Southland's Sandy Shores

A Resource for Teachers

SOUTHLAND CONSERVANCY

Department of Conservation
Te Papa Atawhai

Southland's Sandy Shores

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Contents

This resource is intended to facilitate a class study of Sandy Beaches in Southland.

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Introduction

This guide has been compiled for school classes and other people who are interested in the history, geography and ecology of sandy shores in the south of the South Island. Although there are sandy beaches at intervals around the southern coast, three have been examined in detail for the purposes of compiling this resource. These are Oreti Beach which stretches 30km from Riverton to the mouth of the New River Estuary, Orepuki Beach by Monkey Island at the eastern end of Te Waewae Bay and Mason Bay on the west coast of Stewart Island.

Sandy shores are dynamic. Seasonal weather patterns, storms, human disturbance and changing currents and tides can erode or deposit sand. The change is often rapid with sand bars, spits and beaches being built up or scoured away. Wind can rapidly build up or tear down dunes and the sand can be a metre deeper on the beach in summer than in winter. All this has implications for the plants and animals inhabiting the sandy shore. Plants must be able to rapidly extend exposed root systems and grow through smothering sand that provides little nutrient. Animals have to cope with a shifting environment, extremes of temperature and a fickle food supply.

In the early days of settlement, the drifting sand was regarded as a menace particularly on the Kapiti and Taranaki coasts as it overwhelmed coastal settlements, pasture, crops and forests. In Southland there was a problem with shifting sand on Sandy Point. The fragile ecology was disturbed by fire, the burrowing of rabbits and the trampling of stock. Formerly stable sand flats were buried by moving sand until the eventual establishment of marram grass which bound the sand into fixed dunes.

In recent times large-scale sand blowouts near Waipapa Point have been a headache for coastal farmers.

Human history

The human history of Oreti Beach goes back as long as human settlement in New Zealand, thought to be around 1200AD.

In pre-European times the beach served as a pathway, a food resource and a recreation area. There is no reason to suppose that children 500 years ago were any less keen on digging in the sand and playing hide-and-seek than they are today. From middens (rubbish dumps) we have a good idea of the food being consumed by Maori. Flounders were speared or netted and all available shellfish were collected, particularly pipi at the Riverton end of Oreti Beach.

Lack of toheroa in midden sites suggests that there may not have been toheroa on Oreti Beach until fairly recently.

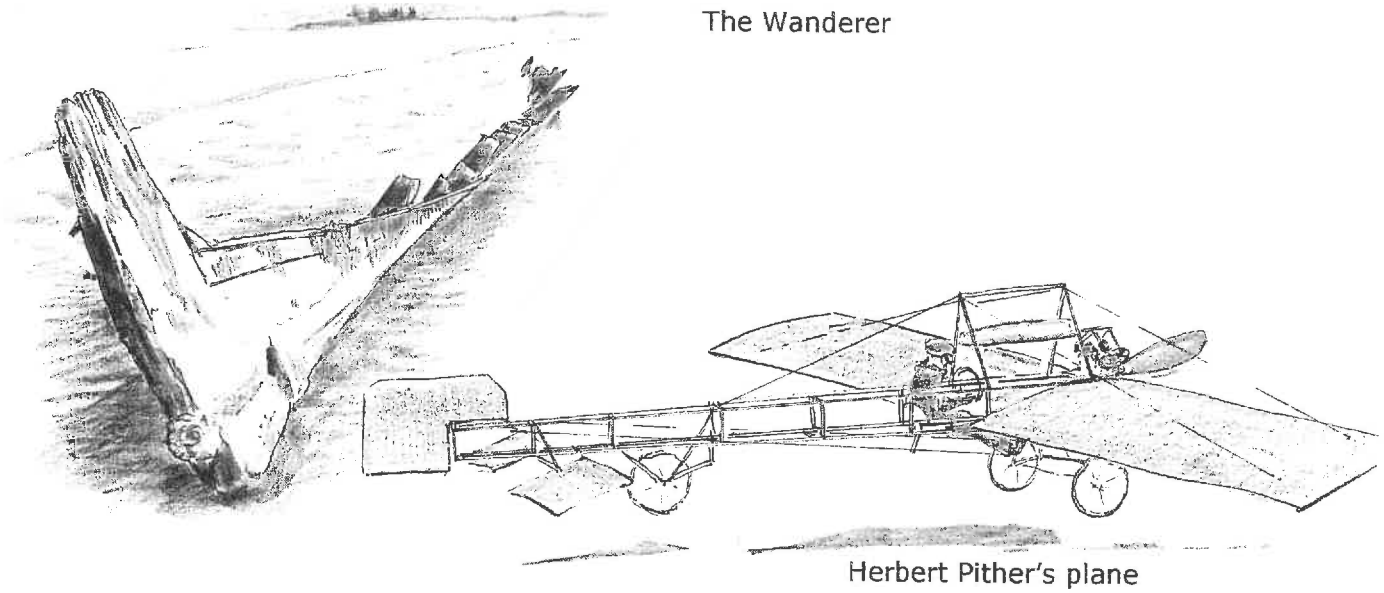
Other assumed uses of the beach by Maori are the netting of flounder and crabs, salvage of stranded whales and dolphins, firewood gathering, killing of seals, collection of disabled seabirds, collection of birds eggs, and recreational activities.

In more recent times the sandy shore and its associated recreational activities appealed to European settlers. Picnics, fishing, toheroa gathering, swimming and surfing have all been popular. Motorbike and car races were held on Oreti Beach. In 1910 Herbert Pither claimed to have flown his Invercargill-built aircraft on the beach.

Shipwrecks

Oreti Beach was the scene of several shipwrecks. The brig **Wanderer** slipped from her mooring at Riverton in 1863 and stranded at the mouth of the Taunamau Creek where her keel can sometimes be seen when the stream flows through it. The cutter **Fly** was stranded near Riverton on 19 April 1863. A few pieces of wood mark her position on the beach about 3km from Riverton. The brig **Hindu**, bringing a cargo of tea from Foo Chow in China to Dunedin, came too close to shore and was stranded on 27 March 1871. Her crew and cargo were saved but attempts to refloat the Hindu were unsuccessful. At very low tides, some of her ribs stick up through the sand about 2km south of the main entrance. The steamer **Express** was holed and sank at Riverton on 1 March 1877. The most famous wreck on Mason Bay is the **Cavalier**, built by Hart Brothers at Riverton in 1895. She was made from rimu, rata and miro and was 22m long

by 5.1m wide. She transported passengers and goods between the ports on the Southland coast - muttonbirds, possums, Ruapuke granite and timber being amongst her cargoes. She was wrecked on Mason Bay on 26 May 1901 at what is now called Cavalier Creek



The Wanderer

Herbert Pither's plane

Waves and currents

Wave action shapes the beach. In winter, stronger winds mean larger waves and more scouring. In the summer, beaches are generally more level with a greater depth of sand. Wave action is greatest on coasts fully exposed to the prevailing westerly wind.

The world's oceans are a complex array of currents. The current that flows from west to east through Foveaux Strait is a mixture of the anticlockwise current which circles the Tasman Sea and the West Wind Drift which sweeps around the Earth to the south of Africa and Australia. Beginning in 1965, research into currents involved the release of 50,000 red plastic drift cards off South Africa. Many of these were picked up on New Zealand beaches including a number on Oreti Beach. The time between release and recovery indicates that the current moves at about 17 cm/sec at this latitude. The pumice on Southland beaches comes from an underwater eruption off the South Sandwich Islands in 1962. The first pumice was noticed on Southland beaches in 1964. Some of the pieces will have been around the world several times before being washed ashore. The presence of cuttlefish bone - the internal shell of a squidlike animal - indicates that part of our current is derived from the warmer water that sweeps south along the east coast of Australia. Floats from Japanese, Russian, Australian and Argentine fishing vessels wash ashore on the Southland coast.

The shape of the coast:

The contour of the land, the exposure to the west, proximity to rivermouths and whether the hinterland is rocky or a plain formed from sediments dictate whether the shoreline is sand, gravel, mud or rock. Mason Bay is sand accumulated over igneous rock, Oreti Beach is the seaward edge of the vast deposit of sand and pebbles that makes up the Southland Plain, and Orepuki beach is a fringe of sand and pebbles formed from the eroding Longwood Range, from cliffs of consolidated sand and from material brought down the Waiau River. The west to east current through Foveaux Strait tugs at rivermouths, drawing them ever-eastwards. Both the Oreti and Mataura rivermouths have been pulled as far east as possible until they encounter the rocks of Omaui and Fortrose respectively. Some years ago the mouth of the Waimatuku River was moving east at about 1m per day. The large deposit of pebbles near the north entrance to Oreti Beach may represent a former mouth of the Oreti River.

Curriculum links:

A study of the sandy shore fits in well with the Making Sense of the Living World strand of the Science curriculum. Here are some suggestions.

Level one

Students can share their experiences relating to the living world and group the living world according to some of its attributes. e.g. Contrast living and non-living, animals with and without bones, marine creatures and land creature, sea weeds and land plants.

Students can observe and identify parts of common animals and plants. e.g. Identify things like flippers, holdfasts, beaks and legs.

Students can investigate and describe the changes in a particular plant or animal over a period of time. e.g. Find cast crab shells and relate these to growth, find hoppers of different sizes, look for spring growth and winter dieback of coastal plants and observe how black-backed gull plumage changes from brown to white as the gulls age.

Level two

Students can use differences and similarities in external characteristics to distinguish broad groups of living things. e.g. Classify things as mollusc, mammal or crustacean, and contrast flowering plants with seaweeds.

Students can investigate and understand the general functions of the main parts of plants and animals. e.g. Examples are seaweed holdfasts, leaves and fronds, crab nippers, digging-legs on hoppers and water-dispersed seeds.

Students can investigate and understand the changes that take place in animals and plants during their life cycles. e.g. Scarab grubs change into beetles, ghost sharks hatch from egg cases and female ghost shrimps carry a mass of eggs under their abdomen.

Students can investigate the response of plants or animals to environmental changes in their habitats. e.g. Investigate how animals are adapted to changing levels of the tide. Observe how dune plants grow in response to scouring.

Level three

Students can distinguish between living things within broad groups on the basis of differences established by investigating external characteristics. e.g. Find similarities and differences between different crustaceans. Contrast and liken different bird species feeding on the beach. Collect and identify a range of shells.

Students can investigate special features of common animals and plants and describe how these help them to stay alive. e.g. Look at protective coloration of spiders, leaping ability of hoppers, thick plant leaves to resist desiccation and the ability of toheroa to dig themselves rapidly back into the sand.

Students can research and describe how some species have become extinct or are endangered. e.g. Examine the beach and describe the effect of a potential 1m lift in sea level. Investigate the threats to a Southland species such as the toheroa, pingao or New Zealand dotterel.

Students can explain using information from personal observation and library research, where and how a range of familiar New Zealand plants and animals live. e.g. Select a coastal plant or animal such as marram grass, pingao, the black-backed gull, godwit or sand hopper, and carry out research on it.

Level four

Students can investigate and classify closely related living things on the basis of easily observable features. e.g. Collect a range of molluscs, identify and classify them. Observe the different gull species on the beach. Observe, and find ways of distinguishing, black oystercatchers and South Island pied oystercatchers.

Students can investigate and describe special features of animals or plants which help survival into the next generation. e.g. Look at how marram and lupin seeds are dispersed and protected from a harsh environment. Investigate the life cycles of toheroa and sand hoppers.

Students can investigate and describe patterns of variability of a physical feature found within a species. e.g. Measure things such as average blade length of marram and flax, and relate this to degree of exposure or proximity to high tide.

Students can use simple food chains to explain the feeding relationships of familiar animals and plants, and investigate effects of human intervention on these relationships. e.g. Investigate the consequences for the food chain of taking large numbers of toheroa and ghost sharks and removing large amounts of driftwood from the beach.

Level five

Students can investigate and classify in broad terms the living world at microscopic level. e.g. Investigate the specialised reproductive mechanisms of sea weeds. Collect and classify the species that make up the phytoplankton that washes ashore as brown scum.

Students can investigate and describe structural, physiological and behavioural adaptations which ensure the survival of animals and flowering plants in their environment. e.g. Social behaviour, photosynthesis, salt tolerance, ability to burrow and response to tidal cycles.

Students can investigate and understand trophic and nutrient relationships between producers, consumers and decomposers. e.g. Construct a foodweb for the sandy shore. This could be partly based on own observations. Understand the special role of lupin as a nitrogen fixer and phytoplankton as a fertiliser for sand dunes.

Level six

Students can investigate and describe examples of different types of helpful and harmful micro-organisms. e.g. Investigate the role and classification of planktonic organisms by sampling seawater and identifying larval animals and diatoms.

Students can investigate a New Zealand example of how people apply biological principles to plant and animal management. e.g. Investigate the criteria used for deciding whether or not to have a toheroa season. Assess the environmental impact of a hypothetical industry such as crab harvesting or ironsand extraction.

Level seven

Students can describe and explain the reasons for the special characteristics of New Zealand's plants and animals. e.g. Investigate how a cool climate and currents, geographic isolation, the ice-age and the lack of mammalian predators and browsers have lent a special character to the plants and animals of the sandy shore.

Students can research and develop a defensible position about a selected issue affecting the New Zealand environment. e.g. Some issues could be: removal of marram grass from dunes and replanting with native sand-binders, exclusion of motor vehicles from the foreshore and dunes, whether or not we should have to pay for a recreational fishing license, compulsory protection of all remaining dune areas, an industry levy to pay for beach cleanups, and oil-spill preparedness.

Level eight

Students can carry out an extended investigation, involving a range of techniques, and origination from their own interests, into some aspect of, or issue related to, the living world. e.g. On the sandy shore this could be a detailed study of a species such as the sand-hopper, toheroa, ghost shrimp or red-billed gull. It could be dune-formation and stabilisation, decomposition of plant or animal remains, a comprehensive species list for a selected area or a study of zonation of inter-tidal species.

Fieldtrip organisation:

- Plan your trip well in advance and be prepared to cancel or postpone it if weather conditions are unsuitable.
- As the beach can be a harsh environment you will need to ensure children have suncream, sunhats, food and drink, adequate footwear and clothing including hats and wet weather gear.
- Your party will need a first aid kit, toilet paper, insect repellent, a spade, collecting bags and pottles, a magnet and magnifying glasses.
- Consider the advantages and disadvantages of swimming.
- It is important to check the tide. Check low tide times in the paper or tide tables.
- Consider what you need to bring back from the beach. Unlike a rocky shore, where most things you collect are live, the sandy shore offers a range of suitable material to bring back to the classroom that is already dead and dried. This means seaweed, sand, driftwood, shells, crab shells, bones and feathers.
- Make rules about water activities, boundaries, collections and excavations.
- As the sandy shore changes from day to day, you should visit the site a day or two before the trip to check on access and to see what is washed ashore and make up a worksheet, identification sheet and activities that are relevant.

Suggested sandy shore fieldtrip activities and investigations.

Recreation: Hide and seek, athletic activities, dune racing, ball games, an Olympic Games from found materials such as caber toss, javelin and long-jump, golf with driftwood and a seaweed ball, skipping with a seaweed rope and swimming. Make a collection of shells or interesting objects, make sandcastles, dig your way to China, orienteering, try to stop the tide coming in, make seaweed balls, make a skipping rope from kelp and have a paddle.

Art: Collect material to make a collage or mobile. Study the patterns in the sand, the sky, the sea and the dunes.

Science: Look for the marks of toheroa, wedge shells, worms, and bird probe holes and footprints. Identify the birds on the beach. Identify plants in the dunes and collect shells and driftwood. Look for hoppers and draw conclusions about their habitat and food.

Investigate the plant and animal life of the dunes. Collect foam to examine it under a microscope.

Use a magnet to separate iron from the sand. Use a magnifying glass to examine insects and crustaceans. Use a sieve to collect small crustaceans from the water's edge.

Make a seaweed collection. Collect and classify plastic rubbish. Check whether exposed hoppers head towards the sun, the water, the dunes or shelter.

Collect crab shells, measure them, graph the results and draw conclusions about crab growth.

Compare the strength and thickness of cast crab shells with those from dead crabs.

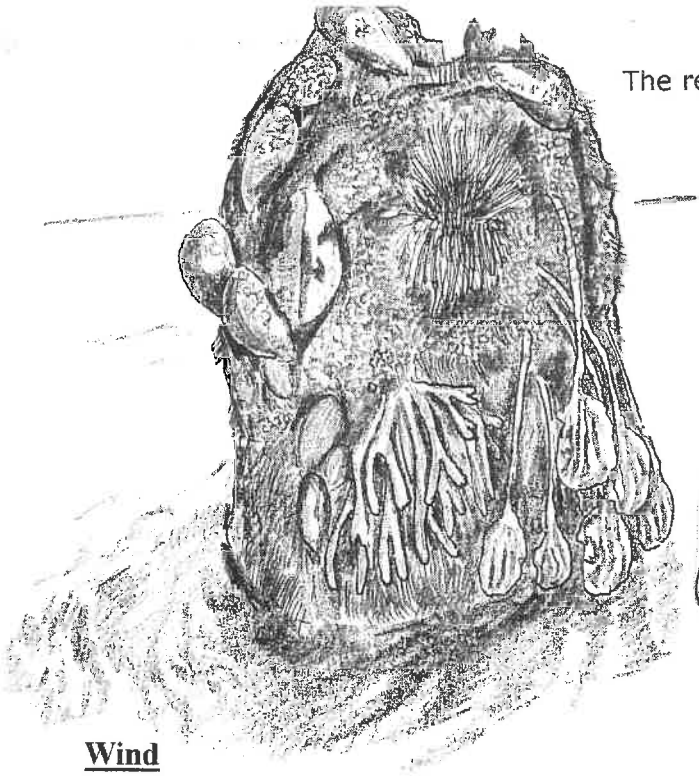
Devise a way of counting how many sand grains make a handful.

Measure and graph the distribution of ghost shrimps on a sandy beach.

Fieldtrip sites:

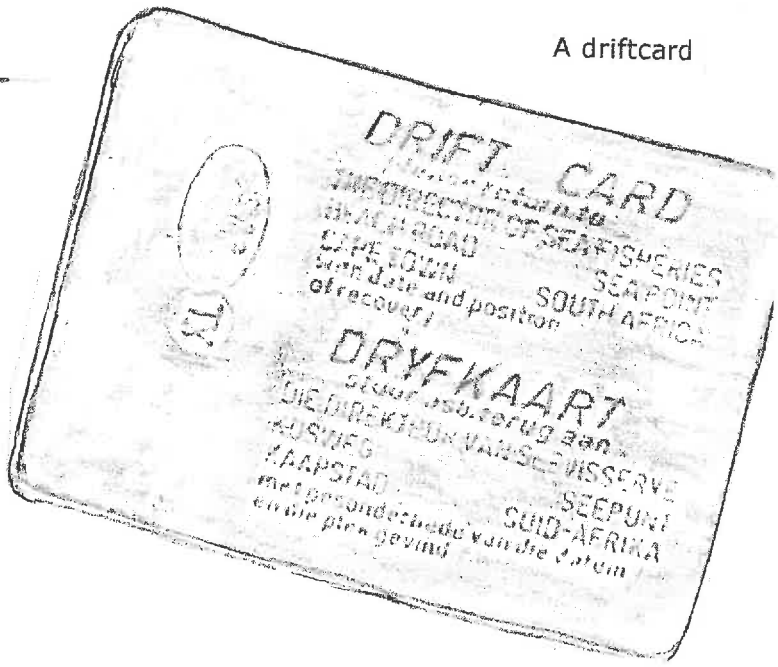
The prime sandy shore fieldtrip site is Oreti Beach. The area in the vicinity of the main entrance is easily accessed, usually safe for vehicles including buses, has a broad intertidal zone, large dunes and washed-up seaweed and driftwood. A remoter part of the beach, where the human impact is less, is at the South Entrance to the beach accessed down Christies Road. The beach is a short walk from the carpark. Because the road is subject to flooding and erosion, it pays to check the site prior to the fieldtrip to see if it is still accessible to buses.

