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- Deep Diving pram travels
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MEMO

1 June 1982

To: IUCN Marine Turtle Specialist Group

From: Archie Carr, Chairman Archie Carr

Re: Draft of IUCN Red Data Book Account for *Lepidochelys olivacea*

Enclosed for your information is a preliminary draft of the new IUCN Red Data Book Account of *Lepidochelys olivacea*. Comments may be sent directly to Dr. Brian Groombridge, IUCN Species Conservation Monitoring Unit, 219(c) Huntingdon Road, Cambridge CB3 ODL, United Kingdom.

* April 1982. PRELIMINARY DRAFT ONLY - FOR REVIEW
('Remarks' to be added, 'Status' to be finalised)

OLIVE RIDLEY
or PACIFIC RIDLEY

ENDANGERED /VULNERABLE

Lepidochelys olivacea (Eschscholtz 1829)

Order TESTUDINES Family CHELONIIDAE

SUMMARY A circumglobal species, present in tropical regions of the Atlantic, Indian and Pacific Oceans. Typically nests on mainland beaches, there is little nesting on islands of the Indian Ocean, southeast Asia or Oceania, and no nesting in the Caribbean. Overall, although the Olive Ridley remains relatively widespread and numerous, most nest sites support only small or moderate-scale nesting (up to around 1,000 females per year), and most populations worldwide are known or thought to be depleted, often severely depleted. Where population densities are high enough, females emerge to nest in synchronised aggregations (arribada), sometimes comprising up to 150,000 turtles. Such aggregations have been reported in the past at many sites in Pacific Mexico, in Panama, French Guiana, Surinam and in India. Very large arribadas remain in only two areas; at two beaches in Orissa State (India) and at two beaches in Pacific Costa Rica. Of the former three major arribada sites in Pacific Mexico only La Escobilla (Oaxaca) retains mass nesting, but even this population has declined severely due to over-exploitation and is near collapse. A small-sized sea turtle, mean carapace length to around 68cm. There is evidence that some groups make moderately extensive post-nesting migrations, in the east Pacific for example, from nest sites in Mexico and other parts of central America southward to feeding grounds off Ecuador. Forages in tropical neritic waters, feeding mainly on benthic crustaceans, sometimes at considerable depth. Sexual maturity possibly attained at 7-9 years. Mean clutch size from 105 to 116. Females may nest twice in a season, sometimes three times. Most females re-migrate to nest at one or two year intervals in different areas. Threatened by legal and illegal commercial harvest of adults (mainly for food or for flipper skin for the leather trade), incidental catch in shrimp trawls and massive harvest of eggs from nest beaches. Severe over-exploitation has led to collapse of some central American populations. Nominally protected by legislation in much of the range, often ineffectually. One of the major Costa Rica arribada sites, at Nancite, lies within Santa Rosa N.P., and one of the major Orissa sites, at Gahirmatha beach, is within Bhitar Kanika Sanctuary; these populations are effectively protected while nesting but still subject to exploitation when at sea. A major conservation action has recently been taken by Ecuador in halting their Olive Ridley fishery. Several hundreds of thousands of turtles have been taken at sea in this area in the past decade, from the same populations subject to even greater exploitation on many of their Central American nest beaches. It remains for legal commercial exploitation in Mexico to be put on a rational basis. Efforts should be made to end the relatively recent utilisation of turtle skin by the fancy leather trade. Listed on Appendix I of CITES.

DISTRIBUTION A circumglobal species present in tropical regions of the Pacific, Atlantic and Indian Oceans (41,53). In the Pacific, not known to nest on Hawaii nor on most islands of Oceania, but low density nesting occurs at many points on the Pacific coast of Central America, from Baja California in northern Mexico, south through Guatemala, El Salvador, Honduras and Nicaragua to Panama. Within this area important mass-nesting beaches exist in Oaxaca (Mexico, and

formerly in other states) and in Costa Rica (53).

