

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.

COMPARATIVE SOCIOECOLOGY OF THE DUSKY DOLPHIN
(*LAGENORHYNCHUS OBSCURUS*) IN NEW ZEALAND

A dissertation presented in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

In

ECOLOGY

At Massey University, Manawatu,

New Zealand

WENDY JANE MARKOWITZ

2012

ABSTRACT

Behaviour and social groupings of animals are often closely tied to habitat structure. Ecological factors (e.g., predation pressure, resource distribution) and social pressures profoundly influence behaviour and social organization. This study examined the socioecology of dusky dolphins (*Lagenorhynchus obscurus*) off Kaikoura, one of the most productive submarine canyon habitats in the world, supporting marine mammal populations and a thriving tourism industry. Behavioural data were collected during 332 dusky dolphin group follows from a small research vessel and onboard 174 dolphin tours during 2006-2009. Continuous and interval sampling were used to document behavioural states, behavioural events, and changes in group composition. Data from small groups (n=197) were compared with similar data collected from 67 small group encounters with Hector's dolphins (*Cephalorhynchus hectori*) in the same habitat. In winter, dusky dolphins formed larger groups that ranged more widely and small groups that primarily rested during the day near shore. Although resting, small groups increased dispersion and swam in parallel formation in winter. In summer, dolphins formed small groups for calf-rearing, mating and resting. Groups with calves were the largest and most stable of these small groups, and were found closest to shore, in relatively shallow water, often near river mouths. In mating groups, rapid chases decreased intromission rates as competition among males increased. Sexual selection may favour traits improving male success in behavioural contests as well as sperm competition in this species. Apparent mechanisms for female choice included 'escape' strategies that prolonged chases. Hector's dolphins formed smaller groups with higher fission-fusion rates, less cohesion, and fewer social bond reinforcement behaviours than dusky dolphins. Interactions with tour vessels had short-term effects on the behavioural state, heading, dispersion, and leaping rate of large dusky dolphin groups. Resting was disrupted during tour

interactions and dolphins increased travel away from approaching tour vessels following tour interactions. Assertive approach methods reduced the duration of swimmer-dolphin interactions, particularly in summer when dolphins may be sensitised to high levels of tourism. These large-brained, highly social mammals form intricate societies that are responsive to changes in habitat, predation pressure and resource distribution. Understanding these responses is vital for protection of dolphins in the wild.

DEDICATION

This dissertation is dedicated to my mentor

Dr. Daisaku Ikeda

ACKNOWLEDGEMENTS

A work of this magnitude could only have been accomplished with the support of many colleagues and friends. First and foremost I thank my supervisor, Professor Doug Armstrong, for taking a chance on me and not letting my doctoral ambitions ‘fall through the cracks’. I owe you an immense debt of gratitude for your humor, advice and support throughout this process. Without the support of my dear friend and co-supervisor, Professor Bernd Würsig, I would never have begun, continued, or completed my doctoral studies. For your support and inspiration, I thank you. Your warm encouragement, woofs and keen insight are a wonder. Without your help I wouldn’t have had a ‘boat to stand on’, gas for the boat, any equipment or logistical support. More than this, knowing you were in my corner has always made all the difference.

Support of friends and colleagues during the initial phase of my project on the North Island was invaluable. Specifically, my heartfelt thanks go to Monika Merriman, for your laughter, stories, and friendship. Your enthusiasm is catching.

Colleagues and friends on the South Island were a joy to work with. Thank you to Sam DuFresne for your boat humor. Thank you to Tracey Cooper for your friendship and time on the water. Thank you to David Lundquist for being the ‘voice on the hill’. Thank you to the staff of Dolphin Encounter; particularly Dennis and Lynette Buurman, Ian ‘Brady’ Bradshaw, Jackie Wadsworth, Hank Posa, Pete Bradshaw, Gary Melville and Alastair Judkins. Thank you for the hot chocolate and biscuits on those bitter cold southerly days. Thanks especially to Alastair for being there the day the swells were high off the peninsula and our boat seemed particularly small.

Thank you to my intrepid research volunteers, who came from all over the world to share dolphin time with me. My deep thanks and appreciation to Rachele Longhitano,

Fredericke Jordan, Jody Hanson, Soledad Tolosa, Annabelle Edmond, Caroline Waring, Sarah Piwetz, Stephanie Milne, Jenna Soulliere, Joana Castro, Erin Rechsteiner, Elizabeth Hall, and Michelle Mudford. There aren't words enough to thank each of you for your special contribution to my dissertation work, and to my life. Your continuing friendship is invaluable to me.

