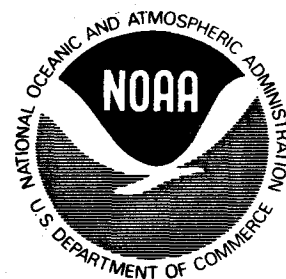


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COMPARISON OF ECOLOGICAL AND LIFE HISTORY INFORMATION ON GOBIID FISHES, WITH EMPHASIS ON THE SOUTH- EASTERN UNITED STATES

**GEORGE H. DARCY
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U.S. DEPARTMENT OF COMMERCE

Philip M. Klutznick, Secretary

National Oceanic and Atmospheric Administration

Richard A. Frank, Administrator

National Marine Fisheries Service

Terry L. Leitzell, Assistant Administrator for Fisheries

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Abstract

Fishes of the family Gobiidae are numerous and diverse, although they share certain similarities in their life histories. This paper compares several of these aspects: temperature and salinity tolerance ranges, food habits, sizes and ages at maturation, maximum sizes, maximum ages, spawning seasons, number of spawnings, intervals between spawning, fecundities, egg sizes, incubation periods, lengths of newly-hatched larvae, times until metamorphosis, and lengths of larvae at metamorphosis. Gobiids are important as aquarium fishes and are used to some extent as food and bait, though their major importance is probably their role in nearshore and pelagic food chains.

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Introduction

The family Gobiidae, of the suborder Gobioidae, is the largest family of marine fishes, probably comprising over 2000 species (C.R. Robins, Univ. Miami, Miami, Florida, pers. comm.). Primarily shallow-water, marine, tropical fishes, gobies are most speciose in the tropical Indo-West Pacific, but occur worldwide in tropical and temperate regions. Gobies are generally small fishes, ranging from 5 to 10 cm long (Herald, 1961), but some species may exceed 50 cm (Jordan, 1905). They occupy a wide range of habitats from true freshwater to marine, and several, such as the mudskipper Periophthalmus, can withstand exposure to air for long periods. Many species are commensals, living in association with burrowing shrimps and echinuroids (MacGinitie, 1934, 1939; Luther, 1958; Palmer, 1963; Magnus, 1967).

Gobies occupy such varied habitats as headwaters of freshwater rivers and streams, lakes, brackish lagoons, mudflats, estuaries, and tidepools on rocky shores. Along with clinids and blennies, gobies form the dominant small-fish fauna of coral reefs (Nelson, 1976). Gobies are among the most successful marine fishes at entering low-salinity or fresh water (Panikkar, 1951), and are foremost among marine fishes colonizing freshwater habitats in areas depauperate of primary freshwater fishes (Böhlke and Chaplin, 1968; Nelson, 1976). However, even those gobies that inhabit fresh water are seldom found far from the sea, and very few (e.g., Rhinogobius similis and Tukugobius flumineus from Japan, Mizuno, 1960) are capable of completing their life cycles in fresh water. Planktonic larvae of freshwater and estuarine gobies are usually swept to the sea where they remain until they metamorphose into juveniles and reenter coastal rivers or estuaries. Larvae of estuarine gobies are common in plankton samples from the Gulf Stream off eastern Florida, and usually greatly outnumber larvae of reef-dwelling gobies (C.R. Robins, pers. comm.), possibly due to the greater abundance and higher fecundity of many estuarine species compared to reef dwellers.

Gobies, although small, are of considerable importance ecologically and commercially. They can be very abundant at certain localities, where they may form an important component of the food web (de Sylva, 1975). Skazkina and Kostyuchenko (1968) reported that Neogobius melanostomus consumes up to 13 percent of the total benthos production of the Sea of Azov each year. Kovtun (1976) found that Pomatoschistus microps leopardinus is an important food competitor of the anchovy in the Sea of Azov and may determine the strength of anchovy year-classes there. Petersen (1917) stated that gobies are among the most common fishes of Denmark and play an extremely important role in the nourishment of larger fishes. Blegvad (1917) similarly reported gobies from the guts of several important Danish food fishes such as cod, turbot, eels, and flounders, as well as from several smaller fishes. Dawson (1966) found that at least ten species of fishes and one species of bird prey on Gobiosoma species in eastern North America, and stated that the importance of these gobies as forage for food and sport fishes is underestimated.

Goby larvae may be very abundant at times, and undoubtedly play an important role in pelagic food chains. De Sylva (1978) found that goby larvae represented the highest biomass of any fish larvae collected by him in Biscayne Bay, Florida. Houde et al. (1979) reported that 15.1 percent of all fish larvae collected by them in the eastern Gulf of Mexico were gobiids, making goby larvae second only to clupeid larvae in abundance in the survey area. Goby larvae were common in all seasons, abundant in both the northern and southern survey areas, and were commonly collected at both inshore (<50 m deep) and offshore (>50 m deep) stations, with estimated abundances usually higher at offshore stations. Houde et al. (1979) stated that if one family of fish larvae were chosen that characterized ichthyoplankton samples from the eastern Gulf of Mexico, Gobiidae would be the best representative family. Unfortunately, identification of gobiid larvae to species is seldom possible due to insufficient knowledge of early life stages of most species.

Several species of gobies are fished commercially for food, especially in the Far East. At least six species of freshwater gobies contribute to the goby fry fishery in the Philippines (Smith, 1901; Manacop, 1953; Dôtu and Mito, 1955a; Marquez, 1968). Fry of the goby Sicydium plumieri are fished in Puerto Rico (Erdman, 1961). Adult gobies are considered delicacies in Japan (Miyazaki, 1940; Okada, 1955), and are canned in Hong Kong and sold frozen in Colombia (C.R. Robins, pers. comm.). Gillichthys mirabilis is the basis for a live-bait fishery in southern California and Mexico (Fitch and Lavenberg, 1975).

Gobies are popular aquarium fishes due to their often bright colors, interesting behavior and general hardiness, with many species appearing in the commercial aquarium trade. Among the most commonly sold gobies are the neon gobies, Gobiosoma (Elacatinus) spp., particularly G. oceanops from Florida coral reefs. Many other goby species are often seen in the trade but are frequently not identified by the sellers by other than a descriptive, but non-specific name such as "banded goby", often applied to more than one species.

This paper is an attempt to bring together information on ecological and biological aspects of gobiid fishes. Although many species covered are from outside the western Atlantic Ocean, the emphasis is on those gobies from the southeastern United States. It is hoped that such comparative data will be of use in the further study and understanding of this important family of fishes; the importance of these fishes in the estuarine, reef, and pelagic ecosystems is just beginning to be realized and will almost surely demand increased attention to their role in coastal food chains.

Ecological Parameters

Temperature and salinity are well known as influencing factors of species distribution and abundance. Inshore and estuarine species are particularly affected by these factors. A comparison of salinity and temperature records of 15 species of inshore gobiids and eleotrids from Florida is presented in Table 1, and shown graphically in Figures 1 and 2. Eleotrids are included because of their ecological similarity to the gobies considered here. While these reports do not constitute maximum and minimum tolerances, they do indicate tolerance ranges and probably reflect ecological preferences of these species.

Table 1. Temperature and salinity ranges of selected gobies and eleotrids from the southeastern United States, as reported in the literature. Ranges are minimum and maximum values for observation records.

