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**Responses of South Island Hector's dolphins
(*Cephalorhynchus hectori hectori*)
to vessel activity (including tourism operations)
in Akaroa Harbour,
Banks Peninsula, New Zealand.**

A thesis presented in partial fulfilment of the requirements for
the degree of Doctor of Philosophy in Marine Biology
at Massey University, Auckland, New Zealand



Emmanuelle Martinez

2010



Massey University

DEDICATION

Je dédie cette thèse

*A ma mère Christine Smagghe,
Ma petite soeur Julie Estève,
Et mon adorable filleul Martin Estève
Pour avoir toujours été là pour moi et avec moi malgré la distance.*

*Ainsi qu'à la mémoire de ceux qui nous ont quitté trop tôt:
Mon père Joseph Martinez
Mon grand-père Jean Smagghe
Ma grand-mère Suzy Smagghe
Mon arrière grand-mère Simone Brunerie
Mon oncle Jean-Michel Stieber
Et Josette Veray qui fut comme une tante pour moi.*

*This thesis is also dedicated to
the emblematic Hector's dolphin, special to me in so many ways.*

FRONTISPIECE



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He tu te Pahu, He tu te Tai
“If dolphin is well, so too are our coasts”

Māori whakatauki (proverb)

ABSTRACT

For over 25 years, tour operators have been undertaking view and swim-with-dolphin trips in Akaroa Harbour off Banks Peninsula, east coast South Island, New Zealand. Following the international exponential growth in the commercial dolphin-based tourism industry, Akaroa Harbour is now a key eco-tourism destination in New Zealand with 32 daily permitted trips targeting Hector's dolphin (*Cephalorhynchus hectori hectori*). Such a high number of trips is of particular concern given that this species is not only endemic but also endangered. Our current understanding of the effects of tourism activities on Hector's dolphins in Akaroa Harbour is far from satisfactory. To ensure the sustainability of the economically-important and rapidly-growing dolphin-based tourism industry, there is an urgent need for sound scientific evidence on which to base management decisions.

One of the challenging issues with the assessment of tourism impacts is the lack of baseline data. Prior to beginning the evaluation of the effects of disturbance on this population, data relating to the occurrence and demographics of Hector's dolphins, as well as vessel traffic in Akaroa Harbour, were collected from land-based platforms during three consecutive austral summers (November and March), commencing in 2005. Examination of Sighting Per Unit Effort (here number of dolphin sightings per hour) and the dolphin fine-scale spatial distribution confirmed an inshore-offshore migration and, in the case of the latter, higher density patterns between the Kaik hills and the harbour entrance. However, no specific area was associated with a particular behaviour or nursery groups. The majority of groups consisted of adults only (91.2%, $n = 2,000$) and comprised mainly 2-5 individuals (83.2%). Group size varied with behaviour, being larger when socialising. Activity budgets within two outer bays were very comparable to Akaroa Harbour, except for socialising.

In the harbour, Hector's dolphins only spent a small proportion (14%) of their day (0600-1800 hr) in the absence of vessels. Vessel traffic in the harbour consisted mainly of recreational vessels (72.9%) although commercial vessels represented 70.4% of observed encounters and interacted twice as long with the dolphins. No



displacement was evident and as a result, Hector's dolphins might compensate for high vessel traffic levels by adjusting their behavioural budget.

To determine the effects of tourism activities on Hector's dolphins' behavioural budget, focal-group follows using a scan sample methodology were conducted from land-based stations and analysed using Markov chain models (n = 330 sequences). Vessel presence affected the activity budget of Hector's dolphins by changing transition probabilities, bout durations and the time taken to return to a behavioural state once disrupted. Both diving (inferred foraging) and travelling were significantly disrupted by vessel interactions. The addition of one or more vessels during an encounter further disrupted diving.

