

The Living Coast



Earlier chapters described the Namibian coast as a meeting place between the sea, land and atmosphere, between fresh water and the ocean, and between the cold maritime world and a warmer terrestrial one. In this chapter the focus is on life in these two contrasting ecological zones. One produces enormous volumes of biomass while the other is the very opposite. Forming a narrow band between this juxtaposition of profusion and paucity is the shore where terrestrial and aquatic life meets, and sometimes mixes.

As terrestrial animals, we humans relate more easily to the land area of the coast even though desert life is tough. Conditions here are dominated by frequent strong winds, heat and aridity, and by saline soils and shifting sand – factors which combine to make the environment harsh and inhospitable.

While life is hard and scarce in this terrestrial environment, a wide range of remarkable species have evolved and adapted to the harsh life of the coastal desert. Some are restricted to particular types of desert habitats while many are endemic and live nowhere else in the world, which means that they are of particular interest for science and conservation. Namibia has exclusive and special responsibility for these species.

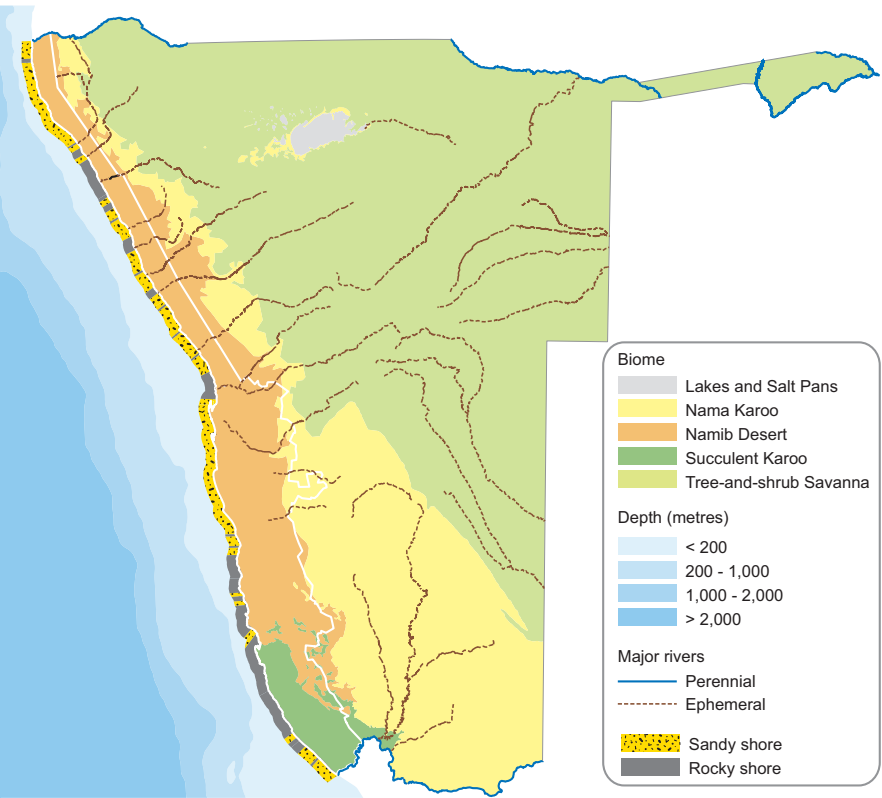


Figure 28. Namibia’s shoreline in relation to the major terrestrial biomes in Namibia. The zone of land considered to be coastal falls almost entirely within the Namib Desert and Succulent Karoo Biomes.

The occurrence of most species is typically closely linked with the distribution of habitats; thus different kinds of animals and plants are at home only in sand dunes of various types and size, or on gravel plains, inselbergs, rocky shore lines, sandy or pebble beaches, for example. The patchwork of habitats along the coast is a consequence of the great variety of underlying geomorphological structures and substrates described in Chapter 3. Extended dry periods interspersed with shorter and wetter periods, and periods of low temperatures separated from warmer periods, have further served to isolate populations and allow new species or adaptations to evolve. For all these reasons, terrestrial life along the Namibian coast is varied and often specialised even though it is generally scarce.

The interface between land and sea also serves as a refuge for concentrations of migratory shorebirds or waders, particularly where there are large bays or estuaries. Likewise, a variety of marine animals stay close to the coast to benefit from protection offered by sheltered bays and food supplied by highly productive plant life in shallow waters. In particular, vast beds of kelp grow in shallow waters where they soak up energy from sunlight.

In this chapter we describe the major biomes and habitats found in the coastal areas, discuss patterns of diversity and endemism, give an overview of the terrestrial and marine life found here, and finally, highlight areas which are of conservation importance because they support particular aggregations of plants and animals. Scientific names of all species mentioned in the text are given on page 192.

Pelagic or open oceanic waters

Namibia’s marine environment extends from the shallow coastal waters out westwards into the open, pelagic waters of the ocean. Pelagic refers to all open marine waters, setting them apart from the shore and the demersal and benthic zones close to the seabed. The ecology of this offshore environment is driven largely by the cold Benguela Current which pushes northwards from the south. It has one of the highest primary production rates in the world and its pelagic fisheries are one of Namibia’s most important renewable natural resources. The economic importance of the fisheries industry is discussed in Chapter 6.

The rich natural resources of the pelagic environment are primarily the result of upwelling cells that bring huge quantities of nutrients to the surface. Several of these cells occur between the Cape of Good Hope and the Angolan border (see page 36), and they are the fundamental ecological ‘engines’ that bring nutrients to the sunlit surface.

Although a few specialised organisms can use nutrients in the dark depths of the ocean, substantial biological production only happens when nutrients become



The shallow inshore waters support shoals of tiny fish which, in turn, provide food for many species of birds and bigger fish.

available to photosynthetic plants close to the surface where sunlight can penetrate. Under these conditions, the growth and reproduction of phytoplankton (tiny floating plants) is often phenomenal. Blooms of phytoplankton off Namibia's coast provide volumes of food which support some of the highest concentrations of zooplankton (microscopic animals) and other marine life found anywhere in the world, including populations of fish with commercial value (Figure 29). These, in turn, supply food for top predators such as whales, dolphins, seals and seabirds.

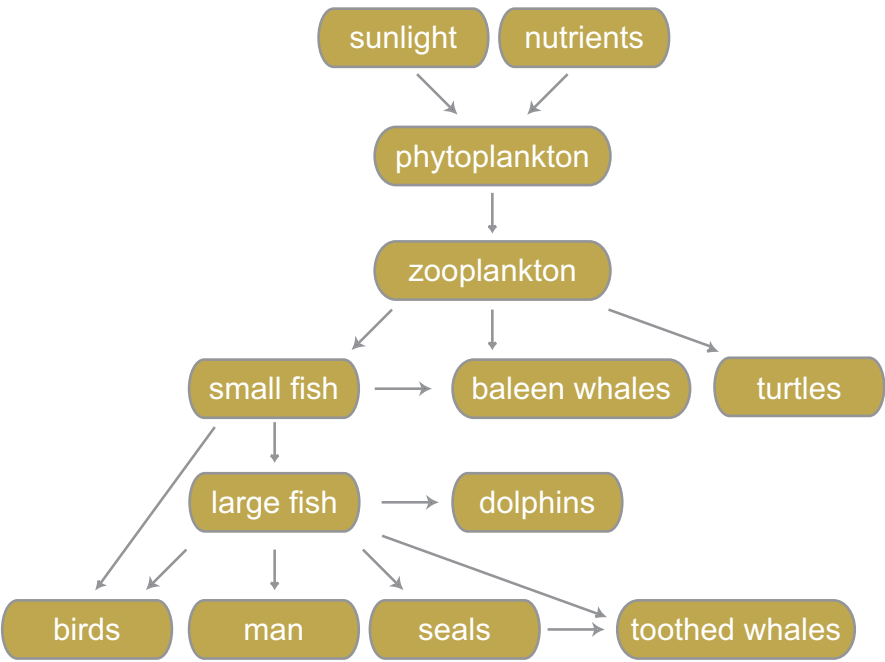
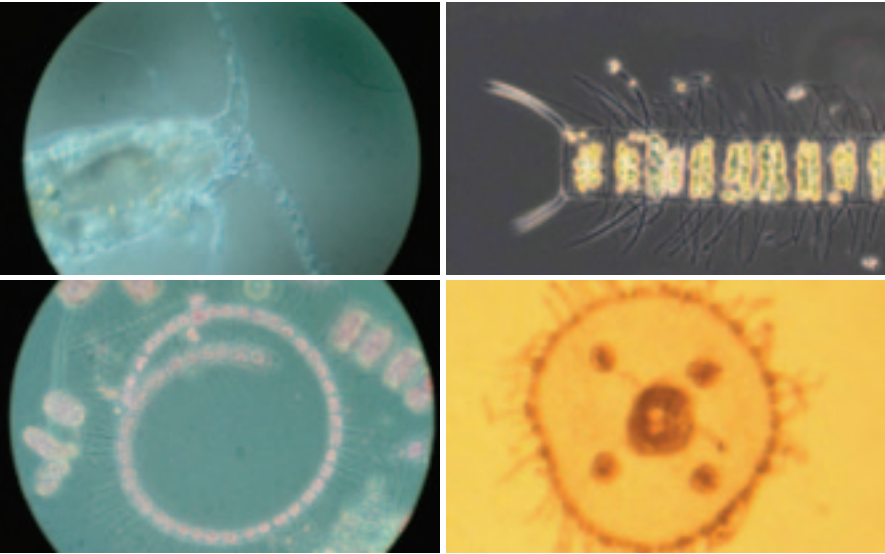


Figure 29. The major flows of production and energy in the Benguela food web, showing how energy from sunlight and nutrients is transferred between different layers of consumers until it reaches us and other large predators. Not shown here is production that leaves the web, for example in the form of fish harvests and the decomposed remains of plants and animals that sink to the ocean floor.

The high productivity of Namibian waters begins with the growth and reproduction of phytoplankton and zooplankton. Growth rates can be phenomenal due to the nutrient-rich water and plankton are a vital food source to larger animals such as fish and cetaceans. In addition to their biological role in the food web, plankton play an important role in the global carbon cycle, transporting carbon from surface waters to the depths of the ocean in the form of dead organisms or faecal pellets. Known as the 'biological pump', this process is partly why oceans constitute the largest carbon sink on Earth.



Most organisms that live off this initial production in the sunlit surface layers remain within 100 metres of the surface. At progressively deeper levels, the mass of living biological organisms (known as biomass) decreases as the atmospheric pressure increases and levels of light, dissolved oxygen and nutrients diminish.

The principal man-made threats to the pelagic environment include over-fishing and pollution from the shore and from ships. However, various natural events also interrupt or limit biological production. The most severe of these are the occasional Benguela-Niño events during which relatively warm, salty and nutrient-poor water is driven southwards from the Angola Current. Benguela-Niño events result in upwelling being reduced and insufficient oxygen being available in the water, the occurrence of harmful algal blooms, the so-called red tides, and sulphur eruptions (see page 43). For instance, huge losses of fish occurred in 1994 and 1995, first as a result of low levels of oxygen in 1994 and then a Benguela-Niño event in 1995 caused fish to move away from their normal feeding and spawning grounds or fail to breed.

Warm water events in 1963 and 1984 had similar effects on fish populations and the fishing industry. West Coast Rock Lobsters are particularly sensitive to low concentrations of oxygen which sometimes cause them to walk ashore and die in large numbers. Fish predators also suffer: for example, an estimated 300,000 seals died in 1994 and 1995.



Over 100 tonnes of lobsters are harvested commercially each year, but during warm water events vast numbers leave the oxygen-starved water and walk ashore and die.

The marine coastline

Of the 1,570 kilometres of Namibia’s coastline, 54% consists of sandy beaches, 28% is mixed sandy and rocky shores, 16% is rocky shores and the remaining 2% consists of lagoons (see Figure 28).¹ Relatively few plants and animals manage to live on the shifting sand of the shores. By contrast, the rocky shores are comparatively rich in life (see page 79). Various plants, mainly algae such as kelp and other seaweeds, can attach themselves to rocks and absorb solar energy in the shallow, sunny waters, while a large assemblage of invertebrates (such as mussels, sponges and barnacles) likewise fix themselves to rocks and find shelter in the algae beds or ‘kelp forests’. Mobile grazers such as limpets feed on the diversity of algae available inter-tidally and sub-tidally. Many of the animals found on rocky shores feed by filtering out tiny particles from the seawater.



