Current Status of Nesting Populations of the Hawksbill Turtle (Eretmochelys imbricata) in the Java Sea, Indonesia

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ABSTRACT. – Some 30 hawksbill turtle (*Eretmochelys imbricata*) rookeries are known from the Java Sea region, but the recent status of their nesting populations has been poorly documented. From 1995 through 1997, we conducted nesting beach surveys of 15 rookeries counting body pits of hawksbills and green turtles (*Chelonia mydas*). We documented serious declines in hawksbill nesting activity of up to 88% at single rookeries during the past 10–15 years with an overall regional decline of about 72%. This decline has been driven by: i) slaughter of turtles to provide raw shell (bekko) for export to Japan (whose imports were abolished in 1991); ii) an increase in human population and coastal development of islands; iii) the increased economic value of eggs collected by Bugis (maritime people originally from South Sulawesi) whose patterns of egg collection vary regionally; and iv) harvest of live turtles for sale to Bali and certain local markets. We describe the impacts of differing systems of illegal hawksbill egg collection. Extinction of some rookeries appears imminent. It may be too late to prepare an adequate conservation strategy for sea turtles in the region.

KEY WORDS. – Reptilia; Testudines; Cheloniidae; *Eretmochelys imbricata*; *Chelonia mydas*; sea turtle; nesting; egg harvest; beach surveys; conservation; population status; Java Sea; Indonesia

Six sea turtle species — green (Chelonia mydas), loggerhead (Caretta caretta), hawksbill (Eretmochelys imbricata), olive ridley (Lepidochelys olivacea), flatback (Natator depressus), and leatherback (Dermochelys coriacea) occur in Indonesian waters (Siswomartono, 1997). All but the green turtle (which legally can be killed and have its eggs harvested) are protected under Indonesian law through presidential decrees (Siswomartono, 1997). Indonesia is also a signatory to CITES, which prohibits international trade in sea turtles, all of which are listed on Appendix I.

The existence of some 30 hawksbill rookeries in the region of the Java Sea has been documented (Salm and Halim, 1984), but their current status, as well as the population dynamics of hawksbill turtles in Indonesia have been poorly studied. From 1995 through 1997, we conducted beach surveys at 15 of these rookeries (Suganuma and Kamezaki, 1996; Suganuma, 1997, 1998) and our findings are presented in this paper.

STUDY AREA

In the Java Sea region, hawksbill rookeries are concentrated on the small coral islands scattered throughout the area, being much less abundant on big islands such as Java. We chose our research beaches based on information from local inhabitants. In this paper we use the local names of islands rather than those used on charts, as the latter vary from chart to chart, and sometimes even the islands themselves are not depicted accurately. The 30 known hawksbill rookeries in the Java Sea are shown in Fig.1, including our 15 study sites which are shown as numbers 1–15 and listed numerically below and in the results section.

1. Tambelan Islands. — These are located midway between Kalimantan Island and Singapore and include 49 islands ranging from coral islands to rock islets, shoals, and sand cays. Of these, 29 are believed to host nesting hawksbills. We conducted beach surveys by foot on 13 of these 29 islands and examined 11 from a boat offshore, but were unable to visit the remaining 5. The 20 islands not used by hawksbills include 3 lava islands, 8 rock islets, 8 coral islands without beaches, and 1 coral island surrounded by mangroves.

2. Lima Islands. — These are located about 20 km west of Belitung Island and comprise five islands and one sand shoal called Ru Island. Most people live on Buntar Island, but Haji Island has a few inhabitants. Lima, Panjang, and Bankai islands are uninhabited.

3. Gresik Island Area. — The main island and six small neighboring islands are located about 20 km west of the Lima Islands across the Baur Strait. Of the seven islands, five are not suitable for nesting turtles — three being heavily inhabited and two enclosed by mangroves or without a beach. Kimar and Selemar islands have suitable nesting beaches.

