Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania

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Summary

This is a literature review compiled by the National Marines Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) Protected Resources Division to facilitate better understanding of green turtle nesting distribution in the Western and Central Pacific Ocean, including a summary of legal protections for sea turtles throughout the region. This synthesis of 189 Pacific green turtle nesting locations, nesting assemblage characteristics where available, and current national legislation provides the background information necessary to identify where gaps exist in monitoring and management. This will help NMFS and other regional stakeholders prioritize and direct future research, management activities, and international collaborations to advance green turtle conservation and recovery efforts in the Pacific.

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Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania

Introduction

Green turtles (*Chelonia mydas*) in the Pacific Ocean are widely distributed, nesting at hundreds of sites among thousands of islands and atolls scattered throughout the Western and Central Pacific Ocean (WCPO or Oceania). Green turtles are listed as *threatened* under the U.S. Endangered Species Act (ESA) and *endangered* under the internationally recognized IUCN Red List of Threatened Species. They are protected under varying degrees of national legislation and international arrangements throughout the region. For the purposes of this document, Oceania refers to Polynesia, Micronesia and Melanesia extending from Hawaii west to Japan, south to Australia, and southeast to the Pitcairn Islands—a total of 22 sovereign nations, including the U.S. which is represented by the State of Hawaii, three U.S. Territories and seven Pacific Remote Island Areas (PRIAs). The quality and amount of green turtle nesting information available is variable among countries in this region as some sites have active monitoring projects and recent data whereas others are not actively monitored. Overall, little information exists regarding stock structure, abundance, or trends for green turtles in this vast region. However, a range of nesting records and survey information is available in published documents, gray literature, and in-country government reports gathered over the past 30+ years representing varying degrees of effort and consistency in monitoring.

There have been prior efforts to compile sea turtle nesting information from this region (Balazs, McCoy, and Pritchard in Bjorndal 1982 and revised in 1995; Hirth 1993 and 1997), but an updated synthesis of current information is lacking. Seminoff (2004) provided a global status assessment for green turtles, but focused primarily on two index sites in the Pacific (Hawaii and Australia) excluding the numerous small Pacific Island states within Oceania where green turtle nesting also occurs. The 2007 Green Sea Turtle 5-year Status Review (NMFS and FWS 2007) provides a comprehensive summary of green turtle biology, life history, ecology, and population threats, but only includes nesting information from four Pacific locations (Hawaii, Guam, Japan, and Australia). The State of the World's Sea Turtles (SWOT)[1] database is another source of information, however, like all datasets, SWOT has its limitations. The database relies on published research and active monitoring projects voluntarily contributing annual nesting data, which in some cases means that known sites will not be represented if projects have not actively provided data to the SWOT effort. As there are many known nesting sites without active research or monitoring projects throughout Oceania, the region may be under- represented in SWOT's database and was overlooked in the two most recent published syntheses (Semioff 2004; NMFS and FWS 2007).

[1] SWOT is a partnership between Conservation International (CI), the IUCN Marine Turtle Specialist Group (MTSG), Duke University's OBIS-SEAMAP, and international collaborators including non-governmental organizations, government agencies, scientists, and conservationists.

The authors compiled a considerable amount of existing information on regional green turtle nesting aggregations in the process of answering management questions about the U.S. American Samoa-based longline fishery that operates in the South Pacific. For our purposes, it was decided that rather than recreate this process for each upcoming management issue, the authors would produce a document that would serve as a starting point for future compilations of data on green turtle nesting activity. This document is not intended to be comprehensive of all information for Oceania green turtles, rather its original purpose was to inform fishery management and impact analysis by the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO). Authors needed to better understand the relative abundance of nesting females in nesting areas that may be contributing individuals to the aggregation of green turtles that interact with U.S.-based fisheries or are exposed to other federal actions in the region. This review also includes a summary of sea turtle regulations in each country and international arrangements (Appendix I) that exist for sea turtle conservation or management. The authors recognize that existing legislation and international agreements do not always represent the reality of species protection due to the practical nature of enforcement, compliance, and socio-economic factors that vary widely between nations. While a detailed discussion of legislation's impact on sea turtle conservation is beyond the scope of this document, a spatial summary of legislation is included for reference with generalized conclusions discussed.

Marine turtles throughout Oceania have a long history of exploitation and are iconic species of high cultural, traditional, and often spiritual significance to many indigenous groups in the Pacific (Allen 2007; Balazs 1975, 1983a, 1983b, 1995; Campbell 2003; Eckert 1993; Fraizer 2003; Groombridge and Luxmoore 1989; Geermans 1993; Johannes 1978, 1986; Kinan and Dalzell 2004; McCoy 1974, 1982, 1997; Pritchard 1995a, 1995b; Woodrum 2003, 2007, 2010). Conservation is critical not only for persistence of the species, but for preservation of cultural folklore, traditions, and indigenous practices throughout the varied cultures of this region. This synthesis of existing information on Pacific green turtle nesting locations, nesting assemblage characteristics where available, and current legislative protections provides the most up to date information the authors encountered through an intensive search. It establishes a foundation for future prioritization of monitoring and recovery projects by identifying where current projects occur and where current assessment efforts may be lacking.

Methods

Available information from published documents, gray literature, and in-country government reports of green turtle nesting assemblage locations, sizes (estimates of annual nesting females), and current nesting trends (increasing, declining, stable, or unknown) within each country or territory's exclusive economic zone (EEZ) was compiled. Nesting beach surveys are the most widely implemented monitoring tool used by the global sea turtle community to assess and monitor the status of nesting sea turtle populations (Schroeder and Murphy 1999). For the purposes of this document, the terms monitoring, census, assessment, and survey are used interchangeably and reference any activity employed to gather nesting beach information, such as number of nests deposited

or number of nesting females at a location, with no intended implication of duration of the survey, unless noted. Long-term monitoring refers to consecutive-year projects that have employed a standardized monitoring protocol over ten or more years.

This literature review is accompanied by several maps created using ArcGIS™ (version 9.3 software, ESRI, Inc., Redlands, CA) that display the spatial distribution and various attributes of green turtle nesting sites in Oceania. Abundance of nesting females and general trend of the nesting aggregation are described, where possible, based on the best currently available information, and summarized in Table 1. Because the type of information available for nesting green turtle abundance in each country varies, estimates of annual nesting females were binned into the following categories for the purpose of displaying the information spatially in Figures 1, 1a, and 1b: < 10, 10-100, 101-500, 501-1,000, 1,001-5,000, 5,001-10,000, and 10,001-25,000. In cases where virtually no information was available beyond the presence of some green turtle nesting activity, a conservative approach was taken and it was assumed that < 10 females nest annually at those sites.

Sea turtle nesting assemblages exhibit natural annual fluctuations in abundance. As such, a conservative approach was taken and a minimum estimated range of annual nesting females was used, unless otherwise noted. Where information was presented in numbers of nests, an estimate of 4.5 nests per individual was applied to determine the number of nesting females likely represented. While this life history trait has not been studied for most of the rookeries in Oceania, our estimate is based on Van Buskirk and Crowder's (1994) reported average for the Heron Island, Australia rookery and an updated estimate for the nesting assemblage at French Frigate Shoals, Hawaii (S. Hargrove, pers. comm.). While the best available nesting information is used in this synthesis, NMFS recognizes that this information represents only one segment (less than 1%) of sea turtle life history (NRC 2010), and therefore population abundance estimates are not inferred from these data. The 155 papers, articles, books, published and unpublished reports, and correspondences used in preparation of this document are included in the References section and linked to the corresponding information within GIS shapefiles.

Generalized legislation reported in this summary is current as of the time of printing, with some possible exceptions where the authors were unable to confirm the accuracy of the most up to date information with in-country representatives. In these cases, information was adapted from a report compiled by SPREP in 2007; as a result, there may be some instances in which new legislation has been passed since 2007 that is not included in this report. To facilitate comparison of legislation between countries despite nuances of variation, regulations were categorized and presented as an overview within maps, while text associated with each country provides more detail. Generalized legislative categories include: allowable (permitted/regulated) take; open/closed harvest periods; minimum size limits; protection while on beaches (i.e., nesting females and eggs/nests only); and no legislation specific to green turtles. In many Pacific Island countries, indigenous and subsistence harvest is acknowledged and permitted.

Synthesis of Existing Data on Green Turtle Nesting and Legislation in Oceania

United States Areas of the Pacific

All U.S. areas of the Pacific are subject to the laws of the United States Federal Government as well as any international agreements to which the U.S. is a signatory. As such, the Endangered Species Act (ESA) of 1973 (16 U.S.C. § 1531 *et seq.*) is the statute under which sea turtles are federally protected in these areas. Six species of marine turtles occurring in the U.S. are listed under the ESA; in the WCPO, five of those species occur in U.S. waters[2] and are under joint jurisdiction of the NOAA Fisheries National Marine Fisheries Service (NOAA Fisheries Service or NMFS) and U.S. Fish and Wildlife Service (USFWS). NOAA Fisheries Service has the lead responsibility for conservation and recovery of sea turtles in the marine environment and USFWS is responsible for sea turtles in the terrestrial environment. Green turtles are listed as *threatened* throughout their range with the exception of breeding colonies in Florida and the Pacific coast of Mexico which are listed as *endangered*. The ESA prohibits unauthorized 'take' of listed species which is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C. § 1532(18)). Under the ESA, exceptions to 'take' prohibitions are permitted for scientific research or when take is incidental to an otherwise lawful activity, as long as the level of take will not jeopardize the existence of the species in the wild or appreciably reduce the likelihood of recovery in the wild. Both NOAA Fisheries Service and USFWS have dedicated enforcement divisions to handle violations of the ESA. The U.S. is a party to several international agreements related to sea turtles (see Appendix I) including the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) and the Convention on International Trade in Endangered Species (CITES) which prohibits international trade of marine turtles and marine turtle derived products. While the U.S. is not a party to the Convention on Migratory Species (CMS), they are a signatory to the Convention on Biological Diversity (CBD). Local state and territory governments may have additional protections in place for sea turtles, as discussed individually below.

American Samoa

The U.S. territory of American Samoa is located east of Samoa in the south Pacific and consists of the main island of Tutuila, the Manu`a group (Ofu, Olosega, and Ta`u Islands), Swains Island, and Rose Atoll (Tuato'o-Bartley et al 1993). In American Samoa, sub-adult and adult green turtles occur in low abundance in nearshore waters around Tutuila, Ofu, Olosega, Ta`u and Swains Islands with sporadic, low-level green turtle nesting occurring on Tutuila and Swains Islands (Tagarino et al. 2008; Tagarino and Utzurrum 2010). A May 2009 survey at Swains identified a total of 56 locations of pits/possible nests, turtle tracks, and evidence of pig activity (wallows) (Tagarino and Utzurrum 2010). However, the primary green turtle nesting location is at Rose Atoll with

[2] Leatherback (*Dermochelys coriacea*), hawksbill *(Eretmochelys imbricata*) loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*).

up to several dozen nests laid annually between October and March (review provided by Balazs 2009). No nesting trend data are available, but anecdotal information suggests major declines in the last 50 years (Tuato'o-Bartley et al 1993, Utzurrum 2002). Since 1971, 42 individual nesting green turtles have been flipper tagged on Rose Atoll during various trips (Grant et al. 1997). Of seven post-nesting green turtles satellite-tagged in 1993-95, six migrated nearly directly to Fiji, possibly to feed on Fiji's extensive seagrass beds (Craig et al. 2004). Several surveys cited in a summary of nesting observations at Rose Atoll 1839-1993 (Balazs 2009) documented pits on Sand and Rose Islands (up to 301 in one survey), however, it is unclear how that relates to numbers of individuals because some pits could be from prior nesting seasons.

In addition to protection under the federal ESA, sea turtles in American Samoa are protected by the Fishing and Hunting Regulations for American Samoa (DMWR 1995) which prohibit the import, export, sale, possession, transport, or trade of sea turtles or their parts and take (as defined by the ESA) and carry additional penalties for violations at the local government level. The Department of Marine and Wildlife Resources (DMWR) is the agency with vested authority and responsibility for conservation of protected species and enforcement of protected species regulations in American Samoa.

Commonwealth of the Northern Mariana Islands

The Commonwealth of the Northern Mariana Islands (CNMI) consists of 15 volcanic islands in the Marianas archipelago (excluding Guam). The three largest and southernmost islands are Saipan, Rota, and Tinian with the majority of the human population residing on Saipan. In CNMI, green turtle nesting occurs from March through August with some year round nesting documented. It is estimated that possibly fewer than 10 individual turtles nest annually on the islands of Saipan, Tinian and Rota (NMFS and USFWS 1998). Surveys of the northern islands, Alamagan, Pagan, Agrigan, and Asuncion, were sponsored by the Department of Defense and organized by the USFWS from May – June 2010. Turtle nesting activity was only observed on Agrigan, with seven nests documented (C. Eggleston and F. Amidon pers. com.). There were no recorded nesting observations during a survey of Anatahan in 2002 (Ilo and Manglona 2002).

The CNMI Division of Fish and Wildlife (DFW) has monitored nesting activity on Saipan since 1999 and has documented four to eighteen nests laid per year (DFW unpublished annual reports to PIRO). At least five beaches on Saipan have been monitored somewhat consistently over the past five years: Bird Island, Wing, Tank, Lao Lao Bay, and Obyan beaches (Ilo et al. 2005; Kolinski et al. 2001; DFW 2009). Nesting likely occurs on all or most of the accessible beaches on Tinian (Pultz et al. 1999), with six beaches occurring on Navy lands monitored for turtle nesting activity by Navy personnel: Chulu, Lamlam, Babui, Chiget, Dangkulo (Long Beach), and Masalok (Vogt 2009). Eleven beaches on Rota are known to support nesting: Songton, Teteto, Mochong, Sagua (Kokomo), Coral Garden, Okgok, Apanon, and Gaonan (the Cave Beaches), Uyulan, Tatgua, and Latte Stone (Lalayak or I Batko) (Ilo et al. 2005), of which two beaches had confirmed nesting activity in 2009 (Okgok and Tagua).

