

Melanesian

ISSUE 8

Geo

The worst
weed in the
Pacific

A THREATENED ISLAND ARC

Environmental catastrophies looming
over Solomon Islands?

SOCIETY AND THE ENVIRONMENT IN MELANESIA



Nature

Tranquility



Ocean



Culture





6



12



14



22



28



32



38



42



43

6 *Wedelia* - invader of Melanesia: Worst weed in the Pacific?

Can a pretty daisy be compared with the likes of the *Anopheles* mosquito, the dreaded malaria vector; the brown tree snake that has brought the birds and lizards of Guam to virtual extinction; or the fire ants that threaten endemic lizards and cause blindness in dogs in New Caledonia?

12 Notes on *Discodeles malukuna*
One of the most conspicuous frogs in this area is *Discodeles malukuna*. Compared to the other anurans of the upland forest of Kolombangra, *Discodeles malukuna* are robust, heavy bodied frogs (64.5-to-104.0 mm) with wide, truncated heads.

14 A Threatened Island Arc:
Environment catastrophies looming over Solomon Islands?

Drastic environmental changes are a daily occurrence on Solomon's far northwest province.

22 Biodiversity and the incredible resource of local foods

Diversity in Melanesian food systems is gradually declining as lifestyles change and people depend less on subsistence farming to provide their food.

28 The fight against an invasive vine, big leaf *Merremia peltata*
Approximately 2,300ha (92%) of

Vatthe forest has been invaded. Of this some 1,300 ha are beyond the ability to control and need to be replanted.

32 Kolombangara, united by a crater
Prompted by several enthusiastic overseas scientists and supported by KFPL, the landholders decided to set up an organisation that would take a lead in the conservation interests on Kolombangara on behalf of all landowners.

38 Empowering Communities to retain their resources

This provides a model of how remote subsistence communities can realise their development aspirations without compromising the natural resources that support them.

42 Kukuvojo: speaking from the grave
Unfortunately, large size, independent young, and ground dwelling habits are a deadly set of traits for an animal to have on an island where cats, rats, and dogs have been introduced.

43 Red-backed button quail are still on Guadalcanal

Mayr (1945) said of the sub-species of Red-backed Button-quail (*Turnix maculosa salomonensis*) found only on the north-coastal grasslands of Guadalcanal in the Solomon Islands, that "Most field naturalists will look in vain for these birds, even in their proper habitat."



Cover: The endemic Solomon sea-eagls (Photo: Patrick Pikacha)



Chris Filardi, Editorial Director, Pacific Programs, American Museum of Natural History, New York and long time researcher in Melanesia

Melanesia has never been an easy place to define. Its diversity of cultures and environments defy meaningful summary, and it seems that whenever one tries to capture even a small bit of all that it is, odd exceptions spring out of every corner of the "dark islands". The scope of this 8th issue of Mel Geo is perfectly in step with this: On the cover, banner taglines of The Worst Weed in the Pacific and Threatened Island Arc draw our eyes down from the piercing gaze of a remarkable animal, the Solomon Sea Eagle. This eagle is found only in the Solomon Islands where it still persists in all of its grace and seeming indifference to invasive weeds and threats from loss of habitat.

Invasions and loss of habitat – two of the greatest threats to island systems worldwide are looming in Melanesia. Across the Pacific, introductions of plants and animals from continental areas, such as rats and cats as well as numerous flowering herbs and woody plants, have devastated countless island species and are a primary factor driving the highest contemporary rates of extinction on earth. The combination of invasive species, loss of habitat from poorly managed resource extraction, and the inevitable clearing of land by growing populations of islanders expanding agricultural and village sites, has strained fragile island systems often to the breaking point.

In this issue, we see that pretty little Wedelia daisies invading massive areas across the Fiji Islands and beyond are replacing native coastal strand and riverine vegetation. This favors other invasives and edges out many natives including species of high cultural and subsistence value like the coconut crab. In Vanuatu's last large tract of intact alluvial forest, the creeper Big Leaf Merremia is having similar impacts within the Vatthe Conservation Area on Santo. And on Choiseul, where one of the world's most spectacular ground pigeons once wandered the deep emerald forests, the only remaining evidence of this extinct bird are specimens held in a far away museum, the last of the species to be documented before feral cats and other changes on the island led to their forever disappearance.

Turn the pages, and in true Melanesian style, there is a contrasting set of more hopeful stories. According to Randy Thaman, the daisies have not yet overwhelmed many areas so there is a chance to act now. G. W. Scoville reports on new records of giant forest frogs with previously unknown flashes of brilliant yellow embellishing their display postures, and Sue Maturin writes that the local landowners of Vatthe are working with Forest & Bird from New Zealand to aggressively address the Merremia infestation there. Just as we ache from the knowledge of Choiseul's extinct Kuku'voju pigeon, we see, with another turn of the page, that secretive little button quail, once feared extinct, still skitter among the high grasses, ghostlike, just outside the growing Solomon capital city of Honiara.

In a sweeping chronicle of his recent journeys across the Solomons, Mel Geo founder and editor, Patrick Pikacha, describes with his coauthors "A Threatened Island Arc," leaving all of us asking bigger questions about where we stand in the struggle to sustain the richness of his Melanesian home, a place of giant rats, miniature frogs, and one of the most diverse and historically vibrant oceanic archipelagos on earth. Our intrepid editor's journeys visit projects that I have been privileged to work with him on. Pikacha visits the Marovo communities of Biche and Zaira that Simon Albert writes are now managing resources in ways that retain intact ecosystems within their customary lands. And also to Kolombangara, where Ferguson Vaghi and Andrew Cox explain that after decades of conflict and unsustainable resource extraction, landholding communities have united to conserve large areas of forest that birthed the Ndigore people indigenous to the island. Each of these stories places looming threat beside grassroots hope, urging support for emerging wellsprings of collective action by customary landholders.

Tucked in the middle of this issue is an article that emphasizes why acting now to address some of these threats is so critical. Growing threats to local food biodiversity sometimes referred to as agro or ethno-biodiversity, jeopardize the security and persistence of Melanesian ways of life. Wendy Foley and colleagues provide strong evidence that the persistence of native foods within the living diversity surrounding human communities can help fortify Melanesian communities against what is lost when invasive lifestyles infiltrate places just as invasive species have.

In the end, Melanesia has always gained its strength and unique identity, its physical and spiritual nourishment, from its nearly indefinable diversity and thriving natural systems. This grassroots magazine reflects this. And now that we are reminded and aware, we can revel in its beauty, become inspired by the actions of its people, and invest in a future that maintains all that Mel Geo seeks to give us a window into – the threatened, the vibrant, the fragile, and the resilient life of Melanesia.

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MELANESIAN GEO

is published at least three times a year for the purpose of dissemination of important issues affecting society and the environment in Melanesia.



Disappearing Landscapes

A photograph of a river flowing through a dense tropical forest. The river is rocky, with many dark, smooth boulders scattered throughout. The water is clear and appears to be moving quickly, creating white foam and rapids. The forest is lush with various green plants, including ferns and tall trees. The scene is captured from a low angle, looking down the river.

River above Siruka on northeast Choiseul Island, Solomon Islands, a nickel rich landscape soon to be altered by mining.

WEDELIA, creeping oxeye, or the trailing daisy, a deceptively beautiful, bright emerald-green creeper with bright yellow daisy-like flowers, is one of the world's most aggressive weeds and is listed among these other destructive organisms as one of the world's 1000 worst invasive alien species. It is now firmly established in Melanesia and throughout the Pacific Islands. It is suggested that it should be immediately declared a serious noxious weed, should be restricted from introduction into new islands and habitats, and, where possible, eradicated from islands, habitats and places where it is yet to gain a firm foothold. If action is taken NOW, islands and communities throughout Melanesia, and elsewhere in the Pacific, can prevent the spread of *Wedelia* BEFORE it replaces extensive areas of indigenous vegetation, particularly along streams, drainage ditches, coastlines, swampland, mangroves and swampland, on offshore islands and in plantations, grazing lands and towns and villages where it out-competes plants of considerable ecological and cultural importance. This conclusion is based on my studies of *Wedelia* over the past 30 years in most of the countries and territories of the Pacific.

Wedelia (*Sphagneticola trilobata*)

Wedelia, now known officially by the scientific name, *Sphagneticola trilobata* (L.) Pruski (USDA-GRIN 2008), is still widely known by its previously accepted name, *Wedelia trilobata* (L.) Hitch., is a member of the family Asteraceae (formerly Compositae), the sunflower or daisy family. The most widely used common name in the Pacific is "*Wedelia*" (after its former genus), although in Australia it is known as "Singapore daisy", in spite of its tropical American origin. Other common names include trailing or creeping daisy, water zinnia, rabbit's paw and creeping or Bay Biscayne oxeye (after Biscayne Bay near the southeast tip of Florida, where it grows profusely and is considered a noxious weed).

Wedelia is native to, and wide ranging

throughout tropical America, where it is found from Mexico to Panama in Central America, in western and northern South America (Peru, Ecuador, Bolivia, Columbia, Venezuela, the Guianas and Brazil), throughout the Caribbean (USDA GRIN 2008), and possibly Florida (Macoboy 1986). It is now cultivated throughout much of the tropics and subtropics as an ornamental groundcover. It is closely related to the widespread tropical strand plant or beach daisy, *Wollastonia biflora* (formerly known as *Wedelia biflora*), a very important medicinal plant found throughout the Pacific. Interestingly, the Hawaiian endemic genus *Lipochaeta* is scarcely distinct from *Wedelia* genetically, and two sections of *Lipochaeta* appear to have been independently derived from *Wedelia*-like ancestors (Wagner et al. 1990, Rabakonadrianina and Carr 1981).

It is a creeping, mat-forming perennial herb with fast-growing, rounded stems up to 40 cm long or longer that root at the nodes and grow upwards (ascend) when flowering. The attractive, bright shiny emerald-green, somewhat fleshy, leaves are regularly toothed on the margins, commonly with three shallow lobes (hence the name *trilobata*). The single attractive bright-yellow daisy-like flowers are borne on the end of terminal and axillary stalks. The fruit, which is rarely seen in the Pacific, is a 2- to 4-angled achene, with short, narrow pappus scales on the top (Whistler 1995). Although seedlings have been observed in Hawai'i, cultivated plants seem to develop few flower heads with mature fertile seeds. Wagner et al. (1990) suggest that: "If a fertile strain develops this species could become a serious pest."

It already is!! And, as suggested above, it has been listed in the French Fondation TOTAL-funded Global Invasive Species Database's "One Hundred of the World's Worst Invasive Species", alongside some of the world's most notorious invasive organisms, which include: the *Anopheles* mosquito, the dreaded malaria vector found in Vanuatu, Solomon Islands and Papua New Guinea; the brown tree snake (*Boiga irregularis*),

which, since accidental introduction into Guam from Solomon Islands near the end of World War II, has brought to extinction most of the indigenous and endemic birds and devastated the gecko and skink populations of Guam; miconia, the "green cancer" (*Miconia calvescens*), the small tree that has invaded and devastated native forests in Tahiti; African tulip tree (*Spathodea campanulata*), which has invaded croplands and secondary forests in Fiji; goats, cats, rats, mongoose, pigs, deer, macaque monkeys and the bushtail possum, all of which have caused havoc on islands throughout the world; the Dutch elm disease fungus (*Ceraticystis ulmi*), which has wiped out the totemic elm tree in North America; the Indian mynah bird (*Acridotheres tristis*), which has spread so widely and is such a nuisance in the Pacific; the rosy wolf snail (*Euglandina rosea*), a carnivorous snail responsible for the extinction of endemic land snails in French Polynesia and Hawai'i; banana bunch-top virus, which crippled export banana production in the Pacific; and avian malaria (*Plasmodium relictum*), the micro-organism widely held responsible for the extinction of endemic birds in Hawai'i (ISSG 2008). Yes, this pretty little ground-hugging daisy is among these monsters of the invasive world!

The Introduction of *Wedelia* into the Pacific Islands

The introduction of *Wedelia* into the tropical Pacific Islands, where it is now widely cultivated as a groundcover and ornamental, seems to be a relatively recent phenomenon. Whistler (1995) suggests that it was first recorded from the Pacific Islands in Hawai'i sometime before 1965. It is described in Neal's *In gardens of Hawaii* (1965), although no information is given regarding its date of introduction or status as a naturalized species. It is not listed in *Stone's Flora of Guam* (1970), Moore and McMakin's *Plants of Guam* (1979), Smith's *Flora Vitiensis nova* (1990), Parham's *Plants of the Fiji Islands* (1972), or Merlin et al.'s 1992 study of the *Plants of Pohnpei*, despite the fact that it is now widely

Wedelia - Daisy invader of Melanesia: The worst weed in the Pacific?

Can a pretty daisy be compared with the likes of the *Anopheles* mosquito, the dreaded malaria vector; the brown tree snake that has brought the birds and lizards of Guam to virtual extinction; or the fire ants that threaten endemic lizards and cause blindness in dogs in New Caledonia? I think so. Words by **Randy Thaman**

naturalized and invasive in all these islands. Similarly, it is not listed as present in Tonga in *Yunker's Plants of Tonga* (1959), where it seems to be naturalized and spreading, and in Sykes' *Contributions to the flora of Niue* (1970), where it seems to have only been introduced in the past few years, but is now the focus of a very expensive, apparently unsuccessful, control program.

It was listed as present in Guam, on Yap in the Federated States of Micronesia, and on Kwajalein and Enewetak Atolls in the Marshall Islands by Fosberg et al. (1979), by Lambertson (1982) in her study of the plants of Eniwetak, and by Thaman et al. (1994) in their *Flora of Nauru*. Fosberg et al. (1979) report that by the end of the 1970s it was present in Palau where it had come to be known by the name **ngesil ra ngebard** ("the foreign *Wollastonia biflora*"). Guerin (1982) in his "The flora of the atolls of French Polynesia" reported that it was successfully established in the Tuamotus by the early 1980. On South Tarawa atoll, it was not recorded present by the author on four visits between 1984 and 1991, and only first seen present 1993.

This evidence clearly indicates that *Wedelia* first arrived in most of Micronesia and Polynesia and parts of Melanesia, sometime in the 1970s, and even later in some places like Niue, Kiribati, Tuvalu and Solomon Islands. It is possible that it was introduced via Hawai'i or from tropical or subtropical Australia via Brisbane in Queensland, either by individual flower gardeners, local horticulturalists or landscape architects contracted to landscape new tourist resorts and other developments that were built then. Interestingly, *Wedelia* is not even mentioned in Macoboy's first edition of his well-known best-seller, *What flower is that?*, published in Australia in 1969 and reprinted many times up until at least 1980, despite the fact that it was deliberately planted in Queensland as a roadside and railway embankment stabilizer, and heavily promoted by nurseries in the mid-1970s (Australian Weeds Committee 2008). It is mentioned,

and its characteristics described in reasonable detail in the revised 1986 edition.

In Fiji, well-known horticulturist and owner of "Flower Power Nursery" and landscaping company, Maureen Southwick, believes it was first planted as an ornamental groundcover at Suva Point in the mid-1970s by a Mrs. Murray. Interestingly, when Mrs. Murray generously gave her some cuttings to plant in her well-known show garden, the long-time Fijian gardener looked at the cuttings and quickly and firmly remarked that this was a weed that should not be planted, and quickly destroyed the intended gift as a potential invader!!

