## Small-Scale Mariculture: A Potentially Significant Threat to Dugongs (*Dugong dugon*) Through Incidental Entanglement

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## Abstract

Dugongs (*Dugong dugon*) are threatened by incidental capture in small-scale fisheries, but other static underwater structures could present a similar entanglement risk. In December 2013, an adult male dugong was entangled in the ropes of a seaweed farm in Busuanga, Palawan, Philippines, and drowned. Anecdotal reports of similar incidents suggest that this was not an isolated occurrence. Given that dugong populations are slow to reproduce and cannot sustain even low levels of mortality, effective marine spatial planning is essential to minimize overlap between dugong habitat and mariculture operations.

**Key Words:** bycatch, dugong, *Dugong dugon*, incidental capture, Palawan, Philippines, seaweed farm



Figure 1. Recovery of entangled dugong (Dugong dugon) from seaweed farm ropes (Photo: Archie Espinosa)



Figure 2. Examination and measurement of dugong carcass (Photo: Archie Espinosa)

Mortalities of small marine mammals due to incidental capture in static fishing gears are likely significant but largely unquantified in small-scale fisheries (Read, 2008). Dugongs (*Dugong dugon*) are chiefly at risk from entanglement in artisanal gillnets, set over seagrass beds, because the species' foraging habitat overlaps areas of intense fishing activity by small-scale fishers in developing countries (Marsh et al., 2002), including the Southeast Asia region (Hines et al., 2005, 2008; Ilangakoon & Tun, 2007; Briscoe et al., 2014). One such location is the Philippines where small, isolated dugong populations are spread across the archipelagic republic (Hines, 2012).

Dugongs are sighted in the waters of Busuanga, Palawan, on a daily basis, and the area is likely to host a viable population (Aragones, 1994). Mariculture in the Philippines has been promoted by the government since 2000 to diversify smallscale coastal livelihoods in response to declines in traditional fisheries (Salayo et al., 2012). Seaweed is often grown by tying seedlings to long nylon ropes suspended in the water between wooden stakes (McHugh, 2003). In 2014, 25 seaweed farms were registered in Busuanga Municipality, covering 41 ha and providing livelihoods for 66 farmers, many of whom had previously earned their living from destructive fishing practices such as dynamite and cyanide fishing (Busuanga Municipal Agriculture Office, pers. comm., July 2015). The rope mariculture system presents potential risks of entanglement and drowning for dugongs in a similar manner to set gillnets; herein, we report on the death of a dugong that was entangled in the ropes of a seaweed farm in Busuanga and note other anecdotal accounts of similar mortality events (see Aquatic Mammals website for video link: www.aquatic mammalsjournal.org/index.php?option=com\_ content&view=article&id=10&Itemid=147).

On 6 December 2013 at 0830 h, one of the authors (DDL) was contacted by the Fisheries and Aquatic Resources Management Council Chairman of Barangay Cheey, Busuanga Municipality, Palawan, and notified of the death of a dugong due to entanglement in the ropes of a seaweed farm (Figure 1). Two young fishermen had noticed the dead animal at 0700 h, entangled in the ropes of a seaweed farm located just in front of the coastline of Sitio Minuit (12° 14' 23.98" N, 120° 1' 30.27" E) at a depth of 7 m. At 1130 h, DDL arrived at the site, met with local officials,

and recovered the carcass. The animal was a 2.6-m-long male (fluke width: 0.81 m, flipper width: 0.21s m, flipper length: 0.48 m, girth at axilla: 1.50 m). The cause of death was concluded to be drowning due to entanglement (Figure 2). The local community buried and guarded the carcass to ensure that nobody attempted to eat the meat, which is illegal under Philippine law. The seaweed farm had been in the same location for 3 y but was destroyed by Typhoon Haiyan in November 2013. In order to restore local livelihoods after the typhoon, the Municipal Agriculture Office of Busuanga had provided new ropes and seedlings to re-establish the mariculture operation.

The dugong mortality reported herein is unlikely to be an isolated incident. Earlier in 2013, a dugong drowned through entanglement in a seaweed farm further east along the same coastline in Coron Municipality (D. Fahrenbach, pers. comm., 2013). Local fishers have also reported anecdotal instances of dugong entanglement in the ropes of pearl farms and grouper culture cages which are common in the area. Thus, it appears that dugongs are not only susceptible to entanglement in set fishing nets but that static ropes associated with other anthropogenic marine activities can pose a significant threat. The threat of entanglement could potentially be reduced through the use of alternative seaweed farming methods that do not employ ropes (see Titlyanov & Titlyanova, 2010). Mortalities of small cetaceans through entrapment in static underwater structures have been occasionally noted in the past (e.g., Noke & Odell, 2002; Díaz López & Bernal Shirai, 2007).

The site where the dugong mortality occurred is well known to be frequented by dugongs (Aragones, 1994), and seaweed farms are commonly established in sheltered bays, which are also ideal foraging habitat for dugongs (Heinsohn et al., 1977). Populations of dugongs cannot sustain even low annual mortality (> 10%) because of their low fecundity and late maturity, so the death of even one animal is a serious concern for small populations (Marsh et al., 1984). Busuanga Island has been proposed as a protected area for dugongs and sea turtles by the Department of the Environment and Natural Resources. Clearly, spatial planning to minimize overlap and conflict between mariculture activities and dugong habitat will be essential when designing an effective management plan (Grech & Marsh, 2008). Thus, the success of any marine protected area on Busuanga will be heavily dependent on the close consultation and involvement of seaweed farmers and other coastal stakeholders.

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