



Ecotales from Kubulau

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Ecotales from Kubulau

A guide to the
cultural and natural heritage
of the Vatu-i-Ra Seascape

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Foreword

I would like to express my deepest gratitude to two organisations, the Coral Reef Alliance (CORAL) and the Wildlife Conservation Society (WCS), for the work they carried out in documenting some of the traditional stories of Kubulau.

I had been away from Kubulau for a substantial period of time, and upon my return, I noticed that some of our traditional knowledge is being forgotten. I really appreciate the support provided by these organisations in undertaking the task of preserving some of the traditional accounts of our people's history.



This project is vital right now, as some of the traditional stories and knowledge of our people have already been lost. It is important to document the existing traditional narratives of our people and our ancestors before they are gone forever, including some of our legends and traditional associations with birds, fishes, animals, and plants.

Therefore, it was my humble request that records of these traditional narratives be documented and kept as a memento for





Above: A view of Kubulau's reefs out to Koro Island from Natokalau village. Opposite page: Ratu Apenisa Vuki, Tui Kubulau. Below: Tui Kubulau entertains visitors to Kiobo village with his skilled guitar playing.

our children, so that they are aware of their heritage and will continue to convey the traditional stories and practices of our ancestors to our future generations. In this way, our knowledge and stories will persist, even when my generation has passed from this earth.

We were fortunate that some of our village elders were still around and were able to recount some of the traditional narratives of our people for documentation. I hope this guide will serve as an example to the people of Kubulau, and that it will inspire them to keep records of our traditional history, a legacy of which we in Kubulau can be proud.

Once again, a big "thank you" to CORAL and WCS for making this guide a reality.

Vinaka vakalevu.

Ratu Apenisa Vuki, Tui Kubulau
(high chief of Kubulau)





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Preface

In 2009, the high chief of Kubulau, Ratu Apenisa Vuki, made a request to the Coral Reef Alliance (CORAL) and the Wildlife Conservation Society (WCS) to find a way to showcase the distinctive species of the region. As you will find in the pages of this guide, Kubulau District and the broader Vatu-i-Ra Seascape region of Fiji host some remarkable plants and animals that are both astounding in their beauty and culturally important to the people who live here.

Ecotales from Kubalau is not designed to be a comprehensive catalogue of all of the species found in the forests, streams, coasts, and seas of the Vatu-i-Ra Seascape. Instead, it provides a glimpse into some of the plants and animals that have strong cultural and economic significance for the people of the seascape. In addition, the guide introduces some of the species that are only found in this part of the world and discusses how we can conserve them for future generations.

It is our hope that the guide will raise awareness about the importance of the plants and animals to local livelihoods, cultures, and ecosystem functions.

The stories in these pages come directly from the elders of Kubulau, who have described their associations with species for medicine, decorative arts, building materials, food, and totem spirits. When you see the Fijian word *talanoa* (which means dialogue or conversation) among the pages of the guide, it introduces a story from one of the village elders. By collecting these stories, the traditional knowledge that is rapidly fading away with modernisation can now be preserved for the youth of Kubulau and the Vatu-i-Ra Seascape.



Opposite page: A boy with a homemade wheelbarrow at Nacamaki village, Koro. Above: Children of Kubulau District.



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Geology & Geography of Kubulau & Vanua Levu



Above: A view of Namenalala Island and the Namena Marine Reserve.

Vanua Levu is the second largest of the islands in Fiji, comprising over 5800 square kilometres of interior mountain ranges and coastal hills that are drained by river systems into estuaries and deltas. The island is believed to have formed as a volcano about 7 million years ago, and has since rotated slightly clockwise through movement of the Earth's tectonic plates.¹

Vanua Levu has a tropical climate due to its location between 16 – 17°S latitude and the influence of the ocean's warm South Equatorial Current. The south side of the island, where Kubulau District is located, faces the prevailing southeast trade winds and receives more precipitation than the northwest, which is in a rain shadow formed by the interior highlands. The climate is seasonal, with a dry





Above: A local fisherman from Nasavu village, Nadi District, hunting from a bamboo raft (bilibili).

Below: A boy collecting firewood near Natokalaus village, Kubulau District.

Opposite page: Young boy in Kiobo village, Kubulau District.

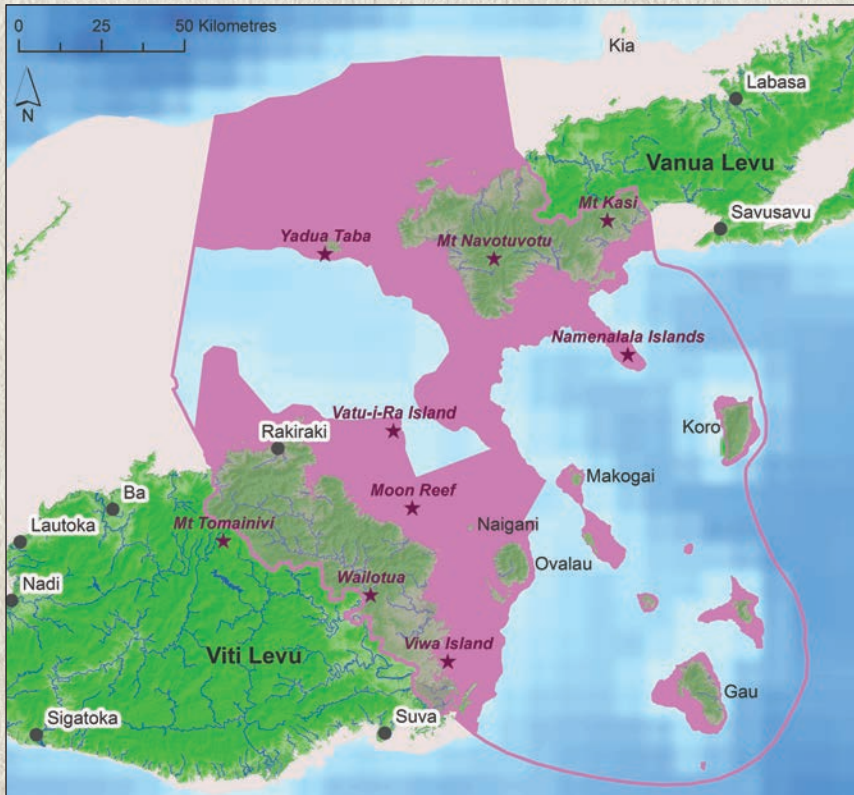


season from May to October and a wet season from November to April, when tropical cyclones often occur.

The people of Kubulau District and the Vatu-i-Ra Seascape are highly dependent on natural resources for their livelihoods. In Kubulau, 62 percent of all households depend on fishing for income, and 76 percent of households rely on farming.² Coastal villages with easy access to markets tend to be more reliant on marine resources, while villages further upstream rely heavily on forestry and crops, such as taro and kava. Population census data show a trend towards a youthful population, with over 40 percent below the age of 20, suggesting that there will be increasing pressure on natural resources and biodiversity in the coming decades.



Below: The location of the Vatu-i-Ra Seascape (dark pink line) between the islands of Viti Levu and Vanua Levu in Fiji. Fisheries management areas (qoliqoli) which fall inside the Vatu-i-Ra Seascape are shaded dark pink; qoliqoli outside it are shaded light pink. The Vatu-i-Ra Seascape includes the seas, watersheds and islands of Bua, Ra, Tailevu and Lomaiviti provinces.





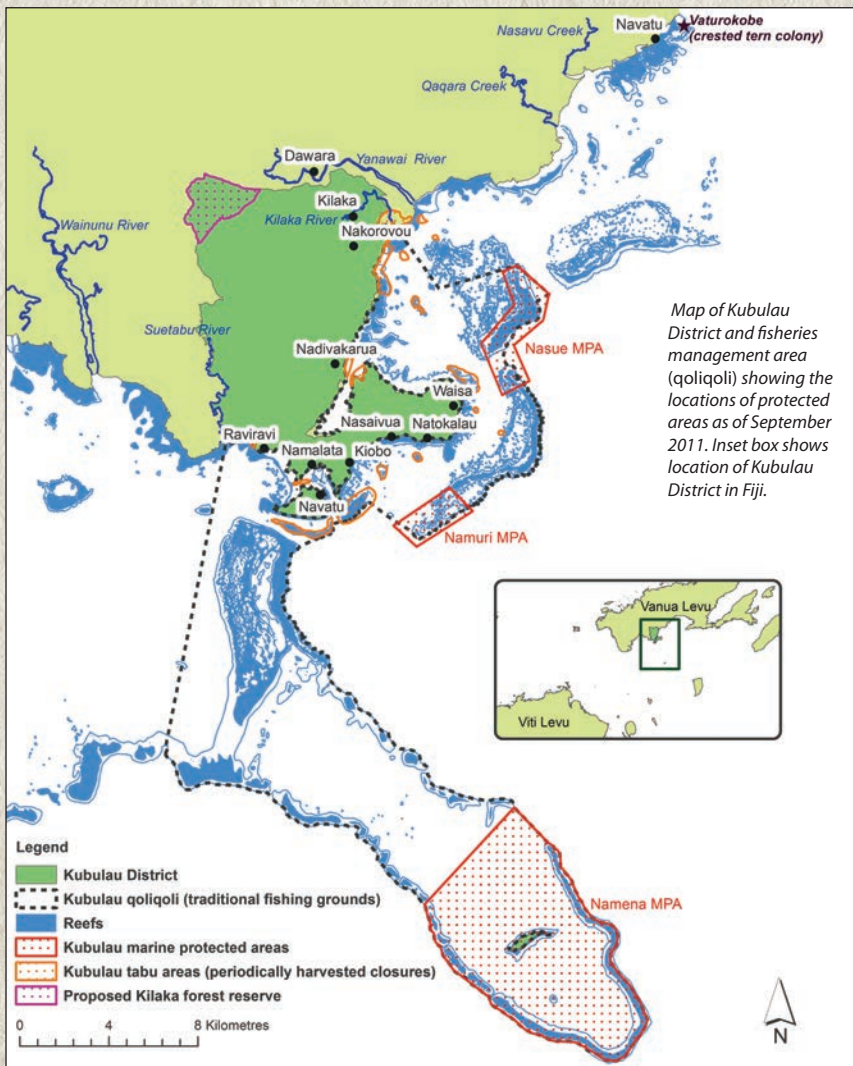
How Kubulau Got Its Name



*Top: A view of Natokalau village and their inshore protected area, Cakau Vusoni.
Above left: Spectacular underwater scenery within the Namena Marine Reserve.
Above right: A rooster in Nakorovou village, Kubulau District.*



There have been various narrations of the origins of Kubulau and how this district was named. One commonly recounted version tells a story about a time when the early settlers of this region and the ancestors of the current Kubulau people were standing on a ridge near Waisa Village, known as *Delaikubulau* in Fijian. Looking out to the east, they saw smoke rising within the vicinity of the Lau islands. Upon this sighting, they remarked, "*Sa kabu o Lau*", meaning, "It's misty in Lau". So they named this new land *Kabu-o-Lau* after the significance of this event.



Traditional Hierarchies in Fijian Society

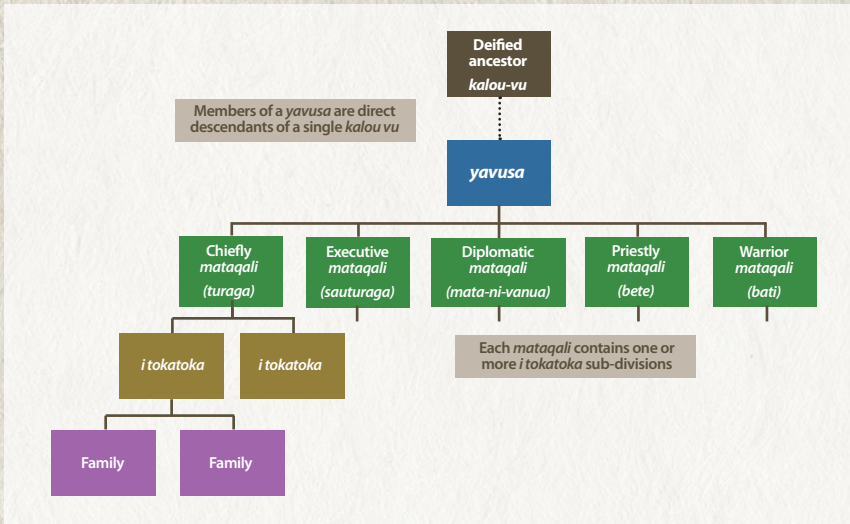
The *yavusa* is the largest social unit in Fijian society. A *yavusa* is neither strictly a tribe nor a clan, but its members are direct descendants of a single *kalou-vu*, or deified ancestor.

A *mataqali* is a sub-branch of the *yavusa*. In a fully developed *yavusa*, traditionally there are 5 separate *mataqali* exercising distinct functions: (i) the *turaga*, or chiefly *mataqali*, who are in the chosen direct line of descent from the common ancestor, and from whom the ruling chiefs of succeeding generations are chosen; (ii) the *sauturaga*, or executive *mataqali*, whose rank is next to that of chiefs of the blood, and whose function is to carry out their commands and to support their authority; (iii) the *mata-ni-vanua*, or diplomatic *mataqali*, from whom the official heralds or masters of ceremony are chosen; (iv) the *bete*, or priestly *mataqali*, through whom the *kalou-vu* communicate; and (v) the *bati*, or warrior *mataqali*.



The third and smallest social unit is the *i tokatoka*, a subdivision of the *mataqali* that consists of closely related families acknowledging the same blood relative as their head.

Under certain circumstances, *yavusa* consolidate and form confederations called *vanua*, which come under the rule of a paramount chief. In the *Vanua-o-Kubulau*, the paramount chief is the Tui Kubulau.



Opposite page top: Tui Kubulau dressed in traditional tapa for a ceremony to bless the marine protected areas.

Opposite page bottom: Ladies of Kia Island, Macuata Province, performing a traditional dance (meke).

Above: Schematic diagram of the relationship between different families within their household units (i tokatoka) and clans (mataqali) of a single yavusa. Below: Young men of Kubulau in traditional warrior dress.



The Vatu-i-Ra Seascape

Stretching across the channel that links Fiji's two main islands of Viti Levu and Vanua Levu is a blue-green jewel of forest and reef. Called Vatu-i-Ra, its vibrant seas are laced with coral reefs, masses of colourful reef fish, and sea turtles, while the adjoining landscape of coastal forests is alive with crested iguanas, tree frogs, and sea birds.



Top: The coastline of Kubulau, part of the Vatu-i-Ra Seascape. Above: Nesting red-footed booby (Sula sula) on Vatu-i-Ra Island.

This extraordinary 20,000 square kilometre mosaic of forests, mangroves, seagrass meadows, reefs, deep channels, and seamounts is one of the Pacific's last great wild places. It is home to the largest population of nesting hawksbills in Fiji, as well as green and loggerhead turtles. It is one of the few remaining sanctuaries for the highly prized but globally endangered humphead wrasse, which animates the reef alongside bumphead parrotfish and grey reef sharks. Local people thrill to frequent sightings of resident pilot whales and dolphins, as well as humpback whales passing through on their annual migrations. Strong currents run through the deep Vatu-i-Ra channel, nourishing a magnificent diversity of more than 300 species of corals and well over 600 species of reef fish. These, in turn, sustain breeding colonies of frigate-birds, black noddies, and red-footed boobies.

Vatu-i-Ra's intact forests boast many species unique to Fiji—crested iguanas, tree frogs, and more than 120 endemic

plant species. Flowing rivers connect the forest to the reef, allowing small but spectacularly colourful goby fish to migrate from upland streams to the coast and back.

Within the pages of this guide, you will encounter the species and ecosystems that make the Vatu-i-Ra Seascape one of the last great wild places on the planet.



