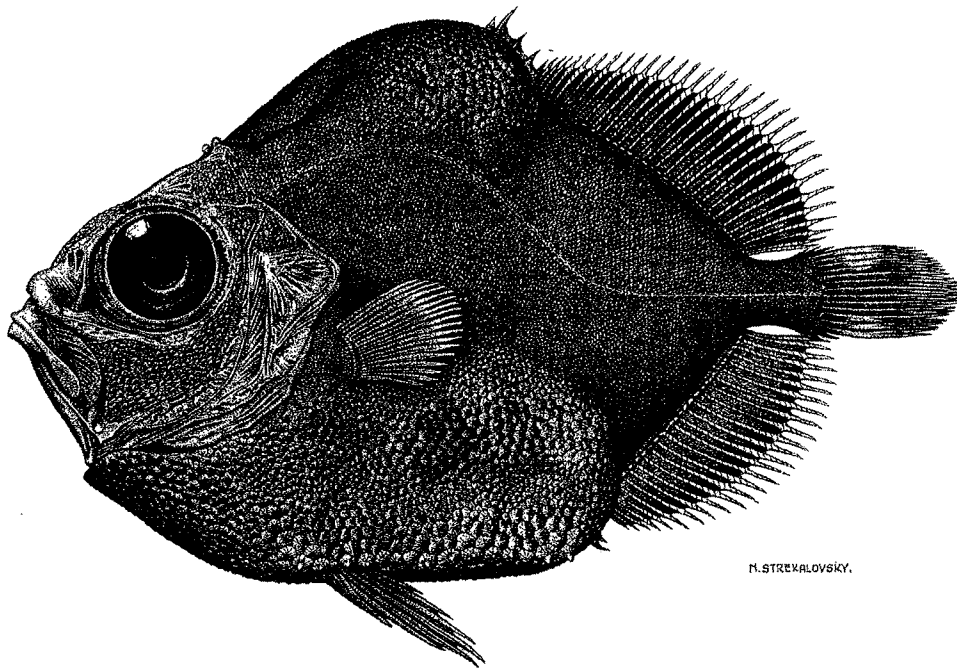
Table Zeiformes 3. Distribution and habitat of zeiform fishes including species unreported from the western central North Atlantic area

| Species                        | Distribution   | Habitat   | Source   |
|--------------------------------|--|---|--|
| <b>Grammicolepididae</b>       |  |   |  |
| <b><i>Daramattus</i></b>       |  |   |  |
| <i>americanus</i>              | unknown in area                                      |   |  |
| <b><i>Grammicolepis</i></b>    |  |   |  |
| <i>brachiusculus</i>           | U. S. Atlantic to Surinam                            | meso- to benthopelagic; 300-900 m                   | Machida 1984; Karrer & Heemstra 1986; Moore et al. 2003; Vasconcelos et al. 2003 |
| <b><i>Xenolepidichthys</i></b> |  |   |  |
| <i>dalgleishi</i>              | U. S. Atlantic & Gulf coasts & Caribbean             | meso- to benthopelagic; 90-900 m                    | Machida 1984; Okiyama 1988; Karrer 1990; Moore et al. 2003.                      |
| <b>Oreosomatidae</b>           |  |   |  |
| <b><i>Allocyttus</i></b>       |  |   |  |
| <i>verrucosus</i>              | Suriname, rare                                       | meso- to benthopelagic; 600-1600 m                  | Gilchrist 1908; Welander et al. 1957; Machida 1984; Karrer 1986.                 |
| <b><i>Oreosoma</i></b>         |  |   |  |
| <i>atlanticum</i>              | unknown in area                                      | meso- to benthopelagic                              | Karrer 1986; Gomon et al. 1994.  |
| <b><i>Pseudocyttus</i></b>     |  |   |  |
| <i>maculatus</i>               | rare, single specimens off Suriname & Iceland        | meso- to benthopelagic                              | Gilchrist 1908; Karrer 1986; Post and Jonsson 1996; Smith et al. 2002.           |
| <b>Parazenidae</b>             |  |   |  |
| <b><i>Parazen</i></b>          |  |   |  |
| <i>pacificus</i>               | Cuba, Panama, Columbia, Caribbean                    | meso- to benthopelagic; 150-500 m                   | Mead 1957; Moore et al. 2003.  |
| <b>Zeidae</b>                  |  |   |  |
| <b><i>Zenopsis</i></b>         |  |   |  |
| <i>conchifer</i>               | throughout area                                      | meso- to benthopelagic; 65-400 m, usually 200-300 m | Weiss et al. 1987; Moore et al. 2003.  |
| <b><i>Cyttopsis</i></b>        |  |   |  |
| <i>rosea</i>                   | throughout area                                      | meso- to benthopelagic; 150-600 m                   | Goode & Bean 1895; Machida 1984; Karrer & Heemstra 1986; Moore et al. 2003.      |
| <b>Zeniontidae</b>             |  |   |  |
| <b><i>Zenion</i></b>           |  |   |  |
| <i>hololepis</i>               | U. S. Atlantic and Gulf coasts through the Caribbean | Benthopelagic, 300-600 m                            | Goode & Bean 1895; Heemstra 1986; Moore et al. 2003.                             |
| <i>leptolepis</i>              | unknown, rare  | meso- to benthopelagic                              | Gilchrist & von Bonde 1924; Heemstra 1986.                                       |
| <i>japonicum</i>               | unknown in area                                      |   | Kamohara 1934; Uyeno et al. 1983; Machida 1984                                   |
| <i>longipinnis</i>             | unknown in area                                      |   | Kotthaus 1970; Uyeno et al. 1983   |

