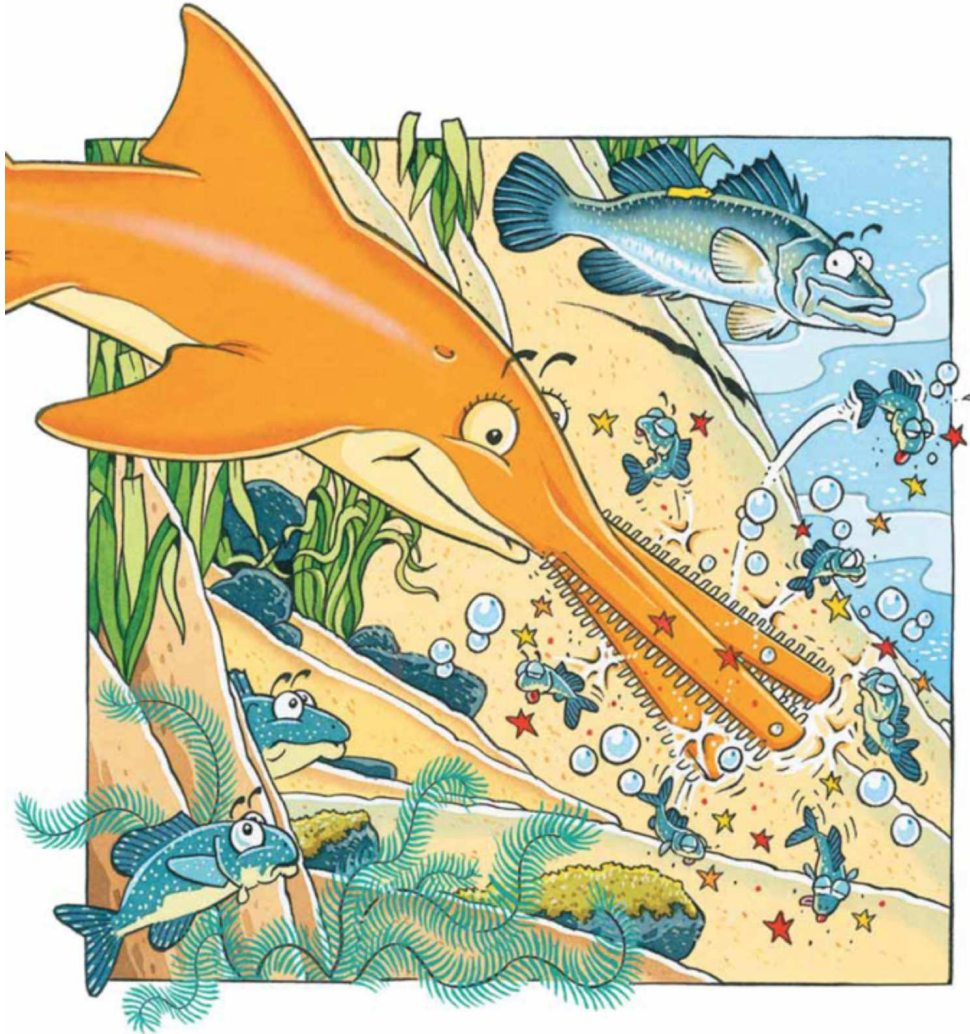


A North Australian Food Web Game

by

Barbara E. Wueringer, Hannah Cook and Jillian Morris Brake

with special thanks to
Stirling Peverell and Paul Lennon



Queensland
Government



Author associations: Barbara E. Wueringer (Sharks And Rays Australia)
Hannah Cook (Sharks And Rays Australia volunteer), Jillian Morris Brake (Sharks 4 Kids)

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Sharks And Rays Australia www.saw.fish

Sharks 4 Kids www.sharks4kids.com

It is forbidden to sell this game or use it to generate money.

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Queensland
Government

and



The authors would like to thank
Stirling Peverell (Biologist) and
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for granting permission to use images
from their children's comic book, 'Sonya
the sawfish'.

The comic can be purchased here
[https://shop.australiazoo.com.au/australia-
zoo/books-and-calendars/1579-sonya-the-
sawfish-paperback-book](https://shop.australiazoo.com.au/australia-zoo/books-and-calendars/1579-sonya-the-sawfish-paperback-book)

If you use this game in your school
please feel free to email feedback and
images to
hello@saw.fish,
we'd love to hear from you!

Instructions for teachers & presenters:

1. Species facts and colouring session

Today the kids will learn about some of the species of animals that inhabit the rivers and estuaries around them.

- Can they name a river in the area?
- Have they been there?
- What did they do there and which animals and plants have they seen?

When you start going through the species, hand out the sheets for the kids to colour in. This allows the kids to go through the facts for each species with you. Encourage them, do they know more facts about these animals? If they are Indigenous children, maybe they want to talk about their traditional uses and importance of these species. Also don't forget to show them the actual pictures of the species.

- You can also talk about croc safety with them!

You can also pick an animal and its colouring in sheet and print it out large and get the whole class to colour the animal in together.

2. Let's lay out a food web

This can be done in a separate session!

For each species there are 3 sheets in the handout, one with multiple specimens of a species, one with a large specimen and one with a tiny specimen. You will need all of them for the food web, but begin with the sheets that feature a large specimen each.

Ask the kids

- Do they know who eats whom?
- Can they identify the food chain that we are building today?

Some of the factors affecting the food chain are: Is the species a plant or an animal. How large does the animal get? You could tell the kids that some animals change their diet when they grow.

Notes for the presenter – example of a marine food chain (adapt for our food chain!):

- FOOD CHAINS are a possible path that ENERGY and nutrients may take as they move through the ECOSYSTEM. Food chains can be long and complicated, or very short.
- Phytoplankton are the main PRODUCERS in marine ecosystems. Tiny creatures called zooplankton are PRIMARY CONSUMERS, feeding on the plankton. Jellyfish are opportunistic, happily feeding on phytoplankton as well as zooplankton and are SECONDARY CONSUMERS.
- Juvenile green sea turtles feed on jellyfish as TERTIARY CONSUMERS. Tiger sharks are APEX PREDATORS, feeding on green sea turtles. When the tiger sharks die, their bodies sink to the seafloor and DECOMPOSERS such as worms break down the material. The nutrients released by the decaying flesh provide chemicals for phytoplankton to start a new series of food chains.
- BIOMASS is the energy in living organisms. AUTOTROPHS, the producers in a food web, convert the sun's energy into biomass. Biomass decreases with each TROPHIC LEVEL, there is always more autotrophs than HETEROTROPHS (consumers) in a healthy ecosystem. Smaller animals are more numerous than larger ones. Tiger sharks and jellyfish are both CONSUMERS, however, it takes much more biomass to support a tiger shark population

than a jellyfish population. As the number of plants and other autotrophs is reduced, the rest of the food web is forced to adapt or die.

When you look at the picture of the food web (Figure 1), you will see that it is very confusing. An easier way to represent it as is by the levels of the food pyramid.

→ When playing the food web game with the kids, it might be easier to pick only the animals from one food chain within the web, and work with them

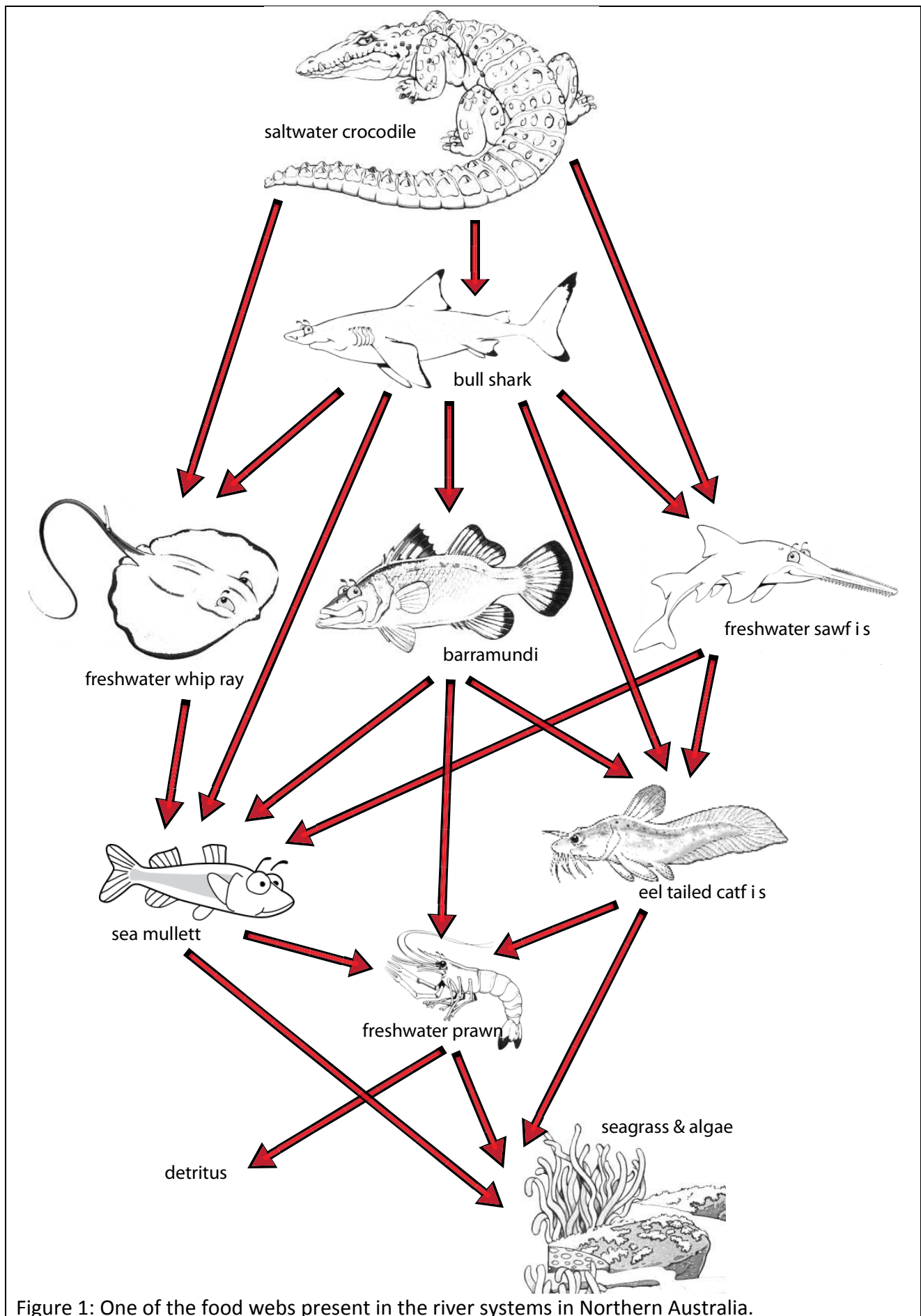


Figure 1: One of the food webs present in the river systems in Northern Australia.