Below: Limpets in the inter-tidal zone feed by grazing on algae which grows on the rock surfaces. They protect themselves from predation, desiccation and strong wave action by clamping down tight against the rock surface when necessary.



Right: Namibia’s kelp forests provides shelter and food for a wide range of marine organisms. The rocky areas around the islands provide crucial substrate for kelp beds and these are important in providing shelter to juvenile lobsters which migrate to surrounding areas as they mature.

Lobsters, crabs and many species of fish, for instance, are attracted by these sources of food and the protection from predators afforded by the kelp beds and nooks and crannies along rocky shores. These inter-tidal and sub-tidal zones also provide nursery habitats for certain pelagic fishes, such as Horse Mackerel, as well as supplying harvests of kelp, mussels and lobsters which contribute to the Namibian economy.

One of the greatest impacts on the southern coastline has been from diamond mining, in particular the stripping away of beach from Oranjemund to about 100 kilometres north (see the photo on page 140). Much of this stretch was sandy beach which should largely recover when the mining operations cease. Further north and up to Lüderitz, diamonds are mined by sucking up gravel off the sea floor. This causes considerable short-term disruption to the rich fauna and flora that live in the sub-tidal zone. The diamond mining companies are, increasingly, making efforts to manage and reduce their impacts and to rehabilitate damage. The central and northern coast, from Sandwich Harbour to the Kunene River, is affected by tourism including off-road 4x4 driving and angling. These issues are discussed in Chapter 7.

Islands

The margins of Namibia’s islands are largely composed of rocky shores which support rich sub-tidal, inter-tidal and kelp communities. Another conspicuous value of the islands is in providing breeding and resting places for seabirds and seals where they are safe from terrestrial predators, such as hyaenas and jackals, and marine predators such as sharks. Eleven seabird species breed on the islands, which provide space for a majority of the global breeding populations of seven of these birds (see page 90). Many of the islands have no terrestrial plants although small boxthorn bushes do grow on some of them.

Most of Namibia’s islands and islets (see Figure 1, page 6) are just offshore from the southern coast where they fall within the newly formed Marine Protected Area (MPA).² Thin layers of guano, sand, shells and seal hair now cover most of the islands, but many had thick coverings of guano before the guano rush began in the 1840s. Layers of guano were then 10 metres or more in depth before they were stripped, bagged and shipped for use as fertiliser (see page 115).

The sun-hardened guano provided African Penguins with ideal nest sites in burrows which protected them both from the hot sun and predation by Kelp Gulls. The penguins have been seriously affected by the removal of guano since most of them are now forced to breed on the surface where their eggs and chicks are more exposed to predators, heat, storms and flooding.



Islands off the coast are a haven for sea birds and seals as land predators cannot reach them there. For the Cape Gannet (top) and African Penguin (bottom) Namibia’s islands provide critical breeding and roosting sites.



The marine environment immediately surrounding the islands is comparatively rich in nutrients due to guano from the large numbers of seabirds and seals. As a result, there is a relatively concentrated production of algae and phytoplankton that supports masses of zooplankton and successively higher levels of consumers in the food chain (Figure 29). The rocky sea floor around the islands provides a rich habitat and substrate for high densities of bottom dwelling (called benthic) animals and plants, such as anemones, mussels, sponges and seaweeds. The large kelp beds provide food, protection and shelter to vulnerable juvenile life stages of many marine animals, including those of the commercially valuable West Coast Rock Lobster (see page 149).

The proclamation of the Marine Protected Area resulted in the cessation of mining activities close to the islands. Prior to this, one of the main threats to the ecology of the islands was diamond mining off boats. Kelp may be cut or dislodged and sediments shifted when gravel on the seabed is sucked up and then discarded after being sorted for diamonds. One study found that mining significantly reduced species diversity and the abundance of both inter-tidal and sub-tidal communities, but in that case, both diversity and abundance recovered within two years.³



Welwitschia with male (right) and female (above) cones.⁴ It is estimated that the largest Welwitschia plants are about 600 years old. Possibly Namibia’s most charismatic plant, it obtains water from condensed fog through stomata (pores) on its leaves as well as from underground using a long taproot.

The land

The long history of aridity along the coast (see page 24) has given plants and animals extensive time to evolve strategies for survival and reproduction in these harsh conditions. For example, selective pressures have led to the development of physiological, structural and behavioural adaptations to the very low, variable and unpredictable rainfall as well as to the extreme and highly variable temperatures. Life in the Namib Desert and the Succulent Karoo biomes (Figure 28) teems with examples of specialisations that are unusual and seldom seen elsewhere. Amongst the most fascinating of these adaptations is the use of moisture from fog by plants and animals, since fog supplies about five times more water than rain along much of the coast (see page 27).



Although the sand dunes are stark and bare, a surprising range of invertebrate and vertebrate species occur there. Hummock dunes, which are mounds of sand on the leeward side of bushes and other obstructions, provide small patches of habitat for animal species. The only plants found in the shifting sand seas are those that can tolerate being buried in sand.

On the firmer ground of the plains, the vegetation largely comprises lichens and widely spaced shrubs. The plains are strongly influenced by fog, especially close to the sea where fog is most frequent and heavy. Further east and away from the marine fog, habitats are characterised by barren, open areas with shallow, sandy substrates which support hardy grasses and herbs, and some succulent shrubs. Sporadic rains bring these plants to life and their fresh, green growth then attracts large numbers of gemsbok, springbok, ostriches, sandgrouse, larks and other birds. Still further east, more regular and higher rainfall near the escarpment supports scattered tall shrubs and trees.

Because it is protected and very inaccessible, much of the coastal land area is relatively unspoilt, being visited or occupied by very few people. Strong winds have also obliterated many older scars left by people and their vehicles. However, current and potential threats to the animal and plant life include poaching, off-road driving, mining and the restriction of animal movements by fencing. Environmental conditions may also change as water tables drop as a result of the extraction of groundwater and increased climate variability and change (see page 34).

Despite the efforts of numerous researchers, the mechanisms that cause ‘fairy circles’ in the desert remain unknown. Scientific theories have included the effects of termites, ants, poisonous plants and radioactivity.



Large mammals were previously abundant in the central coastal regions, at least after good rains and prior to the arrival of hunters and settlers. For example, elephant, rhino, gemsbok and springbok were plentiful at the confluence of the Khan and Swakop Rivers in the late 1700s, while the fossilised tracks of elephant, zebra and ostrich have been found at Khaeros, near the Kuiseb River and less than 20 kilometres from the coast.⁵



Linear oases

The large and well-known ephemeral rivers such as the Ugab, Hoanib, Swakop, Omaruru and Kuiseb support substantial corridors of trees and other associated vegetation. These and other large water courses are shown in Figure 28, but there are a great number of other smaller drainage lines feeding into the rivers. Many do not have names and some are no larger than deep, wide gullies. All these courses are nonetheless marked by denser and taller vegetation than that in the surrounding landscape. Most of the large trees are Camelthorns and Ana Trees, while stands of denser vegetation usually comprise Bitter Bush, Mustard Bush, Tamarisk and !Nara.

There are two perennial rivers, the Kunene and Orange. Along the downstream stretches that form Namibia’s border the course of the Kunene River is largely confined to rocky gorges. Little riparian plant life grows in the gorges, and it is only where the river widens into broader valleys that substantial groves of riparian woodland are found. The mouth of the Kunene is dominated by the flow of fresh water from the river with little intrusion of sea water. It is therefore not considered to be an estuary, but the river mouth is an important habitat for a wide variety of coastal birds, fish, marine reptiles and other wildlife for which it is an oasis in the desert (see page 101).

The Orange River also supports little riparian woodland and runs through gorges in the upper stretches and a broad valley for the last 80-100 kilometres to the sea. While the Orange River usually flows directly into the Atlantic Ocean, a sand bar periodically blocks its mouth. The river mouth then becomes a sheltered area of shallow water, mudflats, marshes, islets and pans which are used by large concentrations of wetland birds for breeding or as a migration stopover (see page 107). The Orange River mouth is a designated Ramsar site, while Ramsar status has also been proposed for the Kunene mouth (see box below).

Riparian vegetation along many rivers provides food, shade, nest sites and many other vital resources for a variety of animals. Some of these live permanently along the rivers while others, such as elephant and lion in northern Namibia, follow the rivers into areas that would otherwise be unsuitable. Trees and shrubs along the dry river courses obtain water from subterranean reserves but in some places the underground water seeps or is forced to the surface by underlying rock formations to form surface pools which are crucial to animals that need to drink regularly.



Above and left: The resources of the linear oases attract herbivores, and their predators

The main threat to ephemeral rivers is the reduction of groundwater from damming of water in their upstream catchments and the over-extraction of underground water for use along the coast (see page 161). As a consequence, seedlings and saplings are unable to obtain sufficient water to grow, meaning that as the mature trees age and die they are not replaced. Even mature trees with extensive root systems are unable to survive in severe cases of groundwater loss.

The vegetation of the Uniab River delta provides welcome grazing to large herbivores such as these gemsbok.



The Convention on Wetlands of International Importance, known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Convention’s mission is “the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world”.⁶

Sites recognised in terms of the international Ramsar convention are wetlands deemed to be of national and global importance in terms of their ecology and hydrology.

There are four Ramsar sites in Namibia, all designated in 1995: Walvis Bay; Sandwich Harbour; Orange River Mouth; and lastly, the area incorporating Etosha Pan, Lake Oponono and the Cuvelai drainage.

Right: Many of the smaller ephemeral rivers such as the Tsondab and Tsauchab no longer or very seldom reach the sea, and disappear into the sand. Sossusvlei, at the end of the Tsauchab River, holds floodwaters only after exceptional rains. During these periods, several types of algae and tiny crustaceans (copepods, ostracods and cladocerans) emerge from the dry pan sediments, and wetland birds then often arrive to feed on these newly available sources of food.



Above: The Kunene River mouth is an important habitat for a range of wildlife.

Right: While the Orange River itself does not support much riparian vegetation along its course, the mudflats and salt-marshes at the river mouth constitute an important wetland which can boast over 20,000 birds of over 56 species.



PATTERNS OF DIVERSITY AND ENDEMISM

The offshore environment

While Namibia's marine offshore environment boasts a very high biomass of plants and animals, it is home to few endemic species. As is typical in cold water habitats, the overall diversity of species is generally low, especially in the south. The richness of species increases northwards as more warm-water tropical species are found. Species in the south are typical of those which occur in the cold waters of the southern oceans, whereas those in the north are more characteristic of western coastal Africa.

The Angola Current is warm and nutrient-poor, and forms the northern distributional barrier for important Namibian fish stocks. The zone of transition between the cool temperate and tropical communities shifts as cold Benguela waters move northwards or warm Angola Current water flows south (see page 36). The warmer tropical waters are more likely to extend down the Namibian coast during summer, bringing tropical species further south than they usually occur, but unseasonal intrusions of warm water – Benguela-Niños – can also occur sporadically at any time of the year.

The Lüderitz upwelling cell (see page 36) also appears to act as a barrier preventing the north-south movement of fish. The cool offshore environment of the Benguela is thus divided into two ecological zones. Just what creates this barrier remains unknown since no significant differences in surface temperature, salinity or other environmental features have been discovered north and south of the upwelling cell.