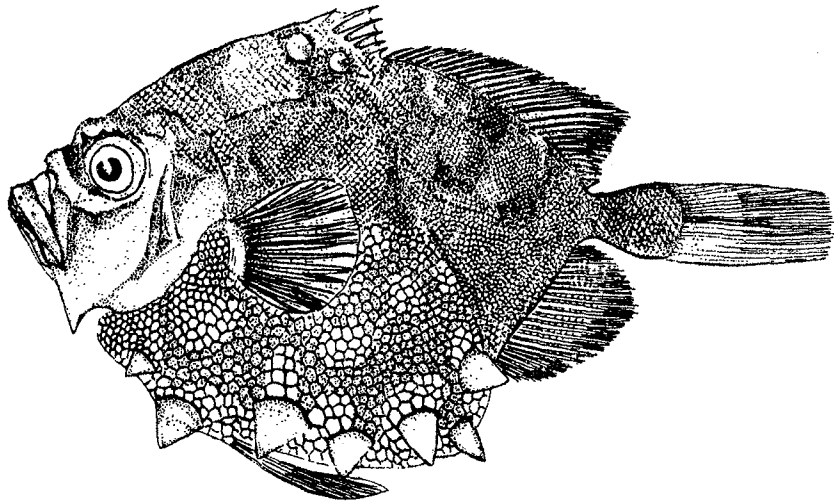


Figure Zeiformes 1. Illustrations of early stages of rare zeiform species. A) *Allocyttus verrucosus* small juvenile; B) *Allocyttus verrucosus* large juvenile; C) *Neocyttus helgae* juvenile; D) *Oreosoma atlanticus* juvenile (not known from area). A & B from Kobayashi et al 1968; C) from Backus et al 1965; D) from Abe & Kaji 1972.





C



D

**ZEIDAE*****Zenopsis conchifer* (Lowe 1850)****MERISTICS**

|                             |               |    |
|-----------------------------|---------------|----|
| Vertebrae                   |               |    |
| Precaudal                   | 14-15         |    |
| Caudal                      | 20-31         |    |
| Total                       | 35(34-36)     |    |
| Number of fin spines & rays |               |    |
| Dorsal                      | VIII-X, 24-27 |    |
| Anal                        | III, 24-26    |    |
| Pectoral                    | 12(13)        |    |
| Pelvic                      | 0, 6          |    |
| Caudal                      |               |    |
| Dorsal Secondary            |               | 1  |
| Principal                   |               | 13 |
| Ventral Secondary           |               | 1  |
| Total                       |               | 15 |

**LIFE HISTORY**

Range: throughout area.  
Habitat: meso- to benthopelagic; 65-400 m,  
usually 200-300 m.  
ELH pattern: oviparous, planktonic larvae.  
Spawning: Unknown.

