Australian Marine Mammal Centre

Final Report

Season 2014/0X

- **Title** - Distribution and abundance estimate of Australian snubfin dolphins (*Orcaella heinsohni*) at a key site in the Kimberley region, Western Australia
- **Chief Investigator** - Dr Deborah Thiele[1] and Dr Kelly Waples[2]
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Activity Period - May 2014-April 2015

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1. Activity Summary

A clear summary of approximately 500 words outlining the work undertaken and any significant findings (for publication on the Department's web site)
This project used existing datasets to produce an abundance estimate of snubfin dolphins for Roebuck Bay for 2009 and a broad-scale estimation of extent of occurrence and area of occupancy for the species across the Kimberley region of WA. The latter incorporated sightings of snubfin dolphins from a) dedicated surveys with Indigenous sea ranger groups on the sea country of Dambimangarri, Uunguu and Balanggarra between 2009and 2011; b) opportunistic and dedicated surveys by the CI (DT) from Cambridge Gulf to Broome 2004-2012. Dedicated surveys with Indigenous sea ranger groups included training in inshore dolphin survey techniques. Results of the project were presented to representatives from these ranger groups by the Kimberley Land Council in February 2015. The use of these data is under a formal data sharing agreement between the CI (DT) and the Indigenous groups. The extent of occurrence and area of occupancy of snubfin dolphins across the Kimberley region were calculated as minimum convex hulls (MCH) and alpha hulls in GIS. The former polygons were also clipped according to two variables: maximum water depth (<= 40m) and distance from the coast (<= 10km) believed to reflect the known preference of the species for coastal, shallow water habitats. Resulting estimates ranged between 9,874 and 38,875 km^2 for the EOO and 151 and 8,305 km^2 for the AOO, respectively, depending on the method used. The broad-scale mapping is one approach for identifying high interest areas within the overall range of a species for more focussed research. The abundance estimates for Roebuck Bay (approx. 75km^2 study area) were modelled using Pollock's Robust Design and ranged from a low of 33 (CI 17-67) to a high of 90 (CI 47-174) over a 2-3 day period in 2009. The confidence intervals were large and these could be improved with more data. This population had a high apparent survival over the five month study period and a high proportion (89%) of the population were distinctively marked, allowing mark-recapture analysis. Distance sampling performed comparatively poorly for abundance estimation due to the complex coastline of the region

and the lack of dolphin sightings in some parts of the study area.

A partnership was established with the Northern Territory Government (NTG) as a result of this project and NTG have provided a centralised relational online database to WA Government Parks and Wildlife to manage data on coastal dolphin species. This database will have the wider application of accommodating data from other research projects on coastal dolphins in WA. This will enable data to be more easily integrated over a larger area and between jurisdictions and will assist in building information on the population status of these species.

2. The Outcomes/Objectives

The degree to which the Activity has achieved the objectives

The project had four objectives. These are listed below with an evaluation of how these objectives were achieved.

1) Provide a quantitative abundance estimate for Roebuck Bay, WA, across multiple years, using existing data that will stand as a baseline for this population and will also enable comparison with abundance estimates of the species from sites in QLD and NT ***e.g.*** Cleveland Bay and Darwin Harbor

This objective has been partially achieved as we were only able to provide an abundance estimate using the the data from 2009 surveys. Data collected in 2007 and 2008 was not sufficient for a quantitative estimate, therefore we could not achieve a multiple year estimate.

Systematic surveys of snubfin dolphins were undertaken in Roebuck Bay in 2007, 2008 and 2009 by the Chief investigator (Dr Thiele) using standard methodology, i.e. photo identification mark-recapture and distance sampling. Survey design varied between years with zig-zag line transects used in 2007 and 2008 and a grid used in 2009. These data were entered into a purpose-built, oracle database (developed and provided by the Northern Territory Government). This involved processing 12,000 photos, including grading and identifying individual dolphins. These identifications were used to build a photo-ID catalogue within the database that stores attributes of each individual dolphin. A total of 75 dolphins were identified and considered distinctive with adequate marks on their dorsal fin to make them recognisable if re-sighted at a later date. An additional 22 individual dolphins were identified but were not considered sufficiently marked for the purpose of mark-recapture analysis. The marked proportion was calculated by the total number of distinctively marked individuals in each group sighting divided by the total number of images of individual dolphins in that group. The marked proportion was 0.899 and this factor was applied to the uncorrected abundance estimate modelled in the computer program MARK.

