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Chelonia mydas (Hawaiian subpopulation), Hawaiian Green Turtle

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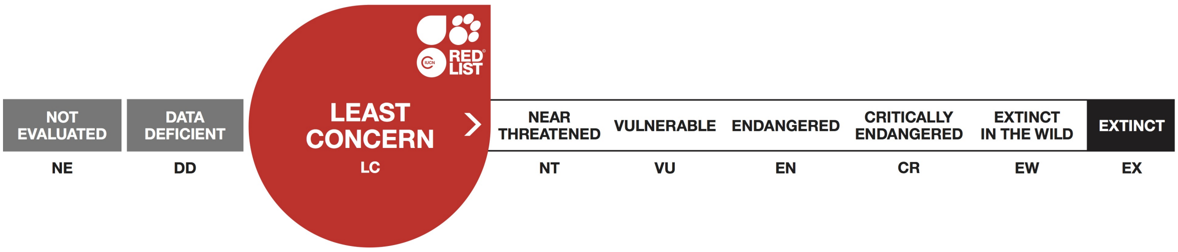

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Reptilia	Testudines	Cheloniidae

Taxon Name: *Chelonia mydas (Hawaiian subpopulation)* (Linnaeus, 1758)

Synonym(s):

- *Testudo mydas* Linnaeus, 1758

Parent Species: See *Chelonia mydas*

Common Name(s):

- English: Hawaiian Green Turtle, Green Turtle, Tortuga Blanca
- Spanish: Tortuga Verde

Assessment Information

Red List Category & Criteria: Least Concern ver 3.1

Year Published: 2019

Date Assessed: August 20, 2018

Justification:

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The Hawaiian Green Turtle subpopulation is genetically isolated and restricted to the Hawaiian Island region of the Central North Pacific (Figure 1 in the Supplementary Information; Dutton *et al*. 2008), and was designated a Distinct Population Segment under a recent US NOAA National Marine Fisheries Service global status assessment (Seminoff *et al*. 2015). Analysis of published peer-reviewed literature indicates that this endemic and genetically isolated Hawaiian Green Turtle stock – interchangeably referred to as the Central North Pacific subpopulation – is either approaching or has reached full recovery to pre-exploitation levels and anthropogenic hazards are not restricting population recovery (Balazs and Chaloupka 2004a, Chaloupka and Balazs 2007). The previous assessment of this subpopulation determined that its status is Least Concern; this update requires no change to this subpopulation's status.

Criterion A. Reduction in population size

This Red List assessment used annual nester counts at one key rookery in the French Frigate Shoals (FFS) as the index of abundance for this subpopulation. This index of abundance continues to increase at 5.4% per year with fluctuations from year to year (Figure 2 in the Supplementary Information), which are normal for nesting sea turtle populations because they are non-annual breeders (Hughes 1982); the proportion of nesting females in any given year is dependent on quality and quantity of foraging grounds in the preceding years (Limpus and Nicholls 1988) and climatic effects such as El Niño events (Limpus and Nicholls 2000). For these reasons, the inter-annual abundance trend increases then decreases due to fewer breeders in some years (for instance in 1982/83, 1997/98, and 2015/16), following which abundance of nesters increases. However, the increasing trend over time is clear (Figure

2 in the Supplementary Information).

The assessment of Hawaiian Green Turtle population abundance is based on monitoring the number of female nesters at East Island, FFS, in the Northwestern Hawaiian Islands (NWHI; Figure 1 in the Supplementary Information). This 43-year data series is one of the longest nesting abundance records for sea turtles worldwide and longer than one Green Turtle generation length (often a restricting limit when determining population trends using IUCN Red List Criteria). Using the 42-year nesting series, a robustly growing population trend of 5.44% (95% CI: 4.8-6.1) per annum was estimated based on a Gompertz state-space population dynamics model that accounted for regional ocean-climate effects driving breeding propensity and weighted by annual sampling effort (Figure 2 in the Supplementary Information). These nesting trends on FFS represent only *c*. 50% of all nesting in Hawaii and the numbers of mature animals nesting on East Island alone exceed thresholds for threatened status under Red List Criteria.

Historically Green Turtles were subject to a degree of harvest around the Main Hawaiian Islands (MHI) and the NWHI by Hawaiian people and outsiders (Kittinger *et al*. 2013). In the past 100 years (approximately three Green Turtle generations; see Seminoff *et al*. 2015 and references therein) the Hawaiian Green Turtle population was exploited for its meat (Witzell 1994, Chaloupka and Balazs 2007) and was depleted to around 20% of pre-exploitation abundance. However, exploitation stopped in the 1970s. In 2004 it was estimated that Hawaiian Green Turtles were at 83% of their pre-exploitation numbers (Balazs and Chaloupka 2004a), representing a population decline of ~17% to that point. Since then, the population has continued to grow at 5.44% per annum, and in several places within the Hawaiian islands it is likely the turtles have reached carrying capacity (Chaloupka and Balazs 2007, Wabnitz *et al*. 2010; but see Snover 2008).

While the Hawaiian Green Turtle subpopulation is still subject to a small degree of anthropogenic threat, the causes for the population decline are understood, and most of these have been addressed, reversed and/or ceased

Given the number of adult females is >2,500, the long-term population trend is and has been increasing for decades at ~5.44% per annum (Balazs and Chaloupka 2004a, Chaloupka and Balazs in prep.), the Hawaiian Green Turtle subpopulation is classified as Least Concern under IUCN Red List Criteria.

Criterion B. Geographic range

Extent of occurrence (EOO) for the Hawaiian Green Turtle was defined as the area contained within the shortest continuous boundary which encompassed all known occurrence for the Hawaiian Green Turtle, which includes the Main Hawaiian Islands (MHI) extending all the way up to the NWHI. The minimum convex polygon around the MHI alone comprises some 41,000 km², and thus the Hawaiian Green Turtle EOO is >20,000 km².

Area of occupancy (AOO) was defined as the nesting habitat, which is critical to turtle reproduction and the smallest area essential to the survival of the population. There are ~226 km² of nesting habitat currently used throughout the archipelago, using the 2 x 2 km IUCN minimum grid size, as described in the previous assessment (Pilcher and Chaloupka, 2012). This estimate was derived by taking the total linear distance of each current known nesting beach for Hawaiian Green Turtles in the archipelago (113 linear total km of beach length for nesting site locations provided by Parker and Balazs 2015), dividing by

2 to derive the number of grids, and multiplying by 4 (for each 2 x 2 km square grid). While this could trigger a Vulnerable assessment under criterion B2, there is no continuing decline or fluctuation in AOO or the population; therefore, this subpopulation is also classified as Least Concern under this criterion.

