Comparison of the activity budget between wild and reared juvenile hawksbill turtles

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ABSTRACT

Headstarting is one of the biggest challenges for the sea turtle conservation program. This program should be conducted with adequate evaluations like influence on local ecosystem including natal populations of target species. As a first step toward evaluation of the headstarting program of hawksbill turtles *Eretmochelys imbricata*, we compared the general activity budget between wild and reared turtles under natural conditions. The acceleration data logger was used as a motion detector. Four wild and three reared turtles with the loggers were released in Yaeyama Islands, Okinawa prefecture, Japan. Time-series data of depth and surging acceleration were obtained for ca. 4 days. The activities of turtles were divided into “active” or “non-active (i.e. rest)” using surging acceleration. Our results showed no significant difference in the activity budget between wild and reared turtles during monitoring periods.

KEYWORDS: Acceleration data logger, *Eretmochelys imbricata*, headstarting, behavioral time budget

INTRODUCTION

Hawksbill turtles *Eretmochelys imbricata* were listed as endangered on the IUCN Red List in 1986. The Japan Fisheries Agency has been conducting propagation technologies of hawksbill turtles since 1999, and recently the spontaneous nesting of captive turtles was observed (Shimizu *et al*. 2006). This success is expected to lead to stock enhancement of the hawksbill turtle stock. However, reinforcement of reared turtles should be carried out with caution because it might influence the natural population.

Using ultrasonic telemetry, Okuyama (2007) examined the underwater behaviour of both wild and reared hawksbill turtles in Yaeyama Island, Okinawa Prefecture, Japan. The study showed that the number of detections of transmitter signals in the daytime is greater than in the nighttime. In the daytime, transmitters on both wild and reared turtles send signals from various depths. In contrast, in the nighttime, the number of detections decreased or the transmitter signals were sent from the constant depth zones. These results suggest that the wild and reared turtles were active in daytime whereas they were inactive in the nighttime (Okuyama 2007). However, it is difficult to detect whether an animal is motionless by ultrasonic transmitter signals with depth data. On the other hand, an acceleration sensor recently has been used to detect motion of animals. In this study, we re-examined the diurnal activity pattern of juvenile hawksbill turtles and compared between wild turtles and reared turtles using an acceleration data logger.

MATERIALS AND METHODS

From May to July in 2007, field studies were conducted in Yaeyama Islands. Four wild and three reared turtles were used in the experiment. Standard carapace lengths of the turtles ranged from 38.9 cm to 60.8cm in the wild turtles and from 46.1 cm to 47.9 cm in the reared turtles, respectively. The sizes of turtles are common in the Yaeyama Islands (Kamezaki and Hirate, 1992), and all turtles were juveniles. The wild turtles were legally caught by local fisherman. The reared turtles had been bred from the eggs for three years at the Yaeyama Station, Seikai National Fisheries Research Institute, Fisheries Research Agency, Japan before experiments.

To monitor diving behavior of the turtles, the data logger recovery system was used. The methodology of the system was previously published in Kataoka *et al.* (2007). In brief, an acceleration data logger (M190-D2GT, 15 mm diameter, 53 mm length, 16 g in water, Little Leonard Co. Ltd., Tokyo, Japan) with both a floating system and a VHF transmitter was attached on the top of the carapace of the turtles. Sampling intervals were 1 Hz for depth, 0.1 Hz for temperature and 16 Hz for 2-axes of acceleration, respectively. The logger was released from the turtle about 4 days after attachment, and then we recovered the logger floating on the surface using a VHF receiver. Before the experiments, we confirmed the behavior of the turtles with the logging system visually at a breeding tank on the Yaeyama Station. As a result, we could not find any clear influence of the attachment of the system on turtle's behavior.

Individual dives were analyzed using Igor Pro version 5.0 and Igor Filter Design Laboratory version 2.0 (WaveMetrics, Lake Oswego, OR, USA). To extract each dive, a dive was defined as a depth of more than 1 m for at least 30 s.

