Student Information Sheet 3

The Role of Rays in the ecosystem

Background

The fish that we call rays, stingrays and skates belong to the same group as sharks. This is because rays, skates and sharks all have a skeleton that is made of a material called **cartilage**. Cartilage is similar to bone but it lacks the chemical that makes bone hard. Your nose and ears are strengthened by cartilage rather than bone. This means that **cartilaginous fish** (sharks, rays and skates) have strong but relatively soft and flexible skeletons.

A tropical whipray (Himantura sp.) (© Shane Litherland)

Rays and skates are the most diverse of the cartilaginous fishes. There are around 600 **species** worldwide. These range from the gigantic manta rays, with a 'wingspan' of over six metres, right down to skates the size of a person's hand. Though they vary greatly in size and body form, a common characteristic of rays and skates is that they all have a flattened body with broad **pectoral fins** that form a body 'disc'.

A typical encounter with a large ray, swimming close to the sea floor. (© Andrea Marshall)

Stingrays are bottom dwelling rays and their pectoral fins are ideally adapted to burying in sand or mud. The pectoral fins of **pelagic** rays, such as eagle rays and mantas, are more wing-like with strong muscles for prolonged swimming. These pelagic rays seem to literally 'fly' through the water.

Manta rays can grow to have a wingspan many metres across, but feed on small organisms filtered from the water. They are often accompanied by remoras or suckerfish that 'hitch a ride' to the rays using a specialised suction mechanism on the top of their head. (© Andrea Marshall)

Distribution

Rays are found throughout the oceans, from the **tropics** to the cold waters around the Arctic and Antarctica. They are also found at all depths, from the intertidal zone down to the deep sea. While most rays live in the sea, a few also live in fresh water; some up to thousands of kilometres inland in South America.

Their wide distribution and diversity means that rays have an important role in almost all marine ecosystems, with each species having its own distinctive **niche**.

The ocean is a three-dimensional environment, with underwater habitats structured both vertically and horizontally. Almost all rays feed on prey living close to, on, or just underneath the bottom. They act somewhat like the vacuum cleaners of the ocean. This means that the animals that feed on them live on the bottom as well. Rays feed mainly on **invertebrates** and small **vertebrates**, with prey ranging from quite large fish down to tiny **crustaceans**. All known rays are carnivorous, and as a group they are high in the **food web**.

Feeding

Rays can be quite selective feeders, and the various shapes of their mouth and teeth can be a good indication of their food preferences. Eagle and cownose rays have a series of flattened tooth plates for crushing hard-shelled **molluscs**. Rays such as torpedo rays that often feed on fish, have an arched lower jaw studded with small spiny teeth that can be thrust forward to suck up small fish. The huge mouth of the plankton-feeding manta ray is at the front of the snout, while the teeth, which are not important in feeding, are minute and covered in skin in the lower jaw and totally absent in the upper jaw. Skates and most stingrays have compact rows of strong, pointed teeth in both jaws for holding and crushing their prey.

Sensory biology

As the majority of rays are bottom dwellers, their mouths are located on the under-surface of the disc and although they have good vision (colour vision in at least some species), this means that rays often cannot see what they are eating. To find their prey without vision, they have developed a number of other sensory systems.

These systems include an ability to 'touch' things from a distance by using their **lateral line** systems to detect minute water currents, an acute sense of hearing and the ability to detect one drop of fish extract in 10 billion drops of water. Rays also possess another sense that is quite alien to humans.

Organs, known as the **ampullae of Lorenzini**, are clustered around the head and mouths of rays. These organs can detect weak electric signals created by muscles and nerves in potential prey.

Rays perceive these signals as an 'aura' around the animal. In combination, these senses mean that rays are very good at detecting prey hidden under the mud or sand of the sea floor.

This bluespot fantail ray (*Taeniura lymma*) is commonly encountered on and around coral reefs. Coral sand, thrown up during 'pit-digging' can be seen on the back of the ray. The protruded jaws are visible under the animal as the ray feeds.
(© Andrea Marshall)

Many rays such as this species of *Himantura* can often be found feeding in very shallow water, usually over sand or mud substrates
(© Shane Litherland)

Threatening processes

Because rays are at the top of ocean food webs they have few predators themselves. Their low natural death rate has allowed them to adopt a life history strategy focussed on producing a few, large young.

Compared to most **bony fish**, rays are long-lived, slow-growing, and are late to **mature**. Unfortunately, this strategy makes rays highly vulnerable to human-made pressures such as fishing, habitat degradation and pollution.

This bluespot maskray *(Dasyatis kuhlii)* seen on the sorting tray of a trawler was caught as bycatch in a prawn fishery. (© Peter Kyne)

Rays are a common catch within many fisheries, both inshore and offshore. Although rays are targeted in fisheries elsewhere in the world, in Australia they are largely caught accidentally, as a **bycatch** of **commercial** and **recreational fisheries** targeting other species. Most fishing pressure occurs in waters over the **continental shelves**, putting the species living in this area at risk. Deep-sea rays are even more at risk to fishing pressures than coastal and pelagic species, as the low **productivity** of the deep-sea floor means that many of the species found there grow extremely slowly and have a low reproductive rate.

As a consequence, many of these species are naturally rare. Many species are found in only a small area, while others may live only in specific habitats over a wider area. Fisheries in the deep-sea are still being commercially developed, and rays will increasingly be caught as bycatch in these areas. Unfortunately, the low reproductive rate of these rays means that species can be heavily reduced, even to extinction, before the targeted bony fish species shows a significant decline in catch.

Habitat modification and pollution are also major issues for some inshore species. **Estuarine** and coastal areas are suffering increasing alteration through development, restriction of river flows, land reclamation and other pressures. The young of many inshore species spend their first few months or years in high productivity 'nursery' areas. Often these nursery areas are located in estuaries or shallow mangrove-fringed ecosystems where there is plenty of food and protection from larger predators. The destruction of these nursery areas can result in a permanent reduction in the local ray population.

Conclusion

Rays are present in most marine ecosystems worldwide, and have a vital role in maintaining the health and function of these ecosystems. Their ecological niche has been little-studied when compared to sharks, but their diversity, **abundance** and worldwide distribution are evidence of their success. The challenge for marine science now is to ensure these rays are protected, so they do not quietly disappear before we can fully understand just how important they are.

Harry Breidahl adapted this information sheet for children (which is suitable for primary school students) from the information sheet compiled for the general public by © Simon Pierce (simon.pierce@uq.edu.au).