Criteria C and D. Population size of mature individuals

The number of mature female Green Turtles is ~4,000 (Balazs *et al*. 2015). This figure is also supported by more recent analyses by Chaloupka and Balazs (in prep) which modelled the number of nesters at East Island based on annual capture-mark-recapture histories (black dots, Figure 2 in the Supplementary Information). The annual nester estimated are based on observed nesters corrected for detection probability (as standard for any capture-mark-recapture based method), because the capture-mark-recapture estimates are based on approximated a few weeks sampling each season (and this is highly variable) to get the annual estimate (whole of season). Hence those estimates are derived with variable precision (measurement error).

The modelled trend in Figure 2 (see the Supplementary Information) is a density-dependent population model (Gompertz model) fitted to the dots accounting for the sampling error in deriving those dots and the process error (environmental variability) related to regional ocean-climate factors driving the actual nester abundant each season.

Females comprise ~61% of all adult-sized turtles (Balazs *et al*. 2015), suggesting the number of mature individuals (including males) at ~6,550. While this is lower than the 10,000 mature individuals threshold for a Vulnerable listing, there is no continuing decline, and there are no extreme fluctuations in EOO, AOO, or number of mature individuals, making this subpopulation Least Concern under both criteria.

Criterion E. Quantitative analysis of the probability of extinction

A formal quantitative analysis of the probability of extinction of Hawaiian Green Turtles has not been conducted. Chaloupka and Balazs (2007) earlier suggested that nesters might be nearing carrying capacity at nearly 500 nesters per annum at East Island, but the inclusion of more recent nesting data indicate the population is growing at a rate of 5.44% per annum (Chaloupka and Balazs in prep.) and recent years have supported over 700 nesters. Tiwari *et al*. (2010) concluded the beach at East Island was well below carrying capacity and was capable of supporting an even larger nesting population.

For further information about this species, see Supplementary Material.

Previously Published Red List Assessments

2012 – Least Concern (LC)
http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T16285718A16285879.en

Geographic Range

Range Description:

The distribution for this subpopulation comprises only the Hawaiian archipelago. While the Green Turtle is distributed circumglobally and nests in over 80 countries, the Hawaiian Green Turtle comprises a discrete and genetically distinct population segment, which is endemic to the Hawaiian archipelago (Dutton *et al*. 2008). The stock and was designated a Distinct Population Segment under a recent US NOAA National Marine Fisheries Service global status assessment (Seminoff *et al*. 2015) and has also been identified recently as a Regional Management Unit, and so fits the definition of a subpopulation for IUCN Red List assessment purposes (Wallace *et al*. 2010).

The isolated Hawaiian archipelago stretches approximately 2,400 km from Hawaii Island (Big Island) in the southeast to Kure Atoll in the northwest. Hawaiian green turtles are found throughout the entire island chain (Figure 1 in the Supplementary Information). Like other Green Turtle subpopulations, they are migratory, but in this case the subpopulation is limited to the Hawaiian island chain.

French Frigate Shoals (FFS) is the primary rookery, located in the centre of the 2,400 km island chain and accounts for >90% of all nesting activity, with approximately 50% occurring on East Island (Balazs and Chaloupka 2004a). Recent evidence of additional nesting habitat being exploited by Hawaiian green turtles throughout FSS and other parts of the Hawaiian archipelago suggest the population is not limited by its close affiliation with East Island (Frey *et al*. 2013, Dutton *et al*. 2014). There are numerous foraging grounds found throughout the archipelago. Adult female turtles resident in these foraging grounds migrate every 3–4 years to their preferred nesting grounds at FFS (Chaloupka and Balazs 2004a).

Only three turtles with haplotypes not found at FFS have been identified, indicating that Hawaiian foraging grounds might occasionally, albeit rarely, be visited by animals from rookeries outside the Hawaiian archipelago. Three Hawaiian turtles have been recorded outside of Hawaii (one in Japan, one in the Philippines, one in the Marshall Islands), but there is no evidence that the normal range of Hawaiian Green Turtles extends beyond the central Pacific region. These findings indicate that the numerous foraging aggregations around the Hawaiian Islands can be considered part of a distinct regional population for management.

For further information about this species, see Supplementary Material.

Country Occurrence:

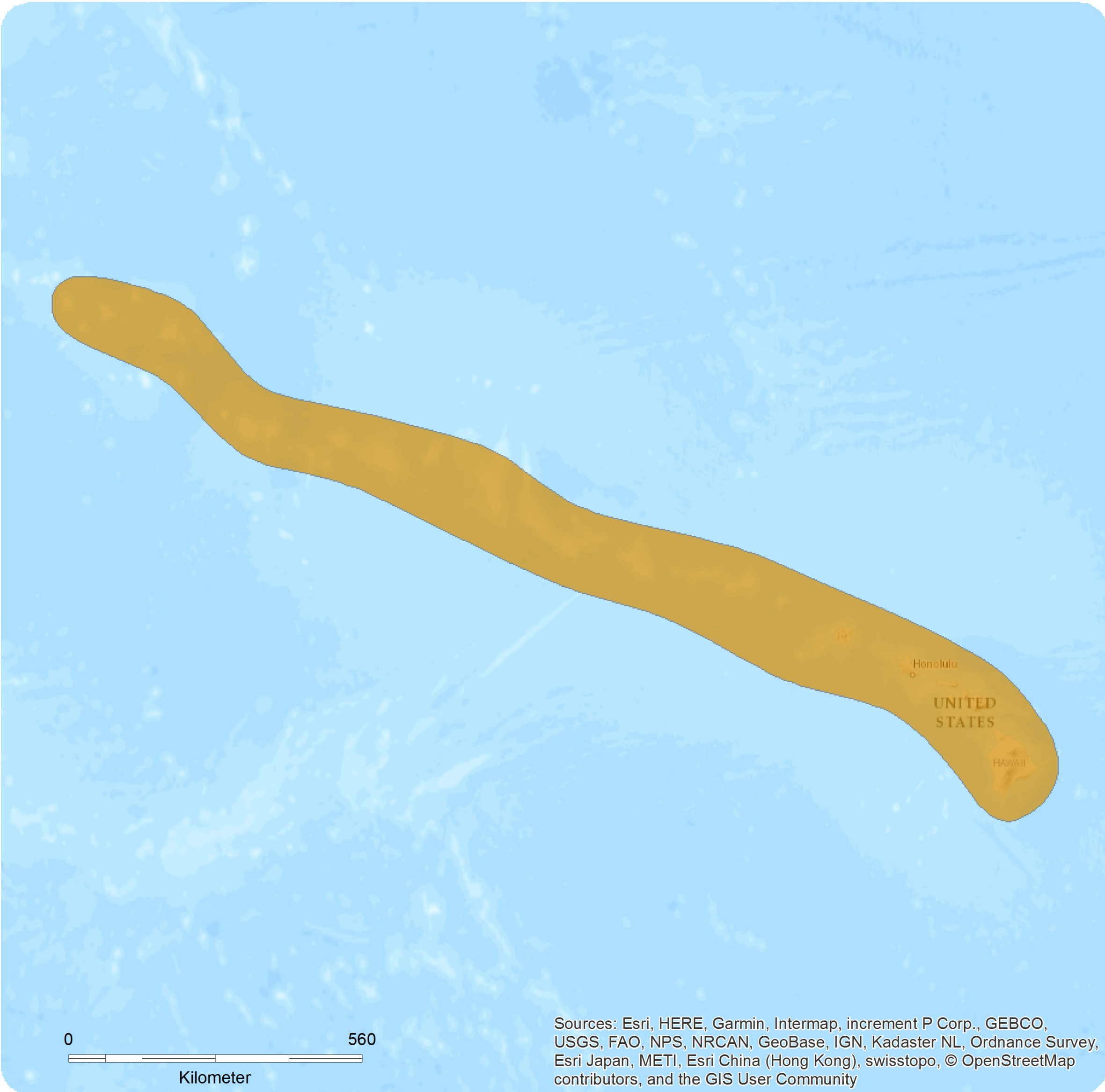
Native: United States (Hawaiian Is.)

