GLOBAL STATUS OF MARINE TURTLES: AN OVERVIEW

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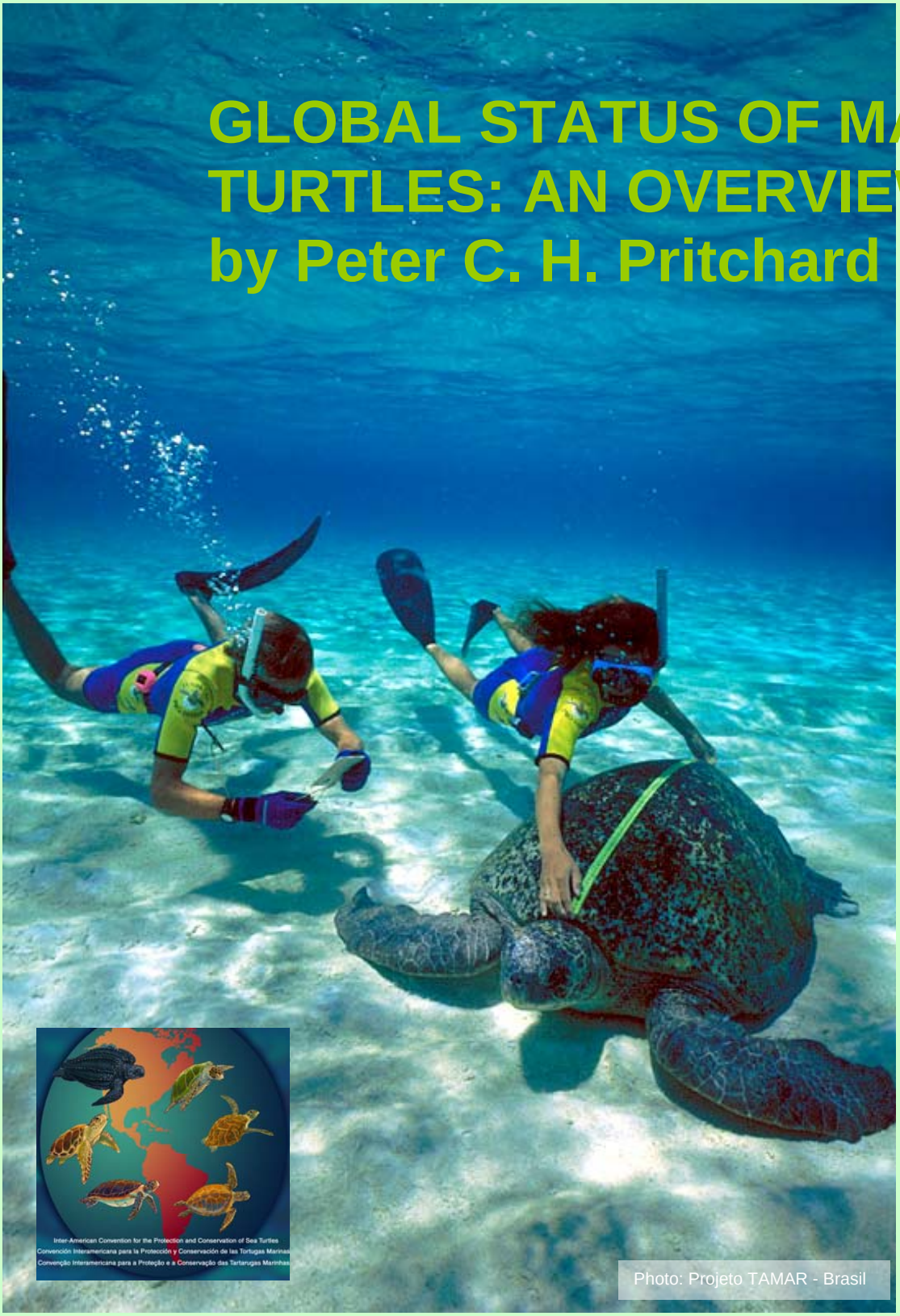

BACKGROUND

Marine Turtles are perhaps the most famous and celebrated of endangered species, and among many conservationists it has become almost obligatory to precede any mention of the name of any of the various marine turtle species with the words “endangered,” “critically endangered,” or “threatened,” almost as if the adjective were part of the name. Yet the sea turtles are hardly typical examples of taxa in danger of extinction. Some endangered species are disappearing relicts with ghostly remnants of once-wide continental ranges, but most such life forms are relatively obscure, poorly-known, localized, and unavailable for human consumption mainly because they are too rare to provide useful biomass, thus provoking much public sector comment along the lines of “what good is it anyway?” The classical endangered species also typically has a restricted distribution, perhaps limited to a single remote island or archipelago, or to a single nation or even province or state within that nation.

