

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

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

2015



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.

I want to express my deepest gratitude to Dr Karen Stockin, my primary supervisor, for initiating this project, giving me the opportunity to come to New Zealand, and more particularly to the Bay, and start this incredible journey. It has been a passionate, amazing learning experience that I will cherish forever. Thanks for your guidance, advice and re-assurance, whether being on the water or behind my computer. Thank you also for your availability in these final weeks when my submission coincided with your maternity leave.

Very grateful thanks to my co-supervisor Prof Mark Orams for his very encouraging emails, although followed by extensive suggestions and corrections ☺ Your guidance and advice has been very inspiring and provided me great support throughout the project.

Merci à ma co-superviseur Dr Manue Martinez! Who would have thought I could get a French one down under! Despite you being away, “touring” around the islands :-p, your advice, corrections and support have always been really appreciated. Thank you!

Additional thanks for surrogate supervisor, Dr Mat Pawley, aka Paul, who has been of invaluable help and support. Huge thanks for your time and statistical advice, and for putting up with my crazy questions! Your help has been enormous and I can't wait to co-author more papers with you!

I would like to deeply thank Dr Colin Macleod for his guidance, especially his advice relating to Chapter 2. I am not sure in what direction I would have taken that topic without your feedback! Extended thanks also to Jason Roberts for extended hours solving issues with satellite maps, GIS and associated codes. I am really impressed and grateful for your availability and extensive help. Massive thanks also to Prof Graham Pierce for your very thoughtful advice and comments on GAMs. Dr Deanna Clement,

your answers to my twisted questions have always been very clear and helpful so thank you also for your time and interest in this research!

Particular thanks are extended to Dr Kim Young, Clint Savage, Laura Christie, Mark Anderson, Dan Rapson, Dr David Lundquist and Dr Laura Boren from Department of Conservation, for your assistance and input with all aspects of this project and mostly for your kind support during my field work.

I would like to also extend my acknowledgments to Dr Carol Scarpaci and Mary Cowling for time spent on the waters in the BOP and for sharing interesting findings and thoughts on fur seals. Thank you for your advice! Finally, thanks to Nicky Filby for brainstorming over Markov chains with me and best of luck with your own thesis!

I would like to extend my acknowledgments to Mark Fitzpatrick and Caroline Schweder-Goad for sharing data with me and providing feedback on historical aspects of marine mammal occurrence in the BOP.

This research was possible thanks to the funding provided by the East Coast Bay of Plenty Conservancy of the Department of Conservation. I am deeply grateful for the financial support of the Institute of Natural and Mathematical Sciences at Massey University for support via a fees scholarship and a Massey University doctoral scholarship.

Massive thanks to Bridge Marina and Bridge Marina Travelift, and particularly to Tony Arnold, Bruce Goodchap, Fred Jeanes for looking so well after the “banana boat” and her crew. Fred, your knowledge and guidance with everything related to the boat have been without limits. I owe you so much and will never forget your help and kindness from the first day *Aronui* got to the marina until her last trip. Thank you also to Tauranga Coastguards for looking after us for over 1,000h while on the water and bringing us home safe!

I have had the most breathtaking five years of my life. Amazing dolphins, whales and sharks, amazing sunrise and sunset memories, amazingly freezing camps on Mayor thanks to the Tūhua Trust Board (had to be in winter of course!). Memories and friends I

