Although it is widely recognized that alligator snapping turtle populations are heavily exploited (Sloan and Lovich, 1995) and likely declining (Pritchard, 1989; Ernst et al., 1994), little attention has been focused on the overall role of the species as a scavenger, predator, and possible plant disperser. Our data suggest that *Macroclemys* has an important function in the trophic structure and dispersal mechanisms of riparian systems. Effective management strategies for rivers and wetlands in the southern United States should include efforts to protect turtles such as *Macroclemys*.

Acknowledgments. — We thank the operator of the processing operation who not only allowed collection of the viscera and shells, but also assisted with data collection. We also thank the Louisiana Department of Wildlife and Fisheries, Fur and Refuge Division, who funded the collection and compilation of the data; C. Ebel was very helpful in the examination of the stomach contents; J.P. Demuth, J.W. Gibbons, V.J. Burke, and J. Oldemeyer reviewed earlier drafts of the manuscript. Manuscript preparation was supported by Contract No. DE-AC09-76SR00-819 between the US Department of Energy and the University of Georgia's Savannah River Ecology Laboratory.

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Received: 19 July 1995. *Accepted*: 26 November 1995.

Chelonian Conservation and Biology, 1996, 2(1):99–101

Distribution of Nesting Sites of Sea Turtles in Okinawajima and Adjacent Islands of the Central Ryukyus, Japan

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The Ryukyu Archipelago is located in the subtropical region of East Asia and extends from Taiwan to Kyushu in Japan (123°E, 24°N – 131°E, 31°N, Fig. 1). Three sea turtle species, the loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*), are known to nest on islands of this archipelago (e.g., Kamezaki, 1989, 1991). Nesting data have largely been collected from the southern and the northern Ryukyus (Kamezaki, 1991). Very little information is available regarding sea turtle nesting in the Okinawa Islands of the central Ryukyus (Uchida et al., 1984), even though islands in this region have many sandy beaches that are apparently suitable for sea turtle nesting. Considering that quite a few

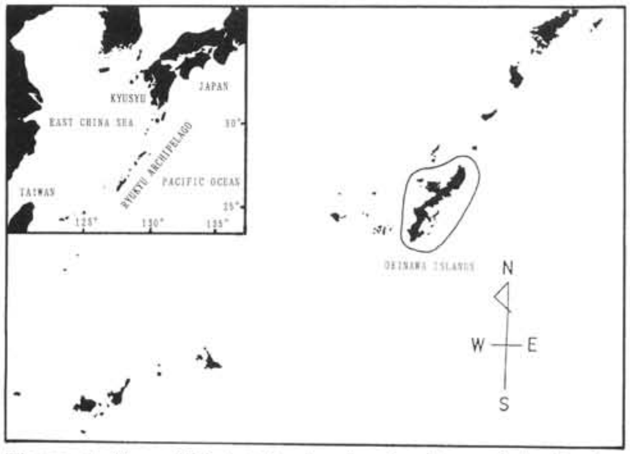

Figure 1. Map of East Asia showing locations of the Ryukyu Archipelago and the Okinawa Islands.

beaches of the central Ryukyus are currently subject to rapid artificial development, it is very important, from both ecological and conservation standpoints, to clarify the current status of these beaches as nesting sites of sea turtles.

We have recently obtained quantitative data for emergence traces of sea turtles on Okinawajima and adjacent islands. In this note, we assess the beaches of these islands as nesting sites of sea turtles and briefly discuss environmental factors that may influence their nesting frequency.

Methods. — A total of 113 beaches were investigated, of which 63 were on Okinawajima and 50 on adjacent islands (Fig. 2, Table 1). Available data indicate that in the Ryukyus the three sea turtle species emerge on the beaches from May to October (Kamezaki, 1987), so, field surveys were conducted during this period in 1994. To minimize the variation in frequency of emergence among beaches attributable to seasonal considerations, we visited each beach three times: first between early May and late June, second between early July and late August, and last between early September and late October.