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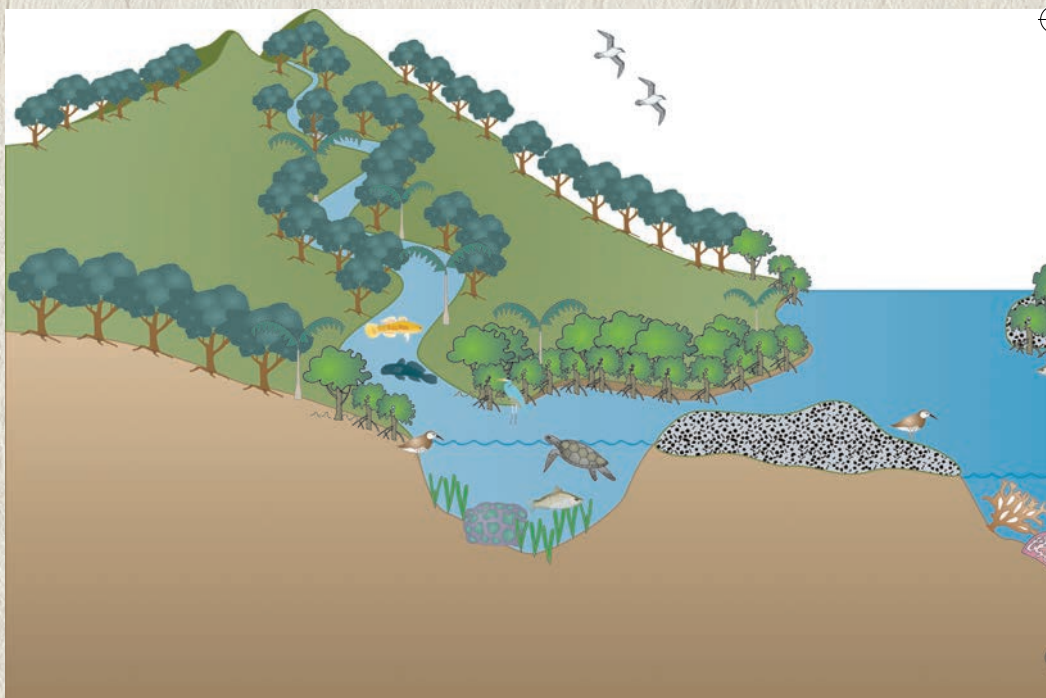
The Vatu-i-Ra Seascape astounds divers with large numbers of top predators such as sharks (above) and spectacular colours of anemones and fairy basslets that congregate in high current conditions (below).



Ecosystems & Ecosystem Linkages

Humans have an intuitive feel for the concept of an ecosystem. We can walk through a rainforest and experience the cool moist air, buzzing of insects, and dappled light streaming through a canopy of green. When we dive into a blue coral sea, where the skeletons of millions of tiny polyps form the framework on which thousands of other plants and animals thrive, we can tell that we are in a different ecosystem.

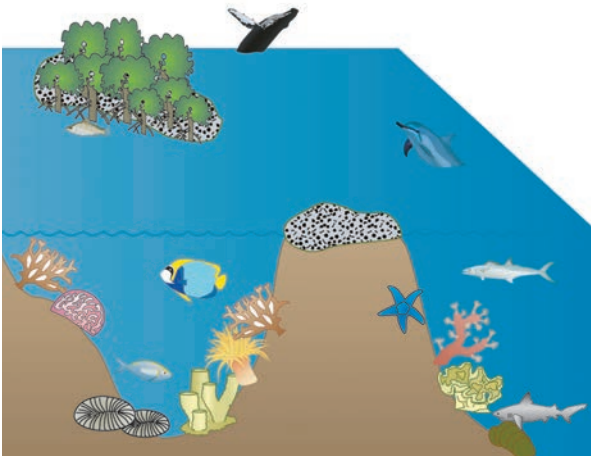
Above: Bluegreen chromis damselfish (*Chromis viridis*) decorate the reef flats off Naigani Island.





Above: Vatu-i-Ra Island, home to the largest breeding colony of black noddies (*Anous minutus*) in the Pacific.

In a healthy ridge to reef ecosystem, terrestrial, freshwater, coastal and marine habitats are connected by the flow of water and the movements of animals for feeding and breeding.



However, defining an ecosystem is always tricky because the boundaries are hard to describe. An ecosystem includes all of the plants, animals, microbes, soil, air, and water within a physical space and the interactions among them. Thus, it is possible to simultaneously talk about the ecosystem of a single rainforest tree—with orchids that cling to its trunk, insects that bore through its wood, and fungi that live in harmony with its roots—and the ecosystems of entire forest or island communities.

Because organisms and materials do not necessarily stay within the boundaries of an ecosystem, ecosystems are inherently linked to each other. They can be linked by the movement of animals. For example, seabirds that hunt for fish in the ocean can fertilise the land with marine-



derived nutrients through their guano. Ecosystems can also be linked by the movement of materials through physical processes. For instance, leaves shed by trees into streams can be carried downstream, where they form part of the riverine food chain.

People are central components of the ecosystems in which they live. As growing human populations use natural resources for food, fuel, and shelter, they exert large pressures on ecosystems and can easily upset the natural balance. These imbalances can be felt in other linked ecosystems. For example, land clearing on steep forested slopes can result in sedimentation in rivers, which affects native biodiversity. Thus, protecting our species and natural resources requires managing for these domino effects.

*Above: Cloud forests atop Fiji's largest peak, Mt. Tomainivi, at 1324 m.
Below: Purple sea fans decorate the reefs of the Namena Marine Reserve.*





Threats to Vatu-i-Ra's Ecosystems

The future of Kubulau and the Vatu-i-Ra Seascape is at risk: land is increasingly being converted for agricultural use, land owners are tempted by lucrative logging propositions, and limited livelihood options encourage coastal communities to fish unsustainably.

Traditional fishing grounds have long sustained coastal communities, but human population growth, increased market demand, new fishing methods that encourage over-exploitation, and encroachments by outsiders on Vatu-i-Ra's fishing grounds combine to severely deplete reef fish and sharks. Meanwhile, Fiji's corals are impacted by periodic tropical cyclones, which damage reef structure, as well as outbreaks of crown-of-thorns

Above: Spearguns are an extremely efficient way to remove large quantities of fish from the reefs. Right: Outbreaks of the coral-eating crown-of-thorns seastar (Acanthaster planci) has caused massive mortality on some of Fiji's reefs.

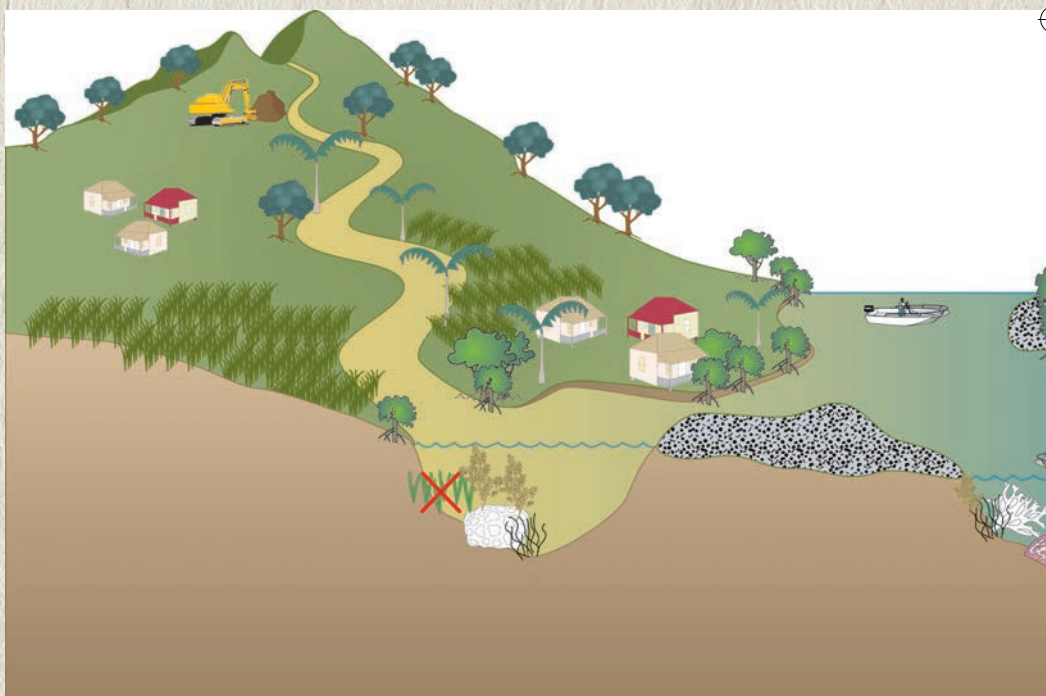




seastar (*Acanthaster planci*), which feed on coral polyps.

One quarter of Fiji's most intact and unique forests lie within Vatu-i-Ra Seascape,³ yet most of them are being logged without careful planning or consideration for impacts. This practice deprives wildlife of habitat, fragments the landscape, and reduces water quality.

Freshwater fish are stressed as they face competition from non-native tilapia in Vatu-i-Ra's rivers, while their migratory pathways from forest to sea are jeopardised by deforestation that allows rivers to become choked with silt.⁴ Other invasive species, such as the small Indian mongoose (*Herpestes auropunctatus*), have severely reduced populations of Fiji's native land animals and insects.





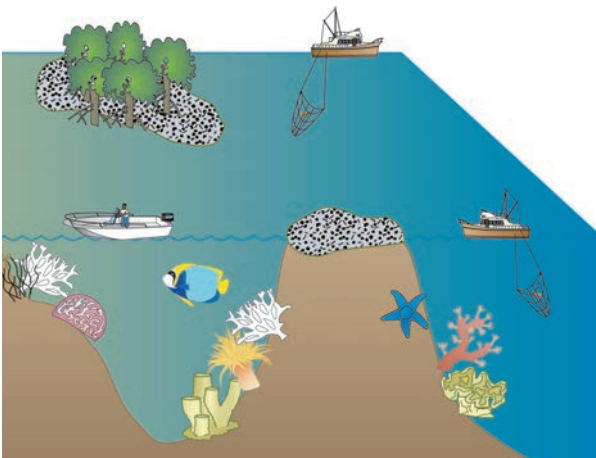
Opposite page: Unregulated fishing from local and foreign fleets can reduce fisheries stock and put pressure on vulnerable species such as sharks and dolphins. Above and below right: Run-off of sediments and nutrients from agricultural and logged lands reduce water quality in island streams and can affect freshwater and marine organisms.

Threats from land clearing, coastal development and overharvesting can damage ecosystems and cause damage in adjacent, linked habitats.



At the same time, climate change looms large for Vatu-i-Ra: predicted sea level rise, warming seas, and extreme climate events are likely to exceed the coping capacity of coral reefs, seagrass meadows, mangroves, forests, and the wildlife and local livelihoods they support.

Fiji's leaders and coastal communities must face the challenge of planning for climate change to build ecosystem and economic resilience and maintain the livelihoods and cultural practices they inherited from stewards past.





Above: Kubulau community members discussing how to adapt their management plan at a workshop in Nakorovou village.

Managing Ecosystems for the Future

In Fiji, indigenous people have strong control over the use of natural resources within their traditional lands and fisheries management areas (*qoliqoli*). Land tenure by *mataqali* is legally recognised, and the Fiji Fisheries Act grants traditional resource use rights to *qoliqoli* owners for fishing.⁵

For centuries, local people have exercised management over their natural resources by issuing periodic bans on harvesting natural resources when they are deemed to be scarce. In 2000, the Fiji Locally-Managed Marine Area Network (FLMMA, www.lmmanetwork.org) was formed to build on these traditional resource management techniques. FLMMA is a learning network made up of



Above: Tui Kubulau and members of the Kubulau Resource Management Committee (KRMC), with staff from WCS and CORAL, during a communications training workshop.

local communities implementing marine management initiatives. It works with partner organisations from government, NGOs, academia, and the private sector, which provide information and support to the communities on best practices for management. The FLMMA Network has grown to include over 150 communities working in more than 35 percent of Fiji's 410 traditional fishing grounds.⁶

Within the FLMMA Network, the Coral Reef Alliance (CORAL), the Wildlife Conservation Society (WCS), and other conservation partners have been working

WCS and CORAL staff working with Kubulau communities to identify locations for management of terrestrial (above right) and marine (below right) protected areas.



together with the 10 villages of Kubulau District to establish a network of protected areas, both on land and at sea, to safeguard their resources and unique ecosystems for the future. There are currently 20 marine protected areas (MPAs) within the Kubulau *qoliqoli*, including the Namena Marine Reserve (www.namena.org), which together include nearly 80 square kilometres of mangroves, seagrass, and coral reefs. Kubulau's MPAs cover more than 30 percent of the *qoliqoli* area, making it one of the first districts in Fiji to have achieved locally the Fiji government's commitment to protect 30 percent of its inshore and offshore waters.



All of the terrestrial, freshwater, and marine resources in Kubulau are managed under an ecosystem-based management plan,⁷ which provides rules governing actions that affect the land and sea. This plan was the first comprehensive ridge-to-reef management plan developed in Fiji. The Kubulau Resource Management Committee (KRMC), made up of representatives from each village in the district, is tasked with ensuring that the management rules and actions are followed. As management activities necessarily involve some costs for monitoring and enforcement, CORAL helped the KRMC devise an innovative scheme to raise money: all visitors to the Namena Marine Reserve are requested to purchase a user tag before undertaking any recreational activity, such as snorkelling or diving. The proceeds from the sales are currently being used to support management and community development projects, as well as to fund scholarships for Kubulau youth.

Above: Effective management of Kubulau's resources requires participation by men, women and youth from the 10 villages in the district.

Opposite page: Lowland rainforests of Wainunu District, Bua Province.





Terrestrial Habitats



Terrestrial Habitats

The terrestrial habitats of Kubulau and the broader Vatu-i-Ra Seascape include a mix of natural vegetation types, including rainforest, mesic (moderately moist) forest, wetlands, and coastal vegetation. These natural habitats are interspersed with various human-modified vegetation cover, such as gardens and plantations, grasslands maintained by grazing, *talasiga* grasslands maintained by burning, and secondary forests at various stages of recovery following logging, clearing, or burning. These habitats support a range of important animal species, such as the charismatic crested and banded iguanas (*Brachylophus vitiensis*, *B. fasciatus* and *B. bulabula*), brilliantly coloured orange doves (*Ptilinopus victor*) and red shining parrots (*Prosopeia tabuensis*), and the endangered Fiji ground frog (*Platymantis vitianus*).

The rainforests of Kubulau and the Vatu-i-Ra Seascape contain some of Fiji's last intact stands of primary growth, and they are characterised by a high degree of endemism. During a two-day survey of Kubulau led by Gunnar Keppel in 2005, a total of 288 indigenous plant species were recorded, including 126 endemic to Fiji.⁸ Of these species, 15 are endemic to Vanua Levu only. During the survey, several unique and very rare species were collected, which are protected under the Fiji *Endangered and Protected Species Act* (EPSA) of 2002. Some of these species are described below.

The *manawi vula* tree (*Zanthoxylum myrianthum*) is endemic to Fiji and is found in dense forests at elevations of 100 – 250 m. Until Keppel's 2005 survey, this tree was only known from a 1947 collection by renowned botanist A.C. Smith in the Macuata Range on Vanua Levu. Another rare endemic tree is *rusila* (*Astronidium*

kasiense), which occurs in dense forests at elevations of 300 – 430 m. Scientists long believed that this species was confined within the vicinity of Mount Kasi, the site of an important gold mine located northeast of Kubulau. However, Keppel's 2005 forest expedition revealed that this species was also present within the Kubulau region. *A. kasiense* is listed as



Left: A Pacific boa (*Candoia bibroni*) in the forests of Bua Province.

