

**Class:** Reptilia; **Subclass:** Anapsida; **Order:** Testudines; **Family:** Cheloniidae; **Subfamily:** Chelonini

**Taxon Name:** *Chelonia mydas* (Linnaeus 1758)

**Common Names:** Green turtle (English); tortue comestible, tortue franche, tortue verte (French); tortuga verde, tortuga blanca (Spanish); tartaruga verde, aruanã (Portuguese).

**Status:** Endangered globally (EN A2bd; IUCN 2001a)

**Distribution:** Multiple genetic stocks occurring worldwide in tropical and subtropical marine waters.

**Range:**

Circumglobal, tropical to subtropical seas. Nests in over 80 countries worldwide.

**Habitats:**

Adults nest on sandy beaches; posthatchlings, small juveniles, and migrating adults occur in oceanic zones; larger juveniles and adults forage in neritic habitats.

**Threats:**

Primary threats include long-term harvest of eggs and adults at nesting beaches and capture of juveniles and adults at feeding areas. Secondary threats include incidental capture in marine fisheries, habitat loss at nesting and foraging areas, and disease.

**Rationale.** Analysis of historic and recent published accounts indicate extensive subpopulation declines in all major ocean basins over the last three generations as a result of overexploitation of eggs and adult females at nesting beaches, juveniles and adults in foraging areas, and, to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats. Analyses of subpopulation changes at 32 Index Sites distributed globally (Fig. 1, Table 1) show a 48% to 67% decline in the number of mature females nesting annually over the last 3-generations.

**Range & Population.** The green turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Mediterranean Sea; Pacific Ocean – eastern central, northwest, southwest, western central). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

**Taxonomic structure.** The genetic substructure of the green turtle regional subpopulations shows distinctive mitochondrial DNA properties for each nesting rookery (Bowen et al. 1992). Mitochondrial DNA data suggest that the global matriarchal phylogeny of green turtles has been shaped by ocean basin separations (Bowen et al. 1992, Encalada et al. 1996) and by natal homing behavior (Meylan et al. 1990). Within the eastern Pacific Ocean, specific or subspecific status has been applied to green turtles (also known as black turtles; *C. (=mydas) agassizii*) ranging

from Baja California south to Peru and west to the Revillagigedos Islands and Galápagos Archipelago (Márquez 1990, Pritchard 1997); however, genetic analyses do not support such taxonomic distinctiveness (Bowen et al. 1992, Karl et al. 1992).

**Generation Length.** Generation length is based on the age to maturity plus one half the reproductive longevity (Pianka 1974). Although there appears to be considerable variation in generation length among sea turtle species, it is apparent that all are relatively slow maturing and long-lived (Chaloupka and Musick 1997). Green turtles exhibit particularly slow growth rates, and age to maturity for the species appears to be the longest of any sea turtle (Hirth 1997). As a result, this assessment uses the most appropriate age-at-maturity estimates for each index site. At Index Sites for which there are local age-to-maturity data, those data are used to establish generation length. When data are lacking, as they are for a majority of subpopulations, information from the closest subpopulation for which data are available are used to generate age-at-maturity estimates (Table 2). For example, ages-to-maturity for subpopulations in the Indian Ocean and Mediterranean Sea, for which there are no age-at-maturity estimates, are based on the mean age derived from studies in the Pacific Ocean and Atlantic Ocean, respectively.

Estimates of reproductive longevity range from 17 y to 23 y (Carr et al. 1978, Fitzsimmons et al. 1995). Data from the apparently pristine green turtle stock at Heron Island in Australia's southern Great Barrier Reef show a mean reproductive life of 19 y (Chaloupka et al. 2004). Because Heron Island is the only undisturbed stock for which reproductive longevity data are available (M. Chaloupka, pers. comm.), this datum is used for all Index Sites (Table 3). Thus, based on the range of ages-at-sexual-maturity (26 yrs to 40 yrs) and reproductive longevity from the undisturbed Australian stock (19 yr), the generation lengths used for this assessment range from 35.5 yrs to 49.5 yrs (Table 3).

**Habitats.** Like most sea turtles, green turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (for review see Hirth 1997). Upon leaving the nesting beach, it has been hypothesized that hatchlings begin an oceanic phase (Carr 1987), perhaps floating passively in major current systems (gyres) that serve as open-ocean developmental grounds (Carr and Meylan 1980, Witham 1991). After a number of years in the oceanic zone, these turtles recruit to neritic developmental areas rich in seagrass and/or marine algae where they forage and grow until maturity (Musick and Limpus 1997). Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years (Hirth 1997). Migrations are carried out by both males and females and may traverse oceanic zones, often spanning thousands of kilometers (Carr 1986, Mortimer and Portier 1989). During non-breeding periods adults reside at coastal neritic feeding areas that sometimes coincide with juvenile developmental habitats (e.g., Limpus et al. 1994, Seminoff et al. 2003).

**Threats.** Green turtles, like other sea turtle species, are particularly susceptible to population declines because of their vulnerability to anthropogenic impacts during all life-stages: from eggs to adults. Perhaps the most detrimental human threats to green turtles are the intentional harvests of eggs and adults from nesting beaches and juveniles and adults from foraging grounds. Unfortunately, harvest remains legal in several countries despite substantial subpopulation declines (e.g., Humphrey and Salm 1996, Fleming 2001, Fretey 2001). In addition, a number of incidental threats impact green turtles around the world. These threats affect both terrestrial and

marine environments, and include bycatch in marine fisheries, habitat degradation at nesting beaches and feeding areas, and disease. Mortality associated with entanglement in marine fisheries is the primary incidental threat; the responsible fishing techniques include drift netting, shrimp trawling, dynamite fishing, and long-lining. Degradation of both nesting beach habitat and marine habitats also play a role in the decline of many green turtle stocks. Nesting habitat degradation results from the construction of buildings, beach armoring and re-nourishment, and/or sand extraction (Lutcavage et al. 1997). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the quantity and quality of nesting area available to females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1990). Habitat degradation in the marine environment results from increased effluent and contamination from coastal development, construction of marinas, increased boat traffic, and harvest of nearshore marine algae resources. Combined, these impacts diminish the health of coastal marine ecosystems and may, in turn, adversely affect green turtles. For example, degradation of marine habitats has been implicated in the increasing prevalence of the tumor-causing Fibropapilloma disease (George 1997).

**Conservation measures:** Green turtles have been afforded legislative protection under a number of treaties and laws (for review see Navid 1982, Humphrey and Salm 1996, Fleming 2001, Fretey 2001). Among the more globally relevant designations are those of *Endangered* by the World Conservation Union (IUCN; Baillie and Groombridge 1996, Hilton-Taylor 2000); Annex II of the SPAW Protocol to the Cartagena Convention (a protocol concerning specially protected areas and wildlife); Appendix I of CITES (Convention on International Trade in Endangered Species); and Appendices I and II of the Convention on Migratory Species (CMS). A partial list of the International Instruments that benefit green turtles includes the Inter-American Convention for the Protection and Conservation of Sea Turtles, the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA), the Memorandum of Understanding on ASEAN Sea Turtle Conservation and Protection, the Memorandum of Agreement on the Turtle Islands Heritage Protected Area (TIHPA), and the Memorandum of Understanding Concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa.