4. Tiga Islands Area. — This area includes several island groups scattered south of Belitung Island. Their names and positions relative to Belitung are as follows: the Tiga Islands, comprising three main islands and seven smaller uninhabited ones (18 km to the south); heavily inhabited Sumedang Besar and uninhabited Sumedang Kecil islands (35 km to the southwest); inhabited Ketapang Island



Figure 1. Map showing the locations of 30 known hawksbill rookeries in the Java Sea. The following 15 rookeries (indicated by closed circles) were surveyed during the present study: 1. Tambelan Islands, 2. Lima Islands, 3. Gresik Island Area, 4. Tiga Islands Area, 5. Rotan Island Area, 6. Ayermasin Islands, 7. Momperang Islands, 8. Langkuas Island Area, 9. Segama Islands, 10. Seribu Islands, 11. Karinmunjawa Islands, 12. Masalima Islands, 13. Spermonde Islands, 14. Balabalakan Islands, and 15. Lerelerekan Island. The remaining 15 sites (indicated by open circles), have been identified by Salm and Halim (1984), but were not surveyed during the present study: 16. Riau Islands, 17. Anambas Islands, 18. Natuna Utara Islands, 19. Natuna Besar Islands, 20. Natuna Selatan Islands, 21. Badas Islands, 22. Laut Kecil Islands, 23. Marabatua Islands, 24. Kangean Islands, 25. Tengah Islands, 26. Kalukalukuang Island Area, 27. Sabalana Islands, 28. Banawaya Island Area, 29. Selayar Island Area, and 30. Takabonerate Islands.

(35 km to the south); and the two Batu islands (70 km to the southeast).

5. Rotan Island Area. — This group southeast of Belitung includes five neighboring islands. Three of the six islands are densely inhabited, two are covered by mangroves, and one has no beach.

6. Ayermasin Islands. — These are southeast of Rotan, comprising eight islands, only two of which are suitable for hawksbill nesting — previously inhabited Sankigi and uninhabited Pengapit. The other six include four islands covered by mangroves, one with narrow beaches not suitable for nesting, and one (Long Island) that is densely inhabited with no evidence of hawksbill nesting.

7. Momperang Islands. — This group, some 70 km northeast of Belitung Island, consists of 25 islands. We surveyed 11, including Pesemut and uninhabited Momperang. The remaining 14 islands include 6 sand shoals washed over by high tide, 1 rock islet, 4 coral islands surrounded by mangroves, 1 coral island without beaches, and 2 that were densely populated.

8. Langkuas Island Area. — Langkuas and its eleven neighboring islands, located northwest of Belitung Island, are a picturesque group of rock islets and exposed rocks, where plans are underway to develop a resort.

 Segama Islands. — These two islands are 120 km northwest of Jakarta and include Segama Besar and uninhabited Segama Kecil. 10. Seribu Islands. — Located 50 km north of Jakarta, these islands have been designated as the Seribu National Marine Park. The park comprises 74 islands, one rock cay and one sand shoal. Most hawksbill nesting occurs on six of the islands. Three special protection wards have been designated within the park. These incorporate nine of the 74 islands, and include three of the six hawksbill rookeries. More than half of the islands within Seribu Marine National Park are inhabited (population 12,000) and 11 islands have been developed as a resort.

11. Karimunjawa Islands. — This group, 50 km north of Jepara (central Java), is designated as the Karimunjawa National Park. It includes 26 islands, 26 islets, 6 sand shoals, and 4 rock cays.

12. Masalima Islands. — This group 180 km west of Ujung Pandang (southern Sulawesi) includes five islands and the small uninhabited Togotogo Islet on the reef edge of Pemantauwang Island.

13. Spermonde Islands. — Also off Ujung Pandang, these islands extend east and west for 70 km and north and south for 150 km. Most of the Spermonde islands are densely inhabited; we surveyed 16 islands previously studied by Schulz (1984).

14. Balabalakan Islands. — Located 100 km southeast of Balikpapan (eastern Kalimantan), this group includes 16 islands and 9 sand shoals, of which 10 islands and 1 sand shoal are inhabited. 15. Lerelerekan Island. — This island (also known as Larilarian Island), 120 km south of the Balabalakans, is isolated and uninhabited.

METHODS

We assessed the status of the nesting populations using the following sources of data: i) beach surveys (at all sites except the Tambelan Islands); ii) interviews with local inhabitants (at all sites); and iii) records kept of payments made to the government where the bid system of egg collection was implemented (at the Tambelan Islands). We surveyed the Seribu Islands during seven visits spread over three seasons (1995–97), the Segama Islands during three visits (1996–97), and the Tiga and Lima Islands each during two visits (1996–97). The other eleven rookeries we surveyed during only a single visit in one of the three seasons.