**LITERATURE**

Moore et al. 2003, Tyler et al. 2003, Weiss et al.  
1987.

**EARLY LIFE HISTORY DESCRIPTION**

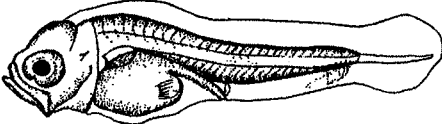
**EGGS:** undescribed.

**LARVAE:**

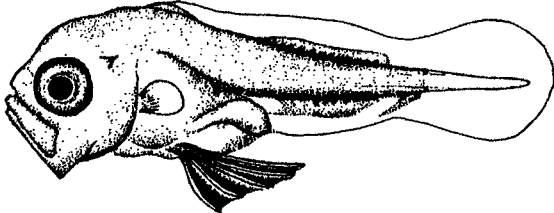
Length at flexion: ca. 6.6-mm.  
Sequence of fin development: P<sub>2</sub>, D<sub>1</sub>, ?  
Pigment: heavily pigmented P<sub>2</sub> & D<sub>1</sub> fins;  
unpigmented caudal peduncle.  
Diagnostic: large oblique mouth; deep body;  
precocious P<sub>2</sub> & D<sub>1</sub> fins; from other regional  
zeiforms by having a combination of fewer D, A,  
& P<sub>1</sub> rays; more D<sub>1</sub> spines; and lacking a spine in  
the P<sub>2</sub> fin.

**ILLUSTRATIONS**

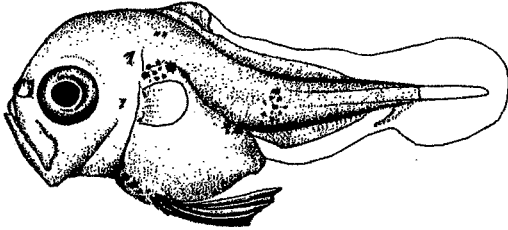
A) 4.2-mm, B) 4.6-mm, C) 4.8-mm, & D) 6.6-  
mm. All from Weiss et al. 1987.