will cherish for life... To all my volunteers I owe this PhD to you! You guys have been the most incredible source of energy, support and help, albeit sometimes a source of stress but often laughter, throughout this journey. I have not enough words to thank you for your dedication, interest and help. In alphabetic order I would like to deeply thank the following persons who gave their time, mostly on the water, but also helped processing so many of my data: Bobby Anthony, Natalia Asplanato, Stephanie Bathgate, Phil Beale, Aaron Boland, Roddney Boullairde, Nichaela Boxall, Jassalyn Bradbury, Tania Bramley, Valissa Buchanan, Hudyn and Maria Butler, Helen Caldwadell, Sean Coollins, Jessica Corkum, Manon Cornille, Katy Cox, Amandine Destables, Sarah Duncan, Sunny Gurule, Tracey Green, Sarah Holmes, Noelle Hope, Chris Ishiwood, Sandra Jean, Fred Jeanes, Marie Larivière, TA Sayers, Alexandra MacKinnon, Mathieu Moreau, Charlène Pérez, Tiffany Plencner, Rachael Plunkett, Alice Podziewska, Christina Ravinet, Nichola Shaw, Lydia Green, Miriam Vorenhout, Janneke Ransijn, Giulia Raponi, Nicole Sturgess, Laura Torre, Rihannan Tucker, Dom Waller, Kevin Wells, Mark Young, Inger van der Bosch, Raphaël Vaton, Elise Verschoor, Lindy Whitehouse, Thomas Windus. (I really hope I haven't missed anybody!)

I would also like to thank the C-MRG team, who I wish I had spent more time with. Thank you to Sarah Dwyer and Monika Merriman for making it to the Bay helping and advising during my first days on the water, and Sarah for making density kernel a little bit less complicated ;-) Thank you to Sarah Gardner who I probably shared my office with for the longest period I had an office at Massey, thanks for getting me addicted to flat whites! Thank you Friederike Jordan for ecofriendly lunch breaks. Thanks to Krista Hupman for our chats and brainstorming over photo-ID. Thanks to Cat Peters for helping with Markov stuff and welcoming me several times in the BOI. Cheryl Cross, thanks for all your calls ... they often reminded me it wasn't so bad for me!!! Of course you had to move into my office, now I'm finished ;-) Thank you to Dr Manue Martinez, Sonja Clemens, Cat Lea and Emma Betty for their ongoing support in all kind of admin stuff. Thanks to Jochen Zaeschmar for sharing your knowledge about Pseudos and visiting us here. Big thanks also to Christophe Amiot for the chats in French, stats and R advice! To all the Master and PhD students: best of luck with your own projects!

I would like to deeply thank the tour operators for their support, co-operation and in-kind sponsorship of this study via platform and data access: Stuart and Rosie Arnold, Graeme and Mary Butler, Cameron Fines, Peter and Jenny Tait, Mark Tucker, Phil and Stephanie Van Dusschoten. You have not only been great colleagues to work besides, but became friends I'm really looking forward to see again soon!

Thanks also to Rosemary Tully, without whom aspects of Chapter 2 would be impossible. Massive thanks for providing this great contribution to my work!

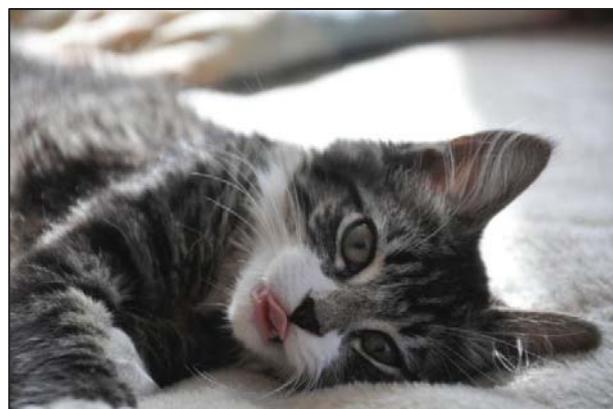
Huge thanks to friends from Auckland and Tauranga for their ongoing help, support and encouragement. The Scott, Riddell and Parlour families, you guys are my family here and I would have given up so many times if not for your love and support. You have been my rock. Special thanks to Anne and Dennis Scott, Jo Riddell, David and Trish Parlour, as well as Donna Bennett and Kevin Wells: I owe you so much!

Chciałabym także podziękować moim Rodzicom i Braciom za ich bezgraniczne wsparcie. Szczególne wyrazy wdzięczności pragnę przekazać Mamie. Kocham Was mocno.

