Papua New Guinea
Distribution, Threats and Conservation Prioirities

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Introduction

Of the seven sea turtle species that live in the world's oceans, six species are known to occur in the waters of Papua New Guinea's (PNG's) Economic Exclusive Zone (EEZ) which is estimated to be about 3,120,000 km^2 (Fig 1), with maritime borders shared with Australia, the Solomon Islands, Palau, and Indonesia (which also shares a land border). The six species of sea turtles that can be found in PNG include the following:

Green turtle (*Chelonia mydas*);
Hawksbill turtle (*Eretmochelys imbricata*);
Leatherback turtle (*Dermochelys coriacea*);
Loggerhead turtle (*Caretta caretta*);
Flatback turtle (*Natator depressus*); and
Olive Ridley turtle (*Lepidochelys olivacea*).

Sea turtles globally have a priority for conservation action through their listing in the respective texts or appendices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Other international instruments, including the United Nations Convention on Law of the Sea (UNCLOS), the FAO Code of Conduct for Responsible Fisheries, the International Convention for the Prevention of Pollution from Ships (MARPOL), and the Convention on Biological Diversity (CBD), are also relevant to the conservation of marine turtles and their habitats.

Across the world, 42 Countries and Territories permit the direct take of sea turtles which has been estimated to be in excess of 42,000 turtles per year with PNG accounting for an estimated 36 percent of this total or around 15,217 turtles per year, with mainly green turtles, small catches of hawksbill turtles and lesser numbers of the remain species (1). Limpus (2) previously thought that the harvest of green turtles in PNG was between 10,000-20,000 per year.

Sea turtle harvesting in the PNG is a traditional fishery undertaken by islanders for turtle meat and eggs for consumption and trade; utilitarian items such as needles and limes spatulas; decoration such as earrings and bracelets; and ceremonial purposes.

Inititial investigations into turtle population distribution and take first begun after 1975 in the post-Independence with surveys conducted by postal census or excursions to various Provinces around PNG (see 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) but these were largely anecdotal. In the late-1980s, market surveys and some ethnographic work were carried out in the Western and Gulf Provinces (see 13, 14, 15, 16, 17) with these surveys concentrating on green and hawksbill turtles. The most substantial assessments of nesting and take have occurred in the West Calvados Chain of the Milne Bay Province for green and hawksbill turtles (18, 19, 20, 21); and along the Huon Coast in the Morobe Province for leatherback turtles (22, 23, 24, 25; 26, 27; 28; 29, 30; 31, 32, 33, 34, 35, 36, 37, 38, 39, 40; 41, 42). Additional surveys for leatherback turtles have also occured on Lihir Island in the New Ireland Province (43), the now Autonomous Region of Bougainville (44) and the north coast of the Madang Province (45). In addition, a market survey of the hawksbill turtle shell (bekko) trade was conducted in major Provincial centres (46), and Rei (47) also conducted market surveys in three markets in the PNG Capital of Port Moresby.

Overall, an accurate estimate of take in PNG is complicated because the majority of harvesting is centred in remote areas, where little government presence is visible and subsequently, there have been no rigorous assessments of the impact of harvesting of turtles in PNG. Complicating things further, is that sea turtles are also taken across the jurisdictions of Australia, Indonesia, PNG and the Solomon Islands (1).

Subsequently, there is a large paucity of data on sea turtles in PNG regarding their nesting, foraging and migratory locations and estimates of harvesting levels of both turtles and their eggs.

Section 1. *Chelonia mydas* – Green turtle - Pacific Southwest (CM – PAC SW)

1.1. Distribution, abundance, trends

Green turtles are found widespread in the waters of PNG, but overall densities are unknown.

1.1.1. Nesting sites

Green turtles are known to nest across PNG, with Spring (9) citing several uninhabited island groups in Manus Province, and Long Island in the Madang Province as major nesting areas. Pritchard (11) visited several areas of PNG in the late-1970s and reported green turtle nesting to occur in the following locations:

East Sepik Province at Kwala Village, Wom Point, Musschu Island, Kairuru Island, Wuvulu Island, and Kaniet Island;

Manus Province at Tulu Village on the north coast, Ponam Island, Pak Island, Los Reyes Islands, Harengan Island, Bipi Island, and the Ninigo Group of Islands;

New Ireland Province in the Boloma Group of Islands; Emirau, Mussau, and Emananusa Islands; Eloaue Island, and the Tanga Islands;

West New Britian Province on the islands off Provincial Capital of Hoskins;

East New Britian at Nuguria;

Madang Province on the north coast and at Long Island; and in

Western Province along the whole coast.

Green turtle nesting areas identified in TREDS have more than 50 nesting records from Long Island in the Madang Province (n = 179) from surveys that were carried out on Long Island in 1980, 1981 and 1991 (48).

In the nothern end of the New Ireland Province, green turtles nest at Nago, Atmago, Nusalaman, Usen and Lemus Islands (49). In the past, green turtles also used beaches on Limanak, Limalam and Nusailas Islands to nest although they are no longer in use due to an increase in human populations on these islands and associated harvesting pressure (49).

The only detailed nesting program for green turtles has been in the West Calvados Chain and the Conflict Group in the Milne Bay Province (Fig 2). Kinch (18) recorded a total of 27 green turtle nesting crawls on Panayayapona Island during the period the 22nd-27th of January 2003 and eight green turtle nesting crawls on neighbouring Panadaludalu Island during the period of the 25th-27th of January 2003. Both of these islands are in the Jomard Passage area. Sixteen nests were successful deposited on Panayayapona Island and four nests were successfully laid on Panadaludalu Island.

Wangunu et al. (20) record a total of 120 adult green turtles encountered whilst nesting during a survey from the 1st-21st of December 2003 at the Conflict Group and Jomard Passage. In the Conflict Group, 20 nesting green turtles were recorded at Irai Island, 10 at Tobiki Island and 29 on Lunn Island. In the Jomard Passage area, 27 green turtles were recorded nesting at Panalailai Island, nine at Enivala Island and 25 at Panayayapona Island.

During a nesting survey in the Conflict Group of Islands from the 10th-20th of December 2009, Aigoma (21) notes nine green turtles tagged during that period, three at Irai Island, three at Reef Island No. 2, and three at Pananiu Island.

The Conflict Island Conservation Initiative located in the Conflict Group of Islands started a turtle monitoring program in 2017 with the aim are to create a baseline dataset on the population of green turtles resources in the Conflict Group of Islands. Surveys were conducted in the 2017-2018 and 2018-2019 nesting seasons but due to discrepencies in the collected data is not reported here.

1.1.2. Marine areas

Green turtles migrate large distances across the Pacific Islands Region. Green turtles tagged while nesting in New Caledonia have been recaptured as foraging turtles in PNG (50). Spring (9) reports five green turtles tagged on Long Island in the Madang Province that were later recaptured in the now West Papua Province of the Republic of Indonesia. Hirth (51) also reports of a green turtle tagged off Wuvulu Island in the East Sepik Province which was also later recaptured in West Papua.

From the Turtle Research and Monitoring Database System (TREDS) that is managed by the Secretariat of the Pacific Regional Environment Program, of the 27 green turtles recorded as tagged in French Polynesia, two were later recaptured in PNG; of the 29 green turtles tagged in the Federated States of Micronesia, one was later recaptured in PNG; of the nine green turtles tagged in the Republic of the Marshall Islands, three turned up in PNG (48). Tag recovery of a green turtle that was tagged initially in PNG was also reported from the Aru Islands in West Papua.

1.2. Other biological data

Genetic studies conducted on the Long Island green turtle rookery in the Madang Province is dominated by the A3 allele, which is common throughout the Pacific and also has the C7 allele, which is only known to occur in PNG, in low frequency (52).

During the survey conducted by Kinch (18) in the Jomard Passage area of the Milne Bay Province, Curved Carapace Length (CCL) and Curved Carapace Width (CCW) of green turtles encountered whilst nesting (n = 5) ranged from 102.5 to 109.5 cm and 92.5 to 103.0 respectively.

The mean CCL for green turtles encountered during the surveys conducted by Wangunu et al (20) in the Jomard Passage area and the Conflcit Group of Islands in the Milne Bay Province was 104.6 cm (range = 98.2 cm to 118.0 cm, n = 117) and the mean CCL for foraging turtles was 47.3 cm (range = 46.6 cm to 47.9 cm, n = 2).

1.3. Threats

As noted in the Introduction, harvesting of all sea turtles and their eggs within PNG is widespread and largely undocumented and difficult to accurately quantify.

Threats to green turtles in PNG include the increasing human population which advertently also places more people on the sea and in situations whereby green turtles will be encountered. Modernisation of equipment especially the use of the motorised canoe allowing for ease of access to nesting places or the ability to ‘ rodeo’ green turtles in the water. Technology is also contributing to the demise due to the ability now of better telecommunications to ring up and place orders especially during the end of year school closing and Christian celebrations over the Christmas and New Year period which also corresponds with the peak green turtle nesting season in most areas of PNG. Another contributing also, is the apparent breakdown of traditional beliefs in some areas and the increasing fluidity of local marine tenure arrangements. Taste preference also plays a part as people show a strong preference for large female turtles, especially breeding females because of their perceived better taste and higher fat content. Finally green turtles are occasionally caught in fishing nets during regular fishing activities (26).

1.3.1. Nesting sites

Levels of predation of green turtle nests are unknown at present for all of PNG, though it is considered to be widespread with eggs taken when nests are encountered. The exception to this is the research conducted by Jeff Kinch during his PhD anthropology fieldwork on Brooker Island in the West Calvados Chain of the Milne Bay Province during the years 1998-1999 whereby it was recorded that over the period from September 1998 to May 1999, a total of 371 green turtle nests had there eggs taken from the various islands within Brooker Islanders’ sea

territory with the most popular areas for harevsting being the Jomard Passage area including the Bramble Haven Group of Islands. Eggs are a constantly sought after food. Average turtle eggs per nest for green turtle was 123 (n = 22) equating to just over 45,600 green turtle eggs taken in one season by Brooker Islanders.

1.3.2. Marine areas

Previous estimates in the early-1990s, Hirth and Rohovit (17) suggested that approximately 6,000 green turtles were sold in coastal markets around PNG. Estimates of take for PNG side of the north eastern area of the Torres Strait Protected Zone in the Western Province, have reported a minimum harvest by the Kiwai people estimated at 953-1,363 turtles annually during the years of 1985-1987 with an estimated 94–98 % of this take being green turtles (15, 53). An independent study based in Tureture village on the western coast of Western Province during 1986 provides a larger estimate by almost double of the harvest by the Kiwai (14). This harvest centred and still does on Daru, the former Capital of the Western Province and villages along the adjacent coast.

