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The Bocas del Toro's dolphin watching industry relies on a small community of bottlenose dolphins: implications for management.

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Abstract: The bottlenose dolphins of Dolphin Bay in the Archipelago of Bocas del Toro (BDT) sustain the largest dolphin industry in Panama. An exponential increase in the dolphin watching boat fleet and lack of compliance by operators has raised concerns about the impact the industry in this bottlenose dolphin population (SC/64/WW2, SC/65b/WW06, SC/65b/WW09, see reports presented this year to SC and WW). In this report we present preliminary estimations of population size and residency patterns for the Bocas del Toro dolphin's population using capture-recapture data from 2004 to 2013. Our exploratory analysis suggests that the dolphin population of Bocas del Toro ranges from 72 to 87 dolphins. This population is divided into two social communities. The largest community has a low recapture (1-5 months) and residency rate (7.7 to 38.5%) and a wider distribution within the Archipelago. The smallest dolphin community is restricted to Dolphin Bay and consists of 37 animals with a high recapture rate (5-13 months) and residency rate (38.5 to 100%). The Dolphin community is further organized into four social units (A-D) with 35% of the individuals showing residency rates ranging from 77 to 100% and 75% of the community with residency rates ranging from 38.55 to 70%. Communities also differ in their levels of associations, within the largest community dolphins show loose associations while in the Dolphin Bay community several individuals associate regularly and for long-periods of time. In a previous study SC/65a/SM15 we had found that BDT dolphins showed (both males and females) high levels of philopatry and that they possessed a unique mtDNA haplotype not found anywhere else in the Caribbean. In this meeting in a report presented by Barragan-Barrera et al. to the SC/66a subcommittee we find further support for the genetic isolation of the BDT dolphins using microsatellite data. Together these results emphasize the need for urgent measures to protect the BDT dolphin population. This dolphin population merits (1) a special consideration by the IUCN as threaten and (2) the commitment of the Panamanian government to ensure its well-being by finalizing the update of the current **Resolution ADM/ARAP NO. 01** which has neither been updated nor enforced in eight years of its publication.

Introduction

A decade of research has provided a number of reports that shows how intensive interactions with multiple dolphin watching boats in Dolphin Bay, Bocas del Toro are negatively affecting the resident dolphins and their habitat. The increasing number of dolphin watching boats interacting simultaneously with a group of dolphins is associated with an increase in noise levels (see May-Collado and Wartzok) and because of this increase in noise levels, dolphins appear to modify the

acoustic structure and emission rate of their communicative signals (SC/64/WW2, see May-Collado and Wartzok, May-Collado reports to SC/66a/WW), primarily when the animals are foraging (May-Collado and Quinones-Lebron 2014).

Surface dolphin behaviors are also negatively affected by interactions with multiple dolphin watching boats present. May-Collado et al. found that the presence of two boats already triggers avoidance behaviors and reduces the frequency of important biological activities such as foraging and social (SC/65b/WW06). These patterns are intensified when calves were present. In a recent study by Kassamali et al. (see report SC/66a/WW) shows how these boat interactions significantly reduce the foraging time of mother-calf pairs. Sitar et al., (see report SC/66a/WW) also shows how lack of compliance in terms of number of boats and proximity to the dolphins also triggers avoidance behaviors and reduces overall foraging time.

Following the Scientific Committee recommendations in continuing our research to monitor the impacts of dolphin watching activities on this population (IWC 2013b, p.80), here we present preliminary estimations the Bocas del Toro bottlenose dolphin population size, community structure, and residency patterns.

Methods

Boat-based surveys were conducted between the Archipelago and the mainland from 7 a.m. to 5 p.m. (Fig.1). Once a dolphin school was sighted, it was approached slowly, to a maximum distance of 50 m, to record its location, group size, and take photographs of individual animals for photo-identification. Photographs of dolphin's dorsal fins were on both sides when possible. All photographs taken on surveys were examined and classified into three grades (excellent, good, and poor) according to focus, contrast between dorsal fin and background, relative angle to the animal, and the size of dorsal fin relative to the frame. Photographs classified as excellent and good were used to identify individuals and develop identification catalogues for each species ([Würsig and Jefferson, 1990](#)).

