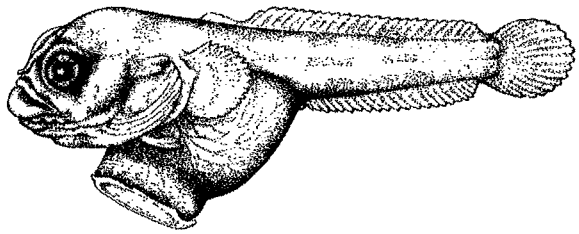
NOAA Technical Memorandum NMFS-SEFSC-510

PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF BATRACHOID FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

B. B. Collette



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It will be a chapter entitled Order Batrachoididae and Batrachoididae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

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ORDER BATRACHOIDIFORMES: TOADFISHES

By B. B. Collette

The order contains only the family Batrachoididae and is frequently considered to be the sister group of the Lophiiformes (Nelson 1994). The classical name for the order, Haplodoci, is derived from the Greek, in reference to the undivided posttemporal bone. Toadfishes superficially resemble sculpins, but their pelvic fins are situated on the throat well in front of the pectoral fins ("jugular"), and they have only three gills and three gill arches.

FAMILY BATRACHOIDIDAE: TOADFISHES

By B. B. Collette

Both the spinous and soft portions of the dorsal fin are well-developed as separate fins, the former with 2 or 3 strong spines and much shorter than the latter. The upper hypural bones have a peculiar inter-vertebral basal articulation with the posterior caudal vertebrae. The body is naked in most species but covered with small cycloid scales in some species of Batrachoidinae. There are three subfamilies with 22 genera and about 73 species in the family. The greatest species diversity is in the New World with all three subfamilies, Batrachoididinae, Thalassophryninae, and Porichthyinae present. There are a total of 23 species in 7 genera in the west central Atlantic (Collette 2003a). Most toadfishes are benthic inhabitants of warm seas. A few species are restricted to freshwater. Toadfishes are sluggish ambush predators, feeding mainly on mollusks and crustaceans. The venomous toadfishes, subfamily Thalassophryninae, have 2 hollow spines in the first dorsal fin and an opercular spine which are all connected to venom glands. The midshipmen, subfamily Porichthyinae, have photophores along the multiple lateral lines.

All toadfishes for which spawning habits have been described lay demersal eggs which are attached to the undersides of objects with a peculiar adhesive disc (Breder & Rosen 1966). Even after hatching following an incubation period of two or three weeks, the young remain attached for some time. The male parent guards the egg clusters. Toadfishes lay relatively few (14-451) large (2-6 mm in diameter) eggs, according to reports for several west central Atlantic species. Larval toadfishes are benthic and attached to nests and so are infrequently taken with gear that samples other larval fishes. Newly released juvenile midshipmen (*Porichthys*) have occasionally been taken by CalCOFI samples (Watson 1996f). *Porichthys plectrodon* juveniles apparently become free-swimming at 12-15 mm (Lane 1967).

Extensive descriptions and figures of development have been published for the oyster toadfish, *Opsanus tau*, by a series of authors (summarized by Martin & Drewry 1978) and an eastern Pacific species of *Porichthys* (*P. notatus*) by Arora (1948) and Watson (1996f). Representative figures from Martin & Drewry and fromWatson are reproduced here (Figure Batrachoididae 1 & 2). Little information, other than number and size of eggs, is available for most other

species.

I have included several tables of meristic data that should prove useful in identifying yolk-sac or free swimming larvae (Tables Batrachoididae 1-5).

Summary of ELH Information, Fecundity, and Egg Size

Batrachoides gilberti Meek & Hildebrand 1928. Males ripe by 161 mm SL, females by 188 mm. 192-mm female had 398 eggs, 4.4-5.3 mm in diameter (mean 4.86 mm). Collette & Russo 1981: 215.

Batrachoides manglae Cervigón 1964. Males ripe by 108 mm SL, only mature female 148 mm SL, apparently began spawning, 114 eggs, 2.2-3.0 mm in diameter (mean 2.60 mm). Collette & Russo 1981: 217.

