EFFECTS OF BEACH USE AND ENVIRONMENTAL CONDITION ON EMERGENCE SUCESS OF LOGGERHEAD TURTLES (CARETTA CARETTA) IN YAKUSHIMA ISLAND, JAPAN

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ABSTRACT

Emergence success of loggerhead turtles in Inakahama beach is decreasing and this phenomenon seems to be related to human beach use. To clarify this relationship, locations and numbers of loggerhead turtle's nests and beach users were recorded at each area. Some nests were excavated and development of embryos was checked. Pressure, temperature, and humidity in the nests were also measured (40cm under the surface) at each examination area. In Inakahama Beach, mean rate of emergence success was lower than the areas which are frequently used by visitors. In this area, visitors stomping on the nests cause the decrease of emergence success of the turtles. Visitors stomping on the nests cause overheating in the nests, resulting in retarding of hatchling emergence from their nests.

INTRODUCTION

Inakahama Beach located in Yakushima Island, Japan is an important nesting area for loggerhead turtles (Caretta caretta) in the North Pacific Ocean. Recently, its emergence success rate in this beach is decreasing with increase of the number in sightseeing visitors to this island (Yakushima-umigamekan, 2000). As factors of the emergence success, Mortimer (1990) suggested that desiccation and caving-in of beach sand depressed emergence success of green turtles at Ascension Island. Peters et al. (1994) indicated that compactness of beach sand obstructed emergence of loggerhead hatchlings in Turkey. These studies reported that the change of sand density and three-phase system made up of solids, liquids and gases of the sand (Campbell 1985) in nests might affect emergence of hatchlings. Temperature (Mrosovsky et al. 1984), gas diffusion (Ackerman 1980, Bustard and Greenham 1968) and moisture content (McGehee 1990., Mortimer 1990) in nests have also influenced hatchlings mortality.

Thus, to clarify relationship between their hatchlings mortality and beach use, particularly focusing on the upper pressure of nest cavity, we made field survey at this beach.

SURVEY AND METHODS

Study site, Inakahama Beach on Yakushima Island, Japan (Fig.1), was divided into several examination areas at intervals of 100m along the shoreline for this study. Locations and numbers of loggerhead turtle's nests and beach users were recorded at each examination area during a period from 23rd of June to 4th of September 2001. In addition, some nests were excavated to count the number of empty egg shells, unhatched eggs, embryos that died during the process of hatching, and dead plus live hatchlings remaining in the egg chamber. The terms used in this study were defined as follows; hatchling success as a ratio of the number of empty eggshells to the number of reburied eggs and emergence success

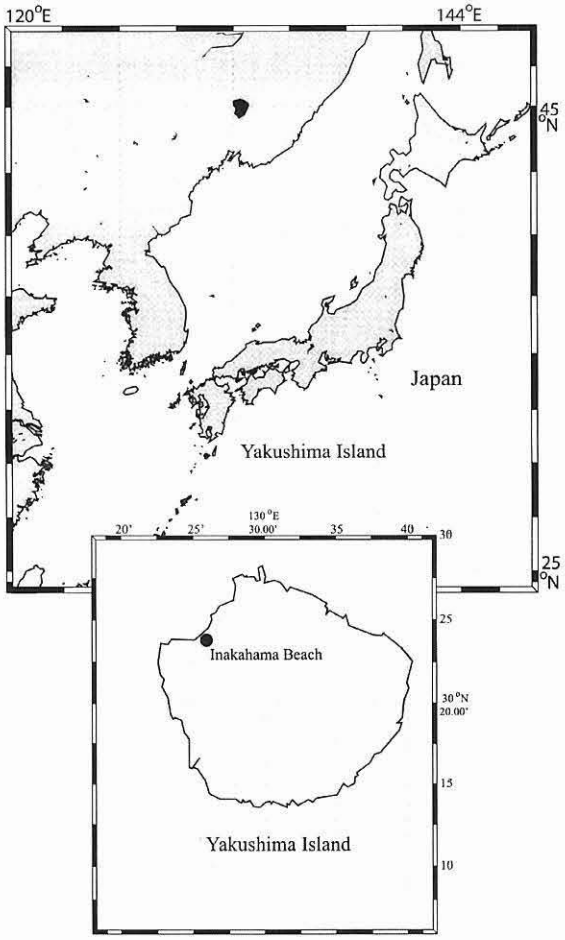

Fig. 1 Study site, Inakahama Beach on Yakushima Island

as a ratio of the number of hatchling completely emerged out of the nest. Furthermore, temperature and humidity in random sampled nests were also measured (40cm under the surface) at each examination area, and pressure was measured in some nests located in 5m away from the entrance of Inakahama Beach.

RESULTS AND DISCUSSION

Figure 2 shows the comparison hatchling success, emergence success, and number of beach users among examination areas in Inakahama Beach. Mean rate of emergence success in 10~200m areas frequently used by visitors was significantly lower than other areas (ANOVA followed Fisher's PLSD by post-hoc test n=5~20 $p<0.05$,). In addition, the emergence success rate negatively was correlated with cumulative pressure during the period from the nesting to the last emergence ($r_s=-0.829$, n=6, $p<0.05$, Fig.3). These results suggest that visitors stomping on nests affect emergence success of turtle hatchlings.