Islands and the coastal environment

Unlike the northward increase in diversity in the pelagic environment, research suggests that the number of species of invertebrates along the shore generally increases southward from the Kunene mouth down to the southern Cape, on both rocky and sandy shorelines (Figure 30). These species are sensitive to sedimentation and localised areas of lower diversity are evident where there is increased sedimentation caused by, for example, strong wave action, river-borne sediments, strong upwelling or mining activities; some of the beaches currently being mined near the Orange River are completely devoid of invertebrate macrofauna.⁸

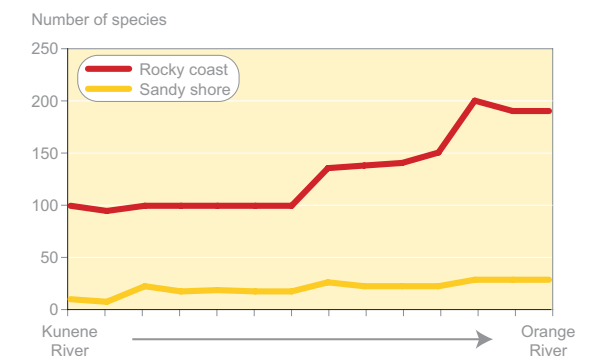


Figure 30. More species of invertebrates occur on rocky coast than on sandy shores.

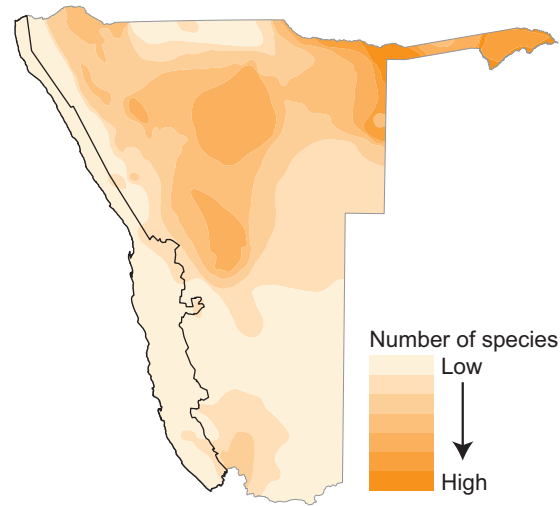


Figure 31. Patterns of terrestrial diversity of animals and plants.⁹

Terrestrial environment

Compared with the rest of Namibia, the diversity of terrestrial plants and animals in the coastal areas is low, particularly in the Namib Sand Sea and in areas closest to the coastline (Figure 31). There is thus a west-to-east gradient with diversity increasing inland. Although the concentrations of species on inselbergs and mountains are not apparent in Figure 31, these highlands support a particularly diverse assemblage of plants in the coastal area.

Vegetation in the Sperrgebiet is, however, an important exception to the west-to-east diversity trend. As a transition area between winter and summer rainfall, the Sperrgebiet has several times more plant species than the rest of the coast to the north. In fact, 1,050 species of flowering plants and ferns have been recorded in the Sperrgebiet. These represent nearly a quarter of Namibia's entire plant diversity, on just 3% of the land area. A large proportion of these plants are succulents. As a consequence of this diversity and the high concentration of species having restricted ranges, the Sperrgebiet has been identified as an Important Plant Area (IPA) and the Succulent Karoo biome has been globally recognised by Conservation International as one of the world's top 34 biodiversity hotspots. It is the only hotspot in an arid region.¹⁰ About one quarter of the terrestrial coastal area falls within the Succulent Karoo Biome and the rest in the Namib Desert Biome (Figure 28).



The Sperrgebiet is a hotspot of plant diversity with many amazing desert-adapted plants which are found nowhere else on earth.



Important Plant Areas (IPAs)¹¹

IPAs form an integral part of the Convention on Biological Diversity's Global Strategy for Plant Conservation, which was first endorsed by governments all over the world in 2002. However, being identified as an IPA does not confer any additional protection status.

The identification of IPAs is based on three broad criteria, namely: threatened species, botanical richness and threatened habitats.

A site qualifies as an IPA if it fulfils one or more of the following criteria:

- It holds significant populations of species of global or regional concern
- It has exceptionally rich flora in a regional context in relation to its biogeographic zone
- It is an outstanding example of a habitat type of global or regional importance.

As a result of their special adaptations to the unusual environmental conditions, many species of plants, frogs, reptiles, mammals, birds and invertebrates are endemic to the zone between the coast and escarpment (Figure 32). Perhaps the best known examples are the famous *Welwitschia* (see page 74), fog-basking beetles (see page 100) and the Vegetarian Desert Plated Lizard (see page 96). Since these endemic species are found nowhere else in the world or have the greater part of their range only in the Namib, Namibia has responsibility for their continued existence.

Many of the endemic plants have very small ranges, some even being restricted to a single inselberg.¹² There are several areas where endemic plants are concentrated, such as along the northern Kunene escarpment and in the Sperrgebiet Succulent Karoo biome. There are at least 136 endemic plant species plus 75 near-endemics (species which also extend north into Angola) in north-western Namibia, while 180 Namibian plant endemics and nearly 200 near-endemic species (species which extend south into South Africa) have been recorded in the Sperrgebiet.¹³

Many of Namibia's endemic plant species have been designated as Red Data species because of their restricted distributions and potential vulnerability to threats due to habitat degradation or uncontrolled collecting, for example.

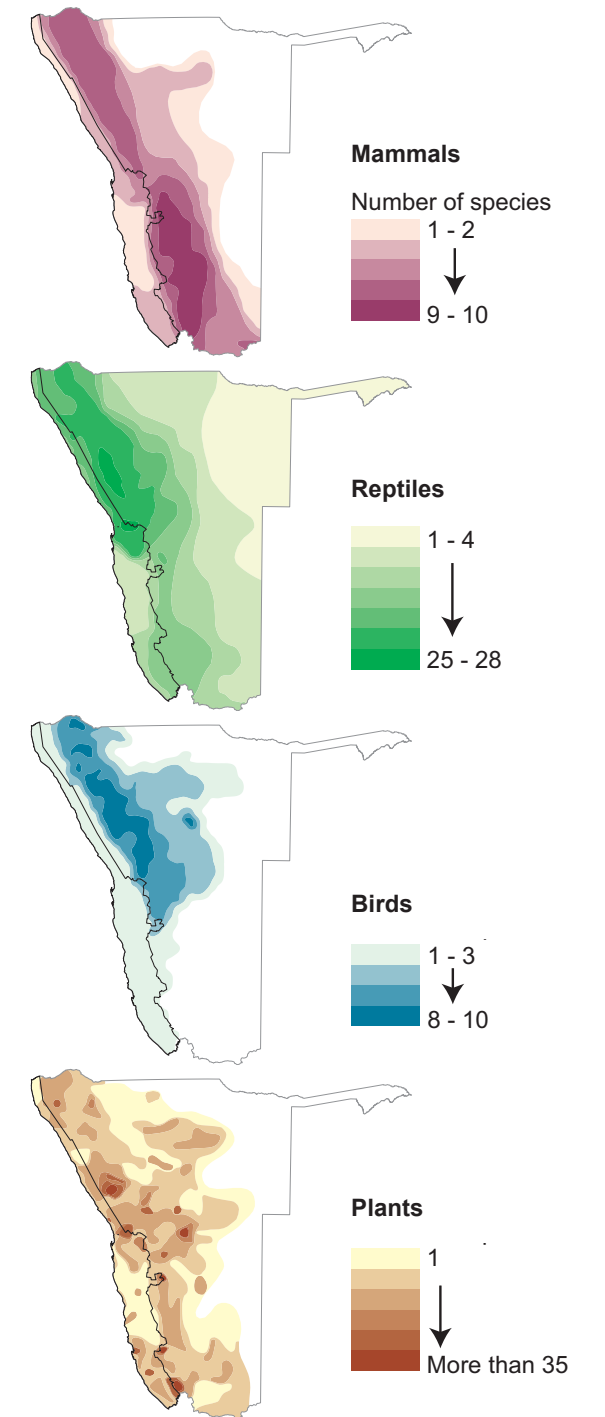


Figure 32. Numbers of endemic species in four taxa, in relation to the coastal zone.

PLANTS OF THE COAST

Terrestrial plants

Plants of the coastal areas have evolved a range of adaptations to cope with heat, wind, sand, brackish water and soil, low and irregular supplies of water, and soils that provide few nutrients. Fog is a water source for many species, especially those close to the coast where it occurs most frequently (see page 27), but also for plant communities near the tops of mountains where fog persists longer than at lower altitudes. One of the few species that can survive on the dunes during prolonged dry periods and is thus important in providing shelter and food for a large variety of desert animals is a small succulent dwarf tree called *Trianthema hereroensis* which is known to satisfy some of its water needs by absorbing water vapour directly from the air using its leaves. Other species use special structures, such as grooves and hairs on the leaves, to channel condensed fog water towards their roots.



The Dollar Bush only occurs in the Namib Desert and can survive in environments where few other plants can grow.

The majority of plants also have physical adaptations to help them conserve water. These include waxy layers on leaves, leaves which have been reduced to scales, and hairs which reflect light and heat to curb water loss.

Plants within the hummock dunes include widely and regularly spaced salt-tolerant shrubs, such as Ganna and Pencil Bush. The Dollar Bush – a semi-deciduous shrub with succulent leaves – is endemic to the Namib Desert and can survive in very saline soils, even on beaches. In many areas these species are the only shrubby vegetation, and sand is often trapped on their leeward sides to form sand hummocks. Gravel plains are the typical habitat of the Welwitschia.



The Bushman's Candle is common in the western parts of the southern Namib which receive winter rainfall. It has waxy stems and large colourful flowers that transform the desert.

Gypsum plains in the fog zone support vast lichen fields. Lichens are not single plants, but symbiotic associations of algae and fungi. They grow slowly, obtain virtually all their moisture from fog precipitation, and are important pioneers that colonise bare desert habitats, even bare rock. Over 100 species are estimated to occur in the Namib Desert, many of which are endemic to the Namib. The Sperrgebiet alone is known to hold more than 90 species.¹⁵

Lichens provide micro-habitats for other flora and fauna, and are important food sources for such animals as insects, beetles, spiders, reptiles and mammals including gerbils and springbok. They play a key role in soil-crust formation, entangling the soil surface along with cyanobacteria, algae, mosses and liverworts to form a protective layer resistant to wind and water erosion. Soil crusts help to retain moisture at the soil surface, encouraging grass seed germination, nutrient uptake by plants and the cycling of nitrogen and carbon. Their presence can significantly increase the nitrogen content of soil.



A lichen named *Santessonia namibensis* which occurs in the Skeleton Coast Park probably has one of the smallest ranges of all lichens in the world.

Lichens are fragile, taking 5 to 530 years to recover from vehicular disturbance. Century-old wagon tracks are still visible in parts of the Namib where the lichens have not recovered.¹⁶ They are highly vulnerable to the impacts of off-road driving, now inflicted mostly by the tourism/recreation (quad-biking, scrambling, 4x4 enthusiasts) and mining (prospecting and exploration) sectors. The lichen fields in the central coastal area have been identified as an Important Plant Area.



Above: Collecting and habitat degradation caused by mining are potential threats to many of Namibia's endemic plants. *Lithops ruschiorum* is a dwarf succulent which is known from only about 30 locations in the coastal area between Walvis Bay and the Kunene River mouth.

Right: Subterranean water beneath sand dunes supports the !Nara, the melon-like fruits of which are important for both people and wildlife.

Below: Many of the plants in the coastal area are highly specialised and have very restricted ranges such as the Krimpvarkie which is known from just a handful of locations in the Sperrgebiet. It favours steep, east-facing slopes that receive both full sun and fog precipitation.



Threats to terrestrial plant life include both legal and illegal trade in succulents such as living stones or lithops and halfmens which is thought to be considerable. Alien species have become established in some areas and have negative impacts on indigenous flora as a result of competition for nutrients, light and water. For example, mesquite and wild tobacco occur in many of the ephemeral rivers.