Current Status in the Pacific Islands

Wedelia has been successfully introduced into most Pacific Island countries and territories and is now widely cultivated as an easy-to-maintain attractive, vigorously growing groundcover. It is commonly planted in extensive plots and planting boxes at tourist resorts, as landscaping around airports, golf courses, cemeteries, government buildings, schools and universities, office blocks and other buildings in towns, on road cuts and river embankments to control surface erosion and as landscaping, along road verges and in central dividers along roads and highways, around trees in parks and lawns, in houseyard gardens, and occasionally as a pot plant. Whistler (2000) in his *Tropical Ornamentals* says that it is preferred as a groundcover "since it is able to crowd out nearly all other herbaceous species" and "does well in coastal situations and large planters, and can be grown in elevated containers so that its flowering stems hang down in yellow cascades."

Owing to its vigorous vegetative reproduction and wide environmental tolerance, the frequent pruning and disposal of its cuttings, and its ability to float and withstand saltwater, *Wedelia* has escaped from cultivation and become naturalized and invasive in most Pacific Island countries and territories, including continental islands, recent volcanic islands, limestone islands,

atolls and small uninhabited offshore islands, often colonizing areas from the high tide mark to up elevations of 700 m or more in Fiji and to 1400 m in Tahiti (PIER 2003). It is now also present in all countries and territories of Melanesia, although still absent in some more isolated outer islands and rural areas. In most cases, it has become a noxious weed covering extensive areas in agricultural and pasture lands, along roadsides and trailsides, in open lots, wastelands and garbage dumps and other disturbed sites. Once established in moves into lawns, flower gardens, and disturbed sites in villages, towns, tourist resorts and other developments. It is also naturalized and invasive along streams, canals, the inner margins of mangroves and in coastal strand vegetation. It is usually found in disturbed sites, although it also seems very much at home in relatively undisturbed sites along coastlines and the margins of mangroves and swampland, often out-competing native coastal herbaceous species, most of which have important cultural utility.

Wedelia's potential to become invasive is made very clear in Macoboy's description of it in the revised edition of *What flower is that?* (1986):

"... the rampageous *Wedelia* is only seen at its best in a truly tropical climate, where heat and humidity combine to help it produce great sheets of foliage starred with golden daisy flowers. Recent visitors may have admired its blanketing of the ghostly new carparks by the Royal Hawaiian Hotel. In fact, it grows over quite a climatic range, though frost may cut it back temporarily. Grow from rooted cuttings in any soil, and cut back hard if it begins to grow too thickly. Best in full sun with plenty of water, particularly in sheltered seaside gardens."

Because it is a fast-growing vegetatively-reproducing, somewhat unruly groundcover, one of the main reasons for its rapid spread is that it is routinely pruned or cut-back to keep it under control or low-growing. The easily-established cuttings are then transported to waste places, dumps (rubbish tips) or dumped



Wedelia spreading into Nabou Pine Forest, Viti Levu, Fiji.



Wedelia trilobata, Nabukalou Creek, Suva, Fiji.



Wedelia spreading along beach, opposite Beq Island, Fiji.



Wedelia spreading, behind school, Fenua Fala Islet NW of Fakaofu Islet, Fakaofu, Tokelau Group (left).

Wedelia infestation, Navai Village, 400 m asl, Fiji (right).

Wedelia on isolated stretch of River, Upper Navua River, Fiji (below).



along the seashore or riverbanks, or thrown in the water, where they easily establish themselves or are taken by rivers and streams, river-mouth outflows or even ocean currents to other potential sites, including offshore islands.

It is now common in tropical and subtropical areas of the Queensland coast and spreading in New South Wales and the Northern Territory. It competes with native groundcover and in North Queensland forms dense infestations along the disturbed edges of rainforest (Australian Weed Committee 2008). In Hawai'i, it has escaped on all of the main islands and on Midway Atoll (Wagner et al. 1990). In Honolulu, it has escaped from cultivation and is spreading along Manoa Stream near the University of Hawai'i, and has spread into lawns between Lincoln Hall and Jefferson Hall at the East-West Center and on some of the sports fields at the university.

In Samoa, where it is also a recent introduction, reconnaissance surveys in September and October 1999 showed that it was spreading in the capital city of Apia and in some rural villages on the island of Upolu. In downtown Apia, it was found in extensive plantings in the main rock-walled planter boxes surrounding the Samoa Visitors Bureau, as a groundcover in one plot in front and one plot in back of the recently constructed Government Building, and in the parkland seaside of the building around the monument to commemorate the Japanese rehabilitation of the Apia waterfront after the devastation caused by Tropical Cyclone Val in 1991. In the latter site, *Wedelia* was beginning to spread into the surrounding lawns and parkland. It was also found planted as an ornamental groundcover in the "island" planter box in the centre of the main waterfront road at "3-corners" where the road turns right towards "4-corners" and Apia Park, and at Mary More's Guesthouse opposite the U.S. Peace Corps Headquarters, from where it has jumped the road. It was also found planted along the road fronting at the Ah Siu residence on Taufusi (Vaea) Rd. in Chinatown where it is beginning to spread along the roadside drain. Finally, it was also seen

planted and rapidly spreading in the villages of Saoluafata and Falefa to the east of Apia, in both cases, spreading rapidly. In Saoluafata it had spread into roadside lawns forming extensive "meadows". In Falefa, where it was found planted along the road frontage at one residence, it had totally covered the roadside culvert and had jumped the road into the small plot of bananas on the other side. Given time, it will probably spread along the banks of the nearby Falefa River to Falefa Falls, a popular tourist destination and recreational site.

On Tahiti, Moorea and Borabora in the Society Islands, *Wedelia* is also rampant and out of control, festooning seawalls, spreading along drains and into coastal wetlands, introduced mangroves, swamp taro gardens, prawn maricultural areas, grazing land and coconut, pine and eucalyptus plantations. On Rarotonga, it is out of control, spreading along the margins of beaches, swamp taro gardens and festooning abandoned, partially completed houses and bankrupt hotel projects. On the volcanic main island of Pohnpei in the Federated States of Micronesia it has spread from sea level where it is found along the coast and bordering mangroves up to elevations of 500 meters where it has become the dominant weed in deforested areas used for kava or *sakau* (*Piper methysticum*) planting, the expansion of which has led to extensive deforestation. On the two main islands of Palau, Babeldaob and Koror, it has escaped and now growing along the

new Compact Road and is encroaching on swamp taro gardens. It is now also invasive in disturbed sites on Kosrae and Chuuk, covering much of the area bordering the land-ward side of the runways at both international airports, and is invasive in disturbed sites, and covers extensive areas of limestone on Guam. On Nauru, although only seen as an ornamental groundcover in the early 1980s, by 1987, it had invaded the upper beach and seaside borders of the main coastal road near the Meneng Hotel, displacing native coastal plants,

including *Triumfetta procumbens* (*igiao*), a locally endangered medicinal plant, and by 2007 had infested the margins of Buada Lagoon, the most important agricultural and aquacultural area on the island.

On the raised limestone island of Niue, where it seems to be a fairly recent introduction, in early 1999, it was only seen in a limited number of locations, in extensive plantings at the Matavai Resort Hotel (where it was possibly introduced) and in a few houseyard gardens. From one of these gardens at the top of the Kalaone Sea Track (path to the beach) in South Alofi, *Wedelia* was rapidly spreading down the borders of the sea track and becoming naturalized. It was also present and spreading in Lakepa Village in northeast Niue. I reported this to Department of Agriculture, and, at their request, wrote a technical paper for them about its characteristics and the threat that it posed to the island (Thaman 1999). After taking no immediate action and waiting over a year for funding from the Secretariat of the Pacific Community (SPC), a control campaign commenced in early March 2001, at which time it was found at 35 sites in 11 villages. After an unsuccessful campaign to control it in early 2001, using Roundup and Gramoxone and costing almost \$30,000, it was then found in 52 sites in 13 villages and covered a total area of about 1400 m² (14 ha) (Liebregts 2001). Although there was some sign of control in some sites, it clearly looks like *Wedelia* will probably take over Niue,

and have serious implications for the habitats of the ceremonially important coconut crab (*Birgus latro*) and a range of other land crabs that are important as bait and for food on Niue. On Tongatapu, the main islands in Tonga, it has also become naturalized and now covers extensive areas of limestone and disturbed sites around the main town of Nuku'alofa.

In the atolls, *Wedelia* seems to be particularly out of control. In the Marshall Islands, Lamberson (1982) reported that it was growing at the "top of the beach near pier at northeast end of Enewetak Atoll". In 1999, on Majuro Atoll, the author found it very common in houseyard gardens and beginning to spread along some roadsides and towards beaches on both the lagoon and ocean sides of the islets, expanding into wet sites in and bordering giant swamp taro (*Cyrtosperma chamissonis*) pits, forming extensive daisy meadow-like areas around the Royal Garden Hotel and a couple of other sites, and taking over the lawn of the recently completed Capitol Building. By 2004, it had spread even

archipelago of French Polynesia, it has spread into coconut plantations bordering the main settlement of Tuherahera.

In Melanesia, *Wedelia* has been seen out-of-control by the senior author in all countries, except Solomon Islands, where it is reportedly also present in Honiara. The table is an attempt to assess the seriousness of *Wedelia* as an invasive in the five main areas of Melanesia. It has been a particularly serious problem in Fiji, an increasing problem in Vanuatu and New Caledonia, but apparently a more recent introduction and less well-established in Solomon Islands and Papua New Guinea, although I have not travelled as widely in these two countries as I have in the others.

In Fiji *Wedelia* has become rampant in most coastal areas, and is now found along most stretches of the main highway between Suva and Nadi, often forming unbroken carpets, covering coastal areas out to the high-water mark, extending out along the roadside from most villages, and up river banks and along drainage ditches. In the

complex bordering Laucala Bay, where it has already been found (and removed by the author!) in a planted seaside plot of the indigenous beach morning-glory *Ipomoea pes-caprae*.

It is currently growing in downtown Suva along the outer tidal reaches of Nabukalou Creek festooned on the cement channel walls, the growing tips extending below the high tide mark. At Muaivuso Village, one of Fiji's most important coastal fishing villages, it has spread from the village along a small creek towards the coastal mangroves. It has also become established and is spreading on coastal sites and into coconut plantations on Naigani Island, between Viti Levu and Ovalau, where it has undoubtedly spread from the nearby tourist resort; and on the beaches of the uninhabited sand cay island of Makuluva on the Suva Barrier Reef off Rewa River Delta, to where it was possibly dispersed, as a discarded cutting, by accelerated river outflow from the Rewa River system during heavy rains. It was also found in 1998 near Navai Village on Viti Levu, naturalized and spreading out of control

In Melanesia, *Wedelia* has been seen out-of-control by the senior author in all countries, except Solomon Islands, where it is reportedly also present in Honiara. The table is an attempt to assess the seriousness of *Wedelia* as an invasive in the five main areas of Melanesia. It has been a particularly serious problem in Fiji, an increasing problem in Vanuatu and New Caledonia, but apparently a more recent introduction and less well-established in Solomon Islands and Papua New Guinea, although I have not travelled as widely in these two countries as I have in the others.

more widely.

In Kiribati, *Wedelia* was not seen during four surveys between 1984 and 1991, and only first recorded in 1993. By 2002, despite attempts at control by both the Agriculture Division and the Environment Unit, it had spread out of control in an area just south of the airport and just north of the Temaiku milkfish ponds and was totally out of control and spreading in numerous other sites and around the Catholic Mission at Teoraereke on South Tarawa. It was also seen spreading out of control in a poorly drained site near Ukiangang Village on Butaritari Atoll in the north of the main Gilbert group in 2002.

In Tuvalu, where *Wedelia* was first seen present in 1993, by early 2003 it was spreading out of control and naturalized on Fogafale Islet on Funafuti Atoll in Tuvalu, where it was out-competing herbaceous strand vegetation on the lagoon side of the island south of the main settlement; in November 2006 it was seen as a serious invasive, well established in gardens on all three atolls in Tokelau and spreading from a rubbish tip onto the outer ocean beach on Nukunonu Atoll; and, on Tikehau Atoll, in the Tuamotu

capital city of Suva, it has colonized disturbed areas bordering extensive areas of mangroves and coastal littoral sites where it grows right up to the water's edge, often extending below the high water mark. In both cases it seems to be out-competing indigenous coastal strand and mangrove species, such as the creepers *Ipomoea pes-caprae*, *Vigna marina* and *Derris trifoliata*, the shrubby *Clerodendrum inerme*, the grass, *Paspalum vaginatum*, the mangrove fern *Acrosticum aureum*, and the seedlings of important coastal species such as *Calophyllum inophyllum*, *Barringtonia asiatica* and *Terminalia catappa*, to mention only a few.

At The University of the South Pacific in Suva, in 1999, it was found planted or invasive, in at least 40 separate locations as ground cover in garden beds, around trees and shrubs, bordering parking lots, along fencelines, climbing fences, covering embankments and roadcuts, invasive in dump sites bordering roadsides, valleys, mangroves, mangrove channels and creek beds, and in a number of disturbed, poorly maintained sites. It has even been planted as a groundcover as part of the primarily indigenous coastal landscaping of the new Marine Studies

along steam valleys at an elevation of about 700 m in the foothills of Tomaniivi, Fiji's highest mountain.

In Fiji's western Yasawa Islands, *Wedelia* was seen planted and spreading at the exclusive Turtle Island Resort and a number of other resorts and villages in the late 1990s and early 2000s. In 2000, it was seen in native coastal vegetation and spreading at Long Beach on Turtle Island, at Naisisili Village on Nacula Island, where it had spread throughout a cemetery; on a beach south of Yaqeta Village on Yaqeta Island, and in the beach vegetation on the east coast of Nanuya Lailai, north of backpacker's resorts.

Wedelia has also invaded the Sigatoka Sand Dunes National Park, a unique and spectacular ecosystem in southwestern Viti Levu, and despite repeated efforts to eradicate it, it is still spreading along the beaches and lower dunes. It has also spread and colonised the river banks in isolated sections of the Upper Navua Conservation Area, Fiji's first Ramsar Wetlands Convention site, and has become well-established and dominates significant areas in the sandy herbaceous outpost zone on Nasoata, a mangrove islet in

the mouth of the Rewa River, which is being considered for designation as another Ramsar site. Finally, it also became established, but was fortunately eradicated from the Yadua Taba Island, a 70 ha island located off southwestern Vanua Levu and the only reserve for the endemic Fiji crested iguana (*Brachylophus vitiensis*).

In Vanuatu, it is common in Port Vila, where it is planted as a groundcover and has escaped along road cuts, roadsides and areas near resorts. In New Caledonia, it is very common in Noumea and the main groundcover at the Jean-Marie Tjibaou Cultural Centre. It is also spreading uncontrollably along roadsides and in lawns and gardens on the wetter east coast of the main island in the areas of Poindimié and Yaté. It was also seen planted and spreading from one site next to the Paradise Hotel in the Faiava area in southeast Ouvea, a raised limestone island in the Loyalty Islands to the east of New Caledonia. It is also reportedly present in Honiara, although there has been no opportunity to carry out a careful survey there. In Papua New Guinea, *Wedelia* was seen present and spreading in small coastal villages between Alotau and East Cape in Milne Bay Province.