During more recent assessements conducted in Daru by the Australian Commwealth Science and Industry Research Organisation, villagers in Daru were reported to have caught and sold at the Daru market an estimated 222 green turtles in the 2012-2013 season, which was lower than previous estimates (see above) with the greatest decline in catches being observed on the home-reefs around the PNG Islands and reefs adjacent to the villages (54). Previously, green turtles sold at the market in Daru were exclusively taken during dedicated hunting expeditions, while in 2012-2013 season, about 50 % of turtles sold were caught as by-catch during fishing trips whose main target were other species which aslo has a resultant change in harvesting technology from mostly using harpoons previously to a great use of nets (54). Green turtles recorded at the Daru market in the 2012-2013 season were only a small fraction of the total quantities of turtles that would have been hunted by PNG inhabitants along the Western Province coast. Stock composition of this PNG harvest in the Western Province is similar to that described for the Torres Strait Islands with approximately 90 % of the harvested green turtles originating from Queensland rookeries in northern Australian waters (55). During a survey in 1985-1987, Kwan (53) noted that 17 green turtles caught in the Western Province that were tagged at Raine Island, in the far north of Queensland in Australia.

In PNG's Capital of Port Moresby, Hirth and Rohovit (17) conducted a market survey at Koki Market. Unfortunately, they did not record actual numbers of green turtles sold, but noted that most of the green turtles sold in Koki Market and other smaller markets were caught in the vicinity of Fishermen's Island (17). During a four month survey from December 2008 to March 2009 in Port Morseby markets which were monitored three days per week, 166 green turtles were recored in December 2008, 58 in January 2009, 56 in February 2009, and 37 in March 2009, with the majority of these green turtles on sale being sub-adults or juveniles (47).

During Jeff Kinch's PhD anthropology fieldwork on Brooker Island in the West Calvados Chain of the Milne Bay Province during the years 1998-1999, it was recorded that over the period from September 1998 to May 1999, a total of 142 green turtles were taken from the various islands within Brooker Islanders' sea territory with the most popular areas for harevsting being the Jomard Passage area including the Bramble Haven Group of Islands.

1.4. Conservation

Green turtles are not protected in PNG despite their vulnerability to anthropogenic impacts during all life stages, as well as increasing impacts of human induced environmental change (e.g. climate changes, coastal developments, effluents and pollution).

The taking of green turtles by Papua New Guineans within Australia's EEZ (i.e. the Torres Strait Protected Zone) is allowed under the 1985 Torres Strait Treaty as long as they are traditional inhabitants of 'Treaty' Villages though each Party should to its best endeavours identify and protect fauna that are or may become threatened with extinction.

International intruments applicable to green turtles in PNG are listings on :
Appendix 1 of CITES, and
Appendices II of CMS.
Green turtles are also listed as Endangered (Criteria A2bd) on the IUCN Redlist.

1.5. Research

There is no systematic monitoring programmes to determine harvesting levels of green turtles or their eggs, their nesting or foraging sites.

Section 2. *Eretmochelys imbricata* – Hawksbill turtle - South West Pacific DPS (EI-PAC SW)

2.1. Distribution, abundance, trends

Hawksbill turtles are found widespread in the waters of PNG, but overall densities are unknown.

2.1.1. Nesting sites

Spring (7) reports that hawksbill turtles have been recorded nesting on Tabar and Anir Islands in the New Ireland Province. Pritchard (11) visited several areas of PNG in the late-1970s and reported hawksbill turtle nesting to occur in the following locations:

East Sepik Province at Laboin Island, Musschu Island, Kairuru Island, Wuvulu Island, and Kaniet Island;

Manus Province at Pak Island, Los Reyes Islands, Harengan Island, Paluwak Island, Bipi Island, and the Ninigo Group of Islands;

New Ireland Province in the Boloma Group of Islands; Emirau and Mussau Islands; and the Tanga Islands;

East New Britian at Nuguria;

Madang Province on the north and south coasts and at Long Island; and in

Western Province along the whole coast.

The TREDS database records one hawksbill turtle nesting in Wide Bay of East New Britian Province and one hawkbill turtle on Suau Island on the south coast of the Milne Bay Province (48).

The only detailed nesting program for green turtles has been in the West Calvados Chain and the Conflict Group in the Milne Bay Province. Kinch (18) recorded a total of eight hawksbill turtle nesting crawls on Panayayapona Island during the period the 22nd-27th of January 2003 and no hawksbill turtle nesting crawls on neighbouring Panadaludalu Island during the period of the 25th-27th of January 2003. Both of these islands are in the Jomard Passage area. Four nests were successful deposited on Panayayapona Island.

Wangunu et al. (20) record a total of 20 adult hawksbill turtles and two sub-asult hawksbill turtles encountered whilst nesting during a survey from the 1st-21st of December 2003 at the Conflict Group and Jomard Passage. In the Conflict Group, six nesting hawksbill turtles were recorded at Irai Island, and three on Lunn Island. In the Jomard Passage area, six hawksbill turtles were recorded nesting at Panalailai Island and seven at Panayayapona Island with two of these being sub-adults.

During a nesting survey in the Conflict Group of Islands from the 10th-20th December 2009, Aigoma (21) notes three hawksbill turtles tagged during that period, one at Irai Island and two at Pananiu Island.

The Conflict Island Conservation Initiative located in the Conflict Group of Islands started a turtle monitoring program in 2017 with the aim are to create a baseline dataset on the population of hawksbill turtles resources in the Conflict Group of Islands. Surveys were conducted in the 2017-2018 and 2018-2019 nesting seasons but due to discrepencies in the collected data is not reported here.

2.1.2. Marine areas

Nesting hawksbill turtles from the northern Great Barrier Reef in Australia are known to migrate to the Northern Territory, also in the Australia, to the southern coast of the West Papua Province of the Republic of Indonesia and to PNG (56). Hawksbill turtles that forage on the Great Barrier Reef migrate to neighbouring countries including Papua New Guinea, Vanuatu, and the Solomon Islands (56, 57).

TREDS records that one hawksbill turtles that was tagged in Samoa was later reported as a tag recovery in PNG; similarly, three hawksbill turtles that were tagged in Australia

were later reported as tag recoveries in PNG (48). Other tagging data shows that an adult female hawksbill turtle that was tagged at Kerehikapa in the Arnavon Group of the Solomon Islands in December 1976 was later killed on its foraging grounds at Fisherman's Island, Central Province, PNG in February 1979 (58). Similarly, other hawksbill turtles tagged at Kerehikapa in July 2001, was later found in mid-September 2001 on its foraging grounds at Tagula Island in the far south-eastern end of the Milne Bay Province. These tag returns show that hawksbill turtles in Australia, PNG and the Solomon Islands are a shared resource (56, 57).

More recently, in April 2016 and May 2017, The Nature Conservancy placed satellite trackers on 20 female hawksbill turtles that were nesting within the Arnavons Community Marine Park between Isabel and Choisel Islands in the Solomon Islands with 18 of these 20 turtles surviving the nesting seasons and migrating back to their foraging grounds (57). One turtle returned to its nearby foraging grounds in the Solomon Islands and one turtle returned to foraging grounds in the Milne Bay Province. The remaining hawksbill turtles migrated back to the Great Barrier reef and the Torre Straits Islands in Australia and of these hawksbill turtles, 50 % of them migrated through the Milne Bay Province before swimming across the Coral Sea to Australia, again highlighting the shared nature of these resources.

2.2. Other biological data

During the survey conducted by Kinch (18) in the Jomard Passage area of the Milne Bay Province, Curved Carapace Length (CCL) and Curved Carapace Width (CCW) for the one hawksbill turtle encountered whilst nesting was 83.0 cm and 71.5 cm respectively.

The mean CCL for green turtles encountered during the surveys conducted by Wangunu et al (20) in the Jomard Passage area and the Conflcit Group of Islands in the Milne Bay Province was 81.6 cm (range = 71.5 cm to 91.7 cm, n = 16) and the mean CCL for foraging turtles was 73.7 cm (range = 73.5 cm to 73.9 cm, n = 2).

2.3. Threats

As noted in the Introduction, harvesting of all sea turtles and their eggs within PNG is widespread and largely undocumented and difficult to accurately quantify.

Threats to hawksbill turtles in PNG include the increasing human population which advertently also places more people on the sea and in situations whereby green turtles will be encountered. Modernisation of equipment especially the use of the motorised canoe allowing for ease of access to nesting places or the ability to ' rodeo' hawksbill turtles in the water. Technology is also contributing to the demise due to the ability now of better telecommunications to ring up and place orders especially during the end of year school closing and Christian celebrations over the Christmas and New Year period which also corresponds with the peak hawksbill turtle nesting season in most areas of PNG, noting that hawksbill turtles are known to be in some instances poisonous (59, 60, 61). Another contributing also, is the apparent breakdown of traditional beliefs in some areas and the increasing fluidity of local marine tenure arrangements.

The main threat however to hawksbill turtles is the use of the shell in the 'bekko' trade for the production of jewellery, ornaments and other artefacts (46). There is a long history of hawksbill turtle shell being used by coastal and island villagers in PNG for a variety of utilitarian, decorative and ceremonial purposes. However, with the arrival of Eurpoeans, the use of hawksbill turtleshell became a valuable trade commodity between coastal and island and European traders.

Hirth and Rohovit (17) monitored several markets, hotels and supermarkets in Port Moresby for tortoiseshell products over 36 days from February 1989 to January 1990 with regular inspections at the Boroko Market saw on average one to six women vendors selling tortoiseshell earrings, bracelets and combs with unworked scutes and juvenile carapaces (unworked and polished) were also observed on rare occasions. At this time, the turnover in tortoise shell products was not considered high (17).

A more comprehensive survey of the hawksbill turtle shell trade across PNG was conducted by Jeff Kinch in May and August 2007 (46). The hawksbill turtleshell trade in PNG is centred on the manufacture of jewellery and motifs (decorative designs or patterns, such as Chinese dragons or bird-of-paradise) for domestic sale particularly targeting the international tourist market. In total, 1,437 hawksbill turtleshell products were observed for sale in retail outlets during this study with the majority being jewellery items (94.2%), particularly earrings (50.6%) and bangles (22.5%).

