

### In this review:

#### A. Recent articles with abstracts

O/A denotes an open access article or journal

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Peckham, S.H., Diaz, D.M., Walli, A., Ruiz, G., Crowder, L.B., and Nichols, W.J. **Small-scale fisheries bycatch jeopardizes endangered Pacific loggerhead turtles.** *PLoS ONE* 2(10): art. e1041, 2007. O/A

**Notes:** *Background.* Although bycatch of industrial-scale fisheries can cause declines in migratory megafauna including seabirds, marine mammals, and sea turtles, the impacts of small-scale fisheries have been largely overlooked. Small-scale fisheries occur in coastal waters worldwide, employing over 99% of the world's 51 million fishers. New telemetry data reveal that migratory megafauna frequent coastal habitats well within the range of small-scale fisheries, potentially producing high bycatch. These fisheries occur primarily in developing nations, and their documentation and management are limited or non-existent, precluding evaluation of their impacts on non-target megafauna. *Principal Findings/Methodology.* 30 North Pacific loggerhead turtles that we satellite-tracked from 1996-2005 ranged oceanwide, but juveniles spent 70% of their time at a high use area coincident with small-scale fisheries in Baja California Sur, Mexico (BCS). We assessed loggerhead bycatch mortality in this area by partnering with local fishers to 1) observe two small-scale fleets that operated closest to the high use area and 2) through shoreline surveys for discarded carcasses. Minimum annual bycatch mortality in just these two fleets at the high use area exceeded 1000 loggerheads year<sup>-1</sup>, rivaling that of oceanwide industrial-scale fisheries, and threatening the persistence of this critically endangered population. As a result of fisher participation in this study and a bycatch awareness campaign, a consortium of local fishers and other citizens are working to eliminate their bycatch and to establish a national loggerhead refuge. *Conclusions/Significance.* Because of the overlap of ubiquitous small-scale fisheries with newly documented high-use areas in coastal waters worldwide, our case study suggests that small-scale fisheries may be among the greatest current threats to non-target megafauna. Future research is urgently needed to quantify small-scale fisheries bycatch worldwide. Localizing coastal high use areas and mitigating bycatch in partnership with small-scale fishers may provide a crucial solution toward ensuring the persistence of vulnerable megafauna.

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Day, R.D., Segars, A.L., Arendt, M.D., Lee, A.M., and Peden-Adams, M.M. **Relationship of blood mercury levels to health parameters in the loggerhead sea turtle (*Caretta caretta*).** *Environmental Health Perspectives* 115(10): 1421-1428, 2007. O/A

**Notes:** BACKGROUND: Mercury is a pervasive environmental pollutant whose toxic effects have not been studied in sea turtles in spite of their threatened status and evidence of immunosuppression in diseased populations. OBJECTIVES: In the present study we investigate mercury toxicity in loggerhead sea turtles (*Caretta caretta*) by examining trends between blood mercury concentrations and various health parameters. METHODS: Blood was collected from free-ranging turtles, and correlations between blood mercury concentrations and plasma chemistries, complete blood counts, lysozyme, and lymphocyte proliferation were examined. Lymphocytes were also harvested from free-ranging turtles and exposed in vitro to methylmercury to assess proliferative responses. RESULTS: Blood mercury concentrations were positively correlated with hematocrit and creatine phosphokinase activity, and negatively correlated with lymphocyte cell counts and aspartate aminotransferase. Ex vivo negative correlations between blood mercury concentrations and B-cell proliferation were observed in 2001 and 2003 under optimal assay conditions. In vitro exposure of peripheral blood leukocytes to methylmercury resulted

in suppression of proliferative responses for B cells (0.1 µg/g and 0.35 µg/g) and T cells (0.7 µg/g). **CONCLUSIONS:** The positive correlation between blood mercury concentration and hematocrit reflects the higher affinity of mercury species for erythrocytes than plasma, and demonstrates the importance of measuring hematocrit when analyzing whole blood for mercury. In vitro immunosuppression occurred at methylmercury concentrations that correspond to approximately 5% of the individuals captured in the wild. This observation and the negative correlation found ex vivo between mercury and lymphocyte numbers and mercury and B-cell proliferative responses suggests that subtle negative impacts of mercury on sea turtle immune function are possible at concentrations observed in the wild

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Koch, V., Brooks, L.B., and Nichols, W.J. **Population ecology of the green/black turtle (*Chelonia mydas*) in Bahia Magdalena, Mexico.** *Marine Biology* 153(1): 35-46, 2007.