<u>Species</u>	<u>Salinity Range</u> (ppt)	<u>Temperature Range</u> (°C)	<u>Reference</u>
<u>Bathygobius soporator</u> (Valenciennes)			
Cedar Key, Florida	21.2	15.5	Reid, 1954
Cedar Key, Florida	23.8 - 37.6	17.0 - 25.0	Kilby, 1955
Tampa Bay, Florida	31.4	32.1	Springer and Woodburn, 1960
St. Lucie Estuary, Florida	1.26	16.8	Gunter and Hall, 1963
Jupiter Inlet, Florida	10.5 - 38.8	18.0 - 36.0	Christensen, 1965
Everglades National Park, Florida	0.0 - 4.0	25.0 - 28.9	Roessler, 1967
Charlotte Harbor Estuary, Florida	33.1 - 36.6	28.0 - 28.5	Wang and Raney, 1971
<u>Dormitator maculatus</u> (Bloch) (Eleotridae)			
Everglades National Park, Florida	0.0 - 4.0	21.0	Tabb and Manning, 1961
Jupiter Inlet, Florida	1.0 - 4.0	17.0 - 27.0	Christensen, 1965
Everglades National Park, Florida	38.4	28.5	Roessler, 1967
<u>Eleotris pisonis</u> (Gmelin) (Eleotridae)			
Jupiter Inlet, Florida	36.6	30.0	Christensen, 1965
Everglades National Park, Florida	17.5 - 18.5	25.0 - 25.5	Roessler, 1967
Coral Gables Waterway, Dade County, Florida	0.0 - 12.0	26.3 - 27.0	Darcy, 1978

<u>Species</u>	<u>Salinity Range</u> (ppt)	<u>Temperature Range</u> (°C)	<u>Reference</u>
<u>Gobioides broussonneti</u> Lacépède			
St. Lucie Estuary, Florida	0.24 - 25.5	14.4 - 28.7	Gunter and Hall, 1963
St. Johns River, Florida	0.0 - 23.7	16.8 - 32.4	Tagatz, 1967
<u>Gobionellus boleosoma</u> (Jordan and Gilbert)			
St. Lucie Estuary, Florida	0.24 - 25.9	15.8 - 26.1	Gunter and Hall, 1963
Caloosahatchee Estuary, Florida	0.12 - 8.6		Gunter, 1965
St. Johns River, Florida	0.0 - 20.1	11.0 - 31.0	Tagatz, 1967
* <u>Gobionellus gracillimus</u> Ginsburg			
St. Lucie Estuary, Florida	0.24 - 27.2	16.6 - 26.7	Gunter and Hall, 1963
Everglades National Park, Florida	29.0 - 34.0	26.7 - 28.9	Roessler, 1967
St. Johns River, Florida	22.7	26.4	Tagatz, 1967
* <u>Gobionellus hastatus</u> Girard			
St. Lucie Estuary, Florida	0.15 - 25.5	15.0 - 25.6	Gunter and Hall, 1963
Everglades National Park, Florida	17.9 - 34.0	25.0 - 28.9	Roessler, 1967
St. Johns River, Florida	4.0 - 12.0	11.0 - 20.0	Tagatz, 1967
* <u>Gobionellus oceanicus</u> (Pallas)			
Everglades National Park, Florida	17.9 - 18.2	25.0 - 25.1	Roessler, 1967
Charlotte Harbor Estuary, Florida	37.2	25.5	Wang and Raney, 1971
<u>Gobionellus shufeldti</u> (Jordan and Evermann)			
St. Johns River, Florida	0.0 - 21.3	12.0 - 31.6	Tagatz, 1967

*The status of these closely allied species is uncertain (C.R. Robins, Univ. of Miami, pers. comm.)

<u>Species</u>	<u>Salinity Range</u> (ppt)	<u>Temperature Range</u> (°C)	<u>Reference</u>
<u>Gobionellus smaragdus</u> (Valenciennes)			
Everglades National Park, Florida	0.0 - 37.0	24.0 - 27.0	Tabb and Manning, 1961
Jupiter Inlet, Florida	22.9 - 33.3	24.0 - 30.0	Christensen, 1965
Everglades National Park, Florida	17.9 - 42.9	23.3 - 28.9	Roessler, 1967
St. Johns River, Florida	15.3	34.1	Tagatz, 1967
<u>Gobiosoma bosci</u> (Lacépède)			
Tampa Bay, Florida	0.0 - 24.8	21.1 - 32.5	Springer and Woodburn, 1960
St. Lucie Estuary, Florida	10.0	26.0	Gunter and Hall, 1963
Caloosahatchee Estuary, Florida	0.09 - 33.0 (mean 4.2)		Gunter, 1965
Mississippi Sound, Mississippi	<22.3		Dawson, 1966
St. Johns River, Florida	0.0 - 26.8	11.0 - 31.0	Tagatz, 1967
Sapelo Island, Georgia		12.7 - 31.3	Dahlberg and Conyers, 1973
<u>Gobiosoma longipala</u> Ginsburg			
Caloosahatchee Estuary, Florida	25.6 - 32.9		Gunter, 1965
Mississippi Sound, Mississippi	24.8 - 32.2		Dawson, 1966
<u>Gobiosoma robustum</u> Ginsburg			
Cedar Key, Florida	17.5 - 31.5	10.5 - 30.5	Reid, 1954
Cedar Key, Florida	28.1 - 37.6	19.0 - 23.0	Kilby, 1955
Bayport, Florida	7.0	18	Kilby, 1955
Tampa Bay, Florida	7.0 - 37.6	10.0 - 32.5	Springer and Woodburn, 1960
Everglades National Park, Florida	4.0 - 31.0	16.0 - 28.0	Tabb and Manning, 1961

<u>Species</u>	<u>Salinity Range</u> (ppt)	<u>Temperature Range</u> (°C)	<u>Reference</u>
<u>Gobiosoma robustum</u> Ginsburg (continued)			
Lower Matecumbe Key, Florida	34.5 - 34.7	22.0 - 33.5	Springer and McErlean, 1962
Jupiter Inlet, Florida	31.5 - 31.9	18.5 - 29.0	Christensen, 1965
Mississippi Sound, Mississippi	22.3 - 32.3		Dawson, 1966
Everglades National Park, Florida	30.8	28.3	Roessler, 1967
St. Johns River, Florida	0.0 - 11.0	14.0 - 30.0	Tagatz, 1967
Charlotte Harbor Estuary, Florida	2.1 - 37.2	16.5 - 29.5	Wang and Raney, 1971
Crystal River, Florida	15.4 - 31.2	18.5 - 30.0	Mountain, 1972
<u>Lophogobius cyprinoides</u> (Pallas)			
Marco Island, Collier County, Florida	0.0 - 39.3	20.9 - 31.8	Brockmann, 1974
Clearwater Pass, Whitewater Bay, Florida	0.0 - 30.0	24.0 - 28.0	Tabb and Manning, 1961
Snapper Creek, Dade County, Florida	0.0 - 34.0	21.7 - 28.5	Darcy, 1978
Coral Gables Waterway, Dade County, Florida	0.0 - 26.0	22.6 - 27.0	Darcy, 1978
Turkey Point, Biscayne Bay, Dade County, Florida	17.0 - 30.0	19.5 - 39.5	Nugent, 1970
<u>Microgobius gulosus</u> (Girard)			
Cedar Key, Florida	10.5		Kilby, 1955
Tampa Bay, Florida	0.0 - 35.0		Springer and Woodburn, 1960
Everglades National Park, Florida	0.0 - 32.0	16.0 - 29.0	Tabb and Manning, 1961
Caloosahatchee Estuary, Florida	0.18 - 11.1		Gunter, 1965
Jupiter Inlet, Florida	1.5 - 36.6	18.0 - 34.0	Christensen, 1965
Everglades National Park, Florida	18.3 - 31.8	24.4 - 28.9	Roessler, 1967
St. Johns River, Florida	0.0 - 19.9	12.0 - 34.1	Tagatz, 1967
Charlotte Harbor Estuary, Florida	0.0 - 32.7	19.0 - 29.0	Wang and Raney, 1971
Crystal River, Florida	17.0 - 33.0	16.5 - 33.5	Mountain, 1972

Figure 1. Comparison of temperature ranges reported in the literature for selected gobies (Microgobius, Gobiosoma [robustum and bosci], Gobionellus, Bathygobius, Lophogobius) and eleotrids (Eleotris, Dormitator) from the southeastern United States. Each bar or point represents one report.