Marine turtles of one species or another, by contrast, occur in the waters or on the beaches of most tropical or subtropical nations that have a seacoast, and may occur as waifs or accidentals in waters that are decidedly temperate or even subarctic. Indeed, most individual marine turtle species occur in all three of the great oceans and associated seas, and thus have the widest ranges of all reptiles. Moreover, far from being so obscure as to provoke puzzlement among the general public as to their utility, the value of marine turtles is manifest to all. It was the green turtle, *Chelonia mydas*, that Archie Carr called “the world’s most valuable reptile,” and in terms of real utility to the human species as opposed to unit value in specialized live reptile markets, he was right. Sea turtles are good to eat, their eggs are even more widely appreciated, and the ecotourism value of nesting sea turtles is considerable – and growing. There has been lucrative trade in non-edible turtle products too, including the shell scutes of hawksbills, the leather of ridley flippers, the oil of leatherbacks, and the souvenir carapaces and stuffed juveniles of several species.

There is also growing appreciation of the ecological roles played by marine turtles, ranging from maintenance of healthy sea grass beds to control of jellyfish proliferation. And the prey functions of these highly prolific reptiles, which may on occasion produce close to a thousand eggs in a season, should also not be ignored. It has been said that the primary ecological function of a marine turtle is to bring the productivity of the marine ecosystem ashore, depositing it on land in the form of a high biomass of eggs rich in fats and protein. Only one in a thousand of these eggs may ultimately produce a reproducing adult turtle, and the remainder, as eggs or hatchlings, are available to provide nutrition for an extraordinary gamut of marine and littoral predators, not to mention humans as well.

Public recognition of the value of marine turtles is thus not the primary battle today; the importance of conserving these charismatic, popular animals is rarely denied. The difficulty and disputation lie rather in whether sea turtles should be managed for maximal productivity for human benefit or protected as

fundamentally vulnerable, slow-maturing, k-selected species. The answers to such policy questions are inextricably tied up with social and economic considerations, as well as discussions as to whether management of exploited populations may sometimes be more effective, or at least socially acceptable, than management of protected ones. The emerging model has often been one in which, in the developed, wealthier nations that have sea turtle populations, complete protection, with significant enforcement effort, has become the norm. In the poorer nations with considerable numbers of subsistence-level peoples, turtle policy has ranged from attempts to emulate the developed-world model in the face of funding shortfalls and human demand for turtle products, to models recognizing either that local marine turtle populations are not obviously depleted, or that subsistence-level people either cannot or should not be restrained. This may result in a scenario ranging from some degree of legalized take of marine turtles or their eggs, to one in which a government may theoretically legislate or agree to complete protection, but in practice turn a blind eye to localized or subsistence usage.

Complicating such policy-making is the curiously bimodal sociology of marine turtle exploitation. Turtle eggs or meat may be the special-occasion fare (or even routine victuals) of people well below the poverty line, however defined, who happen to live close to the resource. At the other end of the scale, turtle leather in Italy, hawksbill shell in Japan, or green turtle soup in England were, at least until recently, the domain of the rich and privileged. Only the middle class was left out of the game. The wealthy have actually acceded to loss of turtle privileges relatively gracefully, possibly because they were not all that important to them anyway; and the maturation and relatively high profile of the CITES convention in recent years has eliminated marine turtle products from most international markets. The principal voice of protest to such a ban has been that of a partnership between Cuba and Japan, offering the possibility of a controlled trade in hawksbill shell products derived from the thriving hawksbill populations of Cuba and earmarking them for the lucrative *bekko* markets of Japan. At recent CITES Conferences of the parties, this proposal, requiring the downlisting of Cuban hawksbills from Appendix I to Appendix II, has gained a simple majority of votes but not the obligatory two-thirds. It has also spawned far-reaching discussions between pro- and anti-exploitation voices in the conservation world as to whether seemingly well-managed, abundant, or protected turtle populations might progressively be opened up to international trade, or whether protection in perpetuity should be maintained in the face of increasing economic demand. The emerging key question is: do you reduce the actual human take of sea turtles the most by exercising complete protection but realizing that poaching will occur, or by negotiating an annual quota with the exploitation interests in the expectation that poaching will then cease? The correct answer is unquestionably not the same in all places or at all times.

