Assessment of Leatherback Turtle Nesting and Consumptive Use in the Autonomous Region of Bougainville, Papua New Guinea

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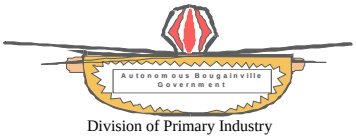

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Plate 1: Leatherback turtle eggs speared on a stick

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Acronyms

ARB	Autonomous Region of Bougainville
DEC	Department of Environment and Conservation
HCLTCP	Huon Coast Leatherback Turtle Conservation Project
MOU	Memorandum of Understanding
PIT	Passive Integrated Transponder
PNG	Papua New Guinea
SPREP	Secretariat of the Pacific Regional Environment Program
WPRFMC	Western Pacific Regional Fisheries Management Council
WMA	Wildlife Management Area

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Executive Summary

The Western Pacific Regional Fisheries Management Council (WPRFMC) has been funding several leatherback turtle recovery projects in Melanesia for a number of years. The major contribution by the WPRFMC in Papua New Guinea (PNG) is the ongoing support of the Huon Coast Leatherback Turtle Conservation Project (HCLTCP) in the Morobe Province (Kinch, 2006; Pilcher, 2005, 2006, 2007. 2009).

Satellite tagging programs of leatherback turtles from the Huon Coast have provided some indication of movement by nesters from the Huon Coast to Bougainville (Benson *et al*, 2007; Dutton *et al*, 2007), with the possibility of some nesters coming from the Solomon Islands, though the extent of this is currently unknown (Dutton *et al*, 2007). Subsequently, the WPRFMC contracted the Secretariat of the Pacific Regional Environment Program (SPREP) to conduct an assessment not only of nesting patterns, but also community and conservation (for protection and recovery) issues; along with the dissemination of education and awareness materials.

Following several weeks of radio announcements, an on the ground survey was conducted around the main island of Bougainville of leatherback turtle nesting beaches. This survey covered six days from the 19th-16th January, 2009. The total trip length was 565 km, with 389 km actually surveyed by running parallel to the beach in a 23 ft fiberglass dinghy at a distance of 20-50 m at a speed 8-15 km/h, depending on sea conditions. Of this 389 km, 38 km was surveyed physically by walking the beaches, of this 38 km, 28 km was walked during the daytime (for a total of 17 walks), and 10 km was walked during night surveys (3 walks, note that the distance is actually 20 km in total, because of the return leg is over the same distance).

Results from the recent survey recorded 46 leatherback nests and one false crawl at the peak nesting period (the aerial survey in 2007 reported 58 sea turtle nests for Bougainville Island). Given that leatherback turtles are known to nest between 3-5 times/season, this would thus give an estimate of the current total leatherback turtle nesting population from the recent survey for Bougainville island at approximately 9-15 leatherback turtles nesting annually.

The highest concentration of leatherback turtle nesting was 19 nests and one false crawl located along a 5.4 km stretch between the villages of Papona and Naboi on the central west coast. The other main concentration was the beaches south of Mamarego Point. Leatherback turtles nesting in other areas were sparse and sporadic, due in part to unsuitable beach or offshore morphology.

A further 12 non-leatherback nests were also observed. The latter were reported as green (n = 5) and hawksbill (n = 7) turtles due to nest size, location and beach morphology. The main concentration of these recoded nests were in the south of Bougainville Island, correspond with known nesting data for these species.

Of the 46 leatherback turtle nests recorded during the recent survey, 26 of these had eggs removed, while another 12 were presumed to have had their eggs removed, making a total of 83 % of all nests recorded having had eggs removed. Of the unidentified (green and hawksbill) turtle nests, two were observed to have eggs removed with another eight presumed to have eggs taken, again making 83 % of all unidentified species nests having had eggs removed.

Results of surveys and interviews with local inhabitants suggest that leatherback turtles have been taken on a relatively frequent basis by communities on Bougainville Island in the past. Perceptions amongst villagers varied, but in general the consensus was that leatherback turtle numbers had declined within the last 30-50 years. Reasons for the decrease were unanimously given as wide-scale egg take and the killing of adult nesting leatherback turtle females.

It is apparent that leatherback turtle resources in the ARB are under severe pressure, with implications for leatherback turtle nesting populations for the Huon Coast, Morobe Province, and possibly the Solomon islands due to implied connectivity between these areas, and the excessive egg take and the killing of adult nesting leatherback turtle females that is occurring on Bougainville Island.

If a recovery program was to be developed for the ARB, it would need to be concentrated on the 5.4 km stretch of beach between the villages of Papona and Naboi, as 19 leatherback turtle nests were reported here with 100 % egg harvesting, as well as the one false crawl. This stretch of beach therefore accounts for approximately 43 % of all leatherback turtle nesting activity on Bougainville Island. The second area of concentrated leatherback turtle nesting (n = 13) is the beaches south of Mamerego Point, covering an area of 34.7 km, this is too large an area to do anything overtly practical beyond education and awareness.

It would also be possible to build on the conservation efforts implemented by Father Louis for the Papona-Naboi area, combined with a more enforced '*tambu*' generated by the 'chief(s)'. It may also be possible to get The Nature Conservancy who is active in the ARB to support the Fisheries Section of the ARB's Administration's Division of Primary Industries to oversee conservation and recovery efforts.

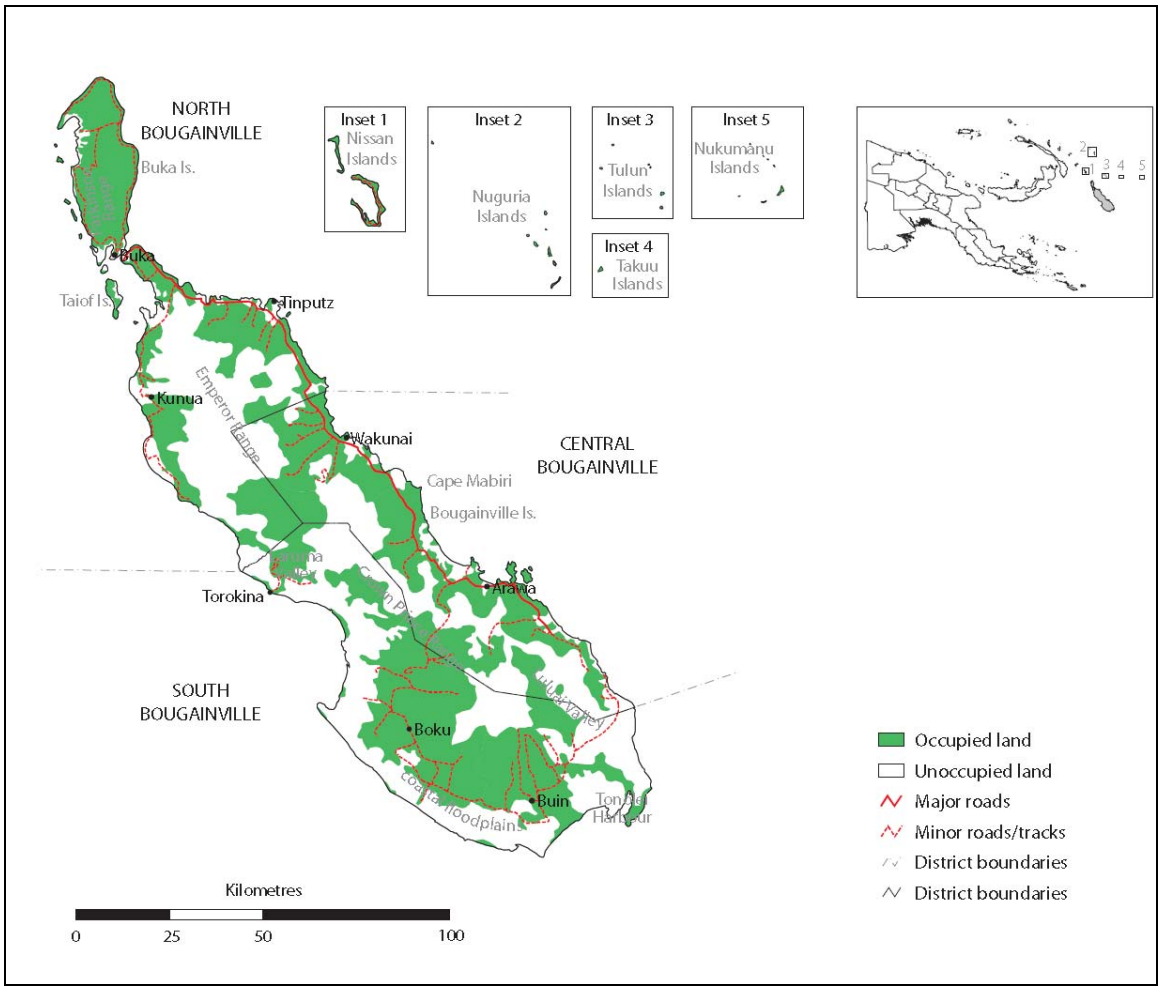
An immediate step, however, should be a blanket education awareness progress, with regular radio programs on Radio Bougainville on the ecology and vulnerability of leatherback turtles in the ARB, wider PNG and the wider Western Pacific Region; and also details on the legislation that bans the sale and take of leatherback products (meat and eggs) under the 1976 *Flora and Fauna Act*; and the opportunities for supporting local conservation activities under the WMA section of the 1976 *Flora and Fauna Act*, but also the establishment of Ward or Local Level legislation under Sections 42 and 44 of the 1997 *Organic Law on Provincial Governments and Local-level Governments*.

It is known that depleted leatherback turtle populations can respond positively to relatively simple conservation strategies (e.g. St Croix, U.S. Virgin Islands; Dutton *et a*l, 2002, 2005), but for recovery to be effective in the ARB, successful intervention would require comprehensive and immediate action.

1. Introduction

1.1 Location and Geomorphology

The ARB consists of a group of islands in the far east of PNG, bordering the neighbouring Solomon Islands. The ARB includes the main island of Bougainville and adjacent Buka Island, and a number of small offshore island groups including the Nissan, Nuguria, Takuu, Nukumanu and Tulun Islands (Map 1).



Map 1: Autonomous Region Bougainville (source: Hanson *et al*, 2001)

The main island of Bougainville is dominated by the volcanic peaks of the Crown Prince Range, including the active volcano of Mt Bagana. Coastal areas include raised coral limestone plains, volcanic plains and fans, valleys, floodplains and swamps (Scott *et al*, 1967; McAlpine *et al*, 1975). All other islands, including Buka are derived from limestone or coral rubble in the case of the atolls.

Rainfall is high throughout the main islands of Bougainville and Buka, with intensity increasing from north to south, with a range from around 3,000-5,000 mm/year (Scott *et al*, 1967; McAlpine *et al*, 1975). All months are relatively wet and rainfall is well distributed throughout the year, with all months receiving 200-300 mm on average. July and August are generally the wettest period of the year.

1.2 Demography

The population of the ARB is currently estimated (i.e. at the time of the survey) to be around 223,250 people based on further extrapolations of original estimates detailed in Bourke and Betitis (2003). Approximately 75 % of the total population lives on Bougainville Island, with a further 20 % living on Buka Island and the remainder residing on the smaller islands and atolls.

Estimates from the 2000 Census, suggest that 43 % of the population is younger then 15 years of age, with the median age being 18 years (National Statistical Office, 2002). Average household size is between 5-6 people/household.

Population densities range from 4-41 persons/km² on the main island of Bougainville, with a mean figure of 15 persons/km² for the entire island, which is considered low (Bourke and Betitis, 2003). Population density in the west, south-west, and southern areas of Bougainville, the areas where the main leatherback turtle nesting beaches are located range from 10-18 people/km². In the west and south-west areas, much of the topography is dominated by rugged mountains, with populations concentrated on the coastal plains. In the south of Bougainville Island, most villages are located inland, with a few on the coast.

Most people are members of the Catholic Church, but some belong to the United Church, and the Seventh-Day Adventist faith. Both the Catholic and United churches provide many educational and health services.

A civil war known as the 'Bougainville crisis' engulfed most of Bougainville and Buka Islands from mid-1989 to the end of 1997, resulting in demographic shifts in some parts of the ARB, and the collapse of the cash economy. Many people also migrated to the Solomon Islands and other parts of PNG. During the worst years of the crisis, the PNG government supported tens of thousands of people in care centres throughout the ARB, with the largest concentration centred in the Buin area (Bourke *et al*, 1998). Since the crisis finished, there has been little recent out-migration from the ARB, with villagers returning to their 'traditional' lands (which is beginning to contribute to pressure on land, as are new plantings of cocoa, see below). Bougainvilleans are now also returning home from other parts of PNG and the Solomon Islands.