On a positive note, there are some areas, where *Wedelia* is still not present. In Fiji, it was not seen present in 2007 in any of the four villages on the raised limestone island of Kabara in the Lau Group; on, Espiritu Santo, the largest island in Vanuatu, it was not seen present in 2002 around the Lonnoc Beach Resort and Rotol Village near Champagne Beach and in Matantas Village and the coastal and riverine areas of Vathe Conservation

area in the Big Bay area; and was also not seen in the village on Tangoa Island off the south coast of Santo. It was also not seen in two weeks on Bellona Island, south of Guadalcanal, nor in the Western Solomon Islands on Tetepare, the largest uninhabited island in the world. Surprisingly, it was also not seen in villages of tourist resorts on the beautiful Isle of Pines to the south of the main island of New Caledonia.

Present and Potential Threat of *Wedelia* to Pacific Island Ecosystems

The evidence is clear that *Wedelia* (*Sphagneticola trilobata*), the daisy invader, a relatively recent introduction into the Pacific Islands, is spreading out of control on many islands in a wide range of habitats. It seems to be equally suited to dry and moist sites, and although it seems to prefer and do best in sunny sites, survives very well in shady sites under trees and bordering mangroves. It grows well on almost any soil type, including bare limestone, nutrient-poor sandy beaches and atoll soils and swampy or waterlogged soils. It is also tolerant to inundation and high levels of salinity.

Because it is very fast-growing, roots at the nodes of fast-growing stems, and is normally vegetatively-propagated, it has greater potential than most plants for rapid and uncontrolled spread. Moreover, because it is a very weedy fast-growing groundcover, it is periodically pruned and cutback, and the cuttings are normally disposed of elsewhere in waste places, at dump sites, are thrown along the banks or margins of, or even thrown into rivers, mangroves and the ocean, where the cuttings quickly establish themselves, or

are dispersed to a new site where they might become successfully established.

In short, *Wedelia* has already shown itself to one of the Pacific's most serious invasive weeds, particularly in terms of its ability to colonize coastal sites, on sandy beaches, bordering mangroves, on limestone outcrops, and penetrating along mangrove channels, streams and river mouths. It clearly deserves it ranking among the world's worst 100 invasive alien organisms. Contrary to my previous assessment, almost a decade ago, when I said that it is probably most threatening on recent high oceanic volcanic islands, such as Pohnpei, Samoa, Tahiti and Hawai'i, and raised limestone islands, such as Palau, Nauru, Tonga and Niue (Thaman 1999), *Wedelia* is clearly a threat on ALL islands, including atolls and older continental islands, such as the island of the Solomons, New Caledonia and New Guinea, where it is probably a more recent arrival. It is a very serious threat to coastal, riverine and swampy ecosystems, where it severely inhibits the regeneration of indigenous herbaceous plants and tree seedlings of considerable cultural, economic and ecological importance, which it either out-competes or prohibits from ever germinating.

Niue, as a single isolated raised limestone island, some 258 km² in area, is an example of island that could be almost totally overwhelmed by *Wedelia*, if the current attempts at eradication fail. The same can be said for atolls, where it has escaped and taken over coastal areas, limited areas of wetland, and spread like a plague through settled areas on the main atolls of the Marshall Islands, Kiribati, Tuvalu, Tokelau and Tikehau in French Polynesia. The same could happen to raised limestone islands, such a Kabara, Ouvea, Isle of Pines, Bellona and many other limestone islands and atolls in Melanesia, if it is not prevented from arriving or is not eradicated or strictly controlled, if that is at all possible. The uncontrolled spread of *Wedelia* on extensive areas of limestone and sandy, rocky soils, which would be almost impossible to clear, could have a very negative impact on the habitats and food chains of native birds, reptiles, insects, and many other ecologically important invertebrate animals, especially the economically and culturally important coconut crab (*Birgus latro*) and a range of other land and hermit crabs that are either eaten or constitute an important baits on almost all limestone islands and atolls.

Actions to be Taken to Stop the Spread of *Wedelia trilobata*

The following suggestions are put forward, as what I believe to be necessary priority actions

Habitat	Fiji	Vanuatu	N. C.	S.I.	P.N.G
Urban Areas	V	A	C	O	O
Resorts	A	O	O	?	O
Houseyard gardens	A	O	O	?	U
Urban landscaping	A	O	C	U	?
Roadsides	V	O	O	?	U
Lawns	O	U	?	?	?
Dumps	C	C	O	?	
Rural Villages	A	U	C	?	C
Gardens and Plantatations	O	?	O	?	?
Plantation forest	C	?	?	?	?
Grazing lands	A	?	?	?	?
Coastal Areas	A	O	O	?	O
Lowland Rivers	A	?	O	?	?
Mountain streams	C	?	?	?	?
Mangroves and estuaries	C	?	?	?	?
Littoral vegetation	C	O	O	?	?
Outer Islands	U	?	C	-	?
Uninhabited offshore Islands	O	?	?	?	?
National Parks	C	?	?	?	?

Table 1. Geographical extent, habitat, abundance and status of *Wedelia trilobata* in specified areas of Melanesia, based on in-the-field observations by the author and communications with reliable informants between the early 1970s and 2008 (V = very abundant, very serious, escaped and invasive; A = abundant, increasingly serious, invasive, C = common, occasionally as an escape; O = Occasional, sometimes adventive; U = uncommon; R = rare, just introduced, not escaped; - = absent).



Jone Niukula of National Trust removing *Wedelia* from Sigatoka Sand Dunes



USP student inspects *Wedelia* infestation, Sigatoka Sand Dunes National Park, Fiji

to halt the spread of *Wedelia* in Melanesia and other Pacific Islands:

1. Declare *Wedelia* (*Sphagneticola trilobata*) a noxious weed, and develop regional and national protocols for its control and eradication from islands and habitats where it can be potentially invasive and ecologically destructive.
2. Prohibit its introduction to islands, villages and areas where it still does not exist, particularly small outer islands with tourist resorts and uninhabited offshore islands or atoll islets (motu) where it can easily escape into the surrounding coastal environments or take over entire small islands. This is particularly important, because many of our uninhabited offshore islands are relatively pest-free and, like Yadua Taba in Fiji and Tetipare in Solomon Islands are critical habitats for threatened plants and animals, such as seabirds, sea turtles and crabs, which are often threatened or extirpated (locally extinct) on inhabited main islands.
3. When possible, on islands, such as Ouvéa, where it is still restricted to only a few localities, eliminate it immediately, and recheck the sites periodically to insure that it has been successfully eradicated. This needs to be done urgently, because, any wait, like that which occurred on Niue, could prove the difference between success and failure.
4. Where possible, eradicate it, especially from coastal and mangrove sites, riversides, villages and other ecosystems where it seems to be particularly

invasive.

5. Mount awareness programs to alert people to the invasiveness of *Wedelia* and the problems it can cause if people plant it as a groundcover and dispose of its cuttings indiscriminately. This should especially focus on groups promoting it as a groundcover in major landscaping schemes.

In short, *Wedelia* (*Sphagneticola trilobata*), the beautiful tropical American daisy invader, may ultimately end up being considered the worst weed to ever enter the Pacific Islands. Whereas some islands, like Bellona and the Pacific islands to the west of Solomon Islands and Vanuatu are fortunate enough to be free of malarial mosquitoes; and some small offshore islands throughout the Pacific are free of rats, cats, pigs, goats and mongooses or brown tree snakes, and have healthy bird, reptile and crab populations, it is our duty to ensure that as many islands, villages, town, parks, conservation areas, mangrove forests, swamps, river banks, plantations, gardens and other areas are kept free from *Wedelia*, the daisy invader. Only through such action can we ensure that the indigenous and long-established plants and animals of cultural, economic and ecological value to Pacific peoples will survive for the benefit our children and grandchildren. To ensure that these areas are protected from *Wedelia* will require an immediate effort to alert all people, young and old alike, to the serious threat that *Wedelia* poses to the ecological, economic and cultural survival of Pacific peoples, and the actions that must be taken now to minimise the number of islands and communities that are invaded

and transformed. Most importantly, there is the urgent need to stop its spread to islands and areas where it still does not exist and to eradicate it from those areas where this is still possible. Coincident with these efforts, it is hoped that other control efforts will continue in areas already infested and that a biological control agent can be found in the tropical American homeland of *Wedelia*, which can be safely introduced into the Pacific to level the island playing field that *Wedelia* increasingly dominates.

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NOTES ON *DISCODELES MALUKUNA*

Genus: *Discodeles* (Boulenger)

AMNH No.: 18300, 18301, 18326, 18330

by Gerald W. Scoville



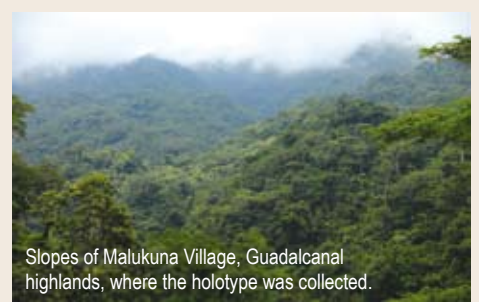
Discodeles malukuna, Kolombangara island



Discodeles malukuna, Gatokae island, blending into river bed.



Discodeles malukuna, Gatokae island



Slopes of Malukuna Village, Guadalcanal highlands, where the holotype was collected.

In May of 2004 I had the privilege to accompany the American Museum of Natural History's expedition up the southwest flank of Mount Mbatuvana, Kolombangara Island, to a small clearing in a mature sub-montane forest, approximately 1,100 meters above sea level, just below the edge of the stunted cloud forest. This site was known as the "Professor's Camp." Albert Meek, Jared Diamond and Christopher Filardi have made significant contributions to our understanding of avian ecology and evolution from the upland forests of Kolombangara and this camp specifically. In contrast, I was there to study the behavior of frogs.

One of the most conspicuous frogs in this area is *Discodeles malukuna*. Compared to the other anurans of the upland forest of Kolombangara, *Discodeles malukuna* are robust, heavy bodied frogs (64.5-to-104.0 mm) with wide, truncated heads. They were noted both swimming in the pools near the headwaters of a cascading creek and adjacent to the ridges near the American Museum of Natural History's 2004 camp. These frogs are strong and powerful swimmers, plying the torrent waters of the cascading creek just below our camp. On land, *D. Malukuna*, preferred unimpeded travel routes through open forest, with little dead or down trees or understory vegetation. This species was noted moving intentionally along horizontal benches rather than down cliff faces or adjacent steep terrain. In the forest this frog was deliberate in its movements, making large saltations through the forest, never seeking cover beneath rocks or fallen trees.

Discodeles malukuna fingers lacked webs

and the first and third fingers were nearly the same length. The tips of the fingers were rounded and not dilated, and lacked terminal circummarginal grooves. The toes were only moderately webbed. The most prominent webbing was between the second and third, and the third and fourth toes. The species came in two color types; dark olivaceous or buff-tan with dark, irregular or broken bands or stripes. The skin on the dorsal surface was absolutely smooth, lacking warty tubercles on the dorsum or upper surfaces of the hind limbs. All four individuals that were closely inspected had various amounts of a vibrant, electric, canary-yellow running down the lower third of the median area, between their dorsal surfaces and their bellies, continuing down the median area of their legs to the webbing of the hind toes.

When cornered on land and in the water, all individuals exhibited the same defensive behavior posture: they pulled their heads down in a ventriflexed position, touching the substrate with their lower jaw and tucked their heads into alignment with their forefeet, which were extended to just below their eyes. Their hind legs were pulled up behind their vents, and they reduced or closed their eyes, assuming a flat and ovoid profile. With their heads tucked down into the substrate, their snouts appeared shorter than when they were in relaxed positions. After assuming this posture they proceeded to extend either a single leg, or both legs, revealing the yellow webbing between their toes. This display of yellow could be either quick or slow, whereby an individual would flick its webbing open



Habitat of *Discodeles malukuna* in Western Solomon Islands

and “flash” the yellow coloration or slowly spread its toes, exposing the canary-yellow skin, then abruptly close the webbing, eliminating the vibrant coloration from view.

The brilliant yellow coloration of *D. malukuna* toe webbing suggests a number of possible functions. The yellow coloration was visible only when they were escaping or threatened, and never when the frog was in a resting posture. This color pattern may be aposematic or function to misdirect visually-oriented predators, such as birds, to non-lethal areas of the body. Hypothetically, when this frog is leaping, swimming, or assuming a defensive posture, a potential predator would cue upon the brilliant “flash” of yellow. Such flash coloration is thought to disorient predators that witness a sudden and momentary brilliance of coloration followed by immobility (Dickerson 1908; Williams et al. 2000). When the yellow is not visible *D. Malukuna*’s flat ovoid posture may be a form of crypsis, offering false cues to predators (Johnson and Brodie 1975), since it mimics the shape of river stones.

Alternately, although not exclusively, the yellow coloration could be used for signaling prospective mates, as a declaration of territory, or to warn kin of potential dangers. This frog is frequently found in or near pools below cascading falls where the use of vocalizations may be hindered by the sound of tumbling water and a signaling regime may be exceedingly useful.

Discodeles malukuna was the last and forth species of *Discodeles* to be discovered in the Solomon Islands (Brown and Webster

1969). On July 2nd, 1968, T. Preston Webster, collected the first specimen (MCZ 79462) in the central highland mountains of Guadalcanal Island at approximately 2,500 feet above sea level, at what is now the abandoned village of Malukuna. The few specimens collected suggest this is a montane species. This new site record on Kolombangra Island is over 350 kilometers from the Guadalcanal central highlands. The deficient documentation of *D. malukuna* is likely due to lack of survey work in the highland forests and not because this species is rare or difficult to find. It is also possible that the Kolombangra’s *D. malukuna* are a distinctly different species from those found in the highlands of Guadalcanal? The frogs of the Solomon Islands surely warrant further investigations.

I was only in the forest of the Solomon Islands for a very short period of time. As a natural historian, I felt like a little boy just before Christmas, there were so many surprises and wonderful secrets just waiting to be unveiled; I cannot wait to get back to those beautiful untrammelled forests.

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Table 1. Measurements taken on *Discodeles malukuna* (n=4). In the first column, ranges are given on the top line with the mean ± standard error in parentheses below. In the second column, ranges are given with the mean in parentheses.

<i>Discodeles malukuna</i>	Measurements (mm)	Measurements/ Snout-vent Length
Snout-vent length	64.5-104.0 (87.1 ± 9.2)	
Head width	29.0-50.0 (40.5 ± 4.6)	0.450-0.480 (0.464)
Tibia length	32.5-52.0 (43.1 ± 4.2)	0.470-0.513 (0.497)
Snout length	11.0-16.5 (14.2 ± 1.3)	0.159-0.171 (0.163)
Ventral snout length	3.0-4.0 (3.6 ± 0.2)	0.034-0.050 (0.043)
Tympanum height	4.0-6.0 (5.4 ± 0.5)	0.058-0.069 (0.062)
Tympanum width	4.0-6.0 (5.3 ± 0.5)	0.058-0.063 (0.061)
Longest front toe	1.0-3.0 (2.5 ± 0.5)	
Longest front toe length	11.0-15.0 (12.5 ± 1.0)	0.130-0.171 (0.146)
Longest hind toe	4	
Longest hind toe length	11.0-27.0 (17.0 ± 3.5)	0.154-0.270 (0.192)



a threatened island arc

**Environmental catastrophes looming
over Solomon Islands?**

Words by **Patrick Pikacha, Myknee Sirikolo, David Boseto, Tyrone Lavery, and Edgar Pollard**

Photographs by **Patrick Pikacha, Myknee Sirikolo, David Boseto, and Tyrone Lavery**

Making our way up the Kolombangara River we enter Sirebe land, the name interchangeably used as Pisuku, and refers to a stream and a bivalve shell that people suppose is only found in this stream and nowhere else. Sirebe Rainforest and Biodiversity Conservation Area (SRBCA) is roughly 750ha and located in the upper reaches of the Kolombangara River on southwest Choiseul, one of many customary areas stewarded by indigenous landholding communities wishing to protect their forests from industrial logging and large scale forest loss.