A further complication is that, while the international trade in marine turtle products is all but dead, not only is local subsistence take far more intractable, but the problems of incidental catch also remain. Many years of Turtle Excluder development, largely initiated by the United States, have yielded a variety of devices to reduce or eliminate the drowning of turtles in shrimp

trawls and other fishing gear. They include contraptions with such colorful names as “Cameron Parish Jellyball Shooter,” “Morrison Soft Ted,” and “Georgia Jumper,” and they have been introduced to many coastal nations of the hemisphere by a combination of cooperative technology transfers and potential or actual trade sanctions. A given model does not necessarily work at all times for all species or all sizes of turtles, and it is necessary that they be deployed conscientiously, by fishers who are trying to make them work rather than to prove that they don’t. But there are many who consider that regional harmonization and enforcement of TED regulations may be the most important single outcome of the Inter-American Convention for the Protection and Conservation of Sea Turtles.

It needs to be recognized, too, that it is not only well-capitalized or industrial operators who have significant incidental impact upon marine turtles. In French Guiana, artisanal near-shore net fishing operations by Carib people in the Marowijne area result in disturbingly high mortality of adult female leatherback turtles in the largest documented nesting colony of this species even though the direct take of turtles and their eggs is essentially controlled; and the same is happening in Guyana, where much smaller leatherback populations are also still subject to a variable level of direct take as well as incidental catch by subsistence Arawak people.

But, sociology aside, it is the biology of marine turtles that is fixed and non-negotiable, and it behooves those who advocate or tolerate any level of exploitation of marine turtles to generate demographic insight to justify such take. The obligation is presumably least if justification is sought for a very small take from very large populations. Another approach, used for example in Suriname some years ago, is to identify the purely natural losses encountered by an ostensibly thriving turtle population – in the Suriname case, loss of eggs of green turtles (*Chelonia mydas*) occurring through beach erosion uninfluenced by human activities – and to learn to identify “doomed eggs” and divert them for human consumption, presumably without impact upon the numbers of hatchlings successfully reaching the ocean.

Models have been developed for various sea turtle populations, and are constantly being refined, although few if any have reached the stage of actual predictive capability. There are persistent difficulties with calibration of all models because population responses to manipulations (either negative or positive) may be delayed for many years; cases rarely occur in which the results of many simultaneous manipulations, planned and unplanned, can be teased apart and analyzed, and there is also difficulty associated with the selection of an appropriate population index. It is obviously impossible to count all individuals in a population, or even to make estimates of total population numbers, in view of the vast, ephemeral boost that a population may receive as the season’s hatchlings hit the water. Catch–per-unit-effort surveys have been attempted from time to time, but few capture techniques target both sexes and all life stages equally, and the complex migratory patterns and differential seasonal presence or availability of various life-stages, especially of the breeding adults, confound comparisons, as do the early-life

one-time travels of post-hatchlings. Most demographers, therefore, use a population index based upon numbers of nesting females.

Such an index has been criticized because it is thought to represent an index of population status, or at least reproductive success, a generation (i.e. perhaps several decades) earlier rather than offering contemporary insight into population vigor, and recruitment failure could have occurred for many years before it would be reflected in reduced numbers of nesting females. Such criticisms may be valid, but a more optimistic evaluation would suggest that, if recruitment failure was substantial or complete, it would be obvious on the beaches at the egg or hatchling stage and could be evaluated at the same time as the nesting females or nests were being quantified. Ideally, a count of nesting females provides insight not only into success of reproductive effort a generation ago, but also offers some prognostication of population status a generation hence, when the surviving hatchlings produced by today's nesters reach maturity and come home.

But even then, determining population status and population trends from counts of nesting females is tricky. Confounding factors include the following:

1) It is probable that certain marine turtle populations are not "naturally" stable. In the Guianas, for example, a mixed population of green turtles, hawksbills, olive ridleys and a few leatherbacks in the early 1960's had been replaced by a population almost entirely of leatherbacks forty years later. In Suriname a thriving arribada of olive ridleys in the 1960s had been displaced, by a combination of beach erosion and replacement and resurgent leatherback nesting, into eastern French Guiana and Brasil forty years later; and some, perhaps all, arribadas of olive ridleys – the most numerous sea turtles in the world today – may have natural cycles of waxing, peaking, waning and collapsing, with an amplitude of at least several decades, perhaps more.