Funding for this project was provided by the New Zealand Department of Conservation. In particular, thank you Andrew Baxter for your support and advice. Additional funding was provided by a doctoral scholarship from Massey University. Without this additional financial support, I would not have been able to conduct my work. A travel grant from Jai John Analytics funded presentation of my findings at a Society for Marine Mammalogy conference in Quebec, Canada.

Last but not least, my deepest thanks and appreciation to my family. To my son, Victor Tannehill, "Tanner", you are a brilliant light in this world. Thank you for your baby patience and sweet smile. To my husband, Timothy Michael, you are my rock. I hope to spend many lifetimes repaying my debt of gratitude to you.

My gratitude and thanks to my brother, "Jai" John Mitchell, you are my best friend; to my mother, Janey Mitchell, without whose alloparenting skills this dissertation would have remained in a dark, dusty corner of my computer, and to my father, Daniel Mitchell. Thank you for believing in me and sending my mother to me when I needed her. Thank you to my new family; to my sister Jenny Markowitz, and Hal and Krista Markowitz. Thank you for your encouragement and enduring good humor. Thank you to N. Markowitz for your companionship and love. I miss you. Thank you to my sister in faith, Maggie Eisenberg. We have definitely won.

TABLE OF CONTENTS

Chapter 1 – Introduction.....	1
Socioecology	1
Marine Mammal Social Organization	2
Dolphin Socioecology.....	2
Dusky Dolphins.....	4
Dolphins and Tourism.....	5
Study Area	7
Dusky Dolphin Research	8
Research Objectives.....	10
Summary of Chapters.....	11
Chapter 2 –	
Socioecology of the New Zealand dusky dolphin: Life on the edge of the Kaikoura Canyon.....	14
Introduction.....	14
Methods.....	23
Results.....	36
Discussion.....	68
Summary of Findings.....	72
Chapter 3 –	
Social cohesion and reproductive effort in small groups of dusky dolphins off Kaikoura, New Zealand	75
Introduction.....	75
Methods.....	86
Results.....	93
Discussion.....	118
Summary of Findings.....	133
Chapter 4 –	
Comparative socioecology of sympatric dusky and Hector’s dolphins at Kaikoura, New Zealand	134
Introduction.....	134
Methods.....	141
Results.....	146
Discussion.....	164
Summary of Findings.....	170
Chapter 5 –	
Interactions of dusky dolphins with tours and recreational vessels at Kaikoura, New Zealand	174
Introduction.....	174
Methods.....	178
Results.....	183
Discussion.....	200
Summary of Findings	206
Chapter 6 –	
Reactions of dusky dolphins to tour vessels and swimmers off Kaikoura, New Zealand.....	208
Introduction.....	208
Methods.....	214
Results.....	218
Discussion.....	247
Recommendations and Summary of Findings	257
Chapter 7 – Conclusions.....	260
References.....	264

LIST OF TABLES

Chapter 1

<i>Table 1.1. Some life history parameters of the dusky dolphin</i>	4
---	----------

Chapter 2

<i>Table 2.1. Incidence of social-sexual activity documented in large groups is compared by season.</i>	54
--	-----------

Chapter 3

<i>Table 3.1. Movement patterns of small mating groups off Kaikoura</i>	112
---	------------

Chapter 4

<i>Table 4.1. Life history parameters of dusky and Hector's dolphins are compared.</i>	137
---	------------

<i>Table 4.2. Terms related to social grouping patterns examined in the current study are defined.</i>	143
---	------------

<i>Table 4.3. Mean durations \pm SE of behavioural state, dispersion, formation and directional heading are compared for Hector's dolphin and dusky dolphin small groups.....</i>	151
--	------------

Chapter 5

<i>Table 5.1. Research effort by time of day and dolphin swim tour activity</i>	178
---	------------

<i>Table 5.2. Estimated speeds and angles of swim-with-dolphin tour vessels approaching and leaving dusky dolphin groups.</i>	187
--	------------

<i>Table 5.3. Estimated speeds and angles of non-swim dolphin watching tour boats approaching and leaving dusky dolphin groups</i>	194
--	------------