The other recommended sandy shore fieldtrip site is the end of Te Wae Wae Bay at Monkey Island. Other possible sites are the Riverton end of Oreti Beach accessed via Princess St, Omaui, Colac Bay, Porpoise Bay, Tautuku, Waipati and Wakapatu.



The remains of the Hindu

A driftcard



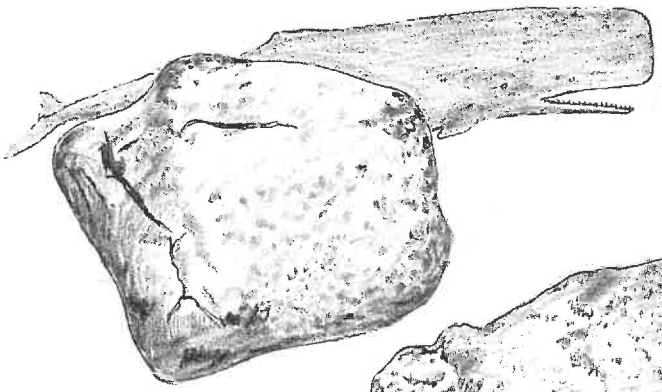
Wind

The prevailing wind in southern New Zealand is westerly. This means that west coast beaches have an onshore wind and catch more of the sea's drifting treasures than east coast beaches. All manner of manmade and natural debris reaches our sandy shores, brought by currents, blown in by the wind, cast ashore from the ocean depths or carried down flooded rivers. There is a specialised group of animals, the *pelagic* fauna, which lives on the surface of the ocean. This includes goose barnacles, jellyfish, violet snails and a crab. After a period of prolonged westerlies the high-tide line can be strewn with floating sealife that serves merely as food for gulls and hoppers. Sometimes weather balloons wash ashore. These are released at the Meteorological Office at Invercargill Airport and caught in high altitude winds that have pushed them out over the sea before they burst. You might find the balloon itself, the instrument package called a radiosonde or the silver radar reflector.

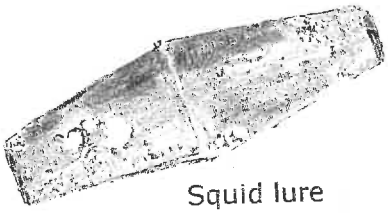
Flotsam and jetsam

We use this term to refer to debris, usually manmade, washed up after rough weather. Technically jetsam is material thrown overboard to lighten a sinking ship and flotsam is wreckage of that ship which sank anyway.

Some of the manmade debris is a nuisance and we are annoyed at conspicuous plastic waste. Some is fascinating - The beach produces messages in bottles, useful timber and valuable fishing gear. Amongst the miscellaneous debris you might find squid lures, bulbs from squid boats, pumice and ambergris. Ambergris is a hard, waxy substance that comes from the intestine of sperm whales. It has a fragrance like tobacco and is still valuable in the manufacture of perfumes.

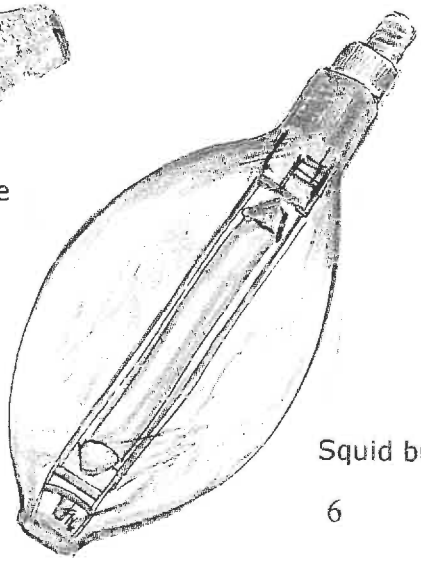


Ambergris



Squid lure

Pumice



Squid bulb

Sand

Sand is made from powdered rock in a process that starts high in the mountains. Stones tumbled down mountain torrents are gradually rounded and the constant friction eventually wears them down to sand. Look closely at the sand and you will see that the grains are many colours. The white and yellow ones are quartz, the commonest mineral in New Zealand, and most of the black ones are iron. You can work out the iron content of sand by placing a magnet under paper on which dry sand is spilled. Iron sand can also contain gold and other heavy metals. There are substantial deposits of iron sand on Ringaringa Beach and at Te Wae Wae Bay where there are also platinum and gold claims.

On the beach you can see patterns of light and dark sand. This is caused as the sand, stirred up by a wave, is drawn seawards as the water recedes. The heaviest particles, iron, fall first leaving a dark band and the lightest particles fall last making an intricate pattern.

On some Western Southland beaches there are deposits of sand composed largely of red garnet crystals. At Orepuki large pebbles of hydrogrossular garnet are found. These are very hard and were used by Maori for hammer-stones. The Catlins coastline from Fortrose to Nugget Point, including the fossil forest at Curio Bay, is mostly cliffs of Jurassic and Triassic rock. Petrified wood is quite common on the beaches along this coast, especially along the sandy beach at Waipapa Point.

The more gently the beach slopes, the finer the sand, and Oreti Beach sand is exceptionally fine although coarser towards the Riverton end of the beach.

Because of the constant stirring of the top centimetres of sand, any animal resident below high tide mark must either have a deep burrow or be nimble enough to dig in quickly as the sand is disturbed. Toheroa, ghost shrimps and bamboo worms are deep burrowers and paddle crabs and the teeming mass of tiny crustaceans that live right at the edge of the water dig into the sand rapidly when they are disturbed.

The creatures that live buried in the sand in the intertidal zone are filter-feeders and deposit feeders. They suck in seawater or generate a current from which they filter plankton, or swallow sand and digest any organic matter adhering to it.

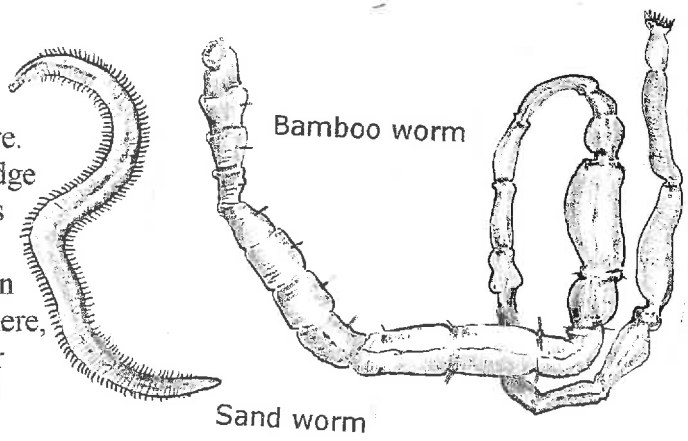
The beach at night

A night visit to a sandy beach is an interesting experience. There are all the possibilities for night games as well as for investigating a natural world that wakes when night falls. Sand hoppers are nocturnal and masses of them swarm over seaweed and range up and down the beach looking for new food sources. Look for phosphorescence. This is a pale glow in breaking water caused by zooplankton being agitated. Pat the sand exposed after a wave has receded and you may see the plankton sparkling.

The night sky can often be better observed from a beach where there is a clear horizon and city lights are far away. Find a current sky chart and use it to locate stars, planets and constellations. Look for the glow of the aurora to the south and watch for satellites and shooting stars.

Zonation

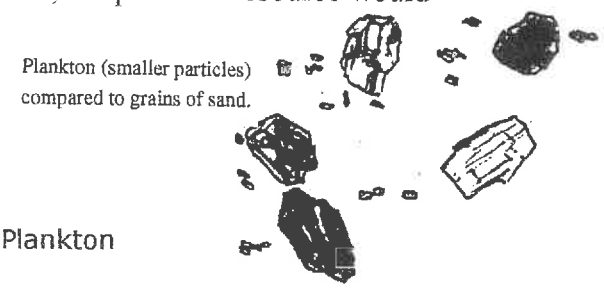
Tidal movement is caused by the gravity of the moon and to a lesser extent by the gravity of the sun. Spring tides - the highest and lowest tides - occur when the sun and moon are pulling from opposite directions (full moon) or in the same direction (new moon). Neap tides, when there is least variation between high and low tides, occur at first quarter and last quarter. There is a high tide about every 12 hours and 25 minutes, the interval between when the moon is closest to Southland and when it is most remote. In Southland, tides vary from about 2.9m at extreme spring tides to about 1.5m at neap tides. The flattest sandy beach, where the tide goes out the greatest distance, is at the south end of Oreti Beach. Tide zones are best defined on sheltered coasts where plants and animals are zoned according to the amount of time they are exposed to salt water. The sandy shore could be divided into three zones: intertidal, driftline and coastal.



The intertidal life is sparse compared to a rocky shore. On Oreti Beach it consists of buried toheroa and wedge shells, worms, ghost shrimps and minute crustaceans plus the birds that feed on these. The driftline zone extends from high water back to where the vegetation starts. Insects and spiders, hoppers and slaters live here, feeding on decaying wood, seaweed and carcasses or preying on those creatures that do so. Dotterels feed and nest in this zone and pipits search amongst the dried seaweed for insects. The coastal zone extends back to pasture, bush or plantation, taking in the dunes and associated wet areas and is subjected to strong winds, blown sand and salt spray. At Orepuki Beach the coastal zone terminates abruptly at a line of cliffs and on Mason Bay the blown sand extends over a kilometre inland and reaches the top of Big Sandhill, 156m above sea level. On Sandy Point, farming and forestry have nibbled away at the coastal zone, marram has replaced native vegetation and the whole ecology is vastly different from what it was 150 years ago.

Plankton

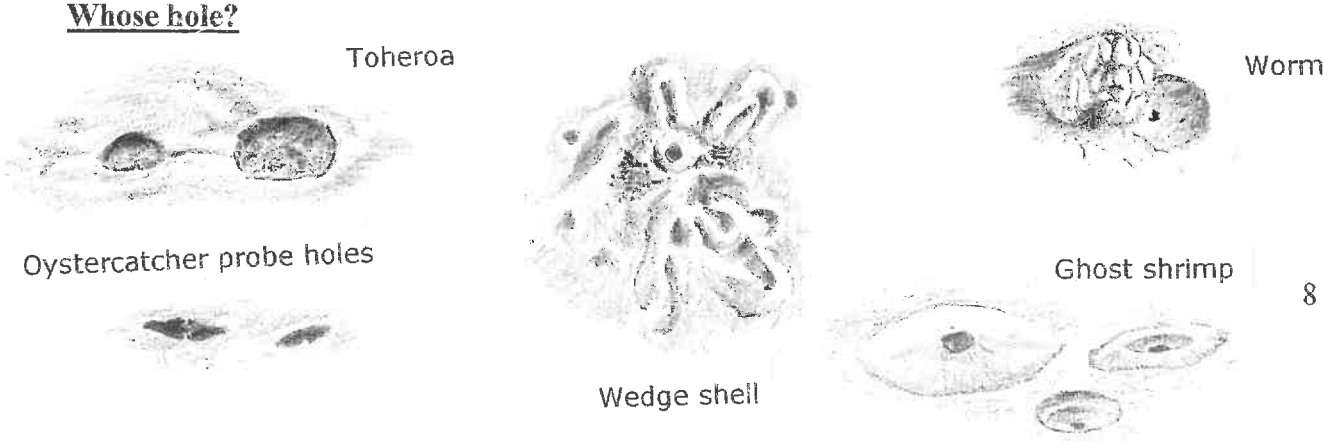
The brown froth on the beach is not pollution, it is phytoplankton, the ocean equivalent of grass - the bottom level of a food chain which is topped by sharks, seals, whales and humans.
On the beach, the plankton is food for filter-feeding creatures such as hermit crabs, toheroa, wedge shells, ghost shrimps and other species. The foam which is blown up into the dunes is an important source of nutrients in an otherwise impoverished environment.
Collect some and examine it under a microscope and you will see that it is made of a host of single-celled algae called diatoms. Without an onshore wind, the plankton resource would diminish and our coast would lose much of its diversity.
At times, excessive growth of plankton, called a red-tide, can deplete oxygen in the seawater and there are occasional blooms of toxic algae which make shellfish and other filter-feeders unfit for eating.

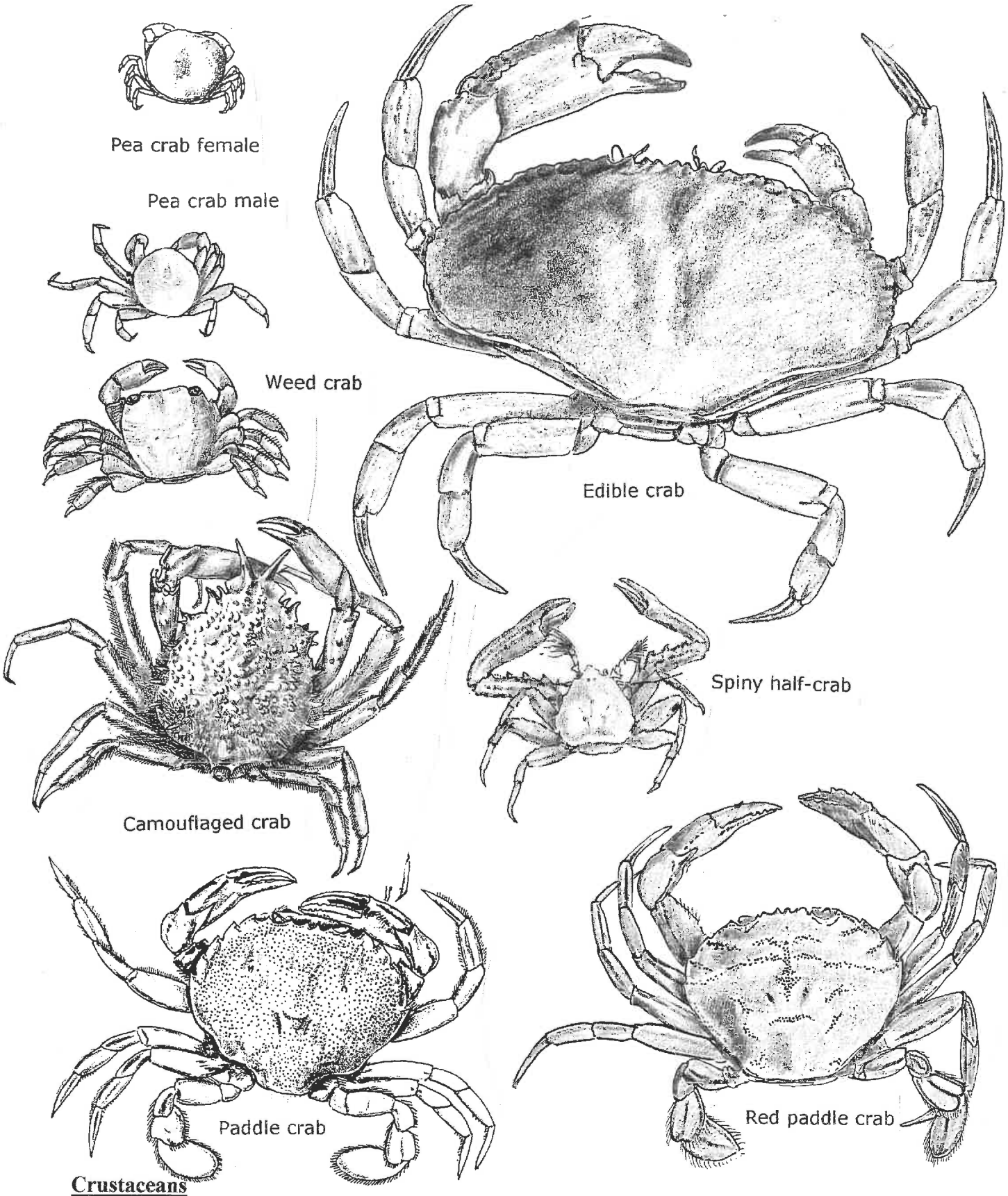


Sandy shore food webs:

Producers are the plants. They make all other life on Earth possible. They require sunlight, carbon dioxide, water and nutrients and produce oxygen and living tissue. The sandy shore producers are the seaweeds, living in shallow coastal waters or cast ashore to provide nutrients for herbivores, plankton sieved from seawater or blown inland to provide fertility to the sand and salt-tolerant plants in the dunes.
Filter feeders such as toheroa, barnacles, sea tulips and sponges extract plankton from the water.
Deposit feeders swallow sand and digest from it the algae, bacteria and particles of organic matter that cling to it. Examples are the many species of sand worms.
Scavengers such as black-backed gulls, hoppers and crabs clear the beach of dead matter.
Decomposers break down carcasses and kelp. Examples are kelp-fly and blow-fly maggots.
Herbivores such as tussock butterfly caterpillars and scarab beetle larvae eat dune plants.
Examples of sandy shore ***carnivores*** are dotterels, dragonflies, swallows, spiders and whelks.

Whose hole?



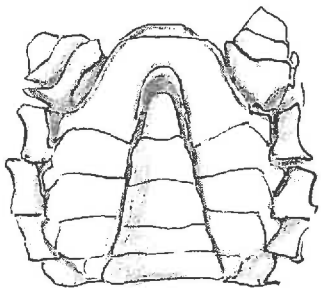


Crustaceans

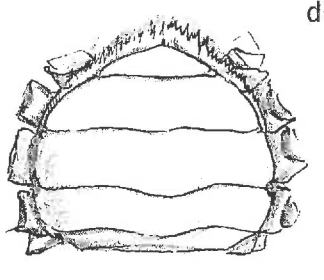
Two species of crabs are common offshore judging by the number of carapaces (shells) washed ashore. These are the **edible crab** *Cancer novaezelandiae* and the **paddle crab** *Ovalipes catharus*. An uncommon relative of the paddle crab is the **red paddle crab** *Nectocarcinus antarcticus*. The **pea crab** *Pinnotheres novaezelandiae* lives as a commensal within the shell of a mussel or other larger bivalve. The relationship is beneficial to the crab but probably has little effect on the host. Almost all mussels more than 10cm will be the host of a pea crab. The male, with longer legs, is quite mobile and moves from one mussel to another looking for females. The **camouflaged crab** *Notomithrax ursus* lives amongst seaweed and is sometimes stranded

after stormy weather. The **Pacific weed crab** *Planes sp.* is a rare visitor. It arrives as a passenger amongst the goose barnacles on drifting logs. The **spiny half-crab** *Petrocheles spinosus* is sometimes washed ashore. Other crabs sometimes found washed up are the **purple shore crab** and **half-crab** from the rocky coast and the **common mud crab**, **stalk-eyed mudcrab** and **hairy-handed crab** from the estuary.

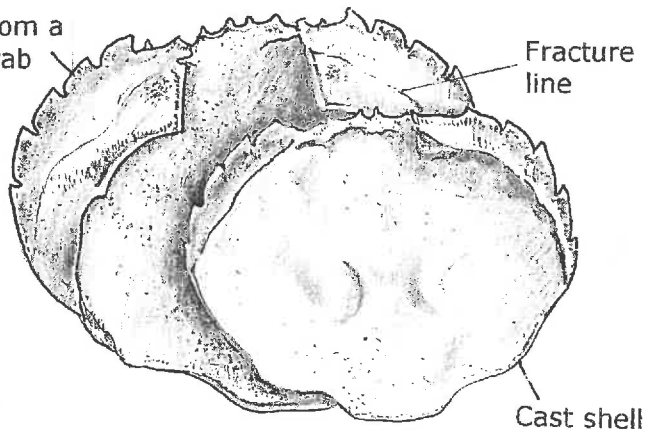
Most of the shells we find washed up are not from dead crabs but have been shed as the crabs grow. Calcium from the shell is reabsorbed by the crab prior to shedding to conserve this mineral which is then used in rebuilding the new shell. You can easily tell a cast shell from one off a dead crab as a cast shell is very thin and has broken along a fracture line that allows it to be shed easily. You can tell a male and female crab apart as the male has a narrow tail and the female has a broad tail to hold the developing eggs.