**Notes:** The mangrove channels of Bahia Magdalena, Mexico, are important developmental areas for juvenile green, or black turtles (*Chelonia mydas*), but incidental bycatch and illegal hunting threaten population persistence. We studied size distribution, condition index (CI), growth rates, and mortality of black turtles in Estero Banderitas, the largest mangrove channel in Bahia Magdalena, to supply information for the development of effective conservation strategies. A total of 213 black turtles (including 88 recaptures) were caught in entanglement nets between July 2000 and July 2003. Average yearly catch per unit of effort (CPUE, 1 unit: 100 m of net fishing for 12 h) dropped during the study from 2.19 to 0.76. About 97% of all turtles were considered juveniles, average size was  $54.6 \pm 9.5$  cm. Turtles were significantly smaller at the head of Estero Banderitas than in the central part of the Estero and in the open bay, indicating size-based habitat segregation. Average growth rate was 1.62 cm/year and declined with increasing size. Growth was seasonal and three times higher in summer (0.28 cm/month) than in winter (0.09 cm/month), body CI was also significantly higher during the summer months. A seasonalized von Bertalanffy growth function (VBGF) was used to model growth for the size range studied (43-73 cm SCL), with the parameters:  $L_{\infty} = 101$  cm SCL;  $K = 0.04 \text{ year}^{-1}$ ;  $t_0 = 0$ ;  $C = 0.4$  and  $t_s = 0.75$ . Growth data indicate that black turtles may spend up to 20 years in Bahia Magdalena before they reach maturity at about 77 cm SCL. The total mortality estimate ( $Z$ ) from the length converted catch curve was 0.16, corresponding to a yearly survival probability of 0.85.

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Dutton, P.H. and Squires, D. **Reconciling biodiversity with fishing: A holistic strategy for Pacific sea turtle recovery.** *Ocean Development and International Law* 39(2): 200-222, 2008.

**Notes:** Recovery of sea turtle populations requires addressing: multiple sources of mortality; nonmarket, diffuse benefits with costs localized on the poor; and a transboundary resource with incomplete jurisprudence, markets, and institutions. Holistic recovery strategies include: beach conservation protecting nesting females, their eggs, and critical breeding habitat to maximize hatchling production; enhanced at-sea survival of turtles on the high seas and in commercial coastal fisheries; and reduced artisanal coastal fisheries mortality of turtles. The traditional approach of focusing long-term sustained conservation efforts on the nesting beaches has by itself led to increases in several sea turtle populations. However, current conservation is inadequate to reverse declines in other cases such as the critically endangered leatherback populations in the Pacific. This article discusses policy instruments comprising a holistic recovery strategy that reconciles fishing with biodiversity conservation.

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McClellan, C.M. and Read, A.J. **Complexity and variation in loggerhead sea turtle life history.** *Biology Letters* 3(6): 592-594, 2007.

**Notes:** Juvenile loggerhead sea turtles spend more than a decade in the open ocean before returning to neritic waters to mature and reproduce. It has been assumed that this transition from an oceanic to neritic existence is a discrete ontogenetic niche shift. We tested this hypothesis by tracking the movements of large juveniles collected in a neritic foraging ground in North Carolina, USA. Our work shows that the shift from the oceanic to neritic waters is both complex and reversible; some individuals move back into coastal waters and then return to the open ocean for reasons that are still unclear, sometimes for multiple years. These findings have important consequences for efforts to protect these threatened marine reptiles from mortality in both coastal and open-ocean fisheries.

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Bowen, B.W. and Karl, S.A. **Population genetics and phylogeography of sea turtles.** *Molecular Ecology* 16(23): 4886-4907, 2007.

