

## Short Note

# Sighting and Stranding Reports of Irrawaddy Dolphins (*Orcaella brevirostris*) and Dugongs (*Dugong dugon*) in Kep and Kampot, Cambodia

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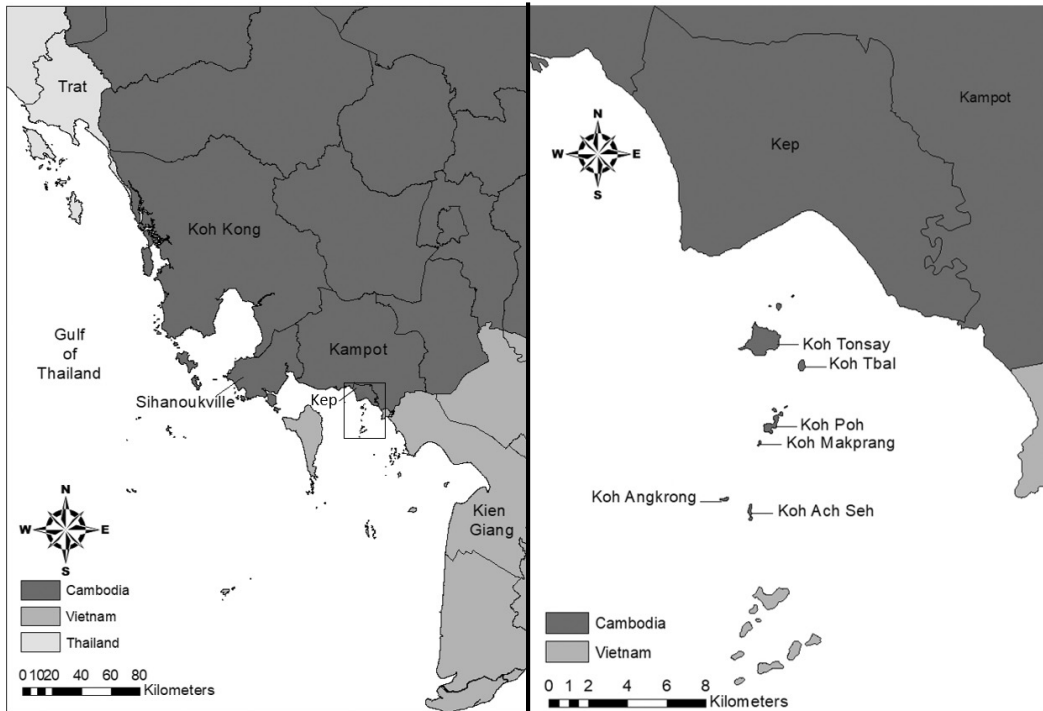
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In Cambodia, information on the distribution of Irrawaddy dolphins (*Orcaella brevirostris*) and dugongs (*Dugong dugon*) has been limited (Beasley & Davidson, 2007; Hines et al., 2015a). Irrawaddy dolphin presence is confirmed in the coastal waters of Thailand's Trat Province, Cambodia's Koh Kong and Sihanoukville Provinces, and Vietnam's Kien Giang Province (Figure 1; Beasley & Davidson, 2007; Ponnampalam et al., 2013; Smith et al., 2014, 2016; Vu et al., 2015; Hines et al., 2015b). Unconfirmed fisher reports identify the presence of small and sporadic dugong populations at both the Thai-Cambodian and Vietnamese-Cambodian border regions (Perrin et al., 1995, 1996; Nelson, 1999; Beasley & Davidson, 2007; Hines et al., 2008). The coastal distribution of both species exposes them to anthropogenic threats, specifically habitat degradation and fisheries bycatch (Reeves et al., 2003; Hines et al., 2008; Smith et al., 2008; Jaaman et al., 2009; Marsh et al., 2011; Peter et al., 2016a, 2016b; Pilcher et al., 2017). Dugongs are also affected by targeted hunts (Hines et al., 2008; Marsh et al., 2011; Robards & Reeves, 2011). Irrawaddy dolphin and dugong populations are declining across Southeast Asia (International Whaling Commission [IWC], 1994; Robards & Reeves, 2011), with conservation statuses reflecting these declines. Irrawaddy dolphins were reclassified from "vulnerable" to "endangered" by the International Union for Conservation of Nature in November 2017 (Minton et al., 2017), and dugongs were classified as "vulnerable" in 2015 (Marsh & Sobotzick, 2015). According to Cambodian fisheries law, *Sub-Decree No. 123* (2009), both species are considered to be endangered fisheries resources and, therefore, are protected by law (*Law on Fisheries*, 2007). In September 2017, the Cambodian Marine Mammal Conservation Project

