# Striking a balance between fishing, tourism and dolphin conservation at Chilika Lagoon, India

Thesis submitted by

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# Abstract

The conservation of natural resources and wild species is often a "wicked"[1] problem, with multiple interacting elements, non-linear relationships between elements, constant irreversible change, a lack of controls, and no clear resolution. These characteristics necessitate interdisciplinary approaches to generate acceptable solutions, drawing on several traditional disciplines and local knowledge.

I used an interdisciplinary approach to study the interface between Irrawaddy dolphins *(Orcaella brevisrostris)* and impoverished human communities that share common space and resources at Chilika Lagoon, India. Chilika, a brackish water lagoon located in the state of Odisha on the east coast of India, spans an area of between 906 and 1,165 $km^2$, depending on the season. The lagoon has been a Ramsar site since 1982, because of its high avifaunal and fish diversity. Its high productivity supports fishing communities living in approximately 150 villages around the lagoon. The lagoon also supports a population of resident Irrawaddy dolphins, which is likely Critically Endangered and declining. This study was conducted in the Outer Channel of the lagoon, which corresponds to the area of highest dolphin density and is used by a large number of both fishers and dolphin-watching tourist operators.

The specific aims of my thesis were to investigate:

a. The nature and drivers of fisher attitudes and perceptions towards Irrawaddy dolphins;

b. The fine-scale behavioural adaptations of the dolphins to fishing gear, and hence to the presence of fishers;

c. The social sustainability of the dolphin-watching tourism industry;

d. The value of the dolphin-watching tourism industry using economic substitution, and the extent to which local and regional stakeholders depend on dolphin-watching tourism in the lagoon.

[1] Defined by the US National Socio-Environmental Synthesis Center as "urgent problems that are ill defined, dynamic, complex, public, and often intractable, typically related to global climate change, water resource management, biodiversity, and sustainable development. A key attribute of such problems is that there is not necessarily a single solution, as social consensus on priorities, outcomes and modes of action has often not been reached" (source: SESYNC 2014).

I investigated the attitudes and perceptions of fishers towards the dolphins and the drivers of these perceptions. I surveyed fishers across 30 fishing communities located around the study area. To validate the drivers of fisher perceptions, I: (1) observed dolphin foraging behaviour at "stake nets", and (2) compared catch per unit effort (CPUE) and catch income of fishers from stake nets in the presence and absence of foraging dolphins. I found that the fishers' attitudes were mostly positive towards dolphins, and that most fishers, particularly traditional fishers believed that dolphins augmented their fish catch. Foraging dolphins were observed spending about half their time at stake nets. Although foraging dolphins were not associated with a higher overall fish catch at stake nets, they were associated with a significantly higher catch income and CPUE of mullet (*Liza* sp.), a locally preferred food fish species. These results indicate that positive perceptions of fishers towards dolphins were likely because fishers associated the dolphins with higher fish catches and income.

To further understand the adaptations of the dolphins to the presence of fishers, I studied the fine-scale behaviour of dolphins at "stake nets"; the most commonly used fishing gear within my study area. I conducted boat-based surveys of dolphin behaviour both at stake nets and in open waters. I found that dolphin mothers with offspring and lone immature individuals barrier-foraged at stake nets most frequently, showing evidence that critical dolphin life stages are likely to be reliant on nets and hence fishers. Stake nets date back about 25 years, indicating that the dolphins of Chilika exhibit behavioural plasticity, and have learned to exploit these nets within one generation.

I used tourist visitation numbers, satisfaction, preferences, perceptions and tourist specialisation as indicators of the social sustainability of dolphin-watching tourism at Chilika. My approach included participant observation, a survey instrument to ascertain information from dolphin-watching tourists conducted on tourists and secondary data on tourist visitation numbers. My results suggest that dolphin-watching tourism at Chilika Lagoon is socially unsustainable. The rate in increase of tourists in the study site is beginning to decline. Tourists are mostly novices and were dissatisfied with their dolphin-watching experience. Satisfaction levels were positively influenced by boat-driver encounter management and the number of dolphins sighted. Tourist preferences and perceptions pointed out useful insights, but also reflected the demands of a novice tourist demographic. Participant observation and tourist perceptions highlighted the important issues in the way in which the industry is conducted and managed.

To understand the value of the dolphin-watching industry at Chilika, and the extent to which local and regional stakeholders depended on the industry, I used economic substitution between dolphin-watching tourism and neighbouring tourist attractions in the destination of Odisha. The valuation of wildlife tourism is often used to justify wildlife conservation through the potential

of such tourism to support human livelihoods. This value is crucially dependent on the degree to which a target species can be economically "substituted" by other local attractions, so that tourist expenditures that are "attributable" to the target species can be established. Previous wildlife tourism evaluations have not considered the effect of economic substitution across multiple spatially connected tourist attractions within a destination region, and their resultant impact on the accurate economic value of the industry. I addressed this gap by estimating economic substitution between dolphin-watching tourism at Chilika and other tourist attractions in a destination. Using surveys and government visitation numbers, I found that dolphin-watching at Chilika Lagoon was "partially substituted" by neighbouring attractions in the destination of Odisha (India). The total number of days attributable to dolphin-watching was 0.34 locally, -0.13 at neighbouring sites, and 0.21 in the destination as a whole. Hence the total expenditure attributable to dolphin-watching was approximately US$1.4 million locally, US$-0.4 million at neighbouring sites and US$1 million in the destination as a whole. If dolphins are extirpated, local stakeholders and the destination stand to lose, but neighbouring tourism stakeholders are likely to gain. Understanding local and destination-level substitution of wildlife tourism is necessary to estimate, (1) the true value of wildlife tourism and (2) which stakeholders to target through management interventions.

This multidisciplinary approach enabled me to focus on the interface between Irrawaddy dolphins and human communities at Chilika Lagoon, and gain a better understanding of how to inform the conservation and management of the dolphins in a seascape dominated by humans.

My thesis has led to the following conservation recommendations:

a. Efforts to conserve the Irrawaddy dolphins should, where possible, use positive local perceptions and cultural values to build a constituency for conservation.

b. Critical life stages of Irrawaddy dolphins are likely reliant on barrier-foraging at stake nets and hence on fishers. Excluding fishers from Chilika or banning the stake net fishery may have negative consequences for the dolphins.

c. Dolphin-watching tourism at Chilika Lagoon is socially unsustainable. A social-ecological approach to management that integrates dolphin-watching tourism and dolphin conservation should be a priority.

d. Dolphin-watching tourism is an important industry for local and regional livelihoods, and can be used to justify wildlife conservation to managers and policy makers. The local and regional value of dolphin-watching tourism using economic substitution can potentially be used in conservation planning.

Taken together, the findings of my thesis can be used to identify areas of conservation opportunity both for Irrawaddy dolphins at Chilika and for wildlife management in human dominated landscapes more generically.

# Contents

**Acknowledgements** ..... **i**

**Statement on the Contribution of Others** ..... **iv**

**Abstract** ..... **vii**

**1 General Introduction** ..... **1**

1.1 Broad rationale of thesis: considering the importance of the social-ecological context and human dimensions of conservation ..... 2

1.2 Identifying gaps in the knowledge on the conservation of marine mammals ..... 3

1.3 Thesis design and objectives ..... 9

1.4 Thesis outline ..... 9

**2 Study site and social-ecological context** ..... **13**

2.1 General background of Chilika Lagoon ..... 14

2.2 Specific background of study site ..... 18

2.3 Summary ..... 22

**3 Interactions between dolphins and fishers and drivers of the same** ..... **25**

3.1 Introduction ..... 26

3.2 Materials and methods ..... 28

*3.2.1 Study area* ..... *28*

*3.2.2 Fisher attitudes and perceptions towards dolphins* ..... *28*

*3.2.3 Dolphin foraging at stake nets* ..... *30*

*3.2.4 Effect of dolphin foraging on stake net catch biomass and income* ..... *31*

3.3 Results ..... 36

*3.3.1 Fisher attitudes and perceptions towards dolphins* ..... *36*

*3.3.2 Dolphin foraging at stake nets* ..... *37*

*3.3.3 Effect of dolphin foraging on stake net catch biomass and income* ..... *37*

3.4 Discussion ..... 39

*3.4.1 Fisher perceptions towards dolphins* ..... *39*

*3.4.2 Drivers of fisher perceptions towards dolphins* ..... *40*

*3.4.3 Conservation implications of this study for Irrawaddy dolphins at Chilika Lagoon ..... 42*
3.5 Conclusions ..... 43
3.6 Summary ..... 43
**4 Fine-scale behaviour of Irrawaddy dolphins at stake nets ..... 45**
4.1 Introduction ..... 46
4.2 Methods ..... 48
4.3 Results ..... 49
4.4 Discussion ..... 52
4.5 Summary ..... 56
**5 Sustainability of dolphin-watching tourism at Chilika Lagoon ..... 57**
5.1 Introduction ..... 58
5.2 Methodology ..... 63
*5.2.1 Study site ..... 63*
*5.2.2 Tourist visitation numbers and growth rate ..... 63*
*5.2.3 Approach to assess the indicators of sustainability of the dolphin-watching industry ..... 64*
5.3 Results ..... 66
*5.3.1 Description of the dolphin-watching industry at Chilika Lagoon . 66*
*5.3.2 Tourist visitation over a ten year time period as an indicator of sustainability ..... 68*
*5.3.3 Demographics of dolphin-watching tourists ..... 71*
*5.3.4 Tourist specialisation, satisfaction, preferences, perceptions and likelihood of returning as indicators of social sustainability ..... 74*
5.4 Discussion ..... 78
*5.4.1 Summary ..... 78*
*5.4.2 Satisfaction benchmarking and likelihood of returning ..... 78*
*5.4.3 Dolphin-watching at Chilika Lagoon ..... 79*
*5.4.4 The importance of understanding tourist specialisation and profiles ..... 80*
*5.4.5 Sustainable management of cetacean-watching tourism in developing countries ..... 80*
*5.4.4 Conclusion ..... 81*
5.5 Summary ..... 82
**6 Economics of dolphin-watching tourism at Chilika Lagoon ..... 85**
6.1 Introduction ..... 86

6.2 Materials and methods ..... 89
*6.2.1 Background of study site and the dolphin-watching tourist industry at Chilika Lagoon ..... 89*
*6.2.2 Framework and methods used in valuing wildlife resources ..... 90*
*6.2.3 Valuation of the dolphin-watching industry at Chilika Lagoon ..... 92*
*6.2.4 Data collection ..... 93*
*6.2.5 Interview survey design ..... 93*
*6.2.6 Data Analysis ..... 96*
6.3 Results ..... 98
*6.3.1 Dolphin tourist visitation numbers at Chilika Lagoon ..... 98*
*6.3.2 Total tourist expenditure ..... 98*
*6.3.3 Days attributable to dolphins ..... 99*
*6.3.4 Total expenditure attributable to dolphins ..... 101*
6.4 Discussion ..... 102
*6.4.1 Valuation of the wildlife tourism industry ..... 102*
*6.4.2 Implications of applying economic substitutability at the destination level ..... 102*
*6.4.3 Advantages of using this approach ..... 103*
*6.4.4 Implications of using this approach for the conservation and management of target species ..... 103*
6.5 Conclusions ..... 104
6.6 Summary ..... 105
**7 General Discussion ..... 106**
7.1 Understanding the relationship between fishers and Irrawaddy dolphins in Chilika Lagoon ..... 107
7.2 Socio-economics of dolphin-watching tourism at Chilika ..... 108
7.3 Synthesis: implications for theory that can be applied to wildlife tourism research ..... 109
7.4 Synthesis: implications for the conservation and management of Irrawaddy dolphins in Chilika Lagoon ..... 111
7.5 Recommendations for future research ..... 114
7.6 Conclusions ..... 116
**References ..... 117**
**Appendix A ..... 135**
**Appendix B ..... 139**

**Appendix C .....141**

**Appendix D .....149**

# List of Tables

**Table 2.1** Communities/castes of the Outer Channel of Chilika Lagoon, their occupations, and fishing gear used ..... 21

**Table 3.1** Emergent themes reflecting positive fisher perceptions towards dolphins, number of respondents, values attributed to each theme and illustrated examples within each theme ..... 32

**Table 3.2** Descriptions of behavioural states performed by Irrawaddy dolphins at Chilika Lagoon and approximate proportion of time spent in each of them ..... 34

**Table 3.4** Results of the restricted maximum likelihood (REML) mixed model, showing the effect of dolphin presence (absent or present) as a fixed factor and year as a random factor on the (a) total CPUE, (b) CPUE of mullet, (c) CPUE of tiger prawn, (d) CPUE of prawns and shrimp, (e) CPUE of the rest of the catch, and (f) catch income (per unit effort)..... 39

**Table 4.1** Plausible alternatives to the Culture Hypothesis to explain reasons for Irrawaddy dolphin dependence on barrier-foraging at Chilika Lagoon in India ..... 53

**Table 5.1** Demographics and Indian region of origin of dolphin-watching tourists at Chilika ..... 71

**Table 6.1** Impact of dolphin-watching tourism on tourist time (days) spent in Chilika Lagoon ..... 99

**Appendices:**

**Table A.1** List of survey questions used in the study. Surveys comprised both closed-ended (used for attitude score) and open-ended questions (used for thematic analysis) ..... 135

**Table A.2** Emergent themes reflecting negative fisher perceptions towards dolphins, number of respondents and illustrated examples within each theme..... 136

**Table A.3** Tukey's post-hoc test for unequal N, conducted for two-way ANOVA with attitude score as the dependent variable, and fisher community type (traditional or non-traditional) and probability of encountering dolphins

(high or low) as fixed categorical variables. Significant values have been highlighted in bold. Error: Between Mean Square (MS) = 0.21846, degrees of freedom (df) = 295.00 ..... 136

**Table A.4** Average CPUE and SE values of, (a) total CPUE, (b) CPUE of mullet, (c) CPUE of tiger prawn, (d) CPUE of prawns and shrimp, (e) CPUE of the rest of the catch, and (f) catch income (per unit effort), grouped across dolphin presence (absent or present) and year. Key: g/h = grams per hour, USD/h = US Dollars per hour ..... 137

**Table B.1** Descriptions of Irrawaddy dolphin categories ..... 139

**Table C.1** Thematic analysis on what tourists visiting Chilika Lagoon liked about their dolphin-watching experience ..... 144

**Table C.2** Thematic analysis exploring what tourists at Chilika Lagoon disliked most about their dolphin-watching experience ..... 145

**Table C.3** Tourist perceptions of how dolphin-watching at Chilika Lagoon could be improved ..... 147

# List of Figures

**Figure 1.1** Number of peer-reviewed publications from 2009-2014 on marine mammal conservation, showing the disciplines on which papers are focussed, organised across mammalian order ..... 6

**Figure 1.2** Number of peer-reviewed studies from 2009-2014 on marine mammal conservation, showing the disciplines on which papers are focussed organised across developed versus developing countries..... 7

**Figure 1.3** Percentage of peer-reviewed studies from 2009-2014 on each of the 12 Critically Endangered small cetacean taxa (IUCN 2014), showing the disciplines on which papers are focussed ..... 8

**Figure 1.4** Structure and outline of thesis, showing broad objectives and relevant chapter numbers..... 10

**Figure 2.1** Map of Chilika Lagoon, showing the Outer Channel..... 15

**Figure 3.1** Map of Chilika Lagoon, showing villages surveyed in the Outer Channel..... 28

**Figure 3.2** Attitude scores (mean ± SE) of fishers towards Irrawaddy dolphins at Chilika Lagoon, India where Tukey's post-hoc results for unequal N (Appendix A, Table A.3) shows that (a) is significantly higher than (b). Statistical significance is at $p < 0.01$ ..... 36

**Figure 3.3** Barrier-foraging in Chilika Lagoon with: (a) Proportion of total foraging time in which Irrawaddy dolphins were observed employing various foraging strategies; (b) Irrawaddy dolphin barrier-foraging alongside a local fisher; (c) an illustration of how Irrawaddy dolphins herd fish towards stake nets during stake nets barrier-foraging; and (d) evidence of an Irrawaddy dolphin pushing fish against stake nets during barrier-foraging..... 38

**Figure 4.1** Percentage of total Irrawaddy dolphin foraging encounters by: (a) strategies adopted by various dolphin categories in the Outer Channel of Chilika Lagoon in India (n = 30), and (b) category of dolphin group, where CO = Cow-offspring pairs; GA = Groups of adult individuals; GI = Groups of immature individuals; MG = Mixed groups of adult and

immature individuals; SA = Solitary adults; SI = Solitary immature individuals....51

**Figure 5.1** The evolution of a tourist site showing (a) Butler's Tourism Area Life Cycle (TALC) model (Butler 1980), and (b) Duffus and Dearden's model (Duffus & Dearden 1990), which integrates the TALC model, the user specialisation framework and limits of acceptable change....62

**Figure 5.2** Map of Chilika Lagoon showing the four dolphin-watching centres of the Outer Channel....63

**Figure 5.3** Dolphin-watching at Chilika showing, (a) a signboard depicting a breaching Irrawaddy dolphin, (b) a crowded dolphin-watching boat, (c) a tourist boat on a dolphin-watching trip, with a typical dolphin sighting, and (d) the banks of the lagoon littered with garbage....67

**Figure 5.4** The total number of tourists visiting the state of Odisha (India) annually, and the total number of tourists visiting the Outer Channel of Chilika for dolphin-watching, over a ten year time period from 2003 to 2013....69

**Figure 5.5** The total annual number of tourists visiting Chilika with (a) the number of dolphin-watching tourist boats per year and (b) the annual number of tourists serviced per boat. Data on tourist boat numbers were collected only in certain years....70

**Figure 5.6** Distribution of satisfaction levels of dolphin-watching tourists at Chilika Lagoon (n = 231)....74

**Figure 6.1** Map of Chilika Lagoon, and the Outer Channel region, tourist boat associations and neighbouring tourist sites (such as Puri and Bhubaneswar) within the destination of Odisha....90

**Figure 6.2** Average expenditure per group of dolphin-watching tourists at Chilika Lagoon....98

**Figure 6.3** The average number of days that tourists spent in Chilika, elsewhere in Odisha and in Odisha as a whole, along with the hypothetical number of days that tourists would spend in these places if there was no opportunity to view dolphins at Chilika. Bars indicate standard errors; n = 39....100

**Figure 6.4** Total annual expenditure attributable to the dolphins in Chilika Lagoon, elsewhere in Odisha and in the destination of Odisha overall....101

**Figure 7.1** The prototype of an early warning system for tourist sites known as Interactive Destination Evaluation System (IDES), where: (a) is a spider plot showing preselected variables and their thresholds, and (b) depicts the measurement of these variables as a tourist site changes over time. Where v1-v7 represent preselected variables and appropriate thresholds, and T1-T5 represent phases of a tourist site. Illustration adapted from (TNO-CISNET 2004) ..... 110

**Figure 7.2** Ostrom's framework to analyse complex social-ecological systems, may be used to understand sustainability, and the ability of local users to manage their resources; taken from Ostrom (2009) ..... 116

**Appendices:**

**Figure D.1** Data on annual tourist visitation to Odisha, India between 2002 and 2013. Data provided by the Tourism Department of Odisha..... 149

**Figure D.2** Data on annual tourist visitation to Satapada, the Outer Channel of Chilika Lagoon, India between 2002 and 2013. Data provided by the Tourism Department of Odisha ..... 150

# List of Colour Plates

**Plate 2.1** Types of fishing gear and techniques traditionally used in the Outer Channel of Chilika Lagoon: (a) drag net or "*khaddi jaal*" (photo depicts a newer version of the traditional net, with a nylon filament), (b) cast net or "*Kheypa jaal*", (c) crab traps, (d) bamboo fish traps, (e) hand sediment-sifting, and (f) hook and line fishing ..... 19

**Plate 2.2** Stake nets or "*Khanda jaal*" ..... 20

**Plate 2.3** Modern types of fishing gear and techniques used in the Outer Channel of Chilika Lagoon: (a) a shore seine or "*Aaleem jaal*", (b) multi-meshed bag net or "*Gangia*", (c) single filament and multi-layered gill nets, and (d) bag nets or "zero" mesh nets ..... 20

# List of Information Boxes

**Box 6.1** Types of economic "substitutability" used in the valuation of tourism resources ..... 88

**Box 6.2** Interview survey questions administered to dolphin-watching tourists at Chilika Lagoon relevant to this research ..... 94

**Box 6.3** Equations used in data analysis of total tourist expenditure and expenditures attributed to the target species (in this case, dolphins). In this paper, Chilika Lagoon is Site 1, Puri and Bhubaneswar or elsewhere in Odisha are Site 2 ..... 97

# List of Acronyms and Abbreviations

**ANOVA**..... Analysis of Variance

**CART** ..... Classification and Regression Trees

**CPUE**..... Catch per unit effort

**HP** ..... Horse power

**IUCN** ..... International Union for Conservation of Nature

**REML**..... Restricted maximum likelihood

**SE**..... Standard Error

**TALC** ..... Tourism Area Life Cycle

**UNDP** ..... United Nations Development Programme

**US** ..... United States

**USD**..... United States Dollars

**ha** ..... hectares

**km** ..... kilometres

**m** ..... metres

**N/n** ..... number

**pers. comm**..... Personal communication

**pers. obs**..... Personal observation

# 1 General Introduction

**Chapter 1 provides the broad rationale for my thesis, and emphasises the importance of addressing marine mammal conservation problems using multiple lenses, particularly in human-dominated landscapes.**

# 1 General Introduction

**"The real voyage of discovery consists not in seeking out new landscapes, but in having new eyes"**

Marcel Proust (1871-1922)

Conserving natural resources and wild species in human-dominated landscapes is typically challenging, and is considered to be a "wicked" problem (Game et al. 2014; Ludwig 2001; Read 2013). Wicked problems are characteristically urgent, ill-defined, dynamic, complex, public, and intractable and lack any single, clear solution (source: SESYNC 2014). Addressing the inherent complexity of conservation problems necessitates the use of interdisciplinary approaches (Daily & Ehrlich 1999; Game et al. 2014; Young & Marzano 2010), including local knowledge and understanding, and an acceptance that a satisfactory solution might depend on the active involvement of local people (Berkes et al. 2003; Ludwig 2001). Uncertainty in conservation is often attributed to the fact that conservation problems are embedded in larger, complex systems (Game et al. 2014).

## 1.1 Broad rationale of thesis: considering the importance of the social-ecological context and human dimensions of conservation

As such, an understanding of social-ecological systems can prove useful for conservation, particularly in human-dominated landscapes. Scholars of integrated social-ecological systems are strong proponents of the view that these systems are coupled, and deem any delineation between natural and social systems to be arbitrary (Adger 2000; Berkes et al. 2003; Berkes & Folke 1998; Ostrom 2007, 2009). The broad aim of scholars of social-ecological systems is to better understand sustainability, or the judicious use of the environment to meet the needs of the present without compromising the needs of the future. Sustainable management of social-ecological systems precludes the use of resources to their limit, but instead focuses on maintaining diversity and variability while allowing for flexibility, and adaptability.

Adopting a social-ecological approach to a conservation problem thus enables a better understanding of the complex relationships and interactions between people and the environment in which they live, on multiple scales (Ban et al. 2013). Ineffectiveness in conservation is often due to a lack in consideration of the social processes that impact

conservation decisions and actions (Adams et al. 2004; Ban et al. 2013). For instance, a lack of understanding of the socioeconomic constraints, opportunities and trade-offs is likely to result in a failure to implement conservation initiatives effectively (Cowling & Wilhelm-Rechman 2007; Knight & Cowling 2007; Naidoo et al. 2006). Moulding conservation plans to local stakeholder attitudes and preferences, and engaging stakeholders transparently in management decisions is likely to improve compliance with management recommendations (Ban et al. 2013).

Although compelling evidence supports the importance of understanding the social context of conservation problems, the need to bridge the disciplinary gap between the biological and human dimensions when addressing such problems has only fairly recently been recognized. This is likely because conservation practice has traditionally been based on biocentric values, driven largely by natural science perspectives of both conservation problems and solutions (Redford 2011). Scientists and conservationists need to appreciate that a wide range of values and goals may influence people's priorities; for instance, the relative importance of biodiversity conservation and issues such as poverty and social justice is often contentious (Ban et al. 2013; Lele 2011). Thus broader perspectives are philosophically more consistent and more likely to be universally appropriated (Igoe 2011; Lele 2011).

## 1.2 Identifying gaps in the knowledge on the conservation of marine mammals

Despite these recent advances in conservation research in general, research on the conservation of marine mammals still draws mostly on the natural history and ecology of wild species, and far less frequently on the human dimensions of wildlife management. The natural history and ecology of wild species provides knowledge on how species interact with the ecosystems they inhabit. Arguably, this information is vital to determine where to invest management efforts, and to understand how species and their habitats respond to these management efforts. However, especially where human communities and wild species overlap, it is impossible to overlook the influence that these communities have on natural systems and the interactions between human and natural systems. Effective management of marine mammals therefore needs to embrace this social-ecological interface, and to dedicate more effort to understanding the dynamic interactive space where humans and ecosystems mix.

Despite the fact that social-ecological and interdisciplinary research are considered important in the conservation literature (and parallel literatures) in general (Ban et al. 2013; Berkes et al. 2003; Ostrom 2007, 2009) the limited effort on the human dimensions of marine mammal conservation, seems to be rarely acknowledged by marine mammal scientists. To quantify this research gap, I conducted a review of literature in October of 2014, using the Scopus search

engine (©2014 Elsevier B.V.); I focussed only on recent peer reviewed publications from 2009 to 2014. My preliminary search included the terms "conservation" AND "marine mammals" AND "social-ecological research" OR "social-ecological systems", and "conservation" AND "marine mammals" AND "human dimensions". The total number of entries obtained from this search was eight. I then conducted a more detailed search, including terms such as "conservation" AND "dolphins", "conservation" AND "whales", "conservation" AND "porpoises", "conservation" AND "sirenians", "conservation" AND "pinnipeds", and "conservation" AND "marine carnivores"[2] OR "marine carnivora". All entries were reviewed, and individual abstracts were read; papers were classified based on their broad subject area, and on whether they addressed interdisciplinary issues. Categories into which papers were classified included: (1) biology and ecology[3], (2) biology and ecology and human impacts[4], (3) human dimensions[5], and (4) biology and ecology and human dimensions[6]. All irrelevant papers were discarded. A total of 967 studies was identified as relevant, of which 65% focussed on the biology and ecology of marine mammal conservation alone, 15% dealt with issues relating to the biology and ecology of species in relation to human impacts, 14% focussed on the human dimensions of marine mammal conservation, and 5% addressed both the biological and human dimensions of marine mammal conservation. A breakup of these results by mammalian order is illustrated in Figure 1.1.

The studies on the human dimensions of marine mammals were mostly conducted in developed countries[7] (Figure 1.2), despite the fact that the need for this type of research is likely to be greater in developing countries. Human communities living in close proximity to wild species in developing countries are often impoverished and depend on wild species and natural ecosystems for their livelihoods. These communities are typically very vulnerable when conservation

[2]Here, I consider only polar bears (*Ursus maritimus)*, sea otters (*Enhydra lutris)* and marine otters (*Lontra feline)* as "marine mammal carnivores" as they are exclusively marine (see McCafferty & Parsons 2011).

[3]This category comprised papers on the biology and ecology of marine mammal conservation such as abundance and distribution estimates, habitat use, movement ecology, behaviour etc.

[4]This category included papers on some aspect of the biology and ecology of the species concerned and the impacts of humans on the species, such as vessels, fishing gear, noise etc.

[5]This category included only papers that dealt with the human dimensions of marine mammal conservation and included social sciences, policy and governance issues, environmental economics etc.

[6]This category included both aspects of the biology and ecology of species and the human dimensions of marine mammal conservation.

[7]Here I classify developed countries as those that have a "very high" human development index (HDI), and developing countries as those that have an HDI of "low", "medium" or "high" (UNDP 2014).

measures force them to restructure their livelihoods, especially as a social security safety-net is typically not available. In addition because the conservation measures have been developed in the absence of understanding the human dimensions of the problem, they are often unsustainable from socio-economic and managerial perspectives. In many cases, such conservation measures are not enforced and largely ineffective. An understanding of the human dimensions of wildlife conservation is thus highly relevant in developing countries.

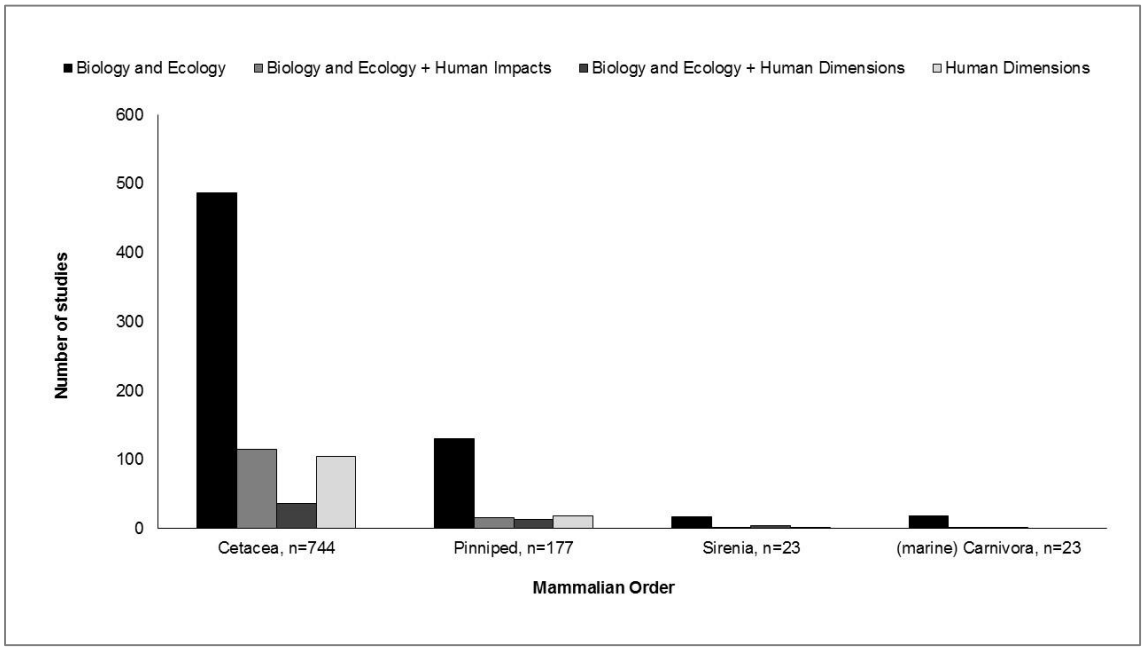



**Figure 1.1:** Number of peer-reviewed publications from 2009-2014 on marine mammal conservation, showing the disciplines on which papers are focussed, organised across mammalian order.

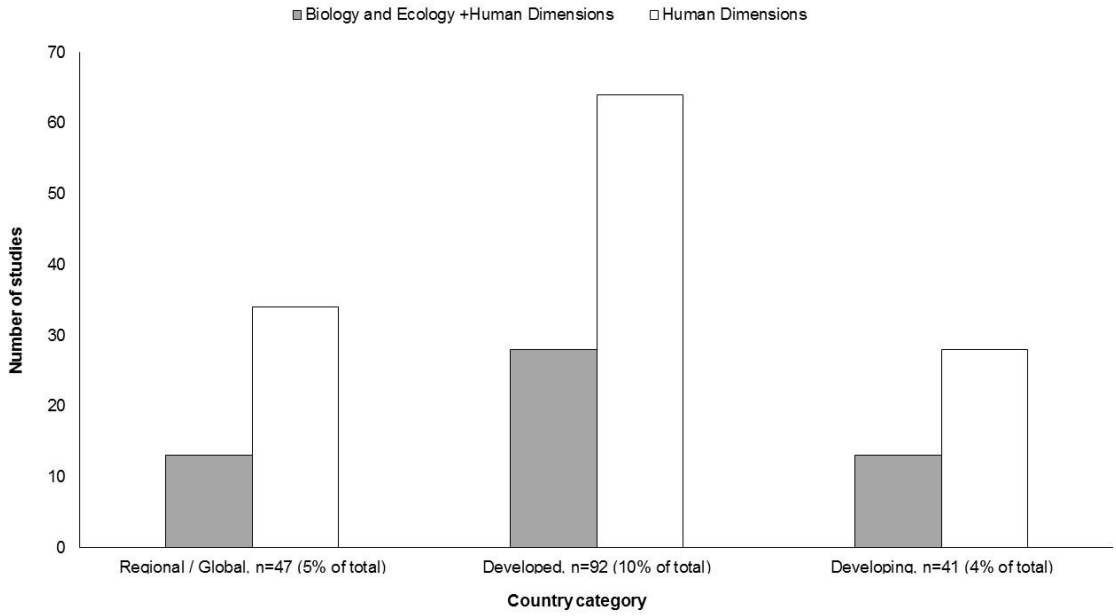



**Figure 1.2:** Number of peer-reviewed studies from 2009-2014 on the human dimensions of marine mammal conservation, organised across global studies, developed and developing countries.

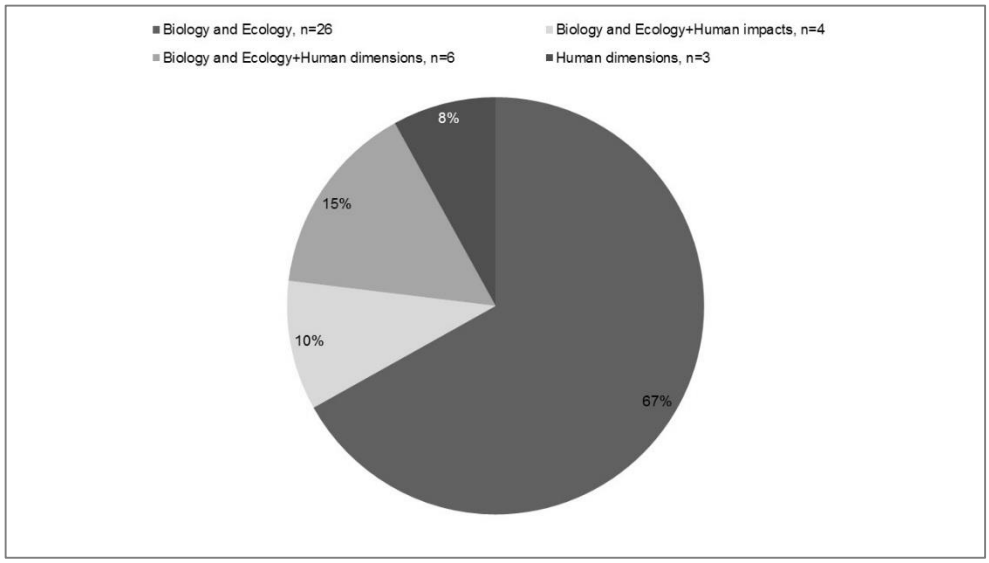



**Figure 1.3:** Percentage of peer-reviewed studies from 2009-2014 on the 12 Critically Endangered small cetacean taxa (IUCN 2014), showing the broad disciplines on which papers are focussed.

Serious marine mammal conservation problems persist due to an imbalance between human livelihoods and conservation needs. For instance, of the 12 taxa (species, subspecies and subpopulations) of small cetaceans listed on the IUCN Red List as Critically Endangered, 11 are under threat due to fisheries bycatch (IUCN 2014; IUCN SSC 2014). Yet published research adopting a social-ecological approach to mitigating the impacts of destructive fishing gear in such systems is scarce. Using the methodology highlighted above, I conducted a literature search including "conservation" AND each of the 12 Critically Endangered taxa of small cetaceans (IUCN 2014); my results showed that only 23% of these studies included aspects of the human dimensions (n=9, Figure 1.3), of which only four studies addressed the social context of the conservation problem (for instance to elicit fisher data to create incentive schemes, to research local knowledge etc.). Further, of these 12 taxa, eight occur in developing countries (source: UNDP 2014). Hence research on how human livelihoods and the conservation needs of small cetaceans of conservation concern can be balanced is likely to be of prime importance at present, and in the future, particularly in changing environmental circumstances, with increasing pressure on fisheries and food security. Turvey et al. (2012) point out that marine mammals such as dolphins may act as indicators of ecosystem health. Adopting a social-ecological approach to marine mammal conservation in such circumstances is thus likely to yield positive results for the ecosystems which marine mammals inhabit, and the human communities with whom they share common space.