Intensive monitoring occurred on Saipan at seven beaches from March 4 to August 31, 2009 resulting in 16 green turtle nests documented (DFW 2009). Of major concern, however, is that three of potentially five nesting turtles and three nests were illegally harvested which suggests that poaching remains a significant threat to turtles on Saipan. Rapid assessments at Rota beaches Okgok and Tatgua on July 12, 2009 yielded 13 nests. On Tinian, from July 22-31, 2009, 36 nests at five beaches were documented with evidence of one nesting female illegally harvested (DFW 2009). Additional nesting assessments and dedicated monitoring efforts at Tinian and Rota are needed as these islands may provide viable nesting beaches in CNMI and are likely good candidate index sites for long-term monitoring to assess nesting trends over time. Genetic samples analyzed to date indicate that nesting females in CNMI and Guam are indistinguishable and should be treated as a single management unit (Dutton 2009 unpublished). However, sample sizes are small and additional sampling may reveal other haplotypes. Sufficient information on nesting trend is not available for green turtles in CNMI although anecdotal information from residents suggests that nesting activity has decreased over time, likely as a result of direct harvest, coastal development, and WWII impacts to nesting turtles and their habitats.

In addition to protection under the federal ESA, sea turtles in CNMI are protected by the Fish, Game and Endangered Species Act (PL 2-51). CNMI PL 2-51 establishes a Fish and Wildlife Division and states that the Director of Natural Resources shall determine whether any species shall be designated as threatened or endangered. Green and hawksbill turtles are listed as protected species in the CNMI Hunting Regulations (CNMI DFWb, accessed 2010) prohibiting hunting for these species. The CNMI Department of Land and Natural Resources, Division of Fish and Wildlife is the agency with vested authority and responsibility for the conservation of protected species and enforcement of protected species regulations in CNMI.

Guam

Guam is the southernmost island in the Marianas archipelago located in the western Pacific, south of Japan and north of Papua New Guinea. There is regular, low density green turtle nesting on Guam at a number of sites. Nesting activity appears to occur at low levels year round with a more concentrated nesting season apparent from May through August (Pritchard 1995b; NMFS and USFWS 1998a). Documented nesting beaches include: Ritidian National Wildlife Refuge, Haputo, Urunao, Tumon Bay, Cabras Island, the waterfront annex of Naval Base Guam, Spanish Steps, Cocos Island, Acho Bay, Nomña Bay, Jinapsan, and Taragüe Beach (DAWR 2004; Grimm and Farley 2008). The nearshore marine environment around Guam has been degraded by impacts from intense combat during WWII, shoreline development, sediment-laden runoff, pollution, and years of poorly treated wastewater effluent. Spanish Steps is at the mouth of Apra Harbor which has been heavily modified, particularly since World War II (USN 2010).

The Guam Department of Agriculture Division of Aquatic and Wildlife Resources (DAWR) initiated a sea turtle program in 1999 with primary objectives to monitor nesting activity and collect population data. From October 1, 2006 through July 31, 2008, 55 green turtle nests were counted at various beaches during opportunistic surveys

throughout Guam (DAWR 2009). Spanish Steps, or Orote point, on U.S. Navy land is considered one of the primary nesting locations on Guam (Grimm and Farley, 2008). Naval Facilities Engineering Command Marianas (NAVFACMAR) monitored nesting beaches at Spanish Steps three times per week from May to July during 2007 and 2008 that resulted in five and 18 green turtle nests, respectively (Grimm and Farley, 2008). Based on this limited information, one to four adult green turtles may nest per season at Spanish Steps; however, sufficient long-term and standardized monitoring information is not available to quantitatively describe the abundance or trend of nesting green turtles at Spanish Steps or for Guam overall. In 2000 and 2007, two post-nesting green turtles were satellite tagged on Guam and traveled to the Philippines and Japan, respectively (DAWR unpublished). Currently, nesting activity is documented opportunistically by Haggan-watch, a community-based volunteer network administered by DAWR.

In addition to protection under the federal ESA, sea turtles are protected by the Endangered Species Act of Guam which adopts the same definitions and status designations as the federal ESA and carries additional penalties for violations at the local government level. DAWR is the agency with vested authority and responsibility for the conservation of protected species and enforcement of the ESA of Guam. Other Guam resource agencies, such as the Bureau of Statistics and Plans (BSP), also have specific mandates in relation to sea turtle conservation. The BSP administers the Guam Coastal Management Plan (GCMP) through the Coastal Zone Management Act of 1972 (Guam Public Law 92-583 and Public Law 94-370). The GCMP guides the use, protection, and development of land and ocean resources within Guam's coastal zone, which includes all non-Federal property and all submerged lands and waters out to 3 nm (5.6 km) from the shoreline.

Hawaii

The State of Hawaii is an archipelago in the central Pacific Ocean containing hundreds of volcanic islands, separated into two groups: eight large southeastern Main Hawaiian Islands (MHI; seven of which are inhabited), and numerous uninhabited Northwestern Hawaiian Islands (NWHI; designated the Papahanaumokuakea Marine National Monument by Presidential proclamation in June 2006). Green turtles nesting and foraging within the Hawaiian Archipelago are likely comprised of one genetic stock, and may be considered a discreet management unit separate from other Pacific stocks (Dutton et al. 2008). Nesting occurs between May and August, and the primary nesting location at French Frigate Shoals (FFS) in the NWHI supports over 90% of documented green turtle nesting in Hawaii (Balazs 1976, 1980). Minor nesting also occurs at other atolls and islands in the NWHI[3] and on Kauai, Oahu, Molokai, Lanai, and Maui within the MHI (PIFSC unpublished). Within FFS, over 50% of all nesting occurs on East Island (Balazs 1976; Niethammer et al. 1997, Balazs and Chaloupka 2004), where nesting surveys have been conducted annually at this index site since 1973 via a collaborative arrangement between NMFS Pacific Islands Fisheries Science Center (PIFSC) and USFWS.

[3] Known nesting occurs at Laysan, Lisianski, Pearl and Hermes, and Midway. Four infertile nests were laid at Kure in 2009. No information exits about nesting activity at Nihoa and Necker.

The Hawaiian green turtle population was subjected to extensive human exploitation in the form of turtle and egg harvest at foraging and nesting grounds from the mid-1800s until the early 1960s, and nesting habitat destruction as a result of development (Balazs 1975a, 1976; Niethammer et al. 1997; Balazs and Chaloupka 2004).[4] Since enactment of State and federal ESA protections in 1974 and 1978, respectively, the nesting population at FFS has exhibited high annual variability in nesting female abundance, and a consistent upward trend over the past thirty years with an estimated annual growth rate of 5.7% (Chaloupka et al. 2008). The largest number of nesting females observed during a field season at East Island occurred in 2008 with 580 females identified during the six week sampling period (PIFSC and FWS unpublished).

In addition to protection under the federal ESA and international agreements and conventions, sea turtles in Hawaii are protected by the Hawaii Revised Statutes, Chapter 195D (Hawaii State Legislature, accessed 9/10/2010) and Hawaii Administrative Rules, 13-124 (Hawaii Administrative Rules, accessed 9/10/2010) which adopt the same definitions, status designations, and prohibitions as the federal ESA and carry additional penalties for violations at the State government level. The Hawaii Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) is the state agency responsible for the conservation and management of protected species in Hawaii. The Division of Conservation and Resources Enforcement (DOCARE) is the agency with enforcement authority at the state level in matters involving violations of Hawaii's protected species regulations.

Pacific Remote Island Areas

The Pacific Remote Island Areas (PRIAs) are U.S. areas that are widely spread throughout the Pacific and include Wake, Johnston and Palmyra Atolls, Kingman Reef, and Jarvis, Howland, and Baker Islands. Following a 28 day assessment in 1983 it was concluded that green turtles do not nest at Johnston Atoll, but occur foraging within the atoll (Balazs and Forsyth 1986). Low-level nesting was observed at Palmyra in 1987 and along the west coast of Jarvis Island in the 1930s (NMFS & FWS 1998) but no recent surveys have been conducted. Both Jarvis and Palmyra are geographically part of the Line Islands chain of coral atolls and islands in the central Pacific and are uninhabited remote National Wildlife Refuges administered by the USFWS. Jarvis is visited infrequently by refuge staff for one to two days at a time every two years. There is a research station on Cooper Island at Palmyra Atoll operated by The Nature Conservancy (TNC) that houses a small maintenance staff year-round and various research groups for shorter time periods. Anecdotally, no evidence of sea turtle nesting has been observed at Palmyra in recent years (USFWS, pers. comm.). In 2007, an in-water sea turtle research project was initiated at Palmyra by the American Museum of Natural History and Columbia University. While nesting beach monitoring is not a focus of the project, any nesting activities will be documented by either the project or by TNC staff that currently reside at the Atoll.

[4] Green turtle and egg harvest at FFS officially ended in 1964 when it was permanently placed under the jurisdiction of the USFWS, but the last documented harvest event was in 1959 when a commercial fishing boat harvested a minimum of 25% of nesting females present that season (Balazs 1975a).

The PRIAs do not support resident human populations and do not have local governments. Therefore, all sea turtle species that occur in the PRIAs are protected by the federal ESA as described previously.

International – States with Compacts of Free Association[5]

Federated States of Micronesia

The Federated States of Micronesia (FSM) consist of 607 islands in the western Pacific that are divided into four states: Yap, Chuuk, Kosrae, and Pohnpei. Green turtle nesting in FSM peaks between April and August, with some evidence of year round nesting (J. Cruce pers. comm.), in all states except Kosrae where nesting has not been documented. FSM has laws and regulations that prohibit the harvest of all sea turtles while they are on shore and of all eggs, establishes minimum size limits for hawksbills (27 inches curved carapace length [CCL]) and greens (34 inches CCL), and establishes closed seasons from June 1 – August 31 and December 1 – January 31, during which time no sea turtle of any size shall be taken or killed (www.fsmlaw.org, accessed 9/10/2010). However, these regulations are only applicable within FSM waters outside the 12 mile-state territorial waters zone. FSM is not a signatory of CITES. Each state has additional individual regulations described below.

Yap State, FSM is comprised of approximately 134 islands and 11 atolls of which 22 are inhabited by Yapese people, many of whom continue to practice cultural traditions. Turtles are an integral part of many aspects of Yapese life. Green turtles are the most common species nesting in Yap. During a four and a half month field season on Olimarao Atoll in 1990, 27 adult females were tagged (Smith et al. 1991). A field season on Elato Atoll in 1992 yielded 36 tagged adult females (Kolinski 1993). A total of 70 nesting green turtles were tagged in Ngulu Atoll on the islands of Lathow and Meseran from May through July in 1992 and another 75 nesting green turtles were tagged the following year from April through July of 1993 (Kolinski 1993). In addition, two tagging efforts were carried out at Elato Atoll where 36 nesting green turtles were observed from July through September of 1992 and 41 nesters from May through August of 1993 (Kolinski 1993). Ulithi Atoll, located approximately 185 kilometers (km) northeast of Yap Proper, is home to several "Turtle Islands" which are identified as significant green turtle nesting sites by local people including the island trio of Loosiep, Bulbul and Yeew and duo of Gielop and Iar (Cruce 2006). These islands may be among the largest green turtle rookeries in Micronesia (Kolinski 1992) and are the focus of current monitoring efforts in Yap. Turtles nesting on or mating near these islands have traditionally been hunted for their meat and eggs (Lessa 1983).

In 1991, 417 nesting green turtles were tagged on Gielop between May and August (Kolinski 1992). This study site was revisited subsequently when a turtle tagging project

[5] "Freely Associated States", the Republic of Palau, Federated States of Micronesia and Republic of the Marshall Islands, were formerly governed by the U.S. as part of the United Nations Trust Territory of the Pacific Islands but have since become sovereign states, are still eligible to receive funds from U.S. Federal agencies, and maintain close ties with the United States.

was carried out on the islands of Gielop and Iar from June 9 to August 24, 2005. Islands were monitored a total of 59 nights on Gielop and 25 nights on Iar with a total of 310 nesting green turtles tagged (186 from Gielop and 124 from Iar) and one nesting hawksbill turtle on Iar (Cruce 2006). During subsequent monitoring seasons on Gielop in 2006 and 2007, 329 and 250 nesting green turtles were tagged, respectively, between June and August each year (Cruce 2007).

In 2008, a research ban was instituted by local chiefs at Gielop so monitoring efforts switched to nearby Loosiep Island where 66 nesting green turtles were tagged between April 22 and July 18 with some evidence of predation documented (Cruce 2008). Research resumed at Gielop in 2009, with a total of 553 green turtles recorded, including eight non-nesting female green turtles and one male turtle tagged and assessed. Tag returns were documented from turtles originally tagged on Gielop in 2005 and 2006. At Loosiep Island, 118 nesting females were tagged between April 13 and August 2 with continued evidence of nest predation by exotic varanids and pigs (17 of 20 staked study nests) suggesting that management measures are needed on this island (Cruce 2009).

Genetic samples have also been collected during monitoring efforts, of which 462 have been analyzed to date. Results suggest nesting green turtles in Yap are comprised of one genetic stock distinguishable from other Pacific nesting populations, although additional samples and analysis are needed to provide increased resolution (Dutton 2009 unpublished). Of seven post-nesting green turtles satellite tracked from Gielop during 2005-2006, five migrated to the Philippines and one to Malaysia while another turtle's transmitter ceased sending signals while still in the FSM EEZ (Kolinski et al. 2007 draft manuscript). An additional seven post-nesting greens were tracked from Gielop in 2007; four turtles migrated to the Ryukyu Islands, Japan and three to the Philippines (PIRO and PIFSC unpublished data).

Yap State Code prohibits the commercial sale of sea turtle meat and eggs (Yap State Code, accessed 9/10/2010). Traditionally, nesting green turtles throughout Ulithi Atoll have been managed and conserved by the imposition of cultural limitations on take for consumption, put in place by leaders of the chief island, Mogmog (Lessa 1983). In recent years, it appears turtle take has increased due to the degradation of traditional practices although the number of turtles taken annually within Ulithi Atoll has not been assessed or quantified (Cruce 2009).