Critically Endangered on the IUCN Red List. The small tree *Gardenia anapetes* is another Fiji endemic, only known to exist in two locations in south Vanua Levu. It is listed as Critically Endangered on the IUCN Red List. *Metrosideros ochrantha*, listed as Vulnerable by IUCN, is restricted to Mount Kasi and the surrounding area. WCS and CORAL are therefore helping the communities of Kubulau and adjacent districts increase the amount of forest area under protection where these species are known to be found.

Mesic forest characterises the lower-lying coastal areas of Kubulau and the Vatu-i-Ra Seascape. However, only tiny fragments of intact forest remain, as most of it has been clear-felled for agriculture. These forests still contain a number of economically and culturally important tree species. *Intsia bijuga*

(*vesi*) is particularly prized as a high-quality construction and carving timber, and has been over-harvested in many parts of the

country. The Pacific kauri, *Agathis macrophylla* (*dakua makadre*), is also valued for its high-quality timber. Fijian sandalwood, *Santalum yasi* (*yasi dina*), is harvested for its valuable heartwood, which is used to produce fragrant oil. Sandalwood attracts a premium price, and populations of the species have been depleted throughout its range due to overharvesting.



Above: Highly humid cloud forests are scattered on ridges and peaks of coastal ranges at altitudes above 400 m.

The chiefs of Kubulau and the KRMC set 5 main management goals for the protection and management of their terrestrial systems:

- Maintain or restore forests along waterways
- Maintain or restore drinking water catchments, including groundwater sources
- Maintain or restore populations of indicator species, including tree frogs and banded rails
- Maintain the availability of non-timber forest products, including edible ferns (*ota*)
- Maintain or improve availability of sandalwood (*yasi dina*)



Mythical Trees

Above: Fruits of the fish poison tree.

Fish Poison Tree

Scientific name: *Barringtonia asiatica*

Fijian names: Vutu, Vuturakaraka

Fish poison trees are common along the seashore, the edge of mangroves, lowland river margins and coastal forests. The flowers of this thick-trunked tree are very distinctive, with many long, pinkish filaments. Flower buds open during the night and flowers fall off the tree by late morning. The large, shiny, green fruit is square in cross-section and contains a seed that can be used to stun fish—a practice now illegal in Fiji under the *Fisheries Act*. The fruits are buoyant and in earlier times were used as floats for fishing nets in Samoa and Fiji.⁹ The fish poison tree is protected under Schedule 2 of Fiji's *Endangered and Protected Species Act* (EPSA).





talanoa

Amala receives wake-up call

In the ancient days, there were no mosquitoes in Kilaka Village. One day Amala, the ancestral god of Kilaka, requested a wake-up call from Rokomatawalu, the ancestral god of Nasasaivua Village. So Rokomatawalu wrapped up his totem mosquitoes in a *vutu* leaf and brought them as a gift to Amala. The mosquitoes buzzed in Amala's ear and urged him out of sleep.

The spot where Rokomatawalu placed the parcel of mosquitoes in Kilaka is a site of significance to the people of Kilaka and Nasasaivua. Out of the *vutu* leaf that held the mosquitoes, a *vutu* tree sprouted that still exists to this very day, and in this *vutu* tree resides a colony of mosquitoes.

This special relationship between Kilaka and Nasasaivua villages still exists to this day. If villagers of Kilaka want to plant on the piece of land where this special *vutu* tree grows, they must first make an offering to the chief of Nasasaivua to inform him of their plans. Any harvest from this land must also be shared with the chief of Nasasaivua or the Kilaka farmer will become ill.



Varasiko Naulu,
Namalata village.

Ironwood

Scientific name: *Casuarina equisetifolia*

Fijian names: Nokonoko, Cau ('Thau')

This tree with drooping branches grows in coastal forests, grasslands and dry degraded areas, thriving in some of the poorest soils on earth. Its deep and spreading roots help it survive with a very limited water supply. Its needle-like 'leaves' and its fruits, which resemble small pinecones, give the tree the appearance of a conifer, but in fact these 'leaves' are small, jointed branches—the true leaves are hidden in the joints of these structures. This strange arrangement reduces

Right: Coastal ironwood trees along the foreshore resemble conifers.





water loss through the leaves to a minimum, allowing the tree to survive in areas where water is very scarce.

Ironwood trees are believed to eliminate nearby competing plants using chemicals that inhibit the growth and development of those plants. This allows the trees to rapidly form dense stands that reduce sunlight available to the understorey. Wood from the tree is unsuitable for timber, as it is difficult to saw, and it cracks, splits or shrinks when dried. The pollen and sawdust can cause allergic reactions and respiratory irritation to humans.

Ironwood commonly grows in the mountains of Nadivakarua. One tree in particular is believed to have special powers of meteorological significance. The people of Nadivakarua regard the *nokonoko* or *cau* tree as the 'rain tree'. They believe that if you strike this tree, the skies will open up and it will begin to rain.



Above: Permanent fish weir in which water vines are used to bind together native reeds.



Indian Mulberry/Noni

Scientific name: *Morinda citrifolia*

Fijian name: Kura

The noni, known as *kura* in Fijian, is a member of the coffee family that is common in coastal areas. It is a small tree, growing to 8 m, and it has square stems. This species was introduced to Fiji and the other Pacific Islands from

Left: Noni fruit has multiple medicinal properties in Fiji.





Southeast Asia by ancient voyagers who were the ancestors of present-day Pacific Islanders.¹⁰

The small white flowers produce fruit with a lumpy surface, which is green at first, but becomes almost white when mature. Although edible, the noni fruit has a bitter and unpleasant taste, and its pungent odour when ripening has led to the nickname 'vomit plant'. Plants mature in just 18 months and then yield 4 to 8 kilograms of fruit every month throughout the year.

The noni was traditionally used in the Pacific Islands to treat various ailments, from bad breath to boils and intestinal infections.¹¹ It is now commercially produced and used as a health tonic or herbal tea in the Pacific region and other parts of the world.

Traditional noni tonic is derived from fermented noni fruits. Following the fermentation process, the fermented noni juice is decanted, filtered, and bottled. New technology has also allowed noni juice to be extracted from fresh noni fruits, bypassing the traditional fermentation process.

Water Vine

Scientific name: *Entada phaseoloides*

Fijian name: Wa-lai

Wa-lai is the Fijian name for a common liana (woody vine) that grows anywhere from coastal thickets to forests at altitudes of up to 200 m. As a woody member of the pea family, it is no surprise that the *wa-lai* produces seeds in an enormous pod, and its vines resemble the climbing tendrils of pea plants. The pod is over 1 m long and the shiny, brown, disc-shaped seeds inside can withstand immersion in seawater for long periods of time, which helps the plant to disperse great distances across the oceans.

Wa-lai has many uses in Fiji. Watery sap from large *wa-lai* vines provides a decent amount of drinking water when the stem is cut, hence the name 'water vine'. Vines with smaller stems are used as ropes for fasteners in various construction works, from *bures* (Fijian thatched cottages) to fish traps, where—along with tree stems—they bind together the native reed called *gasau* (*Miscanthus floridus*). The seeds of *Entada phaseoloides*, known as *cibi* in Fijian, are edible when roasted and are also used as dart heads in children's games.



Above: Water vines curl around rainforest trees.





Above: Harvested kava drying in Nasavu village, Bua Province.

Kava

Scientific name: *Piper methysticum*

Fijian name: Yaqona ('Yanggona')

Yaqona is a woody shrub that belongs to the pepper family and grows to 4 m in height. Thought to be native to Melanesia (e.g. Vanuatu), *yaqona* was distributed by Pacific Islanders through Melanesia, Micronesia and Polynesia in ancient times.¹² It is widely cultivated in Fiji and thrives near streams at elevations up to about 800 m. There are distinctive swollen nodes on its green stems, and it has heart-shaped leaves. Male flowers are tiny, arranged in greenish-white spikes. Amazingly, for a plant so widely used in Fiji and across the Pacific, female flowers and fruits have not yet been described by scientists.

Yaqona is used to make the traditional beverage of Fiji, which is served at virtually all ceremonial occasions. The drink itself is also known as kava, or more colloquially as 'grog'. The drink is prepared from the plant's root, which can be used either fresh or dried, although the latter is more common. The drink has a slight anaesthetic effect, and when consumed in quantity, can lead a person to feel very 'groggy'.





To prepare fresh *yaqona*, the roots are cleaned and either pounded or grated with a special grating rock. They are then simultaneously mixed with water and sieved into a *tanoa* (wooden bowl) until a desirable mix is achieved. This infusion is served out to the drinkers in a *bilu* (a cup made from a coconut half-shell). The most important person in the group takes the first drink. To prepare dried *yaqona*, the roots are dried in the sun for a few days before being pounded into a powder. This powder is then used in the same manner as the pounded or grated fresh *yaqona*.

Borneo Teak/Moluccan Ironwood

Scientific name: *Intsia bijuga*

Fijian name: Vesi

The *vesi* tree is an important timber tree in Fiji and is found growing along the coastline up to altitudes of 400 m. Although this tree is not native to Fiji, its many uses strongly suggest that it was an ancient introduction. This flowering tree of the pea family has a trunk up to 1 m in diameter and grows to 30 m tall. Buttresses around the trunk increase the tree's resistance to cyclones.¹³ Its fragrant flowers have just one white petal that easily falls, leaving only the 4 green sepals. The fruit is a large flattened pod, which opens at maturity to release the seeds.

The trunk of the *vesi* tree has been used for hundreds of years in Fiji for carving and construction purposes ranging from making kava bowls (*tanoa*) to erecting houses and building canoes. Canoes made from *vesi* trunks include dug-out canoes (*takia*), double-hulled sailing canoes (*camakau*), and massive war canoes (*tabilai*), which were the fastest and most sea-worthy vessels in the Pacific's ancient maritime history.

The *vesi* tree is sacred to the communities of Kubulau, and it is a village totem in 8 of the 10 villages in the district. This once-abundant tree is now threatened by over-harvesting; it is currently listed as Vulnerable on the IUCN Red List, as well as being protected in Fiji under the *Endangered and Protected Species Act (EPSA)*.

Right: Borneo teak is a preferred carving wood in Fiji.





Sandalwood

Scientific name: *Santalum yasi*

Fijian names: Yasi, Yasi dina ('Yasi ndina')

Sandalwood grows in open or dry forest up to an altitude of 200 m, but can also be cultivated. In Fiji, *yasi* bears flowers in the summer, and the fruiting season corresponds with the wet season (January to March). The small cream-coloured flowers change colour through pink to purple-red as they mature, and the round fruits have a similar purple colour when mature. Sandalwood is partially parasitic

on other plants during its early stages of growth. While it can photosynthesise to produce its own food, its roots also leach out nutrients from the roots of nearby trees.



Above: Immature fruits of the sandalwood tree.

Sandalwood is the tree whose fragrant wood brought worldwide renown to Bua Bay in the early 1800s and resulted in Fiji's first trade with the Western world. It was an abundant tree in Bua prior to its discovery by European traders, who quickly began harvesting it to sell in Asian

markets. Unfortunately, the trade resulted in mass depletion of this species, and the sandalwood trade died as quickly as it started. In fact, accounts of this early trade tell that it only lasted for about 10 years.

Sandalwood trees still exist in Bua and other parts of Fiji. However, these trees represent only a minute fraction of the number that existed prior to European contact. Sandalwood is listed on Schedule 1 of the Fiji *Endangered and Protected Species Act* (EPSA).

Today, sandalwood remains extremely valuable: at 10 years old, one tree can be worth a staggering US \$12,000. In order to re-establish *yasi* populations and provide a valuable source of income, the Forestry Department in Fiji has carried out research on methods to grow *yasi*, and seedlings have been provided to communities. The villagers of Ono-i-Lau planted seedlings of *yasi* on their island as part of their terrestrial ecosystem restoration project. On Kadavu Island, the villagers of Lomati have established a sandalwood nursery with support from a BirdLife International project.





Pacific Kauri

Scientific name: *Agathis macrophylla*

Fijian names: Dakua
makadre ('Ndakua
makandre')

The Pacific kauri is an evergreen tree native to Fiji, Vanuatu and the Solomon Islands, and is also cultivated in other countries in the Pacific. The trunk of a Pacific kauri can grow over 2 m in diameter: old trees have been known to need 5 men with outstretched arms to encircle their trunks. They grow to over 30 m tall in Fiji and are estimated to live for 300 to 1000 years, making them among the largest and longest-lived trees in the southwest Pacific.

The smooth green-brown bark of young trees becomes thick, grey and peeling as the tree matures. Male and female cones are found on separate trees. After fertilisation, female cones may take up to 2 years to mature and release their winged seeds which can travel for tens to hundreds of kilometres.¹⁴

Partly as a result of its fast growth and easily worked cream-coloured wood, the Pacific kauri is a highly valued timber tree for uses including surface veneers, boat-building and furniture.¹⁵ In addition, its well-developed root system makes it able to withstand strong winds—a great benefit to forestry in this cyclone-prone region. If it is cut, the tree exudes a clear resin (*makadre*) that hardens to a white or yellow colour. Traditionally, this resin was used to glaze pottery, seal canoe joints and light torches. The resin was once exported commercially from Fiji, but this practice was banned in 1941.¹⁶ The Pacific kauri is listed on the IUCN Red List as Lower Risk/Near Threatened, although an intensification of commercial timber harvesting is creating greater concern for populations in Fiji.¹⁷



Above: Female cone of a Pacific kauri.





Unique Terrestrial Animals

Above: The crested iguana is the most critically endangered land animal within the Vatu-i-Ra Seascape.

Fiji Crested Iguana

Scientific name: *Brachylophus vitiensis*

Fijian names: Vokai, Vokaivotovoto, Saumure

Fiji's crested iguana and its close relatives, the Fiji banded iguana and the Lauan banded iguana, are the world's most geographically isolated iguanas. Their closest relatives are found in continental America. These species are believed to have evolved from green iguanas that rafted on debris across the Pacific Ocean from South America.

The crested iguana is a large lizard with a pale green body, over which there are narrow white stripes with black edges. Male crested iguanas have large pores on their inner thighs; females have these pores too, but they are much smaller. The iguanas live in trees and are active in the daytime, when the herbivorous adults feed on leaves, seeds and flowers. Iguanas usually meet only to mate or for males to confront each other, when they communicate by head-bobbing and darkening their body colour almost to black. Female iguanas lay 2 to 5 eggs in shallow burrows, after which it can take up to 35 weeks for the eggs to hatch—one of the longest known incubation periods for reptiles.

The crested iguana is endemic to Fiji, and is largely confined to the tropical dry forests on the islands of Yadua Tabu and Macuata within the Vatu-i-Ra Seascape, with some scattered populations in the outlying islands west of Viti Levu in Fiji's





dry zone. It is listed as Critically Endangered on the IUCN Red List and is listed under the Convention on International Trade in Endangered Species (CITES) Appendix I (this listing strictly forbids trade in the species). Yadua Taba is home to over 13,000 crested iguanas, representing 99 percent of the world's population. The National Trust of Fiji has worked with the local land-owning communities of Yadua Taba to declare an iguana sanctuary on the island to protect the species and its endangered dry forest habitat.

In some parts of Fiji, the crested iguana is a totem (*i cavuti*), or sacred animal, and the people of Yadua Taba Island believe that crested iguanas will die if they are removed from the island. Other popular myths say that crested iguanas have a sting in their tail or that they can curse you by looking at you with 'bad eyes'.

The greatest threats to Fiji's remaining populations of crested iguanas are habitat destruction by goat grazing and wildfire, and the possibility that feral cats and the small Indian mongoose (*Herpestes auropunctatus*) will be introduced accidentally to islands currently free from these non-native predators. These predators eat hatchling iguanas, juveniles and adults, as well as iguana eggs. Zoos are making a significant contribution to iguana conservation efforts.¹⁸ For example, Kula Eco Park near Sigatoka carries out research, captive breeding programs and educational programs.