1.3 Economy

The impacts and length of the 'Bougainville crisis' was very uneven within the ARB. For example, there was minimal impact on the small offshore islands, apart from loss of employment and education opportunities. The main area of disturbance was in the central, south and south-west areas of Bougainville Island, with infrastructure either destroyed or in a severe state of neglect, causing a complete collapse of markets and services. The economy is slowly expanding as infrastructure, services and market opportunities improve.

Overall, the level of cash income for rural villagers in the ARB is moderate. The main source of cash income in most areas is cocoa. The ARB was once a major contributor to PNG's copra and cocoa production before the 'Bougainville crisis' started (Hanson *et al*, 1998; Bourke and Betitis, 2003). The resumption of copra and cocoa sales in the ARB following the cessation of hostilities in 1997 has led to the resumption of smallholder activity in the cocoa sector, particularly in those areas serviced by the improved road infrastructure on Bougainville and Buka islands. Unfortunately, cocoa production has been affected by excessively wet weather and a fungal disease in recent years. White cockatoos also do considerable damage to pods. The production of copra has also increased in recent years, but is affected by fluctuating market prices.

Other contributing commodities to household incomes include fresh food, betel nut, fish, bêche-de-mer, trochus and shark fin. There is a large market in Buka township, and smaller ones in Arawa and all other government stations. A little income is also earned from the sale of handicrafts, particularly for those close to Buka. Remittances of cash from relatives working in urban centres are a relatively minor source.

Food in the ARB is derived from food gardens, coconut palms, fruit and nut trees, fishing and other marine produce, imported or market purchases, some pigs and chickens, hunting, and the harvesting of sea turtles and their eggs. For most villagers, food gardens are the main source of food, with sweet potato by far the most important food crop now grown in the ARB, surpassing taro, which was the 'traditional' food crop before World War II, but was decimated by disease just after World War II finished (Nash 1974; Packard 1975; Mitchell 1976; Moulik, 1977). Sweet potato now accounts for 65 % of production of all energy foods by weight (Bourke and Betitis, 2003; Bourke and Vlassak, 2004). There has also been a significant expansion in planting of banana since the 1997 El Niño event which caused severe drought throughout the ARB. Cassava is now also widely grown in the ARB and its production is now second to sweet potato. Consumption of imported food, especially rice, is moderately high. More rice is consumed when sweet potato is in poor supply, particularly in households with some cash income.

Other garden foods include cassava; banana; Chinese taro; yam; green vegetables, including *aibika*, pumpkin tips and ferns; corn; *pitpit* and beans. Fruit grown includes pineapple, pawpaw, rambutan, watery rose apple, Malay apple, mango, guava, watermelon, *bukabuk* (*natu*) and soursop. Nuts include *galip*, which is very common; *pao*, some Polynesian chestnut and sea almond. Betel nut, betel pepper and tobacco are also commonly grown.

2. Methodology

Following several weeks of radio announcements (see Appendix A), an on the ground survey was conducted around the main island of Bougainville of leatherback turtle nesting beaches. This survey covered six days from the 19th-16th January, 2009. The total trip length was 565 km, with 389 km actually surveyed by running parallel to the beach in a 23 ft fiberglass dinghy at a distance of 20-50 m at a speed 8-15 km/h, depending on sea conditions. Of this 389 km, 38 km was surveyed physically by walking the beaches, of this 38 km, 28 km was walked during the daytime (for a total of 17 walks), and 10 km was walked during night surveys (3 walks, note that the distance is actually 20 km in total, because of the return leg is over the same distance) (Map 2).

Areas that were physically walked were areas that were highlighted by the 2007 aerial survey that was conducted by the National Oceanic and Atmospheric Agency (NOAA) (see Map 3, Appendix B for location details) or areas that nesting was observed from the dinghy. Visibility was adequate from the dinghy for observation of nests. When nests were observed from the dinghy, the survey team dismounted the dinghy in the open sea and waded to shore through the beach breakers, and thus began recording and walking the beaches to determine other nests in the vicinity. Local people were also asked about recent nesting locations, and on occasions acted as guides, they also assisted in identifying species of sea turtle that had laid nests (e.g. “no not the large black turtle, the smaller one with the hard back”).

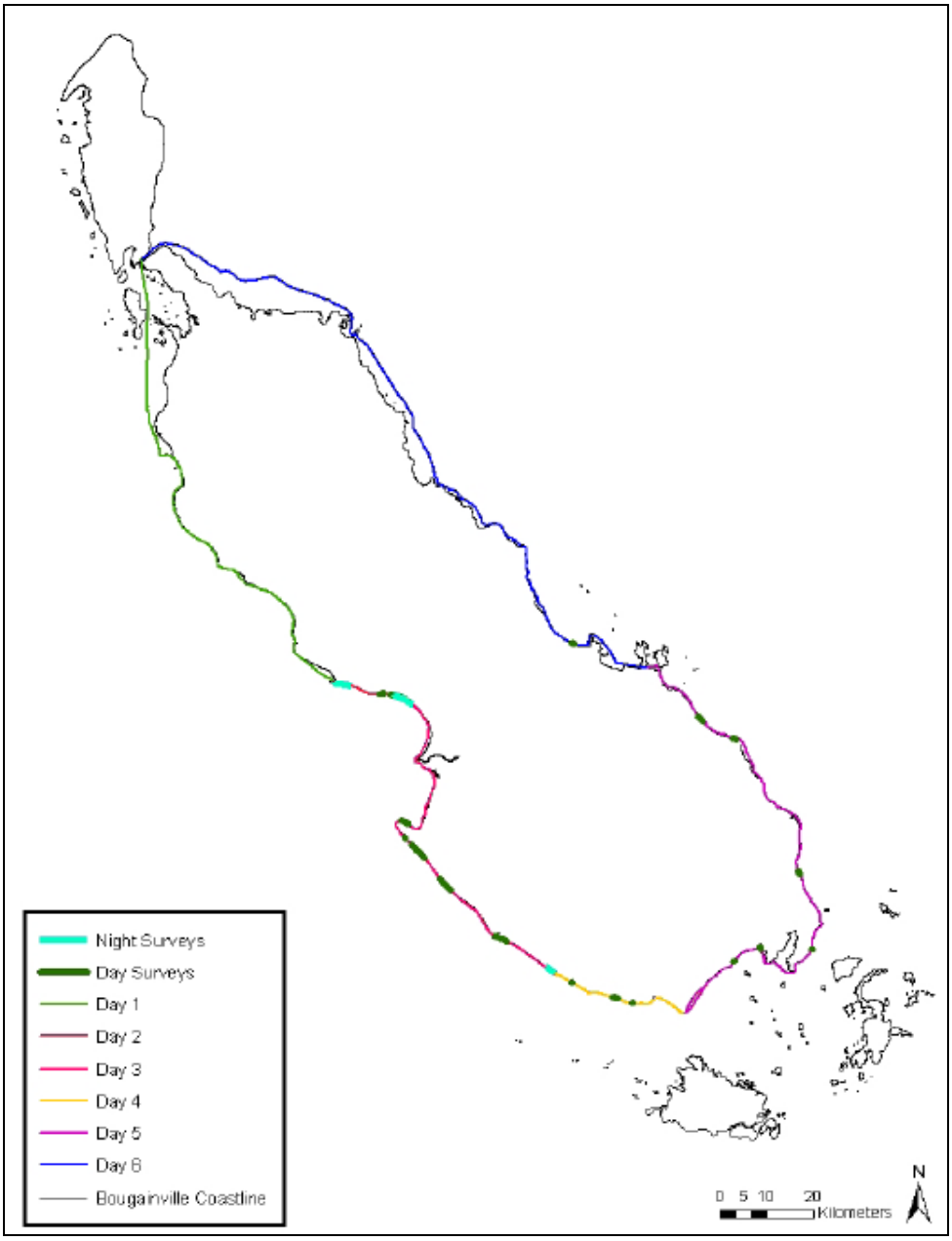
All nests were recorded using a Garmin GPSmap 60CSx. Due to unobstructed satellite signals, the accuracy of the coordinates ranges between 2-4 m (which represents the higher limit for consumer grade GPS units). Coordinates were also recorded on paper as backup. The daily tracks (routes) the dingy followed were recorded, as well as the tracks of the day and night beach walk surveys. All data was later downloaded and converted to ArcGIS shape file format with free, third party software called DNR Garmin, created and distributed by the Minnesota Department of Natural Resources in the United States of America. The data was then cleaned, naming conventions for nest sites enforced and the coordinates were converted from decimal degrees, the GPS native format, to degrees, minutes, seconds. Photographs were also taken at each nest site and recorded as an attribute of each site. Leatherback nesting sites, false craws and other species nests were separated into different shape files to allow for enhanced cartographic representation (see Appendix C for location details, Section 3.2 for maps).

A second GPS unit was given to Kevin Anana, a Fisheries Officer with the Fisheries Section of the ARB’s Division of Primary Industries. Kevin was trained over the course of the survey to utilise the Garmin 60CSx for navigation, coordinate acquisition, and how to upload and download information from the unit to a computer.

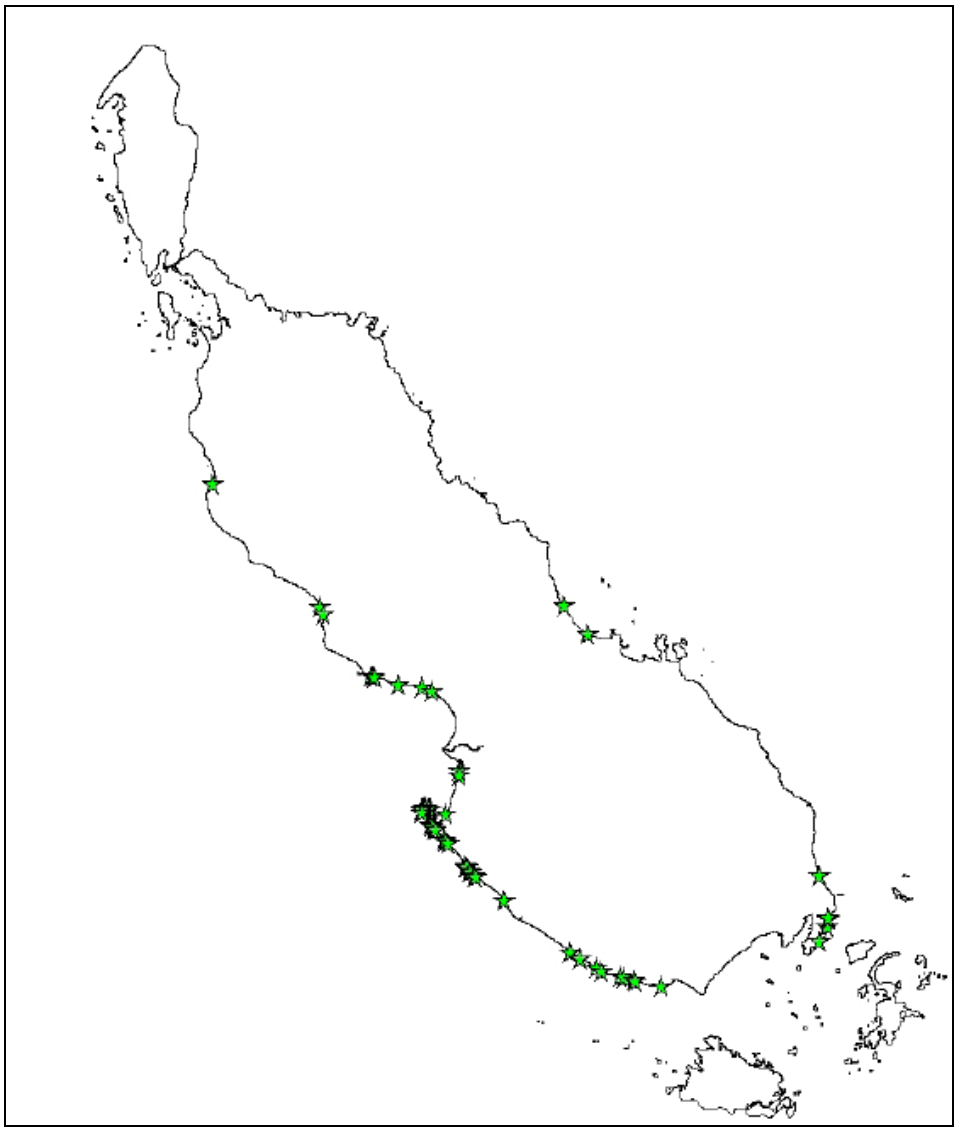
Surveys were conducted with community members either with individuals, small household groups or in community settings to determine the level of consumptive use, any general information about the status of leatherback turtles in their area, as well as any traditional knowledge and management regimes, including the need for protection (see Appendix D for survey form, a similar type survey had been used by the lead author in Bougainville previously for dugongs; see Kinch, 2008a). Surveys were either conducted amongst individuals when encountered either fishing or on beaches; or as semi-structured interviews in larger groups and community fora. All surveys, interviews and community consultations were conducted in ‘pidgin’ as this is the ‘*lingua franca*’ used by Bougainvilleans (the lead author is proficient in ‘pidgin’). General scans of communities were also conducted during semi-structured interviews and community awareness.