In Chuuk State, FSM, nesting sites include Fanang Island, East Fayu Island, and Murilo Atoll. According to a report from 1993, six to seven green turtles nested each night from February to June on East Fayu (Pritchard 1995b). One to three turtles per night were also reported to nest on Fanang Island as well as a few per night at Murilo Atoll (Pritchard 1995b). Chuuk State Code was still in draft form at the time of drafting of this report.

In Pohnpei State, FSM, green turtle nesting has been recorded at Oroluk Island, Oroluk Atoll. Oroluk is an atoll west of Pohnpei Island and has over 30 sandy islets and sandbanks. Only Oroluk Island is inhabited with fewer than 20 residents. Pritchard (1977) noted that Oroluk Atoll was apparently the only nesting ground of importance for

the green turtle in Ponape District (Pohnpei State) and he estimated 9 to15 nests per night at Oroluk with up to 20 nests on a good night. Pritchard also reported a nesting pattern with two peaks, December to January and June to July. At least some nesting is reported by inhabitants all year round (Edson and Curren 1987). Surveys from June through July of 1985 resulted in an average of 2.3 nests per month and May through August of 1986 averaged 3.4 nests per month, significantly lower abundance than the 9 to 15 nests per night reported by Pritchard in the 70s (Edson and Curren 1987). During a one day survey in November, 1990, no evidence of nesting was seen on Oroluk, however, Typhoon Owen had passed just north of the island eight days earlier and caused considerable damage to the island and reefs (Naughton, 2001). During Naughton's 1990 expedition, an individual on the island stated that between five and eight turtles nest or attempt to nest on Oroluk Island every month, except June and July when they are "too numerous to count." He reported that island residents take every turtle they encounter. In the 1990s, nesting activity still occurred on Oroluk although at a reduced level from that reported in the 1970s. According to Naughton (2001), there is little question that Oroluk Atoll is critically important to green turtles in the Caroline Islands, (Eastern range of FSM) and is probably the most important site for the species in eastern FSM.

Regarding other sites in Pohnpei, 74% of people surveyed by Buden and Edwards (2001) on Pohnpei Island indicated they had no knowledge of nesting activities of turtles on Pohnpei and its lagoon islands. Four people contributed unsolicited comments on nesting on Ant Atoll, and three described incidents of nesting on three different lagoon islands in Kitti (Buden and Edward 2001) indicating the possibility of very low-level nesting at a few sites in addition to Oroluk Atoll.

According to Pohnpei State laws, there is a minimum size limit for greens (34 inches carapace length) and hawksbills (27 inches carapace length) and closed harvest seasons June 1 to August 31 and December 1 to January 31, with nesting turtles protected and egg collecting prohibited at all times (SPREP 2007; Buden and Edwards 2001).

Although no nesting has been reported in Kosrae, state code regulates the take of turtles in water with a minimum size limit for all species of 27 inches carapace length, closed seasons June 1 to August 31 and December 1 to January 31, and prohibition of egg collecting and killing turtles while onshore at all times.

It is estimated that between 500 and 1000 green turtles nest annually in FSM, however, estimates are based on available data from the few nesting sites that have been monitored and sampled, whereas green turtles may nest at many more sites throughout Micronesia undocumented. As such, it is likely that we have underestimated nesting activity in this under-monitored region. The unknown impact of long-term and unregulated harvest of nesting females and their eggs in FSM further supports the need for more consistent monitoring and additional monitoring sites to establish the current status of the nesting green turtle population within FSM.

Republic of the Marshall Islands

The Republic of the Marshall Islands (RMI) is made up of 29 atolls and five islands with a total land area of approximately 70 square miles, and a total lagoon area of about 4,500 square miles. Atolls and low coral islands are aligned in two roughly parallel northwest-southeast chains: the northeastern Ratak Chain and the southwestern Ralik Chain. Green turtles are most common in the RMI with hawksbill turtles considered rare or scarce (NMFS and FWS 1998). Atolls most recognized as significant green turtle nesting areas include Bikar, Erikub and the island of Jemo. Additional minor nesting sites include the atolls of Bokak, Ailinginae, Rongerik, Bikini, Wotje, and Taka (McCoy 2004). First described by Tobin (1952 in McCoy 2004), northern RMI atolls are well known traditionally as "game reserves" due to the presence of nesting turtles and seabirds (this refers to Bikar, Bokak, and Taka atolls, the island of Jemo, and certain islands in Erikub atoll). Nesting occurs from May through November, peaking mid-June to mid-September. Lagoons throughout Marshall Islands atolls provide significant areas of potential shallow water foraging habitat for sea turtles (Eckert 1993), but in general, sea turtle nesting and foraging activity are more common in inverse proportion to proximity or density of human habitations and activities in the RMI (McCoy 2004).

Bikar Atoll likely supports the largest green turtle nesting assemblage in the RMI. Based on observations in the early 1970s (Hendrickson 1972), approximately 950 nests were laid, or 237 females may have nested annually at Bikar. At the time, Hendrickson concluded that Bikar represented one of the major breeding groups of sea turtles in the then-Trust Territory of the Marshall Islands (McCoy 2004). NMFS and FWS (1998) estimated a mean annual total of approximately 100-500 nesting females at Bikar Atoll based on an 11 night survey where 48 turtles were tagged in 1992. During the same expedition, eight turtles were tagged in one night on Jemo and a one-time survey of Erikub Islet at Erikub Atoll revealed "…many nesting excavations, some well within the interior of the islet. So numerous were these excavations that no attempts were made to count them" (Puleloa and Kilma 1992). Also at Erikub, two pits were observed on Aradojairek Islet and 48 pits on Aradojairen Islet, although it was apparent that some of these were from previous seasons.

Five post-nesting green turtles were satellite tagged on Loj Islet, Erikub Atoll in 2007-2008. One turtle migrated to Bikini Atoll, RMI, one to Tarawa Atoll in Kiribati, one to the Philippines passing through CNMI, and two turtles circled for long periods of time in the open ocean with one having final transmissions in the FSM EEZ and the other in RMI (PIRO and PIFSC unpublished). Between 2005 and 2007 a project supported by NMFS PIRO was implemented to collect genetic samples. Results from the analysis of 125 samples suggest that green turtles nesting in RMI are comprised of one genetic stock distinguishable from other Pacific nesting populations in Palau, Yap and the Mariana Islands (Dutton 2009 unpublished). Again, additional samples from nesting sites throughout RMI are needed to provide greater resolution for a regional stock analysis.

Turtles in the RMI have long been a food source and have played an important cultural role in the lives of inhabitants. In 2009, the Marshall Islands Marine Resources Authority began to implement an outreach and education program with support from NMFS PIRO.

The level of exploitation of turtles is unknown, and there are no current data available on status of turtle stocks in the RMI (McCoy 2004), although based on the available information an estimated 100-500 green turtles may nest in the RMI annually (NMFS and FWS 1998). While there does not appear to be enough data to conclude if trends are increasing or decreasing, anecdotal information from local people suggests that the number of nesters has decreased over time, possibly by as much as 50 percent in the last 10 years (McCoy 2004).

The harvest of sea turtles in the RMI is regulated by the Marine Resources Act (RMI 1997) which sets minimum size limits for greens (34 inches carapace length) and hawksbills (27 inches carapace length) and closed seasons from June 1 to August 31 and December 1 to January 31. Egg collecting and take of turtles while they are onshore is prohibited at all times. The Marshall Islands Marine Resources Authority is the entity with the responsibility of managing marine resources in the RMI. RMI is not a participating party to CITES.

Republic of Palau

Palau is an island nation made up of four populated islands and several hundred smaller islands and atolls organized into 16 states, 800 km east of the Philippines. Green turtle nesting has been documented at Helen Reef in Hatohobei State and Merir Island in Sonsorol State with additional low level nesting in Ngarchelong, Kayangel, and Melekeok States. Based on 42 genetic samples analyzed to date in comparison with samples from nearby rookeries, green turtles nesting at monitored sites in Palau appear to be one genetic stock distinguishable from other Pacific nesting populations, although additional samples are needed to provide increased resolution (Dutton 2009 unpublished). Nesting summaries for each State are as follows:

Hatohobei State: During a study at Helen Reef from April 19 through December 8, 2005, 301 green turtle nests were counted, 47 individual nesting turtles were flipper tagged, and nesting turtles emerged almost every night between April and August 2005 (Barr 2006). On April 22, 2008 a female green originally tagged on Helen Island, Hatohobei State, on September 5, 2006 was recovered near Goulburn Island, Northern Territory, Australia after being speared with a traditional harpoon (Palau BMR 2008). Reduced abundance of green sea turtles at Helen Reef has been noted by the Tobian community (Emilio et al. 2002 in Barr 2006).

Sonsorol State: From November 2004 through September 2005, 331 green turtle nests were documented during daily surveys and 36 individual turtles were tagged during night surveys at Merir Island (Palau BMR 2005). Five green turtle nests were documented during surveys conducted on April 17 and 25, 2005 at Pulo Ana Island (Palau BMR 2005). During daily monitoring from November 2007 to August 2008, 739 green turtle nests and 382 non-nesting emergences were documented with peak nesting observed in May (Palau BMR 2008). A green turtle tagged on June 7, 2007 by conservation officers on Merir Island, Sonsorol State was recaptured in a set net near the village of Yomitami, Okinawa, Japan on October 15, 2007. The turtle was retagged and released (Palau BMR 2008).

Ngarchelong State: Between March and August of 2008, four surveys found 11 green turtle nests along 2.4 km of the island of Ngerechur, nine of which had been destroyed by wild pigs (Palau BMR 2005). On July 22 and 23, 2008 turtle nesting surveys were conducted along a 1.5 km beach on Ngerechur Island, just off of Ngarchelong state where one green turtle nest was documented (Palau BMR 2008).

Kayangel (Ngcheangel) State: Kayangel is an atoll with four islets on its east side. Kayangel Island, with a land area of 1.12 km^2 and a perimeter of 6 km, is the largest island in the atoll. Ngeriungs is just south of Kayangel and is the second largest island of the atoll with a land area of .32 km^2 and a perimeter of 3 km. Between April 28 and October 10, 2005, two green turtle nests were documented during occasional nesting beach surveys on Kayangel Atoll (one on Kayangel and one on Ngeriungs) (Palau BMR 2005). Green turtle nesting also occurs at Ngeruangel Islet, Ngeruangel Atoll, 10 km northwest of Kayangel. Between June 22, 2005 and October 10, 2005, five green turtle nests were documented as a result of three surveys (Palau BMR 2005).

Melekeok State: Melekeok is a town on the east coast of Babeldaob Island with a beach area of 4.43 km^2. On, November 11, 2005, five sites along the beach were surveyed with no turtle nests documented. Interviews with several residents indicated turtle nesting in the area with a maximum of five green turtle nests in a year (Palau BMR 2005).

Palau domestic fishing laws specify minimum size limits for green turtles (34 inches carapace length) and hawksbills (27 inches carapace length) and closed seasons from June 1 to August 31, and December 1 to January 31 (SPC and BMR Palau, 2007). Taking of eggs or female turtles while onshore is prohibited at all times. Palau is a participating party to CITES.

International

Australia

Green turtles nest at numerous sites along the east, north and west coasts of Australia as well as many islands and islets offshore and on the Great Barrier Reef (GBR) and in the Coral Sea. To remain within the scope of this document, only those sites along the eastern coast, on the GBR and in the Coringa-Herald National Nature Reserve (CHNNR) in the Coral Sea will be discussed. Nesting occurs in these areas between October and March (Limpus 2009). The Northern Great Barrier Reef (NGBR) includes the largest nesting concentration of green turtles in the world (Chaloupka et al. 2007), with 90% of nesting activity in the area occurring on Raine Island, Moulter Cay, and No. 7 and No. 8 Sandbanks (Limpus 2009). Minor breeding aggregations also occur on the Murray Islands, Bramble Cay, and other outer barrier islands of the NGBR, most inner shelf cays, and mainland beaches north of Cape Grenville and along the Torres Strait (Limpus 2009). Raine Island is the primary index beach for the NGBR stock, but a total tagging census has not been attempted and there has been limited annual monitoring of the nesting aggregation at NGBR and Torres Strait rookeries due to size of the nesting assemblage and logistical challenges associated with site remoteness (Limpus 2009). This region

experiences significant inter-annual fluctuation in nesting female abundance, ranging at certain sites from a few dozen to over 10,000 annual nesting females, driven primarily by the El Niño Southern Oscillation (Limpus et al. 2003; Chaloupka et al. 2007; Limpus 2009). Moulter Cay has nightly nesting activity and average density that is strongly correlated with the activity and density at Raine Island. High density nesting (in excess of 10,000 females annually) was reported in the past in the mid 1950s and 60s (Limpus 2003). It is also expected that during a high density season several thousand additional females nest at No. 7 and No. 8 Sandbanks, the Murray Islands, Bramble Cay and other smaller nesting sites in the NGBR and Torres Strait (Limpus 2009). Bramble Cay is monitored annually via saturation tagging; abundance estimates range from 40 to 700 nesting females each year (Limpus 2009). Although Limpus (2009) does not estimate size of the adult female population occurring at Raine Island, he approximates that 41,000 female green turtles may occur annually during a typical high-density nesting season. Seminoff (2004) and NMFS and USFWS (2007) estimate 18,000 and 25,000 annual nesting females at Raine Island, respectively. Chaloupka et al. (2007) reports 4,000 to 12,000 annual nesting females at Raine Island. Based on available information, a conservative estimate of the annual mean number of nesters in the NGBR is 10,000-25,000 females.