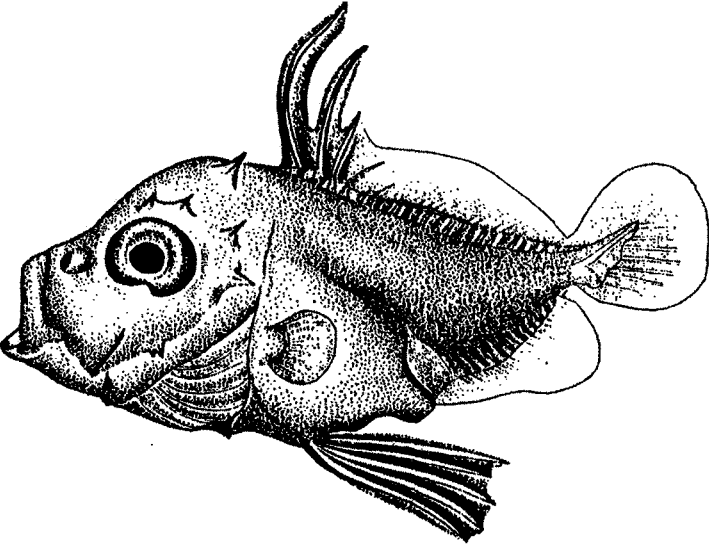
A



B



C



D

**GRAMMICOLEPIDAE*****Xenolepidichthys dalgleishi* Gilchrist 1922****MERISTICS**

|                               |               |
|-------------------------------|---------------|
| Vertebrae                     |               |
| Precaudal                     | 10            |
| Caudal                        | 26-28         |
| Total                         | 37(36-38)     |
| Number of fin spines and rays |               |
| Dorsal                        | (V)VI, 27-31  |
| Anal                          | II, 33-35(36) |
| Pectoral                      | (14)15        |
| Pelvic                        | I, 6(7)       |
| Caudal                        |               |
| Dorsal Secondary              | 1             |
| Principal                     | 15            |
| Ventral Secondary             | 1             |
| Total                         | 17            |
| Branchiostegals               | 7             |

**EARLY LIFE HISTORY DESCRIPTION****EGGS:** undescribed.**LARVAE:**Diagnostic: from *Grammicolepis* by having a much longer first anal spine and fewer total myomeres**ILLUSTRATIONS**

A) 10.7-mm original, B) 17.2-mm from Okiyama 1988, C) ~60-mm from Myers 1937.

**LIFE HISTORY**

Range: U. S. Atlantic &amp; Gulf coasts through the Caribbean.

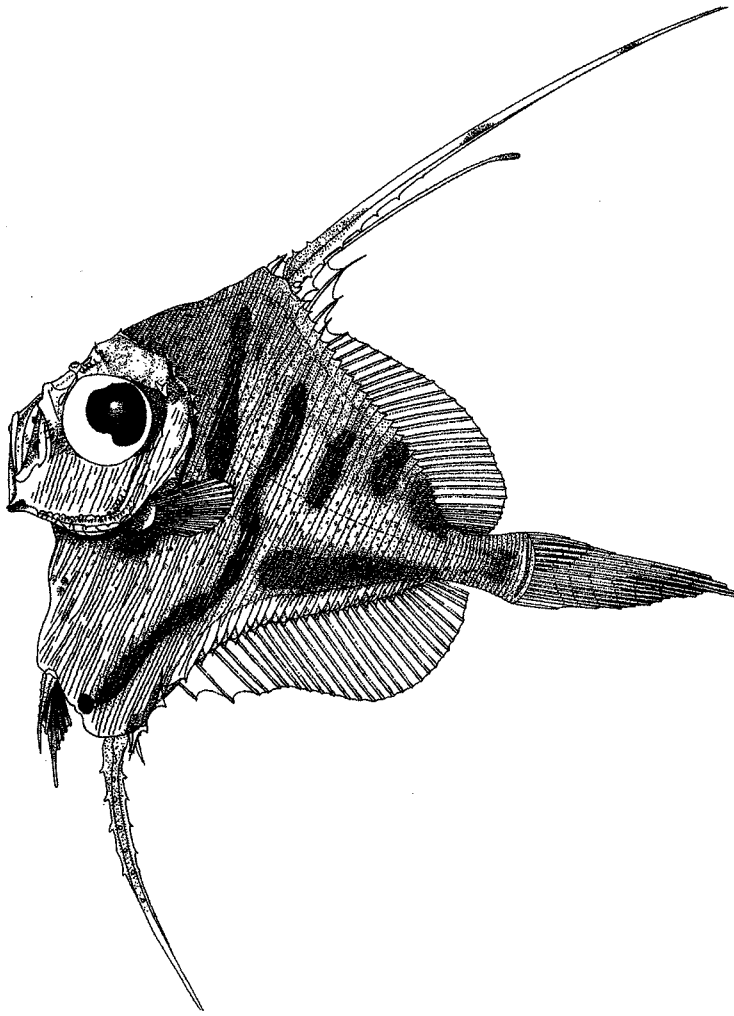
Habitat: meso- to benthopelagic; 90-900 m.

ELH pattern: oviparous, planktonic larvae.