2) Ridleys may frequently nest in successive years, but other species of marine turtles very rarely do so, even though they may nest up to nine or ten times in a single season. Various complex factors, internal and external, combine to concentrate nesting effort of such species into certain years, so that even an unharvested, presumably stable population may show sharp annual alternations of "good" and "bad" nesting seasons. Many years of data will thus be needed for a trend to become clear, and standard statistical procedures to determine validity of trends are obfuscated by the data for "good" and "bad" years being fundamentally different in nature, a "good" year at least providing a minimum estimate as to how many adult female turtles are in the population, whereas a "bad" year may not provide a useful estimate of anything. The result is that lines drawn to join the data points of many successive nesting seasons show a zig-zag quality that almost certainly does not correspond to real population changes; and straight-line regression plots that give equal value to all points, high and low, may indicate an overall trend that is not supported by a regression line based

only on the points representing maxima (i.e., years in which the nest count was higher than in both the year before and the year after).

3) Over the long term, data may vary in quality. Different sections of beach may be surveyed, or the "index value" or relative importance of the section of beach selected for sampling (e.g. the northern 5-miles of the 22-mile green turtle nesting beach at Tortuguero, Costa Rica) may change over the years. In dynamic situations, especially when manpower is limited, there is a tendency to deploy one's field crew to the area judged to have the most turtles during the current season, even though this represents a moving target and complicates year-to-year comparisons. Most long-term monitoring projects introduce "improvements" over the years, with advances ranging from better staff training to use of beach motorcycles to facilitate wider coverage, and these actions will increase the accuracy of nest counts or encounters with nesting turtles, or improve ability to distinguish between actual nests and false crawls. Over very long time spans, the oldest data are likely to be highly anecdotal, and may possibly be exaggerated; or an opposing phenomenon is that of the "diminishing baseline," whereby over a short time span of a few seasons, memory or knowledge of primordial population levels may be non-existent, and a trend may be considered positive or a population healthy if a given annual nesting cohort is the strongest in, say, the last five years, even though it may be only a fraction of that of a century before.

4) Theoretical and pragmatic approaches may, at least superficially, conflict. This may not be because the science is wrong, but rather because it has not addressed the real-world decisions that are faced by the user community. Thus, population models of the loggerhead turtle, based upon a great deal of information on population demographics made available through incidental capture and beach stranding statistics, have indicated that, for the loggerhead at least and perhaps for sea turtles in general, the most important members of the population are female turtles on the brink of maturation. They have the hazards of youth behind them and the reproductive years all lie just ahead, while a given single egg is considered insignificant to the population because, statistically, it is almost certain to fail to yield a turtle that survives to maturity. Such models, rightly or wrongly, have been interpreted as downplaying the importance of the eggs themselves for population maintenance, and may have been used as justification for certain ill-considered egg harvest programs. But the pragmatists point to certain strong populations, reasonably protected on their nesting grounds and with good recruitment, that have survived and even expanded in the face of considerable directed take (in the case of the Tortuguero green turtles) or incidental capture (in the case of Florida loggerheads), whereas populations where adults have been protected but egg collection been very heavy have collapsed (see examples below). And the pragmatists observe that the question before a given fisherman is not whether to take a large turtle, a small turtle, or a single egg, but rather whether he should catch, say, one 200 kg turtle, ten 20 kg turtles,

or take 200 kg of turtle eggs – a question to which the answer is not obvious.

COLLAPSED AND RECOVERED POPULATIONS

Over recent centuries, some turtle populations have collapsed and others are in the process of so doing. Collectively, the examples demonstrate unequivocally that an abused turtle population may decline dramatically, even though the collapse may be postponed years or decades if the stress takes the form of egg harvest rather than capture of turtles themselves. However, recent evidence also points to the potential of turtle populations for recovery in response to effective protection, to tolerate surprising levels of abuse at times, and sometimes even to initiate a new nesting colony from scratch.

A few examples of collapsed populations include (there are many others):

I) Several Caribbean, Atlantic and Gulf of Mexico populations of the green turtle, including those of Bermuda, Grand Cayman and Little Cayman, and the Dry Tortugas, west of Key West. The accounts of contemporary chroniclers are particularly abundant and vivid for the extraordinarily abundant green turtles of the Cayman Islands in the 17th century, which for 200 years played a key role in the victualling of expeditions of exploration, colonization, and warfare in the Caribbean region. One or two thousand nesting greens, it was reported by Pieter Adriaensz Ita to the Dutch chronicler Johannes de Laet in 1630, could be taken every night from a single beach on northwestern Little Cayman alone. Today, only desultory nesting by green turtles occurs anywhere in the Cayman Islands. The Bermuda population is now almost entirely composed of juvenile turtles. Nesting by both loggerheads and green turtles does occur today in the Dry Tortugas, the *Chelonia* colony being the largest in Monroe County (Florida); but it is not a large population in absolute terms.