Banded Iguanas

Scientific names: *Brachylophus fasciatus*,
Brachylophus bulabula
Fijian name: Vokai

The Fiji banded iguana (*Brachylophus bulabula*) and Lauan banded iguana (*B. fasciatus*) are also native to Fiji, although they are more common than the crested iguana. Recently, DNA studies of banded iguanas and crested iguanas have identified the Fiji banded iguana as a new species, found in the moist forests of Ovalau, Gau, Kadavu and Viti Levu.¹⁹ The Lauan banded iguana is found in the Lau group of islands and Tonga. In addition to differences between the DNA of these two species, researchers identified 10 distinguishing features to tell the two species apart. However, some of these would require a very close-up view of an iguana! For example, the shape of the nostril differs (circular in *B. bulabula* compared to elliptical in *B. fasciatus*), as does the colour of the iris (red in *B. bulabula* and orange-red in *B. fasciatus*).

Beyond these differences, the two species are visually very similar. The males have broad white bands along their bodies, whereas the females have a uniform green



Above: A Fiji banded iguana on Ovalau.



colouring with some spots and a whitish band. Tails of both females and males are encircled by alternating white and green bands, giving them their common name. Both species have spine-like scales on their backs from the nape of their neck to the base of their tail, but compared with the crested iguana, the spines are small. Unlike their endemic relative the crested iguana, which is herbivorous, banded iguanas occasionally eat smaller lizards and insects in addition to their diet of plant leaves. Most information about the life history and behaviour of banded iguanas has been gained from research on captive individuals, such as those in Kula Eco Park near Sigatoka.

The greatest threats to this species are habitat destruction by goat grazing and fire, predation by introduced predators such as cats and small Indian mongoose (*Herpestes auro-punctatus*), and poaching. The Lauan banded iguana is currently listed as Endangered on the IUCN Red List.

In some parts of Fiji, banded iguanas are said to attack you in the forest, sticking to you, and taking your skin with them as you try to remove them. These frightening myths have put additional pressure on the populations of this lizard, because they have led to the practice of killing iguanas encountered in the forest.



Above: The distinctive colours of a male orange dove.

Orange Dove

Scientific name: *Ptilinopus victor*

Fijian name: Bune ('Mbune')

The orange dove is a striking forest bird endemic to the forests of Vanua Levu, Taveuni, and better-forested offshore islands, such as Qamea, Laucala and Matagi. The males have an olive green head and a bright orange body, which gives the species its common name. The feathers of the male are elongated and give the bird a distinctive hairy appearance. This bird is also called the flame dove, because the long orange feathers of the male make it appear as if he is on fire when in flight. The females are uniformly green with yellow under their tails, and young birds resemble females. Adults grow to about 20 cm from beak to tail.

The orange dove feeds on wild berries and fruits, and has also been reported to eat caterpillars and insects. The female lays a single white egg and tends it while her male partner hovers close by.

Further information on the reproduction of this beautiful endemic bird is very limited.



The females are sighted more frequently than the males, as the latter often try to hide their conspicuousness with reserved behaviour. This dove is quite common within its range, but it is more common to hear its loud, repetitive 'tock' call than to see the bird. The species is listed as Least Concern on the IUCN Red List, but is protected under Schedule 2 of Fiji's *Endangered and Protected Species Act* (EPSA).

Red Shining Parrot

Scientific name: *Prosopaea tabuensis*

Fijian names: Kaka, Vaga ('Vanga'), Koki

Three different related parrot species live in Fiji, but only the red shining parrot is found in the forests of Vanua Levu. This parrot is also found on Taveuni and some well-forested offshore islands within the Vatu-i-Ra Seascape, such as Koro and Gau.

The red shining parrot can be distinguished by its vivid colour: a crimson to dark-maroon head and underside, with a blue collar and green wings. It was these distinctive colours that drove the feather trade between Fiji and the Polynesian islands of Tonga and Samoa, and the bird was eventually introduced into Tonga in the eighteenth century. Females and males look alike, but immature birds can be distinguished by their dark irises, compared to yellow or orange-red irises in adults.

The red shining parrot is one of the noisiest forest birds. Especially in the early evenings, a flock of these birds can easily be heard during a walk through the forest making a variety of raucous squawks, dry rattles and screeches. They also make grating notes, and a soft 'ra-ra-ra-ra' when perched. They normally aggregate in small noisy parties in their favorite feeding sites. These parrots nest in excavated rotten trees, laying 2 or, occasionally, 3 eggs.

Although primarily a forest bird, this parrot can be seen intermittently foraging near settlements and feeding on cassava roots, which it scrapes out of the soil with its sharp claws. However, its diet normally consists of soft and hard fruits, as well as buds, seeds, leaves and insects. The main threats to this parrot are from habitat loss and the regular capture of birds for pets. This parrot is listed as Least Concern on the IUCN Red List, but is listed on CITES Appendix II.



Above: The charismatic red shining parrot.



Fiji Ground Frog

Scientific name: *Platymantis vitianus*

Fijian name: Dreli ('Ndreli')

The Fiji ground frog is endemic to Fiji and is one of only two surviving frogs native to the Fiji Islands. The ground frog inhabits forested areas, but has also been found in open plantation habitat. It was once widely distributed in Fiji, but until recently was widely believed to survive only on islands without populations of small Indian mongoose (islands such as Ovalau, Viwa, Gau and Taveuni). However, it was found on Vanua Levu in 2003²⁰ and on Viti Levu in 2009.²¹ These rediscoveries are a reminder of how much there is still to learn about the forests of Fiji and the species that live there.



Above: The elusive Fiji ground frog.

You will never see tadpoles of the Fiji ground frog because the eggs hatch directly into tiny frogs. Adult females measure 10 cm from snout to vent, slightly smaller than adults of the commonly seen cane toad (*Bufo marinus*), which average 10-15 cm, but have been recorded as large as 38 cm in length in captivity! Cane toads were introduced to Fiji in the 1950s to combat cane beetles that infested sugarcane plantations, but now the toads compete with Fiji ground frogs for space and food. Other factors which distinguish the Fiji ground frog from the cane toad are the smoothness of its skin and

the long hind legs that enable it to jump distances of more than a metre. Unlike the cane toad, the Fiji ground frog dries out easily and therefore lives in shady, damp areas. To further avoid the sun, the frogs are nocturnal: you can see them during the night foraging for food or looking for mates. Their call—a short sharp whistle—can often be heard from dusk until dawn.

This frog is now listed as Endangered on the IUCN Red List due to habitat destruction from deforestation, as well as predation from the mongoose, feral cats, cane toads, rats, and even by big-headed ants (*Pheidole megacephala*). The small Indian mongoose (*Herpestes auropunctatus*), introduced to Fiji in the late 1800s, is the most ferocious of these predators, and its presence has led to a dramatic reduction in the Fiji ground frog population on Viti Levu and Vanua Levu, the largest two islands in Fiji. Therefore, an important conservation component is preventing the spread of mongoose to islands where the Fiji ground frog still survives. It is one of the priority species for protection listed in Fiji's National Biodiversity Strategy Action Plan.

Fiji Longhorn Beetle and Taveuni Beetle

Scientific name: *Xixuthrus* spp.

Fijian names: Quo ('Ngguo'), Qou ('Nggou'), Tinaniyavato

These beetles are the second longest in the world. There are 3 species in the *Xixuthrus* genus: *X. heros*, *X. ganglbaueri* and *X. terribilis*. All are endemic to Fiji, with *X. heros* and *X. ganglbaueri* found only on Viti Levu, whereas *X. terribilis* specimens have also been found on Vanua Levu and Taveuni.

These beetle species can grow to a length of 15 cm and spend a substantial amount of their lives as pupae, living inside large decaying trees. Despite their large size, the beetles are herbivores that feed on leaves and wood. During laboratory experiments, adult males have never been observed feeding, suggesting that only female adults feed.²² Their enormous mouthparts, adapted for chewing through wood, are used to bore into trees to lay eggs. These mouthparts may also serve a defence function.²³ The beetles remain as pupae for as long as 12 years before they emerge as adults.²⁴ They produce a loud hissing noise from their hardened front wings if threatened. In flight, these beetles have been described as 'small B52 planes'.

During a two-year survey by WCS, only 6 specimens in this genus (*Xixuthrus*) were collected throughout Fiji.²⁵ Their rarity, long pupal stage, and preference for large decaying trees that are becoming scarce due to deforestation have all increased the vulnerability of these beetle populations. Predation by cats, rats, Indian mongoose, and even humans has added yet more pressure to these species. In certain areas in Fiji, particularly in the interior provinces of Viti Levu, the larvae of these beetles were considered a sacred delicacy and were reserved for consumption by the paramount chief. These 3 species have been submitted for protection under Fiji's *Endangered and Protected Species Act* (EPSA) and an outcome of this submission is awaited. To date, it has not been assessed for the IUCN Red List.

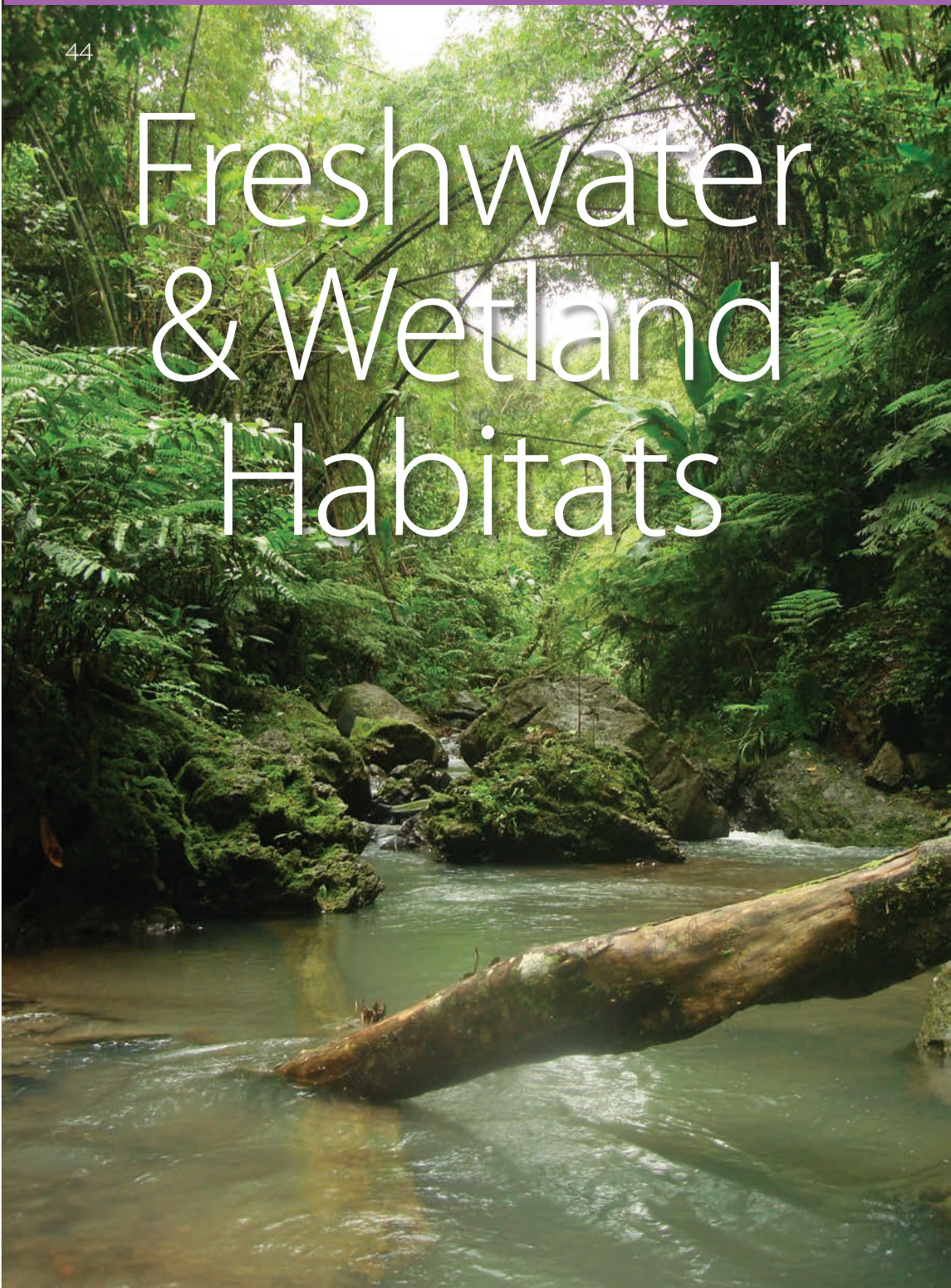


Above: The second longest beetle in the world is a Fiji icon.



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Freshwater & Wetland Habitats





Freshwater & Wetland Habitats

The rivers of Kubulau and the Vatu-i-Ra Seascape cascade over waterfalls and under thick forest canopies before meandering through mangrove estuaries and eventually discharging into the sea. These rivers are some of the most pristine in Fiji and contain healthy populations of freshwater fish, prawns, and snails that people rely on for food. They also provide important sources of clean drinking water.

In 2008 and 2009, freshwater surveys of Kubulau's rivers and streams by Wetlands International-Oceania documented 68 species of freshwater and estuarine fishes, representing 41 percent of the total species known from Fiji. The river systems are free of invasive fish species, which is very rare globally. Of the fish species collected, over 98 percent move across multiple habitats to interact with marine systems for feeding or breeding. In addition, the invertebrate fauna observed included river and mangrove prawns (*Macrobrachium* spp., *Palaemon* spp.), snails (of the Neritidae and Thiariidae families) and crabs (*Varuna* spp.), all of which are highly migratory and will traverse large sections of river catchments during their lives. This level of connectivity between freshwater and marine habitats is common for tropical high islands and demonstrates the necessity of protecting habitats throughout the entire watershed to effectively manage these species.

The waterways of Kubulau and the Vatu-i-Ra also boast a high number of endemic fishes. Streams in the corridor between Mt. Navotuvotu and Mt. Kasi contain at least 5 species of endemic freshwater fish and also support sensitive species that are conspicuously absent from other Fiji catchment streams where forests have been cleared and non-native tilapia have been introduced.²⁶

The lower reaches of rivers form important habitat for many marine species that come upstream to find food, reproduce or seek shelter. These include important



Opposite page: A small stream near Wailotua village, Tailevu Province, which flows through the Snake God Cave. Above: Mangrove red snapper (*Lutjanus argentimaculatus*) is a popular food fish that comes into the lower reaches of streams to hunt its prey.





Above: *Giururus magritaceus* (ika bau) are commonly found in Fiji's waterways.

food fish species such as snappers (*Lutjanus argentimaculatus*, *L. johnii*), ponyfishes (*Leiognathus equulus*, *L. splendens*), goat fishes (*Upeneus sulphureus*, *U. vittatus*), trevally (*Carangoides chrysophrys*), mullet (*Liza melinoptera*), and tarpon (*Megalops cyprinoides*). Many of these species may move upstream during the wet season to take advantage of organic matter washed into the waterways that can serve as a direct food source or as an attractant for smaller prey items.²⁷

Highly threatened coastal pandanus (*Pandanus tectorius*) wetlands are also present in Kubulau and the Vatu-i-Ra, though many of these areas have been drained and burned by local residents. Since wetlands play a crucial role in filtering water and storing carbon, restoration efforts may be warranted.

The chiefs of Kubulau and the KRMC set 3 main management goals for the protection and management of their freshwater systems:

- Manage catchments to reduce or eliminate waterborne disease
- Maintain abundance and biomass of freshwater food species
- Maintain abundance and biomass of key indicator species, such as those that migrate across multiple aquatic habitats during their lives





Unique Freshwater Fish

Teardrop Goby

Scientific name: *Stenogobius (Insularigobius) sp.*

Fijian name: Beli ('Mbeli')

The teardrop goby, named for the black patch under its eye that resembles a teardrop, is an undescribed new species, endemic to Fiji and only discovered in 2003. This species of goby is found over fine sand and gravel patches in many streams of Viti Levu and Vanua Levu, including the Kilaka River in Kubulau. The adults grow to a maximum of 13 cm and prey on smaller fish species.²⁸



Above: The teardrop goby is very sensitive to human disturbance.