A major part of this survey also involved the wide dissemination of education and awareness that were originally developed under the WPRFMC supported HCLTCP in the Morobe Province, PNG (see Appendix E). The *'Leatherback Turtle: Their Future is in Our Hands'* was originally developed by the lead author and has been recently modified to be used across Melanesia and formally published by the SPREP (see Kinch, 2008b). Awareness activities were also conducted in major villages, smaller hamlets, fishers, and groups that were residing in fishing camps; these were also conducted in 'pidgin'.

In all, approximately 210 youths and adults (approximately 135 males and 75 females and their children) were either interviewed or provided information in formal or informal settings, as well as having awareness materials provided to them.



Map 2: Survey area



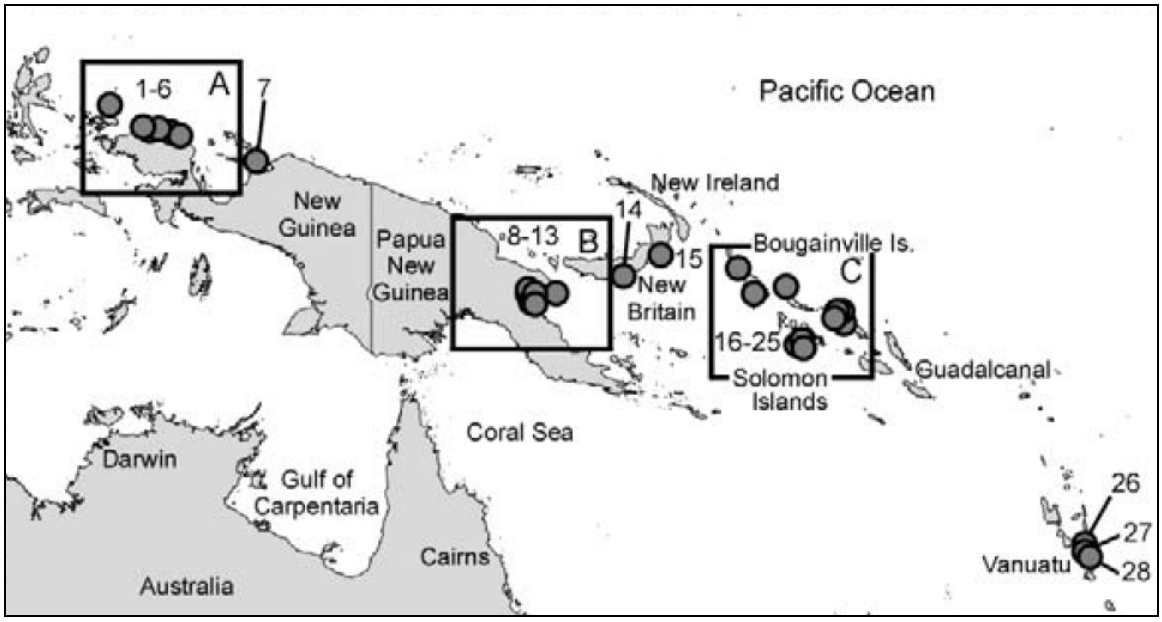
Map 3: Location of turtle nests (January 2007 aerial survey)

3. Results

3.1 Leatherback Turtle Nesting and Migration in Melanesia

In Melanesia, the main leatherback nesting beaches are located in the West Papua Province of Indonesia (Bhaskar, 1987; Petocz , 1987; Tomascik *et al*, 1997; Hitipeuw, 2003a; Hitepeuw and Maturbongs, 2002; Hitipeuw *et al*,2006, 2007; Maturbongs, 2000; Suganuma *et al*, 2005), PNG (Pritchard, 1979; Spring, 1982a; Quinn and Kojis, 1985; Quinn *et al*, 183, 1985; Bedding and Lockhart, 1989; Hirth *et al*, 1993; Spotila et al, 1996; Read, 2002; Kisokau, 2004; Kisokau and Ambio, 2005; Kinch, 2006; Pilcher, 2006, 2007, 2009), the Solomon Islands (Vaughan, 1981; Leary, 1990; Leary and Laumani, 1989; Dutton *et al*, 1999; Pita, 2005), and Vanuatu (Petro *et al*, 2007).

Results from recent aerial surveys and satellite telemetry conducted with support from NOAA has confirmed the importance of these areas within Melanesia as important leatherback nesting areas, and thus vital to the recovery of leatherback turtle populations in the Western Pacific Region (Map 4) (Benson *et al*, 2007; Dutton *et al*, 2007).

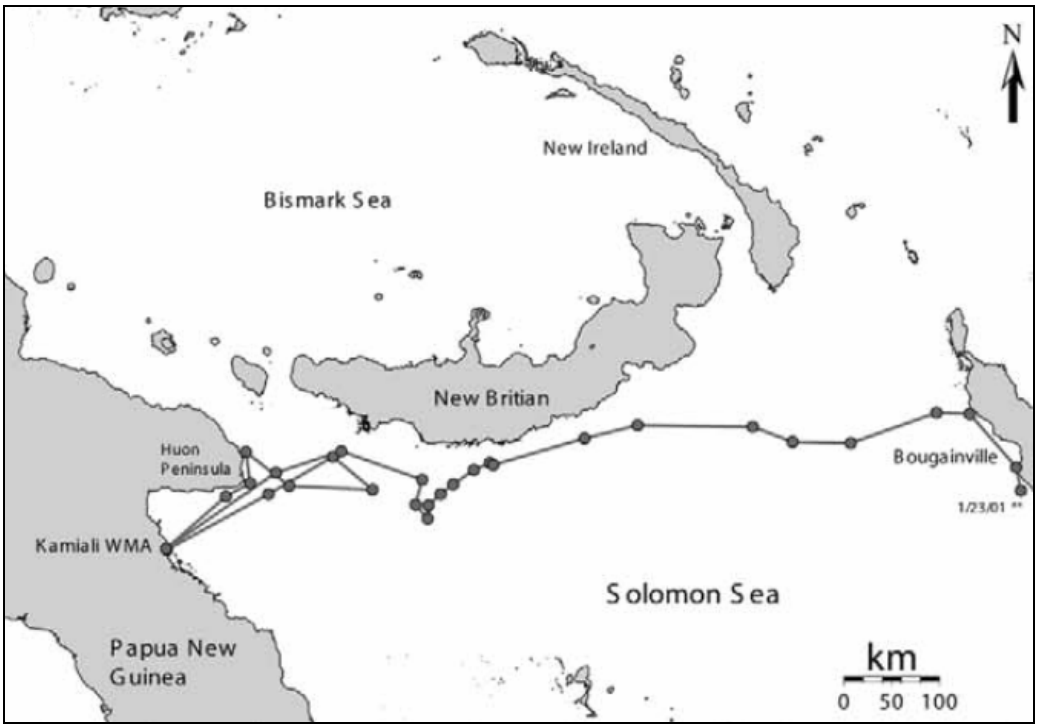


Map 4: Leatherback turtle nesting beaches in Melanesia (source: Dutton *et al*, 2007)

In PNG, leatherback nesting is more prolific along the north coast and around the large islands of New Britain and Bougainville (Benson *et al*, 2007) with the highest density nesting occurring on the Huon Coast in the Morobe Province (Kinch, 2006; Pilcher, 2006, 2007, 2009; Dutton *et al*, 2007). Nesting in Melanesia tends to begin in October with peak nesting in December to February and declining until April (Hirth et al, 1993; Kinch, 2006; Benson *et al*, 2007; Dutton *et al*, 2007), though nesting in West Papua appears to occur year round (Benson *et al*, 2007).

Genetic analysis also indicates that leatherback turtles that nest in PNG are part of a western Pacific meta-population that includes the Solomon Islands, and West Papua (Indonesia) (Dutton *et al*, 1999; Dutton *et al*, 2007). Satellite tagging programs of leatherback turtles from the Huon Coast have confirmed movement by nesters from the Huon Coast to Bougainville Island (Benson *et al*, 2007; Dutton *et al*, 2007) (Map 5). It is also thought probable that some leatherback turtles

nesting on Bougainville Island maybe coming from the Solomon Islands, though the extent of this is currently unknown (Dutton *et al,* 2007).



Map 5: Leatherback turtle migration from the Huon Coast to Bougainville (source: Benson *et al,* 2007)

3.2 Nesting

Dutton *et al* (2007) have estimated the number of leatherback turtles nests laid annually in Melanesia to be between 5067-9176 nests/year, with estimates for the ARB between 160-415 nests/year (Table 1). This latter figure was based on the 2007 aerial survey, with added compensation for any potential error. It is thus estimated that if leatherback turtles nest between 3-5 times/season, that this would equate to between 32-138 leatherback turtles possibly nesting annually on Bougainville Island.

Results from the recent survey recorded 46 leatherback nests and one false crawl (Map 6, Appendix C for details) at the peak nesting period (the aerial survey in 2007 reported 58 sea turtle nests for Bougainville Island). Using the same formula, this would thus give an estimate of the current total leatherback turtle nesting population from the recent survey for Bougainville Island at approximately 9-15 leatherback turtles nesting annually.

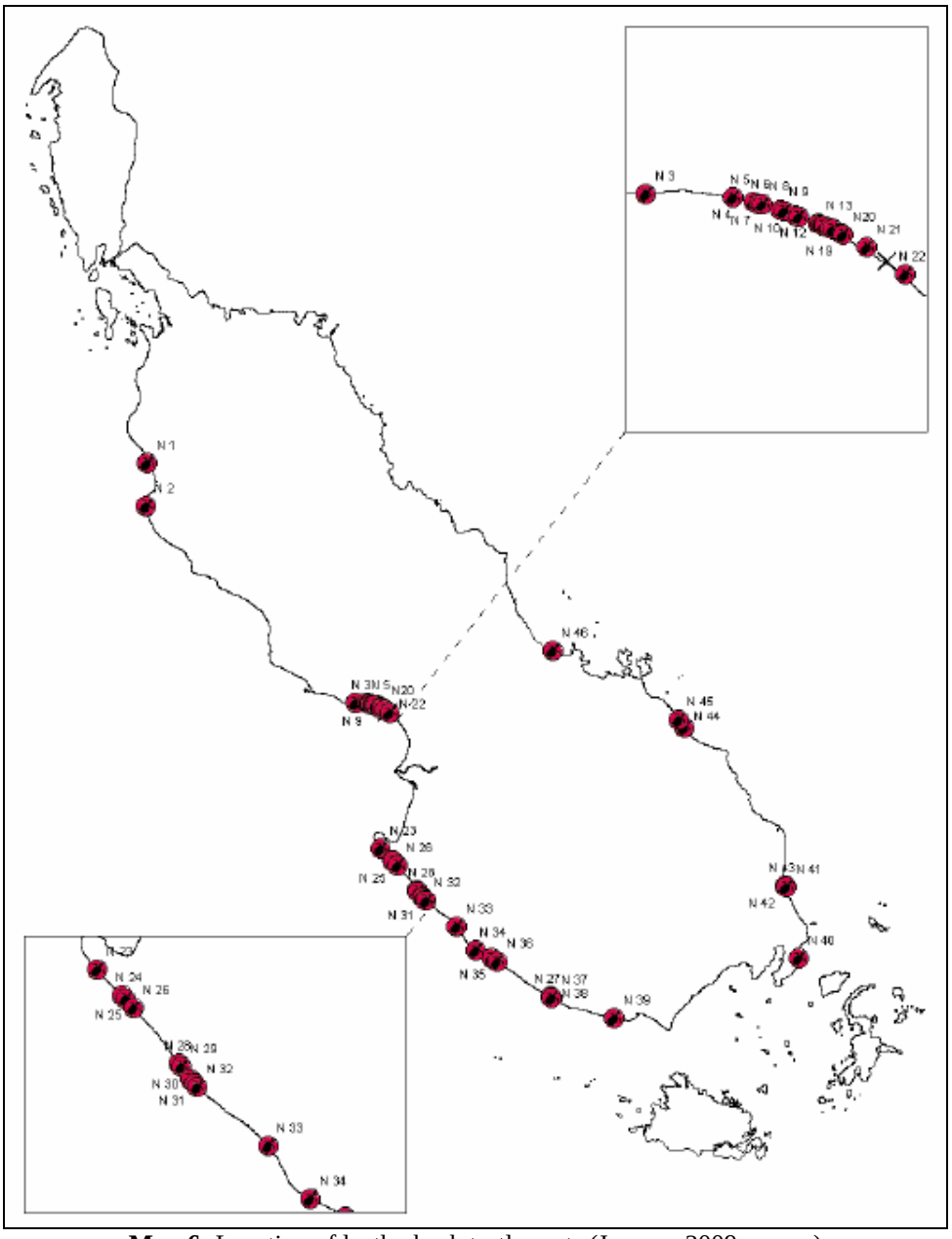
The highest concentration of leatherback turtle nesting was 19 nests and one false crawl located along a 5.4 km stretch between the villages of Papona and Naboi on the central west coast. The other main concentration was the beaches south of Mamarego Point. Leatherback turtles nesting in other areas were sparse and sporadic, due in part to unsuitable beach or offshore morphology.