**Notes:** The seven species of sea turtles occupy a diversity of niches, and have a history tracing back over 100 million years, yet all share basic life-history features, including exceptional navigation skills and periodic migrations from feeding to breeding habitats. Here, we review the biogeographic, behavioural, and ecological factors that shape the distribution of genetic diversity in sea turtles. Natal homing, wherein turtles return to their region of origin for mating and nesting, has been demonstrated with mtDNA sequences. These maternally inherited markers show strong population structure among nesting colonies while nuclear loci reveal a contrasting pattern of male-mediated gene flow, a phenomenon termed 'complex population structure'. Mixed-stock analyses indicate that multiple nesting colonies can contribute to feeding aggregates, such that exploitation of turtles in these habitats can reduce breeding populations across the region. The mtDNA data also demonstrate migrations across entire ocean basins, some of the longest movements of marine vertebrates. Multiple paternity occurs at reported rates of 0-100%, and can vary by as much as 9-100% within species. Hybridization in almost every combination among members of the Cheloniidae has been documented but the frequency and ultimate ramifications of hybridization are not clear. The global phylogeography of sea turtles reveals a gradient based on habitat preference and thermal regime. The cold-tolerant leatherback turtle (*Dermochelys coriacea*) shows no evolutionary partitions between Indo-Pacific and Atlantic populations, while the tropical green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and ridleys (*Lepidochelys olivacea* vs. *L. kempi*) have ancient separations between oceans. Ridleys and loggerhead (*Caretta caretta*) also show more recent colonization between ocean basins, probably mediated by warm-water gyres that occasionally traverse the frigid upwelling zone in southern Africa. These rare events may be sufficient to prevent allopatric speciation under contemporary geographic and climatic conditions. Genetic studies have advanced our understanding of marine turtle biology and evolution, but significant gaps persist and provide challenges for the next generation of sea turtle geneticists.

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Grazette, S., Horrocks, J.A., Phillip, P.E., and Isaac, C.J. **An assessment of the marine turtle fishery in Grenada, West Indies.** *Oryx* 41(3): 330-336, 2007.

**Notes:** The marine turtle fishery of Grenada was assessed using interviews with marine turtle fishermen and by examination of turtle catch data from a major landing site. An estimated 782 turtles, mainly Endangered green turtles *Chelonia mydas* and Critically Endangered hawksbill turtles *Eretmochelys imbricata*, were caught around Grenada and its sister island Carriacou each year between 1996 and 2001 during an annual 8-month open season, with only a small percentage being officially recorded at a landing site. Turtles were primarily caught with nets and spearguns, with more green turtles caught by net fishermen and more hawksbill turtles by spear fishermen. Catch per unit effort data suggested that relative abundance had declined since the previous estimate was made in 1969. Few adult green or loggerhead turtles *Caretta caretta* were caught, indicating the relative scarcity of this size class of these two species around Grenada. Adult-sized hawksbill turtles were caught regularly, with larger adults being caught in the non-breeding months of the open season than in the breeding months. A higher percentage of adult hawksbill turtles present during the breeding season are likely to be animals that nest in Grenada, and their smaller size may result from historically heavy fishing pressure. The larger sized adults caught during the non-breeding season are likely to be animals that forage around Grenada but breed elsewhere in the Caribbean where they are protected.

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Allen, M.S. **Three millennia of human and sea turtle interactions in Remote Oceania.** *Coral Reefs* 26(4): 959-970, 2007.

**Notes:** Sea turtles are one of the largest vertebrates in the shallow water ecosystems of Remote Oceania, occurring in both sea grass pastures and on coral reefs. Their functional roles, however, over ecological and evolutionary times scales are not well known, in part because their numbers have been so drastically reduced. Ethnographic and archaeological data is analysed to assess long-term patterns of human-sea turtle interactions (mainly green and hawksbill) prior to western contact and the magnitude of turtle losses in this region. From the ethnographic data two large-scale patterns emerge, societies where turtle capture and consumption was controlled by chiefs and priests versus those where control over turtle was more flexible and consumption more egalitarian. Broadly the distinction is between societies on high (volcanic and raised coral) islands versus atolls, but the critical variables are the ratio of land to shallow marine environments, combined with the availability of refugia. Archaeological evidence further highlights differences in the rate and magnitude of turtle losses across these two island types, with high islands suffering both large and rapid declines while those on atolls are less marked. These long-term historical patterns help explain the ethnographic endpoints, with areas that experienced greater losses apparently developing more restrictive social controls over time. Finally, if current turtle migration patterns held in the past, with annual movements

between western foraging grounds and eastern nesting beaches, then intensive harvesting from 2,800 Before Present in West Polynesia probably affected turtle abundance and coral reef ecology in East Polynesia well before the actual arrival of human settlers, the latter a process that most likely began 1,400 years later.