In each survey the number of emergence traces (i.e., body pits and/or tracks) was counted. For body pits, however, the presence of eggs was not confirmed. Our preliminary observations indicate that body pits usually remain visible for more than two months, so we believe there is no substantial difference between the number of body pits we counted and the actual number of body pits made on each beach. However, because tracks disappear more easily, it is probable that our methods underestimated their actual number. Shore-line length, width, and height of each beach was also measured.

Results. — Emergence traces of sea turtles were found on 47 beaches including 29 on Okinawajima and 18 on other islands (Fig. 2; Table 1). The number is equivalent to 41.6% of the total number of beaches surveyed.

On Okinawajima, emergence traces were found on 46.0% of the beaches surveyed, most of which were located in the northern part of the island. The number of body pits per km shore-line was 4.65 in the northern half of Okinawajima (defined on the basis of the total shore-line length of all Okinawajima beaches surveyed), whereas it was 0.24 in the southern half. The mean value for the other islands was 3.20 body pits/km (Table 1).

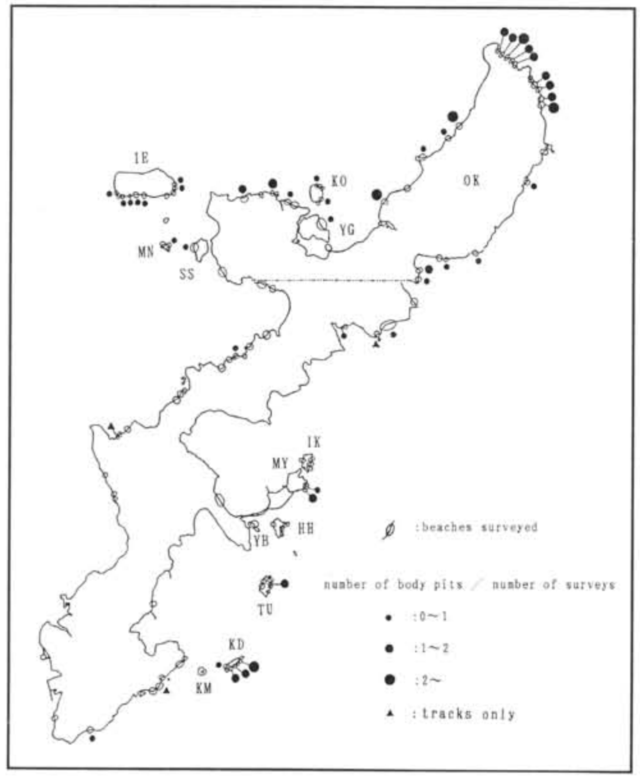

Figure 2. Map showing the locations of beaches surveyed and frequency of emergence traces found on each beach. Island abbreviations — OK: Okinawajima, KO: Kourijima, YG: Yagajijima, IE: Iejima, MN: Minnajima, SS: Sesokojima, IK: Ikeijima, MY: Miyagijima, HH: Hamahigajima, YB: Yabuchijima, TU: Tukenjima, KD: Kudakajima, KM: Komakajima. The dashed line indicates the boundary between northern and southern regions of Okinawajima defined on the basis of the total shore-line length of the beaches surveyed.

A significant positive correlation was identified between the number of body pits per km shore-line and beach width ($r = 0.162$, $df = 107$, $P < 0.05$). However, no significant correlation was identified between the number of body pits and beach height ($r = 0.138$, $df = 107$, $P > 0.05$) or shore-line length ($r = 0.204$, $df = 107$, $P > 0.05$). No significant

Table 1. The numbers and frequencies of emergence traces found on beaches on each island or region.