Although most endemic plants occur in the southern Sperrgebiet, several endemic and Red Data plants live in the northern coastal areas including species such as Sesfontein-aalwyn, the dwarf succulent *Lithops ruschiorum* and Elephant's Foot. Red Data species in the Sperrgebiet include perennial shrubs such as Gewürzdoelje, a Namibian endemic known from only a handful of locations, spiny succulents such as *Hoodia alstonii* and *H. officinalis*, succulents which can survive being completely buried in sand such as the clump-forming grass *Tridentea pachyrrhiza*, and species such as Krimpvarkie which have a range of less than 100 square kilometres. Some of these rare species are targeted by illegal collectors.¹⁷

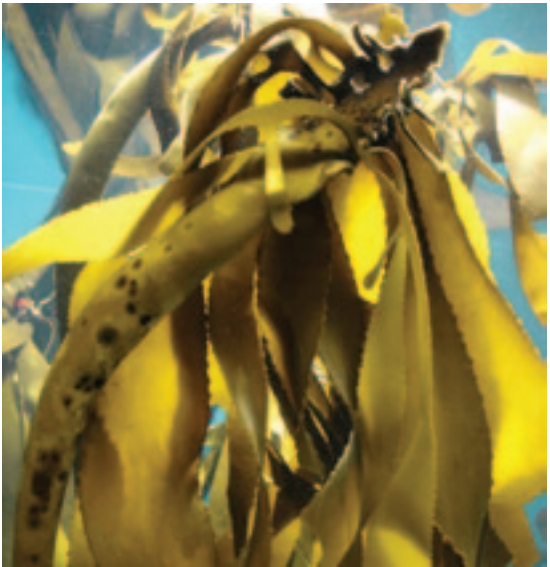
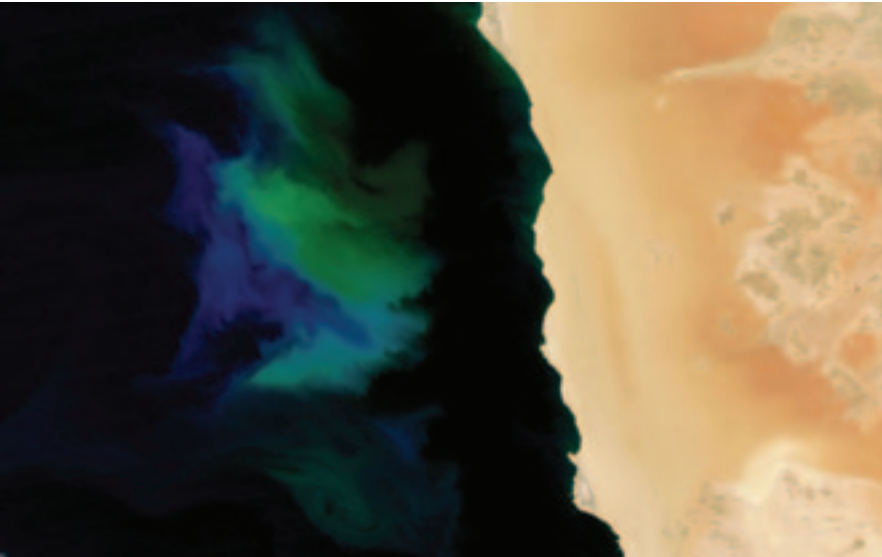


Marine plants

In comparison with the sparse terrestrial vegetation, marine plant life is highly productive. The biological wealth of the Benguela Current stems from primary production of phytoplankton – microscopically small plants. Diatoms dominate the phytoplankton, and undergo very rapid population blooms after upwelling events (see page 38). There are at least 184 species of diatoms in Namibian waters of which just a handful are endemic to the Benguela system.¹⁸ A secondary role in production is played by another group of marine plankton – the dinoflagellates – which multiply more slowly than diatoms, grow well under low nutrient conditions and dominate production blooms some time after upwelling has occurred. At least 158 species of dinoflagellates occur in Namibian waters.¹⁹ Dinoflagellates are responsible for the harmful algal blooms known as ‘red tides’ which may poison fish, shellfish, birds and mammals.

Seaweed is a loose term encompassing macroscopic, multi-cellular, benthic algae. About 205 species from the three main groups of green, red and brown seaweed have been collected in Namibian waters, yet none is endemic.²⁰ However, relatively few of the species which occur off the Kunene coast have been recorded in Angola, suggesting that a major change in the marine flora occurs at, or just north of, the national border. There are more seaweed species along the southern part of the coast than the north, and most species found in Namibia also occur on the west coast of South Africa, which has twice as many species.

Seaweed growth rates on the Namibian coast are amongst the highest in the world, presumably because of the rich supply of nutrients in the Benguela. The substantial kelp forests provide protection and shelter to many marine animals and a substrate



Above: The kelp forests are an often-overlooked but important feature of the coast, providing food, protection and shelter to young and vulnerable life stages of many marine animals.



Above: The nutrient-rich waters of the Benguela support very high rates of seaweed growth along Namibia's coast.

Left: A phytoplankton bloom captured by NASA's Aqua satellite in November 2007. The bloom persisted for several days and stretched hundreds of kilometres up the coast. The stretch between Lüderitz and Walvis Bay (shown here) had the highest phytoplankton concentrations.

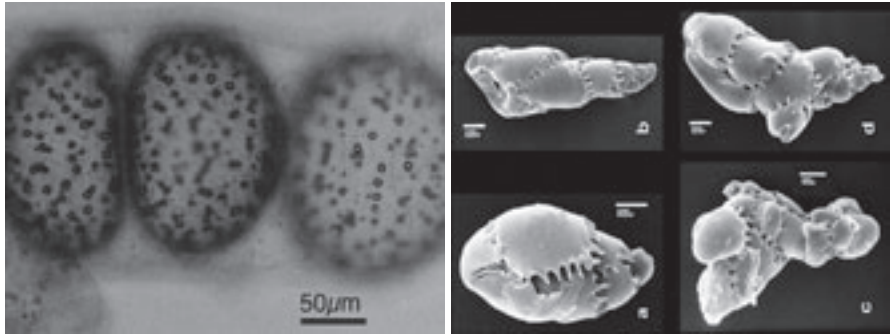
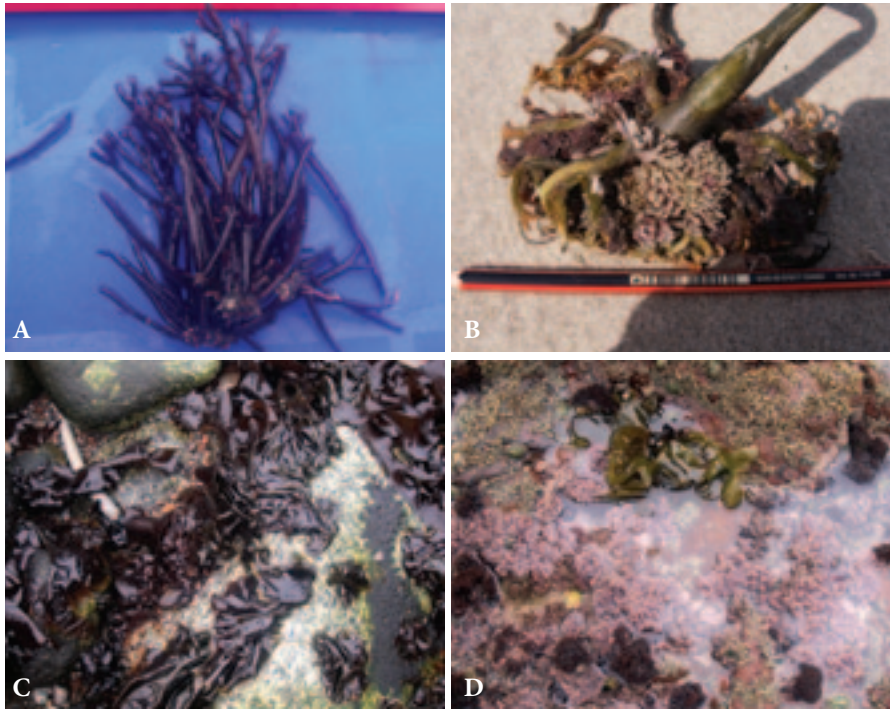


Above: Foam on beaches often occurs after algal blooms when the phytoplankton decompose and is an indication of high concentrations of dissolved organic matter in the water.

A - D right: Typical of cold water habitats, the species diversity in the inter-tidal zone is relatively low, but densities are high.
 A. Red algae - *Champia* species.
 B. Kelp - *Thais haemostoma*.
 C. Red algae - *Porphyra* species.
 D. Inter-tidal diversity.

on which other organisms can live. The kelp also feeds herbivores, and contributes energy to sandy beaches in the form of decomposing plant material, as well as acting as a buffer against the effects of wave action.

In addition to their ecological role, seaweeds are also of economic importance. Products derived from seaweeds are used as food thickeners, stabilisers, emulsifiers and gelling agents. Many species of seaweed in Namibia have been identified as having economic potential, and some are already utilised commercially. Warty Gracilaria – a red algae – is harvested from beaches and cultivation ponds in the Lüderitz area, dried and exported to produce agar, which is a microbiological medium. Kelp – a brown algae – is harvested for human consumption. At least six other species in Namibia could be harvested for sale.

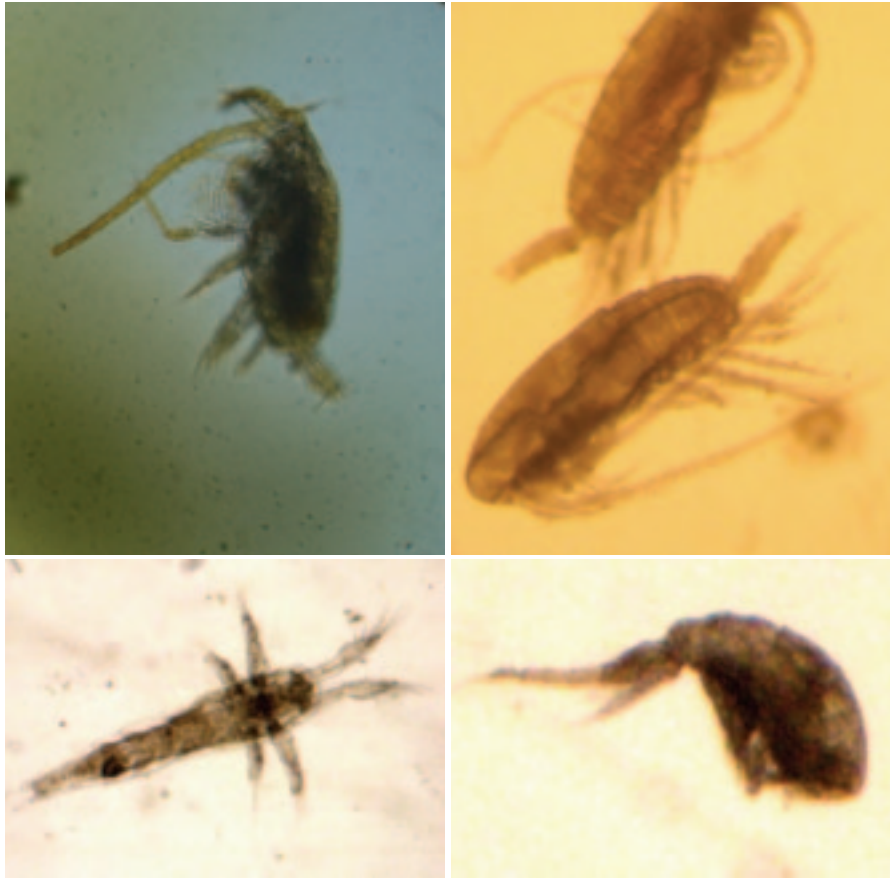


Right: Diatoms are one of the most common types of phytoplankton and key producers in the food web.

ANIMALS OF THE COAST

Zooplankton

Zooplankton comprise many different floating or swimming organisms as well as the eggs and larvae of a range of marine organisms including fish. In Namibian waters they are, however, dominated by small crustaceans such as planktonic copepods and euphausiids (krill). Copepods are important food for juvenile fish and are the most diverse group of zooplankton, with at least 243 species in Namibian waters.²¹ Other major zooplankton groups include single-celled protozoans, hydrozoans and chaetognaths (planktonic arrow worms). Numbers of zooplankton increase rapidly following blooms of phytoplankton and they play an important role in the aquatic food web, providing an important food resource for higher animals such as fish and whales. There is a zone of consistently high zooplankton biomass to the west and north-west of Walvis Bay, attracting the whales which gave it the name ‘Bay of Whales’.