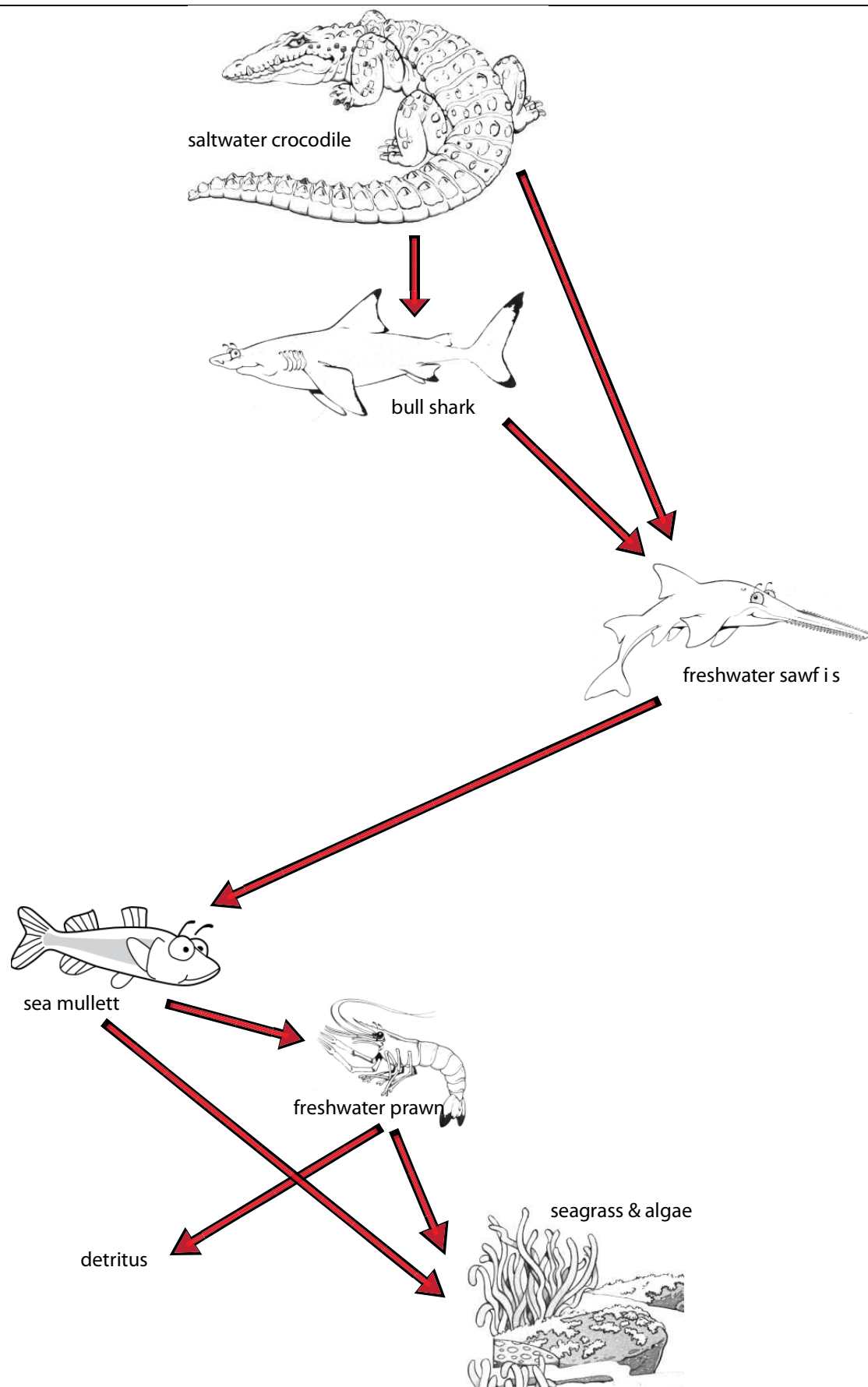


Figure 2: A food chain from a river in Northern Australia that includes a freshwater sawfish *Pristis pristis*

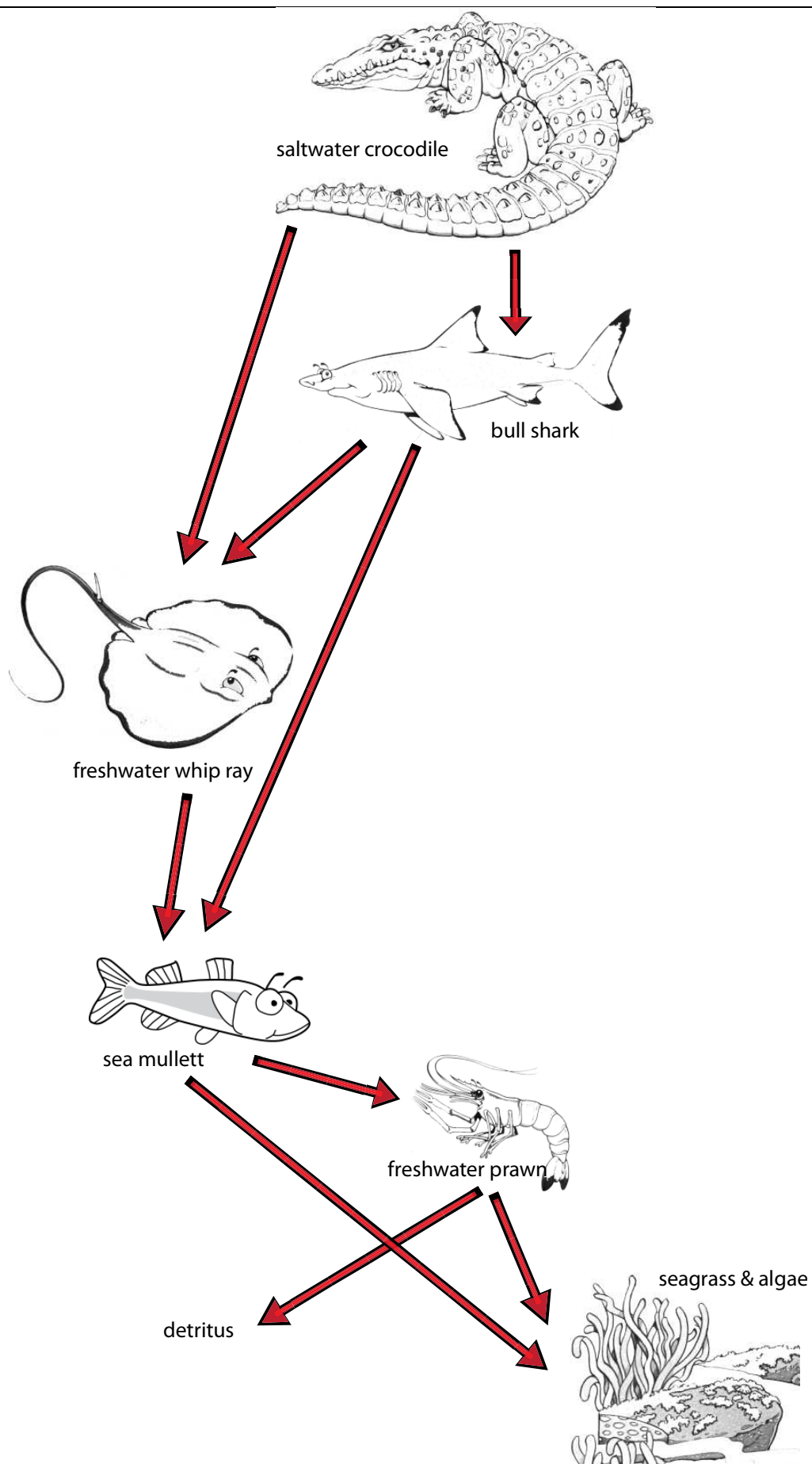


Figure 3: A food chain from a river in Northern Australia that includes a freshwater whipray *Urotrygon dalyensis*

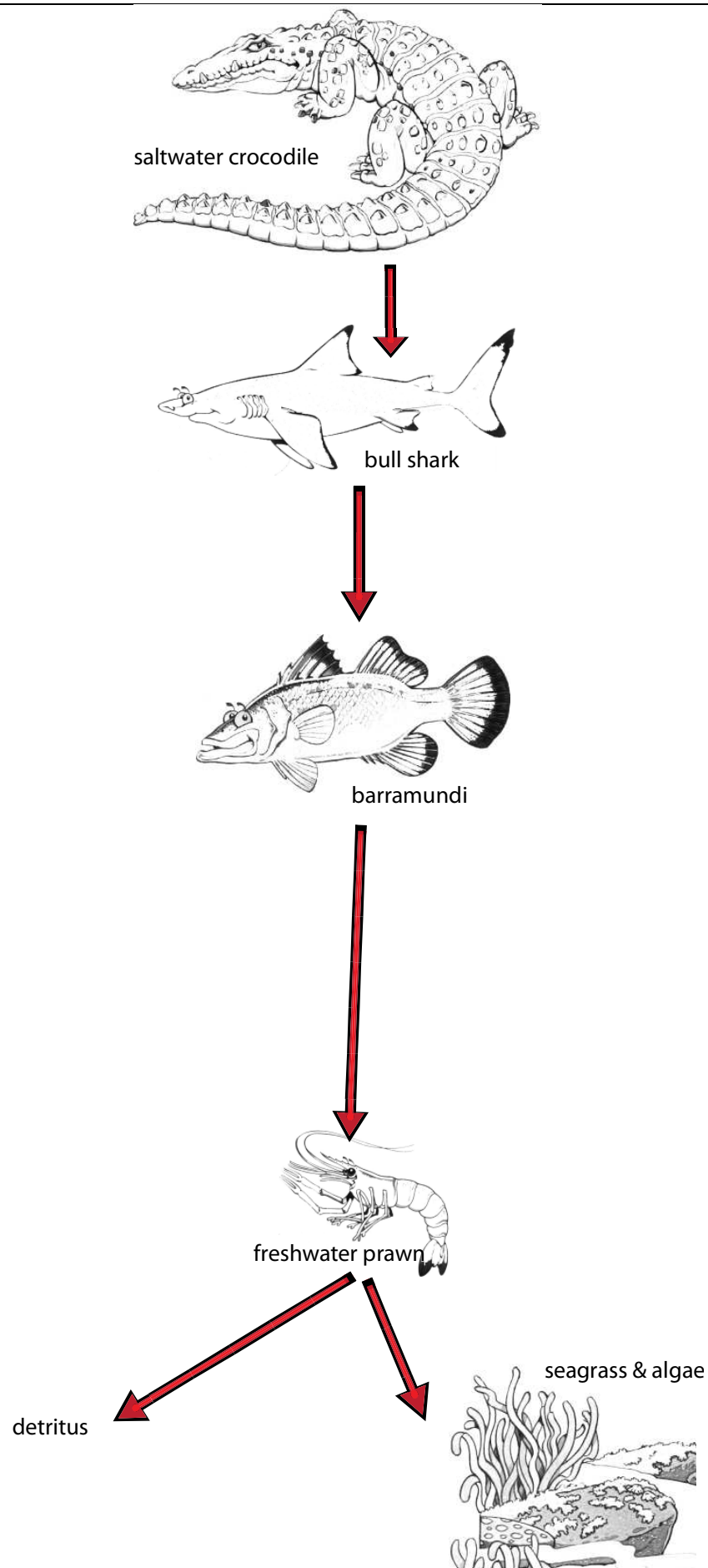


Figure 3: A food chain from a river in Northern Australia that includes a Barramundi *Lates calcarifer*

Food Pyramid

- In a balanced ecosystem, the FOOD PYRAMID shows the POPULATION of organisms on each trophic level. There are more producers (base) than there are consumers (upper levels). It is estimated that if there are a million producers, there may only be 10,000 primary consumers, supporting 100 secondary consumers. All these organisms support only one tertiary consumer.
- In the ocean, phytoplankton are at the base of the pyramid. They make their own food using energy from the sun through PHOTOSYNTHESIS.
- Shark species are at the top of the food pyramid in almost every part of the world's oceans. This means sharks play a critical role in the largest BIOME on the planet, the marine biome, which covers 71% of the Earth's surface.
- As apex predators, scientists believe sharks are critical for maintaining ocean BIODIVERSITY and the health of ecosystems. They eat old, sick, dead or dying fish and keep the population of fish beneath them on the food chain from overpopulating.
- Without sharks, fish species below them on the food chain swell in population and can overeat their food source. These fish will die off and the next level has a swell in population and so on. This can cause a TROPHIC CASCADE, impacting all levels of the food pyramid.

Food Web

- FOOD WEBS consist of all the food chains in a single ecosystem, a more accurate way to display interactions because each living thing in an ecosystem is part of multiple food chains. A food chain is only one possible path of many that energy and nutrients may take as they move through the ecosystem.
- Organisms in food webs are grouped into categories called trophic levels. These are divided into producers (first trophic level), consumers, and decomposers (last trophic level).

Bioaccumulation and Biomagnification

BIOACCUMULATION is the gradual build up over time of a chemical in a living organism. Many chemicals can't be broken down by the body so they build up in the organism's tissues.

BIOMAGNIFICATION refers to the tendency of pollutants to concentrate as they move from one trophic level to the next when eaten by higher level consumers.

When a toxic pollutant is in the water, it quickly enters the food chain:

- Phytoplankton absorbs the pollutants from the water, but because there is so little pollutant in each phytoplankton it doesn't cause much damage at this level of the food web.
- When zooplankton consumes ten phytoplankton, it now has ten times the level of the pollutant in its body.
- A small fish eating ten zooplankton will have 100 times the level of toxic pollutant as a single phytoplankton.
- This multiplication continues throughout the food web until it reaches the apex predator. This bioaccumulation of toxins is what makes eating shark flesh so dangerous. By eating the top predator from an ecosystem, humans get a dangerous dose of toxins like mercury and various pesticides.