Responses of Hector's dolphins to swim attempts were assessed from commercial tourism vessel trips (n = 420). The method of approach and swimmer placement affected the dolphins' behaviour, with a reduction in avoidance when regulations were adhered to, i.e. using *line abreast* and *around* methods. Dolphin responses to swim encounters were also correlated with the number of successive attempts, dolphin group size and initial behaviour. Although Hector's dolphins appear to be more tolerant of the presence of swimmers over time, some level of sensitisation to seasonally high levels of vessel interactions was also detected. The effects of swim encounters could potentially be exacerbated by the use of stones as an auditory stimulant. Specifically, swimmers who used stones had a greater probability of close and sustained approaches by dolphins than those who sang or simply floated on the surface of the water.

Based on opportunistic photo-identification surveys (n = 254), 46% and 44% of the 50 identifiable individuals were infrequently and occasionally recorded interacting with commercial tourism vessels, respectively. It was also estimated that individuals using Akaroa Harbour are exposed to the highest level of cetacean-based tourism in New Zealand. This implies that dolphins that are frequent users of the harbour are likely to be more exposed to intensive tourism pressure. The high resighting rate of some individuals further suggests that frequent users are unlikely to discontinue using the harbour, even though they face increased human disturbance.



Data presented here reveal the nature and the susceptibility of Hector's dolphins to tourism activities, warranting the continuation of a moratorium on new permits. Furthermore, a reduction in daily trip numbers should be considered. Ongoing monitoring of this population's response to tourism activities, combined with an integrated and adaptive approach to management, gives the best chance of ensuring the sustainability of the industry.

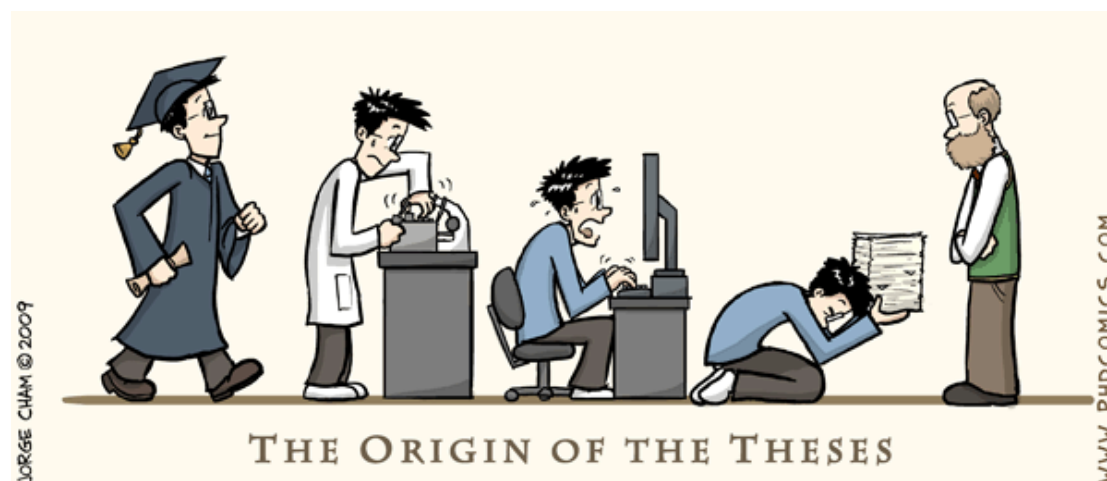


ACKNOWLEDGMENTS

“The road of life twists and turns and no two directions are ever the same. Yet our lessons come from the journey, not the destination” (Don William Jr). There have been an uncountable number of people involved during this journey in one way or another over the past few years, without whom this thesis would have never been completed. “Tēnā rāwā atu koe”, thank you everyone, “merci à tous”!!!

Like any journey, it first starts with an idea and people who have unwavering trust in your capabilities, no matter what the potential length and difficulties ahead. My sincere gratitude goes first to Professor Mark Orams for providing the opportunity for me to do this PhD project and to continue researching the unique and endangered Hector’s dolphin. Thank you for being such a great mentor over the years (Sir Peter would have been proud) and the constant encouragement. My personal and academic growth as a researcher has been possible thanks to your willingness to let me learn from personal experience.