We used body pit counts, conducted during all beach surveys, as an index of nesting activity. A body pit is the circular depression, measuring about a meter in diameter, that a nesting turtle leaves in the sand after constructing her nest. Body pit counts could only be interpreted after we determined how long the pits remain visible on the beach. This we did over a period of three years at the Seribu Islands and two years at the Segama Islands by monitoring the visibility of individual body pits over time. We marked each pit with flagging tape and photographed it during every visit to the beach. We also distinguished hawksbill body pits from those made by green turtles and leatherbacks.

During all beach surveys we assessed each pit for obvious signs of human harvest or predation by animals. When we found nests from which hatchlings had emerged naturally, we excavated the contents and evaluated clutch survival by counting egg shells, unhatched eggs, and dead hatchlings.

Information on nesting seasonality at the Seribu and Segama Islands is based on our own observations. At other sites, however, we depended on information obtained during interviews with the local inhabitants or egg collectors.

At the Tambelan Islands (in Riau Province) the government administers a bid system for the collection of eggs. There our estimates of the annual numbers of egg clutches laid were based not on beach surveys, but rather on the bid price paid to the government.

RESULTS

Because most of the nesting beaches that we surveyed had narrow foreshores, most hawksbills laid their eggs under low bushes in the dune vegetation rather than on the open beach. The vegetation provided shelter that enabled the body pits to remain visible for long periods of time — usually about 1.5 years. Based on our observations at Segama and Seribu, we were able to distinguish between body pits produced during the current and previous seasons. The only site at which we were unable to use body pits as an index of nesting activity was at the Tambelan Islands where hawksbill body pits were destroyed by nesting green turtles. Fortuitously, the bid system in operation there provided us an alternate source of data. The results of our surveys, the estimated annual clutch production, and comparison to previous annual clutch estimates provided by Groombridge and Luxmoore (1989) are presented in Table 1.

1. Tambelan Islands. — On these islands, the peak nesting season for hawksbills is December to March, and for green turtles, June to August. On the 13 islands we surveyed, we found 42 hawksbill body pits and 972 green turtle body pits. Disturbance by nesting green turtles probably accounted for the low number of hawksbill body pits we recorded. In fact, based on the bid price, we estimate the actual number of hawksbill nests to be approximately 370– 500 nests annually, using figures that take into account both reported figures and a 30% profit margin for the egg trader.

Since 1973, the government of Riau Province has administered a bid system for egg collection at the Tambelan Islands despite the fact that it is illegal in Indonesia. The bid price in 1996 was as high as Rp. 147,000,000 (US\$ 50,000). By this system, the tendered trader receives rights to collect eggs from all beaches, but he is obligated to release hawksbill and green turtle hatchlings after rearing them for three months. The bid price determines how many hatchlings need to be released, which in 1996 was 973.

According to an egg trader, one egg could be sold for Rp. 200 in these islands, Rp. 400 at Pontianak in Kalimantan Island, and Rp. 800 if illegally exported to Malaysia. Most of the eggs were sold to Pontianak. Assuming that the average price of one egg was Rp. 400, then at least 387,500 eggs of both hawksbill and green turtle would have been collected. These figures represent only about one-third of the 125,000 hawksbill and 750,000 green turtle eggs reported by Schulz (1987). The bid trader divided the rookery into three regions, assigned egg collectors to each island, and sent three boats daily to pick up the eggs. Egg collectors received only Rp. 20 per egg.

2. Lima Islands. — In this area, the nesting season for hawksbills extends from December to July with a peak during December to March. In total, we counted the following numbers of hawksbill body pits at each island: Panjang, 132; Bankai, 55; Haji and Lima. 33: and Ru, 18. We found only a single nest at Buntar, which was inhabited during the 1996 season. We did not count green turtle body pits during our first visit to the islands. During our second visit we found 57 green turtle and 206 hawksbill body pits. We estimate the annual number of hawksbill clutches laid to be 300.

At Panjang, only the island owner has the right to collect eggs. At the other islands, whoever first finds the nest has rights to the eggs. All eggs collected in this region are transported and sold in Tanjung Pandang of Belitung Island.

