

Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) inhabiting Perth metropolitan waters (Western Australia): A complex population with several communities



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1 Background

Information about demographic independence, intra-community structure, and gene flow are necessary to understand and apply appropriate measures for the conservation of resident dolphins in coastal areas where urbanisation is rapid and on-going.

In the 1990s and early 2000s, two independent studies documented the presence of two small resident dolphin communities in the metropolitan waters of Perth (WA) separated by only a few kilometres [a, b]. Interactions between these communities were not known.

The first step of this study aims to explore whether distinct groupings of resident dolphins are present within the metropolitan waters of Perth and investigate to what degree they interact.

2 Methods

Fieldwork

- Boat based year-round photo-identification surveys;
- From June 2011 to August 2014 ($n = 252$ surveys);
- Study area divided in 4 zones (Fig. 1):
 - SCR: Swan-Canning Riverpark (estuary)
 - CS: Cockburn Sound (semi-enclosed embayment)
 - OA: Owen Anchorage
 - GR: Gage Roads (open to sea)
- Zig-Zag transects: 3 per zone to maximise the coverage and the different habitat types;
- Sampling effort: 4 zones, 4 austral seasons, 5 repeats per season.

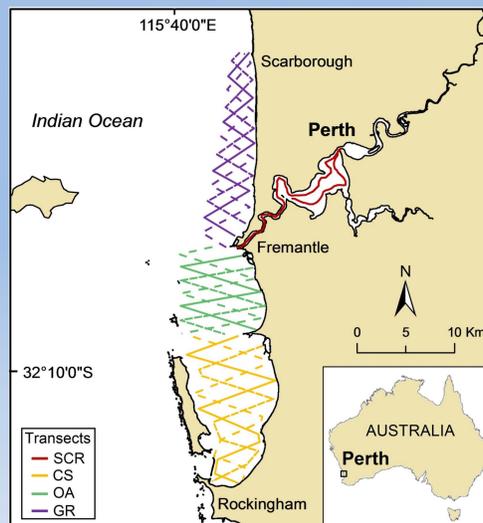


Fig 1: Map of the metropolitan waters of Perth, Western Australia, showing the systematic survey routes within each zone: SCR – Swan-Canning Riverpark; CS – Cockburn Sound; OA – Owen Anchorage; and GR – Gage Roads

Photo-identification

- Non-invasive method used to identify and monitor individuals over time [c];
- Natural marks, nicks and notches on dorsal fin are permanent and allow for long-term identification [d];



Fig 2: Left and Right sides of the dorsal fin of a bottlenose dolphin (Id called: "Backpack"). His trailing edge has multiple notches that are now permanent and easy to recognise.

- Each individual encountered during a survey was photographed for identification.

3 Results

Site fidelity

Site fidelity describes the tendency of an animal to remain in an area over an extended period, or to return to an area previously occupied [e].

Sighting rates were calculated for each individual observed in the study area (Fig. 3-Insert). Sighting frequencies were calculated per zone for individuals seen > 10 % of the surveys (Fig. 3).

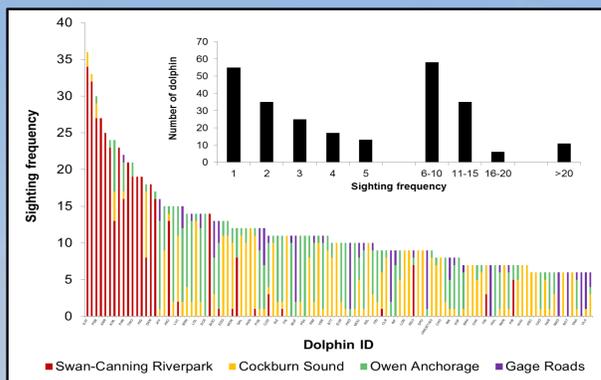


Fig 3: Sighting rates of adult/sub-adult bottlenose dolphins observed in the metropolitan waters of Perth from June 2011 to August 2014; Top – for all; Bottom – for individuals seen in more than 10% of the surveys (with zone details: Swan-Canning Riverpark, Cockburn Sound, Owen Anchorage, and Gage Roads).