What a boring journey it would have been if I hadn't discovered myself some other passion besides dolphins! Thanks to all the kite-surf instructors and mates for all the laughs and screams on the water! I would like to thank all the dancers from Ceroc Tauranga Club and Bay Salsa that I am looking forward to seeing soon. Thank you to my sweetest swimming coach Paul Kane for finally teaching how to really swim! Namaste Erika Van Oirschot and Clair Herron, Bikram yoga saved my nerves and my back! Thanks to Bronwyn, Donna, Kristy, Jess and Jo from The Studio for all the good fun and painful bruises! Thank you ALL for all the fun, good and relaxing moments that allowed me to escape the thesis for few hours and kept me fit despite the crazy amount of chocolate I have been eating!!! Thank you for the kind thoughts, encouragement and support especially during these last few months. Particular thanks are extended to Brett Bensemann.

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

hanging around Tauranga harbour, so I guess it makes her a marine mammal too ☺. It has been so comforting having your little furry tail around... You always knew when I needed a break and when I did not need it! Thank you for keeping me entertained, making me open doors on “meow” command! Thank you for listening to my doubts and worries, massaging my tummy and my back, and just being the cutest little pet on Earth! You always felt when you had to stay by my side, under my desk, on my desk or my keyboard!!! I promise to get back to our rope games now it’s all over ☺.



THANK YOU ALL!!!

Table of contents

Dedication	i
Abstract	ii
Acknowledgments.....	v
Table of contents.....	x
List of figures	xiv
List of tables.....	xv
List of abbreviations	xvi
Author's declaration.....	xviii
Preface	xix
Publications and presentations	xx

Chapter 1: General Introduction

1.1	Introduction.....	2
1.2	Challenges and implications of marine mammal data collection	3
1.3	Marine mammal-watching in the tourism industry.....	5
1.3.1	Marine mammal tourism world-wide	5
1.3.2	Marine mammal tourism in New Zealand	8
1.3.3	Marine mammal tourism in the Bay of Plenty region.....	11
1.4	Importance of marine mammal distribution studies	14
1.5	The study area	15
1.6	The study species	17
1.6.1	Common dolphins	18
1.6.2	New Zealand fur seals.....	25
1.7	Thesis rational	30
1.8	Thesis structure	32

Chapter 2: The use and contribution of opportunistic data to infer historical occurrence of marine mammals off the Bay of Plenty, New Zealand: A critical approach

2.1	Introduction.....	38
2.2	Methods.....	42
2.2.1	Study area.....	42
2.2.2	Data collection and classification	43
2.2.3	Data processing	49
2.2.4	Data analysis	50
2.2.5	Common dolphin habitat use	52
2.3	Results.....	54
2.3.1	Effort	54
2.3.2	Marine mammal sightings, species identification and observer confidence...55	55
2.3.3	Common dolphins	58
2.3.4	Bottlenose dolphins.....	66
2.3.5	Killer whales	67
2.3.6	New Zealand fur seals.....	67
2.3.7	Blackfish: Pilot and false killer whales.....	68
2.3.8	<i>Balaenopteridae</i> (excluding humpback whales).....	68
2.3.9	Humpback whales	69
2.3.10	Sperm, beaked and southern right whales.....	69
2.4	Discussion	70
2.4.1	Common dolphins	71
2.4.2	Bottlenose dolphins.....	73
2.4.3	Killer whales	75
2.4.4	New Zealand fur seals.....	76
2.4.5	Blackfish: Pilot and false killer whales.....	76
2.4.6	<i>Balaenopteridae</i> (excluding humpback whales).....	78
2.4.7	Humpback whales	80
2.4.8	Sperm, beaked and southern right whales.....	81
2.4.9	Recommendations	82
2.5	Conclusion	83

