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The status of common dolphins (*Delphinus delphis*) within New Zealand waters

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ABSTRACT

New Zealand common dolphins (*Delphinus delphis*) are subject to a range of human-induced threats including fisheries bycatch and tourism impacts. Common dolphins are incidentally captured in the trawl fishery for jack mackerel (*Trachurus* spp) and appear susceptible to entanglement within coastal set nets. Pollutant burdens and tourism impacts reported for New Zealand population appear in line with those previously reported for coastal conspecifics such as the bottlenose dolphin (*Tursiops truncatus*). Despite this, common dolphins remain the most poorly understood delphinid within New Zealand waters. Until recently, majority of the information relating to their identity, abundance and ecology had relied upon untested assumptions. This lack of empirical data has historically resulted in the inadequate recognition of this species. To date, common dolphins remain the only resident cetacean within New Zealand to lack a species-specific Marine Mammal Action Plan. This is of concern, since fundamental data necessary to assess their status and stability remain unknown for the New Zealand population. Limited insights offered by strandings and opportunistic sightings data suggest the coastal distribution of New Zealand *Delphinus* may, at least in part, offer some explanation as to why common dolphins within these waters appear vulnerable to human-induced impacts. Furthermore, small pod sizes reported during vessel and aerial surveys indicate that the New Zealand population may not be as large or robust as previously assumed.

KEY WORDS: TAXONOMY, FEEDING, SHORT-TERM CHANGE, SITE FIDELITY, POLLUTION, INCIDENTAL CAPTURE, CONSERVATION, AUSTRALASIA

INTRODUCTION

Common dolphins (*Delphinus delphis*) are one of six cetacean species regularly targeted by commercial marine mammal tour operations in New Zealand waters (Suisted and Neale 2004). However, despite their apparent commercial value, they remain the most poorly understood delphinid resident within New Zealand waters, with baseline data relating to taxonomy, abundance and reproductive biology all at best, limited. Nonetheless, human-induced impacts known to affect this population include tourism and fisheries bycatch (Stockin 2008). The majority of available data detailing New Zealand common dolphins have resulted from independent post graduate studies conducted over the past decade under the auspices of Massey University, New Zealand (e.g. Neumann 2001a; Leitenberger 2002; Schaffar-Delaney 2004; Burgess 2006; Stockin 2008). Such studies have resulted in the culmination of a long-term research programme, referred to herein as the New Zealand Common Dolphin Project (NZCDP). We examine the available literature and unpublished datasets to provide an overview of the current status and understanding of the New Zealand common dolphin population.

CURRENT KNOWLEDGE

Taxonomy and population structure

To date, two species of common dolphin are recognised worldwide: (1) the short-beaked (*Delphinus delphis*) and (2) the long-beaked (*D. capensis*) common dolphin, with a subspecies of the long-beaked (*D. capensis tropicalis*) acknowledged (Jefferson & Van Waerebeek, 2002). Heyning & Perrin (1994) did not include New Zealand or Australia in the known range of the long-beaked common dolphin; they found no information nor morphological data that would indicate the species was present. Rice's (1998) statement that specimen(s) of long-beaked common dolphin have been identified from New Zealand was apparently based on an inaccurate citation of Heyning & Perrin (1994) (D. W. Rice, pers. comm., and W. F. Perrin, pers. comm.). Some putative evidence of *D. capensis* in New Zealand waters was provided by Bernal et al. (2003) who suggested that common dolphins exhibiting long rostra, as photographed in New Zealand by Doak (1989; Plates 34A, 34B), are long-beaked common dolphins. However, as Amaha (1994) and Jefferson & Van Waerebeek (2002) highlighted, neither New Zealand nor Australian common dolphins neatly fit the morphological description of either *D. delphis* or *D. capensis*. Currently, 50+ skulls recovered from the New Zealand population are being prepared for additional morphometric analyses (NZCDP, unpubl. data).

The taxonomic status of the New Zealand common dolphin was recently assessed using 92 samples analysed for 577 base pairs (bps) of the mtDNA control region (D-loop) (Stockin 2008; Stockin *et al.* in review). The New Zealand samples were subsequently compared with 177 published sequences (370bp) from eight different populations including short- and long-beak morphotypes (short-beaked: Eastern North Atlantic, Eastern Central Atlantic, Western North Atlantic, Mauritania, Argentina, and North Pacific; long-beaked: North Pacific and South Africa, Natoli *et al.* 2006). The New Zealand population revealed high genetic variability (gene diversity = 0.991, nucleotide diversity = 0.018). A total of 65 different haplotypes were identified, three of which were shared with other short-beaked populations (Eastern North Atlantic, Argentina and North Pacific) and a further three with long-beaked populations (North Pacific and South Africa). The New Zealand population showed significant genetic differentiation (F_{ST} analysis) when compared with all other populations except the short-beaked North Pacific population. The Φst analysis confirmed these results but also indicated no significant differentiation when compared to the Western North Atlantic population (Stockin *et al.* in review).

Rooted Neighbour-Joining (NJ) and Bayesian trees were reconstructed using all 152 haplotypes and a homologous sequence of a pantropical spotted dolphin (*Stenella attenuata*) used as an outgroup (LeDuc *et al.* 1999). Although the Bayesian tree identified more lineages than the NJ tree, neither of those resolved any clustering consistent with geographical origins. Although not significant, the Tajima's D value was high (D = -1.234, p = 0.077) and the Fu's Fs was highly significant (f = -24.28, p = 0.000) indicating population expansion. The mismatch distribution analysis supported these results showing an unimodal distribution (Stockin *et al.* in review).

