FEMALE REPRODUCTIVE STRATEGIES AND MOTHER-CALF RELATIONSHIPS OF COMMON DOLPHINS (*Delphinus delphis*) IN THE HAURAKI GULF, NEW ZEALAND.

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ABSTRACT

This study reviewed the habitat use, social organisation and behaviour of common dolphin groups categorised by their youngest member, as well as the behaviour of common dolphin calves of different age classes.

Most newborn calves were sighted over late spring and early summer, and in water temperatures warmer than for other groups. The water depths at which common dolphin groups were found did not vary according to the age class of their youngest member. However, only groups containing newborns or infants were sighted under 20 metres of water depth. A high percentage of groups encountered contained calves (82.5%), suggesting the importance of the Hauraki Gulf for common dolphins' reproduction.

Groups of common dolphins containing calves were found to be of larger size than any other group type. All groups proved to be similarly involved in different behavioural states and showed comparable patterns of association with other species, although groups including newborns were significantly less likely to be seen associated with whales and birds. Groups of common dolphins as a whole did not show a differential reaction to the boat according to the age class of their youngest member. However, mothers and their young calves kept greater distances to the boat than mothers and older calves did, suggesting that the boat may be perceived as a threat during the newborn period.

Most of the behaviours that characterise mother-calf relationships varied according to calf age class. The occurrence, frequency, duration and distance of separations increased with older aged calves. A similar increase was found in the time spent without the mother, in the occurrence of association with non-mother dolphins, in the time spent in 'echelon position', and in both mothers' and calves' dive time. Mothers also had longer dive times than calves. Older aged calves tend to present the lowest proportion of synchronous breaths. These changes are likely to represent a gradual increase in calves' independence.

Results from this study have extended our knowledge of common dolphins' reproductive ecology, demonstrated that studies of mother-calf relationships in pelagic species of dolphins can be achieved, and allowed future research needs to be identified and management recommendations to be made.

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EXPLANATION OF TERMS

Calf age classes

Common dolphin calves were categorised according to their size relative to that of their mothers.

Infant: individual around half the size of the mother.

Juvenile: individual around two-thirds the size of the mother.

Newborn: individual noticeably less than half the size of the mother.

Group and individual identification

Adult: all individuals that are neither newborns, nor infants or juveniles.

Calf: general term designating non-adult dolphins and including newborns, infants and juveniles.

Group: dolphins observed in close proximity, within 200 metres of each other, and in apparent association, moving in the same direction or engaged in the same behaviour.

Mother: adult individual consistently associated with a smaller animal.

Group type

Each group of common dolphins was categorised according to the age class of its youngest member.

Group type 1: the youngest member of the group was a newborn calf.

Group type 2: the youngest member of the group was an infant.

Group type 3: the youngest member of the group was a juvenile.

Group type 4: group composed only of adults.

Activity state (definitions derived from Shane *et al.*, 1986; and Shane, 1990a)

Feeding: dolphins are involved in an effort to capture and consume prey. They are observed herding and chasing fish.

Milling: dolphins remain within a given area, not moving in any definite direction, and continuously changing their heading.

Resting: dolphins are grouped in a tight formation and are moving slowly at the surface in a co-ordinated manner, and in one particular direction.

Socialising: dolphins are essentially involved in social behaviours, such as mating, rubbing and playing. Much physical interaction and surface displays can be observed.

Travelling: dolphins are all moving at a sustained speed in a persistent direction.

Mother-calf relationships

Allomaternal behaviour: association of a calf with a non-mother dolphin.

Calf solitary surfacing: calf breaks the surface of the water for a breath on its own.

Echelon position: calf is swimming alongside its mother, paralleling her course less than 30cm from her side.

Infant position: calf is swimming underneath its mother.

Nursing position: the calf's rostrum is in contact with the mother's mammary slit area for over two seconds.

Overlapping surfacing: mother and calf break the surface of the water one immediately after the other, resulting in a breathing overlap.

Separation: observable increase (>1 metre) in the distance between a calf and its mother.

Synchronous surfacing: mother and calf break the surface of the water in perfect unison.

Reaction to the boat

Attraction: the dolphins are coming towards the boat, swimming at the bow for extended periods of time and staying around the boat even if stopped.

Avoidance: dolphins are continuously changing their heading away from the boat.

Neutral: no observable reaction or change in the behaviour of the dolphins can be noticed, they are not attracted to the boat and neither avoiding it.

Mating behaviours

Mating behaviours with genital contact: genital-to-genital presentation, beak-to-genital contact.

Mating behaviours without genital contact: non-genital contact including rubbing, chase, leap, head slap.

Oceanographic seasons

Summer: January to March.

Autumn: April to June.

Winter: July to September.

Spring: October to December.

Chapter 1: INTRODUCTION

Common dolphins (*Delphinus delphis*) represent one of the most abundant and most widely distributed species of cetaceans (Evans, 1987). They can be found in all oceans and all seas of the world, and their abundance has been estimated to a few million (Gaskin, 1992). Paradoxically, common dolphins also represent one of the least studied species to date, and our knowledge on many aspects of their life history and behaviours appears to be rather limited.