We use both close and open capture-recapture model implemented in SOCPROG 2.5 to estimate population size. The close model selection was justified based on previous evidence of genetic isolation. In SC/65a/SM15 and Barragan-Barrera (see report submitted to SC/66a) we documented the genetic structure of the BDT dolphin population reporting a unique control region haplotype not found anywhere else in the Caribbean and support for a degree of genetic isolation based on microsatellite data. It is important to note that we are still in the process of adding the photo-ID work from 2014 and upcoming 2015 field season thus the present estimations are primarily exploratory. Future analysis will be done in MARK. To identify dolphin communities and the nature of associations we use the half-weighted association index and the lagged association rate (LAR) also implemented in SOCPROG 2.5. Residency rates were calculated manually following Rossi-Santos et al. (2007).

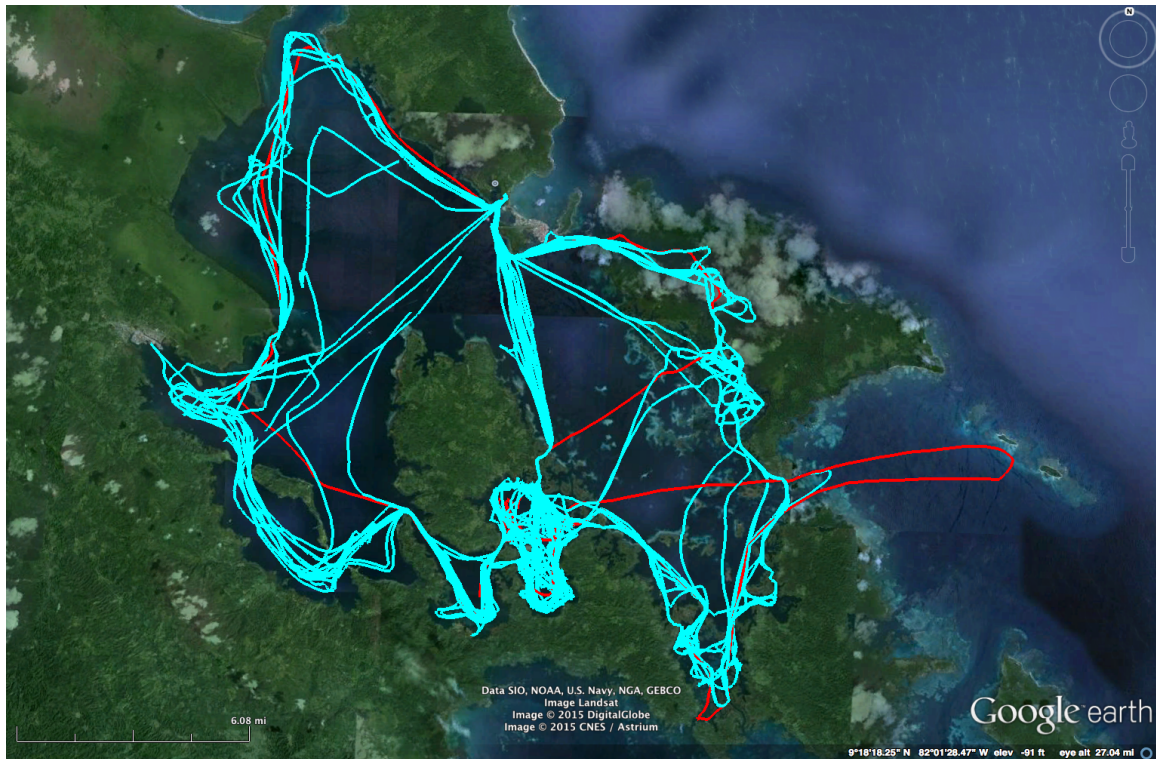


Figure. 1. Study site and survey effort only showing the month of July 2013 for purpose of clarity.

Results

PhotoID: Between 2004 and 2013 we have photo-identified a total of 126 individuals. The addition of new individuals to the population is shown evident in figure 2 where there are moments of reaching stabilizations and then shutting up again. This increase in ‘capture’ animals may be the result of an increase in survey effort from 2012 to 2014.