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Casale, P., Cattarino, L., Freggi, D., Rocco, M., and Argano, R. **Incidental catch of marine turtles by Italian trawlers and longliners in the central Mediterranean.** *Aquatic Conservation: Marine and Freshwater Ecosystems* 17(7): 686-701, 2007.

**Notes:** 1. The fishing effort and turtle catch of vessels harbouring at Lampedusa Island and fishing in the wider central Mediterranean area was monitored using a voluntary logbook programme. Two large trawlers were monitored between 2003 and 2005 and six small vessels using trawl nets, pelagic longline or bottom longline were monitored in the summer 2005. 2. The observed turtle catch rates of pelagic longline and bottom trawl were among the highest recorded in the basin, and high catch rates by bottom longline were observed too. This suggests that the area contains major oceanic and neritic habitats for the loggerhead turtle *Caretta caretta* in the Mediterranean Sea. 3. When fishing effort is considered, these results suggest a very high number of captures by Italian trawlers and longliners in the area, as well as by fleets from other countries. This is reason of concern for the conservation of the loggerhead turtle within the Mediterranean Sea. 4. Different fishing gear have different technical/operational characteristics affecting turtle catch and mortality and the present knowledge about associated parameters of these gear varies too. 5. All this considered, specific actions are recommended: (i) an awareness campaign to fishermen to reduce post-release mortality, (ii) technical modifications to pelagic longline gear to reduce turtle catch, (iii) further investigation into turtle bycatch in all fishing gear, with priority given to bottom longline fishing and quantification of mortality caused by trawlers, (iv) assessment of the turtle populations affected by fishing activity in the area, and (v) international cooperation in undertaking threat assessments, and implementing regulations, management measures and monitoring.

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Arthur, K., Limpus, C., Balazs, G., Capper, A., Udy, J., Shaw, G., Keuper-Bennett, U., and Bennett, P. **The exposure of green turtles (*Chelonia mydas*) to tumour promoting compounds produced by the cyanobacterium *Lyngbya majuscula* and their potential role in the aetiology of fibropapillomatosis.** *Harmful Algae* 7(1): 114-125, 2008.

**Notes:** *Lyngbya majuscula*, a benthic filamentous cyanobacterium found throughout tropical and subtropical oceans, has been shown to contain the tumour promoting compounds lyngbyatoxin A (LA) and debromoaplysiatoxin (DAT). It grows epiphytically on seagrass and macroalgae, which also form the basis of the diet of the herbivorous green turtle (*Chelonia mydas*). This toxic cyanobacterium, has been observed growing in regions where turtles suffer from fibropapillomatosis (FP), a potentially fatal neoplastic disease. The purpose of this study was to determine whether green turtles consume *L. majuscula* in Queensland, Australia and the Hawaiian Islands, USA, resulting in potential exposure to tumour promoting compounds produced by this cyanobacterium. *L. majuscula* was present, though not in bloom, at nine sites examined and LA and DAT were detected in variable concentrations both within and between sites. Although common in green turtle diets, *L. majuscula* was found to contribute less than 2% of total dietary intake, indicating that turtles may be exposed to low concentrations of tumour promoting compounds during non-bloom conditions. Tissue collected from dead green turtles in Moreton Bay tested positive for LA. An estimated dose, based on dietary intake and average toxin concentration at each site, showed a positive correlation for LA with the proportion of the population observed with external FP lesions. No such relationship was observed for DAT. This does not necessarily demonstrate a cause and effect relationship, but does suggest that naturally produced compounds should be considered in the aetiology of marine turtle FP.

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Chaloupka, M., Bjorndal, K.A., Balazs, G.H., Bolten, A.B., Ehrhart, L.M., Limpus, C.J., Suganuma, H., Troeeng, S., and Yamaguchi, M. **Encouraging outlook for recovery of a once severely exploited marine megaherbivore.** *Global Ecology and Biogeography* 17(2): 297-304, 2008.