Table 1: Estimated number of leatherback turtle nests laid annually in Melanesia

Location	**No. of Nests**
West Papua Province (Indonesia)	
Jambursba-Medi	1,865-3,601
Wermon	1,508-2,760
Papua New Guinea	
Huon Coast (Morobe Province)	500-1,150
New Britain Province	140-260
Autonomous Region of Bougainville	160-415
Solomon Islands	
Choisel Province	50
Western Province	123
Isabel Province	640-717
Vanuatu	31-50
Total	5067–9176

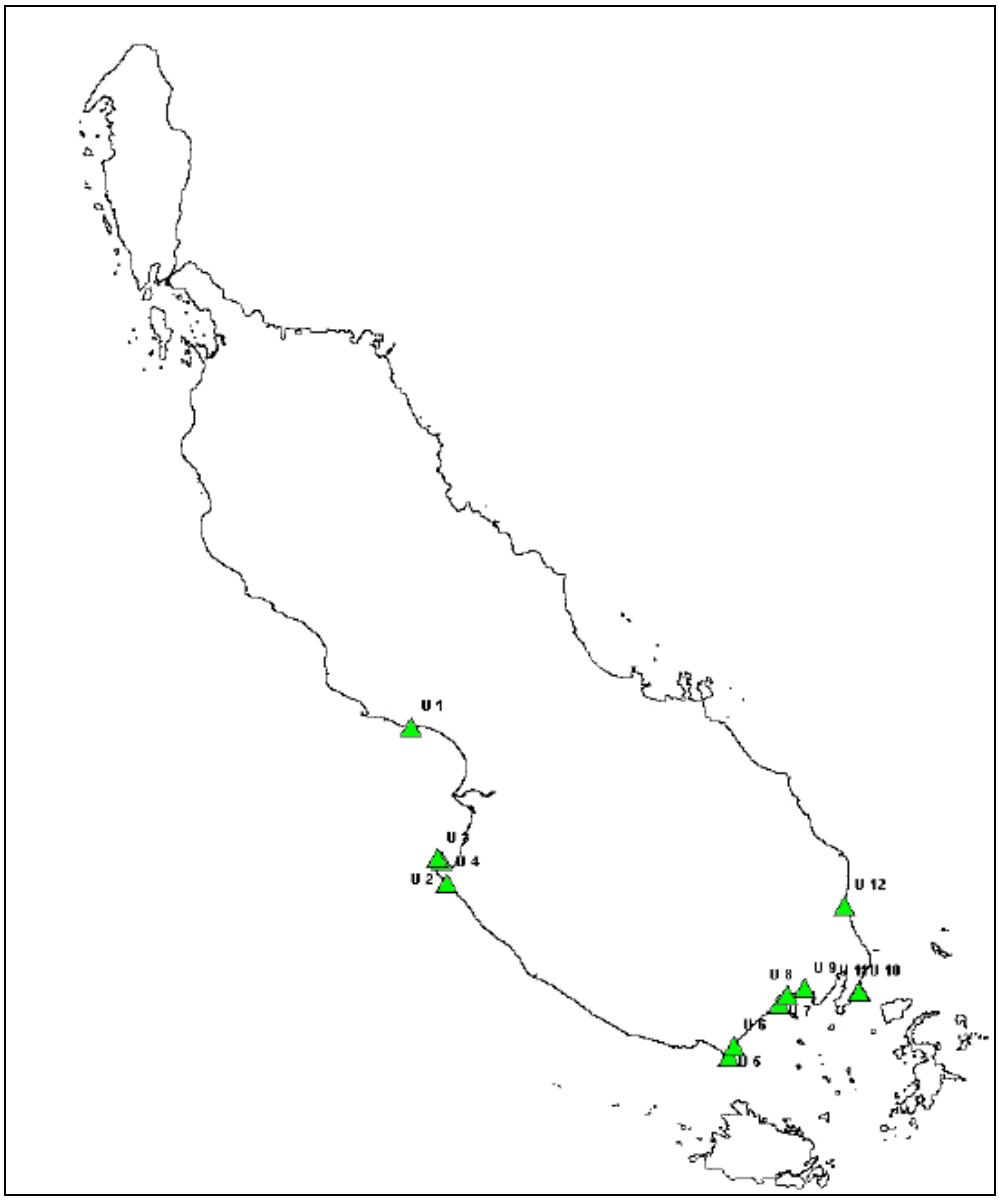
Source: Dutton *et al*, 2007.

Unfortunately, no leatherback turtles were encountered on any of the night walks, and subsequently it was not possible to do any tagging application or scanning with Passive Integrated Transponder (PIT) tags that had been supplied by NOAA, or collect any genetic samples. The leatherback turtle that made the false crawl near the village of Naboi was missed by a couple of hours. Overall, one would have had to be extremely lucky (i.e. in the right place at the right time) to come across a leatherback turtle nesting during the night, as mentioned above, leatherback turtles nesting was sparse and sporadic. Only four fresh tracks from the night before were observed during the survey.



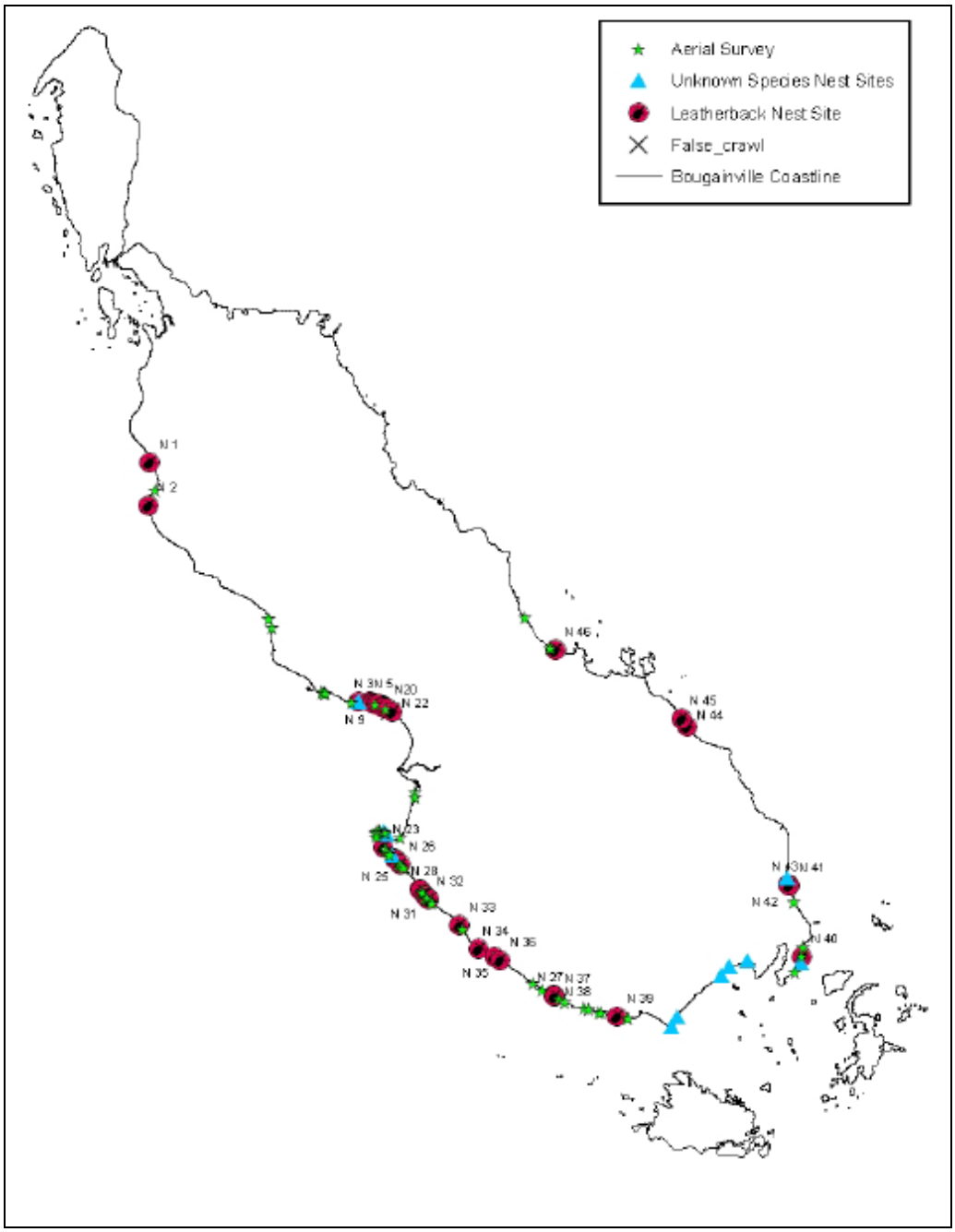
Map 6: Location of leatherback turtle nests (January 2009 survey)

A further 12 non-leatherback nests were also observed (Map 7). The latter were reported as green (n = 5) and hawksbill (n = 7) turtles due to nest size, location and beach morphology. The main concentration of these recoded nests were in the south of Bougainville Island, correspond with known nesting data for these species (see [http://stort.unep-wcmc.org/imaps/indturtles/viewer.htm]). Note that other sea turtle species' nests could have been laid in the north-east region of Bougainville Island, but because of the outer barrier reef structure that lies offshore this area of coast and the subsequent change in beach morphology, this area was not surveyed extensively as it is not suitable leatherback turtle nesting areas.



Map 7: Location of unidentified turtle nests (January 2009 survey)

When the results of the 2007 aerial survey and the recent survey are overlayed, there is consistency in nesting activity (Map 8).



Map 8: Overlay of January 2009 survey and 2007 aerial survey

3.1 Consumptive Use

In PNG, leatherback turtles and their eggs have been consumed in different areas of PNG (Pritchard, 1979; Spring, 1982a,b; Quinn *et al*, 1985; Lockhart, 1989; Hirth *et al*, 1993; Kinch, 2006). In some areas, they were part of the subsistence diet or were utilised in extending social relationships through trade. The only utilitarian use of leatherback turtles recorded in PNG is a mention that their oil was used in lamps in Manus (Pritchard, 1979), though it was reported during the recent survey that in the ARB, that oil rendered from leatherback turtles was used 'traditionally' to oil their wooden canoes.

3.1.1 Egg Harvesting

Leatherback turtle egg harvesting is widely practiced in Melanesia, partly because the beaches are also used as pathways for local people that go to and from their gardens, or to visit neighbouring residential areas, and because local fishers use the beaches at night to catch fish. Leatherback turtle eggs are consumed immediately after cooking or distributed through clan and kin networks upon harvesting. Some are occasionally sold in local or urban markets, such as Arawa or Buin, retailing for PGK 0.50/egg (particularly, when the Bougainville Copper Limited mine was operating at Panguna, and there was a greater circulation of cash within the community).