Chaloupka et al. (2007) identified a nonlinear nesting trend, increasing from the mid-1970s and leveling off by the mid-1990s. Lack of a continued increasing trend at Raine Island may be due to a number of factors including: increasing sea surface temperature (Chaloupka and Limpus 2001; Limpus et al. 2003); decreasing reproductive output as the stock approaches carrying capacity (Troëng & Chaloupka 2007); over-harvest in northern Australian and New Guinean waters (Limpus et al. 2003; Limpus 2009); and hydrology or rising groundwater that floods egg chambers (Limpus et al. 2003). Therefore there is concern regarding long-term stability of the NGBR nesting assemblage given a significant decline in breeding success (low hatchling production and recruitment) over the last three decades at Raine Island (Limpus et al. 2003; Limpus 2009). Additionally, there has been a significant downward trend in mean curved carapace length (CCL) of nesting females at Raine and Moulter Cay over 26 breeding seasons, 1976-2001 (Limpus et al. 2003). This decrease in carapace size has occurred in conjunction with a progressive increase in remigration interval (Limpus 2009), and while long-term monitoring for abundance of annual nesters has not provided a clear indication of the stability of this stock, changes in CCL and remigration interval are consistent with a group that could be in early stages of decline as a result of excessive loss of adult females (Limpus et al. 2003; Limpus 2009).

In the southern Great Barrier Reef (SGBR), major green turtle breeding areas include the islands of the Capricorn Bunker Group: Northwest, Wreck, Hoskyn, Tryon, Heron, Lady Musgrave, Masthead, Erskine, Fairfax, North Reef, and Wilson Islands. Minor breeding aggregations occur at Bushy Island, the Percy Islands, Bell Cay, Lady Elliot Island, mainland beaches from Bustard Head to Bundaberg, and the northern part of Fraser Island. Greater than 90 percent of all SGBR nesting occurs within protected habitats of National Parks and Conservation Parks (Limpus 2009). Size of the annual breeding assemblage has been monitored at several rookeries for varying periods since 1964 and

there exists a wealth of information for this stock (summarized in Limpus 2009). Heron Island is the SGBR index nesting beach and has exhibited a stable fluctuation (i.e., no significant upward or downward trend) in annual nesting activity for almost four decades, 1967-2004 (Limpus 2009). Chaloupka et al. (2007) reported a stable nesting trend with approximately 1,500 nesting females during a good season at Heron Island. However, there has been significant long-term reduction in mean size of breeding females within this stock over 26 breeding seasons that may be indicative of over-harvest of adult females (Limpus 2009). Based on mid-season nightly track counts, the SGBR is estimated to support 5,000-10,000 nesting green turtles annually (Limpus et al. 1984 and Limpus 1985, in Limpus 2009).

The Coringa-Herald National Nature Reserve (CHNNR) is located 440 km east of Queensland, Australia and is comprised of three pairs of islets: Herald Cays (NE & SW), Coringa Islet (SW & Chilcott), and Magdelaine Cays (NW & SE). Nesting takes place at NE Herald Cay, SW Herald Cay, Chilcott Islet and SW Coringa Islet. The reserve is afforded some protection by virtue of its remoteness and lack of introduced predators (Harvey et al. 2005). Nesting activity at CHNNR extends from late October until approximately mid April, peak nesting occurring from late November through February. With the exception of the 1992/93 nesting season, NE Herald Cay was monitored for 13 years from 1991/92 through 2003/04 with surveys that ranged from four to 33 nights per season. Additionally, SW Herald Cay, Chilcott Islet and SW Coringa Islet were monitored sporadically during this 13 year timeframe. A total of 6,193 female turtles were recorded nesting at all four islets, 4,924 of which nested at NE Herald Cay. Yearly nesting abundance ranged from 12 females (2000/01 season) to 1,445 females (1999/00 season) (Harvey et al. 2005). During the 13 year monitoring period 3,141 turtles were tagged, 2,267 of which were tagged at NE Herald Cay (Harvey et al. 2005). Moritz et al. (2002) report 1,095 green turtles tagged during the 1999/00 season in the CHNNR. In the same season, Harvey et al. (2005) recorded 1,715 total nesting turtles during 33 survey nights of which 922 individual turtles were tagged at three islets: NE & SW Herald Cays and SW Coringa Islet. Insufficient data are available to discern an overall nesting trend, however curved carapace length of nesting females has declined significantly over time which may be the result of harvest pressure or other sources of adult mortality, potentially from the Torres Strait/Papua New Guinea region (Harvey et al. 2005).

Marine turtles in Australia are protected under the Environment Protection and Biodiversity Conservation Act of 1999 (EPBC Act), which implements several international agreements/conventions to which Australia is a signatory. The EPBC Act lists all marine turtles in Australia as 'threatened' species, and provides several mechanisms to address declines in population numbers of listed species that include: recovery plans, threat abatement plans, wildlife conservation plans, conservation agreements and conservation orders. It does not, however, apply within individual states; State Governments are primarily responsible for wildlife and habitat conservation in Australia. In Queensland, for example, the Nature Conservation Act (1992) and associated regulations provide protection for marine turtles and their habitat within Queensland. Additional types of legislation that vary by state and impact marine turtle

conservation include Marine Parks legislation and fisheries regulations. Traditional Owners, as recognized under the Australian Government's Native Title Act of 1993, are able to assert their rights to gain customary authority for shared resources such as marine turtles which includes traditional hunting rights. Within the Great Barrier Reef, Traditional Use of Marine Resources Agreements can be accredited under Marine Park zoning plans, and Indigenous Land Use Agreements are also being used more frequently. Indigenous groups in Australia have made progress working with governments, wildlife managers and scientists to develop co-operative frameworks of shared expertise and decision-making that incorporate their cultural, social, and political imperatives (K. Dobbs pers. comm.). These initiatives are intended to give indigenous groups greater authority and responsibility, and hence a sense of ownership, commitment, and compliance with regulations as opposed to government-imposed initiatives to sustainably manage turtle resources. On a regional level, the Torres Strait Treaty between Australia and PNG outlines the boundaries between the two countries and how the sea area may be used. The Treaty includes provisions for traditional fisheries in the area, including turtle harvest by indigenous groups. Australia is a participant in the Convention for the Protection of the World Cultural and Natural Heritage (World Heritage Convention), as well as CMS and CITES, both of which list sea turtles under Appendix I (species threatened with extinction).

Cook Islands

The Cook Islands consist of fifteen islands spread over 2.2 million square kilometers of ocean, divided into two distinct groups: the Southern Cook Islands which were formed by volcanic activity, and the Northern Cook Islands which are older and consist of six atolls.

In the northern Cook Islands, green turtles nest at Penrhyn (Tongareva), Rakahanga, Pukapuka, and Manihiki Atolls (Balazs 1995). Woodrom-Rudrud (2010) additionally lists green turtle nesting activity at Suwarrow atoll and Nassau island, although additional information regarding number of nesting females is not included for these sites. At Pukapuka, green turtles nest on one of the uninhabited islets and there is some directed harvest of turtles and eggs (Balazs 1995). Reports from the 1960s and 1970s indicate the presence of green turtle nesting activity at other locations but no further details on nesting female abundance or trends are available (Balazs 1995). In the southern Cook Islands, green turtles nest primarily at Palmerston Atoll, which hosts the majority of green turtle nesting within the Cook Islands. According to a review provided by Balazs (1995), reports from the 1960s and 1970s refer to Palmerston as an important nesting location for green turtles in the Pacific, although no indications of numbers of nesting females were provided. From 1972 to 1977 a decline in the number of nesting turtles was observed by inhabitants (Balazs 1995). Annual nesting numbers declined from 30 or 40 to fewer than 10 in under ten years (Helfrich 1974). Additional sites in the southern Cook Islands identified by Woodrum-Rudrud (2010) include Mangaia, Atiu, Mauke, and Roratonga islands, although no further information on nesting abundance is available.

In November 2000, the Center for Cetacean Research and Conservation, a local NGO in the Cook Islands, conducted a consecutive 25 night nesting beach survey on Cook's Islet of Palmerston Atoll (CCRC 2004). Only seven turtles were recorded nesting at Cook's

Islet during this survey, and few turtles crawled at the other islets, indicating much lower level nesting than previously reported (anecdotally) at this site. These results were corroborated by Palmerston fishermen, all of whom commented on the paucity of turtles that season (CCRC 2004).

In the Cook Islands, the Marine Resources Act of 1989 provides for the protection and management of fishery resources, the definition of which includes marine turtles. Specific regulations regarding marine turtle harvest were unavailable at the time of printing although there is full protection of marine turtle eggs (Pulea 1992). The Cook Islands is a participating party to CITES.

Fiji

Fiji consists of an archipelago of more than 300 islands, of which 110 are permanently inhabited, and more than 500 islets located in the South Pacific. The last remaining nesting sites for green turtles in Fiji are small, isolated islands and sand isles north of Taveuni including Nanuku Levu and Nukumbalati Islands within the Hemskercq and Ringgold reef systems. In 1970, eight nests were observed and in January 1980, 16 nests were observed at Nanuku Levu and Nukumbalati (Guinea 1993). As of 1996, the Fisheries Division estimated 30 to 40 nesting green turtles in Fiji (Weaver 1996) with a more recent estimate of 50 to 75 (Batibasaga et al. 2006). A commercial ban on sea turtle harvest was instituted in 1997 (Batibasaga 2002). However, green turtles in Fiji are regularly harvested for consumption and harvest continues to play a significant role in the subsistence economy of many Fijian communities despite the moratorium [May 1997 to December 2000, and February 2004 to December 2008, recently extended through 2019] (Guinea 1993; Laveti and MacKay 2009). There are no long term studies in Fiji to provide information on sea turtle nesting trends but evidence suggests a decline in nesting green turtles due mainly to overharvest (Batibasaga et al. 2006).

Sea turtles and their eggs are managed under Fisheries Regulations in Fiji. The Fisheries Act, as amended in 1979 and 1991, outlines gear requirements when spearing a turtle and also states that "No person shall at any time dig up, use, take, sell, offer or expose for sale, or destroy turtle eggs of any species or in any way molest, take, sell, offer or expose for sale, or kill any turtle the shell of which is less than 455 mm [18 inches] in length. No person during the months of January, February, November or December in any year shall in any way molest, take, sell, offer or expose for sale, or kill any turtle of any size". The possession, sale or export of any turtle shell less than 18 inches in length and the export of turtle flesh and turtle shell unless it is worked into jewelry or otherwise processed into a form approved by the Permanent Secretary for Primary Industries and Cooperatives are all prohibited acts (Government of Fiji 1992). A National Moratorium prohibiting the killing, harming or molesting of any marine turtles including their meat, eggs or shell was first enforced in 2004 by the Fijian Government. It was recently extended for a further ten years by the Fijian Cabinet until 2019. Indigenous Fijians are still able to legally harvest marine turtles if they obtain prior approval from the Fisheries Department (South Pacific Projects, accessed 9/10/2010). There is some disagreement, however, regarding the effectiveness of Fiji's moratorium mostly due to lack of compliance and enforcement (Laveti and Mackay 2009). Fiji is a participating party to CITES.

French Polynesia

French Polynesia consists of 130 islands and atolls spread over a large geographic area in the central south Pacific. In western and central French Polynesia, green turtles have historically been observed nesting at Tupai Atoll, Maupiti, Bellinghausen Atoll, Manihi Atoll, Tetiaroa Atoll, Bora Bora, Mopelia Atoll, and Scilly Atoll. Green turtle nesting is concentrated at Scilly Atoll in the Leeward Islands. Observations in the late 1970s, early 1980s, and early 1990s suggested 300 to 400 nesting females occurred there annually between November and March (Balazs et al. 1995; Lebeau 1985). These observations in conjunction with information from local residents indicate a likely decline in nesting numbers between the 1950s and early 1970s, although numbers may have stabilized between 1972 and 1991 (SPC 1979b; Balazs et al. 1995; Pritchard 1995a). Nesting females and adult males flipper tagged and/or satellite tagged at Scilly Atoll have been recovered in Tonga, New Caledonia, Vanuatu, the Cook Islands, and Fiji (Balazs et al. 1995; Craig et al. 2004); this tag return information reveals some of the longest range migrations recorded for green turtles (SPC 1979b, Craig et al. 2004).

Nesting occurred on Manihi Atoll in 1971 (Hirth 1971, cited in Pritchard 1995a) but recent information is not available. A survey in 1991 at Bellinghausen Atoll resulted in 33 tagged green turtles (SPREP TREDS 2009 Annual Report). Sporadic nesting surveys at Tetiaroa Atoll have been conducted since 2004 although 2008-2009 was the first nesting season with an organized, sustained survey effort which revealed 81 crawls and 33 nests (Te Mana O Te Moana 2009). Low level nesting has also been observed at Tikehau Atoll (Te mana Tea 2007), and four to 18 turtles nest each year on Bora Bora (Chelonia Polynesia, pers. comm.). Since 2000, adult green turtles occurring on Maupiti Island and Tupai Atoll (Leeward Islands) have been harvested[6] (Chelonia Polynesia, pers. comm.). During the 2007 nesting season, only one crawl was recorded at Tupai.

In eastern French Polynesia, green turtles have been documented historically nesting at Pukapuka Island (a different island from Pukapuka coral atoll in the northern Cook Islands). The most recent information is from 1938 and does not provide an estimate of annual nesting females, although it is noted that turtles and eggs were regularly taken for consumption and residents were already beginning to observe turtles "dying out" (Beaglehole and Beaglehole 1938, cited in Pritchard 1995a).

French Polynesia is an overseas territory of France and sea turtles have been completely protected since 1990 by the Polynesian government (DELIBERATION No. 90-83 AT du 13 Juillet 1990 relative à la protection des tortues marines en Polynésie Française). Prior to this date, traditional harvest with seasonal and size restrictions was permitted. Under the revised statutes, turtles are fully protected and it is strictly forbidden to harm, own or hunt sea turtles or engage in commerce of any kind pertaining to the sale of shell, meat and eggs. Scilly Atoll has been protected as a marine reserve for sea turtles since 1971 by the local government (Vu l'arrêté No. 2559 DOM du 28 Juillet 1971 portant classement

[6] Additionally, approximately 20-50 juvenile green turtles are harvested annually from waters of the Leeward Islands by poachers (Chelonia Polynesia, pers. comm.).

du lagon de l'île Manuae ou Scilly). French Polynesia is not a participating party to CITES (although France is a participating party).