Intrapopulation structure within New Zealand waters was examined by comparison of three putative populations; coastal, Hauraki Gulf and oceanic. Shared haplotypes among putative populations were rare. The F_{ST} analysis indicated significant genetic differentiation between Hauraki Gulf individuals and the other putative populations, but not between coastal and oceanic groups (Stockin 2008). Within the Hauraki Gulf, a large shallow body of water on the northeastern coastline of the North Island (Figure 1), common dolphins occur year-round (Stockin *et al.* 2008a) and exhibit a higher degree of site fidelity compared with neighbouring waters (Neumann *et al.* 2002). These results suggest that differences in habitat choice and site fidelity may play a role in shaping the population structure of New Zealand common dolphins. However, the constraints of mtDNA and the need to apply nuclear markers prevent further discussion of population structure.

Numbers and population trends

Currently there are no abundance estimates available for New Zealand common dolphins, although a population analysis is underway for Hauraki Gulf waters, using a photo-identification catalogue comprising 600 marked individuals (NZCDP unpubl. data). Previous photo-identification undertaken in the Bay of Plenty (Figure 1) resulted in a catalogue of 408 distinguishable individuals (Neumann *et al.* 2002). A cross comparison of these catalogues is currently in progress. Thus, insight into population size has primarily been derived from sightings data collected during vessel and aerial surveys. While dedicated vessel surveys in the Hauraki Gulf (Stockin 2008) and Bay of Plenty (Neumann 2001a) have been conducted, all aerial and other vessel surveys undertaken elsewhere around the New Zealand coastline have focused on alternative species e.g. Hector's dolphin (*Cephalorhynchus hectori hectori*), Maui's dolphin (*C. h. maui*) and humpback whale (*Megaptera novaeangliae*). As such, *Delphinus* data collected as part of these surveys represent opportunistic sightings only. Aerial surveys conducted off west coast North Island (DoC unpubl. data), west coast South Island (Rayment *et al.* unpubl. data), east coast

South Island (Dawson *et al.* unpubl. data) and over the Hauraki Gulf (Behrens and Constantine unpubl. data) ranged from 1 to 150 animals (mean = 13.6, SD = 20.6). Groups containing 50+ animals (n = 4) were infrequent except in Cook Strait (Figure 1) where large aggregations comprising 30 to 200+ animals were reported (Childerhouse and Bott unpubl. data). Unfortunately, not all common dolphin groups encountered during these humpback whale surveys were recorded (Nadine Bott, pers. comm) so no further discussion about the significance of this is possible.

Distribution and demographics

Common dolphins reportedly occur around most of North Island, New Zealand, although exhibit a more limited distribution off the South Island (Gaskin 1968). Sightings and strandings data suggest their occurrence is most concentrated along the north eastern coast of the North Island (Figure 2), although small groups of *Delphinus* are regularly observed off Wellington Harbour (Gaskin 1968; Figure 1). Larger aggregations of common dolphins reported in Cook Strait (Figure 1) during the austral winter months (Childerhouse and Bott unpubl. data) may occur as a result of seasonal localised temperature anomalies (Gaskin 1968). Generally, common dolphins around the New Zealand coast exhibit a seasonal distribution, often closer to shore during the austral summer months (Neumann 2001b; Stockin *et al.* 2008a). The exception is the Bay of Islands (Figure 1), where common dolphins reportedly occur in shallower waters during late autumn, moving into deeper waters during the summer (Constantine 1995). In the northwestern Bay of Plenty, *Delphinus* moved a mean distance of 9.2km (SD = 4.42) from shore in spring and summer to a mean distance of 20.2km (SD = 3.86) during autumn, an offshore-shift correlated with SST (Neumann 2001b). During warmer *La Nina* conditions, the mean distance common dolphin groups were recorded from shore was further reduced to only 6.2km (SD = 2.56) (Neumann 2001b). In the Hauraki Gulf, common dolphin occurrence was significantly affected by month, latitude and depth (Stockin *et al.* 2008a). In this region, dolphins occur year-round, although typically observed closer to shore during the summer months (Stockin *et al.* 2008a). Group size varies significantly by season, depth and latitude and is highly skewed towards smaller groups (<50 animals) (Stockin *et al.* 2008a). Larger aggregations (>50 animals) were most frequent during the austral winter when nutrient upwelling leads to increased prey availability within the region (Stockin *et al.* 2008a). Over 70% of groups encountered by Stockin *et al.* (2008a) contained immature animals, with 25% of groups including neonates. Calves were observed throughout the year but were most prevalent in the austral summer months of December and January. The year-round occurrence and social organisation of common dolphins in Hauraki Gulf waters suggest this region may be important as a nursery and potential calving area (Schaffar-Delaney 2004; Stockin *et al.* 2008a).