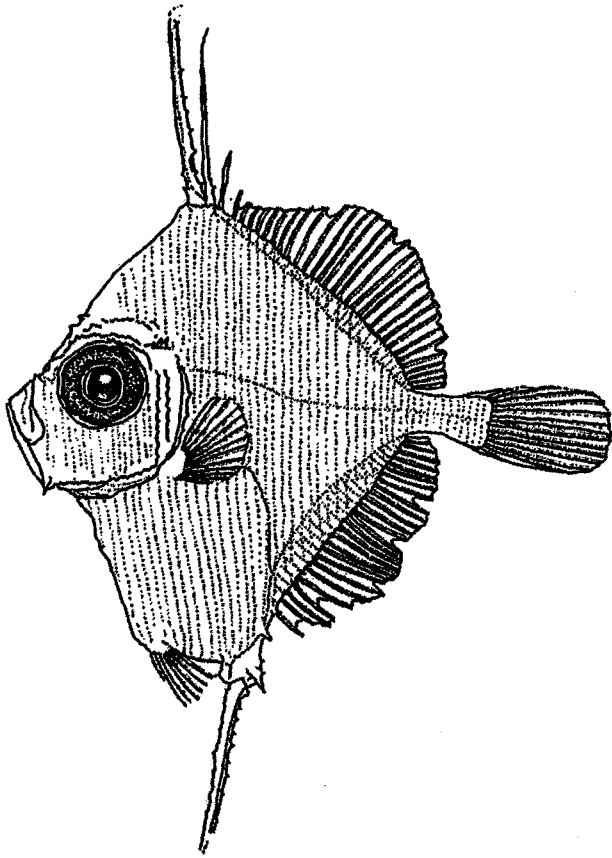
Spawning: Unknwon.

**LITERATURE**

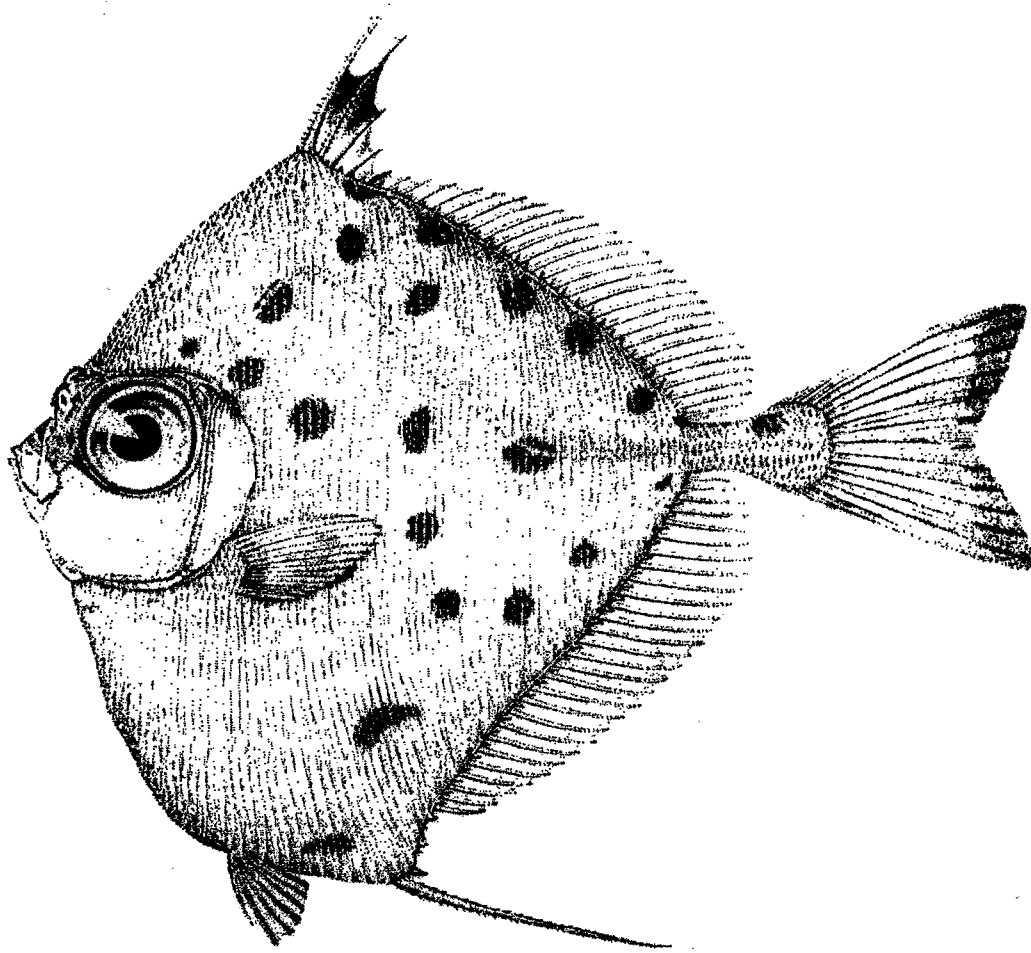
Karrer 1990, Machida 1984, Moore et al. 2003, Okiyama 1988, Tyler et al. 2003.