3. Effects of fishing and hunting have on the food web

Together with the kids you have now laid out the food web or food chain of your choice!

Now you can explain to them the effects of overfishing or hunting of one species.

For example, ask what happens if there are too few crocodiles in the food web?

- Replace the crocodile card with the one that only shows a small crocodile

- The effects trickle down to the nearest lower trophic level, i.e. the numbers of bull sharks, sawfish or stingrays could increase. To show this, pick the sheets with large numbers of bull sharks, freshwater whip rays and sawfish.

- But if the numbers of bull sharks increase, then the numbers of freshwater whipsnakes and sawfish could decrease. Replace the sheets with the group of stingrays and the group of sawfish with those that only show one tiny stingray or sawfish.

- Continue on down the food chain

Remember, when we oversimplify things, even adults might walk away thinking, 'Ok, if we want more turtles to survive we just have to kill all tiger sharks!' which is wrong. Scientific research of many different food webs globally indicates that overexploitation of one species or a group of species within an ecosystem leads to simplification of food webs in a less productive ecosystem.

4. Terminology

This section contains terms that you might want to explain or use in your class. It is important to adapt this according to the age of your audience. Remember, it is more important that the kids get an idea of how a food web works rather than learning all these terms!

Abiotic - The non-living parts of an ecosystem (sunlight, soil, air, water).

Apex Predator - top predator of an ecosystem, no natural predators.

Autotroph - organisms that produce their own food from the environment (sunlight or chemicals).

Bioaccumulate - toxins accumulating in organisms as they move up trophic levels.

Biomagnification - refers to pollutants concentrating as they move from one trophic level to the next.

Biodiversity - The variety of different species within an ecosystem.

Biomass - living organisms and the energy contained within them.

Biome - regions of the world with similar climate, animals and plants.

Biotic - living parts of an ecosystem.

Consumer - organisms that depend on producers or other consumers as a food source.

Decomposer - organisms that break down organic matter.

Ecosystem - Animals, plants and nonliving things that make up an environment and impact one another.

Energy - the ability to do work.

Energy Pyramid - shows the biomass at each trophic level in an ecosystem.

Food Chain - group of organisms linked in order of the food they eat.

Food web - The whole group of interacting food chains in an ecosystem.

Heterotroph - organisms that can't produce their own energy and rely on consuming other organisms.

Photosynthesis - the process by which sunlight, carbon dioxide and water are converted into simple sugars and oxygen.

Population - All of the individuals of the same species living within a given area.

Producer - living things that make their own food through photosynthesis.

Predator - an animal that hunts and eats other animals.

Prey - an animal that is hunted and eaten by other animals.

Primary Consumer - organisms that eat plants or other autotrophs.

Secondary Consumer - organisms that eat meat.

Species name: is in latin, and is different for each species. The first part of the name describes the genus, which is like the last name for people. The second part of the name is different for each species. This system allows biologists to identify a species. Normally, people use common names, but for scientists they can be confusing as for example the freshwater sawfish (Species name *Pristis pristis*) has a few different common names, including large-tooth sawfish. Another example is "mullet" as this word is used for a lot of different species.

Tertiary Consumer - carnivore that mostly eats other carnivores.

Trophic Cascade - The loss of a top predator that leads to a series of population increases and crashes, cascading down the trophic levels of an ecosystem.

Trophic Level - one of three positions on the food chain: autotrophs (first), herbivores (second), and carnivores and omnivores (third).

Other small fish that are commonly seen in rivers and estuaries in Far North Queensland, Cape York and the Gulf of Carpentaria are:

- Australian bass

- Mangrove jack
- Grunter
- Mary river cod
- Jungle perch
- River cod
- Murray cod
- Silver perch

On the next page you will find actual pictures of each species used in this game. You can print a few for the kids to look at.

Food web game species *print and laminate*



Saltwater crocodile *Crocodylus porosus*

Image by B.E. Wueringer (SARA)



Bull shark *Carcharhinus leucas*

Image by Barbara Wueringer (SARA)



Freshwater sawfish, *Pristis pristis*

Image by David Morgan (Freshwater Fish Group, Murdoch University)



SHARKS AND RAYS AUSTRALIA | Sarah O'Hea Miller

The SARA team with a freshwater sawfish ready for release
Image by Sarah O'Hea Miller (SARA)



SHARKS AND RAYS AUSTRALIA | Ashley Dew

Freshwater whip ray *Urotrygon dalyensis*

Image by Ashley Dew (SARA)



A forktail catfish (Family Aridae)
Image by Barbara Wueringer (SARA)



Barramundi *Lates calcarifer*
Image by Mark Allen (Freshwater Fish Group, Murdoch University)



Sea mullet *Mugil cephalus*
Image by BE Wueringer (SARA)



a school of pop-eye mullet *Rhinomugil nasutus*
Image by Barbara Wueringer (SARA)



Freshwater prawn *Macrobrachium* sp.
Image by Dean Thorburn (Indopacific Environmental)



Seagrass

Image by Barbara Wueringer (SARA)



Sea grass and algae

Image by Dave Morgan (Freshwater Fish Group, Murdoch University)

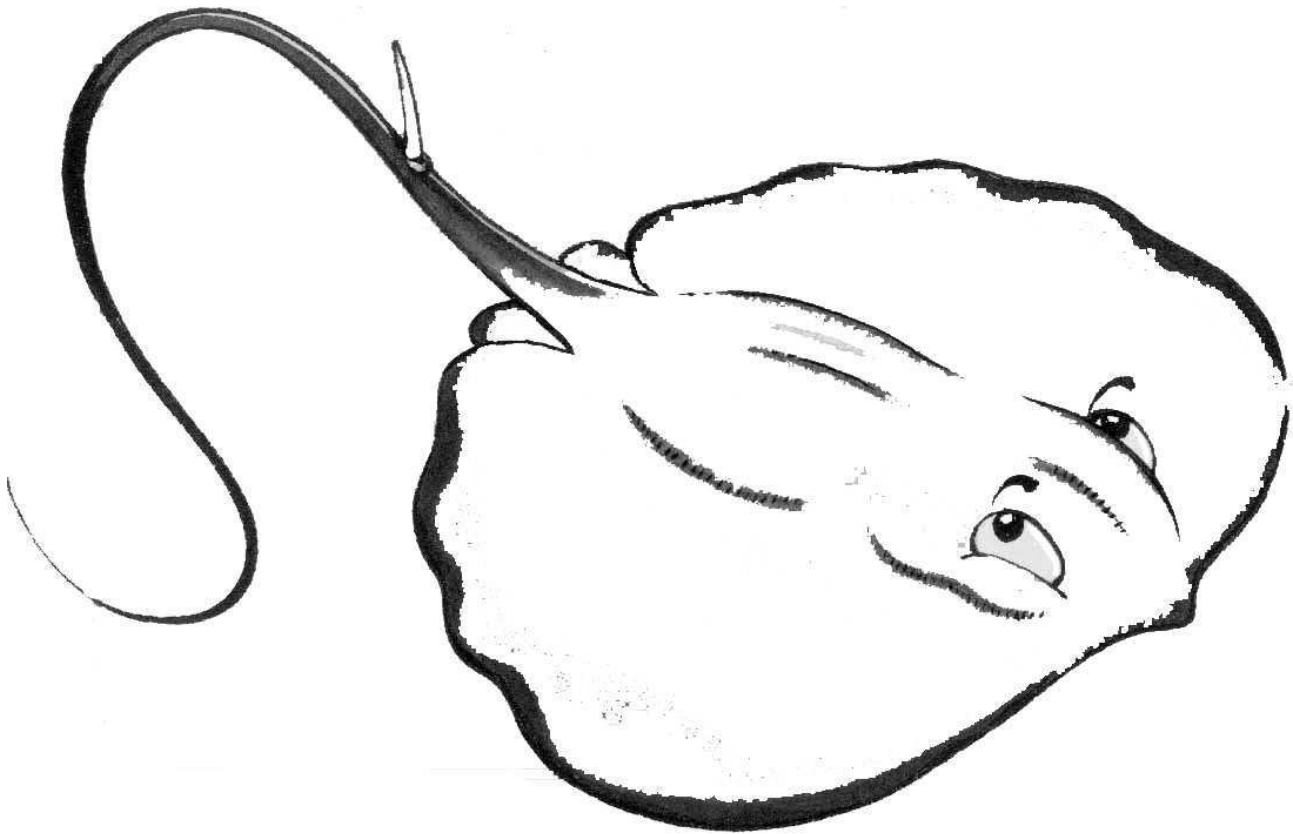
Food web game species colouring sheets

PRINT THE SHEETS STARTING FROM NEXT PAGE SINGLE SIDED FOR CHILDREN TO COLOUR IN.

Ideas:

- Can the children match these drawings with the pictures of the animals?
- You can also print individual animal sheets on large paper so that the kids can all colour one animal in together!!

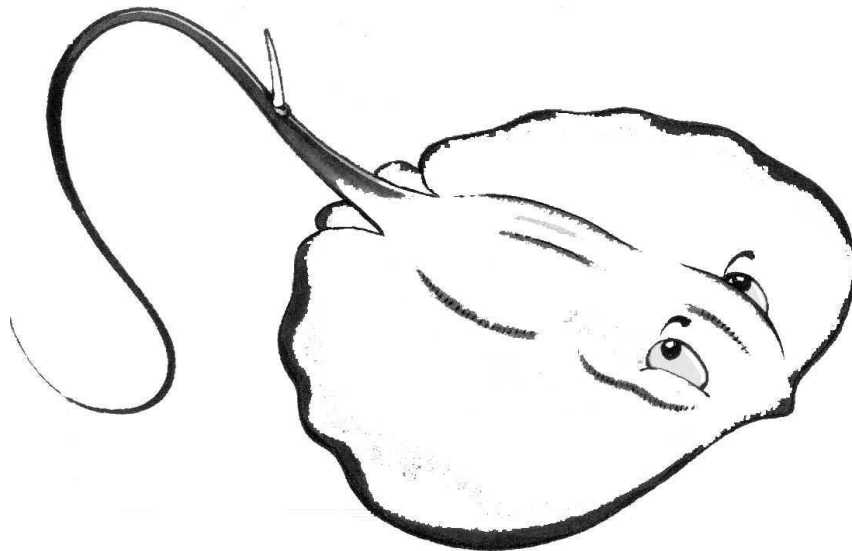
Freshwater whipray



Facts:

- Species name: *Urotrygon dalyensis*
- Very small eyes
- Eats small fish and prawns
- Light brown to grey brown on the top side and white underneath
- Venomous spine
- Can grow up to 1.24m
- Pregnant for up to 12 months, and have 2 to 6 young
- Live in estuarine systems and freshwater systems