Of the 46 leatherback turtle nests recorded during the recent survey, 26 of these had eggs removed, while another 12 were presumed to have had their eggs removed, making a total of 83 % of all nests recorded having had eggs removed (Table 2). This latter assumption was based on the condition of the nest pit, and proximity to human habitation, or evidence of human presence or interference with the nest. Nests that had eggs taken usually had a stick or tree branch staked in or near the nest or sharpened sticks that had been used to probe the nest strewn nearby, or discarded egg fragments visible.

Table 2: Fate of leatherback turtle nests

Activity	No. of Nests	% of Total
Eggs taken	26	57
Presumed taken	12	26
Not taken	4	9
Unknown	4	9
Total	**46**	**100**
Total Taken	**38**	**83**

On one occasion, we happened upon a group of fishers that had harvested a leatherback turtle nest that morning, they removed 107 eggs, and left 21 rejects (Plates 2 and 3).

Plate 2: Harvested leatherback turtles eggs

Plate 3: Rejected leatherback turtle eggs

Of the unidentified (green and hawksbill) turtle nests, two were observed to have eggs removed with another eight presumed to have eggs taken, again making 83 % of all unidentified species nests having had eggs removed (Table 3).

Table 3: Fate of unidentified (green and hawksbill) turtle nests

Activity	No. of Nests	% of Total
Eggs taken	2	17
Presumed taken	8	66
Not taken	2	17
Total	**12**	**100**
Total Taken	**10**	**83**

3.1.2 Adult Take

Results of surveys and interviews with local inhabitants suggest that leatherback turtles have been taken on a relatively frequent basis by communities on Bougainville Island in the past (Table 4). Occasionally, leatherback turtle meat was cooked with vegetables and sold for PGK 10/packet at local and urban markets.

Table 4: Incidences of leatherback turtle take

Place	Comments
Sisiapa Beach	• People from the Sapaso Islands come and kill leatherback turtles occasionally. • During the 1980s, several were killed.
Torokina Station	• One leatherback turtle killed in 1998, an another in 1999.
Papona Village	• One leatherback turtle killed in 2001 for Easter celebrations.
Koiari Village	• One leatherback turtle killed last year in 2008.
Naboi Village	• One leatherback turtle killed in 2005.
Mamorego Village	• One leatherback turtle killed in 2007, there is now a prohibition in place on killing leatherback turtles, the man responsible was fined PGK 100 fine. • Three leatherback turtles were killed in the early 2000s.
Orava Village	• One leatherback turtle killed in 2008 [06.50.446/155.43.920].
Duse Beach	• Two leatherback turtle killed in 1999, one was found freshly killed by a crocodile and was subsequently butchered. • In 2001, five leatherback turtles were captured, two were slaughtered, while the other three died of exposure before they could be slaughtered. • One leatherback turtle killed in 2007.
Kangu Port	• During mine operations, people from the Solomon Islands would occasionally bring leatherback turtle (and other species) meat to sell at Buin market. • One leatherback turtle killed in 2007, another in 2008.
Roviana Village	• One leatherback turtle killed in early 2000s by inland ('bush') people looking for a change in their diet.
Aropa Airport area	• During the 'Bougainville crisis' in the early 1990s, members of the Bougainville Revolutionary Army from Siwai would come and shoot leatherback turtles and take them away in trucks for food. • One leatherback turtle killed in 2005.

The process of capture involves digging a pit next to the leatherback turtle that is on the beach and then tipping her over into it. She is then killed and butchered. On two occasions we were taken to 'kill' sites where a leatherback turtle had been killed the previous year.

3.2 'Traditional' Aspects

Leatherback turtles are a well recognised sea turtle species amongst the people of Bougainville Island, having several names in local languages. The leatherback turtle is called '*iboro*' in the Raboisi language, '*toneusu*' in Banonni, '*laulau*' in Siwai, '*muko*' in Terei, '*torowai*' in Naasioi, and '*torue*' in Teop (see Map 9 for language areas).

Map 9: Language groups of Buka and Bougainville Islands (source: www.Ethnologue.com)

During surveys, the leatherback turtle was only claimed as a totem animal by one clan in the north-west of Bougainville Island, and thus prohibited from consuming leatherback turtle meat and eggs. Interestingly, one group of inland ('bush') people at Duse, claimed that their migratory history from the Solomon Islands (originating from Vella la Vella) was assisted in their movements to Bougainville Island by using the backs of leatherback turtles as canoes. Despite, this ancestral support, there are no prohibitions on consuming leatherback turtle meat or eggs.

Local knowledge with regards to leatherback nesting was reported by informants to peak during the Christmas period, with hatchlings observed around the Easter period. Leatherback turtles were also reported to nest during stormy periods ("when there is lightning, there will be leatherback turtles coming up"), and also when pidgin cries, these are probably *Ducula* spp., which also nest in shoreline vegetation during the Christmas period.

3.3 Perceptions of Abundance

Leatherback turtles are currently listed on the International Union for the Conservation of Nature's Red List [http://www.redlist.org] and in Appendix I of the Convention on the International Trade in Endangered Species. Leatherback turtles were moved from Endangered to Critically Endangered on the Red List in 2000, following increased concern about population decline in the Pacific (Godley and Broderick, 2001).

Previous studies indicate that the numbers of leatherback turtles are decreasing in many areas of PNG (see Pritchard, 1982; Spring, 1982a,b).

Perceptions amongst villagers varied, but in general the consensus was that leatherback turtle numbers had declined within the last 30-50 years. Elderly informants at a large community meeting at Koiari Village reported remembering that 100-200 leatherback turtles would nest in any given year, when they were in their youth. A similar story was reported amongst elderly informants at Mamorego Village, whereby it was reported that around 30-40 leatherback turtles would come to nest annually during their youth.

Reasons for the decrease were unanimously given as wide-scale egg take and the killing of adult nesting leatherback turtle females.

3.4 Other Threats

3.4.1 Predation

Crocodiles (*Crocodilus porosus*) have been reported to occasionally kill leatherback turtles as they come up to nest (Rei *et al*, 2003; Hirth *et al*, 1993; Quinn *et al*, 1983; Kinch, 2006). Sharks have also been reported as a potential threat to both nesting adults and hatchlings (Hirth *et al*, 1993; Quinn *et al*, 1983).

One death by crocodile attack on a leatherback turtle was reported to have occurred on Duse Beach, south-west Bougainville Island in 1999.

Predators of leatherback turtle eggs include the monitor lizard (*Varanus indicus*), local dogs (*Canis familaris*) and ghost crabs. Dogs were regularly observed on beaches, particularly in fishing camps during the survey.

3.4.2 Climate Change

Climate change impacts are likely to exacerbate current threats to leatherback turtles (in fact, all sea turtles) in Melanesia. In a recent study on eastern Pacific leatherback populations by Saba *et al* (2007), their results showed that nesting leatherback turtles exhibited a strong sensitivity to El Niño Southern Oscillation (ENSO) events, the major climatic phenomenon that governs the overall inter-annual productivity of the equatorial Pacific (Chavez *et al*, 1999; Raskoff, 2001; Turk *et al*, 2001; Yáñez *et al*, 2001; Ruhl and Smith, 2004). Saba *et al* (2007) found that cool La Niña events corresponded with a higher remigration probability for leatherback turtles, while warm El Niño events corresponded with lower remigration probability; variable remigration intervals is thought to cause variable annual egg production, and subsequently, could render leatherback turtles more vulnerable to anthropogenic mortalities, particularly in places like the ARB, where adult nesting leatherback turtle females are taken as well as the majority of eggs. It should be noted that green turtles in the western Pacific have already shown sensitivity to ENSO that is reflected in their egg production, nesting numbers and their inter-nesting intervals (Limpus

and Nicholls, 1988, 1994, 2000; Lanyon *et al*, 1989; Miller and Limpus, 1991; Chaloupka 2001; Chaloupka and Limpus, 2001).

Increases in air and water temperatures could also alter the time of year when sea turtle nesting occurs could be drastically changed (Wesihampel *et al*, 2004; Poloczanska and Milton, 2006; Hamann *et al*, 2007). Evidence is also growing that changes in temperature due to climate change shift critical life events in many species including their breeding, feeding and migration cycles (El-Sayed *et al*, 1996; Hughes, 2000; Walter *et al*, 2002) and thus could have impacts for leatherback turtles and their preferred prey. Disease for some groups of marine species, including sea turtles is reported to increase with higher warming temperatures (Harvell *et al*, 1999, 2002; Lafferty *et al*, 2004).

Increased air temperatures will also affect embryo development through alterations to sex ratios in favour of females (Bull and Voight, 1979; Binckley *et al*, 1998; Booth and Astill, 2001; Freedberg and Wade, 2001, Chaloupka, 2002; Hays *et al*, 2003; Hawkes *et al*, 2007), phenotype, or through direct mortality (i.e. complete nesting failure). Some sea turtle nesting beaches are already reporting a strong female bias (Binckley and Spotila, 1998; Hays *et a*l, 2003; Glen and Mrosovsky, 2004) so if temperatures rise, the production of males may quickly be eliminated.

During La Niña, the South Equatorial Current (close to the equator) and the South Equatorial Counter Current along 5º S are particularly strong, varying the flow along the coasts of individual islands between El Niño and La Niña conditions. For example, using sea level and temperature measurements, Ridgway and Godfrey (1993) inferred large unprecedented changes to the flow and temperature of water through the Vitiaz Strait and along the coasts of New Ireland and New Britain Provinces in PNG during the 1982/83 El Niño event. Ridgway and Godfrey (1993) also reported variations of 45 cm in sea level height from tide gauge data on the New Ireland coast, and thus subsequent sea level rise in coastal areas.

Sea level rise is predicted to flood low coastal areas and accelerate erosion. Even a small rise in sea level could result in a large loss of beach nesting habitat as nesting beaches are inundated (Fish *et al*, 2005). An increase in cyclones can also produce adverse effects on leatherback turtle nesting beaches (see U.S. Fish and Wildlife Service, 1989).

The beaches on Bougainville Island are regularly subject to seasonal or storm-related erosion and accretion. Severe beach erosion can be observed around Bougainville Island, which was reported to have begun in the 1960s, but has accelerated since the 1980s. It is not known what is causing the reported sea erosion and whether it is related to changes in sea level, but severe erosion is evident by several Japanese bunkers and gun emplacements that are now located in the sea. Alternatively, in some places, landing craft from World War II are now located considerable distance inland as accretion as occurred.

Several leatherback turtle nests were reported lost at Papona in 2008 during to excessive high tides and wave action. Several other nests were observed to be inundated. At sites with excessive seasonal beach erosion and tidal inundation, eggs could be relocated to prevent destruction (see Dutton *et al*, 2005).

3.4.3 Fishing Impacts

While it has not been empirically linked to increased mortality of PNG leatherback turtles, long line fishing in the Pacific Ocean has been documented as a large threat to multiple stocks of leatherback turtles in the northern and southern Pacific oceans (see Spotila *et al*, 1996, 2000). Previous consultation with both the Secretariat of the Pacific Community and the PNG National Fisheries Authority show no records (based on observer reports) of leatherback turtle interaction with tuna fishing vessels in PNG's EEZ waters (Kinch, 2006).

While fishing is carried out by local fishers around Bougainville Island, this is mainly done by handline from small dugout canoes, or by beach gillnets. These could trap leatherback turtles, though no such interaction was reported, unlike a previous assessment of dugong mortalities conducted in the ARB (see Kinch, 2008a).

Benson *et al* (2007) and Rei (2005) have advocated the establishment of a large off-shore Marine Protected Area (MPA) within the Huon Gulf area that borders the eastern side of Bougainville Island. Rei (2005) has also called for all commercial fishing to cease in the Solomon Sea during the leatherback-nesting season and for commercial fishing operators to target the Bismarck Sea instead.

4. Conservation

4.1 Local Management

Traditionally, 'chiefs' in the ARB would implement bans or '*tambu*' on the harvesting of certain resources for a certain period of time. This was observed as a recent activity at Koiari Village, whereby villages had been prohibited from harvesting shellfish from the river and beaches. In general though, there does not appear to be any great concern over the fate of the leatherback turtle in Bougainville Island, particularly as people were well aware that they were the 'agent' of decline. There are however, some local initiatives that do show some conservation concern, though these efforts are a little misguided.