3. Gresik Island Area. — Here the hawksbill nesting season extends from February to August, with a peak during March to May. We counted 121 hawksbill body pits at Kimar, and 85 at Selemar. On the three densely populated islands in the group, we found one nest at Gresik, and nine at Kueal. We did not survey Kalangbahu because all the

Map Reference (Fig. 1)	Region	Present Study Body Pits Counted			1995–97 Estimated Annual	1980s Estimated Annual	Percent Nesting
		1995	1996	1997	Clutch Production	Clutch Production ^a	Decline
1	Tambelan	42 ^b			< 500 ^b	1000	50
2	Lima		66	206	300	300	0
3	Gresik		216		250		
4	Tiga		23	96	150	350	57
5	Rotan		0		0		
6	Avermasin		44		50		-
7	Momperang		384		400	3250	88
8	Langkuas		18		< 50	100	50
9	Segama		152	180	200	-	-
10	Seribu	124	96	100	150	500	70
11	Karimuniawa			56	100	300	67
12	Masalima		0		0		-
13	Spermonde		43		50		222
	(Panambungan)		(4)		(4)	(40)°	(90)
14	Balabalakan			85	100	_	
15	Lerelerekan			42	50	-	
	Totals	166	1042	765	< 2350	5840	-
	Comparative Totals ^a				1650 ^d	5800 ^d	72

Table 1. Estimated annual clutch production by hawksbill turtles at various sites in the Java Sea. Data collected during the present study are compared with those compiled from other sources during the 1980s by Groombridge and Luxmoore (1989).

^a Data from sources reported in Groombridge and Luxmoore (1989).

^b Body pits not a reliable indicator of nesting, annual clutch production calculated from the bid price.

^e From Schulz (1984).

^d Includes only localities surveyed both during the present study and by sources reported in Groombridge and Luxmoore (1989).

houses were on the sea and there was only one small beach nearby. We counted a total of 25 green turtle body pits. We estimate that about 250 hawksbill clutches are laid annually.

The Belitung government manages Kimar Island and rents it to people on Gresik Island who have the right to collect eggs on all three of the island's beaches. On Selemar Island the first finder of a nest has the rights of collection.

4. Tiga Islands Area. - In the vicinity of south Belitung Island, the hawksbill nesting season extends from December to August with a peak during January to March. Local people report that the highest nesting density for both hawksbill and green turtles occurs on Palma Island in the Tiga group. At the three main islands of the Tiga group, we counted 58 hawksbill body pits on Palma and 5 on Tengah. We did not visit Dua Island but were told that nesting density there was similar to that on Tengah. At the other Tiga islands we recorded the following: 15 body pits on an un-named island, 5 on Belatok, 2 on another un-named island, 1 on Perut, and none on any other islands. We found twice as many green turtle as hawksbill body pits. At the Sumedang Islands we recorded the following: at Sumedang Kecil, 14 hawksbill and 3 green turtle body pits; on Ketapang Island, 19 hawksbill and 3 green turtle body pits. We did not survey the two Batu Islands. Batu is a rock island without beaches, and Putih Island reportedly has little nesting as it is densely populated. For the entire Tiga Islands area we estimate the annual number of hawksbill egg clutches to be 150.

Since 1969, members of the egg collector's family used to live on Palma Island in the Tiga group during the December through August hawksbill and green turtle nesting seasons. During the peak season, from January to March, several fishermen also used to come to collect eggs. At present, however, nobody spends the nights on the island because of a decline in nesting activity. Instead people may come from their village and collect eggs two or three times a week. Tengah has a small hut and a storehouse for fishermen who collect eggs in their spare time. At Dua and the other islands in the region, the first finder has the right to egg collection.

In the vicinity of the small islands in the Tiga area, green turtles are captured and placed in a temporary holding pen constructed in the fall of 1996 in Jepun Village. Here they are kept for up to several months until they can be sold to Bali Island. We saw about 200 green turtles in the pen, including many adults.

5. Rotan Island Area. — This area no longer has any value as a sea turtle rookery.

6. Ayermasin Islands. — Green and hawksbill turtles reportedly nest in this area from September to May. We found 34 hawksbill body pits on Sankigi Islands, 10 on Pengapit, and none on Long Island. We estimate the annual number of hawksbill clutches laid to be 50.