As a result of these designations and agreements, many of the intentional impacts directed at sea turtles have been lessened: harvest of eggs and adults has been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas. In regard to incidental take, the implementation of Turtle Excluder Devices has proved to be beneficial in some areas, primarily in the United States and South and Central America (National Research Council 1990). However, despite these advances, human impacts continue throughout the world. The lack of effective monitoring in pelagic and near-shore fisheries operations still allows substantial direct and indirect mortality, and the uncontrolled development of coastal and marine habitats threatens to destroy the supporting ecosystems of long-lived green turtles.

**Assessment Procedure:** In accord with the IUCN criterion that Red List Assessments focus on the number of *mature* individuals (IUCN 2001a), this report assesses changes in the annual

number of nesting females. Because reliable data are not available for all subpopulations, the present report focuses on 32 Index Sites (Figure 1, Table 1). These Index Sites include all of the known major nesting areas as well as many of the lesser nesting areas for which quantitative data are available. Despite considerable overlap at some foraging areas, each is presumed to be genetically distinct (Bowen et al. 1992, Bowen 1995) except for the Turtle Islands of Malaysia (Sabah) and Philippines (Moritz et al. 1991). These two Index Sites are, however, treated independently because of the different management practices exercised by the two governments and the resultant differences in subpopulation trends. Selection of the 32 Index Sites was based on two primary assumptions: (1) they represent the overall regional subpopulation trends and (2) the number of individuals among Index Sites in each region is proportional to the actual population size in that region. Any regional inconsistencies in this proportion may result in a biased global population estimate.

It should be noted that a major caveat of using the number of nesting females to assess population trends is that this data type provides information for the proportion of the adult females that nest in any given year, not the total adult female population. However, when monitored over many years, this index can be reliable for assessing long-term population trends (Meylan 1982, Limpus 1996). In the case of green turtles, which display high inter-annual variability in magnitude of nesting (Limpus and Nichols 1987, Broderick et al. 2001a), using short-term or single-season data sets could misrepresent the actual mean number of nesters over a longer timeframe. To alleviate this potential source of error, we used multiple-year data sets whenever available. However, in several cases, single-season datasets represented the only information for a given time period at an Index Site, and in these cases, as long as the estimate was in accord with qualitative information from other references, we would use the datum.

Because data on annual number of nesting females are not always available, we also used data on number of nests per season, annual hatchling production, annual egg production and annual egg harvest. When these proxies were used, we converted units to number of nesting females based on a constant figure of 100 eggs/nest and three nests/season/female, unless otherwise noted. These conversions were based on the assumptions that (1) the mean number of eggs/nest and nests/female/season differ insignificantly through time, and (2) efforts to monitor nesting female activity and egg production are consistent through time. When using egg harvest data, we also assumed that harvest effort was consistent during all years for which data are available and 100% of the eggs was harvested in any given year. We believe these assumptions are accurate, but their absolute validation is very difficult. Qualitative information does, however, suggest that they are reasonable assumptions. For example, in the case of historic egg harvest, the same group of people usually harvested the eggs at a particular nesting beach each year, and they typically took every egg they could find (e.g. Parsons 1962, Pelzer 1972).

In the present assessment, population abundance estimates are based on raw data, linear extrapolation functions, and exponential extrapolation functions. In most subpopulations, more than one trajectory was exhibited over the 3-generation interval; changes in subpopulation size are thus often based on a combination of raw data and extrapolations. If no change is believed to have occurred outside the time interval for which published abundance data are available, we use the raw data to determine the change in population size. However, when it is believed that change in subpopulation abundance occurred outside the interval for which raw data were available, we used extrapolation techniques to determine the overall change. Linear extrapolations were used when it was believed that the same amount of change occurred each year, irrespective of total subpopulation size. Exponential extrapolations were used when it was

believed that change was proportional to the subpopulation size. In cases where there is a lack of information on the specific rate of change, we used both linear and exponential extrapolations to derive an population estimate. However, when either the linear or exponential function resulted in an obviously inaccurate number, we used only one of the functions to estimate population change (see Table 5).

*Uncertainties in assessment process:* As with any assessment based on historic data or small data sets, there is a great deal of uncertainty relating to the final results of this report. The sources of uncertainty are rooted in both the procedure itself as well as in the stochastic nature green turtle biology. Both sources of uncertainty are ultimately related to a lack of information, and when dealing with an animal as long-lived as a green turtle, this can be a particularly acute problem.

First and foremost is the uncertainty related to the assumptions invoked for this assessment. For example, if, contrary to our assumption, efforts to monitor nesting female activity and egg production were not consistent through time, then our results may be biased. Similarly, our estimates may be inaccurate if harvest effort or the relative amount of eggs harvested was not consistent through time. Due to a lack of information, it is possible that we did not choose the best extrapolation procedure for all examples. Therefore, the extrapolations in this assessment may also be a source of error. This problem is exacerbated when extrapolations were made over long time intervals or when they were based on short-term data sets.

The second source of uncertainty relates to green turtle biology, particularly the highly variable proportion of a population that will nest in any given year. If, for example, the proportion of a subpopulation's adult female cohort nesting each year oscillates over decadal or longer time frames, then it is conceivable that our estimates of annual change in nesting numbers does not correspond to actual changes in the entire subpopulation. In addition, if our conversion values for eggs/nest and nests/female/season are not accurate for the specific subpopulation being addressed, inaccuracies may result. Finally, with respect to the migratory behavior of green turtles, it is expected that each of the Index Sites included in this assessment represent a distinct subpopulation. Indeed, current genetic data support this claim, however, in the absence of complete data for all rookeries, it is possible that turtles moving back and forth between nesting areas in close proximity could have gone undetected. It is thus conceivable that a female could be counted twice. This would, of course, only be a problem when subpopulation size is based on an actual count of individual turtles visiting the beach. Although unlikely, it amounts to an additional source of uncertainty in this assessment.

**Population trends.** Based on the actual and extrapolated changes in subpopulation size at the 32 Index Sites, it is apparent that the mean annual number of nesting females has declined by 48% to 67% over the last three generations (Table 5). In addition, it is apparent that the degree of population change is not consistent among all Index Sites or among all regions (Tables 5, 6). Because many of the threats that have led to these declines are not reversible and have not yet ceased, it is evident that green turtles face a measurable risk of extinction. Based on this assessment, it is apparent that green turtles qualify for *Endangered* status under Criteria A2bd.

