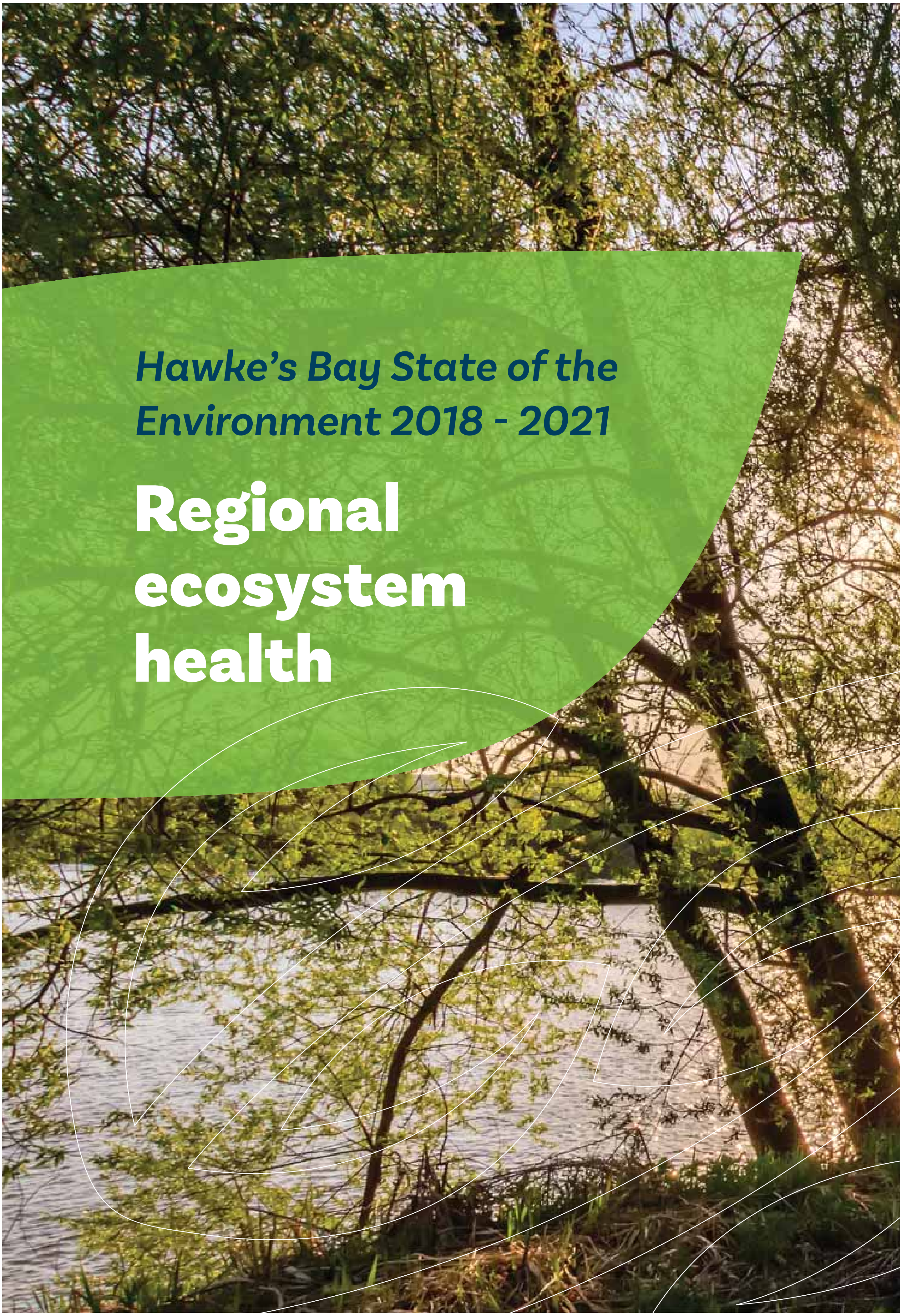
Hawke's Bay State of the Environment 2018 - 2021

Regional ecosystem health



9. Ecosystem health

A healthy ecosystem is one that is resilient and can recover from external stressors like severe weather events or the impacts of human activities. Healthy ecosystems support biological communities that are robust, diverse, and characteristic of their specific ecosystem type. In this chapter, we take a closer look at the health of three native ecosystems: forests, rivers, and coastal rocky reefs.

