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Status of sea turtle populations and its conservation at Bird's Head Seascape, Western Papua, Indonesia

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Abstract. *Tapilatu RF, Wona H, Batubara PP. 2017. Status of sea turtle populations and its conservation at Bird's Head Seascape, Western Papua, Indonesia. Biodiversitas 18: 129-136.* Bird's Head Seascape region in the northwest of Papua contains the world's highest marine biodiversity. The area is a unique site which contains a full range of marine and coastal habitats that are important for the breeding, foraging and migration of several species of sea turtles. This survey aimed to characterize critical habitats that are in use by sea turtles across Yapen, Wondama, Manokwari and Kaimana at Bird's Head Seascape and to assess existing and potential threats to both habitats and population. Eight beaches were inspected for evidence of nesting and predation and anecdotal information was collected through interviews with 121 fishermen at 23 villages. The survey confirmed the occurrence of hard-shelled turtles: Green (*Chelonia mydas*), Olive-ridley (*Lepidochelys olivacea*) and Hawksbill (*Eretmochelys imbricata*) nesting and foraging populations. In addition, the critically endangered leatherback turtle (*Dermochelys coriacea*) is occasionally seen by fishermen. Sea turtles have long been a source of protein for locals. The predictability of the timing and location of turtle abundance exposes nesting populations to long-term subsistence exploitation that cannot be sustained by these populations. Protection of significant rookeries is seen as the best conservation option for sea turtles in the Bird's Head Seascape region. It is strongly recommended that these areas should be considered in any conservation initiative in order to maintain the sustainable population (s) in the Bird's Head Seascape.

Keywords: Bird's Head Seascape, *Chelonia mydas*, conservation, *Dermochelys coriacea*, *Eretmochelys imbricata*, *Lepidochelys olivacea*

INTRODUCTION

The status of the sea turtle stocks in the Pacific Ocean basin is poorly understood (Spotila et al. 1996; Meylan and Donnelly 1999; Chaloupka and Limpus 2001; Seminoff 2002; Chaloupka et al. 2004). Most marine turtle populations in the Indo Pacific region are severely depleted (Limpus 1994, 1997), and the Pacific leatherback has declined by 95% over the past 30 years (Spotila et al. 2000). Tapilatu et al. (2013) found that the estimated annual number of leatherback nests at Jamursba Medi beach of the Bird's Head region, Indonesia has declined 78.3% over the past 27 years. The data from Jamursba Medi combined with data from another primary nesting area in that region (i.e. Wermon beach), indicate a continual and significant long-term decline in nest numbers of 5.9% per year since 1984 (Tapilatu et al. 2013). The continual decline is of particular concern since these beaches support 75% of leatherback nesting in the western Pacific (Dutton et al. 2007). As such, the leatherback turtle is identified as one of the 131 "critically endangered" species by the International Union for Conservation of Nature (IUCN). In Canada, the species is listed as endangered under the Species at Risk Act (SARA). An estimated 90% decline in global population in less than three generations is cited as the reason for the designation.

In the Pacific, the decline was primarily caused by excessive harvesting of eggs and nesting females (Meylan and Donnely 1999; Chaloupka 2001; Seminoff 2002; Horikoshi et al. 1994; Trinidad and Wilson 2000; Gardner and Nichols 2001; Limpus et al. 2004; Tapilatu 2013; Tapilatu and Ballamu 2015), incidental fishery bycatch (Chan et al. 1988; Cheng and Chen 1997; Chaloupka 2003), and development of coastal areas (Sharma 2000; Matsuzawa et al. 2002). Multi-year telemetry studies of western Pacific leatherback movement indicated that boreal summer nesters forage in the northeast Pacific region, which includes Canadian Pacific waters (Benson et al. 2011). However, threats to this critically endangered species occur outside of US-Canadian waters, therefore actions to recover Pacific leatherbacks are focused on critical nesting beaches in Indonesia.