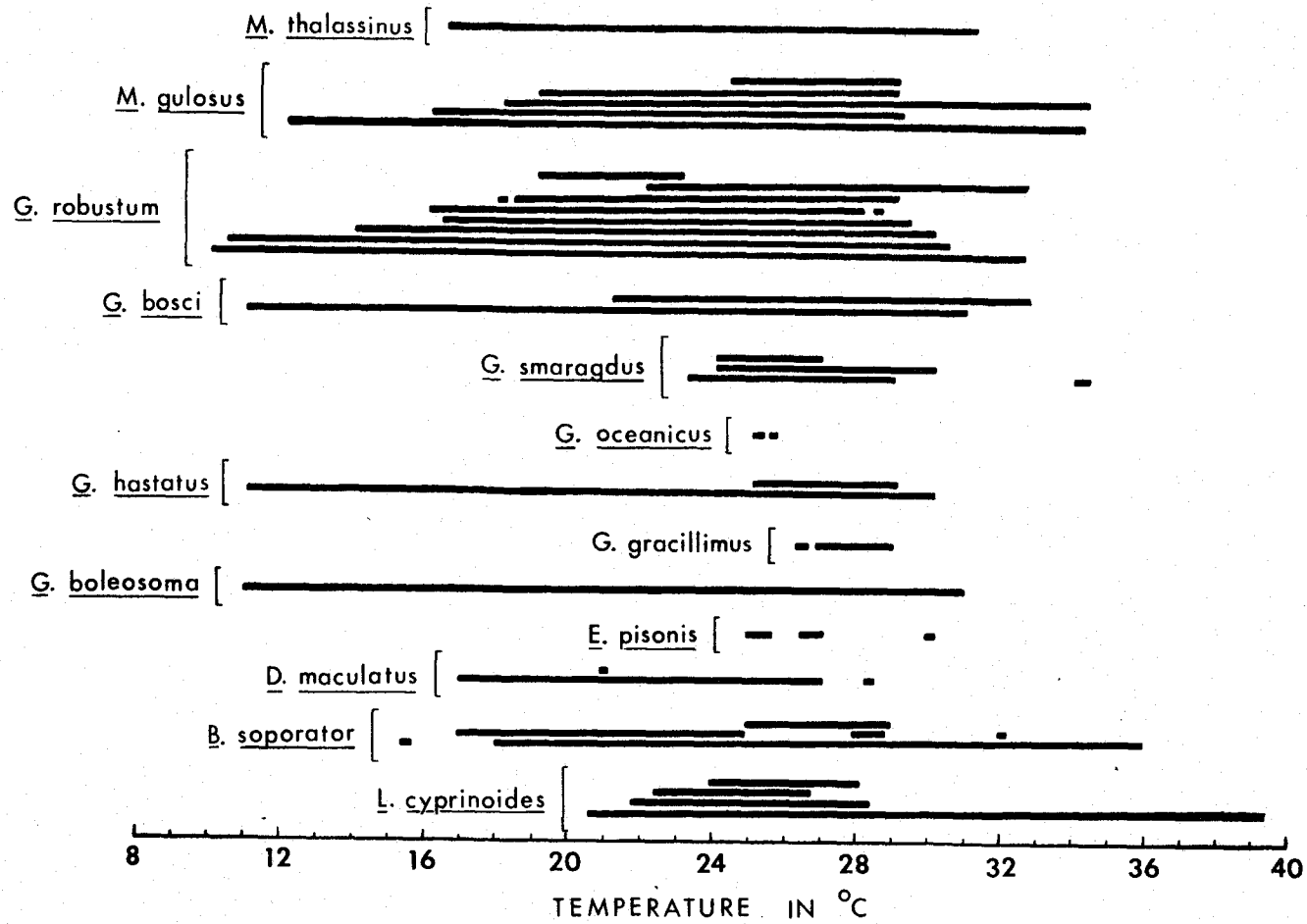
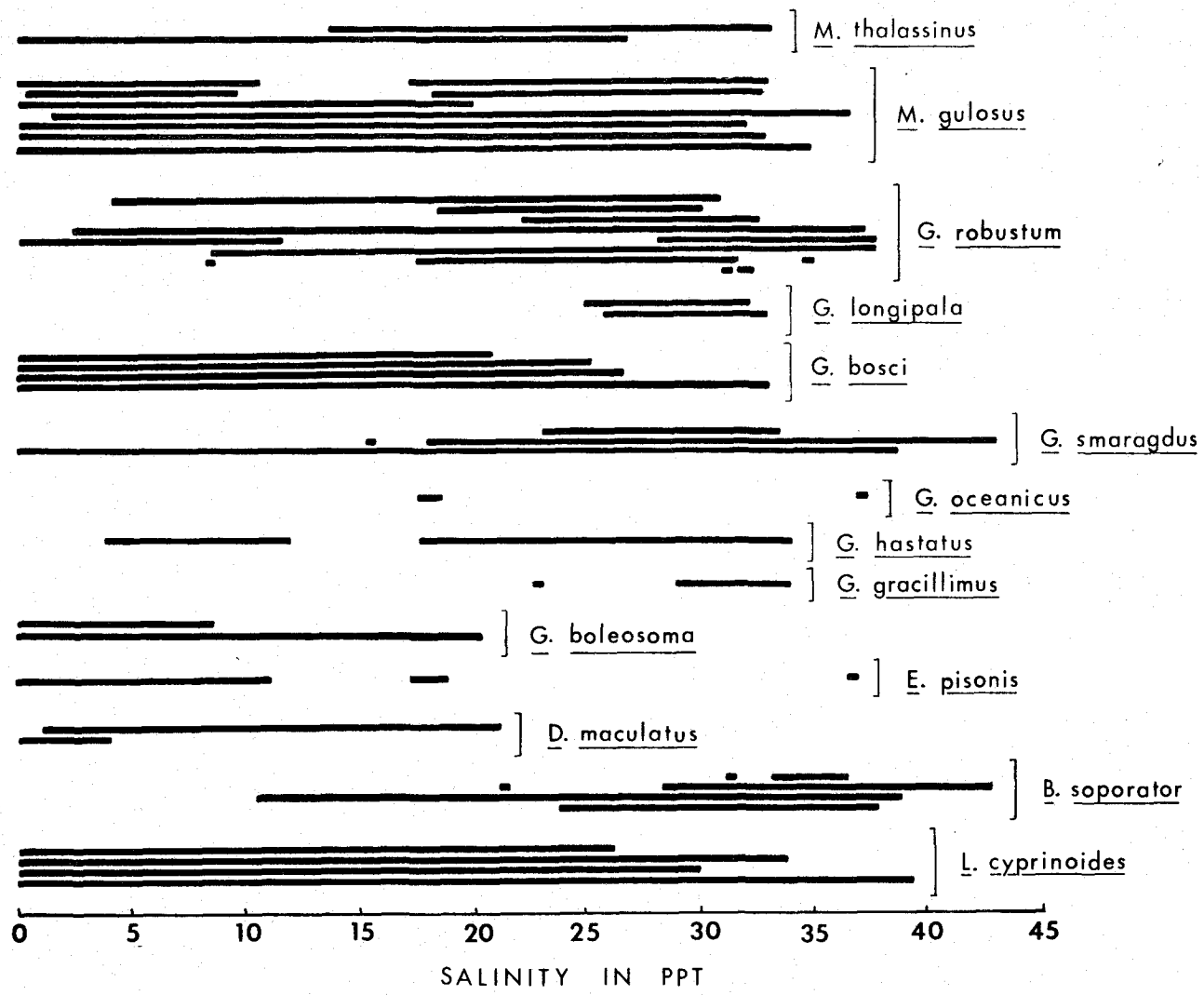


Figure 2. Comparison of salinity ranges reported in the literature for selected gobies (Microgobius, Gobiosoma [robustum, longipala, bosci], Gobionellus, Bathygobius, Lophogobius) and eleotrids (Eleotris, Dormitator) from the southeastern United States. Each bar or point represents one report.



