Remoras

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Remora, suckerfish, diskfish, and sucker are some of the names describing eight species of marine fishes in the family Echenedidae (=Echeneidae) (Lachner, 1966; Lachner in Fischer, 1978). Remoras inhabit tropical and subtropical waters worldwide, except for the whitefin remora (*Echeneis neucratoides*), which is believed to be restricted to the western Atlantic Ocean.

I. Remora Biology

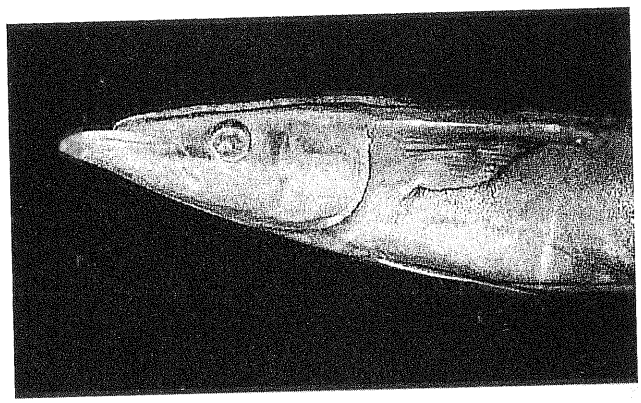
Remoras use a suction disc to attach to sharks, rays, bony fishes, sea turtles, cetaceans, sirenians, and ships and other floating objects. When attached to these hosts, remoras appear to swim upside down, but the disc is really on top of the head. The oval-shaped disc is a modified dorsal fin that has become split and flattened, forming a series of transverse, plate-like fin rays (disc lamellae) that resemble slats of a venetian blind (Fig. 1). When these fin rays are lifted, a strong vacuum is created between the remora's disc and its host.

The tenacity with which remoras attach to their hosts is best illustrated by the practice of sea turtle fishing by fishermen in the Caribbean and off China and northern Australia, and in Yemen, where it continues to this day. A fisherman ties a line around the tail of a remora and throws the fish into the water. The remora tightly attaches itself to a turtle, and the remora and its "catch" are then hauled ashore.

Suspected benefits of a remora's association with these hosts include transportation, protection from predators, increased courtship/reproduction potential, enhanced respiration, and expanded feeding opportunities. Remoras opportunistically feed on parasitic copepods (which constitute the bulk of their diet), zooplankton and smaller nekton, food scraps from meals of their hosts, and sloughing epidermal tissue and feces of the host.

II. Marine Mammal Hosts

Adult remoras typically attach to the body of a marine mammal (Fig. 2). At least three remora species utilize marine mammals as hosts: whalesucker (*Remora australis* = *Remilegia*



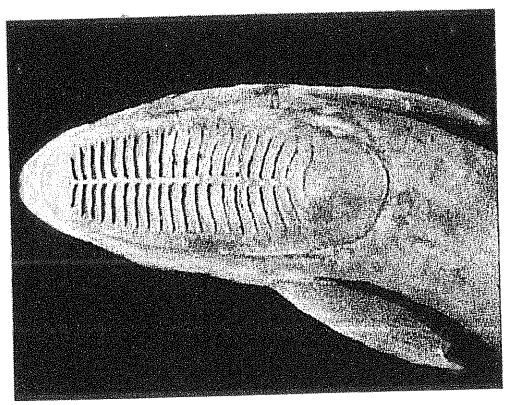


Figure 1 *Lateral and dorsal view of the head of a remora, with suction disc visible. Photographs by Bill Dailey.*