Chapter 3: Distribution, density and group dynamics of common dolphins (*Delphinus* sp.) and New Zealand fur seals (*Arctocephalus forsteri*) in the Bay of Plenty, New Zealand

3.1	Introduction.....	85
3.2	Methods.....	88
3.2.1	Study area.....	88
3.2.2	Data collection	89
3.2.3	Data analysis	95
3.3	Results.....	100
3.3.1	Effort	100
3.3.2	Sightings	103
3.3.3	Temporal relative density.....	109
3.3.4	Spatial relative density	110
3.3.5	Modeling results.....	115
3.4	Discussion	117
3.4.1	Common dolphins.....	117
3.4.2	New Zealand fur seals.....	123
3.4.3	Study limitations and recommendations for further research	127
3.5	Conclusion	129

Chapter 4: 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

4.1	Introduction.....	131
4.2	Methods.....	135
4.2.1	Study area.....	135
4.2.2	Data collection	136
4.2.3	Regulations applying to commercial tour vessels in the BOP	142
4.2.4	Statistical analysis	142
4.3	Results.....	148
4.3.1	Effort	148

4.3.2	Effect of boat interactions	149
4.3.3	Levels of vessel traffic	153
4.3.4	Cumulative behavioural budget	155
4.3.5	Swimming with the dolphins	157
4.4	Discussion	158
4.5	Conclusion	164

Chapter 5: An assessment of site fidelity and potential cumulative exposure of common dolphins (*Delphinus sp.*) to tourism operations in the Bay of Plenty, New Zealand

5.1	Introduction	167
5.2	Methods.....	171
5.2.1	Study area.....	171
5.2.2	Data collection	172
5.2.3	Data analysis	174
5.3	Results.....	179
5.3.1	Effort	179
5.3.2	Site fidelity	180
5.3.3	Exposure of individuals to tourism	183
5.4	Discussion	186
5.5	Conclusion	192

Chapter 6: Conclusions

6.1	Introduction	194
6.2.	Summary of findings.....	196
6.3.	Limitations of the study	198
6.4	Contribution of present findings, implications for management and perspectives on future research.....	200
6.5.	Concluding statement.....	204

References	206
-------------------------	-----

Appendices	266
-------------------------	-----

List of figures

Chapter 1

Figure 1.1: Maps of countries participating in marine mammal tourism activities	7
Figure 1.2: Marine mammal tourism in New Zealand: species and locations	9
Figure 1.3: Location of the Bay of Plenty.....	13
Figure 1.4: Bathymetry slope map of the Bay of Plenty.....	17
Figure 1.5: Global distribution of common dolphins	19
Figure 1.6: Global distribution of New Zealand fur seals.....	27

Chapter 2

Figure 2.1: Distribution of marine mammals.....	55
Figure 2.2: Seasonal TER for marine mammals	59
Figure 2.3: Seasonal distribution of marine mammals.	61
Figure 2.4: Effect of SST, distance to front, slope on common dolphin occurrence.....	65
Figure 2.5: Effect of depth and season on common dolphin occurrence	66

Chapter 3

Figure 3.1: Location of the Bay of Plenty.....	90
Figure 3.2: Observation platforms	91
Figure 3.3: Search effort	102
Figure 3.4: Distribution of survey effort.....	104
Figure 3.5: Distribution of seasonal survey effort.	105
Figure 3.6: Composition of common dolphin groups.....	107
Figure 3.7: SR and ER for common dolphins and New Zealand fur seals	111
Figure 3.8: Relative density of common dolphins.	113
Figure 3.9: Relative density of New Zealand fur seals.	114
Figure 3.10: Effect of effort, depth, slope, SST and Chl-a on dolphin occurrence.	116
Figure 3.11: Effect of effort, depth, slope, SST on New Zealand fur seal occurrence ..	117