Associated Species

Common dolphins have been observed in association with seven cetacean and ten avian species around New Zealand (Table 1). In the Bay of Islands, Bay of Plenty and Hauraki Gulf, common dolphins were most frequently associated with the Australasian gannet (*Morus serrator*). In the Hauraki Gulf, *Delphinus* were observed in association with four cetacean and eight avian species (Table 1), although most frequently with the Bryde's whale (*Balaenoptera brydei*) and Australasian gannet (Stockin *et al.* 2008a; Stockin *et al.* 2009). In the Bay of Plenty, common dolphins were recorded to feed and travel in association with the Australasian gannet, Bryde's whale and on occasion, minke (*B. acutorostrata*) and sei (*B. borealis*) whales. Off the South Island, most mixed species groups involving common dolphins have typically included the dusky dolphin (*Lagenorhynchus obscurus*) (Markowitz 2004; Merriman 2007).

Behaviour and ecology

Using activity budgets, Neumann (2001c) revealed travel and mill as the primary behaviours of common dolphins observed in the northwestern Bay of Plenty, accounting for 54.8% and 20.5%, respectively. Seasonal and diurnal patterns in the behavioural pattern of common dolphins were also recorded in this region (Neumann 2001c). In a replica study, marked differences in the activity budget of dolphins examined in the Hauraki Gulf were evident, with forage and travel accounting for 46.6% and 28.9%, respectively (Stockin *et al.* 2009). In this region, 100km east of the Bay of Plenty, behaviour varied seasonally, with foraging groups most prevalent in spring and resting behaviour most frequently observed during the autumn. Behaviour also varied with water depth, with foraging and resting groups observed in the deepest and shallowest regions of the Hauraki Gulf, respectively (Stockin *et al.* 2008a). A correlation between group size and behaviour was evident, although behaviour did not vary with the composition of dolphin groups (Stockin *et* *al.* 2009). Foraging behaviour was prevalent in both small and large group sizes, suggesting foraging plasticity exists within this population. Behaviour differed between single- and multi-species groups, with foraging more frequent in mixed-species groups involving Bryde's whales. Resting, milling or socialising groups were rarely observed in the presence of any associated species, indicating the primary mechanism for association is prey-related (Stockin *et al.* 2009).

During a study of foraging strategies in the northwestern Bay of Plenty, Neumann and Orams (2003) described high-speed pursuits (n = 19), fish whacking (n = 1), and kerplunking (n = 2) as feeding methods employed by individual common dolphins. Cooperative feeding strategies described by Neumann and Orams (2003) for Bay of Plenty groups include carouseling (n = 26), line abreast (n = 7), and wall formation (n = 1). A replica study in the Hauraki Gulf revealed high speed pursuits (n = 29) and kerplunking (n = 15) as the only foraging strategies used by individual common dolphins (Burgess 2006). Meanwhile, groups in the gulf were found to engage in synchronous diving (n = 50), line abreast (n = 28), carouselling (n = 26) and wall formation (n = 4). Results of these independent studies suggest differences in prey distribution and productivity, possibly as a result of habitat differences (i.e. shallow enclosed gulf *vs* open ocean) may affect strategy selection.

Diet

Qualitative insights into the diet of New Zealand common dolphins were first offered by Neumann and Orams (2003), using underwater video footage taken during feeding activities in the Bay of Plenty. As a result, kahawai (*Arripis trutta*), jack mackerel (*Trachurus* spp.), yellow-eyed mullet (*Aldrichetta forsteri*), flying fish (*Cypselurus cineatus*), parore (*Girella tricuspidata*) and garfish (*Hyporamphus ihi*) were identified as potential prey items. A more recent diet analysis based on 53 common dolphins collected from around the North Island provided the first quantitative dietary assessment for the New Zealand population (Meynier *et al.* 2008). Stomach contents derived from 42 stranded and 11 commercially bycaught carcasses collected between 1997 and 2006 were examined. Although the diet of bycaught and stranded individuals comprised a diverse range of fish and cephalopod species, the most prevalent prey identified included arrow squid (*Nototodarus* spp.), jack mackerel and anchovy (*Engraulis australis*). Stranded animals and those bycaught within neritic waters, fed on both neritic and oceanic prey. Moreover, this mixed prey composition was evident in the diet of common dolphins bycaught in oceanic waters, suggesting likely inshore/offshore movements over a diel basis (Meynier *et al.* 2008). Prey differences were also evident in the stomach content of carcasses recovered from the Hauraki Gulf. However, small sample sizes and the inclusion of several individuals from a single stranding event, likely affected the results obtained from this region.

Biology and life history

Currently no published data are available to describe growth and reproductive biology of the New Zealand population. However, teeth, ovaries and testes recovered from beach cast and bycaught carcasses are currently being processed for subsequent life history analyses (NZCDP, unpubl. data). As such, basic biological parameters including age at sexual maturity and calving interval will be available for this population shortly. Within the Bay of Islands, 43% of observed common dolphin groups (n = 24) involved mother-calf pairs (Constantine 1995). While calves are observed in the Hauraki Gulf year-round, the occurrence (Stockin *et al.* 2008a) and frequency (Schaffar-Delaney 2004) of newborns suggests peak calving is likely to occur during late spring to summer. This is concurs with data from the Bay of Islands (Constantine 1995) and the Bay of Plenty (Neumann 2001a).