Japan

Japan is not typically included in the definition of Oceania, but is included in this synthesis given the documented linkage with the region highlighted by post-nesting satellite tracked green turtles migrating from Guam and FSM to Japan (DAWR unpublished data; PIRO and PIFSC unpublished data). Green turtle nesting in Japan occurs primarily in the southern portion of the country in the Ryukyus Islands of the Okinawa prefecture and the Ogasawara Islands (AKA Bonin Islands), a group of over 30 tropical and subtropical islands (only two of which are inhabited) located approximately 1000km south of Tokyo (Kamezaki et al. 1999; Horikoshi et al. 1994). For the purposes of this synthesis, the primary green turtle rookery that occurs at Chichi-jima within the Ogasawara Islands is included. The Ogasawara Islands were designated a National Park by the Japanese government in 1972, and most uninhabited islands have restricted access. Green turtles nest during the summer season mainly at Chichi-jima with a mean annual total of approximately 500 nesting females in recent years (Chaloupka et al. 2007).

Historically, Ogasawara was a whaling operation base and green turtles were harvested locally for their meat since the 1830s (Ishizaki 2007). Records kept since the late 19th century show a rapid decline in the sea turtle population between 1880 and 1920. By the beginning of the 20th century, efforts were made to manage marine turtles through harvest regulations and artificial hatcheries (Ishizaki 2007). Today, sea turtle harvest in the Ogasawara Islands continues under strict governmental regulation with a harvest limit of 135 mature turtles per year, alongside various resource recovery efforts led by the Ogasawara Marine Center and supported partially by the Ogasawara Village Government (Ishizaki 2007). Concurrent with regulated harvest activities, the sea turtle population has steadily increased since the early 1980's and has exhibited an estimated annual population growth rate of 6.8% per year (Chaloupka et al. 2007).

In Japan, there are eight laws and ordinances that regulate (allow via permit) or prohibit actions harmful to sea turtles, such as taking, buying, and selling turtles, their eggs, and any derivative products, or restrict access to nesting beaches. In general, harvest is prohibited but exemptions may be obtained for subsistence use. The Law for the Conservation of Endangered Species of Wild Fauna and Flora is the primary law in Japan that intends to conserve endangered species. It prohibits the capture of sea turtles and eggs for sale for all seven species and prohibits domestic assignment or transfer of endangered species listed in CITES (Umigame Hogo no tameno 2006). This law was established in accordance with CITES and is enforced by the Japan Ministry of Environment.

Kiribati

Kiribati is an island nation that consists of 32 atolls and one raised coral island that are separated into three distinct chains, the Gilbert Islands, Phoenix Islands, and Line Islands, dispersed over 3.5 million square kilometers. The westernmost islands in Kiribati (formerly known as the Gilbert or Tungaru Islands) consist of a chain of 16 atolls and

coral islands including Tawara, the capital of Kiribati. In this region, green turtles have been documented nesting at Tawara Atoll, Katangateman Sandbank northeast of Makin, and another sandbank by Nonouti Island (although anecdotally, turtles have historically nested at all 16 atolls and islands except Banaba [SPC-NMFS 1979a]) with a minimum total of approximately 20 nests at Tarawa in 2007-2008 (Bell et al. 2009b). No information is available regarding nest numbers at other sites or trend for this island group.

The Phoenix Islands consist of eight low coral islands and atolls. Green turtle nesting has been observed at all eight locations including Canton, Nikumaroro, Enderbury (aka Rawaki), Phoenix, Birnie, Hull (aka Orona), Sydney (aka Manra), and McKean Islands. Canton and Enderbury Islands reportedly host the largest numbers of nesting green turtles of these eight sites. Observations in the early 1970s suggested several hundred nesting females occurred on Canton Island (Balazs 1975b) and a survey done in the summer of 2002 recorded at least 160 old nests on Enderbury Island (Obura and Stone 2002). A combined total of 60 to 80 nests were recorded annually at the other six islands in the Phoenix group during surveys in the summers of 2000 (Stone et al. 2001) and 2002 although this is likely an underestimate of nesting activity because the peak nesting season regionally is October – November (Balazs 1995). Based on the available information, it is estimated that 100-300 green turtles may nest in the Phoenix group annually. Little to no information on trend is available for the Phoenix group.

The Line Islands consist of eleven atolls and coral islands in the central Pacific south of Hawaii, eight of which belong to Kiribati and three of which are the U.S. possessions of Palmyra, Kingman, and Jarvis. Of those under the jurisdiction of Kiribati, green turtles have been documented nesting at Christmas, Fanning, Vostok, and Caroline Islands. Information on abundance of nesting females in recent years is not available for these sites as no surveys have been conducted. Turtles appear to have declined considerably at both Fanning and Christmas Islands between the early 1800s and 1990s when human habitation began (Balazs 1995).

In Kiribati, the Wildlife Conservation Ordinance (Laws of the Gilbert Islands 1977) prohibits hunting, killing or capturing any wild turtle on land and fully protects the green turtle in the following places: Birnie Island, Caroline Island, Christmas Island, Flint Island, Gardner Island (Nikumaroro), Hull Island (Orona), Malden Island, McKean Island, Phoenix Island, Starbuck Island, Sydney Island (Manra), and Vostock Island. Kiribati is not a participating party to CITES.

Nauru

Nauru is the world's smallest island nation and consists of one small island, approximately 21 square kilometers in area, located in the southwestern Pacific Ocean. The authors are unaware of any reports of green turtle nesting activity on Nauru. Nauru is not a participating party to CITES.

New Caledonia

New Caledonia is an overseas territory of France that consists of one large Main Island (Grande Terre), the Isle of Pines, the Belep islands, the d'Entrecasteaux islands, the Chesterfields, the Loyalty Islands group, Astrolabe, Walpole, Matthew, Hunter (Fearn) islands and additional small islands and islets. The largest known nesting area for green turtles is the d'Entrecasteaux atolls, located 160 miles north of Grande Terre. It is comprised of four islands, Surprise, LeLeixour, Fabre, and Huon. There was evidence of 'major' nesting in the past, dating back to the 19th century documented by American explorer William Billings (Pritchard 1994). Pritchard (1994) described turtles to be "abundant on the southern island of Surprise, and saturation level on the additional three islands (LeLeixour, Fabre, and Huon)." Based on this survey, Pritchard (1994) estimated that 50 nesting emergences occurred per night at Huon (or approximately 2,800 nests annually). An estimate of 80 nesting females per night has also been reported (Anon. 2004). In a 1991 survey, 310 tracks were counted on Surprise island with 14 turtles tagged, 1,800 tracks and 149 turtles tagged on Huon island, 572 tracks on Fabre island, and 54 turtles were tagged in one night on both Fabre and LeLeixour islands. An additional 280 tracks and 80 nests were located on small unnamed sandy islets (Pritchard 1994). A country-wide survey of over 6,000 km of nesting habitat in December 2006 and January 2007 identified 22 green turtle nesting locations hosting an estimated 1,000 – 2,000 nesting females annually (Limpus et al. 2009). The most recent nesting data are from a series of surveys carried out each December from 2007 to 2009 (service de la marine marchande et des pêches maritimes, 2010): on average, on all four islets, around 150 turtle tracks were counted daily in December 2007 as well as 2009. However, in 2008, more than 1,150 turtle tracks per day were reported. While trend information is not available, recent information compared to historic accounts (Pritchard 1994 & 1995a) does not suggest there has been a significant decline in abundance of green turtles nesting in New Caledonia.

Regulations related to sea turtle management in New Caledonia vary within the country. In the Loyalty Islands province (as per fishery regulations of 1985) the take of marine turtles and their eggs is prohibited from November 1 through March 31. As of January 2008, the 1985 regulations have been amended for the EEZ, the Main Island (Northern and Southern provinces), and remote islands such that it is not permitted to capture, sell, purchase, or disturb any marine turtle species or nest at anytime. Additionally, the compulsory use of handling equipment (de-hooker, line-cutter, etc.) in commercial fisheries is required for incidental catch of turtles. Regulations prohibit the export or import of marine turtles (alive or dead) or any turtle parts or products, and exceptions may be granted for customary celebrations or scientific purposes. New Caledonia is not a participating party to CITES (although France is a participating party).

Niue

Niue is an island nation in free association with New Zealand. It consists of a single island approximately 256 square kilometers in area located east of Tonga. Green and hawksbill turtles occur in Niue waters (Government of Niue 2001), but the authors are unaware of any reports of green turtle nesting activity on Niue. Domestic Fishing

Regulations (1996) prohibit the harvest or take of all turtle species unless approval is received from the cabinet. Niue is not a participating party to CITES.

Papua New Guinea

The Independent State of Papua New Guinea (PNG) occupies the eastern half of the island of New Guinea and numerous offshore islands. Offshore islands in the northern area include New Hanover, the Tigak Islands, Djaul (including Mait Island), the St. Mathias Group (Tench, Emirau and Mussau), Tabar, Lihir, Tanga and Anir islands. Very little information is available on the abundance and trends of nesting green turtles in PNG. According to a PNG National Fisheries Authority (NFA) report, nests are raided for eggs at Nago, Atmago, and Ral islands indicating nesting activity at these locations (NFA 2007). Villagers around Kavieng indicated a peak nesting season for greens of August through October. Around Kavieng, green turtles nest at Nago Island, Atmago, Nusalaman, Usen and Lemus. In the past, green turtles used beaches on Limanak, Limalam and Nusailas Islands to nest although they are no longer in use which may be attributed to the increase in human population on these islands which led to increased harvest pressure (NFA 2007).

Long Island is a volcanic island located north of the island of New Guinea in PNG. There is limited information on green turtle nesting at this location although this rookery has been sampled for genetic analysis (Moritz et al. 2002). According to local inhabitants, greens are the most common nesters and nest all year long but with a pronounced peak nesting season from May through October (Pritchard, 1979). Nesting density was reported to be variable with anywhere from two or three nests between the villages of Malala and Point Kiau up to six or seven on a given night, according to local inhabitants. In September, 1978, Pritchard (1979) walked the seven mile stretch of beach between the villages of Malala and Point Kiau on Long Island and observed twelve nesters and tracks of at least seven others in one night. He estimated a total of 35 for the night with more likely beyond the scope of the survey (Pritchard 1979). Informants revealed that 20 to 30 nesting turtles per month were eaten by island residents and also that, at the time, turtles were considered "as plentiful as they ever have been." Much of this information is inconsistent making it difficult to estimate an abundance of annual nesting females at this site. Harvest pressure was apparent in 1978 and has likely continued so a more recent survey of turtle nesting activity on Long Island is needed for a reliable current estimate of nesting females.

In January 2003, the first assessment of turtle stocks in the Milne Bay Province commenced at Panayayapona Island of the Brooker Islands (Kinch 2003a). Sixteen green turtle nests were documented from January 21-27, 2003 with a total of 71 tracks recorded. For comparison, during a reconnaissance survey on Nov 28, 1998 a total of 177 tracks (not discerned by species) were recorded at Panayayapona. The previous year 126 tracks were counted (not discerned by species). In mid-December 1997 an average of 30 to 40 turtles arrived each night to nest and on one night in mid-January 2002, 72 tracks (not discerned by species) were counted (Kinch 2003b). More intensive surveying December 1-21, 2004 at the Jomard Islands (Panadaludalu and Panayayapona), Siva of

the Bramble Haven group, and Irai, Pananiu, and Tobiki islands of the Conflicts group resulted in 115 green turtle nests recorded (Wangunu et al. 2004).

A comprehensive survey of PNG for green turtle nesting abundance has not been done nor is current trend information available, but previous (dated) studies indicated that numbers of green, hawksbill, and leatherback turtles were decreasing throughout PNG (Pritchard 1982; Spring 1982; Bedding and Lockhart 1989). It is likely that this declining trend has continued over time, with the exception of green turtles nesting in areas of Seventh Day Adventists (this religion prohibits eating meat, including turtles), such as Mussau and Emirau Islands in the St. Mathias Group (NFA 2007). In these areas, Pritchard (1995) reports a "noticeable increase in the turtle populations over a 30 to 50 year period," although NFA (2007) reports that people from Kavieng and Manus visit the islands to harvest turtles.

In PNG, marine resources and lands are owned by a large number of clan and sub-clan groups whose tenure rights are recognized in the national Constitution. With respect to sea turtles, the 1976 Fauna (Protection and Control) Act restricts the harvesting of protected wildlife, the devices and methods by which fauna may be taken, and the establishment of localized protective regimes on land and waters under customary tenure (Kinch 2006). Additionally the 1979 International Trade Act regulates and restricts the export of CITES listed species. In PNG, only leatherback turtles are protected under the Fauna (Protection and Control) Act that makes killing of leatherbacks or taking of leatherback turtle eggs illegal with fines of 500-1000 kina (100 to 300 USD). Any person who buys or sells or offers for sale, or has in possession leatherback turtle eggs or meat can also be fined 500 kina. The Act does not formally protect green turtles and makes provisions for persons with customary rights to take or kill turtles, but states that turtles cannot be taken, killed, or sold during the months of May through July. Furthermore, the Act stipulates payments for turtles: (a) K20.00 for a turtle less than 60 cm in length; and (b) K30.00 for a turtle of 60 cm or more in length. The PNG government Department of Environment and Conservation has the authority and responsibility to enforce laws and environmental Acts. The Torres Strait Treaty between Australia and PNG outlines the boundaries between the two countries and how the sea area may be used. The Treaty includes provisions for traditional fisheries in the area, including turtle harvest. PNG is a participating party to CITES.