For many years, post-mortem data from stranding events and fisheries by-catch have represented the only source of information available on common dolphins. Scientific investigations of wild populations of common dolphins have indeed been restricted by several of the factors that characterise the species. Common dolphins usually inhabit deep offshore waters that can prove difficult to access on a regular basis for researchers (Evans, 1987). Therefore, many of the observations made on wild common dolphins have remained of anecdotic status. Common dolphins are also mostly found in relatively large and fast moving groups (Dawson, 1985; Evans, 1994), limiting the range of data that can be collected, as well as the possibility of studying individual animals. As a result, most of the information found in the literature regarding common dolphins relates to their anatomy, genetics, and biology, and many of the questions regarding social organisation that have been answered for other cetacean species have not yet been addressed for common dolphins.

In order to enhance our knowledge of common dolphins, a few recent studies have focused on documenting the behaviour and ecology of the species. The identification of common dolphin populations located closer to shore, and the use of consistent surveys, have enabled these studies to gather relevant information on the distribution and abundance of the species in different locations (Bearzi *et al.*, 2003; Neumann, 2001; Cañadas *et al.*, 2002; Dohl *et al.*, 1986; Goold, 1998; Selzer and Payne, 1988), as well as on seasonal movements (Dohl *et al.*, 1986; Forney and Barlow, 1998; Yukhov *et al.*, 1986; Bearzi *et al.*, 2003; Würsig *et al.*, 1997; Neumann, 2001; Goold, 1998; Selzer and Payne, 1988), and feeding strategies and activity budgets (Neumann, 2001). Some insights into common dolphins' social organisation were also provided by the study

conducted by Neumann (2001). Although these findings provide basic data on common dolphins and constitute the foundation for further research to take place, several other aspects of common dolphins' behaviour need to be investigated in order to reach a better understanding of the population dynamics of the species. The main goal of this study is to redress the lack of information in certain areas of our knowledge of common dolphins, and more specifically to contribute to an increased understanding of their reproductive ecology.

The importance of studying the reproductive patterns of a species in order to comprehend its social organisation has been emphasised by several authors (Townsend, 1935; Sverdrup *et al.*, 1942; Whitehead and Mann, 2000; Thayer *et al.*, 2003). In fact, reproduction is one of the main drivers of animals' social behaviour, and as such, it has been identified as being the source of most of the behavioural biology that characterise a species (Townsend, 1935; Sverdrup *et al.*, 1942). In cetaceans, only females actively parent and therefore, their role as a mother represents a fundamental element of any whale or dolphin population and is likely to influence its social structure (Whitehead and Mann, 2000). For these reasons, investigating the reproductive strategies used by female cetaceans appears to be of primary importance in order to appreciate the dynamics of a population (Whitehead and Mann, 2000; Thayer *et al.*, 2003).

The only delphinid species for which female reproductive strategies and mother-calf relationships have been extensively studied is the bottlenose dolphin (*Tursiops truncatus*) (Evans, 1987; Whitehead and Mann, 2000). These studies have emphasised the conditions favoured by females in the production and care of their young, and this has lead to an enhanced understanding of the behavioural ecology of the species (Mann and Smuts, 1998, 1999; Mann *et al.*, 2000). In the field of reproductive ecology, breeding seasonality represents the only variable ever investigated for common dolphins. However, many studies have relied on the analysis of postmortem specimens, which may not always provide reliable conclusions (Fernandez and Hohn, 1998). Observations of wild populations have lead to some interesting results, but the significance of breeding seasonality for the species has never been discussed.

In an attempt to obtain an insight into female reproductive strategies and mother-calf relationships in common dolphins, a 14-month study was conducted in the Hauraki

Gulf, New Zealand. The waters of the Hauraki Gulf provide a great opportunity to further our knowledge of common dolphins. Compared to other locations worldwide, common dolphins can be found in relatively shallow waters and in smaller groups (O'Callaghan and Baker, 2002), allowing observations to take place on a daily basis and providing suitable conditions to monitor their behaviour. Common dolphins are also found year-round in the Hauraki Gulf, which enables the investigation of temporal patterns such as breeding seasonality. The objectives for this study are represented by the following general research questions:

1) Do the common dolphins in the Hauraki Gulf display reproductive seasonality?
2) What are the specific characteristics of common dolphin groups containing calves?
3) What is the role of the Hauraki Gulf for female common dolphins?
4) What are the behavioural patterns that describe the relationships between calves of different age and their mothers?

Answering these questions will have different beneficial outcomes. Firstly, it will enable us to increase our knowledge of common dolphins in a field never investigated before for the species. Secondly, due to the important role of mother-calf relationships within cetacean populations, a better understanding of females' reproductive strategies will lead to a better appreciation of the potential effects of different growing threats on the dolphins. Thirdly, the results of this study will provide baseline data on different characteristics of common dolphin groups, as well as on mother-calf relationships. The importance of baseline observations has been emphasised by different authors, especially in investigating the impact of tourism on the dolphins (Bejder and Dawson, 1999; Constantine, 1999), as they enable the identification of subsequent changes in the behaviour of the animals, and allow researchers to consider them relative to changes in their environment.