The western Pacific population represents the best remaining prospect for avoiding extirpation of the species in the Pacific. Efforts to protect leatherbacks and other marine turtles at the largest nesting beaches on the Bird's Head Seascape (BHS)-West Papua are ongoing, however, slaughter of adults and egg harvesting continues elsewhere. Turtle meat and eggs from unprotected areas at Bird's Head are sold in local markets. Schultz (1989) believed that the decrease of sea turtle populations in Indonesia was due to severe over-exploitation. Limpus (1997) concluded that the rate of turtle harvest in the entire Pacific region exceeds the replacement capacity of existing populations. Therefore, community and government support is needed to ensure that all remaining pockets of leatherbacks are protected and maintained in West Papua, Indonesia.

MATERIALS AND METHODS

This study is the first to systematically survey villagers and marine turtle nesting habitat in the Bird's Head Seascape (BHS) region of Western Papua, Indonesia. To assess the current status of sea turtles at Yapen Island, Wondama, Manokwari and Kaimana (Figure 1), a team from the Research Center for Pacific Marine Resources (RCPMR), Universitas Papua (UNIPA) Manokwari, West Papua, Indonesia conducted beach surveys and interviewed villagers between October 2015 and October 2016. The team surveyed potential nesting beaches, and identified the turtle species and threats at each nesting beach (both natural and anthropogenic). Two interviewers used a standardized questionnaire to interview local fishermen at each survey location (reference for technique).

Beach-based surveys followed a technique designed to identify and characterize potential nesting beaches in the absence of turtles (Schroeder and Murphy 1999). Field team members documented and quantified evidence of nesting, such as crawl track markings and the dimension of nesting depressions. Evidence of predation, including the presence of eggshells and turtle remains (carapaces, skulls, plastrons), were also noted.