2) The leatherback turtles of Kuala Terengganu, Malaysia. When first reported to the outside world in the 1950's, this was by far the most important known leatherback nesting colony in the world. However, a long-standing policy of auctioning the rights to the eggs to local egg merchants, with only a small number being bought back by the State government for hatching, doomed the nesting colony and threw the extensive local turtle-oriented touristic development into confusion. Today very few nestings occur in Terengganu.

3) Similarly, the once vast green turtle nesting colonies of the Talang Islands, not far from Kuching, Sarawak, and the subject of the pioneering studies of Tom Harrisson and John Hendrickson for many years, have passed into oblivion. Again, a local policy of protecting the turtles but taking almost all of the eggs yielded its inevitable results.

4) The only known nesting colony of Kemp's ridley, *Lepidochelys kempi*, was discovered by Andres Herrera in 1947, although not publicly announced until 1963. A daytime emergence of an estimated 40,000

nesting turtles on a section of beach near Rancho Nuevo, near Aldama, Tamaulipas, Mexico was filmed by Herrera, and the film subsequently examined by Henry Hildebrand and Archie Carr. By 1965, when beach patrols were established to protect the turtles, the total population had been reduced to the low thousands, and it continued to decline for years following protection. Somewhat fragmentary evidence indicates that egg exploitation had been massive during the "arribada years," and this factor combined with high levels of incidental trawler capture in both the northern and southern Gulf of Mexico – and to some extent in the southeastern United States – almost exterminated the entire species.

5) The most dramatic and alarming contemporary decline of a marine turtle population is that of the leatherback in the eastern Pacific. The species was never particularly widespread or populous in the Indian Ocean region, and the Atlantic populations remain very strong, but enormous nesting colonies documented in the early 1970s in Michoacan, Guerrero, and Oaxaca, Mexico, and on Playa Grande and some other beaches in Pacific Costa Rica have been reduced by over 95% throughout the region, despite the presence of beach and egg protection in these areas throughout the 90s. The decline is thought to stem from a variety of factors, including many years of egg collection in the recent past, beach-slaughter of nesting females at least on the Mexican beaches, and widespread incidental mortality in longline and swordfish fisheries in pelagic waters of the eastern and southeastern Pacific.

CURRENT STATUS OF EXTANT SPECIES

Many authorities recognize just seven species of marine turtle, the leatherback (*Dermochelys coriacea*), the green turtle (*Chelonia mydas*), the loggerhead (*Caretta caretta*), the olive ridley (*Lepidochelys olivacea*), Kemp's ridley (*Lepidochelys kempii*), the hawksbill (Eretmochelys *imbricata*), and the Australian flatback (*Natator depressus*). However, a growing body of evidence, based not only upon morphological divergence but also upon demonstrable sympatry between the two forms without intergradation, suggest that the genus *Chelonia* should be considered to include two species, *Chelonia mydas* in the western Pacific and the Indian and Atlantic Oceans, and *Chelonia agassizii* in the eastern Pacific, both on continental shores from the Gulf of California to Peru and also in the offshore archipelagoes (Galapagos, Revillagigedos, etc.). This would raise the total to eight species.

1) **Marine turtles of the Atlantic Ocean.** In the Atlantic system, there are significant populations of all species of marine turtle except for the two localized forms *Chelonia agassizii* and *Natator depressa*. Overall status is as follows:

   a) Leatherback (*Dermochelys coriacea*). In the western Atlantic, populations appear to be strong and increasing throughout most of the nesting sites from the Lesser Antilles including Trinidad through the Guianas to French Guiana. In the United States Atlantic and

Caribbean and Gulf coasts of Mexico there is little nesting. In West Africa a very substantial nesting colony has recently been discovered in Gabon; trend data are unavailable and the past history of this colony is unknown.