Male crab



Female crab

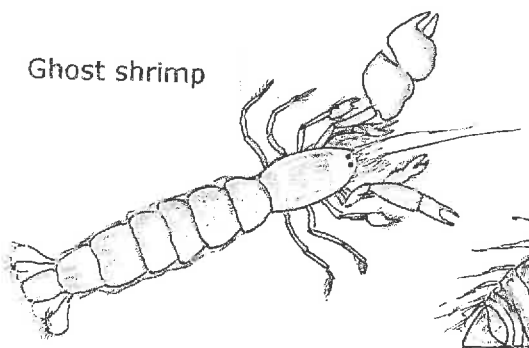


Barnacles are crustaceans. **Goose barnacles** *Lepas antarctica* have stalks up to 40cm or more. They are filter feeders, waving their legs to draw plankton into their shells. Two other goose barnacles are sometimes washed ashore on Southland beaches. These are the bottom-dwelling **hairy goose barnacle** *Calantica villosa* and a thin-shelled barnacle *Lepas fasciatus* which is purple and translucent. Wood, bottles and even dead birds often have barnacles attached indicating the abundance of the free-swimming larvae in Southland waters. The **large pink barnacle** *Balanus decorus* is commonly found attached to shells and especially to the stalks of sea tulips

The **ghost shrimp** *Callianassa filholi* is abundant on sandy shores, buried about 20cm between mid-tide and low-tide. These shrimps have a density of about 300 per square metre in places, their presence indicated by their holes which can look like miniature volcanoes. Males have one claw greatly enlarged. There are equal numbers with the right claw or left claw enlarged.

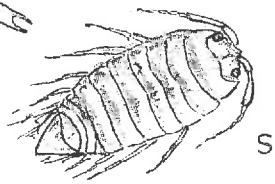
The **sand hopper** *Talorchestia quoyana* is abundant along the high-tide line. Hoppers are nocturnal, swarming over seaweed and other dead matter and eating it. They are important scavengers and are themselves an important part in the diet of birds such as the dotterel and turnstone. On Mason Bay they are an important food item of the kiwi.

Many small species of crustaceans live in the sea just at the extreme edge of the water where they are a food source for gulls and other birds. These can be trapped in a fine net. They include isopods which have seven pairs of legs of equal length and shape, and amphipods with different pairs of legs specialised for feeding, digging and jumping. A typical land isopod is the **slater**, very common in decaying driftwood. Its marine cousins include the **sea centipede** and **sea louse** of which there are many species. The amphipod shown here is typical of the many amphipods, usually a few millimetres long, that throng in shallow water. *Diastylis sp.*, about 3mm long, is related to amphipods. Gulls can be seen puddling at the edge of the water. This action liquefies the sand and brings buried crustaceans to the surface.

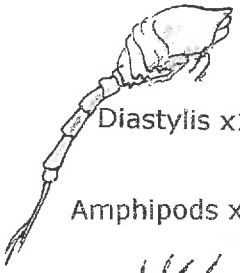


Ghost shrimp

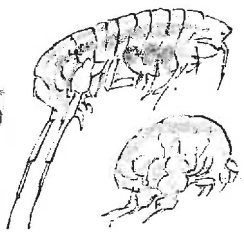
Sand hopper x2



Sea louse x3

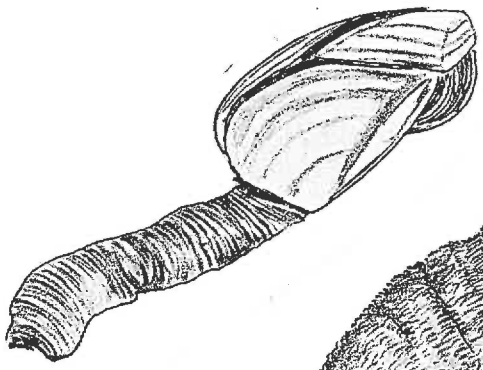


Diastylis x10



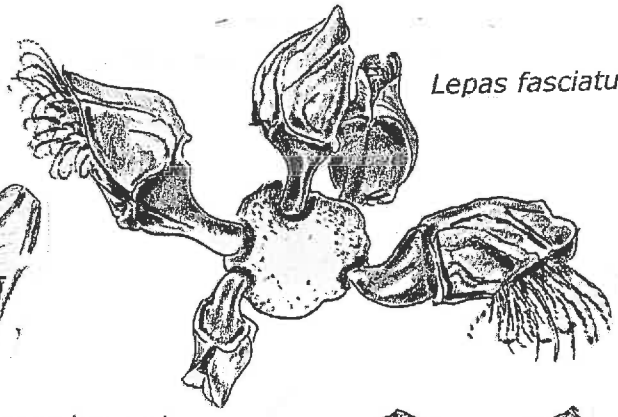
Amphipods x5

Sea centipede x2



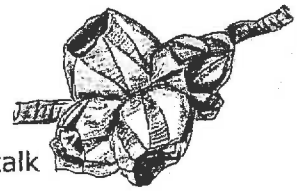
Goose barnacle

Hairy goose barnacle

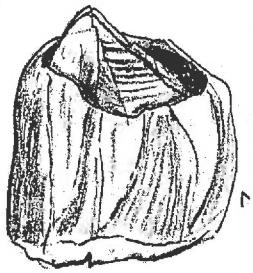


Lepas fasciatus

Large pink barnacle

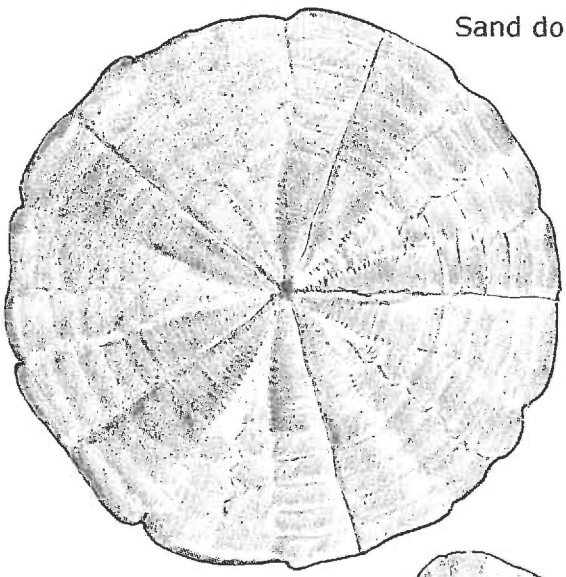


Large pink barnacle on sea tulip stalk

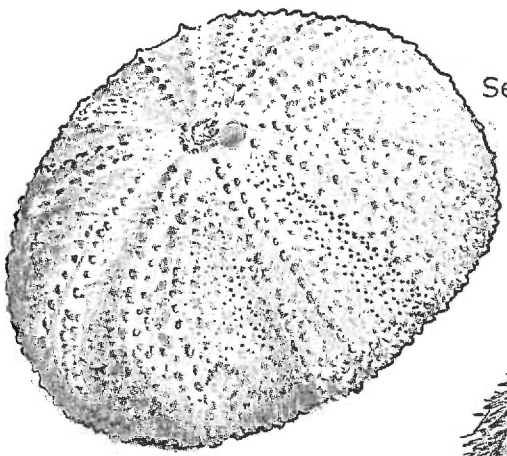


Echinoderms

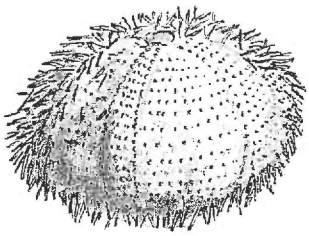
Echinoderms are starfish, sea urchins, sea cucumbers and sand dollars. There are few species associated with a sandy shore but the abundance of starfish and sea urchins on the rocky shore and in the waters of Foveaux Strait means that they are sometimes cast ashore. The **sand dollar** *Fellaster zelandiae* is a common inhabitant of sandy beaches throughout New Zealand. When alive it is covered in short spines but these fall off soon after death. Like many echinoderms, sand-dollars have five axes of symmetry and break easily into five parts. A second echinoderm, the **sea urchin**, **kina** or **sea egg** *Evechinus chloroticus* is abundant and commercially harvested. Another species from Foveaux Strait occasionally washed ashore is the **pink sea urchin** *Pseudechinus huttoni*. The **heart urchin** *Echinocardium cordatum* is found throughout New Zealand but in Southland is common only on Maori Beach. A second species *Apatopygus recens* is occasionally met with.



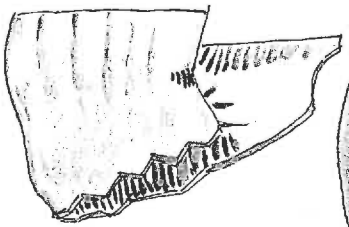
Sand dollar



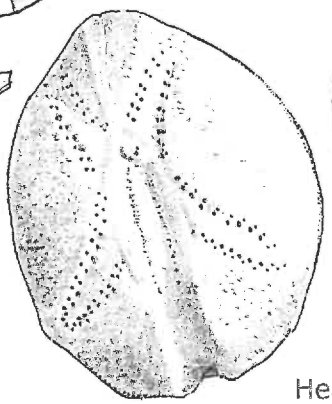
Sea urchin



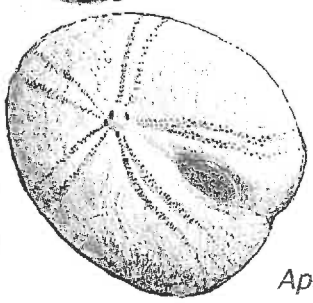
Pink urchin



10c worth of sand dollar

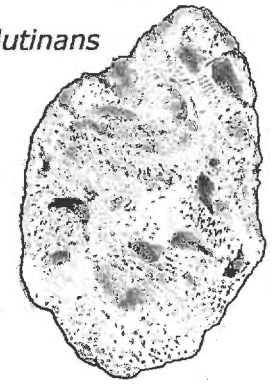


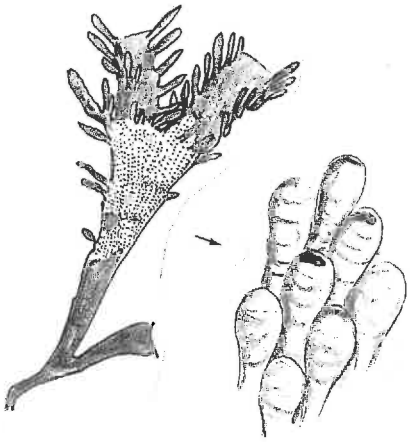
Heart urchin



Apatopyrgus recens

Celleporaria agglutinans





Bryozoan on seaweed

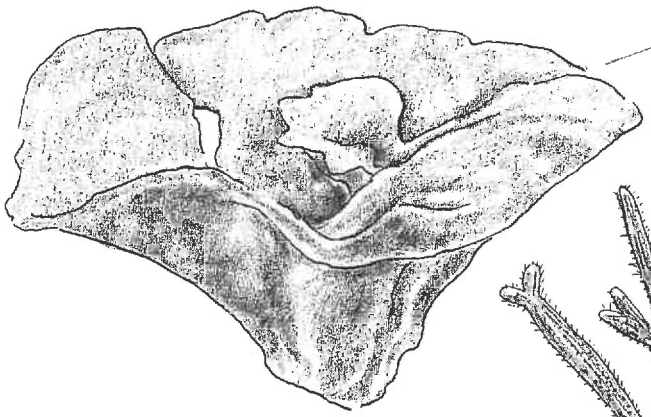
Bryozoans

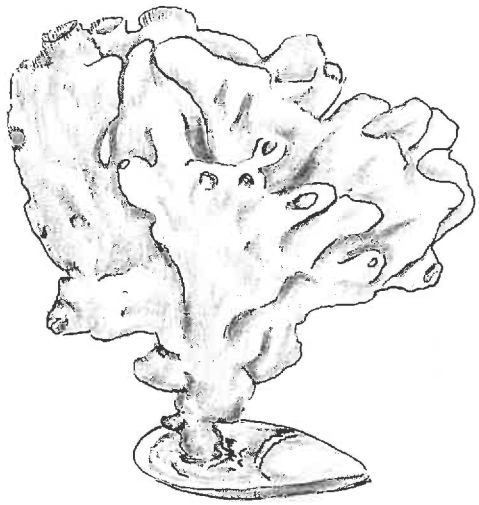
The bryozoans or moss animals are extremely diverse and common although easily overlooked. The most obvious is the bryozoan *Celleporaria agglutinans*, bright red when living but reduced to a grey porous lump when dead. It forms colonies up to 50cm high and is often incorrectly called coral. Bryozoans live as encrusting organisms on seaweeds, rocks and shells.

Sponges

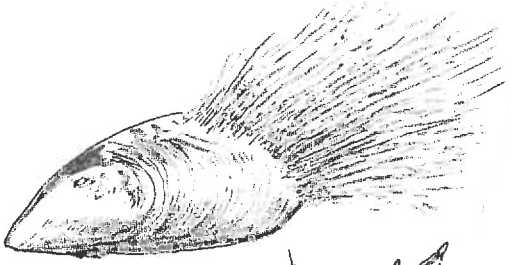
There are many different sponges, common examples being **dead man's fingers** with antler-like branches and many encrusting species. When living , these are often brightly coloured but are reduced to a grey or yellow fibrous structure when decayed. Fan shells are often found by pulling sponges apart.

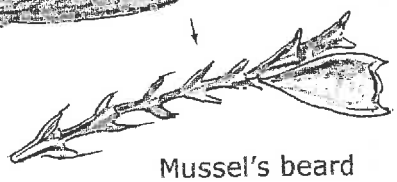
Sponges





Seaweed sponge





Mussel's beard

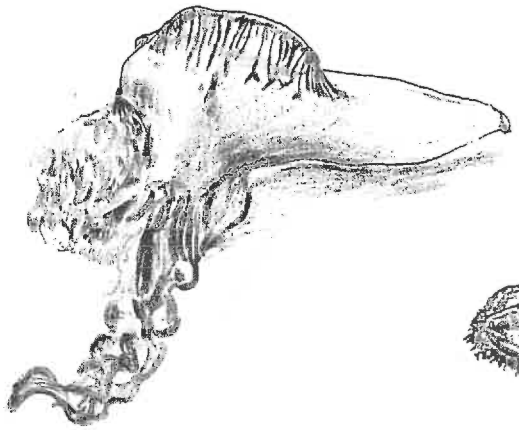
Hydrozoan on
Sea tulip stalk

Coelenterates

Jellyfish, corals, sea anemones and hydrozoans are coelenterates.

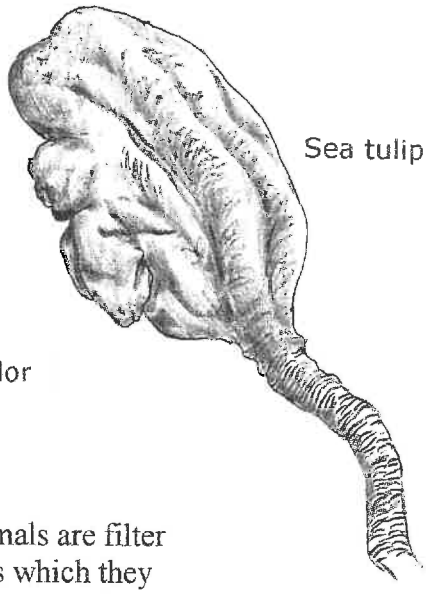
Two common jellyfish are the **bluebottle** or **Portuguese man-o-war** *Physalia physalis* and the **by-the-wind sailor** *Velella velella* (Velella means little sail). Both species are common on the beach after prolonged westerly winds. Bluebottles have a powerful sting and traversing the beach in bare feet can be an interesting experience. The deep blue colour of these, and other pelagic species, is camouflage. Potential predators cannot see them against the dark sea. A third species, the well-known **common jellyfish** *Aurelia aurita*, is abundant in some waters such as Paterson Inlet. It is recognised by its four horse-shaped lilac markings on an otherwise colourless disc about 20cm across. It does not sting.

Hydrozoans are abundant but often overlooked. They are typically feathery and horn-coloured, the best-known example being the **mussel's beard** *Amphisbetia bispinosa*. The other species illustrated grows on the stalk of the sea tulip.



Bluebottle

By-the-wind sailor

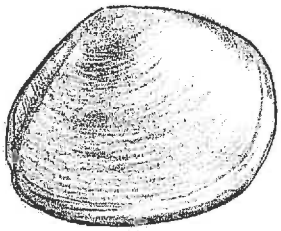


Sea tulip

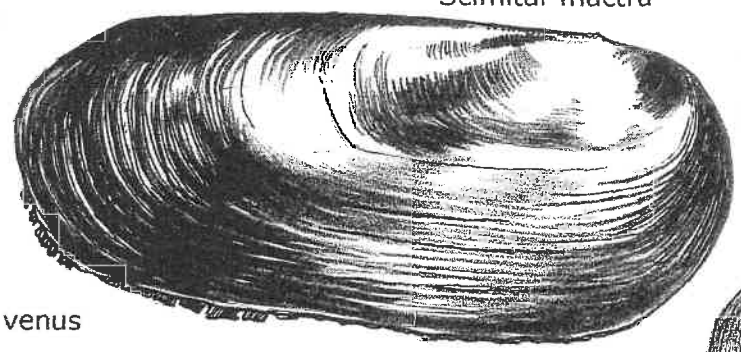
Sea squirts:

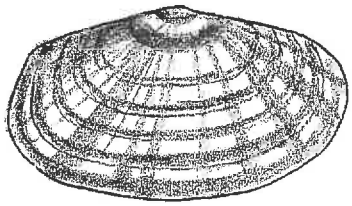
There are many sorts of sea squirts on the rocky coast. These animals are filter feeders, drawing in water and filtering out the minute living things which they digest. The commonest species is the **sea tulip** *Pyura pachydermatina,* often cast ashore in large numbers after a storm. Sea tulips grow quickly from free-swimming larvae which settle on solid objects. Logs, stones and even old cars abandoned close to low-tide can become the host of sea tulips.