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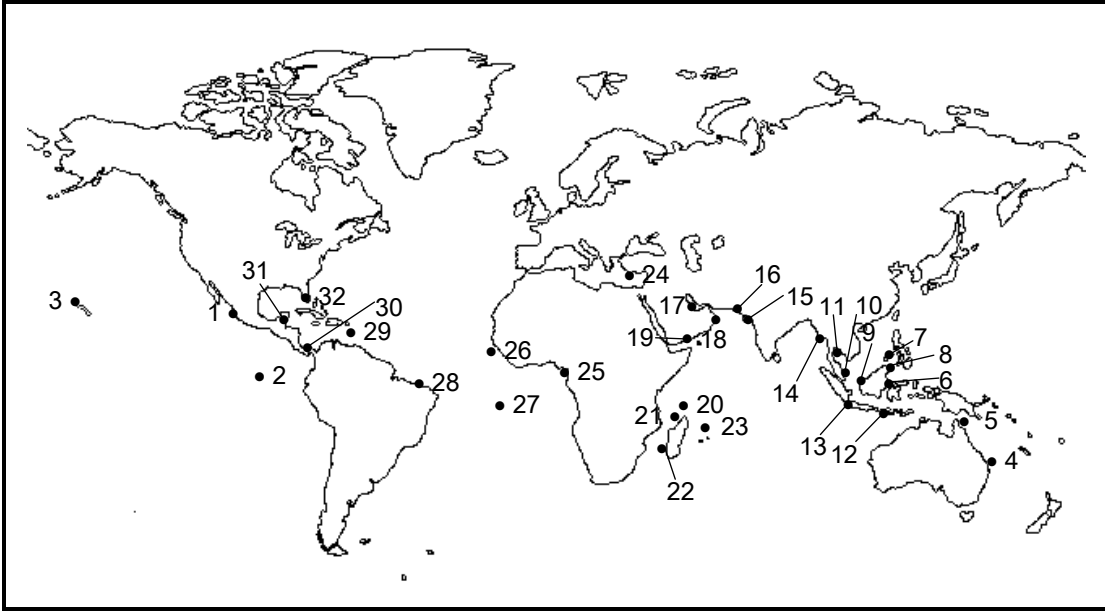


Figure 1. World map with the geographic locations of the 32 Index Sites used for the 2003 MTSG Green Turtle Assessment. See Table 1 for the rationale for inclusion of each site.

Table 1. Summary of 32 *Chelonia mydas* nesting rookeries used as Index Sites for the 2003 MTSO Global Green Turtle Status Assessment. See Figure 1 for map of all Sites.

Index Nesting Site		Justification
EASTERN PACIFIC OCEAN		
1.	México (Colola, Michoacán)	Historically the most important <i>C. mydas</i> nesting rookery in the eastern Pacific Ocean (Alvarado and Figueroa 1989).
2.	Ecuador (Galápagos Is.)	Currently the largest nesting congregation in eastern Pacific Ocean (Hurtado 1984, Hurtado 2001).
CENTRAL PACIFIC OCEAN		
3.	United States (Hawaii, French Frigate Shoals)	Hawaii has greatest nesting density of <i>C. mydas</i> in central Pacific; 90% of nesting in Hawaii is at French Frigate Shoals (Balazs 1980).
WESTERN PACIFIC OCEAN		
4.	Australia (southern Great Barrier Reef, Heron Is.)	Australia currently hosts some of the largest nesting congregations of green turtles in the world (Limpus et al. in press); Heron Is. and Raine Is. represent the most important nesting areas in the sGBR and nGBR, respectively (Limpus et al. in press).
5.	Australia (northern Great Barrier Reef, Raine Is.)	
SOUTHEAST ASIAN SEAS		
6.	Indonesia (Berau Islands)	Indonesia is among the most important nesting areas in the world (Groombridge and Luxmoore 1989); Berau Islands host some of the largest nesting colonies in Indonesia.
7.	Philippines (Turtle Islands)	Historically one of the largest and most important nesting colonies in Southeast Asia (Groombridge and Luxmoore 1989).
8.	Malaysia (Sabah Turtle Islands)	Historically important nesting colonies (de Silva 1982);
9.	Malaysia (Sarawak)	Sarawak and Sabah are two of the two most important insular regions in SEA; Terengganu has greatest nesting density in peninsular Malaysia (Mortimer 1991).
10.	Malaysia (Terengganu)	
11.	Thailand (Gulf of Thailand)	Increases area of coverage for SEA region.
EASTERN AND NORTHERN INDIAN OCEAN		
12.	Indonesia (Suka Made, Meru Betiri National Park)	Represents a nesting area in EIO that has been protected for several decades (Arrinal 1997)
13.	Indonesia (West Java, Pangumbahan)	Pangumbahan is most important nesting colony along the coast of Java (Groombridge and Luxmoore 1989).
14.	Myanmar (Thamihla Kyun)	Myanmar is a notable nesting area in northeast Indian Ocean region. Thamihla Kyun hosts largest nesting congregations in the area.
15.	India (Gujarat)	Provides added context for the Indian subcontinent.
16.	Pakistan (Hawkes Bay and Sandspit)	One of the largest nesting congregations along Indian subcontinent.
17.	Saudi Arabia (Karan Is.)	Largest nesting site in Arabian Gulf for which data are available.
18.	Oman (Ras al Hadd)	Historically one of the most important nesting areas in the northern Indian Ocean (Ross and Barwani 1982).
19.	Peoples Democratic Republic of Yemen (Sharma)	Described as "without any doubt one of the best nesting beaches remaining in the world" (Hirth and Carr 1970).

Table 1. - *Continued*

WESTERN INDIAN OCEAN		
20.	Seychelles Is. (Aldabra and Assumption)	Seychelles historically an important nesting area; Aldabra and Assumption represent two sites with largely different management histories.
21.	Comoros Islands	Currently one of the largest nesting rookeries in the western Indian Ocean.
22.	Isles Eparces (Europa Is.)	Europa Is. is a historically important nesting area in the western Indian Ocean and has total nesting beach protection.
23.	Isles Eparces (Tromelin Is.)	Tromelin Is. is one of the largest nesting congregations in the western Indian Ocean and has total nesting beach protection.
MEDITERRANEAN SEA		
24.	Turkey	Currently hosts the largest nesting congregation in the Mediterranean Sea (Kasperek et al. 2001).
EASTERN ATLANTIC OCEAN		
25.	Equatorial Guinea (Bioko Is.)	Important nesting area along the West African coast; Bioko Is. hosts almost all of nesting in this country (Groombridge and Luxmoore 1989).
26.	Guinea-Bissau (Bijagos Archipelago)	Guinea-Bissau currently hosts the largest nesting congregation along the West African coast (Fretey 2001).
CENTRAL ATLANTIC OCEAN		
27.	Ascension Is.	Represents the primary nesting rookery in the central Atlantic Ocean (Godley et al. 2001).
WESTERN ATLANTIC OCEAN		
28.	Suriname	Most important nesting area along northeastern South America.
29.	Venezuela (Aves Is.)	Presently the second largest rookery in the Wider Caribbean Region (Lagueux 2001).
30.	Costa Rica (Tortuguero)	Largest nesting rookery in the Caribbean Sea and intensively studied since 1956 (Carr et al. 1982, Bjorndal et al. 1999).
31.	México (Yucatan Peninsula)	Provides added context for the western Caribbean region. Includes the states of Campeche, Yucatán, and Quintana Roo.
32.	United States (Florida)	Provides added context for western Atlantic Ocean; only site included in southeastern United States.

Table 2. Estimated age-at-sexual-maturity<sup>a</sup> for wild green turtles, *Chelonia mydas*. These published values are used in calculations of generation length for each Index subpopulation (see Table 3).