Healthy forests

Before humans lived in New Zealand, forests covered about 97% of Hawke's Bay, with many different forest types. These forests continually changed over time in response to climate cycles and disturbances like volcanic eruptions, tectonic activities, and the arrival of new species. When humans arrived, they cleared forests to a fraction of their former extent (see Biodiversity in Hawke's Bay), and the ecosystem functions of the remaining forests changed rapidly.

All forests experience natural events like landslides, fires, or storms, which cause mature trees to fall. In a diverse and healthy forest system, such events create open spaces that are taken over first by colonising plants and then by a succession of shrubs, small trees, and finally secondary forest (Figure 9-1).

This regeneration requires lots of different plant species to be nearby, producing seeds for recolonisation of the bare land. Adjacent forest also provides habitat and food for animals like birds or insects, which help to pollinate plants and spread seeds – also critical to forest regeneration. This complex web of structures and functions like habitat, food, pollination, dispersal, and colonisation includes plant and animal species that are often highly specialised for their roles – and the more diverse the better.

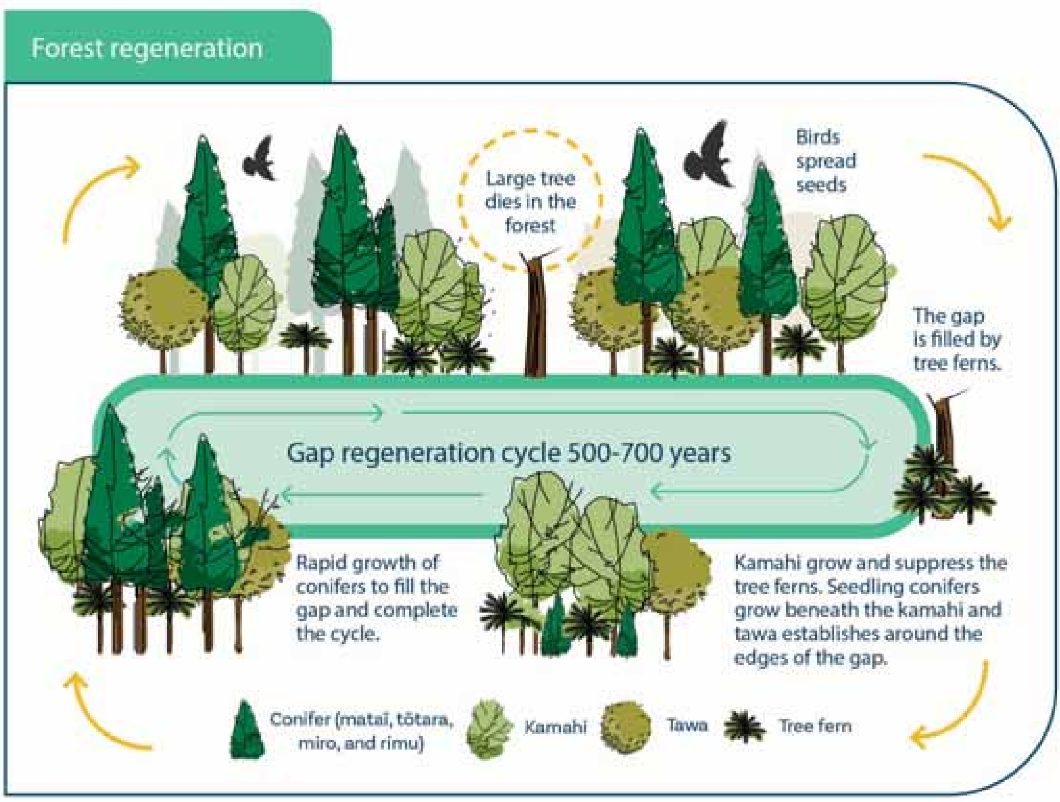


Figure 9-1. Stages in gap regeneration of a conifer-broadleaf forest in New Zealand.

Figure 9-2. Comparison of forest understory with deer access (left) compared to no deer access (right)

These natural processes have been disrupted in many New Zealand forests today. One cause of this disruption is the introduction of exotic animals, which often have a competitive advantage over native animals. Browsing by deer is a good example of this competition. They have no natural predators in New Zealand, so populations can become large quickly. Deer may alter the forest composition by preferentially browsing plant species that are more palatable, including seedlings, ferns and shrubs (Figure 9 2).

The resulting reduction in species diversity and the loss of an intact understory makes the forest less drought-resistant, and it means native animals lose shelter and food sources. It also limits the capability of the forest to regenerate, because there are fewer young trees that can grow into higher tiers and ultimately into the canopy. In these ways, a single introduced species can change the entire forest ecosystem.