Round wedge shell



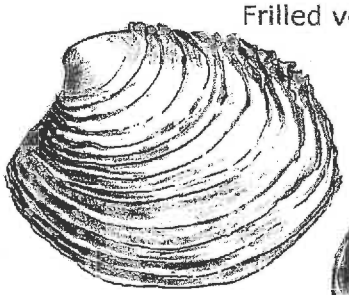
Scimitar mactra

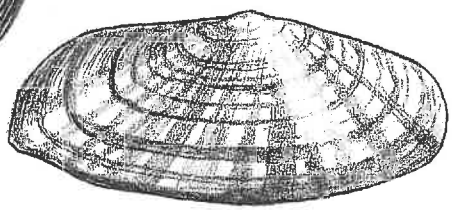




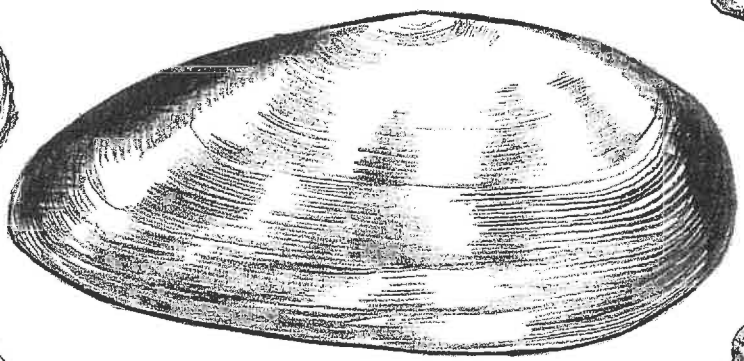
Purple sunset shell

Frilled venus

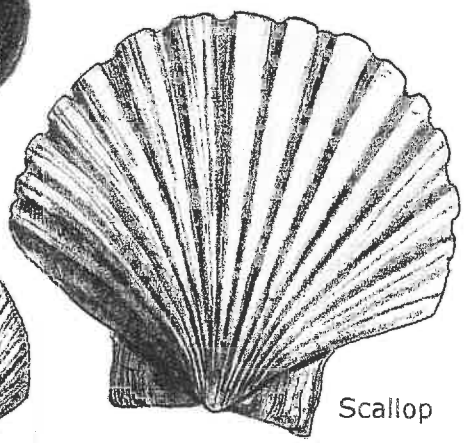




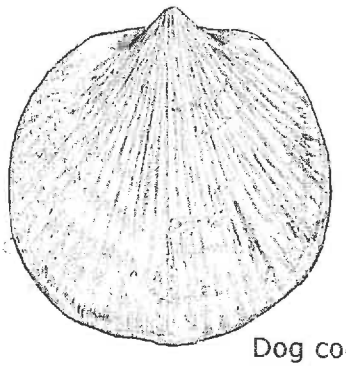
Pink sunset shell



Lance mactra



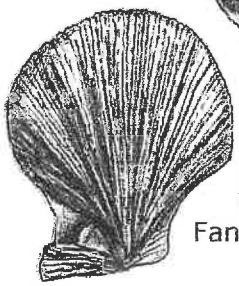
Scallop



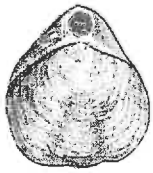
Dog cockle

Ramshorn

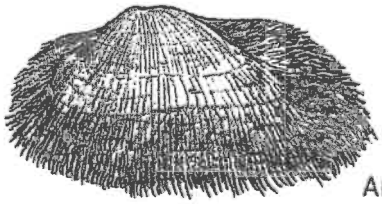
Pink lampshell



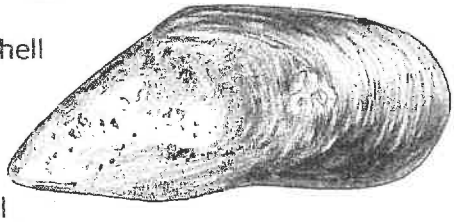
Fan shell



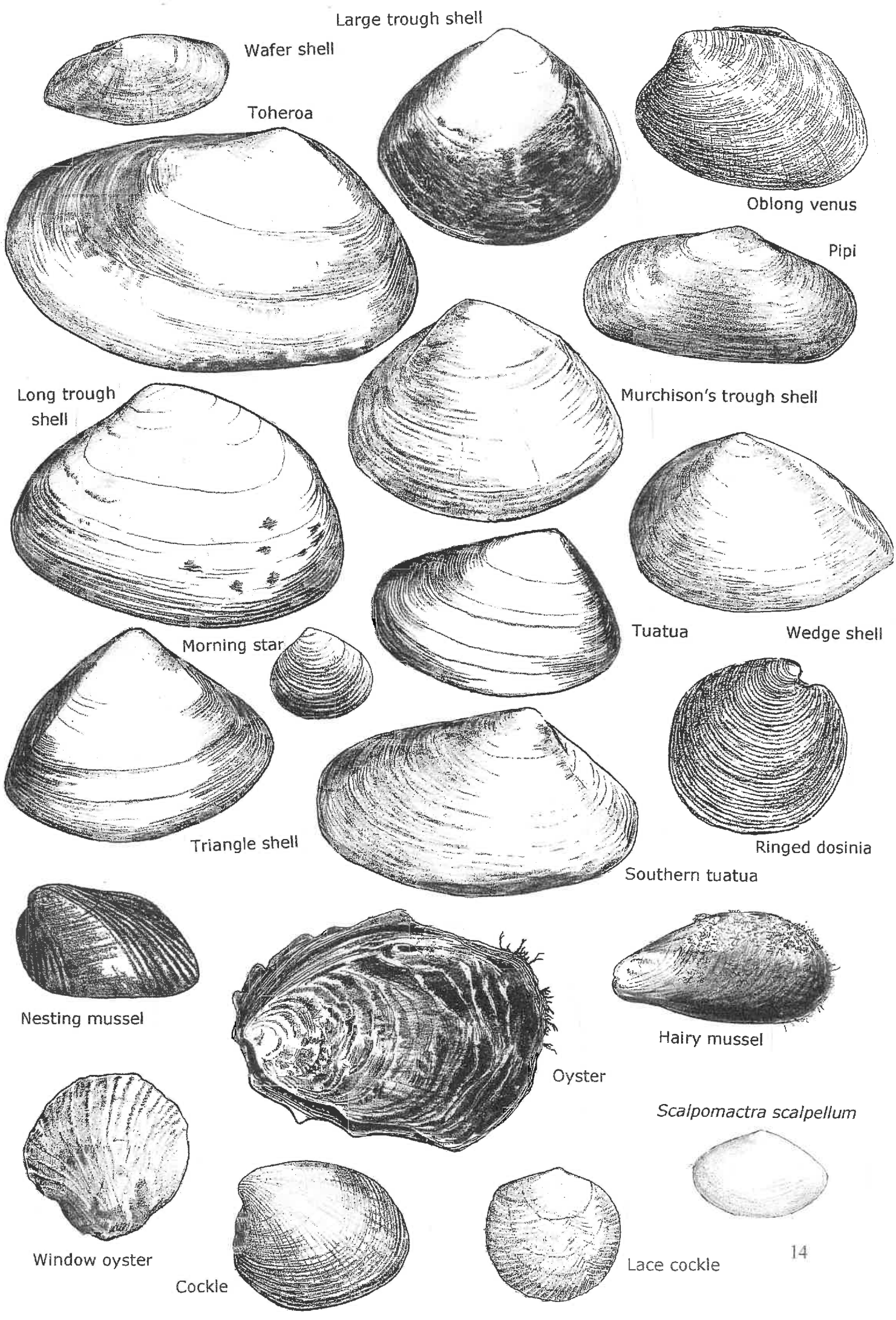
Black lampshell

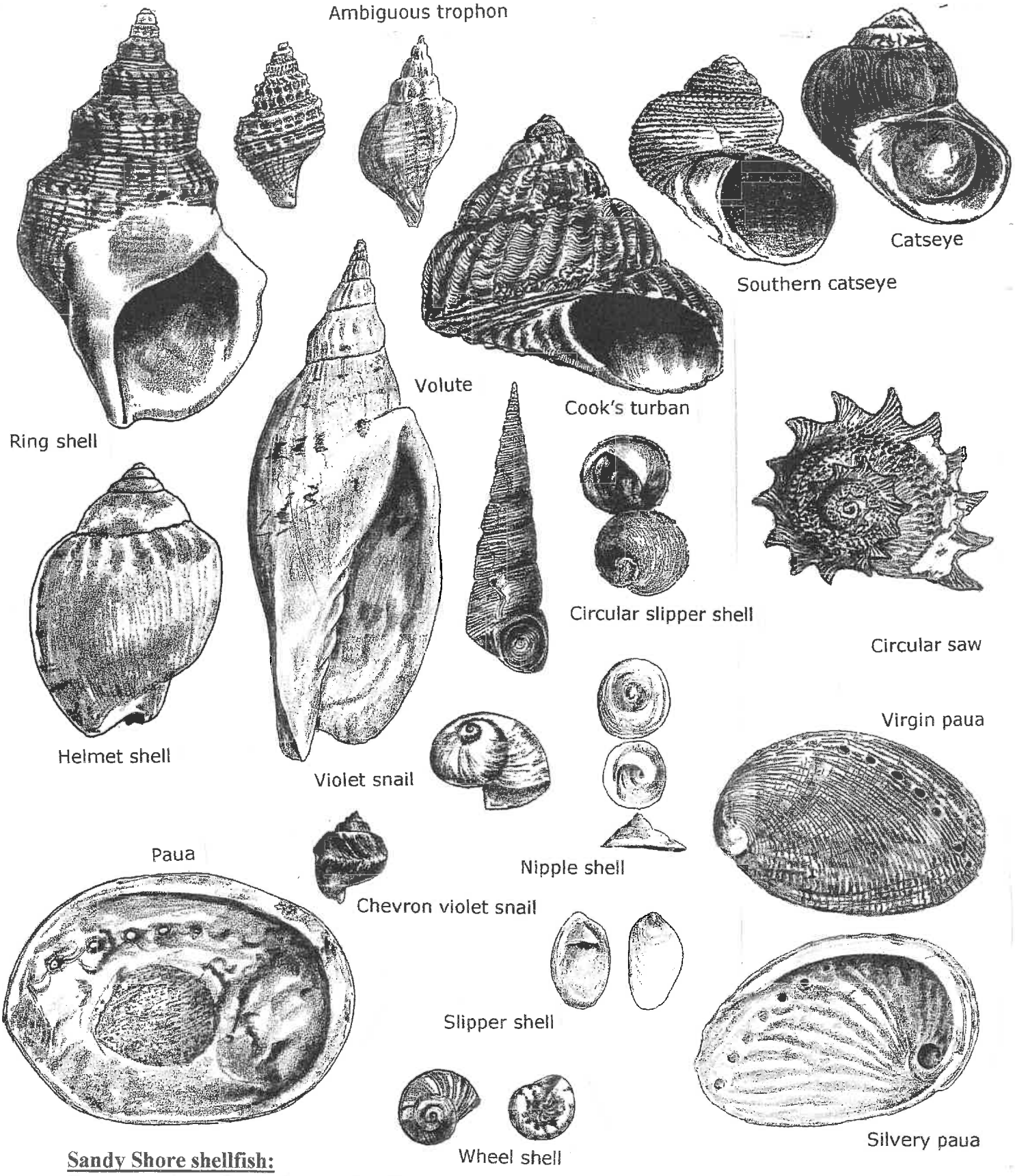


Ark shell



Green mussel


Large trough shell
Wafer shell
Toheroa
Oblong venus
Pipi
Long trough shell
Murchison's trough shell
Tuatua
Wedge shell
Morning star
Triangle shell
Ringed dosinia
Southern tuatua
Nesting mussel
Hairy mussel
Oyster
Scalpomactra scalpellum
Window oyster
Cockle
Lace cockle



Sandy Shore shellfish:

Representatives of two classes of molluscs are common on our sandy shores. The gastropods are commonest along the rocky shore, but the sandy shore is the domain of the bivalves which feed by filtering minute food particles from the water. Oreti Beach is one of the few Southland beaches with abundant **toheroa** *Paphies ventricosa* which grow to 16cm. There are a few toheroa on Bluecliffs Beach and occasional examples on Tautuku Beach. Towards the Riverton end of Oreti Beach, the toheroa is replaced by the **long trough shell** *Oxyperas elongata*. The toheroa and the **wedge shell** *Peronaea gaimardi* are the only intertidal bivalves. The other species found on sandy beaches live just below low-tide or are cast ashore from deeper water

after storms. Three abundant bivalves are the **large trough shells** *Mactra discors* and *Mactra murchisoni* and the **triangle shell** *Spisula aequilatera*, together known as **sou'westers**. The two mactra species are similar but M. murchisoni is more elongated and flattened. Common sandy shore species are the **morning star** *Tawera spissa*, **tuatua** *Paphies subtriangulata*, **cockle** *Austrovenus stutchburyi*, **pipi** *Paphies autralis*, **fan shell** *Chlamys zelandiae*, **pink sunset shell** *Gari lineolata*, **purple sunset shell** *Gari stangeri*, **green mussel** *Perna canaliculus*, **ribbed mussel** *Aulacomya atra maoriana*, **oyster** *Tiostrea chilensis lutaria*, **oblong venus shell** *Ruditapes largillierti*, **horse mussel** *Atrina pectinata zelandica*, **nesting mussel**, *Modiolarca impacta*, **hairy mussel** *Modiolus areolatus* and **ringed dosinia** *Dosinia anus*. Less common are the **round wedge shell** *Pseudarcopagia disculus*, **small mactra** *Scalpomactra scalpellum*, **dog cockle** *Tucetona laticostata*, **arc shell** Barbatia novaezealandiae, **window oyster** *Pododesmus zelandicus*, **battleaxe** *Myadora striata*, **scallop** *Pecten novaezelandiae* and the **southern tuatua** *Paphies donacina* and the rarely seen **frilled venus** *Bassina yatei*, **lace cockle** *Divaricella huttoniana*, **scimitar mactra** *Zenatia acinaces* and the **lance mactra** *Resania lanceolata*. The **wafer shell** *Soletellina nitida* is abundant some years and totally absent in others.

The gastropods or snails are better adapted to the rocky shore where most are grazers on algae-covered rocks. The most conspicuous sandy shore gastropod is the edible **Cook's turban** *Cookia sulcata*, which can often be gathered live after rough weather. Low tides often reveal **wheel shells** *Zethalia zelandica*, the **top shell** *Micrelenchus tenebrosus* and the **large trophon** *Xymene ambiguus* which comes in two forms, the male shell is smooth and the female is reticulated. Other gastropods are the **ring shell** *Struthiolaria papulosa*, **volute** *Alcithoe arabica*, **helmet shell** *Semicassus pyrum*, **turret shell** *Maoricolpus roseus roseus*, **circular slipper shell** *Sigapatella novaezelandiae*, **white slipper shell** *Crepidula monoxyla*, **nipple shell** *Zegalerus tenuis*, **circular saw shell** *Astraea heliotropium*, **swollen trumpet** *Argobuccinum pustulosum tumidum*, **catseye** *Turbo smaragda*, **granose turban** *Modelia granosa*, **paua** *Haliotis iris*, **silvery paua** *Haliotis australis* and **virgin paua** *Haliotis virginea virginea*.

The remains of two cephalopods, relatives of the octopus and squid, are washed ashore. These are the **ram's-horn** *Spirula spirula* - the internal buoyancy organ of a small squid, often abundant after westerly winds - and the **cuttlefish** *Sepia apama*, whose chalky shells reach Southland after drifting thousands of kilometres.

Two lampshells common around our coast are the **pink lampshell** *Calloria inconspicua* and the **black lampshell** *Notosaria nigricans*.

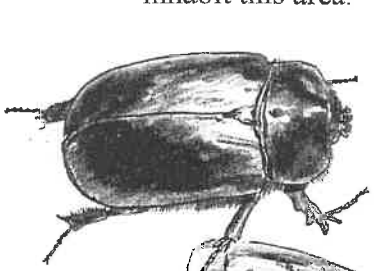
Occasionally after prolonged westerlies, two species of **violet snail** *Janthina janthina* and *Janthina exigua* are washed ashore. These shellfish drift on a raft of bubbles and feed on jellyfish. Many other shells can be picked up on Southland beaches. These are described in the book **Southland Shells**.

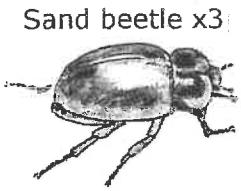
Insects:

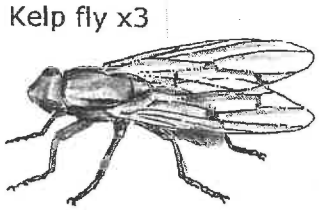
There are some New Zealand insects adapted to life in the littoral zone (above high tide) or in the dunes. The most evident dune insect is the **scarab beetle** *Pericopyus truncatus* which ploughs its way ponderously through the loose sand at night. The large, white grubs are found coiled beneath decaying logs. The **sand beetle** *Chaerodes trachyscelides* is sometimes found in large numbers, sharing its food resource - decaying seaweed - with an army of sandhoppers. Several species of **kelp fly** lay eggs on slimy seaweed which their maggots devour. They resemble slender blowflies with stout legs. The **tussock butterfly** *Argyrophenga antipodum* and **sandfly** are common along our sandy shores in summer. The butterfly caterpillars are probably feeding on marram. The small **copper butterfly** *Lycaena salustius* is common amongst the dunes, taking nectar from a variety of flowers. Its caterpillars feed on the leaves of muehlenbeckia. In warm weather a small cicada adds its tune to the rumble of surf, the whisper of the wind, and the mew of gulls.

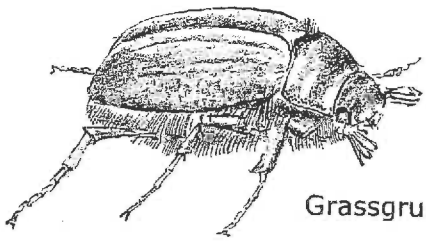
The **seashore earwig** *Anisolabis littorea*, common under driftwood further north does not appear to live in Southland.

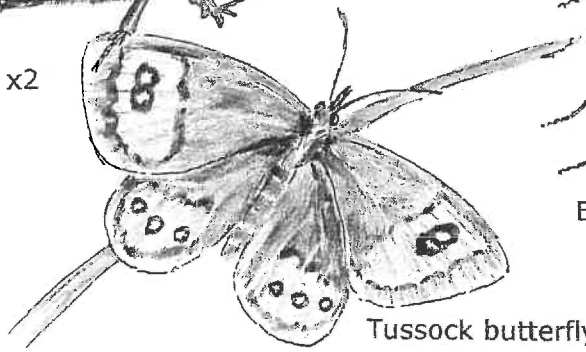
As dunes are stabilised further back from the shore and develop a covering of grasses and shrubs, the insect diversity increases enormously. Beetles, flies, grasshoppers, moths and many more inhabit this area.

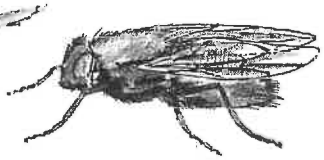

Scarab x2

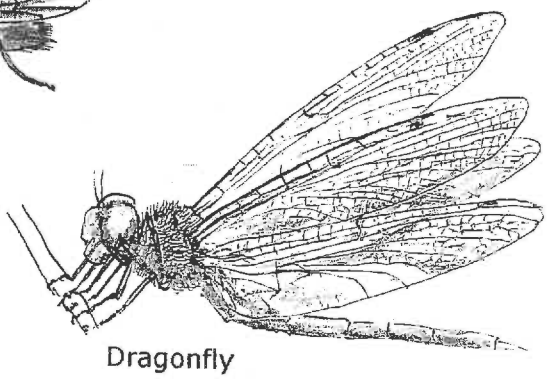

Sand beetle x3

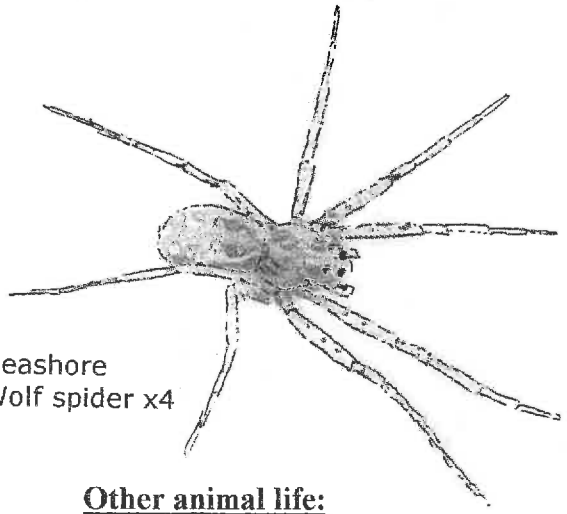

Kelp fly x3


Grassgrub x3


Tussock butterfly x2


Blowfly x3


Dragonfly


Seashore
Wolf spider x4

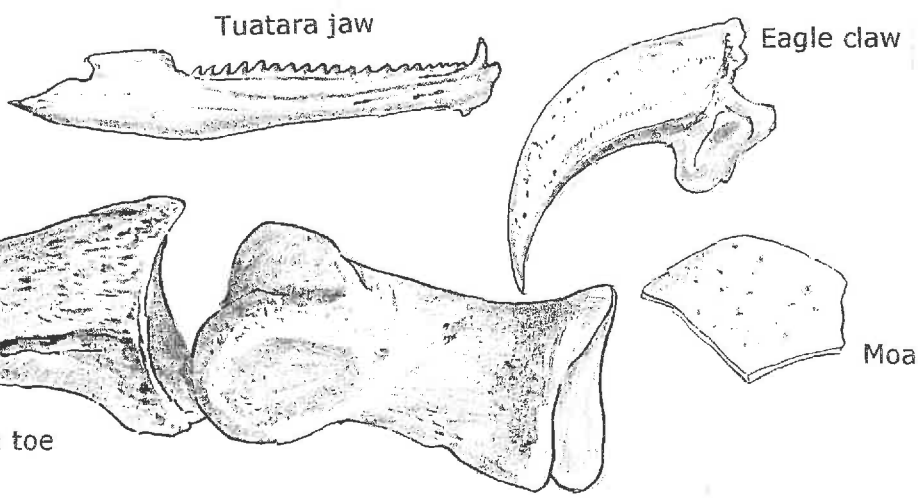
Spiders:

There is a sparse spider fauna on our sandy shores. On warm days you may observe the **seashore wolf spider** running over the dry sand. This spider is well camouflaged and an active hunter. Various **orb-web spiders** make their webs in marram. The venomous **katipo** does not occur as far down the coast as Southland.