To produce an abundance estimate for snubfin dolphins that inhabit Roebuck Bay we analysed the 2009 dataset using Pollock's Robust design modelling approach in the computer program MARK . This model was chosen for two reasons. Firstly, it allowed us to incorporate temporary emigration as it was anticipated that the study area was smaller than the dolphins' home ranges and they moved in and out of Roebuck Bay during the five month study period. Secondly, it is the same method as that used for the recently published abundance estimate for Coburg Peninsula, Port Essington, Northern Territory (Palmer, Brooks *et al.* 2014), allowing for comparison between populations.The resulting abundance estimates for Roebuck Bay ranged from a low of 33 (CI 17-67) to a high of 90 (CI 47-174) over a 2-3 day period. These results confirm that not all individuals are present in Roebuck Bay at one time and that their range is larger than the study area. These results also suggest that more than 100 dolphins may be present in Roebuck Bay during part of the year. This is a significant finding as many abundance estimates from the NT and QLD have been much lower for snubfin dolphins (Cagnazzi, Parra *et al.* 2013; Palmer 2010; Parra, Corkeron *et al.* 2006). However, it should be noted that the confidence intervals were large and therefore additional estimates should be made in future with more data to improve precision. The apparent survival estimate produced over the study period was almost 100%.

This was expected over a period of 80 days for such a long-lived species that displays strong site fidelity.

We chose the larger dataset collected in 2009 to estimate abundance and excluded the 2007 and 2008 datasets as they were not comparable for our purpose due to differences in spatial design and timing of surveys between years. Additionally, the data were too sparse and the capture rates too low to meet minimum requirements for mark-recapture analysis. However the survey and photo identification data have been entered into the database and can be used to create capture histories of individuals in this population and for information on life history (age class and reproductive state), demographic (survival) and long-term residency.

We are in the process of presenting these results in a peer-reviewed publication and have a well advanced manuscript that will be submitted to a relevant peer-reviewed journal by the end of June 2015 (see attached draft manuscript).

2) Compare methods for abundance estimation (Mark-recapture versus distance sampling) and the suitability of these methods for abundance estimation of this species.

Analysis of the 2009 dataset was attempted in standalone software DISTANCE6.2 but was hampered by the limited range of model types and parameterisation options currently available in the program. Two issues were of particular concern: Firstly, the lack of dolphin sightings in some portions of the study region introduced some level of zero-inflation in the data. Secondly, standard spatial smoothing (for predictive modelling within a generalised additive modelling framework) may perform poorly in areas with complex shape, such as the coastline of Roebuck Bay. Tackling this issue requires more advanced modelling techniques such as soap film smoothing which will not smooth across boundary features, but will instead incorporate complex coastline features such as peninsulas and rivers. The data are thus being analysed further in program R 3.1.2, which allows greater modelling flexibility.

To date we have only produced an abundance estimate of 723 (CI 481-1088) for the whole of Roebuck Bay (area of approx. 460km^2). This estimate is possibly inflated and additional work is underway to refine the analysis for the final manuscript. Pending refinement of the distance sampling analysis, we believe that mark-recapture provides the additional information at the individual level which produces a better estimate of group size. In our opinion photo-identification through mark-recapture is the best method for estimating abundance as it produces more precise abundance estimates and provides additional data that can be used to answer questions on life history, demographics (survival, temporary emigration) and residency. Distance sampling (in its spatial form as applied in this project) allows insights into species-habitat relationships (GAM models quantify link between abundance and for example depth or distance to shore), and responses to human disturbances. However, we can't reach firm conclusions until all analyses are complete.

Further detail is provided in the attached draft manuscript (noted above for objective 1).

3) Map the extent of occurrence and area of occupancy of snubfin dolphins in the Kimberley, WA by combining traditional knowledge and dolphin sightings from Indigenous communities by integrating sea ranger and scientific survey sightings.

The objective of mapping and estimating the extent of occurrence and area of occupancy of snubfin dolphins was achieved with data from opportunistic sightings and dedicated surveys conducted by the chief Scientist (DT) in conjunction with indigenous sea ranger groups between 2009 and 2012 across the Kimberley focussing on three broad regions – the sea country of Dambimangarri, Uunguu and Balanggarra. In addition, we incorporated snubfin dolphin sightings from published literature (Allen, Cagnazzi *et al.* 2012) and other open-source repositories (Global Biodiversity Information Facility and Atlas of Living Australia; Naturemap). This information was used to produce a map with the species' range across the Kimberley region. The IUCN relies on the extent of occurrence (EOO) and area of

occupancy (AOO) as the two key range metrics to assess the conservation status of species (Gaston and Fuller 2009). The EOO encapsulates the spatial spread of sites at which a taxon is reported to have been encountered, and can be seen, in its most elementary form, as the shortest continuous imaginary boundary that encloses all distribution points. The AOO refers to the sub-area, within the larger EOO, where animals are actually known to be present. Minimum convex hulls (MCH) and alpha hulls were used in GIS to estimate the EOO and AOO for snubfin dolphins across the Kimberley. Resulting estimates ranged between 9,874 and 38,875 km^2 for the EOO and 151 and 8,305 km^2 for the AOO, respectively.The broad-scale mapping is one method of identifying high interest areas within the overall range of a species for more focused research.

We are in the process of presenting these results for publication and have a well advanced manuscript that will be submitted to a relevant peer-reviewed journal by the end of June 2015 (see attached draft manuscript).