Study	Location	Age at	Reference
		maturity (years)	
A.	Hawaiian Archipelago	30	Zug et al. 2002
B.	Australia (nGBR)	30 <sup>b</sup>	Limpus and Walter 1980
C.	Australia (sGBR)	40	Limpus and Chaloupka 1997
D.	Florida	30	Mendonca 1981
E.	Florida	27	Frazer and Ehrhart 1985
F.	U.S. Virgin Islands	33	Frazer and Ladner 1986
G.	Ascension Island	35	Frazer and Ladner 1986
H.	Costa Rica	26	Frazer and Ladner 1986
I.	Surinam	36	Frazer and Ladner 1986

<sup>a</sup> It has been suggested that a measure of mean nesting size will provide a closer estimate of the average size-at-maturity for green turtles than does minimum nesting size (e.g. Frazer and Ehrhart 1985, Limpus and Chaloupka 1997). Therefore, when possible, age-at-sexual-maturity is based on mean nesting size at each rookery.

<sup>b</sup> Estimate based on minimum nesting size

NOTE: Additional growth data are available for subpopulations not listed in Table 2, however, these studies focused on head-started turtles (Ehrhart and Witham 1992, Burnett-Herkes et al. 1984), generated age-at-sexual-maturity estimates using un-reliable methods (e.g. Marquez and Doi 1973), or were based on non-applicable age classes (e.g. Zug and Glor 1998), thus reducing their utility for the present calculations.

Table 3. Summary of age-at-maturity, generation length, and calendar year of start date for Index subpopulations included in the 2003 MTSO green turtle assessment. See Table 2 for summary of the values used to determine age-at-maturity for each site.

#	Index Site	Age at Maturity (years)	Age at maturity calculation (From Table 2)	$\frac{1}{2}$ Reproductive Longevity (years)	Generation Length (GL; years)	3-generation duration ([= GL * 3]; years)	Calendar year 3 generations back (= 2001- 3GL)
1.	Eastern Pacific Ocean, México (Colola, Michoacán)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
2.	Eastern Pacific Ocean, Ecuador (Galápagos Is.)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
3.	Central Pacific Ocean, United States (Hawaii)	30	A	$\frac{1}{2}$ (19 yr) = 9.5	$30 + 9.5 = 39.5$	$39.5 * 3 = 118.5$	1883
4.	Western Pacific Ocean, Australia (sGBR, Heron Is.)	40	C	$\frac{1}{2}$ (19 yr) = 9.5	$40 + 9.5 = 49.5$	$49.5 * 3 = 148.5$	1853
5.	Western Pacific Ocean, Australia (nGBR, Raine Is.)	30	B	$\frac{1}{2}$ (19 yr) = 9.5	$30 + 9.5 = 39.5$	$39.5 * 3 = 118.5$	1883
6.	Southeast Asia, Indonesia (Berau Is.)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
7.	Southeast Asia, Turtle Islands, Philippines	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
8.	Southeast Asia, Turtle Islands, Malaysia (Sabah)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
9.	Southeast Asia, Malaysia (Sarawak)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
10.	Southeast Asia, Malaysia (Terengganu)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873

Table 3. – *Continued*

#	Index Site	Age at Maturity (years)	Age at maturity calculation (From Table 2)	$\frac{1}{2}$ Reproductive Longevity (years)	Generation Length (GL; years)	3-generation duration ([= GL * 3]; years)	Calendar year 3 generations back (= 2001- 3GL)
11.	Southeast Asia, Thailand (Gulf of Thailand)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
12.	Eastern Indian Ocean, Indonesia (E. Java, Suka Made)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
13.	Eastern Indian Ocean, Indonesia (W. Java; Pangumbahan)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
14.	Eastern Indian Ocean, Myanmar (Thamihla Kyun)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
15.	Northern Indian Ocean, India (Gujarat)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
16.	Northern Indian Ocean Pakistan (Hawkes Bay and Sandspit)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
17.	Northern Indian Ocean, Arabian Gulf Saudi Arabia (Karan Is.)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
18.	Northern Indian Ocean, Oman (Ras al Hadd)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873
19.	Northern Indian Ocean, Peoples Democratic Republic of Yemen (Sharma)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	33.3 + 9.5 = 42.8	42.8 * 3 = 128.4	1873

Table 3. – *Continued*

#	Index Site	Age at Maturity (years)	Age at maturity calculation (From Table 2)	$\frac{1}{2}$ Reproductive Longevity (years)	Generation Length (GL; years)	3-generation duration ([= GL * 3]; years)	Calendar year 3 generations back (= 2001- 3GL)
20.	Western Indian Ocean, Seychelles (Assumption)	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
21.	Western Indian Ocean, Comoros Islands	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
22.	Western Indian Ocean, Isles Eparces, Europa	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
23.	Western Indian Ocean, Isles Eparces, Tromelin	33.3	Mean of A,B,C	$\frac{1}{2}$ (19 yr) = 9.5	$33.3 + 9.5 = 42.8$	$42.8 * 3 = 128.4$	1873
24.	Mediterranean Sea, Turkey	31.2	Mean of D,E,F,G,H,I	$\frac{1}{2}$ (19 yr) = 9.5	$31.2 + 9.5 = 40.7$	$40.7 * 3 = 122.1$	1879
25.	Eastern Atlantic Ocean, Equatorial Guinea (Bioko Is.)	31.2	Mean of D,E,F,G,H,I	$\frac{1}{2}$ (19 yr) = 9.5	$31.2 + 9.5 = 40.7$	$40.7 * 3 = 122.1$	1879
26.	Eastern Atlantic Ocean, Guinea-Bissau (Bijagos Archipelago)	31.2	Mean of D,E,F,G,H,I	$\frac{1}{2}$ (19 yr) = 9.5	$31.2 + 9.5 = 40.7$	$40.7 * 3 = 122.1$	1879
27.	Central Atlantic Ocean, Ascension Is.	35	H	$\frac{1}{2}$ (19 yr) = 9.5	$35 + 9.5 = 44.5$	$44.5 * 3 = 133.5$	1868
28.	Western Atlantic Ocean, Suriname (Galibi)	36	J	$\frac{1}{2}$ (19 yr) = 9.5	$36 + 9.5 = 45.5$	$45.5 * 3 = 136.5$	1865

Table 3. – *Continued*

#	Index Site	Age at Maturity (years)	Age at maturity calculation	$\frac{1}{2}$ Reproductive Longevity (years)	Generation Length (GL; years)	3-generation duration ([= GL * 3]; years)	Calendar year 3 generations back (= 2001- 3GL)
29.	Western Atlantic Ocean, Venezuela (Aves Is.)	31.2	Mean of D,E,F,G,H,I	$\frac{1}{2}$ (19 yr) = 9.5	$31.2 + 9.5 = 40.7$	$40.7 * 3 = 122.1$	1879
30.	Western Atlantic Ocean, Costa Rica (Tortuguero)	26	I	$\frac{1}{2}$ (19 yr) = 9.5	$26 + 9.5 = 35.5$	$35.5 * 3 = 106.5$	1895
31.	Western Atlantic Ocean, México (Yucatan Peninsula.)	31.2	Mean of D,E,F,G,H,I	$\frac{1}{2}$ (19 yr) = 9.5	$31.2 + 9.5 = 40.7$	$40.7 * 3 = 122.1$	1879
32.	Western Atlantic Ocean, United States (Florida)	29	Mean of D,E	$\frac{1}{2}$ (19 yr) = 9.5	$29 + 9.5 = 38.5$	$38.5 * 3 = 115.5$	1886

Table 4. Summary of published estimates of *Past* and *Present* nesting activity and subpopulation trends for *Chelonia mydas* at the 32 Index Sites. Data codes include: AN, nesting females; AC, number of nests; EP, egg production; EH, egg harvest; HP, hatchlings produced; and TC, tally count for high density nesting area. ALL VALUES ARE BASED ON ANNUAL MEANS UNLESS OTHERWISE STATED.