Island or Region	No. Beaches	No. Body Pits	Body Pits/km	No. Tracks	Tracks/km
Okinawajima north	31	83	4.65	113	5.41
Okinawajima south	32	5	0.24	14	0.66
Adjacent islands (total)	50	57	3.20	57	3.20
Kourijima	5	3	3.43	6	6.86
Yagajijima	1	2	1.14	0	0
Iejima	10	7	1.65	17	3.51
Minnajima	5	1	0.60	0	0
Sesokojima	1	1	1.74	2	3.48
Ikeijima	4	0	0	0	0
Miyagijima	3	4	10.00	5	12.50
Hamahigajima	7	0	0	0	0
Yabuchijima	1	0	0	0	0
Tukenjima	7	17	6.24	6	2.20
Kudakajima	5	22	22.56	21	21.54
Komakajima	1	0	0	0	0

difference was identified in beach width between beaches in the northern and southern regions of Okinawajima (t-test: $P > 0.05$).

Discussion. — The number of body pits per km shoreline in the northern half of Okinawajima (4.65) was ca. 19 times greater than that in the southern half of the island (0.24). This variable merely reflects the total number of nesting attempts per km shore-line, and thus might not strictly correlate with the actual nesting frequency. However, such a prominent difference should be interpreted as indicative of much greater importance of beaches located in the northern part of the island than those in the southern part as nesting sites. The number of body pits per km in the other islands (3.20) was lower than that in northern Okinawajima, but much higher than that in the southern half of Okinawajima. The number of body pits found on adjacent islands (57) equaled 39% of the total found in the present survey. Thus, these islands also seem to offer important nesting sites for sea turtle populations around the Okinawa Islands.

Hays and Speakman (1993) found that in Greece the loggerhead turtle tends to lay eggs away from the sea, and that the hatching success increases significantly in nests laid farther from the sea. This means that the width of beaches can be an important factor for sea turtles emerging on beaches to nest. Therefore it is suggested that sea turtles prefer wider beaches, resulting in the presence of a significant correlation between the pit density and the beach width in our data.

As was mentioned above, however, there was no significant difference in width between beaches of the northern and the southern regions of Okinawajima. So, one cannot attribute the striking difference in the density of nesting traces between these regions to beach width. On Ascension Island, nesting frequency is reported to be less on beaches near civilization (Stancyk and Ross, 1978). Many types of artificial lighting also have the potential to disrupt the nesting of sea turtles (Witherington, 1992). The southern regions of Okinawajima accommodate a much greater human population and have more facilities for tourists than the northern portion (National Geographic Agent of Japan, 1990). Thus, disturbances to nesting sea turtles in the southern regions are probably much greater than in the northern portion. Collection and analyses of data for artificial obstructions, as well as for natural beach characteristics other than those considered above (Mortimer, 1982), are strongly needed to verify this hypothesis and to advance conservation measures for nesting sea turtles in the central Ryukyus.

In this survey, the confirmation of the presence of eggs or species identification was not made for each body pit because of time limitations. In the future, efforts to search for eggs will be necessary to solve these problems.

Acknowledgments. — We thank Y. Chigira and M. Nisime for valuable support, and many students of the University of the Ryukyus for helping with the field surveys. We are also much indebted to H.M. Smith for critically reading the manuscript. This study was financially supported by the Department of Culture, Education Branch, Okinawa Prefectural Government.

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Received: 6 August 1995. *Accepted*: 24 September 1995.

Chelonian Conservation and Biology, 1996, 2(1):101–105

Mating Behavior in Captive Alligator Snapping Turtles (*Macroclemys temminckii*)

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There is no information about mating or courtship behavior of alligator snapping turtles (*Macroclemys temminckii*) in their natural environment and only limited information exists about captives (Allen and Neill, 1950; Dobie, 1971; Grimpe, 1987). Described mating behavior occurs in the water where the larger male pursues the smaller female. After a short pursuit the male climbs onto the female's carapace and grasps the front and back margins. The chin of the male touches the back of the head of the female, and the female may bite the male around the head region. Duration of coitus is from 5 to 25 minutes. The male's body is slanted to one side with the tail pushed downward which pushes the female's tail aside, allowing