

Identifying sexually mature, male short-beaked common dolphins (*Delphinus delphis*) at sea, based on the presence of a postanal hump

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Abstract

For detailed studies on the behaviour and social organization of a species, it is important to distinguish males and females. Many delphinid species show little sexual dimorphism. However, in mature male spinner dolphins, *Stenella longirostris* (Perrin & Gilpatrick, 1994) and Fraser's dolphins, *Lagenodelphis hosei* (Jefferson *et al.*, 1997), tissue between the anus and the flukes forms a so-called peduncle keel, or postanal hump. We discovered an analogous feature in free-ranging short-beaked common dolphins, *Delphinus delphis*, off the north-eastern coast of New Zealand's North Island. Genetic analysis of skin samples obtained from bow-riding individuals revealed that dolphins with a postanal hump were indeed always male. Observations of individuals with calves during focal-group follows, examinations of beached specimens, and comparisons with published photographs (Heyning & Perrin, 1994) all supported this hypothesis. Therefore, we believe that the presence of a postanal hump is a secondary sexually dimorphic character in short-beaked common dolphins, only occurring in mature males. This is a valuable tool, which will help researchers to visually sex a number of individuals at sea, thus providing a much more detailed picture of common dolphin behavioural ecology and social organization. Application of this method during focal-group observations revealed that mixed-sex groups were prevalent, but that segregation of the sexes does occur in short-beaked common dolphins during the formation of nursery groups and bachelor groups, respectively.

Key words: short-beaked common dolphin, *Delphinus delphis*, sexual dimorphism, gender identification, peduncle keel, postanal hump, social organization, behavioural ecology, group formation, segregation of sexes

Introduction

To fully comprehend the behaviour and social organization of a species, it is necessary to distinguish males and females. Long-term studies of bottlenose dolphins (*Tursiops truncatus*, *T. aduncus*), which tracked focal individuals of known sex, revealed sexual segregation of mature males from females (Wells, 1991), the formation of male coalitions (Wells, 1991; Connor *et al.*, 1992), and differences in the activity budgets of males and females (Waples *et al.*, 1998). Many delphinid species show little sexual dimorphism, which makes it exceedingly difficult to sex individuals at sea. For many species, the only individuals that can be sexed without capture are those that are consistently accompanied by a calf and thus presumed to be female.

One of the species which is subject to these difficulties is the short-beaked common dolphin, *Delphinus delphis*. To date, no study has successfully investigated the gender composition of groups of free-ranging common dolphins. Their mating strategies, and possible sexual differences in activity budget or habitat use, remain largely unknown. We present here a new method which allows researchers to reliably identify sexually mature male short-beaked common dolphins at sea. This is a valuable tool, which will help provide a much more detailed picture of common dolphin behavioural ecology and social organization.

Materials and Methods

Over the course of a 3-year study, from December 1998 to April 2001 (with the exception of the winter months May–August each year), observations on the behaviour and ecology of short-beaked common dolphins were conducted in the greater Mercury Bay area, based from Whitianga (36°50' South, 175°42' East), on the eastern coast of