Index #	Subpopulation	Data type	Past Estimate 1		Past Estimate 2		Present Estimate		Citation (Past)	Citation (Present)
			Years	Mean	Years	Mean	Years	Mean		
1.	Eastern Pacific Ocean, México (Colola, Michoacán <sup>a</sup> )	AN	1970	15,000 females			1997-2001	851 females	Cliffton et al. 1982, R. Márquez, pers. comm.	Alvarado et al. 2001, R. Marquez, pers. comm.
2.	Eastern Pacific Ocean, Ecuador (Galápagos Is.)	AN	1976-1982	~1,400 females			1999-2001	~1,400 females	Hurtado 1984	Hurtado 2001, M. Hurtado, pers. comm.
3.	Central Pacific Ocean, United States (Hawaii)	AN	1974-1978	378 females			1991-2000	574 females	Balazs 1980, G.	Wetherall et al. 1998
4.	Western Pacific Ocean, Australia (Heron Is.)	AN	1964-1969	~400 females			1993-1999	562 females	Bustard 1974	Limpus et al. 2002
5.	Western Pacific Ocean, Australia (nGBR, Raine Is. <sup>b</sup> )	TC/ AN	1974-1979	2,361 females/night	1995-2000	3,680 fem/night	2001	~18,000 females/season	(1) Limpus et al. 2002; (2) Limpus et al. 2002	Dobbs 2002, K. Dobbs, pers. comm.
6.	Southeast Asia, Indonesia (Berau Islands, NE Kalimantan)	AN	1940s	~36,000 females; 200 fem/night, peak sea.			1984	~4000-5000 females; 25 fem/night, peak season	Schulz 1984	Schulz 1984
7.	Southeast Asia, Turtle Islands, Philippines	EH	1951	1,401,450 eggs			1981-1985	917,189 eggs	Domantay 1953, Groombridge and Luxmoore 1989	Reyes 1986 in Groombridge and Luxmoore 1989

Table 4. - *Continued*

	Subpopulation	Date type	Past Estimate 1		Past Estimate 2		Present Estimate		Citation (Past)	Citation (Present)
8.	Southeast Asia, Turtle Islands, Malaysia (Sabah)	EH/EP	1965-1968	556,278 eggs	1983-1986	255,877 eggs	1995-1999	975,480 eggs	(1) de Silva 1982; (2) de Silva in Groombridge and Luxmoore 1989; (3) Basintal and Lakim 1994, E. Chan, pers. comm.	E. Chan, pers. comm.
					Past Estimate 3					
					1989-1993	540,000 eggs				
9.	Southeast Asia, Malaysia (Sarawak)	EH	1927-1934	2,264,886 eggs	1981-1985	229,990 eggs;	1998-1999	228,618 eggs	(1) Banks 1937, Harrison 1962; (2) Leh 1986 in Groombridge and Luxmoore 1989	E. Chan, pers. comm.
10.	Southeast Asia, Malaysia (Terengganu)	EH, EP	1961	928,900 eggs	1993	317,105 eggs	1998-1999	218,354 eggs	(1) Hendrickson and Alfred 1961; (2) Ibrahim 1993	E. Chan, pers. comm.
11.	Southeast Asia, Thailand (Gulf of Thailand)	AC	1973-1983	405 nests			1992-2001	255 nests	Charuchinda and Monanunsap 1998	Charuchinda and Monanunsap 1998
12.	Eastern Indian Ocean, Indonesia (E. Java, Suka Made)	AC	1970-1974	1,555 nests			1991-1995	395 nests	Schulz 1987	Arrinal 1997, C. Limpus, pers. comm.
13.	Eastern Indian Ocean, Indonesia (W. Java; Pangumbahan)	EH	1950s	2,500,000 eggs			1980s	400,000 eggs	Schulz 1987	Schulz 1987
14.	Eastern Indian Ocean, Myanmar (Thamihla Kyun)	EH	1883-1898	1,744,164 eggs			1999	<250,000 eggs	Maxwell (1911) as cited in Groombridge and Luxmoore (1989)	Thorbjarnarson et al. 2000
15.	Northern Indian Ocean, India (Gujarat)	AC	1981	866 nests			2000	461 nests	Bhaskar 1984	W. Sunderraj, pers. comm.

Table 4. - *Continued*

#	Subpopulation	Data type	Past Estimate 1		Past Estimate 2		Present Estimate		Citation (Past)	Citation (Present)
16.	Northern Indian Ocean Pakistan (Hawkes Bay and Sandspit)	AC	1981-1985	1286 nests			1994-1997	~600 nests	Khan in Groombridge and Luxmoore 1989	Asrar 1999
17.	Northern Indian Ocean, Arabian Gulf Saudi Arabia (Karan Is.)	AN	1970s	500-1000 females			1990s	500-1000 females	Basson et al. 1977	Al-Merghani et al. 2000
18.	Northern Indian Ocean, Oman (Ras al Hadd)	AN	1977-1979	~6,000 females			1988	~6,000 females	Ross and Barwani 1982	Ross in Groombridge and Luxmoore 1989
19.	Northern Indian Ocean, Peoples Democratic Republic of Yemen (Sharma)	AN	1966, 1972	30-40 females/night, peak season			1999	750 females, 15 females/night, peak season	Hirth 1968, Hirth and Hollingworth 1973	Saad 1999
20.	Western Indian Ocean, Seychelles Islands <sup>c</sup>	AN	ca. 1900	11,000–13,000 females	1968	~1,700 females	1981-1984	3,535 – 4755 females	(1) Horneil 1927, Mortimer 1985; (2) Mortimer 1984, Mortimer 1988	J. Mortimer, pers. comm.
21.	Western Indian Ocean, Comoros Islands	AN	1972-1973	1,850 females			2000	5,000 females	Frazier et al. 1985	S. Ahamada, pers. comm.
22.	Western Indian Ocean, Isles Eparces, Europa <sup>d</sup>	AN	1970-1971	4-5,000; females	1978-1979	9-18,000 Females	1973-1985	2,000-11,000 females	(1) Hughes 1970; (2) Lebeau et al. 1983	Le Gall et al. 1986
22.	Western Indian Ocean, Isles Eparces, Europa <sup>d</sup>	HP	1983-1987	153,000 hatchlings			1990-1994	119,000 hatchlings	Rene and Roos 1996	Rene and Roos 1996
23.	Western Indian Ocean, Isles Eparces, Tromelin <sup>e</sup>	HP	1983-1987	427,600 hatchlings			1990-1994	377,000 hatchlings	Rene and Roos 1996	Rene and Roos 1996
24.	Mediterranean Sea, Turkey	AN	1978-1982	1,000 females			1998-2001	76-383 females	Geldiay 1987	Kasperek et al. 2001, Broderick et al. 2002