The Ayermasin Islands have a manager of egg collection to whom all eggs are brought. Prices paid are Rp. 75 for hawksbill turtle and Rp. 100 for green turtle eggs. The first residents arrived at the islands in the 1970s and egg collection started then. At that time, 15–20 females reportedly nested during a single night, even on Long Island.

7. Momperang Islands. — Here we counted a total of 384 hawksbill body pits, including 200 on Pesemut and 77 on Momperang, as well as 456 green turtle body pits. We estimate hawksbills to lay some 400 egg clutches annually.

Momperang Island, which is uninhabited, has a small hut to store turtle eggs. Any fisherman who lands while the island is deserted automatically gains exclusive rights to collect eggs for a week and utilize the hut. Eggs collected are usually sold either in Manggar on Belitung Island or in Pontianak on Kalimantan. On Pesemut Island, located at the east end of the Momperang group, there is a lighthouse managed by a small staff who live on the island in fourmonth shifts. They are supplied with egg probing sticks which they use every morning. They sell what eggs they find for Rp. 65 per egg to a fisherman who arrives once a week. In the Momperang region, turtle eggs retail at Rp. 150 for green turtles and Rp. 100 for hawksbills.

8. Langkuas Island Area. — We surveyed seven of the eleven islands in this group, and recorded a total of 18 hawksbill body pits, distributed among the following islands: 8 on Langkuas, 3 on Burung, 3 on Aji, 2 on Teluklabu, 2 on Kelayang, and none on any other island. We recorded 24 green turtle body pits.

During four years since 1990, the Japan Bekko Association (JBA) operated an egg hatchery on Langkuas which collected 10,000 eggs each year. In 1996, we estimate that fewer than 50 egg clutches (about 7,500 eggs) were laid.

9. Segama Islands. — Here nesting peaks during December to April, but also occurs later in the year. During our three visits to these islands, we counted body pits and marked each with flagging tape. We counted a total of 152 hawksbill body pits in 1996 and 180 in 1997. We recorded 8 green turtle nests in 1996 and 13 in 1997. We estimate that 200 hawksbill egg clutches were laid annually during our study period.

We found only a single clutch of hawksbill eggs that hatched naturally. For that clutch which numbered 193 eggs, the survival rate was 51.8%. Although 100 eggs hatched, 26 dead hatchlings were found in the nest.

The lighthouse staff on Segama Besar sold eggs to the fishermen who brought them supplies once a week. A portion of the nests were also transplanted to the hatchery on Pramuka Island in the Seribu group which is managed by the Directorate General of Forest Protection and Nature Conservation (PHPA) and the JBA. On Segama Kecil Island, eggs were collected by fishermen from Lampung Province, West Java Province, or Seribu Islands.

10. Seribu Islands. — In these islands, designated as a National Park, hawksbill nesting peaks from January to April but also occurs later in the year. The total numbers of body pits we counted were the following: 124 in 1995. 96 in 1996, and 100 in 1997. The following six islands accounted for more than 70% of total nesting, each with at least ten pits recorded: Peterolan Timur, Gosong Rengat, Rengit, Gosong Sepa, Belanda, and Dua Barat. The most important nesting site was Peterolan Timur, the special protection ward of the Seribu National Marine Park. There, the numbers of recorded nests were 30 in 1995, 30 in 1996, and 36 in 1997. Only small numbers of green turtles nested in these islands. We counted 13 body pits in 1995, 2 in 1996, and 5 in 1997. We estimate the annual numbers of hawksbill clutches laid in the Seribu group to be about 150 per year.

Since 1995, the national park staff has transplanted most of the egg clutches from these islands to the hatchery project on Pramuka Island — 25 clutches in 1995, 22 in 1996, and 12 in 1997. Of the 37 nests left *in situ*, 35 were taken by poachers, 1 was destroyed by high tides, and 1 incubated naturally, but we were not able to assess its hatching success. Despite the Marine National Park status of the area, the pressure of the egg harvest is very high in the Seribu Islands, and almost all eggs not transplanted to the hatchery were collected by local people.