(CMMCP) was established to fill marine mammal knowledge gaps in Cambodian waters and highlight the need for marine mammal conservation strategies in the region. As an initiative of CMMCP, the current study aims to provide initial sighting and occurrence records of Irrawaddy dolphins and dugongs in Cambodia's Kep and Kampot region. Additionally, we have initiated a photo-identification catalog for the region's Irrawaddy dolphins, which is part of ongoing survey work in the region.

The Kep and Kampot coastline spans from Sihanoukville Province, Cambodia, to Kien Giang Province, Vietnam, on the eastern coast of the Gulf of Thailand (Figure 1). Coastal waters range between depths of 2 and 12 m, with the exception of a deeper channel off the western Kampot coast reaching 25 m. Kep supports 13 offshore islands, collectively known as the Kep Archipelago (Figure 1), home to fringing coral reef, seagrass meadows, and commercially valuable fish and crustacean species (Cockerell et al., 2016).

Between October 2017 and May 2018, CMMCP conducted 14 boat-based cetacean surveys in Kep's coastal waters (Table 1). Surveys lasted for a minimum of 3 h, during Beaufort sea state conditions of  $\leq 3$ . Surveys were conducted on a 20 m long  $\times$  4.5 m wide converted pair trawling boat with a 200 HP inboard engine and a viewing platform 3.8 m above sea level. The vessel travelled at an average speed of 4 kts, following a circular route that gave visual coverage of all islands and regions in the Kep Archipelago with known marine mammal occurrence (Figure 2). The entire survey route was covered on each survey day, with routes recorded using a Garmin 64s GPS. Each survey employed three cetacean observers, scanning the sea surface with Bushnell 8  $\times$  42 binoculars. When

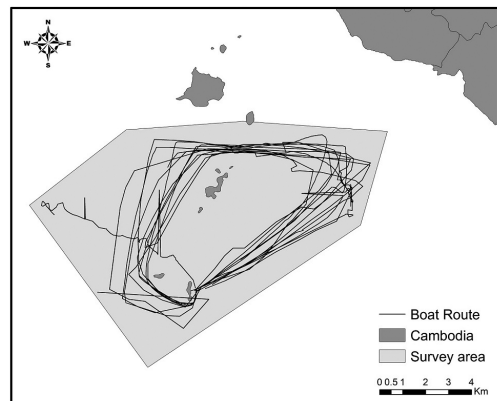


**Figure 1.** The eastern coast of the Gulf of Thailand and the islands of Cambodia's Kep Archipelago

**Table 1.** Dates of boat surveys undertaken

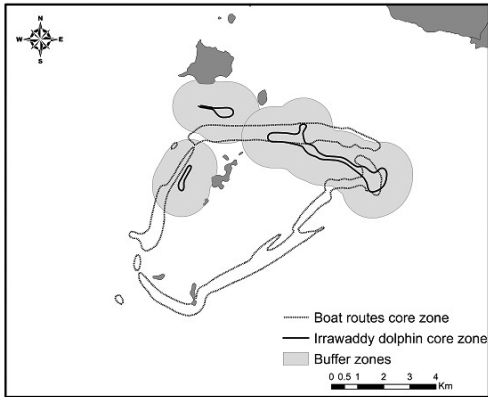
Boat survey identification number	Date
1	5 October 2017
2	27 October 2017
3	23 November 2017
4	7 December 2017
5	4 January 2018
6	18 January 2018
7	23 January 2018
8	14 February 2018
9	20 February 2018
10	20 March 2018
11	26 April 2018
12	3 May 2018
13	10 May 2018
14	15 May 2018

a group or an individual was sighted, time, species, group size, and the number of subadults were recorded. Subadults were distinguished based on their size. GPS coordinates of dolphin sightings



**Figure 2.** Boat survey tracklines and study area covered between October 2017 and May 2018

were calculated using boat GPS coordinates, the distance of the group or individual from the boat, and the angle of the group or individual from the north. Tracklines and resultant sighting locations were transformed into line data using Esri® ArcGIS™ (Environmental Systems Research Institute [ESRI], 2014) and were used to create kernel density maps, with sightings weighted by



**Figure 3.** Boat route core zones and Irrawaddy dolphin (*Orcaella brevirostris*) core and buffer zones produced from tracklines and sightings between October 2017 and May 2018

the number of animals per group. Raster maps for tracklines and sightings were produced from mask extractions as in Bertrand et al. (1996) and Gubbins (2002), and 50% contours were selected as core use zones (Dixon & Chapman, 1980; Samuel et al., 1985; Hauser et al., 2007). Finally, for sightings, buffers of 1 km radius were created around the core zones. Due to the level of sample effort to date, we did not adjust densities for bias due to survey effort (e.g., McBride-Kebert et al., 2019). However, this approach will be employed in future surveys.