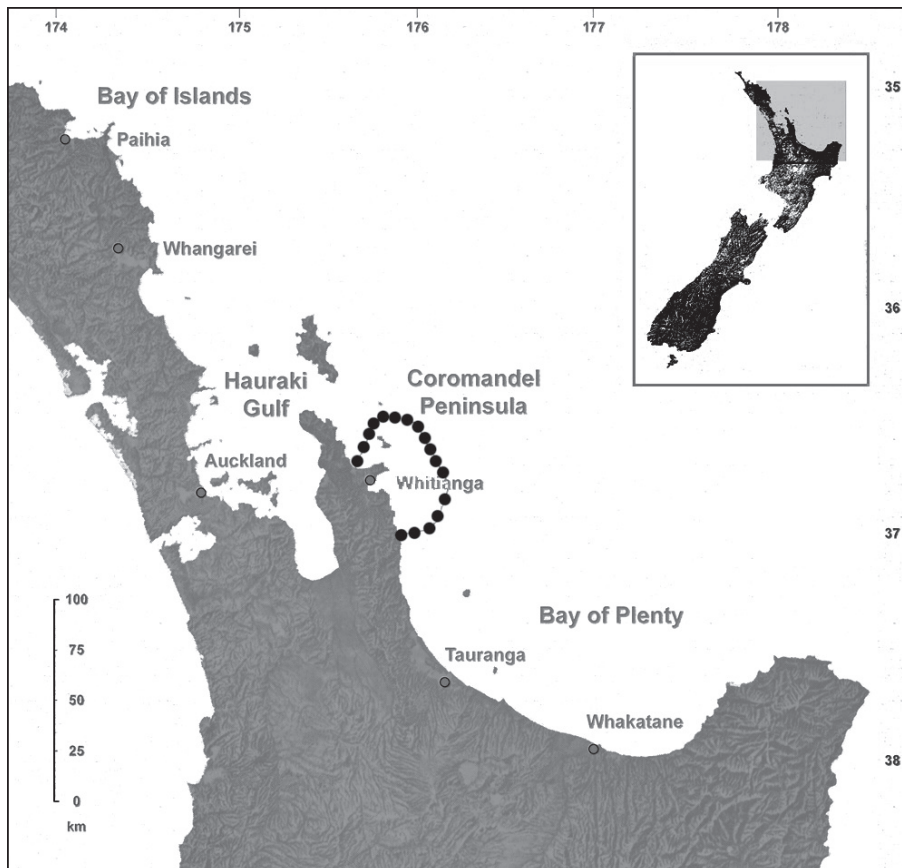


Figure 1. Map of north-eastern New Zealand. Study area indicated by dotted black line.

Coromandel Peninsula, North Island, New Zealand (Fig. 1). The research vessel, *Aihe*, a 5.5 m centre-console, rigid-hull inflatable boat with a 90 hp outboard engine, served as an observation platform. Field effort at sea was 640 h, 118 h of which were spent observing a total of 105 focal groups, with an average of 57.3 (SD=51.3, range=3 to 400) individuals present in each group.

During the second half of the third and final field season (2000/2001), exfoliated skin was collected from nine bow-riding common dolphins, in an attempt to genetically determine the gender of these individuals from DNA isolated from these skin samples. Samples were obtained by using a slightly modified skin-swabbing technique used successfully for genetic sampling of dusky dolphins, *Lagenorhynchus obscurus* (Harlin *et al.*, 1999). A piece of the 'soft' part of velcro was glued to the tip of a 1.5-m wooden broomstick. A 5-cm piece of the 'hard' part of velcro was folded back onto itself, so that one side stuck to the soft velcro on the broomstick, while the other faced outward. Latex gloves

were worn while handling velcro to avoid contamination. This apparatus was then scraped firmly across the backs of bow-riding dolphins. When pieces of skin remained attached to the hard velcro, these were transferred immediately to a Falcon tube containing 70% ethanol, for preservation. DNA was then extracted from these samples using a Simple Chelex Extraction Method, followed by Polymerase Chain Reaction using x-y-related primers (Gilson *et al.*, 1998). The DNA analysis was carried out blindly, i.e. K. Russell analysed numbered samples, without knowing which samples came from dolphins with a postanal hump.

Results

Evidence for sexual dimorphism in common dolphins
To test whether common dolphin individuals with a postanal hump were indeed always male, DNA-samples were collected from individuals in the wild. The presence or absence of a postanal hump in these animals was determined visually during



Figure 2. The adult dolphins on the left (presumed males) feature a prominent postanal hump, while the adult dolphin on the right (presumed female) does not.

sampling (Fig. 2). DNA was successfully extracted from the skin of nine individuals sampled by skin-swabbing. Genetic techniques can identify the gender of a sampled individual through distinct banding patterns on an electrophoresis gel (Fig. 3); one of the bands (the lower one) relates to the Y-chromosome, the other band is a control band indicating that PCR was successful. Only male dolphins carry a Y-chromosome. This analysis revealed that all dolphins with a postanal hump were indeed male (Table 1).

The success rate of obtaining visible pieces of skin on the velcro pads was *ca.* 20%. The reason for this lies more in the difficulty of applying sustained, firm pressure onto the back of a fast-moving dolphin, than in the skin-capturing properties of the velcro. All sampled dolphins showed an immediate response to being scratched with the broomstick. They accelerated, dove, and/or veered-off to the side, leaving the bow-wave. When multiple dolphins were bow-riding during sampling, all of them left the bow-wave, showing a coordinated flight response, even though only one group member had physically been touched. Eight of the sampled animals returned to bow-ride, within 30–90 s after being scratched, while one remained visible in the focal group at a distance of 5–10 m from the boat, but did not return to the bow-wave. No scratch marks resulting from the velcro were obvious on any of the sampled animals.

Unfortunately, the difficulties associated with skin-sampling live dolphins in their natural habitat left us with a small DNA-sample size ($n=9$).