A



B



C



## Zeiformes Literature Cited

- Abe, T. & S. Kaji. 1972. A record of *Oreosoma atlanticum* (Oreosomatidae, Zeiformes, Teleostei) from Tasman Sea. U. O. (8): 5-7.
- Eschmeyer, W. N. (ed.). 1998. Catalog of fishes. Center for Biodiversity Research and Information. California Academy of Sciences. Spec. Publ. (1). 3 vols, 2,905 p.
- Gilchrist, J. D. F. 1908. Description of fifteen new South African fishes, with notes on other species. Mar. Invest. South Africa IV(106): 143-171 + pls.
- Gilchrist, J. D. F. & C. von Bonde. 1924. Deep-sea fishes procured by the S. S. "Pickle" (Part II). Rep. Fish. Mar. Biol. Surv., Union S. African Rep. 3(7): 1-24 + 6 pls.
- Gomon, M. F., J. C. M. Glover, & R. H. Kuitert (Eds.). 1994. The Fishes of Australia's South Coast, Flora & Fauna of South Australia Handbooks, Commer. State Printer, Adelaide: 992 p.
- Goode, G. B. & T. H. Bean. 1896. Oceanic ichthyology, a treatise on the deep-sea and pelagic fishes of the world based chiefly upon collections made by the steamers Blake, Albatross, and Fish Hawk in the northwestern Atlantic, with an atlas containing 417 figures. Spec. Bull. U. S. Nat. Mus. 2: Text, 553 p.; Atlas, 123 pls.
- Heemstra, P. C. 1986. Family No. 141: Zeniontidae. Page 441 in Smith's Sea Fishes. M. M. Smith & P. C. Heemstra (eds.); Macmillan, South Africa Ltd., Johannesburg. 1047 p.
- Heemstra, P. C. 2003. Order Zeiformes, Parazenidae, Zeniontidae, Zeidae, Oreosomatidae, & Grammicolepididae. Pages 1203-1216 in The living marine resources of the western central Atlantic. Vol. 2: bony fishes. Pt 2 (Acipenseridae to Grammatidae). K. E. Carpenter (ed.). FAO species identification guide for fishery purposes & Amer. Soc. Ichthyol. Herpetol. Spec. Publ. (5): 601-1374.
- Kamohara, T. 1934. On a new fish, *Zenion japonicum* from Japan. Proc. Imp. Acad., Tokyo 10(9): 597-599.
- Karrer, C. 1986. Family No. 139: Oreosomatidae. Pages 438-440 in Smith's Sea Fishes. M. M. Smith & P. C. Heemstra (eds.); Macmillan, South Africa Ltd., Johannesburg. 1047 p.
- Karrer, C. & P. C. Heemstra. 1986. Family No. 140: Grammicolepididae. Pages 440-441 in Smith's Sea Fishes. M. M. Smith & P. C. Heemstra (eds.); Macmillan, South Africa Ltd., Johannesburg. 1047 p.
- Karrer, C. & H.-C. John. 1998. Dories & their allies. Pages 165-167 in Encyclopedia of Fishes. J. R. Paxton & W. N. Eschmeyer (eds.). Acad. Press, San Diego, California.
- Kobayashi, K., M. Mikawa, & J. Ito. 1968. Descriptions of the young and one immature adult specimen of the coster dory, *Allocyttus verrucosus* (Gilchrist) from the northern part of the Pacific. Bull. Fac. Fish., Hokkaido Univ. 19(1): 1-5, plus plates.
- Kotlyar, A. N. 2001. A rare zeid species - *Parazen pacificus*: osteology, systematics, and distribution (Parazeidae, Zeiformes). J. Ichthyol. 41(9): 687-697.
- Machida, Y. 1984. Families Grammicolepididae and Zeidae. Page 118 in The Fishes of the Japanese Archipelago. H. Masuda, K. Amaoka, C. Araga, T. Uyeno & T. Yoshino (eds.). Tokai Univ. Press, Tokyo, Japan. Vol. 1 (text) 437 p., Vol. 2, 307 pls.
- Mead, G. W. 1957. An Atlantic record of the zeid fish *Parazen pacificus*. Copeia 1957(3): 235-237.
- Moore, J. A., K. E. Hartel, J. E. Craddock, & J. K. Galbraith. 2003. An annotated list of deepwater fishes from off the New England region, with new area records. Northeast Naturalist 10(2): 159-248.
- Myers, G. S. 1937. The deep-sea zeomorph fishes of the family Grammicolepididae. Proc. U. S. Nat. Mus. 84: 145-156 + 3 pls.
- Nichols, J. T. & F. E. Firth. 1939. Rare fishes off the Atlantic coast, including a new grammicolepid. Proc. Biol. Soc. Washington 52: 85-88.