Other animal life:

Evidence preserved in the sand shows that in the past there were cycles of windblown sand followed by vegetation establishment leading to stabilised dunes which broke down again. Almost all of the vegetation has gone but bone and shell remains and sub-fossil landsnails, tuatara bones and moa bones and eggshell indicate changing climates and changing vegetation patterns. The land snails are native species, possibly thousands of years old.

They are common on some beaches such as Colac Bay and Ocean Beach. In more recent times the spread of marram grass means fewer blowouts and less opportunity to see these relics.


Tuatara jaw

Eagle claw

Sub-fossil
Landsnail

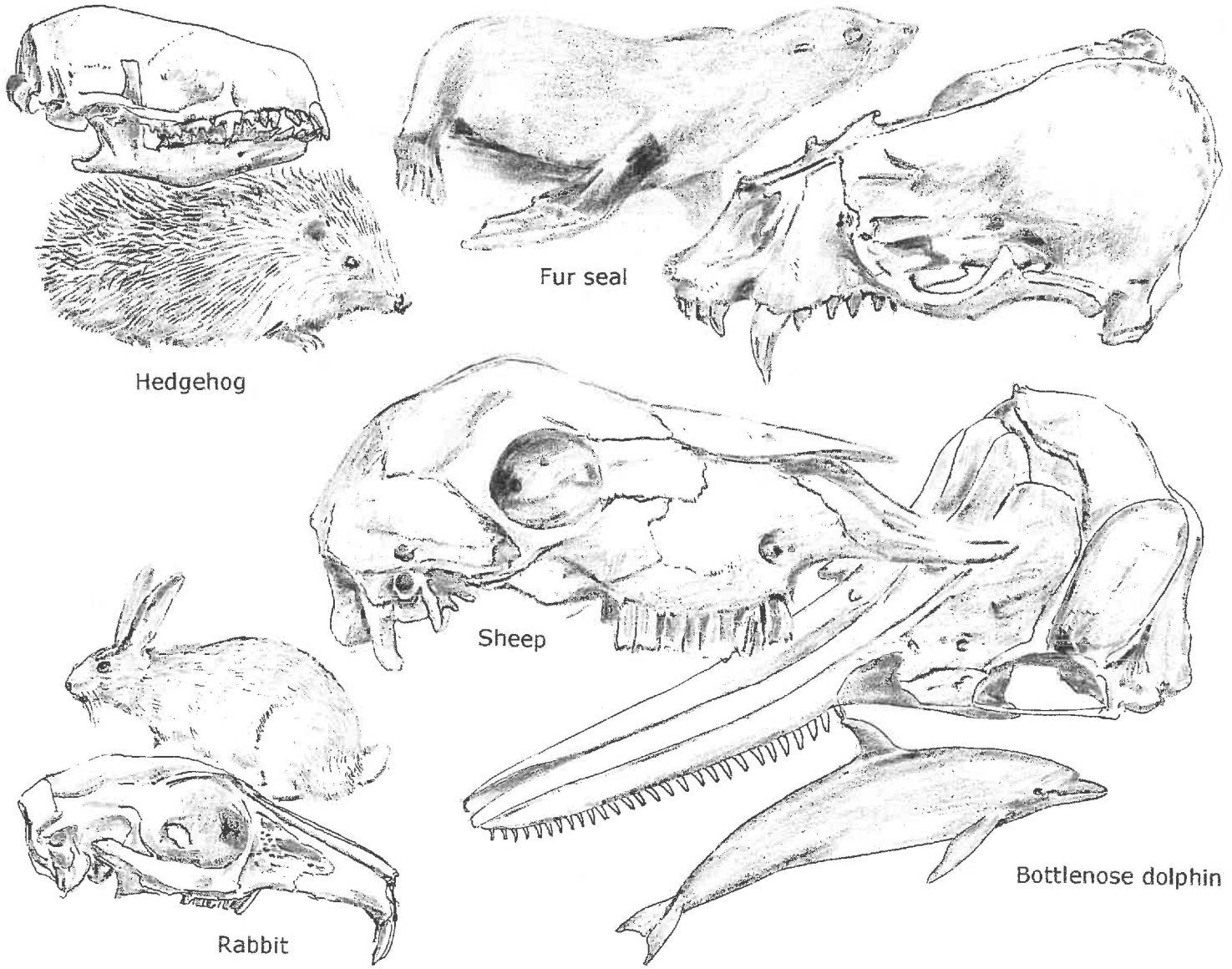
Moa eggshell

Moa toe

Mammals

New Zealand has only two groups of sea mammals, the seals and the cetaceans (whales and dolphins). The **fur seal** is a frequent visitor to Oreti Beach and numbers appear to be increasing around our coast. Seals should not be approached as they can be aggressive. The **New Zealand sea lion** is becoming more common around the Southland coast. There are usually two or more at Waipapa Point but they can show up on beaches anywhere. The male sea lion is much bigger than a fur seal and has a blunt snout. Two other seals come ashore occasionally. These are the **elephant seal** and the **leopard seal** .

Four dolphins species live in our coastal waters and dead ones are sometimes found stranded. These are the large **bottlenose dolphin**, the middle-sized **dusky dolphin** and **common dolphin**



and the small **Hector's dolphin**. Hector's dolphins live close to shore in small pods. They can be seen at Porpoise Bay, Toetoes Bay and Te Waewae Bay. Whales strand infrequently on the Southland coast. Occasionally pilot whales come ashore in large schools. A recent example was the school of 288 on Doughboy Bay 28 October 1998, all of which died.

The commonest mammal remains to be found on our beaches are sheep that have drowned or been dumped into waterways. Other mammals that use the sandy shore include hedgehogs - presumably feeding on hoppers, rabbits - feeding on dune plants, and feral cats which visit the beach at night to scavenge dead birds or hunt.

Birds

There are a number of birds typical of sandy shores, although none are confined only to this habitat. **Black-backed gulls** *Larus dominicanus* are scavengers, quickly clearing the beach of fish and bird carcasses and pecking at anything that looks edible. They drop toheroa, trough shells and triangle shells to smash them and eat the contents and have been seen dropping bird carcasses in a futile attempt to break them apart. They swallow large numbers of small toheroa whole, periodically regurgitating the empty shells. The **red-billed gulls** *Larus novaehollandiae* and **black-billed gulls** *Larus bulleri* are much more delicate feeders, pecking at small crustaceans along the edge of the sea and sometimes puddling to liquefy the sand to bring the crustaceans to the surface. Look for gulls with coloured plastic or metal bands. There is a gull-banding project in Southland and sightings of banded gulls help to show how the population disperses. Black-backed gulls usually nest in colonies but sometimes alone on shellbanks and gravel bars around Bluff Harbour, Awarua Bay and New River estuary as well as on swampland inland. Black-billed gulls nest in colonies of 50 - 5,000 pairs on major riverbeds in Southland and red-billed gulls nest on shellbanks and atop maimais and other man-made structures. **Caspian terns** *Sterna caspia* and **white-fronted terns** *Sterna striata* nest on shellbanks in our harbours and estuaries and on gravel bars near river-mouths. **Black-fronted terns** *Sterna albostriata* nest on riverbeds and in autumn and winter feed in coastal waters and often roost on the beach in small flocks. The **brown skua** *Catharacta skua* is a relative of the gulls. Skuas nest around the Stewart Island coast and visit sandy shores. They feed on carrion but are aggressive predators, often harrying other birds.

The commonest of the sandy shore predators is the **harrier hawk** *Circus approximans* which patrols the coast looking for injured and stranded birds.

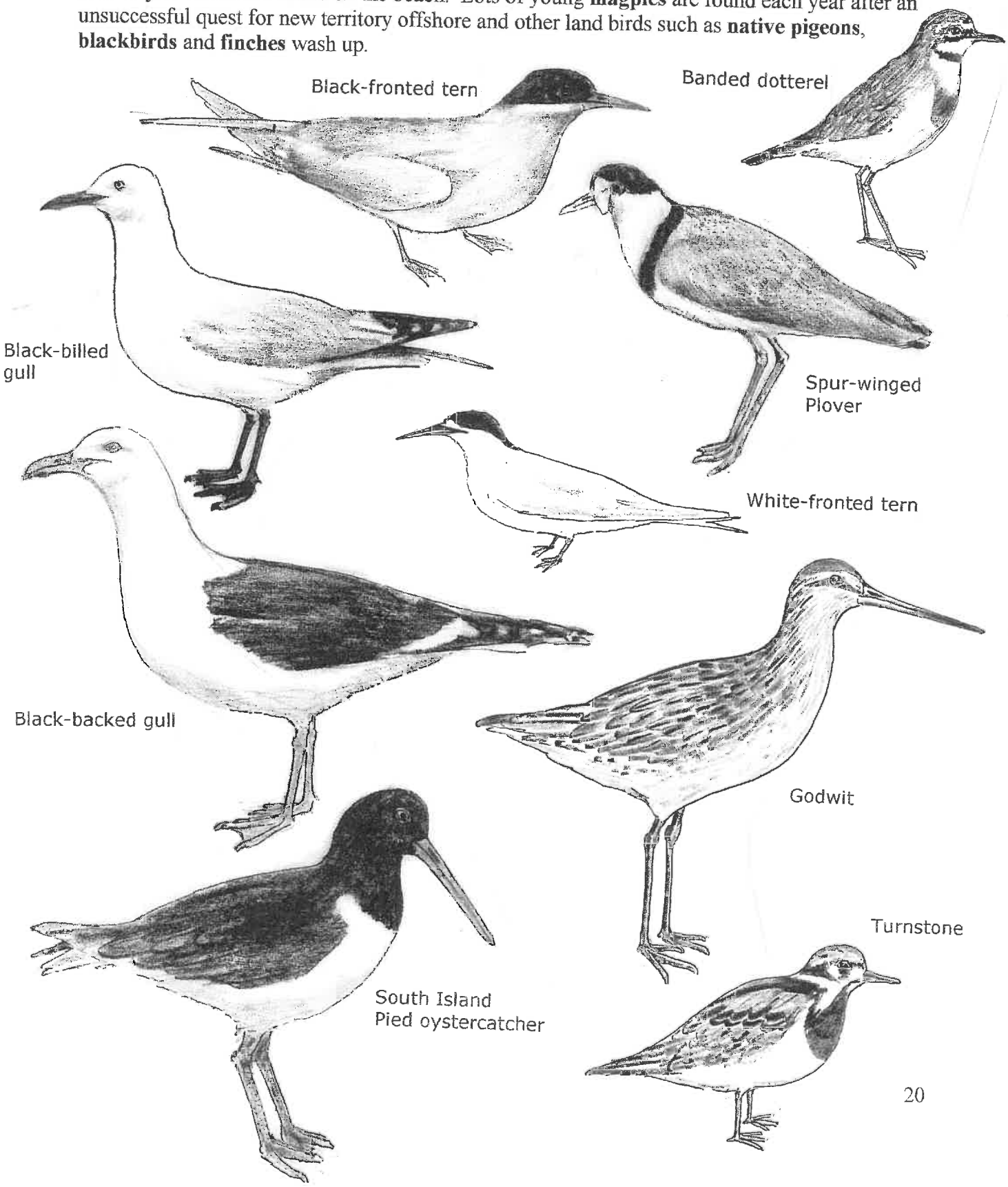
South Island pied oystercatchers *Haematopus ostralegus,* usually known by the acronym **SIPO**, nest inland mostly on farms and congregate on the beaches out of the breeding season. They probe the sand for crustaceans, molluscs and worms. A more robust relative, the **variable oystercatcher** *Haematopus unicolor* lives in twos and threes and sometimes associates with the SIPOs. In Southland variable oystercatchers and almost always entirely black. They are also a typical bird of mud-flats and rocky shores and nest on rock platforms or in a territory extending several hundred metres along a sandy beach.

Banded dotterels *Charadrius bicinctus* nest on riverbeds and sandy beaches. The eggs are well camouflaged and very hard to locate although the broken-wing display and agitation of the parents will often indicate that they are nesting nearby. Dotterels feed on crustaceans and insects, probably largely sand hoppers. **Spur winged plovers** *Vanellus miles* nest on the beach. They are Australian immigrants that first nested in Southland in 1932 and are now well established. A second dotterel, the southern subspecies of the **New Zealand dotterel** *Charadrius obscurus obscurus* nests on the higher parts of Stewart Island and odd birds are reported roosting on Oreti Beach. It is one of New Zealand's rarest birds. The **godwit** *Limosa lapponica* and **turnstone** *Arenaria interpres* nest in Siberia and Alaska and make the long journey back to their breeding grounds about the middle of March, returning to Southland about 24 September. A number of these birds, presumably youngsters, over-winter in Southland and small numbers can be seen on the beach throughout the year. **Swallows** *Hirundo tahitica* are frequently seen along the beach, hawking insects above the dunes. **Pipits** *Anthus novaeseelandiae*, **skylarks** *Alauda arvensis*, **chaffinches** *Fringilla coelebs* and **starlings** *Sturnus vulgaris* are common along the beach, feeding on seeds and invertebrates.

Beach wrecked carcasses For many years the Ornithological Society has been surveying New Zealand beaches, collecting and identifying dead birds. This survey tells us how many birds and what different species are around at different times, provides early warning of disasters such as oil spills, starvation or disease and provides museum specimens and samples for the analysis of parasites. It is thought that a large number of dead birds on Southland beaches generally indicates the presence of large number of birds in Foveaux Strait rather than an unusually high

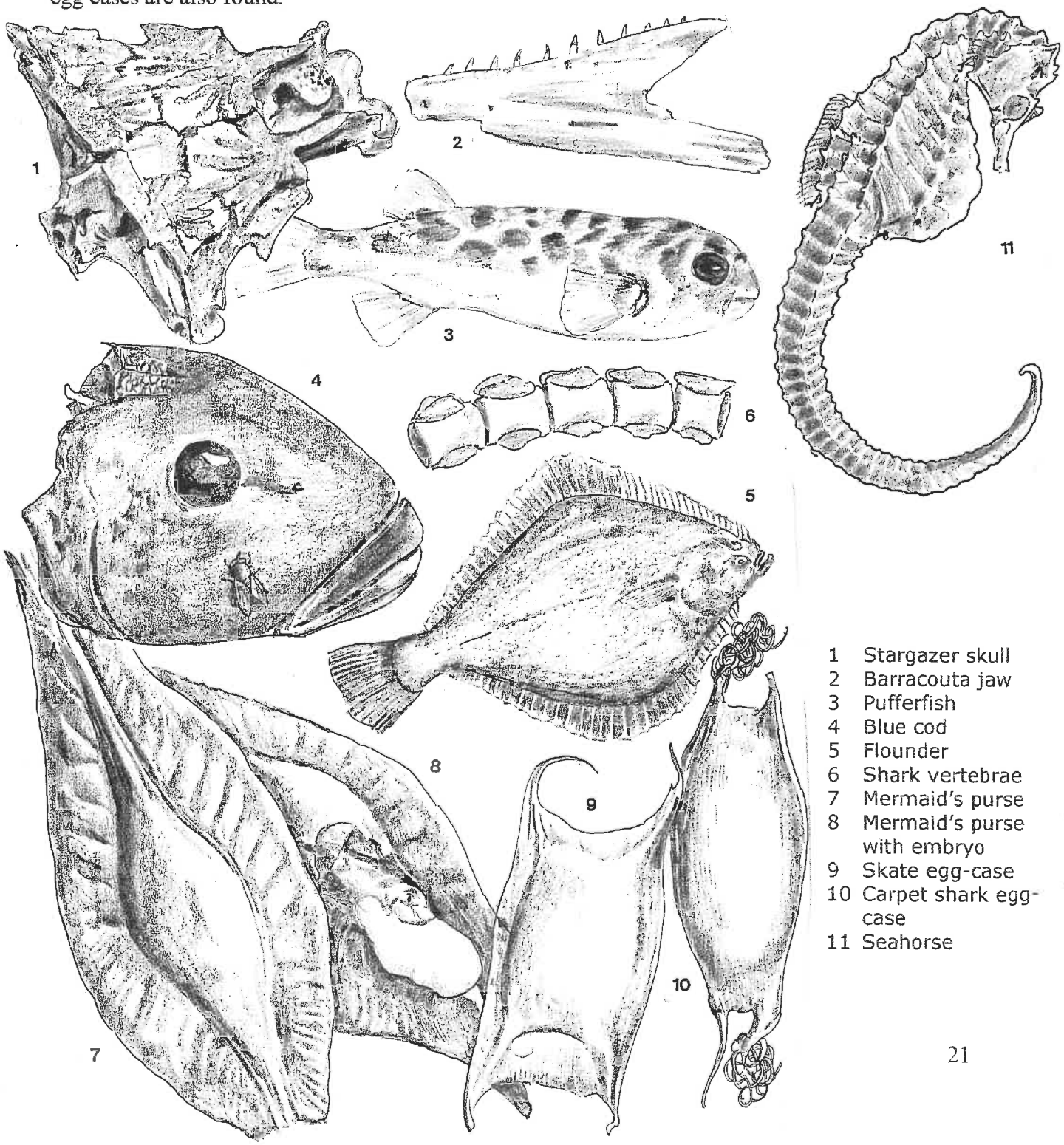
mortality. Many people assume that dead birds have somehow been killed indirectly by humans. In fact almost all have died of natural causes, drowning when they are unable to take off from the sea in a weakened condition. Rarely a bird is found entangled in plastic or fishing line and sometimes gulls and oystercatchers have been shot or hit by vehicles on the beach. The results of many years of beach surveys on Oreti Beach show that there are two clear seasonal trends. These are the large number of juvenile **sooty shearwaters** (muttonbirds) washed ashore at the beginning of May and an irruption of southern ocean birds such as **fulmars**, **Antarctic petrels**, **blue petrels** and **Kerguelen petrels** which move north to warmer Southland waters to dodge winter close to the ice.

Not only sea birds are found on the beach. Lots of young **magpies** are found each year after an unsuccessful quest for new territory offshore and other land birds such as **native pigeons**, **blackbirds** and **finches** wash up.



Fish

Many fish live off sandy beaches, and the remains of others are washed ashore. The following fish are caught by fishermen and netters: **yellow-belly flounder** *Rhombosolea leporina* and others, **sole** *Peltorhamphus novaezeelandiae*, **kahawai** *Arripis trutta*, **yellow-eyed mullet** *Aldrichetta forsteri*, **spotted stargazer** *Genyagnus novaezelandiae*, **pufferfish** *Contusus richei* and **common smelt** *Retropinna retropinna*. The author has noted the following fish cast ashore on Oreti Beach: **barracouta** *Thyrsites atun*, **ling** *Genypterus blacodes*, **seahorse** *Hippocampus abdominalis*, **longsnout pipefish** *Leptonotus norae*, **conger eel** *Conger verreauxi*, **leatherjacket** *Parika scaber*, **red cod** *Pseudophycis bachus*, **spotty** *Notolabrus celidotus*, **hagfish** *Eptatretus cirrhatus*, **lamprey** *Geotria australis*, **spotted spiny dogfish** *Squalus acanthias*, **rough skate** *Raja nasuta*, **short-tailed stingray** *Dasyatis brevicaudatus* and **porcupine fish** *Allomycterus jaculiferus*. Most do not last long because of the scavenging gulls. The egg-cases of three sharks are washed ashore. The commonest is the **mermaid's purse**, the egg-case of the elephant fish. These are laid in shallow water and partly buried in sand. Rarely an intact one is washed ashore containing a developing embryo. Carpet shark egg cases and skate egg cases are also found.