FAO Marine Fishing Areas:

Native: Pacific - eastern central

Distribution Map

Chelonia mydas (Hawaiian subpopulation)

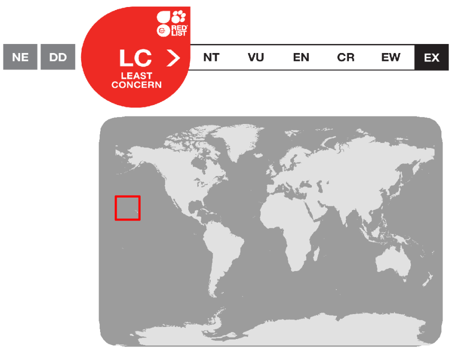


Range

Extant (resident)

Compiled by:

IUCN



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

Population

The geographic isolation of the Hawaiian Island chain has led to a distinct genetic stock derived from a single nesting population at French Frigate Shoals (FFS) (Dutton *et al*. 2008). Genetic studies using mitochondrial DNA (mtDNA) analysis identify FFS as an Evolutionary Significant Unit (ESU) and demographically discreet Management Unit (Bowen *et al*. 1992, Bowen and Avise 1995, Dutton *et al*. 2008). Recent analysis using nuclear DNA corroborates this (Roden *et al*. 2010). mtDNA analysis shows that Green Turtles found foraging throughout the Hawaiian Islands originate from the FFS rookery and indicates that juvenile and adult Green Turtles foraging and breeding throughout the Hawaiian Archipelago comprise a single stock (Dutton *et al*. 2008). Turtles from outside the archipelago infrequently stray to the Hawaiian Islands, as three turtles have been recorded with haplotypes not associated with Hawaii turtles. Two of these were foraging turtles and one was a turtle which had lost both front flippers, and which may have drifted to Hawaii from the Eastern Tropical Pacific (Dutton *et al*. 2008). It is unknown if there is any interbreeding, but these rare haplotypes have not been recorded at the nesting site (Dutton *et al*. 2008).

For further information about this species, see Supplementary Material.

Current Population Trend: Increasing

Habitat and Ecology (see Appendix for additional information)

Major aspects of the biology and ecology of Hawaiian Green Turtles are summarized by Balazs *et al*. (2015). Green Turtles are the largest of the hard-shelled sea turtles, reaching lengths of 100 cm in carapace length (straight and curved carapace length) and weighting 150 kg as adults.

Hatchlings emerge from nesting beaches and enter a post-hatchling oceanic phase. It is estimated that the oceanic developmental phase is approximately six years, but ranges from four to ten years (Zug *et al*. 2002). Following the oceanic phase, juveniles recruit to coastal or neritic habitats mostly around the islands in the southeastern part of the archipelago (Zug *et al*. 2002). Nesting females average 92 cm SCL (Balazs 1980, Zug *et al*. 2002). Females can lay up to six clutches and an average of 1.8 to 4 clutches / season, with an average of 104 eggs per clutch, during a nesting season (Balazs 1980, NMFS 1998, Balazs *et al*. 2015). The eggs incubate for 64 to 67 days, with an average of 66 days (Balazs *et al*. 2015), after which hatchlings emerge (Balazs 1980). Niethammer *et al*. (1997) determined that the nesting peaked between mid-June and early August and hatchling emergence peaked between mid-August and early October, with these being confirmed recently by Balazs *et al*. (2015). Mean hatching success is around 78.6% when averaged over success of individual nests, and 81.1% when calculated as percentage of total number of eggs. Emergence success averages 70.8 to 71.1%

Adult Hawaiian Green Turtles live and forage in the MHI. Every three or four years, females migrate to FFS to nest (Balazs and Chaloupka 2004a). There is direct evidence of non-random dispersal and habitat use, with Hawaiian Green Turtles returning to natal beaches as they mature, as evidenced through their genetic isolation. The extent to which Hawaiian Green Turtles disperse to foraging areas in either the eastern or western Pacific is unknown (only a small number of Hawaiian turtles have been recorded outside of the islands) and there is no evidence from limited studies to date that the range of Hawaiian Green Turtles extends beyond the central Pacific region (Dethmers *et al*. 2006, Dutton *et al*. 2008). Foraging grounds range from coral reefs to seagrass beds to algal-dominated hard substrates throughout the Hawaiian archipelago (Balazs and Chaloupka 2004a).

Pelagic juveniles recruit to Hawaiian neritic foraging grounds from *c*. 35 cm SCL or 5 kg (~6 years of age), and grow at foraging-ground specific rates resulting in different size- and age-specific growth rates of 0–3.8 cm/yr. Juvenile Green Turtles (10 years and older) exhibit a relatively constant growth rate until about 28 to 30 years or approximately 80 cm straight carapace length (Zug *et al*. 2002, Balazs and Chaloupka 2004b).

Age-at-maturity was first estimated to be ca. 35–40 years for four southeastern populations, and possibly >50 years for the northern population at Midway (Balazs and Chaloupka 2004b), but this has since been revised to ~23 years (Van Houtan *et al*. 2014), based on long-term mark-recapture data. Piacenza *et al*. (2016) calculated mean nester carapace lengths ranging from 89.2 to 91.7 cm and an annual nester survival of 0.929 / yr, representative of a healthy and robust nesting stock.

Sex ratios of immature turtles captured in-water at three sites in the Hawaiian islands did not differ statistically from a 1:1 ratio and were homogeneous relative to location and turtle size (Wibbels *et al*. 1993). Analysis of stranded turtles indicated that adults comprised roughly 62% female turtles, and subadults had a nearly equal female to male ratio (Balazs *et al*. 2015).