Pitcairn Islands

The Pitcairn Islands are an overseas territory of the United Kingdom (UK) consisting of four volcanic islands. Green turtles nest at Henderson Island with an estimated total of 10 females annually (Brooke 1995). No nesting was recorded at Pitcairn, Ducie, or Oeno Islands during the 1991-1992 nesting season. Pitcairn and Ducie were deemed to have unsuitable substrate for nesting while Oeno had suitable substrate but no activity was observed (Brooke 1995). This small nesting assemblage does not appear to be threatened by direct harvest or other major anthropogenic sources of impact. As per the Local Government Ordinance of 2001, no person may harass, hunt, kill or capture any sea turtle (*Cheloniidae and D. coriacea*), and exception may be granted under permit for scientific purpose or for traditional subsistence use (Laws of Pitcairn, Henderson, Ducie, and Oeno

Islands, 2001). The Pitcairn Islands are a territory of the UK which is a participating party to CITES.

Samoa

The Independent State of Samoa consists of two large islands, Upolu and Savai`i, and eight small islets and is located west of American Samoa in the south Pacific. Although both green and hawksbill turtles are known to occur in the waters of Samoa, only hawksbill turtles nest here with no green turtle nesting reported (Witzell 1982). Adult greens have been observed near reefs year-round, and from December through February have been observed gathering near reef passages connecting large lagoonal foraging areas near Upolu Island. Witzell (1982) surmised that these adults may be part of the group that nests on Rose Atoll during August-September.

Local Fisheries Regulations in Samoa prohibit fishing for, possession, or sale of greens and hawksbills under 70cm (27.6 inches) curved carapace length as well as the disturbance or take of nests or eggs. The Ministry of Agriculture and Fisheries (formerly the Department of Agriculture, Forests, and Fisheries) is the responsible authority to manage fishery resources, including sea turtles, and enforce local fisheries regulations in Samoa. Additionally, the Marine Wildlife Protection Regulations (2009), under the Ministry of Natural Resources and Environment, make exemptions for subsistence take of turtles, prohibit captivity of turtles (unless permitted), prohibit the commercial capture and sale of turtles, protect turtles and eggs during the nesting season (November to February), prohibit the sale, purchase and possession of eggs, and require that any turtle caught during fishing activities be released and reported. Samoa is a participating party to CITES.

Solomon Islands

The Solomon Islands are located east of Papua New Guinea and consist of nearly one thousand islands. More is known about hawksbill nesting in the Solomon Islands with limited information available regarding current overall nesting of green turtles. McKeown (1977) estimated that 45 green turtle nests were laid in the Arnavon Islands that year. The Solomon Islands Fisheries Division undertook the first extensive turtle survey in the Solomons focused primarily on the Arnarvon Islands in Isabel Province (Vaughan 1980 and 1981). Vaughan (1981) estimated that the number of breeding individuals of all sea turtle species combined in the Solomons was about 1,500 and that 42% of hawksbill and green turtles present in the Solomon Islands nested in Isabel Province. This survey recorded 53 green turtle nests on Kerehikapa, Arnavon Island, during the months of September to March, with Hakelake Island also supporting 15 to 20 nests per year. Ramohia and Pita (1996) identified only five green turtles nesting in the Arnavon Islands during summer of 1995. Vaughan (1981) also documented green turtle nesting activity within the provinces of Choiseul, Shortlands and Makira primarily on the islands of Wagina, Ausilala, Maifu, Balaka, and Three Sisters (Malaulaul and Malaupaina), with approximately 50 to 100 green turtle nests laid per year at each island. While Vaughan's 1980 survey noted anecdotal reports of a reduction in abundance due to

high harvest pressure[7] on nesting females and their eggs, Leary and Laumani (1989) estimated a modest increase of nesting activity in Isabel province of 259 to 438 nests, compared to 211 to 341 nests in 1980 (not including the Arnavon Islands). This discrepancy is likely a result of normal fluctuations in turtle nesting activity and not indicative of a measurable trend in this nesting assemblage. Long distance migrations between foraging and breeding grounds have been documented indicating that there is reciprocal movement between Australia and the Solomon Islands (Broderick, unpublished 1998).

Currently, the only continuous nesting beach monitoring projects in the Solomons occur at the Arnavons (green and hawksbill), Sasakolo (leatherback), and Tetepare (leatherback and green) (C.Siota pers. comm.). Updated information from the Arnavons and Tetepare for green turtles was not available at the time of printing. Sufficient data on abundance and trend for Solomon Islands green turtles are not available.

The Solomon Islands Fisheries Act (1993) regulations prohibit the sale, purchase, or export of sea turtle species or their parts, protect nesting turtles and eggs during the breeding season (June to August and November to January), and contain specific protections for leatherback turtles (SPREP 2007). The Solomon Islands is a participating party to CITES and the Wildlife Protection and Management Act (1998) prohibits the export of five turtle species or their derivative products (greens, hawksbills, loggerheads, olive ridleys, and leatherbacks).

Tokelau

Tokelau consists of three coral atolls, Atafu, Nukunonu, and Fakaofu, all of which are known to have green turtle nesting. Balazs (1983b) estimated 120 total nesting females annually in Tokelau. Sea turtle capture rates declined from the early 1900s to the 1980s despite more sophisticated hunting methods, indicating a likely population decline (Balazs 1983b). Updated information regarding abundance and trends of nesting green turtles in Tokelau was not available to the authors at the time of printing.

According to a 1998 marine resources survey at Fakaofu, the local council of elders has established village rules stating that when a turtle is caught, it must be shared among the village using a traditional system or resource sharing called Inati (Passfield 1998). Local village rules also protect sea turtles while they are nesting. Ono and Addison (2009) claim that today turtle fishing is officially prohibited throughout Tokelau, however the Project Global country profile for Tokelau (Project Global, accessed online 10/2010) states that there are currently no formal regulations by the Fisheries Department to protect sea turtles or their eggs in Tokelau; therefore the actual protective status of sea turtles remains unclear. Tokelau is not a participating party to CITES.

[7] Based on intensive surveying between 1993 and 1996, Broderick (unpublished, 1998) concluded that the Solomons serve as important developmental habitat for juvenile green turtles, but that a large proportion of turtles are being harvested. Pita and Broderick (2005) estimated that over 1,000 green turtles are harvested per year in the Solomons in three different villages (Kia, Wagina, Katupika) of Isabelle and Choiseul provinces.

Tonga

The Kingdom of Tonga is composed of at least 170 islands, 36 of which are inhabited. Islands are grouped into three main regions: the Ha`apai Group, Vava`u Group, and Tongatapu Group. Nesting takes place from October to February with peak nesting in December and January (Bell et al. 1994). Green turtles nest in low levels on several islands in the Ha`apai Group as well as islands in the Vava`u Group, with an estimated 10 to 20 green turtle nests annually based on anecdotal information from turtle hunters (Havea and MacKay 2009). Sporadic nesting surveys were carried out in the Ha`apai Group in December 1971, December 1973, and December 2007 to January 2008 (Bell et al. 2009c) although most did not distinguish between hawksbill and green nests and effort was not consistent among surveys. Wilkinson (1979 in Bell et al. 1994) reported that fishermen have seen green turtles nesting on the uninhabited islands of Nukufaiva, Fetoa, Mango, and Malinoa in the Ha'apai group but nesting numbers were not provided. Based on limited available information from past surveys, it appears that 10 to 100 females may nest annually in Tonga, with numbers likely toward the lower end of that range.

Havea and MacKay (2009) surveyed fishermen for their perceptions of sea turtle abundance trends in the Ha`apai group. In spite of previous reports and an apparent decline in nesting turtles, less than 50 percent of fishermen reported that turtle stocks were declining and almost 40 percent indicated stocks were increasing. However, the survey did not distinguish between greens and hawksbills. Directed take of green turtles for consumption and sale still occurs in Tonga and laws are generally not adhered to or enforced (Havea and MacKay 2009). Limited available data on nesting in addition to these survey results suggest there may be a decline in green turtle nests (Havea and MacKay 2009).

Fisheries Conservation and Management Regulations (1994) prohibit the possession, disturbance, take, sale, purchase, or export of turtle eggs, sale, purchase, or export of hawksbills or their shells, and use of a spear gun to take a turtle and establish closed seasons for leatherback turtles January 1 to December 31 (Bell et al. 1994; Folumoetui'i, 2006). Hawksbills are the only sea turtle species fully protected via Tongan legislation and harvest of other turtle species is permitted seasonally (November to February) with a minimum size specified (shell length of <45cm) (Folaumoetu'i 2006). Tonga is not a participating party to CITES.

Tuvalu

Tuvalu is an independent nation made up of nine coral islands and atolls. Green turtles nest in the capital of Funafuti as well as on several outer islands (Pita 1979). The only available information on nesting turtles in Tuvalu is from a 10 day survey of nesting sites on Funafuti conducted in December 2006 where a total of nine nest sites were identified (Alefaio et al. 2006). In 1979, turtle meat was rarely consumed in the capital of Funafuti but turtles were still taken from the water and nesting beaches for consumption in the outer islands where there was no refrigeration (Pita 1979). According to interviews with local fishermen in 2006, the number of turtles sighted and harvested has declined rapidly (Alefaio et al. 2006).

In Tuvalu, the Wildlife Conservation Ordinance (1975) prohibits hunting, killing or capturing any wild turtle on land except under and in accordance with the terms of a valid written license granted to that person by the Minister (Government of Tuvalu 1975). Tuvalu is not a participating party to CITES.

Vanuatu

Vanuatu consists of approximately 82 islands, 65 of which are inhabited. Turtles in Vanuatu are described as "plentiful" with Malekula island identified in 1979 as an important nesting area with 40 to 120 turtles nesting annually (although species was not specified, this likely refers to a combination of greens and hawksbills) (Pritchard 1982 in Pritchard 1995a). Currently, the only published information on sea turtle nesting activity is summarized in Petro et al. (2007) based on interviews of knowledgeable turtle monitors and limited surveys that occurred from November to December 2002 and January to February 2003, focused primarily on leatherback turtles. During a survey at Votlo, Southern Epi Island, two green turtles were tagged and 10 false crawls and 15 nests were recorded. Current information collected at Wan Smolbag workshops in 2007 and 2008 by monitors of the Vanua-Tai network identified over 189 nesting sites on 33 islands of Vanuatu, with approximately 200 turtles (both green and hawksbill) nesting at Malekula island per year (Fletcher and Petro, unpublished 2009). Additionally, Santo Island and its offshore neighboring island of Thion support 50 or more nesting turtles per year, and approximately 30 turtles nest annually at Tegua and Hiu islands. Coverage of Vanuatu's beaches is not yet comprehensive so total nesting activity may be underestimated. A number of sites have emerged over the past few years as potential index sites, in particular the Bamboo Bay area on the island of Malekula, and possibly Moso and Wiawi (G. Petro pers. comm.). Current trend information is not available for green turtles in Vanuatu. Green turtles and their eggs are commonly harvested and there was recent momentum to revive traditional management systems to regulate (or sustainably manage) community-based harvest of turtles (Hickey 2007). Primary threats to green turtles identified in Vanuatu in addition to direct harvest include nest predation by dogs, wave inundation and beach erosion.

Fisheries Regulations under the new Vanuatu Fisheries Act (2009) prohibit the take, harm, capture, disturbance, possession, sale, purchase of or interference with any turtle nest (or any turtle in the process of nesting), and the import, or export of green, hawksbill, and leatherback turtles or their products (shell, eggs, or hatchlings). The Act also prohibits the possession of turtles in captivity. A person may apply in writing to the Director of Fisheries for an exemption from all or any of these provisions for the purposes of carrying out customary practices, education, and/or research. Vanuatu is a participating party to CITES.

Wallis and Futuna

Wallis and Futuna consist of three main islands and low coral or volcanic islets. The authors are unaware of any reports of green turtle nesting activity on any of the islands or islets at Wallis and Futuna. Wallis and Futuna is not a participating party to CITES.

Discussion and Recommendations

This is the most recent comprehensive compilation of peer-reviewed publications, gray literature, and local government reports of green turtle nesting information from locations throughout Oceania. A total of 189 sites were identified (Table 1 and Figure 1), but many more nesting sites are likely to occur throughout the region as we describe only those that have been surveyed, monitored, or observed and reported in publicly available documents covering the past 30 to 40 years. A historical perspective or baseline of nesting locations and abundance in the region (e.g., 200 to 300+ years ago)[8] is beyond the scope of this document but is necessary to identify recovery goals for green turtles in Oceania.

Although there are currently a number of active monitoring projects throughout the Pacific (Figure 2), consistent long-term datasets necessary to draw reliable conclusions about trends of annual nester abundance only exist for four of the 189 sites in the region: Hawaii (Chaloupka et al 2008), Japan, and two sites in Australia (Chaloupka 2007). According to our review, a number of sites in addition to these four are thought to have relatively substantial nesting activity (between 100 and 1,000 nesting females annually; Table 1). The varied levels of survey effort and methodology within and among countries from year to year, and discrepancies in types of data reported for many sites make it difficult to clearly discern nesting female abundance and trends. With respect to management objectives, there is an emergent and immediate need to initiate or facilitate consistent long-term monitoring projects at more locations throughout the region. The potential for such projects to be established (or maintained), considering cultural, financial, and logistical limitations, should be investigated as additional index sites would allow scientists and managers to more adequately assess overall green turtle abundance, stock structure, trends, and threats in the Pacific. Areas for consideration include: Helen Reef in Palau, Ulithi Atoll[9] in Yap, d'Entrecasteaux Reef complex in New Caledonia, Scilly Atoll[10] in French Polynesia, Malekula Island[11] in Vanuatu, and the Coringa-Herald National Nature Reserve in the Coral Sea. Additional sites reported to support, or to have once supported, significant nesting activity that do not have consistent survey efforts in place include: Rose Atoll of American Samoa, Bikar and Erikub Atolls in the Marshall Islands, Canton Island in the Phoenix Islands of Kiribati, and Palmerston Atoll in the Cook Islands. Many of these areas are extremely remote and logistically challenging to access and/or may involve associated cultural challenges and island-specific politics that may affect beach access and approvals necessary to conduct monitoring activities. Rapid

[8] Baseline historical information from naval, explorer, economic, ethnographic, and anthropological sources dating from the 1600s to present is currently in preparation by the NMFS PIFSC Marine Turtle Assessment Program.