Over a total of 14 survey days (40 h, 12 min), Irrawaddy dolphins were sighted on 8 days (18 groups). No other cetacean species were encountered during the surveys. Core dolphin habitat was found south of Koh Tonsay, southeast of Koh Tbal and west of Koh Poh (Figures 1 & 3). It also should be noted that project scientists remained in the study area, residing on Koh Ach Seh Island (Figure 1), over the entire survey period. During this time, Illegal, Unreported, and Unregulated (IUU) fishing activities, specifically bottom and electric trawling, were observed in the study region at least once per day, with an observation log kept.

For all marine mammals sighted between 4 January and 15 May 2018, photographs of dorsal fins and/or tail flukes were captured with a Canon Rebel T6i Digital SLR and EF 75-300 mm f/4-5.6 III lens. The photographer avoided bias towards more distinctive individuals by trying to capture images of both sides of each individual in the group. Photograph resolution was used to sort photographs in “good” and “poor” quality folders, with only “good” quality photographs used for post-analysis to identify individuals. Photographs

were also assessed for the number of distinctive characteristics shown (e.g., nicks, notches, unusual fin shapes, fin scars, body scars, and body deformities). If a “poor” quality image showed two or more distinctive characteristics, it was also included in the analysis. Images of calves and unmarked individuals were discarded to avoid misidentification. *Discovery* software (Gailey & Karczmarski, 2012) was then used to catalogue individuals.

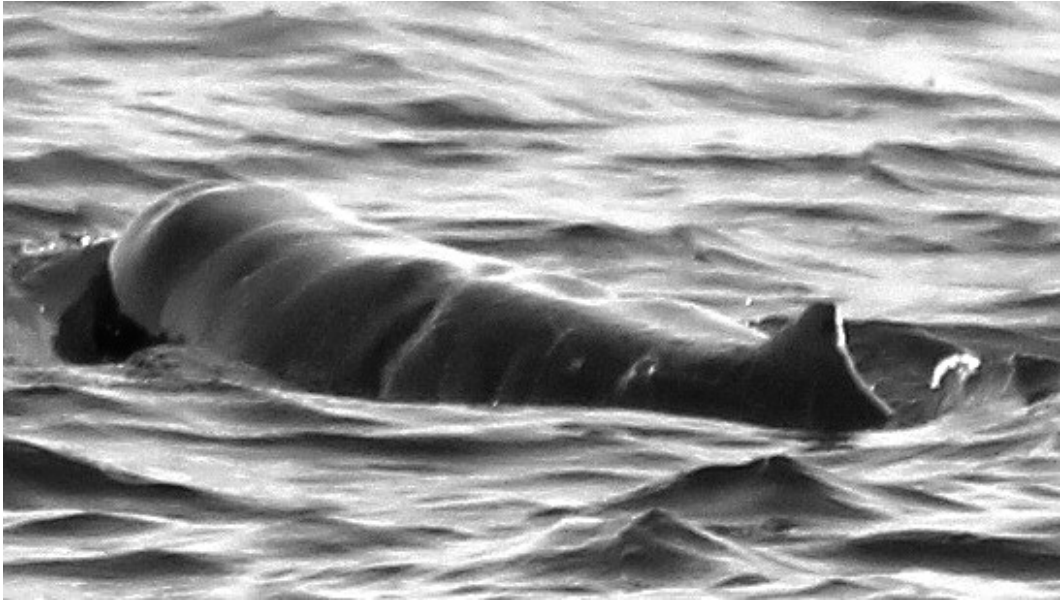
Fifteen individual Irrawaddy dolphins were identified through photo-identification techniques as reported in CMMCP’s 2018 technical report (Tubbs, 2018). One identified individual possessed deep scars characteristic of entanglement in fishing gear (Figure 4).