My heartfelt thanks extend to my other main supervisor, Dr Karen Stockin, who has been such an inspiration to succeed. No words can express how grateful I am for all the things you have done for me over the years. I am blessed to have first known you as a friend while doing our PhD, so I am aware that there is another side to the “slave driver” and the infamous “whip” (he he he). Here it is!



Karen (aka da Boss), your friendship and commitment as a supervisor have no bound and I am eternally indebted. Thanks for bearing with me and my puns. I hope that “flip her” will get “stuck in” your mind even though it might be un-bear-able to admit it! Thanks also for



Acknowledgments

making me apart of the New Zealand Common Dolphin Project and training me in necropsy procedures, although I admit, I prefer them alive than smelly. By the end of this journey, you've almost turned me into a "common" girl, although I still think that the Hector's are the cutest! It has been a privilege to be part of the Coastal-Marine Research Group (C-MRG) and see it grow first under Mark and now your leadership.

I also wish to acknowledge my other co-supervisors, Associate Professors Dianne Brunton and Dr Deanna Clement for their advice and support throughout this doctorate. Particular thanks are extended to Dianne for stepping in as main supervisor during the transition period when C-MRG was without a director. Last but not least, I am grateful to Deanna for agreeing to jump on board my committee half-way through, not only providing such great support, encouragement and opportunities to do aerial surveys, but also for being such a good friend ever since our days at the University of Otago.

I make no apology for the hearty serving of appreciation that follows, for I am truly indebted to many people and organisations, thanks to whom this research was possible.

Big thanks go to my supervisors for providing feedback on drafts of the thesis. Even bigger thanks to Sarah Dwyer, Mike Corbett, Carol Duffield, and Krista Rankmore for patiently reading, editing, and/or commenting on final versions.

In addition to my committee, I am also indebted to a number of people who contributed their time and expertise throughout the years. I am very grateful to A/P Liz Slooten, Dr Matt Pawley, Dr Will Rayment, Dr Rochelle Constantine, Dr Eric Kneist, John Harraway, Trudy Webster, and Vicky Binedell for their guidance and support. A special thank you goes to Jofe Jenkins, as always, I could not have started the fieldwork without you!

A project like this could not have been established without the financial support and sponsorship of many commercial companies, organisations and non-profit groups. Significant sponsors of this project include: the Department of Conservation (Canterbury Conservancy), the Institute of Natural Sciences (Massey University at Albany), the New Zealand Federation of Graduate Women, the Helping Hand Fund, the Whale and Dolphin Conservation Society, the New Zealand Forest and Bird Protection Society and Project Aware Australasia. I also thank Sokkia Optical Services Limited, Measurement Solutions Ltd, Battery Direct, T.A. Macalister, DiGiLink, Massey University and Professor Mark Orams for sponsoring the project by providing equipment.



Acknowledgments

I am grateful to the many personnel in various departments of Massey University who have assisted with logistics and administration issues during the length of this project. Particular thanks are extended to Marleen Baling, Antonio Jalilian, Kathy Hamilton, Barbara Just, Muharram Khossainova, Jim Lee, Simon Middleton, Sri Nagappan, Dr Gabriele Schmidt-Adam, Dr Mark Seabrook-Davidson, Rachel Summers, and Kathryn Teal.



A heartfelt thanks to David Janiger (Natural History Museum of Los Angeles County) for providing invaluable references not easily accessible. You truly deserved the student award at the SMM conference in Quebec in 2009.