Complex forest ecosystems are resilient because of the multiple interactions among resident plants and animals. Over time, the compositional changes that deer create may become increasingly irreversible if the competitive balance between plants shifts, if successional pathways and ecosystem processes are altered, or if seed sources are eliminated. Deer are valued by many as a recreational, cultural, and economic resource, but the challenge is to find a balance between these values and protecting native ecosystems.

An example of a forest remnant where ecosystem health was being impacted by deer in Hawke's Bay is Little Bush in Puketitiri. It houses many native plant and bird species with several trees over 500 years old. HBRC partnered with Forest and Bird and Biodiversity Hawke's Bay to exclude deer browsing by adding deer fencing around the reserve (see Biodiversity in Hawke's Bay). Protecting sites like Little Bush from deer is essential for their long-term viability and survival.

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Healthy rivers

Measuring ecosystem health is a more holistic approach than just focusing on certain aspects like nutrients or sediments, which are indicators of stress in an aquatic ecosystem. An ecosystem is made up of a complex set of biotic and antibiotic interactions, which determine how it responds to adverse events.

In freshwater ecosystems, we evaluate five core components of health. Water quality, water quantity, habitat, aquatic life and ecological processes are all assessed and analysed in a comparable way. This monitoring program was started recently, and we do not have enough data for water quantity yet, but the other core components have been assessed at 50 sites in the Tukituki and TANK catchments for three years (Figure 9-3).

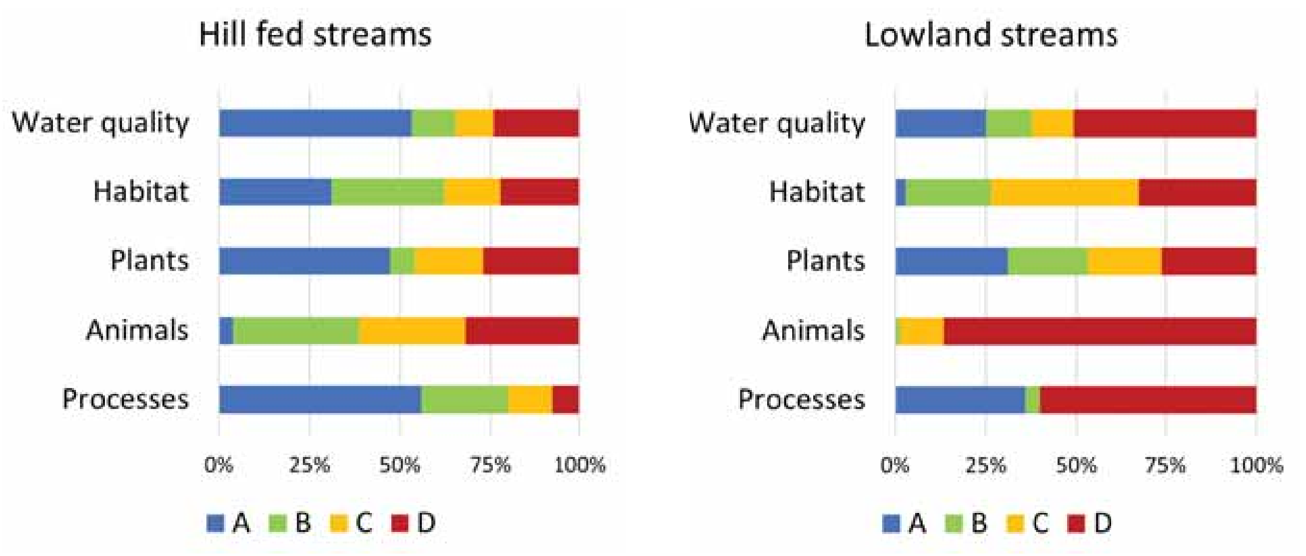

Figure 9-3. A new monitoring programme has assessed five core components of stream ecosystem health at 50 sites in the Tukituki and TANK catchments. Hill fed streams (left) typically performed better than lowland streams (right). Only four components are shown here, because there is not enough data from all sites to assess water quantity. The 'Aquatic Life' component has been split into plants and animals.

Hill country streams in the Tukituki and TANK catchments are generally in better health than lowland sites. The less healthy sites in the hill country streams have elevated nutrient concentrations (particularly phosphorus), growth of algae or aquatic plants, and high water temperatures. Water temperatures above 21°C for several hours on warm summer days are harmful to sensitive aquatic organisms. The low macroinvertebrate community scores show ecosystem stream health is compromised at the sites with a combination of these issues.