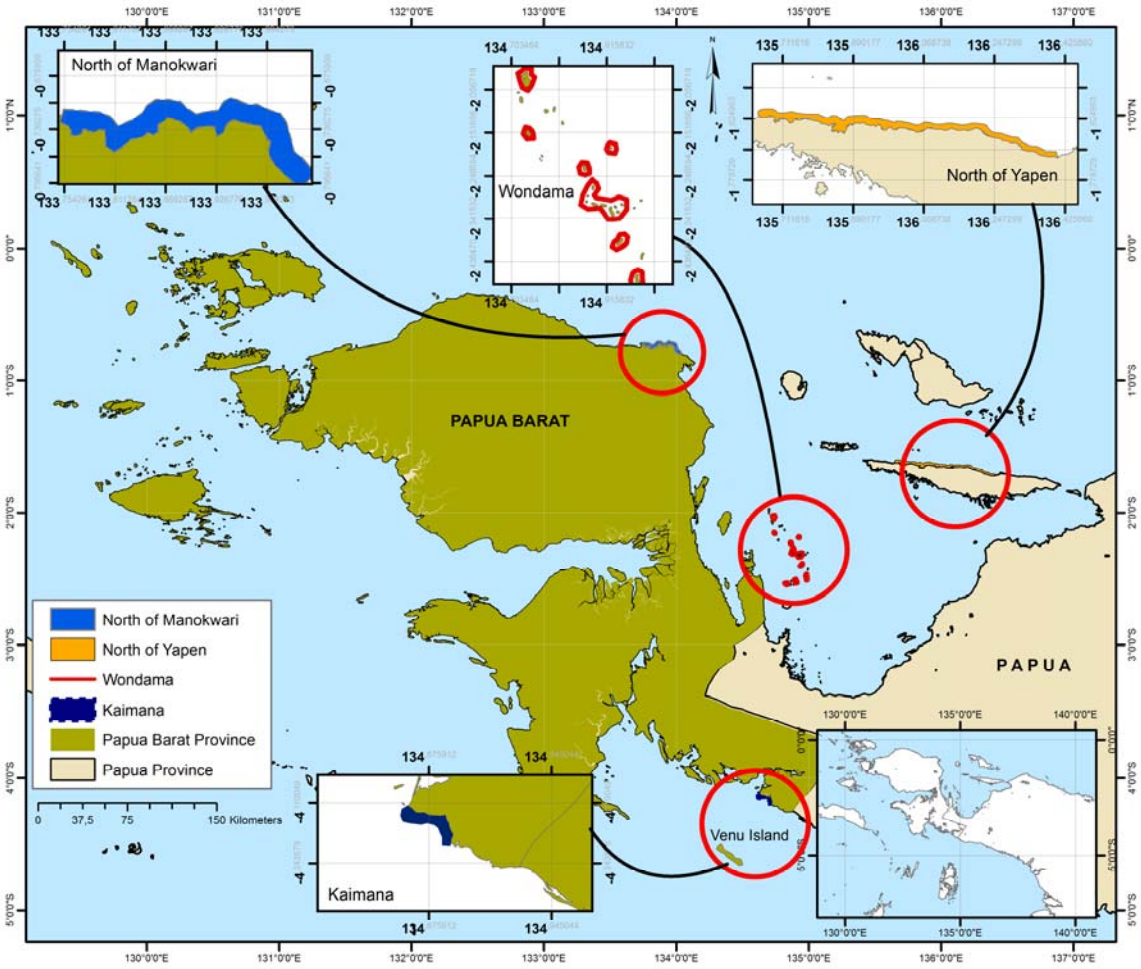

Figure 1. Bird's Head Seascape region survey areas of Western Papua, Indonesia: North of Yapen, Wondama, Manokwari, and Kaimana

Table 1. Type of data collected during this survey at Bird's Head Seascape, Western Papua, Indonesia

Method	Type of Data Collected	Notes
Beach survey	Nesting evidence: identification of species from crawl tracks and nest depressions; and Predation evidence: slaughter of turtles, predation of eggs and probable source.	Data collected by inspecting beaches and littoral vegetation. Beach surveys.
Village interviews	Species of turtle most commonly sighted; Nesting or underwater observations; Seasonal trend of sightings; Known nesting sites; and Type of exploitation activities (subsistence and commercial activity)	Interviews in villages. Data primarily collected on local consumption of sea turtles and socio-economic components.

RESULTS AND DISCUSSION

Villager interview results

Respondents in all the villages surveyed reported an overall decline in the abundance (as measured by catchability) of turtles relative to 10-20 years ago suggesting the rate of exploitation for local consumption in these villages was high 10-20 years ago.

Results from the community questionnaires also indicated that sea turtles (juveniles, sub-adults and adults) are occasionally entangled in gillnets. Critically endangered hawksbill (IUCN red-list, CITES Appendix 1) and green turtles were noted in the gillnet captures.

Evidence of turtle consumption was found at all (n=23) villages visited (Table 2), while evidence of turtle nesting was found at all (n=8) beaches visited during turtle nesting season (Table 3).

Yapen Island

Yapen Island, in the eastern part of the BHS region, has been hypothesized to be one functional seascape. Remote beaches on the northern coast of Yapen Island are suited for nesting (Hitipeuw 2002), and offshore waters provide foraging habitat for sea turtles (WWF 1997). However, the current status of turtle populations in Yapen are poorly known and anthropogenic threats to existing turtle populations in the region are increasing due to human population growth.

The results of our village interviews and field surveys confirmed previous records indicating green turtles and hawksbill turtles are the most common species nesting at Yapen Island (Salm et al. 1982; Gilkes dan Adipati 1987; and WWF 1997). From the survey, nesting by olive-ridleys (*L. olivacea*) has been reported on small islands off Yapen. The preference of olive-ridleys for nesting along the open beach zone reduces the chances of observing nesting evidence. Several respondents reported common sightings of olive-ridley turtles associated with flotsam, which confirmed the conclusions of Pitman (1992) who stated sea turtles are often associated with flotsam.

The leatherback turtle (*D. coriacea*), locally called "Kumep", has been reported nesting on Inggresau beach on the north coast of Yapen island, but they are rarely sighted by local communities around larger straits in the waters around Yapen island.. A satellite tracked leatherback that was released from Warmon beach was documented at Inggresau, likely to lay eggs (Hitipeuw et al. 2007). Sightings of leatherbacks following the prevailing westward current is common along Sorenarwa Strait (between south Biak and Yapen island) and in Cenderawasih (Irian) Bay (Hitipeuw et al. 2007), furthermore a villager reported observing a leatherback turtle swimming eastward across the Sorenarwa Straits around October, suggesting that the Sorenarwa strait could be a migratory corridor for western Pacific leatherbacks (Hitipeuw et al. 2007).