- Okiyama, M. 1988. Zeiformes. Pages 379-382 in An atlas of the early stage fishes of Japan. M. Okiyama (ed.). Tokai Univ. Press, 1,157 p. [In Japanese].
- Post, A. & G. Jonsson. 1996. *Pseudocyttus maculatus* Gilchrist, 1906 (Pisces, Oreosomatidae) - First record from the boreal Northern Hemisphere. Arch. Fish. Mar. Res. 43(2): 195-199.
- Smith, P. J., P. J. McMillan, B. Bull, S. M. McVeagh, P. M. Gaffney, & S. Chow. 2002. Genetic and meristic variation in black and smooth oreos in the New Zealand Exclusive Economic Zone. New Zealand J. Mar. Freshw. Res. 36: 737-750.
- Tighe, K. A. & M. J. Keene. 1984. Zeiformes: Development and Relationships. Pages 393-398. in Ontogeny and Systematics of Fishes. H. G. Moser et al. (eds.). Amer. Soc. Ichthyol. Herpetol. Spec. Publ. (1): 760 p.
- Tyler, J. C., B. O'Toole & R. Winterbottom. 2003. Phylogeny of the genera and families of zeiform fishes, with comments on their relationships with Tetraodontiformes and caproids. Smithsonian Contrib. Zool. (618): 110 p.
- Uyeno, T., K. Matsuura, & E. Fujii (eds.). 1983. Fishes Trawled off Suriname and French Guiana, Japan Marine Fishery Resource Res. Center, Tokyo: 1-519.
- Vasconcelos, P., M. N. Santos, & M. B. Gaspar. 2003. First record of *Grammicolepis brachiusculus* in Portuguese waters. J. Fish Biol. 63(2): 533-537.
- Weiss, G., G. Hubold, & A. C. D. Bainy. 1987. Larval development of the zeiform fishes *Antigona capros* Lowe, 1843 and *Zenopsis conchifer* (Lowe, 1852) from the south west Atlantic. Cybium 11(1): 79-91.
- Welander, A. D., R. C. Johnson, & R. A. Hajny. 1957. Occurrence of the boar fish, *Pseudopentaceros richardsoni*, and the zeid, *Alloctytus verrucosus*, in the North Pacific. Copeia 1957(3): 244-246.