[9] NMFS PIRO has supported monitoring activities at Ulithi Atoll with funding and technical expertise since 2005 and, as available funding permits, intends to continue support for at least 10 years.

[10] Scilly Atoll has not been surveyed since 1995, however, a local NGO, Chelonia Polynesia, with funding support from NMFS PIRO plans to revisit this atoll in 2010-11 to gather updated census information on this nesting population and collect genetic samples.

[11] Green turtle monitoring activities in Vanuatu are led by the WanSmolbag Theater Turtle Conservation Program. WanSmolbag has received support from NMFS Southwest Region since 2007 for monitoring activities of the Vanua-tai turtle network, and in 2010 received additional support from NMFS PIRO to incorporate genetic sample collection in their monitoring protocol.

assessments of nesting activity occurring during peak nesting periods (if known) over consecutive years (each conducted within a 3 to 4 week timeframe) may be an option to assess nesting activity to inform management at sites that can be accessed (i.e., permissions granted).

A cursory look at the relationship between local legislation and nesting abundance indicates a slight pattern (Figure 1), and although this should be interpreted with caution, this pattern confirms previously described observations (Bjorndal 1982 revised in 1995; Eckert 1993). In general, larger nesting assemblages occur in countries that have full or relatively strong legal protection for sea turtles while countries with weaker or less effective protective regulations in place tend to support smaller nesting populations or those that are not consistently monitored and assumed to be small. Additionally, larger nesting assemblages appear to occur in countries that are more developed and have advanced science and conservation programs that can produce information on marine turtle resources on a regular and consistent basis. In contrast, smaller, less developed countries likely have fewer resources for scientific research and/or alternative priorities. Sea turtles are also highly migratory and those that nest in one region are vulnerable to threats or causes of mortality in other geographic areas, often with different levels of legislative protection, during different phases of development and migration (Craig et al. 2004; Dutton and Squires 2008; Seminoff 2004). For example, Australia has relatively strong legislative protections (Figure 1), yet tag return data confirm that Australian turtles are captured in the Torres Strait, New Guinea, and Solomon Island waters (Limpus et al. 2003; Limpus 2009) where the same level of protective legislation does not exist. Similarly, post-nesting females from French Polynesia, the Cook Islands and Rose Atoll have been recorded traveling westward, primarily to Fiji (Craig et al. 2004), passing through several EEZs and high seas areas where various domestic and international fisheries operate, highlighting the value of collaborative management strategies among nations.

Where indigenous and unregulated subsistence harvest of sea turtles is permitted, many of the existing regulations in place are not appropriate because they do not reflect a basis in the biology of sea turtle life history. Rather, they appear to mimic regulations designed to optimize population levels of fish which often have very different life history characteristics than turtles. Minimum size regulations designed to protect small juveniles yet permit the harvest of large juveniles (subadults) and adults do not provide the protection necessary for long-term sustainable management of sea turtle populations as large juveniles and adults have the highest reproductive value of all life stages (Crouse, 1999; Heppell 1998). Throughout Micronesia, Melanesia, and some parts of Polynesia (Figures 1, 1a, and 1b), there are many nesting sites without reliable estimates of annual nesting females or with low numbers of nesting females (less than 100) where turtles are subject to biologically irrelevant regulations (i.e., allowable size limits, harvest open/closed seasons). Micronesia in particular is reported to support a large number of known rookeries yet hosts few monitoring projects and imposes regulations that are inappropriate for effectively managing sea turtle populations. As such, Micronesia is still (as previously suggested by Pritchard 1977, Buden and Edward 2001, and NMFS and USFWS 1998) considered a priority area to initiate more monitoring activities coupled

with intensive and integrated education and awareness efforts. Government collaboration to develop stronger, more biologically relevant regulations for the effective management of local sea turtle populations is warranted.

Many countries throughout Oceania are signatories or participating parties in various regional and international arrangements (Appendix I). Nine of the 22 countries in the region are participating parties to the Convention on International Trade in Endangered Species (CITES) which prohibits international trade of marine turtles and marine turtle derived products. Several countries throughout the region are also participants in other global environmental agreements including: the Convention on Biological Diversity (CBD), Convention on Migratory Species (CMS), and the Ramsar Convention on Wetlands. In total, there are eight regional arrangements in Oceania that address aspects of marine turtle conservation, protection, or management. The three most prominent arrangements include the Western and Central Pacific Fisheries Commission (WCPFC), Pacific Islands Forum Fisheries Agency (FFA), and Secretariat of the Pacific Regional Environment Programme (SPREP). All countries discussed in this technical memorandum are members of SPREP (with the exception of Japan) and SPREP has developed a non-binding 2008-2012 Marine Turtle Action Plan (MTAP) (SPREP 2008). The MTAP identifies actions focusing on reducing threats including unsustainable harvest, nest predation, incidental capture in commercial fishing, degradation of habitat, pollution, marine debris, pathogens, boat strikes, and climate change. It also highlights national and regional priority actions that have been identified and endorsed by member countries for marine turtle conservation and monitoring work in the region. Therefore, a foundation exists for international collaboration in the Pacific to address the management and conservation challenges discussed above pertaining to marine turtles and regulations governing subsistence or direct harvest.

The vast majority of the 189 sites described here have 100 or fewer documented annual nesting females, with many likely to have 10 or less (Table 1). While these nesting assemblages make up a small proportion of the overall Oceania green turtle nesting aggregation, they may possess unique adaptations in genetic diversity and ecological significance to their particular environments, and may therefore be important for recovery of the species (Bjorndal and Bolten 2008). There is legitimate concern over the loss of small isolated nesting aggregations and the implications for the species as a whole, as well as associated consequences for local ecosystems (McClenachan et al 2006; Bjorndal and Jackson 2003). Female green turtles tend to exhibit strong natal homing (Miller 1997), returning to the beach from which they hatched to lay their eggs, making particular rookeries reproductively isolated over ecological timescales. Although 'mistakes' in natal homing occur with sufficient frequency to facilitate founder or seed populations and some genetic exchange between conspecific rookeries over short evolutionary timescales, the decline or loss of a given rookery is not likely to be compensated for by natural recruitment of females hatched elsewhere (at least over ecological timescales relevant to immediate human conservation interests) (Avise and Bowen 1994).

The authors recognize that this synthesis of information refers to nesting females which is just one aspect of sea turtle life history affecting population dynamics. An understanding of key foraging habitats, foraging population demographics (including males, juveniles and subadults), and mixed stock genetic analyses at foraging grounds are necessary for a complete assessment of population status and sources of mortality (as described and summarized in NMFS and FWS 2007, and NRC 2010). While there are indications that some Pacific Island nations may provide important green turtle foraging habitats (Balazs and Forsyth 1986; Balazs and Chaloupka 2005; Chaloupka and Limpus 2001; Craig et al. 2004; Kolinski 2004; Meylan 1982; Pritchard 1995a,b; Pultz et al. 1999), a region-wide understanding of sea turtle foraging, stock connectivity, and the relative contribution of Pacific stocks within foraging habitats does not currently exist. The genetics lab at the NOAA Fisheries Service Southwest Fisheries Science Center continues to work with partners like the University of Canberra in Australia to sufficiently characterize Pacific green turtle nesting stocks with informative genetic markers in order to improve the ability to assign stock origin of individual animals in foraging and migratory habitats. In the future, this genetic information may be applied to determine Regional Management Units (such as those proposed by Wallace et al. [*in press*]) or to evaluate the need for Distinct Population Segments as recognized by the ESA.

In summary, more information is available for green turtle nesting in Oceania than has been previously summarized or compiled, but the available information suggests there are large gaps in current information gathering and monitoring efforts. This compilation is a step in identifying those gaps and will assist scientists and managers in prioritizing projects and funding considerations in accordance with where needs may exist to bolster management and assessment efforts for recovery planning. In addition to research and monitoring, local legislation in countries with green turtle nesting assemblages should be evaluated and government collaborations encouraged to facilitate implementation of more biologically effective regulations coupled with integrated education and awareness initiatives. These efforts will help prioritize and direct future research, management activities, and international collaborations to advance green turtle conservation and recovery efforts in the Pacific.

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Tables and Figures

Table 1: Summary Estimates of Nesting Green Turtles in Oceania, Including Current Generalized Legislation

Country/Territory/State	Est. # Known Sites	Est. # Annual Nesting Females (min.)	Est. Trend	Legislation
American Samoa (USA)	3	30 - 100	Unknown	A
Australia (NGBR)	5	10,000-25,000	Stable*	B
Australia (SGBR & HNNR)	21	5,000 – 10,000	Increasing* (SGBR)	B
Cook Islands	11	<10	Unknown	D
CNMI (USA)	16	<10	Unknown	A
Federated States of Micronesia	16	530 - 1,300	Unknown	C
Fiji	2	10 - 100	Decreasing	A
French Polynesia	7	300 - 400	Unknown	A
Guam (USA)	15	<10	Unknown	A
Hawaii (USA)	12	400 - 500	Increasing*	A
Japan (Ogasawara Isl.)	1	400 - 500	Increasing*	B
Kiribati	15	80 - 800	Unknown	A,C^
Nauru	0	0	NA	D
New Caledonia	4	1,000 - 2,000	Stable	A,C^
Niue	0	0	NA	A
Papua New Guinea	15	10 - 100	Unknown	D
Pitcairn Islands	1	<10	Unknown	A
PRIAs (USA)	2	<10	Unknown	A
Republic of Marshal Islands	9	300 - 400	Decreasing	C
Republic of Palau	13	250 - 400	Unknown	C
Samoa	0	0	NA	C
Solomon Islands	8	80 - 700	Unknown	C
Tokelau	3	<10	Unknown	E
Tonga	3	<10	Unknown	C
Tuvalu	1	<10	Unknown	C
Vanuatu	6	20 - 100	Unknown	B
Wallis and Futuna	0	0	NA	E
Total	189	18,480 – 42,470		

* Chaloupka et al. (2007)

** Generalized Legislation Categories (excluding reference to CITES, international arrangements (Appendix 1) and commercialized export of sea turtles):

A. Full protection, may include permitted incidental take and/or moratoriums
B. Full protection except permitted or recognized direct take (indigenous/subsistence harvest)
C. Open/closed harvest periods, or minimum size limits, or protected when on land only (i.e., nesting females & nests), and/or recognized indigenous/subsistence harvest
D. No legislation specific to green turtles (but may include loose protections of nesting turtles when on land), and recognized indigenous/subsistence harvest
E. Sea turtle legislation unclear or unknown to authors

^ Most sites in Kiribati and New Caledonia fall into category A however the Loyalty Islands in New Caledonia and some islands in Kiribati are not included in full protection regulations.

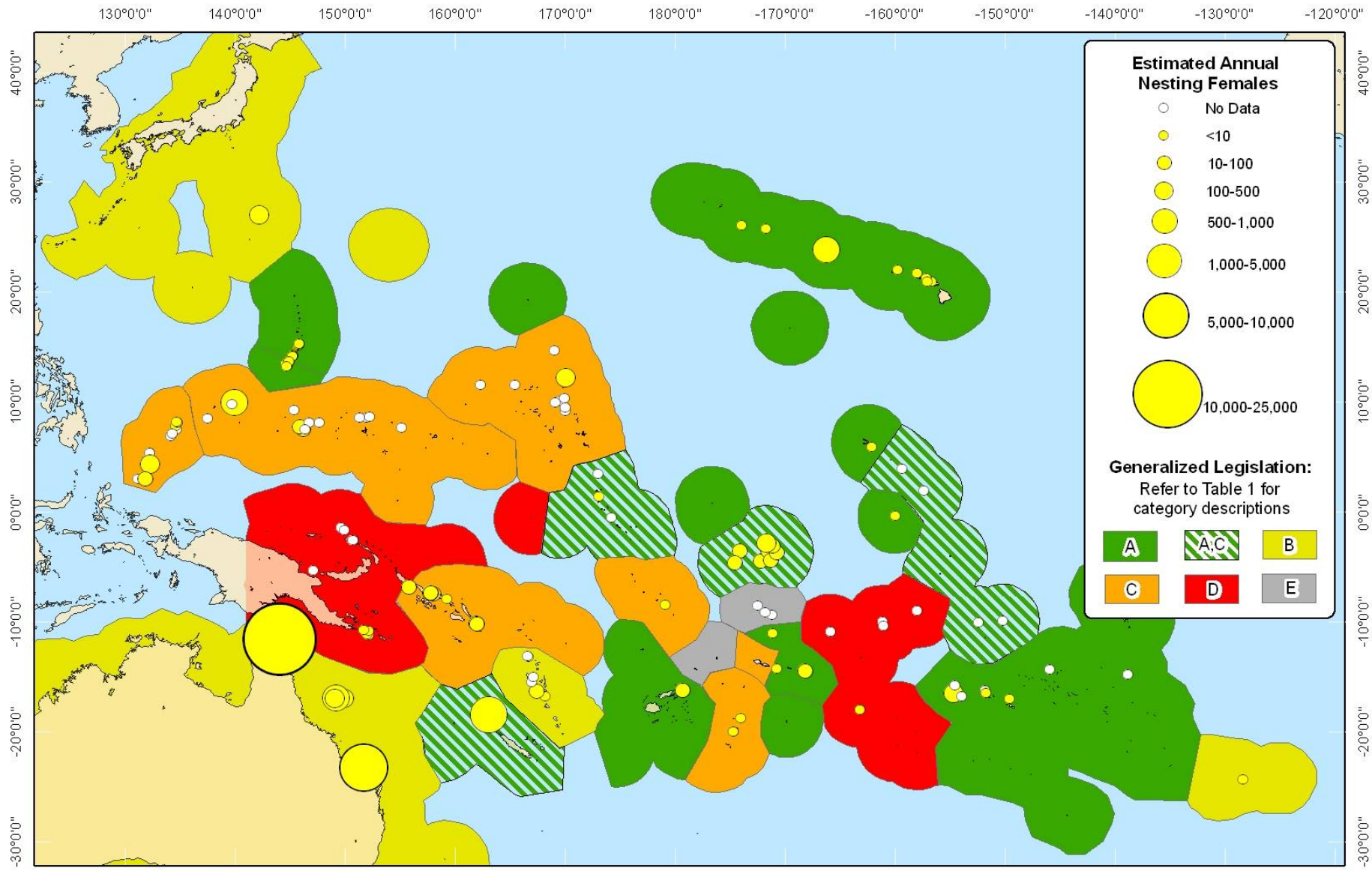

Figure 1

Green Turtle Nesting and Legislation in Oceania

This map shows nesting sites for green turtles throughout Oceania and the estimated minumum annual nesting females at each site along with the varied categories of legislation associated with each country where nesting takes place.