The Olive Ridley does not nest in the Caribbean but nesting occurs on the Atlantic coast of South America from Venezuela southward, occasionally Trinidad, to the Guianas (notably Surinam), and on parts of the Brazilian coast from Para to Sergipe (53).

Nesting occurs along the coast of West and Central Africa at least from Senegal south to Angola, but no information appears available on actual sites and abundance. In the Indian Ocean the species nests in good numbers in northern Mozambique, with minor nesting in Tanzania and Glorieuse (Reunion). Very rarely nests in South Africa. Minor or moderate nesting occurs on Masirah Island (Oman), in the Lakshadweep Islands (Laccadives), the Andaman Islands, the vicinity of Karachi (Pakistan), and at several sites around the Indian subcontinent notably in Orissa State in the northeast (with two very important sites), also Sri Lanka. Little nesting is known in Southeast Asia generally, with the exception of Trennganu (eastern West Malaysia), other records include Burma, Sarawak and Sabah (East Malaysia), Papua New Guinea including New Britain, and northern Australia (53).

Further details on specific nesting beaches are provided in the following section.

POPULATION Although the Olive Ridley remains widespread and relatively numerous in tropical waters, most nesting sites support only small or moderate-scale nesting (up to around 1,000 females per year), and most populations are known or thought to be depleted, often severely depleted, and some are virtually extinct. Females of Lepidochelys species tend to emerge to nest in large synchronised concentrations (arribadas) when population density is sufficiently high. Very large arribadas have been reported in the past from French Guiana, Surinam, Panama, several sites in Pacific Mexico, and more recently in India, but remain in only two regions; at two beaches in Orissa State (northeast peninsular India) facing the Bay of Bengal, and at two beaches in Costa Rica, facing the east Pacific. Relatively large (but depleted) populations also persist in several parts of Pacific Mexico, but of the three former very large arribada sites in Mexico only La Escobilla (Oaxaca) still supports dense nesting and this has greatly declined in recent years. It has been suggested (23) that all populations away from the major centres (cited as India-Sri Lanka, East Pacific, equatorial South Atlantic) may not be self-sustaining in the long term, and represent only gene 'leaks' from the main population.

Angola The species is known to nest, probably mainly on northern coasts, but no data available on numbers or sites (29).

Australia No major rookeries are known, low density nesting is recorded or suspected to occur widely in northern Australia, from Coburg Peninsula in Northern Territory east to Crab Island in Queensland (32). Feeding populations are found in the Gulf of Carpentaria and around the Arnhem Land coast. No major change in population levels has been noted over the past two centuries (32).

Burma In the early 1900s about 1.5 million eggs of 'Loggerhead' (probably not Caretta caretta, but the species now known as Olive Ridley Lepidochelys olivacea (4)) were taken on the turtle grounds of the Irrawaddy region (34). It was estimated that around 3,750 females nesting annually (this estimate assumed that each female laid 400 eggs per year, this is somewhat higher than is recorded elsewhere, so the population figure may be an underestimate). Eggs were laid on islands off the mouths of the Irrawaddy and Dalla Rivers, and to a lesser extent on the mainland from the To River along the coast to the Sandoway district (34). It was suggested that the turtles coming to nest were from feeding grounds around

the Andaman Islands (34). No data available on present population, if extant.

Costa Rica Solitary females may emerge to nest along most of the Pacific coast (11), but mass nesting emergences (arribadas) are concentrated at Ostional and Nancite beaches in Guanacaste Province (12). Between 200,000 and 300,000 females participate annually in arribades at each locality (12). Mass emergences on some scale may occur at any time of year. An Nancite, while dry season arribadas involve from several hundred to 20,000 females, peak numbers are reached in the rainy season, with 50,000 to 150,000 females emerging to nest (11). Since some females nest two or three times over the year, total nestings are higher in number; estimated between 700,000-850,000 at Nancite and probably 400,000-500,000 at Ostional (11). These beaches, along with those in Orissa (eastern India), are at present by far the most important Olive Ridely nesting sites anywhere in the species' range (although the three or more arribada sites in Pacific Mexico were formerly of comparable significance). Egg predation by humans is intense and adults suffer high mortality due to exploitation in feeding grounds in other areas of the east Pacific (notably Ecuador) and due to incidental catch in shrimp trawls, so the future of these populations is not secure.