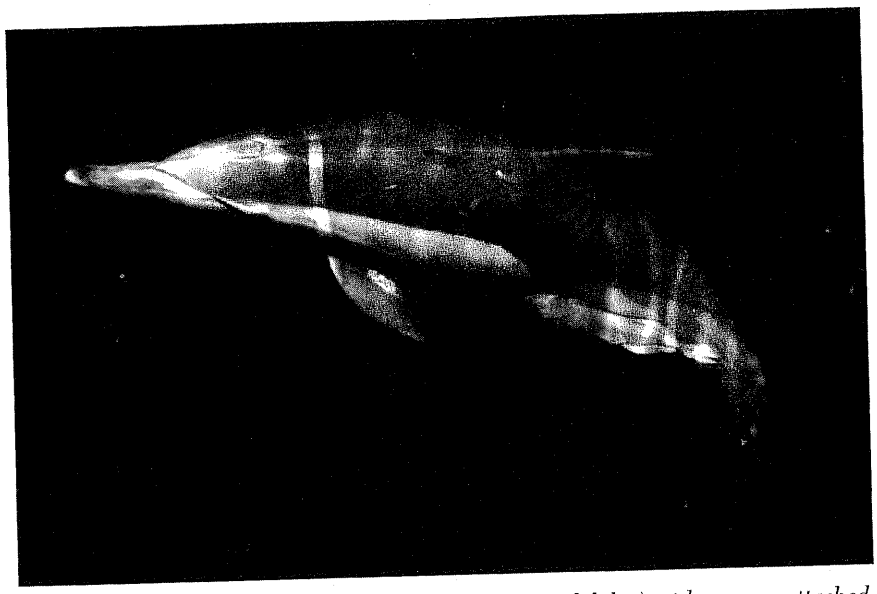


Figure 2 *Short-beaked common dolphin* (Delphinus delphis) *with remora attached. Photograph by Bernd Würsig.*

australis), sharksucker (*Echeneis naucrates*), and whitefin remora (=whitefin sharksucker, *Echeneis neucratoides*). Remoras associate with at least 20 cetaceans and 2 sirenian species (dugong and West Indian manatee). The whalesucker has been most often collected and identified from cetaceans (e.g., Rice and Caldwell, 1961; Fertl and Landry, 1999), hence its common name. A sharksucker was recently collected from a common bottlenose dolphin (Fertl and Landry, 1999). Two species of remora have been collected from West Indian manatees; these were positively identified as the whitefin remora (Mignucci-Giannoni *et al.*, 1999) and the sharksucker (Williams and Bunkley-Williams, 1996).

The remora's suction mode of attachment does not hurt the host, or leave scars, as has been suggested. However, a temporary mark resembling the disc imprint can be seen. Wounds attributed to remoras are most likely caused by cookie-cutter sharks (*Isistius brasiliensis*) or lampreys (*Entosphenus tridentatus*), which actually bite their prey or host.

Whether the remora irritates its host is uncertain. A remora may slide all over its host's body, possibly tickling the animal. Dolphins and manatees observed with remoras sliding over their bellies sometimes will jerk, and even roll over. Dolphins of various species leap with remoras attached to them, perhaps to dislodge the "hitchhiker." There also are reports of dolphins dislodging remoras from themselves or their calves and then biting them. Large-sized remoras or multiple remoras on the same host may produce a hydrodynamic drag.

III. Problems with Remora Identification

The whalesucker's preference for cetaceans leads many observers to assume that any remora spotted on a cetacean is of this species. Most remora–marine mammal associations described in the literature are based on visual or photographic observations of a remote, free-swimming host and its passenger(s) rather than specimens collected from strandings or whaling victims. Host records determined from remote observations should be considered suspect, as the identification of remoras to species is difficult without the actual specimen in hand.

The whalesucker and other host-specific remoras are typically pelagic forms with a specialized morphology consisting of large discs, short stout bodies, and reduced fin size (when compared with inshore counterparts). More commonly reported remoras are slender-bodied, inshore forms, such as the sharksucker, that are least particular about their hosts. The possibility that small, slender remoras, as well as more stocky remoras photographed on cetaceans, may represent different life history stages of one species further complicates positive identification from afar.