b) Olive ridley (*Lepidochelys olivacea*). Western and eastern Atlantic populations of this species appear to be morphologically distinct from each other and from those of the East Pacific, although not currently recognized nomenclaturally. The nesting populations of Guyana and Surinam, significant to substantial in the 1960s, are now reduced to relict status; however a nesting colony has become established in eastern French Guiana (Montjoly and other beaches) in recent years. Furthermore, nesting beaches for *L. olivacea* have been discovered in tropical Brazil in recent years, and in some cases (e.g. in Sergipe) nesting numbers have shown significant upward increases in recent years. Trends in western Africa are unknown.

c) Kemp's ridley (*Lepidochelys kempi*). With a single nesting flotilla estimated at 40,000 turtles in Tamaulipas, Mexico, in 1947, the species was progressively reduced in the next four decades to just a few hundred breeding females. However, for about fifteen years the nesting colony has progressively increased, as a result of beach protection, head-starting, and TED utilization.

d) Loggerhead (*Caretta caretta*). This is primarily a temperate-zone species, with nesting in various parts of the Mediterranean (Zakynthos and other Greek Islands; parts of the Turkish Coast; Libya), and with the main threat on the European side being beachfront tourist development. The largest colonies nest in the United States (mainly Florida, but northwards to Virginia), with some also in Yucatan (Mexico). The Florida-nesting populations appear to be strong and increasing, as a result of years of legal protection, beach patrols and hatcheries, TED utilization, etc. North of Florida, the situation is less secure, in that the turtle populations are less dense and shrimping more intensive. The Gulf of Mexico colonies are small compared to those of the Atlantic coast.

e) In the Atlantic, the hawksbill (*Eretmochelys imbricata*) has a wide range and nesting sites encompass both continental coastlines and islands, large and small. Overall, there has been a generalized depletion, and the scattered nature of the nesting make beach patrols difficult and sometimes unproductive. However, in US Caribbean waters (Puerto Rico, Mona etc.), legal protection appears to be yielding results and sighting of hawksbills are increasing, and in the Yucatan Peninsula (Mexico) and in Cuba hawksbill populations are considered to be large and stable or increasing.

f) The green turtle, *Chelonia mydas*, has maintained a large and stable nesting colony at Tortuguero, Costa Rica, throughout the years since monitoring started in the 1950s, in the face of heavy

subsistence exploitation in many of the nations where the turtles feed (Nicaragua, Panama, Honduras, Venezuela, etc.). The formation of the Tortuguero National Park has probably been a key factor in the ability of the colony to withstand such exploitation, although the legal take of adult females in waters near Puerto Limon in recent years has been an ambiguous factor, possibly bringing about some control by establishing a legal quota, but more likely adding legal take to illegal, resulting in a high but unquantifiable overall take. Recent action by the Costa Rican Constitutional Court has eliminated the legal quota, and theoretically offered the species complete protection in Costa Rica.

Other Atlantic green turtle nesting colonies include those of several remote islands without civilian populations and under largely military jurisdiction (Isla Aves, Venezuela; Ascension Island; Atol das Rocas and Trinidade Islands, Brazil), and the turtle populations there are probably stable now, although that of Isla Aves diminished massively since the 1940s, as the island itself became smaller. During the last two decades green turtle colonies have become established both at Rancho Nuevo, Tamaulipas, Mexico (best known as the Kemp's ridley nesting beach) and at South Melbourne Beach, Florida (primarily a loggerhead beach). On the other hand, the Guyana nesting colony has virtually disappeared during the last three decades, although the colony in neighboring Surinam (where beach slaughter of turtles is rare) remains strong. In the eastern Atlantic, the largest nesting colonies appear to be those of the Bijagos Archipelago (Guinea-Bissau). There are recent indications that the nesting turtles there are undergoing massive exploitation. In the Mediterranean, most nesting is by loggerhead turtles; the best green turtle nesting ground is probably that of Akyatan, Turkey.

2) Marine turtles of the Indian Ocean.

a) The loggerhead turtle is poorly known and rather locally distributed in the Indian Ocean, with a reportedly huge nesting colony on the small island of Masirah, off the coast of Oman, a modest but progressively increasing colony on the Mocambique/Natal border area (known as Tongaland), South Africa; and reasonably strong and stable colonies in temperate parts of Western Australia. There are few other areas in the entire Indian Ocean where the loggerhead is anything more than an occasional straggler.

b) The olive ridley is also bizarrely localized in the Indian Ocean. Virtually the entire nesting population is concentrated at two or three sites of extraordinarily aggregated nesting in the Gahirmatha area of the coast of Orissa, India. Otherwise, there is dispersed nesting on much of the eastern coast of peninsular India and some in Sri Lanka, but without significant concentrations. The Orissa colony is stressed by very high mortality in shrimp trawls operating in the area during the turtle nesting season.

