

HUMAN INTERACTIONS

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Interactions between humans and rays extend back to pre-historic times. Cave drawings and rock engravings of stingrays and sawfishes indicate that rays were possibly an important food resource for Indigenous Australians for thousands of years. In ancient Egypt, craftsmen and artisans valued stingray leather for its durability and beauty. It was used to make armour and decorative items and has been found in the tombs of pharaohs. Some statues of the Egyptian god Min, dating back to the 4th millennium BCE, are decorated with engravings of sawfish rostra. The enlarged pearl thorn found on the mid-disc of some stingrays was highly sought after by ancient Egyptians and was considered a symbol of wealth and good luck.

In ancient Greek civilisations, rays figured prominently in mythology and medicine. Aristotle described rays as dangerous and Hellenes observed that venom from the caudal sting remained active well after the fish's death. The legendary Greek King of Ithaca, Odysseus (Ulysses), died at the hand of his son Telegonus after being pierced through the chest by a spear tipped with the caudal sting of a ray – fulfilling a prophecy that his death would come from the sea. Ancient Greek dentists apparently used the venom from stingray spines as an anaesthetic. References to the numbing effect of an electric ray (*Torpedo*) encounter are common in ancient Greek and Roman literature. The Greek philosopher Plato once compared the appearance of Socrates and his ability to baffle opponents to these rays and their numbing effect created by the discharge of their electric organs.

In more recent times, rays have retained a special place in many societies. Ray images, usually sawfishes and stingrays, figure prominently in the contemporary art of indigenous Australians, as well as western society. In Māori mythology, Punga is a supernatural being that is the ancestor of sharks, lizards and rays, and all other 'deformed ugly beasts'. In Mayan culture, the associated physiological effects of stingray envenomation using intact spines was considered an important part of blood-letting rituals to sustain gods and provide a conduit between natural and supernatural worlds. Sawfish rostra have been used by some Asian shamans for ceremonies to repel demons and disease, and also stand as totems on top

of hut roofs to protect their inhabitants. Sawfishes are important to the native people of the Bijagos archipelago off Bissau Guinea where they are symbols of fecundity; masks surmounted with sawfish rostra are worn by adolescents during their manhood ritual ceremonies. The skin of electric rays are sealed in amulets and attached to the prow of the pirogues of West African fishermen to protect them against the dangers of the sea. It has even been suggested that the Yanomami people in the Brazilian Amazon have bizarre sexual rites involving copulation with various animals of the forest, including giant freshwater stingrays! The venomous nature of the caudal sting led to the belief that ray flesh is also poisonous, hence eating them is considered taboo by some native tribes of the Indo-Pacific. The Aztecs revered sawfishes as a type of 'earth monster'.

RAY FISHERIES

Rays are important as food in many parts of the globe. Annual catches of chondrichthyan fishes were estimated recently to be around 800 000 tonnes but the relative proportions of sharks to rays landed is not well documented. According to FAO fishery data, the world production of rays was around 26 000 tonnes in 2013, i.e. about 30% of the total production of chondrichthyan fishes. However, these figures do not reflect the actual catches as they do not include discards or undeclared catches. Most ray catches are bycatches of trawl and net fisheries. Ray

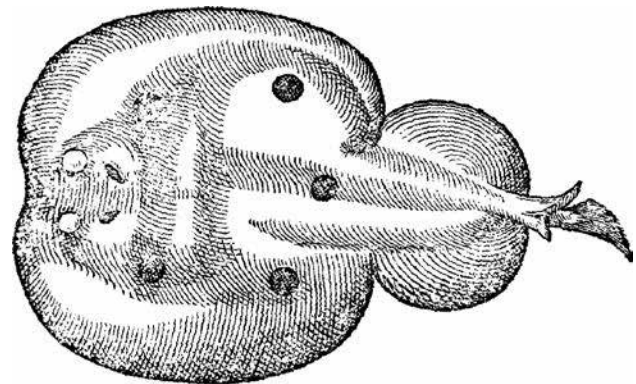


Fig. 3.1. 16th century scientific sketch of an electric ray.



Fig. 3.2. Large wedgefishes (*Rhynchobatus*) at an Asian fish market. (WW)

catches in some regions (e.g. India and Indonesia) are especially high. Most of the catches are not reported by species, but by larger mixed categories that do not allow accurate stock management. In many instances shark-like rays (wedgefishes, guitarfishes, sawfishes) get grouped into 'sharks', so estimates of 'ray' landings can be seriously underestimated. Indonesia has the largest shark and ray fishery in the world, with landing estimates in the low 2000s to in excess of 100 000 tonnes annually. In the artisanal fishery sector of Indonesia, rays account for about half of the total chondrichthyan catches, with stingrays (*Dasyatidae*) comprising about 90% of the total catch of rays by number and almost 45% by weight. In Mexico, artisanal fishery catches of chondrichthyans comprise almost equal quantities of rays to sharks.