Table 4. - *Continued*

#	Subpopulation	Data type	Past Estimate 1		Past Estimate 2		Present Estimate		Citation (Past)	Citation (Present)
25.	Eastern Atlantic Ocean, Equatorial Guinea (Bioko Is.)	AH	1940s	200-300 females / night	1980s	50-100 females/night	1996/97-1997/98	1468 nests	(1) Eisentraut 1964; (2) J. Tomas, pers. comm.	Tomas et al. 1999
26.	Eastern Atlantic Ocean, Guinea-Bissau (Bijagos Archipelago)	AN	1990-1992	~2000 females			2000	~2465 females	Limoges and Robillard 1991, Paris and Agardy 1993 as cited in Fretey 2001	Catry et al. 2002
27.	Central Atlantic Ocean, Ascension Is.	AC	1977-1978	5257-10,764 nests			1998/99-2000/01	11,127 nests	Mortimer and Carr 1987	Godley et al. 2001, Broderick et al. 2001b
28.	Western Atlantic Ocean, Suriname (Galibi)	AN	1975-1979	1,657 females	1983-1987	1,740 females	1995	1,803 females	(1) Schulz 1982; (2) Mahadin in Ogren 1989	Weijerman et al. 1998
29.	Western Atlantic Ocean, Venezuela (Aves Is. <sup>f</sup> )	AN	1947	150-200 emergences /night, 1199 females	1984-1987	700-900 nests/season	1994	267 females	(1) Pinchon 1967 as cited in Pritchard and Trebbau 1984; (2) V. Vera pers. comm. to K. Eckert	V. Vera, pers. comm. to K. Eckert
30.	Western Atlantic Ocean, Costa Rica (Tortuguero)	AC	1971-1975	~41,250 nesting emergences			1992-1996	72,229 nesting emergences	Carr et al. 1982, modified from Bjorndal et al. 1999	modified from Bjorndal et al. 1999
31.	Western Atlantic Ocean, México (Yucatan Peninsula.)	AC	1983	~874 females			2000	~1547 females	Marquez 1984 a,b	R. Marquez, pers. comm.
32.	Western Atlantic Ocean, United States (Florida)	AN	1980	366 females			1995-2000	~759 females	Dodd 1982	Meylan et al. 1994, FMRI, INBDP (c/o B. Witherington)
	<i>Remainder<sup>a</sup></i>	AN				1860 – 2001		declining	Groombridge and Luxmoore 1989, Humphrey and Salm 1996, Fretey 2001, Fleming 2001	

<sup>a</sup> Value for nesting females in Colola for 1970 is based on the estimate of 25,000 females for that year in all of Michoacán (Cliffon et al. 1982) multiplied by 60%, the relative amount of Michoacán nesting that is at Colola (R. Marquez, pers. comm.).

- <sup>b</sup> Dobbs (2002) estimates that the annual number of nesting females in nGBR is ~ 30,000. 60% of this is at Raine Is. (K. Dobbs pers. comm.)
- <sup>c</sup> Seychelles data are based on counts from Assumption Is. and Aldabra Is..
- <sup>d</sup> Two separate *Past – Present* data input lines are provided for Europa Island (Isles Eparces) to report (1) counts of nesting females and (2) hatchling production. Hatchling production data are based on the index site called Station Beach (M. Taquet pers. comm.) and represent only a subset of the entire production for Europa Is. Because these data more are based on hard counts rather than estimations presented in Ross (1982) we used them for the extrapolations in Table 3.
- <sup>e</sup> There are a variety of estimates available for Tromelin Island (see Hughes 1982), however the methods used to derive these estimates are unclear. Therefore, the present assessment is based on hatchling production data from the entire island (M. Taquet pers. comm.). Because these data are based on hard counts rather than unclearly derived estimations they were used for the extrapolations in Table 3.
- <sup>f</sup> At Aves Is., the Past estimate of nesting is based on estimate of 150-200 emergences per night during a one week period in 1947 (Pinchon 1967 as cited in Pritchard and Trebbau 1984). Taking this number and conservatively assuming that 1/3 of these were false crawls arrives at a nests/night estimate of 100-132. Using the midpoint of this estimate (116 nests/night) and, conservatively assuming that the season is only 1 month (31 d in July) long arrives at a value of 3,596 nests per season. At a rate of 3 nests per female, this equals 1199 females/season.
- <sup>g</sup> In addition to the 32 Index Sites included in this report, there are many areas that host green turtle nesting for which there are no long term quantitative data. Green turtle nesting congregations of particular interest include, but are not limited to, those at the Aru Islands (Shultz 1984), western coast of Australia (R. Prince pers. comm.), Gulf of Carpentaria coast of Australia (C. Limpus pers. comm.), Pacific Coast of Costa Rica (Cornelius 1982), Natuna Islands (Schulz 1984), New Caledonia (C. Limpus pers. comm.), Papua New Guinea (Philip 2002), Scilly Atoll (Lebeau 1985) and additional islands of the South Pacific (C. Limpus pers. comm.). Despite the lack of quantitative data from these areas, the 'Remainder' category appears to be in overall decline. This conclusion is based on the overwhelming number of qualitative reports that describe declining green turtle subpopulations at non-Index areas (e.g., Groombridge and Luxmoore 1989, Salm and Humphrey 1996, Fretey 2001, Fleming 2001, C. Limpus pers. comm.). Although past versus present comparisons are not commonly possible, these reports suggest that green turtle declines have been extensive and widespread, occurring within one human generation. Declines are attributed to intentional harvest of eggs and adult females at nesting beaches, and juveniles and adults in marine habitats.

Table 5. Summary of estimates of population change for the 32 green turtle Index Sites as determined with raw data, and Exponential and Linear extrapolation functions (IUCN 2001b). Past and Present published estimates are provided in Table 4. Subpopulation size units are mean annual number of nesting females. Unless otherwise stated, conversions from Table 2 data on number of eggs to number of nests and number of nests to number of females was determined using a mean value of 100 eggs/nest and 3 nests/female, respectively, for any given nesting season (Groombridge and Luxmoore 1989). Note: extrapolation functions are used only when there is a suspected change in the subpopulation size over a specific time interval outside of the period represented by data in Table 4. In such cases, unless otherwise noted, both linear (L) and exponential (E) functions are used due to a lack of information on the true rate of change over the time interval.

Index #	Subpopulation (Index Site)	Raw Data (from Table 4)		Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
		Past	Present				
1.	Eastern Pacific Ocean, México (Colola, Michoacán)	15,000 (1970)	851 (1997-2001)	1873-1959: no change 1960-2001: declining (Craig 1926, Caldwell 1963, Seminoff et al. 2003).	37,851 (E)	851	- 98%
					19,564 (L)		- 96%
2.	Eastern Pacific Ocean, Ecuador (Galápagos Is.)	1,400 (1976-1982)	1,400 (1999-2001)	1873-2001: no change (Hurtado 1984, M. Hurtado, pers. comm.)	1,400	1,400	0%
3.	Central Pacific Ocean, United States (Hawaii)	378 (1974-1978)	574 (1991-2000)	1883-1977: no change 1978-2001: increasing (Balazs 1980, G. Balazs pers. comm.)	378	574 (E)	+ 52%
						583 (L)	+ 54%
4.	Western Pacific Ocean, Australia (Heron Is.)	400 (1964-1969)	562 (1993-1999)	1853-1968: no change (Parsons 1962) 1969-2001: increasing (C. Limpus pers. comm.)	400	575 (E)	+ 44%
						573 (L)	+ 43%
5.	Western Pacific Ocean, Australia (nGBR, Rainels <sup>a</sup> )	11,538 (1974-1979)	18,000 (1995-2001)	1883-1973: no change (MacGillivray 1910) 1974-2001: increasing (Limpus et al. 2002)	11,538	18,000	+ 56%