See Also the Following Articles

Cetacean Ecology ■ Parasites

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Reproductive Behavior

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Taking a very broad view, the "function" of marine mammals is to convert prey into offspring. Reproductive behavior is an important part of the process by which this is brought about and must serve to create a situation in which the young can safely be born and nurtured and one which facilitates mating with suitable partners. In long-lived animals, however, reproduction has to be linked to the process of gathering the resources for both reproductive effort and continued survival. Because many marine mammals do not feed where they reproduce, they must also locate breeding areas where reproduction and parental care can take place without compromising nutritional requirements. This article considers the basic problems that the animals must solve to reproduce and gives some illustrative examples of their behavior. We will take just such a broad, strategic view and look at reproductive behavior in a life history context and consider how animals balance their needs for resources and reproduction.

I. Basic Problems to Be Overcome

Although they spend most of their time in the water, seals give birth on land and most newborn pups require a period ashore before being able to cope with life at sea. The vulnerability of pinnipeds on land means that suitable breeding sites need to be isolated from potential predators, limiting the choice of suitable ones. Pinnipeds do not feed while ashore. The widely separated, patchy distribution of resources that typifies most marine ecosystems means that animals are often widely separated from one another while foraging and suitable breeding sites are often few and far between. This necessarily requires the use of stored reserves for periods of days to months. The geographical separation of feeding and breeding sites and the reliance on stored reserves are arguably the most important determinants of seal reproductive strategies and life history patterns.

Whales can give birth, nurse, and mate at sea, but conditions suitable for the birth of young may not be suitable for foraging so these two phases of their annual cycle can take place in widely separated geographical locations. Long migrations between breeding and foraging locations may still be necessary. While foraging, individuals might be widely separated from potential mates, creating difficulties for locating suitable partners. Little food may be available during the birthing and mating period, which therefore can require stored energy and materials for its success. Therefore, even though whales are not constrained to spend time ashore for breeding, in some cases, they face some of the same problems as pinnipeds.

On the whole, smaller cetaceans, including most odontocetes, opt for a different strategy. Foraging, parturition, and calf rearing overlap both spatially and temporarily. As a result, annual breeding MIGRATIONS are absent and instead nursing females and calves appear to be aided by associating with conspecifics.

Both seals and the larger whales must move to breeding areas and choose a suitable breeding site where they can safely give birth and protect and feed their young. They must choose a mate, copulate, and produce fertilized eggs. They must protect and feed their young and provide the resources and guidance needed for them to become nutritionally independent and give them a good chance of reaching maturity and recruiting into the breeding population. Then the adults must reestablish successful foraging patterns to provide resources for their own survival and reproductive success in the following year(s).

The marine habitat and the geographic and energetic constraints acting on marine mammals have shaped their life histories and reproductive behaviors to create some of the most dramatic and extreme (some might even say bizarre) reproductive patterns among mammals.

II. Importance of Size

Marine mammal groups contain some of the largest mammals in existence as well as possibly the largest animal to have ever existed. The size adopted by the various species is such an obvious characteristic that we often look past it to other features of the animals without considering its fundamental importance to BEHAVIOR. However, size stands out as being of fundamental importance as to how these animals organize their reproductive behaviors. Because of the scaled relationship between body volume or mass (M) and metabolic rate (MR), where $MR \propto M^{0.75}$, size has obvious implications for diving and foraging behavior. Larger species and individuals will require more prey each year, but they may be able to dive for longer and go longer without food and thus be able to contend with less predictable or widely distributed food distribution. It has equally fundamental implications for variations in reproductive behavior within and between species. Size in large part determines how long animals can fast during reproduction and how often they must leave their pups or the vicinity of potential mates for food. In general, bigger animals can maintain their presence on beaches for longer and can breed farther from food sources. Size also sets the relationship between the duration and the efficiency of lactation (energy used in the process divided by energy stored in the pup). It sets the weaning mass of offspring and the relative cost to the mother of achieving offspring of that mass; larger mothers can produce larger pups without putting themselves at risk. The metabolic overheads (i.e., the amount of energy required to support the metabolism

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