Wondama

Wondama Bay is part of the Cenderawasih Bay Marine National Park. Green and hawksbill turtles breed in small numbers at the islands of Moor, Mambor, Kumbur, Nu Tabari, Mangguar, Anggrameos, Kabuai, Auri islands, Roon islands, Mioswaar and Rumberpon, and a relatively large number of green turtles breed at Wairundi island (Putrawijaya 2000).

The field surveys also found a green turtle rookery on Kumbur Island. The sandy beach is approximatly 3km long and is situated southeast of Tanjung Mangguar. Three green turtle nest depressions were recorded in December 2015. Nesting in this area is difficult due to the rooting of Casuarinas vegetation which has invaded the suitable nesting area. A recent campsite and the footprints of transient fishermen were found on the island. This finding implies local subsistence exploitation by nearby villagers.

Wairundi Island is an isolated island east of Rumberpon Island that has approximately 5km of beach and hosts a substantial amount of green turtle and hawksbill turtle nesting. Evidence of nesting was found on the eastern beach, including nest pits, both old and new nests, hatched nests, eggshells, and fresh tracks. Forty-three body pits were found, suggesting this is a locally important green turtle rookery. A recently emerged nest found during this survey was excavated for hatching success evaluation. Of a total of 121 eggs, 102 (84%) eggs hatched and 19 (16%) failed to hatch. The clutch size is within the range of green turtle nests compiled by Van Buskirk and Crowder (1994) from various nesting sites. The nesting beaches utilized by green turtles on Wairundi ranged from large, open beaches to small, inlet beaches with an open offshore approach. A ranger reported that he saw a couple of green turtles mating on the coral reef of Wairundi Island during November 2015. This observation implies that nesting in the region may occur in December, confirming the reports by Isenebuai villagers on Rumberpon Island and the park rangers.

Leatherback turtles were rarely sighted by locals, but there were reports of leatherbacks resting in the inner part of Cenderawasih Bay in Wondama, close to Tanjung Mangguar. Additionally, satellite tracking indicated that Wondama served as a resting and/or foraging area for leatherbacks during inter-nesting periods (Hitipeuw et al. 2007). The results obtained during this survey were consistent with the assumption that this species migrates through the region, utilizing the area for resting and/or foraging, probably during inter-nesting periods, but does not use the area for nesting. It was reported that in 2013, a basking leatherback in Kwatisore (south of Cenderawasih Bay) was killed by fishermen using a harpoon.

When interviewed, local respondents reported green and hawksbill turtle nesting and foraging areas, however they could not locate these areas on maps. Green turtles aggregate on specific beaches for nesting, therefore they are more vulnerable to hunting and poaching during the nesting season. On the other hand, hawksbill turtles demonstrate more seasonally and geographically diffuse nesting, making it more difficult for hunters and poachers to find them ashore; instead they are forced to trap or spear hawksbills in foraging areas.

Table 2. Summary of village interview results at Bird's Head Seascape, Western Papua, Indonesia