Hawaiian Green Turtles feed on native and introduced algae that commonly occur throughout the Hawaiian Islands (Russell and Balazs 2009, 2015), with an active selection for non-native species in many cases even when native species are present (Arthur and Balazs 2009). It is possible that some level of consumption of non-native species may even be beneficial to Hawaiian Green Turtles (McDermid *et al*. 2015). Turtle growth rates are similar amongst forage habitat types (Balazs and Chaloupka 2004b) even with the introduction of an alien species of algae (Arthur and Balazs 2009, Russell and Balazs 1994). Of approximately 400 species of algae present in the Hawaiian archipelago, nine species account for the majority of Green Turtle diet, including invasive algae species in Kaneohe Bay, for example, which have stifled reef growth for many years (Arthur and Balazs 2009, Russell and Balazs 2009). The transition in choice over native species is a process that takes ten to twenty years, but the choice of the nutritionally-rich non-native species appears to be an important contributing factor to the recovery of the Hawaiian Green Turtle subpopulation (Russell and Balazs 2009).

Systems: Terrestrial, Marine

Use and Trade

See the Threats section.

Threats (see Appendix for additional information)

Among the key threats is fibropapillomatosis (FP), which causes debilitating tumours of the skin and internal organs. FP is among the seven most significant cause of stranding and mortality in Green Turtles in Hawaii (Murukawa 2016), accounting for 28% of strandings and an 88% mortality rate of stranded turtles (Chaloupka *et al*. 2008). The disease has regressed over time (Chaloupka *et al*. 2009) but persists in the population at varying spatial scales (Van Houtan *et al*. 2010). Recent evaluations of FP in Hawaii indicate there has been a substantial decline in prevalence of FP, that it occurs primarily in juvenile and sub-adult turtles, and that turtles show the ability to recover from all but the most extreme cases

(Hargrove *et al*. 2016, Murukawa 2016). While much has been learned over the past decades about FP, and the mortality impact of FP is not currently exceeding population growth rates in Hawaii, there is a need to better understand the linkages to environmental stressors, pathogens, hosts, and potential disease and environmental cofactors, along with continued monitoring to detect changes in the distribution, occurrence, and severity of the disease (Hargrove *et al*. 2016).

Restricted nesting habitat is a concern for the Hawaiian Green Turtle as they primarily utilize one rookery (Balazs 1980, Niethammer *et al*. 1997, Balazs and Chaloupka 2004a), but Tiwari *et al*. (2010) suggest that East Island is still well below carrying capacity to support nesting Green Turtles even given the robust recovery and increase in nesting females over the years. While the small nesting site is below carrying capacity (i.e. the number of nesting females could increase by up to 90% within the existing area; Tiwari *et al*. 2010), the impact of erosion and habitat loss throughout the NWHI can not be ignored. Encouragingly however, nesting has been recorded at an increasing number of sites throughout the archipelago, suggesting the close link to East island may not be entirely limiting (Frey *et al*. 2013, Dutton *et al*. 2014). Historically, turtles nested at many other sites in the Main Hawaiian Island and the NWHI prior to human exploitation (Kittinger *et al*. 2013) and thus the potential exists for these sites to be used in the future.

Projected sea-level rise, combined with likely increases in storm and wave energy, suggest that there is a high likelihood of inundating low-lying islands within the NWHI and increasing coastal erosion on all islands over the next 50–100 years (Wagner and Polhemus 2016). Natural sand accretion may replace eroded habitat (Baker *et al*. 2006), and there are other suitable nesting sites throughout the archipelago.

East Island, which hosts most turtle nesting in the FFS, was projected to lose 15% of its area with an Intergovernmental Panel on Climate Change (IPCC)-projected 48 cm increase in sea level, and up to 26% of its area under the extreme predictions of 88 cm rise in sea level. These predictions are based on IPCC suggested rises up to 2100 (Church *et al*. 2001), or roughly three Green Turtle generations. There are no accurate predictions beyond this 2100 cut-off. This reduced nesting habitat would continue to support large numbers of turtles if predictions on carrying capacity by Tiwari *et al*. (2010) hold true, and if sand accretion offsets the beach loss resulting from sea level rise (see Baker *et al*. 2006). In addition, coastal habitats migrate landward where unobstructed in response to relative sea-level rise, and where the slope of upland adjacent to the existing landward margin of the coastal habitat affects the change in width of the coastal habitat as it migrates landward. So, while there may be a decrease in turtle nesting habitat as a result of a reduction in the circumference of East Island and hence length of the coastline, there may be nominal change in habitat area due to change in beach width.

Given that sea turtles colonize new nesting habitat with sea level rise and fall, there is no behavioural reason why Hawaiian Green Turtles could not also colonize other potential nesting areas throughout the MHI and the NWHI. In the last 20,000 years alone, sea levels have changed by 120 m (e.g. Kominz 2001), so that today's nesting beaches would not have existed or been accessible to sea turtles. There is also a wide range of precision in sea turtle natal homing, sometimes in the order of several hundred km (Bowen and Karl 2007), which would allow for colonization of other nesting habitat over time, which turtles have used in the past (Kittinger *et al*. 2013).

A warming climate could lead to additional feminisation of a marine turtle stock (Jensen *et al*. 2018) but this has yet to be demonstrated for the Hawaii Green Turtle stock, or indeed for most global Green Turtle stocks. Indeed, recent work by Pilcher *et al*. (2015) in the Arabian Gulf where turtles live and reproduce under extreme warm climatic conditions has shown that turtle stocks are not highly skewed, and are in keeping with turtle stocks elsewhere.

Today, recreational fishing is one of the greatest threats to Hawaiian Green Turtles, especially interaction with inshore fisheries (Nitta and Henderson 1993), and incidences of strandings and interactions with fishing gear has continue to increase every year (Francke 2015). Hook-and-line fishing gear induced trauma accounted for roughly 7% (n=261 of 3,732 Green Turtle strandings between 1982 and 2003) of turtle strandings in Hawaii but this figure had grown to 21% in 2011, 2012 and 2013, and 17% in 2014. Less than half of these strandings were released alive (Francke 2015).

Gillnet fishing gear-induced trauma causes about 5% of stranding (Chaloupka *et al*. 2008). There is a high mortality rate (>50%) associated with strandings caused by commercial fishing gear (Chaloupka *et al*. 2008).

In the past, human exploitation was the greatest threat to the Hawaiian Green Turtle, but this threat has since abated. Hawaiian Green Turtles were exploited in the 19th century during the expeditions to the NWHI (Amerson 1971). Turtles were also taken at foraging grounds from the mid-1800s. Commercial exploitation began in the mid-1940s (Amerson 1971) and due to restaurant demand and tourism, and concomitant affluence and presence of turtles in markets had increased significantly in the 1960s and early 1970s (Witzell 1994, Chaloupka and Balazs 2007).