c) The leatherback is also very restricted in the Indian Ocean, possibly because so many shorelines are guarded by coral reefs, which can

seriously damage the delicate integument of this pelagic species. Small but increasing numbers of individuals nest in Tongaland with the loggerheads. In former times (1930s) the coast of Sri Lanka was important for leatherback nesting, but now this is very slight. Today the largest nesting colonies are probably those of Irian Jaya (Vogelkop Peninsula), but these too are decreasing. In the South China Sea, between the Indian and Pacific Oceans, the once crucial leatherback colony at Kuala Terengganu has now collapsed.

d) In the Indian Ocean, very important nesting colonies of the green turtle, *Chelonia mydas*, occur at a number of points around the Arabian Peninsula, especially in Oman, and with outlying concentrations as far east as Karachi and south as far as the Somali coast. Other major colonies occur in Western Australia. Europa Island, in the Mocambique Channel, and Aldabra Atoll, north of Madagascar, are also very important nesting sites, and both areas lack civilian populations. Nonetheless, these colonies are not immune to exploitation on the feeding grounds, e.g. in Madagascan waters.

e) Hawksbills are widespread in the Indian Ocean, although no really major nesting colonies have been reported. Reasonable numbers nest on certain islands off the Arabian Peninsula and in the Seychelles, but in most places nesting is scattered.

f) Some flatback turtles (*Natator depressus*) nest in northern Western Australia and are probably reasonably safe, but even though this species is rarely consumed by humans, it is subject to incidental capture in prawn trawls.

3) Marine turtles of the Pacific Ocean.

a) In recent decades the most important nesting colonies of the leatherback turtle anywhere were those of the eastern Pacific, especially in Michoacan, Guerrero and Oaxaca, Mexico, and Playa Grande, Playa Langosta and other beaches in Pacific Costa Rica. These colonies have recently undergone serious collapse and are in danger of complete extirpation. This may be a legacy of the years of heavy egg collection (everywhere) and slaughter of nesting females in Mexico, but the current stresses appear to be incidental capture by pelagic fisheries. In the western Pacific, nesting occurs principally in Melanesia (Papua New Guinea including New Britain and New Ireland; Solomons, etc). In most places, the nesting turtles are likely to be slaughtered by indigenous peoples. There is virtually no nesting in Australia, New Caledonia, or the countless small islands of Micronesia and Polynesia, and very little in western South America.

b) The olive ridley is almost unknown in the Pacific islands and scarce in the western Pacific. However, it achieves extraordinary nesting concentrations in Pacific Mexico (currently Playa La Escobilla, Oaxaca; formerly other beaches such as Piedra de Tlacoyunque (San Luis la Loma), Guerrero, and Playon de Mismaloya, Jalisco), and in

Costa Rica (Playa Nancite and Playa Ostional, Guanacaste). These turtles apparently move southward after nesting, and large numbers have been reported in Ecuadorian waters. Currently, the Nancite arribada, although located in a national park, is diminishing and losing integrity, whereas the Ostional colony, although subject to a controlled egg harvest of significant proportions, appears to be increasing, and may be drawing turtles that formerly nested at Nancite. These population shifts and fluctuations are probably natural and may reflect the fact that, in very large arribadas, the percentage of eggs actually producing viable hatchlings is very small. Eventually such arribadas will collapse for this reason, and others will form where there is less crowding and where more eggs may hatch.

c) The black turtle (*Chelonia agassizii*) is confined to the Pacific Ocean and has its major nesting colonies in the Galapagos Islands and in Michoacan, Mexico. Nesting also occurs on the offshore islands of Mexico (Clarion, Revillagigedos, etc). Others nest in mainland Central America (especially Costa Rica). Occasionally specimens occur in the western Pacific (Japanese waters, and Manus Island, Bismarck Sea) and throughout the range there is some degree of sympatry with the green turtle, *Chelonia mydas*. The principal feeding area for the Michoacan colony is the Gulf of California, but traditional hunting by the Seri people combined with widespread contemporary illegal hunting have brought this colony to highly endangered status. The Galapagos population, whose nesting is scattered over dozens or hundreds of beaches on most of the major islands, is more secure but is still subject to some hunting, including in Central American waters.