Village (No. of respondents)	Location	Species sighted nesting and inwater by villagers	Months nesting observed by villagers	Known nesting/ foraging habitat	Types of exploitation
Yapen					
Mios Indi (3)	Island north of Yapen Island	Cm, Ei	Unknown	Mios Indi	Inwater poaching
Sambrawai (5)	North of Yapen Island	Cm, Lo, Dc	April-September	Inggresau	Egg harvest, inwater poaching
Yobi (5)	North of Yapen Island	Lo, Dc, Cm	April-September	Inggresau	Egg harvest, adult harvest on the beach
Soromase (7)	North of Yapen Island	Cm, Dc, Lo	April-September	Inggresau	Egg and adult harvest on the beach
Inggresau (10)	North of Yapen Island	Cm, Dc, Lo	April-September	Inggresau	Egg and adult harvest on the nesting beach
Aisauw (9)	North of Yapen Island	Lo, Cm, Dc	April-September	Inggresau	Egg and adult harvest
Worabori (2)	West Yapen Island	Cm, Ei	Year round	Woinap, Kuran islands, Naori, Bawei, Kuriati	Egg harvest, inwater poaching
Wondama					
Kamrei (2)	Moor Island	Cm, Ei	Year round	Cm and Ei at Moor islands, Lo at mainland	Egg harvest, inwater poaching
Hariti (2)	Mambor Island	Cm, Ei	March-April	Nu Tabari, Kumbur, Papaya, Nuburi and Mambor islands	Egg harvest, inwater poaching
Yaur (5)	Yaur	Cm, Ei	November-January	Kumbur, Kikir, Rori islands, Tj. Mangguar	Egg harvest, inwater poaching
Kayop (2)	Roon Island	Cm, Ei	Year round	Auri islands, Anggrameos, Kabuai, Kom, Waurundi	Egg harvest, inwater poaching
Isenebuai (2)	South Rumberpon	Cm, Ei	January-March	Waurundi, Rooswar	Egg harvest, inwater poaching
Manokwari					
Nuni (5)	Mainland	Lo, Cm, Dc	April-September	North coast of Bird's Head	Egg and adult harvest
Minyeifoka (3)	Mainland	Lo, Cm, Dc	May-September	North coast of Bird's Head	Egg and adult harvest
Mubraidiba (6)	Mainland	Lo, Cm, Dc	April-September	North coast of Bird's Head	Egg and adult harvest
Warbefor (3)	Mainland	Lo, Cm, Dc	April-October	North coast of Bird's Head	Egg and adult harvest
Sairo (2)	Mainland	Lo, Cm, Dc	May-September	North coast of Bird's Head	Egg and adult harvest
Mandopi	Mainland	Lo, Cm, Dc	May-September	North coast of Bird's Head	Egg and adult harvest
Sidey (7)	Mainland	Lo, Dc, Cm	Year round	North coast of Bird's Head	Egg and adult harvest
Mubrani (5)	Mainland	Lo, Dc, Cm	Year round	North coast of Bird's Head	Egg and adult harvest
Kaimana					
Lakahia (11)	Island at Etna Bay	Cm, Ei	May-August	Southeast of Bird's Head	Egg and adult harvest
Omba Nariki (5)	Mainland	Cm	May-August	Southeast of Bird's Head	Egg and adult harvest
Venu (4)	Island west of Kaimana	Cm, Ei, Lo	Year round	Island, west of Kaimana	Egg and adult harvest

Note: Cm = *Chelonia mydas*, Ei = *Eretmochelys imbricata*, Lo = *Lepidochelys olivacea*, Dc = *Dermochelys coriacea*

Table 3. Beach survey results at Bird's Head Seascape, Western Papua, Indonesia

Locations	Number of potential nests	Species	Survey time and numbers
Inggresau, north of Yapen	0		October 2015, once
Wairundi Island, Cenderawasih Bay	67	Cm	October 2015, once
Warbefor, Manokwari	2	Cm	February 2016, once
Sidey, Manokwari	2	Cm , Dc	April 2016, once
Mubrani, Manokwari	3	Dc	April 2016, once
Lakahia, Kaimana	0		March and October 2016, twice
Omba Nariki, Kaimana	0		March and October 2016, twice
Venu Island, Kaimana	214 (counted as of Jan 2016)	Cm, Ei	March and October 2016, twice

The field survey found evidence of poaching and two disturbed nests, which were devoid of eggs, at Wairundi Island. Green turtles dominated the small islands scattered around the Cenderawasih Bay in Wondama, and though less dominate in numbers, hawksbill turtles also use these beaches. Villagers reported gill-net entanglement of all age classes of green and hawksbill turtles.

Manokwari

Sea turtle surveys were concentrated at the north coast of Manokwari, on a 30 km stretch of beach that included 19 villages. Salm (1982) used aerial surveys to identify the Sidey-Wibain area, located to the east of Manokwari, as an important nesting area for leatherbacks. Three other species of turtles, olive-ridley, green and hawksbill, also use this area for nesting. Sea turtle populations on the north coast of Manokwari have declined significantly since the 1990s due to village development as part of devolution policy of the Manokwari regencial government and over exploitation. Residents stated that the leatherback was the dominant species of turtle nesting prior to the 1980s. This matches the chronology of the decline observed in the estimated number of nests at the principal nesting beaches, Jamursba Medi and Wermon (approx. 200 km west of Manokwari). Currently, the dominant nesting turtles along the north coast of Manokwari are olive-ridleys, followed by green turtles. Leatherback and hawksbill turtles have become rare in this area compared to 25 years ago.