2.3.1. Nesting sites

Levels of predation of hawksbill turtle nests are unknown at present for all of PNG, though it is considered to be widespread with eggs taken when nests are encountered. The exception to this is the research conducted by Jeff Kinch during his PhD anthropology fieldwork on Brooker Island in the West Calvados Chain of the Milne Bay Province during the years 1998-1999 whereby it was recorded that over the period from September 1998 to May 1999, a total of 178 hawksbill turtle nests had there eggs taken from the various islands within Brooker Islanders' sea territory with the most popular areas for harevsting being the Jomard Passage area including the Bramble Haven Group of Islands. Eggs are a constantly sought after food. Average turtle eggs per nest for green turtle was 145 (n = 6) equating to 25,810 hawksbill turtle eggs taken in one season by Brooker Islanders.

2.3.2. Marine areas

During the 1970s and 1980s, several market surveys were conducted in PNG to determine the levels of trade in hawksbill turtles. Between February 1979 and December 1981, daily surveys at Koki Market in Port Moresby recorded a total of 154 hawksbill turtles for sale (unpublished data, cited in 62).

Kwan (15) estimated that from 1985 to 1987, Hawksbill Turtles accounted for 2-5 % of the catch in the turtle meat fishery in Daru, Western Province. During a longer-term survey in the New Ireland Province during the early-1980s, less than five percent of all marine turtles harvested for sale were Hawksbill Turtles (63).

In Milne Bay Province, between two and eight live juvenile Hawksbill Turtles were regularly cited on sale in the Alotau town market (18). During a four month survey from December 2008 to March 2009 in Port Morseby markets which were monitored three days per week, 23 hawksbill turtles were recored in December 2008, 10 in January 2009, four in February 2009, and six in March 2009, with the majority of these green turtles on sale being sub-adults or juveniles (47).

During Jeff Kinch's PhD anthropology fieldwork on Brooker Island in the West Calvados Chain of the Milne Bay Province during the years 1998-1999, it was recorded that over the period from September 1998 to May 1999, a total of 48 hawksbill turtles were taken from the various islands within Brooker Islanders' sea territory with the most popular areas for harevsting being the Jomard Passage area including the Bramble Haven Group of Islands.

2.4. Conservation

Hawksbill turtles are not protected in PNG despite their vulnerability of to anthropogenic impacts during all life stages, as well as increasing impacts of human induced environmental change (e.g. climate changes, coastal developments, effluents and pollution).

The taking of hawksbill turtles by Papua New Guineans within Australia's EEZ (i.e. the Torres Strait Protected Zone) is allowed under the 1985 Torres Strait Treaty as long as they are traditional inhabitants of 'Treaty' Villages though each Party should to its best endeavours identify and protect fauna that are or may become threatened with extinction.

International intruments applicable to green turtles in PNG are listings on :

Appendix 1 of CITES, and

Appendices II of CMS.

Hawksbill turtles are also listed as Ctitically Endangered (Criteria A2bd) on the IUCN Redlist.

2.5. Research

There is no systematic monitoring programmes to determine harvesting levels of hawksbill turtles or their eggs, their nesting or foraging sites.

The issue of vulnerability of hawksbill turtles and the relationships as a shared stock between various countries was highlighted in the 'Regional Hawksbill Crisis Workshop' which was organised by the Australian chapter of the World Wide Fund for Nature (WWF) in October 2016 (64). The outcomes of this workshop has resulted in a 'Bring Back the Hawksbills Partnership Prospectus' which is to be used as a blueprint to bring hawksbill turtles back from the brink of extinction in Australia and the Asia-Pacific region,

A PhD research program by Christine Hof of WWF started in 2018 and will look at identifying and describing the migration paths and foraging grounds of hawksbill turtles originating from major nesting sites in north-eastern Australia and PNG. The results of this research will then be used to address major threats impacting hawksbill turtles and provide recommendations for policy and conservation management outcomes and sustainable livelihood alternatives to protect hawksbill turtle populations in north-eastern Australia and PNG and to encourage recovery of hawksbill turtle populations.

Section 3. *Dermochelys coriacea* – Leatherback turtle - West Pacific DPS (DC-PAC W)

3.1. Distribution, abundance, trends

Leatherback turtles are found widespread in the waters of PNG, but overall densities are unknown.

3.1.1. Nesting sites

Leatherback turtle nesting in PNG has been reported to occur widely along the north coast of PNG in the East Sepik Province at Kwala Village, Wom Point, Aitape, Vanimo, and Ataliklikun Bay (11) and the Madang Province (11, 46); on the islands of the New Guinea Islands Region, these being Tulu Village on the north coast of Manus, Ponam Island, Rambuso Island, mainland coast opposite Harengan Island, and Lou Island in the Manus Province (11); on Tanga, Lambon Island, and the South Kapit Beach on Lihir Island in the New Ireland Province (Pritchard, 1978; 43); on the islands off Hoskins in the West New Britain Province (11); Kambubu Village, and the south Gazelle Coast in the East New Britain Province (11); the now Autonomus Region of Bougainville (29, 31, 44) and around Cape Pierson on north Normanby Island, Woodlark and Misima Islands, and near Vivigani Village on Goodenough Island in the Milne Bay Province (11). There have also been reported cases of leatherbacks nesting on the south coast of PNG (65). The largest leatherback nesting area however in PNG is along the Huon Coast of the Morobe Province and is thought to be the second largest nesting population in the western Pacific. All leatherback turtles that nest in PNG are likely to be from the western Pacific genetic stock that nests in northwest Papua, northern Papua New Guinea, the Solomon Islands and Vanuatu (29, 30, 31).

Along the Huon Coast, nesting beach surveys began at Labu Tali and Busama in the early-1980s. Quinn et al. (22) identified 286 nesting leatherback turtles at Maus Buang (a site approximately 2 km in length) between November 1982 and January 1983. Based on these results, they estimated that 15 turtles nest per night between Labu Tale and Busama, with a breeding female population estimated in the range of 1,250. Quinn and Kojis (24) and then Bedding and Lockhart (66) later estimated that 10 turtles nested each night from November to January between Labu Tale and Busama, with estimates of annual nesting ranging from 200-300 each year, respectively (extrapolated from an estimated 5 renesting events per season). Additionally, Hirth et al. (26) in his survey of 725 meters of beach at Labu Tale, during 15 days of December 1989, tagged 34 turtles and recorded 79 nests.

In the early-2000s, the Western Pacific Regional Fisheries Management Council (WPRFMC) bagan supporting a more intensive monitoing program under Huon Coast Leatherback Turtle Conservation Project (HCLTCP), which also involved other communities along the Huon Coast at Salus, Lababia (Kamiali), Paiawa, Sapa and Kobo Villages (Figure 3). The majority of nesting is located on beaches withing the Kamiali Wildlife Management Area (WMA) at Lababia Village. The total number of nesting females at the Kamiali WMA was reported to have ranged from 41 to 71 between 2000-2001 and 2003-2004, with an average inter-nesting interval of 11 days (29).

There are some caveats required in interpreting the variability in leatherback turtle monitoring efforts over the years. For instance, at Lababia (inclusive of the Kamiali WMA) the initial (1999 to 2004) data reflects a monitored beach length of only 1 km. In the 2004-2005 season this expanded to 2 km, and from the 2005-2006 season onwards a further 1 km, for a total of three. In the 2006-2007 and 2007-2008 season is was extended to approximately 6-8 km and then set at 7.48 km in the rest of the years up until 2013-2014 when moniroing ceased. The differences in length affects the counts of adults recorded, and thus an estimate of the number of turtles that might have nested. Similarly, the beach length at Busama increased significantly in 2006-2007 (more than double) and therefore the apparent increase in number of tracks could be misleading without acknolwedgeing these increases in beach monitoring length (33).

As noted above, aerial censuses of leatherback turtle nesting areas has been undertaken in PNG with assistance of the National Oceanic and Atmospheric Agency (NOAA). The

first of these aerial surveys was conducted along the north coast of PNG from the 13th-20th of January 2004, just after the peak of the austral summer nesting season. The area of coverage included the north coast of PNG, from the Indonesian border eastward through the West Sepik, East Sepik, Madang, and Morobe Provinces. Additional surveys were conducted along the entire coast of New Britain Island and the northeast coasts of Goodenough, Fergusson, and Normanby Islands in the Milne Bay Province (29). During this survey, nearly 2800 km of coastline was surveyed with 415 nests counted. Of these 415 nests counted, 71 % of nests were found along the Huon Gulf coast in the Kamiali WMA and Busama 'index' areas (29).

Another aerial survey was conducted during the period, 15th-21st of January 2005 whereby 284 leatherback turtle nests were counted over a distance of 2,692 km of coastline, including the Madang, Morobe, and Oro Provinces on the north coast of PNG, and the West and East New Britain Provinces, the Autonomous Region of Bougainville, and the south-western coast of the New Ireland Province (67). During this survey, 47 % of all nests recorded were found along the Huon Gulf coast, with 53 % of all nests recorded for this area being inside of the two index beaches at Busama and the Kamilai WMA. Outside of the Huon Gulf, the greatest nesting aggregations were encountered on south-facing beaches of New Britain Island with 54 nests recorded, while 41 nests were encountered at the previously unsurveyed Bougainville Island. A total of 1,195 leatherback nests were estimated for the surveyed area during entire the 2004-2005 season, after applying the error coefficients to the aerial survey results (67).

The only other area within PNG that has had any detailed survey work is the Autonomous Region of Bougainville. This survey was to essentially ground truth the result of previous aerial surveys undertaken during 2005-2007. The aerial survey on the 20th of January 2005 indicated that beaches on Bougainville Island accounted for about 14% of leatherback turtle nesting activity in PNG for this year with 41 nests recorded, with the survey on the 20th of January 2006 recording 107 nests, and the survey on the 11th of January 2007 recorded 57 nests (44) (Fig 4). Thus, leatherback turtle nesting on Bougainville Island represents a significant but variable proportion of total nesting activity during the austral summer.