Strandings

Between 1950 and 2008, 749 common dolphins stranded or were found beach cast along the New Zealand coastline (Figure 2), comprising 205 females, 207 males and 337 individuals of unknown sex (National Strandings Database 2009). Total body length ranged from 80 to 240cm, 91 to 233cm and 83 and 240cm for males, females and unsexed individuals, respectively (Figure 3). Strandings were recorded in all months (Figure 4), although seasonal variations were evident, with 29.8% (n = 223) of strandings occurring during the austral summer (December to February), compared with 14% (n = 105) during autumn (March to May). December was the overall peak month for strandings (14.4%, n = 108). Between 1998 and 2008, 133 carcasses were recovered from standings and beach cast events (Stockin et al. in review) Of these, 96 underwent post-mortem examinations by veterinarians and researchers at Massey University, in which likely cause of death could be ascertained for 87% (n = 85, Figure 6).

THREATS AND IMPACTS

Fisheries bycatch

Between 1998 and 2008, 115 common dolphins were reported as incidental bycatch within New Zealand commercial fisheries (Ministry of Fisheries (MFish) unpubl. data). An additional 24 unidentified dolphins, likely representing *Delphinus*, were also reported by MFish observers during the same period. Of the confirmed dolphins bycatch reported, 86% (n = 99) occurred within the commercial trawl fishery for jack mackerel (JMA), which includes species *T. declivis, T. s. murphyi* and *T. novaezelandiae*. Observer effort within the JMA fishery ranged from 5 to 40% during 1998 to 2008 (Figure 5). The remaining 14% of common dolphins were incidentally captured by vessels targeting hoki (*Macruronus novaezelandiae*), skipjack tuna (*Katsuwonus pelamis*), barracouta (*Thyrsites atun*), snapper (*Pagrus auratus*) and trevally (*Pseudocaranx dentex*).

Crude extrapolations based on the number of reported common dolphins and observer effort within the JMA fishery suggests *ca* 600 common dolphins may have been lost from the New Zealand population between 1998 and 2008. Furthermore, of the beach cast carcasses examined by Massey University during the same period, a further 28% of individuals (n = 24) exhibited trauma and lesions indicative of net entanglement (Figure 6, Stockin *et al.* in review). The latest bycatch data indicate nine common dolphins were incidentally killed during the January/February 2009 observer programme (MFish unpubl. data). During this period, extensive observer coverage was applied to quantify the extent of *Cephalorhynchus*-fisheries interactions (MFish unpubl. data). These latest data highlight the need for a rigorous assessment of *Delphinus* bycatch, since crude extrapolations detailed herein are not sufficient to appropriately assess the true extent of common dolphin mortality within the New Zealand JMA fishery.

Tourism

Common dolphins are the focus of several commercial tours operating within the North Island, with at least 13 permits currently targeting *Delphinus* in the Bay of Islands, Hauraki Gulf and Bay of Plenty regions (DoC, unpubl. data). Consequently, a number of studies (refer to Table 2) have been undertaken to investigate potential impacts associated with both dolphin-watching and/or swim-with dolphin activities (e.g. Constantine 1995; Leitenberger 2002; Neumann and Orams 2006; Stockin *et al.* 2008b).

During a recent impact assessment in the Hauraki Gulf, foraging and resting bouts were significantly disrupted by boat interactions to a level that raises concern about the sustainability of this impact (Stockin *et al.* 2008b). Both the duration of bouts and the time spent in these two behavioural states decreased. Furthermore, foraging dolphins took significantly longer to return to their initial behavioural state in the presence of the tour boat (Stockin *et al.* 2008b). Common dolphins in this region exhibited an increased preference to shift behaviour to socialising or milling after tour boat interactions, typically at the expense of feeding and resting. Impacts identified in Stockin *et al.* (2008b) were similar to those previously reported (e.g. Lusseau 2003) for the bottlenose dolphin (*Tursiops truncatus*), a coastal species typically considered within New Zealand to be more susceptible to cumulative anthropogenic impacts.

Pollution

Trace elements, polychlorinated biphenyls (PCBs) and organochlorine (OC) pesticide levels were recently examined in tissues collected from stranded and bycaught common dolphins from New Zealand waters (Stockin *et al.* 2007). The concentrations of mercury (Hg), selenium (Se), chromium (Cr), zinc (Zn), nickel (Ni), cadmium (Cd), cobalt (Co), manganese (Mn), iron (Fe), copper (Cu), tin (Sn), lead (Pb), arsenic (As) and silver (Ag) were determined in blubber, liver and kidney tissue. PCBs (45 congeners) and a range of OC pesticides including dieldrin, hexachlorocyclohexane (HCH) and dichlorodiphenyltrichloroethane (DDT) and its metabolites DDE and DDD were determined in blubber samples. Cr and Ni were not detected in any of the samples and concentrations of Co, Sn and Pb were generally low. Concentrations of Hg ranged from 0.17 to 110mg/kg wet weight. Organochlorine pesticides dieldrin, hexachlorobenzene (HCB), *o,p'*-DDT and *p,p'*-DDE were present at the highest concentrations. Sum DDT concentrations in the blubber ranged from 17 to 337 and 654 to 4,430µg/kg wet weight in females and males, respectively. Similarly, Σ45CB concentrations ranged from 49 to 386 and 268 to 1,634µg/kg wet weight in females and males, respectively (Stockin *et al.* 2007). The mean transmission of ΣDDTs and International Council for the Exploration of the Sea seven chlorinated biphenyls congeners (ICES 7CBs) between a genetically determined mother-offspring pair was calculated at 46% and 42%, respectively. Concentrations of organochlorine pesticides determined in Stockin *et al.* (2007) were within similar range to those previously reported for Hector's and bottlenose dolphins from New Zealand waters (Jones *et al.* 1999).