The content of this thesis is set as follows (Figure 1):
Chapter 2 presents a review of the current literature available on common dolphins, as well as on mother-calf relationships in other delphinid species. Based on this knowledge, specific hypotheses are developed in order to investigate the general research questions outlined above. The methods used to collect data during field observations are described in chapter 3. In chapter 4, the results of the statistical

analysis conducted on the empirical data are presented for each of the hypotheses investigated in this study. In chapter 5, results on common dolphins' breeding seasonality, on the characteristics of common dolphin groups containing calves, and on common dolphin calves' development are discussed in light of other studies conducted on similar topics. The significance of each of these results is also reviewed. Finally, chapter 6 summarises the main findings of this study, outlines their implications for the common dolphins of the Hauraki Gulf, and includes suggestions for future research and recommendations for the conservation of the species.

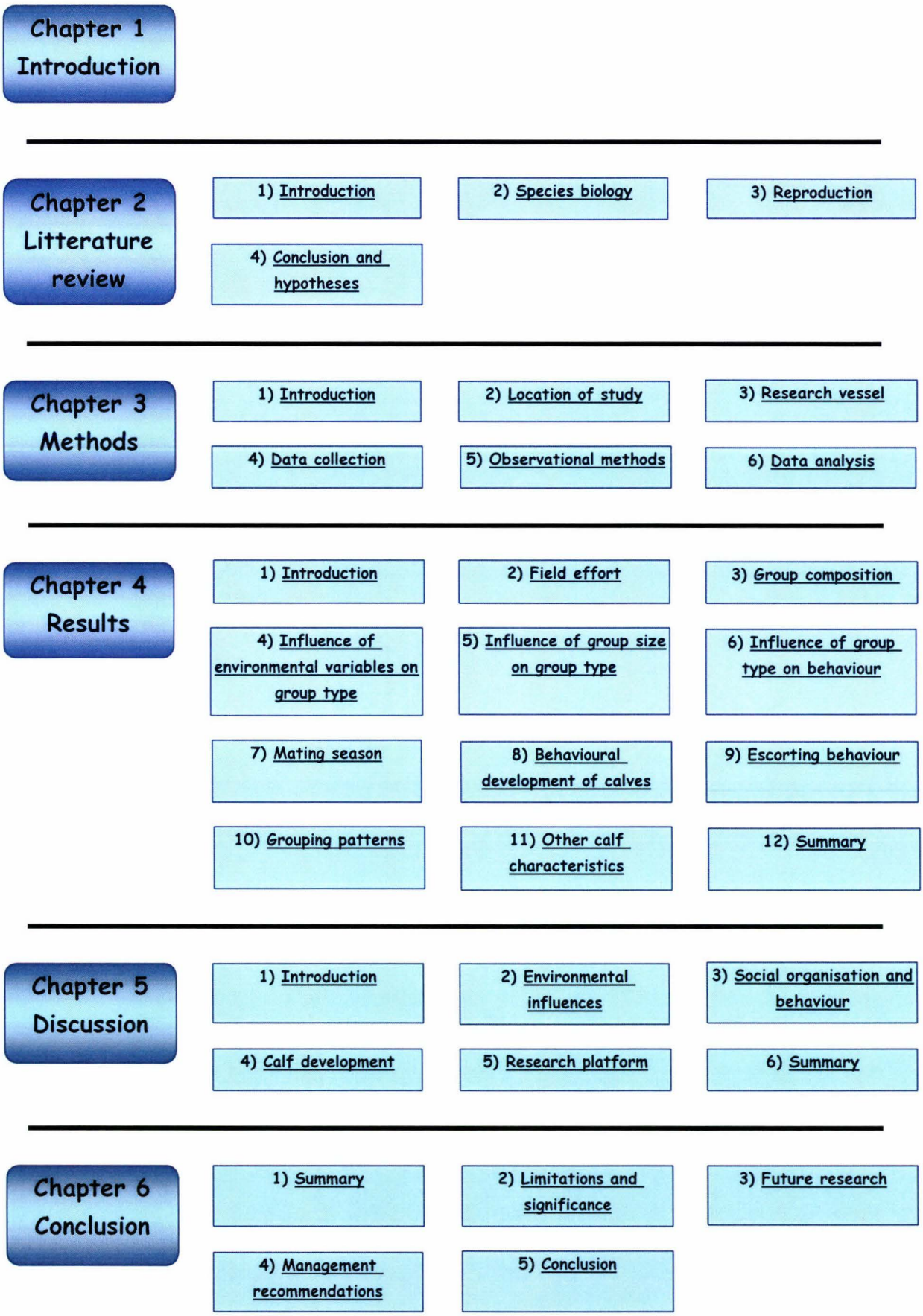

Figure1. Thesis structure diagram