## 1.3 Thesis design and objectives

The overarching aim of my thesis is to inform the conservation and management of small marine mammals by focussing on how human livelihoods and small cetacean conservation needs can be balanced in a complex social-ecological system. To achieve my aim, I study the interface between dolphins and human communities that share common space and resources. Specifically, in my study site in East India, fishing and dolphin-watching tourism are the main livelihoods of some 200,000 human communities (Chapter 2), and are most likely to impact dolphin conservation; hence this is the interface on which I focus. In line with complex social-ecological systems thinking, I use an interdisciplinary approach in this thesis. As such, the two main objectives of my thesis were:

**Objective 1:** To understand the relationship between human communities and dolphins by studying, (i) the attitudes and perceptions of fishers towards dolphins, and the drivers of the same (Chapter 3); and (ii) the fine-scale behaviour of dolphins at fisher nets (Chapter 4).

**Objective 2:** To understand the socioeconomics of the dolphin-watching tourism industry by, (i) investigating the social sustainability of dolphin-watching tourism (Chapter 5); and (ii) assessing the economic value of dolphin-watching tourism, and the extent to which local and regional stakeholders depended on the industry (Chapter 6).

## 1.4 Thesis outline

This thesis comprises seven chapters in total (Figure 1.4), including four data chapters (Chapters 3 to 6). The data chapters have been written in a format designed to facilitate publication in internationally recognised peer-reviewed journals.

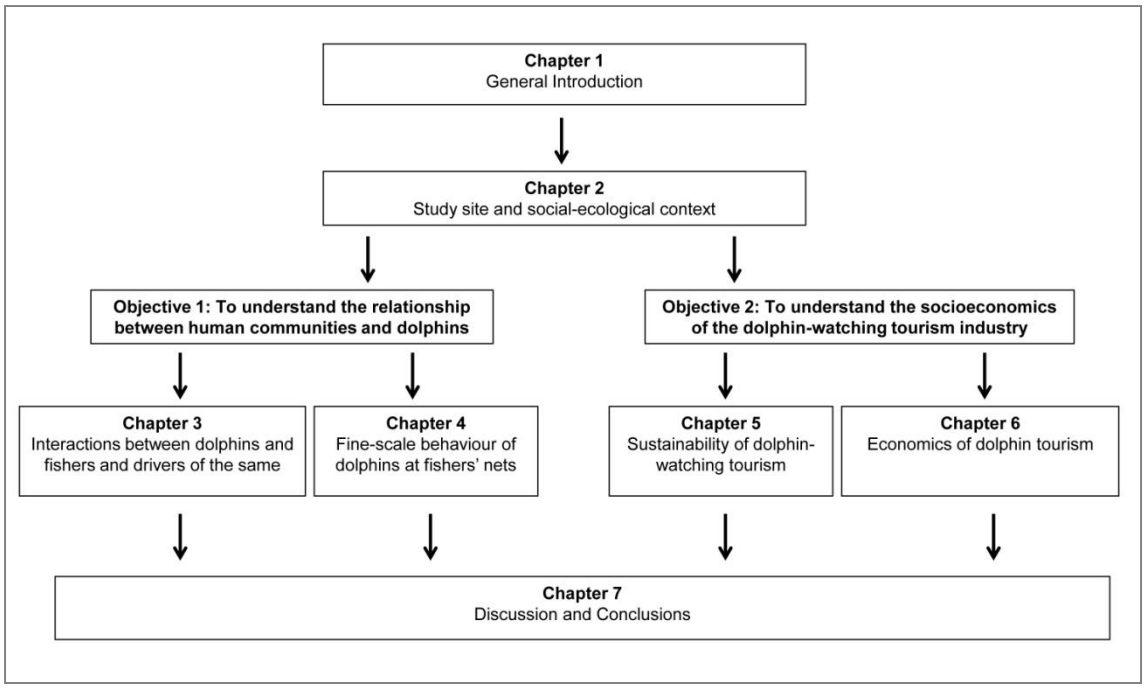



**Figure 1.4:** Structure and outline of thesis, showing broad objectives and relevant chapter numbers.

**Chapter 1** (this chapter) provides a general introduction to this thesis, identifying broadly the problem that conservation poses, and considering the importance of a social-ecological and an interdisciplinary approach when dealing with complex problems, such as conservation. With these considerations, I then identify important gaps in the knowledge with regards to the conservation of marine mammals, and highlight the importance of applying a social-ecological and interdisciplinary approach to research on the conservation of endangered small marine mammals.

In **Chapter 2**, I focus on the historical, political and social background of my study site, providing knowledge that is vital to appreciating the context in which this study was conducted.

In **Chapter 3,** I investigate the attitudes and perceptions of fishers towards the dolphins and the drivers of these perceptions, highlighting the unique relationship between dolphins and fishers in my study site, but also more generically pointing out the multidisciplinary and complex drivers that can potentially influence local attitudes, perceptions and behaviour towards wild species. This chapter has been published in a peer-reviewed journal:

**D'Lima, C.**, Marsh, H., Hamann, M., Sinha, A., Arthur, R. (2014) Positive interactions between Irrawaddy dolphins and artisanal fishers in the Chilika Lagoon of eastern India are driven by Ecology, Socioeconomics, and Culture. *AMBIO*, 614-624.

**Chapter 4** focuses on the fine-scale behaviour of dolphins at fisher nets, thus highlighting the potential of threatened dolphins to adapt to the presence of fishers with whom they share mutual space and resources. A version of this chapter has been submitted as a short communication to a peer reviewed journal:

**D'Lima, C.**, Sinha, A., Arthur, R., Hamann, M., Marsh, H. *(submitted)* Evidence of behavioural plasticity of endangered dolphins in fisher-modified seascapes: implications for conservation. Submitted to *Endangered Species Research.*

**Chapter 5** investigates the social sustainability of the dolphin-watching industry in my study site, and is a typical example of how dolphin-watching is conducted and managed by local communities in developing countries. With the knowledge gained through this study, I highlight novel insights on how wildlife tourism industries in developing countries may be improved in the future, particularly where such industries come into conflict with the needs of wildlife conservation. This chapter will be submitted to a journal for peer reviewed publication:

**D'Lima, C.**, Everingham, Y., Diedrich, A., Mustika, P.L., Hamann, M., Marsh, H. *(ready to submit)* Assessing the sustainability of wildlife tourism in developing countries: a dolphin-watching case study. To be submitted to *Tourism in Marine Environments.*

In **Chapter 6,** I assess the value of the dolphin-watching industry in my study site and the extent to which local and regional stakeholders depend on the industry. To do this, I use the concept of economic substitution between dolphin-watching tourism and neighbouring tourist attractions in the destination. Thus I highlight the importance of using this approach in correctly valuing wildlife tourism industries, particularly as local and regional economies are linked. A version of this chapter is in review as an article for peer review:

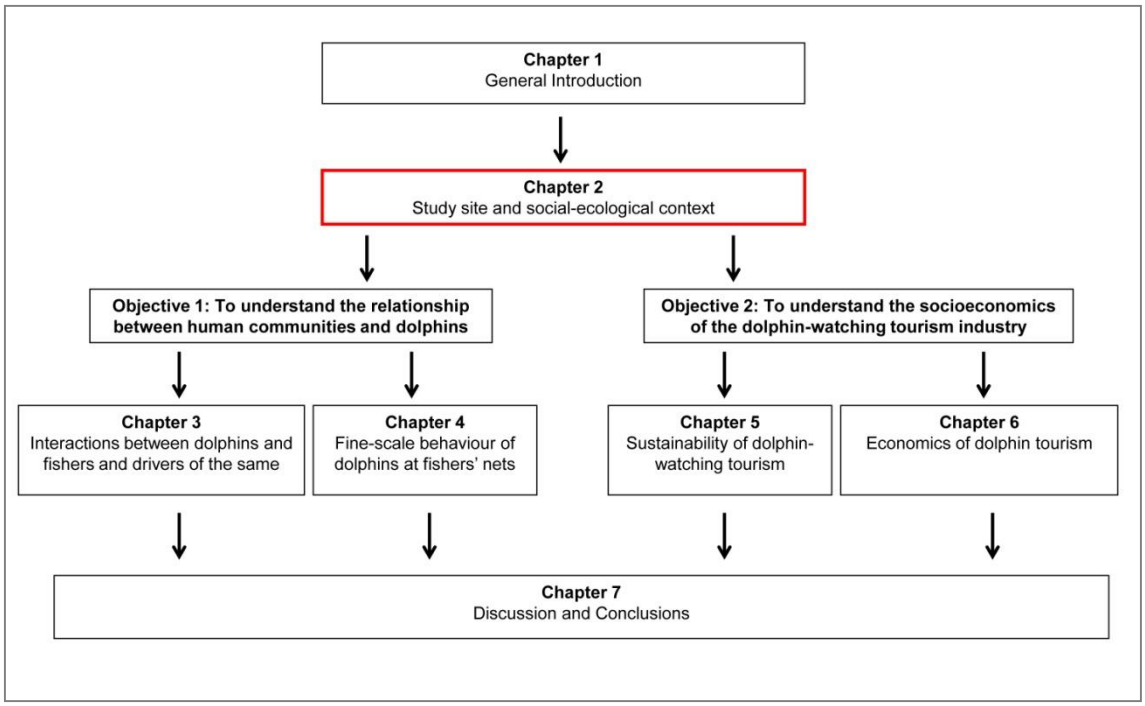
**D'Lima, C.**, Welters, R., Hamann, M., Marsh, H. *(in review)* Should wildlife conservation be enhanced by more accurate valuation of wildlife tourism? A dolphin case study. In review in *Journal of Environmental Management.*

**Chapter 7** represents a synthesis of my results and conclusions based on the previous chapters of this thesis. In this chapter I also summarise the contribution of this thesis to theory and

specify a number of ways in which knowledge gained from this thesis may be used to improve conservation and management of dolphins, in my study site, and more generically in similar social-ecological systems.

# 2 Study site and social-ecological context

**This chapter provides the background to my study site and the social-ecological context in which my research was conducted.**



# 2 Study site and social-ecological context

| | |
|---|---|
| **"Alanda Konkoda,** | *"[The village of] Alanda [is famous for] Crabs,* |
| **Gurubai Tampada,** | *[The village of] Gurubai [is famous for] Dried Prawns,* |
| **Titip Ghiya,** | *[The village of] Titip [is famous for] Ghee[8],* |
| **Tichhana Jhiya."** | *[The village of] Tichhana [is famous for] Girls."* |

Anonymous, Chilika Lagoon

## 2.1 General background of Chilika Lagoon

Chilika, located in the eastern state of Odisha, India (19°28'N-19°54'N, 85°05'E-85°38'E), is the largest lagoon in Asia, and extends over an area of 906 to 1,165 km$^2$, depending on the season (Figure 2.1) (Ghosh et al. 2006). The lagoon and its adjacent coast are affected by three seasons: the North-East monsoon from October to January, the South-West monsoon from June to September, and the dry season from February to May (Sutaria 2009). Chilika receives fresh water from three river systems in the north and west and opens out into the Bay of Bengal towards the south. Thus Chilika environments range in salinity from fresh to brackish through to saline, forming a highly productive ecosystem (Ghosh et al. 2006). Due to its productivity, the lagoon is a biodiversity hotspot and a designated Ramsar site (Ramsar 2002), supporting a high avifaunal and fish diversity. As such, the lagoon encompasses the Nalabana bird sanctuary, which is a renowned wintering site for migratory water birds, and is home to a number of species that are on the IUCN Red List of Threatened Species (Ghosh et al. 2006; IUCN 2014).

A subpopulation of one such threatened species, the Irrawaddy dolphin *(Orcaella brevirostris)* resides in the lagoon, and is one of five subpopulations of freshwater Irrawaddy dolphins in Asia (Smith et al. 2007). Irrawaddy dolphins globally are listed as Vulnerable on the IUCN Red List (IUCN 2014), and four freshwater subpopulations (the Ayeyarwady River, Mahakam River, Mekong River and Songkhla Lake subpopulations) are listed as Critically Endangered (IUCN 2014). Although the Chilika Lagoon subpopulation of dolphins is not officially listed as Critically Endangered (IUCN 2014), research conducted by Sutaria (2009) and Sutaria and

[8] *Ghee* refers to locally made clarified butter, typically produced in a cow-herd community.

Marsh (2011) indicates that it comprises <150 individuals, is likely Critically Endangered and declining, due to a number of human-induced threats (Smith et al. 2007). Sutaria (2009) used the IUCN Red List categories and criteria and RAMAS RedList software to assess the status of the Chilika Lagoon subpopulation of Irrawaddy dolphins as Critically Endangered based on criterion A4 (a,b,c,d; population size reduction), and Criterion C (small population size and decline) and D (very small and restricted population), assuming a generation length of 10 years. If the generation length was assumed to be 7 years, the population qualified as Endangered under Criteria A, B (geographic range), and D. The IUCN Cetacean Specialist Group has not yet formally listed the population but hopes to do so in 2015 (Randy Reeves, chair of IUCN Cetacean Specialist Group *pers comm* January 2015).

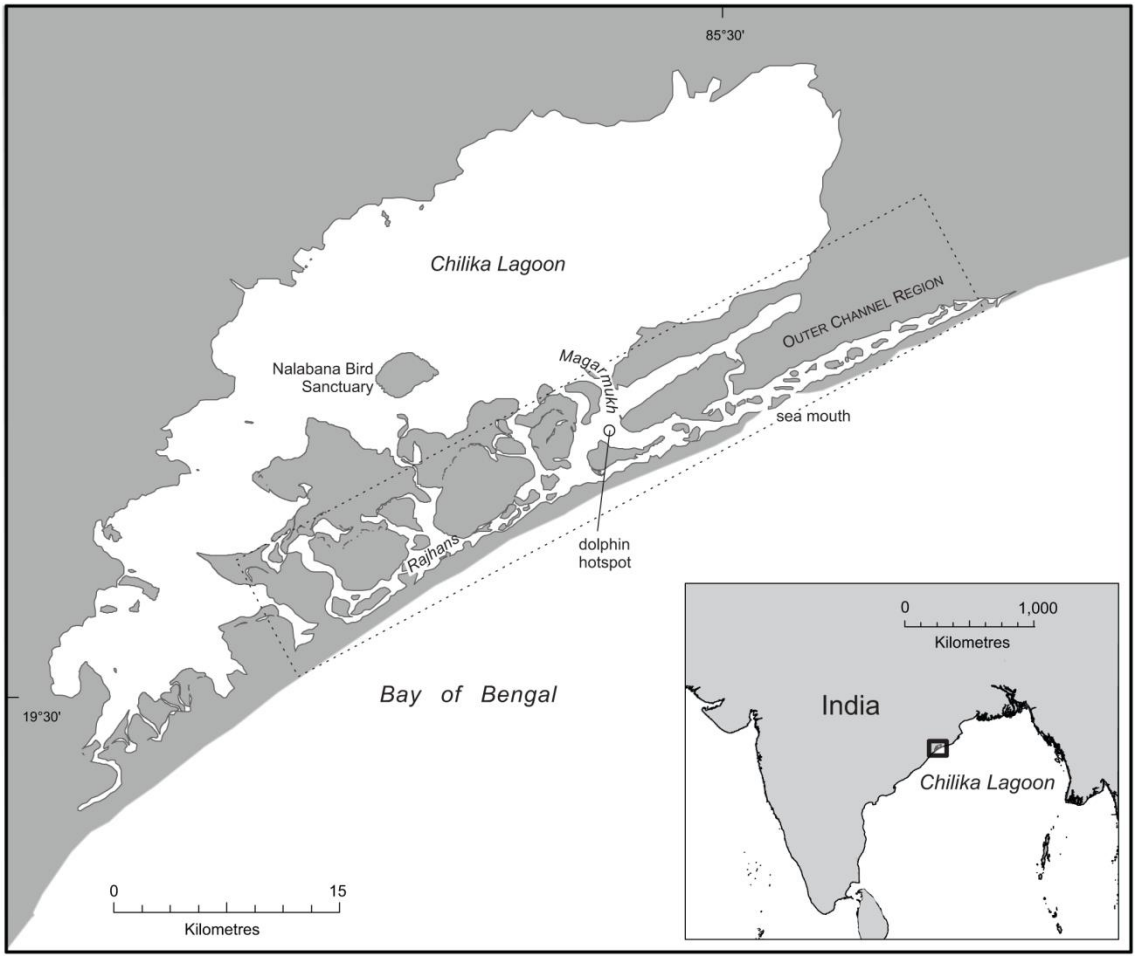



**Figure 2.1:** Map of Chilika Lagoon, showing the Outer Channel.

Some key findings provided by Sutaria (2009) on the Irrawaddy dolphins of Chilika Lagoon and the social-ecological context of their conservation provide an important basis on which my thesis was conducted. As such, I summarise these findings as follows: In addition to being small

and potentially declining, the Chilika Lagoon Irrawaddy dolphins are likely isolated. The habitat of the dolphins within the lagoon is less than half the available habitat. Dolphins occupy two core areas in the lagoon, the main core area being the Outer Channel of the lagoon (Figure 2.1); site fidelity within the core areas is high, and core areas are important feeding grounds for dolphins. The site fidelity of individual dolphins is high and most individuals have small home ranges, with a large number of individuals overlapping in home ranges. The minimum and maximum home range of the animals studied by Sutaria (2009) being 1.07 $km^2$ and 186 $km^2$ respectively. Average group size was small (3-4 individuals) and did not differ with behavioural state. Associations among individuals were weaker than most other populations of *Orcaella* and only 14 or 48 individuals studied has an Association Index of > 0.5

Sutaria's (2009) interviews with fishers showed that the range of the dolphins within the lagoon appeared to have decreased; interview surveys also indicated that people of the lagoon coexisted with the dolphins and frequently fished alongside them. Fishing gear such as gill nets and collisions with motorised vessels such as tourist boats were the primary direct cause of human-induced dolphin mortality in the lagoon from 2002 to 2006 (Pattnaik et al. 2007). Although efforts to mitigate dolphin mortality due to direct threats are likely to have reduced the high rate of population decline, the dolphins of Chilika Lagoon continue to be impacted due to their high extent of overlap with human communities who extract resources from the lagoon. Hence an understanding of the social-ecological context of the lagoon is warranted.

Chilika Lagoon provides the main livelihood of approximately 200,000 fishers belonging to various castes or communities, living in 40,000 households, across 150 fishing villages located around the lagoon (Nayak 2014; Nayak & Berkes 2010). Fishing for these communities is part of their tradition, and fisher vocation is identified by their Hindu caste (Nayak & Berkes 2010). As such, seven traditional fisher groups may be identified in the lagoon: the *Kaibartya*, *Niari*, *Karetia*, *Gokha*, *Khatia*, *Kandra* and *Tiara* (Nayak 2014). Another traditional fisher group, the *Nolia* also extracts resources from the lagoon, but is originally from the neighbouring state of Andhra Pradesh, hence traditionally this group does not belong to the lagoon, although they are fishers by caste and hence tradition. The lagoon also indirectly supports some 800,000 non-traditional fishers living around the lagoon, who belong to other castes (Nayak 2014), and whose traditional occupation may be farming, forestry, animal husbandry, performing priestly rituals, etc. More recently some of these non-traditional fisher groups who originally considered fishing to be a menial occupation, have turned to extracting the lagoon's resources as fishing became more lucrative.

From a historical perspective, prior to 1980 fishing at Chilika was primarily based on a capture fishery, and traditional fishers had the uncontested right to extract resources from the lagoon

(Nayak 2014; Sekhar 2004, 2007). Fisher caste norms helped regulate and manage the use of the lagoon's resources, which were partitioned between traditional fishers based on the area around a fisher group's village, species availability, specialisation of fishing gear and season (Nayak 2014; Sekhar 2004). Fishing norms evolved from customary practice, and led to the establishment of specific management and access rights, which turned into entitlements by way of mutual agreements among traditional fishers, and government recognition of these agreements as traditional fisher entitlements (Nayak 2014). Fishing areas surrounding the village of traditional fisher groups were clearly demarcated and boundaries were mutually agreed upon (Nayak 2014; Sekhar 2004). Village and higher-level institutions and a non-interference government policy supported the management of the fishery; thus Chilika Lagoon was a well-functioning commons (Nayak 2014).

Post 1980, with the growth in the international tiger prawn market, fishing in the lagoon became more lucrative (Nayak 2014) leading to the development of prawn aquaculture, and as a consequence, non-traditional fishers began to enter the industry, with a shift from capture to culture (Nayak 2014; Pattanaik 2007; Sekhar 2004). This resulted in encroachment of traditional fishing areas by non-traditional fishers with the establishment of illegal aquaculture farms. Additionally, due to the increased revenues from the fishery, the government became interested in the industry. In 1991, the government attempted to endorse prawn aquaculture in the lagoon by passing a High Court ruling to legalise shrimp aquaculture and allow non-traditional fishers and corporates to enter the industry through a new lease area policy. Thus 600 ha of traditional fishing area was given to non-traditional fishers for aquaculture. Traditional fisher cooperatives challenged this new lease area policy in court. After several years of legal dispute, shrimp aquaculture was banned by the High Court of Odisha in 1993, and by the Supreme Court in 1996, and the Odisha State Assembly in 1997. However, due to a lack of enforcement, illegal shrimp aquaculture still continues in the lagoon. Lease areas are often too expensive for traditional fishers to afford, and customary fishing norms, institutions and agreements have eroded (Nayak 2014). This has led to the marginalisation of traditional fishers and the "decommonisation" of Chilika Lagoon (Nayak 2014; Nayak & Berkes 2011).

Another historical event that impacted the livelihoods of fishers was the creation of the new sea mouth to the Chilika Lagoon in 2001. In the early 1990s, the mouth through which Chilika Lagoon opens out into the Bay of Bengal started getting blocked due to excessive sediment input and siltation. As a solution, government authorities dredged a new mouth to the lagoon, at a different location from the original mouth. Fishers living close to the new sea mouth claim that they were adversely impacted by the new sea mouth, due to the sudden, excessive salinisation of their lease areas (Nayak 2014; Nayak & Berkes 2010).

Both historical events, the growth of the shrimp aquaculture industry and the opening of the new sea mouth correlate with loss in fisher livelihoods and out-migration (Nayak and Berkes, 2010). Although there are many social indicators to show that the fishers of Chilika Lagoon were severely marginalised due to these two historical events, out-migration is the most significant indicator (Nayak and Berkes 2014). Strategies used by fishers to deal with their livelihood crisis include coping with subsistence (taking loans and mortgages, discontinuing their children's education, changing food habits, etc.), intensification of fishing (changing gear, no fishing restrictions, intensive aquaculture, etc.), extensification of fishing (travel long distances for fishing, catching all available species, selling sea and freshwater species, etc.), migration (long-term, seasonal or rotational) and diversification (developing non-fisher occupations such as driving dolphin-watching tourist boats) (Nayak 2014). Hence the strategies used by fishers to cope with their marginalisation are likely to affect the endangered subpopulation of Irrawaddy dolphins in the lagoon, and its conservation.

## 2.2 Specific background of study site

This study was conducted in the Outer Channel of the lagoon (Figure 2.1), an area with the highest density of Irrawaddy dolphins, (Sutaria 2009) as well as a high density of fishers. The Outer Channel is a highly productive region; however, depending on their proximity to the new sea mouth, fishers of this region have been impacted to various extents. Consequently, whereas some communities within this region maintain fishing as their sole and primary occupation, others have diversified their livelihood and have turned to dolphin-watching tourism as an alternative livelihood.

Nevertheless, changing social-ecological circumstances have resulted in gear change over the past 25 years, with a shift from locally-made cotton filament, larger mesh nets such as the "*khaddi jaal*"[9] (Plate 2.1, a), group fishing techniques, and other low impact fishing methods such as the use of bamboo traps (Plate 2.1, a-f), to the use of new, more efficient, intensive methods of fishing, targeted mostly at higher priced catch, with smaller mesh nylon filament nets, based more on individual harvesting techniques (Plate 2.3, a-d). Hence communities of the Outer Channel may belong to either traditional fishing or non-traditional fishing castes, and may solely depend on fishing as a livelihood or may adopt a diversity of occupations (Table 2.1). In general, people use a variety of fishing gear when extracting resources from the Outer Channel, but stake nets or "*khanda jaal*" are the most frequently used gear (Table 2.1, see also Plate 2.2).

[9] A traditional large-mesh, cotton-filament drag net.

Although the use of stake nets is similar to a traditional technique, contemporary nets began to be extensively used approximately 25 years ago.


**Plate 2.1:** Types of fishing gear and techniques traditionally used in the Outer Channel of Chilika Lagoon: (a) drag net or "*khaddi jaal"* (photo depicts a newer version of the traditional net, with a nylon filament), (b) cast net or *"Kheypa jaal"*, (c) crab traps, (d) bamboo fish traps, (e) hand sediment-sifting, and (f) hook and line fishing.

**Plate 2.2:** Stake nets or *"Khanda jaal"*.


**Plate 2.3:** Modern types of fishing gear and techniques used in the Outer Channel of Chilika Lagoon: (a) a shore seine or *"Aaleem jaal"*, (b) multi-meshed bag net or *"Gangia"*, (c) single filament and multi-layered gill nets, and (d) bag nets or "zero" mesh nets.

**Table 2.1:** Communities/castes of the Outer Channel of Chilika Lagoon, their occupations, and fishing gear used.

| Fisher caste | Traditional occupation | Current primary occupation | Current secondary occupation | Gear most used the Outer Channel of Chilika |
|---|---|---|---|---|
| *Kaibartya* | Fishing | Fishing | Dolphin-watching tourism | Stake nets, shore seine, gill nets, hook and line fishing |
| *Khandayat* | Farming | Farming/ fishing | Farming/ fishing | Fish traps, stake nets, gill nets, cast nets |
| *Nolia* | Fishing | Fishing | None | Stake nets, "ring" net, "kava" net, shore seine, "bag" net |
| *Khatia* | Fishing | Fishing | Dolphin-watching tourism | Stake nets |
| *Bohi* | Manual labour | Fishing | Manual labour | Hand fishing, stake nets |
| *Gopal Behera* | Animal rearing | Animal rearing | Fishing | Fish traps, stake nets |
| *Muslims (no caste)* | Manual labour | Fishing | None | Hook-line and bag nets |
| *Karan/ Maharana* | Business | Prawn aquaculture | None | Aquaculture enclosures, stake nets |
| *Khandia* | Fishing | Fishing | None | Stake nets |
| *Kandara* | Fishing | Fishing | Manual labour | Stake nets |

The Outer Channel of Chilika is also an important centre for dolphin-watching tourism. The industry operates through locally-managed tourist associations. Members of dolphin-watching tourist associations in the Outer Channel belong to either traditional or non-traditional fisher communities. Competition between associations is high, no horizontal institutions exist to regulate and manage the tourist industry, and petty conflicts between tourist associations are common.

Dolphin-watching tourism started in this region in 1989 as a local initiative (Sutaria 2009). Supported by government stakeholders such as the Chilika Developmental authority (Kumar & Pattnaik 2010), the industry grew rapidly from two tourist boats in 1989 to 348 boats in 2004 (Sutaria 2009). By 2009, when I began data collection for this study, a maximum of 894 boats were licensed to operate within the Outer Channel, operating through five tourist boat

associations. However, on 4 June 2010 a major conflict over lease area boundaries between two adjacent fishing communities that were part of one dolphin-watching association resulted in one association completely shutting down its operations. Hence in the second half of 2010, only 492 tourist boats were functioning in the region. Nevertheless, the number of dolphin-watching boats in the region has since increased to 940 (key informant, pers. comm. 2014) operating through seven tourist boat associations. Government visitation records indicate that although the number of tourists visiting Odisha on the whole has steadily increased since 2003, the rate of increase in tourist visitation to the Outer Channel appears to have slowed down (Chapter 5, Section 5.3.2, Figure 5.4, Appendix D1 and D2).

## 2.3 Summary

- Chilika Lagoon, located on the east coast of India is a highly productive ecosystem that supports a large diversity of species and provides the main livelihood of approximately 200,000 traditional fishers and 800,000 non-traditional fishers located around the lagoon.

- The Lagoon is also home to a subpopulation of Irrawaddy dolphins, which is likely Critically Endangered and declining.

- Irrawaddy dolphins and fishers overlap significantly in the lagoon, particularly in the Outer Channel of the lagoon, where this study is focused. Hence an understanding of the social-ecological context of the Lagoon is warranted.

- Two important historical events resulted in major social-ecological changes in the Chilika; the first was the rise in the price of tiger prawns due their demand in the international export market, which resulted in the advent of illegal prawn aquaculture, breakdown of traditional fishing norms, institutions and rights; the second was the opening of the new sea mouth which resulted in the salinisation of certain fisher lease areas within the lagoon.

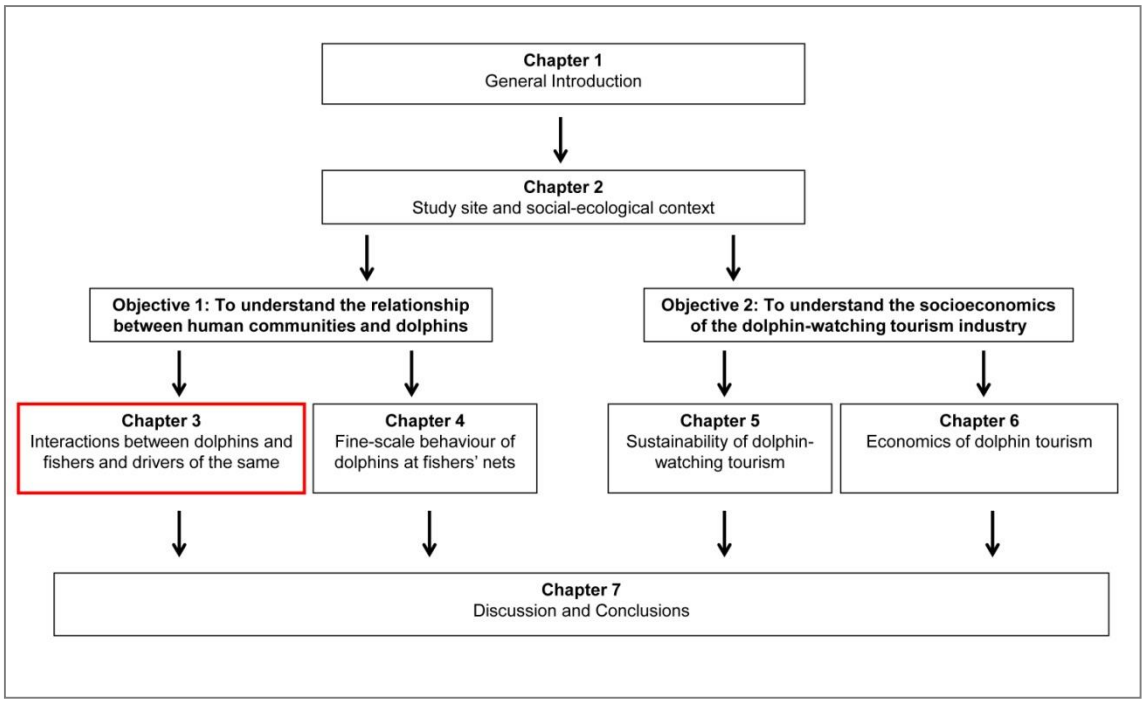
- A consequence of these events was the loss of fisher livelihoods and the marginalisation of fishing communities in the lagoon, as indicated by strategies employed by fishers to cope with subsistence, intensification of fishing, extensification of fishing, migration and livelihood diversification.

- Particularly within the Outer Channel (the study site of this thesis), over the past 25 years, changing social-ecological circumstances have resulted in changes in fishing gear and more intensive fishing techniques, and a reliance on the rapidly growing dolphin-watching tourism industry.

- Such changes are likely to have adversely impacted the subpopulation of Irrawaddy dolphins in the lagoon.

# 3 Interactions between dolphins and fishers and drivers of the same[10]

**Previous evidence indicates that the Outer Channel has a high density of both dolphins and fishers (see Chapter 2), and hence a high degree of dolphin-fisher overlap. Consequently, the social-ecological conditions that impact fishers are also likely to impact the dolphins and their conservation. Under such circumstances, the attitudes and perceptions of local fishers towards dolphins are bound to shape the relationship between fishers and dolphins. In this chapter, I therefore explore the attitudes and perceptions of local traditional and non-traditional fishers of the Outer Channel towards the Irrawaddy dolphin with which they share space and resources. Further, I investigate the underlying drivers of fisher perceptions, and discuss the implications of these findings for the conservation and management of the dolphin population.**




[10] Chapter 3 is based on the following publication: D'Lima, C., Marsh, H., Hamann, M., Sinha, A., Arthur, R., 2014. Positive interactions between Irrawaddy dolphins and artisanal fishers in the Chilika Lagoon of eastern India are driven by Ecology, Socioeconomics, and Culture. AMBIO, 614-624.

# 3 Interactions between dolphins and fishers and drivers of the same

## 3.1 Introduction

Conservation is becoming an increasingly important priority in the developing tropics (Adams et al. 2004), and balancing conservation needs with human livelihoods is often the principal challenge (Sanderson & Redford 2003), particularly where the human-wildlife interface is large (Woodroffe et al. 2005b). Managing this interface requires a clear understanding of local perceptions underlying human-wildlife relationships. These perceptions in turn may be complex and multidimensional and are likely driven by experiential, ecological, socioeconomic and cultural factors (Dickman 2010; Evely et al. 2008; Infield 2001; Peterson et al. 2010; White et al. 2009). Together the dynamic interplay of these factors influences local behaviour towards wild species, with significant implications for the management of wild species and the ecosystems they inhabit.

Local community perceptions and behaviour towards wild species are often disproportionate to the directly measureable costs and benefits of human-wildlife interactions (Dickman 2010; Peterson et al. 2010). For instance, the negative attitudes of fishers towards otters in Portugal and seals in South Africa often leads to these animals being killed, although the extent of economic damage they cause to the fishery appears not to warrant this extreme reaction (Freitas et al. 2007; Wickens 1996; Woodroffe et al. 2005a). Similarly, the reaction of people towards sharks is disproportionate to the actual risk of being "attacked" (Neff 2011), a reaction that has been attributed in part to stereotypes generated by movies like "Jaws" (Harrison & Cantor 1999). By contrast, many traditional communities ascribe considerable value to wild species both for the resources they provide (Garibaldi & Turner 2004), as well as for the potent cultural symbols and totems they represent (Passariello 1999; Telesco & Hall 2002).

Local perceptions and worldviews are based on experience, and may be influenced by multiple ecological, socioeconomic and cultural drivers. People living close to or within natural spaces view these areas not merely as biologically diverse and physical landscapes, but also as "cultural constructions", often filled with strong symbolic significance (Infield 2001). Such cultural constructions, are a consequence of the historical accumulation of abstract environmental information, and form the basis of traditional ecological knowledge, religious

and belief systems (Berkes 2008). For instance, nature conservation is an important part of Buddhist culture and religion, and greatly influences the worldview of people in Bhutan (Rinzin et al. 2009). Hence multiple drivers shape the experience, worldview and behaviour of local communities interacting with wild species and spaces (Evely et al. 2008).

Attempts to understand human-wild species interactions, therefore, need to be multidimensional and interdisciplinary (Evely et al. 2008). Such an approach is necessary in order to appreciate the motivations and drivers behind the attitudes of local people and the capacity for local stakeholders to accept wild species with which they share common spaces (Carpenter et al. 2000). Appreciation of this approach has been slow to enter management philosophy, yet is vital for a more holistic and effective conservation of the human-wildlife interface.