From the 19th-26th of January 2009, Kinch et al (44) conducted a survey of 389 km of coastline by running parallel to the beach in a 23 ft fiberglass dinghy at a distance of 20-50 m at a speed of 8-15 km/h, depending on sea conditions. Of this 389 km, 38 km was surveyed physically by walking the beaches, and of this 38 km, 28 km was walked during the daytime, and 10 km was walked during night surveys (the distance is actually 20 km in total, because the return leg was over the same distance). A total of 46 leatherback nests and one false crawl were recorded during the survey, with the highest concentration of leatherback nesting located along a 5.4 km stretch between the hamlets of Papona and Naboi on the central west coast with 19 nests and the one false crawl recorded in this area and accounted for approximately 43 % of all leatherback turtle nesting activity observed on Bougainville Island during the survey (Fig 5). The second area of concentrated leatherback turtle nesting (n = 13) were the beaches south of Mamerego Point, covering an area of 34.7 km. Leatherback turtles nesting in other areas were sparse and sporadic, due in part to unsuitable beach or offshore morphology. When the results of the aerial survey and the physical survey are compared, there is consistency in locations of primary nesting activity (44).

3.1.2. Marine areas

Leatherback turtles are often sighted floating in the deep sea in PNG waters. Between 2001-2003, satelitte transmitters were attached to 19 leatherback turtles that had nested at the Kamiali WMA during consecutive nesting seasons. Nine were attached during December 2001, and 10 were attached during February 2003 (29). The distance travelled by these tagged turtles ranged from 123 to 9,438 km before the harnesses released or transmissions stopped with track durations ranging from 6 to 240 days (29).

Post-nesting leatherbacks initially travelled east and southeast once they had moved away from the Huon Gulf nesting beaches and out into the Solomon Sea. Most leatherback turtles that were harnessed with satellite transmitters moved in a route over the New Britain Trench,

moving southeast from the Solomon Sea and traversing the eastern edge of the Coral Sea as they continued to move in a south-eastern direction. Only six of the original 19 transmitters remained active to 20 degrees south latitude. Four of these six continued to move southeast between the islands of New Caledonia and Vanuatu, over the New Hebrides Trench, while two others moved in a southerly direction through the Coral Sea. Only one leatherback turtle continued into the high latitudes of the productive Southern Transition waters, where she remained for over five weeks before moving northward back into tropical latitudes with the track ending near the islands of Tonga (29; see also 68).

3.2. Other biological data

Steckenreuter et al (41) investigated the sex ratio of leatherback turtle hatchlings along the Huon Coast from January to March 2007. Results from this research showed that the leatherback turtle nesting population was predominantly producing male hatchlings throughout the peak of the nesting season. The long-term decline of leatherback nesting along the Huon coast, in conjunction with the highly male-biased sex ratio, presents serious challenges for the management and recovery of the western Pacific leatherback meta-population.

Appendix Tables 1-5 list details of leatherback turtle nesting under the WPRFMC supported HCLTCP from 2006-2013 (32, 33, 34, 35, 36, 37, 38, 39, 40).

From the monitoring surveys that were supported by the WPRFMC to the HCLTP (32, 33, 34, 35, 36, 37, 38, 39, 40), data on the size of nesting leatherback turtles and size of egg clutches is detailed in Appendix Tables 6 and 7.

During the WPRFMC's interventions along the Huon Coast, it is estimated that from 2006-2013, a total of 87,805 leatherback turtle hatchlings were successfully hatched in the areas where the HCLTP was active (see 32, 33, 34, 35, 36, 37, 38, 39 for annual estimates).

The HCLTCP during its time in operation obtained near-saturation tagging along the Huon Coast, though there was still some influx and steady encounters with previously-unrecorded nesters (Appendix Table 8) (33, 34, 35, 36, 37, 38, 39).

The average renesting interval for leatherback turtles nesting along the Huon Coast was has been estimated to be between 15 days (35) and 16 days (34).

Overall, the long-term data from the WPRFMC supported HCLTCP shows that leatherback turtles nesting in along the Huon Coast are able to nest over four consecutive seasons, with intervals being as short as ten and a half months between seasons; are able to lay at least two clutches per season; and can be reproductively active for at least nine years (37).

3.3. Threats

Human activities that threaten leatherback turtles populations directly or indirectly in the Western Pacific include human and animal take of eggs and/or turtles, destruction and modification of nesting habitats (e.g.: logging, mining, village and urban expansion), incidental mortality from fishing gears (longlines, coastal gillnets and trawls), pollution (e.g. ingestion of plastics and other synthetic material and toxins), disease, and insensitive tourism (28). In PNG, leatherback turtles have been consumed in different areas of Madang, Morobe, Manus, East Sepik, East New Britain, Milne Bay and Central Provinces (9, 10, 11, 69). In some areas, they were part of the subsistence diet or were utilized in extending social relationships through trade, but in general it appears that the consumption of leatherback turtles was not widely practiced because their oily flesh is considered unpalatable (23; Pritchard, 1979), although direct harvest does occur, as done incidental killings not for subsistence purposes. The only utilitarian use of leatherback turtles recorded in PNG is a mention that their oil was used in lamps in Manus (11).

Along the Huon coast, three leatherbacks were reportedly killed at Kobo in 2003; Ewa village, south of Kobo, killed at least 2 leatherbacks in 2005-06; Sapa village documented 17 adults killed from 2001 to 2005; two leatherbacks were taken in Maiama, one each in Salus and

Busama in 2006 (28). More recently, Pilcher (39) reports three leatherback turtles killed along the Huon Coast.

3.3.1. Nesting sites

Levels of predation of leatherback turtle nests are unknown at present for all of PNG. However, egg harvesting was/is however widely practiced, partly because the beaches where leatherback turtles nest 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. Previously all eggs laid along sections of the Huon Coast were taken soon after laying (22, 28).

Turtle eggs are either consumed immediately or distributed through clan and kin networks, or sold at market to generate income for things such as school fees, medical expenses, or church commitments (9, 10). In historical periods, egg exploitation along the Huon Coast would have likely had a reduced impact on the leatherback turtle populations, as the villages were small and scattered, with little access to markets. After World War II, egg exploitation increased, with leatherback turtle eggs changing from a protein supplement to a commercialized commodity, and it has been suggested that all turtle eggs laid along sections of the Huon Coast were taken soon after laying (22, 66, 70). For example, Quinn et al. (22) witnessed the harvest of all nests laid during their survey period. It is entirely possible that the leatherback population in PNG has experienced near total egg loss for some 40+ years.

Predators upon leatherback eggs include monitor lizards (*Varanus indicus*), local dogs (*Canis familaris*) and ghost crabs (*Ocypode cordimanus*). Predation by dogs occurs as the hatchlings are digging to the surface (two to three days after initial hatching as hatchlings are digging to the surface, but not after oviposition or during incubation). Crocodiles (*Crocodylus porosus*) have also been documented to occasionally kill leatherback turtles as they emerge to nest (22, 26, 71). One fatal attack by a saltwater crocodile on a leatherback was reported on Duse Beach, southwest Bougainville, in 1999 (44).

Along the Huon Coast in the Morobe Province, narrow nesting beaches are subject to seasonal or storm-related erosion and accretion cycles, resulting in leatherback turtle nests being lost. Rivers frequently breach at different times of the year at different sites and nests located close to the river bank and other natural drainage systems are exposed. Nests are also destroyed during high tides (11, 22). During the 2004-05 nesting season, approximately 40% of nests at the Lababia were lost to erosion (27). At Paiawa all nests laid were washed away during the 2005-2006 season, and erosion has continued to be an issue (28). During a 25-km beach survey undertaken during the period of the 20th-23rd of January 2006 from Labu Tale to Busama, many nests were observed to have been washed over in several locations, and considerable flotsam was observed covering nests, suggesting periodic inundation (28). In addition, strong storms and tidal surges have resulted in substantial erosion of nests and changes in beach shape, for example, much of the original Labu Tale monitoring section has now been lost to erosion (39).

Appendix Tables 9-11 list details of leatherback turtle nesting loss under the WPRFMC supported HCLTCP from 2006-2013 (32, 33, 34, 35, 36, 37, 38, 39, 40).

3.3.2. Marine areas

As noted in Section 4.1.2, leatherback turtles are often sighted floating in the deep sea in PNG waters. Pritchard (11) reports a leatherback turtle caught at sea off Mapua Island in the New Ireland Province. A female leatherback turtle with a carapace length of 147.5 cm was reported caught off Port Moresby in 1979 (17).

Given that the WPRFMC interventions on the leatherback turtle nesting beaches was to assist with recovery of the Hawaii-based longline fishery to reduce sea turtle interactions (28) it is probable that some leatherback turtles in PNG waters are also caught in the longline or purse-seine tuna fishery.

3.4. Conservation

The leatherback turtle is the only sea turtle in PNG that is protected under the 1976 Fauna and Flora Protection and Control Act (amended in 2014), 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 a penalty is K 500.00 (USD 152.00).

As the Huon Coast in the Morobe Province has the largest leatherback turtle nesting area in PNG, and given this area's proximity to Lae, the Morobe Provincial Capital, conservation initiatives were initiated at Busuama and Labu Tale in the early-1980s but lacked sufficient funding and commitment to maintain their objectives for more than a few years (24, 66).

At Lababia, more consistent efforts for conservation began in 1998 at the Kamiali WMA under the Kamiali Integrated Conservation Development Group (KICDG). In October 2003, following concern over the financial accountability by the KICGD, the WPRFMC rejuvenated conservation activities under the HCLTCP which began monitoirng and conservation activities in the Kamiali WMA and later expanded to incorporate other communities along the Huon Coast.

The HCLTCP employed a community-based approach which involve local communities in monitoring activities, beach management and conservation initiatives focussed on reducing nesting beach impacts and to optimize hatchling production and bolster leatherback turtle population recovery overall. Community incentives were also offered with support for specific projects within respective communities such as assistance with school or church activities and infrastructure.

Nest and hatchling protection measures were developed during the HCLTCP which involved the construction and deployment of locally-made bamboo grids over leatherback turtle nests which prevented predation by dogs and a disincentive to humans to harvest eggs, though egg harvesting continued in areas that were not under the HCLTCP. The bamboo grids are a low-cost solution to protecting nests, and have effectively bolstered hatchling production and population recruitment.

Operations of the HCLTCP was not easy with community conflict a continual concern (28). The dependence of participating communities relying on the WPRFMC also raised questions on the financial sustainability of these projects along the Huon Coast as nesting beach protection depends on long-term support with local communities. Unfortunately, looking down from a historical vantage point and viewing the present and looking towards the future, the WPRFMC will need to find long-term funding or provide input into the development of a trust fund to ensure leatherback turtle recovery projects along the Huon Coast continue, because there is a real risk that when the funding for the leatherback turtle recovery projects run out or if the WPRFMC focus changes, so will the participation from the communities.