4) Integrate data into a standardised database system for the management of data and facilitation of data sharing between jurisdictions and sites

A standardized and purpose-built database was designed by the Northern Territory (NT) Government to store data on dolphin distribution, photo-identification and survey effort. We entered into a partnership with the NT and have acquired a version of the database which has been populated with the data used in objective 1. The database will be migrated to the custodianship of the Department of Parks and Wildlife where it will be maintained and will have wider application to manage data from ongoing research on coastal dolphins in Western Australia. This will (1) ensure that data gathered across jurisdictions is integrated into the same system ,with consistent formats across the NT and WA, and (2) guarantee compatibility when comparing data across these jurisdictions.

3. Appropriateness

The appropriateness of the approaches used in the development and implementation of the Activity

1) Provide a quantitative abundance estimate for Roebuck Bay, WA

To better meet the assumptions of Pollock's Robust Design model for estimating abundance some modifications to the sampling regime should be made in future. Ideally the primary periods should be separated in time but multiple secondary samples performed in intensive bursts as close together as possible within a primary period. This minimises the effect of movement of dolphins within the study area and ensures more complete coverage of the study area during suitable weather, thus improving the assumptions around closure of the model and resulting in more accurate abundance estimates. Recommendations to meet this would include covering the entire study area in the shortest time possible which could be achieved by using more than one boat during the survey period. s. It should be noted that the modelling approach is also data hungry and therefore more suitable for studies with large datasets and high capture rates. While Roebuck Bay is considered a 'hotspot' area and has a reasonably high density of snubfin dolphins, this method may be less suitable in other areas of the Kimberley where snubfin sightings occur with less frequency.

2) Compare methods for abundance estimation (Mark-recapture versus distance sampling) and the suitability of these methods for abundance estimation of this species.

Overall, Distance sampling to estimate abundance was not found to be as appropriate as mark-recapture for two reasons the complex coastline and the absence of dolphin sightings in some parts of the study area. Importantly, we also found that Distance software was not adequate for modelling these data, which require advanced and more flexible techniques currently only implemented in the package R. This should be of interest to scientists when considering appropriate software packages for modelling distance sampling data.

3) Map the extent of occurrence and area of occupancy of snubfin dolphins in the Kimberley

A traditional approach to computing the extent of occurrence (EOO) is to construct a minimum convex hull (MCH) between all known, projected or inferred records of a species, excluding cases of vagrancy (Gaston et al 2009). Although recommended by the IUCN for species range assessments, MCH have a number of undesirable properties: they are sensitive to irregular, concave habitat patches (particularly for widespread species) and they consistently (and substantially) overestimate range, with important biases introduced by location errors and spatio-temporally varying sampling effort. This approach was refined by first clipping the MCH polygon according to two variables maximum water depth (<= 40m) and distance from the coast (<= 10km) to make it a more realistic representation of the species' range based on existing knowledge (Brooks, Carroll et al. 2014; Cagnazzi, Parra et al. 2013) . We also computed alpha hulls, a refinement over MCH that is more appropriate for long, non-convex, discontinuous ranges.

4) Integrate data into a standardised database system for the management of data and facilitation of data sharing between jurisdictions and sites

The relational database utilised in this project was fit for purpose. Additional functionality of the database was developed during this project including data summary reports produced in a format that can be directly imported into programs such as ArcGIS, MARK and SOCPROG, thereby streamlining data analysis and reporting processes.

4. Effectiveness

The degree to which the Activity has effectively met its stated objectives

The activities of this project, including data archiving, analysis and communication, have all been effective in meeting the objectives. The overarching aim for this project was to compile these datasets, analyse them and prepare manuscripts so that this information is in the public domain through peer-reviewed literature and so that the data is available in an accessible format for comparison and integration into ongoing research and monitoring of this species throughout its range. We have utilised existing datasets to produce estimates of abundance, extent of occurrence and area of occupancy for WA. This information substantially adds to our understanding of this little known species in WA and will provide a benchmark for future research in the state. Further, the development of a State database for WA that is compatible with the system held and used by NT will enhance information sharing across jurisdictions and aid in our understanding of the snubfin population across its range.

The project incorporated Indigenous knowledge and sightings into the broad-scale map and associated manuscript. The KLC held a meeting in February 2015 and presented the results of the project and a proposed outline of the manuscript to representatives of the BardiJawi, Dambimangarri, Uunguu and Balanggarra. A formal data sharing agreement was also finalised between the CI and the Indigenous groups to use the data in the proposed format. An additional capacity building and training workshop was held in Broome with the Nyamba Buru Yawuru in April 2015. This group has actively been monitoring snubfin dolphins in Roebuck Bay since 2014. The workshop provided an opportunity to present the database functionality, including the reporting capability, abundance estimates and distribution mapping of this project to the Yawuru sea country managers and rangers.

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