In this chapter, I examine the interaction between the Irrawaddy dolphin and artisanal fishers at Chilika. In the lagoon, dolphins and local fisher livelihoods overlap in their use of space and resources. Chapter 2, Section 2.1 provides an overview of the global and local status of Irrawaddy dolphins, and population estimates in the Chilika Lagoon. Dolphin foraging overlaps closely in the lagoon with areas that fishers use to deploy their gear, as the animals track much of the same fish and invertebrate resources as local fishers. Dolphins are often seen feeding at fishing nets, particularly at permanently installed stake nets (see Chapter 2, Section 2.2, Plate 2.1).

My broad research aim was to investigate the nature of fisher attitudes towards Irrawaddy dolphins in the Outer Channel of Chilika Lagoon, and to test whether fisher perceptions were influenced by their community background or group, and by the probability of them encountering dolphins while fishing. My research objectives were to explore the drivers of fisher perceptions by: (1) observing dolphin behaviour in the presence of stake nets; (2) evaluating the influence of dolphins on: (a) the fish-catch biomass of stake nets, (b) fisher income from stake net catches; and (3) characterising the cultural drivers of fisher perceptions that underlie this dolphin-fisher interaction.

## 3.2 Materials and methods

### *3.2.1 Study area*

For a detailed background of the study site, refer to Chapter 2.

### *3.2.2 Fisher attitudes and perceptions towards dolphins*

I conducted semi-structured questionnaire surveys in 30 villages (n = 299 interviewees) between 15 January and 5 June 2008, around the Outer Channel, to assess the attitudes and perceptions of fishers towards Irrawaddy dolphins (Figure 3.1).

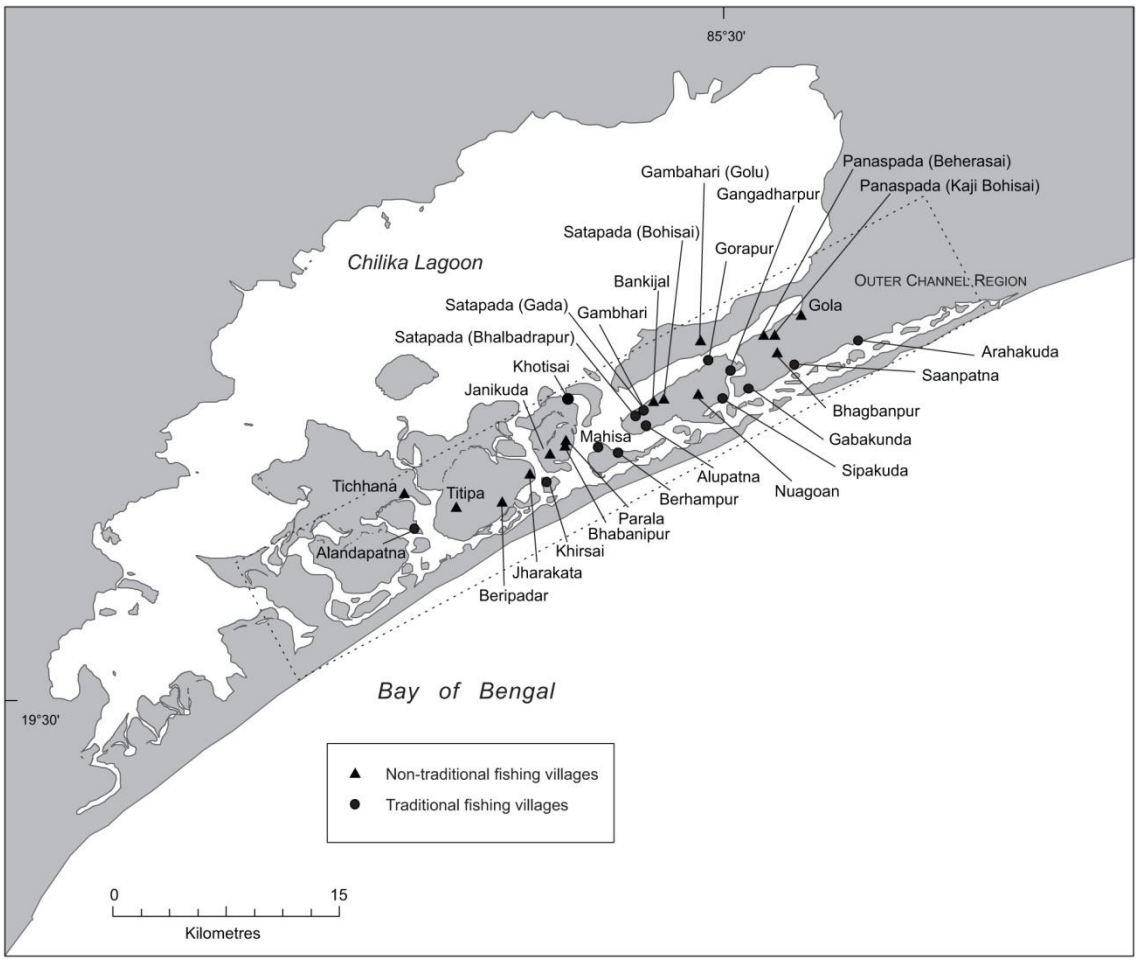



**Figure 3.1:** Map of Chilika Lagoon, showing villages surveyed in the Outer Channel.

Surveys were based on pilot informal group discussions conducted with fishers. Participants within the village were chosen opportunistically. However, villages at Chilika are organised strictly along community lines and are homogenous (Nayak & Berkes 2010; Sekhar 2004), so I conducted surveys by walking through the whole village to ensure that respondents were systematically sampled across the spatial extent of the village. Questionnaire surveys comprised both closed and open-ended questions (Huntington 2000). I analysed the responses using quantitative and qualitative research methods respectively (Appendix A, Table A.1).

My survey comprised two closed-ended questions asking fishers to identify any "animals" in the lagoon that potentially benefitted or harmed fishers (Appendix A, Table A.1). This approach ensured that respondents did not assume *a priori* that they were being questioned about dolphins, and clarified that respondents understood that questions specifically regarded their perception towards an animal. Responses to closed-ended questions were added for each respondent to provide an "attitude score" which was normalised to range between -1 and +1 (where -1 to less than 0 were negative scores, 0 was neutral, and scores greater than 0 to +1 were positive).

I surveyed fishers belonging to both traditional and non-traditional fishing communities (refer to Chapter 2, Section 2.1), who had either high or low probabilities of fishing alongside dolphins. "Traditional" fishers were defined as those whose traditional livelihood was fishing, whose families had been extracting resources from the lagoon for more than two generations, and who traditionally had tenure rights to extract resources from specific areas of the lagoon surrounding their villages (Nayak & Berkes 2010; Pattanaik 2007; Sekhar 2004). "Non-traditional" fishers were new entrants, who traditionally had other livelihoods, whose families had entered the fishery for less than two generations, and did not have traditional tenure rights to extract resources from the lagoon (Nayak & Berkes 2010; Pattanaik 2007; Sekhar 2004). Traditional and non-traditional villagers were therefore distinct in terms of their background, identity, heritage, community or caste, and experience of fishing in the lagoon, alongside dolphins. Villages surveyed were strictly separated according to community type or caste, but nevertheless, each respondent was asked to confirm his or her community identity. Respondents were provided with a map and asked to identify their fishing grounds and where they thought dolphins could be encountered. I later classified respondents into fisher groups (traditional and non-traditional) based on the above criteria, and according to their probability of encountering dolphins while fishing (high and low), based on where fishers said their fishing grounds were, and on the known spatial distributions of the dolphin population (Sutaria 2009; pers. obs.).

The effect of fisher group and probability of encountering dolphins on cumulative attitude scores of fishers were analysed using a two-way ANOVA, with the individual attitude score as

the dependent variable, and fisher group (traditional or non-traditional) and probability of encountering dolphins (high or low) as fixed categorical variables. I checked that the assumptions of the ANOVA were fulfilled. Tukey's test for unequal *N* was conducted for post-hoc results, with Bonferroni corrected *p* values.

I qualitatively analysed positive perceptions, oral histories, anecdotes, rituals and mythologies related to the Irrawaddy dolphin, documented in survey responses to the open-ended questions. I focused only on positive perceptions because negative perceptions were few (10% of respondents had negative perceptions, themes and quotes given in Appendix A, Table A.2), and neutral perceptions lacked detail. Responses were analysed by extracting themes commonly expressed by fishers that referred to positive human-dolphin interactions, and how fishers perceived dolphins to benefit them (Table 3.1). Some fisher responses were classified into more than one theme. I listed the total number of respondents that expressed each theme, along with examples of opinions articulated and values attributed within each theme (Table 3.1).

### *3.2.3 Dolphin foraging at stake nets*

I conducted behavioural observations on dolphins between 14 January and 4 April 2008[11]. Observations were divided equally between areas within 50m of fixed stake nets and open waters. For each observation, the GPS location, time at the start and end of each encounter, and dolphin group composition were recorded. Dolphin behaviour was recorded by continuous sampling (Altmann 1974) of focal groups defined as individuals within 10m of one another and usually performing the same behaviour. From these observations, I calculated the proportion of time that dolphins spent travelling, resting, milling[12], socialising and foraging (Table 3.2).

I conducted detailed observations of dolphin surface behaviour, with a specific focus on foraging. Dolphin surface foraging behaviour was classified into four strategies; (1) open-water foraging defined as a foraging strategy adopted by individual dolphins in open waters, more than 50m away from stake nets and which did not fall into any other foraging strategy, (2) barrier-foraging at stake nets as a strategy performed within 50m or less of fixed stake nets, in which Irrawaddy dolphins distinctly used stake nets to aid their foraging, (3) mud-plume foraging in which the dolphins created plumes of mud in the water, which they use to catch fish (Lewis & Shroeder 2003), and (4) cooperative foraging wherein a group of six to eleven

[11] Note: No conclusions about seasonal variation in dolphin behaviour can be drawn as I collected data at only one time of the year.

[12] Milling typically refers to a behaviour that cannot be attributed to a real state (such as foraging, resting, socializing, etc).

dolphins less than one body length from each other coordinated to herd fish into a ball before feeding on them (Gazda et al. 2005).

### *3.2.4 Effect of dolphin foraging on stake net catch biomass and income*

I examined the fish catch harvested from stake nets in a random sample of locations across the Outer Channel region from 2008 to 2010, both after dolphins were observed or known to be foraging at stake nets, and in the absence of dolphins. The species and numerical composition of the fish catch were recorded. Scaled digital photographs of the catch were used to measure standard lengths of each fish (L) using Image J[13] (Ferreira & Rasband 2011). The biomass of the catch was calculated using the standard length-weight relationship $W=a*L^b$, where the constants a and b for each species were obtained from *FishBase* (Froese & Pauly 2011). I asked each fisher to provide information regarding his[14] fishing effort (the total duration of time for which the net was set) and thus I calculated the catch per unit effort (CPUE) for each catch, by dividing the biomass by the number of hours for which the net had been set. CPUE for each of the main components of a catch was also calculated. Species or species groups that: (1) made up more than 5% of the total catch biomass sampled in each of the three years, and (2) were caught more than once a year, were considered as main components of the catch. In addition, I included tiger prawns (*Penaeus monodon* and *Penaeus semisulcatus*) as a main catch component, whenever they occurred, because of their high economic value. The main components of a catch therefore consisted of small prawns and shrimps, mullet (*Liza sp.*), tiger prawns (*P. monodon* and *P. semisulcatus*), and the remaining catch species, which were combined and classified as the "rest" of the catch.

I asked fishers to estimate the price of each catch based on their knowledge of current market prices, and questioned them to confirm the presence or absence of foraging dolphins at the nets at the time of fishing, supplementing our personal observations of the same. Price estimates were cross-verified using local market surveys.

I analysed fish catch data using restricted maximum likelihood (REML) mixed models (Piepho et al. 2003), with: (1) total CPUE, (2) CPUE of each of the main catch components, and (3) catch income (per unit effort) as the respective dependent variables, and with dolphin presence

[13] Image analysis is an established method used to estimate fish catch (see Cinner & McClanahan 2006). In addition, some samples of fish catch were measured directly to check if there was any discrepancy between direct and image analysis methods; the error in image analysis was small.

[14] Note that stake nets were set out only by men, and hence all fishers whose fish catch I sampled were male.

(absent or present) as a fixed categorical variable and year (2008, 2009 or 2010) as a random categorical variable. Data were transformed to conform to the assumptions of mixed models.

**Table 3.1:** Emergent themes reflecting positive fisher perceptions towards dolphins, number of respondents, values attributed to each theme and illustrated examples within each theme. Refer page 34 for footnote descriptions.

| **Theme, number of respondents** | **Value type** | **Illustrated example** |
|---|---|---|
| Dolphins helped fishers to catch fish, n = 205[a] | Utilitarian and cultural/mythical | "Dolphins help fishermen by herding fish from deeper waters into nets during the feeding process" (1 trad[b], high[c] respondent) |
| | | "Dolphins help us, especially when we used the *Khaadi jaal* [d], 20 years ago. Fishermen called out to dolphins that would drive fish into nets" (1 trad, high respondent) |
| | | "If dolphins die, fishermen will suffer, as fishing is impossible without them" (1 trad, high respondent) |
| | | "If it (the dolphin population) increases, it is good for fish productivity" (1 trad, high respondent) |
| | | "If it (the dolphin population) increases, it is good for fishing, which helps increase income" (1 trad, high respondent) |
| | | "(Before fishing) we pray to goddess *Harchandi*[e], and she sends dolphins to help fishermen catch fish" (1 trad, high respondent) |
| Dolphins provided fishers with other economic benefits, n = 32 | Utilitarian | "Dolphins are good for tourism" (1 non-trad, high respondent) |
| Dolphins benefited fishers (unspecified), n = 26 | Unspecified | Fishers stated their opinion, but could not substantiate their belief with any explanation |
| | Cultural/ mythical and aesthetic | "Dolphins add beauty to Chilika" (1 non-trad, low respondent) |

| Theme, number of respondents | Value type | Illustrated example |
|---|---|---|
| Dolphins were beautiful/gentle creatures, n = 16 | | "The dolphin is a *buhashani magar*"[f] (1 non-trad, high respondent) |
| Dolphins helped reduce other threats, n = 3 | Utilitarian | "Dolphins help fishermen by scaring away sharks and other fish that break nets" (1 trad, high respondent) |
| Dolphins protected/rescued fishers, n = 2 | Utilitarian and cultural/mythical | "My boat was sinking, so I prayed and dolphins came to rescue me" (1 trad, low respondent) |

[a] Indicates the total number of respondents that expressed each theme

[b] Trad = traditional fisher, non-trad = non-traditional fisher

[c] High = high probability of encountering dolphins, and low = low probability of encountering dolphins

[d] "*Khaddi jaal*" is a cotton-filament drag net (see Chapter 2, Section 2.2 and Picture 2.1a. of this thesis)

[e] "Goddess *Harchandi*", a female deity is the embodiment of Mother Earth

[f] "*Buhashani magar*" means "bride shark" in Oriya (the local language), and refers to the gentle nature and large size of the dolphin

**Table 3.2:** Descriptions of behavioural states performed by Irrawaddy dolphins at Chilika Lagoon and approximate proportion of time spent in each of them.

| Behavioural state | Description | Proportion of time observed[a] |
|---|---|---|
| Foraging | Distinct hunting of prey, indicated by prey being pursued and/or jumping out of water, being flung/thrown, and/or seen in the mouth of the dolphin | 70% |
| Travelling | Moving steadily in a particular direction | 16% |
| Milling | Moving in an undirected fashion that could not be attributed to foraging, resting, socializing, etc. | 14% |
| Socialising | Distinct interactive behaviour between two or more individuals | <1%[15] |

[15] Given that social behaviour was rarely observed within the Outer Channel region, it is likely that this behaviour mostly occurred elsewhere in the lagoon or at other times of year. Sutaria (2009) provides some preliminary insights.

| | | |
|---|---|---|
| Resting | Stationary or moving slowly at the surface of the water | 0% |

[a] Total observation time = 28 hours

## 3.3 Results

### *3.3.1 Fisher attitudes and perceptions towards dolphins*

The average attitude score of fishers towards dolphins ranged from neutral to positive (i.e. average scores were from 0 to +1, Figure 3.2), although few individual attitude scores of fishers were negative towards dolphins. Both fisher group ($F = 16.66$, $df = 1$, $p < 0.01$) and the probability of encountering dolphins ($F = 38.32$, $df = 1$, $p < 0.01$) were associated with significantly higher attitude scores of fishers towards dolphins, as indicated from my ANOVA results (Figure 3.2). The interaction between the two factors was, however, not significant (two-way ANOVA, $F = 1.97$, $df = 1$, $p > 0.01$). As indicated from my ANOVA post-hoc results (Appendix A, Table A.3), on average, traditional fishers with a high probability of encountering dolphins were significantly more positive towards dolphins when compared to those who fished in areas with a low probability of encountering dolphins or non-traditional fishers.

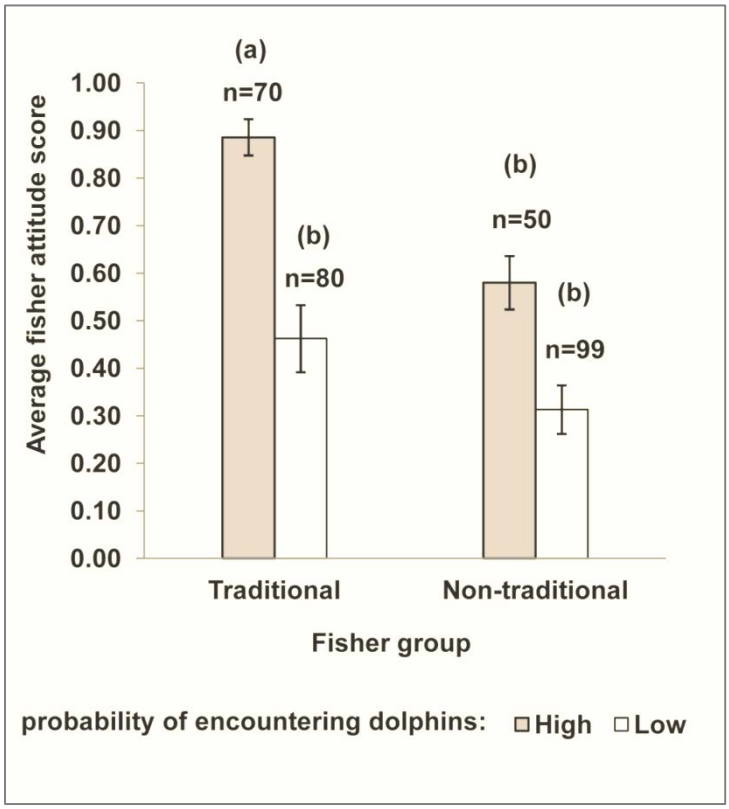



**Figure 3.2:** Attitude scores (mean ± SE) of fishers towards Irrawaddy dolphins at Chilika Lagoon, India where Tukey's post-hoc results for unequal N (Appendix A, Table A.3) shows that (a) is significantly higher than (b). Statistical significance is at $p < 0.01$.

Responses to open-ended questions aligned along six positive themes, reflecting the perceptions of fishers towards dolphins, and included: (1) dolphins helped fishers catch fish (n = 205, 69% of respondents), (2) dolphins provided fishers with other economic benefits (n = 32, 11% of respondents), (3) dolphins benefitted fishers in an unspecified way (n = 26), (4) dolphins were

beautiful/gentle creatures (n = 16, 5% of respondents), (5) Dolphins helped reduce other threats (n = 3, 1% of respondents), and (6) dolphins protected/rescued fishers (n = 2, 1% of respondents) (Table 3.1). My results indicate that a majority (69%) of fishers surveyed expressed the belief that dolphins helped them catch fish, supporting this assertion with detailed descriptions linked to utilitarian, cultural and mythical values (Table 3.1). For example, one traditional fisher with a high probability of encountering dolphins said:

> **"[Before fishing] we pray to Goddess *Harchandi* and she sends dolphins to help fishermen catch fish."**

Table 3.1 summarises the proportions of responses of traditional and non-traditional fishers with low and high probabilities of encountering dolphins who expressed positive perceptions included in each of the above themes.

### *3.3.2 Dolphin foraging at stake nets*

The dolphins spent up to 70% of the 28 hours that they were observed, foraging (Table 3.2) and 50% of their foraging time (19.5 hours) barrier-foraging at stake nets (Figure 3.3a). Dolphins were observed to herd fish from deeper channels towards the stake nets and used the nets as a physical barrier against which they caught the fish (Figure 3.3b, c, d).

### *3.3.3 Effect of dolphin foraging on stake net catch biomass and income*

REML results indicate that the average CPUE of stake nets was not associated with dolphin foraging (Table 3.4, Appendix A Table A.4), and suggests that dolphin foraging does not influence overall fish catch volume. However, of the main constituents of the catch, the presence of dolphins was significantly associated with a higher average CPUE of mullet (*Liza sp.*) in nets compared to nets sampled in the absence of dolphins (Appendix A, Table A.4). There was, however, no significant association between dolphin presence and the average CPUE of tiger prawns, smaller prawns and shrimp, or of the "rest" of the catch (Table 3.4). The average catch income per hour of effort was significantly higher when dolphins foraged at nets and were more than double, each year, when compared to catch incomes in the absence of foraging dolphins (Appendix A, Table A.4).

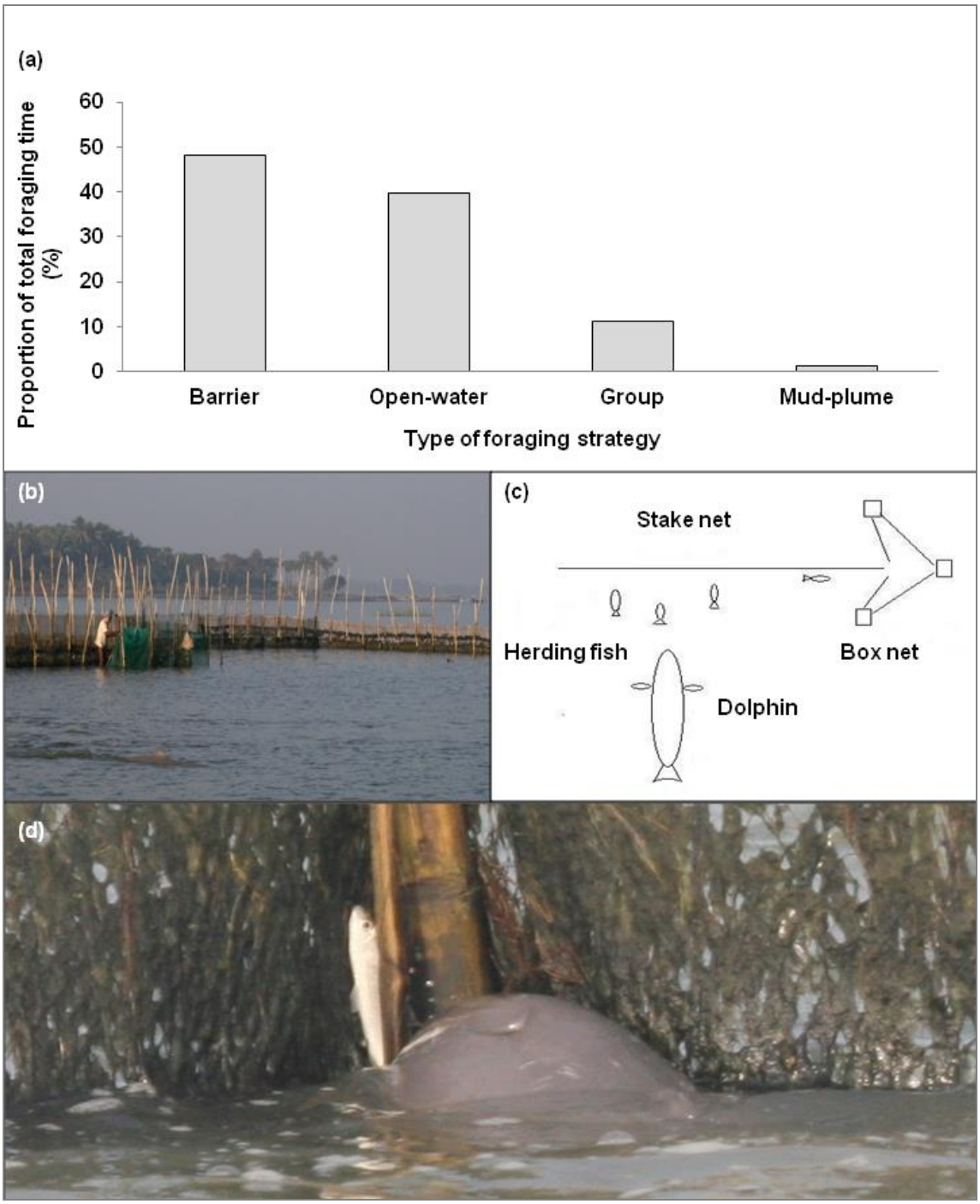



**Figure 3.3:** Barrier-foraging in Chilika Lagoon with: (a) Proportion of total foraging time in which Irrawaddy dolphins were observed employing various foraging strategies; (b) Irrawaddy dolphin barrier-foraging alongside a local fisher; (c) an illustration of how Irrawaddy dolphins herd fish towards stake nets during barrier-foraging; and (d) evidence of an Irrawaddy dolphin pushing fish against stake nets during barrier-foraging.

**Table 3.4:** Results of the restricted maximum likelihood (REML) mixed model, showing the effect of dolphin presence (absent or present) as a fixed factor and year as a random factor on the (a) total CPUE, (b) CPUE of mullet[16], (c) CPUE of tiger prawn, (d) CPUE of prawns and shrimp, (e) CPUE of the rest of the catch, and (f) catch income (per unit effort).

| | Dependent variable | Transformation | df | F value | p value |
|---|---|---|---|---|---|
| (a) | Total CPUE[a] of catch | log | 1, 80.73 | 1.49 | 0.23 |
| (b) | CPUE of mullet | square root | 1, 79.82 | 11.37 | 0.00* |
| (c) | CPUE of tiger prawns | square root | 1, 80.09 | 0.24 | 0.63 |
| (d) | CPUE of prawns and shrimp | square root | 1, 79.86 | 1.57 | 0.21 |
| (e) | CPUE of rest of catch | log | 1, 80.33 | 0.92 | 0.34 |
| (f) | Catch income (per unit effort) | square root | 1, 77.85 | 11.94 | 0.00* |

***** Significant effect at $p < 0.01$

[a] CPUE = Catch per unit effort

## 3.4 Discussion

### *3.4.1 Fisher perceptions towards dolphins*

The relationship between fishers and Irrawaddy dolphins at Chilika lagoon is a clear example of the complexity of the perceptions of local people towards the wild species with which they share natural spaces. Fishers were mostly positively disposed towards dolphins, and their perceptions were strongly influenced by ecological, socioeconomic and cultural drivers. An understanding of the complexity of human-wildlife interactions, and the drivers that influence them is usually not incorporated into standard conservation and management practices. A nuanced appreciation of the human-wildlife interface allows for a better understanding of how to proceed with wildlife conservation. For instance, at Chilika lagoon, the human-wildlife relationship is complex, and influenced by multiple drivers, but is positive, currently undervalued, and worth further promoting. I suggest that investigating the drivers of human-wild species interactions could improve conservation outcomes, both in instances where local

[16] I occasionally observed the dolphins capturing mullet both when feeding at stake nets, and during other foraging strategies.

communities are positively disposed towards wild species, and in instances of human-wildlife conflict.

### *3.4.2 Drivers of fisher perceptions towards dolphins*

Community background shapes worldviews and drives the attitudes and behaviour of local people interacting with wild species and spaces. For example, villagers in China with more traditional practices were linked to more positive conservation attitudes in comparison with villages that used fewer traditional practices (Shen et al. 2012). The community identity of traditional fishers at Chilika is strongly associated with the lagoon and goes back several generations (Pattanaik 2007). Thus fisher group or caste strongly influenced attitudes towards dolphins in responses to closed ended questions. In particular, for traditional fishers who encountered dolphins regularly, the continued experience of fishing with dolphins reinforced culturally existing positive attitudes towards the animals.

Non-traditional fishers on the other hand, had changed their livelihood largely for economic reasons (refer to Chapter 2, Section 2.1) and were more neutral in their attitudes towards dolphins when compared to traditional fishers. However, they too showed positive perceptions towards dolphins in their open ended responses, possibly due to the horizontal transfer of information from traditional to non-traditional fishers, and also possibly because of the other economic benefits that they derived from dolphins.

At Chilika Lagoon, observing dolphin foraging behaviour at nets likely influenced fisher perceptions towards dolphins. Societies directly dependent on natural resources often construct a knowledge of causality with regard to natural phenomena and perceptions are often based on observations and the accumulation of abstract environmental information (Berkes 2008; Berkes et al. 2000). The capacity of stakeholders to accept sharing spaces with wild species, therefore, often reflects the perceived impacts (both positive and negative) of human-wildlife interactions on local communities (Carpenter et al. 2000). In my study, almost two-thirds of the fishers interviewed claimed that dolphins helped them fish and were able to recount detailed narratives to substantiate this belief.

Dolphins spent approximately half their foraging time barrier-foraging at stake nets. Given the high density of nets in the Outer Channel, it is difficult to determine whether dolphins barrier-forage in this region due to the presence of stake nets, or because of the high density of preferred species coincidentally targeted by fishers. However, during barrier-foraging, dolphins clearly used stake nets and exhibited a suite of behaviours as they herded fish from shallow channels towards stake nets against which they trapped the fish before eating them. Although barrier-foraging is not unique to Irrawaddy dolphins at Chilika Lagoon (Gazda et al. 2005), this

specific adaptation of the Chilika dolphin population to fixed stake nets laid out by fishers suggests that dolphins benefit from barrier-foraging in this location. Unlike gill nets, there is no risk of dolphins being entrapped in fixed stake nets, although the high density of stake nets could limit dolphin movement. Overall my results indicate that the presence of stake nets benefits the dolphins.

Taken together, my study indicates that fishers and dolphins in Chilika Lagoon share a mutually positive relationship; where fishers perceive dolphins to help them catch fish and dolphins benefit by feeding at fisher nets. The Chilika fisher-dolphin interaction at present is different from other action-response forms of dolphin-fisher mutualisms that have been previously documented such as bottlenose dolphins (Orams 1997; Zappes et al. 2011) and Irrawaddy dolphins in Laos and Myanmar (Smith et al. 2009a; Stacey & Hvenegaard 2002), that herd fish into nets. However, fishers interviewed spoke of a time when they used cotton filament drag nets known as *Khaddi jaal* (Chapter 2, Plate 2.1a) and said that they used to call out to the dolphins, which would heed their calls and then herd fish into the nets. This information indicates that the dolphin-fisher mutualism at Chilika Lagoon may previously have been more active. Changing social-ecological circumstances, along with changes in gear use are likely to have resulted in altered dolphin behaviour. I therefore argue that the Chilika fisher-dolphin interaction is comparable to other dolphin-fisher relationships and is equally important from the perspective of dolphin conservation.

At Chilika, other socioeconomic or cultural circumstances could have led fishers to blame dolphin barrier-foraging for a decline in their potential catch and livelihoods, leading to conflict. The sight of dolphins foraging could potentially have been interpreted by local fishers as provisioning or stealing. Instances of seals and otters foraging at fishing nets or from fish farms, for instance, have triggered significant conflict with fishers in other locations (Freitas et al. 2007; Kemper et al. 2003). Other positive drivers therefore likely influenced fisher perceptions towards dolphins.

Fish catch and income as well as local preferences were important drivers of fisher perceptions towards dolphins. My observations indicate, however, that although catch volume or efficiency did not increase in the presence of dolphins, fisher incomes were significantly higher, and were linked to an increase in the catch of mullet (*Liza* sp., a locally preferred food fish species) when dolphins foraged at nets. The marked increase in the catch of mullet when dolphins forage at nets complements my behavioural observations of Irrawaddy dolphins feeding on mullet while barrier-foraging and is consistent with other reports of dolphins targeting shoaling species like mullet during dolphin-fisher cooperation (Orams 1997; Zappes et al. 2011). Although the bulk of the catch was formed by small, low value prawns and shrimp which influenced the CPUE of

the total catch, mullet is a preferred food fish species for local fishing communities because it has high economic value. Hence catches with mullet were higher in price on average in comparison to catches without mullet.

Although, fisher group, observing dolphin behaviour, fish catch composition and catch income partially explained positive fisher perceptions towards the Irrawaddy dolphin, culture and mythology also contributed to the overall positive attitudes of the fishers. As an example, in one mythic narrative, the Irrawaddy dolphin was cast as a symbolic and a practical helper of fishers, as well as an emissary of Goddess "Harchandi", an embodiment of the Earth Mother and a powerful force in the local pantheon (Patel 1994). Wild species are often connected to mythic traditions and narratives of local communities with which they share wild spaces, are an important part of local cultural identity (Passariello 1999; Telesco & Hall 2002), and should be used to benefit conservation wherever possible.

### *3.4.3 Conservation implications of this study for Irrawaddy dolphins at Chilika Lagoon*

Although fishers and dolphins in the Chilika Lagoon appear to have a mutually positive interaction, conservation of the dolphin is a challenge in practice. The population of Irrawaddy dolphins at Chilika Lagoon is likely Critically Endangered and decreasing (Sutaria & Marsh 2011), (See Chapter 2, Section 2.1). In addition, a small gill-net fishery occasionally operates in the lagoon, sometimes resulting in dolphin bycatch mortality (Sutaria 2009). There is thus an urgent need to formulate management strategies if this population is to be conserved.

The current legal framework in India affords a limited and restrictive management toolbox for conserving endangered populations. The Indian Wildlife (Protection) Act, 1972 allows for the creation of National Parks and Sanctuaries, where little or no resource extraction is permitted (Anonymous 1992). If Chilika is made a National Park or Sanctuary, local fishing communities would not be able to participate in the design, implementation or monitoring of the protected areas (Rajagopalan 2008). The creation of no-take zones and protected areas could have serious social costs due to the exclusion of local and traditional communities (Brockington et al. 2006) as it assumes that the human-wildlife relationships are detrimental to the existence of wild species (Gómez-Pompa & Kaus 1992). Given the significant overlap between dolphins and fishers at Chilika, a protected area is thus likely to harm the existing positive fisher-dolphin interaction. Stakeholder acceptance of dolphins is likely to decrease (Carpenter et al. 2000) and the existing dolphin-fisher mutualism could turn to conflict.

An alternative would be to capitalise on the existing positive dolphin-fisher interaction in the formulation and implementation of Irrawaddy dolphin management strategies. These strategies

need to be negotiated with local fishing communities in order to reach mutually acceptable solutions. Both traditional and non-traditional fishers need to be co-opted into management plans. In particular, traditional fisher beliefs should be used to build a constituency for Irrawaddy dolphin conservation. Existing policy for natural resource and wildlife management in India is still largely top-down (Rajagopalan 2008). However management of the dolphin population at Chilika Lagoon requires the involvement and active engagement of local stakeholders and a change in management policy to a more pluralistic paradigm (Berkes 2007).

## 3.5 Conclusions

Conservation of threatened species in human-dominated landscapes needs to be based on an understanding of the multidimensional motivations and drivers that influence human-wildlife interactions. Amongst other factors, these drivers could be ecological, socioeconomic or cultural. Particularly in developing countries, where human livelihoods overlap with the needs of wild species, strictly protectionist conservation philosophy often results in considerable social costs to local people (Brockington et al. 2006). A purely preservationist approach may occasionally result in effective conservation of wildlife (Brooks et al. 2009) but is likely to harm the rapport between local and government stakeholders (West et al. 2006) as well as the existing relationships between animals and local communities (Infield 2001), ultimately undermining conservation efforts. Teasing out the drivers of mutually positive human-threatened species interactions such as the fisher-dolphin interaction in the Chilika Lagoon is likely to provide scope for understanding how to improve management of the human-wildlife interface. Even in negative situations, communities may have complex interactions with wild species (Peterson et al. 2010) and a more refined understanding of such relationships could crucially mitigate potential human-wildlife conflict.

## 3.6 Summary

- In human-dominated landscapes, interactions and perceptions towards wildlife are influenced by multidimensional drivers. Understanding these drivers could prove useful for wildlife conservation.