Take of nesting females and their eggs ceased in the early 1960s with the establishment of a US Fish and Wildlife Service permanent presence at FFS following a regulation passed by the Hawaii State Division of Fish and Game (Balazs 1975, Niethammer *et al*. 1997). Despite the cessation of legal take and protection under State and Federal laws, occasional illegal take of Green Turtles still occurs in Hawaii (Balazs 1980).

In recent years there have been increased calls from native Hawaiian groups to delist the Green Turtle in Hawaii and allow a resumption of some level of legal harvest. Notwithstanding the complex legal process and public hearings this would require, a resumption of commercial harvest could threaten this subpopulation, and would need to demonstrate sustainability and be managed via an State-approved plan under Federal observation. Even a resumption of traditional harvest would need to follow the same complex legal process and public hearings, and may be further complicated by the ability to distinguish between permitted take and illegal take, determining if the level of take is sustainable, and determining precisely who would be permitted to harvest Green Turtles, amongst others.

Modification of coastal waterways has caused shallow water coral reefs to degrade (Wolanski *et al*. 2009) and foraging habitats are vulnerable to the effects of coastal development and urbanization. Marine pollution abrades and scours living coral polyps and destroys coral skeletons, which affects reef structure (Donohue *et al*. 2001). Significant amounts of marine pollution are deposited in the Hawaiian archipelago due to oceanic circulation patterns (Donohue *et al*. 2001). While ingestion of marine debris has been documented to impact to marine turtles elsewhere (Stamper *et al*. 2009), death or debilitation due to marine debris ingestion is not a major threat in Hawaii. Less than 0.5% of the 3,732 turtles which were examined by as part of the stranding work by NOAA Fisheries in Hawaii were deemed to have stranded due to marine debris (Chaloupka *et al*. 2008).

Two prominent and highly regulated pelagic longline fisheries industries exist in Hawaii: a deep-set fishery (40 to 350 m hook set depth) that targets primarily bigeye tuna, and a shallow-set fishery (30 to 90 m hook set depth) that targets swordfish. The majority of sea turtles landed dead in the longline fisheries are immature Loggerheads, Leatherbacks, and Olive Ridleys (Work and Balazs 2002, Work and Balazs 2010), with more turtles caught in the shallow-set fishery than in the deep-set fishery (Gilman *et al*. 2006). Sea turtle bycatch in Hawaii-based longline fisheries have been reduced by nearly 90% in recent years due to additional regulatory measures implemented in 2004. The National Marine Fisheries Service has recorded very low levels of Hawaiian Green Turtle interactions in the Hawaii deep-set longline fishery, and Hawaiian Green Turtles are generally at low risk of incidental capture in pelagic longline fisheries operating in the North Pacific (Work and Balazs 2010).

Exposure to the Hawaii-base longline fisheries poses little risk to the long-term viability of the Hawaiian Green Turtle stock. Over the past 12 years (2004–2015) there were only seven Green Turtles in total taken as incidental bycatch in the Hawaii shadow-set longline fishery, which has 100% observer coverage (WPRFMC 2016). There were only 11 observed takes in the deep-set fishery over the 14-yr period (2002–2015) — and that is *c.* 40 estimated takes over that 14-yr period when expanded by NMFS to account for the 20% observer coverage (WPRFMC 2016). NMFS estimates that there could be up to three interactions with Green Turtles annually in the deep-set longline fishery (NMFS 2014) and an additional three interactions with Green Turtles annually in the Hawaii shallow-set longline fishery (NMFS 2012).

Green Turtles also face the threat of vessel collisions. Small boat collisions account for 2.5% of strandings or approximately 10 to 14 turtles per year (Chaloupka *et al*. 2008). Boat strikes often result in a dead stranded turtle (Chaloupka *et al*. 2008). With increased tourism, it is likely there will be elevated threats to turtles through vessel collisions and potential behavioural impacts as humans and turtles interact. At present, however, human/turtle interactions do not appear to drive any substantial behavioural changes.

Increases in sea surface temperature and intensity and number of severe storms are potential climate change-induced threats facing sea turtles. Migratory patterns and life history of sea turtles correlate with ocean temperatures (Weishampel *et al*. 2010). Ambient temperatures may lead to changes in the initiation and duration of nesting (Weishampel *et al*. 2010). Green Turtles may initiate nesting earlier and increase nesting season length with warmer sea surface temperature (SST) (Weishampel *et al*. 2010). Sea level rise threatens to erode coastal habitat, including nesting habitat. The majority of nesting occurs on FFS, a low-lying atoll vulnerable to increases in sea level (Baker *et al*. 2006). However, there is evidence of long term accretion of islands, so that this effect may be somewhat mitigated (Webb and Kench 2010). Warming temperatures may lead to a skewed sex-ratio with far greater number of females than males (Davenport 1997, Hays *et al*. 2003), although recent work suggests warming temperatures may also lead to more clutches being produced, with the additional clutches incubating at sub-optimal or male-producing temperatures (Tucker *et al*. 2008).

Conservation Actions **(see Appendix for additional information)**

Both Federal Legislation and State of Hawaii law protect the Hawaiian Green Turtle. The Green Turtle was listed in 1974 under State Division of Fish and Game Regulation 36, and under the Endangered Species Act (ESA) in 1978. Under Hawaii State law, the Green Turtle received full legal protection consistent to Federal ESA listing, when it was added to the protected list of wildlife of the State of Hawaii under Chapter 194. The primary nesting habitat, FFS, receives protection because it is located within the Northwestern Hawaiian Islands Marine National Monument (NWHIMNM, also called Papahānaumokuākea Marine National Monument). NWHIMNM received World Heritage status in 2010. The recent expansion of the NWHIMNM from ~362,000 sq km to ~1,509,000 sq km (Obama 2016) may further protect some segments of foraging (Balazs and Chaloupka 2004a), and migratory (Balazs *et al*. 2017) habitat (Figure 3 in the Supplementary Information). The marine protected area is managed by both State and Federal agencies.

The Federally managed Hawaii-based longline fishery operates under a number of regulatory measures to reduce turtle bycatch. Prior to the designation of the NWHI Monument, in 1991 the NMFS created a "longline protected species zone" within a 50 nm radius from the geographical centres of designated islands and atolls of the NWHI and within a 100 nm corridor, within which pelagic longline fishing was prohibited, in order to avoid interactions between monk seals and longline fishing vessels. This also offered a concomitant protection mechanism for green sea turtles. Other more recent protection measures include mandatory uses of circle hooks and mackerel-type bait, mandatory annual attendance of a protected species workshop by longline vessel operators, mandatory turtle handling measures to dehook and revive comatose turtles, and annual interaction limits for Loggerhead and Leatherback turtles. These bycatch reduction measures have significantly reduced bycatch by up to 90% (Gilman *et al*. 2007), with 100% coverage in the shallow-set fishery and 20% observer coverage in the deep-set sector of the longline fishery.