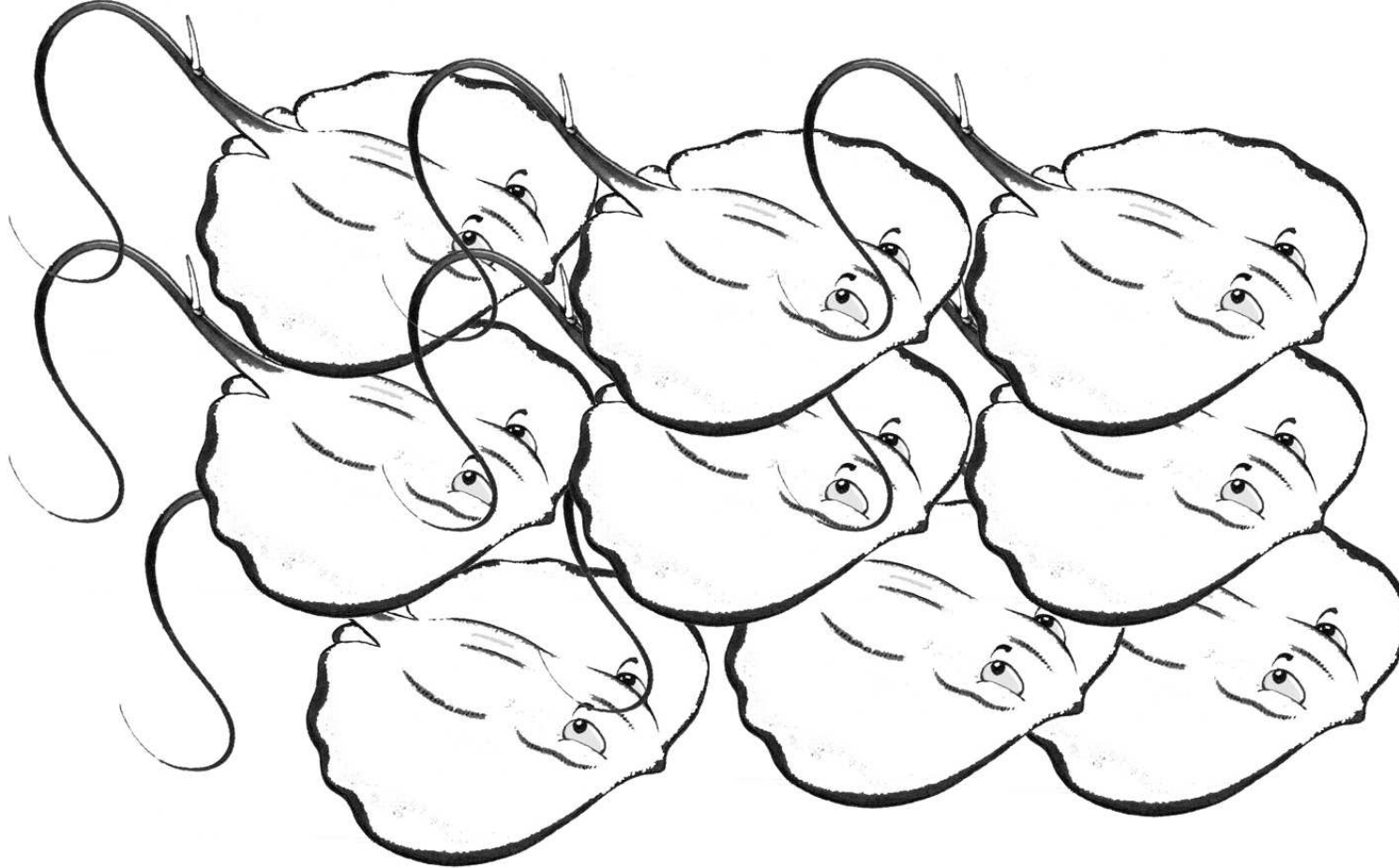
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Freshwater prawns



Facts:

- Species name: *Macrobrachium sp.*
- Females carry eggs until they hatch - 10,000 to 50,000 eggs at a time and up to 5 times per year
- Translucent
- Lives in creeks and streams, in turbid waters
- They are an important food source for many fish species, platypus and stingrays
- Males can grow up to 32cm, females can grow up to 25cm

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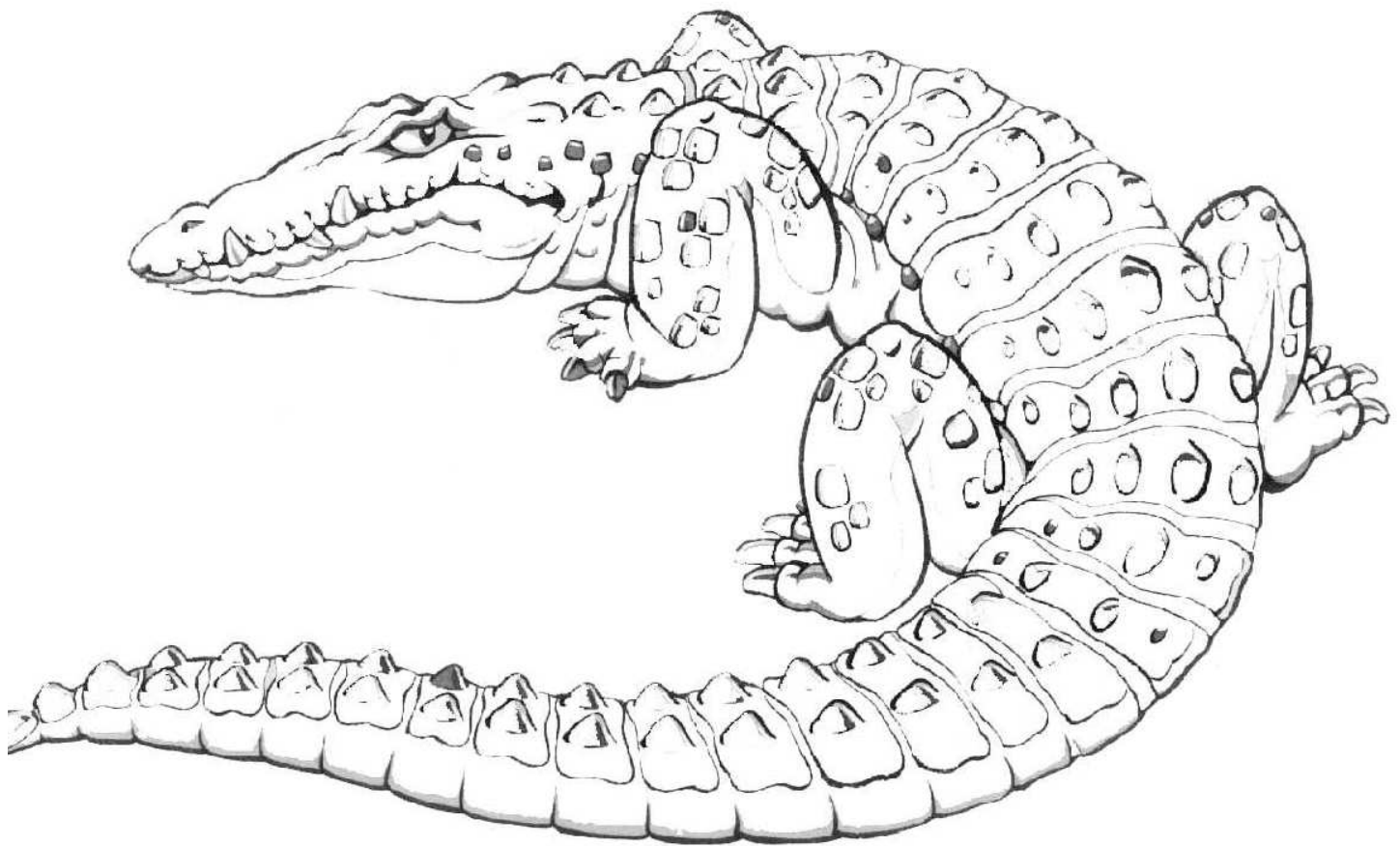
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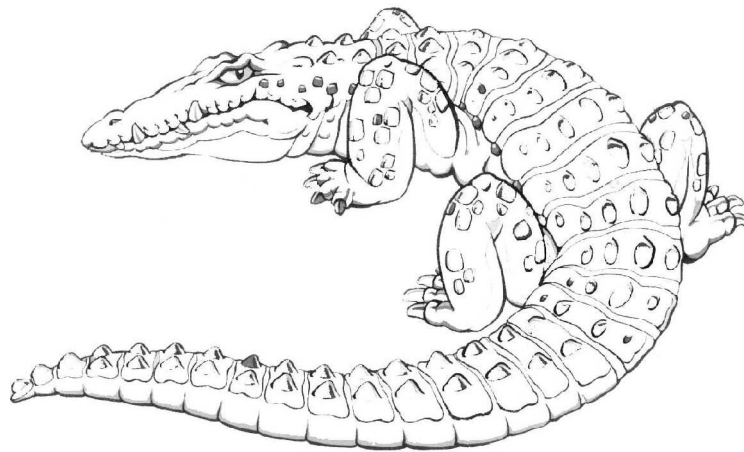
Saltwater crocodile



Facts:

- Species name: *Crocodylus porosus*
- Males can grow up to 5m long and weigh more than 450kg
- Females are smaller around 3m long and weigh up to 150kg
- Hatchlings stay in the nest for up to 2 months
- 90% of surviving crocodiles are within 5 km of their nesting site
- They eat a lot of crabs, and some prawns and insects
- Their nests are usually above the tide line, and get midday sun, shade in the morning and afternoon.
- The saltwater crocodile is the largest of living reptile in the world
- Adult crocodiles feed on mammals like Wallabies and Pigs