However, our focal group observations ($n=105$) supported the hypothesis that the postanal hump in short-beaked common dolphins is a secondary sexual character only occurring in males because:

- (1) dolphins with postanal humps were never accompanied by calves,
- (2) dolphins that were consistently accompanied by calves (i.e., presumed females) never showed a postanal hump,
- (3) calves and juveniles never had a postanal hump,
- (4) an adult common dolphin found dead on 29 December 2000 in the Whitianga Estuary had a postanal hump, and direct examination revealed that it was a male, and
- (5) photographs taken by P. Duignan during necropsies of stranded individuals in New Zealand indicated that a postanal hump was present in the only adult male examined, while it was absent in subadults and females (Fig. 4).

Applying the visual sexing method to identify gender composition of groups

After the above results suggested that mature male short-beaked common dolphins could be identified based on the presence of a postanal hump, we applied this method of visual sexing during focal-group observations. While the sex ratio of a group could not be determined exactly, the existence of three distinct types of short-beaked common dolphin groups became evident:

Nursery groups—These groups contained adults and juveniles without postanal humps, and a large

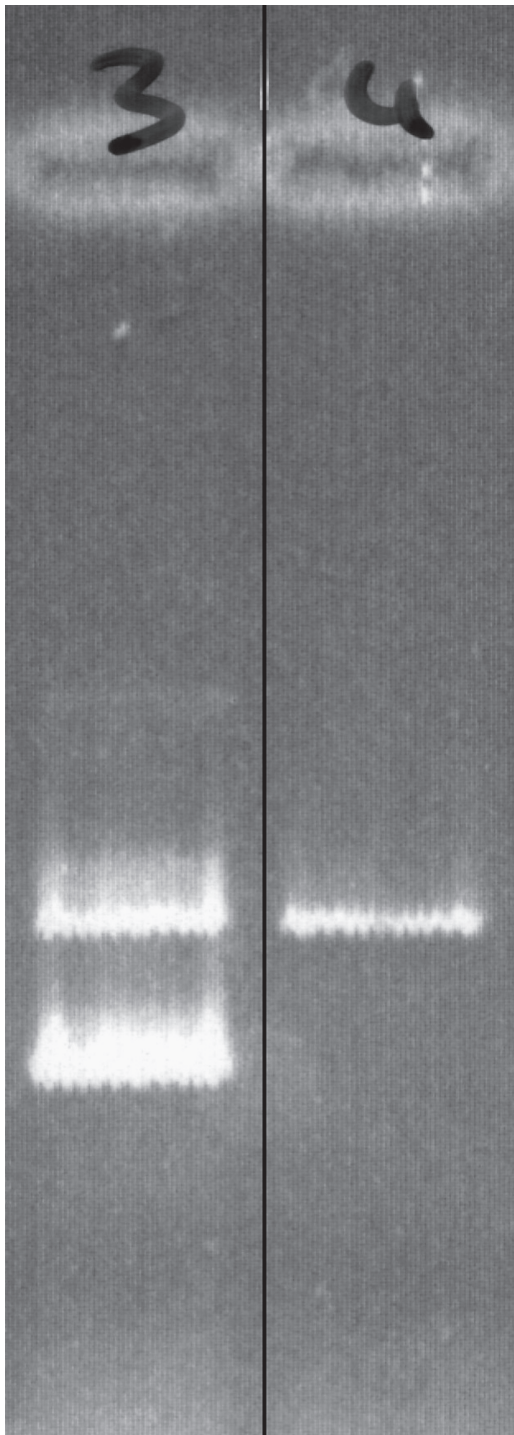


Figure 3. Genetic banding pattern on an electrophoresis gel, from a male (left, number 3) and a female (right, number 4). Note the additional band displayed for the male, which indicates the presence of a Y-chromosome.

Table 1. Presence or absence of a postanal hump in skin-swabbed common dolphins and the results of the genetic sexing of these individuals.

Sample number	Postanal hump	Genetic results for sex
1	yes	male
2	yes	male
3	yes	male
4	no	female
5	no, juvenile size	male
6	no	female
7	no	female
8	no, observed with calf	female
9	no	female

proportion (20–50%) of calves. They never included mature males. At least four sightings fell into this category. Group sizes for these ranged between five and 20 individuals.

Mixed groups—The vast majority of sightings included juveniles, adult females, and their calves, and at least some mature males. Group sizes ranged from three to 400 dolphins.