High phosphorus concentrations are more prevalent in lowland streams, and almost all sites fell below the National Policy Statement for Freshwater Management (NPS-FM) guidelines. Many lowland sites had excessive aquatic plant growth, and periods of very low dissolved oxygen levels. The habitat assessments showed that lowland streams are often uniform channels that provide minimal habitat diversity, and rarely have vegetation along the stream banks. All these factors are linked, and lead to low diversity in macroinvertebrate communities, because only the very tolerant species survive.

No single factor makes an ecosystem unhealthy. Instead, a suite of conditions, which can be interdependent, usually influence ecosystem health (Figure 9-4). However, the one common theme across streams with poor aquatic life is the lack of stream bank vegetation and shade. The water is exposed to the hot Hawke's Bay summer temperatures and direct sunlight and gets too warm for sensitive species. The warm water, supply of nutrients, and direct light cause aquatic plants and algae to grow quickly to nuisance levels. This in turn can cause a lack of oxygen during the night and early morning, when plants respire and don't produce oxygen.

One of the most powerful tools to increase river and stream ecosystem health is planting vegetation along their banks to provide shade, protection from erosion, a buffer to land use, and habitat for native animals. The benefits for stream health include cooler water temperatures, slower plant growth and therefore better oxygen levels, and less accumulation of sediment between plants in the water. Vegetation along the stream bank that reaches over or into the water, and plant parts like roots also provide fish habitat and cover to hide from predators. This aquatic environment in turn supports a more diverse and resilient community of animals.