While rays are used selectively throughout their distribution for their flesh (e.g. skates in the North Atlantic, stingrays from Asian seas), few species have been traditionally targeted. Most are either discarded (dead or alive) or find their way to markets as part of the byproduct of other fisheries. However, in recent years there has been increasing localised effort to target rays for more specialised uses. The Oriental shark-fin trade has led to dramatic increases in shark fishing in many regions over the last century. The shark-like rays are particularly sought after for the shark-fin trade and can attain higher prices than equivalent-sized shark species. These are sold together with other shark fins and are often difficult to distinguish from shark species, particularly once dried. This had led to targeting of rays in some areas. In Indonesia, tangle net fisheries target large rays with the most valuable and principal target being the wedgefishes (*Rhynchobatus* spp.) for their fins.

In many locations, rays are becoming increasingly apparent in market places where they had not been previously observed. There is an obvious trend in heavily fished areas. When effort continues to increase, catches of target

species often drop, resulting in increased retention and marketing of previously undesirable species. Skate wings (skates, stingrays or eagle rays) seem to be increasingly prevalent in the seafood market where they were once rarely encountered. As recently as the late 19th century, rays and skates were not used as food fishes in Britain. However, by the early 20th century a small fishery for skates arose. As a result, many species suffered declines in the latter half of the 20th century with some, such as the once common Grey Skate (*Dipturus batis*), being largely extirpated from large parts of their former range.

There are other specialised uses of rays for food. Steamed shark head is a specialty dish in some Asian restaurants. In this dish, the snouts of wedgefishes or guitarfishes are considered a delicacy and the recent promotion of this dish by a celebrity chef on a television show has further pushed demand for this delicacy in some places. Barbecued stingrays have also become increasingly popular in Singapore and Malaysia.

In the last couple of decades, there has been increasing demand for the branchial filter plates of mantas and devil-rays for use in traditional Chinese medicines in Asia. This has led to increased retention of these fishes in some locations and selective targeting in some instances, particularly in Indonesia. The very low productivity of these species and their subsequent vulnerability to overexploitation is of great concern.

Many of the largest ray species are long lived, and late maturing with low fecundities. As such, their populations are usually very susceptible to overfishing. Stingrays and wedgefishes in parts of the Indo-Pacific are particularly at risk. Catches of these species are not often monitored and their life histories remain poorly known, so their ability to withstand current levels of fishing pressure is not well understood. The inability to adequately identify species has been a widespread and common problem for fisheries managers. Without accurate identifications, the value of existing catch data and specific information on species is questionable.

Some rays are popular game fishes. Large guitarfishes and stingrays are targeted in sport fisheries, but often released after capture following the 'catch and release' rules of the International Game Fish Association (IGFA).

USES OF RAYS OTHER THAN FOOD

Rays are utilised in many ways other than simply as a food resource. Exploitation of stingrays in South-East Asia has led to innovative use of their byproducts, to an extent where these secondary uses have become more valuable than the original commodity. Skins from stingrays have been used for leather (e.g. to make bags, wallets, purses, belts, bracelets, watch bands and shoes), tails used as horse whips, and the cartilages for medicinal (herbal, Chinese)



Fig. 3.3. Rays are major exhibits in oceanaria. (WW)

products and curios (e.g. necklaces, bracelets). The high-value leather (also called 'shagreen'), covered with strong denticles, is particularly resilient to wear and tear. The use of stingray leather goes back a number of centuries. In the 18th century, the King of France, Louis XV, collected a number of items made from stingray leather, including snuff boxes, wig cases and sheaths. Between 1899 and 1933, the famous British artisan, John Paul Cooper, produced around 1000 items made out of stingray leather, including decorative boxes, frames and vases.

The robust nature of stingray leather has been widely recognised through the ages. In Japan, the handles of the most valuable and decorative samurai swords are lined with stingray leather. The rough skin offers the necessary strength and grip needed during the heat of long periods of battle. Samurai warriors also used stingray leather for armour, due to its resistance to being punctured, burnt or torn, and it being waterproof.

The people of Oceania have great respect for sharks and rays and both groups are disproportionately represented in carvings of native timbers. Mantas, eagle rays and stingrays are the most commonly carved rays from many

of the Pacific Islands. Bone carvings of rays are also common in some locations.

Rays figure prominently in marine aquaria across the planet. They are among the most popular aquarium fishes and thus have an important role in attracting and educating the public. Rays include some of the largest fishes (mantas, stingrays, wedgefishes and shark rays) held in captivity and some of the highest profile exhibits. Touch pools featuring rays are a very popular attractions in public aquaria. Aquaria also serve a role in education and science. Our knowledge of their food habits and reproductive biology, and interactions with other species, is partially based on rays kept this way.