Traveling upstream by boat, or by hiking for a few hours inland from Sasamunqa Village, southwest Choiseul, one can access the land. Composed of lowland and ridge forests, the area is an extension of rolling forested hills. Palms and ferns dominate the valleys transected by streams, whilst large trees including strangler figs are abundant on the slopes and the ridges. There is an old abandoned village at the entrance to Sirebe land, which is now being re-inhabited, and a research station has been established here. The flat lands around the station are now gardens or beetle nut groves, with some areas overgrown with shrub and secondary trees. Just above the research station, along the upper reaches of the eastern bank of the Kolombangara River, trees, mostly the large hardwood *Pometia pinnata* or **akwa** as it's locally known, are being felled to build local classrooms and homes at Sasamunqa.

Two main types of natural forest appear to dominate the lower elevations here as elsewhere in the Solomon Islands. These are tropical lowland rainforest, punctuated by hill forest on the steeper slopes and more exposed ridge tops. A third forest type is ordered by mixed composition of old and secondary growth vegetation occurring in

old garden sites and abandoned human settlements. Apart from secondary forests distributed along areas with histories of human occupation, both native lowland and hill forest types surround the gentle and steep ridges and overlap so often that the forest complexity and general structure often merge.

The rainforest here is very rich in commercial timber trees of all age classes, with the understory a wealth of shrubs, herbs, creepers and climbers ascending back into the canopy. Native and endemic orchids that are either epiphytic or terrestrial in nature are distributed randomly in treetops and on the forest floor. An endemic flowering herb, only known to exist on some islands in the Solomons, *Spathiphyllum solomonensis*, is also quite common here. The herb is both terrestrial and epiphytic in nature and is a close relative of the more common and widespread genus *Scindapsus* that includes several species. These evergreen blossoming and perfuming plants with large leaves are common under the forest shade, and do not receive much sunlight, or water. In other parts of the world, some species have been cultivated, and sold as houseplants.

The forest overstory is dominated by *Pometia pinnata*, a variety of hardwood species with distributions through south-east Asia and Indonesia. *Vitex cofassus*, *Flueggia flexuosa*, and many *Syzygium* spp, are also large timber trees whose towering canopies reach for the sky, as *Canarium salomonense* whose delicious and wholesome edible nuts are used extensively in local cooking dishes. *Alstonia scholaris* a flowering plant with medicinal properties, *Amoora cucullata* a hardwood tree used for timber, and *Burckella obovata* a large tree that releases a white gluey sap from broken branches or leaves also dominate the forest structure and are common here. *Calophyllum peekellii* and *Camptosperma brevipetiolata* whose large



The endemic *Spathiphyllum solomonensis* (top). Rarely seen Bougainville giant rat (*Solomys salebrosus*) (center above), and the upper Kolombangara River catchment, Choiseul Island (center) an important biodiversity area for many rare (above) and endemic species.



Lush lowland forests along the Rendova corridor (**top right**) are today rare and disappearing at alarming rates. These habitats are home to many species of frogs such as Solomons eyelash frog (*Ceratobatrachus guentheri*) (**top**), and the endemics Solomon palm frog (*Palmatorappia solomonis*) (**below top**) and Solomon Islands tree frog (*Litoria lutea*) (**above center**). Giant webbed frogs are common along streams and waterways. Sometimes they may be found high up on ridgelines, like this individual (**above**) found feeding on a land crab *Cardisoma carnifex* at 600m a.s.l on Gatokae Island.



buttresses supports these towering evergreen trees that grow to 50m in height, and are also habitats of many forest species. Locals have noted *Terminalia calamansanai*, and several other minor rainforest trees to be the habitat of the extremely rare giant rats of Choiseul. These giant rats, *Solomys salebrosus* and *P. ponceleti*, have been rarely spotlighted in overhanging vegetation along stream-ways. Consequently, making this forest very rich in timber stocks per unit area, which is typical of lowland forested areas in the Solomon Islands, yet supporting exceptionally rich and unique biodiversity.

Another striking feature of the rainforest flora is the typical balance in the abundance and distribution of native palm species throughout the reserve area. Only certain islands in the Solomons Archipelago would boast of such a good mixture of different plant species in one particular plant group or family covering an extensive area. The delicate balance of rich species compositions of floral assemblages are today severely threatened by a number of factors.

Drastic environmental changes are a daily occurrence on Solomon's far northwest province. Logging leases cover the largest land area here than any island in the country and is by far the most damaging to forest habitats. Mining prospecting has begun on the southeast Choiseul in the hope that mining will one day replace the logging industrial as the country's foremost revenue earner. A growing human population, the clearing of land for gardening or agriculture, and to make way for new villages has also placing pressure on these ancient forests.

Frogs – forest thermostats

Known to scientists as biological indicators due to the responsive disposition of some species to environmental changes, frogs have been used as a tool for conservation planning and prioritization, employed as a monitoring group to investigate changes in the nature of the forest, or as thermostats in examining changing climates over time.

Solomon Islands have a very distinct assemblage, with some frogs restricted to specific forest types like montane forests. Of the 23 species of frogs currently known in the Solomon Islands, 19 are found on Choiseul Island. Choiseul and Isabel have the highest diversity of frog species. Yet new species continue to be discovered in less explored islands around the archipelago, especially in high tropical montane cloud forests. Interestingly even small pockets of forest remnants are popping up unknown species, which goes to show how little we know about this fauna.

Most of frogs of the Solomon Islands are oviparous, the eggs guarded by the female or male frog. Once the eggs hatch little froglets emerge. Frog egg masses are easy to spot once recognized. Small sticky-toed frogs of the genus *Batrachylodes* lay egg masses in small shrub plants, while the giant tree frog *Platymantis guppyi* lays their eggs in birds nest epiphytes and other large epiphytic plants. Native frogs do not depend upon standing pools of water to complete the reproductive cycle except for *Rana krefftii*, which lay tadpoles in pools of water.

Our surveys have show that species richness is driven by history, geography and



geology, where islands like Choiseul, Isabel and Guadalcanal have more species diversity compared to the more recently isolated volcanic islands of the New Georgia group or the ancient isolates of Malaita and Makira Islands. Landform patterns, vegetation type, and varying disturbance regimes are also correlated with species richness and the relative abundance within many frog communities across the Solomons. Further land alteration, poor land use planning, and persistent disturbance regimes especially by second entry large scale industrial logging, the introduction of invasive species, and opening of canopy shade cover to make way for gardens which effect changes in forest micro-climates are today threatening these vulnerable taxa in the Solomon Islands. These damaging development options have inspired the communities of Sirebe and other communities around the Solomon Islands to take action to halt destructive and exploitive practices and to pursue more sustainable opportunities. These reactions by communities are critical to saving not only unique frog assemblages, but a host of other amazing wildlife populations.

Freshwater and aquatic communities

The freshwater biota research in the Solomon Islands was revived in late 2004. Since then, freshwater fishes have been a major component of ecology surveys. The freshwater biota survey in 2004 and 2005 served as the basis of the freshwater research in the Solomon Islands. These studies recorded more than 60 species of freshwater fishes and have increased our knowledge of the diversity of

the freshwater fauna. The field surveys have unearthed a dozen dragonflies that are new to science. Also, the first endemic freshwater fish called *Lentipes solomensis* was described and a number of new records of freshwater fishes including *Lentipes kaaea* that was previously thought to be found in New Caledonia only have now also been recorded in Fiji, Vanuatu and now Solomon Islands.

Recent, freshwater fish surveys have been carried out on Choiseul Island, Tetepare Island and the New Georgia Island groups. The mysterious buzzard freshwater fish that was discovered on Tetepare Island made headlines in local, regional and international media. Yet, there are many more new freshwater fishes from the family Gobiidae that are waiting to be described.

Freshwater fish is just one of the many different biotas that live and use the rivers, creeks, streams and freshwater lakes for their life cycle. Our current knowledge is restricted only to freshwater fishes but the freshwater ecosystem still has more species from other organisms to offer. We can only assume for the moment that other freshwater fauna can produce amazing findings.

The excitement about the discovery of the new freshwater fish species on Tetepare Island and other parts of the country will be short lived. The Solomon Islands Government has embarked on introducing the Genetically Improved Farm Tilapia (GIFT) variety of Nile tilapia *Oreochromis niloticus* from Malaysia into the country for aquaculture. GIFT tilapia intends to be distributed on Malaita and Guadalcanal Islands only. However, sooner or later, this introduced fish



Sampling up catchment of the Kolombangara River, southwest Choiseul (**top left**). Kolombangara River is an important habitat for many medium size freshwater fish like Papuan Spotted Bass (*Lutjanus fuscescens*) (**top**), Mangrove Jack (*Lutjanus argentimaculatus*) (**below top**), Tapiroid grunter (*Mesopristes cancellatus*) (above center). Many cryptic and yet to be discovered fishes and aquatic organisms are yet to be discovered along isolated streams and water catchment areas on the large islands (**above**).



will find its way to the other islands before the government or responsible authorities may realize. Historical records show that the invasive tilapia *Oreochromis mossambicus* was introduced Malaita and Guadalcanal in 1957, and has now spread to most islands in the country.

Past and recent studies concur that introduced species such as mosquito fish and tilapia have had negative effects on native fish species. Introduced species usually feed on other native aquatic biotas and also alter the aquatic habitat for their own benefit. Our studies showed that freshwater systems that had tilapia recorded zero to two species of native species compared to an aquatic system without tilapia, which recorded six to ten species per site. Consequently, the diversity of the freshwater fishes and other aquatic fauna in the Solomon Islands may well be a thing of the past as an additional alien species is introduced and takes over.

Western Solomon Islands and The New Georgian islands

As across most of the Solomon Islands, Western Province has had a long history of human disturbance. Of the 5,475km² land area in the province at least 93.2% was forested in 1960. Following the Governments forestry act in 1960, serious industrial logging commence in 1963, and the Western Province was targeted, perhaps

for its accessibility to tree stocks, and the density of log volumes. Civil strife and the economic collapse precipitated the most recent large scale push to liquidate timber here. Agricultural deforestation, and the introduction of invasive animals particularly cats, dogs and rats have further impacted the indigenous flora and fauna of the province. This has resulted in steep declines and extirpation of some mammals, and birds, and has altered or threatened numerous herpetofaunal, bird and mammal assemblages.

The New Georgia Group of islands oriented in a northwest trend across 235 km of ocean in the Western Province are of more recent Plio-Pleistocene volcanic origin. The islands form a matrix of connected cones, interspersed with isolated eroding volcanoes often separated by only a few kilometres of water. Dominated by lowland rainforest only three islands, Rendova, Vangunu and Kolombangara, have peaks above 1000 m asl, whilst three others, Ranongga, Gatokae and New Georgia ranged from 800 – 900 m asl. The islands have attracted many scientists, the most famous being Jared Diamond and Ernst Mayr, who studied patterns of speciation among groups of birds. Today, not all is good in the New Georgia Islands. Extensive logging continues to decimate forest communities, with timber companies entering more than once to remove remnant stands of trees, and now with mining a real threat in the near

future.

During a visit to Rendova Island, we examined the corridor from Rendova Peak to the coast at Elomana and Ughele villages. Although having a history of logging and deforestation the area is rich in vertebrate species. Lower slopes and forests have been cleared to make way for gardens and some forests to the east have been cleared logging. Yet major areas of unlogged and natural forests exist in the upper reaches of the island. Secondary forest were habitats of some endemic fauna such as the frogs *Platymantis weberi*, and *P. solomonis*. Species richness although was lower, yet given the history of forest resilience, high rainfall and sunshine, the forest is able to grow to support an increasingly abundant vertebrate richness.

A total of 9 species of frogs were collected and observed on the island, including the invasive cane toad, *Bufo marinus*. Surprisingly a single cane toad was discovered at 700 m asl on the trail to Rendova Peak and on another occasion was seen at 660m on Malaita. It is likely more stranglers have made it to the summits of other high islands. Cane toads have spread extremely wide in the Solomons with poorly known impacts on native species, though it is incidentally clear that cane toads extirpate many native species along lowland river courses.

Climate and environmental variables affect the activity patterns of vertebrates.



During periods of heavy rainfall most herpetofaunal communities are silent and not as active, and birds are hard to observe. Canopy birds were easily spotted with binoculars, yet within the understory the overcast continually threw a constant shadow making it hard to detect birds.

Bats on New Georgian islands

A discovery of a monkey-faced bat (*Pteralopex taki*) on Vangunu in 1993 showed gaps in our knowledge of mammals. Ecological data is lacking for these rare and spectacular bats in the insular Pacific.

At places like Kukudu School on Kolombangara and Viru Harbour on New Georgia and Ughele on Rendova on the other hand, the large, noisy camps of flying foxes are a familiar sight. Bats are crepuscular, becoming active at twilight. Species such as the large Rayner's flying-fox (*Pteropus rayneri*) can be seen leaving their day-time camps, flying overhead and away to forage. Before heading for the forest, they will often first fly low over the ocean and scoop up mouthfuls of water to drink.

Closely related to flying foxes but less obvious, are the smaller blossom bats. These are very common in lowland primary forest and can often be seen at night along the forest edges where ginger plants and village gardens provide food. Perhaps the most fascinating of these is the Solomon tube-

nosed bat (*Nyctimene bougainville*). They have interesting tube-shaped nostrils, and it is unknown what their exact purpose is. Two species - Fardoulisi's blossom-bat (*Melonycteris fardoulisi*) and northern blossom-bat (*Macroglossus minimus*) were caught in the understory at Rendova Peak.

Nectar from flowering plants attracts blossom bats, and in turn they assist the pollination process for some plants. Fruit bats eat seeds and aid seed dispersal, whilst insectivorous bats control certain insect populations.

Today, large Pteropids are threatened worldwide by a number of factors including habitat loss, hunting and disturbance by humans, and diseases. Low populations and short breeding potential, as females often give birth to only one or two individuals may also place pressure on some bat populations. In parts of the Solomon Islands, Pteropids persist in communities that actively choose to co-exist with them without harassing them.

Waisisi – the Green centre of the Malaita

The island of Malaita known more for its cultural heritage, high population densities and logging ravished landscapes is rarely placed in the same sentence with biodiversity and conservation but if you know where to look, green fragments still do remain. One such fragment is the accessed through the Waisisi harbour, on the western coast of



The lush rainforest understory of the Waisisi ranges (top left), intersperse with bamboo groves (top). Ground frogs *Platymantis weberi*, and butterflies (above left & center) are abundant in the understory, and were studied from field research sites (above center). South Malaita has one of the most spectacular coastlines dominated by waterways and lagoons buffered by extensive mangrove forests.