<i>Table 5.4. Estimated speeds and angles of private recreational boats approaching and leaving dusky dolphin groups.</i>	198
--	------------

Chapter 6

<i>Table 6.1. Characteristics of swim-with-dolphin tours off Kaikoura, New Zealand</i>	219
--	------------

<i>Table 6.2. Dolphin groups encountered by tour vessels before and after the swim..</i>	220
---	------------

<i>Table 6.3. Comparison of current study with previous data collected onboard swim-with-dolphin tours off Kaikoura, New Zealand.....</i>	247
---	------------

LIST OF FIGURES

Chapter 1

<i>Figure 1.1. The New Zealand dusky dolphin</i>	<i>5</i>
<i>Figure 1.2. The study area includes coastal areas from north of the Hapuku River south to the Waiau River, centered on the Kaikoura Canyon.....</i>	<i>7</i>
<i>Figure 1.3. Seasonal primary productivity based on chlorophyll a concentration, summer 2010-11 ..</i>	<i>8</i>

Chapter 2

<i>Figure 2.1. The primary and secondary research areas with river locations and bathymetry.</i>	<i>24</i>
<i>Figure 2.2. Continuous behavioural sampling of focal dolphin groups was accomplished with a digital voice recorder with noise reducing headset.....</i>	<i>32</i>
<i>Figure 2.3. The distribution of large dusky dolphin groups encountered by season</i>	<i>37</i>
<i>Figure 2.4. Encounter locations for small dusky dolphin groups by season</i>	<i>38</i>
<i>Figure 2.5. Areas where dusky dolphin groups were encountered are compared by group size and season.....</i>	<i>39</i>
<i>Figure 2.6. Distance from shore and water depth is compared by season for large groups.</i>	<i>40</i>
<i>Figure 2.7. The water depth (left) and distance from shore (right) at which small groups of dusky dolphins (<50 dolphins) were encountered are compared by season.</i>	<i>41</i>
<i>Figure 2.8. The estimated water depth and distance from shore at which dusky dolphin groups were encountered during summer is compared for two areas.....</i>	<i>41</i>
<i>Figure 2.9. Mean leg speed of large and small dolphin groups is compared by season.</i>	<i>42</i>
<i>Figure 2.10. Mean durations of all behavioural states, dispersion, formations and directional headings were calculated for dusky dolphin small groups from continuous data.</i>	<i>43</i>
<i>Figure 2.11. Proportion of 2-minute scan samples of large dusky dolphin groups were observed in each behavioural state and compared by season.....</i>	<i>44</i>
<i>Figure 2.12. Duration of behavioural states and proportion of time spent in each behavioural state are examined by season for small groups.</i>	<i>45</i>
<i>Figure 2.13. Estimated minimum, mean and maximum dispersion in large groups.....</i>	<i>46</i>
<i>Figure 2.14. Duration and proportion of time at varying dispersions are compared seasonally for dusky dolphin small groups..</i>	<i>47</i>
<i>Figure 2.15. The proportion of 2-minute scan samples with large dusky dolphin groups observed swimming in formation are compared by season.</i>	<i>48</i>
<i>Figure 2.16. Mean duration and proportion of time spent in varying group formations are compared for dusky dolphin small groups by season.</i>	<i>49</i>
<i>Figure 2.17. Duration and proportion of time for directional movement is compared for small groups of dolphins by season.</i>	<i>50</i>
<i>Figure 2.18. The proportion of two-minute intervals during which high-speed activities were documented in large groups is compared by season.</i>	<i>51</i>