El Salvador Olive Ridley are the most abundant sea turtles, dispersed nesting occurs on all sandy beaches from July to December, but no large-scale nesting is known and sea turtle nesting in general is reported to have declined sharply in recent years (12).

French Guiana A decade ago the species nested in large numbers but at present nesting occurs only rarely; it is unknown whether this represents a decline in population numbers or a shift in the site of egg laying (19).

Guatemala No quantitative estimates are available; Olive Ridleys nest in relatively small numbers along the Pacific coast, all sea turtle population are reported to have declined over the past two decades (12).

Guyana Nests in moderate numbers on Shell Beach (40).

Honduras The species is known to nest along the short Pacific coast of Honduras, but apparently in small numbers; no recent data available (12).

India The Olive Ridley appears to nest, generally in small numbers, at many sites on both west and east coasts of the peninsula; records exist for the Gulf of Kutch, around the Saurashtra peninsula (3), the Bombay area, near Goa, the Gulf of Mannar and the entire east coast (54), but large scale nesting is restricted to Orissa in the northeast (4,17). The species occurs in moderate numbers in the Lakshadweep (Laccadive) Islands, and the Andaman and Nicobar Islands (17). The coastline of Orissa is one of two regions, the other being the Pacific coast of Central America, that between them support by far the largest known Olive Ridley nesting concentrations. In the late 1970s over 100,000 females were nesting annually on the 35km beach at Gahirmatha within the Bhitar Kanika Wildlife Sanctuary (Cuttack Dist., Orissa) (6,7,30). Mass nesting has recently been discovered about 100km south of the Gahirmatha beach, between Nadiakhia muhana and Akasia muhana; this nesting area extends for 3-4kms and is estimated to support nesting by 100,000 female Olive Ridleys (31). Combining these populations with those nesting elsewhere in the state leads to an estimate of 300,000 Olive Ridley nesting anually in Orissa (31). It is not clear whether these numbers are maintained each year, and whether such large numbers nest each year at both major nest grounds.

Indonesia Appears to occur quite widely in Indonesian waters, but not in any large concentrations, and sea turtle populations in general are reported to have declined

markedly (75). Nesting records are very sparse; the species is said to nest in the Lesser Sunda Islands (39), on West Sumatra and the Nusa Tenggara Islands (37), and on Sukamade Beach within Meru Betiri Reserve (East Java). At Sukamade Beach 625 sea turtle nests were recorded in 1980, only a small minority of which were Olive Ridely nests (5).

Madagascar No large-scale nesting known, nesting has been recorded in the northwest (28), although other reports indicate presence of a feeding population only (17).

Malaysia West Malaysia Reported in 1975 (38) to occur commonly, nests all along the east coast, mainly in Trengganu, also in Pahang and Kelantan States, but not common in any one area. Rare on the west coast, nesting was more frequent and widespread in the past (50). Egg collectors on the east coast have reported a decline in Ridley numbers (50). Sabah No nesting by Olive Ridley is known (14). Sarawak Said to nest in small numbers (38), on the three 'turtle islands' of Satang Besar, Talang Talang Besar and Talang Talang Kechil (14).

Mexico A conservative estimate suggests that 3,185,000 Olive Ridleys, of both sexes, occurred in the seas of western Mexico in the mid 1960s, and probably around 10,000,000 before the 1950s (9). The major arribadas (see Habitat and Ecology) were centred on three nesting beaches; El Playon ale Mismaloya (Jalisco), Piedra del Tlacoyunque (Guerrero) and La Escobilla (Oaxaca), with smaller scale nesting at several other localities (9,15,33). Massive over-exploitation has severely depleted Olive Ridley populations in Pacific Mexico; the total 1976 population (males and females) was estimated at 485,000 (9). It was estimated that in 1974 (45) 30,000 females nested at Tlacoyunque, 60,000 at Mismaloya, 25,000 at Chacahua, and 100,000 at Escobilla. It is considered (45) that the present (1979 publication) nesting population may have decreased to as little as 10% of that in 1974. Only the Oaxaca beaches, notably La Escobilla, still support large-scale arribada nesting, although now severely depleted; the immense breeding populations at Tlacoyunque, Mismaloya and elsewhere have collapsed (9).