1 Stargazer skull
2 Barracouta jaw
3 Pufferfish
4 Blue cod
5 Flounder
6 Shark vertebrae
7 Mermaid's purse
8 Mermaid's purse with embryo
9 Skate egg-case
10 Carpet shark egg-case
11 Seahorse

Coastal Plants. Although this resource is primarilly a reference for the sandy shore, plants from other coastal habitats are included.

It is hard to draw a line that separates coastal plants from others. In some places, plants such as marram grass extend a long way inland while pasture grasses and weeds can grow a few metres from high tide mark. Included here are plants you might expect on dunes, estuarine gravel bars and shellbanks and within the salt-spray zone on rocky coasts.

In Fiordland, a layer of freshwater on the top few metres of the fiords means that forest species extend to the water's edge without having to be salt tolerant.

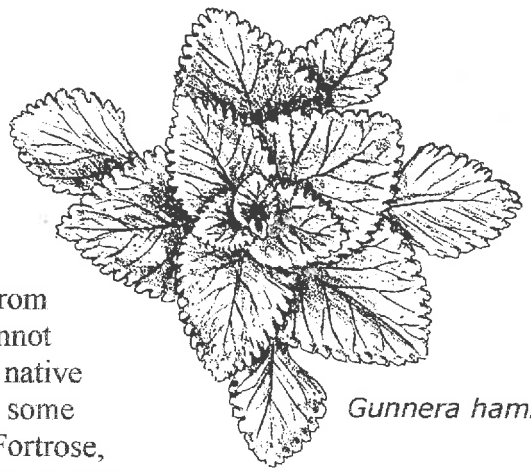
Since European settlement, the dunes along Oreti Beach have undergone a complete change in vegetation. Originally low dunes a few metres high were held in place by **pingao** *Desmoschoenus spiralis*. These dunes would have emerged from a vast sandy plain on, or slightly higher than, the water table. Along the flats were clumps of **flax** *Phormium tenax* and **wiwi** *Isolepis nodosa* with a range of shorter species including **native daphne** *Pimelia arenaria*, **sand coprosma** *Coprosma acerosa*, *Geranium sessiliflorum* var. *arenarium*, *Plantago raoulii*, *Gunnera monoica*, *Gunnera arenaria*, *Gunnera hamiltonii*, **scabweed** *Raoulia australis* and **shore gentian** *Gentiana saxosa*. These species have now been largely displaced.

The first step in the change was the introduction of stock which grazed the fragile dune system, heavy hooves breaking up the surface and starting the movement of sand. The introduction of rabbits in 1863 made the problem worse, and the sea, no longer restrained by firm dunes, began to encroach in the area between the main entrance and the south entrance. Sand blew right across the peninsula and into the Oreti River and it was feared that the river would breach through here. An intensive planting campaign was begun in which many sand-binding species were tried, combined with a system of brushwood groynes to trap blown sand. Eventually **marram grass** *Ammophila arenaria* proved to be the answer and the new dunes developed, restoring the original contour of the beach. In other parts of New Zealand, particularly the Kapiti Coast and Taranaki, moving sand was a major menace, exacerbated by stock trampling and burning. It is estimated that the area of coastal mobile sand had risen from 40,000ha in 1880 to 120,000ha by 1909.

Marram has an extensive root system that holds dunes in place up to about 8m high. These dunes have a limited life and eventually outgrow themselves and collapse. The wind quickly scours out a subsided piece of dune and a new dune begins to take shape. Sand can accrete very rapidly, building up a metre in a day. Plastic bottles exposed as a dune erodes may have only been buried a year or two. It seems likely that human disturbance increases dune growth. Tracks through the coastal vegetation become wind tunnels in which sand is rapidly deposited. The largest dunes on Oreti Beach are in the vicinity of the main entrance where human disturbance is greatest.

Periodically, a breakdown in the stability of marram country allows sand to move out of control. This is a problem in Southland on coastal pasture in the vicinity of the Waipapa Point lighthouse.

In recognising the scenic, cultural and natural values of dunelands, there have been trials with the replanting of sand-country to re-establish indigenous species such as *Gunnera hamiltonii* and pingao, and the clearing of marram where its encroachment on expansive areas of bare sand such as at Doughboy and Mason Bay and at Fortrose Spit threatens the character of these valuable natural features.



Gunnera hamiltonii

Marram is a successful coloniser and rapidly takes over from the native **pingao** *Desmoschoenus spiralis*. The latter cannot live on the high firm dunes and dies out. The last pingao native to Oreti beach disappeared about 1992 but there has been some replanting since. On the end of Toetoes Beach opposite Fortrose, the native dune system is more intact and in fact is listed as an area of national significance.

The only other extensive area of dunes in Southland is at Mason Bay on Stewart Island. In other

The only other extensive area of dunes in Southland is at Mason Bay on Stewart Island. In other parts of the coast, especially the Catlins, Taieri Mouth, Tokomairiro Mouth and Mason Bay, pingao can be the dominant sand binder.

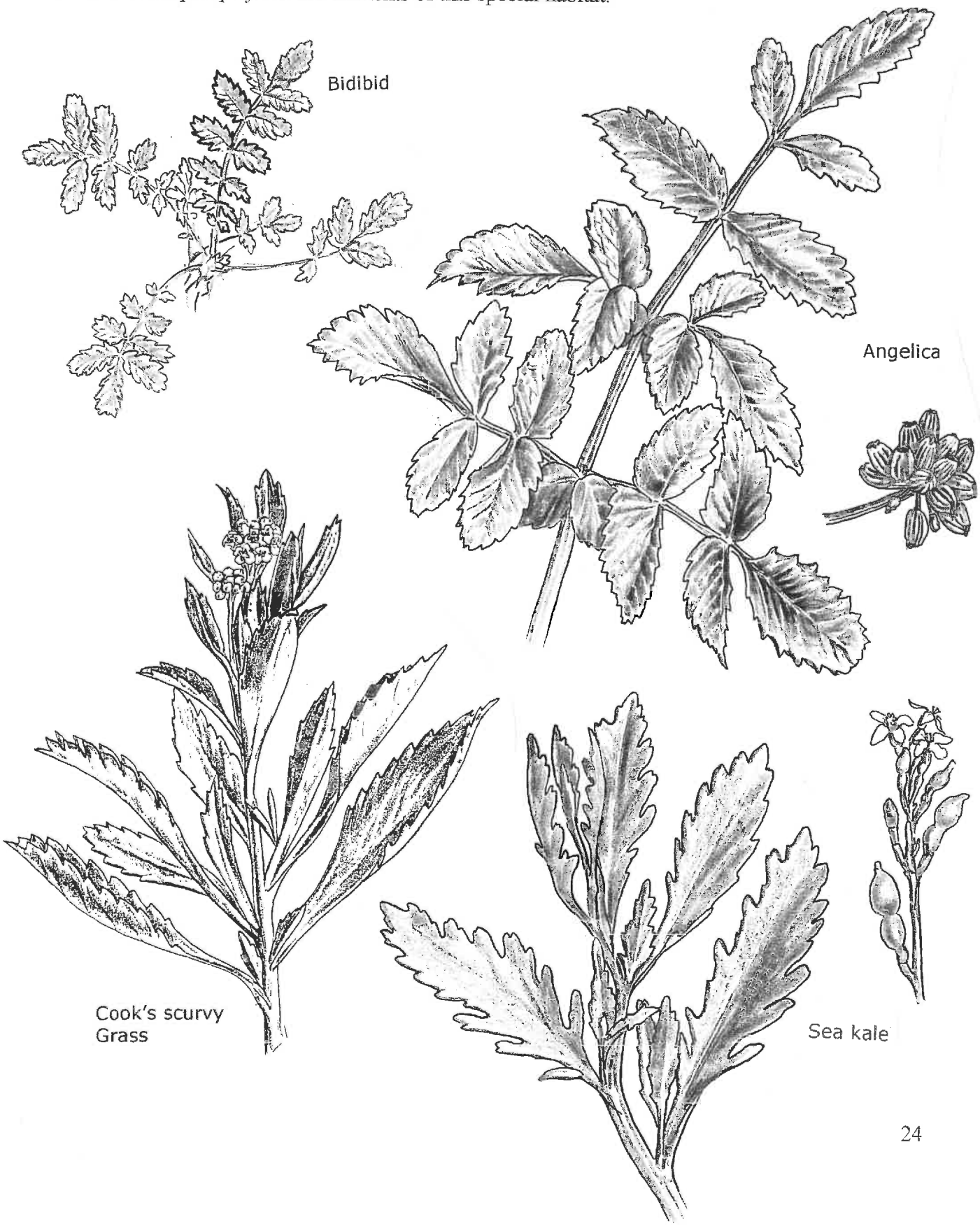
The stabilising of the dunes, draining of the wetlands behind the dunes and oversowing with pasture species has eliminated most of the native vegetation. Apart from marram, a close inspection of marram-dominated dunes shows that there are other plants present, mostly introduced, the number steadily increasing as the dune grades into pasture or scrub. Several plants occur right at the edge of the sea, occasionally inundated by spring tides. Most noticeable is **sea kale** *Cakile edentula*. In parts of Oreti Beach the **iceplant** *Disphyma clavellatum* establishes briefly before being eroded away by the next storm. In the dunes, look for **sand bindweed** *Calystegia soldanella*, **bidibid** *Acaena novae-zelandiae*, *Colobanthus meulleri*, **Jersey cudweed** *Gnaphalium luteo-album*, **sow thistle** *Sonchus oleraceus*, **sea radish** *Raphinus raphanistrum* subsp. *maritimus*, **miners' lettuce** *Montia perfoliata*, **native celery** *Apium prostratum* and **angelica** *Angelica pachycarpa*. Look for **catsear** *Hypochaeris radicata* and its relatives **hawkbit** *Leontodon taraxacoides*, **hawksbeard** *Crepis capillaris*, **dandelion** *Taraxacum officinale* and **mouse-ear hawkweed** *Hieracium pilosella*. Look for **fireweed** *Senecio minimus* and its relatives *Senecio glomeratus*, **jagged fireweed** *Senecio biserratus*, **ragwort** *Senecio jacobea* and **shore groundsel** *Senecio elegans* which has large, purple flowers. Four pasture grasses are common in dunes; these are **Yorkshire fog** *Holcus lanatus*, **tall fescue** *Festuca arundinacea*, **cocksfoot** *Dactylis glomeratus* and **sweet vernal** *Anthoxanthum odoratum*. Others are **timothy** *Phleum pratense*, **crested dogstail** *Cynosurus cristatus* and **rough meadow grass** *Poa trivialis*. **Lupin** *Lupinus arboreus* was dominant on the back of the dunes until it was devastated by disease. Its place has been largely taken by encroaching pasture grass. Two native sand grasses are **fescue tussock** *Festuca novaezelandiae* and **sand tussock** *Austrofestuca littoralis*. **Siberian lyme grass** *Leymus racemosus* is established with marram at Bluff and Colac Bay. Other shrubs of the dunes are **gorse** *Ulex europeus*, *Coprosma propinqua*, **tree mallow** *Lavatera arborea*, **elder** *Sambucus nigra* and occasional pines: **radiata pine** *Pinus radiata*, **lodgepole pine** *P. contorta* and **maritime pine** *P. pinaster*. There are a few relict bushes of the **shore ribbonwood** *Plagianthus divaricatus*. In places where the dune hollows are on the water table, many more species appear such as **oioi** or **jointed rush** *Leptocarpus similis*, **wiwi** *Isolepis nodosa*, **sand buttercup** *Ranunculus acaulis*, **remuremu** *Selliera radicans*, **sea primrose** *Samolus repens*, **arrowgrass** *Triglochin striatum*.

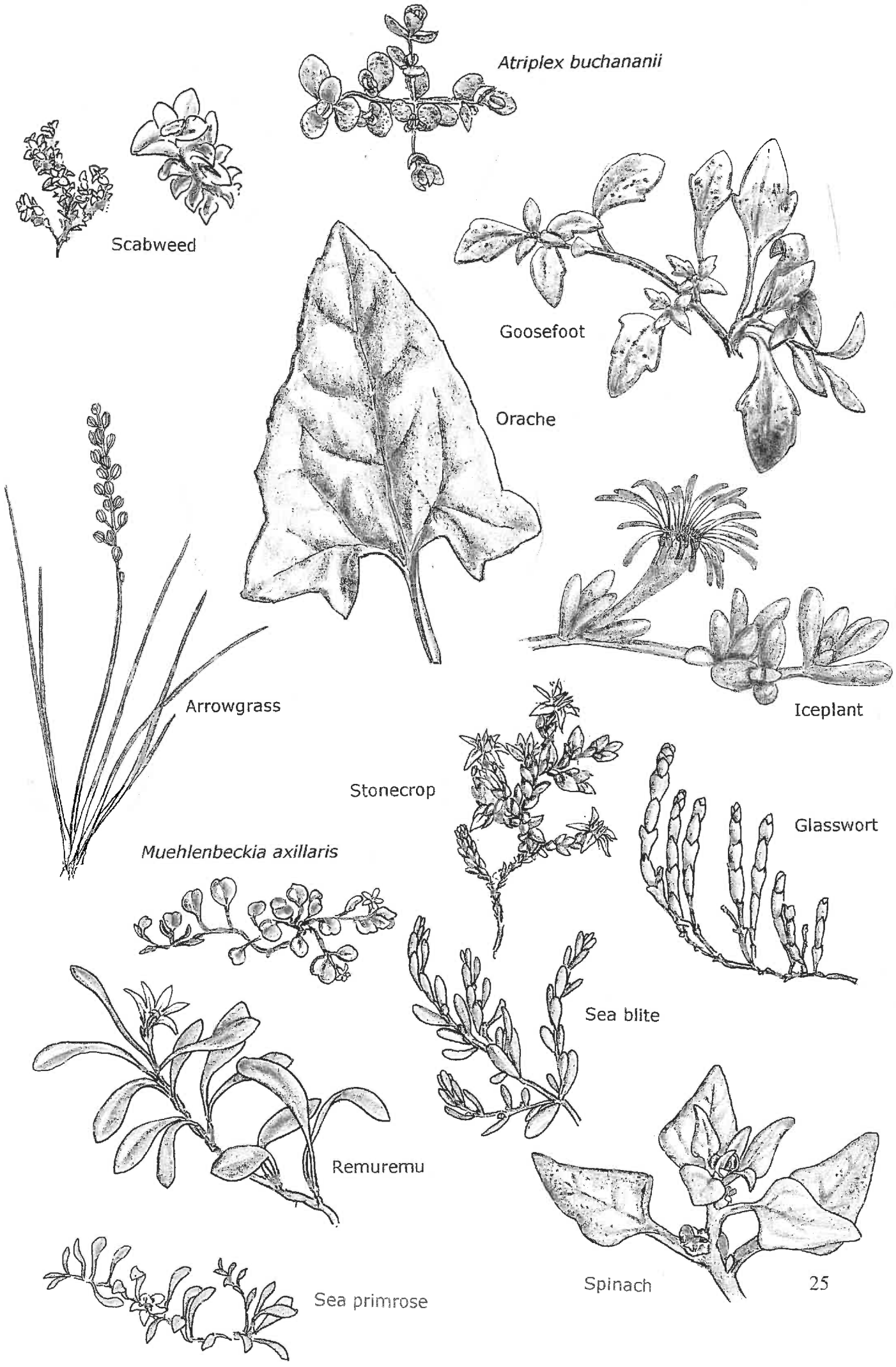
An excellent, accessible place for a shore vegetation study is at Monkey Island and the west end of Te Waewae Bay. Here the beach is steeper than Oreti Beach, large marram dunes are lacking and the sand-country is wetter and more stable, protected from high tides by a barrier of driftwood and bounded to the rear by high cliffs of consolidated sand. Common with the marram is the small native sedge *Carex pumila*, the grass **creeping bent** *Agrostis stolonifera* and odd clumps of **pingao** *Desmoschoenus spiralis*. The cliffs are clothed in **coastal hebe** *Hebe elliptica*, **toetoe** *Cortaderia richardii* and **flax** *Phormium tenax*. Other species in the sand and along the cliffs are **holy grass** *Heirochloe redolens*, *Poa astonii*, **shore gentian** *Gentiana saxosa*, **native linen** *Linum monogynum* and **shore milkweed** *Euphorbia glauca*.

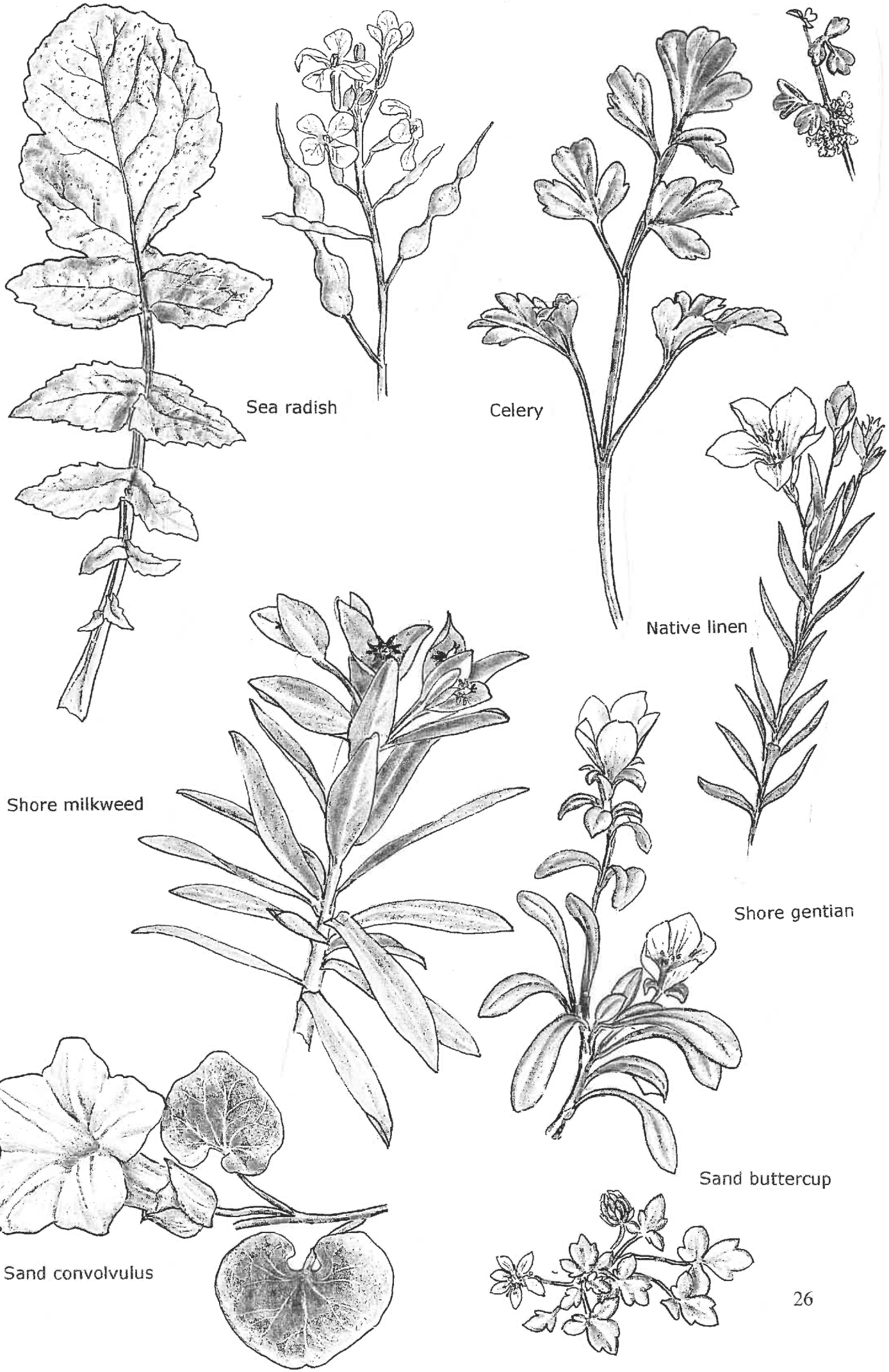
Some beaches such as Tihaka Beach at the east end of Colac Bay are a mixture of sand and gravel. Here, seepage gives life to a more diverse range of plants such as the tiny native **willowherb** *Epilobium komarovianum*, **shore forget-me-not** *Myosotis pygmea*., **tussock sedge** *Carex appressa* and the **splendid sedge** *Carex trifida*.