Zooplankton such as these copepods are a major food source for small fish, whales, seabirds and other crustaceans such as krill.



The productive waters support a commercial fishing industry of great economic value.

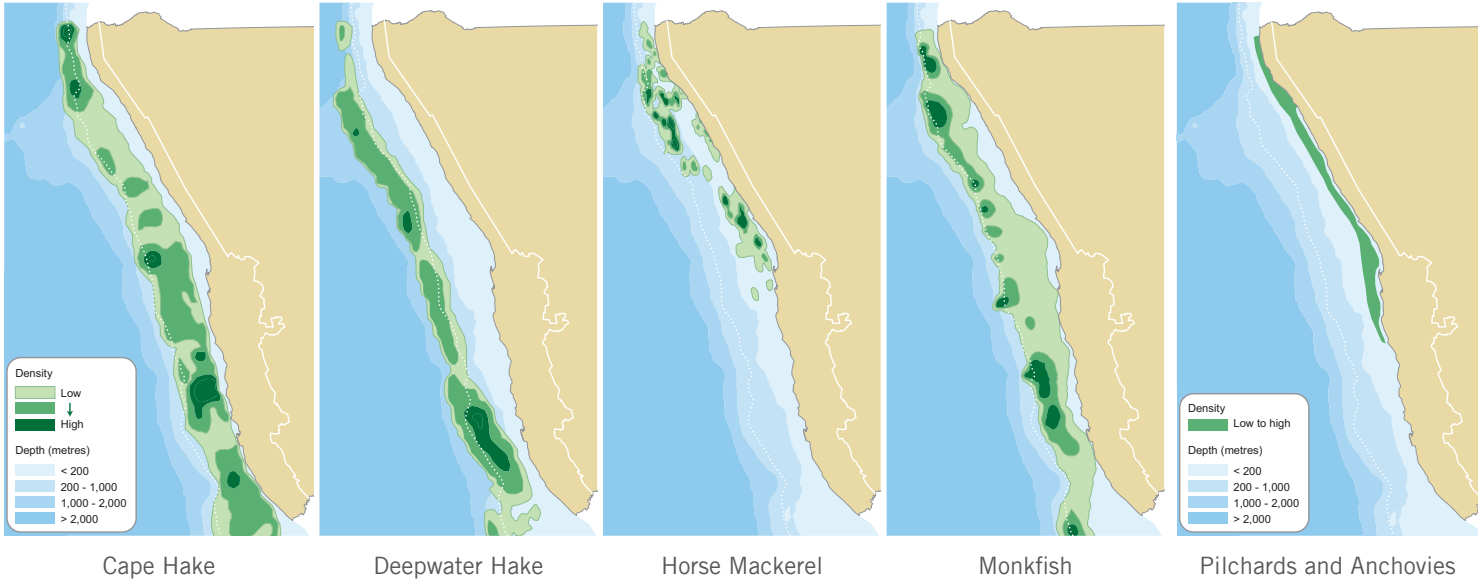
Marine fish

Almost 500 species of fish are known to occur in Namibian waters, comprising about 410 species of bony fish and 83 species of cartilaginous fish.²² Of these, the eight species now fished commercially support an industry which generated over N\$3 billion in 2008 (see Chapter 6 page 148). The marine fisheries are now dominated by Horse Mackerel, Hake, Pilchard, Monkfish, Tuna, Deep-sea Red Crab and West Coast Rock Lobster.²³

The abundance and distribution of Namibia’s marine fish has varied considerably over the years. It is generally assumed that many of the population declines were due to over-fishing, but environmental factors have also affected populations. Perhaps the most influential of these are the intrusions of warm, more saline water with low levels of oxygen from Angola. Local, cold water fish then suffer because of reduced plankton production, while shortages of oxygen particularly affect juvenile fish. The low-oxygen event of 1993–1994 that affected most of the central and northern Namibian continental shelf was linked to catastrophic losses of juvenile Hake.²⁴ Red tides, sulphur and methane eruptions, and shortages of oxygen are also detrimental to the population densities of local cold water fish.

Species of fish vary in their preference for different conditions in the ocean, and are thus found and harvested in different areas and depths. The maps in Figure 33 show the distributions of a selection of commercially valuable species.

Figure 33. The distribution and relative abundance of Cape Hake, Deepwater Hake, Horse Mackerel, Monkfish, and Pilchards and Anchovies. The dashed line is the continental shelf.²⁵



Pelagic fish spend much of their time relatively close to the surface, often in water that is shallower than 200 metres and generally within 50 kilometres of the shore. About 91 species of bony fish and 30 species of cartilaginous fish have been recorded in depths of less than 30 metres; these include Pilchard, Tuna, Albacore, Big-eye Tuna, Swordfish, Short-fin Mako and Blue Sharks.²⁶ Pilchards have had the greatest commercial value, at least in the 1960s and 1970s when hundreds of thousands of tonnes of these tiny fish were caught each year. The stocks of Pilchards then collapsed (see page 149), which apparently contributed to declines in populations of their predators, such as African Penguin, Cape Gannet and Cape Cormorant. The status of the Pilchard stock remains precarious.

A recent shift in conditions in the northern Benguela appears to have followed the collapse of the Pilchard stock in the early 1980s when these fish were replaced by a suite of predators including Horse Mackerel, Pelagic Gobies and jellyfish that feed on zooplankton.

Midwater fish live at greater depths than those in the pelagic zone. The most commercially valuable are Cape Horse Mackerel and juvenile Hake, while significant numbers of Dentex, Hake, Snoek, Angelfish and John Dory are caught incidentally as by-catches. Young Horse Mackerel are generally found close to shore and near the surface, while adults occur further offshore and migrate between surface waters and deeper waters each day.

Demersal fish live near or on the seabed. Commercially, Hake and Monkfish predominate with the following species as by-catch: Sole, Snoek, Jacopever, Dentex, Squid, Kingklip and Angelfish. There are two species of hake: the Cape Hake which is usually found between the shore and depths of about 400 metres, and Deepwater Hake that favours depths of between 150 and 800 metres. A survey of biomass in 2007 estimated an amount of about 700,000 tonnes of hake off the Namibian coast, but indicated that 83% of these were too small to fish commercially.²⁷ Monkfish occur mainly at depths of 300 to 400 metres off the central coast (see page 151).

Deep sea fish also live near the seabed but at depths of 600 to 1,000 metres where the bottom temperature is between 3 and 7°Celsius. Harvesting focuses on Orange Roughy, but significant numbers of Alfonsino, Cardinal fish, Hake and John Dory are taken as by-catches. Orange Roughy are exceptionally long-lived and slow growing, reaching sexual maturity only at about 25 years of age. Recent research using sophisticated lead-radium dating techniques showed that they can reach an age of at least 93 years.²⁸ In 2008, following 11 years of declining catches, the fishing industry agreed to a moratorium on Orange Roughy.



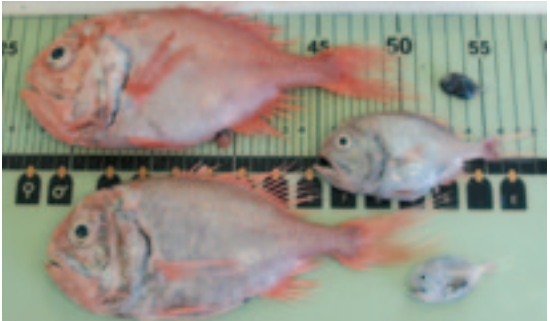
Above: Recreational angling and lobster fishing add value to the coast and attract thousands of visitors annually. Fish species sought by anglers include Galjoen, Steenbras, Kob and Blacktail. Other animals that are harvested on the coast include mussels, crabs and lobsters.



Blacktail



Jacopever



Orange Roughy



Swift terns are known to breed at 8 localities in Namibia. Their main prey is pilchards and anchovies which they catch by plunge-diving or dipping for shoaling fish.



Marine birds

The abundance of fish and other food on and off the coast provides a rich habitat for birds. Sixty-two species of seabirds have been recorded in Namibian waters, and these can be divided into three main groups: species that breed and roost on islands just off the coast; those that forage off the coast but breed elsewhere in the world, and those that frequent estuaries and bays.

The islands off the southern Namib provide important breeding and roosting sites for 11 of the 14 seabird species that breed in Namibia. For seven of these species the islands hold the majority of their global breeding populations: African Penguin, Cape Gannet, Bank Cormorant, Crowned Cormorant, Cape Cormorant, African Black Oystercatcher and Hartlaub's Gull. Ichaboe Island, Mercury Island and Possession Island are particularly important roosting and breeding sites for cormorants, penguins and gannets. Other species that breed on the southern islands are White-breasted Cormorant, Kelp Gull, Swift Tern and Caspian Tern, while Great White Pelicans breed on the Bird Rock platform north of Walvis Bay. Seabirds which breed on the mainland include Damara Tern and Grey-headed Gull. There is also one mainland colony of African Penguins at Sylvia Hill, midway between Lüderitz and Conception Bay.

The recent declines of Bank Cormorant have been attributed in part to the dramatically reduced lobster population, since they forage primarily on West Coast Rock Lobster and Bearded Goby. African Penguins, Cape Gannets and Bank Cormorants are currently the most endangered seabirds in Namibia because the number of breeding pairs has declined drastically. These species, as well as African Black Oystercatchers and Damara Terns, are listed as 'Specially Protected' birds in the draft Namibian Parks & Wildlife Bill 2007.

As one of Namibia's most endangered bird species, the rare and near-endemic Damara Tern has become a flagship species for coastal conservation. Its global population is estimated to be about 14,000 adult birds, of which about 98% breed in Namibia between late October and mid-November. The terns disperse north after breeding and are recorded regularly from west African coastal waters between the Democratic Republic of Congo and Côte d'Ivoire.

The terns usually breed on gravel plains in northern Namibia, but in the south they prefer to nest on salt pans. Most nests are close to feeding grounds along the shore, but breeding colonies are sometimes found up to 11.5 kilometres inland on gravel plains between the dunes. The highest densities of breeding pairs are found in the central coast between Sandwich Harbour and the Ugab River. The densest breeding colony known is at Caution Reef, just south of Swakopmund. Nesting pairs and their single chicks are very sensitive to human disturbance.²⁹

Substantial numbers of non-breeding migrant birds from the islands of the Southern Ocean over-winter in Namibian waters, usually foraging far offshore. These include up to three quarters of a million albatrosses, petrels and shearwaters. The ocean to the north of Walvis Bay is particularly attractive for these birds.³⁰

Other birds which breed along the coast (but which are not considered to be seabirds) include waders such as White-fronted and Chestnut-banded Sandplovers. Most of them nest in coastal salt pans and estuaries.

River mouths and bays along the coast provide rich feeding grounds for terns and waders such as flamingos, plovers and sandpipers (Figure 35 on page 102). The greatest concentrations occur in the central area between Cape Cross and Conception Bay. The most important sites are Walvis Bay, Sandwich Harbour and the wetlands and beaches around Swakopmund.

The average number of birds and species of birds recorded at various coastal sites listed from north to south. ³¹		
Site	No of birds	No of species
Kunene River Mouth	610	46
Hoarusib River Mouth	50	21
Hoanib River Mouth	200	35
Uniab River Mouth	90	31
Huab River Mouth	90	32
Ugab River Mouth	70	28
Durissa Bay sites	33,640	8
Cape Cross sites	15,240	45
Swakopmund sites	63,630	79
Walvis Bay sites	91,160	94
Sandwich Harbour sites	77,420	77
Conception sites	16,780	25
Mercury Island	8,750	5
Ichaboe/Neglectus Island	21,970	16
Lüderitz sites	10,080	53
Elizabeth Bay sites	7,490	22
Sinclair's/Plumpudding Island	1,210	5
Orange River Mouth	4,780	92



The Namibian population of Kelp Gulls is estimated at 2,000 pairs. They are aggressive predators and take every opportunity to rob the nests of African Penguins, Cape Gannets, cormorants, terns and Hartlaub's Gulls. African Penguins, in particular, are highly vulnerable since the removal of the guano in which they used to build burrows has forced them to make their nests on the surface where their eggs and chicks are easy prey.