**Notes:** **Aim** To critically review the status of the green sea turtle (*Chelonia mydas*) using the best available scientific studies as there is a prevailing view that this species is globally endangered and its marine ecosystem functions compromised. **Location** Ogasawara (Japan), Hawaii (USA), Great Barrier Reef (Australia), Florida (USA), Tortuguero (Costa Rica). **Methods** We compiled seasonal nesting activity data from all reliable continuous long-term studies (> 25 years), which comprised data series for six of the world's major green turtle rookeries. We estimated the underlying time-specific trend in these six rookery-

specific nester or nest abundance series using a generalized smoothing spline regression approach. **Results** Estimated rates of nesting population increase ranged from c. 4-14% per annum over the past two to three decades. These rates varied considerably among the rookeries, reflecting the level of historical exploitation. Similar increases in nesting population were also evident for many other green turtle stocks that have been monitored for shorter durations than the long-term studies presented here. **Main conclusions** We show that six of the major green turtle nesting populations in the world have been increasing over the past two to three decades following protection from human hazards such as exploitation of eggs and turtles. This population recovery or rebound capacity is encouraging and suggests that the green turtle is not on the brink of global extinction even though some stocks have been seriously depleted and are still below historical abundance levels. This demonstrates that relatively simple conservation strategies can have a profound effect on the recovery of once-depleted green turtle stocks and presumably the restoration of their ecological function as major marine consumers.

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Fish, M.R., Côté, I.M., Horrocks, J.A., Mulligan, B., Watkinson, A.R., and Jones, A.P. **Construction setback regulations and sea-level rise: Mitigating sea turtle nesting beach loss.** *Ocean and Coastal Management* 51(4): 330-341, 2008.

**Notes:** Global sea-level rise of up to 0.6m is predicted in the next 100 years. In areas where coastal structures prevent landward migration of beaches, a major impact of sea-level rise will be a loss of beach habitat, with repercussions for beach-dependent organisms such as sea turtles. Setback regulations, which prohibit construction within a set distance from the sea, have the potential to mitigate loss of beach area by providing a buffer zone which allows for the natural movement of beaches in response to perturbation. The potential impact of a rise in sea level on 11 important sea turtle nesting beaches in Barbados under a range of setback regulations was determined. Three sea-level rise scenarios were modelled under five different setback regulations (10, 30, 50, 70 and 90m). Beach area was lost from all beaches under all sea-level rise scenarios with a 10 and 30m setback, from some beaches with a 50m setback and from one beach with a 70m setback. No beach area was lost with a 90m setback distance. Sea turtles nest within a range of beach elevations and there was an overall loss of beach habitat within the preferred nesting elevation range with both a 10 and 30m setback under all sea-level rise scenarios. Considerable variation in the extent of beach and nesting area loss was observed. The implementation and enforcement of adequate setback regulations have the potential to maintain the ecological and economic function of beaches in the face of extensive coastal development and sea-level rise.

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McGowan, A., Broderick, A.C., Frett, G., Gore, S., Hastings, M., Pickering, A., Wheatley, D., White, J., Witt, M.J., and Godley, B.J. **Down but not out: marine turtles of the British Virgin Islands.** *Animal Conservation* 11(2): 92-103, 2008.

**Notes:** We present the result of a multi-annual assessment of the spatio-temporal patterns of marine turtle nesting, and foraging in the Eastern Caribbean archipelago state of the British Virgin Islands. Despite exploitation over several centuries, three species (leatherback *Dermochelys coriacea*, green *Chelonia mydas* and hawksbill *Eretmochelys imbricata* turtles) are still nesting and green and hawksbill turtles are found foraging. Leatherback turtles are showing signs of a recovery co-incident with the implementation of an effective moratorium on adult take. When compared with historical data we demonstrate an apparent reduction in nesting levels in green and hawksbill turtles and a nesting range contraction in green turtles. Despite current conservation steps, it will be a decade or more before evidence of recovery can be expected in the two hard-shelled species. Coupled with wider biological knowledge, our findings offer insights into the relative resilience of the different species to exploitation pressure. Additionally, the intra-annual temporal and spatial spread of nesting demonstrated underlines the difficulties of monitoring such a multi-species assemblage in such a diffuse archipelago.

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Pike, D.A. **The benefits of nest relocation extend far beyond recruitment: A rejoinder to Mrosovsky.** *Environmental Management* 41(4): 461-464, 2008.

**Notes:** Individual sea turtle nests have an extremely low probability of producing adult turtles; thus the practice of moving nests away from the ocean (where they will not be inundated by seawater) is a questionable conservation strategy. Recently in *Environmental Management*, Mrosovsky used the repeatability of nesting female turtles to place their eggs in certain locations to infer that some females may consistently nest in areas which will be flooded, lowering the chance that any eggs will hatch. This information was used to hypothesize that saving "doomed" sea turtle nests may then alter the genetic composition of the population, ultimately resulting in turtles that nest in poor habitats. Here I question Mrosovsky's

argument by focusing on several weaknesses inherent in the original article, namely that at present there is no evidence to suggest that nest-site selection is a heritable trait with an underlying genetic basis.