Table 5. - *Continued*

Index #	Subpopulation (Index Site)	Raw Data (from Table 4)		Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
		Past	Present				
6.	Southeast Asia, Indonesia (Berau Islands)	36,000 (1940s)	4,500 (1984)	1873-1933: no change 1934-2001: declining (Schulz 1984, C. Limpus pers. comm.)	47,803 (E)	2,015 (E)	- 96%
				<i>Linear forward extrapolation would have resulted in a '0' estimate for present population size which is not possible. Therefore, only exponential forward extrapolation is used.</i>	40,295 (L)		- 95%
7.	Southeast Asia, Philippines <sup>b</sup>	4,886 (1951)	3,198 (1981-1985)	1873-1929: no change 1930-2001: declining (Domantay 1953, Reyes 1986).	6,348 (E)	2,620 (E)	- 59%
					5,929 (L)	2,404 (L)	- 59%
8.	Southeast Asia, Malaysia (Sabah <sup>c</sup> )	1,854 (1965-1968)	3,251 (1995-1999)	1873-1932: no change 1933-1986: declining (n <sub>1986</sub> =853) 1986-2001: increasing (de Silva 1969, 1982; E. Chan, pers. comm.).	8,389 (E)	3,994 (E)	- 52%
					3,800 (L)	3,620 (L)	- 05%
9.	Southeast Asia, Malaysia (Sarawak)	7,549 (1927-1934)	763 (1984-1988)	1873-1988: declining (Parsons 1962, Pelzer 1972, Mortimer 1990a); 1989-2001: no change (E. Chan pers. com.).	57,416 (E)	763	- 99%
					13,556 (L)		- 94%
10.	Southeast Asia, Peninsular Malaysia	3,096 (1961)	728 (1998-1999)	1873-1932: no change 1933-2001: declining (Hendrickson and Alfred 1961; C. Eng Heng, pers. comm.).	8,996 (E)	675 (E)	- 92%
					4,841 (L)	603 (L)	- 88%
11.	Southeast Asia, Thailand, Gulf of Thailand	135 (1973-1983)	85 (1992-2001)	1873-2001: declining (Parsons 1962, Charuchinda and Monanunsap 1998).	2,281 (E)	85	- 96%
					441 (L)		- 81%

Table 5. – *Continued*

Index #	Subpopulation (Index Site)	Raw Data (from Table 4)		Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
		Past	Present				
12.	Eastern Indian Ocean, Indonesia (Suka Made, East Java)	518 (1970-1974)	132 (1991-1995)	1873-1949: no change 1950-1994: declining (Schulz 1984; C. Limpus, pers. comm.) 1995-2001: no change	2,471 (E)	132	- 95%
					959 (L)		- 86%
13.	Eastern Indian Ocean, Indonesia <sup>d</sup> (West Java)	8,333 (1950s)	1,333 (1980s)	1873-1949: no change 1950-2001: declining (Schulz 1984, Groombridge and Luxmoore 1989). <i>Linear forward extrapolation would have resulted in a '0' estimate for present population size which is not possible. Therefore, only exponential forward extrapolation is used.</i>	8,333	370 (E)	- 96%
14.	Eastern Indian Ocean, Myanmar	5,814 (1883-1898)	833 (1999)	1873-1882: no change 1883-2001: declining (Maxwell (1911) as cited in Groombridge and Luxmoore (1989), Thorbjarnarson et al. 2000).	7,759 (E)	802 (E)	- 90%
					6,554 (L)	734 (L)	- 89%
15.	Northern Indian Ocean, India (Gujarat)	289 (1981)	154 (2000)	1873-1966: no change 1967-2001: declining (Kar and Bhaskar 1982; W. Sunderraj pers. comm.	460 (E)	149 (E)	- 68%
					388 (L)	147 (L)	- 38%
16.	Northern Indian Ocean, Pakistan (Hawkes Bay and Sandspit)	429 (1981-1985)	200 (1994-1997)	1873-1985: no change (Groombridge and Luxmoore 1989), 1986-2001: declining (Asrar 1999).	429 (E)	155 (E)	- 64%
					429 (L)	124 (L)	- 71%

Table 5. – *Continued*

Index #	Subpopulation (Index Site)	Raw Data (from Table 4)		Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
		Past	Present				
17.	Northern Indian Ocean, Saudi Arabia (Karan Is.)	750 (1970s)	750 (1990s)	1873-2001: no change (N. Pilcher, pers. comm.).	750	750	0%
18.	Northern Indian Ocean, Oman (Ras al Hadd)	6,000 (1977-1979)	6000 (1988)	1873-2001: no change (Ross 1982).	6,000	6,000	0%
19.	Northern Indian Ocean, PRD Yemen (Sharma)	1,750 (1966-1972)	750 (1999)	1873-1949: no change 1950-2001: declining (Hirth 1968; Saad 1999).	3,490 (E)	704 (E)	- 80%
					2,565 (L)	676 (L)	- 74%
20.	Western Indian Ocean, Seychelles	12,000 (1900)	4145 (1981-1984)	1873-1899: no change 1900-1967: declining (Mortimer 1984) 1968-1884: increasing (N <sub>1968</sub> = 1,700) 1985-2001: no change (J. Mortimer pers. comm.).	12,000	4,145	- 65%
21.	Western Indian Ocean, Comoros Is.	1850 (1972-1973)	5000 (2000)	1873-1973: no change (Parsons 1962) 1974-2001: increasing (S. Ahamada, pers. comm.)	1,850	5,188 (E)	+ 180%
						5,117 (L)	+ 177%
22.	Western Indian Ocean, Isles Eparces (Europa Is. <sup>e</sup> )	463 (1983-1987)	360 (1990-1994)	1873-1987: no change 1988-2001: declining (Rene and Roos 1996, M. Taquet, pers. comm.).	463	280 (E)	- 40%
						257 (L)	- 44%

Table 5. – *Continued*

Index #	Subpopulation (Index Site)	Raw Data (from Table 4)		Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
		Past	Present				
23.	Western Indian Ocean, Isles Eparces (Tromelin Is. <sup>f</sup> )	1,639 (1983-1987)	1,445 (1990-1994)	1873-1987: no change 1988-2001: declining (Rene and Roos 1996, M. Taquet, pers. comm.).	1,639	1,274 (E) ----- 1,251 (L)	- 22% ----- - 24%
24.	Mediterranean Sea, Turkey	1,000 (1978-1982)	230 (1998-2001)	1879-1919: no change 1920-2001: declining (Sella 1982, Kasperek et al. 2001) <i>Exponential backwards extrapolation would have resulted in an estimate for past population size which is not possible. Therefore, only linear backward extrapolation is used.</i>	3,513 (L)	230	- 93%
25.	Eastern Atlantic Ocean, Equatorial Guinea (Bioko Is. <sup>g</sup> )	2,075 (1940)	489 (1996-1998)	1879-1939: no change 1940-2001: declining (T. Butynski pers. comm. to K. Bjorndal as cited in Fretey 2001).	2,075	454 (E) ----- 407 (L)	- 78% ----- - 80%
26.	Eastern Atlantic Ocean, Guinea-Bissau (Bijagos Is.)	2,000 (1990-1992)	2,465 (2000)	1879-1989: no change (but see Agardy 1992) 1990-2001: increasing (Agardy 1992, Catry et al. 2002).	1,898 (E) ----- 1,884 (L)	2,530 (E) ----- 2,523 (L)	+ 33% ----- + 34%
27.	Central Atlantic Ocean, Ascension Island	2670 (1977-1978)	3,709 (1998-2001)	1868-1977: no change (but see Parsons 1962) 1978-2001: increasing (Godley et al. 2001).	2,670	3,709	+ 39%
28.	Western Atlantic Ocean, Suriname	1,657 (1975-1979)	1,771 (1983-1995)	1865-1978: no change 1979-2001: increasing (H. Reichart pers. comm.).	1,657	1,816 (E) ----- 1,814 (L)	+ 10% ----- + 10%