<i>Figure 2.19. Frequency of high speed behaviours is compared by season for small groups.</i>	52
<i>Figure 2.20. The proportion of two-minute intervals during which interactive play behaviours were documented in large groups is compared by season.</i>	53
<i>Figure 2.21 Frequency of social play behaviours for small groups are compared by season.</i>	53
<i>Figure 2.22 . The proportion of two-minute intervals during which social contact behaviour was documented in large groups is compared by season</i>	54
<i>Figure 2.23 Social behavioural events are compared for dusky dolphins in small groups by season</i>	55
<i>Figure 2.24. The number of clean headfirst re-entry leaps in large groups is compared by season....</i>	56
<i>Figure 2.25. The rate of clean headfirst re-entry leaping in small groups is compared by season.....</i>	56
<i>Figure 2.26. Noisy leaping rate in large groups is compared by season.</i>	57
<i>Figure 2.27. Acrobatic leaps in large groups are compared by season.</i>	58
<i>Figure 2.28. Bouts of noisy leaps in small dusky dolphin groups is compared by season.</i>	58
<i>Figure 2.29. Group behavioural events for dusky small groups are shown by season.</i>	59
<i>Figure 2.30. Large Group locations by time of day..</i>	60
<i>Figure 2.31. Encounter locations are compared for small dusky dolphin groups by time of day</i>	61
<i>Figure 2.32. Areas that small groups of dusky dolphins were encountered by time of day.....</i>	62
<i>Figure 2.33. Distance from shore compared by time of day for large dolphin groups..</i>	63
<i>Figure 2.34. The water depth that small dusky dolphin groups were encountered by time of day.</i>	64
<i>Figure 2.35. Proportion of 2-minute scan samples of large dusky dolphin groups were observed in each behavioural state and compared by time of day</i>	65
<i>Figure 2.36. Dive duration is compared by time of day for small groups.</i>	65
<i>Figure 2.37. Proportion of two-min intervals of high-speed activity in large groups by time of day.</i>	66
<i>Figure 2.38. The proportion of two-minute intervals of bubble blowing play in large groups is compared by time of day.</i>	67
<i>Figure 2.39. Noisy leap sequence is shown</i>	70

Chapter 3

<i>Figure 3.1 Dusky dolphin adult and calf encountered in a small group off Kaikoura, New Zealand</i>	78
<i>Figure 3.2. Social-sexual contact behaviors examined in this study.</i>	89
<i>Figure 3.3. Dolphins can be sexed using digital photographs.</i>	90
<i>Figure 3.4. Locations on first encounter are compared for small groups by group type.</i>	94
<i>Figure 3.5. Standard deviation ellipses compare the area across which different types of dusky dolphin small groups were encountered.</i>	95
<i>Figure 3.6 . The water depth and distance from shore at which small groups were encountered are compared between mating groups, non-mating adult groups, and mother calf nursery groups.</i>	96
<i>Figure 3.7. The distance to the nearest river mouth, estimated based on first encounter GPS position, is compared between nursery groups, mating groups, and non-sexually active adult groups</i>	97

<i>Figure 3.8. Association with rivers in the study area is compared between different types of small dusky dolphin groups.</i>	98
<i>Figure 3.9. Mean group size per 2-min interval is compared by group type</i>	99
<i>Figure 3.10. Percent of 2-min intervals with a change in group size is compared by group type.</i>	100
<i>Figure 3.11. Mean subgroup size per 2-min interval is compared by group type.</i>	101
<i>Figure 3.12 Proportion of time spent in each behavioural state and duration of behavioural states are compared for dusky dolphin small groups.</i>	102
<i>Figure 3.13. Mean proportion and durations spent at varying inter-individual distances are compared for dusky dolphin small group types.</i>	103
<i>Figure 3.14 Mean proportion of time and duration in different formations are compared by group type.</i>	104
<i>Figure 3.15. Most small dolphin groups spent majority of their time in a variable heading.</i>	105
<i>Figure 3.16. Frequency of play behaviours are compared by group type</i>	106
<i>Figure 3.17. High speed behaviours are compared by group type.</i>	106
<i>Figure 3.18. Social events are compared by group type for small groups.</i>	107
<i>Figure 3.19. Behavioural events are compared by dusky dolphin small group type.</i>	108
<i>Figure 3.20.. Mean dive duration in seconds is shown by group type.</i>	109
<i>Figure 3.21. Depth and distance from shore are shown by season..</i>	110
<i>Figure 3.22. The swimming formation of small, non-reproductively active adult groups is compared by time of day.</i>	111
<i>Figure 3.23. Dolphin social contact in the context of mating is shown.</i>	112
<i>Figure 3.24. A characteristic ‘U-shaped’ position is held by the individual at the surface during copulation</i>	113
<i>Figure 3.25. Re-entry leaping is shown.</i>	114
<i>Figure 3.26. The water depth and distance from shore at which nursery groups were encountered are compared by season</i>	115
<i>Figure 3.27. Standard deviation ellipses are used to compare the areas in which mother-calf nursery groups were encountered off Kaikoura by season.</i>	116