Chapter 4

Figure 4.1: Effect of vessel interactions on behavioural budget of common dolphins...151	151
Figure 4.2: Effect of vessel presence on transitions between behavioural states of common dolphins.....	152
Figure 4.3: Effect of vessel traffic intensity on common dolphin behaviour	156

Chapter 5

Figure 5.1: Cumulative number of identified common dolphins.....	182
Figure 5.2: Frequency of re-sighted common dolphin individuals.....	182
Figure 5.3: Classification tree characterising common dolphin site fidelity.	183

List of tables

Chapter 2

Table 2.1: Origin of historical data.....	44
Table 2.2: Species identification, description and associated confidence rates of observers to accurately identify them in the Bay of Plenty, New Zealand.....	46
Table 2.3: Effort by observer type and sub-region	56
Table 2.4: Percentage of encounters per species and type of observers	57

Chapter 3

Table 3.1: Survey effort.....	101
Table 3.2: Seasonal marine mammal encounters.....	106
Table 3.3: Group size of New Zealand fur seals at haul out sites.....	109

Chapter 4

Table 4.1: Definitions of behavioural states of common dolphin groups.....	140
Table 4.2: Different approaches of Markov chain analysis	145
Table 4.3: Number and duration of sequences and number of behavioural transitions during control and interaction scenarios	149
Table 4.4: Probability of being in a particular behavioural state and time to return to initial behavioural states during control and interaction scenarios	153
Table 4.5: Average bout length during control and interaction scenarios	153

Chapter 5

Table 5.1: Photo-ID effort conducted on common dolphins.	181
Table 5.2: Observed and extrapolated SR of common dolphins exposed to tourism....	184
Table 5.3: Percentage of identified common dolphins exposed to tour vessels seasonally and annually.....	185

List of abbreviations

AIC	Akaike's Information Criteria
ANOVA	Analysis of Variance
Apr	April
Aug	August
BOP	Bay of Plenty
<i>ca.</i>	<i>circa</i> , approximately
CI	Confidence Interval
Chl-a	Chlorophyll-a concentration
Dec	December
df	Degree of freedom
E	East
<i>e.g.</i>	<i>exempli gratia</i> , for example
ENSO	El Niño Southern Oscillation
ER	Encounter Rate
ESRI	Environmental Systems Research Institute
<i>et al.</i>	<i>et alii</i> , and others
<i>etc</i>	<i>et caetera</i> , 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>i.e.</i>	<i>id est</i> , 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

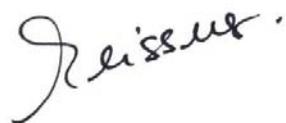
MMPR	Marine Mammals Protection Regulations
N	North
NE	North East
NIWA	National Institute of Water and Atmospheric Research
Nov	November
OCR	Overall Confidence Rate
P	Periodicity
p	Probability
pers. comm.	Personal communication
pers. obs.	Personal observation
photo-ID	Photo-identification
RES	Resting
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

A handwritten signature in black ink that reads "Meissner". The signature is fluid and cursive, with the first name "Meissner" being more stylized and the last name "Meissner" appearing slightly more legible at the end.

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.

Meissner, A. M., Stockin, K. A., Orams, M. B. and E. Martinez. 2013. Effects of commercial tourism activities on bottlenose and common dolphin populations in East Coast Bay of Plenty waters. *Internal report to the Department of Conservation, East Coast Bay of Plenty Conservancy, New Zealand*. 39p.

Meissner A. M., Stockin, K. A., Orams, M. B. and E. Martinez. 2012. Effects of commercial tourism activities on bottlenose and common dolphin populations in East Coast Bay of Plenty waters. *Internal report to the Department of Conservation, East Coast Bay of Plenty Conservancy, New Zealand*. 38p.

Meissner A. M., Stockin K. A, 2011. Impacts of commercial tourism activities on bottlenose and common dolphin populations in East Coast Bay of Plenty waters. *Internal report to the Department of Conservation, East Coast Bay of Plenty Conservancy, New Zealand*. 29p.

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]