The teardrop goby has an amphidromous lifecycle, meaning that it spawns in freshwater, but the larvae swim out to sea. The gobies return upstream in mass migrations following their larval stage. These migrations are essential for teardrop gobies to complete their life cycle; therefore any barriers to migration can negatively impact this species. Physical man-made barriers such as dams, culverts, weirs and roads can prevent migration and significantly reduce local population numbers. Chemical barriers, such as heavy siltation loads, mine waste or factory waste, also appear to restrict or curtail migration.²⁹

Isabella's Goby

Scientific name: *Stiphodon sp.*

Fijian name: Beli ('Mbeli')

Like the teardrop goby, Isabella's goby has an amphidromous lifecycle. Specimens have been collected only in Fiji, on the largest islands of Viti Levu, Vanua Levu, Taveuni, and Kadavu. It is found in swift, clear streams over rocky bottoms. This new species has not yet been described in the scientific literature or evaluated for the IUCN Red List, but is likely to be particularly endangered by catchment clearing, pollution, invasive species, and gravel extraction. Simply by migrating across a wide range of habitats, the gobies have an increased chance of encountering degraded environmental conditions.³⁰



Above: Isabella's goby was named after the daughter of Aaron Jenkins who discovered it.





Freshwater & Wetland Species of Cultural Importance

Above: Women selling piles of freshwater mussels at the central Suva markets.

Freshwater Mussel

Scientific name: *Batissa violacea*

Fijian name: Kai

This bivalve is a member of the family of 'marsh clams'. It burrows in soft sediments of river and estuarine banks and beds, tolerating brackish water as well as fresh water. It is a suspension feeder, gaining nourishment from tiny particles it filters out of the water. The *kai* can withstand periods of drought by remaining deeply buried in the sediment. It is commonly seen in the markets in Fiji and is a freshwater species of major commercial importance.





talanoa

the travelling *kai* of Kilaka & Dawara

There is a special relationship between the villages of Kilaka in Kubulau District and Dawara in Wailevu District regarding the freshwater mussel (*kai*). In the past, when the women of Dawara noticed that there were no *kai* in their river, the Yanawai River, they knew that the *kai* would be in the Kilaka River. So they would go over to the river at Kilaka and collect some *kai*. When these women returned to Dawara, they would light a fire and roast the *kai*. They believed that the *kai* from the Kilaka River would then follow them to Dawara, and their river would be abundant with *kai*. The women of Kilaka would do the same, and in this way the villages have bonded for generations over this valuable freshwater resource.



Valetino Tete, Kilaka village.

an inland pond forecasts death

Koro-i-Sawa, a pond near Nasasaivua village, feeds a stream that flows through patches of Tahitian chestnut trees and mangroves on its way to the sea. Near the ocean, the stream becomes very saline. The sighting of a freshwater mussel in this saline part of the stream forecasts the death of a relative from the inland village of Kilaka. This phenomenon, which occurred in Nasasaivua's ancient history, still occurs to this day.



Eremasi Qurai, Nasasaivua village.





Water Chestnut

Scientific name: *Eleocharis dulcis*

Fijian names: Kuta, Taria

The water chestnut is native to wetland areas from West Africa to Western Polynesia. This sedge, which resembles a tall, cylindrical grass, inhabits lowlands and marshlands from sea level to 1000 m in elevation. It grows to 1.5 m in height, with roots penetrating the mud to a depth of 1 m. The 'chestnuts' that give this marsh plant its name are not actually nuts, but the swollen underground stems that acts as a storage organ for the plant.



In certain areas of Fiji, including Bua, the stems are harvested, dried, and woven into soft sleeping mats. Mats made from this plant are considered superior to mats made from *Pandanus* leaves. The *kuta* mat is associated with Bua Province, as women from this area are renowned for their skills in weaving this type of mat.

Unfortunately, viable habitats that support *kuta* are now under increasing threat from anthropogenic activities and climate disturbance. The protection of wetlands and marshlands is important to ensure the survival of species like the water chestnut.

Top: Women of Bua Province are skilled at weaving water chestnut stems.

Above: A lady from Nakorovou village, wearing a salusalu made from kuta.





Bamboo

Scientific names: *Schizostachyum glaucifolium*, *Bambusa vulgaris*

Fijian names: Bitu dina ('Mbitu ndina'), Bitu-ni-vaivalagi ('Mbitu-ni-vaivalangi')

There are a number of bamboo species found in Fiji, including both native species like *Schizostachyum glaucifolium* (Polynesian bamboo, or *bitu dina* in Fijian), and introduced species such as *Bambusa vulgaris* (*bitu-ni-vaivalagi* in Fijian). *S. glaucifolium* grows up to 15 m tall. It is moderately common locally along river banks, on hillsides, and in relatively undisturbed forests up to 900 m altitude. It is not as commonly used as the more widespread naturalised *B. vulgaris*. This species was first recorded as naturalised in 1949, but is now the most common bamboo in Fiji. It is widespread up to 1000 m altitude.

Bamboo was one of the most important plants to the early Fijians. Bamboo stems were used as water pitchers, food containers and pots, and to fashion bamboo rafts (*bilibili*) and spears.³¹ They were even woven to make walls of traditional thatched houses. Modernisation has introduced tools and equipment that have decreased reliance on this plant. However, *bilibili* are still commonly used to transport goods downstream or for fishing trips close to the coast. They are easy to make from free materials and are biodegradable!



Right: Bamboo stems can be used for cooking pots.





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Coastal Habitats





Coastal Habitats

Mangroves, seagrass beds, coastal littoral forests, intertidal mudflats, and sandy beaches are all essential coastal habitats on which Vatu-i-Ra's biodiversity depends. The mangrove forests and estuaries of the Vatu-i-Ra Seascape's coasts are highly productive ecosystems and play a key role in maintaining the health and resilience of coastal fisheries. They function as hatcheries, nurseries, and feeding grounds, and are habitats that teem with life. They additionally form important buffers for storm surges and help to stabilise coastlines. Live and decaying mangrove leaves and roots nourish plankton, algae, shellfish (*sici*), fish (*ika*) and crabs (*qari*). Many of the fish caught in Kubulau live among mangroves or depend on food chains linked to these coastal ecosystems.

Three mangrove species have been recorded in Kubulau. The district has a large dominant zone of *Bruguiera gymnorhiza* with a narrow zone of *Rhizophora* spp. closer to the sea. Pollen grains of the blind-your-eye mangrove (*Excoecaria agallocha*) and red teruntum mangrove (*Lumnitzera littorea*) were found in sediment cores taken from Kubulau, indicating they were historically also present.³²

Syringodium isoetifolium is the dominant seagrass species in Vatu-i-Ra intertidal and shallow subtidal

Left: Sunset spreading across Kubulau's coastline.
Right: Mangroves and coconut palms are important coastal vegetation zones across the Vatu-i-Ra Seascape.





areas and is found in association with other species in certain areas. Algal species are often found mixed among the seagrasses or in discrete patches, and include red (*Dictyota* spp.) and brown (*Sargassum* spp.) algae, as well as calcareous species of *Halimeda*. Seagrass beds form important habitats for fish—particularly the emperor species *Lethrinus harak*—and marine invertebrates such as shellfish and sea cucumbers, while intertidal flats provide shelter for sought-after mud lobsters (*mana*).

Sandy beaches are important breeding grounds for seabirds and sea turtles. The vegetation along coastal strands also includes many trees of socioeconomic and cultural importance for Fijians, including the coconut palm (*Cocos nucifera*) and hibiscus (*Hibiscus tiliaceus*).

The chiefs of Kubulau and the KRMC set 3 main management goals for the protection and management of their coastal systems:

- Maintain or increase the total area of mangroves
- Maintain or increase the abundance and biomass of crabs
- Maintain or increase the abundance and biomass of food fish and rare fish

Top: Mangrove on Naigani Island.

Middle: Crested terns breeding on Vatuokobe Island in Wailevu District.

Left: Coastal habitats of Ovalau Island.



Mangroves

Mangroves are one of the most conspicuous trees growing along Fiji's coastlines and riverbanks. Although these trees are not obligated to grow in the intertidal zone and will grow well in fresh water, they are outcompeted by terrestrial species at higher elevations.

The environments that mangroves colonise are subject to both variable and extreme conditions. Marine water with a high salt content arrives with high tides, and freshwater input from rivers or run-off can change from day to day and year to year. Low tides expose roots to hot, dry conditions, while at other times the roots find themselves in water-logged soil with little or no oxygen. Added to the challenges presented by these changes in salt and oxygen availability, mangroves must anchor themselves in unstable, soft sediments. Mangroves have developed some curious adaptations which allow them to thrive in such conditions.



Mangrove stilt roots stabilise the trees (top) and form important fish habitat (above).





To survive in waterlogged, airless soils, some mangroves have special breathing roots that are filled with air and project above the ground. Rather than plunging their roots into the anaerobic soil for support, mangroves maintain root systems that are relatively shallow and close to the available oxygen. Some species have additional stabilising structures, such as prop roots descending from the branches and trunk. To cope with high concentrations of salt around their roots, some mangroves prevent salt from entering their roots by using specially adapted membranes in the cells of their roots. Others do allow salt to

enter, resulting in sap with a salt concentration around 100 times higher than in most plants. These mangroves can excrete the salt through glands on their leaves or drop their foliage to remove excess salts. Mangrove seeds germinate on the parent tree, and the seedlings remain attached to parent tree while they grow. These 'ready-to-grow' propagules are buoyant, which helps mangroves to colonise new areas and replenish existing stands effectively.

As described in the coastal habitats introduction, mangroves serve multiple important ecosystems functions. For example, they buffer coastlines and riverbanks from tropical cyclones, tsunamis, and sea level change; produce and sequester large amounts of carbon as their leaf litter rapidly decays and forms soil with sediments trapped by their extensive root structure; and serve as an important breeding, feeding and nursery habitat for countless marine and estuarine organisms. Mangroves

also provide humans with timber for construction and space for drying coconut meat (*copra*).

Mangroves are threatened directly by land reclamation and by sea level rise, and indirectly by increased sediment and agricultural chemicals in run-off water coming from cleared uplands. The mangrove species described below have all been assessed as having a decreasing population trends, according to the IUCN Red List. In Fiji, only *Bruguiera gymnorrhiza* is listed on the *Endangered and Protected Species Act* (EPSA).



Above: Children of Natuvu village, Wailevu District, eyeing mangrove propagules.



Stilt Mangrove

Scientific names: *Rhizophora stylosa*, *R. samoensis*, *R. x selala* (hybrid)

Fijian names: Tiritabua ('Tiritambua'), Tiriwai, Selala

Rhizophora means 'root bearer' in Latin, referring to the arching stilt roots seen in all *Rhizophora* species. These stilt roots allow the trees to maintain their position in the lower intertidal areas where the sediment is less firm and the trees may be affected by waves. Another adaptive feature that enables *Rhizophora* to colonise their wet, muddy habitat more easily is the ability of their seeds to germinate while still attached to the parent tree. These propagules are believed to last for several months at sea in a semi-dormant state.³³ Three types of *Rhizophora* are found in Fiji:

spotted mangrove (*Rhizophora stylosa*), called *tiritabua* in Fijian; Samoan mangrove (*Rhizophora samoensis*), called *tiriwai* in Fijian; and a sterile hybrid of the two (*Rhizophora x selala*), called *selala* locally.

Rhizophora stylosa is of Asian origin and grows at the seaward margin of a mangrove

area. This species can grow to 30 m tall, but is more commonly 5 to 10 m. This mangrove species gets its name from its flowers' long, slender styles, which are clearly visible on open flowers: *stylosa* means 'small pillar-like' in Latin. *Rhizophora samoensis* is of American origin and also grows at the seaward margin of a swamp. It is restricted in Australasia to Fiji, Samoa, Tonga and New Caledonia and is listed as Near Threatened on the IUCN Red List. *R. stylosa* is listed as Least Concern. *Rhizophora x selala* is a sterile hybrid of the above two species, and therefore it only grows in the company of both *R. stylosa* and *R. samoensis*. It is only found in Fiji and New Caledonia.



Above: Coastal mangroves near Navatu village, Kubulau District.



Black Mangrove

Scientific name: *Bruguiera gymnorhiza*

Fijian name: Dogo ('Ndongo')

Unlike the *Rhizophora* spp. described above, black mangroves grow on the landward edges of mangrove swamps. They require the shade and protection of surrounding trees to survive. Trees reach a height of 4 to 15 m, and are found from eastern Africa west to Southeast Asia, Micronesia, Australia and across the Pacific to Samoa and Tonga. Seeds germinate while still attached to the tree, growing roots up to 30 cm before falling and often floating long distances.

The tree roots grow up to 30 cm above ground and turn in a U-shape back into the ground. In addition to these specialised roots, the black mangrove has lenticels (pores) on its trunk that allow oxygen to be obtained from the air. *Bruguiera gymnorhiza* is protected under Fiji's *Endangered and Protected Species Act* (EPSA). Although it is listed as Least Concern on the IUCN Red List, it is threatened by sea level rise and clearing of mangroves for coastal development.



Above: Knee roots of *Bruguiera* mangroves.





Above: Subtidal seagrass beds off Naigani Island.

Fijian name: Vutia

Although they resemble terrestrial grasses, seagrasses are actually flowering plants. They are of great importance to the marine ecosystem, providing habitat for many organisms and helping to filter water entering the ocean. In addition, their extensive root systems help to stabilise sea bottoms, playing a similar role to that of terrestrial grasses in preventing soil erosion. Seagrass communities are good indicators of coastal ecosystem health due to their high biodiversity and sensitivity to water quality.

Seagrasses provide shelter, nursery grounds and food to a diverse range of species, from seahorses to turtles, as well as many other fish and invertebrates. The grasses may be consumed directly by animals like herbivorous rabbitfishes and sea urchins, or indirectly by sea cucumbers and crustaceans feeding on decaying leaf fragments that fall to the bottom. Not only do the seagrasses themselves act as a valuable food source, but they also provide a three-dimensional structure on which lives a bewildering array of epiphytes—organisms that grow on other plants but are not parasites. Red algae are very commonly found as epiphytes on seagrasses and may contribute more to the diets of herbivores in the seagrass meadows than the seagrasses themselves.

Seagrass meadows are at the interface between the land and the rest of the ocean. Occupying this position, they play an important role in filtering water coming from the coast and estuaries, removing many nutrients and sediment



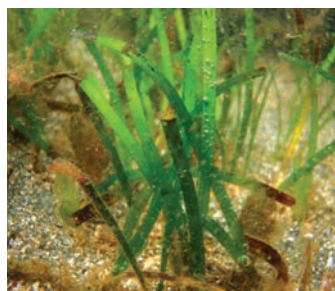


particles. This filtering role means they can be easily impacted by excess nutrients, sediments or pollutants coming from the water that runs off the land. Furthermore, seagrasses are threatened by increasing seawater temperatures associated with climate change.

Syringodium isoetifolium is easily identified by its cylindrical leaves that have smooth, pointed tips. These leaves vary in length from 5 to 50 cm; in calmer conditions the leaves often branch and grow longer. The leaves are filled with air, which makes them easily float to the surface and form dense rafts when detached. *S. isoetifolium* generally occurs in the subtidal zone, and it seems to respond to excess nutrients with rapid growth.