For further information about this species, see Supplementary Material.

Credits

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Bibliography

Amerson Jr., A.B. 1971. The natural history of French Frigate Shoals, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 150: 1-120.

Arthur, K.E. and Balazs, G.H. 2008. A comparison of immature green turtle (*Chelonia mydas*) diets among seven sites in the Main Hawaiian Islands. *Pacific Science* 62(2): 205-217.

Baker, J.D., Littnan, C.L. and Johnston, D.W. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. *Endangered Species Research* 4: 1-10.

Balazs, G.H. 1975. Green turtle's uncertain future. *Defenders* 50: 521-523.

Balazs, G.H. 1980. Synopsis of biological data on the green turtle in the Hawaiian Islands. NOAA Technical Memorandum. NMFS, NOAA-SWFC-7. U.S. Department of Commerce.

Balazs, G.H. and Chaloupka, M. 2004a. Thirty-year recovery trend in the once depleted Hawaiian green sea turtle stock. *Biological Conservation* 117: 491-498.

Balazs, G.H. and Chaloupka, M. 2004b. Spatial and temporal variability in somatic growth of green sea turtles (*Chelonia mydas*) resident in the Hawaiian Archipelago. *Marine Biology* 145: 1043-1059.

Balazs, G.H., Parker, D.M. and Rice, M. 2017. Ocean pathways and residential foraging locations for satellite tracked green turtles breeding at French Frigate Shoals in the Hawaiian Islands. *Micronesica* 04: 1-19.

Balazs, G.H., Rice, M., Murakawa, S.K. and Watson, G. 2000. Growth rates and residency of immature green turtles at Kiholo Bay, Hawaii. In: A. Abreu-Grobois, R. Briseno-Duenas, R. Marquez-Millan and L. Sarti-Martinez (eds), Proceedings of the 18th International Sea Turtle Symposium, 3-7 March 1998, pp. 283-285.U.S. Department of Commerce. NOAA Technical Memorandum NOAA-TM-NMFS-SEFSC-436.

Balazs, G.H., Van Houtan, K.S., Hargrove, S.A., Brunson, S.M. and Murakawa, S.K.K.. 2015. A review of the demographic features of Hawaiian Green Turtles (*Chelonia mydas*). *Chelonian Conservation and Biology* 14: 119-129.

Bowen, B.W. and Avise, J.C. 1995. Conservation genetics of marine turtles. In: J.C. Avise and J.L. Hamrick (eds), *Conservation Genetics: case studies from nature*, pp. 190-237. Chapman & Hall, New York.

Bowen, B.W. and Karl, S.A. 2007. Population genetics and phylogeography of sea turtles. *Molecular Ecology* 16: 4886-4907.

Bowen, B.W., Meylan, A.B., Ross, J.P., Limpus, C.J., Balazs, G.H. and Avise, J.C. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. *Evolution* 46: 865-881.

Chaloupka, M. and Balazs, G.H. 2007. Using Bayesian state-space modelling to assess the recovery and harvest potential of the Hawaiian green sea turtle stock. *Ecological Modelling* 205: 93-109.

Chaloupka, M., Work, T.M., Balazs, G.H., Murakawa, S.K.K. and Morris, R. 2008. Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982 – 2003). *Marine Biology* 154: 887-898.

Church, J.A., Gregory, J.M., Huybrechts, P., Kuhn, M., Lambeck, K., Nhuan, M.T., Qin, D. and Woodworth, P.L. 2001. Changes in sea level in climate change 2001: the scientific basis. In: J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P. van der Linden, X. Dai, K. Maskell and C.I. Johnson (eds), *Contribution of Working*

Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, pp. 641-693. Cambridge University Press, Cambridge, UK.

Davenport, J. 1997. Temperature and the life-history strategies of sea turtles. *Journal of Thermal Biology* 22: 479-488.

Dethmers, K.E.M., Broderick, D., Mortiz, C., Fitzsimmons, N.N., Limpus, C.J., Lavery, S., Whiting, S., Guinea, M., Prince, P.I.T. and Kennett, R. 2006. The genetic structure of Australiasian green turtles (*Chelonia mydas*): exploring the geographical scale of genetic exchange. *Molecular Ecology* 15: 3931-3946.

Donahue, M.J., Boland, R.C., Sramek, C.M. and Antonelis, G.A. 2001. Derelict fishing gear in the Northwestern Hawaiian Islands: diving surveys and debris removal to confirm threat to coral reef ecosystems. *Marine Pollution Bulletin* 14: 1301-1312.

Dutton, P, Balazs, G.H. and Frey, A. 2014. Hawaiian nesting range shift offers rare learning opportunity. *State of the World's Sea Turtes (SWOT), Vol IX*, pp. 22-23.

Dutton, P., Balazs, G.H., Le Roux, R.A., Murakawa, S.K.K., Zarate, P. and Martinez, L.S. 2008. Composition of Hawaiian green turtle foraging aggregations: mtDNA evidence for a distinct regional population. *Endangered Species Research* 5: 37-44.

Francke, D, 2015. Marine Turtle Strandings in the Hawaiian Islands: January – December 2014. NOAA Pacific Islands Fisheries Science Center Internal Report IR-15-008, Honolulu, Hawaii. 21 pp.

Frey, A, Dutton, P.H. and Balazs, G.H. 2013. Insights on the demography of cryptic nesting by green turtles (*Chelonia mydas*) in the main Hawaiian Islands from genetic relatedness analysis. *Journal of Experimental Marine Biology and Ecology* 442: 80–87.

Gilman, E., Kobayashi, D., Swenarton, T., Brothers, N., Dalzell, P. and Kinan-Kelly, I. 2007. Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery. *Biological Conservation* 139: 19-28.

Gilman, E., Zollet, E., Beverley, S., Nkano, H., Davis, K., Shiode, D., Dalzell, P. and Kinan, I. 2006. Reducing sea turtle by-catch in pelagic longline fisheries. *Fish and Fisheries* 7: 2-23.

Hargrove, S. and Balazs, G.H. 2011. Coming of age: 4 decades of tagging sheds light on time to maturity for Hawaiian green turtles. *31st Annual Sea Turtle Symposium*, San Diego, California, 12-15 April 2011.

Hargrove, S., Work, T., Brunson, S., Foley, A.M. and Balazs, G. 2016. Proceedings of the 2015 international summit on fibropapillomatosis: Global status, trends, and population impacts. U.S. Dep. Commer., NOAA Technical Memorandum, NOAA-TM-NMFS-PIFSC-54. 87 pp..

Hays, G.C., Broderick, A.C., Glen, F. and Godley, B.J. 2003. Climate change and sea turtles: a 150-year reconstruction of incubation temperatures at a major marine turtle rookery. *Global Change Biology* 9(4): 642-646.