Male bachelor groups—These groups consisted exclusively of mature males, all sporting a postanal hump. At least two such groups were observed during this study. They contained nine and 15 individuals, respectively. The inter-individual distances in both of these groups were conspicuously small. During both follows the group spread never exceeded 20 m. Within some mixed groups, mature males also were spotted traveling in tight formation with each other (3–5 individuals, separated by no more than 1 m from their nearest neighbour). Future research may determine whether this is consistently the case, and if such associations, in fact, represent long-term coalitions.

These results admittedly only present a very coarse picture of short-beaked common dolphin group structure. One limitation is that the presence or absence of individuals with a postanal hump could not be reliably determined for groups that included animals at a distance of >100 m from the research vessel.

Discussion

Common dolphins are generally accepted to show little sexual dimorphism. Evans (1994) described sexually dimorphic differences in the coloration of the area adjacent to the genitals for common dolphins from the north-eastern Pacific. This 'genital blaze' was only apparent in a handful of individuals seen in this study and could not be used

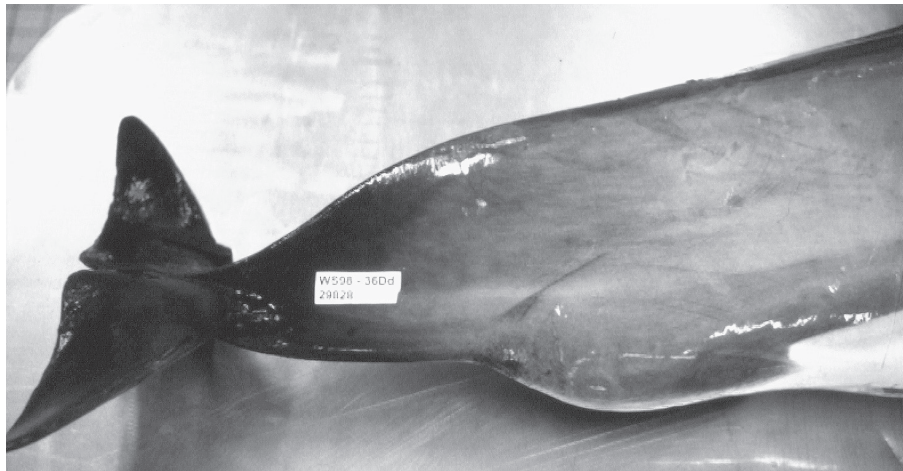


Figure 4. Close-up of the postanal hump of a mature male common dolphin (beached specimen; collection number W 398–36 Dd 29020, P. Duignan, Massey University).

as a reliable characteristic to distinguish males and females. However, we observed some individuals that showed a clearly pronounced ventral peduncle keel, or postanal hump (Figs. 2 and 4). This feature was previously described for spinner dolphins, *Stenella longirostris* (Norris *et al.*, 1994; Perrin & Gilpatrick, 1994), Fraser's dolphins, *Lagenodelphis hosei* (Jefferson *et al.*, 1997), and Dall's porpoises, *Phocoenoides dalli* (Jefferson, 1990). In these species, the postanal hump is a secondary sexually dimorphic character that is highly exaggerated in mature males. This is well illustrated for spinner dolphins by photographs in Perrin (1972).

Photographs of dead common dolphins of known sex, published in Heyning & Perrin (1994, pp. 8–9) clearly show a postanal hump in all adult males, while it is absent in the adult females. These pictures also illustrate that a postanal hump is present in both the short-beaked (*Delphinus delphis*) and the long-beaked (*D. capensis*) common dolphin species.

The function of the postanal hump is not fully understood. For spinner dolphins, Norris *et al.* (1994) hypothesized it could play a role in mimicking the S-posture used as a threat display by some reef shark species (p. 279): 'What engaged our attention was that these humps are placed in exactly the same location as the claspers of adult male sharks'. While there is some evidence for mimicry of shark behaviour among spinner dolphins, this does not sufficiently explain the postanal hump's anatomical existence. Norris *et al.*'s (1994) hypothesis does not explain, why the postanal hump would be much more exaggerated in eastern Pacific spinner dolphins, than in Hawaiian spinner dolphins. It also

fails to address the fact that Dall's porpoises show a postanal hump, while they are very unlikely to encounter any S-posturing reef sharks inside their distributional range. It is much more likely, that this is a character that allows female dolphins to assess the virility of potential mating partners. It could also be a visual signal in establishing dominance hierarchies among males. Agonistic and affiliative displays that may be involved in courtship and competition for mates have been described for bottlenose dolphins (Connor *et al.*, 2000). The presence of the postanal hump may play a part in such displays, as a visual cue.