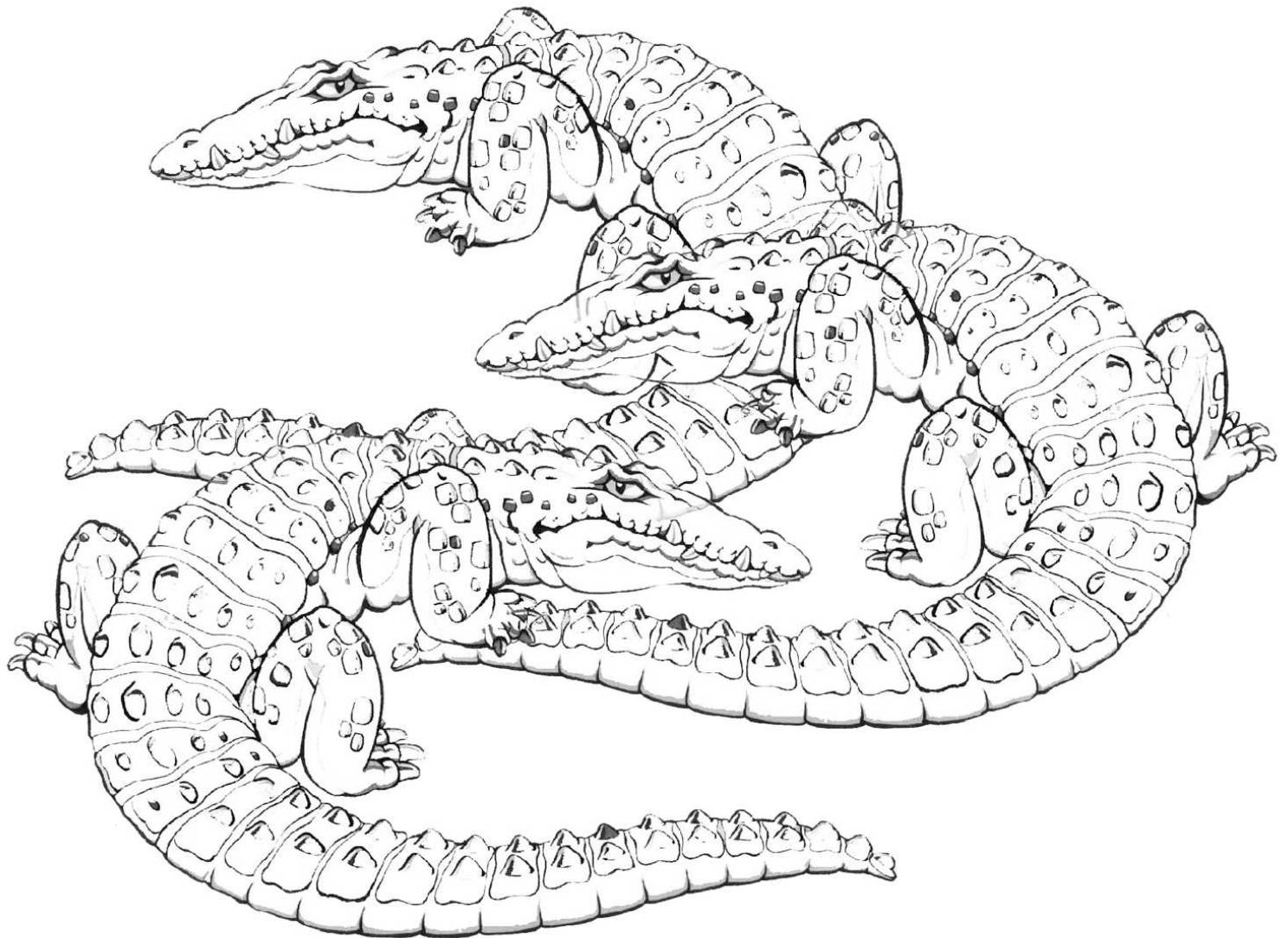
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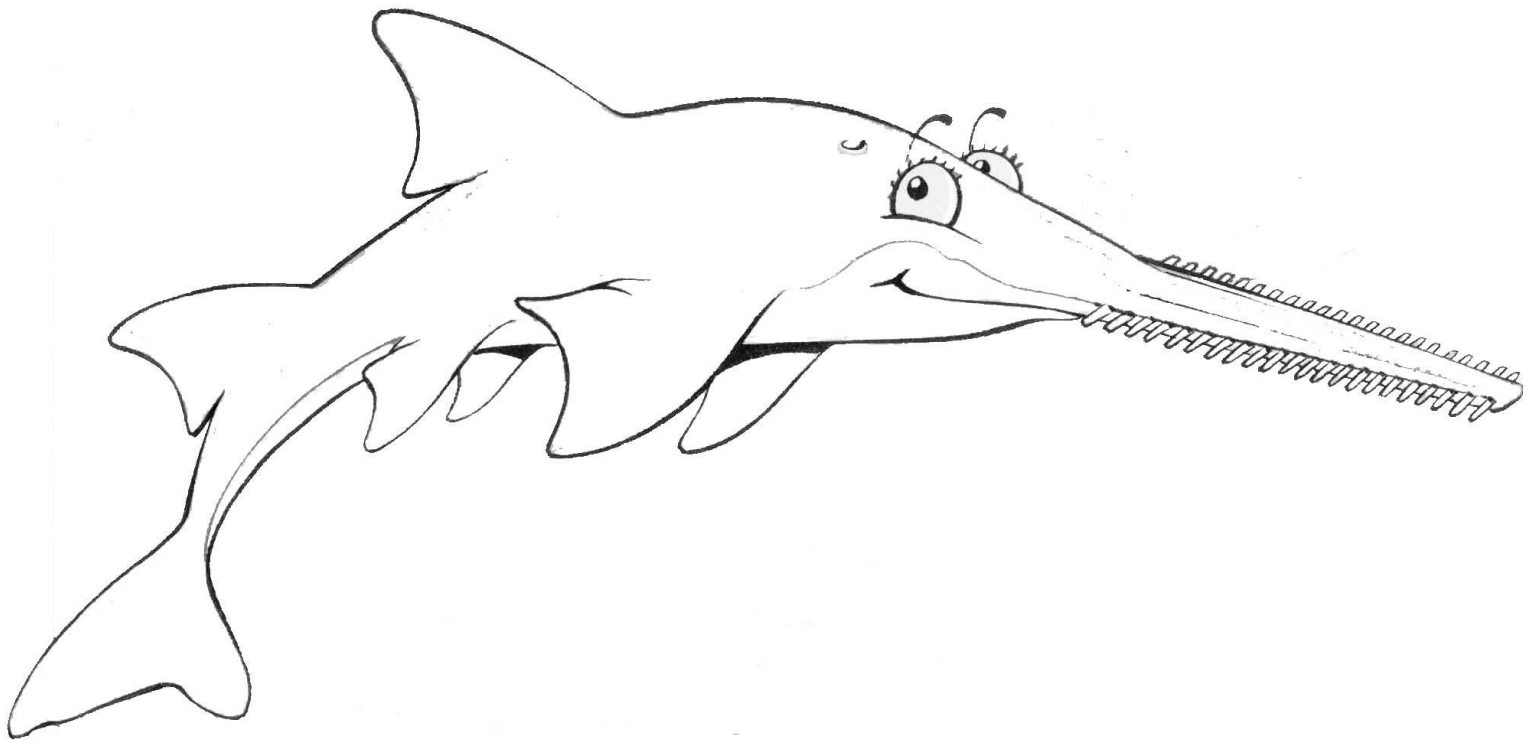
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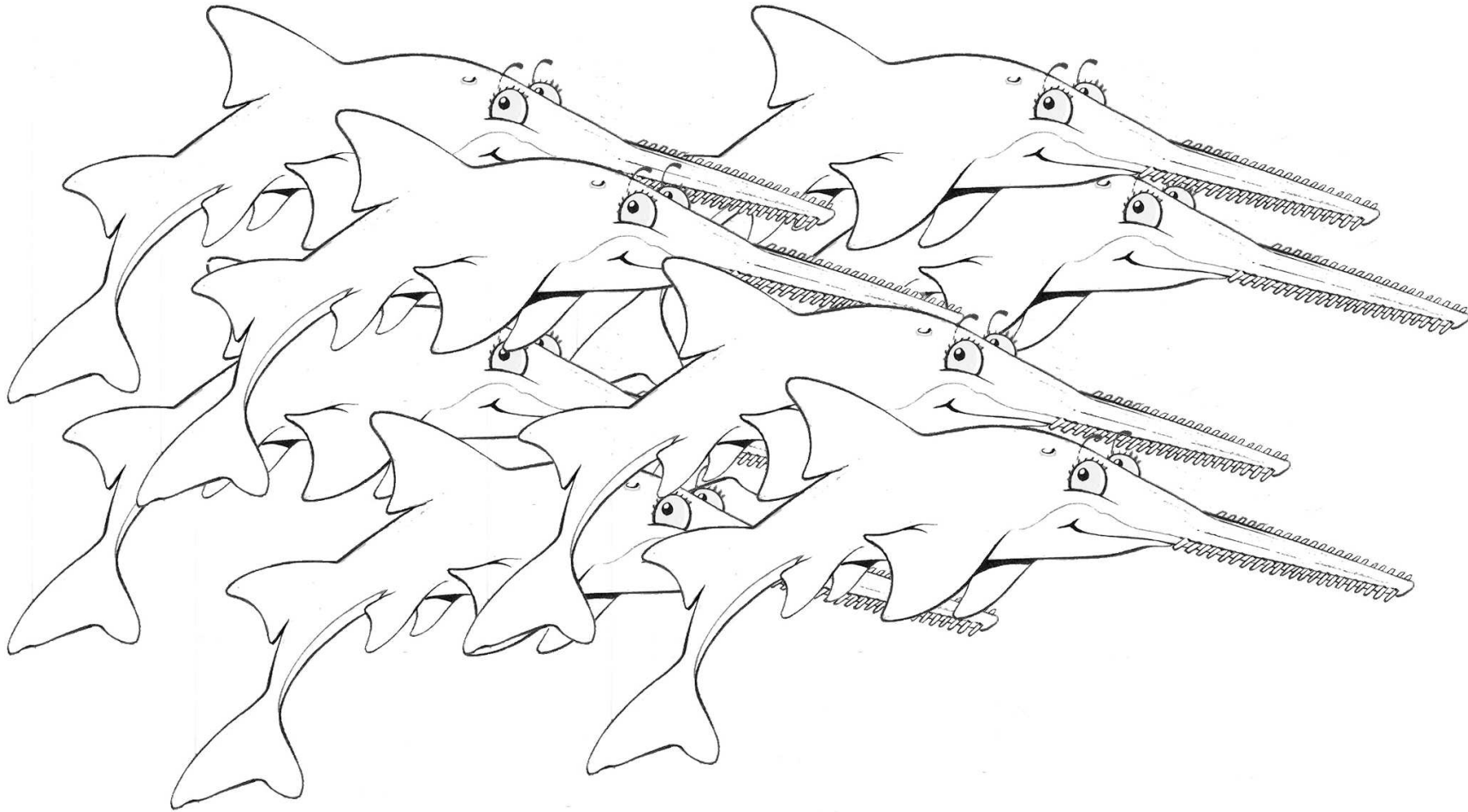
Freshwater sawfish



Facts:

- Species name: *Pristis pristis*
- Can grow up to 7 m long
- Around 20 teeth on either side of the saw
- Used to be found all around the world in tropics and subtropics, now very rare and endangered.
- Some have lived for 44 years
- They like to live in muddy bottoms of the river embayment's and estuaries
- They eat fish and benthic invertebrates
- The saw is used to stun schooling fish, and to get molluscs and crustaceans out of the benthic sediment

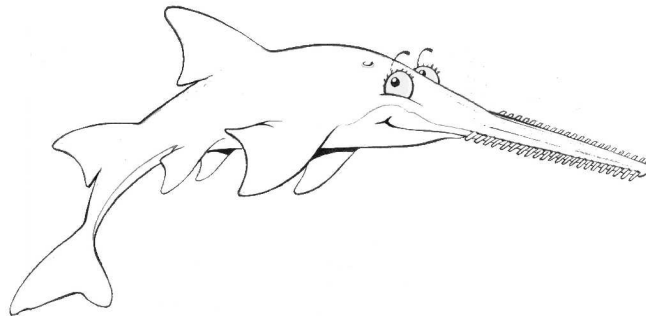
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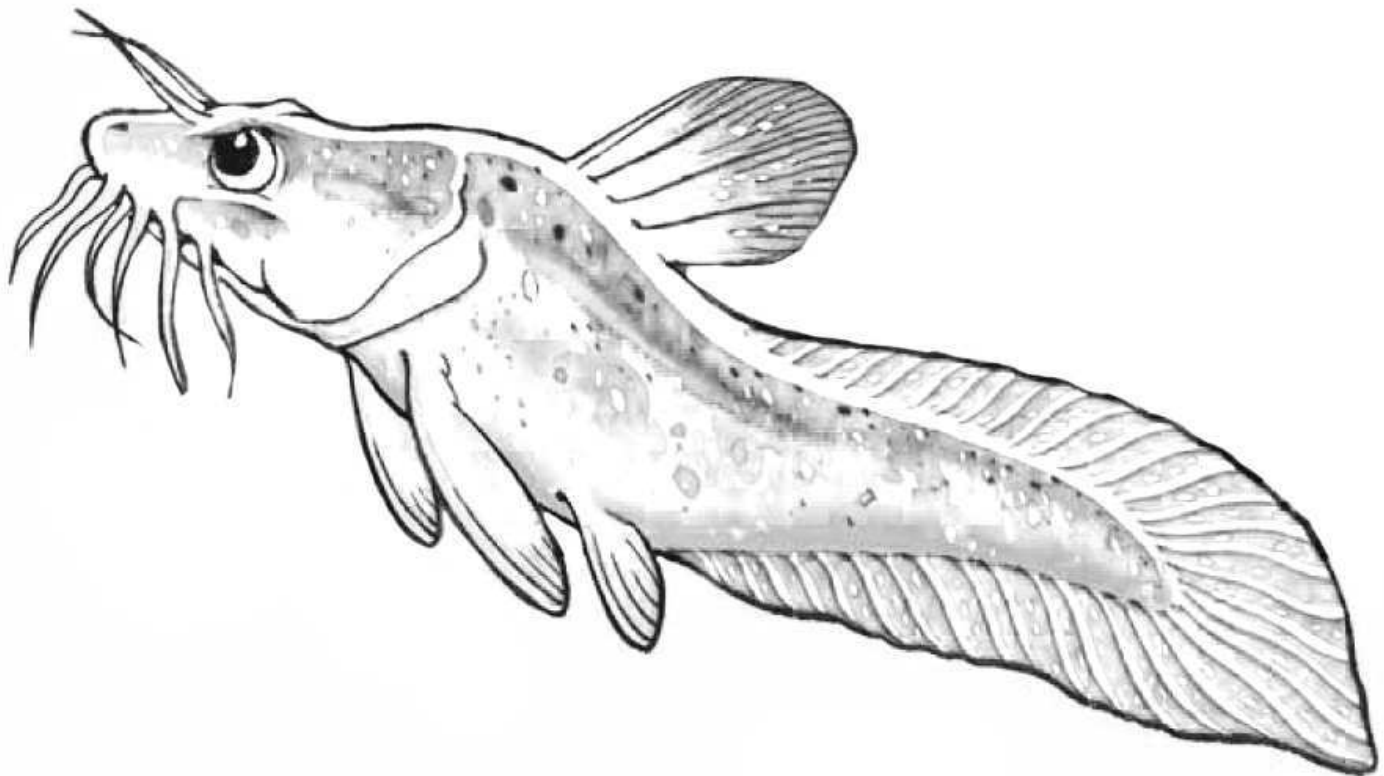
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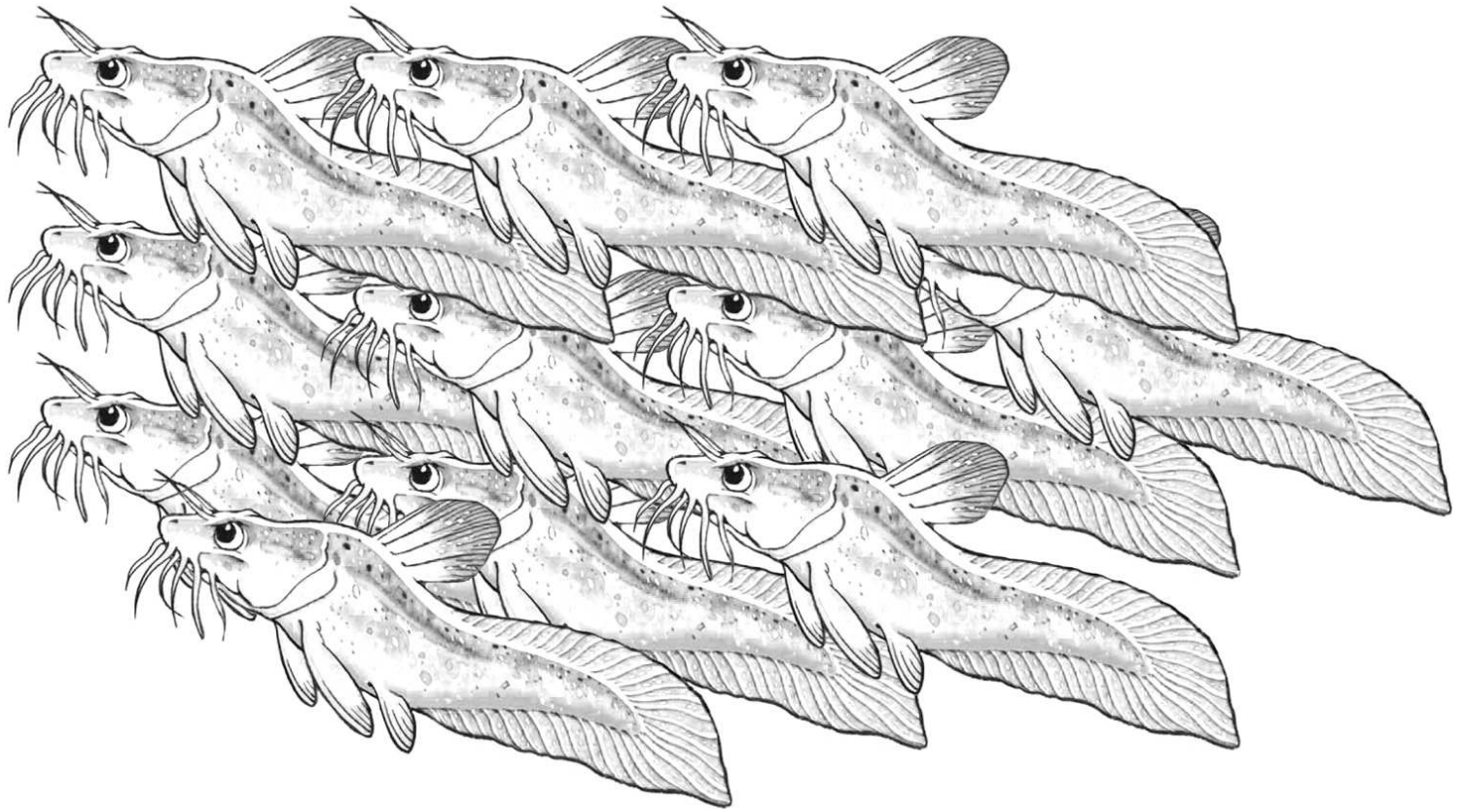
Eel - catfish