Batrachoides surinamensis (Bloch & Schneider 1801). Males ripe by 245 mm SL, females by 211 mm SL. 211-mm female had 432 eggs, 4.3-5.9 mm in diameter (mean 5.10 mm); 225-mm female had 451 eggs, 3.2-4.7 mm in diameter (mean 4.03 mm). Collette & Russo 1981: 206.

Opsanus beta (Goode & Bean 1880). 12 eggs 3.9-4.4 (mean 4.1 mm). nests found Feb.-March, temp. 62-72° F, in old conch shells, cavities in yellow sponges, and tin cans. only males found with eggs. Breder 1941.

Opsanus tau (linnaeus 1766). ca. 100 eggs/nest, 4-6 mm in diameter (mean 5 mm). Gudger 1910.

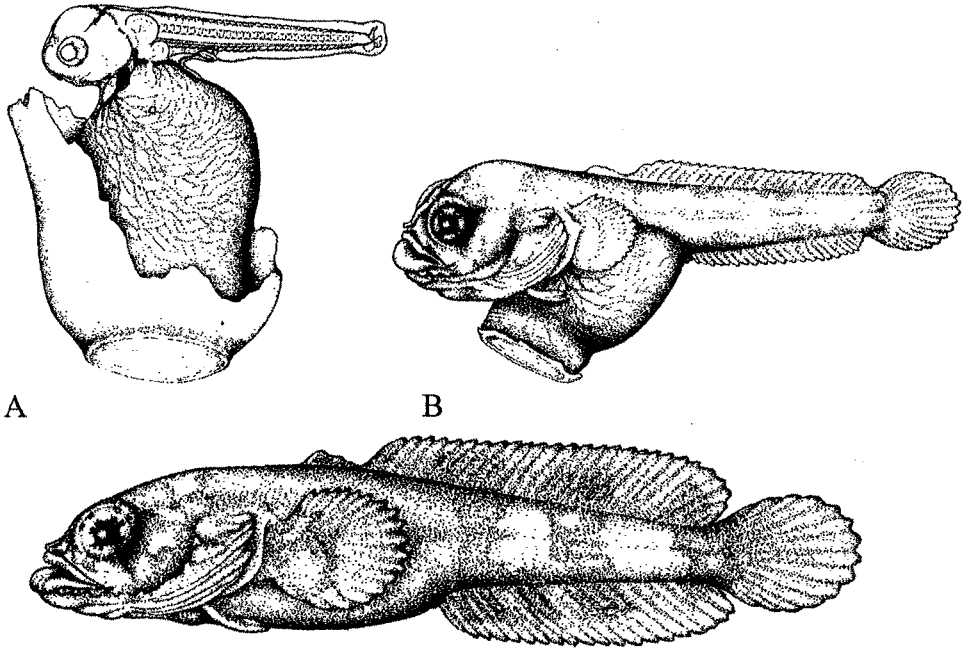
Reproduction.--There are several early descriptions of the life history of the oyster toadfish (Ryder 1886 & 1887b, Gill 1907, Gudger 1910). Toadfish spawn in June and early July in the northern part of the range. Eggs were laid in Chesapeake Bay from May 8 to July 15 at water temperatures of 17.5° to 27° C (Gray & Winn 1961). The very large eggs (about 5 mm in diameter) are laid in holes under stones, under large shells, in old tin cans, among sunken logs, or among eelgrass, where they adhere to whatever serves as a nest, which the male guards during incubation. Incubation takes 5-12 days in Chesapeake Bay (Gray & Winn 1961). After hatching, the tadpole-shaped larvae remain attached to the nest by the yolk sac (cling young) for an extended period until the latter is absorbed at a length of 15 to 16 mm when they break free. Males protect and fan the eggs, attached young, and free young for 23-46 days (Gray & Winn 1961). A series of 10 larvae, from a 7.4-mm TL newly-hatched to a 17.1-mm TL specimen 20 days after hatching was illustrated by Dovel (1960). This series was expanded to include Ryder (1886 & 1887) and other references by Martin & Drewry (1978: figs. 179-185) and Collette (2002).

Porichthys bathoiketes Gilbert 1968. 3 gravid females, collected June 6, 66.5, 71, and 79 mm SL had 23, 14, and 22 eggs respectively, 3.5-4.5 mm in diameter. Gilbert 1968: 685.