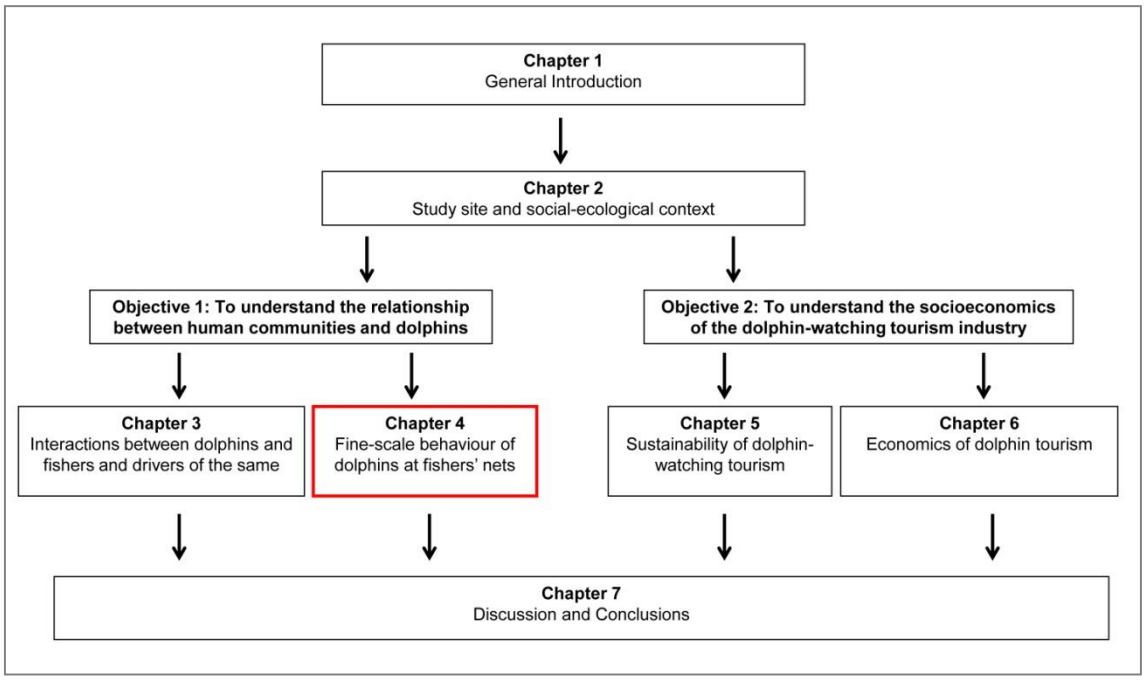
- I surveyed the attitudes and perceptions of fishers towards threatened Irrawaddy dolphins *(Orcaella brevirostris)* at Chilika Lagoon India. To validate the drivers of fisher perceptions, I (1) observed dolphin foraging behaviour at stake nets, and (2) compared catch per unit effort (CPUE) and catch income of fishers from stake nets in the presence and absence of foraging dolphins.

- I found that fishers were mostly positive towards dolphins and believed that dolphins augmented their fish catch, using culture to express their perceptions. Foraging dolphins were observed spending half their time at stake nets and were associated with significantly higher catch income and CPUE of mullet *(Liza sp.)*, a locally preferred food fish species.

- Wildlife conservation efforts should use the multidimensional drivers of human-wildlife interactions to co-opt local stakeholders into management plans.

# 4 Fine-scale behaviour of Irrawaddy dolphins at stake nets[17]

**In Chapter 3, I provide evidence that one of the main drivers of positive fisher perceptions towards dolphins is the fact that dolphins herd fish towards fisher nets. My results indicate that in the Outer Channel, dolphins spend a high proportion of their time foraging, particularly at stake nets. In this Chapter I further investigate the potential dependence of dolphins on stake nets by studying fine-scale dolphin behaviour in the region. Such knowledge is important to understand the extent of the reliance of dolphins on fisher nets and hence the presence of fishers. This information can be used in conservation planning.**




[17] A version of this chapter has been submitted for peer reviewed publication as follows: D'Lima, C., Sinha, A., Arthur, R., Hamann, M., Marsh, H. *(submitted)*. Evidence of behavioural plasticity of endangered dolphins in fisher-modified seascapes: implications for conservation. Submitted to *Endangered Species Research.*

# 4 Fine-scale behaviour of Irrawaddy dolphins at stake nets

## 4.1 Introduction

There is growing recognition that knowledge of animal behaviour can significantly inform actions to improve wildlife conservation and management outcomes (Blumstein & Fernandez-Juricic 2010; Buchholz 2007; Caro 2007; Caro & Sherman 2011; Knight 2001; Sutherland 1998). Human modifications of landscapes and seascapes often result in wildlife behaviour that leads to negative consequences for species inhabiting common areas (Athreya et al. 2013; Pragatheesh 2011). Occasionally, however, wild species adapt positively to human presence, thus exhibiting a degree of behavioural plasticity to human-introduced change (e.g. Chilvers & Corkeron 2001). Irrespective of the nature of the impact, knowledge of the behaviour of the wild species concerned can inform conservation and management actions.

Responses of wild species to human modifications of their habitat are usually species-specific and often site specific. For instance, the provisioning of bonnet macaques (*Macaca radiata*) by tourists visiting protected areas in southern India have had profound effects on the monkey's social organisation as well as their short-term and long-term behavioural strategies (Ram et al. 2003; Sinha & Mukhopadhyay 2013; Sinha et al. 2005). For example, rhesus macaques (*Macaca mulatta*) along roads in central India have responded to provisioning with significantly larger roadside group sizes and high incidences of macaque road-kills (Pragatheesh 2011). In contrast, however, five monkey species in the central African rainforest did not appear to be impacted by the presence of roads (Laurance et al. 2006). Similarly, whereas some bird species may be able to adapt to increased levels of traffic noise by increasing their song pitch, amplitude or by singing during periods of decreased traffic, other species are not able to exhibit such adaptations, with consequent negative effects on their pairing success (Kociolek et al. 2011).

In aquatic environments, the overlap in the habitats used by fishers and marine mammals has increased as a consequence of expanding human populations. In particular, marine mammal interactions with fishing gear and techniques area major source of mortality, often resulting in animals feeding off and getting trapped in fishing gear (such as gill nets), and in accidental mortality or 'bycatch' (Read 2008; Read et al. 2003; Reeves et al. 2003). Bycatch contributed to

the recent extinction of the baiji or the Chinese river dolphin (*Lipotes vexillifer*) (Turvey et al. 2007). Other populations of small cetaceans that continue to be threatened by destructive fishing gear and practices are the vaquita (*Phocoena sinus*) (Rojas-Bracho et al. 2006) and my study species, the Irrawaddy dolphin (*O.brevirostris*) (Smith et al. 2007), throughout its range of occurrence (Reeves et al. 2008; Smith et al. 2007). Indeed, bycatch within a single country is possibly the greatest threat to 11 of the 12 taxa (species, subspecies and subpopulations) of small cetaceans listed on the IUCN Red List as Critically Endangered, due to their increasing exposure to fishing gear (IUCN 2014; IUCN SSC 2014, see Chapter 2).

In contrast, some populations of marine mammals have adapted their foraging strategies to the presence of fishers and fishing gear, and have occasionally used the presence of humans to their apparent advantage. For instance, Irrawaddy dolphins in Myanmar cooperatively foraged with fishers in a cast-net fishery (Braulik 2014; Smith et al. 2009b) while bottlenose dolphins in Moreton Bay, Australia feed in association with trawlers (Chilvers & Corkeron 2001).

As the adaptive capacity towards fishing gear and techniques can affect the survival of endangered populations of small marine mammals, understanding their fine-scale behavioural adaptations to such human devices and practices is crucially important. A marine mammal's behavioural dependence on fishing gear, for example, demonstrates its reliance on the presence of fishers and hence is of relevance to its conservation planning. Studies focusing on such behavioural adaptations of threatened small cetaceans are, however, rare.

I address this gap by studying the behavioural adaptations of the threatened population of Irrawaddy dolphins in the Outer Channel of Chilika Lagoon in eastern India, to "stake nets" (Chapter 2, Plate 2.2 and Chapter 3, Figure 3.3). Stake nets, or "*Khanda jaal*" in the local Odia language, which came to be widely used in the Outer Channel around 1990, are a type of fishing trap placed across channels of the lagoon to catch fish through a corralling technique (Chapter 2, Plate 2.2 and Chapter 3, Figure 3.3). Unlike gill nets, stake nets do not cause direct mortality of the Irrawaddy dolphins in Chilika; indeed, this population of dolphins is known to barrier-forage extensively at stake nets (Chapter 3). Although this population is potentially critically endangered and declining due to a number of anthropogenic threats (Smith et al. 2007; Sutaria 2009), dolphin mortality has greatly reduced in recent years, mainly due to efforts to decrease gill netting (D'Lima, pers. obs.). The Outer Channel, in fact, simultaneously supports both high densities of dolphins (Sutaria & Marsh 2011) and fishers with stake nets. This situation thus provides an excellent opportunity to study fine-scale behavioural patterns of the Irrawaddy dolphins in a human-modified habitat, particularly at stake nets.

## 4.2 Methods

I primarily studied the foraging behaviour and select behavioural states of Irrawaddy dolphins around stake nets and in open waters annually between January and March – and across three years – from 2008 to 2010 in the Outer Channel of the Chilika Lagoon in eastern India. Data were collected by conducting boat-based surveys carried out along transects in the Channel. During each survey, all areas of the Channel were sampled at the same survey intensity, irrespective of the presence of stake nets. Dolphin behaviour was recorded whenever a group of dolphins was encountered (I defined an *encounter* as a sighting of dolphins within approximately 50m of the survey vessel, and *group* as a pod of dolphins within 10m of one another, usually performing the same initial behaviour). I developed decision rules to deal with situations when dolphins split or joined groups during a follow; if individuals joined a group they were not considered in a follow; if individuals left a group, the encounter was ended. The vessel engine was immediately turned off when dolphins were encountered to minimise the impact of the vessel on their behaviour. Whenever possible, the dolphins were photo-identified to ensure independence of observations and data collected during encounters with re-sighted individuals, photo-identified on the same day, were discarded from further analysis to avoid pseudo-replication of the data. An encounter was considered to end when the dolphins moved more than 100m away from the survey vessel or when the group split as explained above.

Data were collected by scan sampling of group behaviour every five minutes. Dolphin behaviour was first classified into behavioural events and states, based on observations *ad libitum*, and compiled in a partial ethogram. The principal behavioural states – foraging, resting, milling, travelling and socialising (Table 3.2, Chapter 3) – and particular foraging strategies of the dolphins, described below, were noted.

My classification of dolphin foraging behaviour was based on prior observations *ad libitum* and included the number of individuals in the group as well as their proximity to stake nets. Following the protocol developed in Chapter 3, I classified the dolphin foraging state to consist of four main strategies: (1) open-water foraging, a foraging strategy adopted by individual dolphins in open waters, usually more than 50m away from stake nets and which did not fall into any other foraging strategy; (2) barrier-foraging, in which Irrawaddy dolphins were sighted explicitly within 50m of stake nets, and used them as foraging aids; (3) mud-plume foraging, in which the dolphins created plumes of mud in the water, which they then used to catch fish (Lewis & Shroeder 2003); and (4) cooperative foraging, wherein a group of six to 11 dolphins, less than one body length from one another, coordinated to herd fish into a ball-shaped cluster before feeding on them (Gazda et al. 2005). Instantaneous behaviours such as *bottom grubbing*, *snacking* (Mann & Sargeant 2008), and *kerplunking* (Connor et al. 2000) were considered as

events within the four main foraging strategies described here (Martin & Bateson 1993). Dolphin groups were also categorised on the basis of their size and life history stages as follows: (1) cow-offspring pairs; (2) mixed groups of adult and immature individuals; (3) groups of adult individuals; (4) groups of immature individuals; (5) solitary adults; and (6) solitary immature (Table B.1, Appendix B; see also Connor and Mann (2006)).

Only encounters longer than ten minutes were analysed. I considered the *predominant behaviour* (the behaviour performed by the dolphins in more than 50% of the scans within that encounter), the foraging strategy and the group category (group composition and number of individuals in the group) in my final analysis of fine-scale dolphin behaviour.

## 4.3 Results

I observed a total of 196 encounters in our survey effort of 106 h in the Outer Channel. Fifty-eight encounters in which the dolphins exhibited clear *predominant* behaviours lasted longer than ten min. Dolphins were observed foraging, milling and travelling in 52%, 29% and 19% of these encounters respectively. Socialising was not observed. There was no significant difference in the frequency of encounters, in which dolphins foraged, milled and travelled, near stake nets compared to those in open waters (Fisher's exact test, $p > 0.05$, degrees of freedom = 2; G-test of independence, $G = 2.05$, $p > 0.10$, 3 x 2, $n = 58$).

Dolphins were observed foraging in 30 of 58 encounters. Each foraging encounter was classified based on the *predominant* foraging strategy adopted by the dolphin group. Of these 30 encounters, 43% (n=13) comprised open-water, 37% (n=11) barrier-foraging, 13% mud-plume (n=4) and 7% (n=2) cooperative foraging strategies.

Cows with offspring and solitary immatures displayed a relatively higher frequency of barrier-foraging at stake nets – in 20% (n=6) and 13% (n=4) of all foraging encounters respectively. Mixed groups were observed barrier-foraging in only 3% (n=1) of all foraging encounters (Figure 4.1). The proportion of cows with offspring that barrier-foraged at stake nets was also greater than those that displayed open-water or mud-plume foraging. Unfortunately, sample sizes were too small for frequentist statistical analysis; nonetheless, the observed pattern was clear (Figure 4.1). In contrast, groups of adults, groups of immatures and solitary adults, which presumably included adult females without offspring, were not observed to barrier-forage, although the sample of

observations is likely to be too small to confirm that these life history strategies never adopt these strategies. These results suggest that barrier-foraging at stake nets may be primarily undertaken by certain life stages of dolphins, primarily cows with their offspring and immatures foraging alone.

Mixed groups, solitary immatures and solitary adults foraged in open waters most frequently, with 20% (n=6), 10% (n=3) and 7% (n=2) of encounters dedicated to this form of foraging respectively (Figure 4.1). Cows with offspring, groups of adults and groups of immatures, however, each foraged in open-water in only 3% (n=) of all foraging encounters. Thus, even though all dolphin categories adopted open-water foraging to some extent, mixed groups (comprising both adults and immatures) were observed open-water foraging most frequently.

Cooperative foraging was limited to groups of adult individuals, who displayed this form of foraging in only 7% (n=1) of their foraging encounters (Figure 4.1). No immature individual was observed to forage cooperatively, although the sample size of observations within this category (n=2) was too low to confirm whether or not immatures ever participate in cooperative foraging.

Cows with offspring, solitary adults and solitary immatures were only occasionally observed mud-plume foraging; in 3% (n=1) of all encounters each (Figure 4.1).

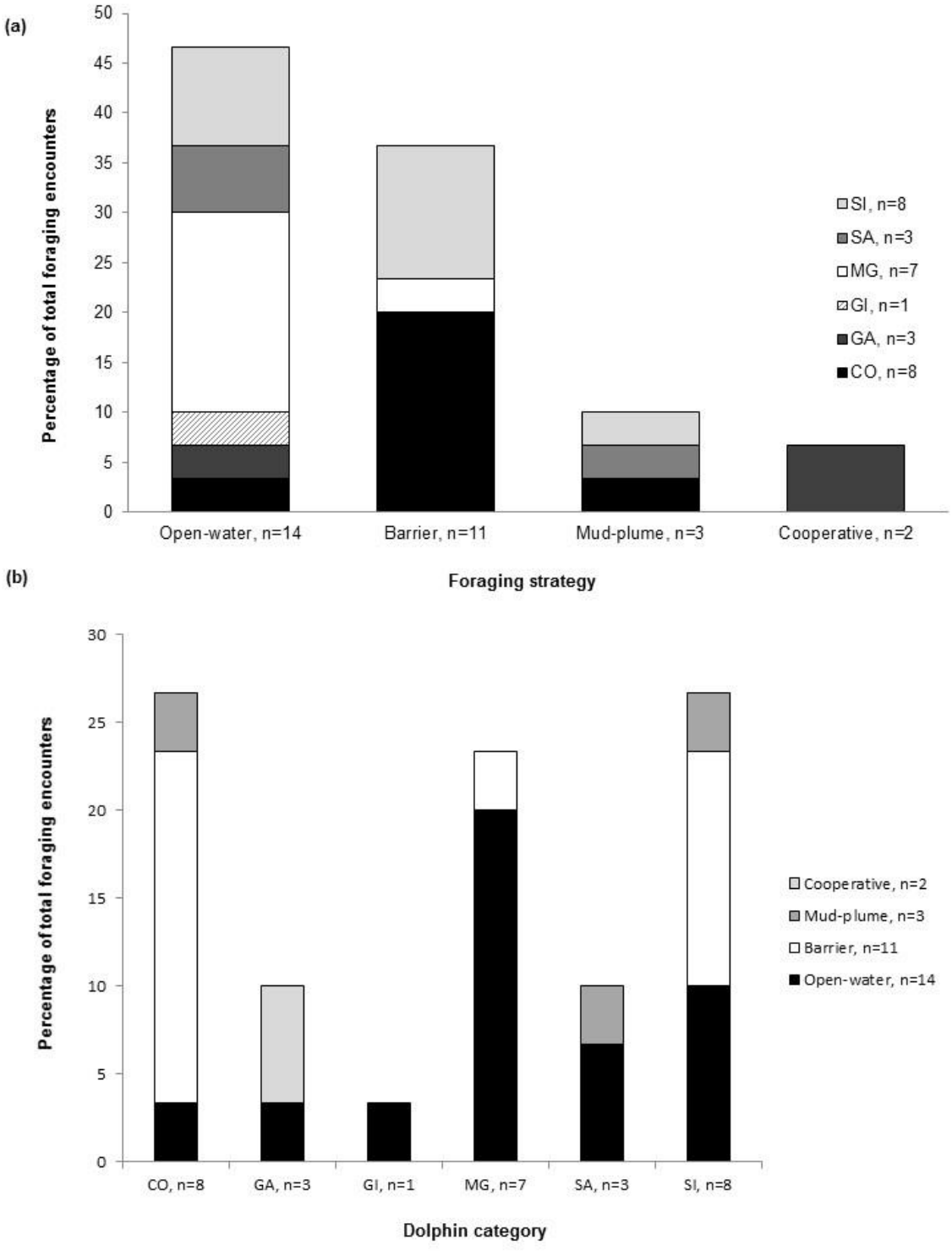



**Figure 4.1:** Percentage of total Irrawaddy dolphin foraging encounters in the Outer Channel of Chilika Lagoon in India (n = 30), illustrated by: (a) strategy adopted, and (b) category of dolphin group, where CO = Cow-offspring pairs; GA = Groups of adult individuals; GI = Groups of immature individuals; MG = Mixed groups of adult and immature individuals; SA = Solitary adults; SI = Solitary immature individuals.

## 4.4 Discussion

Irrawaddy dolphins, especially cows with their offspring and solitary immatures, barrier-forage at stake nets, a behaviour that must have occurred approximately over the past 25 years, ever since these nets came to be used in the Outer Channel of Chilika Lagoon. These observations suggest that the species, and in particular certain life history stages, exhibit behavioural flexibility in their foraging strategies and now may exhibit some reliance on stake nets and hence fishers in the lagoon.

Barrier-foraging at stake nets apparently develops early, during the life cycle of the dolphins in Chilika Lagoon. This behaviour, described in Chapter 3, appears to be the most frequently adopted strategy of dolphin cows with their offspring and solitary immature dolphins (Figure 4.1). In cow-offspring groups, cows were closely followed by their offspring and both cow and offspring were often seen pushing fish together towards stake nets. When in mixed groups, however, individuals appeared to preferentially rely on open-water foraging. In contrast, adults without offspring were observed either open-water foraging when alone or cooperative foraging when in groups. Unfortunately, although the samples sizes are too small to draw firm conclusions[18], my results suggest that immature, maternally-dependent offspring barrier forage and continues to use this strategy when they forage alone. Whether the strategy is adopted by adults in the absence of young is questionable and would need to be confirmed by further observations.

Why does stake net barrier-foraging occur in this population of Irrawaddy dolphins? Plausible hypotheses include the Social Transmission Hypothesis, the Energetics- or Food Quality Hypothesis, Social Behaviour Hypothesis, Food Availability Hypothesis or the Safety Hypothesis (see Table 4.1 for details). At present, however, these alternative hypotheses, which may not be mutually exclusive, cannot be evaluated.

Although barrier-foraging *per se* is not a newly reported strategy and dolphins, including my study species, have been known to drive fish towards nets or other stationary objects in other locations (Simoes-Lopes et al. 1998; Smith et al. 2009b), barrier-foraging at stake nets in Chilika appears to be a recently adopted behaviour that is a modification of a previous foraging strategy. Fishers at Chilika talk of a time approximately 25 years ago when the use of drag nets was more widespread and the dolphins apparently "helped" them by herding fish into their nets

[18] A theoretical but plausible explanation for why adults in the absence of young were not observed barrier-foraging could be because cooperative and open-water foraging strategies are more optimal for this life history stage, yielding larger quantities and more diverse prey species.

in a more active, mutualistic dolphin-fisher interaction (Chapter 3). The use of stake nets in the lagoon became widespread only around this time, along with changing social-ecological conditions in the lagoon (Chapter 2). Changing fishing gear is likely to have resulted in consequently altered dolphin behaviour at fishing nets, an indication that the dolphins of Chilika Lagoon exhibit a considerable degree of behavioural flexibility to changing environmental circumstances. Hence, the adaptation of dolphins to barrier-foraging at these nets must have taken place over one generation, suggesting that Irrawaddy dolphins in Chilika Lagoon show behavioural plasticity in a fisher-modified seascape.

**Table 4.1:** Plausible hypotheses to explain reasons for Irrawaddy dolphin dependence on barrier-foraging at Chilika Lagoon in India.

| **The Energetic or Food Quality and Quantity Hypothesis** | |
|---|---|
| **Explanation** | As cow-offspring groups are often seen adopting this strategy together and this behaviour persists in young, weaned immatures, my first hypothesis is that vertical social transmission plays an important role in the adaptation of this behaviour to stake nets. |
| **Type of data that would be required** | Dietary reconstructions of various life history stages, based on isotope analysis of tissue samples of the dolphins. |
| **The Social Behaviour Hypothesis** | |
| **Explanation** | Cow-offspring pairs and solitary immature individuals are excluded from cooperative foraging because of social linkages and/or coordination and aggression required of adults adopting cooperative foraging strategies, and thus become dependent on barrier-foraging. |
| **Type of data that would be required** | Behavioural observations of aggression towards younger individuals, particularly when adults are in groups. |
| **The Safety Hypothesis** | |
| **Explanation** | Barrier-foraging occurs in shallower, safer waters, where immature individuals and cows with their offspring are less likely to encounter predators such as sharks. This hypothesis could also explain why mixed groups of adult and immature individuals frequently adopt open-water foraging in deeper waters. |
| **Type of data that would be required** | Studies on dolphin abundance and shark predation risk across the Outer Channel. |

Irrespective of the underlying mechanisms responsible for the appearance and maintenance of the behavioural patterns reported here, conservation and management strategies should consider the potential importance of barrier-foraging, stake nets and fishers for the fitness and future survival of the endangered Irrawaddy dolphins in Chilika Lagoon. The frequency of barrier-foraging of cows with offspring and solitary immature dolphins at stake nets suggests that the presence of stake nets may be important for the dolphins, particularly young animals. Although it may be argued that the behavioural plasticity of the dolphins would allow them to adjust to the absence of stake nets, the question of whether feeding efficiency would be the same in other foraging strategies remains unclear. If the management strategies to conserve this population of dolphins included the creation of a protected area in the Outer Channel, local fishers and their stake nets would be excluded from the area, as required by the Indian Wildlife (Protection) Act, 1972 (Anonymous 1992; see also Chapter 3, Section 3.4) and it is likely that in the absence of effective enforcement, fishers would revert to using gear that was more mobile and less "dolphin-safe" such as gill nets. Alternatively, a very high density of stake nets might impact the dolphins by impeding their movement. Conservation planning to protect this likely Critically Endangered population of dolphins (Sutaria & Marsh 2011) therefore needs to consider the costs, benefits and likely unintended consequences of various management strategies.

In a broader context, stake nets may have the potential to be used as "dolphin-safe" nets for fishers, in other coastal, estuarine and riverine areas where bycatch from gill nets is a problem for dolphin conservation. Stake nets are passive traps in which dolphins do not get entangled and yet, constitute an efficient harvest method especially targeting lagoonal and estuarine fish and prawn species (Chapter 3). Modifying fishing gear, for example, has proved to be successful in reducing harbour porpoise (*Phocoena phocoena*) bycatch (Larsen et al. 2007). Thus where gill netting is a conservation issue, resulting in bycatch of dolphins (Read 2008; Read et al. 2003; Reeves et al. 2003), the possibility of replacing gill nets with alternative fishing gear such as stake nets should be considered in other locations as well. Future research on dolphin conservation strategies could benefit if this option can be actively considered and tested in the field.

More generally, the impact of interactions between fishers or fishing gear on the behaviour of marine mammals should be studied more intensively. Such knowledge has the potential to inform and transform conservation planning and form the basis of conservation action, particularly for cetacean populations that are becoming increasingly endangered worldwide.

## 4.5 Summary

- Knowledge of the behaviour of wild species in human-modified landscapes often informs conservation solutions.

- In aquatic ecosystems, for instance, fishing gear such as gill nets are currently the leading threat to small cetaceans listed as Critically Endangered on the IUCN Red List. Yet studies that document behavioural adaptations of small cetaceans to fishing gear are rare.

- I studied the fine-scale behaviour of threatened Irrawaddy dolphins *(O. brevirostris)* to "stake nets" in the Outer Channel of Chilika Lagoon, India.

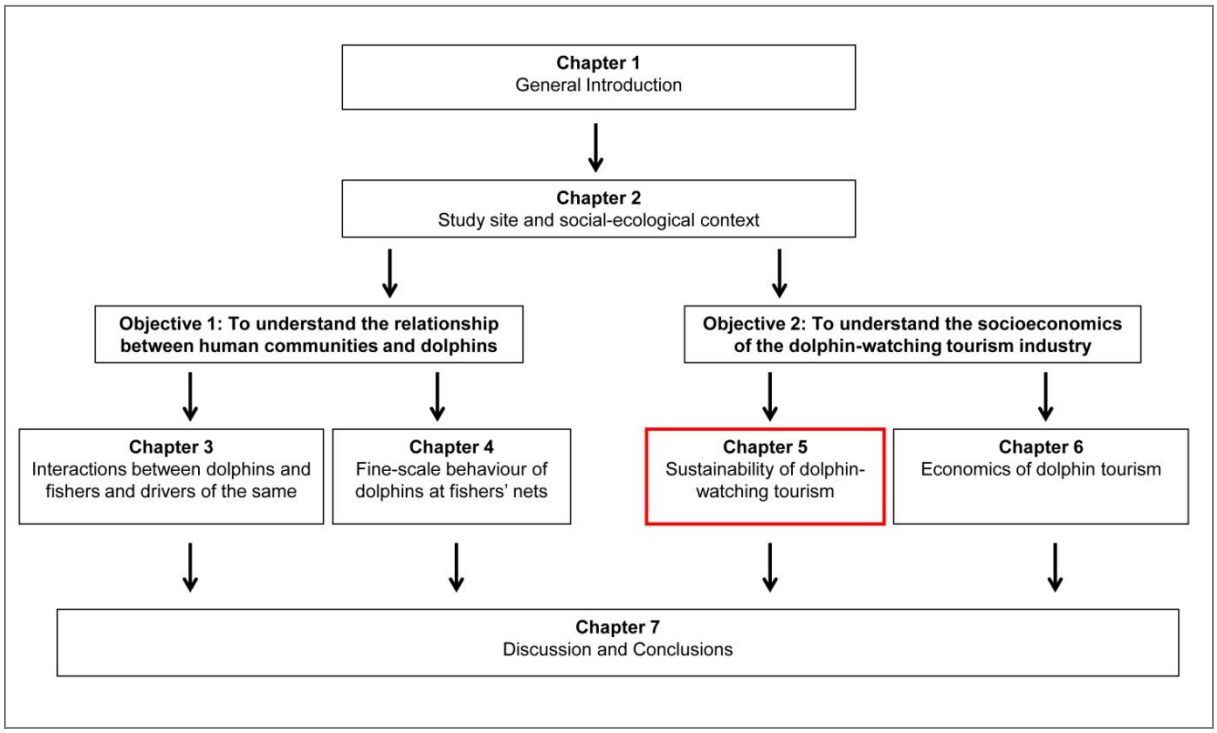
- Dolphin cows with offspring and solitary immatures frequently barrier-foraged at these nets.

- Stake nets date back about 25 years, indicating that the dolphins of Chilika exhibit behavioural plasticity and have adapted to these nets within one generation.

- These findings can specifically be used in conservation planning of the species; more generically, studies on the behaviour of threatened wild species could provide useful solutions to challenging conservation problems.

# 5 Sustainability of dolphin-watching tourism at Chilika Lagoon[19]

**This chapter addresses the second objective of my thesis, which is to understand the socio-economics of the dolphin-watching tourism industry at Chilika Lagoon. As in other developing countries, locally initiated dolphin-watching tourism has emerged as an important livelihood for fishers at Chilika, over the past 25 years (Chapter 2). Effective conservation of the Irrawaddy dolphins at Chilika is thus inextricably linked to the efficient and sustainable management of the dolphin-watching industry, and forms the rationale for conducting this aspect of my thesis.**




[19] A version of this chapter will be submitted for peer reviewed publication as: D'Lima, C., Everingham, Y., Diedrich, A., Mustika, P.L., Hamann, M., Marsh, H. *(ready to submit).* Assessing the sustainability of wildlife tourism in developing countries: a dolphin-watching case study. To be submitted to *Tourism in Marine Environments.*

# 5 Sustainability of dolphin-watching tourism at Chilika Lagoon

## 5.1 Introduction

The need to assess the impacts of non-consumptive wildlife tourism (henceforth wildlife tourism) is important, to inform long-term sustainable management of the industry (Higham & Lück 2008). Particularly in developing countries, where wildlife tourism is growing rapidly (Balmford et al. 2009; Cisneros-Montemayor et al. 2010; O'Connor et al. 2009), local communities often depend on the industry for their livelihoods, despite the inadequacies in the capacity, governance, mechanisms, policies and accountability required to manage the industry appropriately (Beasley et al. 2014). The consequences of unsustainable management of a tourist industry can potentially be devastating (Diedrich & García-Buades 2009), both for the communities who are dependent on wildlife as a tourism resource, and for the conservation of the wild species in question. However, even though wildlife tourism is known to cause several tangible impacts on wild species, the direct implications of these impacts for the sustainable management of wildlife tourism industries, for the most part, still remains unclear.

Few biological studies provide compelling evidence to assess the impacts of wildlife tourism on the species concerned to inform the sustainable management of the industry. For example, most studies on whale and dolphin-watching tourism (henceforth cetacean-watching tourism) assess the presence and density of tourist boats on the behaviour of the species in question (Higham & Lück 2008). Research such as that by Baker and Herman (1989), Bejder et al. (1999), and Constantine et al. (2004) et al. show that tourist boats have an impact on the short-term behaviours of cetacean species. Although these studies may have broad biological implications, they typically fall short of being able to provide managers with vital recommendations necessary for the management of the tourism industry. Other studies such as Lusseau (2003) and Lusseau (2004) establish the impact of tourist boats on the behavioural budget of the species in question, but are unable to draw conclusions to inform the long-term sustainability of the industry on the whole. Only one biological study, being that of Bejder et al. (2006), has been able to conclusively prove that the impacts of the industry are unsustainable in the long-term (Higham & Lück 2008). One reason for the gap between the research conducted and the applicability of such research for the management of cetacean-watching tourism is the difficulty in measuring and detecting thresholds of impacts on ecological sustainability in the absence of:

(1) long-term biological data, and (2) suitable reference points to which thresholds may be compared.

In addition, sustainability itself is multidimensional concept. According to Coccossis (2004), sustainability comprises environmental, social, economic and governance elements. Existing frameworks such as Quadruple Bottomline Sustainability (Horrigan 2002; Wight 2007), and the Prism of Sustainability (Spangenberg 2004; Valentin & Spangenberg 2000) also envisage sustainability as a multidimensional concept, comprising social, economic, environmental and institutional or managerial elements. Each element in these frameworks is linked to the other, hence a focus on social and economic elements has direct implications for the ecological or environmental sustainability of the system as well. In recognition of this fact, Higham et al. (2009) propose a model for the management of cetacean-watching tourism, which includes components of both natural and social sciences. Malcolm and Duffus (2008), Kessler and Harcourt (2010) and Mustika et al. (2012a) also consider some of the human-dimensions of cetacean-watching industries.

Yet there still remains a dearth of literature on the human aspects of cetacean-watching tourism. Coccossis (2004) points out that:

> **"Tourism is a complex socioeconomic phenomenon, based on growing needs of modern societies..."**

This fact is very relevant in developing countries, where cetacean-watching is growing rapidly (O'Connor et al. 2009). Thus assessing the human dimensions of sustainability of the industry (such as the social and economic dimensions), should be an imperative.

Concepts such as "carrying capacity" (Coccossis, 2004), "recreational capacity" (Buckley 1999), and "limits of acceptable change" (McCool & Lime 2001; Stankey et al. 1984) are crucial to understanding the social sustainability of a tourism industry. Following a neo-Malthusian resource limitation perspective, "tourism carrying capacity can be [defined as] the maximum number of people who can use a site without an unacceptable alteration to the physical environment (natural and man-made) and without an unacceptable decline in the quality of the experience gained by visitors" (Coccosis 2004). However, this interpretation of carrying capacity has been repeatedly criticised (Buckley 1999; McCool & Lime 2001; Stankey et al. 1984). Carrying capacity is a function of human needs, objectives and motivations. Thus there could potentially be several different carrying capacities for a particular site or location. For instance, the carrying capacity of a particular tourist site is likely to vary depending on the type of recreational experience that tourists seek (such as adventure, solitude, companionship,

etc.). Thus understanding the objectives of a tourist site is important. Such understanding is a social, not a biophysical process. Beyond setting a numerical limit on the number of tourists, the concept of limits to acceptable change includes a framework for maintaining desired conditions, within mutually agreed and socially accepted limits of change. According to Buckley (1999),

> **"Whereas carrying capacity was supposed to reflect some intrinsic property of the environment concerned, recreation capacity is a broader concept which recognises that different forms of tourist activity have different impacts, and that these may be reflected in different management systems."**

The idea of establishing a numerical carrying capacity thus evolved into concepts such as recreational capacity and limits of acceptable change.

The social sustainability of a tourist site may also be considered using Butler's Tourism Area Life Cycle (TALC) model (Butler, 1980). According to this model, the capacity of a tourist site is dynamic and evolves over time. This change is influenced by changing visitor preferences which result in increased impacts on the site, as the number of tourists visiting a site increases. Butler suggests that a tourist site goes through stages of Exploration, Involvement, Development, Consolidation, Stagnation, and ultimately Decline (Figure 5.1a). Occasionally, a site may be rejuvenated, in instances where the tourist attraction is completely altered (Butler 1980).

Building on Butler's TALC model (Butler 1980), Duffus and Dearden (1990) proposed an integrated model which includes the limits of acceptable change framework suggested by Stankey et al. (1984), and the leisure specialisation continuum developed by Bryan (1977), (Figure 5.1b). Duffus and Dearden's model (1990) has been revisited by Higham et al. (2009) and Catlin et al. (2011), and is used by other studies such as Malcolm and Duffus (2008). According to the Duffus and Dearden (1990) model, as a tourist site evolves and recreational use of a tourist site increases, various critical limits of acceptable change are reached in which the proportion of generalist tourists will increase, relative to the number of specialists visiting the site (Figure 5.1b). With these models in mind, it is possible to use indicators that detect whether limits of acceptable change are being approached or surpassed on a case-by case basis (Diedrich & García-Buades 2009), and hence whether a tourist industry is functioning within sustainable limits, mutually acceptable to all stakeholders.