This is in fact has happened and the HCLTCP stopped moniroing in 2013 due to funding issues and increasing community conflict over both economic opportunities from the program but also a finer demarcation of tenureship boundaries on beaches where monitoring was occurring.

For example, Pilcher (38, 40) reports that at Busama and Labu Tale, the community cut down on their beach length in response to the reduced incentive, and the reduced coverage resulted in nesting events being missed and a reduction in the quality and quantity of data recorded. Reduction in effort by communities due to reduced incentives, also resulted in a substantial number of leatherback turtle nests being poached by outsiders and neighbouring villages along participating project beaches, and it is becoming harder for the communities involved in the project to deal with the incoming groups of people using the coastline. In addition to this is increasing conflict amongst different groups migrating to the coast, in part due to growing human populations. Adding to all this is more civil unrest and land disputes.

International intruments applicable to leatherback turtles in PNG are listings on :
Appendix 1 of CITES, and
Appendices II of CMS.

Leatherback turtles are also listed as Endangered (Criteria A2bd) on the IUCN Redlist.

3.5. Research

Given the difficulty of enforcing species specific conservation regulations in PNG and the lack of resources by the PNG Government to operate effectively, recovery measures for leatherback turtles will continue to lay with communities with support from external agencies. However for leatherback turtle conservation projects such as those funded by the WPRFMC in PNG adequate capacity, awareness and funding needs to be made available. Factors that needs to be considered include the institutional capacity of communities and external agencies to regulate both consumptive and non-consumptive use, as well as the cultural and social impacts of any interventions, and the overall economic importance of leatherback turtles that nest in the territorial domain of participating communities.

Section 4.: *Caretta caretta* – Loggerhead turtle - South Pacific DPS (CC-PAC S)

4.1. Distribution, abundance, trends

Data not available.

4.1.1. Nesting sites

Data not available.

4.1.2. Marine areas

A loggerhead turtle tagged while nesting on Mon Repos on the southern Queensland coast in Australia in January 1969 was recovered 63 days later in the Trobriand Islands in the Milne Bay Province (72). Other tag recoveries recorded in TREDS shown that four post-nesting females initially tagged in Queensland, Australia was later reported as tag recoveries in PNG with the suggestion that the Milne Bay Province is used as a foraging ground for loggerhead turtles originating from Australia (48).

4.2. Other biological data

Data not available.

4.3. Threats

As noted in the Introduction, harvesting of all sea turtles and their eggs within PNG is widespread and largely undocumented and difficult to accurately quantify.

4.3.1. Nesting sites

Levels of predation of loggerhead turtle nests are unknown at present for all of PNG.

4.3.2. Marine areas

Pritchard (11) reported one loggerhead turtle collected at Tabayari Reef and sold at Daru Market in Western Province. In the 1985-1987 survey, Kwan (53) noted two loggerhead turtles that were caught in Western Province waters were originally tagged at Mon Repos and Wreck Island in Queesnsland, Australia respectively.

4.4. Conservation

Loggerhead turtles are not protected in PNG despite their vulnerability of to anthropogenic impacts during all life stages, as well as increasing impacts of human induced environmental change (e.g. climate changes, coastal developments, effluents and pollution).

The taking of loggerhead turtles by Papua New Guineans within Australia's EEZ (i.e. the Torres Strait Protected Zone) is allowed under the 1985 Torres Strait Treaty as long as they are traditional inhabitants of 'Treaty' Villages though each Party should to its best endeavours identify and protect fauna that are or may become threatened with extinction.

International intruments applicable to loggerhead turtles in PNG are listings on :

Appendix 1 of CITES, and

Appendices II of CMS.

The South Pacific Sub-population of loggerhead turtles is also listed as Critically Endangered (Criteria A2b) on the IUCN Redlist.

4.5. Research

There is no systematic monitoring programmes to determine harvesting levels of loggerhead turtles or their eggs, their nesting or foraging sites.

Section 5.: *Natator depressor* – Flatback turtle - Southwest Pacific DPS (ND-PAC SW)

5.1. Distribution, abundance, trends

Data not available.

5.1.1. Nesting sites

Flatback turtles are thought to nest only in Australia and forage over the Australian continental shelf into continental waters off PNG and Indonesia (9), however, Pritchard (11) reports flatbback turtles nesting at Vanimo in the East Sepik Province.

5.1.2. Marine areas

Post-hatchlings and young juveniles of flatback turtles are reported to remain on the Australian continental shelf from Hervey Bay to the Torres Strait in Queensland and up to the Gulf of Papua in PNG (73), however, Pritchard (11) reports sightings of a flatback turtle off Pak Island in the Manus Province.

5.2. Other biological data

Data not available.

5.3. Threats

As noted in the Introduction, harvesting of all sea turtles and their eggs within PNG is widespread and largely undocumented and difficult to accurately quantify.

The only major reported threat for flatback turtles are entanglement with fishing nets used in the prawn fishery in the Gulf of Papua in PNG (9, 11).

5.3.1. Nesting sites

Data not available.

5.3.2. Marine areas

In a 1985-1987 survey in Daru of Western Province, Kwan (53) noted flatback turtle being caught with estimates of maybe 18 flatback turtles being caught each year (74, 75).

During a four month survey from December 2008 to March 2009 in Port Morseby markets which were monitored three days per week, two flatback turtles were recored in March 2009 (47).

5.4. Conservation

Flatback turtles are not protected in PNG despite their vulnerability of to anthropogenic impacts during all life stages, as well as increasing impacts of human induced environmental change (e.g. climate changes, coastal developments, effluents and pollution).

The taking of flatback turtles by Papua New Guineans within Australia's EEZ (i.e. the Torres Strait Protected Zone) is allowed under the 1985 Torres Strait Treaty as long as they are traditional inhabitants of 'Treaty' Villages though each Party should to its best endeavours identify and protect fauna that are or may become threatened with extinction.

International intruments applicable to flatback turtles in PNG are listings on :

Appendix 1 of CITES, and

Appendices II of CMS.

Flatback turtles are also listed as Data Deficient on the IUCN Redlist.

5.5. Research

There is no systematic monitoring programmes to determine harvesting levels of flatback turtles or their eggs, their nesting or foraging sites.

Section 6.: *Lepidochelys olivacea* - Olive Ridley - West Pacific DPS (LO-PAC W)

6.1. Distribution, abundance, trends

Data not available, but is likely that there are shared olive-ridley stocks between Australia, Indonesia and PNG (76).

6.1.1. Nesting sites

Spring (9) has reported olive-ridley nesting sites the East Sepik, and the East and West New Britain Provinces.

6.1.2. Marine areas

Olive-ridley turtles have been reportedly sighted off Pak Island in the Manus Province (11) and in the waters of the Autonomous Region of Bougainville, the Milne Bay, and East and West New Britain Provinces Provinces (Spring, 1982).

6.2. Other biological data

The digestive tract of a olive-ridley turtle that had been drowned in a prawn trawl was examined by Spring and Gwyther (77). It had a CCL of 70.0 cm and a CCW of 50.0 cm and weighed 31 kg. The digestive tract under examination contained mainly shell material of which more than 98 % was gastropod shells. Of the gastropods, three species made up 96 % of the shell material in the digestive tract, these were Nassarius crematus, Nassarius vitiensis, and Turris crispa. Many of the intact gastropod shells (10 % of shell weight), and in particular those of Nassarius spp. contained the hermit crab Diogenes pallescens.

6.3. Threats

As noted in the Introduction, harvesting of all sea turtles and their eggs within PNG is widespread and largely undocumented and difficult to accurately quantify.

The only major reported threat for flatback turtles are entanglement with fishing nets used in the prawn fishery in the Gulf of Papua in PNG (9, 11, 77).

6.3.1. Nesting sites

Data not available.

6.3.2. Marine areas

Kinch and Burgess (46) report one olive-ridley carapace for sale in Madang Market in the Madang Province.

6.4. Conservation

Olive-ridley turtles are not protected in PNG despite their vulnerability of to anthropogenic impacts during all life stages, as well as increasing impacts of human induced environmental change (e.g. climate changes, coastal developments, effluents and pollution).

The taking of olive-ridley turtles by Papua New Guineans within Australia's EEZ (i.e. the Torres Strait Protected Zone) is allowed under the 1985 Torres Strait Treaty as long as they are traditional inhabitants of 'Treaty' Villages though each Party should to its best endeavours identify and protect fauna that are or may become threatened with extinction.

International intruments applicable to olive-ridley turtles in PNG are listings on :

Appendix 1 of CITES, and

Appendices II of CMS.
Olive-ridley turtles are also listed as Vulnerable (Criteria A2bd) on the IUCN Redlist.

6.5. Research

There is no systematic monitoring programmes to determine harvesting levels of olive-ridley turtles or their eggs, their nesting or foraging sites.

Conclusion

Currently, of the six sea turtle species found in PNG, only the leatherback turtle is protected under 1966 Flora and Fauna Protection and Control Act which stipulates that any person who knowingly buys, sells, offers or consigns for sale, or is in possession or in control of a protected animal is liable to a fine of PGK 500.00 (USD 152.00). This Act also provides for the establishment of WMAs. The establishment of a WMA requires the demarcation of social and spatial boundaries and a schedule of rules and penalties to be recognized in consultation with the Conservation and Environment Protection Authority (CEPA, formerly the Department of Environment and Conservation) and the respective Local Level Government (LLG) where the WMA will be established.