Terrestrial birds

Just a few species typically occur close to the coast; these include Ostrich, Rüppell’s Korhaan, Barlow’s Lark, Dune Lark, Benguela Long-billed Lark, Gray’s Lark and Tractrac Chat. All except the Dune Lark favour gravel plain habitats.

Like other animals, birds have evolved a range of physiological and behavioural mechanisms to cope with extreme conditions along the dry coast. These include being opportunistic and moving rapidly into areas which have received rain, placing nests on the most shaded side of plants and being inactive and seeking shade during the heat of the day. The Dune Lark, for example, stops foraging and shelters in the shade of tufts of *Stipagrostis* grass when the sand reaches 50°C. Others, such as Gray’s Lark and Tractrac Chat, perch a few centimetres above ground level and adopt a posture which exposes their less-feathered undersides to cool sea breezes.³²

Marine mammals

Marine mammals in Namibia’s waters include the Cape Fur Seal and 31 species of whales and dolphins (collectively called cetaceans). These comprise eight baleen whales (those that use baleen plates in the upper jaw to filter food such as krill). There are only 11 species of baleen whales in the world. Twenty-three species of toothed whales which hunt prey (called odontocetes, and including sperm whales, beaked whales, killer whales and dolphins) have been recorded off the coast. The Sea Fisheries Act (29 of 1992) gives Namibia’s marine mammals full protection within the 200 nautical mile Exclusive Economic Zone.

Namibia’s most conspicuous marine mammal, the Cape Fur Seal is the only seal to breed along the coasts of South Africa and Namibia. Approximately 60% of the world population of this species occurs in Namibia. Their main prey in Namibian waters includes juvenile Cape Hake, Horse Mackerel and Pelagic Goby as well as squid, lobsters and crabs.³³ The seals breed in dense colonies on small, rocky, offshore islands as well as at a number of mainland rookeries.

Extensive harvesting during the 18th, 19th and part of the 20th century reduced their populations significantly. Seals are still slaughtered annually, but the harvest is limited to allocations set by the Ministry of Fisheries & Marine Resources (see page 155). In 1992-93 the Namibian seal population was estimated at about 900,000. It then collapsed in the mid-1990s due to reduced prey availability, and in 2001 the population numbered 450,000 to 500,000. The 2007 count estimated 770,000 seals in total, of which 120,000 were pups. Their distribution appears to have shifted northwards in recent years: the percentage of all pups born north of 25° South (near Sylvia Hill) was less than 20% in the early 1980s, 30-34% between 1989 and 1993, increasing to over 40% since the mid 1990s. The five main breeding colonies, in order of size are Cape Cross, Atlas Bay, Wolf Bay, Cape Frio and Long Island.³⁴



The aerial census in 2006 found that only 20.1% of all seal pups born in Namibia were in island colonies, while the remainder were in mainland colonies.³⁵

Although seals are relatively abundant their population is influenced by many factors, both natural and man-made. Natural factors include food shortages resulting from reduced upwelling and LOWs (see page 42); poisoning during algal blooms, and predation by Brown Hyaenas, Black-backed Jackals, the occasional Lion, Great White Sharks and Killer Whales. Human-induced change to the environment or direct impacts which may threaten seals include food shortages resulting from over-fishing; sealing (at Cape Cross, Wolf and Atlas Bays); entanglement in fishing gear; and man-made barriers that limit access to breeding sites on islands where the seals would displace breeding seabirds.

Substantial populations of baleen whales were heavily exploited in the 19th century in Namibian waters, and some species were driven almost to extinction before the two collapses of the whaling industry in the early 1800s and early 1900s. For example, more than 3,700 Southern Right Whales were landed at Walvis Bay alone between 1788 and 1803, and hundreds of Blue, Fin and Humpback Whales were harvested each year during the 1930s.³⁶ It is estimated that less than 10% of the original numbers of some species, such as Blue and Humpback Whales, remained in the 1960s. Despite international protection for most species, populations have not yet recovered.



Above: This washed up Fin Whale provided an easy meal for a variety of coastal scavengers such as these ghost crabs.

Left: Whale populations in Namibian waters were decimated during the 18th and 19th centuries. First, American and European whalers drove the Southern Right Whale to virtual extinction in the area and then turned their attention to the Humpback Whale. At the end of the 19th century, modern industrial whaling using steam boats and cannon harpoons began and all species of large whales were intensively exploited. Sperm Whales, Humpback Whales, Fin Whales, Blue Whales and other species were caught and processed at whaling stations along the coast. As whale numbers declined, these shore-based whaling stations were soon replaced by large factory ships.

Left: The birth of a Southern Right Whale in Elizabeth Bay in 1996 was the first breeding record for this species on the Namibian coast for over 100 years. Since then, between one and three calves have been born each year between Conception Bay and the Orange River. The population is still extremely small, however: four animals were reported in the 1970s, seven in the 1980s, and 46 during the 1990s. The most recent aerial survey of the whole coast in October 2010 found 28 Southern Right Whales, all of them between Swakopmund and the Orange River.³⁷



Above: The Namib Golden Mole is highly specialised for underground living: it has webbed feet for shovelling sand, no eyes and a snout which is protected with hard skin for burrowing. It is most active at night when it ‘swims’ through sand just below the surface and moves about on the surface. It feeds almost exclusively on termites.

Right: Brown Hyaenas living on the Namibian coast forage amongst seal colonies, scavenging and killing seal pups, but they also eat other mammals, birds, reptiles and fish. Much of their time is spent on the beaches when and where newborn seal pups and carcasses are abundant.⁴⁰ Those hyaenas living inland are predominantly nocturnal and their home ranges (of up to 3,000 square kilometres) are much larger than those living along the coast, which cover up to 800 square kilometres.⁴¹

Most of the eight species of baleen whales are thought to be primarily seasonal visitors to Namibia, travelling between their summer feeding grounds in the Antarctic up the west coast of southern Africa to their breeding and calving grounds in the tropics north of Angola.³⁸ Of the toothed whales and dolphins, some species such as the Dusky, Bottlenose and Heaviside’s Dolphins are year-round residents and are commonly found in Namibian coastal waters. Heaviside’s dolphin, also known as the Benguela Dolphin, is endemic to the Benguela Current. Two of the three species of Sperm Whales have been confirmed from Namibia, while the Southern Bottlenose Whale and Blainville’s Beaked Whale have recently been recorded here for the first time.³⁹

If there were to be a real increase in whale numbers, whale-watching tourism modelled on the successful enterprises in South Africa could become a significant source of income.

Terrestrial mammals

Very few land mammals live permanently near the coast. There is almost nothing for herbivores to eat, and only scavengers do comparatively well by feeding off animals that come from the sea. Black-backed Jackals are common, while Brown and Spotted Hyaenas are less abundant and relatively inconspicuous because of their nocturnal habits.

More species occur further inland and, as with all animal groups, the number of species increases eastwards as conditions become more hospitable. The Namib Sand Sea is home to the Namib Dune Gerbil and the Namib Golden Mole, which are highly adapted to this habitat and do not occur anywhere else in the world. In the plains and grasslands there are small mammals such as shrews, aardvarks, hares, rabbits, porcupines, bat-eared foxes and larger mammals such as gemsbok and springbok; in the rocky outcrops, mice, rock hyrax, klipspringer and dassie rats. Along the river courses, a more diverse and lush vegetation supports a richer diversity of mammals including larger species such as baboon, black rhino, giraffe, kudu and elephant.



Marine reptiles

Five of the world’s eight species of sea turtles occur in Namibian waters although none breed along the Namibian coast. Most sea turtles are considered globally endangered and all are protected in Namibia by the Sea Fisheries Act of 1992. Leatherback Turtles are the most abundant, being most often seen between Henties Bay and Sandwich Harbour. Although hundreds of dead adult leatherbacks have been found washed up in recent years, the cause of their mortality is unknown.⁴² Generally, their numbers appear to be increasing, probably because their favoured food of jellyfish has become more common in Namibian waters since the collapse of the anchovy and pilchard populations (see page 149). Green Turtles occur all along the coast but are usually found north of Henties Bay, with some being present all year in the warmer water near the Kunene River mouth. Olive Ridley Turtle, Hawksbill Turtle and Loggerhead Turtle are infrequently seen.⁴³

Terrestrial reptiles

With 261 species of reptiles, Namibia has about 30% of all African species.⁴⁴ Few species occur on the immediate coast, but the Namib coastal zone and the adjacent escarpment is home to a rich assemblage of species. About 60 species – mostly lizards – are endemic to, or mainly found in the Namib Desert.

Reptiles in the coastal environment have evolved a range of physiological and behavioural adaptations suited to the arid and hot conditions. The Web-footed Gecko, which is endemic to the Namib, has extensive webbing between its toes which helps it stay on top of the sand and also to bury itself beneath it. Sand-swimming is



Above: Young Green Turtles feed on jellyfish and other floating organisms while older turtles are generally herbivorous. They grow slowly and only reach sexual maturity at age 10 to 15.



Above: Péringuey's Adder (commonly known as the sidewinder) has several adaptations which enable it to survive in the desert. Its infamous sidewinding motion lifts most of its body off the hot surface and allows it to move quickly over hot, loose sand. It shuffles itself into the sand with only its eyes exposed and waves its black tail tip to attract lizards. To obtain water, it drinks fog droplets condensed on its body.

Left: Web-footed Gecko



Above: Bradfield's Namib Day Gecko only occurs from the Kuiseb River to Twyfelfontein. During the heat of the day it hangs on the shaded vertical sides of large, dark rocks, dashing out to seize food such as beetles which come close.

almost unique to the Namib and is typical of species that live in the sand dunes, such as the Shovel-snouted Lizard which dives into the dune slipface when disturbed, swimming deep into the sand. This endemic species can withstand body temperatures of 44°Celsius but avoids overheating by lifting its tail and two feet off the sand. The Desert Plated Lizard is found in scrub-covered sand dunes in the northern Namib and, when necessary, can spend up to 24 hours under the sand sheltering from danger and extreme temperatures. The common Namib Day Gecko takes advantage of any cool breeze by lifting its body high to cool in the wind.⁴⁵



Right: The Namaqua Chameleon lives in some of the hottest, most barren areas. It forages at the coast and has a nasal salt gland which allows it to get rid of excess salt. Females are bigger than males.

Below and right: Hoesch's Toad and the Marbled Rubber Frog are associated with inselbergs and other rock outcrops in arid environments. They breed opportunistically in temporary pools in rocky areas which retain water long enough for the tadpoles to develop.



Terrestrial amphibians

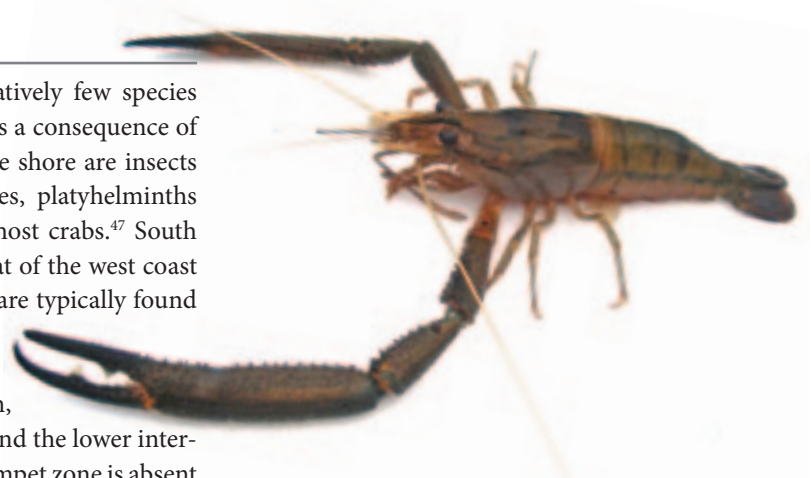
As a result of their dependence on fresh water for breeding, very few amphibians (frogs and toads) occur in the true desert; those that do have evolved behavioural adaptations to endure the aridity. Ten species are known from the coast north of Swakopmund and 13 to the south of Swakopmund.⁴⁶



Marine invertebrates

While Namibia's rocky shores and sandy beaches support relatively few species (see page 79), the biomass of invertebrates is moderate to high as a consequence of the nutrient-rich tidal waters. The most abundant groups on the shore are insects and spiders associated with washed up kelp wrack, nematodes, platyhelminths (flatworms), amphipods (small shrimp-like crustaceans) and ghost crabs.⁴⁷ South of Lüderitz the invertebrate species composition is similar to that of the west coast of South Africa, whilst several species along the northern coast are typically found in tropical areas.