Table 5. – *Continued*

Index #	Subpopulation (Index Site)	Past	Present	Notes on population trajectories	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
29.	Western Atlantic Ocean, Venezuela (Aves Is.)	1,199 (1947)	267 (1979-1997)	1879-1899: no change 1900-1978: declining (Parsons 1962) 1979-2001: no change (V. Vera pers. comm. to K. Eckert).	10,887 (E)	267	- 98%
					2,568 (L)		- 90%
30.	Western Atlantic Ocean, Costa Rica (Tortuguero)	13,750 (1971-1975)	24,076 (1992-1996)	1895-1975: no change 1976-2001: increasing (Bjorndal et al. 1999, S. Troëng pers. comm.).	13,750	27,511 (E)	+ 100%
						26,535 (L)	+ 93%
31.	Western Atlantic Ocean, México (Yucatan Pen.)	874 (1983)	1,547 (2000)	1879-1982: no change (Parsons 1962) 1983-2001: increasing (R. Marquez, pers. comm.)	874	1,600 (E)	+ 83%
						1,587 (L)	+ 82%
32.	Western Atlantic Ocean, United States (Florida)	366 (1980)	759 (1995-2000)	1886-1979: no change (but see Parsons 1962, Witzell 1994a,b) 1980-2001: increasing (FMRI unpubl. data)	366	787 (E)	+ 115%
						779 (L)	+ 113%
<b>TOTAL CHANGE USING RAW DATA + EXPONENTIAL FUNCTIONS</b>					<b>266,133</b>	<b>90,403</b>	
<b>TOTAL CHANGE USING RAW DATA + LINEAR FUNCTIONS</b>					<b>173,429</b>	<b>88,449</b>	
<p><i>Therefore, the minimum change in global annual nesting female population size is from 173,429 to 90,403 females, or a <b>48% reduction</b> and the maximum global annual nesting female population change is from 266,133 to 88,449 females, or a <b>67% reduction</b></i></p>							

<sup>a</sup> For nGBR/Raine Island, past nesting numbers were determined by calculating the relative change in numbers of turtles observed during nightly surveys between Past and Present (+56%) and integrating this into current Raine Is. estimate of 18,000 annual nesting females (Dobbs 2002).

<sup>b</sup> For Philippine Turtle Islands, conversion from egg data to # females was based on 95.6 eggs/nest (Trono 1991)

<sup>c</sup> For Sabah, conversion from nest data to number of females was based on 5 nests/female/season (C. Limpus pers. comm.)

<sup>d</sup> For Pangumbahan, Indonesia, conversion from egg data to # females was based on 107 eggs/nest (Suwelo and Kuntjoro 1969)

<sup>e</sup> For Europa Is. conversions from hatchlings to number of females was determined using hatchling survivorship value of 77.6%; number of nests were determined using a value of 142 eggs/nest (Hughes 1974). Conversion to females from nests was based on a value of 3 nests per season per female (Bonnet et al. 1985).

<sup>f</sup> For Tromelin Is. conversions from hatchlings to number of females was determined using hatchling survivorship value of 69.8%; number of nests

were determined using a value of 124.6 eggs/nest (Hughes 1974). Conversion to females from nests was based on a value of 3 nests per season per nesting female (Bonnet et al. 1985).

<sup>g</sup> For Bioko Is. 1940 nesting subpopulation size (2,075) is based on a linear decline in turtles per night between 1940 (250 turtles) and 1980 (75 turtles) (=1.25 % / yr) extrapolated to 1998 (= 58.5 turtles/night). The actual turtles per season in 1998 (489) is then divided by this value to get a value for the number of turtles per season represented by each turtle counted in a night (= 8.3). This value is then multiplied by mean nightly count from 1940 (8.3 \* 250) to get an estimate of the annual nesting N in 1940.

<sup>h</sup> For Seychelles, the value for past nesters is based on the sum from Aldabra (5,000) + mid-point of range from Assumption (7,000). Value for present nesters is based on data provided in Mortimer (1984) and J. Mortimer pers. com

Table 6. Population changes for the 32 green turtle Index Sites grouped by region. Changes are determined with raw data and *Exponential (E)* and *Linear (L)* extrapolation functions as noted in Table 5. Past and Present published estimates and citations are provided in Table 4.

Region	Past annual nesting female subpopulation size (3 generations back)	Present annual nesting female subpopulation size (2001)	% change
EASTERN PACIFIC OCEAN (Colola, Mexico; Galapagos Is., Ecuador)	20,964 – 39,251	2251	-89% to -94%
CENTRAL PACIFIC OCEAN (Hawaii, USA)	378	574	+52%
WESTERN PACIFIC OCEAN (Heron Is., Australia; Raine Is. Australia)	11938	18573	+56%
SOUTHEAST ASIAN SEAS (Berau Islands, Indonesia; Turtle Islands, Philippines; Turtle Islands, Malaysia; Sarawak, Malaysia; Terengganu, Malaysia; Gulf of Thailand, Thailand)	68,862 – 131,232	9,490 – 10,151	-85% to -93%
EASTERN INDIAN OCEAN (Suka Made, Indonesia; Pangumbahan, Indonesia; Thamihla Kyun, Myanmar; Gujarat, India)	15,846 – 18,563	1,236 – 1,303	-92% to -93%
NORTHERN INDIAN OCEAN (Hawksbay and Sandspit, Pakistan; Karan Is., Saudi Arabia; Ras al Hadd, Oman; Sharma, Peoples Democratic Republic of Yemen)	10,132 – 11,129	7,696 – 7,758	-23% to -31%
WESTERN INDIAN OCEAN (Seychelles Is.; Comoros Is.; Europa and Tromelin, Eparces Is.)	15,952	10,770 – 10,886	-32%
MEDITERRANEAN SEA (Turkey)	3,513	230	-93%
EASTERN ATLANTIC OCEAN (Bioko Is., Equatorial Guinea; Bijagos Is., Guinea-Bissau)	3,959 – 3,973	2,930 – 2,984	-25% to -26%
CENTRAL ATLANTIC OCEAN (Ascension Is.)	2,670	3,709	+39%
WESTERN ATLANTIC OCEAN AND CARIBBEAN SEA (Galibi, Suriname; Aves Is., Venezuela; Tortuguero, Costa Rica; Yucatan Peninsula, Mexico; Florida, United States)	19,215 – 27,534	30,981 – 31,981	+13% to +66%