Other legislation in PNG that could also be applicable for sea turtle conservation and sustainable management include:

Customs (Prohibited Exports) Regulation (1963) regulates the export of flora and fauna from fishing, pastoral, agricultural and forestry industries;

Land Groups Incorporation Act (1974) allows for the formal recognition of social groups over their territory and natural resources;

Conservation Areas Act (1978), like the Flora and Fauna Protection and Control Act (1966, amended in 2014), allows for a variety of protective regimes on land and waters under customary tenure;

Firearms Act (1978) restricts the use of weapons and explosives;

International Trade (Fauna and Flora) Act (1979) regulates and restricts the export of CITES species;

International Trade (Fauna and Flora) (Fauna) Regulation (1982, amended in 2014) prescribes the documentation required to trade in CITES-listed fauna, to and from Papua New Guinea;

Village Courts Act (1989, amended in 2014) lists the 'prescribed offences' which can be dealt with in village courts;

Organic Law on Provincial Governments and Local-level Governments (1997) regulates the respective rights and obligations of the various levels of government in the field of resource management; allows for the development of Ward or Local Level legislation under Sections 42 and 44, which could be used to draw up local-level conservation laws that could potentially ban

Hawksbill Turtle and egg take, and establish nesting beach closures; and the Fisheries Management Act (1998, amended in 2016) provides the framework for policy and decision to promote the management and sustainable development of fisheries;

To ensure that sea turtle resources in PNG endure, there is a need to:

seek funding and technical support to review the status of the sea turtle species in PNG and change their status to a 'Protected Species' under the Fauna (Protection and Control) Act (1966, amended in 2014) if deemed applicable;

conduct an assessment of the subsistence and semi-commercial take to quantify and characterise sea turtle exploitation at the local, provincial and national level, including trade and marketing patterns, and the importance to livelihoods of the income derived from sea turtle exploitation;

provide support for the establishment of sea turtle monitoring programmes that aim to protect nesting and foraging areas, as well as limiting the take of animals and eggs; and to implement an outreach strategy for the general public, with the aim of increasing awareness and appreciation of sea turtles, and the benefits of sustainable management.

The above listed activities are required as the conservation and management of sea turtles in PNG remains a complex challenge, particularly because knowledge of the factors that determine sustainable harvest rates (where the taking of sea turtles and their eggs occurs) is limited. In PNG, almost all nesting beaches (above the high water mark) and marine habitats are owned by a large number of clan and sub-clan groups whose tenure rights are recognised in the National Constitution. Only the open seas, mineral resources, previously alienated land and protected fauna are vested in the State. Subsequently, any plans for the sustainable use or conservation of sea

turtles in PNG requires innovative methods that recognise community rights to sea turtle resources and habitats, while attempting to conserve (and 'recover') these sea turtle species. Thus, there is a need to adopt an approach that strengthens local conservation practices on one hand, but also strengthens or develops appropriate legislative and policy frameworks.

The development of any sea turtle monitoring, management and conservation programmes in PNG however will not result in any reduction in harvesting of sea turtles and their eggs unless there is an improvement in the local economy for the many and mostly rural coastal and island people of PNG. This is particularly important, given the cultural value of both the protein sea turtles and their eggs provide and the additional benefits of handicraft production with regards to hawksbill turtle shells and the ability to capture them, which of course adds to their already significant economic value in dietary terms.

Sea turtle resources in Papua New Guinea are viewed as a subsistence resource and in some cases are also an integral component of many peoples of Papua New Guinea's cultural heritage. Harmonising international conservation priorities and turtle protection activities with local community development realities is required to simultaneously contribute to long-term sea turtle recovery and human wellbeing in low-income regions like Papua New Guinea.

Table 1. Main biology and conservation aspects of sea turtle Regional Management Units (RMU) occurring in Papua New G

RMU	**CM-PAC SW**	Ref #	**EI-PAC SW**	Ref #	**DC-PAC W**	Ref #	**CC-PAC S**	Ref #
Occurrence								
Nesting sites	Y	9, 11, 48, 49, 18, 20, 21,	Y	7, 11, 48, 18, 20, 21	Y	11, 45, 29, 31, 44, 66, 29, 30, 31, 22, 24, 67, 26, 32, 33, 34, 35, 36, 37, 38, 39, 40, 67,	Y ?	11
Pelagic foraging grounds	Y	50, 9, 51, 48	Y	56, 57, 48	Y	29, 68	Y	62, 71, 48
Benthic foraging grounds	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Key biological data								
Nests/yr: recent average (range of years)	n/a	n/a	n/a	n/a	306	32, 33, 34, 35, 36, 37, 38, 39, 40	n/a	n/a
Nests/yr: recent order of magnitude	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of "major" sites (>20 nests/yr AND >10 nests/km yr)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Number of "minor" sites (<20 nests/yr OR <10 nests/km yr)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nests/yr at "major" sites: recent average (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nests/yr at "minor" sites: recent average (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total length of nesting sites (km)	n/a	n/a	n/a	n/a	~19.6-34.86	32, 33, 34, 35, 36, 37, 38, 39, 40	n/a	n/a	n/a	n/a	n/a	n/a
Nesting females / yr	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nests / female season (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Female remigration interval (yrs) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Hatchlings (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Immatures (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sex ratio: Adults (F / Tot) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Min adult size, CCL or SCL (cm)	n/a	n/a	n/a	n/a	90.0-196.0	32, 33, 34, 35, 36, 37, 38, 39, 40	n/a	n/a	n/a	n/a	n/a	n/a
Age at maturity (yrs)	n/a	n/a	n/a	n/a	25-180	32, 33, 34, 35, 36, 37, 38, 39, 40	n/a	n/a	n/a	n/a	n/a	n/a
Clutch size (n eggs) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Emergence success (hatchlings/egg) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Nesting success (Nests/ Tot emergence tracks) (N)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Trends												
Recent trends (last 20 yrs) at nesting sites (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Recent trends (last 20 yrs) at foraging grounds (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oldest documented abundance: nests/yr (range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Published studies	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Growth rates	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Genetics	Y	52	n/a	n/a	Y	29, 30, 31	n/a	n/a	n/a	n/a	n/a	n/a
Stocks defined by genetic markers	n/a	n/a	Y	57	Y	29, 68	n/a	n/a	n/a	n/a	n/a	n/a
Remote tracking (satellite or other)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Survival rates	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Population dynamics	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Foraging ecology (diet or isotopes)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Capture-Mark-Recapture	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Threats												
Bycatch: presence of small scale / artisanal fisheries?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bycatch: presence of industrial fisheries?	n/a	n/a	n/a	n/a	Y	17	n/a	n/a	Y	9, 11	Y	77

Bycatch: quantified?	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Take. Intentional killing or exploitation of turtles	Y	JK, 17, 15, 53, 14, 54, 55, 53, 47	Y	JK, 56, 57	Y	11, 17	Y	11, 52	Y	53, 74, 75	Y	46
Take. Egg poaching	Y	JK	Y	JK	Y	22, 28,	n/a	n/a	n/a	n/a	n/a	n/a
Coastal Development. Nesting habitat degradation	n/a	n/a	n/a	n/a	Y	22, 28, 9, 10, 65, 69, 22	n/a	n/a	n/a	n/a	n/a	n/a
Coastal Development. Photopollution	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Coastal Development. Boat strikes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Egg predation	n/a	n/a	n/a	n/a	Y	22, 67, 72, 44	n/a	n/a	n/a	n/a	n/a	n/a
Pollution (debris, chemical)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pathogens	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Climate change	n/a	n/a	n/a	n/a	Y	11, 22, 27, 28, 32, 33, 34, 35, 36, 37, 38, 39, 40	n/a	n/a	n/a	n/a	n/a	n/a
Foraging habitat degradation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Long-term projects (>5yrs)												
Monitoring at nesting sites (period: range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of index nesting sites	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Monitoring at foraging sites (period: range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Conservation												
Protection under national law	N	n/a	N	n/a	Y	1966 Flora and Fauna (Protection and Control) Act	N	n/a	N	n/a	N	n/a
Number of protected nesting sites (habitat preservation) (% nests)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Number of Marine Areas with mitigation of threats	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
N of long-term conservation projects (period: range of years)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
In-situ nest protection (eg cages)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hatcheries	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Head-starting	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
By-catch: fishing gear modifications (eg, TED, circle hooks)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
By-catch: onboard best practices	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
By-catch: spatio-temporal closures/reduction	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 2. Nesting beaches in Papua New Guinea.

RMU / Nesting beach name	Index site	Year Monitored	Western limit		Eastern limit		Central point		Reference #
			Long	Lat	Long	Lat	Long	Lat	
CM-PSW	Conflict Group of Islands	2003-2004, 2017-2019	151.4035	10.4558	151.5635	10.4835	151.4905	10.4655	20, CICI
	Jomard Groups of Islands	2003-2004	152.0755	11.155	152.1055	11			18
EI-PSW	Conflict and Jomard Group of Islands	2003-2004, 2017-2019	151.4035	10.4558	151.5635	10.4835	151.4905	10.4655	
	Jomard Group of Islands	2003-2004	152.0755	11.155	152.1055	11			20, CICI
									18
DC-PW	Huon Coast	1980s, 2000-2013	146.58	6.445	148.1354	8.2835			22, 24, 66, 26, 29, 32, 33, 34, 35, 36, 37, 38, 39, 40
	Bougainville Island	2009	154.301	5.081	155.554	6.2958			44
CC-PS	n/a	n/a							

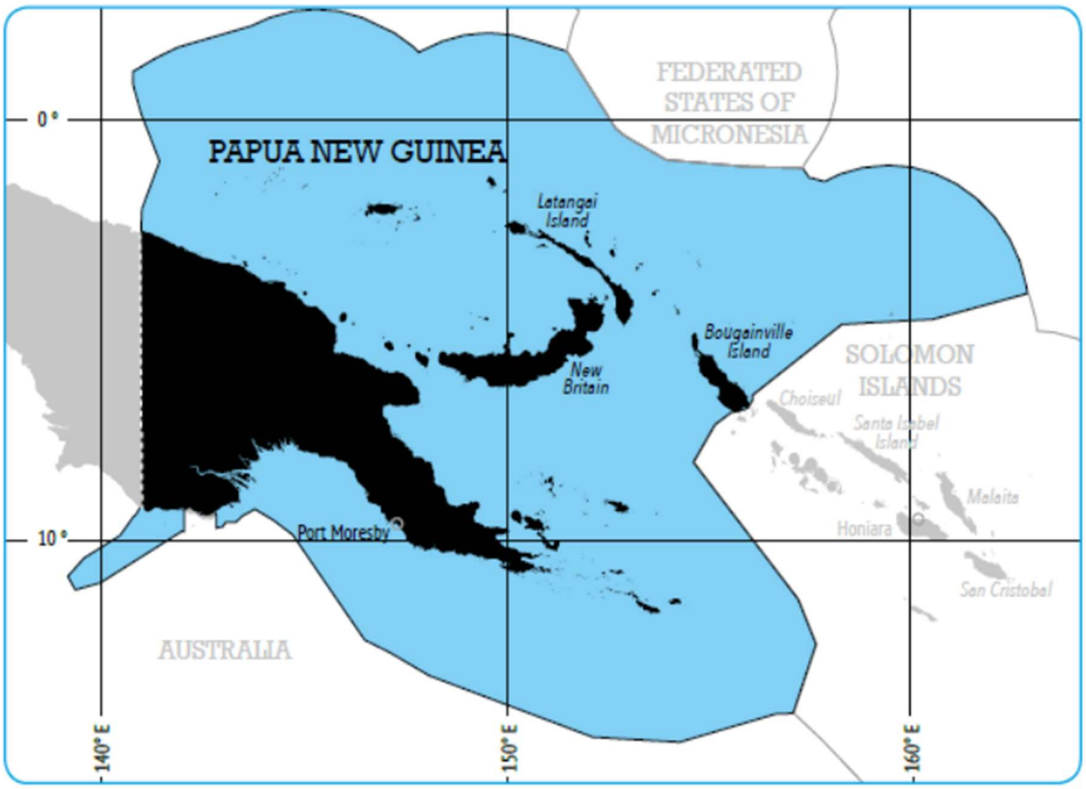

Fig 1. Area of Papua New Guinea and EEZ.

