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Marine mammal tourism in the Bay of Plenty, New Zealand: Effects, implications and management

A thesis submitted in partial fulfilment of the requirements

for the degree of

Doctor of Philosophy in Marine Ecology

At Massey University, Albany, New Zealand

Anna M. Meissner

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This thesis is dedicated to *Babunia*, Genowefa Gawlak (1922-2012)

and to our little Angel

"Life is what happens while you are busy making other plans"

Allen Saunders, 1957

Abstract

Worldwide expansion of marine mammal tourism over recent decades has raised international concerns in terms of the effects of these tourism practices on the species they target. Moreover, the growth and success of the industry have often outpaced conservation planning, including in New Zealand. To illustrate, tour vessels have been operating for *ca*. 25 years in the Bay of Plenty (BOP), situated on the east coast of North Island, New Zealand. By 2010, a total of eight permits had been granted across the region. However, development of this local industry occurred without any baseline data on species occurrence, distribution, habitat use or behaviour.

This study sought to assess the historical occurrence of the marine mammal species off the BOP and determine their spatial and temporal distribution. Current distribution, density and group dynamics were examined for common dolphins (*Delphinus* sp.) and New Zealand fur seals (*Arctocephalus forsteri*), the two most frequently encountered species in the BOP and therefore, the primarily targeted species by tour operators. The extent of anthropogenic interactions with common dolphins was investigated and their effects on dolphin behaviour examined. The number of common dolphin individuals closely interacting with tour vessels was estimated and dolphin-vessel interactions were quantified to assess repetitive encounters.

In the absence of previously undertaken systematic dedicated surveys, the present study investigated the historical spatial and temporal occurrence of dolphins, whales and pinnipeds in the BOP region. The examination of opportunistic data, collected between December 2000 and November 2010 via various platforms of opportunity including but not limited to tour vessels, identified fourteen species of dolphins, whales and pinnipeds occurring in the region. Confidence criteria in successful species identification were assigned based on observer expertise, diagnostic features of reported species and percentage of records reported by observer type. Common dolphins were the most frequently encountered species, followed by killer whales (*Orcinus orca*), bottlenose dolphins (*Tursiops truncatus*) and New Zealand fur seals, other species being infrequently encountered. A detailed examination of common dolphin habitat use

revealed discrepancies with previous findings (*e*.g. higher use of shallower waters), possibly explained by inherent biases to the opportunistic dataset.

Dedicated surveys, conducted between November 2010 and May 2013, investigated the current distribution, density and habitat use of common dolphins and New Zealand fur seals. Both species exhibited a strong seasonality with contrasting occurrence in summer and autumn for common dolphins and in winter and spring for fur seals. Dolphin seasonality is suggested to be linked to movements into deeper offshore waters and/or potentially to neighbouring regions (*i.e*. the Hauraki Gulf) and most likely related to foraging opportunities. Fur seal seasonality suggests that the western BOP supports a non-breeding colony and that foraging reasons may explain the species occurrence in the region. Higher density of common dolphins and fur seals identified over the shelf break and reefs can be explained by enhanced productivity.

First application of Markov chain analyses to common dolphin within oceanic waters, allowed examination of the effects of tourism activities on common dolphins in the BOP. Dolphin foraging behaviour was significantly affected, as dolphins spent less time foraging during interactions with tour vessels and took longer to return to foraging once disrupted by vessel presence. Disruption to feeding may be particularly detrimental to common dolphins in the BOP open oceanic habitat, where prey resources are typically widely dispersed and unpredictable. While the overall level of tour operator compliance with regulations in the bay was relatively high, non-compliance was recorded with regards to swimming with calves and extended time interacting with dolphins.

Evidence of repetitive interactions between tour vessels and common dolphins were examined using photo-identification to assess potential cumulative impacts. An estimated minimum of 1,278 common dolphin individuals were identified in the region, for which the majority (86.9%) showed low levels of site fidelity (*i.e.* only one encounter). At least 61.7% of identified dolphins were exposed to tour vessel interactions. However, spatial (*i.e*. between the western and eastern sub-regions) and temporal (*i.e*. daily, seasonal and annual) cumulative exposure to tourism activities was observed for less than 10% of these individuals. This is likely explained by tour operators “handing over” groups or returning to areas preferentially frequented by

dolphins (*i.e.* presumed foraging hotspots). Due to the opportunistic methods used for photo-identification, these results are indicative only of the absolute minimum of repeated interactions common dolphins may face in the region.

The present thesis represents the first comprehensive assessment of marine mammal tourism in the BOP. It offers important contributions to research and conservation in this area via the critical assessment of historical occurrence of marine mammals in the region. This thesis also provides comprehensive and detailed insights into common dolphin and New Zealand fur seal temporal and spatial distribution in the area. This can serve management agencies to implement efficient conservation plans. While identifying that tourism operations significantly affect common dolphin behaviour and repetitive interactions result in cumulative exposure, this thesis supports adaptive management and further long-term monitoring of marine mammal species in general, and in the BOP region more specifically.

Acknowledgments

This project would not have been possible without the help and support of lots of people I would like to acknowledge here.