Food Habits

Food habits of gobies are very diverse. Although most species are carnivorous, many are omnivorous and a few are herbivorous. Most nearshore, medium-sized gobies appear to feed mainly on small benthic invertebrates and algae. In contrast, tropical reef-dwelling species may have very specialized food habits. Several species of gobies are semi-pelagic and feed on planktonic copepods. Species living in freshwater streams and lakes often feed on diatoms and other microalgae. Food habit information for several gobies is presented in Table 2.

Table 2. Comparison of food habits of several species of gobioid fishes as reported in the literature.

When available, percent dry weights are given, and appear in parentheses following the food items.

In all cases, food items are listed in order of dominance in the diet, or in the order they were listed by the author. All are gobiids unless otherwise indicated.

<u>Species and Locality</u>	<u>Food</u>	<u>Reference</u>
WESTERN ATLANTIC		
<u>Lophogobius cyprinoides</u> (Pallas)		
North River estuary, Florida	Amphipods (43), plant detritus (24), filamentous algae (11), mysids, caridean and penaeid shrimps, <u>Neanthes</u> , ostracods, bivalves, chironomid larvae, harpacticoid copepods, isopods, <u>Rhithopanopeus harrisii</u> , snails	Odum, 1970
Dade County, Florida	Algae (64), crustaceans (17), mollusks (12), insects (4), bryozoans (2), polychaetes (1)	Darcy, 1978
<u>Gobiosoma robustum</u> Ginsburg		
Cedar Key, Florida	Shrimp, caprellid and gammarid amphipods, mollusks	Reid, 1954
Tampa Bay, Florida	Copepods, isopods, gammarid amphipods, bivalves, shrimp	Springer and Woodburn, 1960
North River estuary, Florida	Amphipods (42), chironomid larvae (18), mysids (9), cladocerans (8), ostracods, mollusks, algae, detritus, cumaceans	Odum, 1970

Species and LocalityFoodReferenceGobiosoma bosci (Lacépède)

Chesapeake Bay

Gammarus, small crustaceans, annelids,
small fish, fish eggsHildebrand and
Schroeder, 1928Gobiosoma ginsburgi Hildebrand and Schroeder

Chesapeake Bay

Gammarus, small crustaceansHildebrand and
Schroeder, 1928Bathygobius soporator (Valenciennes)

North River estuary, Florida

Palaemonetes, chironomids, amphipods

Odum, 1970

Coral Gables Waterway, Florida

Insects (100)

Darcy, 1978

Dormitator maculatus (Bloch) (Eleotridae)

Indian River, Florida

Mosquitos (99), cyclopoid copepods,
isopodsHarrington and
Harrington, 1961Eleotris pisonis (Gmelin) (Eleotridae)

Coral Gables Waterway, Florida

Insects, insect naiads, chironomid
larvae

Darcy, 1978

Microgobius gulosus (Girard)

Crystal River, Florida

Juveniles: detritus, copepods
Adults: detritus, amphipods, polychaetes

Carr and Adams, 1973

Cedar Key, Florida

Copepods, mysids, amphipods

Reid, 1954

Species and LocalityFoodReferenceMicrogobius gulosus (Girard) (continued)

Tampa Bay, Florida

Copepods, gammarid amphipods, other crustaceans, polychaetes, bivalves, algae

Springer and Woodburn, 1960

North River estuary, Florida

Amphipods (43), harpacticoid copepods (21), chironomid larvae (10)

Odum, 1970

Gobionellus hastatus (Girard)

Tampa Bay, Florida

Algae (Enteromorpha)

Springer and Woodburn, 1960

St. Lucie River, Florida

Ostracods, copepods, insect larvae

Springer and Woodburn, 1960

Coryphopterus glaucofraenum Gill

Virgin Islands, Caribbean Sea

Algae and detritus (50), ostracods (12), ophiuroids (10), unidentified eggs (10), bivalves (10), copepods (8)

Randall, 1967

Gnatholepis thompsoni Jordan

Virgin Islands, Caribbean Sea

Algae and detritus (74), copepods (18), amphipods (4), ostracods (2), unidentified crustaceans (2)

Randall, 1967

Gobiosoma (Elacatinus) spp.

Virgin Islands, Caribbean Sea

Gnathiid isopods

Randall, 1967

<u>Species and Locality</u>	<u>Food</u>	<u>Reference</u>
<u>Sicydium plumieri</u> (Bloch) Puerto Rico: freshwater EASTERN ATLANTIC	Algal slime on rocks	Erdman, 1961
<u>Aphia minuta</u> (Risso) Denmark, Belt Sea	Harpacticoid copepods, barnacles, mysids, unidentified crustaceans, algae	Hesthagen, 1971
<u>Gobius niger</u> Linnaeus Denmark	Amphipods, mysids, decapod crustaceans, polychaetes, mollusks, insect larvae, small fish, algae	Blegvad, 1917
<u>Gobiusculus flavescens</u> (Fabricius) Denmark	Calanoid and harpacticoid copepods, larvae of small crustaceans, small poly- chaetes, small mollusks	Blegvad, 1917
<u>Pomatoschistus microps</u> (Krøyer) Denmark, Belt Sea	Harpacticoid copepods, mysids, amphi- pods, polychaetes	Hesthagen, 1971
<u>Pomatoschistus minutus</u> (Pallas) Denmark Denmark, Belt Sea	Amphipods, mysids, <u>Crangon</u> , calanoid and harpacticoid copepods, small mollusks Harpacticoid copepods, polychaetes, mysids, amphipods, bivalves, crustaceans, mites	Blegvad, 1917 Hesthagen, 1971

<u>Species and Locality</u>	<u>Food</u>	<u>Reference</u>
<u>Gobius cobitus</u> Pallas	Juveniles: copepods, ostracods, small amphipods Adults: algae, gammarid amphipods, crabs, isopods, chironomid larvae and adults, small fish	Gibson, 1970
<u>Thorogobius ephippiatus</u> (Lowe)		
Western Europe	Crustaceans, polychaetes	Miller, 1969
EASTERN PACIFIC		
<u>Typhlogobius californiensis</u> Steindachner		
Baja California	Animal tissue and debris gathered by commensal shrimp	MacGinitie, 1939
<u>Gillichthys mirabilis</u> Cooper		
Baja California	Polychaetes, mollusks, small worms	Fitch and Lavenberg, 1975
<u>Clevelandia ios</u> (Jordan and Gilbert)		
British Columbia	Larvae: planktonic eggs, copepods, copepod nauplii, barnacle larvae Adults: diatoms, green algae, tintinnids, eggs and young of ghost shrimp	Barraclough and Fulton, 1967, 1968 Hart, 1973

<u>Species and Locality</u>	<u>Food</u>	<u>Reference</u>
INDO-WEST PACIFIC		
<u>Gobiopterus chuno</u> (Hamilton)		
India	Copepods	Pillay and Sarojini, 1950
<u>Acentrogobius neilli</u> (Day)		
India: freshwater	<u>Enteromorpha</u> , other algae	Aiyar, 1935
<u>Boleophthalmus boddaerti</u> Valenciennes		
Singapore, SE Asia	Algal layer on mudflat	Khoo, 1966
<u>Scartelaos viridis</u> Swainson		
Singapore, SE Asia	Mud surface layer containing algae, nematodes, harpacticoid copepods	Khoo, 1966
<u>Parioglossus taeniatus</u> Regan		
Japan	Planktonic copepods	Dôtu, 1955a
<u>Gobius poecilichthys</u> Jordan and Snyder		
Southern Japan	Juveniles: planktonic copepods Adults: mollusks, crustaceans	Dôtu, 1955b
<u>Zonogobius boreus</u> Snyder		
Japan	Small crustaceans	Shiogaki and Dotsu, 1974
<u>Pterogobius elapoides</u> (Gunter)		
Japan	Copepods, detritus, algae	Dôtu and Tsutsumi, 1959