This research was helped by the generosity and additional support of the tour operators based in Akaroa Harbour, namely, in alphabetic order, Akaroa Dolphins Ltd., the Black Cat Group Ltd., Dolphin Experience Ltd., Fox II Sailing Adventures, and Onuku Farm Hostel. I wish to acknowledge the fantastic staff and crew of these tour operators with whom I have worked over the years. They were, in alphabetic order: Alex, Andrew, Chris, Christi, Christian, Ciaran, Craig, Danielle, Daren, Desree, Ducotte, Durelle, Ed, Emily, Emma, Erena, George, Graham, Greg, Hamish, Hannah, Haley, Helen, Helena, Hugh, Ian, Jane, Jess, Julia aka Fred, Julian, Karen, Kat, Kelly, Kerstin, Klinka, Lee-Ann, Liz, Lizzie, Marko, Marky, Meike, Michelle, Nelson, Nicole, Nigel, Pascal, Patsy, Paul, Pete, Pip, Pippa, Rachel, Richard, Robby, Ron, Ross, Rosy, Rowena, Roy, Russel, Samantha, Sonia, Tobias, Tom, Tony, and Trevor. I hope I have not forgotten anyone!!

I am also indebted to the proprietors of Onuku Farm Hostel, Jeff and Steve, as well as three other local land owners, Vern in particular, who provided access to the observation sites. A big thank you to Sue Nelson for letting me rent such a nice house for the team. I also



Acknowledgments

appreciate the continued support of DoC Canterbury, especially Laura Allum, Alistair Hutt, John Andrews, and Derek Cox as well as several members of the Akaroa community.

Of course, no project can be undertaken without the fantastic help of volunteers and friends who gave generously their time and expertise, making this project such a memorable experience! A big thank you, merci, gracias, obrigada, grazie, danke to you all. In alphabetical order, they were: Hélène Augu, Jessica Banning, Thomas Barreau, Sharon Bond, Chiara Bertulli, Daniele Cagnazzi, Carla Christie, Casey Clark, Deanna Clement, Laura Colombo, Vanessa Dantung, Nicolas de la Brosse, Soledad Esnaola Scotto, Maria Fernanda Souza, Nicki Filby, José-Henrique Garcia, Danielle Gibas, Paulina Guzman, Aidan Hubbard, Jennifer Lamb, Maryse Leguèbe, Monica Mariani, Daniela Mello, Monica Merriman, Lucy Phillips, Adam Rosenblatt, Sarah Rueff, Barbara Saberton, Ronan Scullion, Andrea Traub, Andrea van Niekerk, and Stephanie Whyte. Special thank to Monika Mariani for being such a great research assistant. “Gracie mille at te, mia amica, anche a la tua famiglia”. Congratulations to those of you who went on to pursue their own postgraduate studies. I hope that you got some valuable expertise from this experience.

I would like to also acknowledge my osteopath, Dr. Bruce Miller, for fixing my thesisitis (mainly back and shoulder pain) at the most critical stage of writing up. Your hands worked like magic!

Tim Cahill once said that a journey is best measured in friends rather than miles. I feel really blessed to have so many friends around the world that I can count on. “Un grand merci du fond du Coeur” (a big heartfelt thank you) is expressed to my extended family in Aotearoa, all of whom have supported me throughout the most testing times and allowed me to complete this journey. I am truly grateful to, in alphabetical order: Babette Bayet, Mike Boulic, Liz Burgess, Deanna Clement, Mike Corbett, Steve and Terry Holmes, Gabriela de Tezanos Pinto, Sarah Dwyer, Gabriel Machovsky Capuska, Monika Merriman, Laureline Meynier, the Orams, the Renwicks, Karen Stockin, Karen and Sabrina Strydom,

Special thanks are also owed to Pip Journeaux, Milaan, and the Renwick family for their hospitality and friendship while in the field in Akaroa. You guys are my adopted family. Jan, “muchas gracias amiga, eres como una hermana para mi”.

Mere dost, “mein aap ko dhanyavaad deti houn ki aap meri achi se saheli hokar hame hamesha achi achi salaha deti aayi hai. Mei aap aur aap ke bache ko hirday se dhanyavaad



Acknowledgments

deti huon kyuki aap mujhe apni pariwar ki tahara kayi mahine tak apne ghar hame apna saath rakhi. Ye mei hamesha yaad rakhu gi”. Shukriya from DLCB!