MANAGEMENT

New Zealand Threat classification

According to the New Zealand threat classification system described by Molloy *et al.* (2002) and recently revised by Townsend *et al.* (2008), common dolphins are '*not threatened*' within New Zealand waters (Hitchmough *et al.* 2007). This designation is currently under review along with other marine mammal threat classifications categories. In the absence of robust scientific data, it would appear that the current classification is based upon anecdotal information relating to "*frequent sightings of this species at certain locations around New Zealand"* (Hitchmough pers. comm.). Of course, frequent sightings of a species within disjunct '*hotspot*' locations does not necessarily constitute a stabile population, a consideration recently raised by researchers during the convening of the New Zealand Threat Classification Panel in May 2009. In total, five written submissions provided by academics undertaking scientific investigations on *Delphinus* were forwarded to the panel, all of which unanimously supporting the reclassification of New Zealand common dolphin population as '*data deficient*'

Marine Mammal Action Plan 2005-2010

Despite being subject to a range of anthropogenic impacts (e.g. Stockin *et al.* 2007; 2008b), common dolphins remain the only resident cetacean in New Zealand waters to lack species-specific management objectives (Suisted and Neale 2004). Under the current DoC Marine Mammal Action Plan, common dolphins erroneously feature under section '2.16 *Other toothed cetaceans*', an extended appendix which details vagrant species such as rough-toothed dolphin (*Steno bredabensis*), spectacled porpoise (*Phocoena dioptrica*), Risso's dolphin (*Grampus griseus*), hourglass dolphin (*Lagenorhynchus cruciger*) and striped dolphin (*Stenella coeruleoalba*). Such vagrant species are by definition, rare and are not subject to commercial tourism or fisheries impacts within New Zealand waters. Nonetheless, Suisted and Neale (2004) state "*…there are generally few known conservation or management issues*" when referring to common dolphins.

Captivity

Marineland in Napier (Figure 1) is the only facility in New Zealand currently permitted to hold cetaceans in captivity. During its 44 years in operation, Marineland held a total of 41 common dolphins, including two stranded individuals, one captive-born and several captured individuals off the Hawkes Bay region (Figure 1). However, the recent death of their last remaining common dolphin (*Kelly*) and the impending expiration of the existing permit (July 2009) means it is unlikely that any further cetaceans in New Zealand will be held in captivity. To date, no application has been received to display cetaceans in the future, although Marineland still currently house other marine species including penguins and New Zealand fur seals (*Arctocephalus forsteri*). Bringing into, or breeding of cetaceans in captivity is not considered essential for the conservation management of any marine mammal species in New Zealand (Steve Smith, pers. comm.).

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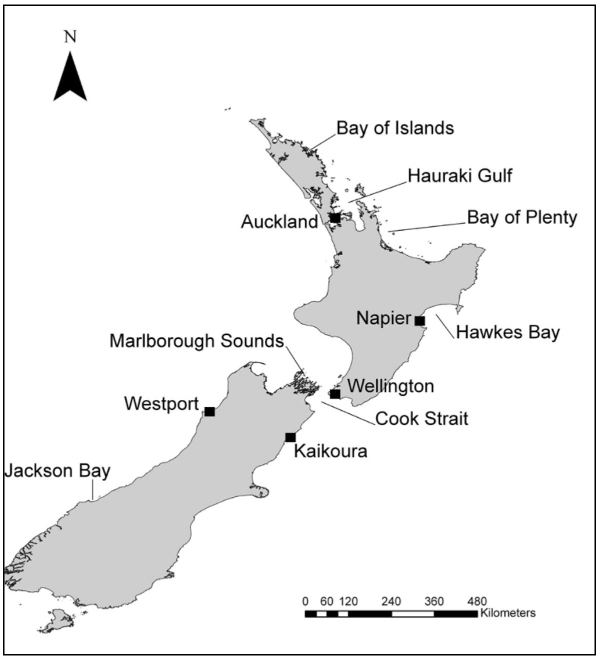

Figure 1 – Map of New Zealand showing locations referred to within the text.

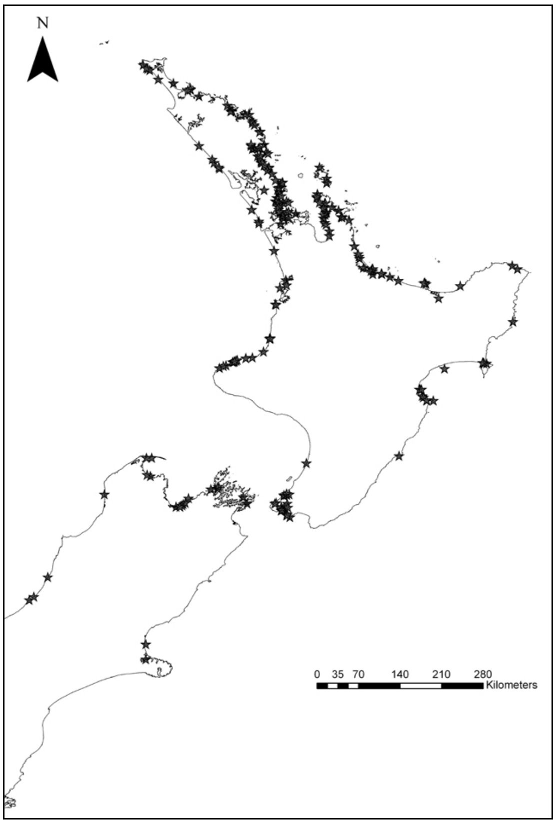

Figure 2 – Distribution of common dolphin strandings (n = 269) recorded between 1961 and 2003. Note each star refers to an independent stranding event and thus may represent a single or herd stranding.