There are also differences within the inter-tidal zone: in the south, the upper inter-tidal zone is dominated by three mussel species and the lower inter-tidal zone is dominated by limpets. On the northern shores, the limpet zone is absent and the mussel belt – with two different mussel species – is more extensive.⁴⁸



Above: The African River Prawn is at its southern limit in the Kunene River and doesn't occur anywhere else in Namibia.

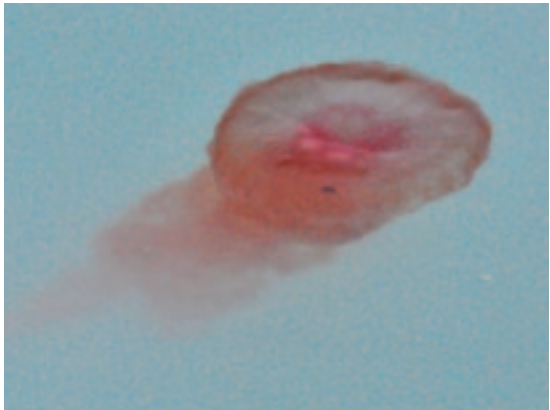


Left: Ghost Crabs are common on the beaches of the Skeleton Coast.



A – Plough snails are scavengers which live on wave-exposed sandy beaches. They emerge from the sand when the tide comes in and surf up the beach to congregate around carrion such as dead and stranded jellyfish and bluebottles which they detect by smell.

B – The inter-tidal zone supports a high biomass of marine invertebrates including dense beds of mussels.



Above: Jellyfish numbers in the Benguela system have exploded in recent years, probably due to the crash in pilchard numbers which has resulted in increased availability of plankton. Many fish avoid jellyfish and few animals eat them, but recent research has found that a small fish called the Bearded Goby does eat them and also appears to gain protection from predators by swimming among jellyfishes' tentacles. The goby has become the main prey of bigger fish such as hake and Horse Mackerel, as well as food for seabirds, penguins, and seals, filling the ecological niche previously occupied by pilchard.

A – Sea urchins are common in some kelp beds and form part of the diet of the West Coast Rock Lobster.

B – Goose barnacles are filter-feeding crustaceans that live attached to ships and floating objects and are often found on washed-up driftwood.

C – Anemones are common in coastal rock pools. Although pretty, they are deadly to small fish and shrimps which they detect and catch using their tentacles which are armed with stinging cells.

D – *Chthamalus* barnacles at Rocky Point. These animals are permanently attached to the rock and do not move.

Further out into the ocean, communities on the rocky seabed are also low in diversity but high in biomass. Dominant groups in the south are mussels, whelks, urchins, sea cucumbers and sea anemones. The West Coast Rock Lobster is the main predator, feeding extensively on mussels but also on other animals if mussels are limited.

West Coast Rock Lobsters are harvested between November and April. They occur in water shallower than 30 metres in summer, while deeper waters up to 100 metres are preferred in winter. The lobsters are long-lived and slow-growing,⁴⁹ taking up to six years to reach the legal minimum size for harvesting. Their populations and harvests have plummeted over the years (see page 149), and so the fishing industry has increasingly been catching Deep-sea Red Crabs, which are found at depths of about 300 to 900 metres far off the coast (Figure 34).

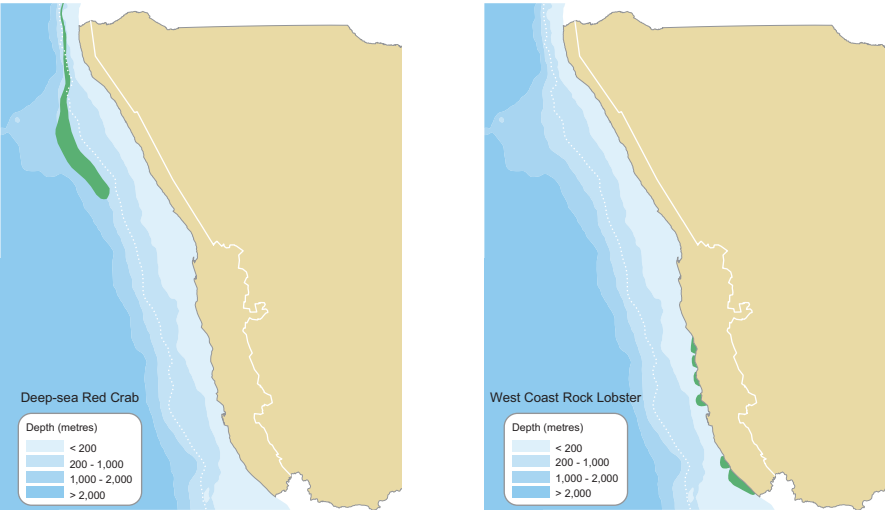


Figure 34. The main concentrations of West Coast Rock Lobster (right) and Deep-sea Red Crab (left).⁵⁰



A – Limpets in the inter-tidal zone are preyed on by birds such as Kelp Gull and African Black Oystercatcher.

B – Bryozoans are colonial invertebrate animals which sieve food particles out of the water using a crown of tentacles.

C – Periwinkles are common on exposed rocky shores; they are herbivores and feed mainly on diatoms and microalgae.

D – Dogwhelks on a rocky shore.



Above: As a consequence of the environment, most of the spiders in the coastal area are ground-living, rather than web-living, spiders.

Below: Beetles play an important role in coastal habitats, often being the dominant detritivores – feeding on wind-blown detritus and thereby recycling nutrients. In wetter environments, soil micro-organisms fulfil this role.



Above: The highest diversity of scorpions is in low rainfall areas of rocky and sandy substrates. Seven species are endemic to the Namib Desert, and three of these occur only on sand dunes. One species of rock scorpion (*Hadogenes lawrenci*) is known from only one inselberg in the Namib Desert sand sea.

Terrestrial and freshwater invertebrates

Namibia’s deserts have a rich fauna of arachnids, particularly solifugids (sometimes called Romans, Sunspiders or Beard Cutters), spiders and scorpions. ‘Solifugid’ is derived from Latin meaning those that flee from the sun and, indeed, they are mostly nocturnal. The sand seas of the southern Namib are particularly rich solifugid areas, and Namibia is thought to have the world’s greatest diversity. Twenty-eight species are known to be endemic to the Namib Desert, of which three are confined to the sand dunes. One species (*Ceroma inerme*) has adopted a truly coastal habitat, living just outside the high tide zone and foraging in the inter-tidal area at low tide.⁵¹ The Namib has relatively few spider species. Thirteen species are known to be endemic to the Namib Desert, of which seven are confined to sand dunes. Some have evolved highly specialised behavioural adaptations which enable them to walk on and burrow into loose sand.

The number of species of spiders, solifugids and scorpions known in the coastal area ⁵²			
Coastal Area	Spiders	Solifugids	Scorpions
Northern (Kunene River to Ugab River)	9	4	13
Central (Ugab River to Kuiseb River)	45	27	19
Sand sea (Kuiseb River southwards)	8	10	6
Succulent Karoo	95	27	20

The central Namib gravel plains and the sand sea between Lüderitz and Swakop-mund have more species of insects than the northern and southern parts of the Namib coastal belt. The central gravel plains are also home to many endemic species, as is the escarpment in Kunene and Sperrgebiet. The Namib Desert is well-known for its substantial number of beetle species (particularly Tenebrionids), some of which have evolved methods of capturing fog as a source of water.

It is no surprise that few freshwater invertebrates are found along the arid and saline coast. But even the perennial Kunene and Orange rivers host relatively few species. The African River Prawn is at the southern edge of its range in the Kunene River, where there is also a freshwater oyster (*Etheria elliptica*). Both are edible and found nowhere else in Namibia.⁵³ The ephemeral rivers, by contrast, support a greater diversity of freshwater invertebrates, perhaps as a result of their more varied habitats which include permanent pools and streams of different depths. Two species of snails, 34 crabs, 90 insects and four other large freshwater invertebrates have been recorded from ephemeral rivers.⁵⁴

PLACES OF CONSERVATION IMPORTANCE

Several sites along the coast are particularly important in terms of conservation and could potentially play a much larger role than they currently do in Namibia’s tourism industry. The sites identified for this book have been selected on the basis of information presented in this chapter and a wider recognition by biologists of the types, combinations or quantities of species or individuals occurring there. The sites are described below from north to south. Whilst the whole coastal area falls within national protected areas, some sites have been recognised as biological hotspots, Ramsar sites, Important Bird Areas (IBAs) or Important Plant Areas (IPAs). However, none of these classifications confer additional conservation or protection status.

Kunene River Mouth is a 500 hectare wetland shared by Namibia and Angola. Being remote and generally unspoilt, it has high wilderness and conservation value. The mouth is an important coastal wetland and valuable stopover for migrating waders. During high tides sandbars to the north and south of the mouth create a lagoon where the water can be up to 10°Celsius warmer than the sea. At least 72 species of birds have been recorded, including African Black Oystercatcher, Lesser and Greater Flamingos, Damara Tern, Great White Pelican, Chestnut-banded Plover, Swift and Caspian Terns. All of these species are rare and/or deserve special conservation attention. Reptiles at the southern edge of their ranges here include Nile Crocodile, Nile Soft-shelled Terrapin and Green Turtle. Sixty-nine species of freshwater fish occur in the lower Kunene, including five that are endemic to the river.

Although proposed, the Kunene mouth has not yet been declared a Ramsar site. The mouth may also receive greater attention and protection if the proposed Iona/ Skeleton Coast Transfrontier Park is created (see page 179). About 5.5 cubic kilo-metres of water runs down the Kunene each year, and much of this comes from the highlands of central Angola. Upstream activities such as dams, irrigated agriculture, pesticide and fertiliser use may alter the quantity and quality of water reaching the lower Kunene.

Damara Tern breeding areas, lichen fields and other areas in the Skeleton Coast National Park and Dorob National Park have been proposed as International Union for the Conservation of Nature (IUCN) category 1A (strict nature reserve) in the draft Management and Development Plans for the Namib-Skeleton Coast National Park.⁵⁵ These highly sensitive and high value conservation/biodiversity areas include wetlands along ephemeral rivers, vegetated dune hummocks, inselbergs and the inter-tidal zone.



Above: Kunene River mouth

Below: The central coast is a particularly important breeding area for Damara Terns. The terns are highly sensitive to disturbance and several key breeding sites are fenced off to restrict access by people, vehicles, quad bikes and dogs. Similarly, the central and northern coast has many lichen fields which are of high conservation value.



Figure 35. Sites and zones of special value for the conservation of life along the coast. Important Bird Areas were thus designated because they support particularly large concentrations of birds or species of special conservation concern. Sites recognised in terms of the international Ramsar convention are wetlands deemed to be of national and global importance in terms of their ecology and hydrology.



Cape Cross Seal Reserve is thought to be the largest land-based seal breeding colony in the world. More Cape Fur Seals breed here than anywhere else. In addition, the lagoons and guano platforms are an important breeding site for Cape Cormorants and also regularly support up to 11,000 other birds.⁵⁶

Walvis Bay/Swakopmund shore. Densities of invertebrates and 13 species of birds (450 – 770 birds per kilometre) along the shore between Walvis Bay and Swakopmund are higher than anywhere else on the coast of southern Africa. This zone also supports the densest colony of breeding Damara Terns known, and has thus been designated an Important Bird Area.⁵⁷



Above: Cape Cross

Left: The 30 kilometre stretch between Swakopmund and Walvis Bay can hold over 13,000 birds, making it the richest shoreline in terms of shorebird density anywhere in southern Africa.