“Un autre grand merci à” Magaly Chambellant, I really enjoyed all our conversations over skype when we were both in the write up stages, going through the usual ups and downs. “Merci copine”! I cannot wait for the next time we see each other, so we can do some bed jumping and drink some Monbazillac to celebrate our achievement.

To all my amazing office mates over the years: Karen Stockin, Liz Burgess, Jodi Smith, Vincenzo Petrella, Gabriel Machovsky Capuska and Sarah Dwyer. You guys have been a real blessing. Thanks for the unconditional support, the good laughs, the treats to keep me going, the hugs and the shared tears. You made the final writing stages bearable and prevented me from going insane (at least more than usual) by letting me vent my frustrations and keeping my stress levels under control. Speaking about stress levels, Gabriel “mi amigo”, a special “muchas gracias” for all the soccer table games, even though the prospect of losing to Argentina (without the “hand of the frog”) was quite stressful and almost defeated the purpose of having a break! I hope that I’ll be able to give you as much support as you guys have given me.

Additional thanks are extended to all my friends and colleagues at C-MRG and the Ecology Conservation Research Groups throughout the years, that I have not already mentioned, especially those from building 86: Anne-Sophie Boyer, Birgit Ziesemann, Brigitte Kriegenhofer, David Gudex-Cross, Fidi Jordan, Jenny Rickett, Sarah Wells and Sarah Whitwell. Special thanks to Sarah Gardner for letting me stay at her house for the last two weeks of the write-up so I would not be homeless. I owe you one!

To Danielle Cagnazzi, Jodi Smith, Dr Claire Garrigue and Aline Schaffar for a welcoming break during the winter times and giving me the opportunity to work with other beautiful cetaceans in Australia and New Caledonia. It was a pleasure to gain further experience in the field of marine mammalogy!

To all my other friends whether in Aotearoa or overseas (you know who you are). “Merci” for your understanding, support and patience. I would never have been able to get to the end of the journey without you. You made the last five years of my life so special. Now that I have finally completed my thesis, I promise to keep in touch more regularly!