Porichthys plectrodon Jordan & Gilbert 1882. females mature at 92-139 mm SL, males at 80-186 mm SL. Lane 1967. non-gravid 109-mm female with 85 eggs 2.0-2.2 mm in diameter. Gilbert 1968: 685. Number of eggs related to size of fish: Log F = 0.00968 L + 1.0647, where F = egg number and L = standard length. Number of eggs in females 92-139 mm SL ca. 85 to ca. 310, mean egg number 140.5, mean size 3.5 mm in diameter. Smallest gravid female 92 mm with 83 eggs. Probably become free-swimming between 12 and 15 mm. Lane 1967:39.

Sanopus greenfieldorum Collette 1983. 270-mm female had 369 eggs, 5-6 mm in diameter. Collette 1983: 723.

Figure Batrachoididae 1. Representative illustrations of *Opsanus tau* from Martin & Drewry 1978. A) Yolk-sac larva with attached yolk-sac, 7.4 mm TL about 24 hours post hatch with yolk-sac shape questionable (after Dovel 1960: fig. 2); B) Yolk-sac larva with yolk-sac reduced, 13.7 mm TL, about 11 days after hatching(after Dovel 1960: fig. 7) ; & C) larva 16.4 mm TL about 16 2/3 days post hatch . (after Dovel 1960: fig. 10)



A B

C

Figure Batrachoididae 2. Illustrations of the eastern pacific *Porichthys notatus* from Watson 1996f: 549. A) demersal embryo, 8.9 mm, note attachement disc at bottom of yolk; B) demersal larva, 17 mm days after hatching (after Arora 1948); C) lateral view, free-swimming juvenile, 20.0 mm; & D) ventral view showing characteristic photophore pattern.