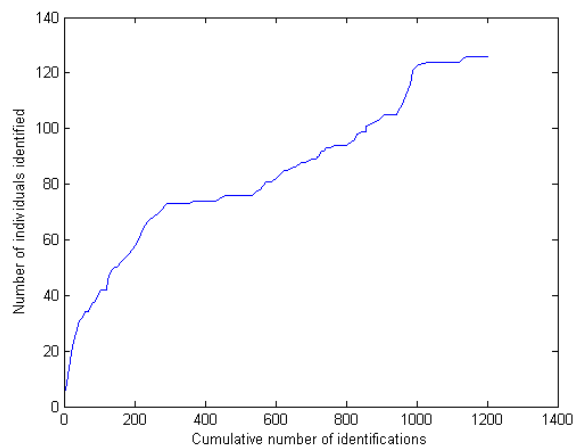


Figure 2. Discovery curves of the cumulative number of bottlenose dolphins identified between June 2004 and October 2013 in Bocas del Toro.

Population size: Table 1 shows the estimations of population size of five models. The selected model was the mortality + trend suggests the bottlenose dolphin population of Bocas del Toro is smaller than previously thought and that is increasing. This increase may be due to an increase in survey effort across the Archipelago of BDT.

Table 1. Population size estimated for the entire Archipelago of Bocas del Toro.

Model	Population size	Bootstrap 95% c.i.	AIC
Petersen	70.3-103	58.9-111.2	-----
‘Closed Schnabel’	109.8	106.9-113	768.6
Jolly-Seber	72-78.8	-----	-----
Mortality model	82.46	77.7-88.5	679.1
Mortality + Trend	80.2	71.9-87	673.5

Association patterns and residency: Our exploratory analyses suggest that the dolphin population of Bocas del Toro ranges is divided into two social communities (Fig. 3). The largest community has a low recapture (1-5 months) and residency rate (7.7 to 38.5%) and a wider distribution within the Archipelago. The lagged association analysis indicates that these dolphins show two levels of association one that is rapid dissociation and casual associates. The smallest dolphin community is restricted to Dolphin Bay and consists of 37 animals with a high recapture rate (5-13 months) and residency rate (38.5 to 100%). The Dolphin community is further organized into four social units (A-D) with 35% of the individuals showing residency rates ranging from 77 to 100% and 75% of the community with residency rates ranging from 38.55 to 70% (Fig. 4). In addition, the lagged association analysis suggest that within the community of Dolphin Bay some dolphins dissociate very quickly, while others show prefer companions, and others associate for some time, dissociate, and then associate again (Goodness of fit chi-squared=9403.7,df=680, $p < 0.0001$, QAIC=8072.2).