Freshwater stingrays from Asia and South America in particular, are important in domestic and international aquarium trades. Keeping these animals alive can be problematic as they are sensitive to water quality, post-capture and handling stress, and the size of the tank they are kept in; also, being carnivorous they need lots of food. These rays usually make good aquaria subjects as they are generally placid and not aggressive toward large fishes also in the aquarium. However, aquarists must carefully select appro-



Fig. 3.4 Dive ecotourism – Manta interactions have become major regional attractions. (Ron Taylor)

priate species as companions. Large non-aggressive fishes, such as characins (tetras) and some South American cichlids, are popular as they are typically docile, too large to be eaten, and do not steal the ray's food. The aquarium trade sometimes provides negative conservation considerations. Illegal poaching of freshwater stingrays in South America is becoming an increasing problem.

The large size attained by some inshore rays has fuelled gladiatorial aspirations among some humans. In recent times, hooking and spearing rays for recreational pursuits has been considered by some to be a challenge. Killing rays unnecessarily is not condoned by most cultures, so the practice now seems to have been reduced in most places.

The high profile of rays in current human civilisation is reflected by their use as names in commercial brands and enterprises. The car manufacturer Chevrolet released its iconic sports car, the Corvette Stingray, more than 50 years ago and current models are still in production; similarly, the Music Man Classic Stingray 4 string bass guitar. A sawfish was used as the emblem for the infamous German submarine U-96 during WWII. Ray names have also been widely adopted as names of seafood outlets, restaurants and holiday resorts, and the stingray shape has been used

as the architectural theme for one of the world's most exclusive hotels at Coles Bay, Tasmania.

HUMAN ENCOUNTERS

Impressions of rays as threats to humans, pests or animals of little use or regard, have been generally replaced by wider community respect and intrigue. Large rays are imposing underwater and usually become memorable moments for divers when encountered. They are curious animals and often approach divers out of interest or for food, and often move comfortably around a diver without concern, making them easy to observe and/or photograph.

Rays have become major regional attractions important for ecotourism and generating revenue. Dive tourists are prepared to travel to remote regions of the world to view special manta aggregations (e.g. Maldives, Yap, Ecuador, Hawaii, Australia). In the Maldives alone, there are an estimated 91 manta dive sites. The revenue generated from diving and snorkelling activities at these sites has been estimated to be worth around US\$8.1 million annually. Still, there has been a realisation in recent years that there are negative impacts caused by large numbers of divers and snorkellers on manta numbers. As a result, there is a need to improve tourist education and develop stricter regional guidelines for these activities to be sustainable.

Observing stingrays has become a major tourist attraction for swimmers and snorkellers in some areas (e.g. the Caribbean and south-western Australia). Diving with rays can contribute to their conservation as long as they are observed naturally without feeding them. The internationally renowned Stingray City at Grand Cayman (Cayman Islands) is a series of shallow sandbars where divers and snorkellers can observe, interact and pet large congregations of Southern Stingrays (*Hypanus americanus*). Similar spots occur in the Bahamas, French Polynesia, and New Zealand. A ray's skin is highly tactile and when stroked some skates move into a state of tonic immobility, or become temporarily paralysed. Similar behaviour in sharks is thought to be a response to make females more accessible to males during mating.

Human encounters with rays can be either opportunistic or premeditated. Fishers and divers can have interactions with live rays that are unplanned. Unlike experiences with some of their shark cousins, the risks of injury from encounters with rays is considerably lower. Nonetheless, rays can inflict injury and have even killed humans, but examples of unprovoked attacks are rare.

Most serious injuries to humans come from stingray groups (Dasyatidae, Potamotrygonidae, Urotygonidae and Urolophidae). Injuries are normally inflicted when a ray is accidentally trodden on or disturbed by an unwary victim. Stabbing wounds from the caudal stings of even