Manente and Pechlaner (2006) propose a series of indicators that can be used to identify whether a tourist site is in decline[20]. Developing and measuring indicators related to the tourist life cycle such as visitor flows, types of visitors, motivations, etc., are a fundamental step to documenting decline (Manente and Pechlaner, 2006). The quality of experience or satisfaction of tourists may also serve as indicators of the sustainability of the industry (Manente and Pechlaner, 2006). Satisfaction levels also serve as post-purchase evaluations of the purchased tourism product (Pearce 2006), and are often used as a measure of service quality (Moscardo & Saltzer 2004), and the viability of the tourist industry, e.g. based on the likelihood of tourists returning to a site, and/or recommending it to others (Akama & Kieti 2003). Satisfaction levels thus serve as outcome indicators of the success of existing management regimes (Orams 1995). Thus tourist expectations, preferences, experiences, perceptions and suggestions are also used as indicators of social sustainability (Birtles et al. 2002; Mustika et al. 2012a), and by extension apply to other elements of tourism sustainability as well. Collectively, these indicators provide compelling evidence of whether an industry is functioning within sustainable limits. To the best of my knowledge, I am unaware of any study on cetacean-watching tourism in developing countries that has addressed the combination of such sustainability indicators that I studied and which are described below.

In this chapter, I use the dolphin-watching tourist industry at Chilika Lagoon (Chapter 2) as an example of a cetacean-watching tourism industry in a developing country. Currently semi-regulated by local cooperatives through tourist boat associations, local fishers service more than 155,000 domestic tourists annually (Anonymous 2011), taking them to watch a likely threatened population of Irrawaddy dolphins in the lagoon (see Chapter 2). Dolphin-watching tourism is an important alternative livelihood for these marginalised fishers (see Chapter 2), and thus the industry depends on a likely threatened wildlife icon. Managing the industry sustainably is therefore a priority.

The aim of my research was to investigate whether dolphin-watching at Chilika Lagoon is socially sustainable. My objectives were to: (1) describe the industry and how it is currently being conducted, (2) investigate tourist demographics,(3) investigate the change in visitation over a ten year time period, tourist specialisation, satisfaction, preferences, perceptions and likelihood of returning as indicators of social sustainability, and (5) use the findings of this case study to suggest generic management solutions that might better enable cetacean-watching industries in developing countries to function within sustainable limits.

[20] Here, a declining site is one "with a certain tradition in providing tourism, but characterised by one or more negative trends" (Manente and Pechlaner).

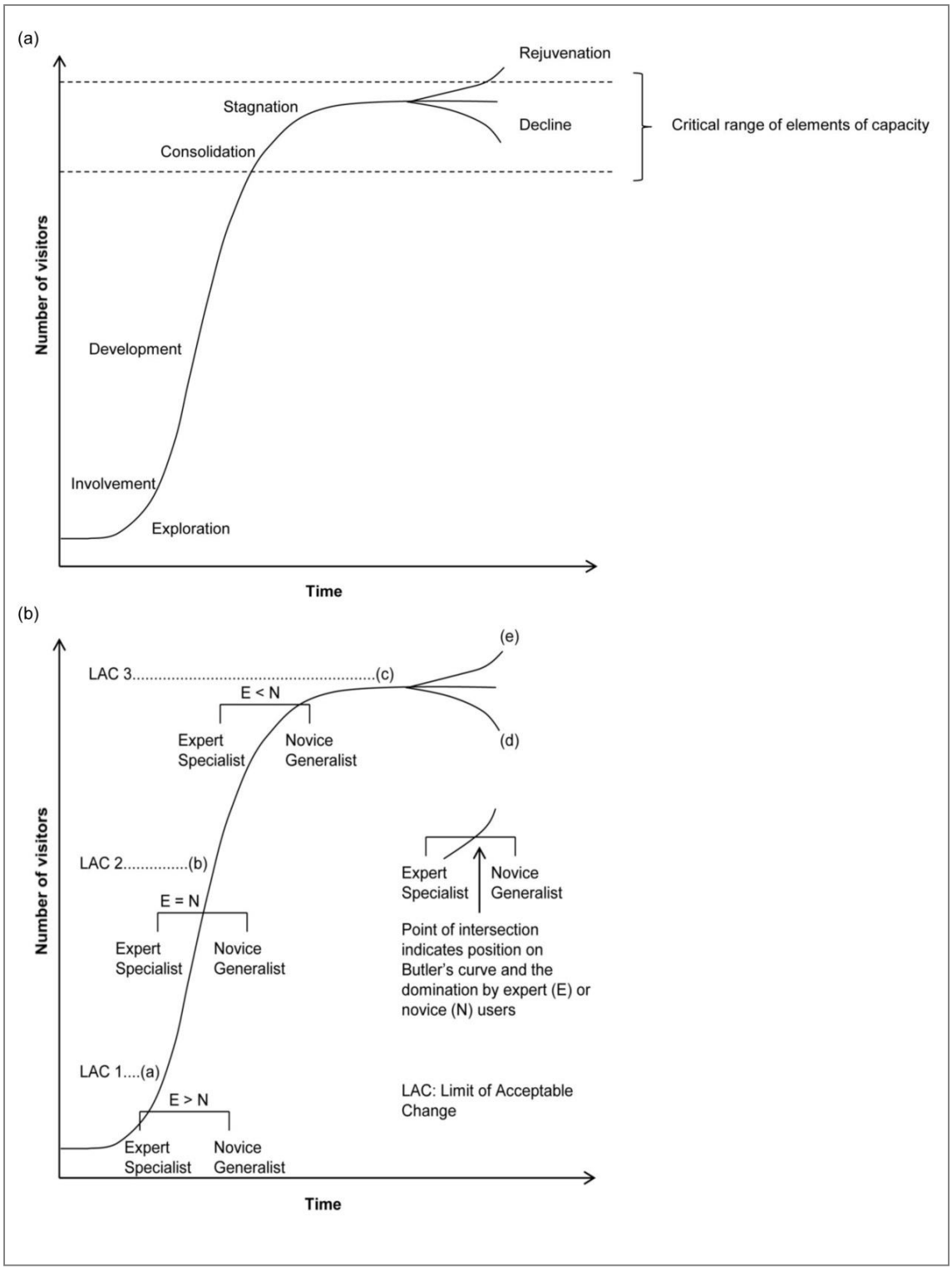



**Figure 5.1:** The evolution of a tourist site showing: (a) Butler's Tourism Area Life Cycle (TALC) model (Butler 1980), and (b) Duffus and Dearden's model (Duffus & Dearden 1990), which integrates the TALC model, the user specialisation framework and limits of acceptable change.

## 5.2 Methodology

### *5.2.1 Study site*

Chapter 2 provides a detailed background of the study site. At the time of this study, dolphin tours were conducted at each of four tourist centres (Figure 5.1), through a tourist boat associations.

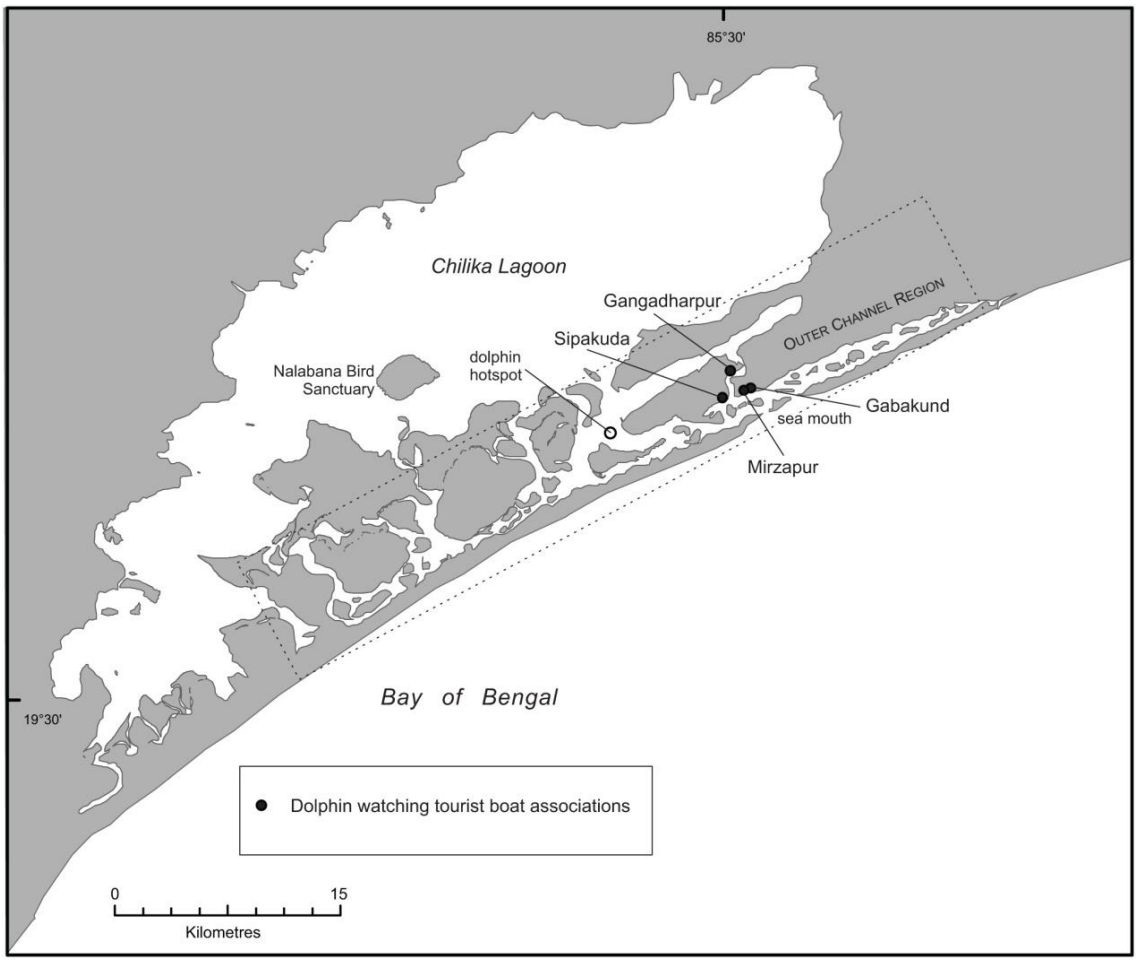



**Figure 5.2:** Map of Chilika Lagoon showing the four dolphin-watching centres in the Outer Channel.

### *5.2.2 Tourist visitation numbers and growth rate*

Secondary data on tourist visitation numbers both for the Outer Channel (Satpada region) and the entire state of Odisha were collected from the Tourism Department of Odisha (Appendix D).

### *5.2.3 Approach to assess the indicators of sustainability of the dolphin-watching industry*

I used a participant observation approach to describe the dolphin-watching industry, and a tourist interview survey instrument to collect data on the indicators of social sustainability as listed above and described below.

#### 5.2.3.1 Interview survey design

I used semi-structured interviews and a mixed methods approach with quantitative and qualitative elements (Bryman 2006; Mustika et al. 2012a), to document tourist profiles, specialisation, satisfaction levels, factors associated with satisfaction levels, preferences, and perceptions. The survey was refined through preliminary reconnaissance interviews conducted with tourists at Chilika Lagoon from January to March of 2010. At the beginning of each interview survey, I also noted the trip conditions including weather conditions and the sea state. The interview survey comprised 21 main questions, and consisted of questions on six broad themes (see Appendix C): (1) tourist demographics, including information on age, gender, education level, occupation, region or state of residence within India; (2) tourist specialisation, including number of reasons for visiting the lagoon, previous visits to Chilika and previous interaction with dolphins, and how tourists had heard about dolphin-watching at Chilika; (3) tourist satisfaction levels (on a scale of 1-10), and factors that could potentially predict satisfaction levels, including number of dolphins sighted, number of passengers in the boat, price of the dolphin ride, boat overcrowding, boat driver encounter management, distance maintained between the tourist boat and opinion on the amount of time spent watching dolphins; (4) questions regarding tourists preferences with regards to their dolphin-watching experience; (5) tourist perceptions on how dolphin-watching could be improved in the lagoon, and (6) questions on the likelihood of tourist returning to the lagoon to watch dolphins and recommending the trip to others.

#### 5.2.3.2 Data collection

Surveys were administered to tourists visiting all four functional tourist centres, and the number of interviews administered at each centre was weighted according to the number of tourist boats owned by that tourist association. The languages in which surveys were administered were English and Hindi; interviewers were proficient in both languages. Responses were recorded on a Dictaphone, and were maintained for our records. I subsequently transcribed all interview surveys.

Tourists were interviewed between noon and late afternoon after they had returned from their dolphin-watching boat ride. Interviews were administered opportunistically, depending on the availability of tourists returning from rides and on their willingness to be questioned. Care was taken to administer only one interview per boat so that the samples were independent. Although respondents have a male bias, other occupants of the boat (usually women family members) often prompted the main respondent. Thus I consider each response to be indicative of the perceptions of a whole family group.

#### 5.2.3.3 Data analyses

To identify the most important variables that were associated with tourist satisfaction levels, I conducted a regression tree analysis (De'ath 2002; Faraway 2006), using the *mvpart* package from CART models in *R v 2.13.0* (*R* Development Core Team, 2011). Tourist satisfaction level was used as the response variable, and tourist gender, place of residence, education level, occupation, previous interaction with dolphins, sea state, weather conditions, number of dolphins sighted, number of passengers in the boat, price of the dolphin ride, boat overcrowding, boat driver encounter management, and distance maintained between the tourist boat and dolphins were used as predictor variables. I excluded 'amount of time spent watching dolphins' from the regression tree analysis, because many respondents did not answer that question, compared with the number of responses to the questions designed to elicit values of other predictor variables measured. I used regression trees as an exploratory analysis, to identify the most important predictor variables and interactions. These predictor variables and interactions were then supplied to a forward linear stepwise regression procedure to model tourist satisfaction level as the dependent variable (using SPSS software, 20.0).

I analysed the qualitative data using thematic analyses (Campbell 2002; Dixon-Woods et al. 2005). Responses to open-ended questions were thematically grouped according to the distinct recurring themes providing information on tourist preferences with regards to their dolphin ride, and their perspectives on how the dolphin-watching industry at Chilika Lagoon could be improved. Quotes cited were chosen to represent the range of responses within a particular theme. Interviews were referred to by number (R1 to R239), to preserve the anonymity of the respondent.

## 5.3 Results

### *5.3.1 Description of the dolphin-watching industry at Chilika Lagoon*

Here I describe how dolphin tourism was conducted at the time of conducting my fieldwork, between November 2010 and January 2011. To the best of my knowledge, there have been no substantial operational changes in the industry since then and I use the present tense to describe the industry.

Dolphin tours are conducted through tourist boat associations, which are run and semi-regulated by village cooperatives. Local people also provide tourists with several other services. For example, each tourist centre has restaurants, snack shops and tea stalls. Nonetheless, few facilities are provided. For example, although tourist centres have toilets and garbage bins, these are very basic. Hence littering is a problem and hygiene standards are low (Figure 5.3c).

Tourists visiting any of the four dolphin-watching centres (Section 5.2.1, Figure 5.2) buy their ticket at the association office before going for their ride. Tourists choose one of several routes for their dolphin-watching ride. Routes differ in terms of the number of locations at which the operator stops, but comprise very similar experiences. The price of the ride varies from US$2-$3 for a single person (buying a ticket as a passenger) to US$24-$50 for a group of 4-6 people (hiring their own boat). The ride lasts 1.5 to 4 hours.

Dolphin-watching tours are conducted from 6-9m long and approximately 1m wide wooden boats known as a *"dongas"* (Figure 5.3b, c). These boats have wooden seats with foam cushions and sun shades, but are essentially modified fishing vessels, which are powered by a 6-9 HP engine, and usually operated by a single boat driver from the local community. Boat drivers are not necessarily the owners of their boats. Each boat is licensed and registered in one of the four tourist boat associations. Ideally boats seat a maximum of 6-8 people comfortably (Figure 5.3c), but occasionally they carry up to 20 passengers.

Codes of conduct for dolphin-watching have been developed by the Chilika Developmental Authority. However, no Memoranda of Understanding or laws exist to encourage or compel operators to follow these rules, and enforcement is lacking. Although some tourist boat drivers maintain a strict distance between their boat and the dolphins, refrain from chasing the animals and ensure that the propeller of their motor is out of the water while near the dolphins, other drivers do not follow such rules. Thus protocol is inconsistently followed during dolphin-watching tours.


**Figure 5.3:** Dolphin-watching at Chilika showing, (a) a signboard depicting a breaching Irrawaddy dolphin, (b) a crowded dolphin-watching boat, (c) a tourist boat on a dolphin-watching trip, with a typical dolphin sighting, and (d) the banks of the lagoon littered with garbage.

Tourist vessels are minimally equipped for safety. No lifejackets are carried and most tourists are non-swimmers. No first aid is available on board, and there are no emergency medical facilities or rescue services in the area. Tourists are not briefed on safety related issues either on board the vessel, or before the trip. Tourist information and interpretation are also minimal. No interpretive guides travel on tourist boats, although tourist buses may have a guide who provides tourists with some information prior to their ride. Occasionally boat drivers provide passengers with some relevant information. Typically, there is a language barrier between the boat driver and the tourists, so little interpretative information is provided to tourists on board the boat. Tourists are not informed about the risks of dolphin-watching to the animals, and the need to follow a code of conduct while dolphin-watching. However, most centres have signboards providing tourists with some relevant information.

Signboards either serve to provide dolphin-watching guidelines, or as advertisements. Signboards with dolphin-watching guidelines inform tourists about the dolphin-watching protocol, caution tourists about chasing or causing harm to dolphins or have a list of do's and don'ts. Signboards often depict illustrations of breaching dolphins (Figure 5.3a), even though Irrawaddy dolphins rarely breach.

### *5.3.2 Tourist visitation over a ten year time period as an indicator of sustainability*

Whereas the annual number of visitors to the state of Odisha increased during 2003 and 2013, the annual dolphin-watching visitation to the Outer Channel of Chilika over this same time period has plateaued (Figure 5.4). In addition, data on the annual number of tourist boats and number of tourists per boat in relation to the annual tourists visiting the Outer Channel also reflect a potential decrease in visitor number, although data were collected for certain years only (Figure 5.5). Taken together, these results suggest that the growth in the tourist industry in the Outer Channel of Chilika Lagoon has slowed down. The annual number of tourists serviced per boat is potentially also decreasing, although more data are necessary to provide firm evidence of such a trend.

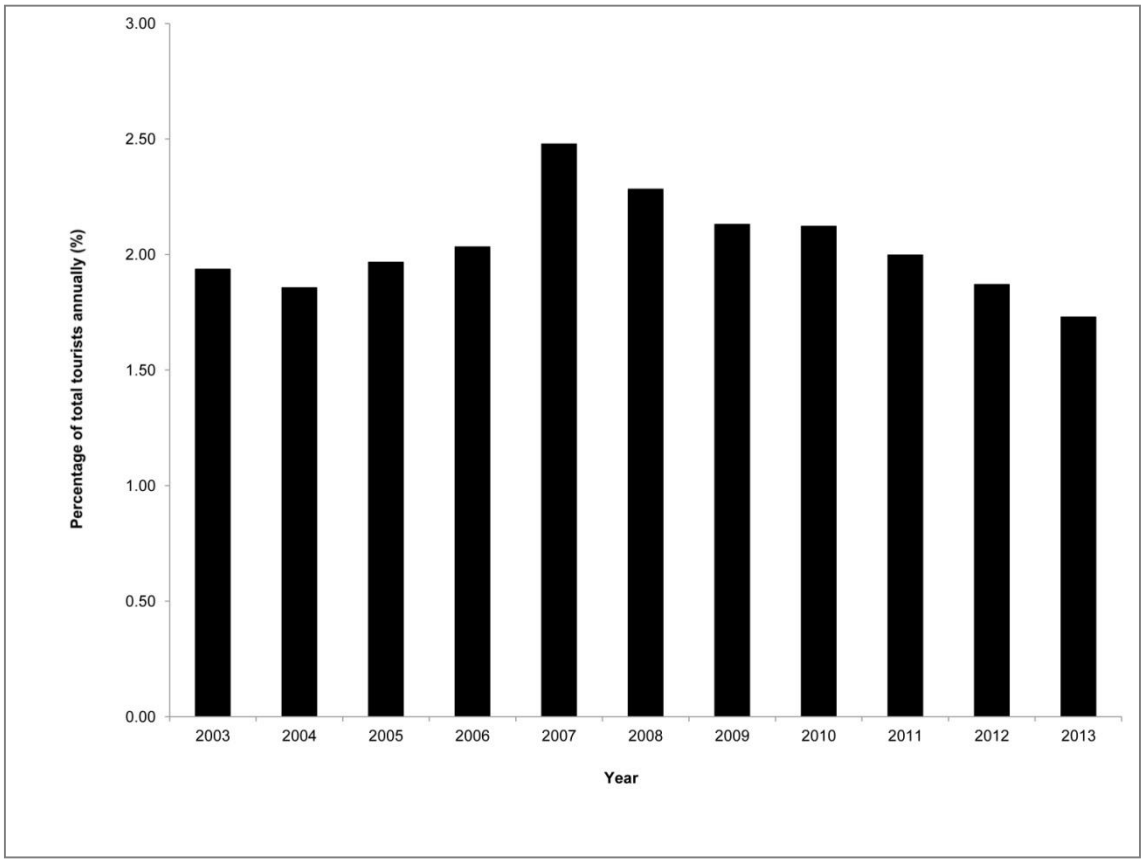



**Figure 5.4:** Dolphin-watching tourists visiting Chilika, expressed as a percentage of the total number of tourists visiting the state of Odisha (India) annually, showing a relative decrease in the number of tourists over a ten year time period from 2003 to 2013.

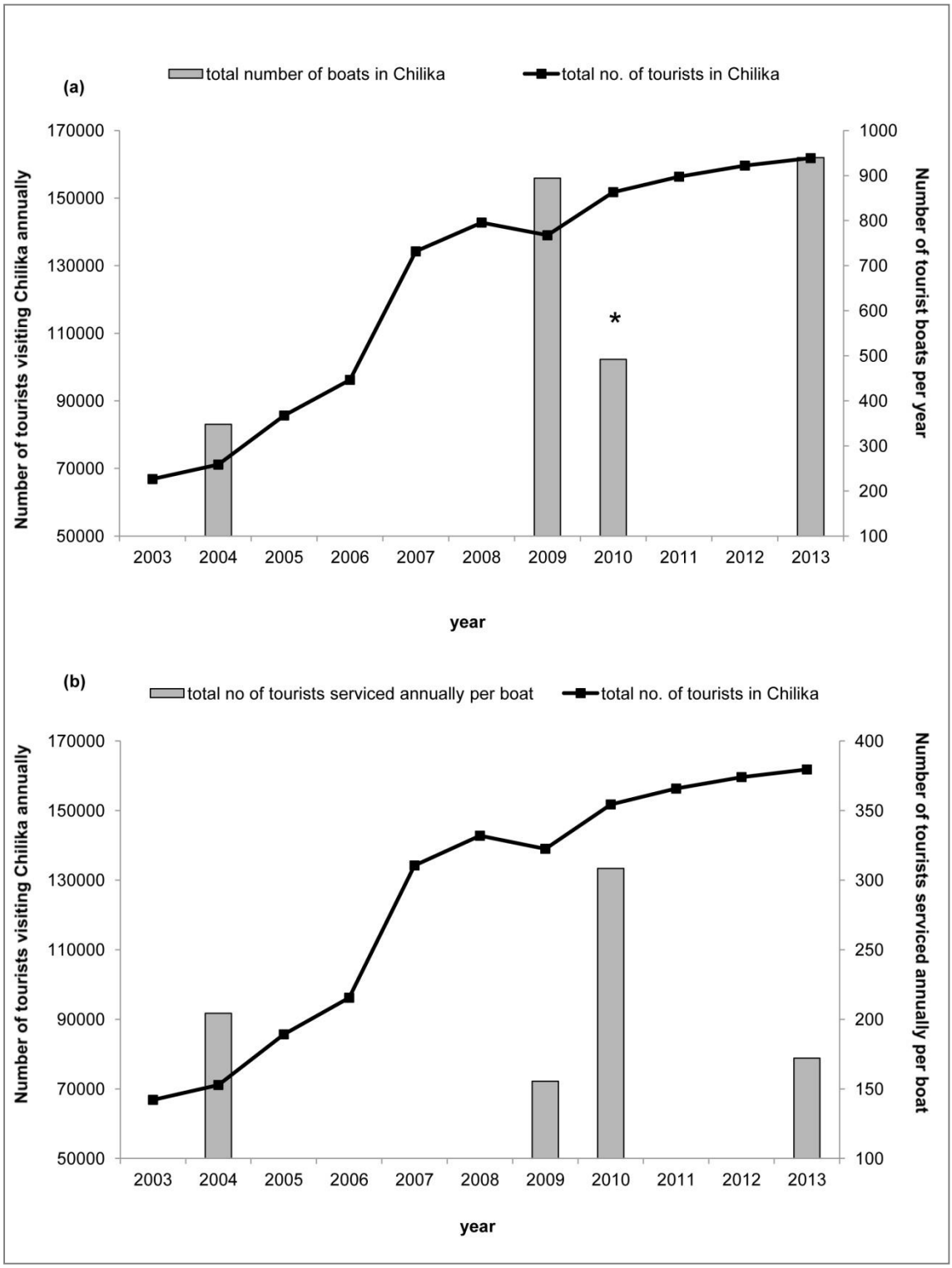



**Figure 5.5:** The total annual number of tourists visiting Chilika with: (a) the number of dolphin-watching tourist boats per year and (b) the annual number of tourists serviced per boat. Data on tourist boat numbers were collected only in certain years. * represents a

decrease in the number of tourists boats operating due to social conflict amongst the communities (see Chapter 2 for details).

### *5.3.3 Demographics of dolphin-watching tourists*

The surveys (n = 231) were conducted over 40 days, from November 2010 to January 2011, during the peak dolphin watching season at Chilika Lagoon. 273 potential interviewees were approached, of which 247 agreed to be interviewed and 231 interviews were successful, making my response rate 85%.

Most interviewees were male (92%), and aged 25-44 years (range 18 to 75, Table 5.1). Respondents were mostly tertiary educated: 42% were graduates, and 31% postgraduates (Table 5.1), and employed in one of three sectors (46% were salaried employees, 20% were self-employed, 12% were government employed, etc., Table 5.1). Most interviewed tourists were from the eastern states of India (71%), while approximately 12% were from the western region, 8% were from the northern region, 4% were from the central region and 3% were from the southern region (Table 5.1). Thirty two tourists (14%) were from the state of Odisha.

**Table 5.1:** Demographics and Indian region of origin of dolphin-watching tourists at Chilika.

| **Demographics and Indian region of origin** | **Respondents (n = 231)** | |
|---|---|---|
| | **Frequency** | **Percentage (%)** |
| **Gender (n = 231, missing values = 0)** | | |
| Male | 213 | 92.2 |
| Female | 18 | 7.8 |
| **Age (n = 231, missing values = 3)** | | |
| 18-24 | 26 | 11.3 |
| 25-34 | 63 | 27.3 |
| 35-44 | 70 | 30.3 |
| 45-54 | 32 | 13.9 |
| 55-64 | 26 | 11.3 |
| Over 65 | 11 | 4.8 |
| **Education (n = 231, missing values = 4)** | | |

| Demographics and Indian region of origin | Respondents (n = 231) | |
|---|---|---|
| | Frequency | Percentage (%) |
| School | 10 | 4.3 |
| High School | 40 | 17.3 |
| Diploma | 9 | 3.9 |
| Graduate | 95 | 41.1 |
| Post-graduate | 71 | 30.7 |
| Post-graduate diploma | 2 | 0.9 |
| **Occupation (n = 231, missing values = 3)** | | |
| Salaried employee | 105 | 45.5 |
| Self employed | 47 | 20.3 |
| Government employed | 27 | 11.7 |
| Student | 20 | 8.7 |
| Professional | 16 | 6.9 |
| Skilled worker | 6 | 2.6 |
| Housework | 5 | 2.2 |
| Unemployed | 2 | 0.9 |
| **Region of origin in India (n = 231, missing values = 4)** | | |
| East | 165 | 71.4 |
| West | 27 | 11.7 |
| North | 19 | 8.2 |
| Centre | 8 | 3.5 |
| South | 8 | 3.5 |

**Table 5.2:** Dolphin-watching tourist specialisation at Chilika Lagoon.

| Question | Index value |
|---|---|
| **How many times interacted with dolphins?** | |
| Never | 1 |
| At least once | 2 |
| 2-5 times | 3 |
| 6-10 times | 4 |
| More than 10 times | 5 |
| **Priority of dolphin-watching?** | |
| Unplanned trip | 1 |
| One of several attractions | 3 |
| Main reason for making the trip to Chilika | 5 |
| **Minimum specialisation score** | **2** |
| **Maximum score** | **10** |

| Specialisation index value | Specialisation group |
|---|---|
| 2-4 | Novice |
| 5-7 | Limited experience |
| 8-10 | Expert |

### *5.3.4 Tourist specialisation, satisfaction, preferences, perceptions and likelihood of returning as indicators of social sustainability*

Most tourists (62%), had never previously interacted with dolphins, and 93% were first-time visitors at Chilika. My dolphin-watching specialisation index (Table 5.2) showed that 52% of tourists visiting Chilika were novices, 29% had limited experience, and only 1% of tourists were experts.

Of the 231 respondents interviewed, 216 answered the question whether they had heard about dolphin-watching at Chilika beforehand (missing values = 15). Responses included: (1) through travel agents, tour agencies and hotels from neighbouring cities (30%), (2) by word of mouth through friends, relatives and acquaintances (27%), (3) through books and magazines and newspapers (11%) , (4) did not know about dolphin-watching beforehand (9%), (5) on account of prior knowledge (8%), (6) through the internet (8%), (7) through the television (4%) and through advertisements and brochures (3%) (total number of responses = 237 as some people volunteered more than one answer).

The average satisfaction level of dolphin-watching tourists at Chilika Lagoon on a scale of 1-10 was 6.6 (SE± 1.4, Figure 5.6). Most tourists (64%) had a satisfaction level less than 8 (n = 231). According to the tourism benchmarking of Pearce (2006) an average satisfaction level of less than 7.1 is considered low, and according to the benchmarking of Hanan and Karp (1989) when less than 60% of the respondents provide a score of 8, 9 and 10, their satisfaction levels are low. According to both these benchmarks, my results indicate that satisfaction levels of dolphin-watching tourists at Chilika Lagoon were low.

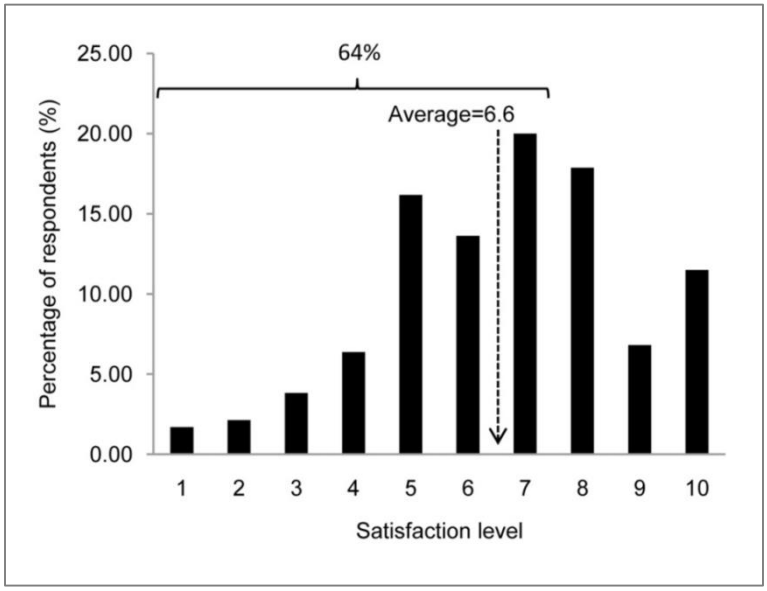



**Figure 5.6:** Distribution of satisfaction levels of dolphin-watching tourists at Chilika Lagoon (n = 231).

The regression tree analysis suggested that the boat driver's encounter management and number of dolphins sighted were the most important variables associated with the satisfaction levels of dolphin watching tourists at Chilika Lagoon ($R^2$ = 23.5%). The stepwise regression produced the following model ($F_{3,203}$ = 126.45, p<0.01, $R^2$ = 65.1%, $R^2$CV = 63%):

$$y = 5.259 + 0.158\, a*b - 1.135a + 0.377b$$

Where $a$ = the number of dolphins sighted, $b$ = boat driver encounter management, and $a*b$ = the interaction between the number of dolphins sighted and the boat driver encounter management. The variable $a*b$ was the first to enter the model followed by variables $a$ and $b$.

A thematic analysis of what tourists liked the most about their dolphin watching trip, elicited responses that were organised into seven emergent themes, as listed in Appendix C. Most tourists (n = 74, 32% of respondents) identified with watching dolphins and dolphin behaviour. For instance, respondent R67 said:

> **"We saw the dolphins spitting. It was a good experience. If we could have seen more dolphins, it would have been better."**

Many respondents simply appreciated that they were close to nature and had the opportunity to visit the lagoon or the sea (n = 64; 28% of respondents), and some enjoyed the journey or the boat ride (n = 47; 20% of respondents). Some respondents said they liked everything (n = 20; 9% of respondents), while others said they liked nothing (n = 10; 4% of respondents). A few respondents enjoyed watching other animals, such as birds (n = 7; 3% of respondents), and others said that the best thing about their dolphin-watching experience was the local people (n = 7; 3% of respondents).

Responses articulating what tourists disliked about dolphin watching at Chilika were organised into nine themes (Appendix C). Although many tourists said that they did not dislike anything (n = 77; 33% of respondents), many tourists (n = 41; 18% of respondents) stated that they were disappointed with their dolphin sighting, and the fact that they did not see dolphins breaching as they had expected. For example, respondent R44 said:

> **"I am not satisfied with the dolphin [watching] because in the [advertisement] they were jumping... I did not see much."**

13% of tourists (n = 30) were disappointed with the dolphin-watching boats, either because they were too uncomfortable, slow, old and in a state of disrepair, or because the boat engine noise was too loud. Respondent R202 said:

> **"...there was a hole in the boat and the boat driver had to bail water out... the boatman said if we don't bail out water the boat will sink and we will drown."**

Some respondents said that the duration of the ride was too long (n = 23; 10% of respondents), or that they found the cost of services at Chilika too expensive (n = 22; 10% of respondents). A number of respondents claimed that the tourist industry was managed improperly, that tourist operators lacked expertise and that tourist facilities were lacking and improperly maintained (n = 16; 7% of respondents). A few respondents complained about littering and pollution (n = 15; 6% of respondents). Some tourists complained about sightings of other animals such as birds, and places which they expected to see on the chosen route (n = 11; 5% of respondents). A few respondents disliked the fact that the dolphin-watching code of conduct was not consistently followed during the ride (n = 7; 3% of respondents).