Halodule uninervis is found in a wide range of habitats, from muddy intertidal areas and estuaries to reef tops. It has flat leaves with 2 or 3 points (sometimes 1). Male and female plants are separate, but their flowers are extremely hard to see because they occur in the base of the leaf and are usually buried in the sediment. *H. uninervis* is able to spread rapidly by vegetative propagation and seeds, and the mat of underground stems and roots it creates helps to stabilise the sediment. A seed bank builds up in the sediment, containing up to 20,000 small, dark seeds in 1 square metre.



Halophila ovalis, called paddleweed, has a very wide environmental range, from intertidal zones to water over 30 m deep. The paddle-shaped leaves are smooth-edged with obvious veins. They sit on leaf stalks arising from the underground stem of the plant. This species is often the first seagrass species to grow in an area after disturbance.



Top: The cylindrical leaves of *Syringodium isoetifolium* are very buoyant.

Above: Strap-like leaves of *Halodule uninervis*.

Left: *Halophila ovalis* has paddle-shaped leaves.





Above: A red-footed booby in flight.

As ocean-going people, the early Pacific Islanders had a strong connection with seabirds. Seabirds indicated the direction of land to mariners and were also a valuable food source. Fiji's waters lack oceanic currents that bring cold, nutrient-rich waters to the surface on a large scale, which means that in spite of the vast extent of ocean surrounding Fiji, there is a relative scarcity of seabirds here.

Added to this natural scarcity, seabird colonies are threatened by coastal infrastructure and egg-harvesting (especially with the advent of outboard engines that allow access to the more remote areas), as well as by predation by invasive species such as rats. There is only a single seabird colony in Fiji that is legally protected: the red-footed booby colony on Namenalala Island in Kubulau's fisheries management area.

Terns and frigatebirds are the most commonly encountered seabirds because of their coastal habits. Noddies also commonly forage in shallow coastal waters, as well as in feeding grounds further offshore. Boobies spend most of their time offshore, and are a common sight from boats at sea.

Fiji also supports a number of rare, globally threatened and highly elusive seabirds known as petrels. These species are unlikely to be seen in coastal areas because they only return to their nests—in underground burrows—on remote forested islands at night. They are occasionally encountered from boats far out to sea by keen observers. These species are a priority for conservation groups working in Fiji, such as BirdLife International and NatureFiji-MareqetiViti.





Lesser Frigatebird

Scientific name: *Fregata ariel*

Fijian names: Kasaqa ('Kasangga'), Manumanunicagi ('Manumanunithangi')

The lesser frigatebird has a distinctive silhouette, with bent pointed wings and a deeply forked tail. It measures 70-80 cm from beak to tail. These are coastal and offshore birds that can range far from their colonies. Males are all black with white flank patches that make them easy to distinguish from males of the great frigatebird (*F. minor*). However, females and juveniles of these two species are difficult to distinguish.

Above: The distinctive wing pattern of a lesser frigatebird.

Frigatebirds steal food from other birds in flight by harassing them and then catching mid-air anything that is dropped before swallowing it in flight. For this reason, colonies of frigatebirds are usually established near colonies of other seabirds, which they use as a source of food. Their behaviour led sailors to name them the 'man o' war' bird. Their feathers lack waterproof coating, so they are not able to land on the water, but they do collect food from the surface if it is available.

The greatest threats to lesser frigatebirds are from hunting and egg collection. They are especially vulnerable because they are only able to reproduce every other year. The lesser frigatebird is listed on Fiji's *Endangered and Protected Species Act* (EPSA).

Fiji Petrel

Scientific name: *Pseudobulweria macgillivrayi*

Fijian name: Kacau ni Gau ('Kathau ni nggau')

The elusive Fiji petrel was first described from a specimen collected in 1855 near Gau Island. Then for 129 years the bird was 'lost', finally to be rediscovered in 1984 on Gau. Sightings are still extremely rare, and the search for a nesting colony continues—if located, a nesting colony would reveal more about the habits of the only seabird endemic to Fiji. Fiji petrels are presumed to nest in

burrows on high ridges of forested islands and to disperse to pelagic waters far away from their nest sites.

The Fiji petrel measures 28 cm from beak-tip to tail-tip. It is small for a petrel, and very dark brown. It may be mistaken for a noddy, but can be identified by its tube-like nostril above the beak and its markedly different flight pattern—

Above: The rare Fiji petrel.



arching over the waves on stiff wings rather than flapping constantly with slightly angled wings.

Listed as Critically Endangered on the IUCN Red List and on Fiji's *Endangered and Protected Species Act* (EPSA), this special seabird is likely to be threatened by egg predation from feral cats and rats, as well as deforestation.

Red-Footed Booby

Scientific name: *Sula sula*

Fijian names: Toro, Taro, Tero, Gutulei ('Ngutulei'),

Vavabiau ('Vavambiau')

As its name suggests, the legs and feet of this seabird are red. The rest of its plumage comes in a dark and a light form: the dark form is brown with a white belly and tail, and the light form is white with black on the wings. This is the only species of booby to nest in trees, and over 20 nesting colonies are known in Fiji. The red-footed booby is commonly observed in offshore waters, often sitting on the water while it catches fish swimming under the surface. Brown boobies (*Sula leucogaster*) are less common than red-footed boobies, but are more often encountered because they spend more time in coastal zones and have a tendency to perch on posts or beacons, making them easy to spot.



Above: A red-footed booby nesting on Vatu-i-Ra Island.

Black Noddy

Scientific name: *Anous minutus*

Fijian names: Gogo ('Ngongo'), Drelo ('Ndrelo')

The black noddy is found in coastal and offshore waters. It is dark chocolate-brown all over, except for a white cap. It feeds on fish at the surface or makes shallow dives. Black noddies breed in colonies, making their nests in trees or bushes from twigs and other material found on the seashore. Their alarm call is like a rattle, and in flight, the call is a 'krikrikrik'. They can be found nesting in large numbers on Vatu-i-Ra Island in the Vatu-i-Ra Seascape, where the BirdLife International Fiji Programme carried out a successful rat eradication campaign in 2006 and 2007, with technical support from the Pacific Invasives Initiative, the Pacific Invasives Learning Network, and the New Zealand Department of Conservation. Vatu-i-Ra Island has been declared one of Fiji's 14 Important Bird Areas.³⁴



Above: A black noddy resting in an ironwood tree.





Above: The crested tern is distinguished by its spiky black crown.

Crested Tern

Scientific name: *Sterna bergii*

Fijian names: Dredre ('Ndrendre'), Ico ('Itho'), Droe ('Ndroe'), Idre ('Indre')

The crested tern is around 45 cm from beak to tail, making it one of the largest of all the terns. These birds have a heavy yellow bill, and are white with light grey upperparts and a black crown. When crested terns are resting, their rough crest can be seen on the back of the crown. All terns have a characteristic way of fishing in which they hold their heads down and hover. They rarely rest on the water, but instead prefer to stand on floating objects.

Surprisingly, despite being one of the most commonly seen seabirds around the coasts of Fiji's main islands, observations of breeding colonies are very rare in the Pacific region, including Fiji. One of these breeding colonies is Vatuokobe Island in Wailevu, making this a special asset for the region. Crested terns are listed on Fiji's *Endangered and Protected Species Act (EPSA)*.



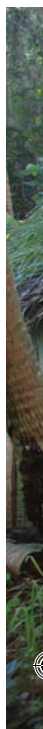
Above: The black-naped tern is a proficient fisher and feeds its young regurgitated prey.

Black-Naped Tern

Scientific name: *Sterna sumatrana*

Fijian names: Ereqia ('Erenggia'), Yaraqia ('Yaranggia')

This graceful tern is all white except for one distinguishing feature, which is difficult to spot: a black nape, only easily visible when the bird rests. Hence it can be confused with the white tern (*Gygis alba*), although the white tern is rarely seen in coastal waters. The black-naped tern's legs and long bill are black, and commonly single birds or pairs forage by hovering just above the surface rather than diving into the water. The black-naped tern is a noisy species that uses varied short calls; for example, a call might sound like 'tsee-chee-chi-chip'. This bird is commonly encountered around coastlines, and its breeding in Fiji is widespread, although under-reported.





Coastal Species of Cultural Importance

Above: Villagers from Navatu in Kubulau building a traditional bure from palm thatch.

Mullet

Scientific name: *Liza* spp.

Fijian name: Tumo

Most mullet species live in coastal waters, lagoons or estuaries, and may enter fresh water at young stages. These long-bodied fish inhabit shallow waters down to a depth of about 20 m, and they can be commonly seen feeding in schools in the shallows. They feed on the bottom, filtering large quantities of benthic detritus to extract algae and small invertebrates. Their efficient filter-feeding mechanism traps particles from water crossing their gills, using elongated 'gill rakers', structures that originally evolved to protect the delicate gills of fish from any solid material in the water. There are numerous species of mullet in the Indo-West Pacific, and many species look alike, making the taxonomy of this group quite a challenge for scientists. *Liza melinoptera* (Otomebora mullet) and *L. macrolepis* (largescale mullet) have been found in the rivers of Kubulau.



Above: The mullet is a prized coastal catch.





talanoa

the *ikavoli* drive

Every year, members of the Vatudadabila clan of Natokalau Village observed a traditional fishing ritual for a certain species of mullet called the *ikavoli*, which is their totem fish. According to traditional belief, the *ikavoli* follow a path in the ocean before aggregating around a sacred rock near Natokalau Village. This rock is the meeting point for two different schools of *ikavoli* that aggregate there to spawn. The school that travels from the North is named Yanawai, and the school that comes from the West is called Wainunu, referring to the two large rivers flanking Kubulau.



Marisilina Wati,
Natokalau village.

Each year, when the *ikavoli* were sighted, members of the Vatudadabila clan prepared themselves for the traditional fishing custom of the *ikavoli* drive by performing a ritual to cleanse the area, whereby they sprinkled a path of ashes in the sea leading to the sacred rock. Then, two villagers would wade out into the sea and stand on either side of the school of *ikavoli*, directing the fish by waving branches in a circular motion while making a whirring sound that called the fish toward the *ikavoli* rock. Villagers would then scoop up the *ikavoli* with nets, which they dragged from the shoreline toward the sea. This practice is called *tataga* or *tagavi*, meaning 'to scoop'.

The first batch of *ikavoli* caught was placed on top of the sacred rock. These fish were later taken by members of the Vatudadabila clan, since they were the traditional custodians of the *ikavoli*. The rest of the villagers then proceeded with their fishing. Interestingly, only 'clean' people were allowed to partake in the *ikavoli* drive. Pregnant women and persons who had engaged in sexual intercourse the night before the drive were considered 'unclean', so they could not go out to sea during the drive. Instead, they had to follow a path on land and help out by making a fire near the shore to cook some of the catch for the villagers to eat.

The *ikavoli* drive was once an annual event, but it no longer occurs. Not only have younger generations lost interest in the ritual, but many of the fish are being caught by members of neighbouring villages before they reach the sacred rock. Villagers who witnessed the days of the traditional *ikavoli* drive all say that the number of *ikavoli* caught nowadays is miniscule compared to the past, when they caught the fish by the hundreds. Only through sound management, including restrictions on fishing, can the people of Kubulau hope to restore the populations to their former abundance.





Mud Crab

Scientific name: *Scylla serrata*

Fijian names: Qari ('Nggari'), Qatio ('Nggatio')

Mud crabs are part of the wider group called swimming crabs, an appropriate name because of the paddle-shaped last two segments of their last pair of legs. They can also be recognised by their roughly hexagonal shell, or carapace, which can vary from green to almost black in colour.

Mud crabs are usually found just offshore on muddy bottoms, where they dig deep burrows in the soft substrate. They prey mainly on small invertebrates such as molluscs, crustaceans and marine worms. Mud crabs usually mature within their first year of life. Before mating, a male carries around a female for several days until she moults, at which point the male seizes his chance to copulate. Female crabs may then retain the sperm for several weeks, or even months, before using it to fertilise several clutches of eggs, each of which numbers in the millions. Bearing their fertilised eggs, female mud crabs migrate to offshore areas, perhaps because the larvae survive better in the saltier offshore waters.³⁵

Almost always marketed alive, mud crabs can command premium prices at markets in China and Singapore, with egg-bearing females ('roe crabs') and large crabs ('meat crabs') costing US \$5-10 per kg. With individuals reaching weights of up to 3 kg, these high market prices have made mud crabs a popular target for aquaculture. So far, however, attempts to culture the crabs in captivity have been unsuccessful. In Fiji, the *Fisheries Act* prohibits catching crabs with a carapace less than 125 mm wide.



Above: A woman of Daria village, Wainunu District, nimbly catching mudcrabs.

Thumbprint Emperor

Scientific name: *Lethrinus harak*

Fijian name: Kabatia ('Kambatia')

The thumbprint emperor gets its name from an elliptical black spot on the side of its body, which may have broad yellow edges. The body of the fish is olive or grey above, shading to silvery white below. It is a member of the emperor family (Lethrinidae). The lack



Above: Thumbprint emperors are commonly caught in seagrass beds.





of scales on its cheek distinguishes its genus (*Lethrinus*) from other members of this family. The thumbprint emperor can be found in a relatively wide range of coastal habitats, including shallow sandy coral rubble, mangrove swamps, lagoons and seagrass beds. It feeds on worms, crustaceans, molluscs, small fishes and echinoderms (sea stars and their relatives). Usually solitary or found in small schools, thumbprint emperors only aggregate in large groups for spawning. They are commonly caught by Fijian fishers using gill nets.

talanoa

obtaining a bride through fish telepathy

The villagers of Waisa hold special reverence for the thumbprint emperor, a species belonging to the family of fishes called *kabatia* in the Kubulau dialect. This particular emperor species holds considerable significance to the villagers of Waisa due to its power to help a man marry the woman he secretly admires. Along the Waisa coastline are three rocks that are together regarded as the *kabatia* rock: one black rock in the intertidal zone; one big rocky cliff adjacent to the black rock; and one small white rock slab located on the top of the big rocky cliff. When a man desires a certain woman, he has to catch a *kabatia* with his bare hands. This can be an exhausting and painful experience, as catching a fish without the aid of fishing tools is quite an intensive exercise. The man will continue chasing

the *kabatia* until the fish is exhausted. When he eventually catches the *kabatia*, the man will toast it in an open fire on the black rock. Then he will climb the big rocky cliff, place the toasted *kabatia* on the white rock, and recite the name of the woman he secretly desires. As the legend goes, he is granted his wish and eventually marries her. According to the villagers of Waisa, the *kabatia* hunt reflects the exhausting and sometimes painful process of wooing a woman and winning her admiration with the intention of marriage. This ancient tradition is not currently practised, and the white rock slab atop the big rocky cliff is missing. The Waisa villagers do not know how it disappeared.



Sairusi Turagalailai,
Waisa village.





Striped Eel Catfish

Scientific name: *Plotosus lineatus*

Fijian names: Boila ('Mboila'), Kaboa ('Kamboa')

The striped eel catfish has venomous spines on its dorsal fin that are capable of producing a painful sting. There are 4 pairs of barbels around its mouth, as well as one pair between its nostrils. Its long body lacks scales and tapers towards the end of the tail; the fins towards the back of its body are merged into a single continuous fin. Its brown body (juveniles are very dark brown) has 2 or 3 whitish stripes, extending onto its head.

This is the only catfish found on coral reefs, and the juveniles of this species are often seen on reefs in ball-like aggregations of around 100 fish. They are also found in estuaries. Adults grow to around 30 cm, and are seen in caves and crevices during daylight hours. When rooting in the substrate for their prey—crustaceans, molluscs or worms—adults stir the sand, creating clouds of sediment.



Above: School of striped eel catfish on a reef flat.

talanoa seeking approval from the catfish

There is a rock out at sea near Namalata Village to which the village fishers pay special attention, as it is home to a very special catfish. During certain fishing trips, the fishers of Namalata Village traditionally seek the help of the catfish to boost their catch. A fisher will dive to the rock and feel for the catfish underneath. If the diver touches the head of the catfish, then the fishing trip has been permitted. With the catfish's approval, the fishers have traditionally always returned with an abundant catch. If the diver touches the tail, then the fishing trip has been turned down, and the fishers have to return to the village.