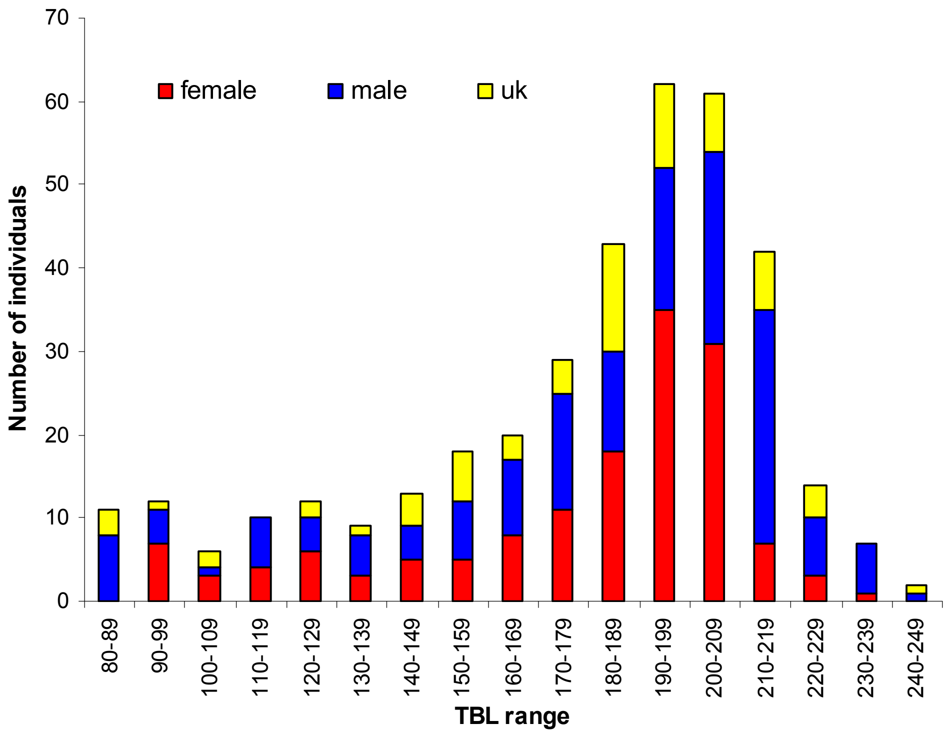

Figure 3 – Length frequency distribution for common dolphin (n = 749) stranded between 1950 and 2008, showing proportions of male, female and unsexed (uk) individuals.

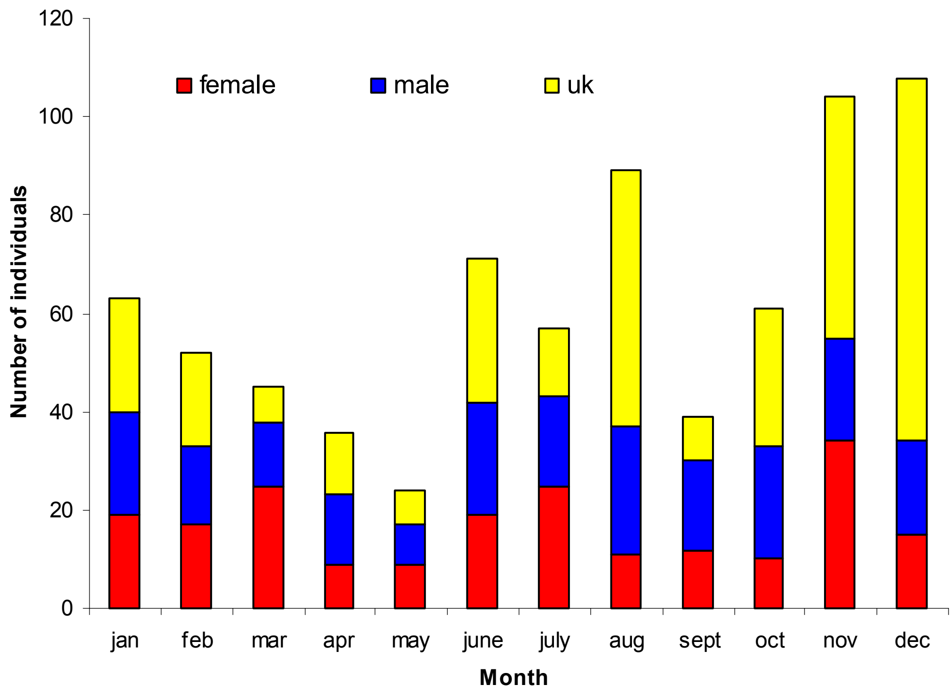

Figure 4 – Frequency distribution of common dolphin stranding (n=749) between 1950 and 2008, showing proportions of male, female and unsexed (uk) individuals.

