Ecology and natural history of the Manta Ray
(*Manta birostris).*

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The manta ray is one of the most intriguing and unique animals found in the world's oceans. Its large size and unusual shape, coupled with the strange horn-like fins used in feeding, make it one of the natural world's most spectacular animals. Rarely in nature does one encounter free-living animals that display a tolerance of their human onlookers. Moreover, animals that seem to have a genuine interest and curiosity about humans may be limited to a few species worldwide.

The Pacific Manta Ray represents this unique combination of great size coupled with a gentle grace and a curious approach to the humans who come to share, if only for a moment its silent world. Large pelagic animals of any species are poorly known because they are few in number, range widely in the world's oceans and spend most of their life in a solitary remoteness that makes them inaccessible to humans.

As pressures for recreational and commercial fishing sites have expanded, so have the inevitable interactions resulting from human use and invasion of the natural world. In the past decade an animal that is almost unknown to science has all but disappeared from areas of the world where it was once commonplace. This charismatic animal, once thought of as 'the devil fish' and feared by seafaring people, begs for an increased understanding of its behavior and ecological status in the sea.

Over the past three decades only a handful of scientific papers have been devoted to any aspect of this species' ecology. The remoteness of most manta populations and the difficulty of long term studies have excluded them from even the most elementary types of investigations that have been conducted on other large marine animals. Recent research by scientists has occurred in concert with divers and cinematographers who have established a long-term photographic record of animals in the wild. These invaluable images have been incorporated into a scientific database, which is being used for analysis of the behavior and distribution of manta rays.

First appearing in the fossil record in the lower Miocene epoch, approximately twenty million years ago, the family to which manta rays belong are members of a much older group of fish whose skeletons are composed entirely of cartilage.

The Class Chondrichthyes (cartilaginous fishes) is a group of ancient ancestry which includes the living elasmobranchs (Elasmobranchii = plate-gilled) sharks, skates and stingrays). Resembling modern guitarfish, the first rays appear in the sea approximately 150 million years ago.

Manta rays are circumtropical, pelagic (distributed around the world in tropical oceans) fish that have been observed as far north as San Diego and New Jersey. They are the largest of the Batoids (rays) with a maximum confirmed disc width (wingtip to wingtip) of 6.7 meters (22 feet) and a

weight of 2000 kg (4400 lbs.). Females are typically larger than males and are thought to give birth to a single pup at two to three year intervals. The gestation period is known to be one year in length.

The giant manta ray is one of eleven living species in the family Mobulidae, which contains two genera, Manta and Mobula. The genus Manta contains two species, Manta birostris and M. alfredi. The remaining nine species belong to the genus Mobula. Of the approximately 1100 described species of living elasmobranchs, manta rays are considered to be the most evolutionarily recent and advanced form.

The anatomy and physiology of manta rays reflect the retention of several well-defined ancestral features. However, these primitive features are accompanied by a suite of surprisingly advanced systems, such as immune function similar to that found among mammals, and the ability of females to nourish their developing embryos with "milk" from their uterine wall prior to birth.

Additionally, it is known that a few elasmobranchs have developed disproportionably large brains. The largest and most complex brains belong to manta rays, having a relative brain weight comparable to mammals, and much larger than the brains of fish of similar body size.

Whether or not the structural similarities between the brains of manta rays and mammals can be correlated with like function remains to be studied. However, the unusually high degree of curiosity and social interactions exhibited toward humans is noteworthy and may prove to be a rewarding behavioral study.

Oceanic Manta rays inhabit the waters around oceanic islands where they feed on small planktonic animals (zooplankton) that are frequently abundant in the nutrient rich waters that surround these sites. Because tropical seas are typically nutrient poor, oceanic islands and submarine ridge systems provide precious few sites that are critical to the survival of manta rays and other pelagic and reef species. These areas also support a large variety of commercially valuable fish species and attract fishing operations that employ gill nets and longlines.

Manta ray fisheries are known to exist along the West Coast of Mexico and the East Coast of Africa as well as in Sri Lanka, Japan and the Philippines. They are used as food and a medicinal aid for humans and as bait for sharks and other fish. However, the primary threat is their accidental entrapment in nets set for other species. They are taken as bycatch in gill net fisheries in Sri Lanka and in the Gulf of California and the Revillagigedo Islands. In a recent fisheries observation in The Sea of Cortez two manta rays, fourteen sailfish, and seventy-four skipjacks were removed dead from one night of gill net fishing by a single boat fishing for sharks. All these non-target species were thrown away. Recently, photographs were taken of fishermen at the Revillagigedos Islands killing a manta by plunging steel bars through its head as it hung in a gill net. This action resulted in the Mexican government listing the manta ray as a threatened species and imposing a $10,000 fine for killing one.

It has been noted that the population at one location in the Philippines has decreased significantly in the past ten years, which is also true for the Gulf of California. The manta populations appear to be more stable in other parts of the world such as Yap and the Hawaiian Islands, where they are protected as a result of their value to the tourist industry.

Very little is known about these spectacular animals and only a small number of scientific studies have been conducted on this species. Almost nothing is known about their population ecology, use of critical habitats, movements or reproductive biology.

Critical habitats are those areas of the world where a unique set of conditions (food availability, safe breeding or birthing, release from extreme environmental conditions) exist that support the life cycles of a species or group of species. These habitats may be a single location, or several distant locations linked by migrations, such as the subpolar feeding grounds and tropical/temperate birthing grounds known for several large whale species. The loss or disruption of critical habitats or the migratory corridors that connect them can have devastating effects on animal populations.

Because of their large size, long developmental periods and utilization of small food items, manta populations are numerically small. Moreover, their low birthrate (one pup/two years) and small litter size (one pup/reproductive event) leave them highly vulnerable to changes in specific habitats and food supply. Coupled with threats from human fisheries, local manta ray populations could decline to low levels in very short periods of time. Their decline in the Sea of Cortez appears to have occurred in far less than a decade.

Our research is focused on the population ecology of manta rays, their association with other pelagic fish species and their use of areas determined to be critical habitats. We plan to determine population composition at several sites through the tropical Pacific Ocean and track animals between sites to establish locations and migratory routes critical to their feeding, mating and birthing. Of additional interest is the genetic nature of different sizes and color patterns between and among populations found at specific sites. The pattern of genetic exchange (if any) that may occur between populations is also being considered.

While working at Cocos Island (West Coast of Costa Rica) during the summer of 2000 I placed acoustic tags on adult mantas. The data obtained from several days of tracking suggest that the animals use the habitat in different temporal and spatial ways during the day and night. During the day the animals swim close to the island in shallow water at fairly constant speeds. At night the animals move offshore over deeper water and exhibit long bouts of apparently stationary or near stationary behavior, followed by swimming intervals, subsequently followed by another stationary period. These observations are likely associated with feeding and the availability of their prey. Recent data obtained by our group support these patterns and find animals diving to depths in excess of 1500 feet.