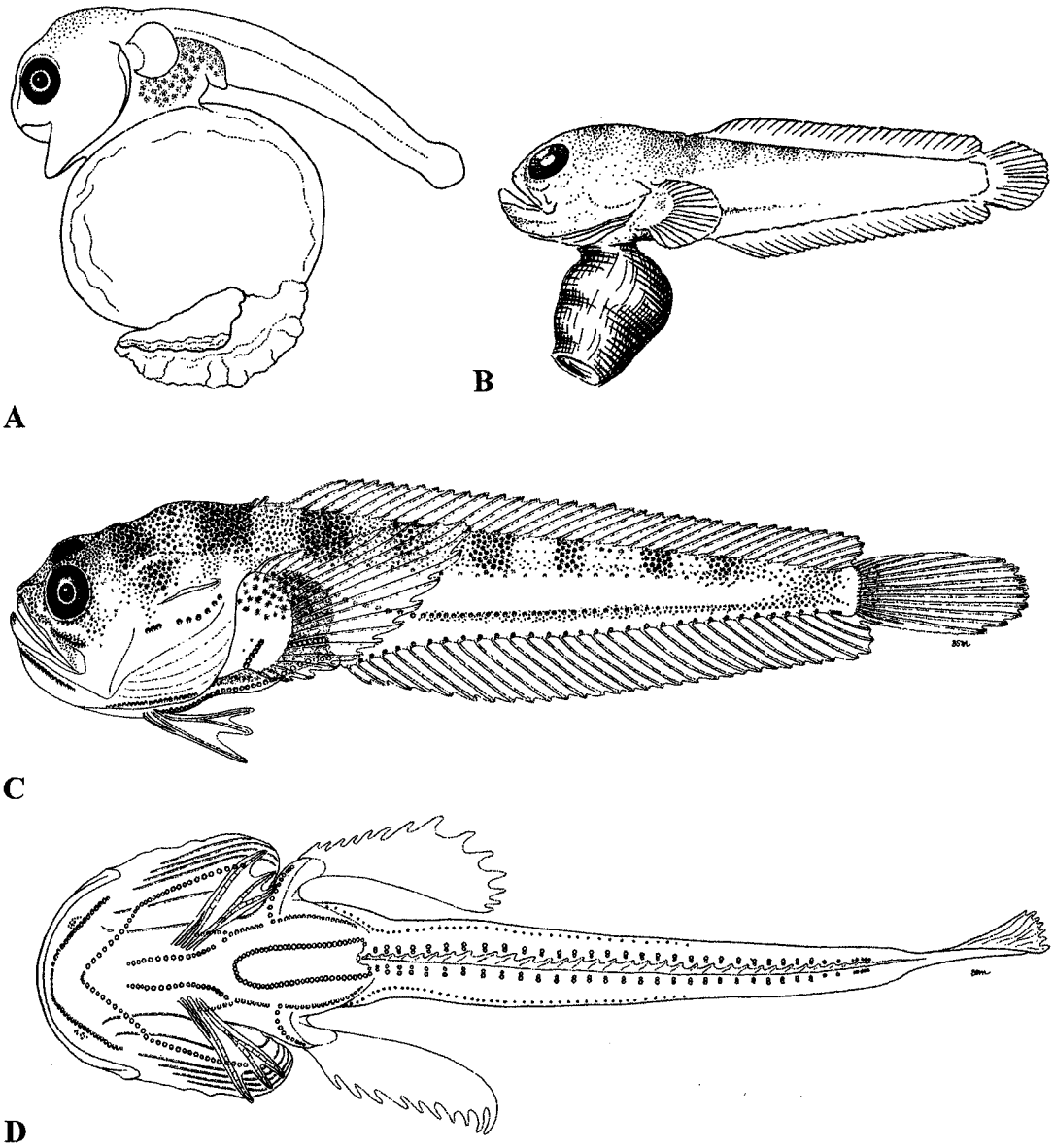


Table Batrachoididae 1. Dorsal fin rays in western central North Atlantic Batrachoididae (medial counts in boldface)

Species	First Dorsal		Second Dorsal Fin Rays																						
	II	III	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Amphichthys cryptocentrus		30												15	14										
Batrachoides gilberti		33								3	**26**	9													
Batrachoides manglae		28					1	**11**	**13**	1															
Batrachoides surinamensis		103												21	**65**	4									
Opsanus beta		8								1	7														
Opsanus dichrostomus		58							2	16	**39**	1													
Opsanus pardus		7									1	**4**	1												
Opsanus phobetron		27							2	**11**	**11**	1													
Opsanus tau		22									2	**14**													
Porichthys bathoiketes	61																		2	14	**30**	15			
Porichthys oculofrenum	2																	2							
Porichthys pauciradiatus	9														4	**4**	1								
Porichthys plectrodon	X																			X	X	**X**	**X**	X	X
Sanopus astrifer		7													4	3									
Sanopus barbatus		12															1	3	7	1					
Sanopus greenfieldorum		3														1	1	1							
Sanopus johnsoni		1																**1**							
Sanopus reticulatus		3															2	1							
Sanopus splendidus		6													1	**5**									
Thalassophryne maculosa	79		11	**52**	15	1																			
Thalassophryne megalops	41		2	**33**	6																				
Thalassophryne nattereri	25				3	**19**	3																		
Triathalassothia gloverensis		16				4	**10**																		

Table Batrachoididae 2. Anal fin rays in western central North Atlantic Batrachoididae (medial counts in boldface)

Species	Anal Fin Rays																						
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Amphichthys cryptocentrus								2	3	**17**	7												
Batrachoides gilberti								17	**21**														
Batrachoides manglae					3	**19**	4																
Batrachoides surinamensis											6	**70**	15										
Opsanus beta						1	**6**	1															
Opsanus dichrostomus						10	**43**	5															
Opsanus pardus						2	**1**	4															
Opsanus phobetron						6	**19**	1															
Opsanus tau						2	**11**	4															
Porichthys bathoiketes																			2	14	**30**	15	
Porichthys oculofrenum																		2					
Porichthys pauciradiatus															4	**4**	1						
Porichthys plectrodon																	X	X	**X**	X	X		
Sanopus astrifer										3	**4**												
Sanopus barbatus											4	**4**	3	1									
Sanopus greenfieldorum										**2**	1												
Sanopus johnsoni											1												
Sanopus reticulatus											**2**	1											
Sanopus splendidus											**6**												
Thalassophryne maculosa		9	**54**	13	3																		
Thalassophryne megalops		5	**31**	5																			
Thalassophryne nattereri				3	**19**	3																	
Triathalassothia gloverensis	1	**10**	3																				