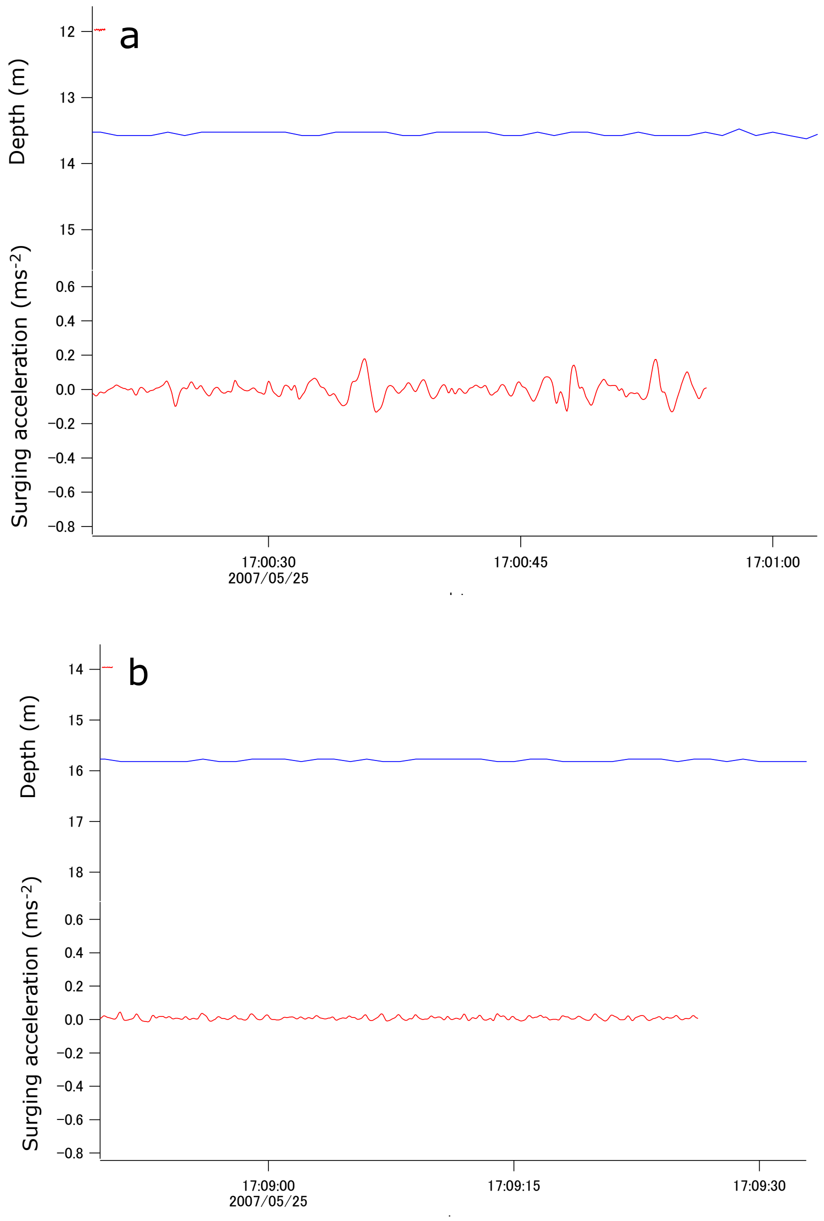

Fig. 1 Example of time-series of depth and acceleration of turtles: (a) active and (b) rest.

The activities within a dive were categorized into two patterns (i.e., active and rest) using time series of surge acceleration. To derive behavioral patterns of turtles from the time series of acceleration, we defined a time window of 15 sec. Moreover, starting with the first acceleration record of each dive, we moved the window sequentially along the time series with an interval of 15 sec. Within each time window, we examined the amplitude of acceleration. In the preliminary observation at the breeding tank, we found that the amplitude of surge acceleration was less than $\pm$ 0.1

ms^{-2} when the turtle with the system rested. Therefore, we defined that the turtle was "active" when the amplitude of surging acceleration was more than $\pm$ 0.1 ms^{-2} (Fig. 1).

RESULTS

All data loggers were recovered in the consecutive experiments. Turtles continuously dived during the monitoring period. The monitoring period ranged from 88-96 hours. The number of dives ranged from 117 dives to 496 dives in the four wild turtles and from 246 dives to 380 dives in the three reared turtles, respectively.