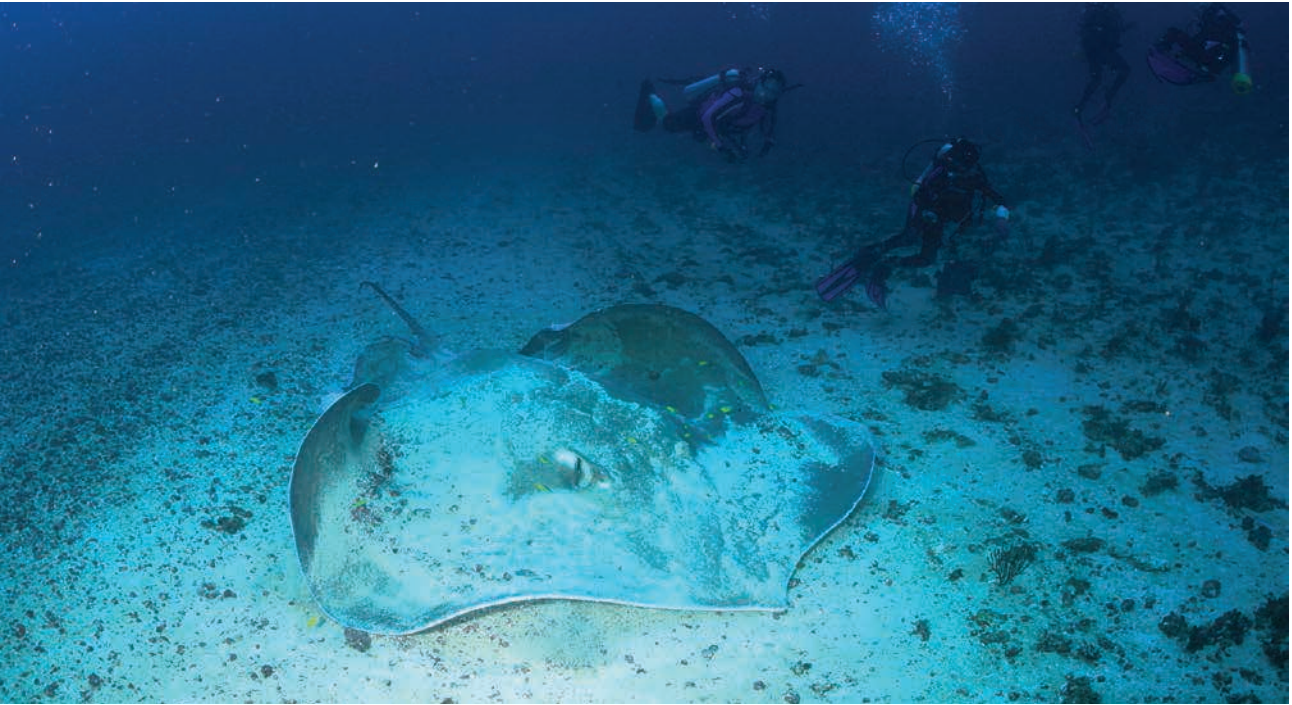


Fig. 3.5. Observing rays underwater – gigantic whipray (*Urogymnus*) off Indonesia. (Mark Erdmann)

small rays can be very painful. While stings usually cause only minor localised tissue damage, the wound can take months to heal due to unusual infections. The caudal stings of large stingrays are usually very long and sharp and, when propelled by the ray's strong tail musculature, are capable of delivering powerful and repeated thrusts causing serious physical injury to the victim. Divers attempting to ride the disc of large stingrays have been seriously injured. In more serious cases, victims have succumbed to fatal stab wounds to the chest. Hammerhead sharks, which often feed on rays, are commonly observed with dislodged barbs embedded in the jaws and skin around the mouth. Surgery is sometimes needed to remove caudal sting fragments from wounds to humans. Stingrays also need to be handled with care when landed by fishers as the tail can thrash around rapidly when the animal is distressed. Although not ideal and not to be encouraged, fishers often remove caudal stings or sever the tail of captured rays to avoid being injured. Despite their imposing size and weaponry, large stingrays are not naturally aggressive. Small ray species are often timid but can cause minor problems for humans. Stingarees (*Urolophidae*) often lie concealed beneath sediments with only their eyes exposed. An unwitting diver or wader placing their hand or foot on the disc can be accidentally stung before the ray rapidly retreats.

Sawfishes have a spectacular saw-like snout sometimes exceeding 1 m long in adults that acts as both a sensory organ and hunting weapon capable of slicing through smaller fishes. Wielded by powerful trunk musculature, a

blow from the saw can cause serious injury to a human in or out of the water if the fish is panicked. There are no confirmed cases of fatalities from a sawfish strike to humans. The inshore habitats where sawfishes once occurred more commonly are still frequented by large crocodiles. Sawfishes are now rare and constitute a much lesser threat to humans than their reptilian counterparts.

SCIENTIFIC RESEARCH ON RAYS

Compared to their bony fish cousins, sharks and rays underwent a long period of time with minimal research focused directly on them. Recent decades have seen a huge increase in the volume of shark research, highlighted by a larger number of publications on various species and their life histories. However, there has been very limited scientific effort focusing on rays. While this is beginning to change, there is still a paucity of data for the vast majority of ray species, even those that are commercially exploited and/or have undergone population declines. Recent taxonomic work on the Critically Endangered Grey Skate (*Dipturus batis*) found that it actually consists of two distinct, co-occurring species! Thus, there is a clear need for much more focused research on rays around the world, particularly on exploited species. This need is highlighted by a recent study that revealed that five out of the seven most threatened elasmobranch families are rays. Future research effort on rays should focus on those species of greatest conservation concern and the many species that are considered to be Data Deficient (see Chapter 4).

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