11. Karimunjawa Islands. — In these islands, also designated as a National Park, we found hawksbill body pits only on the following seven uninhabited islands: 28 on Burung, 16 on Krakal Kecil, 8 on Katang, 3 on Gelean, and (according to the national park staff) only a few scattered among Tengah, Sintok, and Cendikian islands. We recorded a total of 23 green turtle nests, and on Katang Island, a single leatherback nest. We estimate the annual number of hawks-bill clutches produced to be 100. Unfortunately, our data indicate that due to the lack of enforcement within the National Park, all eggs were taken by poachers.

12. Masalima Islands. — Here we found no evidence of either hawksbill or green turtle nesting on any of the six islands. According to local inhabitants, one or two green turtles nested during the dry season, but few nesting hawks-bills have been seen since the 1950s.

The reef edge in the vicinity of Pemantauwang Island apparently provides important foraging habitat for sea turtles. Some 1000 hawksbill turtles and an unknown number of subadult and juvenile green turtles have been captured annually by inhabitants of Pemantauwang, who sometimes eat turtle. Carapaces of adults and live subadult and juvenile hawksbills were sold to Ujung Pandang. Most of the green turtles were sold to Balinese who periodically come to this island to purchase turtles (including some hawksbills).

13. Spermonde Islands. — We found hawksbill body pits on only two islands in this group: 39 on Lannyukang and 4 on Panambungan. A single green turtle body pit was found on each of the following islands: Samalona, Kudingarengkeke, and Langkai. We estimate that hawksbills lay 50 egg clutches here annually.

As elsewhere, almost all eggs are harvested. But the Spermonde Islands are unusual in that people also take nesting females from the beach and juvenile hawksbill and green turtles from nearby waters. Eggs are eaten by local people or sold in Ujung Pandang. Green turtles are mostly sold to Bali, and hawksbill carapaces to Ujung Pandang. Sometimes hawksbills are sold alive to Bali for food. In the 1980s eggs collected at Panambungan Island were transported to Baranglompo and Barangcaddi Islands where they were reared to make stuffed curios (Schulz, 1989), but this no longer occurs.

14. Balabalakan Islands. — In these islands, the duration of the hawksbill nesting season is unclear. We recorded hawksbill body pits at the following four sites: 42 at Melamber Island, 26 at Semangat Island, 11 at Melamber Isle, and 5 at Kamarian Island. Of the four islands, only Melamber Island was inhabited (with five households). Usually no more than a single nesting occurred at any of the other 12 islands and 9 shoals. Lumulumu Island, located about 50 km south of the other islands in the Balabalakan group, was isolated and uninhabited; there we recorded no hawksbill, but 3 green turtle body pits. At Gosong Kamarian shoal we found 1 green turtle pit and a leatherback pit without eggs. In total we recorded 154 green turtle body pits in the Balabalakan group. We estimate the numbers of hawksbill clutches to number about 100 annually. The owner of Melamber Island and Melamber Isle collected eggs there. At other islands, whoever first found a nest collected it.

15. Lerelerekan Island. — Although this island is locally known as the site of the densest nesting activity in the Macassar Strait region, we recorded body pits for only 42 hawksbills and 30 green turtles. Despite its isolation, fishermen have operated regularly around the island and collected eggs almost every day. Most of the boats come from Mamuju, Sulawesi. We estimate 50 hawksbill egg clutches are laid annually.

DISCUSSION

Our surveys of 15 of the 30 known hawksbill rookeries in the Java Sea showed that more turtles nested in the western part and adjacent waters than in the eastern regions. The largest numbers of nests were found on uninhabited islands, and there were only a few very important islands at each rookery.

Most of the islands dotting the Java Sea were uninhabited until Indonesia became independent in 1945. In the 1950s, according to local informants, a large number of Bugis people from southern Sulawesi moved into the area. At present, people continue to move to the islands causing an increase in both the human population and economic exploitation of fishing grounds and turtle rookeries.

Table 1 compares the results of our surveys of Indonesian rookeries conducted in 1995-97 with those from the mid-1980s (Schulz, 1987; Salm and Halim, 1984; and Anonymous, 1984) summarized by Groombridge and Luxmoore (1989). During the past decade there has been a drastic decline in nesting hawksbills over a wide geographic area. Only populations in the Lima Islands appear to have remained stable. Perhaps the most significant population decline occurred in the Momperang Islands where the production of egg clutches has decreased from some 3250 annually to only about 400, a decline of about 88%. Overall, when making direct comparisons for only those rookeries surveyed during both our study and the review by Groombridge and Luxmoore (1989) there has been an estimated regional hawksbill nesting decline of about 72% (1650 versus 5800 annual clutches). Two factors responsible for the decline of hawksbill nesting populations in the Java Sea and adjacent waters are the slaughter of adult and juvenile animals and the collection of eggs.