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Mrosovsky, N. **Against oversimplifying the issues on relocating turtle eggs.** *Environmental Management* 41(4): 465-467, 2008.

**Notes:** Translocating sea turtle eggs at risk from high tides to safer places is one of the most widely undertaken conservation measures on behalf of these species. Recent research work has shown that individual female turtles differ in their nest-site preferences. If more of the nests saved by translocation come from turtles with tendencies to lay near the water, might this perhaps interfere with natural selection? This possibility adds to the controversy already surrounding relocation of turtle nests.

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Gilman, E., Kobayashi, D., Swenarton, T., Brothers, N., Dalzell, P., and Kinan-Kelly, I. **Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery.** *Biological Conservation* 139(1-2): 19-28, 2007.

**Notes:** The reduction of sea turtle mortality in fisheries may contribute to recovering populations. To reduce turtle interactions, regulations for the Hawaii-based longline swordfish fishery required vessels to switch from using a J-shaped hook with squid bait to a wider circle-shaped hook with fish bait. Analyses of observer data showed that, following the introduction of the regulations, significant and large reductions in sea turtle and shark capture rates occurred without compromising target species catches. Capture rates of leatherback and loggerhead turtles significantly declined by 83% and 90%, respectively. The swordfish catch rate significantly increased by 16%. However, combined tuna species and combined mahimahi, opah, and wahoo catch rates significantly declined by 50% and 34%, respectively. The shark catch rate significantly declined by 36%, highlighting the potential for the use of fish instead of squid for bait to contribute to addressing concerns over the sustainability of current levels of shark exploitation. There was also a highly significant reduction in the proportion of turtles that swallowed hooks (versus being hooked in the mouth or body or entangled) and a highly significant increase in the proportion of caught turtles that were released after removal of all terminal tackle, which may increase the likelihood of turtles surviving the interaction. A quarter of turtle captures were in clusters (> 1 turtle caught per set and consecutive sets with turtle captures), which is substantially higher than predicted by chance if the events were independent. This suggests that turtles aggregate at foraging grounds and that instituting methods to avoid real-time turtle bycatch hotspots may further reduce turtle interactions. There was no significant correlation between turtle and swordfish catch rates (vessels with high swordfish CPUE do not necessarily have high turtle CPUE), indicating that there may be a fishing practice or gear design causing some vessels to have low turtle catch rates without compromising swordfish catch rates.

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Harewood, A. and Horrocks, J. **Impacts of coastal development on hawksbill hatchling survival and swimming success during the initial offshore migration.** *Biological Conservation* 141(2): 394-401, 2008.

**Notes:** The impacts of coastal development on survival and swimming success were investigated for hatchling hawksbill turtles (*Eretmochelys imbricata*) swimming away from artificially lighted and dark nesting beaches in Barbados. The overall predation rate was 6.9%. Predation rates were not significantly affected by offshore substrate type or beachfront lighting. However, of those hatchlings leaving lighted beaches that successfully escaped predation, a significantly smaller percentage (32.9%) were able to swim the prescribed distance seawards during the observation period. Moonlight significantly improved the swimming success of hatchlings leaving lighted beaches, particularly when the moon was full, but also significantly influenced predation rates, which were highest during the full moon (12.6%). Some hatchlings released from dark beaches were attracted by lights from neighbouring beaches, which only became visible after they were a substantial distance from shore. Artificial light may override the effects of wave cues in the low wave energy conditions characteristic of leeward Caribbean beaches, making swimming hawksbill hatchlings especially vulnerable to the effects of beachfront lighting.

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Marcovaldi, M.A., Lopez, G.G., Soares, L.S., Santos, A.J.B., Bellini, C., and Barata, P.C.R. **Fifteen years of hawksbill sea turtle (*Eretmochelys imbricata*) nesting in northern Brazil.** *Chelonian Conservation and Biology* 6(2): 223-228, 2007.