Geographic Coordinate System: WGS84

N

0 500 1,000 2,000 3,000 4,000 Kilometers

Map by: Kim Maison, NOAA Fisheries Pacific Islands Regional Office, August 2010

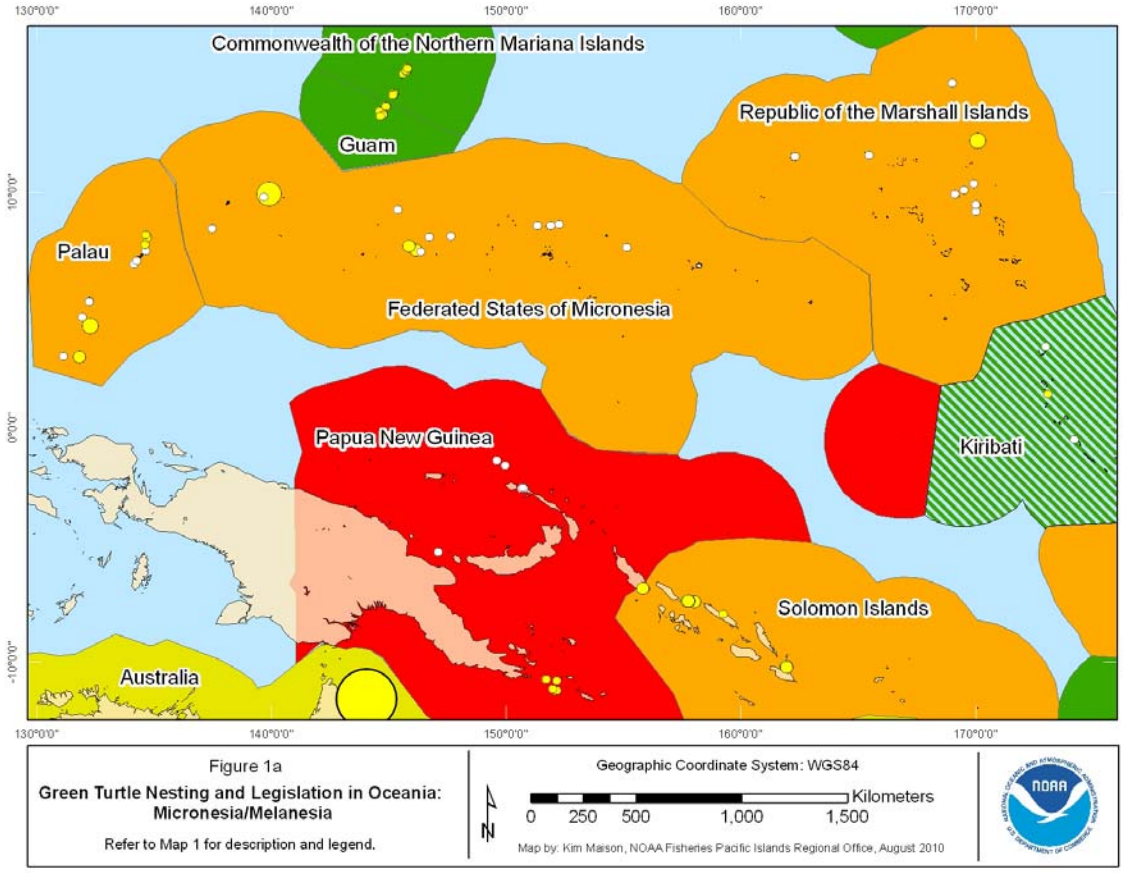

Figure 1a

Green Turtle Nesting and Legislation in Oceania: Micronesia/Melanesia

Refer to Map 1 for description and legend.

Geographic Coordinate System: WGS84

0 250 500 1,000 1,500 Kilometers

Map by: Kim Maison, NOAA Fisheries Pacific Islands Regional Office, August 2010

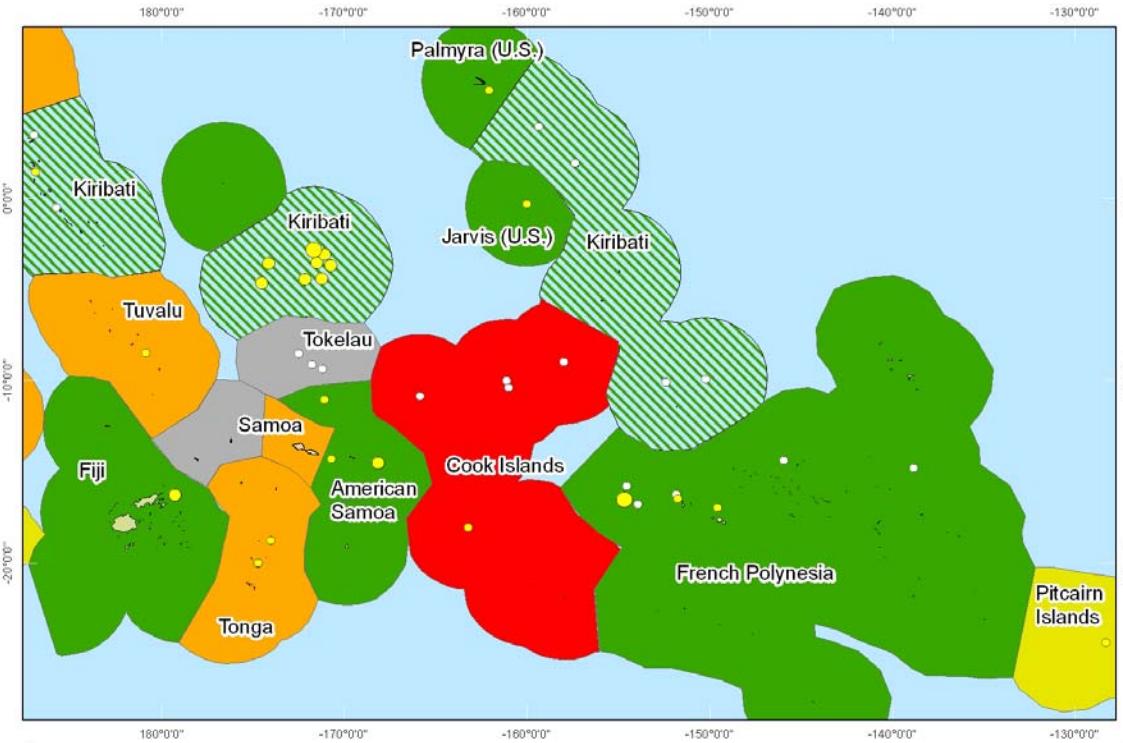

Figure 1b

Green Turtle Nesting and Legislation in Oceania: Polynesia

Refer to MAP 1 for description and legend

Geographic Coordinate System: WGS84

0 500 1,000 2,000 Kilometers

Map by: Kim Maison, NOAA Fisheries Pacific Islands Regional Office, August 2010

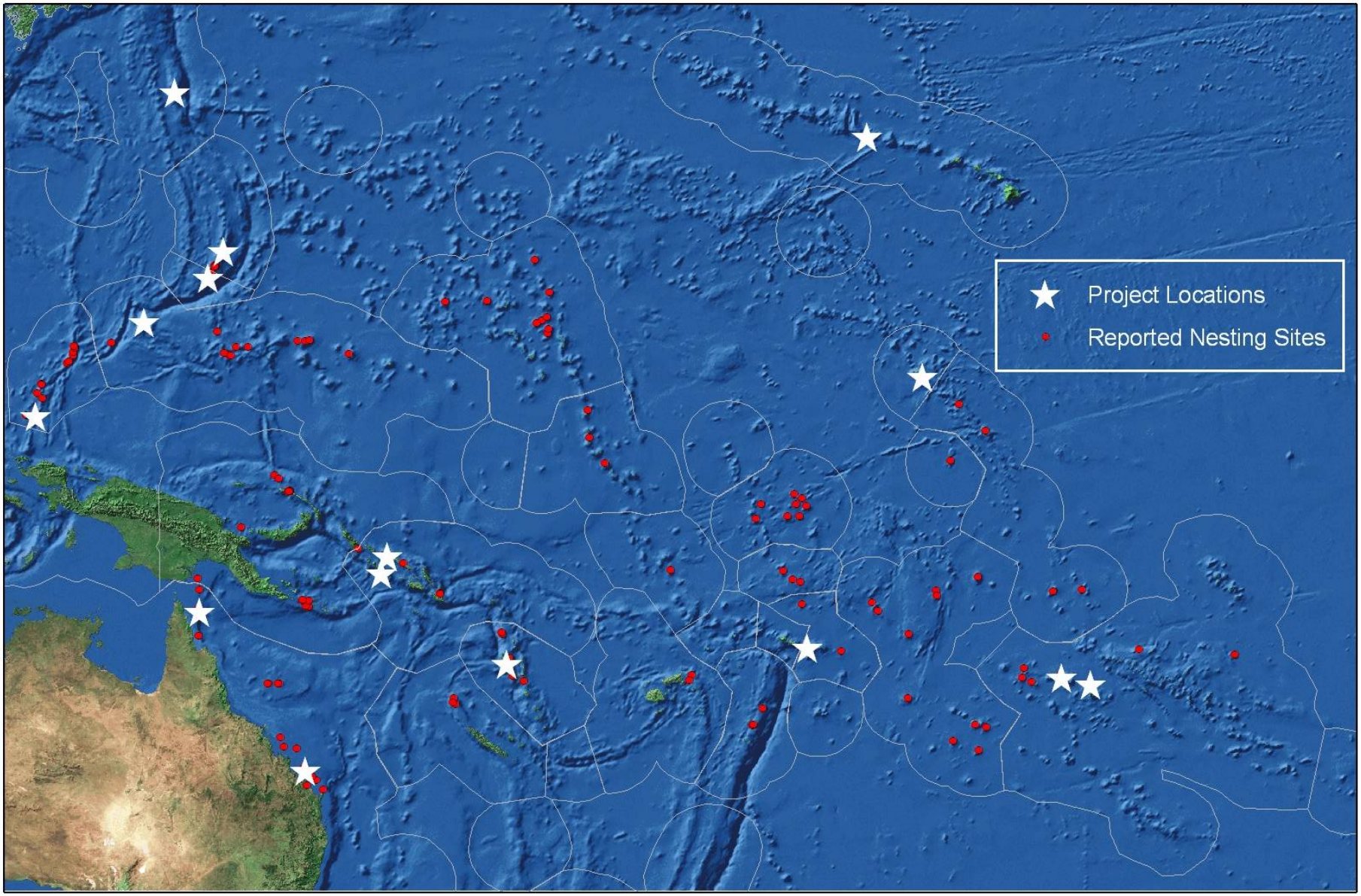

Figure 2

Green Turtle Nesting Beach Projects

This map shows the locations of active monitoring projects at green turtle nesting beaches throughout Oceania that have collected data within the past five years (since 2005).

Geographic Coordinate System: WGS84

N

0 500 1,000 2,000 3,000 Kilometers

Map by: Kim Maison, NOAA Fisheries Pacific Islands Regional Office, August 2010

Appendix I: Pacific Countries and Existing International Arrangements

Pacific Countries and Existing International Arrangements for Sea Turtle Conservation, Protection and Management (information compiled for and presented at 20th SPREP meeting, November 19-20, 2009, Apia, Samoa and still current as of September 2010)

Country	CBD	CITES	CMS	CTI	FFA	IAC	IATTC	IOSEA	IOTC	RAMSAR	SPREP	WCPFC	TNC
American Samoa											S	P	
Australia	P	P	P		S			S	P	P	S	P	
Cook Islands	P		P		S		C				S	P	
FSM	P				S						S	P	
Fiji	P	P			S					P	S	P	
French Polynesia											S	P	
Japan	P	P					P		P	P		P	
Kiribati	P				S						S	P	
Marshall Islands	P				S					P	S	P	
Nauru	P				S						S	P	
New Caledonia											S	P	
Niue	P				S						S	P	
Palau	P	P	P		S					P	S	P	
PNG	P	P		S	S			S		P	S	P	S
Samoa	P	P	P		S					P	S	P	
Solomon Islands	P	P		S	S						S	P	S
Tokelau					S						S	P	
Tonga	P				S						S	P	
Tuvalu	P				S						S	P	
USA	S	P				P	P	S		P	S	P	
Vanuatu	P	P			S		P		P		S	P	
Wallis and Futuna											S	P	

Party or Participating Entity/Territory = P

Signatory = S

Cooperating non-Member = C

Appendix 1 Acronyms:

CBD: Convention on Biological Diversity; **CITES**: Convention on International Trade in Endangered Species; **CMS**: Convention on Migratory Species; **CTI**: Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security; **FFA**: Forum Fisheries Authority; **FSM**: Federated States of Micronesia; **IAC**: Inter-American Convention for the Protection and Conservation of Sea Turtles; **IATTC**: Inter-American Tropical Tuna Commission; **IOSEA**: Indian Ocean South-East Asian Sea Turtle Memorandum of Understanding; **IOTC**: Indian Ocean Tuna Commission; **PNG**: Papua New Guinea; **Ramsar**: Ramsar Convention on Wetlands of International Importance; **SPREP**: Secretariat of the Pacific Regional Environment Programme; **TNC**: Tri-national Commitment to leatherback turtle conservation in the Pacific; **USA**: United States of America; **WCPFC**: Western and Central Pacific Fisheries Commission.

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