Facing page: Tube-nose bat (far left) roosting, and a colony of Solomon Island fruit bat (*Pteropus rayneri*) at Kukudu, Kolombangara (top center). The New Georgia islands have attracted researchers and conservationist alike (below center), in an effort to save some of the last stands of rainforests left on earth. *Cucurma longa* a flowering ground herb of lowland forests (below right). The endemic Solomon monkey-tailed skink (*Corucia zebrata*) (top right), the largest arboreal skink in the world is less common in areas of forest harvest and disturbance. In some areas it may be extirpated due to deforestation.



the southern end of Malaita. Ascending to the peak at 670 m asl the trail goes through a rich array of microhabitats from poly-cultured gardens, *Canarium* groves reflecting the agroforestry history and culture of the area. Bamboo thickets and *Cyathea* ferns dominate gullies and ridgelines, with palm speckled slopes, and strangler fig ridges and moss covered undergrowth. The horned eyelash frog (*Ceratobatrachus guentheri*) and *Batrachylodes* sp., dominate the frog fauna. Yellow-bibbed lories (*Lorius chlorocercus*), Blythes hornbills (*Aceros plicatus*), yellow-faced mynah (*Mino dumontii krefftii*), Red-knobbed Imperial pigeons (*Ducula rubricera rufigula*) and Megapode birds (*Megapodius eremita*) were abundant and apparent with their calling and striking plumages. Many species of butterflies fluttering around the understory were also encountered indicating that this pocket of diversity still has something to share with the world.

Camping at an old village site there is a sense of stepping back in time as we follow the unique stone-laid walls that would have acted as walls restricting access only to those allowed. At the peak after climbing over at least three root-entwined walls the view is majestic and the feeling is one of serenity and anguish as you look down to the beautiful Are'Are lagoon (longest in Malaita) and the almost evenly spaced log ponds situated along it. The thought that not more than a century ago the very site that we were standing would have only been accessed by the high priest of the clans as he would make his traditional pig offering to his ancestors embodied in the form of a giant eagle. The Solomon Sea eagle (*Haliaeetus sanfordi*) still holds cultural

significance to the people of Malaita and though this majestic species is forced to increased vulnerability due to the loss of its habitat and prey, it still soars as a symbol of hope that once the descendents of the area worshiped, revered and respected nature.

Yet even, in this last pocket of true greenery not all is well. There are plans to convert this landscape into a monoculture landscape by establishing an oil palm plantation. With consideration to Vangunu Islands failed palm oil venture in the Western Province, it is probable that this undertaking may end the same way. In both cases, logging was the main stimulus for clearing out the forest.

Also worthy of note are the lakes of Haurakeni, intricate mangrove arched waterways, still brackish lakes and dozing crocodiles make this hidden gem an adventurers dream. But again these treasured wetlands are not without struggles as they face the strain of an increasing population encroaching into the mangroves, overharvesting of fishes and removal of key mangrove species for building materials and firewood.

Mangrove ecosystems are not only ecologically important but also act as a rich supermarket to locals in terms of nutrition and material and not to forget the significant environmental role of protecting and nurturing the coast and its diverse species assemblage. The loss of the mangrove forests can be viewed as one of the greatest losses to future generations.

Kolombangara's Cloud Forest Reserve

Despite the remarkable biodiversity of

the Solomon Islands, and the high levels of biodiversity loss occurring almost on a daily basis, there are optimistic accounts of communities coming together to protect and utilizing their natural resources wisely.

Perhaps a model of community conservation has been the uncommon partnership between a forestry company, Kolombangara Forests Plantation Ltd and a community non-government organization, Kolombangara Island Biodiversity and Conservation Association, and partners like Solomon Islands Community Conservation Partnership, American Museum of Natural History, and World Wildlife Fund for Nature, to protect at least 20,000 ha of upland forests.

The forests of Kolombangara are amazingly diverse and intact, notably the crater forests beginning at the base valley below the Imbu Rano Lodge, and bearing northwards into the crater centre. Upland montane forests are spectacular, and comprise some of the last stands of unscathed tropical montane cloud forests in the insular South Pacific. Elfin forests here are stunted, with ridgelines exposed and dominated by sedge or grass. These are habitats to a few threatened species like the Kolombangara white-eye (*Zosterops murphyi*), pale mountain pigeon (*Gymnophaps solomonensis*), leaf warblers (*Phylloscopus trivirgatus* and *P. amoenus*), blue-faced parrot finch (*Erythrura trichroa*), island thrush (*Turdus poliocephalus*), and a possible endemic form of the peregrine falcon (*Falco peregrinus*).

Diversity of birds is incredibly high for an oceanic island, with more than 50 species easily observed from the decking of the Imbu Rano Research Station. This accounts for



almost 50 percent of the birds recorded on the island. Included are the Kolombangara endemics and others that are restricted to a few islands in the Solomon Islands. Many of these species are found in primary forests, with a few forest generalists.

Mammals of Kolombangara are analogous to the other New Georgian islands, which included fruit bats, and tubenose bats. The multiple endemic *Hippisideros* species inhabiting these forests are globally significant and likely occurred in these assemblages across intact forests of the New Georgia group historically. Insect bats are abundant, and common around the power lights of Ringgi station at dusk hunting for insects. There was a total of 8 species including 2 introduced rat species and two prehistoric introductions on the island.

Reptile faunas of Kolombangara are dominated by the *Emoia* skinks, including *Emoia nigra*, *E. schidti*, *E. cyanura*, and *E. pseudocyanura*. Giant skinks, *Corucia zebrata* are cryptic, occupying mostly strangler figs and large trees with *Epipremnum* creepers. Solomon tree snakes are observable inside the crater with light green variations spot in montane forests. Pythons or sleeping snakes as they are locally referred to may occasionally be chanced upon on the trail curled up in a snake-ball. Little is known of the ecology of many reptiles.

Due to the extreme habitat variation on Kolombangara, the frog fauna is also rich and extremely diverse. Lowlands are dominated by *Platymantis* sp, with riverine habitats along the crater floor occupied by *Discodeles* water frogs. Most abundant are the *Platymantis* and *Batrachylodes* species, the latter found on

shrubs and low trees, and palms. *Batrachylodes* then dominate the high elevation forests, replacing *Platymantis* species. There are still many species new to science, and molecular and acoustic data may reveal cryptic species.

Conservation of habitats is a priority on Kolombangara. Particularly important will be the conservation of the 400m asl contour as a protected area. As habitats in the lowlands are fast disappearing, except for pockets of corridors that extend to the sea, most have been altered. Whilst biodiversity values are high on Kolombangara, still many species are unknown, in particular the frogs and reptiles of montane environments.

Like elsewhere in the Solomon Islands, forest removal and logging threats now extend above 400 m asl on Kolombangara. In desperation companies are swathing high land forests, and will do anything to extract round logs. Even if this means, clearing extremely steep slopes, or entering forests previously inaccessible by law. Whilst there are many threats to biodiversity, there still remain opportunities and potential partners in industries that endeavour to strategically plan land use development in a way that minimizes the ecological footprint on these fragile island arcs, and ensures that biodiversity and humans can co-exist.

Acknowledgement

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Montane cloud forests of Mt Veve slopes (top center left), habitat of many rare and endemic species like the unidentified *Batrachylodes* frog (top), Kolombangara white eye (top center), Meek's lorikeet (above center), and many species of *Emoia* skinks (above).

Extensive mangrove systems of the south Malaita area, extending from Waisisi (top far left) to the island of South Malaita.

Biodiversity and the incredible resource of local foods

Words by **Wendy Foley, Lois Englberger, Graham Lyons, Jeff Daniells**



There is a dynamic relationship between biodiversity and local food systems, which are rich and varied across the Melanesian countries.

Food serves many purposes. While it fills bellies and contributes to health, it also is used in ceremonial exchanges, provides income to its producers and impacts on the national economy. Some food is specific to the place it is grown; but with increasing globalization of food supplies, foods around the Pacific are reflecting less of the local specialty foods.

While biodiversity is important for supplying a wide variety of local foods, this is often not adequately appreciated. It is not taken into account in calculations of economic indicators such as Gross Domestic Product, for example. Yet biodiversity protects food security and provides a basis for living and eating that is in harmony with the environment. Food production, processing and distribution can have a significant environmental impact, depending on how the food is

produced, processed, stored and how far it is transported. Biodiverse local environments provide both employment and food. It is imperative to value the wealth of the diverse foods that comprise Pacific food systems.

Diversity in Melanesian food systems is gradually declining as lifestyles change and people depend less on subsistence farming to provide their food. Many imported foods can be stored more easily and are quicker to prepare and eat, which makes them popular. As imported foods such as rice and wheat flour products are used more in Melanesian diets, some traditional foods are being neglected - their delicious flavours and health values unappreciated. As diets and lifestyles have changed, there has been a related increase in overweight and diseases such as diabetes and problems due to low intake of micronutrients, such as Vitamin

A deficiency, because many of the imported foods do not provide the high nutritional value that local foods do.

Furthermore imported foods can place a significant burden on family budgets as well as the economy of small islands countries. As people have become more dependent on imports, there has been less production and marketing of traditional foods, making people in Melanesian countries more vulnerable to food insecurity. The global food crisis arising from a combination of poor harvests, competition with biofuels, higher energy prices, surging demand for grains and meat, and a blockage in global trade has driven food prices up worldwide. In Melanesian countries, price rises in imported foods such as rice has made it harder for people to buy enough good food.

Research in the Federated States of



Ripe and unripe banana bunches displayed in feast house Arohane Village, Makira, Solomon Islands (top left).

Dorothy Tamasia, Curator of the Bauro highland banana collection, Makira, Solomon Islands (Photo's by Jeff Daniels)



These highly nutritious Fe'i bananas are semi-erect bunches, red-purple or purple

Micronesia (FSM) by Dr Lois Englberger and colleagues has shown that many Pacific plant foods have outstanding health-giving properties compared with the imported rice, noodles, biscuits, bread, sugar and commonly available processed and packaged foods, which provide lots of energy but less of the health protecting nutrients that are found in abundance in the colourful Pacific plant foods. Since the imported foods have been widely consumed in FSM, diseases including diabetes, stroke, heart disease, some cancers and blindness have increased. The FSM *Go Local* campaign promotes the 'CHEEF' benefits of eating local foods, which include Culture, Health, the Environment, the Economy and Food security. Many FSM banana, taro, breadfruit and pandanus varieties have been analysed in laboratories and found to be very high in nutrients and therefore very rich in health-giving properties. The more colourful yellow and orange-fleshed varieties were found to contain greater amounts of provitamin A carotenoids, the most important of which is beta-carotene. This substance is changed in the body to vitamin A and helps protect against infections, eye

disease and night blindness, and weak blood (anaemia). Carotenoid-rich foods also help protect against certain cancers, diabetes and heart disease. The work in the FSM showed that the Pohnpei Karat banana, a Fe'i banana of the Australimusa series (*Musa troglodytarum*) contains exceptionally rich concentrations of riboflavin (Vitamin B₂) in addition to beta-carotene and total carotenoids.

These highly nutritious Fe'i bananas are found almost exclusively in the Pacific and are characterized by unusual erect and semi-erect bunches, red-purple or purple sap and a deep yellow, yellow-orange or orange flesh. The ripe orange-coloured flesh of these bananas provides up to 100 times as much beta-carotene as the common white-fleshed Cavendish banana. Melanesia has a great diversity of Fe'i bananas, but there has been very little documentation or assessment of these varieties. Sweet potato is another important staple food in Melanesian countries and a great diversity of sweet potatoes has developed there. Orange-fleshed sweet potatoes also provide high levels of beta-carotene and contribute to protecting good health. This article

describes findings from a project designed to identify and raise awareness of the high nutritional value of orange- and yellow-fleshed sweet potatoes and bananas in Solomon Islands and Papua New Guinea.

Food diversity – the wealth of foods provided by divine beings – has in past generations been explained by legend. On Bellona in Solomon Islands, for example, legend has it that the *Ghabaghaghi* banana (a Fe'i variety) was thrown down to the island from the invisible heaven by a culture hero, Mautikitiki, but because the plant was reluctant to go down to earth, the fruit bunch always stands upright, pointing towards its place of origin. In the 1960s, a Danish researcher on Bellona, an uplifted atoll of only about 20 km², reported 6 Fe'i banana varieties (*Ghabaghaghi*, *Kangisi'ibai*, *Paunao*, *Takape*, *Tapipiingi*, *Tongaka*) were being used, in addition to about 10 other banana varieties. Just two generations later, the Fe'i bananas have almost disappeared from this island, due to repeated cyclone destruction compounded by replacement of the lost varieties by imported foods such as rice and by neglect of these varieties. The Fe'i banana varieties have become rare and



found almost exclusively in the Pacific and are characterized by unusual erect and sap and a deep yellow, yellow-orange or orange flesh.

younger generations are now unfamiliar with them.

In Melanesia, cultural groups differ in their use of Fe'i bananas. On Malaita in Solomon Islands, Fe'i bananas, which are often referred to as 'wild' bananas (eg *Ba'u kwasi* in Kwar'ae language), are not usually cultivated in domestic gardens and little used. In the Marovo Lagoon in Western Solomons, the old people reportedly used to describe Fe'i type bananas as 'medicine food', but nowadays people there do not use them as much as before. Some people report being afraid of eating Fe'i bananas because after consumption, the urine becomes an unusually bright yellow colour. Jokes abound about this effect and modern myth suggests that this is a sign of disease – maybe yellow fever. However, the urine effect is harmless, and is due to the rich riboflavin (vitamin B₂) content in Fe'i bananas. The body excretes the excess riboflavin in the urine when it has absorbed enough.

On Makira in Solomon Islands, bananas, including many Fe'i varieties are an important staple food and the island is known for its banana diversity. Makira was therefore chosen for the first field site to investigate bananas in Solomon Islands. We aimed to identify orange- and yellow-fleshed bananas and sweet potatoes rich in beta-carotene, as well as other essential nutrients, and to raise awareness of the value of growing and consuming these foods. A main focus was on collecting samples of bananas and mature sweet potato and sending these to laboratories for analysis (Institute of Applied Sciences/University of the South Pacific (USP) in Suva, Fiji, and University of Adelaide in Australia) assessing for carotenoids, riboflavin and essential minerals, as well as collecting germplasm material for conserving in tissue culture. A regional germplasm genetic resource bank is maintained by SPC Centre for Pacific Crops and Trees in Suva, Fiji so that it can provide

healthy planting material to replace species that are lost due to pests, diseases or natural disasters, such as destructive cyclones which often devastate gardens in small Pacific communities. Banana samples collected on Makira were collected specifically to be conserved for the communities that supplied them and permission from the Premier of the province and local farmers was obtained before collecting samples. Formal permission for the export of the plant material for conservation and testing was obtained. This included phytosanitary certificates from the SI Ministry of Agriculture and Livestock to accompany the samples and import permits from Fiji.

A participatory, inter-agency multiple methodology approach (including ethnography, key informant interviews, informal focus group discussions, photography, market survey, and literature review) was used to study the varieties of banana and sweet potato and their uses. In 2007 two areas in Makira Island were visited, Kirakira on the northern coast and a more remote area on the weather coast, reached by flying to Santa Ana, and then going by canoe to Manivovo, Mami, and Mwakorukoru villages. Local partners provided great support in arranging for data collection and the awareness workshops. Around 700 participants took part in the seven workshops. Over 460 photographs were collected for a visual record. In 2008 further awareness workshops were held on Malaita in Solomon Islands, at Malu'u, Basakana Island, Gou'ulu, Royal Harbour and Kolofe and attended by around 320 people in total. Further workshops were also conducted in Papua New Guinea.