Sighting rates indicated:

- One hundred and nine (44%) individuals were regularly observed within the study area;
- Highest fidelity in the Swan-Canning Riverpark (18% of individuals observed >25% of the surveys);
- Lowest fidelity in Gage Roads (7% individuals).

Long-term occupancy

Occupancy pattern describes whether an individual occupies a defined area on a transient, seasonal, or year-round basis [a].

Lagged Identification rates (LIRs) were calculated using the software SOCprog 2.5 [f]. LIRs estimate the amount of time individuals occurred within and outside of the study area using multiple demographic models [g].

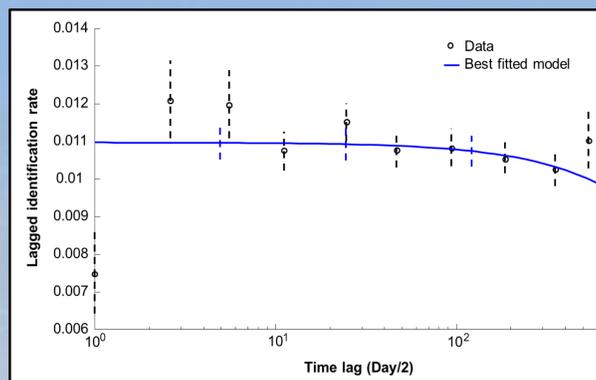


Fig 4: Lagged Identification rates (LIRs) and best fitting model of adult/sub-adult bottlenose dolphins observed in the metropolitan waters of Perth from June 2011 to August 2014.

The best fitting model suggested a demographic pattern of "emigration and mortality" in which an estimated population of 94 dolphins spent more time within the study area than in adjacent waters.

Structured population

Association patterns between pairs of individuals are used to define the social structure of a population [a, f].

Social network was built using SOCprog 2.5 [f] and NetDraw [h] to explore the associations and strength of associations between individuals as well as potential subgroupings using analyses of modularity [h, i].

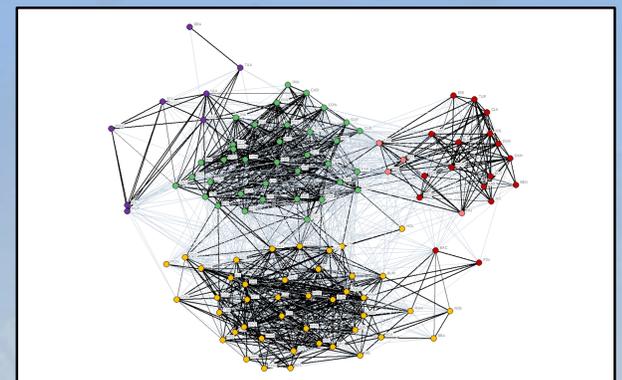


Fig 5: Social network of adult/sub-adult bottlenose dolphins observed in the metropolitan waters of Perth from June 2011 to August 2014. Each individual is represented by a circle. Five clusters (colour of the circle) were defined (Modularity $Q = 0.48$). Darker lines between pairs of individuals (circles) indicates a strength of their association ≥ 0.17 (i.e., mean HWI within clusters).

- Modularity analysis assigned individuals to five clusters ($Q > 0.3$, meaningful representation);
- Dolphins associated significantly more within than between communities (Mantel test: $t = 36.25$, $P = 1.0$);
- Clusters coincided with the zones of the study area: SCR (red & light red); CS (yellow); OA (green); and GR (purple).

4 Conclusion and next step

This snapshot assessment indicates that small communities of resident dolphins inhabit the metropolitan waters of Perth. The structure of the communities seems related to the ecosystem (estuary, semi-enclosed embayment, or open to sea). Although there are some interactions between these communities, further information is needed on the genetic diversity and gene flow between these communities to properly inform management for implementation of conservation measures at appropriate scales.

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References

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