<u>Species and Locality</u>	<u>Food</u>	<u>Reference</u>
<u>Eutaenichthys gilli</u> Jordan and Snyder Japan: estuaries	Organic detritus	Dôtu, 1965
<u>Sicydium japonicum</u> Tanaka Japan: freshwater	Diatoms, blue-green algae	Dôtu and Mito, 1955b
<u>Paleatogobius uchidai</u> Takagi Japan	Worms, young fish, detritus	Dôtu, 1958a
<u>Rhinogobius giurinus</u> (Rutter) Southwest Japan: freshwater, estuaries	Insects, small fishes, mollusks, crustaceans, detritus, fish eggs	Dôtu, 1961a
<u>Chaenogobius scrobiculatus</u> Takagi Southwest Japan: estuaries	Small crustaceans, mollusks, detritus, algae	Dôtu, 1961b
<u>Apocryptodon bleekeri</u> (Day) Ariake Sound, Japan	Juveniles: copepods, detritus Adults: mud, diatoms	Dôtu, 1961c
<u>Glossogobius giuris</u> (Hamilton) Philippines: freshwater	Microalgae, diatoms, some fishes, sponges	Marquez, 1968

Life History

Life history data are lacking for the great majority of gobies. However, certain similarities exist within the family which may be appreciated through comparison of these parameters.

Most small shore fishes tend to be short-lived, many gobies having lifespans of only 1-2 years, with maturation occurring in the first year of life, although larger species may live considerably longer and mature later (Table 3). The great majority of gobies spawn over a period of several months, usually in spring and summer, although several Japanese species spawn in winter (Table 4). The number of eggs produced at each spawning is quite low in most gobies. However, numerous spawnings may take place over the season, with relatively short intervals between spawnings (Table 4). Reef-dwelling gobies generally have low fecundities relative to other goby species, although other species which guard their eggs also tend to shed few eggs at each spawning. Most fishes which build demersal nests and guard eggs shed fewer than 2000 eggs per spawning (Carlander, 1969); fishes such as gobies which are limited in fecundity by their small size often compensate by exhibiting parental care (Dahlberg and Conyers, 1973).

Egg-size of small fishes such as gobies is limited at least somewhat by their small body-size. Goby eggs tend to be small, aspherical, and bear filaments on their germinal ends (Hildebrand and Cable, 1938; Tavolga 1950a; Breder and Rosen, 1966). Of all teleosts, the gobies show the most departure from a spherical egg-shape (Breder, 1943), the eggs typically being pear- or spindle-shaped. Egg sizes and sizes of newly-hatched larvae of gobies are compared in Table 5. Incubation periods of most goby eggs is 4-14 days, depending somewhat on temperature (Table 5).

Larvae of most gobies are planktonic, and little is known of the time until metamorphosis of most species. Lengths of larvae at metamorphosis are somewhat better known, although known for few species (Table 6).

Table 3. Comparison of size at maturation, age at maturation, maximum adult size, and lifespan of several species of gobies.

Species	Length at Maturation (mm)	Age at Maturation (yrs)	Maximum Length (mm)	Maximum Age (yrs)	Reference
<u>Acentrogobius neilli</u> (Day)	20	---	80	---	Aiyar, 1935
<u>Aphia minuta</u> (Risso)	40	1	60	1-2	Miller, 1961; Wheeler, 1969
<u>Apocryptodon bleekeri</u> (Day)	55	2	70 T.L.	---	Dôtu, 1961c
<u>Bathygobius soporator</u> (Valenciennes)	40	---	150	---	Tavolga, 1954; Böhlke and Chaplin, 1968
<u>Chaenogobius castanea</u> O'Shaughnessy	35	1	65	3	Dôtu, 1954
<u>Chaenogobius scrobiculatus</u> Takagi	27	1	40 T.L.	---	Dôtu, 1961b
<u>Chaenogobius urotaenia</u> (Hilgendorf)	55 - 73	1	---	3+	Dôtu, 1955c
<u>Chaeturichthys hexanema</u> Bleeker	135	1	---	3+	Dôtu, Mito, and Ueno, 1955
<u>Chaparruda flavescens</u> (Fabricius)	30 - 45	---	60	1-2	Wheeler, 1969
<u>Clevelandia ios</u> (Jordan and Gilbert)	34	---	51	---	Carter, 1965
<u>Crystallogobius linearis</u> (Düben)	---	1	♂♂ : 50 ♀♀ : 40	1-2	Miller, 1961; Wheeler, 1969
<u>Eutaenichthys gilli</u> Jordan and Snyder	---	1	---	---	Dôtu, 1965
<u>Gillichthys mirabilis</u> Cooper	---	1	200+	2-3	Weisel, 1947; Walker et al., 1961; Barlow, 1963

Species	Length at Maturation (mm)	Age at Maturation (yrs)	Maximum Length (mm)	Maximum Age (yrs)	Reference
<u>Glossogobius giuris</u> (Hamilton)	105 - 114.5	1	---	---	Marquez, 1968
<u>Gobiosoma bosci</u> (Lacépède)	25 - 30	1	---	---	Hildebrand and Cable, 1938
<u>Gobiosoma ginsburgi</u> Hildebrand and Schroeder	25 - 30	1	---	---	Hildebrand and Cable, 1938
<u>Gobiosoma oceanops</u> (Jordan)	---	1	34	2	Feddern, 1967; Colin, 1973, 1975
<u>Gobiosoma robustum</u> Ginsburg	13.1 - 19	0.5 - 0.7	♂♂ : 44 ♀♀ : 29	1	Springer and McErlean, 1961
<u>Gobius cobitus</u> Pallas	---	---	---	10+	Gibson, 1970
<u>Gobius niger</u> Linnaeus	---	1 - 2	170	4+	McIntosh and Masterman, 1897; Wheeler, 1969
<u>Gobius paganellus</u> Linnaeus	50 - 58	2 - 3	120	8 - 10	Miller, 1961; Wheeler, 1969
<u>Gobius poecilichthys</u> Jordan and Snyder	---	---	80 T.L.	4+	Dôtu, 1955b
<u>Lebetus orca</u> (Collette)	---	1	39	2	Wheeler, 1969
<u>Lophogobius cyprinoides</u> (Pallas)	♂♂ : 30.0 ♀♀ : 28.5-30.0	1	♂♂ : 80.0 ♀♀ : 57.0	2	Darcy, 1978

Species	Length at Maturation (mm)	Age at Maturation (yrs)	Maximum Length (mm)	Maximum Age (yrs)	Reference
<u>Microgobius thalassinus</u> (Jordan and Gilbert)	---	---	---	1	Schwartz, 1971
<u>Mistichthys luzonensis</u> Smith	---	---	---	1-2	Te Winkel, 1935; Liu and Walford, 1970
<u>Paleatogobius uchidai</u> Takagi	---	1	35	2	Dôtu, 1958a
<u>Pandaka pygmaea</u> Herre	---	---	---	1-2	Liu and Walford, 1970
<u>Parioglossus taeniatus</u> Regan	20 - 37 T.L.	1	35+ S.L.	2+	Dôtu, 1955a
<u>Pomatoschistus microps</u> (Krøyer)	♂♂ : 31.75 ♀♀ : 29.0	1	70	1-2	Miller, 1964; Jones and Miller, 1966; Wheeler, 1969
<u>Pomatoschistus minutus</u> (Pallas)	45	1	95	1-2	McIntosh and Masterman, 1897; Shann, 1910; Wheeler, 1969; Healey, 1971; Hesthagen, 1977
<u>Rhinogobius giurinus</u> (Rutter)	33	1-2	70 T.L.	---	Dôtu, 1961a
<u>Sicydium japonicum</u> Tanaka	70 T.L.	2	---	---	Dôtu and Mito, 1955b
<u>Thorogobius ephippiatus</u> (Lowe)	---	4+	---	9	Miller, 1969
<u>Typhlogobius californiensis</u> Steindachner	---	---	---	10-12	MacGinitie, 1939

Table 4. Comparison of spawning seasons, number of spawns per season, intervals between spawnings, and fecundities of several species of gobies. The abbreviation (ov) refers to ovarian egg counts, and (sp) to eggs actually spawned, when specified by the author. When fecundity was reported from aquarium spawnings, the locality is followed by (aq).