In both Dall's porpoises (Jefferson, 1990) and spinner dolphins (Perrin & Gilpatrick, 1994), the development of the postanal hump in mature males is accompanied by a forward canting of the dorsal fin. This did not appear to be the case for short-beaked common dolphins, although individuals with postanal humps did consistently have very tall, triangular dorsal fins with a remarkably straight trailing edge. This is analogous to the findings of Jefferson *et al.* (1997) for Fraser's dolphins. However, such tall, straight dorsal fins also were observed on presumed females without postanal humps, which were closely accompanied by calves (this study). Therefore, the two features do not appear to be directly correlated in short-beaked common dolphins. The 'straightening' of dorsal fins could be a function of increasing age in both sexes, as straight fins were never observed on animals that were less than mature size (this study). Future research could test this hypothesis by correlating dorsal fin shape with the number of dentinal growth layers in the same individual.

Considering that our hypothesis is supported by findings from focal-group observations, genetic sexing, direct examination of beached specimens, and previously published photographs (Heyning & Perrin, 1994), we are satisfied that the presence of a postanal hump can be used as a means of identifying sexually mature male short-beaked common dolphins in the field (see Fig. 2). This is a valuable tool, which will allow researchers to create a more complete picture of common dolphin social structure. Not only does it allow for the determination of the gender of another set of individuals in the group (besides presumed females accompanied by calves), it also provides information on their reproductive status (i.e., sexually mature).

A preliminary assessment of the gender composition of short-beaked common dolphin groups using the postanal hump as a visual tool was carried out (this study). A large number of mixed-sex groups were observed, but also a division of the sexes into nursery (adult females and calves only) and bachelor (adult males only) groups. These three categories broadly correspond to the results of Wells (1991) and (Connor *et al.*, 2000) for bottlenose dolphins:

- (1) females were often associated with other females and their calves (nursery groups),
- (2) mixed-sex groups were observed, but their formation was generally restricted to the duration of a specific purpose (e.g., feeding, mating). Subadults of both sexes were more frequently associated with each other than adults. Bottlenose dolphins sometimes formed groups that were composed exclusively of subadults. Such groups were not apparent among the short-beaked common dolphins in this study, and
- (3) all-male groups occurred, and the individual members consistently associated with each other for years, in so-called male alliances. These alliances usually consisted of only two or three individuals. The all-male, short-beaked common dolphin groups were larger, which may be a function of the generally larger group sizes in this species, compared to coastal bottlenose dolphins.

Further study of these grouping patterns, and of other issues relating to gender differences, in short-beaked common dolphins should be facilitated by the method of visually establishing the gender of mature males, presented here. We encourage researchers in other locations to test if our findings also apply to common dolphin populations elsewhere. Furthermore, visual sexing based on the presence of a postanal hump may also be feasible in other species. Genetic techniques may help establish whether or not it can be used as a reliable diagnostic character.

Acknowledgments

A sampling permit is required for the genetic sampling of cetaceans in New Zealand waters. This was granted by the Department of Conservation Hauraki Conservancy in March 2001. Thank you to J. Roxburgh for his help in this process. We thank Ngati Hei and Ngati Tamatera for approving the research proposal. Thanks is given to the great number of colleagues who provided helpful advice regarding sexual dimorphism in delphinids via the Marmam Internet newsgroup. T. Jefferson, J. Thomas, and an anonymous reviewer provided helpful suggestions for improving this manuscript. This study would not have been possible without the help of our volunteer research assistants who were (in chronological order): Trine Baier Jepsen, Colleen Clancy, Paul Grant, Sandra Winterbacher, Jo Moore, Jodie Holloway, Birgit Klumpp, Christiane Knappmeyer, Tina Jacoby, Nikki Guttridge, Lindsey Turner, Karen Stockin, Chris Smith Vangsgaard, Aline Schaffar, Daphne Bühler, Patrice Irvine, Stefanie Werner, Fabiana Mourao, Deanna Hill, Miriam Brandt, and Johanna Hiscock. This research was funded by: Massey University College of Business research grant, Massey University Research Equipment Fund, Massey University Research Fund, Graduate Research Fund (Department of Management and International Business, Massey University), WADAP (Whale and Dolphin Adoption Project), and the Department of Conservation Science Investigation Programme. Additional financial support was provided by Konrad Kohlhammer.

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