Paolo Kolikata, Namalata village.





Top: Coconut palms have become a symbol of tropical island life. Above: Copra meat is dried to be processed for oil.

Coconut Palm

Scientific name: *Cocos nucifera*

Fijian name: Niu

Coconut palms, which inhabit coastal regions of most islands and atolls in the Pacific, are a prominent feature of the Kubulau coastline. Coconut palms are very tolerant of salty soils, with a preference for sandy ground. They are able to grow at altitudes over 1000 m, but they hardly fruit at all at altitudes over 400 m.³⁶ The fruits hang in clusters, and the mature

seed is filled with 'meat' and 'milk'. A coconut is not a nut in the botanical sense, but rather a fruit of the same type as a peach. Coconut palms can yield 1 or 2 coconuts per week *all year* in the right conditions. When the husk is removed



from the coconut, three holes can be seen in the surface through which the root emerges when the coconut seed germinates. Large young coconuts can contain 1 litre of coconut water (*bu*).

There is an old Fijian expression: “useful as a coconut tree”. Indeed, the coconut is one of the most useful trees in Fiji and across the Pacific. From the shoot to the root, all parts of the coconut plant are used: the meat and flesh provide food and water; the leaves, or fronds, can be fashioned into baskets, bags, brooms, roof thatching, and walls for traditional houses; the trunks provide timber; and the roots have medicinal value.

Coconut flesh can be processed to derive coconut milk (*lolo*), or it can be dried to make *copra*, the product from which coconut oil is extracted. Coconut shells are used to make cups (including the ones used for kava drinking), ornaments, and jewellery. The husks can be fashioned into *sennit* (braided cord) and serve as a good source of firewood fuel. Even the inflorescence (the cluster of flowers that will mature into coconut fruit) is used to make an alcoholic beverage called ‘toddy’.

The coconut is still widely used in Fiji, and some rural Fijian communities rely on the *copra* industry to sustain themselves financially. To make 1 tonne of *copra*, it takes around 6000 coconuts.³⁷ Unfortunately, the parasitic coconut beetle has caused a lot of damage in Fiji’s coconut plantations, threatening the viability of Fiji’s *copra* industry.

Top: Woman of Macuata-i-Wai village, Macuata Province, preparing lolo from grated coconut.
Right: Woman of Naviavia village, Wailevu District, weaving a basket from palm leaves.





Pandanus

Scientific name: *Pandanus tectorius*

Fijian names: Vadra ('Vandra'), Balawa ('Mbalawa'), Voivoi

Pandanus is a palm-like tree with aerial roots, adapted to a very wide range of light to heavy soil types. Female flowers resemble pineapples, and the resulting fruit is made up of many fruits fused together, measuring up to 25 cm in diameter. The useful leaves grow over 1 m long and have sharp-toothed edges; one tree can yield up to 300 leaves in a single year.³⁸

The pandanus is a very useful tree in Fiji, and there are many varieties of this species. The wild variety, which is locally called *vadra* or

Left: Coastal Pandanus tree. Below: Ladies of Namalata village, Kubulau District, preparing pandanus leaves for weaving.





balawa, grows into a tall tree and produces a sweet-smelling edible fruit that is a popular food for birds and bats. The leaf of this variety is used as rolling paper for making cigarettes, or *suluka*, in certain parts of the country.

The cultivated type of pandanus, called *voivoi* in Fijian, is used for weaving, and particularly for mat weaving. There are several stages of *voivoi*

preparation. First, the green leaves are removed from the tree, boiled, and dried out in the sun. After the leaves are dry, they are softened by running the edge of a large mussel shell along their surfaces. When the leaves are soft enough for weaving, each *voivoi* leaf is split lengthwise into the desired width for the project.



Above: Pandanus leaves hanging to dry in the sun.

Hibiscus

Scientific name: *Hibiscus tiliaceus*

Fijian name: Vau

Vau, a coastal tree belonging to the *Hibiscus* genus, has been an important plant to Fijians and other Pacific Islanders for centuries. Its seeds float and are very resistant to salt water, hence its wide distribution. It tolerates salty waterlogged soil and is therefore well adapted to grow on beaches, by rivers and in mangrove swamps. This tree produces colour-changing flowers throughout the year: when the flowers open they are yellow, but they turn red during the day.

In Fiji, the bark of this tree is used for making *yaqona* strainers, garlands, cords, and skirts that are similar to hula skirts. The bark is stripped from the tree and soaked in sea water for about a week before it is hung to dry out under the sun. After the bark is thoroughly dried, it separates into paper-thin layers of smooth fibres that are a golden hue.



Above: Hibiscus flowers are also prized for decorations.





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Marine Habitats



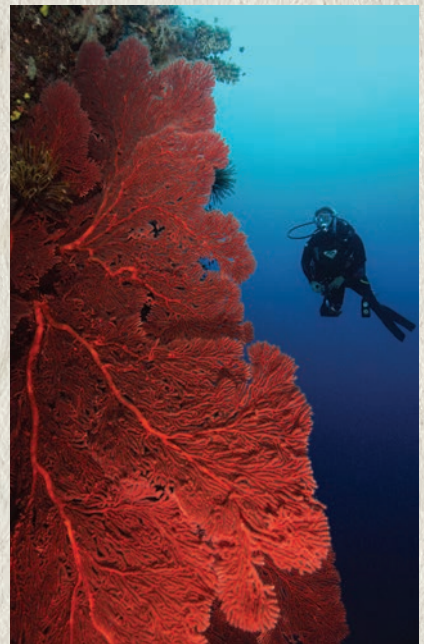


Opposite page: A grey reef shark patrols Nigali Passage off Gau Island. Above: A colourful nudibranch found in Vatu-i-Ra Passage. Below: Giant gorgonian sea fans delight divers in the Namena Marine Reserve.

Marine Habitats

For decades, divers have flocked to the Vatu-i-Ra region of Fiji to enjoy the immense biodiversity across a broad range of marine habitats, including reef flats, coastal fringing reefs, soft-bottomed lagoons, patch reefs, offshore barrier reefs, and channels supporting fish spawning aggregations. These are some of the most intact ecosystems in Fiji and therefore have globally high conservation value.

Fish diversity estimates from rapid surveys in 2003 across the entire Vatu-i-Ra Seascape showed comparable biodiversity to sites in Indonesia (West Bali and West Java) and Papua New Guinea (New Britain).³⁹ In addition, fish sizes and biomass of targeted food fish species were equal to or greater than those measured in studies across multiple locations in Indonesia and Papua New Guinea.⁴⁰ In April 2009, surveys of the Kubulau *qoliqoli* by





Top: Longnose hawkfish (*Oxycirrhites typus*) are resident in the Namena Marine Reserve.
Above: Brilliantly coloured feather stars occur along the many channels of the Vatu-i-Ra Seascape.

Wetlands International-Oceania documented 342 fish species, with a predicted fish fauna of 635 species, on Kubulau's outer reefs. These species represent 73 percent of the total Fijian coral reef fish fauna and 20 percent of the diversity in the Indo-West Pacific.⁴¹

The fish communities of Kubulau and the Vatu-i-Ra are particularly exceptional in Fiji due to the high abundance of co-occurring endemics. Endemic fish represent, on average, approximately 5 percent of the marine fish fauna seen on each dive. Within Kubulau and the Vatu-i-Ra, there are also frequent sightings of fish listed on the IUCN Red List, including the Endangered humphead wrasse (*Cheilinus undulatus*) and Vulnerable humphead parrotfish (*Bolbometopon muricatum*).

The Kubulau *qoliqoli* has been identified as a priority site for cetaceans in Fiji. Resident pilot whales and dolphins are frequently sighted year round, and humpback whales can be sighted during migration seasons.

The communities of Kubulau have established a network of 20 marine protected areas (MPAs), which include 17 small village-managed MPAs and 3 larger district-wide MPAs, including the Namena Marine Reserve (www.namena.org). At nearly 70 square kilometres, the Namena Marine Reserve is Fiji's largest MPA.

The chiefs of Kubulau and the KRMCM set 5 main management goals for the protection and management of their coastal systems:

- Increase fish abundance and biomass, especially of food fish and endangered species
- Increase invertebrate abundance and biomass, especially of commercially important giant clams and sea cucumbers
- Maintain or improve coral reef health, productivity, and resilience
- Maintain abundance of sea turtle populations
- Maintain fish spawning aggregations by protecting spawning sites, particularly reef channels and steep forereefs



Protected & Unique Marine Species

Humphead Wrasse

Scientific name: *Cheilinus undulatus*

Fijian name: Varivoce ('Varivothe')

Above: Large humphead wrasse are commonly sighted along offshore, unfished reefs.

The humphead wrasse is one of the largest species of fish in the world. It can reach over 2 m in length, and the maximum published weight is a staggering 190 kg.⁴² This slow-growing fish reaches sexual maturity at 5 to 7 years. Some adult males develop directly from juvenile males, but other adult males develop from an adult female that undergoes a sex change. Humphead wrasse can live for over 30 years,⁴³ and they feed on fishes and invertebrates such as molluscs, crustaceans and sea urchins. They are one of the few predators of crown-of-thorns sea stars.

Unfortunately, the humphead wrasse is now listed as Endangered on the IUCN Red List as a result of overfishing, particularly through the live reef fish trade (although export of live fish is illegal in Fiji under the *Fisheries Act*). The species is particularly vulnerable due to its predictable behaviour, slow growth, and high retail price (up to US \$130 per kg) for live specimens.⁴⁴ The humphead wrasse is now protected under CITES Appendix II, and it is illegal to catch this fish in Fiji under Fiji's *Endangered and Protected Species Act* (EPSA).





Bumphead Parrotfish

Scientific name: *Bolbometopon muricatum*

Fijian name: Kalia

The giant bumphead parrotfish, called *kalia* in Fijian, can grow to well over a metre in length and is easily recognisable by the large bump on its forehead. These fish generally form small aggregations. They are referred to as 'excavators' because they remove limestone and dead corals from the reef as they feed on algae and live corals. Their feeding activities expose the hard reef matrix, opening up new sites for corals to colonise.

Kalia prefer to sleep in cave-like geological formations at night, making them vulnerable to night fishing. This practice has contributed to unsustainable harvesting of the species, and it is now rare to encounter schools of bumphead parrotfish during undersea excursions. As such, they are listed as Vulnerable on the IUCN Red List. Some of the last remaining schools can be seen in and around the Namena Marine Reserve and on the Great Sea Reef to the north of Vanua Levu.



Above: A bumphead parrotfish photographed near the Namena Marine Reserve.





Green Turtle

Scientific name: *Chelonia mydas*

Fijian name: Vonu dina ('Vonu ndina')

Turtles are the living fossils of this modern era. They first appeared about 215 million years ago, making them one of the oldest reptile groups. The earliest known sea turtle fossils are about 150 million years old. The waters of Fiji boast 5 of the 7 living species of sea turtles: green, hawksbill, leatherback, loggerhead, and olive ridley. The first three of these species also nest in Fiji from October to April every year. The sandy beach on Namanalala Island and other sandy beaches along the Kubulau coastline are nesting sites for green and hawksbill turtles.

The green turtle is the most commonly encountered marine turtle in Fiji, often seen foraging on seagrass beds or nesting on sandy beaches. The name does not describe its shell colour, but rather its green fat, which is prized for its taste. A green turtle's shell can grow up to 1.2 m, and a mature turtle can weigh up to 130 kg. Males have a long grasping tail that extends well beyond the shell edge, whereas the tails of females usually do not pass the shell margin. Female turtles do not start to reproduce until they reach around 30 years of



Above: Nesting beaches for the green sea turtle are found throughout the Vatu-i-Ra Seascape.

age, and they only nest every 2 to 3 years. One female green turtle can lay up to 7 clutches of eggs per nesting season, with 100 eggs per clutch.⁴⁵ Adult green turtles feed during the day in shallow waters on sea grasses, plankton, and fish eggs floating in the sea; young turtles eat invertebrates like jellyfish, crabs, and sponges.

Unfortunately, human impacts threaten green turtles at all life stages. On land, eggs are harvested, nest sites are degraded, and adults and juveniles are hunted. At sea, their foraging grounds are damaged, adults and juveniles drown when they become entangled in marine fishing gear, and they frequently choke on plastics—plastic bags resemble their jellyfish prey. Green turtles are listed as Endangered on the IUCN Red List and are protected under CITES Appendix I. The Department of Fisheries has enacted a 10-year moratorium on harvesting all turtle species in Fiji.





Hawksbill Turtle

Scientific name: *Eretmochelys imbricata*

Fijian name: Vonu taku

Another common turtle species in Fiji waters, hawksbill turtles are primarily carnivorous, feeding on a variety of marine animals such as fish, crabs, molluscs, certain species of sponges, and jellyfish. They use their parrot-like beak to pick encrusting animals off the substrate. They usually feed in the early morning or late afternoon, and at other times of the day they are often seen resting either on the reef or at the surface. The hawksbill turtle's shell can grow up to 1.1 m long, and mature animals reach 80 kg in weight.

Nesting seasons for hawksbills occur every 2 to 3 years. Hawksbills nest at least 4 times per breeding season, with 15 to 20 days between each nesting effort. The 150 or so eggs laid per clutch will hatch at night or in the early morning. Hawksbill turtles can live more than a 100 years, and reach maturity at a minimum age of 30 years in the Indo-Pacific.



Above: Because hawksbill turtles have long been hunted in Fiji, they are often shy of photographers.

The thick plates from the shell of these turtles are known as tortoiseshell. Within the last 100 years, millions of hawksbills have been killed for the tortoiseshell markets of Europe, the United States and Asia. Global analyses of hawksbill populations show a decline of over 80 percent in number of mature females nesting annually over the last 3 hawksbill generations.⁴⁶

In addition to the threat from the tortoiseshell trade, hawksbills face the same threats as green turtles from egg harvesting, hunting, degradation of nesting sites and foraging grounds, entanglement in fishing gear, and ingestion of plastic debris. Hawksbill turtles are listed as Critically Endangered on the IUCN Red List, and like green turtles, are included on CITES Appendix I.





Above: Humpback whale near reefs northeast of Vatu-i-Ra Island.

Humpback Whale, Oceana Subpopulation

Scientific name: *Megaptera novaeanglia*

Fijian name: Tovuto

The humpback whale is a large baleen whale that feeds on krill and schooling fish. Females can grow to be 19 m long (17 m for males), and the maximum recorded weight for this species is 40 tonnes.

Male humpbacks have the longest and most elaborate songs of any whale species. Their songs consist of a complex series of whistles, squeals, and deep sonorous calls that are divided into 'verses' and sung in a specific order. The songs may last for as long as half an hour. Whales in the same breeding ground sing the same song, which evolves over time.

Humpback whales are highly migratory, and travel the longest distance of any mammal on earth. Humpbacks can swim at 25 km per hour or faster, although they travel at a slower rate during migration, occasionally resting and socialising along the way. Some of these pods come to Fiji to breed and calve, and pods of humpback whales can be regularly sighted in Fiji from August to October. The Vatu-i-Ra Seascape, including the area around the Namena Marine Reserve, is a corridor in their migration route.

After commercial whaling greatly reduced humpback numbers, global protection has helped some of their populations to recover. However, the Oceania subpopulation of humpbacks is listed as Endangered on the IUCN Red List and is still classified under the most endangered categories of CITES and the Convention on Migratory Species.





Whale Shark

Above: Whalesharks are infrequent but possibly regular visitors to the Namena Marine Reserve.

Scientific name: *Rhincodon typus*

Fijian name: Dakuwaqa ('Dakuwangga')

The whale shark is the largest fish in the ocean. It can grow to 20 m in length (although it normally does not exceed 12 m), with a maximum weight recorded at 34 tonnes. It can live up to 70 years.