Facts:

- Species name: *Plotosus canius*
- **Highly venomous spines**
- They have an eel like tail and strong barbed spines on the dorsal and pectoral fins, they have slimy scaleless skin
- Live and feed on the bottom of the river
- They eat small fish, yabbies, prawns, molluscs, and other small benthic organisms
- Can survive in harsh conditions
- Many individuals can indicate that the environment is extremely healthy
- Grow to about 50cm to 90cm and weigh about 1.8 kgs to 6.8kg
- They can live up to 8 years
- This is just one species of catfish there are many more in the rivers and coastal areas!

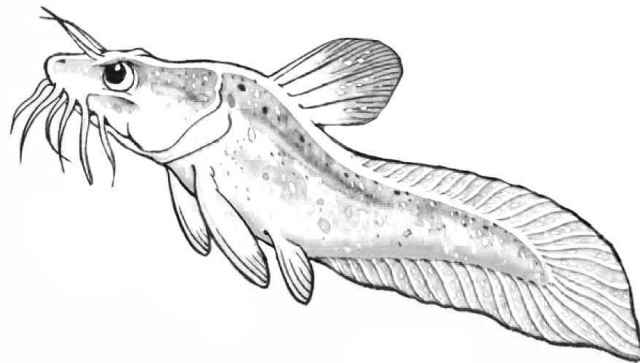
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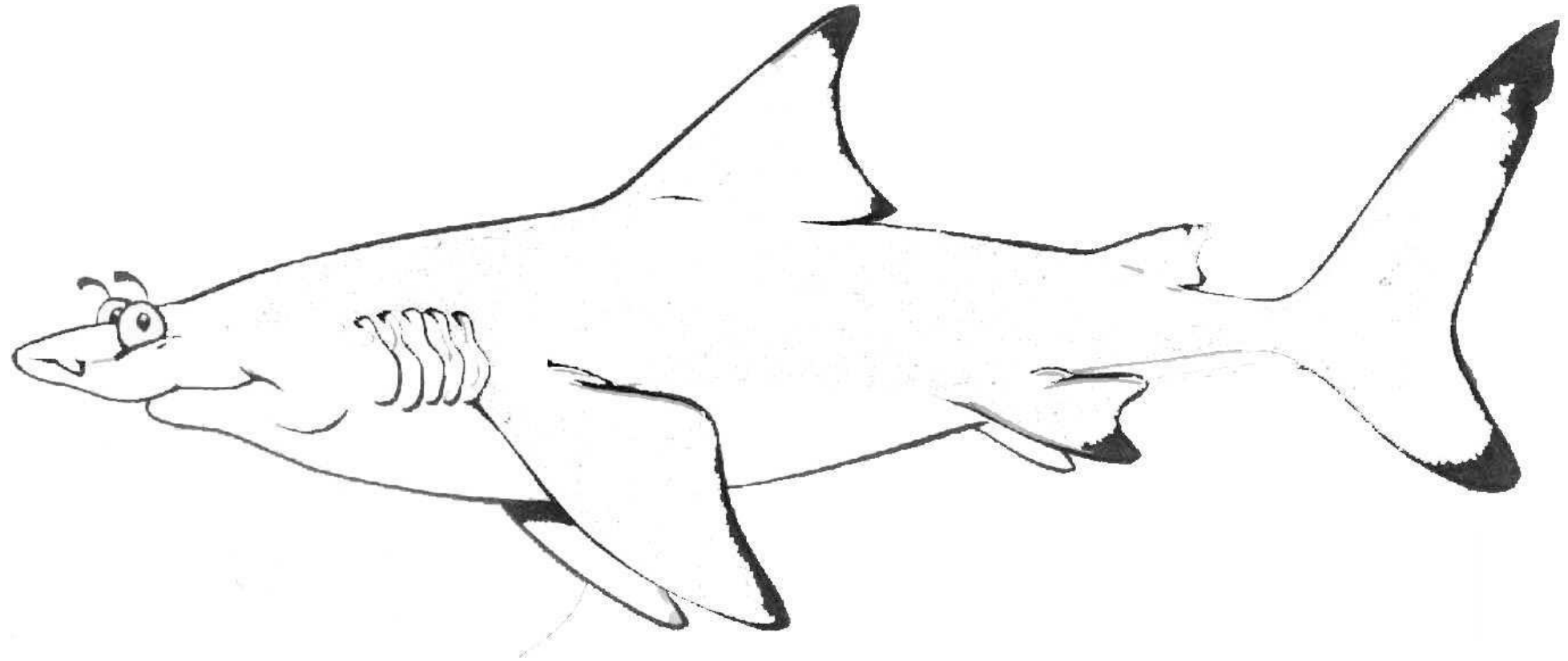
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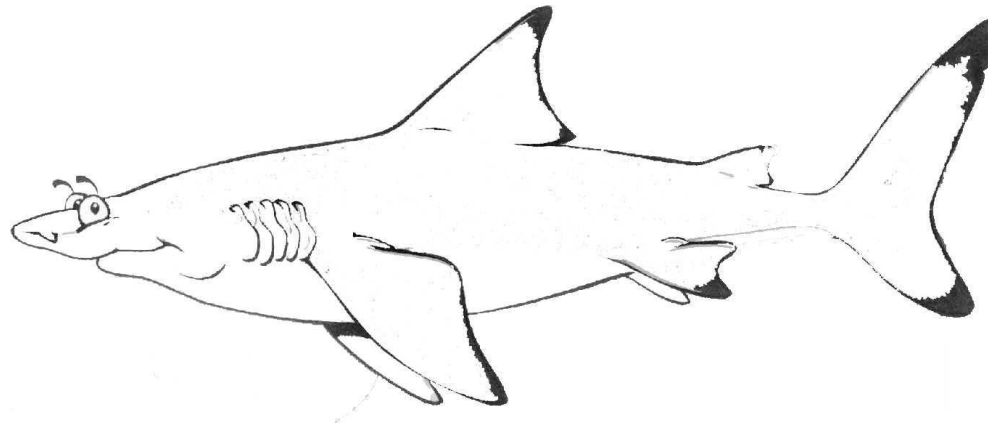
Bull shark



Facts:

- Species name: *Carcharhius leucas*
- Many different names: river shark, freshwater whaler, estuary whaler, swan river whaler
- They can grow up to 3.4 m long
- Adult bull sharks are potentially dangerous to humans
- Adults live in estuaries, rivers, coastal marine waters
- Females give birth to young in river mouths where the young can live for 5 years
- Stays in fresh water for long periods to feed and breed
- Can be found in many locations around Australia
- They eat fish, dolphins, turtles, birds, molluscs, echinoderms, and sometimes terrestrial animals.

