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REPRODUCTION IN FISHES

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In general, animals may be divided into three major groups on the basis of their method of producing young; namely, the oviparous, the viviparous, and the ovoviviparous. Representatives of all three groups are found among the fishes. Much confusion has arisen when distinguishing between the viviparous and the ovoviviparous fishes. In fact, certain of the fishes nourish their developing young in a way that does not fit into either group if one follows the usual definitions of viviparous and ovoviviparous.

A great majority of the fishes are oviparous animals; that is, the eggs are fertilized and develop outside the body of the female. The sexes must be closely associated at spawning time to insure fertilization of the eggs. The nest building fishes, the sunfishes and black basses for example, segregate into pairs during spawning while others, particularly marine species, congregate in dense schools.

The term ovoviviparous is falling into disuse as applied to fishes. This is due in part to the difficulties of distinguishing between the truly viviparous fishes and the truly ovoviviparous one, and in part because the general public considers any species giving birth to live young a viviparous animal. The common top minnow (Gambusia) widely used in mosquito control, is an excellent example of a truly ovoviviparous fish. In this species the eggs develop within the body of the mother and the young are born alive. The developing young, however, receives no nourishment from the parent as it lives entirely on food derived from the yolk of the egg.

The ovoviviparous animals differ from the viviparous one in that they receive nourishment during embryonic development from the egg only, whereas, the viviparous ones receive nourishment from the mother through a vascular connection. Such a connection occurs in some of the sharks and rays in which a network of blood vessels covering the yolk sac of the embryo is attached to the highly vascular wall of the oviduct of the mother. This intimate connection between the embryonic and maternal blood systems allows

an exchange of gases (oxygen and carbon dioxide) and food. The most intimate connection of this sort found among fishes is in the smooth dogfish (Mustelus laevis).

Although this close attachment of the yolk sac to the mother has certain similarities to the placenta of mammals, the similarities are in function only and the placental-like structure found in certain species of fish in no way can be considered a true placenta.

Certain of the sharks and rays provide for the nourishment of the developing young in a way that is neither strictly viviparous nor ovoviviparous. In these the young develop in the oviducts of the mother and receive nourishment not through intimate attachment, but rather by absorbing substances secreted by the wall of the oviduct. The walls thicken and develop finger-like projections called villi. These villi secrete a nutritive fluid in sufficient quantity for the embryo to be bathed constantly in its food. Feeding is accomplished in the earlier stages by absorbing the food into the blood vessels surrounding the yolk sac, and in later stages by the embryo taking the nutritive fluid directly into its digestive tract.

The processes of gestation making a fish either ovoviviparous or viviparous naturally do not allow for great variety in breeding habits. It is among the oviparous fishes that we find a wide variation in these habits. The more common of our marine food fishes are totally lacking in parental instincts for they extrude their eggs into the open water, without any care for the future. Only comparatively few of our marine food fishes lay eggs that do not float, among these are the sculpins, winter flounder, and herring. The eggs that sink to the bottom are designated as demersal to distinguish them from the pelagic (floating) eggs of such fish as the halibut, summer flounder, cod, haddock, mackerel, weakfish, and many other of the marine food fishes. The pelagic eggs float near the surface and are carried about by currents and wave action.

In contrast to the lack of parental care common among the marine species, the brackish and fresh-water fishes have tended more towards developing ways and means of protecting their eggs. The carp and minnow family (Cyprinidae) in general produce eggs that are covered with a sticky substance which causes them to adhere to any solid particles in the water. Other species, especially the sunfishes or breams (Centrarchidae) deposit their eggs in shallow nests made by fanning out a depression in

the bottom with their fins. The males of these species stand watch and fan the eggs while they are hatching and in some instances are very pugnacious, but the mother deserts her family to pursue her usual feeding habits.

To note the ultimate in parental care of fish eggs, we must return to the brackish and sea waters. The brackish and fresh-water sticklebacks carry the nest building habits to the extreme. The male builds a nest of blades of grass and reeds. The eggs are deposited and fertilized in this elaborate nest which is zealously guarded by the father.