Mozambique The species appears to nest sporadically along northern coasts, perhaps 500-1,000 nests per year (17).

Nicaragua The Olive Ridley is the most common of the five sea turtle species nesting on the Pacific coast. Several nesting beaches are known, the most important being in the Departments of Managua and Carrazo; in the former, the 20km beach between Masachapa and Pochomil is known as a mass-nesting site for Olive Ridley. Local inhabitants report that the size and frequency of arribadas have decreased considerably (12).

Oman Olive Ridleys nest regularly around the south of Masirah Island, but only in very low numbers, estimated 150 females per year (44).

Pakistan Nests at Hawks Bay and Sandspit near Karachi in Sind, not in large numbers, and possibly in Baluchistan (17,20).

Panama The Olive Ridley is the second most abundant sea turtle species on the

Pacific coast. There are no precise population estimates available, but sea turtle populations in general are reported to have declined sharply in the last decade. At least 30 beaches were formerly known to support large nesting aggregation, but today 12 beaches are officially recognised as important nest sites; nesting populations are smaller and the season is shorter (12).

Papua New Guinea The species is relatively uncommon in PNG waters (51), recent nesting records are restricted to Turubu Village in East Sepik Province and two areas on New Britain (52).

Senegal Reported to nest in small numbers (45), no details available.

Sri Lanka The most abundant sea turtle in Sri Lanka waters, several thousand may nest annually, with nesting spread through most of the year and occurring at sites all round the island (17). However, continual population decline is reported (25).

Surinam Most Olive Ridleys nest on the Eilanti beaches west of the Morowijne estuary (47). This area is now virtually the only nesting site of any importance on the Atlantic coast of America, but there has been a marked steady decline in the number of nests laid, from 2,455 in 1967 to 531 in 1975 (47). Numbers nesting at Bigisanti beach, further west from Eilanti, rose slightly from 95 in 1964 to 236 in 1975. The estimated total number of nests in Surinam fell from 2,875 in 1967 to 1070 in 1975, since no increase was noted elsewhere in the Guianas it was suggested that the Olive Ridley population is declining (47). Further decline was noted in subsequent seasons, with only 870 and 795 nests recorded in 1978 and 1979 respectively (48). The decline in numbers of nesting females, from an estimated 2,100-3,000 in 1967-1968, to 550-800 in 1978-1979, is attributed to incidental catch by offshore shrimp trawlers (48).

Tanzania Rarely reported, nests in small numbers (17).

Thailand The Olive Ridley is the most common sea turtle in Thai waters, the species occurs all along the west coast and may be considered still a common breeder at a few localities e.g. Laem Phan Wa reserve at Phuket Marine Biological Centre (2). Breeding also occurs in Tarutao National Park, but at low density (21). Sea turtle populations in general are reported to have declined markedly in Thailand (38).

Venezuela Significant nesting is reported (45), no further details available.

HABITAT AND ECOLOGY A small-sized sea turtle, a sample of 53 females nesting at Playa Naranjo (Costa Rica) ranged from 57-72.5cm in carapace length, mean length 65.2cm, mean width 56.5cm (10). The mean length in a sample of 500 females at Eilanti (Surinam) was 68.5cm, range 63-75cm (47).