A visit to West Taraka (now known as "Newest") on the outskirts of Lae was a highlight of our Morobe stay. The *Family Poverty Rehabilitation Association Mama, Newest* provides an inspiring example of what a women's group can achieve in making positive steps in alleviating extreme



Fe'i banana, cv Bonubonu (top), showing bunch growing upwards (Photo by Jeff Daniells). Orange sweet potato collection growing (above) at Kastom Gaden Association, Honiara (photo by Lois Englberger).

Dramatisation of the nutritional benefits of orange fleshed sweet potato (far left), West Taraka, PNG (Photo by Graham Lyons). Local champion Francis Wehi (left) protects food futures by teaching children about the value of local foods using the Pohnpei banana posters, Mami village, Makira (Photo by Wendy Foley).



These highly nutritious Fe'i are characterized by unusual and a deep yellow, yellow-

adversity and improving the lives of those in their community. The group has a local food growing and plant distribution program which includes orange-fleshed sweet potatoes. After the visit, members of the Newest community conducted a local food/nutrition workshop of their own at the local primary school.

During our time on Makira, a customary *Houra* feast was being prepared in Arohane village, close to the capital of Kirakira. This feast demonstrated the cultural significance of traditional foods, including bananas. For days leading up to the feast, a feast house was gradually filled with a cornucopia of bananas, including Fe'i varieties, known on Makira as *Toraka*, together with other culturally valued foods including yams, fermented taro pudding in enormous wooden bowls and pigs, tethered outside, awaiting the feast day.

Although Fe'i bananas clearly are still important in ceremonies on Makira, their limited use as an everyday food reflects dietary changes happening all around the Pacific: the use of old traditional staples like *Toraka* is declining in most areas. Despite its high cultural value in feasts, the *Toraka* fruit is now infrequently used for family consumption and is rarely sold in markets. One woman, who had learned about the health benefits of *Toraka* at the awareness workshop before the *Houra* feast, encouraged people during the feast food distribution not to waste *Toraka*, but to eat them because they are so healthy to eat. We found that people often feel empowered by the message of how rich their local foods are.

As we travelled around Makira, we saw

about 65 banana varieties, and recorded common names, cultivation details, culinary uses and cultural value. We also heard of about 20 other varieties, although time did not allow fuller investigation of these. About 9 or 10 of the banana varieties we saw were different Fe'i cultivars, which ranks Makira as one of the most important locations for diversity and abundance of Fe'i banana anywhere. Banana diversity in Melanesia far surpasses that in its nearest big neighbour, Australia, where 99% of commercial bananas come from just two varieties which are not as rich nutritionally as many Melanesian varieties.

Great diversity of sweet potato varieties was also observed. Some people reported having more than 20 varieties of sweet potato growing in their gardens – to maximise production and resistance to pests and diseases as well as providing a variety of tastes, textures and ripening times.

Very important conservation work is being carried out by local champions who actively maintain community based conservation sites – collections planted to preserve the biodiversity of food crops. The two community based banana conservation sites visited on Makira, in the Bauro Highlands and on the weathercoast at Manivovo, contained at least 52 banana varieties. The Manivovo banana collection, however, is currently untended and some varieties originally established there are no longer growing. Some of this collection is being reestablished at Nana and Wairogurogu. Although there are significant challenges in maintaining these remote living collections, they are particularly important at this time when

food habits are changing rapidly. They are repositories of food diversity, which may otherwise be lost to future generations, and can enhance utilization of these plant foods which can contribute to good health of people in Melanesian communities.

Sweet potato collections are also being maintained in diverse locations: in the Solomons at Kastom Gaden Association (Honiara), International Potato Centre (CIP)'s Binu Farmer Field Trial site (35km E of Honiara), Star Harbour and Bauro (Makira), Busurata and Takwa (Malaita) and in Papua New Guinea at the National Agricultural Research Institute (NARI) in Bubia (Morobe Province) and Aiyura (Eastern Highlands Province). Around 15 local orange-fleshed sweet potatoes varieties which combine the traits of high beta-carotene, high yield, pest resistance, acceptable flavour and texture have been identified in Solomon Islands. Several of these are being bulked and distributed in Makira, Malaita, Guadalcanal and Santa Cruz (Temotu Province).

Despite difficulties due to transport and quarantine regulations with both the samples for nutrient analysis and the plant materials for tissue culture, we successfully collected 16 banana samples, including some *Toraka* varieties, for nutrient analysis at USP and also 18 samples to be maintained in a tissue culture collection held by SPC's Centre for Pacific Crops and Trees in Suva, Fiji, although several of these died during delays. In addition to bananas, 23 orange-fleshed sweet potato samples were collected for nutrient analysis. Many of these proved to be very nutritious, especially when compared with rice.

bananas are found almost exclusively in the Pacific and erect and semi-erect bunches, red-purple or purple sap orange or orange flesh.

This project brought together intersectoral collaboration in agriculture and nutrition, government and non-government, to work with local communities to raise awareness about the value of local food varieties in comparison with many of the popular imported foods. This work is important as it has the potential to help communities become aware of the cultural, health, environmental, economic and food security benefits of local food resources. The awareness campaign, has so far involved 21 workshops in communities in Solomon Islands and 7 in PNG. The *Go Local* message has been taken up enthusiastically by people in all walks of life in both countries and also highlighted in articles in national newspapers. However, the lack of knowledge of the health-promoting properties of the rich local foods remains widespread.

Diversity Fairs held in local areas also provide an opportunity for promoting awareness of the wealth of local food crop varieties to both local people and visitors. These events enable the dissemination of important agricultural information, such as improved banana and sweet potato planting methods and how to minimize pest damage to crops. They also serve to enhance villagers' pride in their local foods and highlight their advantages over imported processed foods. Events like this are great celebrations of community and food biodiversity.

Conclusion

While there is a wonderful diversity of plant foods in the Pacific, younger generations are frequently exposed to limited food varieties

in boarding schools and in towns and often prefer to consume food from a narrow selection of imports that are high in cost but nutritionally inferior. A result of this is the neglect of very rich, diverse and delicious local foods. As Melanesian countries adopt yet more imported foods, it is of vital importance to evaluate and publicise the foods that grow in local environments before it is too late. This investment in Melanesia's food future will help to protect food security, ensure local food biodiversity, celebrate the superior food value of many Pacific plant foods and make them widely available for people to grow, buy and eat, so they can enjoy healthy lives into the future with all the benefits of traditional and locally grown foods.

Acknowledgments

Contributors to the work reported in this article are acknowledged for facilitating this study and awareness project. They include: Island Food Community of Pohnpei, HarvestPlus, Secretariat of the Pacific Community (SPC), the Australian Centre for International Agricultural Research (ACIAR), International Potato Centre (CIP), in Solomon Islands the Kastom Gaden Association, Ministry of Agriculture and Livestock and Ministry of Health and Medical Services, in PNG the National Agricultural Research Institute (NARI) and local communities in both countries. Special thanks go to Dr Mary Taylor (SPC), Belden Taki, Pita Tikai, John and Joyce Murray, Peter Warito, Francis Wehi and Lawrence Atu in Solomon Islands and Maria Linibi, Elick Guaf and, Rosa Kambuou in PNG. 🍌



Variety of Fe'i banana (Toraka) fingers (top), Makira, Solomon Islands (photo by Lois Englberger). Suria, one variety of Fe'i banana, showing both the unpeeled and peeled fruit (above centre) to show the rich orange flesh coloration. Orange-fleshed sweet potato (centre) and sweet potato leaves (above).

Preparing delicious, local food. Caroline and Elsabet cooking Fe'i bananas Manivovo, Makira, Solomon Islands (Photo by Wendy Foley) (top left, page 26)

The fight against an invasive vine, big leaf *Merremia peltata*

Vatthe Conservation Area, Santo, Vanuatu



Words by **Sue Maturin**

Approximately 2,300ha (92%) of Vatthe forest has been invaded. Of this some 1,300 ha are beyond the ability to control and need to be replanted. Effective control is possible in the remaining 800ha surrounding a core area of 200ha which is free of big leaf.

Vatthe the largest Conservation Area, and most extensive lowland alluvial forest left in Vanuatu, is under threat from an invasive vine, big leaf (*Merremia peltata*), which is invading previously uninfested forest, and is causing the death of large numbers of canopy trees.

The Royal Forest and Bird Protection Society of New Zealand (Forest & Bird) has been working with the local landowners of Vatthe Conservation area to investigate options for controlling the vine infestation. Initial small scale trial work suggests that it may be possible to eradicate the vine from small newly established infestations and control it to manageable levels over larger areas by injecting glyphosate into large stems and cutting all small stems.

Approximately 2,300ha (92%) of Vatthe forest has been invaded. Of this some 1,300 ha are beyond the ability to control and need to be replanted. Effective control is possible in the remaining 800ha surrounding a core area of 200ha which is free of big leaf.

Forest & Bird has teamed up with a

Vanuatu NGO partner EcoLifelihood Development Associates (EDA) who will take over management of the project. The two organizations have gained a \$US 50,000 grant from UNDP/GEF/SGP to develop landowner capacity to control the invasive vine, *Merremia peltata*. The project involves trialing hand cutting and herbicide methods aimed at reducing the extent and density of the vine to a level that can be controlled by hand cutting in the future. Initial trial work was funded by Forest and Bird, NZ Quakers and the Pacific Development Trust.

Herbicide Trial Results

Our first trials indicated that cutting and pasting all climbing stems with Vigilant gel in June achieved kills of upto 70% of the smaller stems.

However this method did not reliably kill stems greater than 5cm dbh. We also trialed scrapping larger stems 20cm along both sides with a 10cm overlap, (not a full ring bark) and applying vigilant gel to the scraped surface. This method killed all the trialed vines however we suspect that Vigilant may have been responsible for causing



Looking over Vatthe Conservation Area and Matantas Village (**above**). Vatthe's diverse wildlife includes the globally endangered, *Gallicolumba santaecrusis* and three vulnerable endemic bird species, *Megapodius layardi*, *Erythrura trichroa*, and *Todiramphus farquahari*. Vatthe is on the Vanuatu Government's tentative site list for World Heritage nomination.

damage to a large *Dracontomelon vitiense* (Anacardiaceae). Scrapping is also time consuming and not feasible over hundreds of hectares.

Further trials were established by the Vatthe Landowners with the assistance of Forest & Bird volunteers in July 2009, to test the effectiveness of four different herbicides applied by injecting 10ml (50:50 water) into the main stump of large vines (>4.5cm dbh) vine.

Of the four herbicides trialed, Weedmaster Duo active ingredient 360g/L glyphosate was the most effective completely killing all four injected vines.

Victory Gold (active ingredient 50g/litre picloram plus 100g/litre triclopyr) killed most but not all. Least effective were Vigilant gel (active ingredient 43g/

kg 4 amino, 3,5,6 – trichloropicolinic acid picloram) and Ultimate (active ingredients; 25g/litre metsulfuronmethyl & 75g/litre triclopyr).

Due to the possible impacts of vigilant and the good results obtained by injecting Weedmaster, which is easily obtainable in Vanuatu, is cheaper and has significantly less environmental and human risks than Vigilant (picloram), we have decided to proceed with a larger trial area using 5ml injections of undiluted weedmaster (glyphosate), to all main stems greater than around 4cm dbh. In addition all stems less than 4cm will be cut at the point they climb into the canopy. No herbicide will be applied to these cut ends.

As it is cheaper and quicker to

Approximately 2,300ha (92%) of Vatthe forest (**top**) has been invaded by the invasive vine. Cutting and applying vigilant gel (**above left**) killed only 70% of treated vines. This method over a large area would be expensive, and time consuming. Emily Tasale (EDA) (**above**) using dyed water to test an injector fitted with a blind needle. These will be used to inject undiluted glyphosate (Weedmaster) into large stems.



The results have surpassed everyone's expectations. trees regenerating their crowns.

apply lesser amounts of Weedmaster we established further trials to test the effectiveness of injecting 2.5ml of undiluted Weedmaster in August 2010. We also trialed injecting 5 x 1 ml undiluted Weedmaster at random intervals in the ground running stems of large vines. The herbicide takes 9 or more months to completely kill a vine, so the effectiveness of these trials can not be assessed until next year. It is possible that the herbicide may work faster if applied in the wet season, but this has not been tested.

Ideally, given more time and resources, we would have had significantly larger trials with more intensive monitoring, and would have trialed differing application methods and timing. However our trials to date give us an indication of what can be achieved. There remain many questions to be answered, and further research is needed.

Vine Cutting

Due to the extent of large tree deaths caused by the vine and the time it was taking to find a herbicide method we decided to do a large scale cutting only trial. All climbing stems in some 50ha of forest were cut twice; at shoulder height and ground level, where they climbed into the canopy in July 2009.

The results have surpassed everyone's expectations. The forest canopy has recovered, with many previously unhealthy trees regenerating their crowns. Large canopy trees that last year looked on the verge of death have recovered. The death of the mass of vine stems covering the forest floor seems to have also enabled the development of a dense understory of young seedlings of the canopy species and a diversity of understory shrubs. This may be due to the death and decay of the mass of ground stems creating more space for plants as well as enriching the soil. Death of the vine in the canopy has temporarily increased the sunlight reaching the forest floor which may also be contributing to the increased shrub growth. This new shrub growth appears to be sufficient to prevent large amounts of the vine re-growing.

We had anticipated that it would

be two years before the vine recovered sufficiently to reach the canopy. However assessments this year suggest that it may be even longer and that those reaching the canopy are likely to come from missed vines rather than from extensive re-growth of cut stumps. We found very few examples of multiple re-growth of stems from cut stumps, despite a very wet season.

The vine cutters began work in earnest in June and July 2010 with six teams and more than 30 people cutting. They have now cut more than 100ha of densely infected forest. There are thousands of vines per ha. The focus for the rest of this year will be on applying herbicide. Over the next two years we plan to re-cut the 'cut only' areas to test the effectiveness of two and three cutting cycles as this may be enough to create unfavorable growing conditions and sufficiently weaken the vine.

Work program for large scale herbicide application developed Forest & Bird volunteer, John Dodgson has developed specialized tools for herbicide application. These include a hole punch with a slide hammer to puncture the larger vine stems which enables the

herbicide to be injected by injectors attached to drench packs. A walking stick stem injector (using disposable parts) has been developed and trialed. This concept works and will be developed for use with more robust parts. This will deliver 1ml injections to ground running stems.

The Vatthe landowners and members from Matantas and a nearby village – Talatas, have been trained in safe herbicide handling and the specific methods of application developed for Vatthe. Workshop materials were prepared in bislama (Vanuatu's national language) and will be used to train other communities.

The herbicide application began on August 9 2010, and is now in full swing with 50 people working. The development and training phase of this project has been completed. The focus now will be on the operational control of the vine and monitoring the impacts, to continually refine herbicide application.



Maena Tavue a local cutting small big leaf stems, which is already having dramatic results (top). Emily Tasale, John Dodgson and Bill Tavue trialing the walking stick injector which will be developed to enable 1ml injections of weedmaster to ground running stems (above). Whilst Donna Kalfatak (previous page) – Department of Environment and Conservation and Rosina from Matantas surveying understory re-growth of canopy seedlings in the Vine cut area.