There was a significant positive correlation between the cumulative temperature and cumulative pressure from the nesting to emergence ($r_s=0.771$, n=6, $p<0.05$, Fig.4). The cumulative temperature during nesting to end of emergence was significantly negatively correlated to the emergence success ($r_s=-0.943$, n=6, $p<0.01$). According to Moran et al. (1999), activity of sea turtle hatchlings decreases at high temperature and the critical threshold temperature is 32.4°C. Loggerhead hatchlings cannot emerge above this degree. Taking these into consideration, we conclude that cumulative pressure was supposed to cause temperature rise in nests and hatchlings trapped in their chambers is

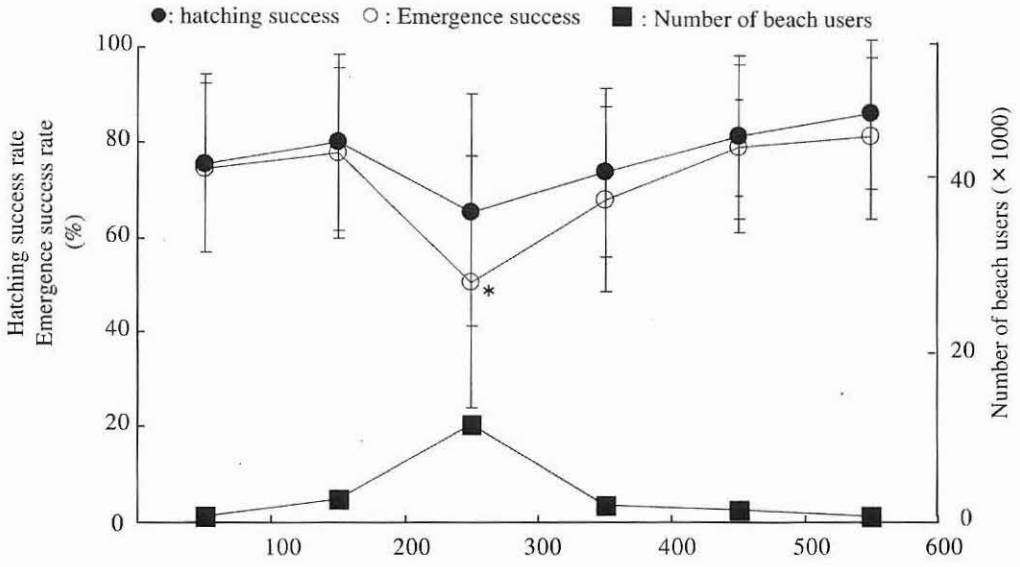

Fig 2. Comparison of hatching success, emergence success, and number of beach users among examination areas in Inakahama Beach
** indicate ANOVA followed Fisher's PSLD by post hoc test n=5~20 p<0.05*

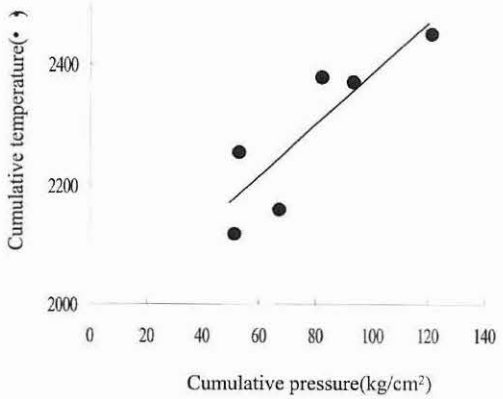

Fig 3. Relationship between cumulative pressure and emergence success rate
(Spearman rank test rs= -0.829, n=6, p<0.05)

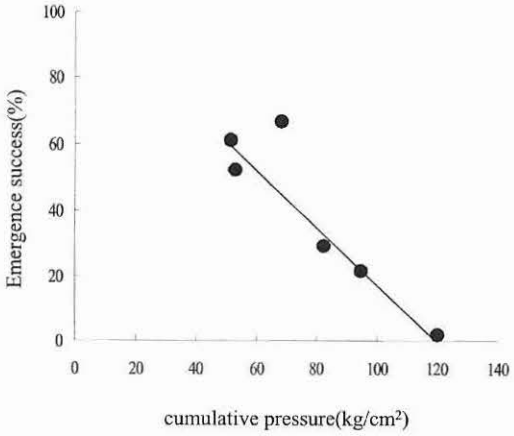

Fig 4. Relation ship between cumulative pressure and cumulative temperature
(Spearman rank test rs= -0.771, n=6, p<0.05)

probably due to heat, not direct physical impact of pressure on the eggs.

In this study, we clarified the mechanism of human impact on hatchling emergence of loggerhead turtles, which is not as simple as previously thought. A conservation strategy for protecting nesting areas in Yakushima Island should be related carefully after further research.

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