**Notes:** We present long-term data for hawksbill (*Eretmochelys imbricata*) nesting in the 2 main rookeries in Brazil: 1) northern Bahia and Sergipe, where the estimated number of nests laid each year increased from 199 in the 1991-1992 nesting season to 1345 in the 2005-2006 season and 2) Rio Grande do Norte, where the estimated number of nests laid in the 2005-2006 season was around 185-475. Adding these results, we estimate that the number of hawksbill nests laid in the 2 main Brazilian nesting grounds in 2005-2006 was between 1530 and 1820 nests. Data on the percentage of hawksbill clutches kept in situ by season in each rookery are also presented. The apparent increasing trend in hawksbill nesting in northern Brazil is encouraging and seems to reflect a range of conservation measures implemented over the past 25 years.

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Chan, S.K.F., Cheng, I.J., Zhou, T., Wang, H.J., Gu, H.X., and Song, X.J. **A comprehensive overview of the population and conservation status of sea turtles in China.** *Chelonian Conservation and Biology* 6(2): 185-198, 2007.

**Notes:** Five species of sea turtles, including leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and olive ridley turtles (*Lepidochelys olivacea*), were found in the waters east and south of mainland China and the associated islands. Decades of harvesting and habitat degradation have led to a drastic decline in the sea turtle population in the last century. Many foraging grounds and nesting sites have been degraded or have disappeared as a result of human activities. Nowadays, there are only a few nesting sites and even fewer foraging grounds for sea turtles in China. Fishery bycatch is also believed to have been a major cause of sea turtle mortality in recent years. There is an urgent need for more efforts to be focused on the conservation of sea turtles in the region. However, limited information is available, which has impeded the formulation of effective conservation measures. The goal of this paper is to provide an overview on the current population and conservation status of sea turtles, as well as recommendations for their effective management in China.

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Chaloupka, M., Kamezaki, N., and Limpus, C. **Is climate change affecting the population dynamics of the endangered Pacific loggerhead sea turtle?** *Journal of Experimental Marine Biology and Ecology* 356(1-2): 136-143, 2008.

**Notes:** The loggerhead sea turtle is an endangered species exposed to many anthropogenic hazards in the Pacific. It is widely held that pelagic longline fisheries pose the major risk for Pacific loggerheads but the effects of other risk factors such as human-induced global climate change have rarely been considered. So we used generalised additive regression modelling and autoregressive-prewhitened cross-correlation analysis to explore whether regional ocean temperatures affect the long-term nesting population dynamics for the 2 Pacific loggerhead genetic stocks (Japan, Australia). We found that both Pacific stocks have been exposed to slowly increasing trends in mean annual sea surface temperature in their respective core regional foraging habitats over the past 50 years. We show that irrespective of whether a population was decreasing or increasing that there was an inverse correlation between nesting abundance and mean annual sea surface temperature in the core foraging region during the year prior to the summer nesting season. Cooler foraging habitat ocean temperatures are presumably associated with increased ocean productivity and prey abundance and consequently increased loggerhead breeding capacity. So warming regional ocean temperatures could lead to long-term decreased food supply and reduced nesting and recruitment unless Pacific loggerheads adapt by shifting their foraging habitat to cooler regions. So the gradual warming of the Pacific Ocean over the past 50 years is a major risk factor that must be considered in any meaningful diagnosis of the long-term declines apparent for some Pacific loggerhead nesting populations.

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Hays, G.C. **Sea turtles: A review of some key recent discoveries and remaining questions.** *Journal of Experimental Marine Biology and Ecology* 356(1-2): 1-7, 2008.

**Notes:** This review highlights some recent important developments in our understanding of the physiological, behavioural and molecular ecology of sea turtles as well as their conservation biology. Key commonalities are identified between the biological questions being addressed with respect to sea turtles compared to those with marine mammals (e.g. pinnipeds and whales), birds (e.g. albatrosses) and fish (e.g. tuna, swordfish and pelagic sharks). Key areas highlighted include (1) objectively identifying oceanic hotspots; (2) measuring what animals are actually doing in different parts of their range (e.g. foraging) rather than simply inferring their state from their position and movement; (3) completing energy budgets for species over ecologically relevant timescales (e.g. the period between breeding seasons); (4) using biological information to help drive conservation management; and (5) assessing the impact of climate change.

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Heithaus, M.R., Wirsing, A.J., Thomson, J.A., and Burkholder, D.A. **A review of lethal and non-lethal effects of predators on adult marine turtles.** *Journal of Experimental Marine Biology and Ecology* 356(1-2): 43-51, 2008.