Very little information is available on the biology of the Olive Ridley away from the nesting beach. Tagging has provided some data on post-nesting movements, but little overall pattern is evident (35). Females tagged in the Guianas have been recovered southward to northern Brazil and, more frequently, northward to Venezuela, Trinidad and Barbados; several have been recaptured offshore from Surinam and French Guiana outside the nesting season, indicating that at least some individuals do not move far from their nest site (35). In the east Pacific, turtles nesting in the Mexican states of Guerrero and Jalisco appear to disperse northward to feeding areas in the Gulf of California and along the west coast of Baja California; at least some of those nesting in Oaxaca disperse southward to El Salvador, Colombia and Ecuador. Most turtles tagged in Mexico have been recovered in Mexican waters (35). At least 53 females tagged in Costa Rica have

been recovered at sea; one each from Mexico, Nicaragua, Panama, Colombia, two from El Salvador, four from Guatemala, 12 from Ecuador, and 29 were recaptured in Costa Rican waters (11).

The species appears to forage mainly in tropical neritic waters (further offshore than the related Loggerhead Caretta caretta), where individuals may dive deeply to feed on benthic crustaceans, or float over deeper waters feeding on crustaceans such as Red Lobsterette Pleuroncodes sp. that rise to the surface at night, and on larger planktonic organisms that may be encountered (24). The main food items recorded are crabs and shrimps, but sessile and pelagic tunicates, jellyfish and other small invertebrates also appear in the diet (36). Olive Ridleys have been captured in prawn trawls at depths of 80-110m, so they are certainly capable of foraging at relatively very great depth.

Sexual maturity is thought to be attained at around 7-9 years (33). Females of both species of Lepidochelys (L. kempii, L. olivacea) tend to emerge to nest in synchronized aggregations, often termed arribada (Spanish, 'arrival'), wherever population density is sufficiently high. The arribada nesting strategy, with the sudden mass arrival of adults and subsequent mass emergence of hatchlings, may serve as a 'predator swamping' device (55). The arribada may be coordinated by pheromonal communication - the two Lepidochelys species are the only sea turtles with a complete and well-developed series of inframaginal secretary pores, and are the only species known to form arribadas (41). At Gahirmatha beach (Orissa, India) small numbers of females may emerge almost throughout the year but the large arribada, involving over 100,000 females occurs in February-March (30). Similarly at Playa Nancite (Costa Rica) relatively small numbers may emerge throughout the year, a typical dry season arribada would involve up to 3,000 females (in March for example), but major arribadas occur in the wet season (September-October), and involve up to 150,000 females (11). In Costa Rica solitary nesting takes place at the same time of year as the large arribadas, and a few tagged individuals have been shown to take part in both solitary (Playa Naranjo) and group (Nancite) nesting during the same breeding season (10). In Costa Rica, Olive Ridleys remain in the nearshore zone throughout the peak nesting period (11). Nesting emergence is mainly at night, sometimes by day (as is typical for Kemp's Ridley) (11). Six of the nine arribadas recorded in January-November at Nancite (Costa Rica) began on, or within one or two days of, the night of the last quarter moon, when a high tide peaked between nightfall and midnight (11). Strong and gusty winds are typical during arribadas (11), but the direction seems unimportant. Similarly at Eilanti (Surinam), nesting females mainly emerge when high water comes between about 19.00-23.00hr., with a strong wind and rough sea (47). In Surinam, while there is an approximate two week interval between mass landings at Eilanti, no such periodicity is recorded for the small-scale nestings at Bigisanti (47). In Costa Rica there is normally a three week interval between arribadas in the peak season, but periodicity is not consistent and intervals have ranged from 14-48 days (12). The percentage of non-nesting emergences varies greatly, occasionally at Playa Naranjo up to half of the females emerging do not appear to nest (11), thus the number of emergences does not necessarily equal the number of nests. Females at Playa Naranjo generally nest on a nearly level stretch of non-vegetated sand beach, free of debris, not far from the high tide limit (10); similar preferences appear to be shown in most other parts of the range. The Olive Ridley completes its nesting relatively rapidly, usually in around 60 minutes, otherwise the process conforms broadly with that seen in other sea turtles (8). Egg-laying itself takes around 15 minutes (11). The nest cavity is relatively shallow, perhaps due to the small size of the flippers (47). Both Lepidochelys species are distinctive in that the sand used to re-fill the nest after laying is compacted by audibly thumping the area with each side of the shell in turn (47). Mean clutch size varies from 105 (range 74-126) at Playa Naranjo (Costa Rica), to 114.7 (94-140) in southeast India, and

116 (37-166) at Eilanti (Surinam) (sources in ref. 55). Eggs are round, mean diameter is from 37.5 (Honduras) to 40.5 (Sri Lanka) (sources in ref. 55).