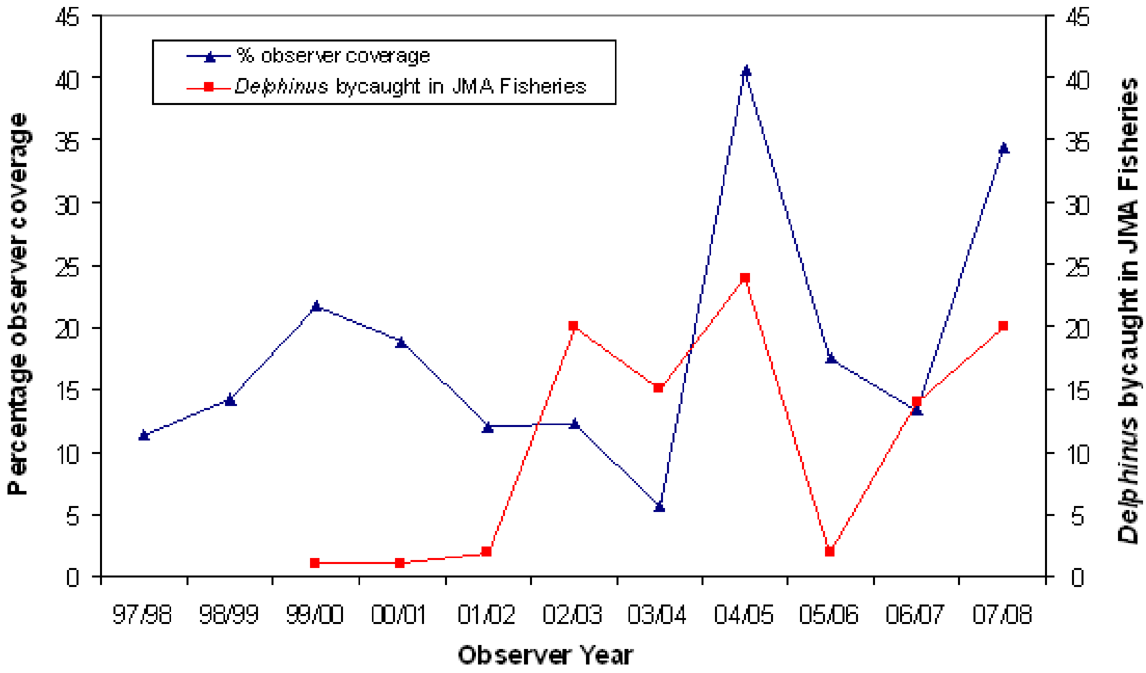

Figure 5 – Percentage observer coverage and number of common dolphin reported as bycatch by vessels targeting jack mackerel (defined as JMA, JMM, JMD or JMN) during 1997 to 2008. Note percentage observer coverage is based on the number of trawls observed by government observers. Observer years runs from July to June.

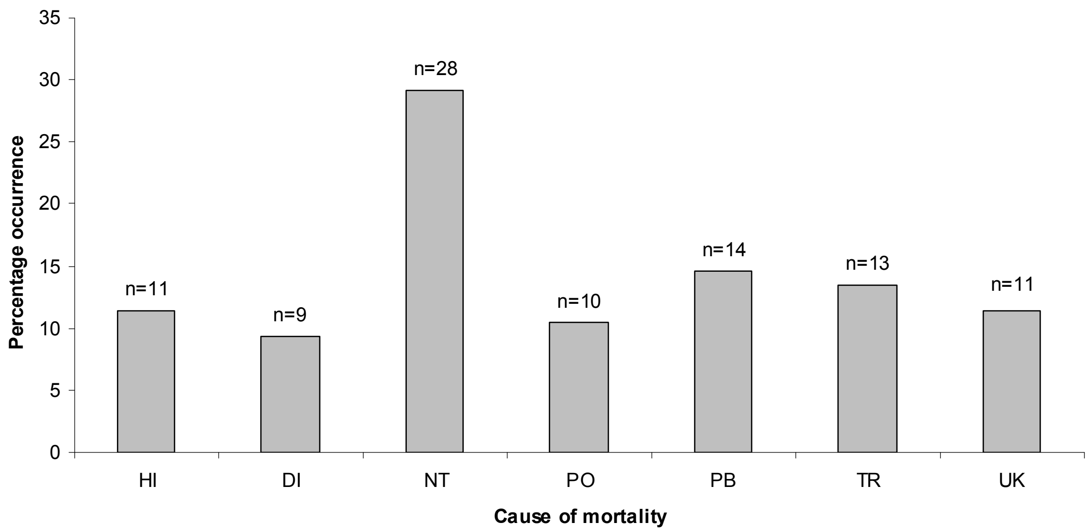

Figure 6 – Percentage mortality of stranded and beach cast New Zealand common dolphins examined opportunistically between 1998 and 2008. HI = *human interaction*, DI = *disease*, NT = *natural* (non-human), PO = *possible entanglement,* PB = *probable net entanglement*, TR = *trauma* (unidentified), UK = *unknown*.

Table 1 –Species observed in association with common dolphins in New Zealand waters.