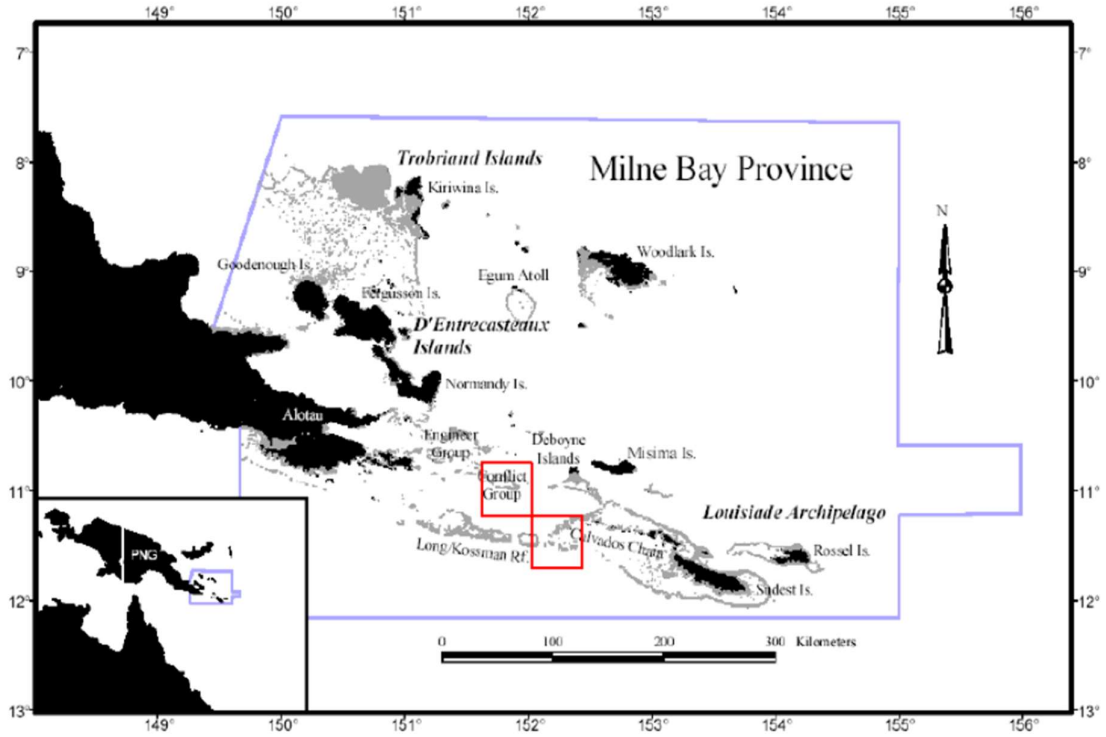

Fig 2: Location of the Conflict Group of Islands and the Jomard Group of Islands in the Milne Bay Province

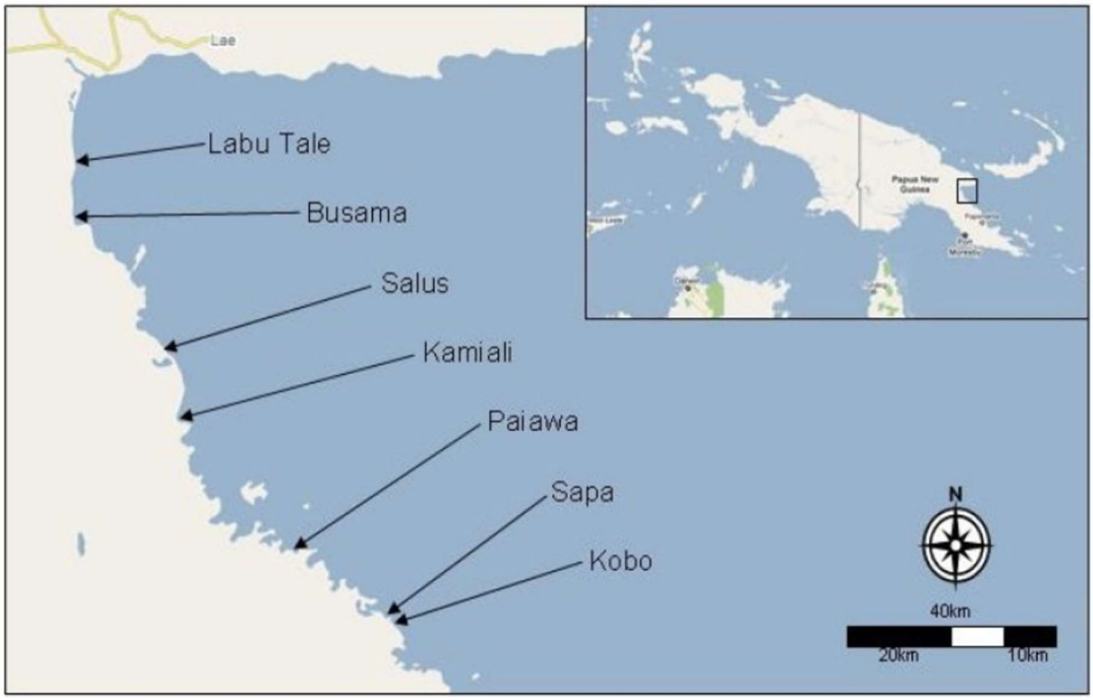

Fig 3: Location of leatherback turtles nesting sites along the Huon Coast in the Morobe Province