At Nancite, females usually nest twice, sometimes three times, during a season, at intervals determined by the timing of arribadas (12). In 1972 at least three large groups were active at successive overlapping two-month intervals, there is some evidence that these groups are maintained from year to year (12). In Surinam (Eilanti beach) the mean interval between nesting seasons is 1.4 years, nearly two-thirds of females tagged in one season return in the following season (47); in Mexico (La Escobilla) the predominant remigration interval is 2 years (55); in India (Gahirmatha) around 24% of females nesting in 1977-1978 nested again in the 1978-1979 season (7). The estimated hatchling output of Olive Ridleys nesting annually in Surinam is 96, and 70 at Eilanti (55).

Survival of eggs deposited at Nancite is extremely poor (11,12). Because the eggs from one arribada do not hatch before the next arribada (incubation c 55 days, arribada interval c 28 days), a large proportion are destroyed as the later females excavate their nests. Similarly, within one arribada 15-30% of earlier eggs may be destroyed by later nesters (12). Furthermore, the hatch rate of undisturbed eggs is extremely low. Hatching success in 1974 was estimated at less than 1% (27), this has not changed over following years (11). The causes of this very low success rate are not clear, but may be found in a complex interaction of organisms having the turtle egg as a nutrient source, including Ghost Crabs, dipteran flies, and notably fungi and bacteria (11). However, hatching success may be around 23% at La Escobilla beach in Mexico, and 59% at Eilanti, Surinam (sources in 55). Egg and hatchling predators include a very wide variety of birds and mammals, including hawks, vultures, caracaras, opposums, raccoons, coyotes (11). Human predation on eggs is locally extreme throughout Central America (11,22). Many nesting females show evidence of shark attack, often very recent, and large cats (puma or jaguar) may occasionally take nesting females (11).

THREATS TO SURVIVAL Three major threats to Olive Ridley populations have been identified; commercial harvest of adults, incidental catch in shrimp trawls, and harvest of eggs from nest beaches (sources cited below). These factors are of differing significance in different areas, although some populations (e.g. in Mexico) are affected by all three. The Olive Ridley is the most economically important sea turtle in Mexico, and is the primary target for both legal and illegal fisheries due to the large aggregations found in the breeding and nesting season (9). It is estimated (9) that at least 2,000,000 Olive Ridleys were landed in Mexico in the five years up to 1969. During this period it was common practice to utilise only a portion of the flipper skin for the hide trade (9) - European and Japanese fancy leather manufacturers having 'discovered' turtle leather in the mid 1960s - the remainder of the animal was discarded. As part of an attempt to put exploitation on a more rational basis, the process was industrialised, and only processing plants able to utilise the whole animal could be legalized (9). Although certain conservation measures are taken (catch quota, incubation of oviductal eggs, protection of nesting beaches), immense numbers of Olive Ridleys have still been taken in the recent past from La Escobilla (Oaxaca), last major arribada beach (9). By far the largest company (PIOSA) took 70,000 turtles from La Escobilla in 1977, at a time when the largest arribada comprised only 58,000 females, and took 58,000 in 1978; thus the greater part of the arribada was taken each year (9). In 1979 the catch quota was halved, it was estimated that 36,000 females took part in the largest arribada and PIOSA took 24,500 (9). Although protection of the Oaxaca nest sites by PIOSA has almost certainly postponed the total collapse of this population, this is the likely outcome if current massive exploitation continues (9). In addition to legal industralized fisheries, millions of eggs and many thousands of turtles are taken illegally by poachers each year (9). There has also been, until very recently, an important Olive Ridley fishery in