The whale shark is a highly migratory species. It feeds on plankton and small fishes and is harmless to humans. Sighting a whale shark in the wild is a rare opportunity; in fact, this shark is rare enough to receive protection under CITES and the Convention on Migratory Species.

Whale sharks have been seen in the Namena Marine Reserve on an occasional but regular basis, including a sighting by divers at the North-Save-a-Tack dive site in June 2010. Although whale sharks are a highly migratory species, they have been known to return to the same site annually.





Yellow Fang Blennies

Scientific names: *Meiacanthus oualanensis*,
Plagiotremus laudandus flavus

Meiacanthus oualanensis is endemic to Fiji. A small fish (maximum size 10 cm), *M. oualanensis* is characterised by its solid bright yellow appearance and two long yellow lobes on its caudal fin. It was supposed to be named for the island of Ovalau, where it was likely first discovered, but typographical errors when the species was formally described led to the name '*oualanensis*'.

M. oualanensis is mimicked by the yellow variant of *Plagiotremus laudandus flavus*, which is only found in Fiji and Tonga and is protected under the Fiji EPSA. By imitating the colouring, morphology and behaviour of the non-threatening *M. oualanensis*, *P. laudandus flavus* is able to get closer to its prey. It attacks other fishes to bite off pieces of mucus, skin tissue and scales. The two types of blennies can be distinguished readily by their mouthparts, which protrude more in *M. oualanensis*.



Plagiotremus laudandus flavus (above) deliberately mimics the non-threatening *Meiacanthus oualanensis* (top)

Pygmy Seahorse

Scientific name: *Hippocampus* spp.

Fijian name: Ose ni waitui

Pygmy seahorses rarely grow more than 3 cm in length. These inconspicuous fish can be found hiding in Fiji's reefs, and viewing one in the wild is a rare and special experience.

Seahorses are interesting and unusual underwater creatures. They are monogamous, and a male and female pair bond for life. Oddly, it is the male seahorse that gets 'pregnant.' A female seahorse produces the eggs, but then deposits them in the male's special brooding pouch. The male then carries the eggs and cares for the developing young.

All seahorses are now protected internationally under CITES, as their survival is threatened by accidental capture (as fishing bycatch), habitat degradation, and direct exploitation. Their susceptibility is increased by their monogamy, low population density, and low adult mobility.



Above: Only divers with good eyes can spot the miniature seahorses that sway like algae on the reef.





Above: The Nai'a pipefish prefers to hide in reef caves.

Nai'a Pipefish

Scientific name: *Dunckerocampus naia*

Fijian name: Ose ni watui

This new species of pipefish was first spotted in a cave on the current-swept corner of a dive site called Maytag by Cat Holloway from the liveboard dive boat *Nai'a*. It was described by scientists in 2004.⁴⁷ It grows to 12 cm and is found at depths around 20 to 30 m. From underwater photographs, it is also thought to occur in southern Japan, northern Sulawesi, Guam, and the Solomon Islands. It could be easily confused with the banded pipefish (*D. dactyliophorus*) from the western Pacific, because both are patterned with light and dark bars. The tailfin of the Nai'a pipefish is mainly red with a white margin on only the upper and lower portions of the fin, whereas the tailfin of the banded pipefish has a bull's eye pattern with a complete white margin. The bars on the Nai'a pipefish also tend to be paler than the banded pipefish, with a reddish hue.



Above: Leaf scorpionfish are always a delight to spot on the reef.

Leaf Scorpionfish

Scientific name: *Taenianotus triacanthus*

Fijian name: Novu

These unusually-shaped fish resemble bits of flotsam, and they sway to and fro to complete the impersonation. Because of their disguise and variable colour patterns, they are often difficult to spot without the aid of a keen dive guide. They are found all across the Pacific Ocean, from southern Japan and Australia in the west to Hawaii, French Polynesia and even the Galapagos Islands in the east. They can be found throughout the Vatu-i-Ra Seascape and across Fiji, as deep as 135 m and as shallow as 1 m.





Marine Species of Cultural Importance



Trumpet Shell/ Triton's Trumpet

Scientific name: *Charonia tritonis*
Fijian name: Davui ('Ndavui')

The trumpet shell is a large marine gastropod (sea snail) that inhabits coral reefs. It can grow up to 45 cm in length. An active predator, it paralyses its prey with a salivary secretion before devouring it, and it is known to

*Top: The colourful mantle of a giant clam.
Left: A Kubulau man announcing the start of a ceremony by blowing the triton trumpet.*





Above: The triton shell is now rarely spotted on the reefs of the Vatu-i-Ra Seascape.

important messages of the *vanua* (land) and is also used on solemn traditional occasions, such as the death of a high chief. The shells can often be found decorating tree fern carvings (*balabala*) in Fijian villages.

The value of trumpet shells was also recognised by curio traders. Unfortunately, the curio trade has resulted in the unsustainable extraction of this animal. Although *Charonia tritonis* was rejected from inclusion on CITES Appendix II in 1994 because of lack of data about the trade, it is now protected under Fiji Law—the sale or trade of this shell is now illegal under the *Fisheries Act*.

feed on the notorious crown-of-thorns sea star (*Acanthaster planci*), which is a coral predator. Trumpet shells live on sandy or rocky bottoms from the intertidal zone to depths greater than 100 m. They lay eggs directly on the substrate in clusters of large capsules.

The shell of this animal has been used by generations of Fijians as a trumpet to relay information. The trumpet shell is blown to convey



Above: Without the mantle covering the shell, it is difficult to tell if the animal is still in the shell.

Tiger Cowrie

Scientific name: *Cypraea tigris*

Fijian names: Buli ('Mbuli'), Buliloa ('Mbuliloa'), Pule

This mollusc can grow up to 15 cm and is fairly common in Fiji waters. The adult tiger cowrie is carnivorous, feeding on coral and various invertebrates, while juveniles eat algae.

Active during the day, the tiger cowrie can be seen on sand patches or branched corals at depths up to around 30 m.

Like all cowries, tiger cowries exhibit two extensions of the mantle 'cloak' (a part of their soft body that extends beyond the shell), which can cover the entire shell to meet at the midline on the back. The outside of the mantle is covered with many small white-tipped projections. The patterning on the shell itself is very variable, but is commonly whitish with a dense covering of dark irregular spots. This is a popular shell for use in handicrafts, and all-white shells are favoured.

Giant Clam

Scientific name: *Tridacna* spp.

Fijian name: Vasua

Giant clams of the genus *Tridacna* are one of the most conspicuous shellfish in Fiji, due to their large size and their colourful mantles. Some of these clams can grow to 1.5 m and live for 200 years, often developing mantles so thick that the two halves of the shell cannot fully close. There are several species of giant clam in Fiji: *Tridacna squamosa* (*cega*), *T. maxima* (*katavatu*), *T. derasa* (*vasua dina*), and *T. tevoroa*. *T. tevoroa* is found only in Fiji and Tonga.

These are highly specialised sedentary bivalves: they 'farm' algae. Algal cells live between the cells of the clams' mantle tissue. Using the sunlight that penetrates clear waters, the algae photosynthesise and provide the clams with food. Bright spots on the mantle are actually transparent patches that act like lenses to focus the light onto the algae. If the algae get too numerous, the clams can change the chemical balance of their tissues so that the algae pass into the gut, where they are digested. The clams supplement this algal food source with plankton filtered from the water. An individual giant clam can produce both eggs and sperm. All clams in an area will spawn at the same time, turning the water milky.



Above: The Fiji Department of Fisheries cultures giant clams on Makogai Island for restocking on the reef.

Harvesting of giant clams for local consumption, combined with aquarium trade harvesting and environmental degradation, threatens their populations. The largest of the giant clams, *T. gigas*, is believed to be locally extinct in the Western Pacific in Guam, Mariana Islands, Federated States of Micronesia, Fiji, New Caledonia and Vanuatu.⁴⁸ However, this species is currently being re-introduced



to Fiji through a restocking program led by the Fiji Department of Fisheries.

The Fiji *Fisheries Act* prohibits the export of giant clam meat. These clams are also protected internationally under CITES. Of the giant clam species in Fiji, *T. tevoroa* and *T. derasa* are the most threatened: both are listed as Vulnerable on the IUCN Red List.

Left: Empty clam shells around coastal villages are a legacy of many past meals.

Sandfish/Sea Cucumber

Scientific name: *Holothuria scabra*

Fijian name: Dairo ('Ndairo')



Above: Sale of sandfish can fetch top dollars, which the village of Natuvu uses for community projects.

Sea cucumbers are relatives of sea stars, sea urchins, feather stars and brittle stars, and share the same 5-fold internal symmetry with these groups. Minute spicules (hard, intricate structures) in the skin of all sea cucumbers act as a protective shield, and can be examined using electron microscopy to distinguish between different species.

Holothuria scabra is a type of sea cucumber that inhabits muddy or sandy seagrass beds and reef flats.

Known as the sandfish, it can be

exposed or partly buried in the sand in shallow water down to around 3 m. The sandfish is brownish-grey, brownish-green or dark grey above with tiny black dots and dark transverse wrinkles, and it has a lighter colour underneath. It can grow over 30 cm long and has a very high commercial value.

Sandfish are being cultured in Natuvu village in Wailevu District, Cakaudrove Province, through a joint project with Fiji Department of Fisheries, the Secretariat of the Pacific Community, and James Cook University.





Above: A grey reef shark enjoying the strong currents of Nigali Passage off Gau Island.

Grey Reef Shark

Scientific name: *Carcharhinus amblyrhynchos*

Fijian names: Qio ('Nggio'), Kula

The grey reef shark can be recognised by a conspicuous wide black margin on its tailfin. It has a dark-grey body with white underparts, and a broad, round snout. Adults grow to about 2.5 m, and young are born live at around 50 cm, in litters of between 1 and 6. Grey reef sharks feed on the bottom, eating small reef fishes and octopuses. They can be aggressive when attracted by spear-fishing or cornered by divers. Within the Vatu-i-Ra Seascape, there is an important grey reef shark pupping ground in Nigali Passage through the reefs surrounding Gau Island. It is a favoured spot for recreational diving.

The grey reef shark is listed as Near Threatened on the IUCN Red List.





talanoa

the story of the *kula* fish

In the month of August, an interesting phenomenon occurs in the island of Namatari. This is the month of the annual *kula* fish call. According to the people from Navatu village, the *kula* is a mythical fish that looks like a crossbreed of a shark and a dolphin. They reckon it is not a very bright animal because you have to speak to it in reverse.

During the month of the *kula* fish call, when a fish is sighted, a caller will call out to it. If the caller wants the fish to come to shore, the caller will call out "*i wai, i wai*", which means "the ocean, the ocean"—and the fish will head for the shore. And if the caller wants the *kula* fish to go to the ocean, the caller will say, "*i vanua, i vanua*", which means "the land, the land"—and the fish will head for the ocean.

The Navatu Islanders say that when the *kula* fish is called, it will come all the way to shore and beach itself. Then the villagers will kill it for their meal. It has been said that the skin of a *kula* fish is so thick that a digging fork is required to pierce it. One *kula* fish can provide lunch and supper for the whole village of Navatu for up to 3 days.

Traditionally, *kula* fish were only killed at sustainable levels for subsistence use. When the villagers of Navatu had enough *kula* fish to keep them fed for a sufficient period, they would tell the rest of the fish to go back to the ocean.

Unfortunately, this practice of calling out to the *kula* fish is not being used anymore. The practice may have ended because the oral traditions have not been effectively passed down. Or it may be because additional fishing pressure from outside interests has reduced the populations below critical level.



Lepani Qio, Navatu village.





Above: A spinner dolphin delighting visitors to Moon Reef, Tailevu.

Spinner Dolphin

Scientific name: *Stenella longirostris*

Fijian name: Babale ('Mbambale')

Dolphins are beautiful and intelligent marine mammals, and watching these graceful creatures in the wild is an amazing experience. The seas of Kubulau boast a sizable population of spinner dolphins all year round. Their colouration is in 3 shades: dark grey on the back, light grey on the flanks, and whitish on the belly, usually with a marked stripe running from eye to flipper. They grow to 2.5 m and generally have a long beak. Females only calve every 3 years after they mature at the age of 4 to 7 years. Gestation lasts 10 months, and nursing lasts up to 2 years.

Spinner dolphins are named for their ability to leap out of the water and spin in the air. In addition to appreciating their beauty and acrobatic skills, people respect these dolphins as an ancient indicator of changing weather patterns. Spinner dolphins are listed as Data Deficient on the IUCN Red List, but all dolphins are protected under the Fiji *Fisheries Act*.



Sperm Whale

Scientific name: *Physeter macrocephalus*

Fijian name: Tovuto tabua ('Tovuto tambua')

The sperm whale is the largest toothed whale. Males grow to a maximum length of 18 m and females to 12 m; the largest recorded weight is 57 tonnes. The sperm whale's head takes up one third of its body length and houses the largest brain in the animal kingdom. In fact, the cavity in its head is large enough to fit a car.

Sperm whales live in all the world's oceans, from the equator to the edge of pack ice in both hemispheres. Fiji is along one of their migratory routes, and sperm whales are sporadically sighted here at certain times of the year. The whales are champion divers. They regularly dive to depths of 400 m, but are capable of diving to depths of at least 1 km. They can hold their breath for over an hour.



Above: Presentation of a tabua during a special ceremony on Totoya Island in Lau Province.

The sperm whale received its rather unusual common name because of the waxy whitish substance found in its head, called spermaceti, which early whalers mistook for the whale's sperm. Believed to help the whale with buoyancy control or focusing sound, this substance was prized for use in candles, cosmetics, pharmaceuticals, and lubricants. Additionally, sperm whales produce an intestinal secretion called ambergris, which was once used as a fixative for perfume. These valuable substances made the sperm whale one of the most sought-after targets for whalers.

The sperm whale is the most treasured whale species in Fiji, and its teeth are the most valuable commodity in Fijian culture. The whale's tooth, called a *tabua*, is used for important exchanges, from traditional Fijian weddings to requesting property. However, sperm whales are not actively hunted in the Fijian tradition. Their teeth are acquired only when a sperm whale beaches on shore.

Although commercial whaling did not reduce their numbers as precipitously as some of the other large whale species, sperm whales are now protected globally. They are listed as Vulnerable on the IUCN Red List, and are protected under CITES and the Convention on Migratory Species. Any *tabua* that is imported to or exported from Fiji needs to be approved under CITES standards.



IUCN Red List Categories

The IUCN Red List of Threatened Species assigns plants and animals to categories of conservation status in order to highlight species with a relatively higher risk of extinction. The categories are assigned by evaluating a species or taxon (a group of species) against globally accepted criteria. The resulting categories are widely understood and are a useful tool for focusing conservation efforts on the animals and plants most at risk of extinction. For a full description of the criteria used and updated assessments, please refer to www.iucnredlist.org.

Critically Endangered: The best available evidence indicates that the taxon is facing an extremely high risk of extinction in the wild.

Endangered: The best available evidence indicates that the taxon is facing a very high risk of extinction in the wild.

Vulnerable: The best available evidence indicates that the taxon is facing a high risk of extinction in the wild.

Near Threatened: The taxon does not qualify for Critically Endangered, Endangered or Vulnerable status now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future.

Least Concern: The taxon does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Data Deficient: There is inadequate information to make a direct or indirect assessment of a taxon's risk of extinction based on its distribution and/or population status.





Recommended Further Reading Identification Guides

Allen GR, Steene R (1996) Indo-Pacific Coral Reef Field Guide. Tropical Reef Research, Singapore. 378 pp.

Allen GR, Steene R, Humann P, Deloach N (2003) Reef Fish Identification – Tropical Pacific. New World Publications, Jacksonville, USA. 457 pp.

Clunie F (2007) Birds of the Fiji Bush. Fiji Museum, Suva. 142 pp.

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