The forest canopy has recovered, with many previously unhealthy





Kolombangara **United by a Crater**

On Kolombangara a new chapter in conservation is unfolding.

Words by **Andrew Cox** and **Ferguson Vaghi**

Photographs by **Andrew Cox & Patrick Pikacha**



High ridgeline of Mt Rano (top), falling sharply into the crater and its many streams (above) and waterfalls (far right). Ferguson Vagi coordinator of Kolombangara Island Biodiversity and Conservation Association (at right) with ranger (top center) at a custom site on the trail to Mt Tapalamengutu (1710m). *Bulbophyllum* sp orchid (below center), and *Dendrobium* sp (below right) in montane forests.

The crater and the mountain slopes are revered in Indigenous culture. More recently scientists starting to venture there have discovered many other secrets.

On Kolombangara in the Western Solomon Islands, a new chapter in conservation is unfolding.

Kolombangara Island is immediately appealing because the dormant volcano has a classic volcanic cone shape. The cone rises from a circular 30km base to a crater rim 1,780m above sea level. The last eruption was about 10,000 year ago and the cone has since heavily eroded, leaving a stunning shattered crater, with a major gash in one side where the Vila River drains the crater centre.

The crater and the mountain slopes are revered in indigenous culture. More recently scientists starting to venture there have discovered many other secrets.

The indigenous people of Kolombangara, the Dughore people, have been actively supporting the scientific studies. They have also begun to re-establish their connection with the high mountains of Kolombangara after a century of living on the coastal shores.

Most importantly, despite the alienation of most of Kolombangara island during colonization, the Dughore are regaining a management role for the forests brought about through a shared vision for conservation.

Land History

Solomon Islands has been subject to many outside forces since British rule and this has had a big impact on the natural environment of Kolombangara Island.

When the early colonists claimed Solomon Islands as a British Protectorate in 1893, they found few people on Kolombangara. They were not seen by the British because they were mostly living on the slopes and in the deep valleys of the volcano crater, out of sight of aggressive headhunting raiding parties from neighbouring islands.

The British, thinking it was largely uninhabited, acquired most of the island as State land and in 1905 granted a 999-year occupation licence to Levers Brothers from the United Kingdom to establish coconut plantations to produce oil for Levers' soap.

From about 1968, Levers Pacific Timber Plantation, a subsidiary of the larger Unilever Company, began extensive logging of the rainforests of the lower slopes, largely below 400m altitude. Very few trees were left standing on the coastal lands of Kolombangara.

After Solomon Island's Independence in 1978, the Levers holding was converted to a 75-year lease and many of the operations converted to plantations. In 1989, the



Government took over the former Levers lease lands and granted it to a new independent forest plantation company, Kolombangara Forest Products Limited (KFPL). The KFPL lease covered 66% of the island.

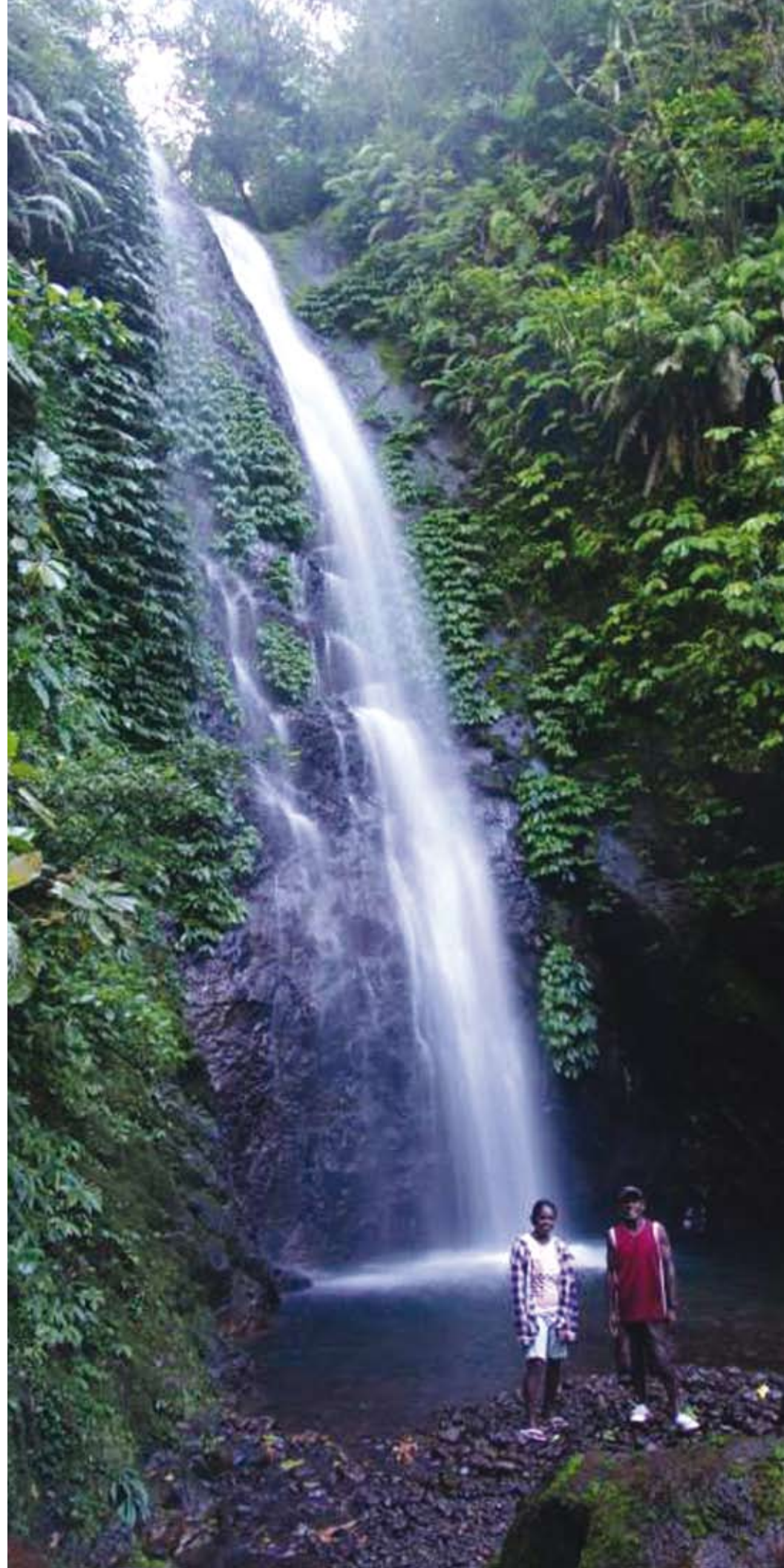
KFPL, while either fully government controlled, or like now, 60% owned by a Taiwanese investor, adopted a constructive relationship with the indigenous people. Most of the employees are Kolombangara people, and KFPL has built good consultation practice with island communities on the lands.

Drawing on the Respect for the Crater

Land issues on Kolombangara, like elsewhere in Solomon Islands, have caused deep-seated conflict.

Landowners regularly fight each other for timber rights and land claims in the High Court. There are different views over which descendant group should prevail in decision-making for the island. There is no easy answer. Several attempts to set up a body of 'chiefs' on Kolombangara has created splits and little real progress.

These conflicts were amplified with the disruption and breakdown of many of the traditional decision-making structures. Compounding matters was the intense pressure





One of many waterfalls in Kolombangara's crater (top). Blue-faced parrot finch (above center), only found on the summit of Kolombangara in the Western Province but occurs also on Guadalcanala and Bougainvilles' high mountains. *Macodes* sp orchid (above), a ground orchid found on ridge and montane forests.

Facing page: Dawn at the Imbu Rano Lodge, a research and eco-tourist lodge found nestled at 400 m over looking the crater forests and the high ridge of Mt Tapalamengutu (1710 m).

from toxic logging deals and the accompanying bribes of alcohol, cash and hollow promises of community services like schools, roads and water tanks.

Once the log ships departed, villages were often left with few trees for building houses or shade and dried up water supplies. Many people felt a deep hurt from both the bitter conflict before the logging and a hard lesson learnt after the logging. The claimed benefits rarely materialised.

Against this roadblock, the landowners of Kolombangara quickly realised that their ancestors and the stories of their recently deceased elders held the key to the future.

The Dughore believe that all their ancestors came from a man and a woman who lived inside the Kolombangara Crater, Kongu Rano. Over time, the people moved out of the crater to live in villages further down the slope, in the major river valleys of the Vila, Kukundu and Rei rivers. More recently, as the headhunting wars between islands stopped, the Kolombangara people settled around the coast, leaving behind old village sites, burial places and other tambu sites in the mountains and the crater.

The Kolombangara elders had a deep respect for and tradition of protecting the high mountain forests and the crater, the birthplace

of the Kolombangara people.

While the people could not agree on how best to organize themselves to resolve the land issues, they could agree on preserving the Kolombangara crater and the forests above 400m altitude.

KIBCA – a Uniting Force

Prompted by several enthusiastic overseas scientists and supported by KFPL, the landholders decided to set up an organisation that would take a lead in the conservation interests on Kolombangara on behalf of all landowners.

So in 2008, Kolombangara Island Biodiversity Conservation Association (KIBCA) was formed.

KIBCA represents landowners via representatives from 10 zones that come together for an AGM, and regular Executive meetings that have at least one representative per zone.

For the first time since about 1900, KIBCA provided a realistic way for Kolombangara indigenous people, long alienated from their land, to be involved in managing at large part of their island.



Strong Steps Forward

KIBCA has moved ahead in leaps and bounds.

KIBCA has secured a long-term funding commitment to pay scholarships to parents of high school and tertiary school students, in return for landholders signing a pledge not to log above 400m altitude. In 2011 it distributed 110 scholarships to Kolombangara parents worth a total of SBD\$94,000 (about USD\$12,000)

It has conducted awareness workshops with villages to help them find alternative forms of income to logging, such as from honey-making and local nut harvesting.

To take advantage of the spectacular scenery on Kolombangara, it has begun to promote the island to overseas visitors.

In June 2011 KIBCA held a festival to celebrate the 400m conservation area. The area was formally dedicated by the Prime Minister and the Minister of Environment. The festival included sporting and other contests, but popular amongst the local people was a walking tour to the crater centre. Up until this time, few indigenous people had the chance to go inside the crater and reconnect with their birthplace.

Science a Fundamental Plank

The overseas scientists had readily understood the significance of the crater and its mountain areas. Kolombangara hosts two high altitude endemic birds, the Kolombangara White-eye and the Kolombangara Leaf Warbler. At least two frogs endemic to the high cloud forests were found by scientists from the American Museum in October 2010. More surprises are likely to be found.

KIBCA has formalised its relationship with International scientists. This ensures that the studies undertaken on the island do not repeat work already done, that they answer the most pressing scientific questions and that benefits clearly flow to the local people.

Scientists fear that the tropical forests will suffer greatly under the impact of global climate change. Something as seemingly benign as a one-degree temperature rise will put animals under greater heat stress and cause the tropical clouds to form at a higher altitude. Then there are predictions of lower rainfall and longer drought periods. This will spell profound change for Kolombangara's mountains and the cool climate and high rainfall specialists living there.

KIBCA is planning to set up long-term remote weather modeling stations and is working with several scientists on long-term

altitudinal monitoring of bats and frogs.

Tourism

Tourism has great promise for the future of Kolombangara. It has the potential not only to put this jewel of an island and KIBCA's conservation efforts in the international spotlight, but also to generate long-term revenue, both for KIBCA and small family-run businesses servicing tourists.

While tourism often promises more than it delivers, KIBCA is careful to offer something unique to adventurous and wildlife loving visitors.

Already KFPL has come to the party and built a well-appointed lodge close to the 400m elevation as a springboard for walks into the Kolombangara Crater and to the crater rim. KIBCA has recently set up a network of walking track, two huts a few hours walk from the lodge and a basic shelter deep inside the crater.

Visit Kolombangara Yourself

All the information you need to visit Kolombangara Island can be found at www.kolombangara.org. Daily flights from Honiara go to either Gizo or Munda airports.

Ferguson Vaghi is Coordinator and Andrew Cox is Technical Officer at KIBCA.

Empowering communities to retain their **RESOURCES**

Words by **Simon Albert**

Photographs by **Simon Albert & Fred Olivier**

Communities across Marovo Lagoon in the Western Solomons have recently endured industrial scale harvesting of their marine and terrestrial resources. Due to a complex combination of unscrupulous companies, selfish landowners and poor governmental management this resource extraction has yielded little if any development benefits for the people of Marovo. As the companies pack up and sail for the next port the Marovo people are left to achieve their development aspirations through other means. Some communities continue to attract companies to extract new resources (mining, oil palm) and continue the pattern of failed promises and environmental degradation. Meanwhile other communities are exploring a new path through environmental management and sustainable development.

The rich environment of the Marovo region supports

the traditional subsistence way of life of the people. The environment provides almost all their needs: housing, water, food, canoes and medicine. There is however an increasing need for cash to pay for essentials such as education, kerosene, transport, soap and an increasing desire for cash to pay for many other items. For many people the only asset that can yield cash is their natural resources. Hence for the past couple of decades the natural resources in Marovo and elsewhere in the Solomons have been sold off cheaply to international (predominately Asian) companies. Finding alternatives to resource extraction has been difficult with agriculture, tourism and carving industries providing limited and unreliable sources of income. Recently NGOs such as WWF, The University of Queensland, American Museum of Natural History and Solomon Island Community Conservation Partnership have been

“This provides a model of how remote subsistence communities can realise their development aspirations without compromising the natural resources that support them.”