Ecuador. The species does not nest in Ecuador but migrates into Ecuadorian waters, and at least some of these individuals are known to have nested in Central America, including Mexico (where the same populations are exploited during nesting) and Costa Rica (9,12). This species in the commonest sea turtle in Ecuador, it tends to remain further offshore than the other species, an island 30km from shore and an area of sea 32-48km from Esmeralda are the two main sites (22). Some turtles are taken as a local subsistence activity, but the vast majority are taken by one of three major companies (six before 1978) for export, mainly in the form of frozen meat for human use and salted skin for the leather trade (22). There has been a marked increase in export volume since 1970 and, although skin export only started in 1973, demand from the leather trade is such that this is now the most important product (22). Approximately 107,714kg were exported in the first six months of 1978, this was nearly as high as the entire 1977 output, itself double that of 1976. An estimated 100,000 Olive Ridley were taken in Ecuador for the luxury goods trade in 1978, most of the 1977 products were exported to Japan and Italy (22). An estimated 150,000 turtles were taken in 1979 (18). Following ministerial discussions, and resolutions made at the 1981 New Delhi CITES Convention, the Ministerio de Recursos Naturales (MRN) prohibited all commercial exploitation of sea turtles in July 1981 (18,26). Many of the several thousand turtles killed recently in Baluchistan (Pakistan) for export of flipper skin are suspected to be Olive Ridleys (16). Harvest of Olive Ridleys on the nesting beach, or in offshore water, mainly for human consumption, is a major threat in other areas. In Sri Lanka, practically all turtles caught are eaten (25), in India the Gahirmatha rookery is well protected but exploitation is high elsewhere (4,30). Egg harvest was formerly heavy at Gahirmatha but this was made illegal in the mid 1970s. Many thousands of females are killed in India (43) and poaching is heavy offshore (30) where effective control is impractical. The turtles may be utilized locally (as the eggs usually are), or transplanted in large numbers by train to urban centres such as Calcutta (4). Human predation on eggs is extreme at many nesting sites in Central America (11), including Mexico (9). For example, hundreds of thousands of eggs are removed from Ostional (Costa Rica) beach during most arribadas even though guards are usually present (the eggs are sometimes fed to domestic pigs and dogs) (11).

A third major threat is heavy incidental catch by shrimp trawlers and long-line shark fishermen. In Central America the shrimping industry is relatively new, having started in 1941 in northern Mexico and spread into the tropical east Pacific in the 1950s (12). The fishery operates throughout the year. Many tag returns have come from turtles caught in trawls, and both juvenile and females are reported. Although there is reason to believe that commercial shrimping is a serious threat to sea turtles in the east Pacific (12), there is little quantitative information available. Turtles not killed for their eggs may often be released (12). The severe decline in Olive Ridley numbers in Surinam, formerly including the major arribada site in the Atlantic, is attributed to high incidental catch in shrimp trawlers operating off the coasts of Surinam, French Guiana and Venezuela (48). This mortality is also significant off West Bengal, Orissa and Anohra Pradesh in India (30) and off southeast Africa (28). Development or other habitat modification in the vicinity of nest beaches is a further threat; on the Hawkes Bay and Sandspit beaches in Pakistan, for example, increased building of holiday accommodation is encroaching into the nesting area (46); in Sarawak access to nesting beaches is often blocked by drift wood washed in from upriver or from log-rafts being towed out to ships (42).