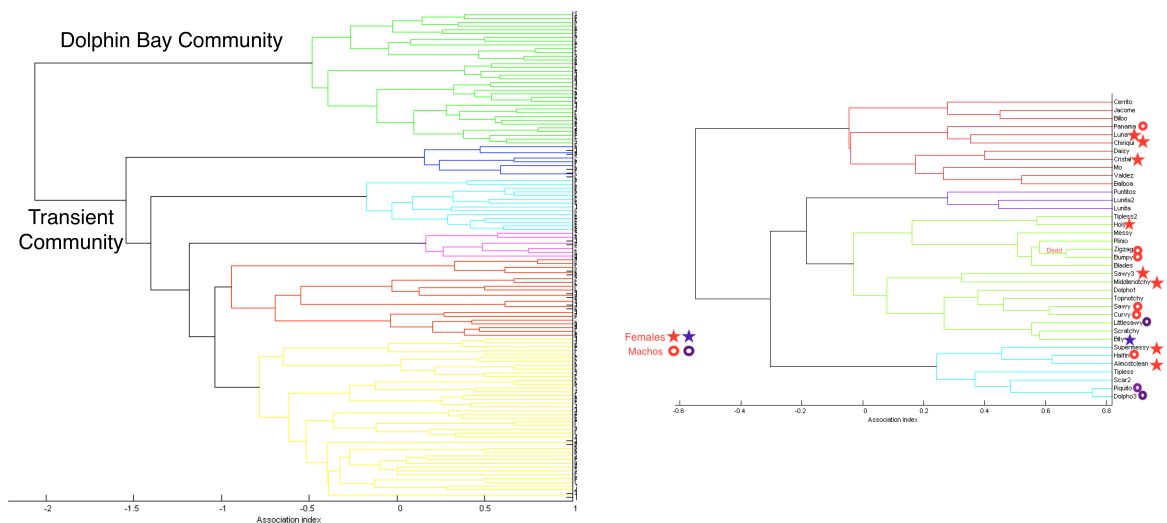


Figure 3. Association patterns reveal the existence of two dolphin communities in BDT (A) Dolphin and Transient communities (B) Dolphin Bay community if further divided into four social units (A=red, B=purple, C or “Bity’s group”=green, and D or “Supermessy group”=light blue. From this community several females and males have been identified as well as the disappearance of a male pair alliance.

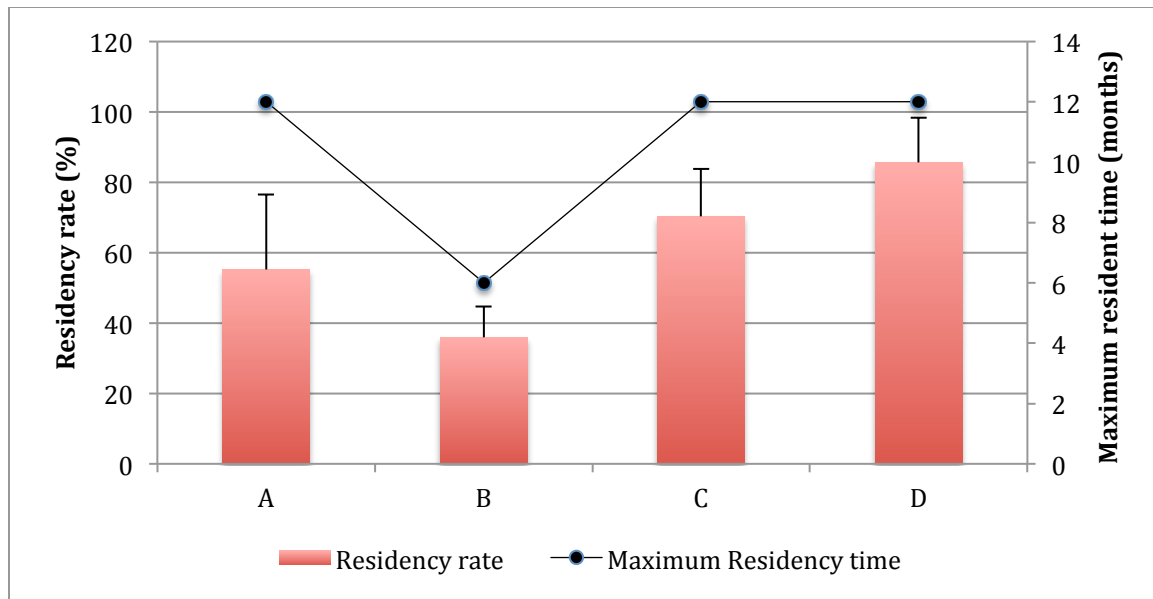


Figure 4. Residency rates given in percentages for the Dolphin Bay dolphin community by social group as shown in figure 3 during 13 months of sampling distributed between 2004 and 2013.

Discussion

Our exploratory analysis estimates for the first time the population size of the BDT dolphin population and the level of residency of these animals in the Archipelago. However, the result of this preliminary must be taken with caution since more data needs to be included and more exhaustive analysis must be run, including the lagged association rate analysis to determine if nonrandom associations persisted over time and the strength of these associations. However, these results are consistent with other bottlenose dolphin coastal populations in that they exhibit small population size subdivided into social communities that show ‘within’ and ‘between’ community variation in social cohesion (Wiszniewski et al. 2009). Because many of the individuals that are part of the Dolphin Bay community use the bay year around and have long-term associations the impact of the dolphin-watching industry on this community may be far more important than the effect of this activity and any other type of watercraft activity outside Dolphin Bay. Future conservation management strategies should include an urgent enforcement and control of the dolphin watching activity inside Dolphin Bay since this is the dolphin community that is primarily targeted by this activity. Multiple studies presented at the IWC (2012, 2013, 2014, 2015) have described the worrying decrease in important biological activities such as foraging.

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