Tourist perceptions on how dolphin-watching could be improved were categorised into nine themes (Appendix C). Most tourists (n = 82; 35% of respondents) considered that the site and infrastructure needed to be better developed, and that the dolphin-watching boats needed to be improved. For instance, respondent R123 said:

> **"They [tourism managers] should have better toilets and bathrooms, shade [and] seating areas."**

Respondents also said that they would have preferred to have had guaranteed dolphin sightings, such as in a dolphinarium (n = 29; 13% of respondents). As an example, respondent R119 said:

> **"There should be more dolphins and a show where you can see dolphins in one hour, so that people spend their money and get to see something. The**

**dolphin sighting is uncertain. They should have trainers which bring the dolphins out of the water."**

Some tourists suggested that local people should be trained as tourist guides, and that tourist awareness and interpretation should be introduced (n = 23; 10% of respondents). Respondent R78 said:

**"They [tourism managers] should have a guide on board [the tourist boat]."**

Others suggested that the management, working systems, and customer service needed to be improved, and that tourist boat associations should be more honest with the customers (n = 20; 9% of respondents). A few respondents considered that the price of the dolphin-watching ride was too high (n = 19; 8% of respondents). Others said that the dolphin rides needed to be improved, by decreasing the total time of the ride, increasing the dolphin-watching time or by consistently following the dolphin-watching protocol (n = 18; 8% of respondents). Some tourists suggested that littering and pollution relating to garbage should be stopped (n = 17; 7% of respondents). For example, respondent R180 said:

**"They [tourists] should not throw packets into the water. I also threw a packet into the water, I'm not going to lie, but people should not do this."**

A few tourists reported that boat safety standards needed to be improved (n = 14; 6% of respondents), and some considered that vendors, hawkers and people providing services to tourists should be less commercial (n = 6; 3% of respondents).

When asked whether they would return to Chilika to watch dolphins, almost 70% of the respondents said "Yes", 14% said "No", and 16% said "Maybe" or "Not sure". Higher tourist satisfaction levels were significantly associated with willingness to return to Chilika to watch dolphins (Kruskal-Wallis $p = 0.00$, $df = 2$, $n = 226$ $\alpha = 0.05$). When asked if tourists would recommend dolphin-watching at Chilika to others, 87% said "Yes", 6% said "No", 3% said "Not sure" or "Maybe", and another 4% did not answer. Higher tourist satisfaction levels were significantly associated with willingness to recommend dolphin-watching at Chilika to others (Kruskal-Wallis $p = 0.00$, $df = 2$, $n = 219$, $\alpha = 0.05$). When tourist responses were "Not sure" or "Maybe", they usually qualified their answer. For example when asked if he or she would return to Chilika to watch dolphins, respondent R144 said:

**"Not immediately, but maybe in the future."**

## 5.4 Discussion

### *5.4.1 Summary*

The results of this study characterise dolphin-watching tourism in Chilika Lagoon, and indicate that the industry is very likely operating within socially unsustainable limits. The annual growth in the number of dolphin-watching visitors to the Outer Channel of Chilika appears to have slowed down. Dolphin-watching tourists surveyed almost entirely comprised novices; these novice tourists were, on average, dissatisfied with their dolphin-watching experience, when compared to the satisfaction benchmarking of Pearce (2006), Hanan and Karp (1989), and other studies (Mustika et al. 2012a; Okello & Yerian 2009). Despite the fact that appropriate dolphin-watching protocols are inconsistently followed, tourist satisfaction was positively influenced by boat driver encounter management and the number of dolphins sighted, possibly because tourists were not sensitive to the needs of the dolphins, but instead were keen on sighting the animals. The number of dolphins sighted alone per se, was negatively associated with tourist satisfaction, probably because tourists have high expectations of their dolphin sightings. Although many tourist preferences and perceptions reveal useful insights on how the industry could be improved, in general perceptions of tourists (such as the idea of watching trained and breaching dolphins) reflect the expectations and demands of an unschooled, novice demographic. Prior research done by Malcolm and Duffus (2008) show that specialist cetacean-watching tourists had stronger conservation attitudes compared to novice tourists in Canada, while Duffus and Dearden's model (1990) indicates that novice tourists tend to visit a site once the destination is close to reaching the limits of its capacity.

Based on the collective indicators of this study, I contend that the dolphin-watching tourism industry at Chilika Lagoon is very likely socially unsustainable in the long-term. Recognition of the social indicators of sustainability are useful where the prerogative of collecting long-term biological indicators does not exist, and where it is important to understand the social context of the industry. Such indicators could also potentially help identify suitable strategies to manage the industry within sustainable limits in the long-term, through the development of an early warning system.

### *5.4.2 Satisfaction benchmarking and likelihood of returning*

Although my study indicates that on average, novice tourists were dissatisfied with their dolphin-watching experience, most tourists said they would return to watch dolphins and would recommend dolphin-watching to others. These results are contradictory, as positive tourist experiences are generally considered as indicators of successful tourism (Pearce 2006), and customer satisfaction levels are often used as a measure of the viability of the industry (Akama

& Kieti, 2003) and to predict the future success of business performances (Pearce, 2006). Plausible explanations for this discrepancy could be: (1) The benchmarking used was inappropriate for the Indian domestic tourists sampled; (2) most tourists sampled were very courteous to the interviewers, and could have said that they would return to watch dolphins and recommend dolphin-watching merely to be polite; and (3) most of the tourists visiting Chilika are religious tourists visiting the holy city of Puri in Odisha (50km away from Chilika), and dolphin-watching at Chilika is an added attraction only (Chapter 6), hence tourists' likelihood of revisiting the lagoon could be dependent on other motivations such as their probability of returning on a pilgrimage to Odisha. Nevertheless, the decrease in the visitation numbers at Chilika and the fact that most tourists were first-time visitors indicate that repeat visitation to watch dolphins is low.

### *5.4.3 Dolphin-watching at Chilika Lagoon*

In general, both participant observation and tourist interview responses indicate that several shortfalls exist in the way in which the industry is currently marketed and that dolphin-watching is currently not being conducted as per best practice management.

First, there appears to be a mismatch between pre-trip tourist expectations and their actual experience of watching dolphins at Chilika, potentially due to the way in which dolphin-watching is marketed. Although watching dolphins alone did not necessarily satisfy tourists, tourist preferences and suggestions indicate that they expect to have guaranteed sightings of breaching dolphins. Aggressive marketing of dolphin-watching at Chilika and misleading signage likely creates the expectation to see breaching dolphins. Chen and Tsai (2007) show that destination image often influences tourist satisfaction and behavioural intentions.

Secondly, the dolphin-watching tourism industry is currently not being conducted according to the norms of practice management. Basic facilities are lacking, littering and pollution are not controlled, safety standards are low, tourist interpretation is minimal, tourism vision, mission and management strategies are not defined, and enforcement is lacking. Tourist opinions also indicate that the dolphin-watching code of conduct is inconsistently followed, and this failure might be cause for conservation concern for the Irrawaddy dolphins in the lagoon. Even though a code of conduct to responsibly watch dolphins exists at Chilika, it is likely inconsistently followed as there are no regulations, Memoranda of Understanding, or mutually agreed local institutions to compel or encourage operators to comply with the code. Chilika Lagoon is a fragile ecosystem (Ghosh, et al., 2006), and the dolphin population upon which the tourist industry depends is likely threatened (Chapter 2). Responsible dolphin-watching and conservation of Irrawaddy dolphins at Chilika Lagoon should therefore be made a priority if

dolphins continue to be used as a tourism resource. However, a strict code of conduct would certainly not be enough to ensure the social sustainability of the dolphin-watching industry at Chilika, and in other developing countries conducting wildlife tourism similarly; as such, I highlight some aspects below that need further consideration.

### *5.4.4 The importance of understanding tourist specialisation and profiles*

Understanding the type of tourist visiting a tourist site is key to sustainably manage a wildlife tourism initiative (Duffus & Dearden 1990; Higginbottom 2004; Orams 1996). For instance, dolphin-watching tourists visiting the Outer Channel of Chilika Lagoon came mostly from the eastern states of India, were generally tertiary educated and employed, were mostly novices, and many had never been on a dolphin-watching ride before. Many of these tourists were in fact religious tourists, and dolphin-watching at Chilika was merely an added attraction to their tourist circuit (Chapter 6). These tourists are clearly non-specialised, and as explained by Duffus and Dearden (1990) are likely to have very different expectations, perspectives, values and behaviours when compared to specialised wildlife enthusiasts. Additionally, most Indian wildlife tourists view wild animals by visiting zoos (Hannam & Diekmann 2011); this factor could possibly also explain tourists' expectation to have guaranteed sightings of trained dolphins in enclosures. Further, Hannam and Diekmann (2011) point out that domestic Indian wildlife tourists have a completely different set of aspirations when compared with international wildlife tourists, visiting India for wildlife tourism. While the former tend to engage in wildlife tourism as a family outing, for both leisure and entertainment, the latter are more contemplative of nature (Hannam & Diekmann, 2011). Hence culture and background play a part in influencing the perceptions and behaviour of tourists (Cochrane 2007). Management strategies targeted towards addressing tourist background culture, and specialisation are therefore likely to be more successful than those that do not.

### *5.4.5 Sustainable management of cetacean-watching tourism in developing countries*

Sustainable management of cetacean-watching tourism in under-developed parts of the world such as Chilika Lagoon is challenging. As mentioned by Beasley et al. (2014), some generic similarities across dolphin-watching industries in developing countries exist: the industry is initiated and operated by local fishers who take tourists to watch dolphins in modified fishing vessels; at least initially, there is no barrier to enter the tourism industry. Local people lack the capacity, institutions, governance, policies, mechanisms and accountability to manage the industry. As a result, the industry grows rapidly, and is managed unsustainably (Beasley et al. 2014). Unsustainable management practices may impact the viability of the dolphin population on which the industry is based (Higham et al. 2009). However, by the time it is recognised that

the industry needs to be appropriately managed, local livelihoods may already be heavily reliant on dolphin-watching tourism.

Given such circumstances, managing the industry to ensure sustainability is likely to be complex. Higham et al. (2009) suggest that a pre-tourism phase in which baseline data are collected is necessary to set up frameworks for monitoring of tourism and management actions. Beasley et al. (2014), advocate adopting the precautionary approach, and suggest that despite potential economic benefits to local communities, in the absence of appropriate management, previously designed regulations and continuous monitoring, vessel-based cetacean-watching tourism should be discouraged. In a situation like Chilika Lagoon however, given that dolphin-watching tourism has already been established (without data collection and monitoring in a pre-tourism phase) and represents a large share of the economic value of the lagoon (Kumar 2010), supporting the livelihoods of already marginalised local communities (Chapter 2), a complete shut-down of the industry, or a sudden mandatory reduction in fleet size is not feasible. Such sudden and mandatory restrictive measures are not likely to be accepted within the local community, and could potentially result in reactionary negative attitudes towards dolphin conservation. In such circumstances, a solution could be to develop an early warning system as a user-friendly decision-making tool, providing managers with specific information regarding the site and its risk of decline (see Chapter 7 for details).

Finally, the need for integrated and adaptive tourism management and dolphin conservation planning at Chilika Lagoon, and other such locations is necessary. As pointed out by Higham et al. (2009), planning, management and policy needs to be integrated, adaptive and inclusive of all key stakeholder groups. The absence of any appropriate tourism management strategies or conservation planning in places like Chilika Lagoon make it difficult to embrace the complexity of the system and balance dolphin-watching tourism and dolphin conservation. There is growing acceptance of the fact that socioeconomic considerations assist conservation planning of social-ecological systems (Ban & Klein 2009; Ban et al. 2013; Naidoo et al. 2006). Thus social indicators may serve to set up preliminary management strategies, before the long-term monitoring of environmental data can yield further tangible results.

### *5.4.4 Conclusion*

As wildlife tourism in developing countries continues to grow, and poor communities begin to depend on such industries for their livelihoods, the need to rapidly assess the sustainability of such industries will continue to increase. In such circumstances, the prerogative to conduct a pre-tourism phase, or long-term assessments on the environmental sustainability of the industry may not exist. A rapid assessment of a combination of social indicators can be used to assess the

sustainability of the industry. Future development of an early warning system (with a combination of social, economic and environmental indicators as variables) could prove useful in the sustainable management of cetacean-watching industries, particularly in developing countries (see Chapter 7).

## 5.5 Summary

- Assessing the impacts of wildlife tourism, particularly in developing countries is important to ensure the long-term sustainable management of the industry.

- Most previous studies assess the impacts of the industry on the behaviour of the species targeted by tourism. However, this approach might not be suitable, particularly in developing countries, because of the difficulty in measuring and detecting thresholds of impacts on ecological sustainability in the absence of (1) long-term biological data, and (2) a suitable reference point to which thresholds may be compared.

- Existing theoretical frameworks show that sustainability has multiple dimensions, including environmental, social, economic and managerial. Each element of sustainability is linked to the other. Hence research on for instance the social element of sustainability has implications on the other elements.

- In this chapter I focussed on the human dimensions of sustainability of a wildlife tourist industry in a developing country, and use tourist visitation numbers, satisfaction, preferences, perceptions and tourist specialisation as indicators of social sustainability.

- I used the dolphin-watching industry at in The Outer Channel of Chilika Lagoon, India as a case study, and my approach included participant observation, a survey instrument conducted on tourists and collection of secondary data on tourist visitation numbers.

- My results indicate that the rate in increase in tourists in the study site is beginning to decline, tourists were mostly novices and were dissatisfied with their dolphin-watching experience. Satisfaction levels were positively influenced by boat-driver encounter management and the number of dolphins sighted. Tourist preferences and perceptions pointed out useful insights, but also reflected the demands of a novice demographic.

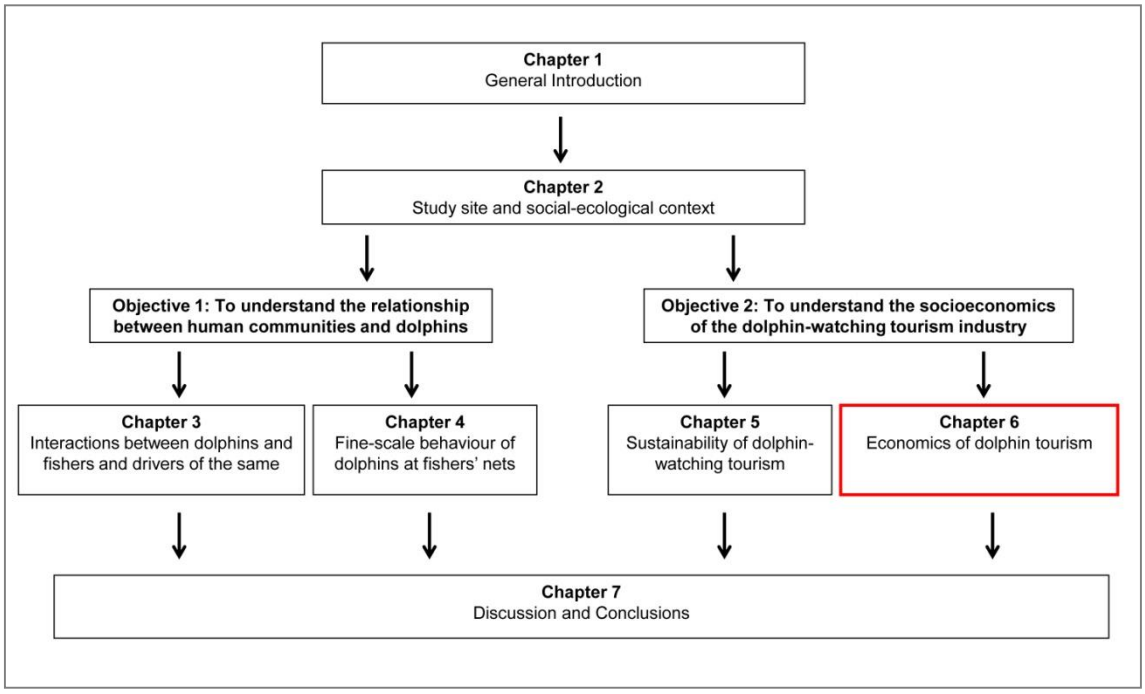
- Participant observation and tourist perceptions highlighted the important issues lacking in the way in which the industry is conducted and managed.

- Such social indicators should be collectively used in assessing the long-term sustainability of a cetacean-watching industry. These indicators could potentially help identify suitable strategies to manage the industry within sustainable limits.

- In the future, such indicators could be used to develop an early warning system to pre-empt destination decline and inform sustainable management of cetacean-watching tourism, especially in developing countries.

# 6 Economics of dolphin-watching tourism at Chilika Lagoon[21]

**The previous chapter (Chapter 5) indicates that dolphin-watching at Chilika Lagoon is very likely socially unsustainable. Yet from the perspective of the livelihoods and the local and regional economy, it is important to establish the value of the industry. Valuation of the industry can also be used in favour of dolphin conservation. In this chapter, I therefore estimate the value the dolphin-watching industry in the Outer Channel of Chilika, on a local and regional scale, to provide a more accurate valuation.**




[21] A version of this chapter will be submitted for publication; details are: D'Lima, C., Welters, R., Hamann, M., Marsh, H. *(ready to submit).* Should wildlife conservation be enhanced by more accurate valuation of wildlife tourism? A dolphin case study. To be submitted to *Journal of Environmental Management.*

# 6 Economics of dolphin-watching tourism at Chilika Lagoon

## 6.1 Introduction

The valuation of wildlife tourism is often used to demonstrate the potential of wildlife tourism to support livelihoods economically. Wildlife tourism is known to contribute significantly to local and regional economies (Balmford et al. 2009; Buckley 2010; Wilson & Tisdell 2003) and valuing the industry can serve as a direct justification for wildlife conservation, based on its ability to generate revenue and support livelihoods (Catlin et al. 2013b; Stoeckl et al. 2005). If the target species and associated tourism are conserved, tourists will continue to visit the site, thus contributing to local incomes, and local opportunities (Stoeckl et al. 2005). Economic valuation of a wildlife tourism industry is important because it provides evidence and an economic rationale justifying the need to contribute effort towards conserving specific wildlife populations, taxa or ecological communities (hereafter, "target species") in a language that resonates with policy makers (Catlin et al. 2013b). With the recent rapid and global growth in wildlife tourism (Balmford et al. 2009; Cisneros-Montemayor et al. 2010; Hoyt 2001; O'Connor et al. 2009), the importance of valuing wildlife tourism industries has become apparent.

There is significant literature on wildlife tourism valuations, and studies differ broadly based on their economic rationale. Marine examples include sea turtle tourism in Australia (Wilson & Tisdell 2003), shark tourism in Australia (Catlin et al. 2010) and in Palau (Vianna et al. 2012), and cetacean-watching in Indonesia (Mustika et al. 2012b), Australia (Stoeckl et al. 2005; Wilson & Tisdell 2003), Tonga (Orams 2013), West Scotland (Parsons et al. 2003), the U.S.A. (Loomis et al. 2000) and Canada (Duffus & Dearden 1993). Irrespective of the various methods employed, these studies are generally divided into two groups based on their rationale. One group shows that the value of an individual animal used as a non-consumptive tourism resource is higher than its consumptive value[22], e.g. Norman and Catlin (2007), Anderson et al. (2011), and Vianna et al. (2012). The other group values the wildlife tourism industry as a whole, and uses hypothetical scenarios to estimate a corrected value of the industry based on how much tourist expenditure would be lost if the target species were extirpated or unavailable for

[22] Direct consumptive use values include the capture and subsequent sale of wildlife; see Section 2.3 for explanation on Total Economic Value.

viewing, e.g. Stoeckl et al. (2005), Stoeckl et al. (2010), and Catlin et al. (2010). Catlin et al. (2013a & 2013b) point out the shortcomings of the former approach; one major drawback is that it assumes that tourists spend money at a particular site due to the target species, when in fact tourists may spend money on goods and services irrespective of their chance to view wildlife. If the chance to view wildlife is not key in the tourist's decision to visit the site, it can be "substituted" by alternative tourism options.

The accurate valuation of a tourism resource depends on the economic "substitutability" of the resource, and requires knowledge of the expenditures that will be lost in the event that the resource is no longer available (Johnson & Moore 1993; Stoeckl et al. 2005). According to economic theory, most resources are substitutable (Chee 2004). Thus from an economic perspective, it is important to estimate the potential change in tourist time allocation at the tourist site if the target species were extirpated or no longer available for viewing. This potential change in time allocation provides information on the extent to which the target species is "substitutable" and how much expenditure can be "attributable" (*sensu* Stoeckl et al. (2005))[23] to the target species in question. As explained in Box 6.1, substitutability between tourist attractions or sites in a particular destination generally comprises three kinds: perfect substitutability, perfect complements and partial substitutability. Understanding substitutability is thus an important step when valuing a species used as a tourism resource.

The broader spatial context in which a tourism resource is valued is another important consideration. Tourists often visit multiple attractions or sites within a particular destination[24], and wildlife tourism is often only part of a larger tourism circuit rather than the sole attraction, an important factor to consider when valuing a wildlife tourism industry (Loomis et al. 2000). Further, if the target species in question were no longer available for viewing, it is important to estimate the potential change in tourist time allocation and consequent tourist expenditure attributable to a target species at: (1) the tourist site, (2) other sites in the same destination, and (3) the destination as a whole. Thus substitutability has an economic impact not only on local stakeholders, but also on the flow of expenditure from one tourist site to another within a destination, thereby affecting stakeholders of neighbouring tourist sites, and the destination on the whole.

[23] I use the term "attribution" as in Stoeckl et al. (2005); not as in Jones and Wood (2008).

[24] Here I refer to "destination" as the broader region within which tourists visit several attractions or sites during a vacation.

Tourists may visit more than one attraction or site within a particular destination. In this context, “substitution” occurs when one attraction or tourist site is replaced by another. I provide three examples below:

•**Perfect Substitutability**: When tourists do not care which site they visit, the two sites can be said to be perfectly substitutable within a destination. Degradation or eventual unavailability of one of the sites will not affect tourist visitation to the destination; it will affect the time allocation across tourist sites.

•**Perfect Complements**: When tourists cannot visit one site without visiting the other, the two sites can be said to be perfect complements and degradation of one of the sites or eventual unavailability of one of the sites will stop tourists from visiting the destination altogether.

•**Partial Substitutability**: Tourists might choose to spend their time at site 1, or at site 2, within the destination, but the experience of visiting each site would be different. Hence the two sites would be only partially substitutable. Degradation or eventual unavailability of one of the sites will reduce the appeal of the destination, possibly leading to: (1) a shift in time allocation across sites, and (2) a reduction in the number of days spent at the destination, and (3) a consequential change in tourist expenditures between tourist sites and at the destination level. As an extension of partial substitutability, low substitutability, is when the experience of visiting site 1 using all senses (sight, hearing, taste, smell, touch, feeling) is aesthetically different from the experience of visiting site 2.

**Box 6.1:** Types of economic "substitutability" used in the valuation of tourism resources.

Although the concept of substitution is not novel to economics, the application of economic substitution to wildlife tourism based on single or multiple target species across multiple, spatially connected sites in a destination, tends to be ignored in the wildlife tourism literature. I identified 72 publications using the Scopus search engine, and key word terms: "wildlife, tourism, economic value" and "wildlife, tourism, substitution, attribution". However, no peer reviewed article addressed this gap in the literature. Stoeckl et al. (2005) suggest that future research should focus on the economic impact of target species over broader regions with multiple attractions. The failure to account for the tourist expenditure attributable to target species in neighbouring tourist sites within a destination and in the destination on the whole results in inaccurate valuations of a wildlife tourism industry. Hence I contend that to confirm the true value and conservation potential of a wildlife tourism industry, it is important to value the industry at: (1) the site, (2) neighbouring tourist sites and (3) the destination region overall.

In my study, I apply the concept of substitutability across spatially connected tourist sites in a destination by using the dolphin-watching industry at Chilika Lagoon (see Chapter 2 and 5). I

thus evaluate the tourist expenditures that can be attributed to a target species (in this case, dolphin) locally, in neighbouring tourist sites, and within the destination of Odisha. My objectives were to: (1) establish if dolphin-watching at Chilika is substitutable by tourist attractions at other tourist sites within the destination of Odisha; (2) estimate the direct tourist expenditures attributable to dolphin-watching at Chilika, at neighbouring tourist sites, and within the destination, thereby accurately valuing the wildlife tourist industry at Chilika; (3) understand the implications of substitution on the beneficiaries of the dolphin-watching industry, locally, at neighbouring tourist sites and at the destination scale; and (4) consider the generic advantages of this approach over other studies on wildlife tourism and its potential future application in conservation planning.

## 6.2 Materials and methods

### *6.2.1 Background of study site and the dolphin-watching tourist industry at Chilika Lagoon*

For a detailed background of the study site, refer to Chapter 2 of this thesis.

Most of the tourists who visit the Outer Channel region of Chilika Lagoon to watch dolphins also visit neighbouring tourist sites such as Puri (approximately 50km away), and Bhubaneswar (approximately 100km away) as part of their tourist circuit (Figure 6.1). Chilika, Puri and Bhubaneswar often form part of a circuit for tourists visiting the destination of Odisha. All these locations have been classified as major tourist sites in the state of Odisha, according to a report submitted to the Ministry of Tourism of the Government of India (Anonymous 2006). Tourists visit Puri and Bhubaneswar mainly for religious tourism (Anonymous 2006; Singh 2009); Puri is one of the four most holy places in India (Patnaik 2008), and Bhubaneswar is known as the temple city of India (Bhargav et al. 1999). Thus both cities are important sites of pilgrimage for domestic Hindu tourists (Singh 2009). In general, tourists travel to the Outer Channel region of Chilika Lagoon to watch dolphins, but may also visit this region for other reasons such as bird-watching, or to see the lagoon (Chapter 5). Visiting the Outer Channel region is therefore a part of a larger tourist circuit, and is an additional activity for tourists who are on a pilgrimage vacation in Odisha. Tourists travel to the Outer Channel of Chilika Lagoon from neighbouring cities such as Puri and Bhubaneswar by road, usually using hired transport. In this chapter I refer to the Outer Channel region, as Chilika Lagoon. All tourists visiting Chilika Lagoon go on a dolphin-watching ride, irrespective of whether they are dedicated dolphin-watchers or not.

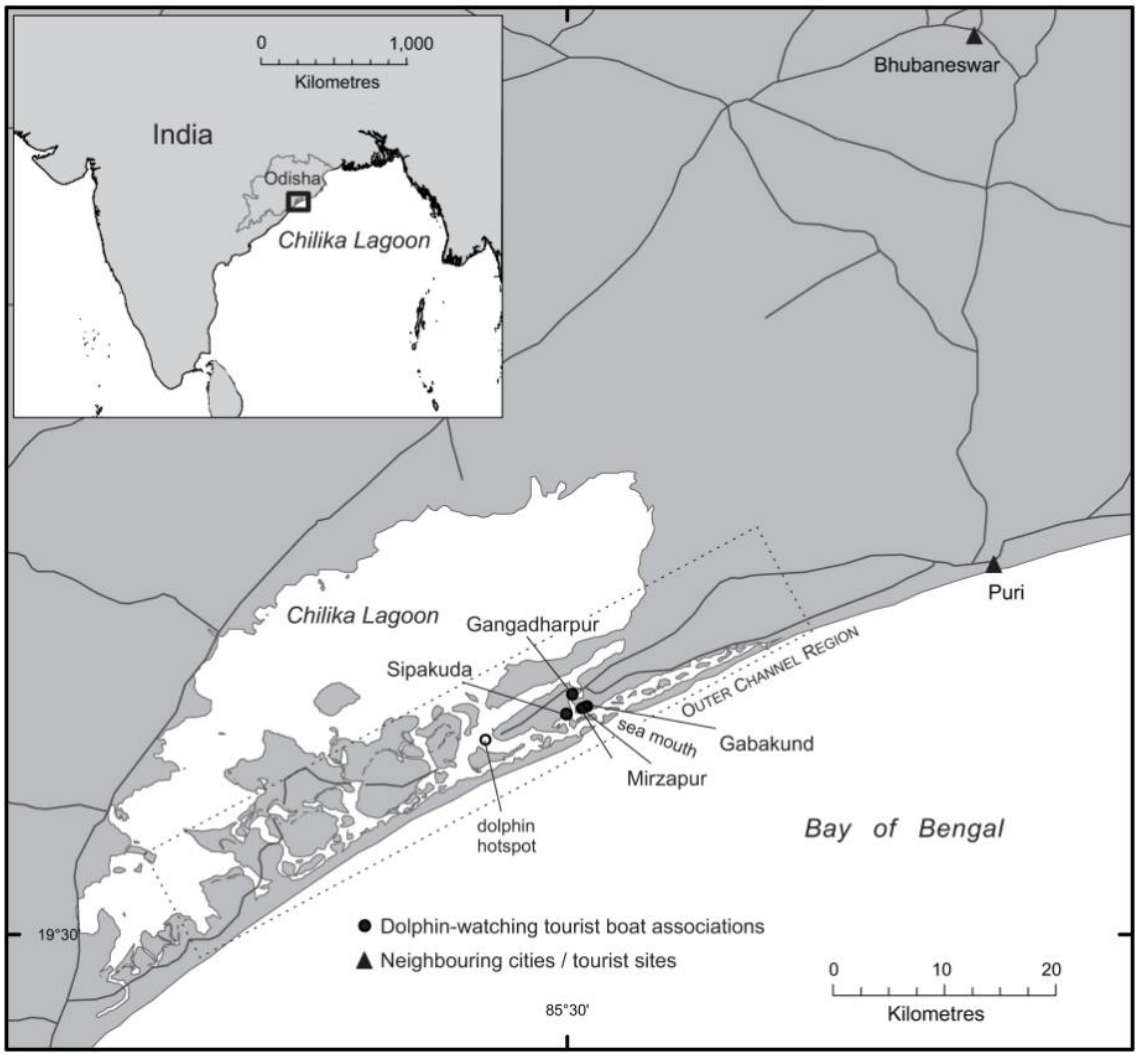



**Figure 6.1:** Map of Chilika Lagoon, and the Outer Channel region, tourist boat associations and neighbouring tourist sites (such as Puri and Bhubaneswar) within the destination of Odisha.

I conducted this study between November 2010 and February 2011 when tourists were usually charged approximately US$2-$3 for a single person (buying a ticket as a passenger on a boat) to US$24-$50 for a group of 4-6 people (hiring their own boat) to go on a dolphin-watching ride. The duration of the ride was usually between 1.5 to 4 hours (See Chapter 5).

### *6.2.2 Framework and methods used in valuing wildlife resources*

The most common framework used to value wildlife resources, is the estimation of the total economic value (TEV) of the resource (Tisdell & Wilson 2004; Turner et al. 2003). TEV includes use values and non-use values. Use values are differentiated into direct and indirect values. Direct use values are further differentiated into consumptive and non-consumptive uses.

For example, direct consumptive uses include the capture and subsequent sale of wildlife, whereas direct non-consumptive use includes revenues generated from wildlife tourism. On the other hand, indirect use values comprise the tangible indirect benefits that humans derive from wildlife because of their function in a particular ecosystem. As an example of indirect use values, dolphins cause tuna to aggregate, thereby positively influencing the human fishing success of tuna fishers in the eastern tropical Pacific (Dill et al. 2003). In contrast, non-use values include: (1) existence value, or values ascribed for instance to wildlife simply because it exists, (2) option value, attributed to a wild resource on account of its future, but yet unknown use, and (3) bequest value or the potential value for future generations. Although this general TEV framework may be inadequate in the valuation of certain cultural and symbolic benefits of nature and wild species (Chan et al. 2012a; Chan et al. 2012b; Kumar & Kumar 2008), it is the most widely used framework. Most studies only consider direct non-consumptive use values when valuing wildlife tourism.

Stoeckl et al. (2005) and Tisdell and Wilson (2004) provide some background on different methods used in the economic valuation of wildlife tourism. In general there are two broad methods used: the first considers the direct costs and benefits of the industry and the second estimates the average expenditure of tourists and the multiplier effects of the industry. Specific valuation methods could include: the Travel Cost Method (Tisdell & Wilson 2004; Tobias & Mendelsohn 1991), Contingent Valuation Method (Tisdell and Wilson 2004), Input-Output analysis (Chang 2001; Johnson & Moore 1993), and the use of Computer Generated Equilibrium models (Dwyer et al. 2004).

Although a detailed critique of these methods is beyond the scope of this thesis, some points are noteworthy to mention. The travel cost method and the contingent valuation method are popular techniques used to estimate the demand and the valuation of outdoor recreational sites; however, when a combination of wildlife and other attractions draw visitors to a site, these methods are not appropriate (Tisdell and Wilson 2004). Input-Output analysis and Computer Generated Equilibrium models are sophisticated methods used to value tourism industries (Stoeckl et al. 2005); such methods estimate the total visitor expenditure, combined with multiplier estimates to measure the strength of economic links between various industries in a particular site. However, the creation of transaction tables to estimate multipliers in Input-Output analyses is costly in terms of time and money (Stoeckl et al. 2005). In addition, in small regional economies, the effect of multipliers may be small; hence it is common to consider only the direct impact of tourist expenditure (Stoeckl et al. 2005). As such, Hoyt (2001) and O'Connor et al. (2009) use only the direct impact of tourist expenditure when valuing whale-watching tourism globally. Further, Input-Output models cannot be used for the specific

research exercise at hand. Input-Output modelling is useful to study how an initial dollar spent at an attraction in a particular site trickles through the site, and if the location of the associated industries is known, the wider impact on the destination's economy may be estimated. However, this chapter explores how the availability of a wildlife attraction in a site influences the tourist's allocation decision of an initial dollar across all available attractions in the destination.

### *6.2.3 Valuation of the dolphin-watching industry at Chilika Lagoon*

I used the direct impact of tourist expenditure or the total tourist expenditure method in the valuation of the economic impact of dolphin-watching tourism at Chilika Lagoon and at other sites in the destination of Odisha. At Chilika Lagoon, I estimated the direct expenditure and direct auxiliary expenditure of dolphin-watching tourists following Mustika et al. (2012). I define direct expenditure here as the direct contribution that tourists make for their dolphin-watching ride at Chilika Lagoon i.e., the price of the ticket, and by direct auxiliary expenditure, I refer to the contribution that tourists make to other businesses (for instance transport, food, drinks and souvenirs) at Chilika. By this definition, "direct auxiliary expenditure" is comparable to "indirect expenditure" as defined by Hoyt (2001) and O'Connor et al. (2009). However, I use the term "direct auxiliary expenditure", to avoid confusion with the term "indirect expenditure" used by Stoeckl et al. (2005), which describes the multiplier estimates or the expenditure of businesses in support of the tourism industry. In my analysis, I do not consider the multiplier effects as creating transaction tables are costly and multipliers are known to be small in regional economies (See Section 6.2.2 above, and Stoeckl et al. 2005). I also do not consider leakages within the system, as the industry is run entirely by local communities. However, some amount of leakage is likely to take place within the system as taxi and bus drivers bringing tourists to Chilika Lagoon, might be based elsewhere.

In general, I follow Stoeckl et al. (2005) and do not consider the costs of the tourism industry. In particular, I do not consider environmental or opportunity costs borne as a consequence of conducting dolphin-watching tourism. I do this because: (a) evaluating the environmental costs of dolphin-watching tourism is beyond the scope of this thesis, as effects on dolphins are complex, and often difficult to detect even with long-term environmental data (Bejder et al. 2006; Taylor et al. 2007), and, (b) the opportunity costs borne by locals due to their involvement in the dolphin tourism industry are likely to be low because dolphin-watching is far more lucrative than other available livelihood options such as fishing (see Chapter 3).

To establish the importance of the dolphins to the tourism industry at Chilika Lagoon, and in the destination of Odisha on the whole, I confirmed how much of total tourist expenditure at

Chilika and at other tourist sites within Odisha was attributable to dolphins. Hence in surveys, tourists were asked about: (1) their direct expenditure and direct auxiliary expenditure per day at Chilika; (2) their average expenditure per day at other tourist sites in destination Odisha; (3) the total number of days they had planned to stay in destination Odisha, and how many of those days they were going to stay in Chilika, and (4) the total number of days they would have spent in destination Odisha and how many of those days they would have spent in Chilika if there was no opportunity to view dolphins. I then used the difference between responses to (3) and (4) to estimate the time that tourists spent in Chilika and Odisha that was attributable to the dolphins. Using responses to (1) and (2) I then converted the time that tourists spent in Chilika and Odisha that was attributable to dolphins in Chilika into tourist expenditure in Chilika and Odisha that was attributable to dolphins in Chilika.

### *6.2.4 Data collection*

I administered interview surveys to collect primary data from dolphin-watching tourists visiting Chilika Lagoon, and estimated total numbers of tourists visiting the Outer Channel of Chilika from secondary data, published in an official report by the Government of Odisha, Department of Tourism and Culture in 2011 (Anonymous 2011).