On 20 February 2018, a C-POD (Continuous Porpoise Detector; Chelonia Ltd., 2014a) was deployed in the Kep Archipelago (10° 21' 29" N, 104° 19' 16" E), suspended 0.5 m above the seabed at a water depth of 2 m. C-PODs are fully automated static data loggers, logging peak frequency, duration, intensity, and bandwidth for sounds between 20 and 160 kHz. *CPOD* software (Chelonia Ltd., 2014b) was used to identify click trains using the KERNO classifier algorithm (Chelonia Ltd., 2014b). Click trains were sorted into “high,” “moderate,” “low,” or “doubtful” quality groups. Based on parameters, including frequency and click interval, “moderate” and “high” click trains were further sorted into species classification groups.

The C-POD recorded data for 62 days, with post analysis revealing 60 click trains characterised as belonging to cetaceans. The *CPOD* software’s KERNO classifier (Chelonia Ltd., 2014b) does not allow for species-specific identification to be made; however, as Irrawaddy dolphins were the only species sighted through observational surveys, it is likely that the acoustic data belongs to this species.

In September 2017, CMMCP launched a marine mammal stranding and bycatch network in the Kep and Kampot region. The network is comprised of local fishers and fisheries officers who report events to project scientists. Between September 2017 and May 2018, four Irrawaddy dolphin carcasses were stranded in Kep Province and one dugong was caught via bycatch in Kampot Province (Table 2; Tubbs, 2018). No necropsies were conducted; hence, causes of death for strandings could not be determined. The figures reported herein are likely underestimates of true stranding and bycatch figures due to lack of rigour of data compilation by fishers or fisheries authorities and/or lack of basic information about species occurrence or identification (Reeves et al., 2005).

Baseline knowledge on species presence is the essential first step in the creation of conservation strategies. Herein, we report the first observations



**Figure 4.** Irrawaddy dolphin with scars characteristic of fishing gear entanglement, Kep Archipelago, 15 May 2018 (Tubbs, 2018)

**Table 2.** Stranding and bycatch records from Kep and Kampot Provinces between September 2017 and May 2018

Date	Location		Species	Age classification	Sex	Information source
	Description	Longitude, latitude				
21 November 2017	Koh Ach Seh, Kep Archipelago, Kep Province	10° 21' 26" N, 104° 19' 13" E	<i>Orcaella brevirostris</i>	Adult	Male	Stranding
21 November 2017	Kep Town, Kep Province	10° 28' 31" N, 104° 18' 11" E	<i>Orcaella brevirostris</i>	Juvenile	Female	Stranding
14 February 2018	Koh Ach Seh, Kep Archipelago, Kep Province	10° 21' 26" N, 104° 19' 34" E	<i>Orcaella brevirostris</i>	Juvenile	Female	Stranding
12 March 2018	Koh Tonsay, Kep Archipelago, Kep Province	No data	<i>Orcaella brevirostris</i>	No data	No data	Stranding
29 May 2018	Kampot coastal waters	No data	<i>Dugong dugon</i>	No data	No data	Bycatch

of Irrawaddy dolphins in Kep and report one incident of dugong bycatch in Kampot. Field observations of IUU fishing were noted during this study in agreement with previous studies by Nelson (1999) and Beasley & Davidson (2007). Past and present observations of IUU fishing, combined with marine mammal entanglement, stranding, and bycatch cases reported during the current study, identify the urgency for regional conservation strategies. As a starting point, we recommend that the Irrawaddy dolphin core and buffer zone habitat presented in Figure 3 should be managed for the purposes

of Irrawaddy dolphin conservation. This study highlights the need for more research activities in the Kep and Kampot region so data can be used to design tailored conservation strategies for the populations. Conservation strategies for both species will require ongoing, comprehensive data collection on their population, ecology, and area use. We, therefore, also recommend expanding survey efforts for Irrawaddy dolphins to the Sihanoukville and Kien Giang Province borders, as well as dedicated dugong studies in Kep Province to fill these knowledge gaps.

### Author Contributions

*Study design and fieldwork:* ST and GC  
*Data analysis:* ST, AAB, and GC  
*Writing the article:* ST, AAB, AJ, and GN

### Acknowledgments

The authors would like to thank Marine Conservation Cambodia and the International Conservation Fund of Canada for funding the research and Cambodia's Fisheries Administration for their collaboration, specifically Phay Somany, Chheng Touk, and Vibol Ouk. The authors would further like to thank the Marine Mammals Research Association for research advice and support.

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