Tremendous numbers of hawksbill turtles were exported to provide raw shell (bekko) and stuffed turtles to Japan. This trade officially ceased in 1991. However, between 1984 and 1986, export to Japan was responsible for an average annual harvest of 9787 large and 10,926 small hawksbills in Indonesia alone (Milliken and Tokunaga, 1987). Even now, buyers in Ujung Pandang purchase hawksbills caught in Masalima and Spermonde Islands to produce bekko and stuffed turtles. Another market is provided by the Balinese who for many years have captured and purchased green turtles for meat. Because large green turtles have become scarce in waters near Bali, the Balinese have been purchasing large numbers of green turtles from other parts of Indonesia and have even turned to hawksbills as a source of meat. In the Masalima and Balabalakan Islands, we found both green and hawksbills kept in holding pens ready for sale to Bali. Most of the animals were juveniles or subadults with carapace lengths measuring 30-60 cm.

The second most important cause for decline of hawksbill populations in the region has been the collection eggs by the Bugis who have extended their influence in the Java Sea. Intensive egg collection prevents reproduction. We were able to find only two egg clutches that hatched naturally among some 2000 associated with the body pits examined in the 15 rookeries surveyed. Although some nests had clearly been predated by the common Asiatic monitor (*Varanus salvator*), most of eggs had been collected by local people. Only in the Seribu and Segama Islands has any attempt been made to protect eggs. But even there, only 35 egg clutches have been transplanted annually to the hatchery program of the PHPA and the JBA.

Such large-scale egg collection, however, is a relatively recent phenomenon in the region. The bid system in the Tambelan Islands started in 1973. Egg collection by temporary residents, as occurs in the Masar Islands, began in 1969. Egg collection by the owner of Kimar Island near Gresik Island began around 1983. These events were brought about by the rapid migration of people into the region during the past 20 to 30 years. The Bugis people have only occupied Tempuling since 1982 and Karangraya since 1996; both are islands in the Momperang group.

There are a variety of systems establishing the right of egg collection in the region, including: i) the bid system (Tambelan Islands in Riau Province); ii) egg collection by the staff of lighthouses (on Pesemut of the Momperang Islands and on Segama Besar of the Segama Islands); iii) egg collection by land owners (Kimar in the Gresik group, Panjang of the Lima Islands, Melamber Island and Melamber Isle in the Balabalakan group, Tempuling of the Momperang Islands, Lannyukang of the Spermonde Islands, etc.); iv) the right of egg collection for short periods (about one week) granted to a person first landing on an uninhabited island (Momperang Island of the Momperang group); v) egg collection by seamen of regular cargo boats (Menderiki Island); vi) sale of eggs by collectors to a local broker (Long Island of Ayermasin group); and vii) the right of the first finder of a nest to collect it (operating on most islands).

Some breeding populations in the Java Sea have already been reduced to local extinction. Lerelerekan, an isolated island, which according to local informants was once a remarkable breeding site for hawksbill and green turtles, now has only about ten females of each species nesting annually. In the Seribu Islands, designated as Seribu Marine National Park, resort development and an increase in the human population have destroyed many rookeries. Moreover, even in the special protection wards of the park, egg collection has not been properly controlled, nor has nest protection by the National Park Division and PHPA been properly implemented.

Many local people make a living by collecting eggs on the numerous small islands scattered throughout the Java Sea. This, combined with the poor communications between the mainland and these small islands makes law enforcement very difficult. The worst case is that in which the local government (i.e., Riau Province) illegally promotes egg collection in a manner contrary to national law.

It may already be too late to prepare an effective conservation strategy that will adequately protect the sea turtles of Indonesia. The immediate priorities for action are to identify and effectively protect the most important remaining rookeries. In a program of the Indonesia Sea Turtle Research Center that has so far proven successful, since December 1997, we have hired former egg poachers to protect natural nests in the Segama Islands. Our best hope may be to delay the local extinction of the various hawksbill rookeries in the region.

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