Associated Species		**Region**	**Source**
Bryde's whale	*Balaenoptera brydei*	Bay of Islands, North Island; Bay of Plenty, North Island; Hauraki Gulf, North Island	Constantine 1995; Neumann and Orams 2003; O'Callaghan and Baker 2002; Schaffar-Delaney 2004; Burgess 2007; Stockin *et al*. 2008, Wiseman 2008
Sei whale	*Balaenoptera borealis*	Bay of Plenty, North Island	Neumann and Orams 2003
Minke whale	*Balaenoptera. acutorostrata*	Bay of Plenty, North Island	Neumann and Orams 2003
Striped dolphin	*Stenella coeruleoaba*	Hauraki Gulf, North Island	Stockin *et al*. 2008
Bottlenose dolphin	*Tursiops truncatus*	Hauraki Gulf, North Island	Stockin *et al.*2008
Hector's dolphin	*Cephalorhynchus hectori hectori*	Kaikoura, South Island	Markowitz 2004
Dusky dolphin	*Lagenorhynchus obscurus*	Marlborough Sounds, South Island; Kaikoura, South Island; Westport, South Island; Jackson Bay, South Island	Markowitz 2004; Merriman 2007
Australasian gannet	*Morus serrator*	Bay of Islands, North Island; Bay of Plenty, North Island; Hauraki Gulf, North Island	Constantine 1995; Neumann and Orams 2003; Schaffar-Delaney 2004; Burgess 2007; Stockin *et al.* 2008; Wiseman 2008
Sooty shearwater	*Puffinus griseus*	Bay of Islands, North Island; Bay of Plenty, North Island; Hauraki Gulf, North Island	Constantine 1995; Neumann and Orams 2003; Burgess 2007; Stockin *et al*. 2008; Wiseman 2008
Buller's shearwater	*Puffinus bulleri*	Bay of Islands, North Island; Hauraki Gulf, North Island	Constantine 1995; Burgess 2007; Stockin *et a*l. 2008; Wiseman 2008
Fluttering shearwater	*Puffinus gavial*	Bay of Islands, North Island	Constantine 1995
Flesh footed shearwaters	*Puffinus carneipes*	Bay of Islands, North Island; Hauraki Gulf, North Island	Constantine 1995; Burgess 2007; Stockin *et al.* 2008; Wiseman 2008
Mollymawk	*Diomedea melanophrys*	Bay of Islands, North Island	Constantine 1995
Skuas	*Stercorarius* spp.	Bay of Islands, North Island	Constantine 1995
White fronted tern	*Sterna striata*	Bay of Plenty, North Island; Hauraki Gulf, North Island	Neumann and Orams 2003; Burgess 2007; Stockin *et al*. 2008; Wiseman 2008
Red-billed gull	*Larus novahollandiae*	Hauraki Gulf, North Island	Burgess 2007
Little blue penguin	*Eudyptula minor*	Hauraki Gulf, North Island	Burgess 2007; Stockin *et al*. 2008

Table 2 – Tourism impact studies conducted on common dolphins in New Zealand waters.

Category	**Region**	**Impact**	**Source**
Vessel	*Bay of Islands*	• 52% of tour boat approaches (n=22) resulted in a behavioural change. • Socialising groups were most likely to change behaviour during a tour boat interaction. • During 43% of encounters (n=18), common dolphins would disrupt their activities in order to bow ride the approaching tour vessel.	Constantine 1995
Vessel	*Bay of Plenty, North Island*	• 21.2% of groups altered their activity as a result of an approaching tour boat, most frequently to bow-ride. • Dolphins spent a higher proportion of their time travelling and socialising in the presence of the tour boat. • Group size was the main factor contributing to boat avoidance, with larger groups being more tolerant (>57 animals).	Neumann and Orams 2006
Vessel	*Hauraki Gulf, North Island*	• Foraging and resting significantly decreased during boat interactions. • Foraging dolphins took significantly longer to return to their initial behavioural state. • Dolphins increased preference to shift behaviour to socialising or milling after tour boat interactions, at the expense of both feeding and resting.	Stockin *et al.* 2008
Vessel	*Hauraki Gulf, North Island*	• As vessel approached, dolphins most likely to change behaviour if milling, and least likely when resting or feeding. • Feeding and travelling dolphin groups less likely to change behaviour during an interaction. • Socialising and milling groups more likely to bow ride.	Leitenberger 2002
Swim	*Bay of Islands*	• Compared to bottlenose dolphins, common dolphins: ▪ Interacted slightly longer with swimmers (5.3 min vs 4.2 min). ▪ Had a lower likelihood of interacting with swimmers (27% vs 41%). ▪ Had a lower success rate (31%, vs 60%). ▪ Were more likely to remain neutral (38% vs. 30%) or avoid swimmers (38% vs 22%) rather than sustain an interaction (24% vs 48%).	Constantine 1995
Swim	*Bay of Plenty, North Island*	• 46.6% of swim attempts resulted in an interaction, with a mean duration of 3 min (SD=1.6). • Swim attempts were more successful when dolphins were socialising, in larger groups (>50) and/or a small number of swimmers were in the water (<5).	Neumann and Orams 2006
Swim	*Hauraki Gulf, North Island*	• Swims occurred in 34.5% of the trips, with a success rate of 21%. • Dolphins interacted 39.7% of the time, while they avoided and remained neutral in 25.7% and 34.6% of encounters respectively. • Swimmers had more chance to interact with dolphins and at a closer range if quiet, active, and in small groups (1-3). • Swim attempts in the summer season were more likely to be successful.	Leitenberger 2002

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