Species	Location	Spawning Season	Number of Spawnings	Interval Between Spawnings	Fecundity	Reference
<u>Acanthogobius flavimanus</u> (Temminck and Schlegel)	Japan	Jan-Mar	---	---	---	Dôtu and Mito, 1955a
<u>Acentrogobius neilli</u> (Day)	India	peaks Oct-Nov	---	---	---	Aiyar, 1935
<u>Acentrogobius masago</u> (Tomiyama)	Japan	May-Sep	---	---	---	Dôtu, 1958b
<u>Acentrogobius viridopunctatus</u> (Cuvier and Valenciennes)	Europe	---	---	---	3000	Jones, 1937
<u>Aphia minuta</u> (Risso)	NW Europe	May-Aug	---	---	1800 - 2000	Wheeler, 1969
<u>Apocryptodon bleekeri</u> (Day)	Japan	May-July	---	---	592 - 5826 (ov)	Dôtu, 1961c
<u>Barbulifer ceuthoecus</u> (Jordan and Gilbert)	Bahamas	---	---	---	177 (ov)	Böhlke and Robins, 1968
<u>Bathygobius soporator</u> (Valenciennes)	Florida	July-Aug	---	7-16 days	800 - 1000 15000 - 18000	Tavolga, 1950a, 1956 Tavolga, 1954
<u>Chaenogobius castanea</u> O'Shaughnessy	Japan (freshwater)	Jan-Apr	---	---	---	Dôtu, 1954
	Japan	May-June	---	---	---	Muroya and Sato 1963
<u>Chaenogobius scrobiculatus</u> Takagi	Japan	Jan-Apr	---	---	---	Dôtu, 1961b

Species	Location	Spawning Season	Number of Spawnings	Interval Between Spawnings	Fecundity	Reference
<u>Chaenogobius urotaenia</u> (Hilgendorf)	Japan (freshwater)	Jan-May	---	---	885 - 2257 (ov)	Dôtu, 1955c
<u>Chaeturichtys hexanema</u> Bleeker	Japan	Feb-May	---	---	1731 - 19258	Dôtu, Mito, and Ueno, 1955
<u>Chaparruda flavescens</u> (Fabricius)	NW Europe	May-July	---	---	---	Wheeler, 1969
<u>Chasmichthys dolichognathus</u> (Hilgendorf)	Japan	Dec-Feb	---	---	---	Okada, 1955
<u>Clevelandia ios</u> (Jordan and Gilbert)	California	Dec-Aug	---	---	1100	Carter, 1965
<u>Coryphopterus nicholsi</u> (Bean)	California	Apr-Oct	---	---	1700	Ebert and Turner, 1962
<u>Crystallogobius linearis</u> (Düben)	NW Europe	May-Aug	---	---	3000	McIntosh, 1896; Wheeler, 1969
<u>Gillichthys mirabilis</u> Cooper	South California	Jan-July	2-3	40-50 days	4000 - 9000	Weisel, 1949; Barlow, 1963
	South California	Jan-Sep	---	---	---	Fitch and Lavenberg, 1975
<u>Ginsburgellus novemlineatus</u> (Fowler)	Saint Barthélemy	---	---	---	103 (ov)	Böhlke and Robins, 1968
<u>Glossogobius giurus</u> (Hamilton)	Philippines	---	---	1 month	---	Marquez, 1968

Species	Location	Spawning Season	Number of Spawnings	Interval Between Spawnings	Fecundity	Reference
<u>Gobionellus boleosoma</u> (Jordan and Gilbert)	North Carolina	May-Oct	---	---	---	Hildebrand and Cable, 1938
<u>Gobiopterus chuno</u> (Hamilton)	India	Sep-Dec	1	---	230 - 300	Pillay and Sarojini, 1950
<u>Gobiosoma bosci</u> (Lacépède)	North Carolina	Apr-Sep	---	---	---	Hildebrand and Cable, 1938
	Georgia	Apr-July	---	---	701 - 1382	Dahlberg and Conyers, 1973
	Mississippi Sound	Apr-Aug	---	---	---	Dawson, 1966
<u>Gobiosoma evelynae</u> (Böhlke and Robins)	(aq)	---	---	14-21 days	300 - 500	Colin, 1973, 1975
	Grenadines	---	---	---	424 (ov)	Böhlke and Robins, 1968
<u>Gobiosoma gemmatum</u> (Ginsburg)	Grenadines	---	---	---	114 (ov)	Böhlke and Robins, 1968
<u>Gobiosoma ginsburgi</u> Hildebrand and Schroeder	North Carolina	Apr-Sep	---	---	---	Hildebrand and Cable, 1938
	Georgia	Apr-Aug	---	---	354 - 790	Dahlberg and Conyers, 1973
<u>Gobiosoma longipala</u> Ginsburg	Mississippi Sound	May-Aug	---	---	---	Dawson, 1966

Species	Location	Spawning Season	Number of Spawnings	Interval Between Spawnings	Fecundity	Reference
<u>Gobiosoma louisae</u> Böhlke and Robins	Bahamas	---	---	---	78 (ov)	Böhlke and Robins, 1968
<u>Gobiosoma oceanops</u> (Jordan)	(aq)	Dec-May	35	1-2 weeks	300 - 450	Valenti, 1972
<u>Gobiosoma pallens</u> (Ginsburg)	Grand Cayman Is.	---	---	---	106 (ov)	Böhlke and Robins, 1968
<u>Gobiosoma prochilos</u> Böhlke and Robins	Saint Barthélemy	---	---	---	154 (ov)	Böhlke and Robins, 1968
<u>Gobiosoma robustum</u> Ginsburg	Mississippi Sound	May-Sep	---	---	---	Dawson, 1966
	Tampa, Florida	Mar-June Apr-Sep	--- 2	--- ---	--- ---	Breder, 1942 Springer and McErlean, 1961
<u>Gobiosoma saucrum</u> (Robins)	Saint Barthélemy	---	---	---	152 (ov)	Böhlke and Robins, 1968
<u>Gobius cobitus</u> Pallas	NW Europe	Apr-June	2	---	2000 - 12000	Gibson, 1970
<u>Gobius niger</u> Linnaeus	NW Europe	May-Aug	---	---	---	Wheeler, 1969
<u>Gobius paganellus</u> Linnaeus	NW Europe	Mar-Aug	2+	---	1500 - 8500	Miller, 1961; Wheeler, 1969
<u>Gobius poecilichthys</u> Jordan and Snyder	S. Japan	June-Sep	---	---	---	Dôtu, 1955b
<u>Lebetus orca</u> (Collette)	NW Europe	Apr-Aug	---	---	---	Wheeler, 1969