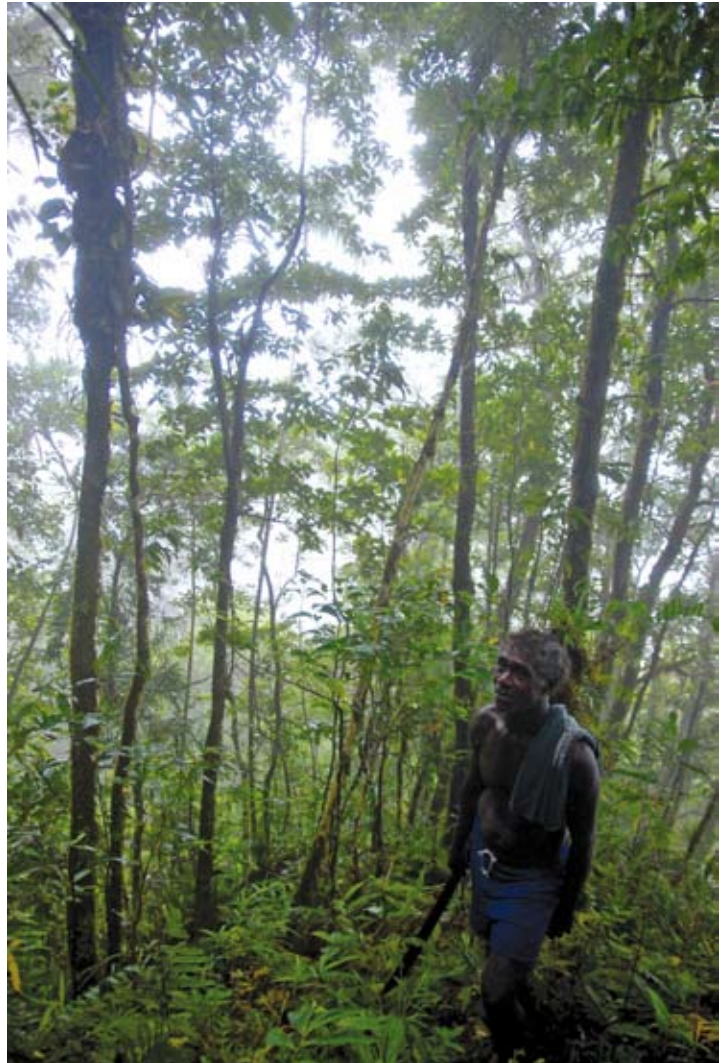
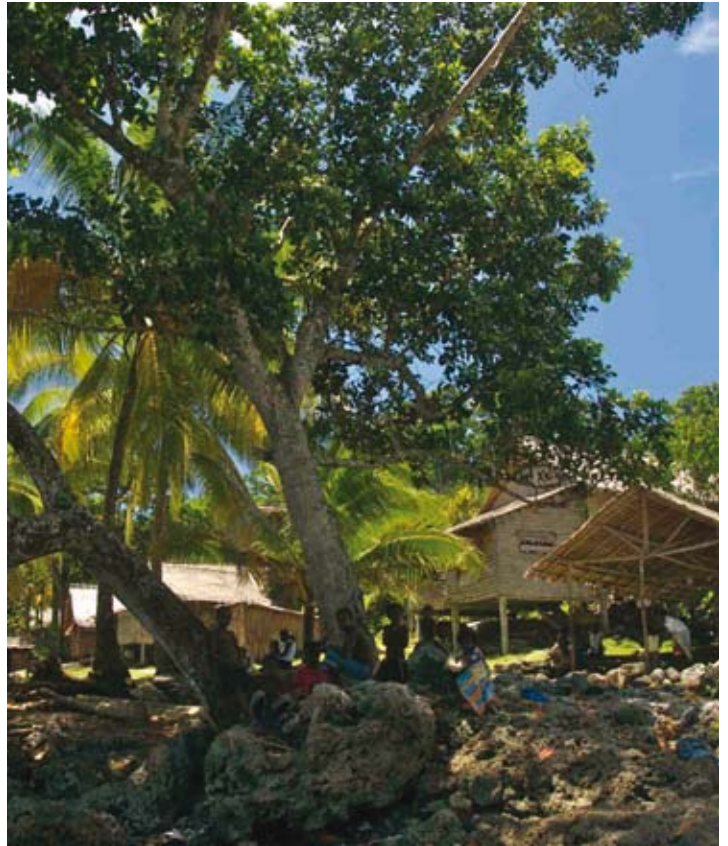
assisting communities to market their natural resources without extracting and destroying them.

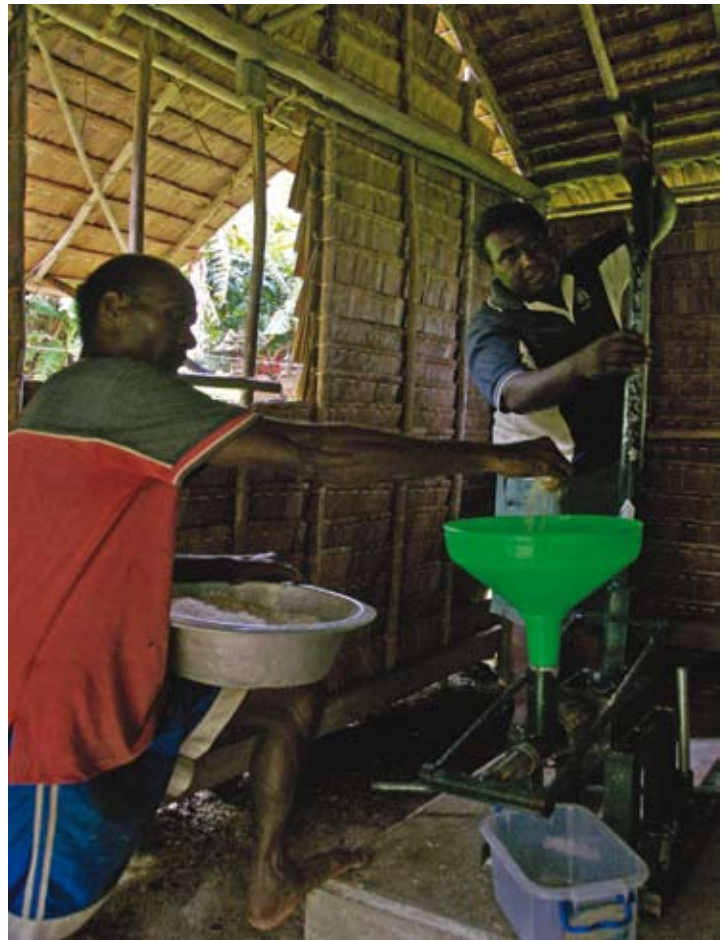
Communities that resisted temptations to sell their resources cheaply to overseas companies are beginning to realise the long term benefits of having an intact terrestrial and marine ecosystem. Increasingly developed nations are interested in supporting community based efforts to preserve their environments for the biodiversity, carbon storage, food security, water catchment, aesthetic and cultural services they provide. The Zaira community on Vangunu and Biche community on Gatokae are two leading examples of

communities that have been able to market their intact ecosystems to outside donors without destroying them.

Biche village has used the modest funds received from the donor to finance a range of small scale development projects aimed at removing the community's dependence on cash and external goods. One such project in 2007 was the installation of solar lighting in every household. This was able to remove the community's dependence on kerosene which had been a major component of a family's expenditure. In addition a scholarship program has been established that subsidises school fees for Biche students attending primary and high schools. Funds have also

Clockwise from top left: James Jino and son, Gerald exploring the still intact south Vangunu bush. Coastal village of Biche, south Gatokae. Exploring the lush south Vangunu crater ridgeline. Intact coastline of Gatokae and, lush Vangunu crater interior.





been used to repair schools and churches. The modest funding (\$20-50,000 SBD PA) that these communities have received has not come from large companies, aid organisations or governments. It has been provided by small scale private, philanthropic and corporate donors that have a strong connection to the Solomons and are interested in supporting the people to retain their natural resources whilst realising modest development goals.

Realising that donor funding of this kind may not be perpetual into the future, Biche have also invested in developing a small scale coconut oil production business to provide long term sustainable income. Using a simple hand press the Biche community coconut co-operative turns their abundant coconuts into high grade organic coconut oil for sale locally. The oil has also reduced the need for cash in Biche as it has replaced palm oil for cooking, soap

for washing and kerosene for lighting. The oil has been deriving a significant income for both families and the community who market it locally to other villages and eco-lodges. The Biche community coconut co-operative has been established to ensure economic benefits are distributed at individual, family and community levels. Families can harvest, grate, dry and press their own oil for personal use or sell it into the co-operative at \$16 SBD (\$3 AUD) per litre. From there the oil is bottled, labelled and sold outside the village at \$24-35 per litre depending on size. The profit is then returned to the community for use on development projects. This provides a model of how remote subsistence communities can realise their development aspirations without compromising the natural resources that support them. This model relies on a robust and thorough community consultation to

Realising that donor funding of this kind may not be perpetual into the future, Biche have also invested in developing a small scale coconut oil production business to provide long term sustainable income.

ensure both the motivation and obligations of community and donor are clear from the outset. In this case this community consultation has been made possible through a grant from the John D & Catherine T MacArthur Foundation.

In Biche and Zaira the past couple of years of experience with 'conservation' has led to a realisation in the community that in many ways the western concept of conservation or resource management is no different from what they have been doing for millennia. Solomon Islanders have a long tradition of looking after their land and sea in a way that sustains their lifestyle. Clearly the transition to a cash economy

has made this job of looking after land and sea more difficult. It is critical that external agencies interested in supporting conservation efforts realise and engage with the need for a modest cash income in modern Solomon society. After the disastrous last few decades of industrial scale logging in the Solomons, communities are motivated to find alternative ways to realise their development aspirations. To date the only groups offering development and income opportunities have been logging, fishing and mining companies. Communities in Marovo are providing important lessons of how development can be achieved though conservation of natural resources.

Clockwise from top left: Children of Biche village, south Gatokae. Coconut press mill a sustainable venture in Biche Villlage. Drying out coconut before pressing. Scraping out rich flesh of coconut before drying out in sun.

Kukuvoju: Speaking from the Grave

Words by **Brian Weeks**



The Solomon Islands lie at a crossroads: they connect biologically rich Australia and Asia to the sprawling islands of the South Pacific. Their unique location and extraordinary biological and geological history have made for levels of bird diversity that are famous around the world. One of the earliest foreign expeditions that came to study birds in the country was in 1904, and was led by a man named Albert Meek. Meek was a British scientist who collected birds throughout the Solomons, and in 1904 on the northwest coast of Choiseul, he captured what is regarded by some as the most remarkable endemic bird of Northern Melanesia: the Kukuvoju, also known as the Choiseul Crested Pigeon, or *Microgoura meeki*. Its name reflects how spectacularly unique this bird was; no known relatives existed, so it was named *Microgoura*, or “small crowned-pigeon” after similar looking crowned pigeons in New Guinea. This large ground-dwelling pigeon, with its strange crest and brightly colored facial skin and bill, most likely lived on Choiseul and nowhere else on earth. It is believed to have nested on the ground or in low branches in swampy lowland areas and its offspring likely would have left the nest at a very small size to head out into the bush to fend for themselves, searching out the rich crops of fallen fruit and seeds that litter the

forest floor in the Solomons. Given its unique characteristics and place in local lore, Kukuvoju must have traveled the rainforest understory beyond all human memory.

Unfortunately, large size, independent young, and ground dwelling habits are a deadly set of traits for an animal to have on an island where cats, rats, and dogs have been introduced. Kukuvoju likely co-existed with dogs and pigs (which probably arrived with the earliest Melanesians) for millennia, and even lived with cats for several generations. However, the later introduction of rats, continued introduction of cats, and increases in dog numbers all may have increased pressure on the Kukuvoju. As well as shifts in these introduced species, the collapse of native peoples’ spirituality that followed increased European influence may have made areas of remote forest, which had to that point been protected by *kastom*, more accessible to humans. This may have exposed Kukuvoju that were previously protected by their isolation to increased human consumption and the indirect impacts of introduced animals associated with people like cats and rats. In 1927, only about twenty-three years later, the Whitney South Sea Expedition from the American Museum of Natural History, returned to Choiseul to re-survey the birds on the island. Although locals reported having seen the Kukuvoju, none could be found. Jared Diamond, an American ornithologist, returned in 1974, and again no Kukuvoju. More recent efforts to look for Kukuvoju on Choiseul and on other islands have not met with any success - so what happened?

Unfortunately, it seems fairly certain that this iconic bird from Choiseul is now extinct – forever gone from the earth. Although it is impossible to tell for sure, the prevailing theory is that Kukuvoju’s nesting habits and ground-dwelling young made it easy prey for cats, dogs, and people. The best guess seems to be that the continued introduction of European cats was the main driver in its extinction, though it is difficult to rule out the possibility of disease or to quantify the

impacts of a changing culture as European influence expanded. There were six birds and one egg that were collected by Meek in 1904, and five of these specimens are still housed at the American Museum of Natural History in New York, USA (the sixth skin and the egg are at the Natural History Museum, Britain). Recently David Boseto, a scientist from Choiseul who is studying in the United States, dropped by the Museum to work on his freshwater fish research and also to collaborate on an education project that is underway in the Solomon Islands (the Network of Conservation Educators and Practitioners; NCEP). He took the chance to see what are probably some of the last individuals of his island’s extraordinary pigeon. This sad story can serve as a cautionary tale as the Solomon Islands thinks about introducing non-native species for various reasons, and indeed served as the example Mr. Boseto used in talking about the risks to native freshwater fish that would come with the introduction of tilapia as a food fish. It also demonstrates the value of continued scientific study of the natural world and the role that museum specimens can play in protecting the natural heritage of the Solomon Islands; Kukuvoju may be gone, but it should not be forgotten.



The extinct Choiseul ground pigeon (above), not seen since 1904, with five specimens lodged at the American Museum of Natural History, one of which is held by local scientist, David Boseto (top left).

Red-backed Button-Quail are still on Guadalcanal

Words by **Mike Tarburton**

Mayr (1945) said of the sub-species of Red-backed Button-quail (*Turnix maculosa salomonensis*) found only on the north-coastal grasslands of Guadalcanal in the Solomon Islands, that “Most field naturalists will look in vain for these birds, even in their proper habitat.” Since then much clearing of this area has reduced their habitat and Doughty (1999) says they are endangered. Other references to their rarity or obscurity may be found at: www.birdsofmelanesia.net/solomons7htm/guadalcanal.pdf

This means there is some significance to the finding of two sets of depredated wings with some of the distinctive wing coverts of this species in August 2002, (pictured). The same black markings on the wing coverts that can be seen in the photo can also be seen in Mayr (p. 59, 1945, Fig 2). Further, Galbraith & Galbraith (1962) make the following observations when comparing the 10 specimens held in museums in the UK & USA: “All specimens have the black markings well developed on the under parts”. They also point out that the females have more barring on the breast than the subspecies on New Guinea, and more barring on the sides of the breast than the subspecies on Cape York Peninsular (Australia). They add that the males have the sides of the breast and wing coverts heavily “spotted”. These bent bar-shaped spots can be discerned on the wing covert feathers attached to the primaries in the photograph.

Doughty’s (1999) comments are contrary to those of observers in the 1940’s. Beecher (1945) found the species was not uncommon in 1943-45. Pendleton (1947) worked in the grasslands 8-10 hours a day for eleven months in endeavours to eradicate or at least control mosquito numbers in the grasslands of northern Guadalcanal for eleven months of the Second World War. He found that the birds were active only early morning and late afternoon, but would freeze if disturbed between those times and was most difficult to see, even when they were only “one foot” from his foot. Because of the birds behaviour and the fact that he regularly found them within 30 yards (metres) of US army camps over a ten month period he was confident that this bird was not in any immediate danger of

extinction.

In spite of this prediction Cain & Galbraith (1956), who spent four months on Guadalcanal in 1953 only found these birds among crops, commenting that they would probably be hard to flush in the tall Kunai grass. Were they looking in the heat of the day or had the birds become more difficult to locate than in earlier days? That the only report of their presence since that time has been from the 1970’s (Pacey pers com), indicates the importance of looking out for this bird and reporting any findings.

The two predated wings that I found were adjacent to a large pineapple patch in the Betikama Adventist College gardens, just south of Honiara. They were on a ridge, such as a bird of prey would use to eat its catch, and between the pineapple patch and a remnant patch of rainforest.

The good news is that two live birds were flushed at one of these ridges in the night at Betikama by Patrick Pikacha while looking for frogs in 2007. Patrick also found hatched egg shells of button quails in 2011 in the same area. In November 2011, a photograph of a button quail was taken by Guy Dutson, who says a healthy population live around these grasslands. With settlement and village expansion occurring around north Guadalcanal, let us hope enough grasslands remain for this striking subspecies.

References:

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Evidence of breeding Red-back button quails, with eggshell closest to the thumb having an even edge right around (top). This indicates that the egg has hatched successfully. Two sets of depredated wings with some of the distinctive wing coverts of Red-backed button quail (above center). A female bird (above) (Photo: Guy Dutson).



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