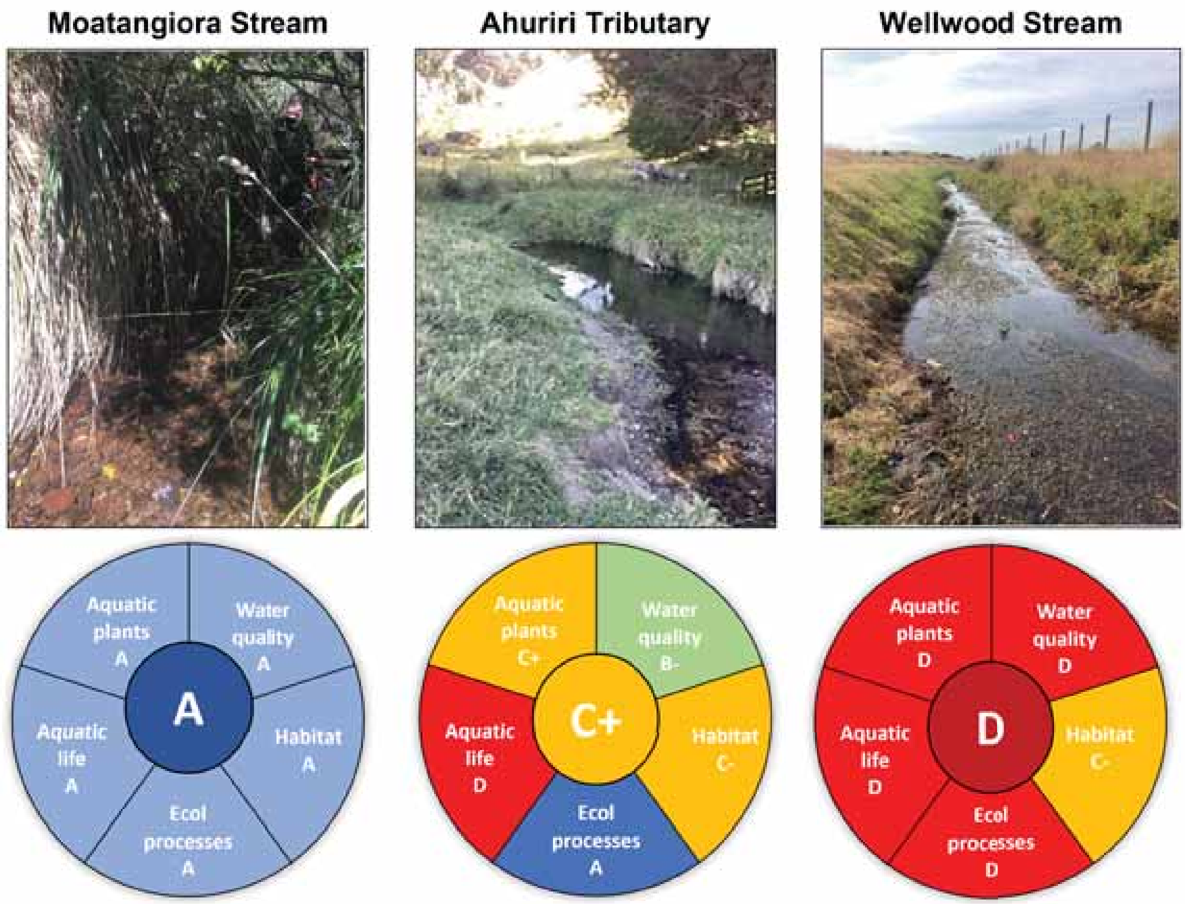

Figure 9-4. A comparison of ecosystem health scores at three sample sites. Left: Moatangiora Stream has excellent ecosystem health based on all measured core components. Centre: Ahuriri tributary has fair health, with scores indicating poor biota, compromised habitat, and nuisance aquatic plant growth. Right: Wellwood Stream has poor health according to all parameters.

Figure 9-5. Close up of a fucoid seaweed, Cystophera torulosa. *Fucoids provide key habitat and food for a variety of other algae and invertebrate species in rocky reefs.*

Healthy coastal reefs

Rocky reefs in the intertidal zone are submerged underwater during high tide and exposed to the air during low tide. This ecosystem is an important interface between the land and sea, and it provides many functions and values. A healthy rocky reef ecosystem provides shelter, and nursery and feeding areas for many marine species. For humans, they provide kai moana and buffer the coastline against the constant force of waves. Fringing coastal vegetation also stores disproportionally large amounts of carbon compared to terrestrial systems. For example, seagrass is one of the most significant global natural carbon sinks, because it can store sequestered carbon dioxide as organic matter in the sediment for long periods of time.

HBRC has been monitoring intertidal rocky reefs since 2011, and the results show that the biological communities here have remained relatively stable. Recent intense marine heatwaves in Hawke's Bay have impacted the rocky reef communities, but overall, they have recovered from these events (for more detail on marine heat waves see the Marine and coastal environments section). Generally, rocky reef systems experience a range of air and sea temperatures each year and therefore are expected to tolerate short-term changes in temperature. However, both terrestrial and marine heatwaves are predicted to increase with climate change, and the impacts on rocky reef systems are unknown.

Healthy ecosystems are diverse and have strong functional resilience, meaning that multiple species perform the same function. This means that if a change to the environment affects one species, other species can take over its role, allowing the ecosystem to continue to function.

The rocky reefs in Hawke's Bay are generally resilient. For example, multiple species of a specific class of brown seaweeds (fucoids) provide key habitat and food for a variety of other algae and invertebrate species (Figure 9-5). By contrast, species living in the sediments of our estuaries currently have only 1-2 species per functional role, which increases the risk of ecosystem function loss there (see Marine and coastal environments section).

While rocky reef ecosystems in Hawke's Bay are generally healthy, we need to keep a close eye on certain pressures. Increased sedimentation along the coast is a threat to seaweeds, because it decreases water clarity and limits plants' ability to photosynthesise and grow. In addition, seaweeds don't have roots and attach to rocks directly, so sediment on rocks can prevent seaweeds from being able to attach. Because of the key functional role seaweeds play, it's important to monitor their abundance.

Another key component of intertidal rocky reef zones is seagrass, a flowering marine plant that also occurs in estuaries. It forms large patches, providing both habitat and food for other species (Figure 9-6). Unlike seaweed, seagrass has a root structure that retains sediment and stores carbon.

Historically, seagrass was known to exist sub-tidally around Cape Kidnappers, the Clive Hard, and in the Ahuriri Estuary, but it has since disappeared from these areas. Currently, seagrass in Hawke's Bay only exists in patches along intertidal rocky reefs and in one known patch in Pōrangahau Estuary. Like seaweed, seagrass is vulnerable to high sediment loads in coastal waters, which prevents successful recruitment of young plants, decreases water clarity, and affects the plants' ability to photosynthesise.

The complexity of the interactions between the physical environment and marine communities highlights the need to look at the whole ecosystem for health outcomes, especially when we consider the suite of stressors that are predicted to affect ecosystems as a result of climate change. The healthier ecosystems are now, the more resilient they will be against future environmental changes.

A healthy rocky reef ecosystem provides shelter, and nursery and feeding areas for many marine species.

Figure 9-6. A seagrass bed in Central Hawke's Bay.