As explained in Chapter 5, interview surveys were administered in English and Hindi, and interviewers were proficient in both languages. I recorded interviews on a Dictaphone, and subsequently transcribed all interviews. I administered interviews to tourists visiting all four functional tourist centres; the number of interviews administered at each centre was weighted according to the number of tourist boats owned by that tourist association. Interviews were administered between noon and late afternoon, after tourists had returned from their dolphin-watching ride. Tourists were approached opportunistically, depending on their availability on returning from rides and on their willingness to be questioned. Only one person per boat was interviewed, to ensure that samples were independent.

### *6.2.5 Interview survey design*

My study was conducted in conjunction with the study of Chapter 5, which focuses on the satisfaction, preferences and suggestions of dolphin-watching tourists visiting Chilika Lagoon. The survey was refined after preliminary reconnaissance interviews conducted with tourists at Chilika Lagoon between January and March 2010. Data were collected over 43 days between November 2010 and February 2011. I approached 273 potential interviewees, of which 247 agreed to be interviewed and 236 interviews were successful, making the response rate for the entire survey 86%. The section of the survey included in this study elicited information on tourist expenditure, and established whether the target species was the reason for tourists to visit

the Chilika Lagoon and the destination of Odisha[25]; interview questions are listed in Box 6.2. The response rate of these ten questions ranged from 14% to 84%. Arguably some respondents may not have answered all of the questions included in this section due to fatigue, as these questions were at the end of survey, and respondents had just returned from their dolphin-watching ride.

Q1= How much money did you [and your family / group] spend on the ticket(s) for the dolphin-watching ride at Chilika?

Q2= Approximately how much money did you [and your family / group] spend on other expenses such as transport, food / drinks, souvenirs etc. at Chilika?

Q3= Approximately how much money on average are you [and your family] spending in Odisha per day?

Q4= For how many days will you be staying in Chilika?

Q5= For how many days will you be staying in Odisha?

Q6= How many people were present in your family / group on the dolphin-watching ride?

Q7= If there were no opportunities to view dolphins in the lagoon, would you [and your family / group] still have visited Chilika? If Yes, Q8=How many days would you have spent in Chilika?

Q9= If there were no opportunities to view dolphins in the lagoon, would you [and your family / group] still have visited Odisha?; If Yes, Q10=How many days would you have spent in Odisha?

**Box 6.2:** Interview survey questions administered to dolphin-watching tourists at Chilika Lagoon relevant to this research.

Since this study was developed as part of a larger survey (Chapter 5), there are some drawbacks to the sampling design. Tourists were surveyed after they had returned from their dolphin-watching ride, and sampling was opportunistic based on tourists who were willing to be interviewed, in order to adhere to the requisites of my human ethics permit. My sample size was small and not random, and hence was potentially not representative of the entire population of tourists visiting Chilika Lagoon. Only tourists visiting Chilika Lagoon to watch dolphins were surveyed. Future studies applying economic substitution of target species across multiple sites within a destination should avoid such drawbacks by: (1) interviewing tourists before they go on a dolphin-watching ride and

[25] Respondents from Odisha were interviewed in the same manner as other tourists as most of them were on a tourist circuit.

much after they return from their ride, giving tourists the opportunity to provide considered responses, (2) increasing the sample size of tourists interviewed, and (3) interviewing tourists in other sites within the destination to confirm the average number of days that they would have spent in the site and in the destination in the absence of the opportunity to view the target species[26].

[26] However, sampling tourists in other sites within the destination would imply that I expect tourists (who do not visit Chilika to watch dolphins) to change their time allocation in Odisha in the absence of the opportunity to watch dolphins in Chilika. Although this is theoretically possible, practically it is very improbable.

### *6.2.6 Data Analysis*

#### 6.2.6.1 Total tourist expenditure

The total tourist expenditure at Chilika Lagoon was calculated as the sum of the direct primary expenditure and the direct auxiliary tourist expenditure (see Box 6.3). At Chilika Lagoon, the price of the dolphin-watching ride is charged per family or group travelling in the boat. Hence I calculated the direct primary expenditure of tourists as the average price of the dolphin-watching ride per tourist, per visit (see Box 6.3). This value was different for each interviewee, as neither the price of the dolphin-watching ride at Chilika nor the group size was fixed. In addition to the price of the dolphin ride, I considered all other expenditures made at Chilika to be direct auxiliary expenditure, including the price of the transport to and from Chilika, food, drinks, souvenirs, etc., at Chilika. As the question on auxiliary expenditures was open-ended, interviewees responding to this question volunteered their own categories, depending on their personal expenditures. I therefore calculated the total annual direct auxiliary expenditure of tourists at Chilika as shown in Box 6.3.

#### 6.2.6.2 Expenditures attributed to target species

To calculate the expenditures attributed to a target species (in this case, dolphins), it is first important to know if tourists would visit the tourist site and the destination on the whole if there is no opportunity to view the wild species in question. I assume that tourists' responses to hypothetical questions would simulate the way in which they would have behaved in case dolphins were extirpated or were unavailable for viewing. Any change in days spent at a site in the absence of the target species would translate to a change in expenditure at that site and possibly the destination. For the sake of convenience in this section, I refer to Chilika Lagoon as Site 1, Puri and Bhubaneswar or elsewhere in Odisha as Site 2, and Odisha as the destination (Figure 6.1). Thus I used the responses to questions in Box 6.2 to estimate the change in number of days that tourists would spend in the tourist sites and the destination in the absence of the target species, as shown in Box 6.3. Further, I calculated the total expenditure attributable to the target species in tourist Site 1, Site 2 and the destination (see Box 6.3). Here I assumed that if there was no opportunity to watch wildlife, the entire annual direct primary expenditure or expenditure that tourists had spent on the ride would be lost.

Eq.1. Annual total tourist expenditure = annual direct primary expenditure + annual direct auxiliary expenditure

Eq.2. Annual direct primary expenditure = average price of ride per tourist, per visit X # tourists per annum

Eq.3. Annual direct auxiliary expenditure = average of total auxiliary expenditures per tourist per visit X # tourists per annum

Eq.4. Change in # days spent in Site 1 if no opportunity to view target species = average # days spent on non-target species activities in Site 1 if no opportunity to view target - actual average # days spent in Site 1

Eq.5. Change in # days spent in destination if no opportunity to view target species = average # days spent in destination if no opportunity to view target species - actual average # days currently spent in destination

Eq.6. Change in # days spent in Site 2 if no opportunity to view target species = change in # days spent in destination if no opportunity to view target species - change in # days spent in Site 1 if no opportunity to view target species

Eq.7. Change in direct primary expenditure in Site 1 if no opportunity to view target species = - annual direct primary expenditure

Eq.8. Change in auxiliary expenditure in Site 1 if no opportunity to view target species = annual direct auxiliary expenditure X estimated change in # days spent in Site 1 if no opportunity to view target species

Eq.9. Total expenditure attributable to target species at Site 1 = estimated change in direct primary expenditure in Site 1 if no opportunity to view target species + estimated change in direct auxiliary expenditure in Site 1 if no opportunity to view target species

Eq.10. Total expenditure attributable to target species in Site 2 = average direct auxiliary expenditure per wildlife tourist per visit in destination X estimated change in # days spent in Site 2 if no opportunity to view target species X average annual # tourists in Site 1

Eq.11. Total expenditure attributable to target species in destination = Total expenditure attributable to target species at Site 1 + Total expenditure attributable to target species in Site 2

**Box 6.3:** Equations used in data analysis of total tourist expenditure and expenditures attributed to the target species (in this case, dolphins). In this chapter, Chilika Lagoon is Site 1, Puri and Bhubaneswar or elsewhere in Odisha are Site 2 (Figure 6.1).

## 6.3 Results

### *6.3.1 Dolphin tourist visitation numbers at Chilika Lagoon*

According to official figures, the number of tourists visiting the Outer Channel of Chilika Lagoon was 151,752 in 2010 and 156,319 in 2011 (Anonymous 2011). I averaged these figures and estimated the total number of tourists visiting Chilika Lagoon to be 154,036 during my sampling period.

### *6.3.2 Total tourist expenditure*

From the interview surveys, I estimated that the direct primary expenditure of tourists to the Outer Channel of Chilika Lagoon was US$1,076,000 annually and the direct auxiliary expenditure of tourists to this region was US$937,000 annually. This amount totalled to an annual expenditure of US$2,013,000. At Chilika, tourists spent the most amount of money on their dolphin ride and on transport to get to the site from neighbouring cities; a lesser amount of money was also spent on food and drinks and on other expenses such as souvenirs while at the site (Figure 6.2).

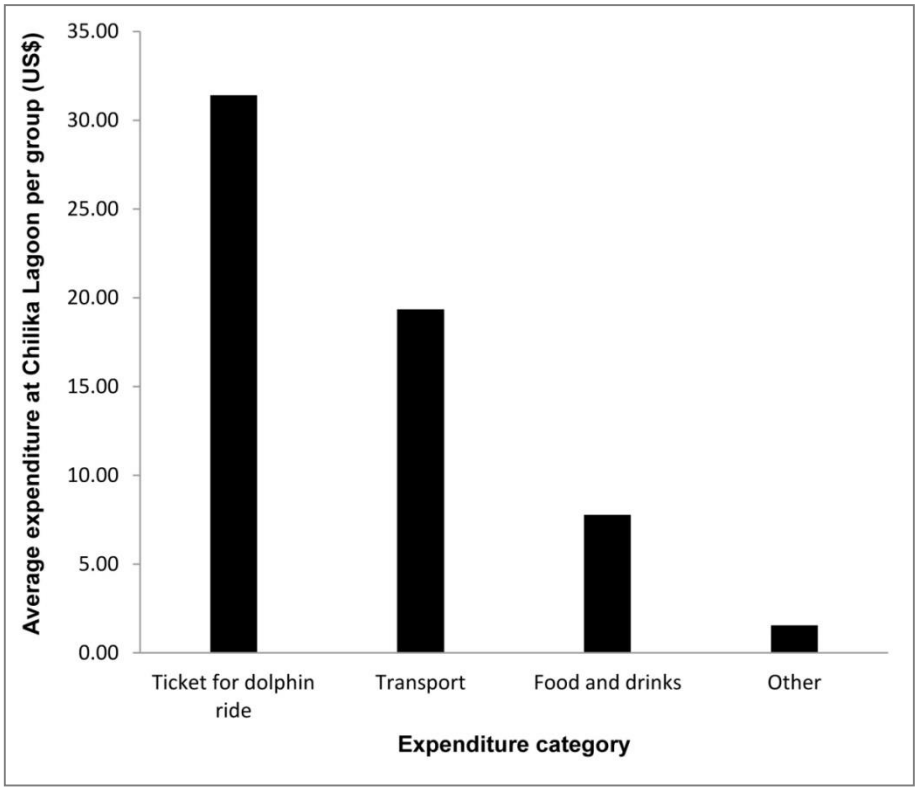



**Figure 6.2:** Average expenditure per group of dolphin-watching tourists at the Outer Channel of Chilika.

### *6.3.3 Days attributable to dolphins*

As none of the tourists interviewed stayed overnight at Chilika, the average number of days that tourists spent watching dolphins at Chilika was one day. The average number of days that dolphin-watching tourists spent in Odisha was 4.52 days (n = 228, range = 1-75, SE = 0.34, see Table 6.1). Thus the average number of days spent elsewhere in Odisha when tourists were watching dolphins was 3.52 (4.52-1, see Table 6.1). The average hypothetical number of days that tourists would have spent at Chilika if there was no opportunity to watch dolphins was 0.66 (n = 191, range = 0-1, SE = 0.03, see Table 6.1). The total number of days at Chilika that were attributable to dolphins was thus 0.34 (1-0.66, see Table 6.1).

**Table 6.1:** Impact of dolphin-watching tourism on tourist time (days) spent in Chilika Lagoon.

| **Impact of dolphin-watching on days spent:** | **Chilika** | **Elsewhere in Odisha** | **Odisha** |
|---|---|---|---|
| If dolphins in Chilika | 1.00* | 3.52* | 4.52* |
| If no dolphins in Chilika | 0.66** | 3.65 | 4.31 |
| Attributable to dolphins in Chilika | 0.34 | -0.13*** | 0.21 |

* n = 228

** n = 191

*** extrapolated from n = 39

Thirty-nine tourists responded to my questions asking: (1) whether they would have visited Odisha if there had been no opportunity to watch dolphins at Chilika, and (2) if yes, how many days they would have spent in Odisha. All 39 respondents said they would have still visited Odisha, but of these, 27 said they would have visited Odisha for the same number of days, and 12 said they would have visited Odisha for fewer days, specifying the number. The average number of days these tourists spent in Odisha was 4.54 (as opposed to 4.52 for the whole sample) and the average hypothetical number of days that they would have spent in Chilika if there were no dolphins was 0.46. For the sample of 39 tourists, the number of days that would have been lost to Chilika if they had had no opportunity to watch dolphins would thus have been 0.54 (1-0.46, Figure 6.3). The average hypothetical number of days that they would have then spent in Odisha would have been 4.21. I thus estimate that these tourists would have spent 0.33 (4.54-4.21) fewer days in Odisha if there had been no opportunity to watch dolphins

(Figure 6.3) and 0.21 (0.54-0.33) additional days elsewhere in Odisha. I estimate that these tourists would have spent 38% (0.21/0.54) of their "lost" dolphin-watching time visiting sites in Odisha other than Chilika and 62% outside Odisha; therefore the destination would have lost valuable tourist visitation. My study thus clearly suggests that dolphin-watching at Chilika is only partially substitutable by other tourist sites in the destination of Odisha.

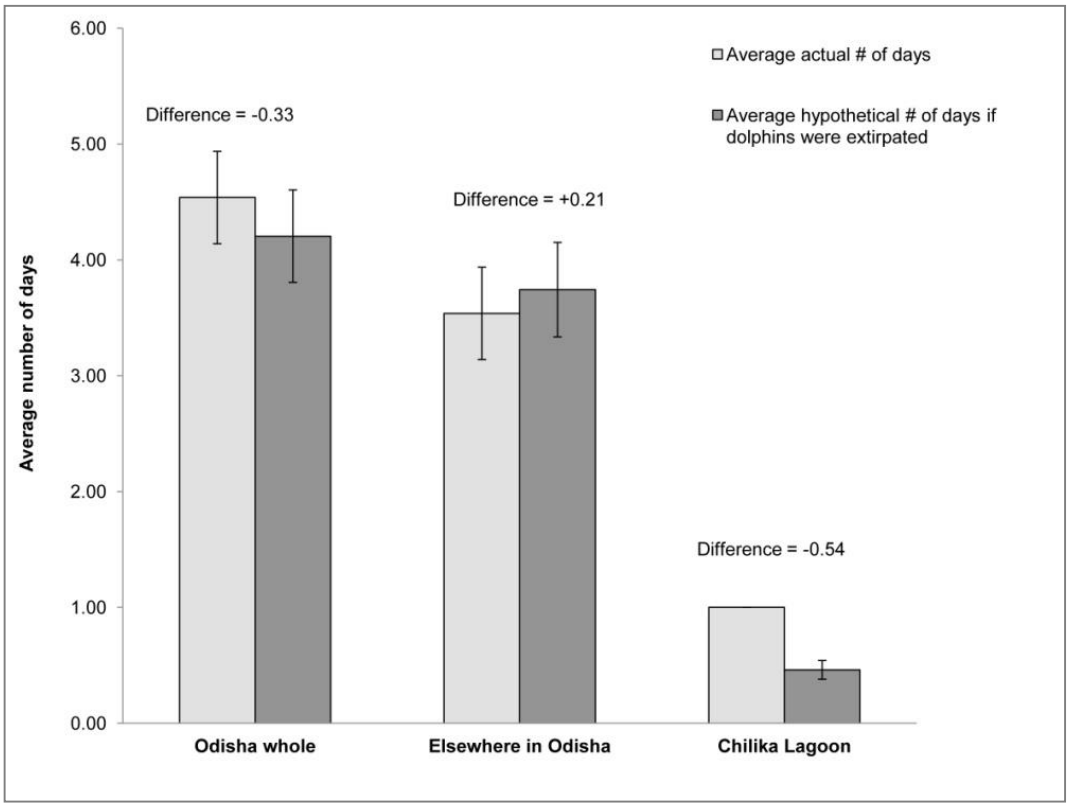



**Figure 6.3:** The average number of days that tourists spent in Chilika, elsewhere in Odisha and in Odisha as a whole, along with the hypothetical number of days that tourists would spend in these places if there was no opportunity to view dolphins at Chilika. Bars indicate standard errors; n = 39.

Extrapolating these estimates to the whole sample, the number of days spent elsewhere in Odisha attributable to dolphins was 0.13 (38% of 0.34, see Table 6.1). Similarly, the total number of days spent in Odisha which was attributable to dolphins was 0.21 (0.34-0.13, Table 1). Hence, if there was no opportunity to watch dolphins in Chilika, the number of days that tourists would have spent elsewhere in Odisha was tentatively estimated to be 3.65 (3.52+0.13), and the number of days spent in Odisha was estimated to be 4.31 (4.52-0.21; Table 6.1).

### *6.3.4 Total expenditure attributable to dolphins*

I estimated that the direct primary expenditure of dolphin-watching tourists in Chilika Lagoon was approximately US$1,076,000 annually. This figure represents the expenditure of tourists for their dolphin-watching ride only. If there was no opportunity to watch dolphins in Chilika Lagoon, tourists would not spend money on dolphin-watching rides, and hence this expenditure would be lost to the Chilika economy. Thus this figure also represents the change in direct primary expenditure in Chilika if there was no opportunity to watch dolphins. Considering the number of days attributable to dolphins in Chilika (0.34 from Table 6.1), the change in direct auxiliary expenditure of tourists was estimated to be approximately US$314,000 annually. The total expenditure attributable to dolphins in the Chilika economy was thus estimated to be approximately US$1,390,000 (Figure 6.4).

The change in direct auxiliary expenditure of tourists elsewhere in Odisha if there was no opportunity to watch dolphins was estimated to be US$389,000 (Figure 6.4). This figure considers the time spent elsewhere in Odisha, that was attributable to dolphins in Chilika (0.13 from Table 6.1), and represents the amount of money that tourists would have spent elsewhere in Odisha if there was no opportunity to watch dolphins at Chilika Lagoon. These figures suggest that the overall change in tourist expenditure in Odisha or the total expenditure attributable to dolphins in the Odisha economy is approximately US$1,001,000 (Figure 6.4). The purpose of these estimates is not to illustrate a representative sample, but to highlight the importance of economic substitution in this case.

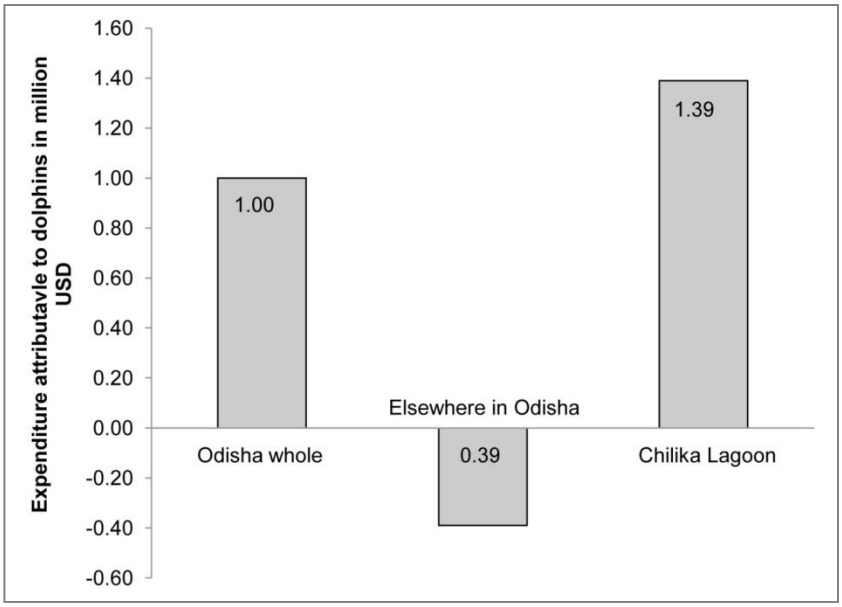



**Figure 6.4:** Total annual expenditure attributable to the dolphins in Chilika Lagoon, elsewhere in Odisha and in the destination of Odisha overall.

## 6.4 Discussion

### *6.4.1 Valuation of the wildlife tourism industry*

My study demonstrates that dolphin-watching is partially substituted by neighbouring tourist attractions or sites within the destination of Odisha. The total number of days attributable to dolphin-watching was 0.34 locally, -0.13 at neighbouring sites, and 0.21 in the destination as a whole, and hence the total expenditure attributable to dolphin-watching was approximately US$1.4 million locally, US$-0.4 million at neighbouring sites and US$1 million in the destination as a whole. This indicates that although dolphin-watching is the main draw-card for tourists to visit the lagoon, it is not the main draw-card for tourists to visit Odisha, which is an important destination for religious tourists (Anonymous 2006; Singh 2009). I demonstrate that dolphin-watching at Chilika is just one of the multiple attractions or sites that tourists visit on their tour in Odisha, and the Chilika dolphin-watching industry is partially substituted by neighbouring tourist attractions or sites within Odisha.

This example demonstrates that to accurately assess the economic value of a wildlife tourism industry, it is clearly important that spatial connectivity between tourist sites in a destination, the scale of the entire tourist industry, and the substitution value between tourist sites in a destination are considered. Taking this broad approach has implications and advantages for the conservation of target species on which the wildlife tourism industry is based.

### *6.4.2 Implications of applying economic substitutability at the destination level*

Applying economic substitution to wildlife tourism at the destination level has implications; first, this approach identifies the range of stakeholders that would be affected in the event that the target species in question were extirpated, or no longer available for viewing if the tourist enterprise were closed. Cater and Cater (2008) point out the need to adopt an approach which accounts for multiple levels and stakeholders involved in a wildlife tourism industry. My study indicated that the tourist expenditure that is attributable to dolphins in Chilika is US$1.4 million locally, US$-0.4 million at neighbouring sites and US$1 million at the destination level. Thus stakeholders both locally and at the destination level would stand to lose considerable income and benefits if dolphins were extirpated or the industry were closed, but neighbouring stakeholders would stand to gain. An understanding of economic substitution is important to appreciate which stakeholders to target through management intervention.

Additionally, this approach strengthens the argument for conserving target species used as a tourism resource. As in Odisha, managers and policy makers responsible for wildlife protection and conservation often operate at a broader level such as that of a province, state or destination,

and are more likely to be convinced by a broader scale economic argument for conserving target species such as the one I present here rather than an argument based solely on a local economic valuation. My study shows that the Chilika dolphins are an important tourism resource both locally and at a broader scale. Thus investing time and money in conserving the species would clearly benefit the local economy as well as the state or destination economy. Hence if tourism is used to value wildlife at a broader level, the conservation argument has a firmer scientific and economic basis and greater relevance (Catlin et al. 2013a; Catlin et al. 2013b).

### *6.4.3 Advantages of using this approach*

The main advantage in the application of destination-scale economic substitution is the ability to predict diverse economic outcomes in case the target species is extirpated or unavailable for viewing. In contrast to our case study, the application of this approach to other examples of wildlife tourism, is likely to predict other outcomes including: (1) economic losses (as opposed to gains) to neighbouring tourist sites, and (2) bigger overall economic losses to the destination than we estimated for Odisha. For example, Vianna et al. (2012) estimate that the shark tourism industry in Palau contributes US$18 million annually to the economy of that country. Approximately half of all tourists visiting Palau are divers, and diving with sharks is one of the main attractions for tourists visiting Palau (Vianna et al. 2012). If sharks are the main draw-card for dive tourists in Palau, it would be possible to estimate the substitution value of sharks with other attractions and sites in Palau, and the total tourist expenditure attributable to sharks in Palau would potentially be higher than estimated by Vianna et al. (2012). Similarly, Anderson et al. (2011) estimate that Manta ray-watching in the Maldives is worth US$8.1 million annually. The description of tourism activities in the Maldives suggests that viewing Manta rays is a major draw-card for tourists to visit the destination (Anderson 1871; Anderson et al. 2011). If Manta ray viewing is not substitutable by other attractions in the destination, the value attributable to Manta rays should be higher than the current estimate. Substitution and attribution in a broader context are therefore important considerations when estimating the value of target species used as tourism resources.

### *6.4.4 Implications of using this approach for the conservation and management of target species*

The destination-scale application of economic substitution of a wildlife tourism industry could potentially be used to influence conservation opportunity. First, it could be used to justify conservation based on the premise that a particular target species is an important tourism resource and supports local and regional livelihoods. I estimated that, dolphin-watching tourism generates approximately US$1.4 million annually to the fishing communities of Chilika that run

the industry. For the local communities involved in dolphin-watching tourism, the revenue generated as a result of artisanal fishing is likely to be far less than that from dolphin-watching, suggesting that tourism is a far more lucrative livelihood than fishing for these specific communities[27]. If dolphins were extirpated at Chilika or if the opportunity to view them was no longer an option, local stakeholders would lose an important livelihood, and the destination on the whole would lose significant tourism revenue. Using substitution at a broader level thus strengthens the argument to sustainably manage the Chilika dolphin-watching industry and conserve the target species on which the industry and hence livelihoods are based.

Secondly, the broad-scale economic value of wildlife tourism could potentially be used to assess the effects of conservation planning and actions on local and regional livelihoods. For instance, if conservation strategies include restrictions on the wildlife tourist industry, (for example seasonal closures), knowledge on the extent to which both local and regional stakeholders economically depend on the target species can be used to build conservation scenarios. Conservation plans based on such scenarios would potentially minimise the impact of conservation actions on stakeholders and are likely to be more cost-effective to manage and implement (Ban & Klein 2009). There is a growing acceptance of the fact that socioeconomic considerations assist conservation planning of social-ecological systems (Ban & Klein 2009; Ban et al. 2013; Naidoo et al. 2006). Hence broad-scale economic substitution could potentially be used to achieve a balance between wildlife tourism management and conservation, and is an avenue that needs to be explored through future research.

## 6.5 Conclusions

As the demand for wildlife tourism increases on a global scale, wildlife tourism industries are projected to grow (Balmford et al. 2009; Cisneros-Montemayor et al. 2010; Hoyt 2001; O'Connor et al. 2009). With the simultaneous increase in economic impact of the industry, the need to accurately and comprehensively value the industry will also rise. An understanding of the spatial connectivity between tourist sites or attractions allows for the application of economic substitution between wildlife tourism and other tourist attractions in a destination, and helps establish the true value of the wildlife tourism industry at a broader scale, thus improving the relevance of the estimates. This approach also has the potential to draw more attention to wildlife conservation needs based on the importance of the industry to both local and regional livelihoods (Catlin et al. 2013b; Stoeckl et al. 2005), and can be used to assess the effects of conservation planning and actions by building conservation scenarios. Such an approach

[27] At present however, there are no estimates of the economic value of the artisanal fishery.

provides an economic justification for the conservation of wildlife to managers and policy makers, thereby assisting in evidence-based investment in wildlife management and maintenance of livelihoods that are based on wildlife tourism industries. Such evidence thus has the potential to strike a balance between wildlife tourism and conservation of target species used as tourism resources.

## 6.6 Summary

- The valuation of wildlife tourism crucially depends on the degree to which a target species can be economically "substituted" by other local attractions, so that tourist expenditures that are "attributable" to the target species can be established.

- Past wildlife tourism evaluations have not considered the effect of economic substitution across multiple, spatially-connected tourist attractions in a destination, and their resultant impact on the accurate economic value of the industry.

- I fill this gap by estimating economic substitution between wildlife tourism and other tourist attractions in a destination.

- Using surveys and government visitation numbers, I found that dolphin-watching at Chilika Lagoon was "partially substituted" by neighbouring attractions in the destination of Odisha (India).

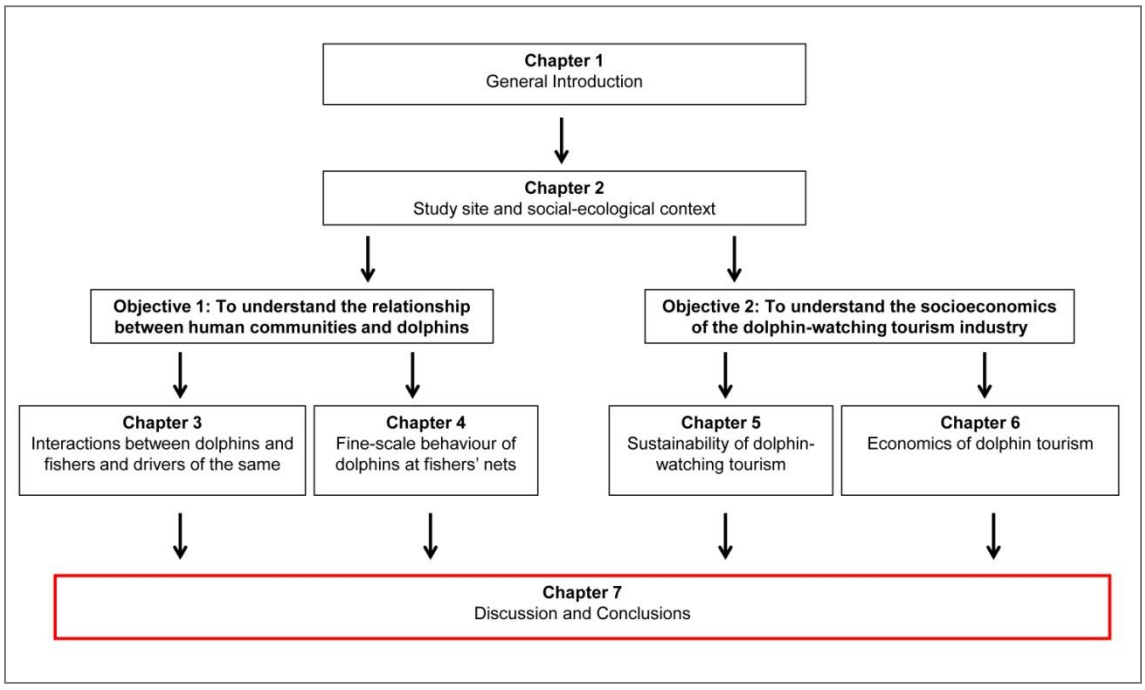
- The total number of days attributable to dolphin-watching was 0.34 locally, -0.13 at neighbouring sites, and 0.21 in the destination as a whole.

- If dolphins are extirpated, local stakeholders and the destination stand to lose, but neighbouring stakeholders gain.

- Understanding local and destination-level substitution of wildlife tourism is necessary to estimate: (1) the true value of wildlife tourism, and (2) which stakeholders to target through management interventions. Such an approach has the potential to build spatially inclusive conservation scenarios as part of conservation planning.

# 7 General Discussion

**This chapter represents a synthesis of my findings, from which I draw my broad conclusions. Importantly, I summarise the contribution of this thesis to theory and suggest a number of ways in which knowledge gained from this thesis may be applied in the conservation and management of the dolphins in Chilika, and more generically in similar social-ecological systems. I also highlight future avenues of opportunity to continue research in Chilika Lagoon.**



# 7 General Discussion

Social-ecological and interdisciplinary research are generally regarded as important in the conservation literature. However, research on the conservation of marine mammals still draws mostly on the natural history and ecology of wild species, and far less frequently on the human dimensions of wildlife management. Indeed, in the introduction of this thesis (Chapter 1), I showed that approximately 65% of recent peer reviewed literature on the conservation of marine mammals comprise studies focussed on the biological and ecological elements of conservation alone; in addition, of these data, most studies on the human dimensions of marine conservation (54%) were conducted in developed countries. Even though the primary threat to 11 of the 12 populations of small cetaceans listed as Critically Endangered on the IUCN Red List is fishing gear such as gill nets (Chapter 1), research adopting a social-ecological approach to mitigating the impacts of gill netting in such systems is scarce (n=3). Clearly research on the conservation and management of marine mammals needs to embrace the social-ecological interface, and dedicate more effort to understanding the dynamic interactive space where humans and ecosystems mix.

To address this knowledge gap, I studied the interface between the threatened population of Irrawaddy dolphins and human communities at Chilika Lagoon, India. I used a cross-disciplinary approach to understand how the Irrawaddy dolphin can best be conserved in a social-ecological system where fishing and dolphin-watching tourism are the main livelihoods of impoverished fishing communities. Both fishing and dolphin-watching tourism are likely to impact dolphin conservation in the lagoon (Chapter 2), hence I focussed on understanding the relationship between fishers and dolphins (Chapters 3 and 4), and on the socioeconomics of the dolphin-watching tourism industry (Chapters 5 and 6). Following a brief summary of my main findings and their interpretation below, I discuss the implications of these findings for the advancement of theory and practice in the remainder of this chapter.

## 7.1 Understanding the relationship between fishers and Irrawaddy dolphins in Chilika Lagoon

*Objective 1 of thesis, Chapters 3 and 4*

On average, fishers were mostly positive in their attitudes towards the dolphins, and traditional fishers with a higher probability of fishing alongside dolphins were more positive than non-

traditional fishers. Positive perceptions of traditional fishers included the belief that dolphins augmented their fish catch. Fishers used culture as a lens through which they expressed these perceptions. Observations of dolphin behaviour showed that dolphins spent up to half their foraging time barrier-foraging at stake nets. In addition, foraging dolphins were associated with significantly higher catch income and CPUE of mullet *(Liza sp.)*, a locally preferred food fish species. The drivers of positive fisher perceptions were thus rooted in ecology, socioeconomics and culture.

One of the key drivers of their positive perceptions was the fact that fishers often saw dolphins feeding at stake nets. Observations of the fine-scale behaviour of dolphins at these nets revealed that dolphin mothers with offspring and lone immature individuals barrier-foraged at these nets frequently. Critical life stages of dolphins thus use the nets and hence have adapted to the presence of fishers. The fact that stake nets date back only about 25 years, indicates that the dolphins of Chilika exhibit a degree of behavioural plasticity and have adapted to these nets within one generation. Thus both dolphins and fishers appear to be reliant on each other in a positive and mutualistic relationship.

## 7.2 Socio-economics of dolphin-watching tourism at Chilika

*Objective 2 of thesis, Chapters 5 and 6*

To assess the sustainability of dolphin-watching tourism at Chilika Lagoon, I used an evidence based-approach and analysed the social indicators of sustainability of the industry. The growth rate of tourists in the study site is beginning to decline, tourists visiting the area were mostly novices and were dissatisfied with their dolphin-watching experience. Satisfaction levels were positively influenced by boat-driver encounter management and the number of dolphins sighted. Participant observation and tourist perceptions highlighted some important drawbacks in the way in which the industry is conducted, however tourist preferences and perceptions also reflected the demands of a novice demographic. Collectively, the social indicators measured in this study were useful in rapidly assessing the long-term social sustainability of the dolphin-watching industry, and could potentially help identify suitable strategies to manage the industry within sustainable limits. My assessment of the dolphin-watching tourism thus indicated that the industry is currently very likely to be socially unsustainable.

Despite the apparent lack of social sustainability, the value of the industry to local and regional stakeholders is high. On applying economic substitution between dolphin-watching tourism and other spatially connected tourist attractions in the destination of Odisha, I tentatively estimated that the total expenditure attributable to dolphin-watching was approximately US$1.4 million

locally, US$-0.4 million at neighbouring sites and US$1 million in the destination as a whole. Thus if dolphins are extirpated at Chilika Lagoon, local stakeholders and the destination stand to lose, but neighbouring stakeholders stand to gain. These findings will help key stakeholders understand the true value of dolphin-watching tourism in the context of the multiple spatially-connected tourist attractions in the destination of Odisha. Taken together, my results indicate that although dolphin-watching tourism is very likely socially (and potentially ecologically) unsustainable, the industry contributes significantly to local livelihoods and is important on a regional as well as a local scale.