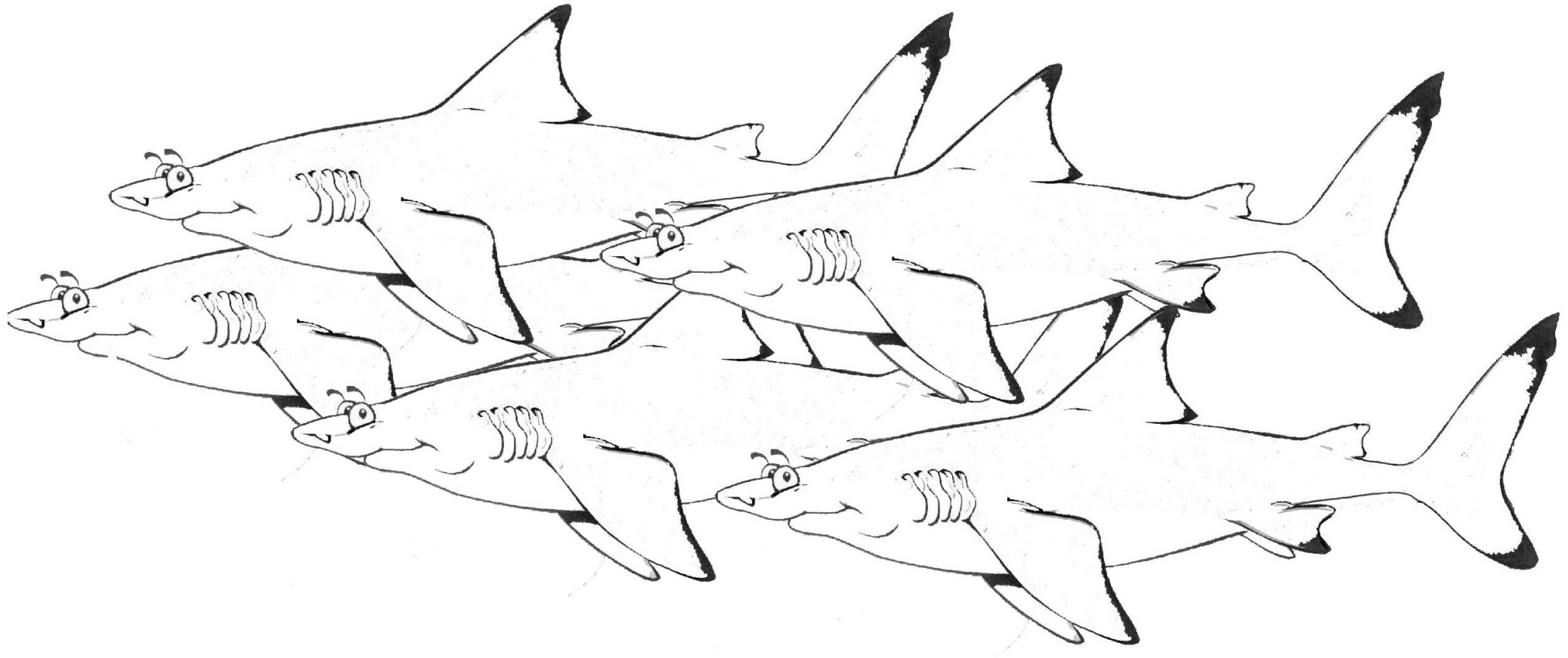
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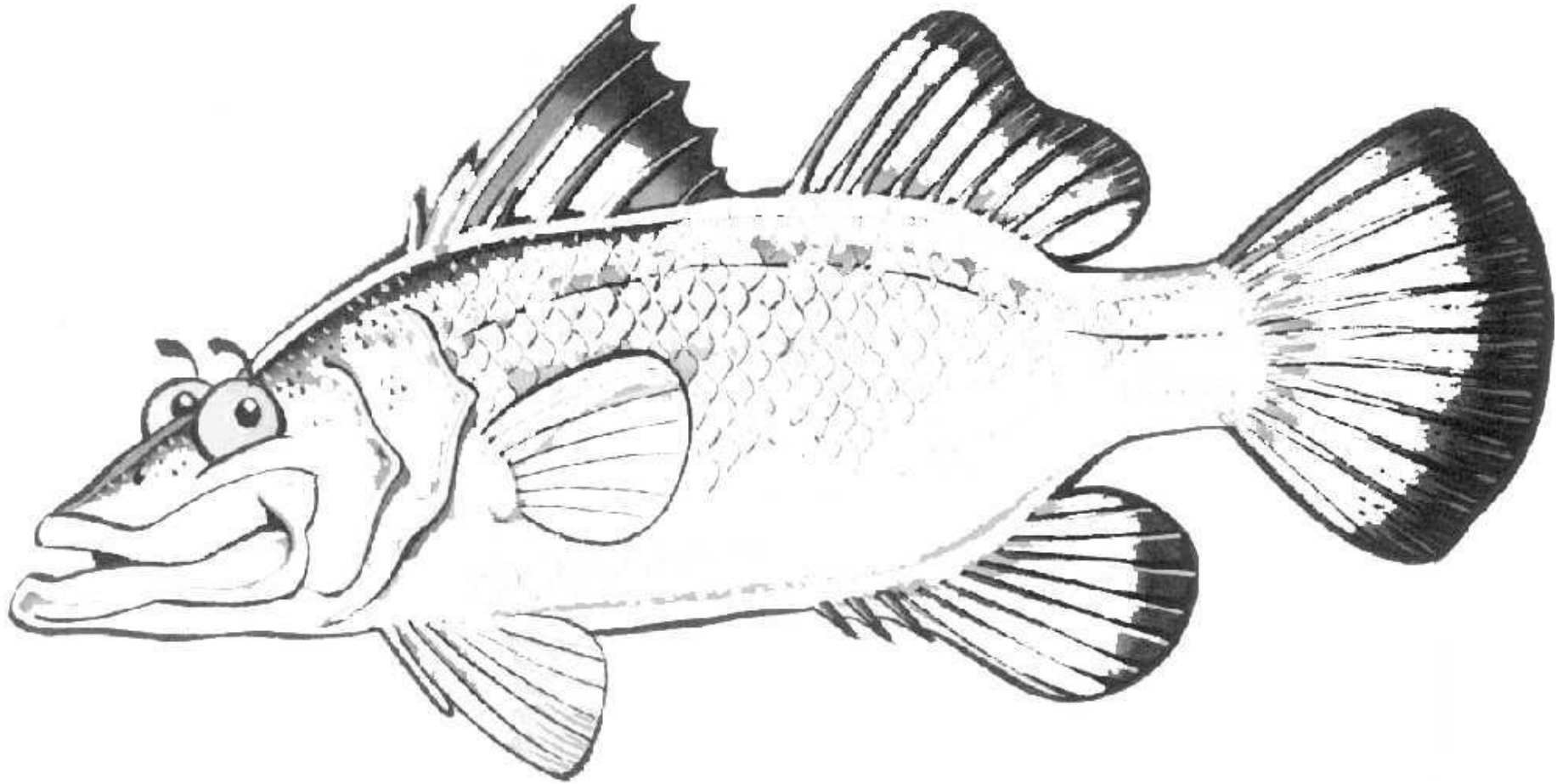
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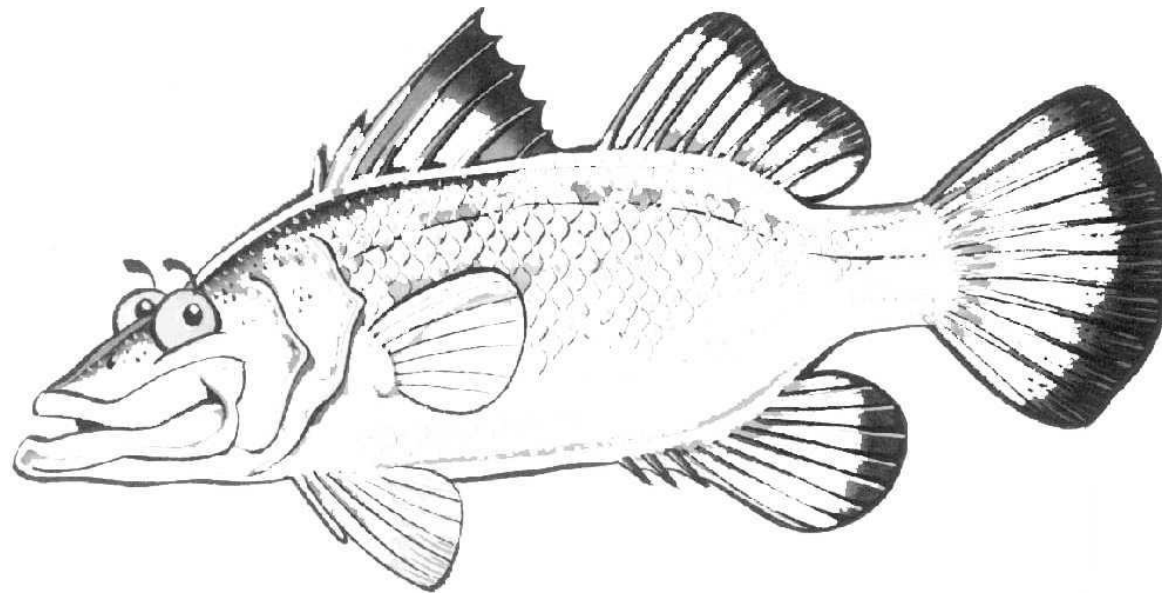
Barramundi



Facts:

- Species name: *Lates calcarifer*
- Can grow up to 60 kg and a length of 120 cm
- Recognisable by pointed head, concave forehead, large jaw extending behind the eye and rounded caudal fin
- Small fish are male, large ones are female
- Lives in a range of conditions in creeks, rivers, and estuaries in clear to turbid waters.
- They eat a range of food, small fish, prawns, crayfish, crabs, and aquatic insects
- Most important freshwater commercial fish in Australia

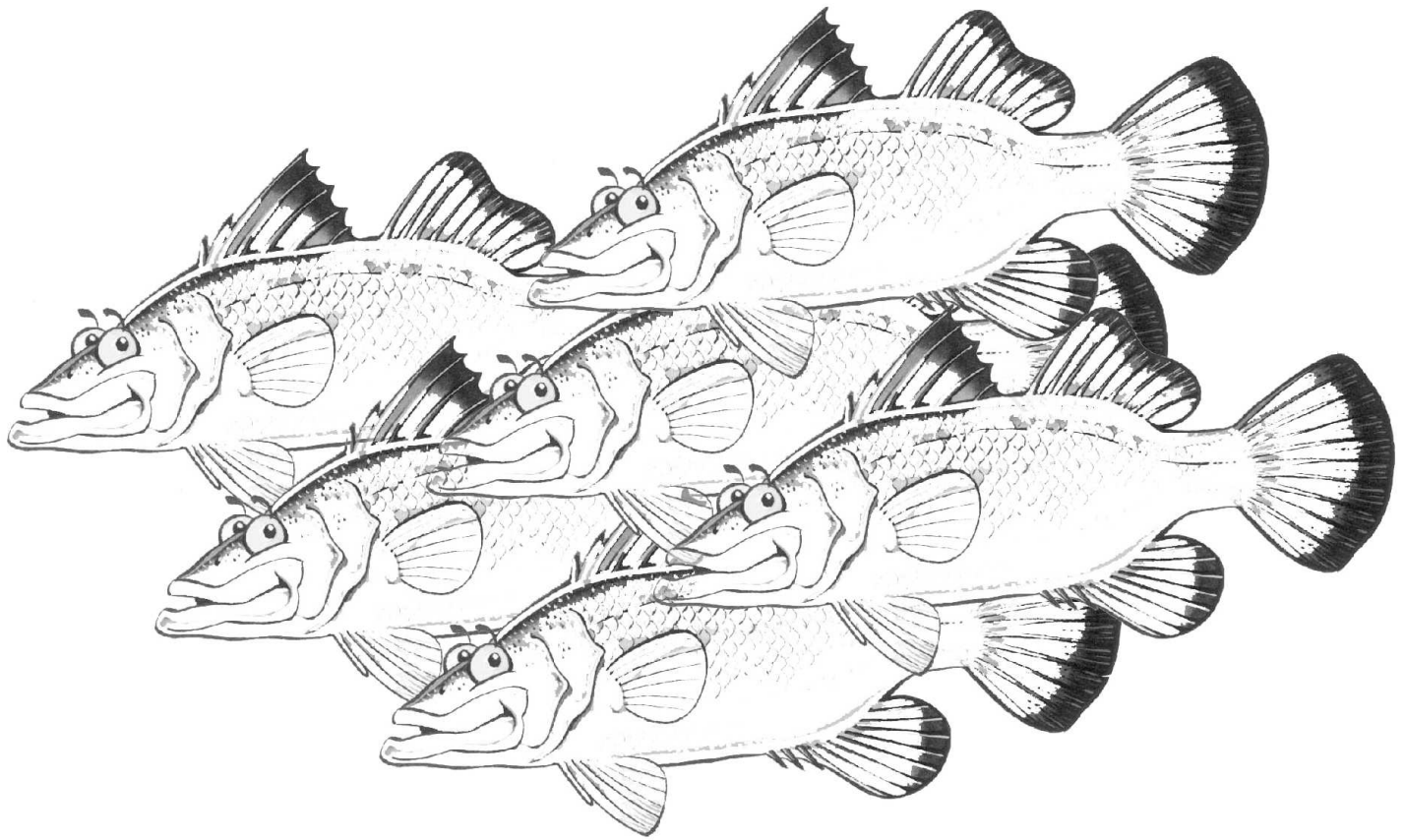
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- Lives in a range of conditions in creeks, rivers, and estuaries in clear to turbid waters.
- They eat a range of food, small fish, prawns, crayfish, crabs, and aquatic insects
- Most important freshwater commercial fish in Australia