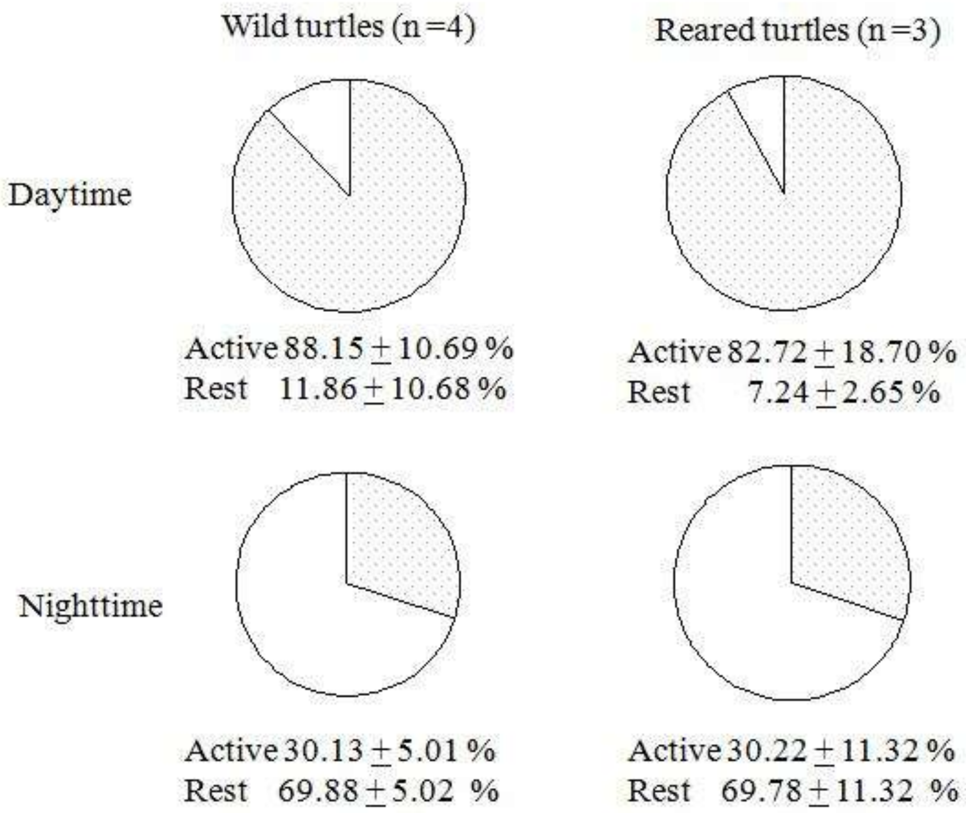

Fig. 2 Activity budgets of wild and reared turtles during daytime and nighttime. Mean $\pm$ SD was indicated.

During the daytime, wild turtles spent 88.15 $\pm$ 10.69 % (n = 4 turtles) of the overall time windows being active (Fig.2). Frequencies of time spent for rest were relatively short (11.86 $\pm$ 10.68 %). Similarly, reared turtles spent a large proportion (82.72 $\pm$ 18.70 %, n = 3 turtles) of the overall time windows being active, and the proportions of the rest were relatively short (7.24 $\pm$ 2.65 %). Therefore, we could not find a significant difference in activity budget during daytime between wild and reared turtles. In contrast, the proportion of activity in both wild and reared turtles decreased in the nighttime (30.13 $\pm$ 5.01 % in wild and 30.22 $\pm$ 11.32 % in reared turtles). Accordingly, the proportions of rest increased (69.88 $\pm$ 5.02 % in wild and 69.78 $\pm$ 11.32 % in reared turtles). There was no significant difference in the activity budget between wild and reared turtles during the nighttime.

DISCUSSION

This study supported the previous study of Okuyama (2007), i.e., results showed that juvenile hawksbill turtles were active in the day time whereas inactive in the nighttime. Also, there was no significant difference in the activity budget during monitoring periods between wild and reared turtles. The data of recovery of the logging system in the experiment showed that the residence area during monitoring period of the reared turtles was not different from that of wild turtles. Moreover, Okuyama (2007) found that there was no significant difference in mean dive depth between wild and reared turtles and that a reared turtle foraged a demosponge (*Chondrosia sp.*) which is the main diet of hawksbill turtles. This all suggest that the fundamental activity of reared turtles might be normal. However, the activity budget is expected to vary with seasonal changes in biotic and abiotic factors. Previous studies (e.g. Dasilva 1992) suggest that long-term monitoring of activity budget and diet hopefully provides significant insights into ecology of target animals. Moreover, in the present study, we did not take account of diving parameters such as dive depth, dive duration, surface duration, and stroke frequency and so on. An extensive analysis of acceleration data enabled us to discriminate the behavioral parameters of animals (Yoda *et al.* 1999, 2001; Watanabe *et al.* 2005; Okuyama *et al.* 2005; Tsuda *et al.* 2006; Lagarde *et al.* 2008). In future studies, detailed discrimination of the main behaviors and comparison of detail diving parameters between wild and reared turtles are needed.

ACKNOWLEDGEMENTS

We would like to thank K. Moriya, T. Sakai, A. Mori, T. Kinoshita, Y. Dosei, S. Shimoji, H. Mitamura, K. Ichikawa, Y. Kawabata, and the members of the Sea Turtle Society in Ishigaki Island for their kind supports and advice. This study was partly supported by National Institute of Polar Research. This study was conducted under special permission for capture of sea turtles (17-30) and for scientific research (18-45) in Okinawa Prefecture, Japan.

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