Species	Location	Spawning Season	Number of Spawnings	Interval Between Spawnings	Fecundity	Reference
<u>Lebetus orca</u> (Collette)	NW Europe	Apr-Aug	---	---	---	Wheeler, 1969
<u>Lophogobius cyprinoides</u> (Pallas)	Panama (aq)	---	---	8 days	---	Delmonte et al., 1968
	S. Florida (aq)	Mar-June, Sep-Oct	many	7 days	1000 (sp)	Stahl, pers. comm., in Darcy, 1978
	S. Florida	Mar-Sep	---	---	1480 (ov)	Darcy, 1978
<u>Mistichthys luzonensis</u> Smith	Philippines (freshwater)	year-round	---	---	20 - 40	Te Winkel, 1935
<u>Neogobius fluviatilis</u> (Pallas)	Black Sea	Apr-July	---	---	---	Bil'ko, 1968
<u>Neogobius melanostomus</u> (Pallas)	Black Sea	May-Aug	---	---	---	Bil'ko, 1968
<u>Nes longus</u> (Nichols)	Biscayne Bay, Florida	---	---	---	1771 (ov)	Böhlke and Robins, 1968
<u>Paleatogobius uchidai</u> Takagi	Japan	Jan-Mar	---	---	158 - 430	Dôtu, 1958a
<u>Pariogobius taeniatus</u> Regan	Japan	July-Sep	---	---	947 - 2433 (ov)	Dôtu, 1955a
<u>Pomatoschistus microps</u> (Krøyer)	NW Europe	Apr-Sep	8	---	---	Miller, 1964; Jones and Miller, 1966
<u>Pomatoschistus minutus</u> (Pallas)	NW Europe	Feb-Sep	2	---	2556 - 2749	Wheeler, 1969; Healey, 1971, 1972; Hesthagen, 1977

Species	Location	Spawning Season	Number of Spawning	Interval Between Spawnings	Fecundity	Reference
<u>Pterogobius elapoides</u> (Günther)	Japan	Dec-Mar	---	2-3 weeks	1800	Nakamura, 1936; Dôtu and Tsutsumi, 1959
<u>Rhinogobius giurinus</u> (Rutter)	Japan (freshwater)	July-Oct	---	---	1118 - 22515 (ov) 1723 - 2061 (sp)	Dôtu, 1961a
<u>Rhinogobius similis</u> Gill	Japan (freshwater)	June-July	---	---	1100 - 1800	Mizuno, 1960
<u>Sicydium japonicum</u> Tanaka	Japan (freshwater)	July-Sep	---	---	224,960	Dôtu and Mito, 1955b
<u>Sicydium plumieri</u> (Bloch)	Puerto Rico (freshwater)	Apr-July	---	---	---	Erdman, 1961
<u>Sicyopterus extraneus</u> Herre	Philippines (freshwater)	year-round	---	---	46000	Manacop, 1953
<u>Thorogobius ephippiatus</u> (Lowe)	NW Europe	May-July	---	---	---	Miller, 1969
<u>Tukugobius flumineus</u> Mizuno	Japan (freshwater)	June-July	---	---	74 - 127	Mizuno, 1960
<u>Typhlogobius californiensis</u> Steindachner	South California	May-July	---	---	2500 - 15000	MacGinitie, 1939
<u>Zonogobius boreus</u> Snyder	Japan	June-Oct	many	---	---	Shiogaki and Dotsu, 1974

Table 5. Comparison of egg size, incubation period, and size of newly-hatched larvae of gobies.

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly-Hatched Larva (mm)	Reference
<u>Acanthogobius flavimanus</u> (Temminck and Schlegel)	5.5	28 days (13)	4.6	Dôtu and Mito, 1955b
<u>Acentrogobius masago</u> (Tomiyama)	1.2	4 days (21-25)	---	Dôtu, 1958b
<u>Acentrogobius neilli</u> (Day)	1.2 X 0.4	70 hrs (24-26)	2.1	Aiyar, 1935
<u>Acentrogobius ornatus</u> (Rüppel)	0.85 X 0.40	8-10 days (27-29)	1.1-1.3	Vijayaraghavan, 1975
<u>Acentrogobius viridopunctatus</u> (Day)	2.4	5-7 days	3.3	Jones, 1937
<u>Aphia minuta</u> (Risso)	1.16 X 0.86	---	4	Wheeler, 1969
<u>Apocryptodon bleekeri</u> (Day)	1.0 (ovarian)	---	---	Dôtu, 1961c
<u>Barbulifer ceuthoecus</u> (Jordan and Gilbert)	0.5-0.6 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Bathygobius soporator</u> Valenciennes	2.36 --- ---	6 days (29) 96-100 hours (27-29) 5.5-7 days (26)	--- 2.3 ---	Breder, 1943 Tavolga, 1950a Tavolga, 1954
<u>Boleophthalmus boddaerti</u> (Pallas)	1.6	---	---	Jones, 1937

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Brachygobius xanthozona</u> (Bleeker)	---	6-7 days (28-30) 5-7 days	---	Roloff, 1935 Janov, 1947
<u>Chaenogobius castanea</u> O'Shaughnessy	4.1	---	7.0	Dôtu, 1954
<u>Chaenogobius dotui</u> Takagi	2.0	---	---	Dôtu, 1958c
<u>Chaenogobius scrobiculatus</u> Takagi	3.15 X 1.05	---	4.7	Dôtu, 1961b
<u>Chaenogobius urotaenia</u> (Hilgendorf)	3.0 X 1.0 ---	14 days (15) ---	4.1 5	Dôtu, 1955c Hamada, 1968
<u>Chaeturichthys hexanema</u> Bleeker	2.9 X 0.8	10.5 days (14-17)	4.2	Dôtu, Mito, and Ueno, 1955
<u>Chaparruda flavescens</u> Fabricius	0.75 X 0.6	10 days	2.6	Wheeler, 1969
<u>Chasmichthys gulosus</u> (Guichenot)	4.65	---	---	Nakamura, 1936
<u>Chasmichthys dolichognathus</u> (Hilgendorf)	4.15	---	---	Nakamura, 1936
<u>Clevelandia ios</u> (Jordan and Gilbert)	0.7-0.85	10-12 days (15-15.5)	2.7-3.8	MacGinitie, 1935; Prasad, 1958a, 1958b; Carter, 1965

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Coryphopterus nicholsi</u> (Bean)	2.10	---	2.97	Ebert and Turner, 1962
<u>Crystallogobius linearis</u> (Düben)	1.35 X 0.5	---	---	Wheeler, 1969
<u>Eutaenichthys gilli</u> Jordan and Snyder	2.7 X 0.8	8.5 days (23)	4.6	Dôtu, 1965
<u>Gillichthys mirabilis</u> Cooper	3.07	10-12 days	---	Weisel, 1947
<u>Ginsburgellus novemlineatus</u> (Fowler)	0.8 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Glossogobius giuris brunneus</u> (Temminck and Schlegel)	3.5	80 hrs (26)	---	Ishikawa and Nakamura, 1940
<u>Gobionellus boleosoma</u> (Jordan and Gilbert)	0.3	18 hrs	1.2	Kuntz, 1916
<u>Gobiosoma bosci</u> (Lacépède)	1.3	5 days	2.0	Kuntz, 1916
<u>Gobiosoma gemmatum</u> (Ginsburg)	0.6 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Gobiosoma oceanops</u> (Jordan)	2.3 ---	175 hrs (24-27) 150-160 hrs (28)	3.4 4.0	Feddern, 1967 Valenti, 1972