Chapter 4

<i>Figure 4.1. Hector’s dolphin surfacing off the Hapuku River mouth</i>	138
<i>Figure 4.2. Purple lines show the line transects surveyed using the zigzag design along the near shore area from the Haumuri Bluffs to the Waiau River.</i>	141
<i>Figure 4.3. Encounter locations of Hector’s dolphin groups and small dusky dolphin groups are compared</i>	147
<i>Figure 4.4. The water depth (left) and distance from shore (right) at which small groups of dusky dolphins Hector’s dolphins were encountered are compared.</i>	148
<i>Figure 4.5. The distance to the nearest river mouth, estimated based on first encounter GPS position, is compared between small groups of dusky dolphins and Hector’s dolphins</i>	149
<i>Figure 4.6. Association of dolphin groups encountered with rivers in the study area is compared between small groups of dusky dolphins and Hector’s dolphins</i>	149

<i>Figure 4.7. Mean dive duration for Hector's and dusky dolphin groups is shown.</i>	150
<i>Figure 4.8. Duration of behavioural state for Hector's and dusky dolphin groups scored using continuous behavioural monitoring and mean proportion of time in each behavioural state are compared for Hector's and dusky dolphins.</i>	152
<i>Figure 4.9. Mean occurrences per hour of seabirds feeding in and around groups of Hector's and dusky dolphins are compared.</i>	153
<i>Fig 4.10. Inter-individual distance is compared for Hector's and dusky dolphin groups.</i>	154
<i>Figure 4.11. Direction of travel is compared for dusky and Hector's dolphin groups.</i>	155
<i>Figure 4.12. Mean proportion of time spent for dusky and Hector's dolphins in various group formations are compared.</i>	156
<i>Figure 4.13. Frequency of behavioural social events is compared for dusky dolphin and Hector's dolphin small groups.</i>	157
<i>Figure 4.14. Mean rates of occurrence of surface social behavioural events are compared for dusky and Hector's dolphins.</i>	158
<i>Figure 4.15. Mean rates of leaping behaviour are compared for Hector's and dusky dolphins.</i>	159
<i>Figure 4.16. Play behaviour is compared for dusky and Hector's dolphins.</i>	160
<i>Figure 4.17. Behavioural event frequency and type for Hector's and dusky dolphins.</i>	161
<i>Figure 4.18. A typical subgroup of Hector's dolphins during the current study.</i>	161
<i>Figure 4.19. Number of dusky and Hector's dolphin subgroups.</i>	162
<i>Figure 4.20. Mean group size and subgroup size per 2-min interval are compared for Hector's and dusky dolphin small groups (above) with mean duration of group size (below).</i>	163

Chapter 5

<i>Figure 5.1. Changes in behavioural state transition proportions based on Markov chain analysis are compared for dusky dolphin groups before versus during and during versus after swim-with-dolphins tour boat interactions.</i>	184
<i>Figure 5.2. Behavioural state of dusky dolphins is compared before, during and after visits by swim-with-dolphins tour vessels</i>	185
<i>Figure 5.3. Directional heading of dolphin groups is compared before, during, and after swim-with-dolphins tour interactions in the morning and afternoon</i>	186
<i>Figure 5.4. Dolphin group bearing is compared before, during and after interacting with swim-with-dolphin tour vessels.</i>	188
<i>Figure 5.5. Changes in dolphin group heading of 45° or more are compared before, during and after swim-with-dolphins tour boat interactions</i>	188
<i>Figure 5.6. Dispersion of dolphin groups interacting with dolphin swim tour vessels and groups not visited by dolphin swim tour vessels is compared by time of day.</i>	189
<i>Figure 5.7. The number of bouts of noisy leaps is compared before, during and after swim-with-dolphins tour boat interactions.</i>	190
<i>Figure 5.8. Acrobatic leaps and non-acrobatic noisy leaping behaviour are compared before, during and after swim-with-dolphin tour vessel interactions</i>	191

<i>Figure 5.9. Proportion of 2-minute intervals during which dolphins engaged in porpoising is compared before, during and after swim-with-dolphin tour vessel interactions.</i>	192
<i>Figure 5.10. Number of dolphins riding the bow of the research vessel increased after swim-with-dolphin tour vessel interactions when compared with bow-riding before tour vessel interactions ..</i>	193
<i>Figure 5.11. Dispersion of dolphin groups during interactions with dolphin watching tour vessels is compared to times when the vessels were not present.</i>	195
<i>Figure 5.12. Number of bouts of acrobatic leaps and total number of flips per 2-minute sampling interval are compared when non-swim dolphin watching tour boats are present and absent.</i>	196
<i>Figure 5.13. The percent of 2-minute intervals during which high speed behaviours were observed is compared in the absence and presence of non-swim dolphin watching tour boats.</i>	197
<i>Figure 5.14. Changes in dolphin group heading of 45° or more are compared in the presence versus in the absence of recreational boats</i>	199