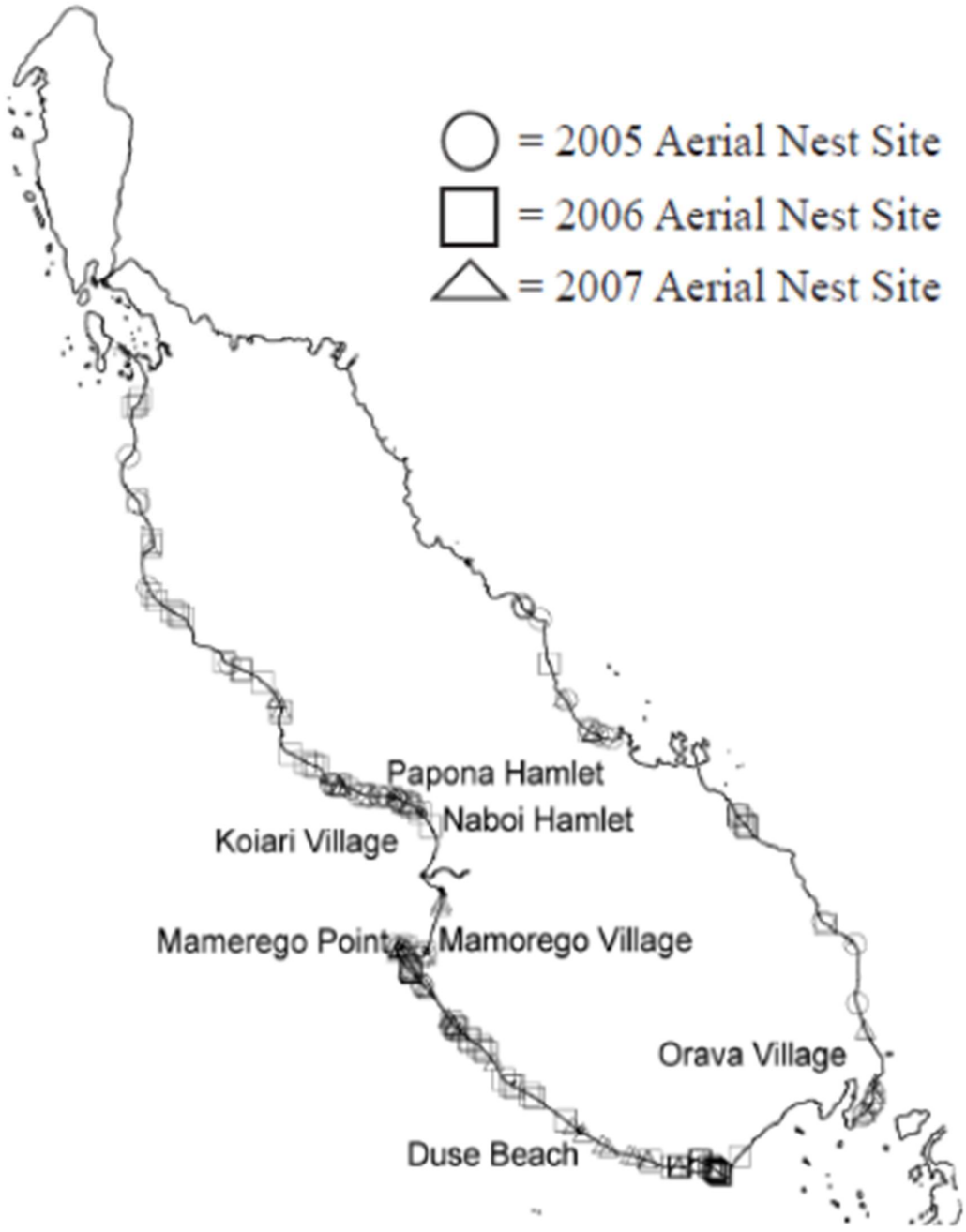

Fig 4: 2005-2007 aerial survey sites

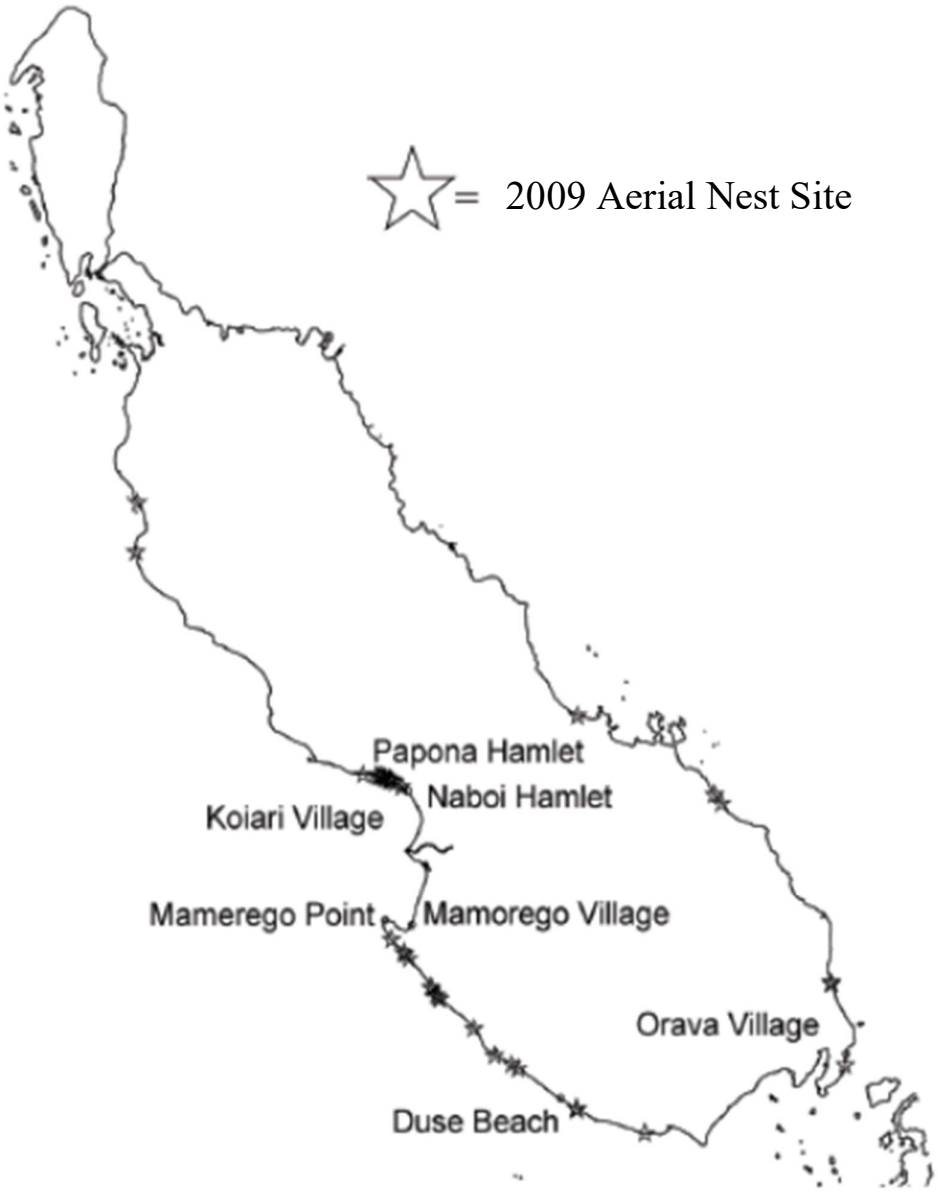

Fig 5: 2009 survey sites.

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Appendix

Table 1: Survey Length (km)

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	~ 1-2	~ 6-8	~ 6-8	~ 1-2	~ 1-2	~ 1-2	~ 1-2
2007-2008	~ 1-2	~ 6-8	~ 6-8	Nil	~ 1-2	~ 1-2	~ 1-2
2008-2009	3.19	6.94	7.48	1.86	7.7	2.16	Nil
2009-2010	3.19	6.94	7.48	1.86	7.7	2.16	5.07
2010-2011	3.19	6.94	7.48	1.86	7.7	2.16	Nil
2011-2012	3.19	6.94	7.48	1.86	7.7	2.16	Nil
2012-2013	3.19	6.94	7.48	Nil	7.7	2.16	Nil
2013-2014	No data collected						

Note: Nil denotes no monitoring.

Table 2: Census Period

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	01/Oct/06 - ??-??-??	01/Oct/06 - ??-??-??	end/Oct/06 - ??-??-??	01/Oct/06 - ??-??-??	01/Oct/06 - ??-??-??	01/Oct/06 - ??-??-??	??/Dec/06 - ??-??-??
2007-2008	01/Oct/07 - 01/Mar/08	01/Oct/07 - 01/Mar/08	01/Oct/07 - 01/Mar/08	Nil	01/Oct/07 - 01/Mar/08	01/Oct/07 - 01/Mar/08	01/Oct/07 - 01/Mar/08
2008-2009	01/Oct/08 - 30/Mar/09	01/Oct/08 - 30/Mar/09	01/Oct/08 - 30/Mar/09	01/Oct/08 - 30/Mar/09	01/Oct/08 - 30/Mar/09	01/Oct/08 - 30/Mar/09	Nil
2009-2010	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10	01/Oct/09 - 01/Mar/10
2010-2011	01/Oct/10 - 07/May/11	01/Oct/10 - 04/Apr/11	01/Oct/10 - 30/Mar/11	01/Oct/10 - 30/Mar/11	01/Oct/10 - 30/Mar/11	01/Oct/10 - 30/Mar/11	Nil
2011-2012	01/Jan/11 - 29/Feb/12	01/Jan/11 - 29/Feb/12	01/Jan/11 - 29/Feb/12	01/Jan/11 - 29/Feb/12	01/Jan/11 - 29/Feb/12	01/Jan/11 - 29/Feb/12	Nil
2012-2013	01/Oct/12 - 30/Mar/13	01/Oct/12 - 30/Mar/13	01/Oct/12 - 30/Mar/13	Nil	01/Oct/12 - 30/Mar/13	01/Oct/12 - 30/Mar/13	Nil
2013-2014	No data collected						

Note: Nil denotes no monitoring.

Table 3: Number of nesting crawls

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
2007-2008	321 with no nesting at Paiawa						
2008-2009	35	157	38	23	0	5	Nil
2009-2010	54	132	36	7	20	17	5
2010-2011	63	311	84	45	34	21	Nil
2011-2012	43	112	47	0	6	0	Nil
2012-2013	37	73	80	Nil	5	16	Nil
2013-2014	No data collected						

Note: Nil denotes no monitoring.

Table 4: Number of nests laid

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	41	80	59	7	11	12	26
2007-2008	270 with no nesting at Paiawa						
2008-2009	28	119	35	23	0	5	Nil
2009-2010	41	96	25	7	17	13	5
2010-2011	59	284	84	45	34	21	Nil
2011-2012	39	101	47	0	6	0	Nil
2012-2013	35	68	78	Nil	4	14	Nil
2013-2014	No data collected						

Note: Nil denotes no monitoring.

Table 5: Nesting success (%)

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
2007-2008	Unknown	Unknown	Unknown	Nil	Unknown	Unknown	Nil
2008-2009	80	76	92	100	0	100	Nil
2009-2010	76	73	69	100	85	76	100
2010-2011	94	91	100	100	92	95	Nil
2011-2012	91	90	100	0	100	0	Nil
2012-2013	95	93	98	Nil	80	88	Nil
2013-2014	No data collected						

Note: Nil denotes no monitoring.

Table 6: Curved-carapace-length data for leatherback turtles recorded nesting along the Huon Coast

Year/Details	Number	Range	Average
2005-2006	94	90.0-189.0	159.1
2006-2007	104	140.0-193.0	164.0
2007-2008	114	110.0-184.0	164.9
2008-2009	83	112.0-193.0	160.0
2009-2010	93	100.0-186.0	163.7
2010-2011	79	160.0-196.0	158.2
2011-2012	No data available		
2012-2013	Unknown	110.0-Unknown	127.1
2013-2014	No data collected		

Table 7: Egg clutch data for leatherback turtles recorded nesting along the Huon Coast

Year/Details	Number	Range	Average
2005-2006	94	31-180	90
2006-2007	95	47-209	101
2007-2008	113	25-180	106
2008-2009	87	47-144	98
2009-2010	72	57-137	97
2010-2011	196	48-135	94
2011-2012	No data available		
2012-2013	77	37-149	79
2013-2014	No data collected		

Table 8: Number of identified leatherback turtles and new nesters recorded nesting along the Huon Coast

Year/Details	Number	New nesters
2007-2008	65	48
2008-2009	89	36
2009-2010	59	14
2010-2011	79	15
2011-2012	No data available	
2012-2013	85	15

Table 9: Nests lost to erosion/flooding

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
2007-2008	Unknown	Unknown	Unknown	Nil	Unknown	Unknown	Nil
2008-2009	0	0	5	7	0	0	Nil
2009-2010	10	4	11	0	0	3	0
2010-2011	0	15	6	0	1	0	Nil
2011-2012	0	0	0	0	0	0	Nil
2012-2013	0	0	13	Nil	0	0	Nil
2013-2014	No data collected						

Table 10: Nests lost to predators

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
2007-2008	Unknown	Unknown	Unknown	Nil	Unknown	Unknown	Nil
2008-2009	0	0	0	1	0	0	Nil
2009-2010	0	0	0	0	0	0	0
2010-2011	0	0	0	0	1	1	Nil
2011-2012	0	0	0	0	0	0	Nil
2012-2013	0	0	0	Nil	0	0	Nil
2013-2014		No data collected					

Table 11: Nests lost to human take

Year/Place	**Labu Tale**	**Busama**	**Lababia**	**Paiawa**	**Sapa**	**Kobo**	**Salus**
2006-2007	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
2007-2008	Unknown	Unknown	Unknown	Nil	Unknown	Unknown	Nil
2008-2009	0	0	0	0	0	0	Nil
2009-2010	0	9	0	0	0	1	0
2010-2011	0	0	0	0	4	0	Nil
2011-2012	0	5	0	0	0	0	Nil
2012-2013	0	11	0	Nil	0	0	Nil
2013-2014	No data collected						