Table Batrachoididae 3. Pectoral fin rays in western central North Atlantic Batrachoididae (medial counts in boldface)

	Pectoral Rays										
Species	13	14	15	16	17	18	19	20	21	22	23
Amphichthys cryptocentrus									5	14	7
Batrachoides gilberti							7	**23**	2		
Batrachoides manglae						1	**10**	8	1		
Batrachoides surinamensis								9	**46**	11	1
Opsanus beta						5	3				
Opsanus dichrostomus					10	**16**	5				
Opsanus pardus							1	**2**	1		
Opsanus phobetron					5	**12**	2				
Opsanus tau							1	**3**	3		
Porichthys bathoiketes			1	37	**70**	5					
Porichthys oculofrenum				2	2						
Porichthys pauciradiatus		11	6	1							
Porichthys plectrodon				X	X	**X**	X				
Sanopus astrifer									1	6	
Sanopus barbatus								4	**6**	2	
Sanopus greenfieldorum										3	
Sanopus johnsoni										1	
Sanopus reticulatus							1	1			
Sanopus splendidus									2	**3**	1
Thalassophryne maculosa		8	**49**	21							
Thalassophryne megalops	4	**32**	6								
Thalassophryne nattereri			4	**18**	3						
Triathalassothia gloverensis						2	**7**	3			

Table Batrachoididae 4. Precaudal and caudal vertebrae in western central North Atlantic Batrachoididae (medial counts in boldface)

	precaudal						caudal												
Species	7	8	9	10	11	12	17	18	19	20	21	22	23	24	25	26	27	28	29
Amphichthys cryptocentrus				2	**23**	1									2	**15**	10		
Batrachoides gilberti			**35**	2											15	**22**			
Batrachoides manglae			**26**									12	**13**	1					
Batrachoides surinamensis			1	**84**													6	**67**	11
Opsanus beta				8									1	**7**					
Opsanus dichrostomus				58								4	**38**	14	1				
Opsanus pardus					7								1	**6**					
Opsanus phobetron				27								2	**19**	6					
Opsanus tau					22								2	**16**	2				
Porichthys bathoiketes																			
Porichthys oculofrenum																			
Porichthys pauciradiatus																			
Porichthys plectrodon																			
Sanopus astrifer					**6**	1										3	3	1	
Sanopus barbatus					**9**	3												5	7
Sanopus greenfieldorum					2	1										2	1		
Sanopus johnsoni					1													**1**	
Sanopus reticulatus					3												1	1	1
Sanopus splendidus					6											6			
Thalassophryne maculosa	77								2	**36**									
Thalassophryne megalops	42								7	**44**	15	2							
Thalassophryne nattereri	25										3	**17**	4						
Triathalassothia gloverensis				16			16												

Table Batrachoididae 5. Total vertebrae in western central North Atlantic Batrachoididae (medial counts in boldface)

	Number of Vertebrae																				
Species	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Amphichthys cryptocentrus											4	**13**	10									
Batrachoides gilberti									14	**22**	1											
Batrachoides manglae						13	**13**	1														
Batrachoides surinamensis												6	**67**	9								
Opsanus beta								1	**7**													
Opsanus dichrostomus							4	39	14													
Opsanus pardus									1	**6**												
Opsanus phobetron							2	**19**	6													
Opsanus tau									2	**16**	2											
Porichthys bathoiketes																	7	**14**	5			
Porichthys oculofrenum																	**2**					
Porichthys pauciradiatus														1	**4**							
Porichthys plectrodon																X	X	X	**X**	X	X	X
Sanopus astrifer												2	**4**	1								
Sanopus barbatus														3	**8**	1						
Sanopus greenfieldorum												1	1	1								
Sanopus johnsoni														1								
Sanopus reticulatus													1	**1**	1							
Sanopus splendidus												6										
Thalassophryne maculosa	7	**44**	15	2																		
Thalassophryne megalops	2	**36**																				
Thalassophryne nattereri			3	**17**	4																	
Triathalassothia gloverensis		**16**																				

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