Chapter 6

<i>Figure 6.1. Dolphin Encounter vessels used during swim-with-dolphin tours</i>	210
<i>Figure 6.2. Size of dolphin groups approached by tour vessels during swim-with-dolphin tour operations, January 2007-February 2009.</i>	218
<i>Figure 6.3. Percent of tours with number of swim-with-dolphin tour vessels present are shown</i>	220
<i>Figure 6.4. The frequency distribution of total number of swim approaches by the tour vessel per tour is shown</i>	221
<i>Figure 6.5. Speed of swim-with-dolphin vessels during approaches of the dolphin group in preparation for a swim drop is shown</i>	222
<i>Figure 6.6. Swim-with-dolphin tour vessel activity during swims is shown with percent of swim drops in which activity occurred.</i>	223
<i>Figure 6.7. Mean swim duration, number of swimmers and number of approaches per tour were compared for trips with 16 swimmers or more and less than 16 swimmers.</i>	224
<i>Figure 6.8. Swim drop duration decreased with increasing number of approaches.</i>	225
<i>Figure 6.9. The percent of tours during which other vessels visited the dolphin group during swim-with-dolphin tours.</i>	226
<i>Figure 6.10. The mean number of vessels and duration of visits are shown for other vessels observed within 300 m of the dolphins during a tour.</i>	227
<i>Figure 6.11. The behaviour of dolphin groups varied significantly from first encounter to final group follow.</i>	228
<i>Figure 6.12. Activity level is shown by approach number.</i>	229
<i>Figure 6.13. The percent of cases when dolphins were tightly grouped by approach number.</i>	230
<i>Figure 6.14. The number of leaping dolphins is compared by approach number</i>	231
<i>Figure 6.15. The number of bow-riding dolphins decreased with increasing approach number</i>	232
<i>Figure 6.16. Mean percent of approaches by swim-with-dolphin tour vessels by approach type,</i>	233
<i>Figure 6.17. Percent change in behaviour is shown with increased deviation from a path parallel to the dolphin group</i>	234

<i>Figure 6.18. Percent change in dolphin group behaviour is compared by median speed of vessel approaches per tour.</i>	<i>235</i>
<i>Figure 6.19. Median activity level of dolphin groups is shown with type of approach</i>	<i>236</i>
<i>Figure 6.20. Mean number of drops in the path of the group is shown by skipper</i>	<i>237</i>
<i>Figure 6.21. Duration of first swim encounters by approach method on first approach</i>	<i>238</i>
<i>Figure 6.22. Median activity level upon group encounter and subsequent approaches for dolphin groups in which skippers chose to drop swimmers in the path of the dolphin group versus using another method.</i>	<i>239</i>
<i>Figure 6.23. Mean swim encounter duration by season</i>	<i>240</i>
<i>Figure 6.24. Behavioural state of dolphin groups prior to dropping swimmers in the water during tour vessel interactions with subsequent swim duration</i>	<i>241</i>
<i>Figure 6.25. The estimated distance of the large group from the swim-with-dolphin tour vessel at the end of the swim by percent of swim drops.</i>	<i>241</i>
<i>Figure 6.26. Swim duration with and without the presence of dolphin subgroups.</i>	<i>242</i>
<i>Figure 6.27. Mode nearest neighbour distance with increasing number of swim-with-dolphin tour vessels</i>	<i>243</i>
<i>Figure 6.28. Dispersion of dolphin groups during the follow is compared for dolphin groups visited by 1, 2, 3, or 4 or more vessels</i>	<i>244</i>
<i>Figure 6.29. Dispersion of dolphin groups during the follow is compared for dolphin groups visited by 0, 1 and 2+ recreational boats during the swim-with-dolphin tour.</i>	<i>245</i>
<i>Figure 6.30. The average encounter and departure positions of swim-with-dolphin tours are shown by season.</i>	<i>246</i>