## 7.3 Synthesis: implications for theory that can be applied to wildlife tourism research

I use several indicators and a lines-of-evidence approach to investigate the social sustainability of dolphin-watching tourism in Chilika. To the best of my knowledge, my research is the first to use such a combination of indicators in association with Duffus and Dearden's modified Tourism Area Life Cycle (TALC) framework (Butler 1980; Duffus & Dearden 1990) to address the social sustainability of a cetacean-watching industry. Previous works have used only some of these approaches. For example, Birtles et al. (2002) and Mustika et al. (2012a) use tourist expectations, preferences, experiences, perceptions and suggestions as indicators of social sustainability of cetacean-watching industries; Higham et al. (2009) advocate the use of Duffus and Dearden's framework (Duffus & Dearden 1990) in the management of cetacean-watching tourism, and Malcolm and Duffus (2008) use this framework as a rationale to create an index for specialisation of cetacean-watching tourists in British Columbia. Manente and Pechlaner (2006) propose a series of indicators along with the TALC framework which can be used to identify whether a tourist site is in decline.

In developing countries, where wildlife tourism comes into conflict with the goals of conservation, I suggest the use of an early warning system as a user-friendly decision-making tool which provides managers with specific information regarding the site and its risk of decline. One such prototype, the Interactive Destination Evaluation System (IDES) is part of the DeTour framework, developed to identify declines in tourist sites (TNO-CISET 2004). IDES is a virtual warning tool, comprising specific variables, preselected with appropriate thresholds (Figure 7.1a, TNO-CISNET 2004). Tools such as IDES enable the effective changes in specific indicator variables to be measured as a tourism site changes through time (Figure 7.1b). Management strategies may then be formulated based on the thresholds of variables that have

been surpassed[28]. Where the option of conducting a pre-tourism phase of monitoring does not exist (see Higham et al. 2009) as at Chilika, such a tool may prove useful for sustainable management of wildlife tourism industries. The indicators I use in this thesis, for instance, may be used as social indicators of an early warning system for cetacean-watching tourism.

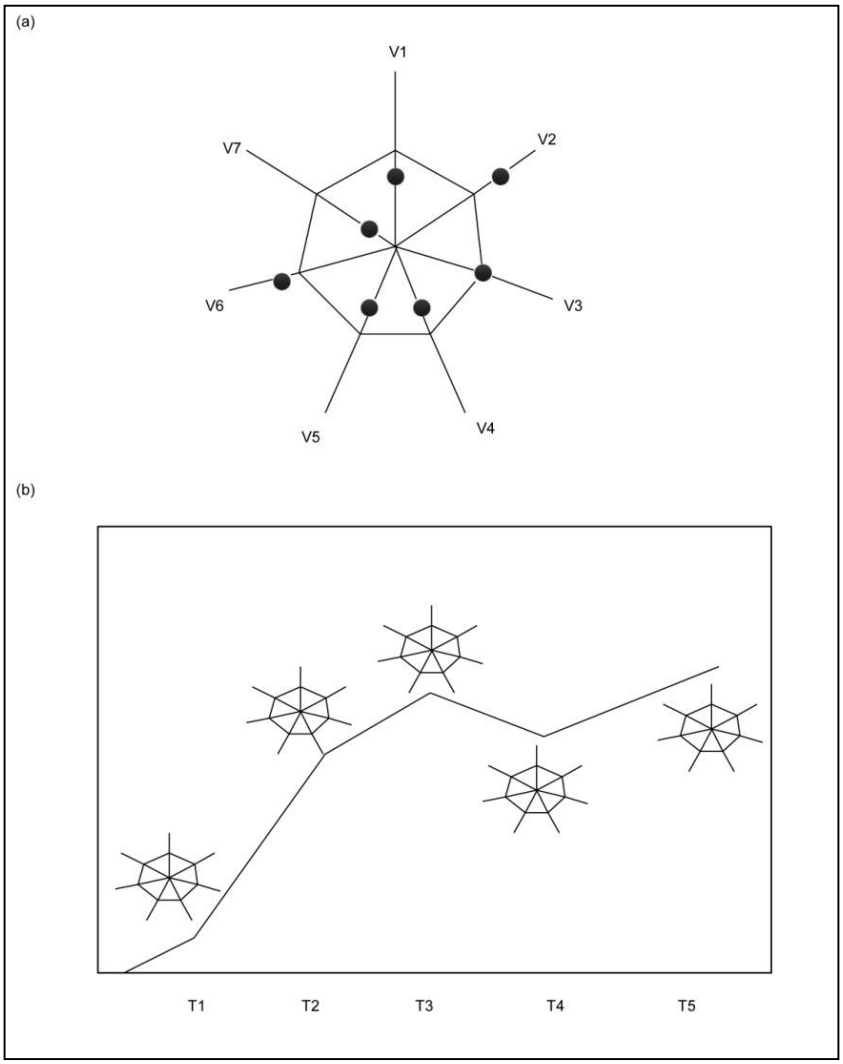



**Figure 7.1:** The prototype of an early warning system for tourist sites known as Interactive Destination Evaluation System (IDES), where: (a) is a spider plot showing preselected variables and their thresholds, and (b) depicts the measurement of these variables as a tourist site changes over time. Where v1-v7 represent preselected variables and appropriate thresholds, and T1-T5 represent phases of a tourist site. Illustration adapted from (TNO-CISNET 2004).

[28] Indicators must be identified and mutually accepted thresholds set by local stakeholders (TNO-CISNET 2004). Thus determining such indicators was beyond the scope of this thesis.

According to economic theory, the value of a wildlife tourism industry is crucially dependent on the degree to which a target species can be economically "substituted" by other local attractions, so that tourist expenditures that are "attributable" to the target species can be established. In Chapter 6, I estimated the value of the dolphin-watching industry at Chilika Lagoon by applying economic substitution between dolphin-watching and multiple spatially connected tourist attractions in the destination of Odisha. To my knowledge, this approach has not been previously used in wildlife tourism research and my research demonstrates that applying economic substitution across multiple spatially connected sites in a destination allows for a more nuanced valuation of the industry. Another advantage of this approach is its ability to predict diverse economic outcomes and identify the range of stakeholders that would be affected in case the target species in question were extirpated or unavailable for viewing. This approach also provides the basis for a regional scale argument to conserve wild species on which wildlife tourism industries are based.

## 7.4 Synthesis: implications for the conservation and management of Irrawaddy dolphins in Chilika Lagoon

Taken together the findings of this thesis have tangible implications for the conservation and management of Irrawaddy dolphins at Chilika Lagoon. I elaborate on these implications below:

As explained in Chapter 3, the legal framework in India currently affords a limited and restrictive management toolbox for conserving endangered populations such as the Irrawaddy dolphin. The Indian Wildlife (Protection) Act, 1972 allows for the creation of National Parks and Sanctuaries, where little or no resource extraction or human presence are permitted (Anonymous 1992). If Chilika were to be designated as a National Park or Sanctuary within the restrictions of this law, local fishing communities would be excluded from the area, and would not be able to participate in the design, implementation or monitoring of the protected area (Rajagopalan 2008). Such laws assume that the presence of humans is detrimental to the existence of wild species (Gómez-Pompa & Kaus 1992). This approach has had serious social costs due to the exclusion of local and traditional communities in India in the past (Brockington et al. 2006). Conservation interventions in areas such as Chilika Lagoon thus need to address issues of ethics and social justice.

At Chilika, highly restrictive conservation laws are likely to harm the existing positive fisher-dolphin interaction. Stakeholder acceptance of dolphins could decrease (Carpenter et al. 2000) and the existing dolphin-fisher mutualism could turn to conflict. A better approach would be to capitalise on the existing positive dolphin-fisher interaction in the formulation and

implementation of Irrawaddy dolphin management strategies. These strategies need to be negotiated with local fishing communities for mutually acceptable solutions. Both traditional and non-traditional fishers need to be involved in the development of management plans. In particular, positive traditional fisher beliefs and values should be used to build a constituency for Irrawaddy dolphin conservation. Westdal et al. (2013) argue that attitudes and perceptions of Nunavut Inuit communities towards killer whales *(Orcinus orca)* play an important role in conservation and ecosystem co-management. Although existing policy for natural resource and wildlife management in India is still largely top-down (Rajagopalan 2008), management of the dolphin population at Chilika Lagoon requires the involvement and active engagement of local stakeholders and a change in management policy to a more pluralistic paradigm (Berkes 2007).

Conservation and management strategies should consider the importance of barrier-foraging, stake nets and fishers to the fitness and survival of Irrawaddy dolphins in Chilika Lagoon. The practice of mothers with offspring and solitary immature dolphins barrier-foraging at stake nets suggests that the presence of stake nets is relevant to the dolphins[29]. The complete exclusion of local fishers or the banning of stake nets may adversely affect the dolphins. On the other hand, a very high density of stake nets might impact the dolphins by impeding movement, and the presence of fishers with gill nets could result in dolphins feeding off gill nets, causing bycatch. Conservation of the dolphins at Chilika therefore needs to consider the importance of optimal densities of stake nets and the presence of fishers to the dolphin population; conservation actions should thus be based on informed, yet cautious decisions.

Although attaining a balance between fishing and dolphin conservation at Chilika may be achievable, the balance between dolphin-watching tourism and dolphin conservation appears to be precarious. Currently dolphin-watching tourism in Chilika Lagoon is likely socially unsustainable (and very likely ecologically unsustainable). The absence of any appropriate tourism management strategies or conservation planning makes it difficult to embrace the complexity of the system and balance dolphin-watching tourism and dolphin conservation. There is a growing acceptance of the fact that socioeconomic considerations assist conservation planning of social-ecological systems (Ban & Klein 2009; Ban et al. 2013; Naidoo et al. 2006). Adopting a social-ecological approach to management that integrates dolphin-watching tourism and dolphin conservation should therefore be made a priority.

The application of economic substitution of the dolphin-watching tourism industry at the destination level could potentially be used to influence conservation opportunity. First, it could be used to justify conservation based on the premise that dolphin-watching tourism generates

[29] Stake nets are not known to cause bycatch mortality of the Irrawaddy dolphins in Chilika Lagoon.

approximately US$1.4 million annually to the fishing communities that run the industry. For the local communities involved in dolphin-watching tourism, the revenue generated as a result of artisanal fishing is likely to be far less than that from dolphin-watching, suggesting that tourism is a far more lucrative livelihood than fishing for these specific communities[30]. If dolphins were extirpated at Chilika or if the opportunity to view them was no longer an option, local stakeholders would lose an important livelihood, and the destination on the whole would lose significant tourism revenue. Using substitution at a regional level thus strengthens the argument to sustainably manage the Chilika dolphin-watching industry and conserve the dolphins on which the industry and hence livelihoods are based.

Secondly, the destination-scale economic value of dolphin-watching tourism could potentially be used to assess the effects of conservation planning and actions on local and regional livelihoods. For instance, if conservation strategies include restrictions on dolphin-watching tourism, (for example seasonal closures), knowledge on the extent to which both local and regional stakeholders economically depend on the target species could be used to build conservation scenarios. Conservation plans based on such scenarios would potentially minimise the impact of conservation actions on stakeholders and are likely to be more cost-effective to manage and implement (Ban and Klein 2009).

Another important implication of this thesis is the fact that as fishers' livelihoods shift towards dolphin-watching tourism, local values may change. According to Schwartz's Value Theory (Schwartz 2006), the motivational goal of "universalism" (including values such as understanding, appreciation, tolerance and protection of the welfare of people and nature) is in conflict with the goal of "power" (including social status, prestige, control or dominance over people and resources, wealth, etc.). Hence theory suggests that a shift in livelihoods from artisanal fishing to dolphin-watching tourism is likely to result in a shift in underlying fisher values, leading to an altered fisher-dolphin relationship with a potential negative impact on dolphin conservation. Hence here I reiterate that efforts to conserve Irrawaddy dolphins would benefit from reinforcing the traditional fisher-dolphin relationship, particularly amongst those who are involved in dolphin-watching tourism.

Global environmental change in Chilika Lagoon will impact the conservation of the dolphins in the long-term. As mentioned in Chapter 2 of this thesis, two historical events impacted the livelihoods of traditional fishers in the lagoon. The first was the advent of aquaculture, and the second was the opening of the new sea mouth to the lagoon. Both these events led to the loss in

[30] Note here I refer to the direct revenue generated by the industry, and not the market and non-market value of fishing and dolphin-watching tourism.

fisher livelihoods and out-migration, and resulted in the marginalisation of the traditional fishing community. Strategies used by fishers to cope with the resultant loss in livelihoods included modernisation of fishing gear, and livelihood diversification such as dolphin-watching tourism (Nayak 2014; Nayak & Berkes 2011). Altered fishing practices and dolphin-watching tourism appear to have had the significant impacts on dolphins in the lagoon. Hence the conservation of Irrawaddy dolphins in Chilika is interwoven in the broader, global social-ecological canvas and is dependent on the resilience of the Chilika Lagoon system. With increasing pressure on fisheries and food security in the future, addressing the global changes that impact the lagoon and fisher livelihoods would therefore likely benefit Irrawaddy dolphin conservation as well.

## 7.5 Recommendations for future research

The social-ecological and interdisciplinary approach I used in this thesis suggests future research that should benefit the conservation of Irrawaddy dolphins in Chilika Lagoon, and potentially other such systems. I suggest some priorities below:

- Dolphin-watching tourism:
    - The use of tourist interpretation in influencing tourist expectations and behaviour;
    - The ecological sustainability of dolphin-watching tourism at Chilika;
    - Using Chilika as a case study to develop an early warning system for cetacean-watching tourism in developing countries based on a combination of social, environmental and economic indicators (refer to Section 7.3, and Figure 7.1 of this chapter); and
    - Better estimating the value of the dolphin-watching tourism industry, by: (1) using a more robust sampling and questionnaire design, (2) increasing the sample size and diversity of tourists interviewed, and (3) surveying tourists in several destinations in Odisha that did and did not go dolphin watching.
- Linking fishing and tourism, using the lens of social resilience to identify social thresholds of sustainability, and the point at which: (i) fishers changed their livelihoods to dolphin-watching tourism, and (ii) fishers are likely to exit the dolphin-watching industry in favour of other livelihoods.
- Using a broad approach to understand sustainability by analysing sustainability of the fishery and the dolphin-watching tourism industry at Chilika using Ostrom's social-ecological

framework (Ban et al. 2013; Ostrom 2007, 2009), (Figure 7.2). This framework would allow for an understanding of the relationships between multiple elements of the core system at different spatial and temporal scales, and thus the factors required for users to self-organise and sustainably manage their ecosystem (Ostrom 2009). In particular, a key area of future research could be local governance systems and institutions, the potential use of adaptive co-management to balance dolphin-watching tourism and dolphin conservation (see Armitage et al. 2009; Folke et al. 2005; Olsson et al. 2004). This research could be conducted, for instance, by studying the potential to engage existing local institutions and governance systems (that are currently used to manage the artisanal fishery) to manage the dolphin-watching tourism industry, by studying the existing social networks within the artisanal fishery and dolphin-watching associations etc.

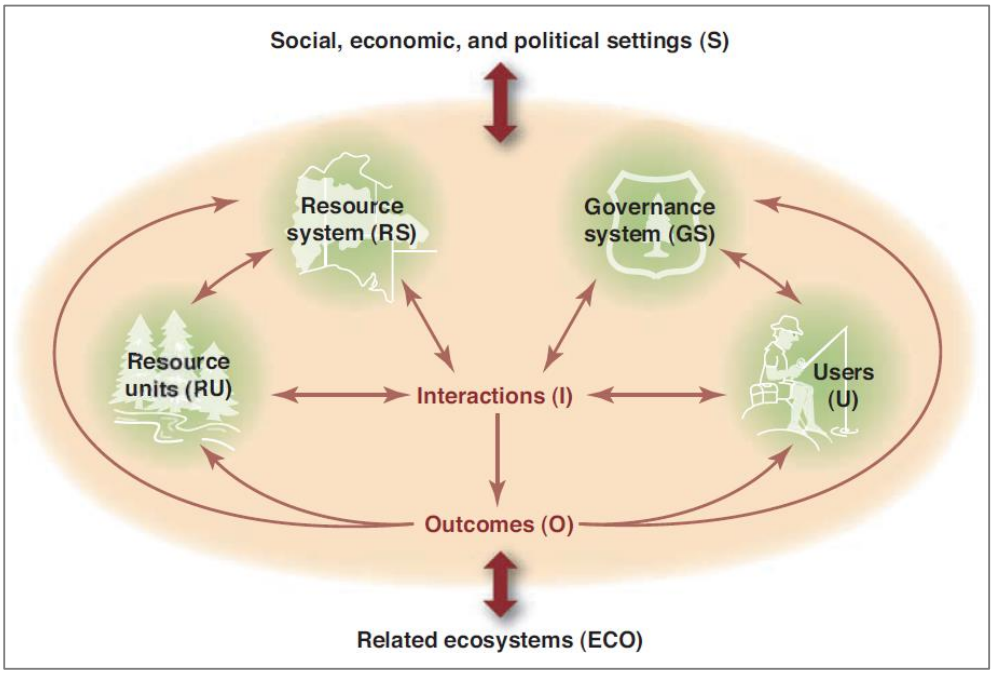



**Figure 7.2:** Ostrom's framework to analyse complex social-ecological systems, may be used to understand sustainability, and the ability of local users to manage their resources; taken from Ostrom (2009).

- Conservation planning and the creation of scenarios to inform conservation decisions and actions. Such planning exercises use systematic ways to develop structured alternative futures based on input from diverse stakeholders and both qualitative and quantitative information (Ban et al. 2013; Peterson et al. 2003). Particularly in circumstances like Chilika Lagoon, where conservation poses complex problems with multiple uncertainties, scenario planning may help develop more resilient conservation policies (Peterson et al. 2003).

- Genetic studies to understand whether the tendency to forage at stake nets is culturally transmitted via matrilines.

- Behavioural studies using focal animal samples to determine the extent to which mothers with calves use stake nets, and compare the social networks between individuals that forage at stake nets with those that do not.

- Repeating Sutaria and Marsh's (2011) assessment of the status of the Chilika dolphin population using mark-recapture methodology.

## 7.6 Conclusions

This thesis provides an initial understanding the social-ecological environment required to conserve the threatened Irrawaddy dolphin population of Chilika Lagoon. As is often the case, balancing human livelihoods and Irrawaddy dolphin conservation needs is a complex, intractable and wicked problem, one that will undoubtedly be fraught with challenges and uncertainty. Nevertheless, some tangible conclusions may be drawn from this study:

- Positive perceptions of traditional fishers should be used to build a constituency for conservation, a pluralistic conservation paradigm should be adopted;

- With the active engagement of local stakeholders, conservation strategies should consider the importance of barrier-foraging, stake nets and fishers to the fitness and survival of Irrawaddy dolphins;

- A social-ecological approach to dolphin-watching tourism management should be considered with an integrated conservation and tourism management plan;

- Conservation planning should include the creation of conservation scenarios with the inclusion of social input; and

- Global social-ecological changes impacting fisher livelihoods should be addressed.

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# Appendix A

**Table A.1:** List of survey questions used in the study. Surveys comprised both closed-ended (used for attitude score) and open-ended questions (used for thematic analysis).

| Question | Question type | Analysis type used | Values used to code response |
|---|---|---|---|
| Is there any animal in Chilika that benefits fishers? | closed-ended | quantitative method, attitude score | 0 or +1[a] |
| If yes, how does it help you? | open-ended | qualitative method, thematic analysis | NA[b] |
| Is there any animal in Chilika that causes difficulties for fishers? | closed-ended | quantitative method, attitude score | 0 or -1[c] |
| If yes, how does it harm you? | open-ended | qualitative method, thematic analysis | NA |
| Will a change in the dolphin population in Chilika affect you? If yes, how? | open-ended | qualitative method, thematic analysis | NA |

[a] Where response was "Yes, dolphin" = +1, while "No" or any other response = 0

[b] NA = Not Applicable

[c] Where response was "Yes, dolphin" = -1, while "No" or any other response = 0

**Table A.2:** Emergent themes reflecting negative fisher perceptions towards dolphins, number of respondents and illustrated examples within each theme.

| Theme, no. of respondents | Illustrated example |
|---|---|
| Dolphins cause problems for fishing, n = 18[a] | "An increase in dolphins is bad because they will eat more fish" (1 non-trad[b], low[c] respondent)<br>"Irrawaddy dolphins damage nets" (1 non-trad, low respondent) |
| Dolphins harm fishers (unspecified), n = 7 | "If they [dolphins[ increase, I will get scared" (1 non-trad, low respondent) |
| Dolphins cause direct harm to fishers, n = 2 | "An increase in the number of dolphins is bad because they will bite people" (1 non-trad, low respondent) |
| Dolphins cause other problems for fishers, n = 2 | "A decrease in dolphins will reduce tourist boats, which is good" (1 non-trad, low respondent) |
| Dolphins cause other problems for fishers (unspecified), n = 1 | "A decrease in dolphins is good" (1 non-trad, high respondent) |

[a] Indicates the total number of respondents that expressed each theme

[b] Non-trad = non-traditional fisher

[c] High = high probability of encountering dolphins, low = low probability of encountering dolphins

**Table A.3:** Tukey's post-hoc test for unequal N, conducted for two-way ANOVA with attitude score as the dependent variable, and fisher community type (traditional or non-traditional) and probability of encountering dolphins (high or low) as fixed categorical variables. Significant values have been highlighted in bold. Error: Between Mean Square (MS) = 0.21846, degrees of freedom (df) = 295.00.

| Fisher community type | Probability of encountering dolphins | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| (1) Non-traditional | low | | 0.022 | 0.180 | 0.000 |
| (2) Non-traditional | high | | | 0.59 | 0.005 |
| (3) Traditional | low | | | | 0.000 |
| (4) Traditional | high | | | | |

**Table A.4:** Average CPUE and SE values of, (a) total CPUE, (b) CPUE of mullet, (c) CPUE of tiger prawn, (d) CPUE of prawns and shrimp, (e) CPUE of the rest of the catch, and (f) catch income (per unit effort), grouped across dolphin presence (absent or present) and year. Key: g/h = grams per hour, USD/h = US Dollars per hour.

| | 2008 | | | | 2009 | | | | 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Presence of dolphins** | **Present** | | **Absent** | | **Present** | | **Absent** | | **Present** | | **Absent** | |
| | **Average** | **SE** | **Average** | **SE** | **Average** | **SE** | **Average** | **SE** | **Average** | **SE** | **Average** | **SE** |
| (a) Total CPUE of catch | 45.47 g/h | 12.28 | 45.34 g/h | 16.46 | 44.92 g/h | 8.25 | 40.16 g/h | 16.14 | 89.05 g /h | 38.47 | 51.51 g/h | 10.12 |
| (b) CPUE of mullet | 8.20 g/h | 7.13 | 0.40 | 0.20 | 7.68 g/h | 2.21 | 2.49 g/h | 1.21 | 36.12 g/h | 30.18 | 2.49 g/h | 0.93 |
| (c) CPUE of tiger prawns | 0.64 g/h | 0.35 | 1.03 g/h | 0.38 | 1.33 g/h | 0.45 | 0.31 g/h | 0.10 | 0.89 g/h | 0.64 | 4.11 g/h | 1.21 |
| (d) CPUE of prawns and shrimp | 28.64 g/h | 16.21 | 16.70 g/h | 5.35 | 2.78 g/h | 2.07 | 3.24 g/h | 2.68 | 1.96 g/h | 1.44 | 17.60 g/h | 5.44 |
| (e) CPUE of rest of catch | 7.99 g/h | 2.66 | 27.21 g/h | 18.06 | 33.12 g/h | 8.62 | 34.40 g/h | 16.17 | 50.08 g/h | 26.31 | 27.31 g/h | 7.30 |
| (f) Catch income (per unit effort) | 5.12 USD/h | 1.68 | 2.35 USD/h | 0.38 | 2.35 USD/h | 0.46 | 0.90 USD/h | 0.24 | 7.21 USD/h | 3.62 | 2.30 USD/h | 0.35 |

# Appendix B

**Table B.1:** Descriptions of Irrawaddy dolphin categories.

| Dolphin category | Description |
|---|---|
| Cow-offspring (CO) | Cow-calf or cow-juvenile pair |
| Mixed group (MG) | Mixed group of dolphins that may comprise adults, subadults, juveniles and/or calves |
| Group of adults (GA) | Two or more adults |
| Group of immature (GI) | Two or more individuals that may comprise subadults, juveniles and/or calves, but distinct by the absence of adults |
| Solitary adult (SA) | A lone adult |
| Solitary immature (SI) | A lone calf, juvenile or subadult |

# Appendix C

**Survey tool used for interviews of dolphin-watching tourists in Chilika**

| **Trip Conditions** | |
|---|---|
| **Weather condition:** | |
| **Sea state:** | |
| **Section 1 – Tourist Demographics** | |
| **1. Year of birth:** | |
| **2. Gender:** | **☐ Male ☐ Female** |
| **3. State of residence (in India):** | |
| **4. Highest level of education:** | |
| **5. Occupation:** | |
| **Section 2** | |
| **6. What is/are the reason(s) for your trip to Chilika Lagoon? Of these reasons, which is the most important reason for your trip? (Please mention only one option)** | |
| **7. Is this your first visit to Chilika Lagoon to watch dolphins? If not, how many times have you previously visited to watch dolphins?** | |
| **8. Have you seen or interacted with wild or captive dolphins before? If yes, where?** | |
| **9. From where and from whom did you hear about dolphin watching at Chilika?** | |
| **Section 3** | |
| **10. Did you see any dolphins during your boat trip here in Chilika? If yes, how many?** | |
| **11. During your boat ride in Chilika, how many people were on your boat including children, your boatman and yourself?** | |

**12. What is the exact fare you paid for the dolphin-watching tour?**

**13. If you did see dolphins, how many other tourist boats did you see around your boat during your first encounter with the dolphins?**

**14. If you had a choice, how many boats would you have liked around your boat while watching the dolphins?**

**15. How do you feel about the way in which your boat driver managed your encounters with the dolphins? What is the reason for your answer?**

| Very Uncomfortable | Uncomfortable | Neutral | Comfortable | Very comfortable |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

**16. If you saw dolphins, what was the closest distance between your boat and the dolphins (please consider all encounters)? What is the reason for your answer?**

| Much too close | Too close | Just right | Too far | Much too far |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☒ |

**17. Was the total amount of time you spent watching the dolphins:**

| Much too much | Too much | Just right | Too little | Much too little |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

**18. How satisfied were you with your overall dolphin-watching tour at Chilika?**

| Not at all satisfied | | | | | | | | | Very satisfied |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Section 4**

**19. What aspect of your experience on the dolphin-watching tour did you like the best?**

**20. What aspect of your experience on the dolphin-watching tour did you dislike the most?**

| Section 5 |
| --- |
| **21. Do you have any suggestions as to how your dolphin-watching experience at Chilika could be improved?** |
| **Section 6** |
| **21. Would you go dolphin-watching in Chilika again?** |
| **22. Would you recommend the dolphin-watching tour to others?** |

**Table C.1:** Thematic analysis on what tourists visiting Chilika Lagoon liked about their dolphin-watching experience.

| Theme | No. of responses (n)[a] | Example |
|---|---|---|
| Dolphins | 74 | "We saw the dolphins spitting. It was a good experience. If we could have seen more dolphins, it would have been better" (Respondent R67)<br>"We liked the dolphins the most" (Respondent R92) |
| The lagoon/ Nature | 64 | "I liked the natural lake [lagoon]" (Respondent R7)<br>"The sea mouth was nice" (Respondent R152)<br>"...the island was attractive" (Respondent R6) |
| The boat ride/ journey | 47 | "The journey was enjoyable" (Respondent R3)<br>"The ride was nice" (Respondent R19)<br>"I got peace on the ride" (Respondent R40) |
| Everything | 20 | "[I liked] everything. I enjoyed it." (Respondent R14) |
| Nothing | 10 | "I did not like anything" (Respondent R33) |
| Other animals | 7 | "The birds were nice" (Respondent R66) |
| Local people | 7 | "The people are nice and friendly which is important for tourism" (Respondent R9) |
| Other | 14 | "I liked the Kali temple" (Respondent R11) |
| **Total** | **243[a]** | |

[a] Some responses were classified according to more than one theme. The total number of respondents was 231.

**Table C.2:** Thematic analysis exploring what tourists at Chilika Lagoon disliked most about their dolphin-watching experience.

| Theme | No. of responses (n)[a] | Example |
|---|---|---|
| Disliked nothing | 77 | "[I had] no negative experience" (Respondent R7) |
| Dolphin sighting | 41 | "I wasted my time and did not see much... the dolphins here don't even come out of the water much" (Respondent R4)<br>"I am not satisfied with the dolphin [watching] because in the ad they were jumping... I did not see much" (Respondent R44)<br>"We could not see dolphins as we expected to see them" (Respondent R118) |
| Boats | 30 | "...there was a hole in the boat and the boat driver had to bail water out... the boatman said if we don't bail out water the boat will sink and we will drown" (Respondent R202)<br>"...the boat was not comfortable..." (Respondent R86)<br>"The boats are slow and there is nothing great about this experience" (Respondent R119)<br>"It was very boring and noisy, I got a headache" (Respondent R74)<br>"Because the boat makes a loud noise, they [the dolphins] don't come out much" (Respondent R222). |
| Duration of the ride | 23 | "The distance is too far. We were a bit bored." (Respondent R63)<br>"The ride was too long for the kids" (Respondent R64) |
| Cost of services | 22 | "... the bargaining is bad" (Respondent R181)<br>"The boat rides are too expensive for normal people" (Respondent R221)<br>"People [here] overcharge for everything" (Respondent R171) |
| Poor management/ lack in expertise | 16 | "The toilets are terrible..." (Respondent R85)<br>"They [the tourism managers] lack professionalism. They do not provide facilities to the tourists." (Respondent R124) |

| Theme | No. of responses (n)[a] | Example |
|---|---|---|
| Littering/ pollution | 15 | “I am disappointed regarding [with] pollution. Some measures should be taken.” (Respondent R164)<br>“...people eat stuff and throw plastic into the lagoon" (Respondent R183) |
| Other sightings | 11 | "We expected to see more birds but we were told that because of the [boat] traffic they have all gone deeper into the Lagoon..." (Respondent R232)<br>"They [the boat drivers] should have taken us to the sea mouth" (Respondent R135) |
| Dolphin-watching protocol | 7 | "During dolphin watching, all the boats were chasing the dolphins" (Respondent R66) |
| Other | 14 | "It [the dolphin watching ride] was a bit hectic when we were returning" (Respondent R182) |
| **Total** | **256[a]** | |

[a] Some responses were classified according to more than one theme. The total number of respondents was 231.

**Table C.3**: Tourist perceptions of how dolphin-watching at Chilika Lagoon could be improved.

| Theme | No. of responses (n) | Example |
|---|---|---|
| Improve infrastructure | 82 | "I think they [tourism managers] should have more [food] stalls here, and more stuff to eat and drink." (Respondent R77)<br>"They [tourism managers] should have better toilets and bathrooms, shade, [and] seating areas." (Respondent R123)<br>"The jetty should be improved ... for ladies it is dangerous." (Respondent R206)<br>"This place should be improved. My first impression was very bad..." (Respondent R80)<br>"Boats should be more comfortable. Someone was bailing water from the boat..." (Respondent R64)<br>"...[I] suggest [that the tourist managers] use speed boats so that time [of the ride] will be minimised." (Respondent R112)<br>"Seating arrangement in the boat [should be improved] and machines [motors] should be pollution free ... boats should be battery powered and solar." (Respondent R144) |
| Guarantee dolphin sightings | 29 | "There should be more dolphins and a show where you can see dolphins in one hour, so that people spend their money and get to see something. The dolphin sighting is uncertain. They [tourist operators] should have trainers which bring the dolphins out of the water." (Respondent R119)<br>"There should be a confined area where we can view them [the dolphins]. [Like] what we have seen in pictures and videos." (Respondent R198) |
| Introduce interpretation | 23 | "They [tourism managers] should have a guide on board [the tourist boat]." (Respondent R78)<br>"There should be some tourist reception...there should be some sort of education about Chilika and dolphins." (Respondent R86) |
| Improve association | 20 | "Management of tourism should improve." (Respondent R13) |

| Theme | No. of responses (n) | Example |
|---|---|---|
| management/ customer service | | "They [the tourist association] should have standard rates and give the right information to everyone." (Respondent R150)<br>"The office [tourist association] should have better behaviour..." (Respondent R68) |
| Decrease cost | 19 | "The price of the ride is too expensive for the common man..." (Respondent R51) |
| Improve dolphin rides | 18 | "The duration of the ride is too long." (Respondent R78)<br>"I want to see dolphins for [a] longer time." (Respondent R100)<br>"Because of the motor sound [of the boat] it is not possible to see the dolphins, so our suggestion is to cut off the engine [when near the dolphins]." (Respondent R118) |
| Stop polluting | 17 | "[There is] too much garbage and plastic in the water." (Respondent R29)<br>"They [tourists] should not throw packets into the water. I also threw a packet into the water, I'm not going to lie, but people should not do this." (Respondent R180) |
| Improve safety | 14 | "The boat should be safer. They should carry lifejackets." (Respondent R50) |
| Vendors/ hawkers less commercial | 6 | "All the hawkers are cheats and the quality is not commensurate with the price." (Respondent R85)<br>"They [the hawkers] cheated us by selling us pearls." (Respondent R108) |
| Other | 16 | "Mangroves should be extended." (Respondent R144) |
| **Total** | **244**[a] | |

[a] Some responses were classified according to more than one theme. The total number of respondents was 231.

# Appendix D

**TOURIST VISITS IN ODISHA**
(Financial Year wise)

| Year | Domestic | % Change | Foreign | %Change | Total | % Change |
|---|---|---|---|---|---|---|
| 2002-2003 | 34,29,027 | 8.4 | 23,488 | 6.9 | 34,52,515 | 8.4 |
| 2003-2004 | 38,05,968 | 11.0 | 25,556 | 8.8 | 38,31,524 | 11.0 |
| 2004-2005 | 43,26,002 | 13.7 | 30,300 | 18.6 | 43,56,302 | 13.7 |
| 2005-2006 | 46,95,647 | 8.5 | 35,731 | 17.9 | 47,31,378 | 8.6 |
| 2006-2007 | 53,77,123 | 14.5 | 39,407 | 10.3 | 54,16,530 | 14.4 |
| 2007-2008 | 62,10,586 | 15.5 | 43,311 | 9.9 | 62,53,897 | 15.4 |
| 2008-2009 | 64,82,213 | 4.37 | 42,303 | -2.32 | 65,24,516 | 4.32 |
| 2009-2010 | 71,04,079 | 9.59 | 47,105 | 11.35 | 71,51,184 | 9.6 |
| 2010-2011 | 77,70,741 | 9.38 | 53,212 | 12.96 | 78,23,953 | 9.4 |
| 2011-2012 | 84,72,208 | 9.03 | 62,816 | 18.05 | 85,35,024 | 9.09 |
| 2012-2013 | 92,91,734 | 9.67 | 65,522 | 4.3 | 93,57,256 | 9.63 |
| 2013-2014 | 1,00,64,072 | 8.31 | 67,400 | 2.87 | 1,01,31,472 | 8.27 |

**Figure D.1:** Data on annual tourist visitation to Odisha, India between 2002 and 2013. Data provided by the Tourism Department of Odisha.

**TOURIST VISITS IN SATAPADA (Same Day Visitors)**

| Year | Domestic | Foreign | Total |
|---|---|---|---|
| 2003 | 66,262 | 587 | 66,849 |
| 2004 | 70,520 | 605 | 71,125 |
| 2005 | 84,880 | 790 | 85,670 |
| 2006 | 95,390 | 814 | 96,204 |
| 2007 | 1,33,380 | 843 | 1,34,223 |
| 2008 | 1,41,900 | 859 | 1,42,759 |
| 2009 | 1,38,070 | 929 | 1,38,999 |
| 2010 | 1,50,831 | 921 | 1,51,752 |
| 2011 | 1,55,356 | 963 | 1,56,319 |
| 2012 | 1,58,463 | 1,150 | 1,59,613 |
| 2013 | 1,60,650 | 1,171 | 1,61,821 |

**Figure D.2:** Data on annual tourist visitation to Satapada, the Outer Channel of Chilika Lagoon, India between 2002 and 2013. Data provided by the Tourism Department of Odisha.