Below: Flamingos are often the most conspicuous birds in the wetlands of Walvis Bay. Maximum counts of over 33,000 Lesser Flamingo and over 31,000 Greater Flamingo have been recorded.



The wetlands of Walvis Bay – including the lagoon, inter-tidal mudflats, the sheltered side of Pelican Point (the 10 kilometre sand spit that shelters the Bay) and the artificial evaporation ponds of the salt works – comprise the most important coastal wetland in southern Africa and one of the top three in Africa. The wetlands provide extensive feeding grounds for a wide range of resident, Palearctic and intra-African migratory birds. Walvis Bay regularly supports up to 250,000 birds in spring and summer and 70 - 100,000 in winter. About 90% of the birds which use the wetland in summer are non-breeding migrants from Europe and Asia, illustrating its importance as a resource for birds that come from the northern hemisphere. Significant numbers of Namibian Red Data species occur here including Chestnut-banded Plovers, Lesser and Greater Flamingos and Black-necked Grebes. In fact, 80 to 90% of southern Africa's flamingos live here in winter. While Walvis Bay is a designated Ramsar Site, it is not currently protected by any legislation.⁵⁸



Above: Once a natural harbour for whalers, Sandwich Harbour is one of the richest wetland areas in southern Africa.



Lüderitz harbour and lagoon.

Sandwich Harbour is one of Namibia’s four Ramsar sites. This is a natural lagoon with two main wetland areas that have changed in size and shape over the years (see page 56). The northern, freshwater wetland is fed by an aquifer lying under the dunes, but it has shrunk considerably since the 1970s when it extended over several square kilometres. The 20 square kilometres of southern mudflats are inundated by tidal flows each day. The lagoon is protected from the ocean by a beach barrier that continuously changes shape due to the long-shore currents and strong south-west winds. The highest count of 238,000 birds was made in 1998. Nowadays, Sandwich Harbour regularly supports over 50,000 birds in summer and over 20,000 in winter. Most of the birds are Palaearctic waders and flamingos. The density of shore birds may exceed 7,000 birds/square kilometre, making it amongst the highest in the world.⁵⁹

Lüderitz Lagoon is relatively sheltered by the Lüderitz peninsula and consists of salt-marsh vegetation in the upper tidal areas, with a large area of mudflats that is exposed during low tide. The total wetland area covers about 5 square kilometres, and is used by at least 28 species of wetland birds and shorebirds. The lagoon is not protected as a conservation area.

Sperrgebiet. The Succulent Karoo biome (see Figure 28) is globally recognised as one of the world’s top 34 biodiversity hotspots due to its diverse succulent flora. At least 1,050 species of flowering plants and ferns occur there, which is nearly a quarter of Namibia’s entire complement of plant species. The area also has high numbers of endemic plants, reptiles and frogs as well as a variety of mammals and other animals.



The diversity of habitats in the Sperrgebiet includes mountains and plains, gullies and coastline. This, in combination with the tough climatic effects of fog, wind and winter rainfall, has resulted in a range of plant and animal species of which many are highly specialised. Many species are restricted to the winter rainfall areas, such as *Hoodia alstonii* (middle left). The halfmens (middle right) only grows on steep fog-receiving slopes around the lower Orange River. Others, such as *Tromotriche pedunculata* (bottom left), are less specialised and extend south into the northern Cape. The Nama Padloper – Namibia’s only endemic tortoise – only occurs in rocky semi-desert areas south of Lüderitz (bottom right).



Above: Halifax Island supports the only African Penguin colony in Namibia that is increasing in numbers and can be seen just behind Dias Point – named after Bartolomeu Dias, one of the earliest explorers who dropped anchor in Lüderitz Bay in 1488.

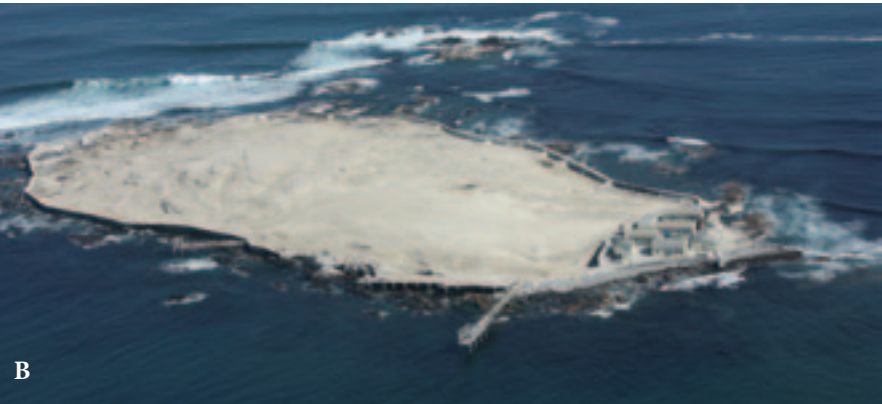
A – Mercury Island

B – Ichaboe Island

Below: Penguin Island in the distance, and Shark Island (which is no longer an island) in the foreground in Lüderitz.



Southern islands (Mercury Island, Ichaboe Island, Lüderitz Bay islands, Possession Island). The islands off the southern Namib fall within the very productive Lüderitz upwelling cell (see page 36). Having largely rocky shores, the islands support relatively high densities of invertebrates and provide key foraging and breeding habitat for a large number of birds. Nine species of sea birds and one wader breed on the islands and many more species forage around them in summer. Up to 145,000 sea birds have been recorded on the islands.⁶⁰ Counts in 2005-2007 recorded 18,400 Cape Cormorant nests, 10,400 Cape Gannet nests and 3,200 African Penguin nests.⁶¹ Other species are predominantly gulls and terns. Significant numbers of Cape Fur Seals occur in breeding colonies on most of the islands, but barriers have been built to keep them off Ichaboe and Mercury islands to avoid competition with breeding birds. Large-scale guano harvesting which began in the 1840s had considerable impacts on birds such as African Penguins which prefer to nest in burrows in the guano. The removal of the guano forced them to breed in the open where their eggs and chicks were exposed to predation by gulls and seals, excessive heat during the day, and storms. The islands were managed as nature reserves by South Africa from 1987 until March 1994, and are now within the Marine Protected Area that was proclaimed in July 2009.



The Orange River Mouth covers 18 square kilometres and is subject to some tidal influence. A sand bank closes the mouth when river flow to the sea is low, and back-flooding then occurs, sustaining the high salt-marsh vegetation and a brackish lagoon. The flow regime of the river has been changed by the Gariep and Van der Kloof dams, with the result that the flow is more regulated, with smaller flood peaks and more sustained flows which keep the mouth open. However, very large floods occur following exceptional rainfall in the river's catchment, such as in 1988 and 2011. Over 20,000 birds of 32 resident species, six intra-African migrants and 18 Palaearctic migrants are found there when flows are low and feeding areas are largest. At least 14 Namibian or South African Red Data species use the wetland.⁶² There are 15 species of freshwater fish in the Orange River system, of which one is endemic to the lower stretches (the Namaqua Barb).⁶³ The Orange River mouth is a trans-boundary Ramsar Site. Recent damage to the salt marshes has been caused by mining activities and road construction, as well as the altered flow levels. The mouth falls within the proposed trans-boundary Richtersveld–Sperrgebiet Park. An average of 11 cubic kilometres of water flows down the river to the mouth each year.

A closing observation...

Although there is such a contrast between life in the sea and in the desert, organisms in both of these mega-habitats require careful management and conservation. Not surprisingly, the reasons for this and the approaches to be taken are quite different.

Namibia's marine area is subject to major environmental changes that have dramatic impacts on the productivity of the Benguela Current and its animal populations. The biggest changes are due to intrusions of warm water from the north, low levels of oxygen, red tides and eruptions of hydrogen sulphide and methane (see page 42). When these changes occur, losses are measured in billions of fish, plankton and other animals. Over the long term, the losses are natural and populations recover, but they have huge impacts on the fishing industry which requires dependable profit in the short term.

Over the last two centuries, the marine world has also been severely affected by human activities: whaling, sealing, the harvesting of guano and commercial fishing operations. These have had serious negative effects on many species; while some have regained at least some of their original populations, many others have yet to recover to any significant degree.

By contrast, few large-scale losses can be counted among terrestrial plants and animals. Life on the land ticks over slowly and the number of individual organisms is low. Most land along the coast has escaped human impacts. Many scars have also



The Orange River Mouth. The bright green fairways of the golf course are clearly visible from the air. The river mouth, mudflats, marshlets and islets near the mouth provide an area of sheltered shallow water which attracts substantial concentrations of wetland birds, many of which are migrants.

been obliterated by driving sands and corrosion, and so large areas appear as they were thousands of years ago, seemingly untouched and unperturbed. The living component of the terrestrial environment, however, generates far fewer dollars than the marine environment (see Chapter 6).

The terrestrial plants, animals and habitats of the coast deserve special attention for a host of reasons. This is a delicate environment where the timescale for recovery from the slightest damage or disturbance is measured in years, decades or even centuries because the rates of reproduction and growth are so slow. There is a high concentration of endemic species that live and depend on this tiny part of the world. Without protection, their populations could easily be jeopardised. There is a moral obligation for humans to respect other life, and to ensure that future generations can enjoy and benefit from life along the Namibian coast. Lastly, the terrestrial environment has much economic potential, as described in Chapter 7, and the development of this potential depends very much on keeping as much of the coast as unspoilt as possible.

Looking after the Benguela environment is much more of a challenge since the dynamic forces at work there are so enormous, and probably beyond human control. However, it is incumbent on everyone to ensure that those strategies which serve only to satisfy short-term greed are replaced by alternative ones which aim to perpetuate the sustained health and use of marine resources. Whilst these comments apply particularly to the harvesting of fish and other marine resources, they are equally relevant to other often short-lived exploitative ventures that so often come the way of the Namibian coast (see Chapter 6).

Although tiny, at just 100 by 500 metres, Mercury Island regularly supports over 3,000 breeding pairs of African Penguin, making it one of the most important breeding sites for this species in the world. The African Penguin population declined from about 42,000 pairs in 1956 to about 3,400 pairs in 2006.



Key points

- Upwelling cells bring nutrient-rich water to the surface giving the marine environment exceptionally high primary production and biomass of plants and animals. However, few marine species are endemic. The pelagic fisheries are one of Namibia’s most important renewable natural resources.
- The marine system is highly dynamic. Episodic environmental changes occur due to intrusions of warm water from the north, low levels of oxygen, red tides and eruptions of hydrogen sulphide and methane. These changes may cause the loss of billions of fish, plankton and other animals.
- Namibia’s islands support rich kelp communities as well as providing breeding and resting places for seals and globally-significant populations of seabirds.
- Over the last two centuries human activities such as whaling, sealing, harvesting of guano and probably commercial fishing operations have had serious negative effects on many species. Some populations have partially recovered but many others have yet to increase to any degree.
- The terrestrial environment supports a diverse fauna and flora, but generally at low abundance. Many species have specialisations that are seldom seen elsewhere, including the use of moisture from fog by plants and animals.
- The terrestrial environment is a delicate environment where recovery from the slightest damage takes many years or even centuries because the rates of reproduction and growth are so slow. Most land along the coast has escaped significant human impacts, however.
- The Succulent Karoo biome in the Sperrgebiet has been recognised as one of the world’s top 34 biodiversity hotspots due to its plant diversity and high concentration of endemic species and those with restricted ranges.
- The coast supports vast lichen fields of global conservation importance. Over 100 species are estimated to occur in the Namib Desert, many being endemic to the Namib. The Sperrgebiet holds more than 90 species.
- Three coastal sites are designated as globally important Ramsar wetlands due to the birdlife they support. Walvis Bay has the most important coastal wetland in southern Africa and one of the top three in Africa. Sandwich Harbour can support over 7,000 birds/square kilometre, making it amongst the highest in the world. The Orange River Mouth periodically supports over 20,000 birds of 56 species.