For example, the Catholic Minister, Father Louis at Koiari Village has told local villagers and their neighbours, that when they take leatherback turtle eggs from a nest, that they should leave some eggs so as to replenish the population. When several villagers were asked, "how many eggs they left when the harvested leatherback turtle eggs", most replied, "oh, three, maybe five". While this maybe considered a conservation measure, it is ineffective in the overall recovery of leatherback turtle populations in this area, as the given 'rule of thumb' is that at least 75 % of all eggs must remain to produce another hatchlings to keep a sustainable adult population.

At Mamorego Village, Chief John Simoke has placed a ban for the last 5 years on killing leatherback turtles. This ban was broken in 2007, when a man killed a leatherback turtle, and was subsequently fined PGK 100. The harvesting of leatherback turtle eggs has also been banned, though the harvesting of eggs from other sea turtle species , no taking of eggs, no killing of leatherbacks

In the Orava Village, Chief Amon Osi has also declared a '*tambu*' on the taking of leatherback turtles. This village is a Seven Day Adventist village, and is thus restricted under Leviticus 11: 9-12 of the Bible, which prevents the consumption of anything that lives in the water that does not have fins and scales. Interestingly though, this does not seem to apply to the consumption of sea turtle eggs.

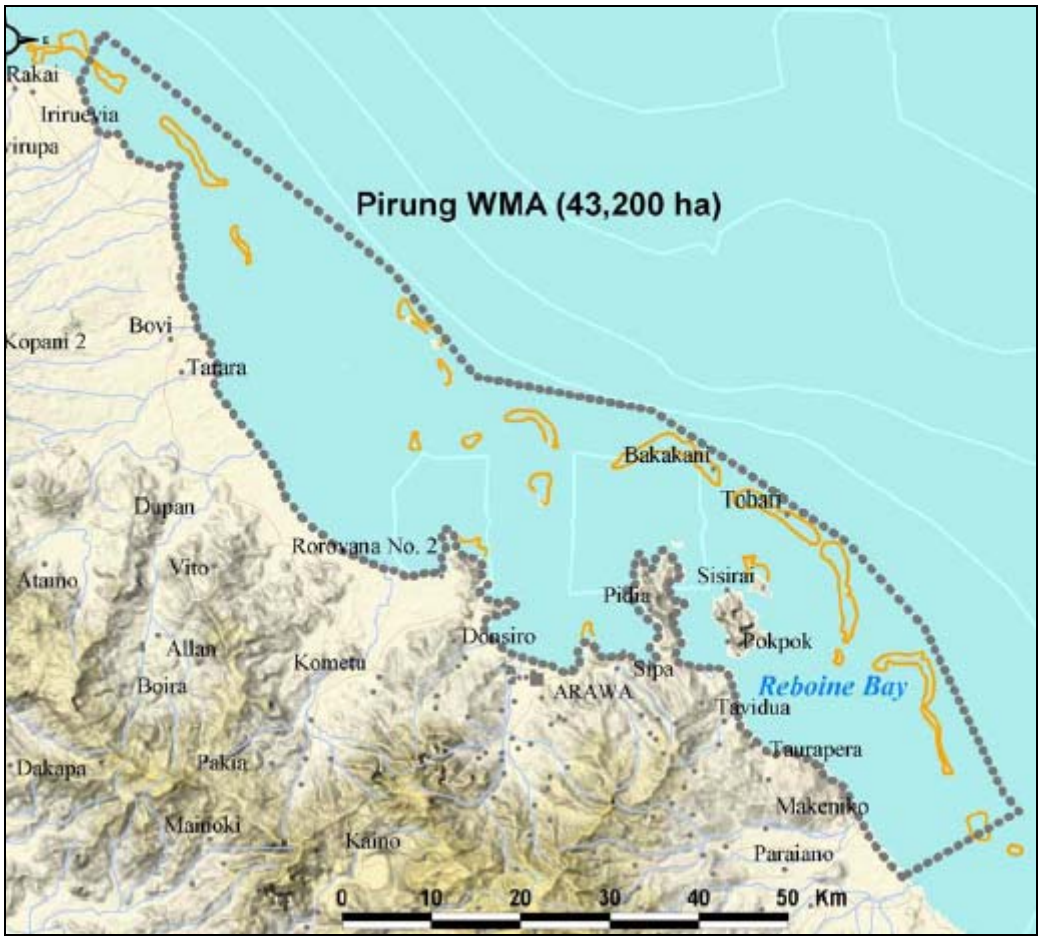
Apart from Mamerego Village, there was no awareness of any government legislation protecting the leatherback turtle. In PNG, the leatherback turtle is the only sea turtle on the protected species list under the 1976 *Fauna (Protection and Control) Act* (Kula and George, 1996).

4.2 National Legislation

As mentioned above, the leatherback turtle is currently the only sea turtle in PNG that is listed as 'protected fauna' under the 1976 *Fauna (Protection and Control) Act* (Kula and George, 1996), which stipulates that any person who knowingly buys, sells, offers or consigns for sale, or has in possession or control of a protected animal is guilty of an offence and the penalty is K 500. Any person who takes (kills) a protected animal, in contravention of a condition of a permit is guilty of an offence and the penalty is K 40/animal.

The 1976 *Fauna (Protection and Control) Act* also provides for the establishment of Sanctuaries, Protected Areas, and Wildlife Management Areas (WMAs) (see Appendix F). WMAs provide a mechanism for local control of fauna on land and in waters held under customary tenure, and have been the most used form of area-based conservation in PNG to date. In order to establish a WMA, the demarcation of social and spatial boundaries in consultation with DEC and LLGs is necessary, as well as the establishment of a Wildlife Management Committee by ministerial appointment and the drawing up of a schedule of rules and penalties is required.

The only protected area in the ARB is the Pirung WMA (declared in 1989); along the east central coast around Arawa, encompassing an area of some 43,200 ha (Map 10). The Pirung WMA was established to control resource access by non-customary people and to protect subsistence resources, including sea turtles.



Map 10: Pirung WMA (source: WWF-PNG)

Other pertinent conservation legislation in PNG that is applicable for leatherback turtle conservation and management include the *Conservation Areas Act* (1978) which also allows for a variety of protective regimes on land under customary tenure; *Organic Law on Provincial Governments and Local-level Governments* (1997) which regulates the respective rights and obligations of the various levels of Government in the field of resource management, and *Local-Level Governments Administration Act* (1997), Under Sections 42 and 44 provide avenues for local communities to draw up local-level conservation laws that could be used to establish beach closures and to regulate take; and the *Fisheries Management Act* (1998) and *Fisheries Management Regulation* (2000), which regulates the set-up of the NFA, the supervision of pelagic fisheries and local and species-specific fisheries management plans.

4.3 International Measures

There are currently several global instruments and regional agreements that PNG has agreed to that provide a legal framework for the conservation and management of leatherback turtles in the Western Pacific. These include the:

- *Convention on Wetlands of International Importance* (1971);
- *Convention on the International Trade of Endangered Species* (1973, and subsequent amendments);
- *Convention on the Conservation of Nature in the South Pacific* (1976);
- *United Nations Convention on the Law of the Sea* (1982), including the *Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea* (1994), and the *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (1995);
- *Convention for the Protection of the Natural Resources and Environment of the South Pacific Region* (1986); and the
- *Convention on Biological Diversity* (1992);

Leatherback turtles can be considered a trans-boundary resource because they cross multiple Economic Exclusion Zones (EEZs) during their life-cycle, which means that there are jurisdictional problems (Dutton and Squires, 2003). In 2006, the World Wide Fund for Nature developed a non-legal binding tri-national partnership Memorandum of Understanding (MOU) with government representatives from Indonesia (West Papua), PNG and Solomon Islands to devise options on how these countries could effectively manage and conserve nesting sites, feeding areas and migratory routes in and across these three countries for leatherback turtles Kinch, 2006; Wilson *et al*, 2006). This MOU has floundered since then, but may gather increased support under the Coral Triangle Initiative (Green and Mous, 2006; Newman, 2008).

4.4 Economic Incentives

Amongst the sea turtle conservation community, there is an increasing focus on using economic incentives or 'compensation' to protect leatherback turtle nesting beaches and to offset the opportunity costs of egg harvesting. For example, incentive payments for leatherback turtle conservation are already occurring in Rendovo and Tetepare Island in the Solomon Islands (Gjertsen and Stevenson, 2003), and at Jamursba Medi (Hitipeuw, 2003b; Hitipeuw and Pet-Seode, 2004) in West Papua, Indonesia; and the Huon Coast, Morobe Province, PNG (Wangi *et al*, 1988; Opu *et al*, 2003; Kinch, 2006; Pilcher, 2006, 2007, 2009).

There has also been significant debate over the benefits of economic incentives for motivating communities to either conserve or participate in leatherback turtle recovery projects. Economic incentives usually take either of form of 'indirect' incentives, whereby conservation generally encourages rural communities to maintain biodiversity by developing business opportunities and markets for products that are dependent on maintaining ecosystem services; or 'direct' (also called 'performance') payments, whereby payments are made directly to communities for the number of nests conserved or the number of hatchlings generated. Empirical and theoretical assessments have indicated that most of these approaches have been ineffective, however (Wells *et al*, 1998, James *et al*, 1999, Salafsky *et al*, 1999, Barrett *et al*, 2001, Ferraro 2001, Ferraro and Kiss 2002), though the use of direct performance payments to achieve conservation outcomes is increasingly being touted as an alternative to traditional regulatory and development-based approaches in low income nations (Ferraro, 2001, 2007a,b; Ferraro and Simpson, 2002; Ferraro and Kiss, 2002; Pagiola *et al*, 2005).

There are several obstacles, however to using direct incentives for sea turtle conservation, and even more so in PNG. These include uncertain land tenure and property rights, limited experience by communities (and conservationists) with enforcement of legal contracts (i.e. in order to strike a contract, results must be measurable and monitoring performance can be difficult), limited local opportunities for residents in remote areas without markets to turn cash or in-kind benefits into the commodities they need for survival (also transaction costs for an individual or community to protect an infrequently seen, migratory species can be quite high), the possibility of displacing biodiversity loss to other areas, the possibility of financial irregularities (i.e. corruption), and the possibility of creating social conflict and power differentials (Ferraro 2001, 2005, 2007a,b; Ferraro and Kiss 2002). Another issue that is often raised is the sustainability of the approach because direct payments require sustained financial commitment; there is no prospect of short-term investments generating long-term returns. Opponents claim that when funding is exhausted or payments stop, conservation efforts will also cease. Thus the use of direct incentives is often linked to discussions of endowed or trust funds (Ferraro 2001, 2007a,b; Ferraro and Kiss 2002).

Mandel *et al* (2008) suggest a slightly different tact, whereby 'environmental stewardship' can be created by capitalising environmental assets locally in a conservation trust and making that capital available to local communities through collateralised lending through microfinance approaches and access to affordable financial services (called 'environmental mortgages' or 'conservation lending') (see also Treong and Drews, 2004) through solidarity approaches that tap into existing social capital to encourage high repayment rates (see Pretty and Ward, 2001; Anderson *et al,* 2002), believing this could bridge the gap between cost-effective direct payments and long-term livelihood sustainability.

Initiating conservation activities in areas of perceived poverty is not easy. Even when initiatives are well accepted and implemented by communities, a fundamental need exists to build capacity over the long term, if efforts are to be sustained beyond the span of individual projects.

6. Conclusion and Recommendations

It is apparent that leatherback turtle resources in the ARB are under severe pressure, with implications for leatherback turtle nesting populations for the Huon Coast, Morobe Province, and possibly the Solomon islands due to implied connectivity between these areas, and the excessive egg take and the killing of adult nesting leatherback turtle females that is occurring on Bougainville Island.

If a recovery program was to be developed for the ARB, it would need to be concentrated on the 5.4 km stretch of beach between the villages of Papona and Naboi, as 19 leatherback turtle nests were reported here with 100 % egg harvesting, as well as the one false crawl. This stretch of beach therefore accounts for approximately 43 % of all leatherback turtle nesting activity on Bougainville Island. The second area of concentrated leatherback turtle nesting (n = 13) is the beaches south of Mamerego Point, covering an area of 34.7 km, this is too large an area to do anything overtly practical beyond education and awareness.

A simple program could probably be developed, with its base at Naboi, and it would be possible to build on the conservation efforts implemented by Father Louis for this area, combined with a more enforced '*tambu*' generated by the 'chief(s)'. It may also be possible to get The Nature Conservancy who is active in the ARB to support the Fisheries Section of the ARB's Administration's Division of Primary Industries to oversee conservation and recovery efforts.

