Cyclic change of dugong’s vocal behavior

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Abstract
We examined relationship between vocal behavior of dugongs (Dugong dugon) and (1) time of day and (2) tide around Talibong Island, using passive acoustical observation. Also, we compared the results of several data and investigate whether the same behavior can be observed over different time of year. We used underwater sound data recorded in February and March 2004, November 2006 and January 2008 off southeast of Talibong Island and analyzed the number of calls detected in unit time in relation to time and tide. We also compared the result of the analysis among three months and investigated whether there was any difference. In terms of the effects of time, more calls were detected in nighttime than in daytime (p<0.05). In terms of the effects of tide, there were significant correlation between maximum tidal range and many calls were detected when tidal range was narrow. Our findings suggest that vocalization pattern of the dugongs is influenced by such external factors as time and tidal range.

Keywords: dugong, vocal behavior, call, time, tide

1. Introduction
Many animals are known to make calls. The calls are often used in communication between conspecifics, and thus play an important role in, for example, mate selection, display of territory and individual recognition between parents and pups (Hall, 2000; Rendell and Whitehead, 2003; Watwood et al., 2004). Studying animal calls is important to understand behaviors of animals in detail. Conventional behavioral studies of marine mammals have relied largely on visual observations. Marine mammals, however, are difficult to observe visually, because they spend almost all of their lives underwater. Also, the probability of finding animals depends on many factors, such as the experience of observers, weather conditions and water clarity. Such difficulty leads to lack of ecological and behavioral information on many marine species.

Recently, acoustical observation is actively used in studies of marine mammals (Akamatsu et al., 2008; Ichikawa et al., 2009a; Soldevilla et al., 2008). Passive acoustical monitoring technique is one of the acoustical observation methods. This method only requires deploying recording devices and recording underwater sound. Therefore it has no physical effect on animal’s body and thus hardly affects their behaviors. Also, it makes long-term observation possible through day and night.

Dugongs (Dugong dugon) are herbivorous marine mammals living in West Pacific Ocean and Indian Ocean, from the tropics to the subtropics. Because seagrass, which dugongs mainly eat, inhabits in shallow water, dugongs live in shallow water near the shore (Chilvers et al., 2004; Sheppard et al., 2009). Thus dugongs tend to be exposed to human activities. Such artificial factors as environmental destruction and by-catch can lead to decrease in population of dugongs in many of their habitats. To prevent extinction and to coexist with dugongs, information of their ecology is indispensable. In a previous study using passive acoustical monitoring, it is reported that dugongs use calls to communicate each other and that dugongs’ vocalization is observed in a specific area (Ichikawa et al., 2009b; 2011). Also, it is suggested that dugongs’ vocal behavior has both circadian and circatidal rhythm (Ichikawa et al., 2006; Ando-Mizobata et al., 2011). However, those previous studies were based on data sets recorded in particular and short period. It is thus unknown whether the same behavior can be observed over different time of year. In this study, we analyzed data sets recorded in different months to investigate the relationship between vocal behavior of the dugongs and time of day and tide.

2. Materials and Methods
The target area of this study is around Talibong Island, Trang, Thailand (Fig. 1). There are extensive seagrass beds in this area, which are very important for dugongs not only as a feeding area but also as areas for breeding and caring calves. In this study, we analyzed underwater sound data sets recorded in the focal area from 24 to 26 February and from 28 February to 4 March 2004 (165 h; hereafter referred to as February and March), from 16 to 23 November 2006 (168 h; referred to as November), and from 11 to 15 and from 17 to 21 January 2008 (180 h; referred to as January). Summary of the data sets