The marine catfishes, of which the gaff-topsail catfish of our Atlantic Coast is an example, impose the most exacting duties found among fishes upon the male for the eggs are incubated in his mouth and gill chambers. Since the eggs of this species measure from 3/5 to 1 inch in diameter and since the incubation period lasts about 70 days, this parent has a real sacrifice to make in order to perpetuate the species. It is not uncommon to find the mouth completely filled with eggs, but no one has ever found any indication that the male satisfies his hunger by eating even a single egg.

Other examples of the general, though not invariable, rule that the male fish takes care of the eggs during incubation are found among the pipefishes and the odd-appearing little seahorses. The male of these fishes has a pouch on the under surface of either the abdomen or tail in which the female deposits the eggs. Fertilization probably occurs at the time the eggs are deposited. The eggs remain in the pouch of the male until hatched. Such an arrangement is much more convenient than either guarding a nest or carrying the eggs in the mouth, as the father may continue his usual mode of life with little handicap during the incubation period.

Another interesting and spectacular method of nest building is found principally among the Labyrinth fishes (family Anabantidae, inhabitants of southern Asia and Africa and neighboring islands) used extensively as pet fishes in aquaria. These fishes build nests of bubbles. The male comes to the surface, draws a little air into his mouth, and then releases the air in small bubbles covered with a saliva-like film. This process is repeated until a raft about 1/2 inch thick and 3 inches wide is formed. As the fertilized eggs sink to the bottom or float at the surface, according to the species producing them, the male seizes them, encloses each in a bubble that is carefully floated to the top of the raft. After all the eggs are on the raft, the male sets about the business of blowing bubbles in a serious way, thereby enlarging the raft sometimes to a width of 4 inches and depth of 1 inch.

Probably the most unique of all relationships between the sexes occurring among vertebrate animals is found among the ceratioid angler fishes (Ceratioidae) inhabiting the mid-waters of the oceans. In these forms the males are dwarfs and attach themselves to the bodies of the females. The attachment finally becomes permanent, with the male presumably becoming a parasite on the female, since his mouth actually grows into her body, making it impossible for him to grasp food. Since these fish live in darkness at rather great depths, and since they are more or less solitary in habits, it has been assumed that the parasitic life of the male is an adaptation to assure the fertilization of the eggs.

Certain of our fishes have breeding habits that are not associated directly with fertilization or with the care of the eggs. The common eel spends most of its life in fresh-water streams and lakes but never spawns there. All sorts of fantastic stories grew up about how eels spawn, and it has been only within comparatively recent years that the truth has be come known. As the eels begin to reach sexual maturity, they begin their migration towards the sea. Eels from both shores of the Atlantic eventually find their way to their spawning ground in the open sea some place south of Bermuda and north of the West Indies. The young eels return to their native shores when about 3 inches long and from 1 to 3 years old. The adults apparently die after spawning since none ever have been known to return to the coasts. One of the surprising features of this breeding habit is that the young of two distinct species feed on about the same grounds south of Bermuda. However, when they migrate to shore they separate so that the European species never is found on the coast of America, and the American species never becomes confused and swims to Europe. Fishes that spend the major portion of their lives in fresh water but migrate to the sea to spawn are designated as catadromous fishes.

Still other of our fishes are anadromous; that is, they spend the major portion of their lives in the ocean but spawn in fresh-water streams. The shad and the salmon are well known examples of anadromous fishes. The salmon, with few exceptions, return to spawn in the identical streams in which they, themselves, developed. The Pacific salmon are peculiar in that the adults of all species die after spawning.

It is understood, of course, that the foregoing account is not a complete statement of the reproductive habits of fishes. They are given merely as outstanding examples of reproduction. The habits and the structural adaptations of the various species associated with their reproductive processes, are so widely varied that a complete

discussion would be awe-inspiring in size. The publications to which the following references are supplied include the major portion of the material used in this discussion as well as a great deal of additional information on the subject.

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