Any further conservation and recovery efforts should employ the use of PIT tagging (McDonald and Dutton, 1996), possibly further satellite telemetry to determine inter-nesting movement and the extent of nesting areas used by individual females (see Dutton *et al*, 2007), and genetic material acquisition (see Dutton, 1996). This woul help determine the level of demographic independence between nesting areas within PNG and any connectivity with the Solomon Islands, and help to better define the units appropriate for management of leatherback turtles in this part of Melanesia.

Due to the isolated location of leatherback nesting areas on Bougainville Island and the poor state of the economy for local residents, any proposed intervention could also look at developing a 'direct' incentive style of program (see Section 4.4) as the engagement with communities is not going to result in a reduction in the take of leatherback turtle eggs alone, unless there is an improvement in the local economy, given the easy accessibility of harvesting them (and their value in dietary terms).

The implementation and use of bamboo grids to protect leatherback turtle nests, as they are used along the Huon Coast, Morobe Province (Kinch, 2006; Pilcher, 2006, 2007, 2009) should also be a priority to any further interventions. Signboards could also be erected at regular intervals along beaches between Papona and Naboi, as they have also been done along the Huon Coast which detail closure of egg takes, thus providing a visual incentive to do the 'right' thing.

An immediate step, however, should be a blanket education awareness progress, with regular radio programs on Radio Bougainville on the ecology and vulnerability of leatherback turtles in the ARB, wider PNG and the wider Western Pacific Region; and also details on the legislation that bans the sale and take of leatherback products (meat and eggs) under the 1976 *Flora and Fauna Act*; and the opportunities for supporting local conservation activities under the WMA section of the 1976 *Flora and Fauna Act*, but also the establishment of Ward or Local Level legislation under Sections 42 and 44 of the 1997 *Organic Law on Provincial Governments and Local-level Governments* (see Section 4.2).

Further printing of the handbook '*Leatherback Turtles: "Their Future is in Our Hands"'* (Kinch, 2008b) and wide-scale distribution to schools and communities in the ARB would also be beneficial. Use of this handbook at the primary school level, using the teaching topic 'research and discuss local endangered species of plants and animals' under the Environment and Resources section of Culture and Community would enhance children's appreciation of the difficulties facing leatherback turtles (Kinch, 2007).

It is known that depleted leatherback turtle populations can respond positively to relatively simple conservation strategies (e.g. St Croix, U.S. Virgin Islands; Dutton *et a*l, 2002, 2005), but for recovery to be effective in the ARB, successful intervention would require comprehensive and immediate action.

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Appendix A: Awareness Letter (translation is in *italics*)

AUTOMOUNOUS REGION OF BOUGAINVILLE
Division of Primary Industry
Fisheries Section

Ph: 973 9397
Fax: 973 9397
Email: ngpfish@datec.net.pg

P.O Box 96
Buka Passage
Autonomous Bougainville Region

The Duty Officer
Radio Bougainville – Maus Bilong Sankamap
P. O Box 35
Buka
Autonomous Bougainville Region

Dear Sir/Madam

Please relay this message through the radio 'toksave program" as quoted;

"Toksave igo long ol pipol long mainland Bougainville, Westcoast, Kunua/Keriaka na bihainim nambis igo long South Bougainville, ikam long Central Bougainville, Koromira, Kieta na ikam long Wakunai, Inus na Iaun village.

This message goes out to all the coastal people on the Bougainville mainland.

Bai igat wanpela wok painimaut or study, ol scientist bai ikarim aut long ol areas bilong yupela long lastpela tupela wik long dispela mun January stat long namba 17th igo inap long namba 30th dei.

There will be one study by scientists in your area from January 17th to the 30th.

Dispela study bai ilukluk long ol nambis we wanpela kain torosel oli kolim long Leather-back turtle isave kam na karim long en. Dispela em wanpela wok study tasol long luksave long ol dispela areas na tu long halivim yumi lukautim ol dispela ol resosis yumi gat long Bougainville.

This study is to identify leatherback turtle nesting areas, and to assist us in looking after all our resources of Bougainville.

Please harim na halivim ol I karim aut gut dispela wok ikamap long region bilong yumi. Toksave ikam long Fisheries Office hia long Buka",

Please help these scientists in their work. This message is from the Fisheries Office in Buka.

end of quote….

Thank you,

Jinro B Boisen
a/Fisheries Advisor

Appendix B: Coordinates for marine turtle nests from 2007 aerial survey

Nest No.	Longitude	Latitude
Nest 1	5 52.201	154 44.617
Nest 2	6 06.739	154 57.333
Nest 3	6 06.781	154 57.354
Nest 4	6 07.712	154 57.713
Nest 5	6 15.047	155 03.323
Nest 6	6 15.060	155 03.397
Nest 7	6 15.096	155 03.607
Nest 8	6 15.110	155 03.695
Nest 9	6 15.116	155 03.740
Nest 10	6 16.135	155 06.635
Nest 11	6 16.401	155 09.338
Nest 12	6 16.858	155 10.492
Nest 13	6 26.277	155 13.820
Nest 14	6 26.790	155 13.729
Nest 15	6 31.390	155 12.121
Nest 16	6 30.831	155 10.435
Nest 17	6 30.761	155 10.288
Nest 18	6 30.595	155 09.863
Nest 19	6 30.601	155 09.681
Nest 20	6 30.765	155 09.479
Nest 21	6 30.835	155 09.439
Nest 22	6 30.905	155 09.407
Nest 23	6 31.235	155 09.387
Nest 24	6 32.694	155 10.402
Nest 25	6 32.884	155 10.578
Nest 26	6 33.118	155 10.802
Nest 27	6 33.326	155 11.004
Nest 28	6 34.385	155 12.021
Nest 29	6 34.615	155 12.219
Nest 30	6 34.880	155 12.468
Nest 31	6 37.480	155 14.493
Nest 32	6 37.613	155 14.590
Nest 33	6 37.659	155 14.617
Nest 34	6 38.100	155 14.938
Nest 35	6 38.136	155 14.970
Nest 36	6 38.258	155 15.070
Nest 37	6 38.311	155 15.122
Nest 38	6 38.703	155 15.588
Nest 39	6 38.810	155 15.706
Nest 40	6 41.663	155 19.050
Nest 41	6 47.820	155 26.937
Nest 42	6 48.495	155 28.018
Nest 43	6 49.595	155 29.938
Nest 44	6 49.943	155 30.569
Nest 45	6 50.582	155 32.689
Nest 46	6 50.746	155 33.212
Nest 47	6 51.090	155 34.409
Nest 48	6 51.128	155 34.562
Nest 49	6 51.707	155 37.539
Nest 50	6 51.747	155 37.630
Nest 51	6 46.559	155 56.310
Nest 52	6 44.797	155 57.121
Nest 53	6 43.787	155 57.278
Nest 54	6 43.745	155 57.279
Nest 55	6 38.637	155 56.267
Nest 56	6 10.045	155 28.991
Nest 57	6 09.996	155 28.901
Nest 58	6 06.670	155 26.075

Appendix C: Survey results

Leatherback turtles: Nesting activity

Nest No.	Latitude	Longitude	Nesting Notes	Eggs Taken	Other Comments	Distance to Vegetation	Distance to Sea
Nest 1	5:49:11	154:44:03		Yes		2.2	6.1
Nest 2	5:54:03	154:43:53		Yes		0.8	7.4
Nest 3	6:16:07	155:07:21		Yes		16.2	5.8
Nest 4	6:16:11	155:08:40		Presumed		16.8	11.6
Nest 5	6:16:11	155:08:40	Nested week 2 of January	Yes		11.7	18.9
Nest 6	6:16:15	155:08:59	Nested week 1 of January	Yes	95 eggs laid with 5 returned to nest	17.0	12.2
Nest 7	6:16:17	155:09:04		Yes		7.4	11.8
Nest 8	6:16:17	155:09:06		Yes		4.1	12.6
Nest 9	6:16:22	155:09:23		Presumed		4.4	13.4
Nest 10	6:16:24	155:09:26		Yes	Shell fragments	6.1	10.7
Nest 11	6:16:27	155:09:37		Yes	Shell fragments	3.1	15.3
Nest 12	6:16:28	155:09:39		Yes	Shell fragments	3.6	15.1
Nest 13	6:16:35	155:09:57		Yes	Shell fragments	6.9	14.8
Nest 14	6:16:35	155:09:59		Yes	Shell fragments	9.4	11.6
Nest 15	6:16:36	155:10:01		Yes	Shell fragments	13.2	9.4
Nest 16	6:16:37	155:10:02		Yes	Shell fragments	9.4	17.4
Nest 17	6:16:39	155:10:07	Nested 19th of January	Yes	Shell fragments	11.0	12.8
Nest 18	6:16:40	155:10:10		Yes	Shell fragments	9.7	13.4
Nest 19	6:16:44	155:10:19		Yes	Shell fragments	17.3	6.2
Nest 20	6:16:45	155:10:20		Yes	Shell fragments	10.8	11.2
Nest 21	6:16:56	155:10:41		Presumed		2.8	7.0
Nest 22	6:17:20	155:11:16		Presumed		0.2	3.8
Nest 23	6:32:31	155:10:16		No	Undisturbed	0.6	3.2
Nest 24	6:33:49	155:11:31		No	Undisturbed	3.2	4.1
Nest 25	6:33:58	155:11:40		Yes	Shell fragments	4.5	4.0
Nest 26	6:34:24	155:12:04		No	Undisturbed	5.4	6.4
Nest 27	6:49:13	155:29:19		Unknown	Observed from boat		
Nest 28	6:37:11	155:14:19		Yes	Shell fragments	2.2	6.8
Nest 29	6:37:23	155:14:27	Nested in December	Presumed	Inundated	2.5	7.1
Nest 30	6:37:59	155:14:53	Nested in December	Presumed		0.6	7.3
Nest 31	6:38:14	155:15:06	Nested in December	Presumed		0.8	5.9
Nest 32	6:38:22	155:15:15	Nested in December	Presumed		1.2	5.5
Nest 33	6:41:19	155:18:47	From boat	Presumed	Observed from boat		
Nest 34	6:43:59	155:20:55	Nested 21st of January	Yes	Observed from boat		
Nest 35	6:44:52	155:22:41		Presumed	Observed from boat		

Leatherback turtles: Nesting activity continued

Nest No.	Latitude	Longitude	Nesting Notes	Eggs Taken	Other Comments	Distance to Vegetation	Distance to Sea
Nest 36	6:45:16	155:23:19		Presumed	Observed from boat		
Nest 37	6:49:16	155:29:25	Nested 22nd of January	Yes	107 eggs taken plus 21 rejects left at nest site	9.8	12.2
Nest 38	6:49:16	155:29:26	Nested 4th week of December	Yes		9.2	11.8
Nest 39	6:51:40	155:36:26		Presumed		13.9	7.9
Nest 40	6:44:55	155:57:06		Yes	Observed from boat		
Nest 41	6:36:52	155:55:41	Nested 3rd week of January	Yes		25.1	21.3
Nest 42	6:36:49	155:55:40	Nested 3rd week of January	Unknown	Inundated	24.3	21.1
Nest 43	6:36:45	155:55:37	Nested 23rd of January	No	Human footprints visible	25.6	22.2
Nest 44	6:19:00	155:44:19		Unknown	Partly eroded through inundation	0.2	5.1
Nest 45	6:18:05	155:43:34		Unknown	Partly eroded through inundation	0.3	4.7
Nest 46	6:10:16	155:29:28	Nested 3rd week of January	Yes	Shell fragments	1.2	6.3

Leatherback turtles: False Crawls

False Crawl.	Latitude	Longitude	Nesting Notes	Eggs Taken	Other Comments	Distance to Vegetation	Distance to Sea
FC 1	6:17:08	155:10:59	Attempted to nest on the 21st of January		False crawl	0.3	8.6

Unidentified turtles: Nesting activity

Nest No.	Latitude	Longitude	Nesting Notes	Eggs Taken	Other Comments	Distance to Vegetation	Distance to Sea
Nest U1	6:16:07	155:07:22		Presumed	Possibly Green	0.4	15.4
Nest U2	6:30:59	155:10:38		Presumed	Possibly Hawksbill	0.4	10.5
Nest U3	6:30:47	155:10:15		Presumed	Possibly Hawksbill	0.6	10.8
Nest U4	6:33:30	155:11:12		Presumed	Possibly Green	1.2	5.4
Nest U5	6:52:48	155:42:29		Presumed	Possibly Hawksbill	0.3	16.1
Nest U6	6:51:36	155:43:05		Presumed	Possibly Green	0.4	2.1
Nest U7	6:46:55	155:48:02		Presumed	Possibly Hawksbill	0.3	2.7
Nest U8	6:45:56	155:48:59		No	Possibly Green	0.3	4.9
Nest U9	6:45:15	155:50:57		No	Possibly Hawksbill	0.3	4.9
Nest U10	6:45:33	155:57:00		Yes	Possibly Hawksbill	0.4	4.3
Nest U11	6:45:31	155:57:01		Yes	Possibly Green	0.2	4.2
Nest U12	6:35:58	155:55:23		Presumed	Possibly Hawksbill		

Appendix D: Survey Form

Name of interviewee: …… Date: ……

Occupation: …… Reporter: …….