d) In the Pacific basin, the green turtle occurs and nests on countless small islands. However, the largest nesting colonies are in Queensland, Australia (especially Raine and Pandora Islands; also islands in the Capricorn group including Heron Island). These colonies are protected in Australia, but are subject to major mortality in directed fisheries in Indonesian waters, especially around Bali. Very dense nesting occurs on the small d'Entrecasteaux Reef islands of New Caledonia (Iles Surprise, Leleixour, Fabre and Huon). In New Guinea the most abundant nesting is probably on Long Island, off northern Papua New Guinea. Nesting also occurs in the Hawaiian Islands, especially French Frigate Shoal. Nesting has virtually stopped in the Talang Islands,off Sarawak, but there is now a binational sanctuary for turtles (mostly greens, some hawksbills) in a small group of islands shared by Malaysia and the Philippines.

e) The loggerhead is unknown throughout vast areas of the Pacific, and nesting is almost unrecorded in the entire western Pacific. However, significant numbers of juvenile loggerheads reach the waters of Baja California in certain years; these turtles derive from nesting colonies in Japan. The most abundant nesting in the Pacific occurs in certain beaches of southern Queensland, including both mainland beaches

such as Mon Repos and islands such as Wreck Island. They enjoy good legal protection, but are subject to significant incidental capture.

f) Hawksbills are rare, and nesting very rare, in the east Pacific. This appears to be natural rather than a result of anthropogenic depletion; the coastal waters are generally cool and very deep, often without significant continental shelf or coral formation. However, hawksbills occur as a minority component of the turtle faunas of a great many tropical Pacific Islands, and in Australia they actually form real nesting colonies in a few places, especially on the island of Milman near Cape York. Some authorities believe that such concentrations may once have been much larger and more widespread, and that the contemporary pattern of nesting scattered over vast areas but with few dense colonies represents the result of centuries of over-exploitation. Even in the seemingly safe areas, such as Australia, the nesting populations may be subject to heavy exploitation in other countries (Solomons, Indonesia), and there are suggestions that even the major Milman Island colony is diminishing. Nevertheless, with a nesting population of 6,000 to 10,000 female hawksbills, there seems little question that the Australian populations are currently the largest in the world. Indonesia may have about 2,000.

g) The flatback turtle has a number of nesting colonies in tropical Australia, usually on mainland beaches or the shores of large, nearshore islands. Few large aggregations exist; Crab Island, west of the tip of Cape York, may be the most important nesting ground, and is also characterized by some degree of year-round nesting, and as much diurnal activity as nocturnal. The populations are thought to be stable.

CONCLUSIONS

I) Five species of marine turtle are widespread in the tropical oceans, and all have at least some areas of abundance as well as extensive areas of depletion.

II) Three species of marine turtle (the black turtle, *Chelonia agassizii*; Kemp's ridley, *Lepidochelys kempii*; and the flatback turtle, *Natator depressus*) are localized, occurring in just one to perhaps half a dozen nations. The first two are severely depleted, although the second (*L. kempii*) is progressively recovering as a result of intense binational conservation effort and investment. The last of the three, the flatback, is probably not significantly depleted but is essentially restricted to the tropical shorelines and waters of a single nation, Australia.

III) Robust sea turtle colonies (i.e. those that are naturally large, possibly because of a highly productive nutritional base) can withstand significant loss of individual turtles, but it is important that the reproductive phases and nesting beaches be adequately protected and hatchling productivity ensured.

Small colonies may easily be pushed into extinction by unsustainable human take.

IV) Whether they are currently strong, or seriously depleted, sea turtle populations do require good management that will restrict unsustainable activities such as slaughter of nesting females, and such management will often include complete protection of all life-stages.

V) “Arribadas” of ridley turtles represent a special case, where scientifically-based management that includes some exploitation, especially of eggs, for human benefit may not only be a sociological imperative but may also be compatible with the long-term maintenance of the nesting aggregations. Arribadas appear to have an optimum size to maximize hatchling productivity, and when they become overwhelmingly large, hatchling productivity may fall.

VI) Incidental catch of marine turtles by fisheries of various kinds, including shrimp trawling and near-shore gill netting, remains a serious problem in many areas, and regionally unified methodologies to control or eliminate it are a high priority.

VII) Conservation does work. With implementation of the US Endangered Species Act, CITES, and a host of local, regional, and national conservation efforts, many marine turtle populations are now recovering.

Global Status of Sea Turtles: An Overview, by Peter C.H. Pritchard. Document INF-001 prepared for Inter-American Convention for the Protection and Conservation of Sea Turtles, First Conference of the Parties (COP1IAC), First Part 6-8 August, 2002.