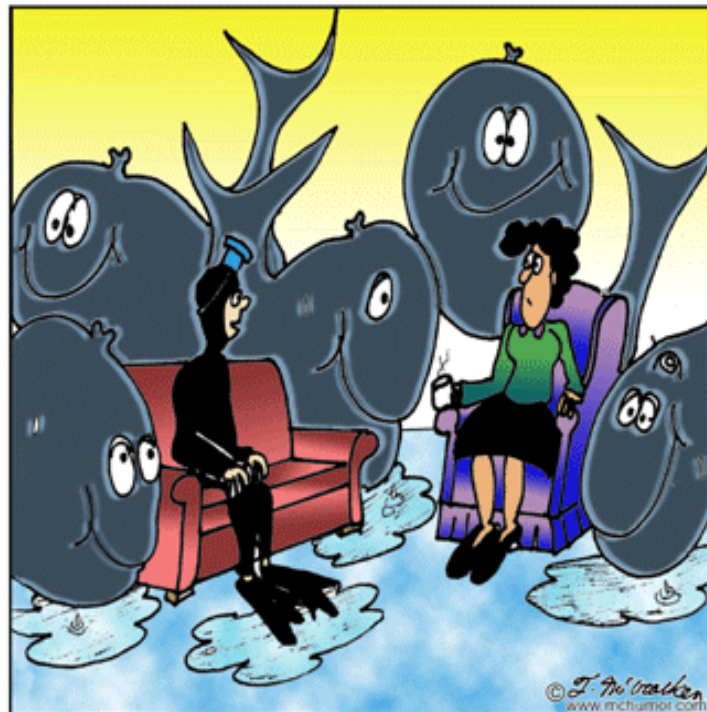
Acknowledgments

Last but not least, I am eternally grateful for the love and unconditional support of my family, in particular my mother Christine, my sister Julie and my godson Martin. Merci à toute ma famille pour son soutien unconditionnel, je n'aurais jamais pu y arriver sans vous! Merci tout particulièrement à maman et Juju pour m'avoir écoutée quand j'en avais le plus besoin. Juju, merci aussi pour tous les colis, un vrai petit bonheur de les recevoir, ainsi que ton chaleureux accueil en France (et d'Olivier et sa famille)! Merci à Martin, mon filleul, un vrai rayon de soleil dans ma vie. Merci aussi d'avoir toujours cru en moi et de m'avoir laissé partir à l'autre bout du monde pour que je puisse continuer à réaliser mon rêve d'enfance. Je vous adore et je suis super fière de vous.

To anyone I forgot to mention (my memory is not what it used to be), I apologise and “merci encore”.

What a journey this has been. It is the interaction and time spent with you all that has truly made this a once-in-a-lifetime experience for me. I will cherish all the memories for the rest of my life.

MCHUMOR by T. McCracken



“Some people save stamps or coins.
I save whales.”



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LIST OF ABBREVIATIONS

AAGR	Average Annual Growth Rate
AEI	The Acoustic Ecology Institute
AHHD	Akaroa Harbour Hector's Dolphin catalogue
AIC	Akaike's Information Criterion
A.R.E.V.A.	Akaroa Research on the Effect of Vessel Activity project
BPHDPC	Banks Peninsula Hector's Dolphin Photo-ID Catalogue
BPMMS	Banks Peninsula Marine Mammal Sanctuary
BWR	Bow riding
BSS	Beaufort Sea State
<i>ca.</i>	<i>circa</i> , approximately
C.I.	Confidence Interval
CJS	Cormack-Jolly-Seber (model)
cm	Centimetre
COC	Code of Conduct
COM	Commercial
C.V.	Coefficient of Variation
d	Days
Dec	December
d.f.	Degrees of freedom
DIV	Diving
DOC	Department of Conservation
DW	Dolphin-Watching
<i>e.g.</i>	<i>exempli gratia</i> , for example
EIA	Environmental Investigation Agency
<i>et. al.</i>	<i>et alii</i> , and others
<i>etc.</i>	<i>et cetera</i> , and other things
Feb	February
Fig.	Figure
GIS	Geographic Information System
GLM	Generalised Linear Model
GOF	Goodness Of Fit
GPS	Global Positioning System
hr	Hour
ID	IDentification
<i>i.e.</i>	<i>id est</i> , in other words
IFAW	International Fund for the Animal Welfare
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
Jan	January
kHz	KiloHertz
kg	Kilograms
km	Kilometre
km ²	Square kilometre
km/hr	Kilometre/hour
kts	Knots
LAC	Limit of Acceptable Change



List of abbreviations

LR	Logistic Regression
Ltd.	Limited
m	Metre
min	Minute
Mar	March
MFish	Ministry of Fisheries
MIL	Milling
MMPA	Marine Mammals Protection Act
MMPR	Marine Mammals Protection Regulations
MPA	Marine Protected Area
MRA	Marine Reserves Act
MSR	Maritime Safety Regulations
NGOs	Non-Governmental Organisation
NIWA	National Institute of Water and Atmospheric research
n	Sample size
nm	Nautical mile
Nov	November
NRC	National Research Council
s	Second
S	South
SIHD	South Island Hector's Dolphin
S.E.	Standard Error of the mean
SOC	Socialising
SPUE	Sighting Per Unit Effort
SST	Sea Surface Temperature
SW	Swim-With-dolphins
TMP	Threat Management Plan
TRAV	Travelling
UNCED	United Nations Conference on Environment and Development
UK	United Kingdom
USA	United States of America
UTM	Universal Transverse Mercator
vs.	<i>versus</i> , against