CONSERVATION MEASURES TAKEN Nominally protected by legislation in much of the range, often ineffectually. Since 1969 only those operations equipped to utilize the entire animal are legally allowed to exploit sea turtles in Mexico, PIOSA is the major company. The industrialized fisheries protection programme includes protection of the Oaxaca nest beaches and the incubation of oviductal

eggs. There are several problems associated with the latter, including low hatch rates (9). Poaching is a major problem even on the protected beaches of Oaxaca (9). In 1979 the government quota for capture of Olive Ridleys was halved. Elsewhere in Central America the Olive Ridley receives some legal protection in Guatemala, Honduras, Nicaragua, Costa Rica and Panama, however, in many areas the laws are inadequately enforced (12). In Costa Rica, large scale poaching of eggs occurs at Ostional despite the presence of guards, but the major arribada beach at Nancite and the important Playa Naranjo site are well protected within the Santa Rosa National Park (11). A major conservation action was taken by Ecuador in June/July 1981; the export of turtle skins and the commercial exploitation of sea turtles was prohibited by the Ministerio de Recursos Naturales (18,26). It appears that a significant proportion of the turtle products exported from Ecuador in 1981 originated from a fishery operating in southern Colombia (26), it is not clear what effect the Ecuador ban will have on exploitation in Colombia. In 1979 the Manchalilla National Park was set up in Ecuador (22). This 35,000 ha park in the province of Manabi includes 43km of coast and the Isla de la Plata, an important feeding area for migratory Olive Ridleys (22). Ports, such as Puerto Lopez, within the park and formerly important centres in the turtle trade can no longer be used to tranship turtles (22). In Panama Olive Ridleys nest within the Biological Reserve of Isla de Canas (12). In Surinam females and their eggs are completely protected on the nest beaches, much of the nesting takes place within the Galibi Sanctuary (47). A large hatchery programme handles approximately 100,000 eggs per annum (45). In Angola all sea turtles are legally protected but this is not enforced (28), a similar situation exists in Mozambique (28). At Hawkes Bay and Sandspit beaches, (Pakistan) a conservation programme has been established which includes patrolling of the beach, a hatchery, and a local education programme (1). In India all sea turtles are on schedule I of the Indian Wildlife (Protection) Act and both turtles and eggs are locally protected. The major Olive Ridley rookery at Gahirmatha lies within the Bhitar Kanika Sanctuary (also holding an important population of the Estuarine Crocodile Crocodylus porosus). The sanctuary also includes 12 offshore islands where there are known to be more turtle nesting sites (4). In 1975 the Tamil Nadu Government outlawed the use of trawl nets by mechanised fishing boats and restricted fishing activity from these boats to between 6am and 6pm. There is a hatchery handling some Olive Ridley eggs at Madras Snake Park (4). Olive Ridleys, their nests and eggs are legally protected in Sri Lanka (4). The species receives some legal protection in Malaysia, a hatchery has been established since 1978 at Penarik where it is intended to incubate 10,000 eggs annually from 1981 onward (49).

The Olive Ridley is listed on Appendix I of The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Appendix I listing requires that trade in a taxon and its products is subject to strict regulation by ratifying states and international trade for primarily commercial purposes is prohibited. Japan has entered a reservation on Appendix I listing of this species.

CONSERVATION MEASURES PROPOSED Where possible, existing laws should be enforced and National Parks and Reserves adequately protected. (56). Where remaining, the leather trade should be brought to an end as soon as possible. This relatively new (post mid-1960s) trade supplies luxury markets only and has no great cultural significance (45,57). Restricted fishing zones should be established in areas of high turtle concentration, particularly off major nesting beaches (45,57) and high priority given to the development of fishing equipment which prevents incidental take of sea turtles (57). Regional agreements on conservation are highly desirable, in the Eastern Pacific for example, and ought to include large scale tagging programmes, using tags which offer no reward for their return (57). Ecuador's recent unilateral prohibition on commercial Olive Ridley exploitation should be matched by similar efforts in other Pacific states. It has

been suggested that major breeding beaches in Mexico should be declared National reserves (9). Japan should be encouraged to withdraw their reservation on Appendix I CITES listing, and to cease providing a major market for newly imported Olive Ridley products (57).

CAPTIVE BREEDING No information on breeding. Three young Ridleys hatched from eggs taken from a natural nest have been maintained in captivity at Madras Snake Park Trust for at least two years (58).

REMARKS [To be completed]

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