Hughes, G.R. 1982. *Nesting cycles in sea turtles—typical or atypical? In: Bjorndal KA (ed) Biology and conservation of sea turtles*. Smithsonian Institution Press, Washington, D.C.

IUCN. 2019. The IUCN Red List of Threatened Species. Version 2019-2. Available at: www.iucnredlist.org. (Accessed: 04 July 2019).

Jensen, M.J., Allen, C.D., Eguchi, T., Bell, I.A., LaCasella, E.L., Hilton, W.A., Hof, C.A.M. and Dutton, P.H. 2018. Environmental warming and feminization of one of the largest sea turtle populations in the world. *Current Biology* 28: 154-159.

Kittinger, J.N., Van Houtan, K.S., McClenachan, L.E. and Lawrence, A.L. 2013. Using historical data to assess the biogeography of population recovery. *Ecography* 36: 001–005.

Kominz, M.A. 2001. Sea level variations over geological time. *Reference Module in Earth Systems and Environmental Sciences*, pp. 2605-2613. Elsevier. doi.10.1006/rwos.2001.0255.

Limpus, C.J. and Nicholls, N. 1988. The Southern Oscillation regulates the annual numbers of green turtles *Chelonia mydas* breeding around northern Australia. *Australian Wildlife Research* 15: 157-161.

Limpus, C.J. and Nicholls, N. 2000. ENSO regulation of Indo-Pacific green turtle populations. In: G. Hammer, N. Nicholls and C.D. Mitchell (eds), *Applications of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems. An Australian Experience*, Atmospheric and Oceanographic Sciences Library, Kluwer Academic Publishers.

McDermid, K.J., Lefebvre, J.A. and Balazs, G.H. 2015. Nonnative Seashore *Paspalum, Paspalum vaginatum* (Poaceae), Consumed by Hawaiian Green Sea Turtles (*Chelonia mydas*): evidence for nutritional benefits. *Pacific Science* 69(1): 48–57.

Murukawa, S. 2016. Hawaiian archipelago fibropapillomatosis data. In: S. Hargrove, T. Work, S. Brunson, A.M. Foley and G. Balazs (eds), Proceedings of the 2015 international summit on fibropapillomatosis: global status, trends, and population impacts. U.S. Dep. Commerce, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-054, pp. 44-56.

National Marine Fisheries Service and U.S. Fish and Wildlife Service (NMFS). 1998. Recovery Plan for U.S. Pacific Populations of the green turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, Maryland, U.S.

National Marine Fisheries Service (NMFS). 2005. Biological Opinion on the Continued Authorization of the Hawaii-based Pelagic Tuna Longline Fisheries. Pacific Islands Region, Protected Resources Division.

National Marine Fisheries Service (NMFS). 2012. Biological Opinion on the continued operation of the Hawaii-based shallow-set longline swordfish fishery. Pacific Islands Region, Protected Resources Division, Honolulu, Hawaii.

National Marine Fisheries Service (NMFS). 2014. Biological Opinion on the continued operation of the Hawaii-based pelagic tuna longline fisheries. Pacific Islands Region, Protected Resources Division, Honolulu, Hawaii.

Niethammer, K.R., Balazs, G.H., Hatfield, J.S., Nakai, G.L. and Megyesi, J.L. 1997. Reproductive biology of the green turtle (*Chelonia mydas*) at Tern Island, French Frigate Shoals, Hawai'i. *Pacific Science* 51: 36-47.

Nitta, E.T. and Henderson, J.R. 1993. A review of interactions between Hawaii's fisheries and protected species. *Marine Fisheries Review* 55: 83-92.

Obama, B, 2016. Presidential Proclamation -- Papahanaumokuakea Marine National Monument Expansion. The White House, Office of the Press Secretary. https://www.whitehouse.gov/the-press-office/2016/08/26/presidential-proclamation-papahanaumokuakea-marine-national-monument. Accessed: 27 August 2016.

Parker, D. and Balazs, G. 2015. Map guide to marine turtle nesting and basking in the Hawaiian Islands. (Unpublished). Marine Turtle Research Program, NOAA, National Marine Fisheries Service, Pacific Islands Fisheries Science Center, 2570 Dole Street, Honolulu, Hawaii 96822-2396 USA.

Piacenza, S.E., Balazs, G.H., Hargrove, S.K., Richards, P.M. and Heppell, S.S. 2016. Trends and variability in demographic indicators of a recovering population of green sea turtles *Chelonia mydas*. *Endangered Species Research* 31: 103-117.

Pilcher, N.J., Al-Maslamani, I., Williams, J., Gasang, R. and Chikhi, A. 2015. Population structure of marine turtles in coastal waters of Qatar. *Endangered Species Research* 28: 163-174. doi: 10.3354/esr00688.

Roden, S., Dutton, P., Morin, P., Balazs, G., Zarate, P. and Cheng, I.J. 2010. Detecting green turtle population structure in the Pacific using single nucleotide polymorphisms (SNPs). Abstracts, *SNP Workshop III Applications of SNP Genotyping in Non-Model Organisms*, Blaine, Washington, USA 22-24 March 2010. School of Aquatic & Fishery Sciences, University of Washington. http://snpworkshop.org/SNP%20III%20program.pdf: 34.

Russell, D.F. and Balazs, G.H. 2009. Dietary shifts by green turtles (*Chelonia mydas*) in the Kane'ohe Bay region of the Hawaiian Islands: a 28-year study. *Pacific Science* 63: 181-192.

Russell, D.F. and Balazs, G.H. 2015. Increased use of non-native algae species in the diet of the Green Turtle (*Chelonia mydas*) in a primary pasture ecosystem in Hawaii. *Aquatic Ecosystem Health & Management* 18(3): 342-346.

Seminoff, J.A., Allen, C.D., Balazs, G.H., Dutton, P.H., Eguchi, T., Haas, H.L., Hargrove, S.A., Jensen, M.P., Klemm, D.L., Lauritsen, A.M., MacPherson, S.L., Opay, P., Possardt, E.E., Pultz, S.L., Seney, E.E., Van Houtan, K.S. and Waples, R.S. 2015. Status Review of the Green Turtle (*Chelonia mydas*) Under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAANMFS- SWFSC-539.

Snover, M.L. 2008. Comments on "Using Bayesian state-space modelling to assess the recovery and harvest potential of the Hawaiian green sea turtle stock". *Ecological Modelling* 212: 545-549.

Stamper, M.A., Spicer, C.W., Neiffer, D.L., Mathews, K.S. and Fleming, G.J. 2009. Morbidity in a juvenile green sea turtle (*Chelonia mydas*) due to ocean-borne plastic. *Journal of Zoo and Wildlife Medicine* 40: 196-198.

Tiwari, M., Balazs, G.H. and Hargrove, S. 2010. Estimating carrying capacity at the green turtle nesting beach of East Island, French Frigate Shoals. *Marine Ecology Progress Series* 419: 289-294.