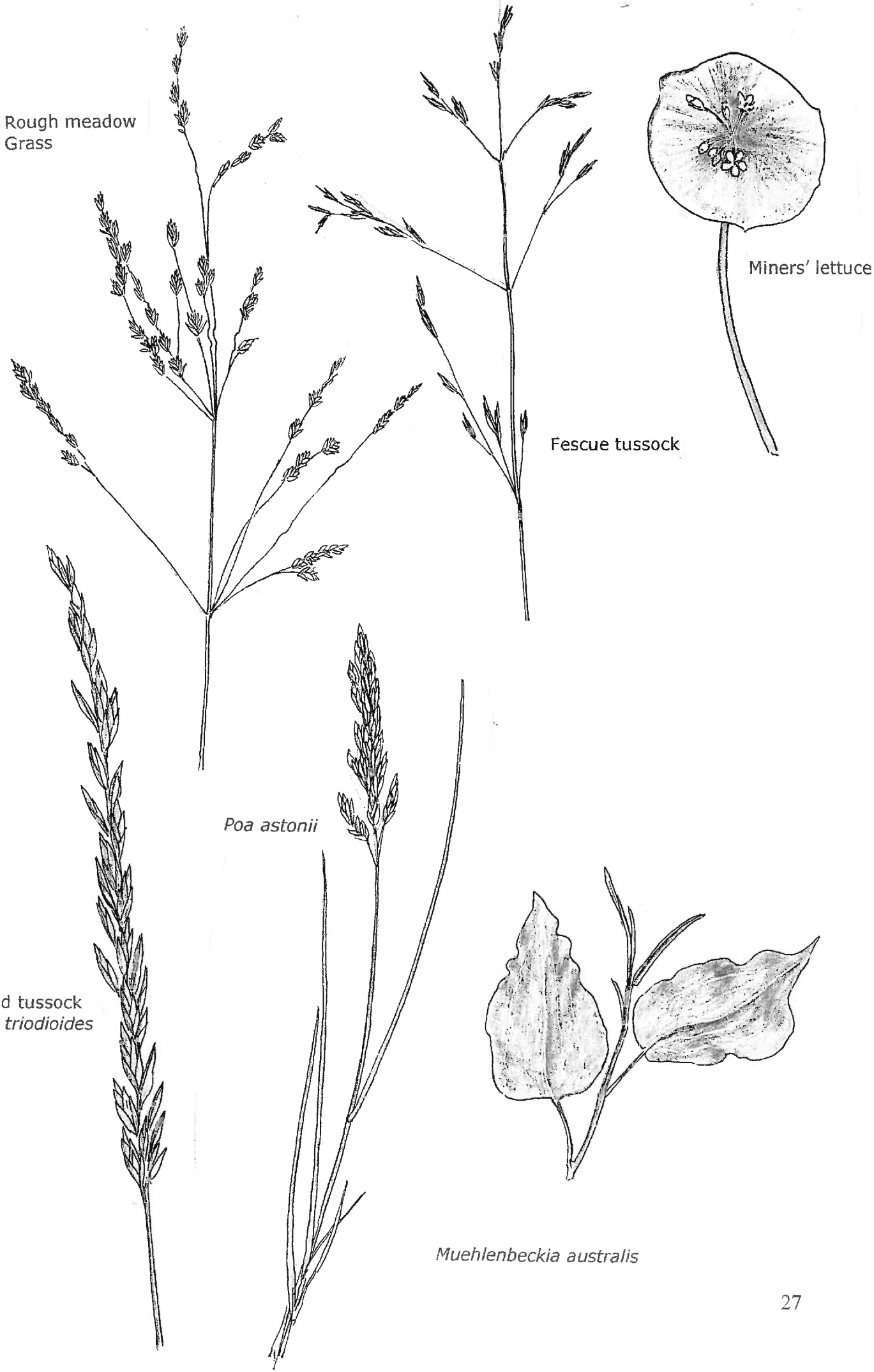
Gravel and shell bars in sheltered waters such as Bluff Harbour and Invercargill (New River) Estuary, beyond the reach of all but the highest tides, have a range of plants tolerant of salt water and resistant to desiccation. These include **remuremu** *Selliera radicans*, **glasswort** *Sarcocornia quinqueflora*, **sea primrose** *Samolus repens*, **sea blite** *Suaeda novae-zelandiae*, **goosefoot** *Chenopodium glaucum* subsp. *ambiguum*, **orache** *Atriplex hastata*, *Atriplex buchananii*, **slender clubrush** *Isolepis praetextata*, **shore groundsel** *Senecio lautus*, **batchelor's buttons** *Cotula coronopifolia*, **buckshorn plantain** *Plantago coronopus*, **native spinach** *Tetragonia trigyna*,

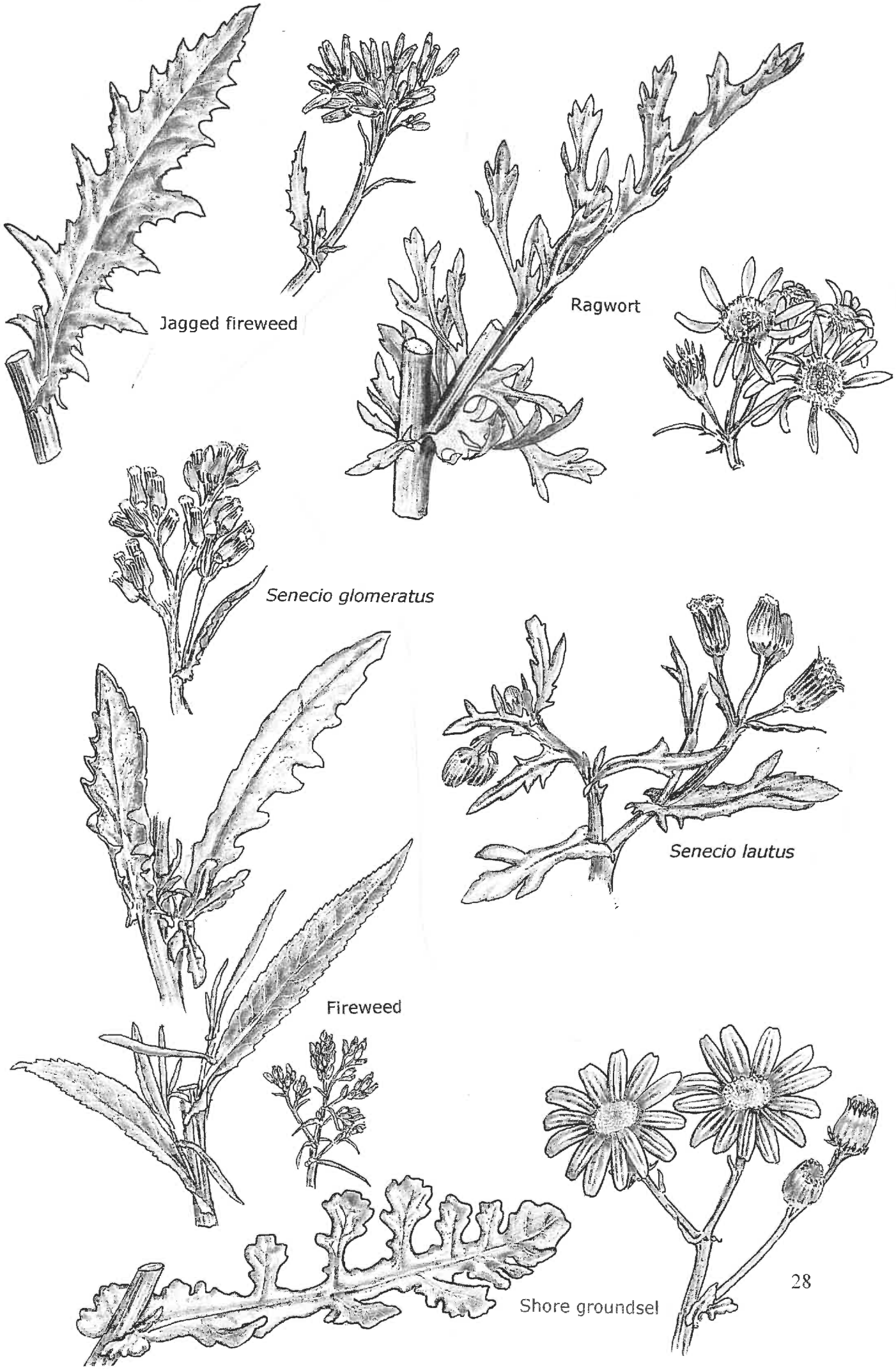
salt-marsh crassula *Crassula moschata* and the introduced **stonecrop** *Sedum acre*.
The very driest coastal areas have clumps of the **scabweed** *Raoulia australis* and *Muehlenbeckia axillaris*.
Coastal turfs on the Bluff coast have been likened to the 'machair' vegetation of Scotland. There is a stable surface of poorly-drained calcareous sand, closely covered in a mat of vegetation. Species such as **shore gentian** *Gentiana saxosa*, **sea spurrey** *Spergularia marina*, **shore dock** *Rumex neglectus*, **hairy plantain** *Plantago australis*, *Plantago raoulii*, **dwarf plantain** *Plantago triandra*, **pearlwort** *Sagina procumbens*, **remuremu** *Selliera radicans* and **glasswort** *Sarcocornia quinqueflora* are elements of this special habitat.



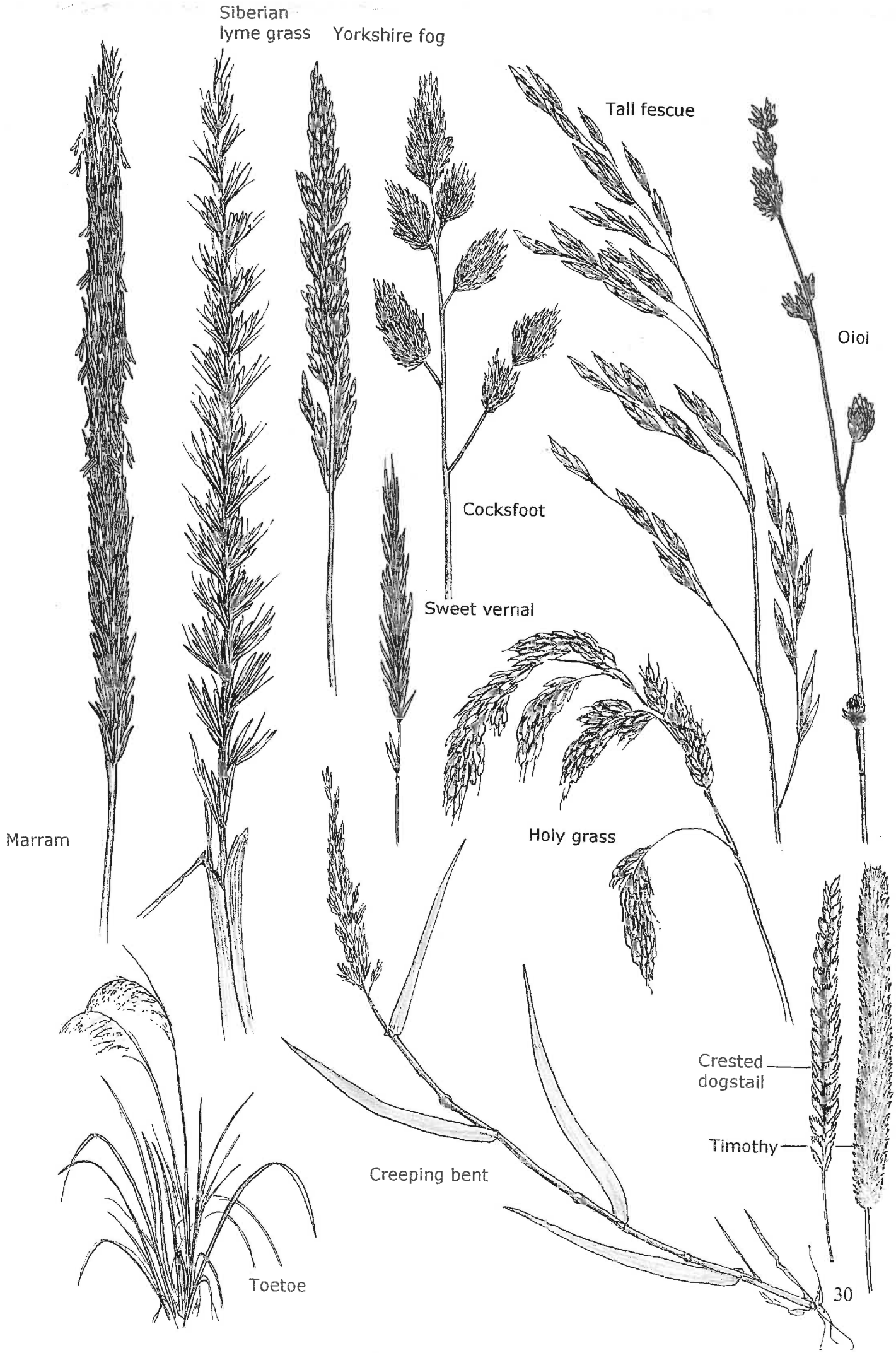

Atriplex buchananii
Scabweed
Goosefoot
Orache
Arrowgrass
Iceplant
Stonecrop
Glasswort
Muehlenbeckia axillaris
Sea blite
Remuremu
Spinach
Sea primrose

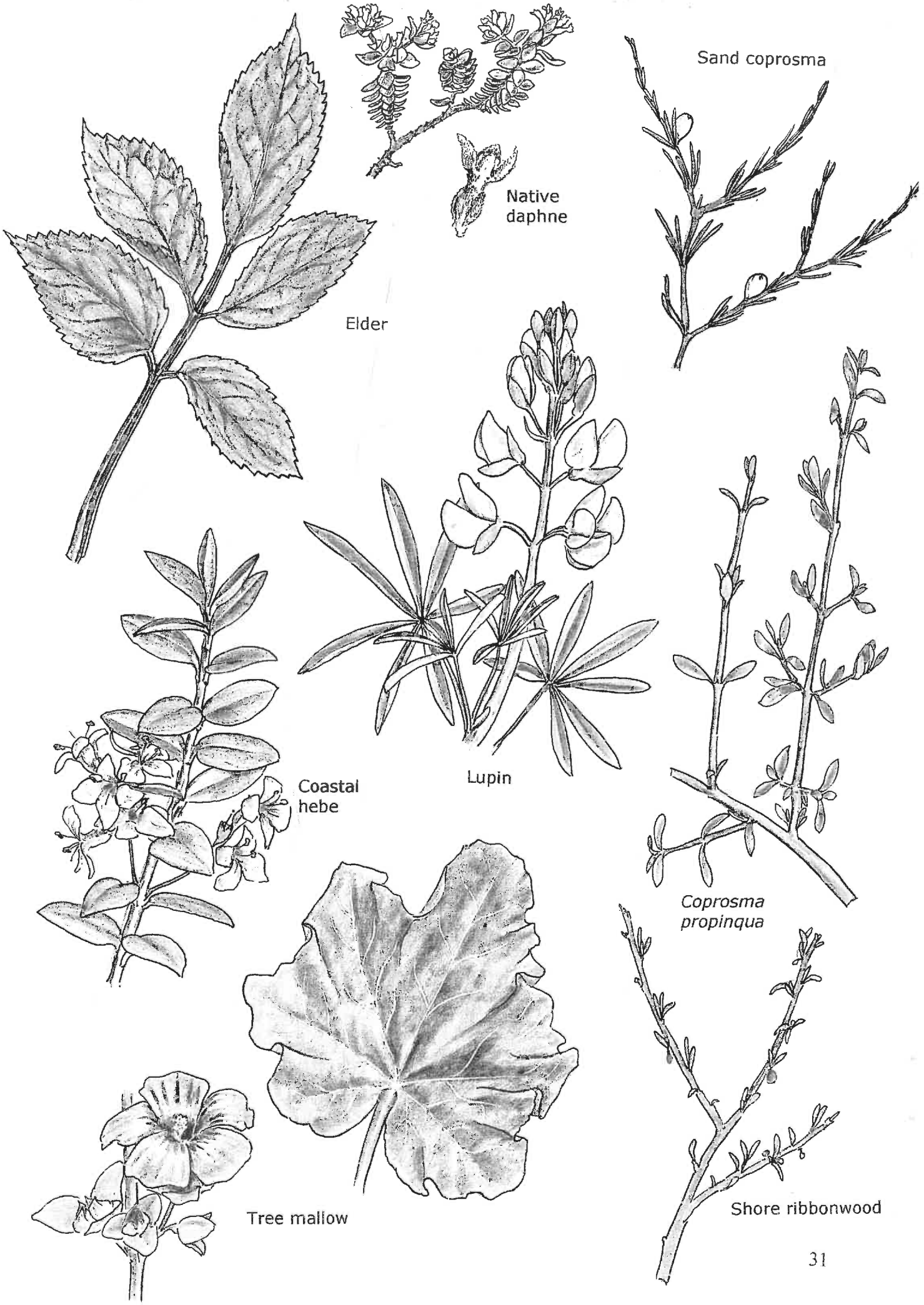

Sea radish
Celery
Native linen
Shore milkweed
Shore gentian
Sand buttercup
Sand convolvulus