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Besides dolphins, I found myself very passionate about another "marine mammal"… Life without a cat wouldn't be worth it! What can I say… Jaz likes water and loves

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List of abbreviations

AIC	Akaike's Information Criteria
ANOVA	Analysis of Variance
Apr	April
Aug	August
BOP	Bay of Plenty
ca.	*circa*, approximately
CI	Confidence Interval
Chl-a	Chlorophyll-a concentration
Dec	December
df	Degree of freedom
E	East
e.g.	*exempli gratia*, for example
ENSO	El Niño Southern Oscillation
ER	Encounter Rate
ESRI	Environmental Systems Research Institute
et al.	*et alii*, and others
etc	*et caetera*, and other similar things
Feb	February
FOR	Foraging
GAM	Generalised Additive Model
GIS	Geographic Information System
gp	Group
GPS	Global Positioning System
h	Hours
hp	Horse power
IDW	Inverse Distance Weighted
i.e.	*id est*, in other words
IQR	Interquartile Range
ind	Individual(s)
IUCN	International Union for Conservation of Nature
Jan	January
Jul	July
Jun	June
KDE	Kernel Density Estimates
km	Kilometre
kts	Knots
Log	Logarithm
m	Metre
Mar	March
mg	Milligram
MGET	Marine Geospatial Ecology Tools
MIL	Milling
min	Minute
MMPA	Marine Mammals Protection Act

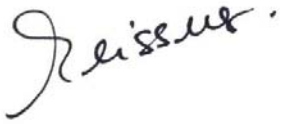
MMPR	Marine Mammals Protection Regulations
N	North
NE	North East
NIWA	National Institute of Water and Atmospheric Research
Nov	November
OCR	Overall Confidence Rate
P	Periodicity
p	Probability
pers. comm.	Personal communication
pers. obs.	Personal observation
photo-ID	Photo-identification
RES	Resting
S	South
SD	Standard Deviation
SE	Standard Error
Sep	September
SLR	Single-Lens Reflex
RV	Research vessel
Sep	September
SOC	Socialising
SST	Sea Surface Temperature
sp.	Unknown species of a genus
spp.	Two or more unknown species within the genus
SR	Sighting Rate
TER	Trip Encounter Rate
TL	Time Lag
TRA	Travelling
TV	Tour vessel(s)
USA	United States of America
US$	US Dollars
VIF	Variation Inflation Factors
W	West
WGS	World Geodetic System
°	Degree
°C	Degree Celsius

Author's declaration

All the photographs and figures have been taken and created by the author unless the source has been specifically acknowledged.

Anna Maria Meissner

July 2015



Preface

The current study, and more specifically Chapter 4 of this thesis, form part of a tendered contract commissioned by the Department of Conservation, former East Coast Bay of Plenty conservancy. The department initiated this research in direct response to concerns raised by the local dolphin tour industry, since operators themselves were opposed to the issuing of further permits within the region due to concerns over sustainability. With a moratorium on further dolphin tourism activities within the region requested by the operators, the department initiated a three year study. As part of the consultation for this study, operators were directly engaged by both the department and Massey University to discuss all aspects of the proposed research. Dialogue concerning the scope of research to be undertaking, including but not limited to the assessment of current compliance levels, took place at the outset of the study and involved Massey University, Department of Conservation and all operators with the ECBOP region. In addition, annual progress reports and presentations were delivered to the operators, via the department in order to keep all stakeholders informed on the progress of the research.

In the framework of this study and in agreement with the Department of Conservation contract (Appendix 1), some of the data presented here were collected aboard tour vessels operating in the Bay of Plenty. Access to the tour vessels for the specific purpose of the predetermined research remit was agreed between all stakeholders including but not limited to the Department of Conservation and the tour operators at the outset of research project. Operators invited the Principle Investigator (Anna M. Meissner) and associated research assistants to board their platforms with the express intent of collecting data with respect to the predetermined research remit. On a daily basis, permission to board each tour vessel was further discussed between the observers (Anna M. Meissner and/or the research assistants) and the tour operators. Furthermore, an introduction of the onboard researchers to the patrons was undertaken along with a brief dialogue about the data collection being undertaken and the overarching purpose of the study.

Publications and presentations

The following publications and presentations have been produced during this PhD, as a result of the research presented in this thesis:

Publications in peer-reviewed journals

Meissner, A. M., Christiansen, F., Martinez, E., Pawley, M. D. M., Orams, M. B. and K. A. Stockin. 2015. Behavioural effects of tourism on oceanic common dolphins, *Delphinus* sp., in New Zealand: The effects of Markov analysis variations and current tour operator compliance with regulations. *PLoS One*: e0116962.

Administrative reports, followed by annual meetings with the Department of Conservation and tour operators from the Bay of Plenty

Meissner, A. M., Orams, M. B., Martinez, E. and K. A. Stockin. 2014. Effects of commercial tourism activities on bottlenose and common dolphin populations in East Coast Bay of Plenty waters. *Final internal report to the Department of Conservation, East Coast Bay of Plenty Conservancy, New Zealand*. 117p.

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Conferences

Meissner, A. M., Martinez, E., Orams, M. B. and K. A. Stockin. 2013. Marine mammal tourism workshop. *20th Biennial Conference on the Biology of Marine Mammals, Dunedin*. [Organising Committee]

Meissner, A. M., Martinez, E., Orams, M. B. and K. A. Stockin. 2013. Occurrence, distribution and behaviour of common dolphins (*Delphinus* sp.) in the Bay of Plenty, New Zealand. *20th Biennial Conference on the Biology of Marine Mammals, Dunedin*. [Oral]

Meissner A. M, Ransijn, J. and K. A. Stockin. 2013. First insight into epidermal conditions affecting common dolphins (*Delphinus* sp.) in the Bay of Plenty, New Zealand. *20th Biennial Conference on the Biology of Marine Mammals, Dunedin*. [Poster]