Outreach for sea turtle conservation was conducted in a total of 10 coastal villages located on the coast at Manokwari by staff from RCPMR-UNIPA. The Marine and Fisheries bureau of Papua Barat Provincial Government followed up our outreach by erecting an announcement board containing a solicitation to preserve sea turtles for the next generation (a hot line number was provided to call to report turtle sightings). Outreach by the same team at Mubraidiba village on November 3, 2015, was combined with a visit to check the construction of a sea turtle hatchery nearby. The hatchery was constructed to accommodate at-risk nests from poaching and high tide that need to be relocated in the area north of Manokwari.

This outreach has successfully increased awareness among coastal villagers of the importance of sea turtle conservation in the area. Evidence for this was demonstrated by community members who reported 52 olive-ridley and green turtle nests between May and July 2015.Thirty five of those nests were relocated into a temporary hatchery at Warbefor, resulting in approximately 3,750 hatchlings that were safely released to the sea. On November 15, 2015, a leatherback nest was found by a villager in Sairo village. Because the nest faced a high risk of poaching, predation by domestic dogs and inundation by high tide, the clutch was relocated to the Laboratory at RCPMR at UNIPA campus, Manokwari. The hatching success was low (7.1%). On November 29, 2015, a female leatherback nested at Nuni village. Unfortunately, the leatherback was killed, but the team was able to save the nest and relocate it to the hatchery in Mubraidiba. On December 24, 2015, a villager found a leatherback between Sairo and Mandopi villages. The villager restrained the leatherback with ropes for 6 hours with the intention to slaughter it for Christmas feasts. Another villager, however, reported this to RCPMR and RCPMR successfully negotiated the turtle's release. The villager who restrained the leatherback came to understand the significance and released the leatherback with minimal compensation. On January 27, 2016, a female leatherback nested in Sairo village and returned safely to the sea. However, the nest was taken and consumed by a family who owns the beach sector where the leatherback nested.

Kaimana

Villagers at Omba Nariki and Lakahia reported that they rarely encounter leatherback nesting on beaches close to the villages. These beaches may not be suitable for nesting due to beach characteristics such as: the narrow width of the beach, the lack of a well developed sand dune, during low tide the beach is long and flat, the water is dirty, and the proximity to multiple rivers and estuaries results in overgrowth of mangroves and casuarinas, . These conditions are in sharp contrast to the typical nesting beach for leatherbacks at the north coast of Bird's Head. However, the villagers were able to confirm the findings of Benson et al (2011) who identified the waters west of Kaimana as a leatherback turtle foraging hotspot. Villagers reported regular encounters with leatherbacks basking and foraging in Kaimana waters, particularly during the dry season when jellyfish are abundant.

Two leatherback gillnet entanglements were documented during the survey. In 2003, a Lakahia fisherman incidentally captured a female leatherback in a gillnet, who was found to have eggs in the reproductive tract. Furthermore, a leatherback was found exhausted and eventually died on the beach of Kaimana city due to entanglement in a gillnet in 2011.

The extent of turtle harvest in this region was described by a villager from Venu Island in Kaimana who stated that prior to 2010 he sold every turtle he captured to commercial turtle dealers on wooden ships. The wooden ship would anchor for several days to collect and ship between 700-1,000 green turtles annually. Only during the peak of nesting season were some turtles allowed to return to the sea. The shell from a recently butchered large adult green turtle was observed drying next to a hut on the island.

No turtle tracks were sighted during beach surveys during the survey period in March 2016 at Omba Nariki and Lakahia (Table 3). However in Venu island, 214 turtle nests were found, mainly from green turtles and hawksbill turtles. At Venu island, one of the green turtles encountered (84 cm carapace length) was nesting and a datalogger was placed at the bottom part of the nest to record nest temperature during the nest incubation period. None of the turtles that nested on Venu island had been tagged and a few females appeared to be free of fibropapilloma, a tumor disease which occurs in the Hawaiian green turtle population (Balazs and Pooley 1991).