**Notes:** Although predation is recognized as an important factor for sea turtles at early life history stages, the possible influences of predators on adult sea turtles have largely been overlooked. Indeed, because predation rates on adult turtles generally are low, it often is assumed that predators do not influence turtle behavior, affect population sizes, or structure sea turtle impacts on marine communities. Yet, sharks, killer whales and crocodiles may take adult turtles, and no sea turtle species is invulnerable. Furthermore, as long-lived animals, adult sea turtles are predicted to invest in anti-predator behavior even when predation risk is relatively low to avoid the reproductive costs of an early death. Several studies suggest that predators may influence behavior and habitat use of adult turtles. For example, in a pristine ecosystem in Australia green turtles, especially those in good body condition, avoid profitable feeding areas in order to be safe from tiger sharks. Such predation-sensitive foraging could lead to populations being partially regulated by synergistic effects of predation risk and food abundance. Indeed, observed rapid rebounds of sea turtle populations may have been facilitated by reductions in shark populations. Finally, if sea turtles modify their foraging habitat use in response to predators, the spatiotemporal pattern of turtle effects on their communities could be shaped by predators. Historical reconstructions of past turtle populations and conservation strategies aimed at increasing turtle populations must consider the possible effects of predators, including non-lethal ones. Future work should focus on gaining a broader understanding of the effects of predators across a range of sea turtle taxa and habitats.

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Seminoff, J.A. and Shanker, K. **Marine turtles and IUCN Red Listing: A review of the process, the pitfalls, and novel assessment approaches.** *Journal of Experimental Marine Biology and Ecology* 356(1-2): 52-68, 2008.

**Notes:** Marine turtles have been exploited by humans since pre-history, with particular intensity in the last century, the result of which has been the depletion of most nesting populations in the world. In many cases these declines have been reversed thanks to a variety of effective conservation programs. Several nesting populations maintain positive growth trends, although most are probably depleted relative to historic levels, while others continue in a severely depleted state, with little or no population growth in recent decades. This mosaic of population trajectories along with demographic and life-history traits that buffer against extinction has created unique challenges for marine turtle assessments such as those by the World Conservation Union's (IUCN) Marine Turtle Specialist Group, which conducts global assessments for the IUCN Red List. While the Red Listing approach describes extinction risk, which theoretically can be useful for developing conservation priorities, the descriptors that have been assigned to marine turtles so far (e.g. Vulnerable, Endangered, Critically Endangered) state an unrealistic imminence of extinction, a problem enhanced by the fact that its global resolution fails to reflect the disparate population trends ongoing in different regions worldwide. Coupled with misuse of the Red List by governments and conservation organizations worldwide, these shortcomings have led to increased debate regarding its efficacy for marine turtles. In this paper we describe the Red Listing assessment process, the problems associated with this approach for marine turtles, as well as the overall value of Red List assessments for marine turtle conservation. We suggest that Red List assessments for marine turtles at the global scale do not accurately depict the current status of marine turtles and may have unintended consequences for their conservation. Largely the data do not exist, or are not reliable, making the use of the current criteria intractable. We discuss novel methods for conducting marine turtle assessments, such as using a wider array of the current Red List Criteria, modelling future population dynamics, and developing regional assessments and/or conservation prescriptive assessments.

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Fossette, S., Kelle, L., Girondot, M., Goverse, E., Hilterman, M.L., Verhage, B., deThoisy, B., and Georges, J.Y. **The world's largest leatherback rookeries: A review of conservation-oriented research in French Guiana/Suriname and Gabon.** *Journal of Experimental Marine Biology and Ecology* 356(1-2): 69-82, 2008.

**Notes:** The Atlantic Ocean hosts a major part of the world's leatherback population, with the largest rookeries being located in the northern part of South America (Suriname/French Guiana) and in western Central Africa (Gabon). In contrast with the dramatic decline of nesting populations in the Pacific Ocean, some Atlantic leatherback rookeries have recently been reported to be stable or even to increase. This raises the question, which particular research and conservation initiatives, past and

present, may have led to such development. Here we present an overview of the historical and present research and conservation efforts in French Guiana, Suriname and Gabon and highlight current gaps in knowledge and required improvements to maintain protection for the major rookeries of this critically endangered species.

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