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Gobiosoma pallens</u> (Ginsburg)	0.4-0.5 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Gobiosoma robustum</u> (Ginsburg)	1.5 0.476-0.782 (ovarian)	--- ---	--- ---	Breder, 1942 Springer and McErlean, 1961
<u>Gobiosoma saucrum</u> (Robins)	0.6-0.7 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Gobiosoma (Elacatinus) spp.</u>	1.5-3.3 0.45-0.8 (ovarian)	approx. 1 wk ---	--- ---	Colin, 1973, 1975 Böhlke and Robins, 1968
<u>Gobius cobitus</u> Pallas	3.4 X 1.1	---	5.1	Wheeler, 1969
<u>Gobius ferrugineus</u> Kolombetović	1.0	---	---	Spartà, 1936
<u>Gobius jazo</u> Linnaeus	2.8 2.0	--- ---	--- ---	Spartà, 1934a Kinzer, 1960
<u>Gobius lidwilli</u> McCulloch	1.2	4.5 days (25)	---	Dôtu, 1957a
<u>Gobius niger</u> Linnaeus	1.5	---	2.8-4.0	Wheeler, 1969
<u>Gobius nudiceps</u> Valenciennes	1.8	---	---	Gilchrist, 1916

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Gobius paganellus</u> Linnaeus	2.8	---	---	Lo Bianco, 1888;
	1.87	---	---	Skowron, 1926
	2.24	---	---	Holt and Byrne, 1897
	2.5	3 weeks	3.6-3.8	Spartà, 1934b
	2.4	19 days	4-4.8	Miller, 1961 Wheeler, 1969
<u>Gobius poecilichthys</u> Jordan and Snyder	1.8 X 0.35	65 hrs (23-27)	2.3	Dôtu, 1955b
<u>Lophogobius cyprinoides</u> (Pallas)	---	>100 hrs	1.5	Delmonte et al., 1968
	1.3 X 0.4	120 hrs (27)	1.5-2.0	Stahl, pers. comm., in Darcy, 1978; Darcy, 1978
<u>Luciogobius guttatus</u> Gill	2.5	10 days (15-20)	---	Dôtu, 1957b
<u>Luciogobius saikaiensis</u> Dôtu	3.0	10 days (15-20)	---	Dôtu and Mito, 1958
<u>Mesogobius gymnotrachelus</u> (Kessler)	3.27 X 1.64	---	---	Bil'ko, 1968
<u>Mistichthys luzonensis</u> Smith	0.375	---	---	Te Winkel, 1935
<u>Neogobius batrachocephalus</u> (Pallas)	4.01 X 2.15	---	---	Bil'ko, 1968
<u>Neogobius ratan</u> (Nordmann)	3.73 X 1.91	---	---	Bil'ko, 1968

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Neogobius syrman</u> (Nordmann)	4.21 X 1.89	---	---	Bil'ko, 1968
<u>Nes longus</u> (Nichols)	0.8 (ovarian)	---	---	Böhlke and Robins, 1968
<u>Paleatogobius uchidai</u> Takagi	2.40	---	4.3	Dôtu, 1958a
<u>Parioglossus taeniatus</u> Regan	1.3 X 0.6	4 days (25-28)	2	Dôtu, 1955a
<u>Periophthalmus barbarus</u> Linnaeus	0.76	25-26 days	---	Kimura, 1958
<u>Pomatoschistus microps</u> (Krøyer)	0.93 X 0.675	14 days	3	Lebour, 1920
	---	10 days	2.5	Nyman, 1953
	0.8	---	3-4	Wheeler, 1969
<u>Pomatoschistus minutus</u> (Pallas)	1.17	---	---	Holt, 1890
	1.24 X 0.75	14 days	3	Lebour, 1920
	0.9	---	2-3	Wheeler, 1969
	0.65 (ovarian)	---	---	Healey, 1971
<u>Pomatoschistus pictus</u> (Malm)	---	---	2.68	Holt and Byrne, 1897
	0.775	14 days	2.7-3	Lebour, 1920
	0.80 X 0.65	---	3	Wheeler, 1969
<u>Pterogobius elapoides</u> (Günther)	2.3 X 0.8	---	---	Dôtu and Tsutsumi, 1959
<u>Pterogobius zonoleucus</u> Jordan and Snyder	2.1 X 0.6	15+ days (10)	2.5	Dôtu, 1955d

Species	Egg Size (mm)	Incubation Period and Temp. (°C)	Length of Newly- Hatched Larva (mm)	Reference
<u>Rhinogobius giurinus</u> (Rutter)	2.4 X 0.45	4 days (25)	2.6	Dôtu, 1961a
<u>Rhinogobius similis</u> Gill	0.6	---	4.0	Mizuno, 1960
<u>Sicydium japonicum</u> Tanaka	0.45	<2 days (25)	1.5	Dôtu and Mito, 1955b
<u>Sicyopterus extraneus</u> Herre	---	20-30 hrs (27.5)	1.1	Manacop, 1953
<u>Stigmatogobius hoevenii</u> (Bleeker)	2.83	---	---	Szabados, 1937
<u>Triaenopogon barbatus</u> (Günther)	1.5	4 days (25)	---	Dôtu 1957c
<u>Tridentiger undicervicus</u> Tomiyama	1.15	4 days (25)	---	Dôtu, 1958d
<u>Typhlogobius californiensis</u> Steindachner	2.78	10-12 days (17-20)	3.25	MacGinitie, 1939
<u>Zonogobius boreus</u> Snyder	1.32	>110 hrs (21-23)	2.07-2.52	Shiogaki and Dotsu, 1974

Table 6. Comparison of metamorphosis times and sizes of several species of gobies.

Species	Time until Metamorphosis	Length at Metamorphosis (mm)	Reference
<u>Acanthogobius flavimanus</u> (Temminck and Schlegel)	---	12-15	Dôtu, and Mito, 1955a
<u>Apocryptodon bleekeri</u> (Day)	---	20 (T.L.)	Dôtu, 1961c
<u>Bathygobius soporator</u> Valenciennes	---	7.0	Tavolga, 1950a
<u>Chaenogobius castanea</u> O'Shaughnessy	---	20 (T.L.)	Dôtu, 1954
<u>Chaenogobius urotaenia</u> (Hilgendorf)	---	25 (T.L.)	Dôtu, 1955c
<u>Chaeturichthys hexanema</u> Bleeker	---	21 (T.L.)	Dôtu, Mito, and Ueno, 1955
<u>Eutaenichthys gilli</u> Jordan and Snyder	---	15.3 (T.L.)	Dôtu, 1965
<u>Gobiosoma bosci</u> (Lacépède)	---	<10	Kuntz, 1916; Hildebrand and Cable, 1938
<u>Gobiosoma ginsburgi</u> Hildebrand and Schroeder	---	<10	Hildebrand and Cable, 1938
<u>Gobiosoma oceanops</u> (Jordan)	---	10 (S.L.)	Feddern, 1967
<u>Gobius niger</u> Linnaeus	---	10-20	Wheeler, 1969

Species	Time until Metamorphosis	Length at Metamorphosis (mm)	Reference
<u>Gobius paganellus</u> Linnaeus	---	9.5-10.5 10-20	Miller, 1961 Wheeler, 1969
<u>Lophogobius cyprinoides</u> (Pallas)	17-18 days 35 days	6.4 (S.L.) ---	Stahl, pers. comm., in Darcy, 1978 Delmonte et al., 1968
<u>Paleatogobius uchidai</u> Takagi	---	15 (T.L)	Dôtu, 1958a
<u>Pomatoschistus microps</u> (Krøyer)	6-9 weeks	---	Jones and Miller, 1966
<u>Pomatoschistus minutus</u> (Pallas)	---	12	Shann, 1910; Wheeler, 1969
<u>Pomatoschistus pictus</u> (Malm)	---	10	Wheeler, 1969
<u>Rhinogobius giurinus</u> (Rutter)	2 mo.	---	Dôtu, 1961a
<u>Zonogobius boreus</u> Snyder	---	7	Shiogaki and Dotsu, 1974

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