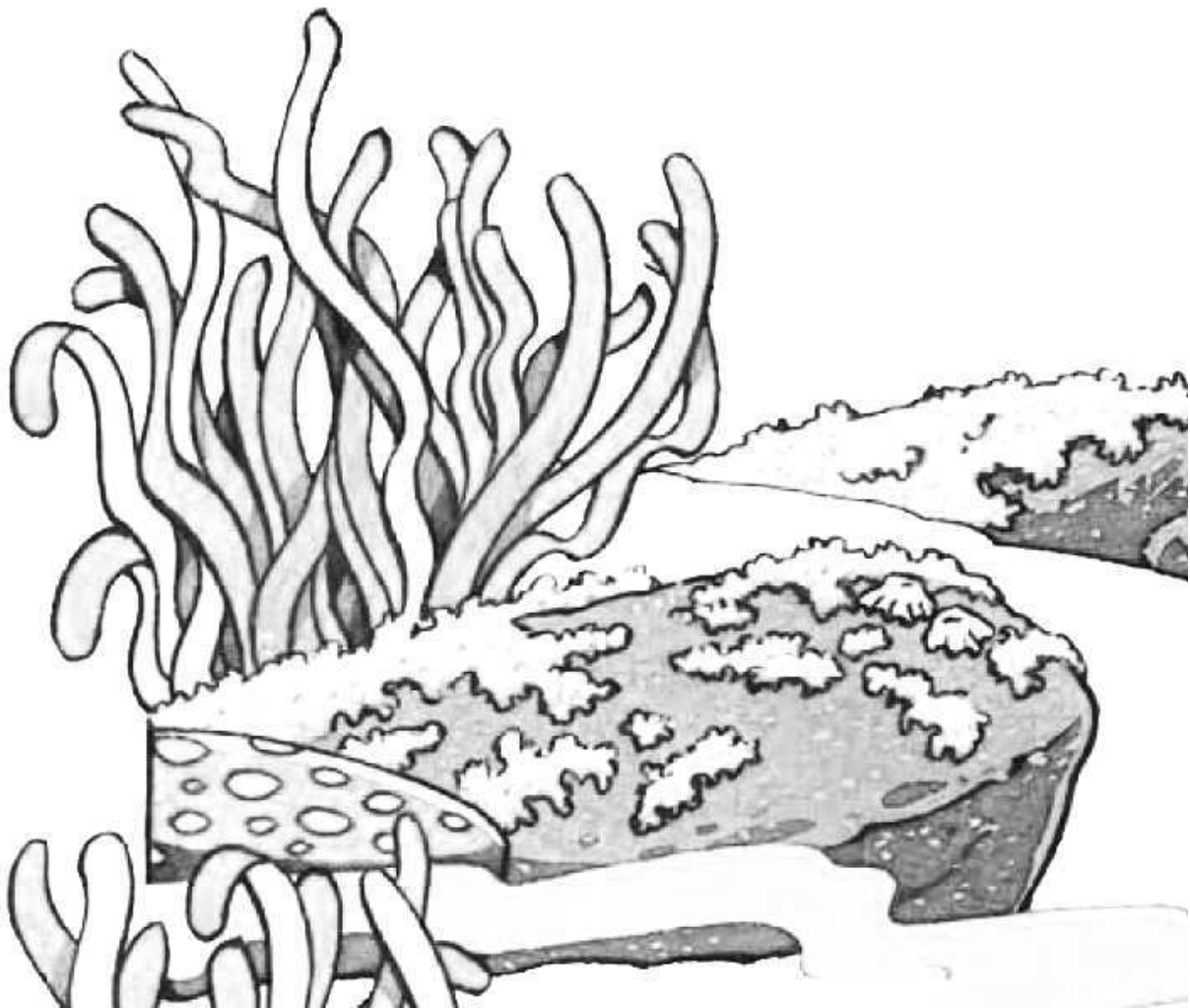
Barramundi



Facts:

- Species name: *Lates calcarifer*
- Can grow up to 60 kg and a length of 120 cm
- Recognisable by pointed head, concave forehead, large jaw extending behind the eye and rounded caudal fin
- Small fish are male, large ones are female
- Lives in a range of conditions in creeks, rivers, and estuaries in clear to turbid waters.
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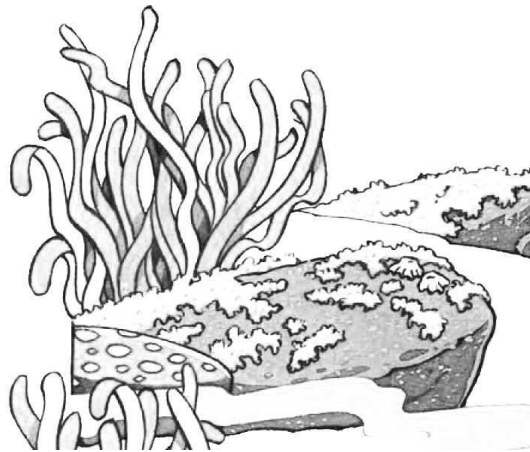
Algae and seagrass:



Facts:

- Plants make sugars from sunlight and nutrients from the ground
- They are food and shelter for many organisms
- Found in shallow, sheltered soft bottomed marine coastlines and estuaries
- Nursery grounds for fish and prawns
- Protect coral reefs as they trap sediments that are washed out from rivers
- Seagrass algae beds are considered the 3rd most valuable ecosystem globally – play important roles for the ecosystem in which they occur and other ecosystems around it

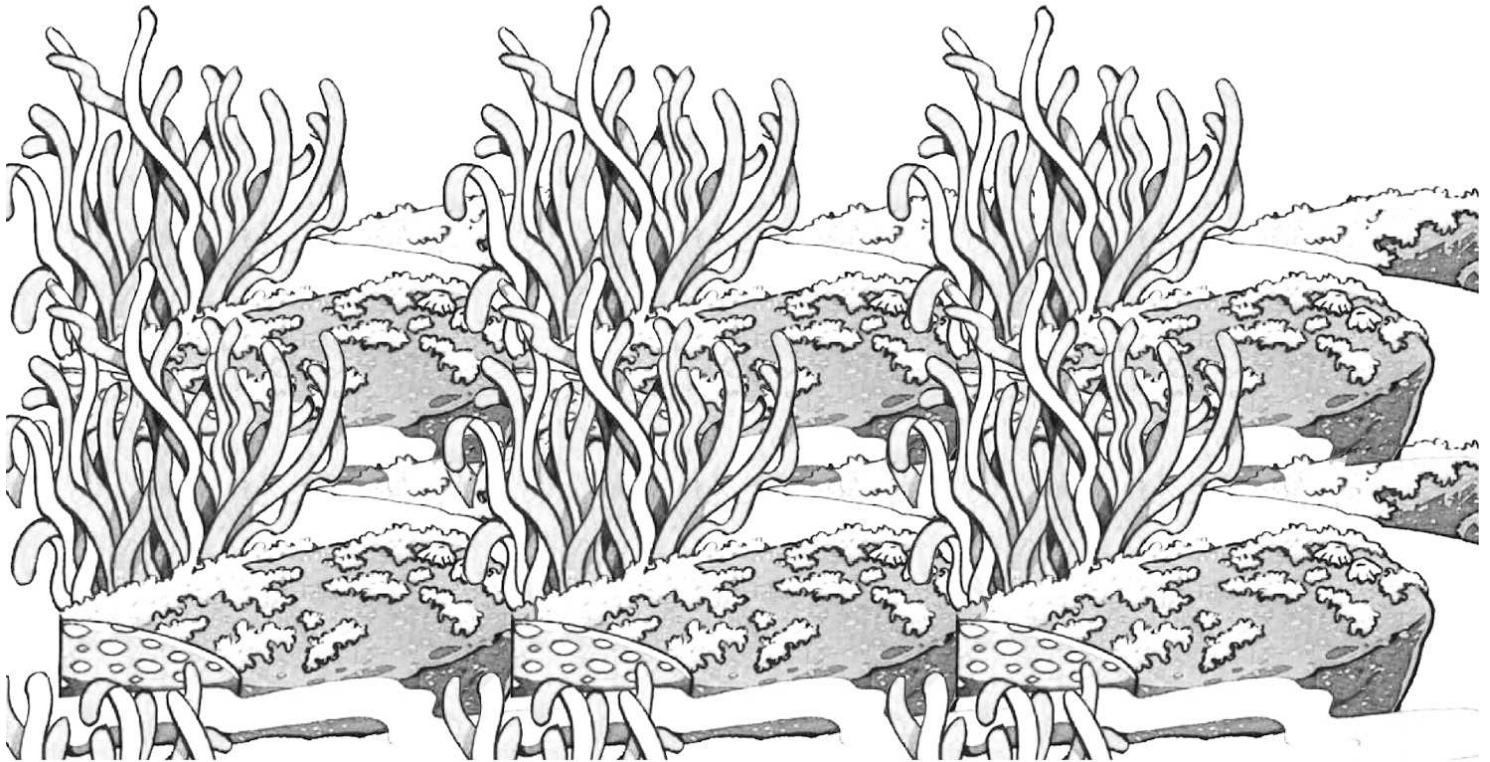
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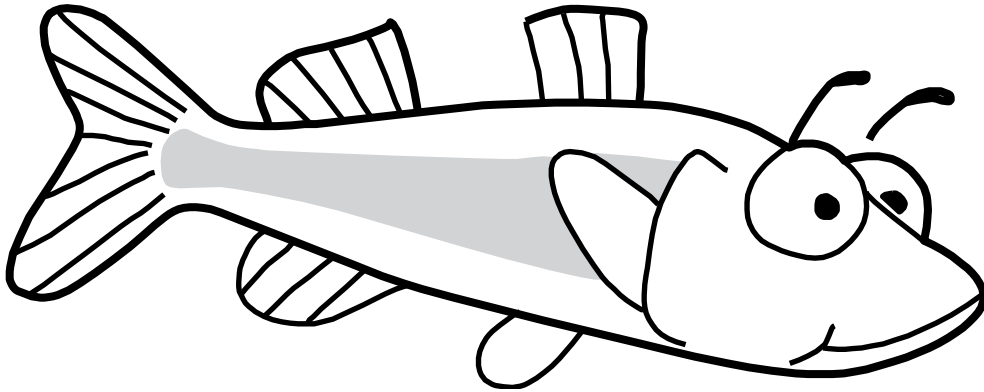
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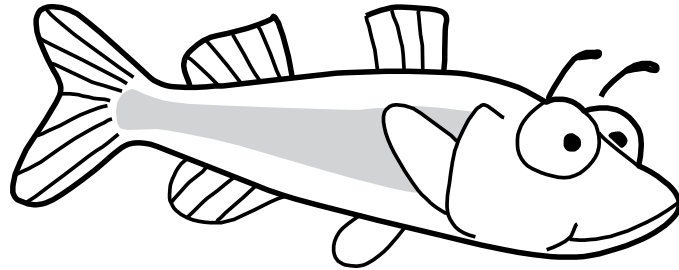
Sea mullet



Facts:

- Species name: *Mugil cephalus*
- Most common length 35cm, maximum total length 91cm;
- Can weigh between 0.5kg to 1.5kg;
- Pelvic fins are pale yellow;
- Likes water temperatures between 12 deg and 25 deg
- An important food source for many species such as stingrays, sawfish, larger fish; some sharks
- Feeds on

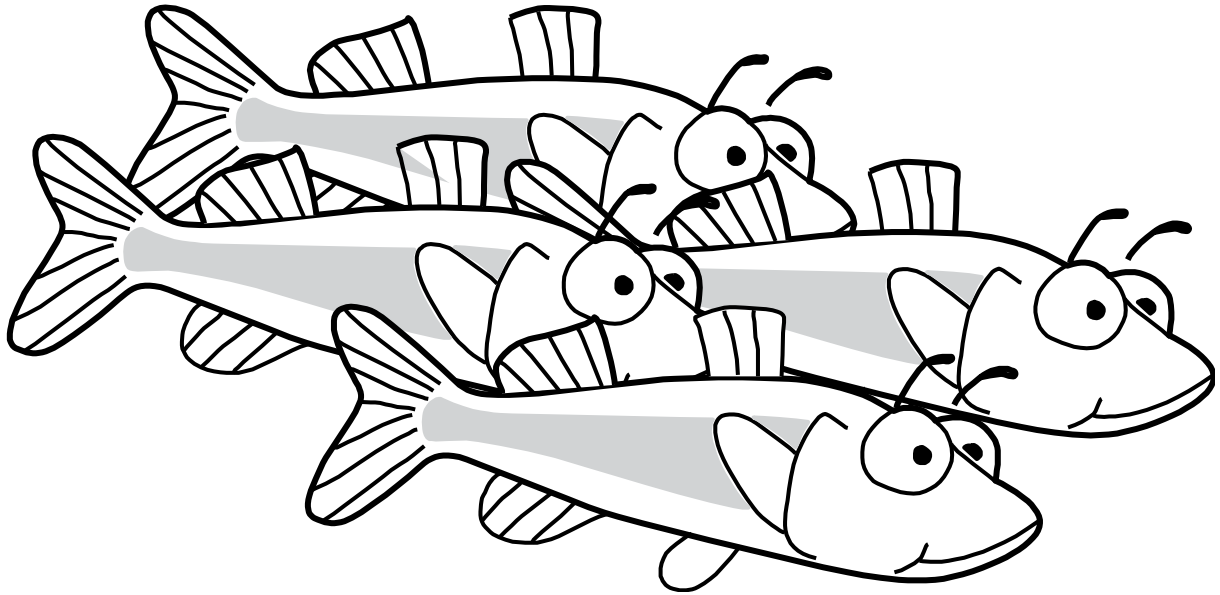
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