Age: <20; 20-35; 35-50; 50+ Location of interview: ……

Gender: Male / Female Village: ……

---

1. Have you seen adult leatherback turtles in this area? **Yes** **No**

- When did you last see a leatherback turtle? (*time of year or date)* ……
- Where did you see it? (*location name, description or mark on map*) ……..
  …...……
- Any time of the year when they are plentiful/few/none? (*location, month*) ……
- Any change in numbers from past years? (*more, less, same*) …….....
  …...……..

2. Have you seen leatherback turtle nesting in this area? **Yes** **No**

- When did you last see a leatherback turtle nesting? (*time of year or date)* ..……
- Where did you see it/them nesting? (*location name, description or mark on map*) ……....
  …….
- How many turtles usually come to nest during a nesting season? *(numbers)* …….
- Any change in numbers from past years? (*more, less, same*) …….....
  …...……..

3. Have you seen leatherback turtle hatchlings in this area? **Yes** **No**

- When did you last see a leatherback turtle hatchlings? (*time of year or date)* ……...
- Where did you see it? (*location name, description or mark on map*) …….
  …….
- What were they doing? (*i.e., emerging from nest, running towards the sea, swimming; etc.*) ……...
  ……...……..

4. Have people ever hunted leatherback turtles in this area? **Yes** **No**

- If yes, do they still hunt them now? **Yes** **No**
- How many leatherback turtles are taken here each year? …….
- When was the last time you ate a leatherback turtle? ……...……
- Was it for a special occasion? ...……
- Do people sell leatherback turtle meat? ……...……..…
- If yes, for how much? (*kina/parcel size).*…...…..…..…..……..

5. Have people ever taken leatherback turtle eggs in this area? **Yes No**

- If yes, do they still take them now? **Yes No**
- When/where do they collect leatherback turtle eggs? ……...
- How many leatherback turtle nests have eggs taken from them each year? ..……...
- When was the last time you ate leatherback turtle eggs? ……..
- Was it for a special occasion? ...……
- Do people sell leatherback turtle eggs? ...…….
- If yes, for how much? (*kina/egg).*…..…..…..…..…….

6. Are there any 'custom' stories about leatherback turtles in this area? ……..……..
…….
…….
…….

7. Are there any 'taboos' with regards to leatherback turtles in this area? ...…….
…….
…….
…….

8. Do you have any 'traditional knowledge' stories about leatherback turtles in this area? ……..
…….
…….
…….

9. Have you seen a change in leatherback turtle numbers over the years? Have numbers increased, decreased or stayed the same? When did you notice this change occur? ……..
…….
…….
…….

10. If numbers have increased/decreased, why have they changed? (*give your thoughts/reason*)
……..…
……..…
…….

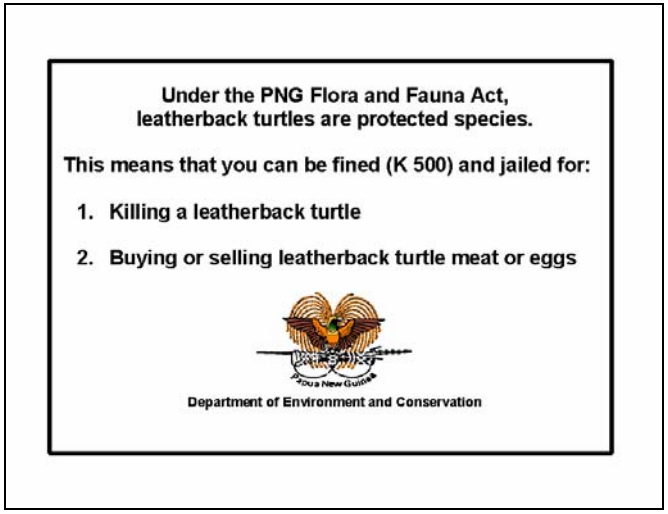
11. Are you aware of any laws that protect leatherback turtles? **Yes No**

12. Do you think leatherback turtles need to be protected? **Yes No**

13. Would you support protected areas for leatherback turtles where no taking and no egg harvest was allowed? …….
……
……
……

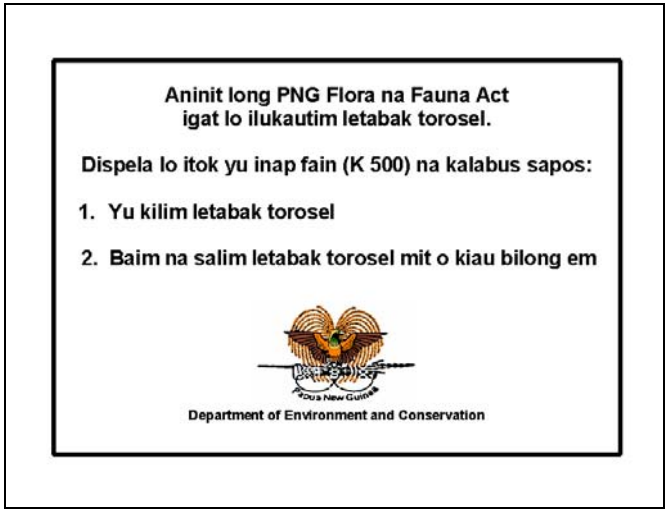
Appendix E: Awareness Materials

Handbook (200 copies)



Legislation sticker (English version) (150 copies)

Prohibition sticker (Pidgin version) (400 copies)



Legislation sticker (Pidgin version) (150 copies)

Appendix F: Excerpts from the 1976 *Fauna (Protection and Control) Act*

PART III.—PROTECTED FAUNA.

6. Declaration of protected fauna.

The Minister may, by notice in the National Gazette, declare any fauna to be protected fauna for the purposes of this Act.

7. Protected fauna vested in the State.

Subject to the regulations, all protected animals are the property of the State.

8. Killing, etc., protected fauna.

(1) Subject to this Act, a person who takes or kills any protected fauna or uses any explosive, dog, net or instrument or other means for the purpose of taking or killing any protected fauna is guilty of an offence.

Penalty: A fine not exceeding K500.00 for each protected fauna.(2) Subject to this Act, a person who takes or kills any protected fauna by use of a firearm within the meaning of the *Firearms Act* 1978 is guilty of an offence.

Penalty: A fine not exceeding K1,000.00 for each protected fauna.

9. Possession of protected fauna.

(1) Subject to Section 29, a person who knowingly buys, sells, offers or consigns for sale, or has in his possession or control, a protected animal is guilty of an offence.

Penalty: A fine not exceeding K500.00 for each animal in respect of which the offence has been committed.

(2) Subsection (1) applies whether or not the animal was killed, taken or brought in or received from a place outside the country.

(3) On the conviction of a person for an offence against this section in relation to a protected animal, the animal concerned shall be disposed of in such manner as the court that convicts him directs.

(4) It is a defence to a charge of an offence against this section if the accused person proves that at the time when it came into his possession the animal was lawfully obtained.

10. Permit to take protected fauna.

(1) The Conservator may, on the application of a representative of an approved organization issue to him a permit authorizing the taking of protected fauna in accordance with the permit.

(2) A permit under Subsection (1) may specify—

(a) the protected fauna that may be taken; and

(b) the numbers that may be taken; and

(c) the area within which the fauna may be taken; and

(d) such further or other conditions as seem necessary or desirable to the Conservator.

(3) A person who takes a protected animal in contravention of a condition of a permit under this section is guilty of an offence.

Penalty: A fine not exceeding K40.00 for each animal in respect of which the offence has been committed.

PART IV.—SANCTUARIES.

11. Declaration of sanctuaries.

(1) The Minister may, by notice in the National Gazette, declare an area to be a sanctuary for the purposes of this Act.

(2) In the notice referred to in Subsection (1) or in a subsequent notice in the National Gazette, the Minister may specify animals or classes of animals that may lawfully be taken or killed in the sanctuary.

12. Fauna not to be taken or killed in a sanctuary.

(1) Subject to this Act, a person who takes or kills in a sanctuary an animal other than an animal, or animal of a class, that is specified under Section 11(2) is guilty of an offence.

Penalty: A fine not exceeding K20.00 for each animal in respect of which the offence has been committed.

(2) In a prosecution for an offence against Subsection (1), the possession of an animal in a sanctuary by a person is *prima facie* evidence that that animal was taken or killed in the sanctuary by him.

PART V.—PROTECTED AREAS.

13. Declaration of protected areas.

The Minister may, by notice in the National Gazette, declare an area to be a protected area in relation to a species or class of animals specified in the notice.

14. Specified fauna not to be taken in a protected area.

(1) Subject to this Act, a person who takes or kills in a protected area a member of a species or class of animals specified under Section 13 in relation to the protected area is guilty of an offence.

Penalty: A fine not exceeding K20.00 for each animal in respect of which the offence has been committed.

(2) In a prosecution under Subsection (1), the possession in a protected area of a member of a species or class of animals specified under Section 13 in relation to the protected area is *prima facie* evidence that that prescribed animal was taken or killed in that protected area.

PART VI.—WILDLIFE MANAGEMENT AREAS.

15. Declaration of Wildlife Management Areas.

(1) Subject to Subsection (2), the Minister may, by notice in the National Gazette, declare an area to be a Wildlife Management Area for the purposes of this Act.

(2) Where the Minister intends to declare an area to be a Wildlife Management Area, he shall—

(a) consult, as far as is practicable, with the owners of the land within the area to be declared; and

(b) where the areas that he intends to declare is wholly or partly within the area of a Local-level Government, consults with that Local-level Government.

(3) Failure by the Minister to consult with a Local-level Government as required by Subsection (2) does not invalidate a declaration in made under this section.

16. Establishment of Wildlife Management Committees.

In the notice referred to in Section 15 or in a subsequent notice in the National Gazette, the Minister may, in his discretion—

(a) establish a Wildlife Management Committee for the area and specify the number of members of the Committee; and

(b) appoint persons to be members of the Committee; and

(c) specify the manner in which other persons may become members of the Committee; and

(d) specify a person or officer to be the agent of the Committee.

17. Rules for Wildlife Management Areas.

(1) Subject to Subsection (2), the Minister may, after consultation with a Wildlife Management Committee, make rules for the protection, propagation, encouragement, management, control, harvesting and destruction of fauna in the Wildlife Management Area for which the Committee is appointed.

(2) Where the Minister intends to make rules in respect of a Wildlife Management Area, he shall—

(a) consult, as far as practicable, with the owners of the land within the area to be declared; and

(b) where the area he intends to declare is wholly or partly within the area of a Local-level Government, consult with that Local-level Government.

(3) Without limiting the matters in respect of which rules may be made under Subsection (1), the rules may provide for—

(a) licenses to authorize persons to take or kill any animals; and

(b) fees for the licenses; and

(c) a scale or scales or royalties in respect of animals taken or killed in the Wildlife Management Area; and

(d) the disposal of fees and royalties.

(4) Failure by the Minister to consult with a Wildlife Management Committee as required by Subsection (1), or with a Local-level Government as required by Subsection (2), does not invalidate rules made under this section.

(5) A person who, without reasonable excuse (proof of which is on him), contravenes or fails to comply with a rule made under Subsection (1) is guilty of an offence.

Penalty: A fine not exceeding K20.00.

18. Functions of agent.

(1) Where the rules made for a Wildlife Management Area provide for the issue of licenses, the agent of the Wildlife Management Committee established for the area shall issue the licenses.

(2) The agent of a Wildlife Management Committee is responsible for receiving any license fees or royalty payments provided for under the rules.

(3) The agent of a Wildlife Management Committee shall account to that Committee for any moneys received by him under Subsection (2).

19. Agent not to receive remuneration, etc.

The agent of a Wildlife Management Committee is not entitled to receive any remuneration or allowance in respect of his duties as agent.