Threats to Turtle Populations in Yapen, Wondama, Manokwari and Kaimana

Exploitation of sea turtles, primarily for subsistence, is a long-standing practice by Yapen, Wondama-Cenderawasih Bay and Manokwari residents. Sea turtles have long been a source of protein for the locals. Residents confirmed the practice of harvesting turtles from various islands for daily consumption and special events, such as Christmas and custodial feasts. Traditional spears and modified hooks are often carried in fishing boats to catch a turtle in-water. Hawksbills are least favored for consumption by villagers while greens are most favoured due to its delicacy. Hunting for subsistence typically occurs when the turtles are foraging in-water or nesting. All respondents reported that over the past two decades a decline in encounter rates with turtles has made it more difficult to catch them. We believe this decline is likely caused by unsustainable exploitation.

Respondents reported that they caught greens, hawksbills, olive-ridleys and occasionally leatherbacks at sea with a traditional harpoon and a modified hook with buoy. The modified hook is similar to the ones used by Yapen, Wondama-Cenderawasih Bay and even Raja Ampat islanders (Figure 2.A-B). They reported that greens and hawksbills are occasionally entangled in gillnets, indicating an overlap between local fishing areas and turtle habitats. Entangled turtles of all sizes are not released but instead consumed.

Our survey results suggests that most, if not all, turtle nests laid in Yapen, Wondama-Cendrawasih Bay, Manokwari and Kaimana are harvested. Increasing harvest pressure on all age classes of turtles in small populations, such as those found in the Bird's Head Seascape region, could prove unsustainable in the future, threatening the viability of the existing populations.

Predators such as monitor lizards and domestics dogs on large island such as Yapen and mainland Manokwari represent additional factors threatening sea turtle populations. Limpus (1997) suggested that a high level of nest predation by such predators would likely cause a decline in numbers of sea turtle nests over the next decade. Moreover, beach erosion on several islands in the region, particularly on Wairundi, has reduced the size of nesting habitats. Further, the root invasion by Casuarina trees on beaches such as on Kumbur island could hamper nesting. The sustained, long term cumulative impact of these threats could cause a substantial decline in sea turtle populations in the region.

Natural predators of sea turtles were recorded during the village surveys in Kaimana. Numerous sharks, species unknown, were recorded. Although these sharks are not known predators of adult sea turtles, they are capable of feeding on hatchlings and small juveniles (Balazs 1980). The tiger shark (*Galeocerdo cuvier*), is the only known major predator of juvenile, sub-adult, and adult green turtles (Balazs 1980). This shark is nocturnal/crepuscular (Balazs 1980), and likely occurs at Kaimana.

The results indicate that the Bird's Head Seascape is prime habitat for both foraging and nesting for all four of these sea turtle species (leatherback, green, hawksbill, and olive-ridley). The results also indicate that all of these species have been declining for at least several decades and are continuing to decline. In the case of the leatherback, it is already at critically low levels, and the Bird's Head Seascape appears to be the most crucial habitat for the leatherback in the western Pacific. The decline of all four species appears to be directly linked to exploitation of the turtles and eggs, both on the nesting beach as well as in-water captures. Much of this appears to be due to subsistence exploitation, but there was also evidence of some commercial exploitation of both turtles and eggs.

Figure 2. A. Typical hook used by fishermen to catch sea turtles in-water at Mios Num (Photo: R.F. Tapilatu). B. The same type of modified hook used by fishermen in Raja Ampat island (Photo: C. Hitipeuw)

The findings from the study are significant and extremely important as baseline information regarding the distribution and conservation status of four sea turtle species (leatherback, green, hawksbill, and olive ridley) in the Bird's Head Seascape area. This type of information is paramount to making science-based management decisions and developing management strategy for ensuring the recovery of all four of these sea turtle species in the Bird's Head Seascape. There is an immediate need for conservation measures to ensure the protection of nesting and foraging sea turtles, and the protection of nests and hatchlings on the beaches to ensure recruitment into the populations with the implications for the entire western Pacific. Without such measures, all populations may continue to decline to critically low levels. Further, protection of the leatherback in the Bird's Head Seascape appears to be pivotal to the recovery of leatherbacks in the western Pacific, as well as the entire Pacific Ocean basin.

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