Tucker, J.K., Dolan, C.R., Lamer, J.T. and Dustman, E.A. 2008. Climatic warming, red-eared sliders (*Trachemys scripta elegans*), and sex ratio in Illinois. *Chelonian Conservation and Biology* 7(1): 60-69.

Van Houtan, K.S., Hargrove, S.K. and Balazs, G.H. 2010. Land use, macroalgae, and a tumour-forming disease in marine turtle. *PLoS ONE* 5(9): e12900. doi:10.1371/journal.pone.0012900.

Van Houtan, K.S., Hargrove, S.K. and Balazs, G.H. 2014. Modeling sea turtle maturity age from partial life history records. *Pacific Science* 68(4): 465–477.

Wabnitz, C.C., Balazs, G., Beavers, S., Bjorndal, K.A., Bolten, A.B., Christensen, V., Hargrove, S. and Pauly, D. 2010. Ecosystem structure and processes at Kaloko Honoko-hau, focusing on the role of herbivores, including the green sea turtle *Chelonia mydas*, in reef resilience. *Marine Ecology Progress Series* 420: 27-44.

Wagner, D. and Polhemus, D.A. 2016. Climate change vulnerability assessment for the Papahānaumokuākea Marine National Monument. Marine Sanctuaries Conservation Series ONMS-16-03. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD.

Wallace, B.P., DiMatteo, A.D., Hurley, B.J., Finkbeiner, E.M., Bolten, A.B., Chaloupka, M.Y., Hutchinson, B.J., Abreu-Grobois, F.A., Amorocho, D., Bjorndal, K.A., Bourjea, J., Bowen, B.W., Briseño-Dueñas, R., Casale, P., Choudhury, B.C., Costa, A., Dutton, P.H., Fallabrino, A., Girard, A., Girondot, M., Godfrey, M.H., Hamann, M., López-Mendilaharsu, M., Marcovaldi, M.A., Mortimer, J.A., Musick, J.A., Nel, R., Pilcher, N.J., Seminoff, J.A., Troëng, S., Witherington, B. and Mast, R.B. 2010. Regional Management Units for marine turtles: A novel framework for prioritizing conservation and research across multiple scales. *PLoS ONE* 5(12): e15465. DOI: 10.1371/journal.pone.0015465.

Webb, A.P. and Kench, P.S. 2010. The dynamic response of reef islands to sea-level rise: Evidence from multi-decadal analysis of island change in the Central Pacific. *Global and Planetary Change* 72: 234-246.

Weishampel, J.F., Bagley, D.A., Ehrhart, L.M. and Weishampel, A.C. 2010. Nesting phenologies of two sympatric sea turtle species related to sea surface temperatures. *Endangered Species Research* 12: 41-47.

Western Pacific Regional Fishery Management Council. 2016. Stock Assessment and Fishery Evaluation (SAFE) Report Pacific Island Pelagic Fisheries 2015. WPRFMC, Honolulu, Hawaii. pp 323 & 340.

Wibbels, T., Balazs, G., Owens, D. and Amoss, M. 1993. Sex ratios of immature green turtles inhabiting the Hawaiian Archipelago. *Journal of Herpetology* 27: 327-329.

Witzell, W.N., 1994. The origin, evolution and demise of the US sea turtle fisheries. *Marine Fisheries Review* 56: 8-23.

Wolanski, E., Martinez, J.A. and Richmond, R.H. 2009. Quantifying the impact of watershed urbanization on a coral reef: Maunalua Bay, Hawai'i. *Estuarine, Coastal and Shelf Science* 84: 259-268.

Work, T.M. and Balazs, G.H. 2010. Pathology and distribution of sea turtles landed as bycatch in the Hawaii-based North Pacific pelagic longline fishery. *Journal of Wildlife Disease* 46: 422-432.

Zug, G.R., Balazs, G.H., Wetherall, J.A., Parker, D.M. and Murakawa, S.K.K. 2002. Age and growth of Hawaiian green sea turtles (*Chelonia mydas*): an analysis based on skeletochronology. *Fishery Bulletin* 100: 117-127.

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External Resources

For Supplementary Material, and for Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
9. Marine Neritic -> 9.1. Marine Neritic - Pelagic	Resident	Suitable	Yes
9. Marine Neritic -> 9.2. Marine Neritic - Subtidal Rock and Rocky Reefs	Resident	Suitable	Yes
9. Marine Neritic -> 9.7. Marine Neritic - Macroalgal/Kelp	Resident	Suitable	Yes
9. Marine Neritic -> 9.9. Marine Neritic - Seagrass (Submerged)	Resident	Suitable	Yes
10. Marine Oceanic -> 10.1. Marine Oceanic - Epipelagic (0-200m)	Resident	Suitable	Yes
12. Marine Intertidal -> 12.2. Marine Intertidal - Sandy Shoreline and/or Beaches, Sand Bars, Spits, Etc	Breeding season	Suitable	Yes
13. Marine Coastal/Supratidal -> 13.3. Marine Coastal/Supratidal - Coastal Sand Dunes	Breeding season	Suitable	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
12. Other options -> 12.1. Other threat	Ongoing	Whole (>90%)	Unknown	Unknown
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.1. Intentional use: (subsistence/small scale) [harvest]	Past, likely to return	Majority (50-90%)	Unknown	Past impact
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.2. Intentional use: (large scale) [harvest]	Past, unlikely to return	Majority (50-90%)	Rapid declines	Past impact
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.4. Unintentional effects: (large scale) [harvest]	Ongoing	Majority (50-90%)	Unknown	Unknown
	Stresses:	2. Species Stresses -> 2.1. Species mortality		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Research, Monitoring and Planning

Conservation Actions in Place
Systematic monitoring scheme: Yes
In-Place Land/Water Protection and Management
Occur in at least one PA: Yes
Area based regional management plan: Yes
In-Place Education
Included in international legislation: Yes
Subject to any international management/trade controls: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
2. Land/water management -> 2.1. Site/area management
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.3. Sub-national level

Additional Data Fields

Distribution
Estimated area of occupancy (AOO) (km^2): 41000
Continuing decline in area of occupancy (AOO): No
Extreme fluctuations in area of occupancy (AOO): No
Estimated extent of occurrence (EOO) (km^2): 226
Continuing decline in extent of occurrence (EOO): No
Extreme fluctuations in extent of occurrence (EOO): No
Lower elevation limit (m): 0
Upper elevation limit (m): 1
Lower depth limit (m): 40
Upper depth limit (m): 0
Population
Number of mature individuals: 6550
Continuing decline of mature individuals: No
Extreme fluctuations: No

Population
Population severely fragmented: No
Continuing decline in subpopulations: No
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: Yes

The IUCN Red List Partnership

The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

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