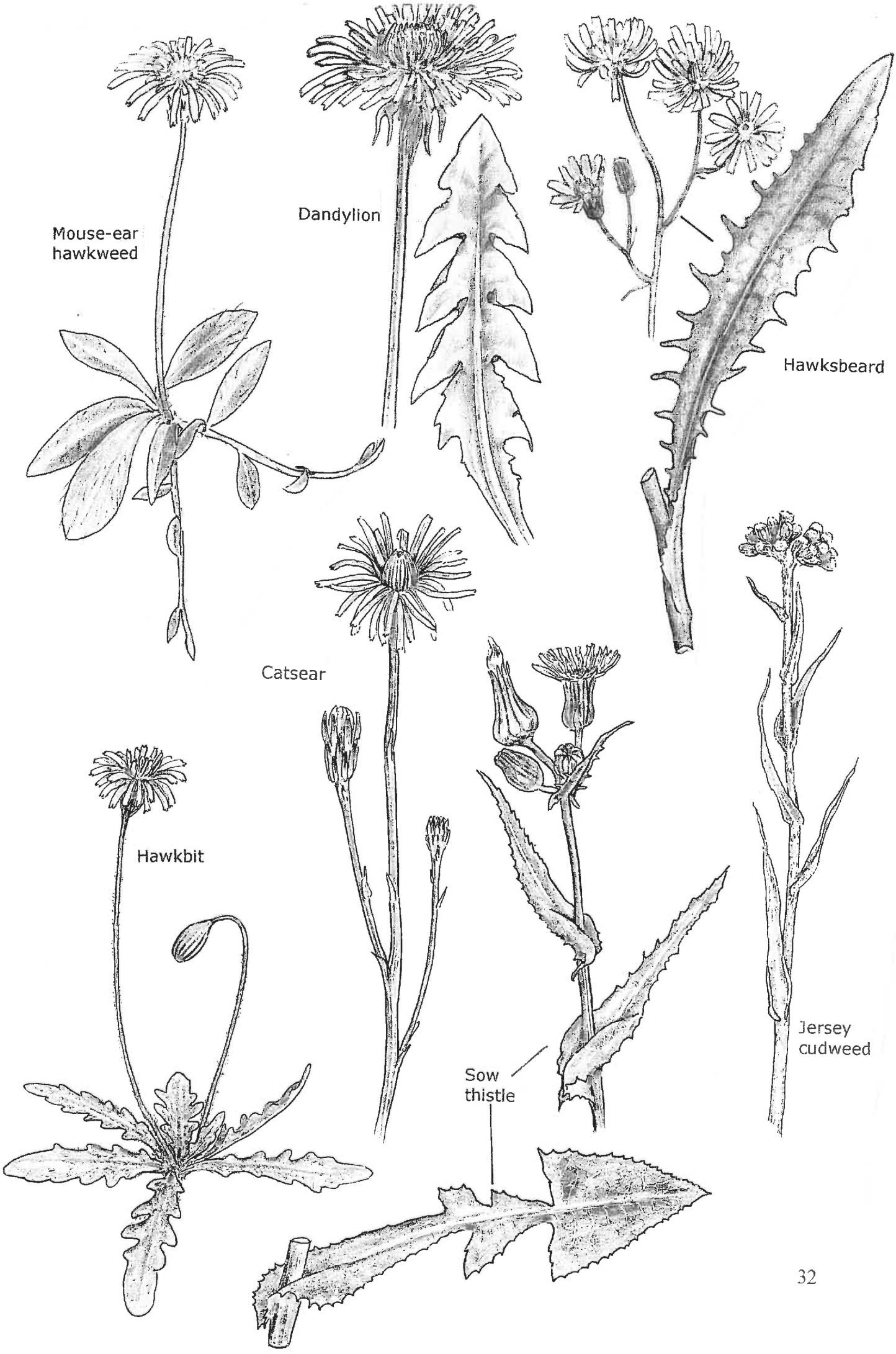

Rough meadow Grass
Fescue tussock
Miners' lettuce
Sand tussock
Poa triodioides
Poa astonii
Muehlenbeckia australis

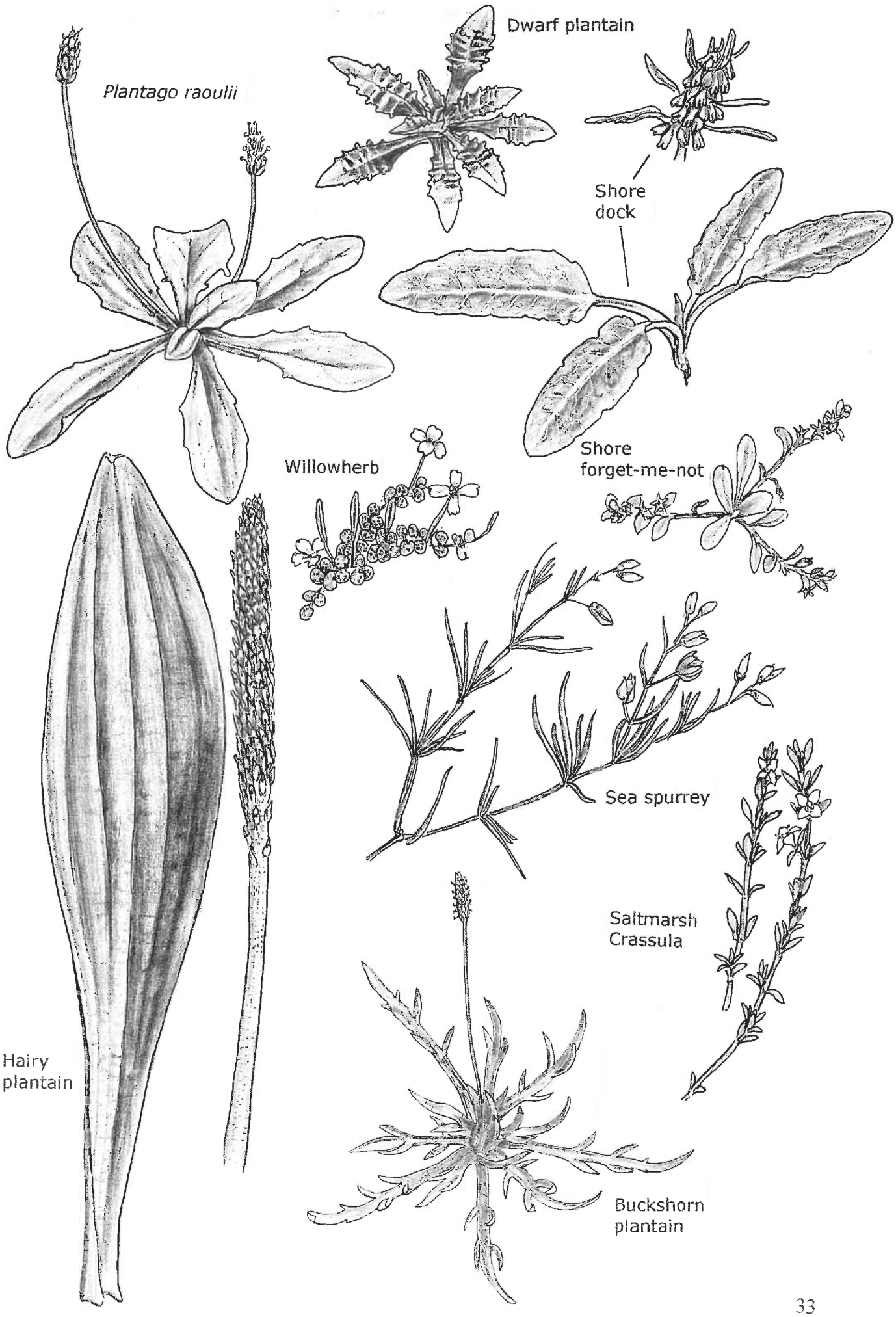

Jagged fireweed
Ragwort
Senecio glomeratus
Senecio lautus
Fireweed
Shore groundsel


Slender clubrush
Carex pumila
Wiwi
Pingao
Splendid sedge
Tussock sedge


Siberian
lyme grass
Yorkshire fog
Tall fescue
Oioi
Cocksfoot
Sweet vernal
Marram
Holy grass
Crested
dogstail
Timothy
Creeping bent
Toetoe


Native daphne
Sand coprosma
Elder
Lupin
Coastal hebe
Coprosma propinqua
Tree mallow
Shore ribbonwood


Mouse-ear hawkweed
Dandylion
Hawksbeard
Catsear
Hawkbit
Sow thistle
Jersey cudweed


Dwarf plantain
Plantago raoulii
Shore dock
Willowherb
Shore forget-me-not
Sea spurrey
Saltmarsh Crassula
Hairy plantain
Buckshorn plantain

Seaweeds

Seaweed or algae replace flowering plants in the sea. The three main classes of seaweeds are classified on the basis of their colour. They are the Chlorophyta (green seaweeds), Rhodophyta (red seaweeds) and Phaeophyta (brown seaweeds).

Being plants, they have chlorophyll and require sunlight, water, nutrients and air. Seawater is a source of nutrients and carbon dioxide. In order to get sunlight, seaweeds must live as close to the surface as possible and some have flotation structures to assist with this.

Bull kelp, for example, has hollow fronds with air cells while most other browns have bladders.

The typical seaweed of the sandy shore is the finely divided red weed that lives just offshore, attached to gravel or just drifting. It is often washed ashore in great piles after rough weather.

The other seaweeds on the beach are mostly brown. These have often drifted a long distance after being torn from rocks.

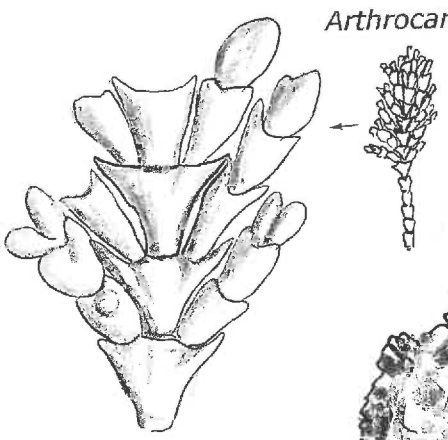
There are two species of massive brown seaweeds - **common bull kelp** *Durvillaea antarctica* and **southern bull kelp** *D. willana*. *Durvillaea antarctica* often has stems (stipes) 10cm or more across and the fronds extend for 5m or more. Kelp is cast ashore in great heaps after storms, often with some of the basal rock still held by the holdfast. As the seaweed decays, the rock remains behind - answering the question 'how do rocks wash up on a sandy beach?' Southern bull kelp is darker, the fronds do not have air cells, the stipe has small side fronds and unlike *D. antarctica*, the holdfast often remains adhering to the rock after the stipe has been wrenched off.

Other brown seaweeds include **bladder kelp** *Macrocyctis pyrifera*, more common in sheltered waters, and **sea-antlers** *Lessonia variegata* whose tough, bleached stipes remain long after the thin fronds have decayed, **strapweed** *Xiphophora gladiata*, **oak-leaved seaweed** *Landsburgia quercifolia*, **paddle-weed** *Ecklonia radiata*, **Neptune's necklace** or **Venus' necklace** *Hormosira banksii*, **comb-wrack** *Marginariella boryana* with ellipsoid floats and *Marginariella urvilliana* with spherical floats, **zigzag weed** *Cystophora scalaris*, **rock-tangle** *Cystophora retroflexa*, **bladder weed** *Cystophora torulosa*, **black bladder weed** *Cystophora platylobium* and **grapeweed** *Sargassum sinclairii*. Stranded seaweeds are the principal food of the sandhopper.

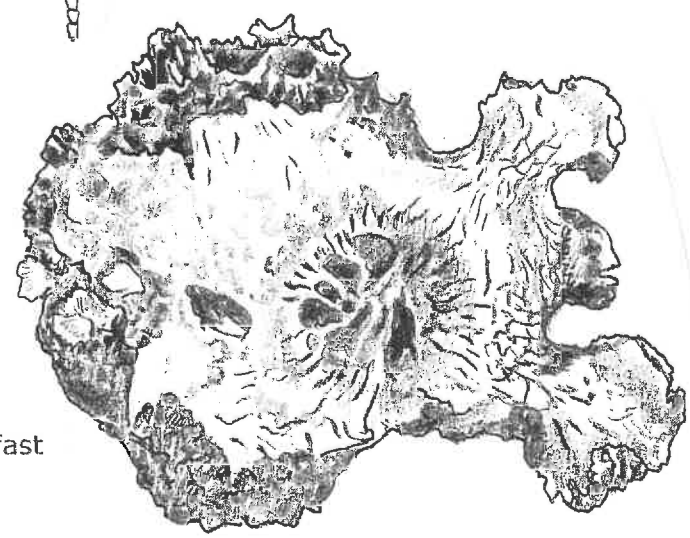
The red seaweeds are usually finely divided and it is very hard to distinguish between dozens of species. A specialised group of red seaweeds, the coralline algae, take large amounts of calcium from seawater and develop intricately detailed forms. They are found attached to holdfasts and other seaweeds. The example shown is *Arthrocardia corymbosa*. Another coralline alga, *Lithothamnion*, grows as an encrustation, often washing ashore as massive chalky lumps or small well-formed nodules called *rhodoliths*.

Green seaweeds are uncommon on sandy beaches. They are common in estuaries and rockpools.

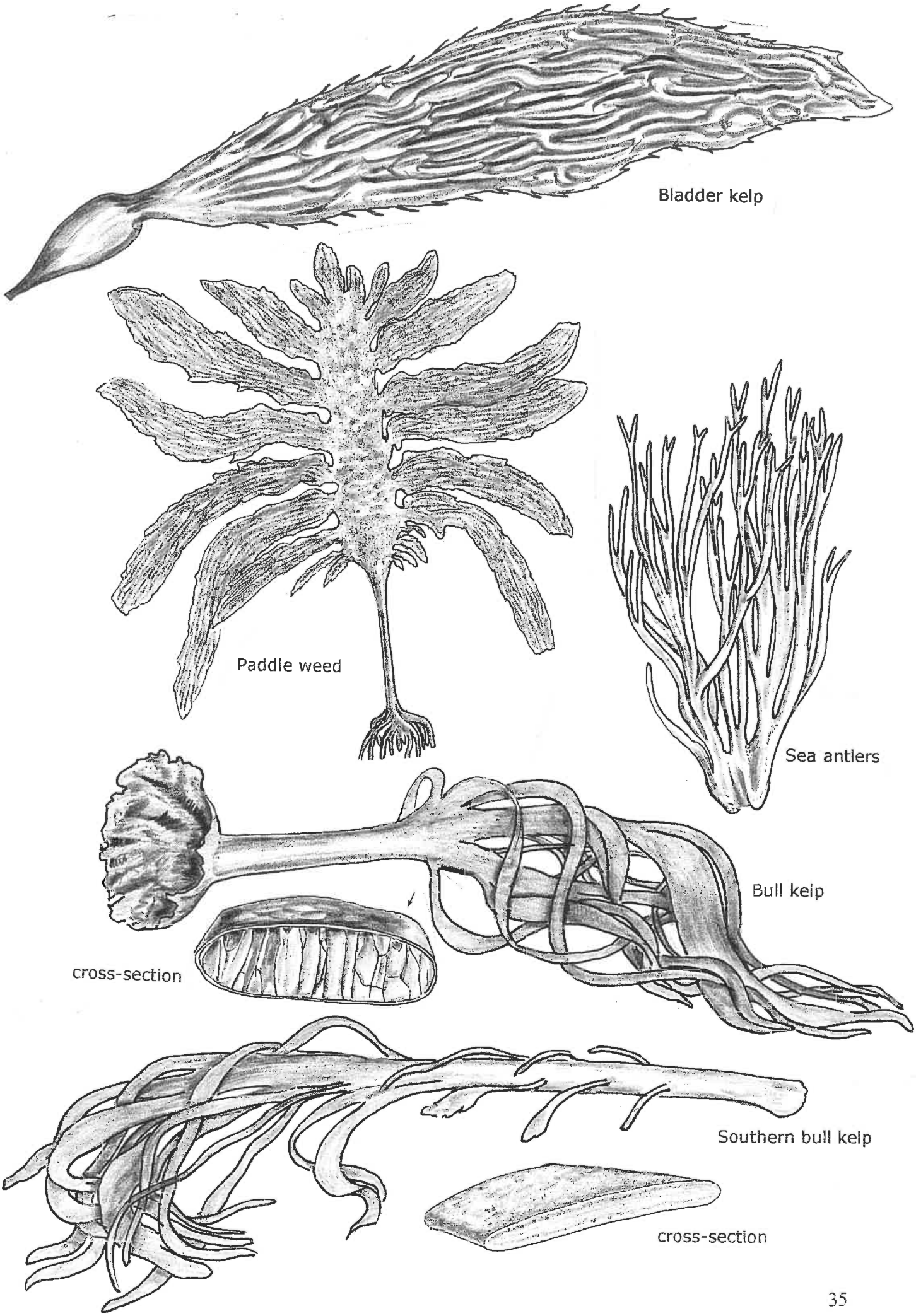
Many other species of seaweeds are cast ashore. Some of these are illustrated in **Southland's Rocky Shore 1997.**

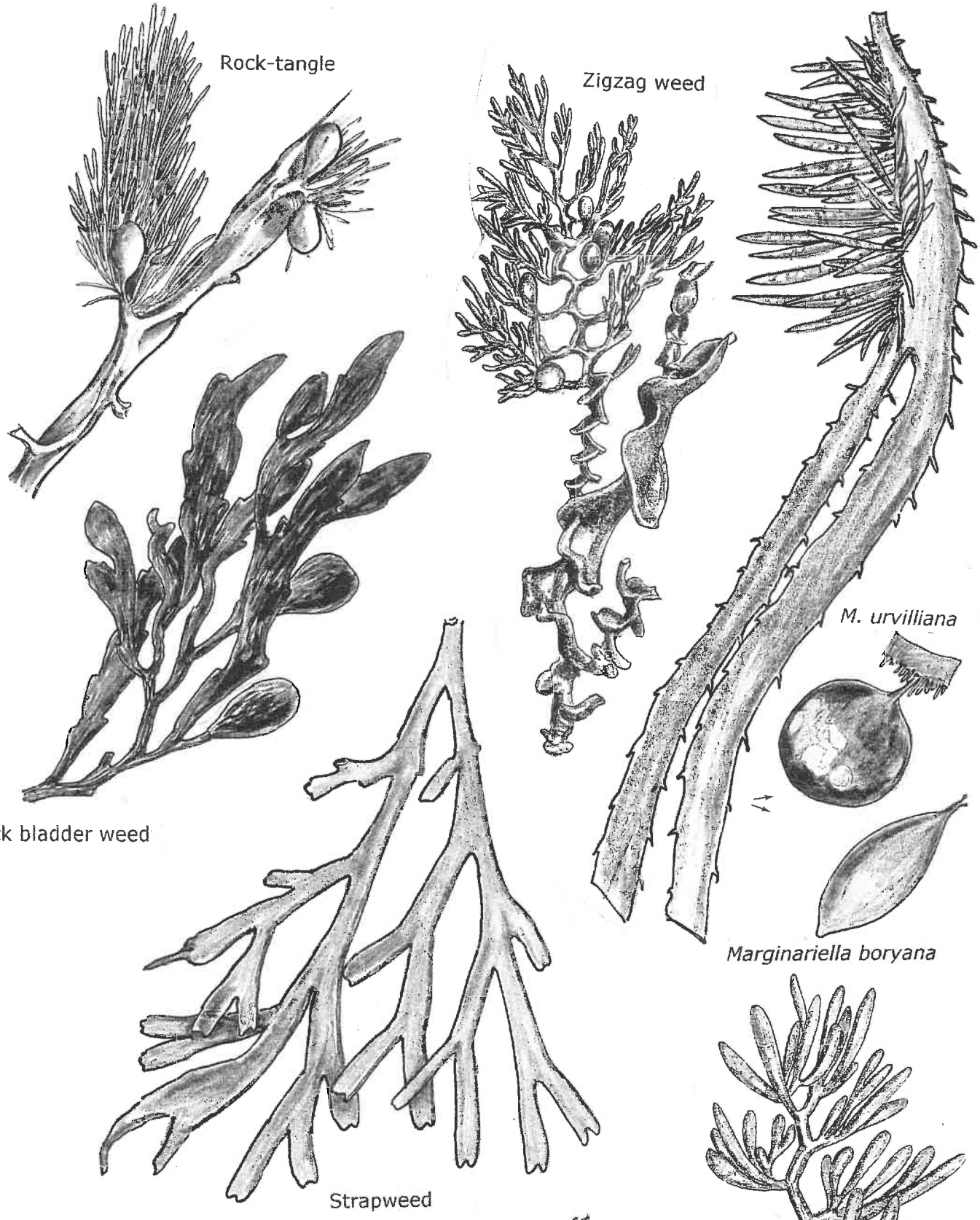


Arthrocardia corymbosa



Dried kelp holdfast


Bladder kelp
Paddle weed
Sea antlers
Bull kelp
cross-section
Southern bull kelp
cross-section


Rock-tangle
Zigzag weed
M. urvilliana
Black bladder weed
Marginariella boryana
Strapweed
Bladder weed
Lithothamnion
Neptune's necklace

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Southland coastal plan

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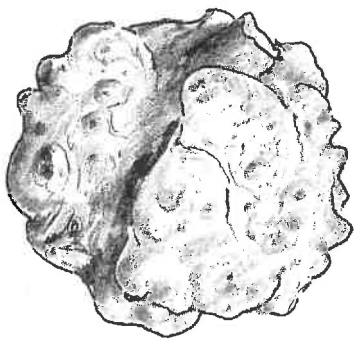

Most of the wood on the beach is beech. Silver beech often has galls caused by a fungus. These are durable and commonly washed ashore.