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Short Note

Multiple Captures of Humpback Dolphins (*Sousa plumbea*) in the KwaZulu-Natal Shark Nets, South Africa

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Humpback dolphins (*Sousa plumbea*) (a synonym for *S. chinensis*) are incidentally caught in shark nets in KwaZulu-Natal (KZN) Province, South Africa (Atkins et al., 2013). For an estimated population size of 165 in KZN (Durham, 1994), the mean annual catch of seven dolphins (4%) is of concern for southern African humpback dolphins, which are classified as Vulnerable to extinction (Friedmann & Daly, 2004). The taxonomy of the humpback dolphin is unresolved (Jefferson & Van Waerebeek, 2004; Frère et al., 2008), making it difficult to classify its conservation status, but *S. plumbea* could be considered Vulnerable on a global scale if it were assessed separately (Reeves et al., 2008). Fisheries are a major threat to humpback dolphins and other small cetaceans globally (Read et al., 2006; Reeves et al., 2008).

Shark nets were first set in 1952 in KZN because of shark attacks on bathers. Currently, 38 beaches in KZN are protected throughout the year. The shark nets are gill nets set to catch and kill sharks to reduce their populations and thereby reduce the probability of shark attack (Dudley, 1997). In addition to the large sharks that are considered dangerous to bathers, a variety of other marine animals are caught, including dolphins (Cliff & Dudley, 2011). In a previous study, we investigated the spatial, temporal, and life history characteristics of the humpback dolphins caught in these shark nets (Atkins et al., 2013).

Many small cetacean bycatch studies have found that dolphins are sometimes caught together with conspecifics. In some fisheries, such multiple captures occur in about half or more (40 to 68%) of the hauls (Morizur et al., 1999; Rogan & Mackey, 2007; Fernández-Contreras et al., 2010), though they occur in lesser numbers in other cases (5%; Silvani et al., 1999). Such multiple captures obviously have a greater impact on the population, which would be exaggerated if these captures involved mother-calf pairs.

Humpback dolphins occur in small groups, usually of less than 10 individuals (Saayman & Taylor, 1979; Durham, 1994; Karczmarski et al., 1999; Jefferson & Karczmarski, 2001). Their social organisation is fission-fusion, group membership is not stable, and strong bonds between individuals other than mother-calf pairs are uncommon (Karczmarski, 1999; Parra et al., 2011). Although age/sex segregation is apparently the norm for delphinids (Perrin & Reilly, 1984), this has not been observed for humpback dolphins in southern Africa (Saayman & Taylor, 1979; Karczmarski, 1999). We aimed to assess the frequency and composition of multiple captures of humpback dolphins in the shark nets in KZN. We tested the predictions that multiple captures are rare and are composed mainly of mother-calf pairs.

The shark nets are made of black multifilament polyethylene braid weaved to a stretched mesh size of 51 cm. Most nets are 213.5 m long by 6.3 m deep and are permanently anchored parallel to the coast beyond the surf, 300 to 500 m offshore, in 10 to 14 m of water. Most (70%) installations comprise one or two nets, but the range is 1 to 17 nets. Detailed information about the nets, the shark control programme, and fishing effort are provided elsewhere (Dudley, 1997; Cliff & Dudley, 2011). The dolphin bycatch data are only considered reliable from 1980 onwards; we used data from 1980 to 2009 in our analyses.

The nets are checked by KwaZulu-Natal Sharks Board (KZNSB) staff 15 to 20 times/mo and sharks and bycatch are retrieved. *Multiple capture* is defined as more than one humpback dolphin retrieved from an installation on the same day. Catches were identified and sexed, and body

lengths were measured. Most of the dolphin carcasses were taken to the KZNSB laboratory where sex and total length were verified. To organise the size classes into meaningful life history categories in the absence of published data on lengths at weaning and sexual maturity (Jefferson et al., 2012), we used Cockcroft's classification system (V. C. Cockcroft, pers. comm., 29 November 1999), generated using a subset (1980 to 1988) of the humpback dolphins in our study (Atkins et al., 2013). Dolphins were grouped into five age/sex classes: (1) both sexes < 1.8 m were classed as dependent calves; (2) females 1.8 to 2.2 m were classed as adolescents as were (3) males 1.8 to 2.3 m; and (4) females > 2.2 m and (5) males > 2.3 m were classed as sexually mature adults. Following Cockcroft, we use the term *adolescence* to indicate the period after maternal independence until sexual maturity. Some others use the term *juvenile* for this stage (e.g., Wells, 2003).

To assess which maturity stage combinations were prone to multiple capture, we assigned captures to six possible combinations: (1) adult-adult, (2) adult-adolescent, (3) adult-calf, (4) adolescent-adolescent, (5) adolescent-calf, and (6) calf-calf. The number of pairs of each type of combination was summed and analysed using a χ^2 test with the null hypothesis that all maturity stage combinations were equally likely to be caught. We calculated the "expected" number of each type of combination as the sum of incidences of capture of pairs of known age/sex (n = 15 pairs) divided by the number of possible combinations (6).

To assess whether particular age/sex classes are susceptible to multiple capture, we tabulated the number of age/sex class combinations involved in each multiple capture event. We then summed the number of dolphins from each age/sex class and analysed (χ^2 test) the null hypothesis that multiple-caught dolphins formed a random subset of the total humpback dolphin bycatch. We calculated the "expected" number by multiplying the total catch (Atkins et al., 2013) of each age/sex class by 0.18, which is the total number of multiple-caught individuals (33) relative to the total catch with age/sex data (186).

Humpback dolphins were retrieved from a shark net installation on 183 occasions. Single captures occurred frequently (n = 164). Of the 19 incidents of multiple captures, two individuals were retrieved on 18 occasions, and three individuals were retrieved together once. The size and sex were recorded for 15 of the pairs and the trio. Most of the pairs consisted of an adult with a calf (Table 1), and the trio comprised an adult female and male calf retrieved from the same net and an adolescent male retrieved from a different net in the same installation. All maturity stage combinations were not equally likely to be caught (χ^2_5 = 13.40, p = 0.020) with adult-calf pairs comprising the majority (47%) of the total (Table 1). Humpback dolphins comprising the multiple captures were not a random subset of the total catch (χ^2_5 = 31.50, p < 0.001). Adult females and male calves formed a high proportion of the total catch, and adolescents formed a low proportion of the total catch (Table 2).

Table 1. The maturity stage combinations of pairs of humpback dolphins retrieved from the same shark net installation on the same day along the KZN coast, South Africa

Possible combinations	# of pairs
Adult-adult	2
Adult-adolescent	3
Adult-calf	7
Adolescent-adolescent	3
Adolescent-calf	0
Calf-calf	0
Total	15

Table 2. The age/sex classes of the individuals of 15 pairs and one trio of humpback dolphins and their relative proportions of the total (single and multiple) humpback dolphin bycatch along the KZN coast, South Africa (Adoles. = Adolescent)

Age/sex class	Adult female	Adult male	Adoles. female	Adoles. male	Calf female	Calf male	Sum
Adult female		2	2		1	6	
Adult male	2		1				
Adolescent female	2	1		2			
Adolescent male			2	2			
Calf female	1						
Calf male	6						
Number of dolphins caught in pairs	11	3	5	4	1	6	30 (15 pairs)
Number of dolphins caught in trios	1			1		1	3 (1 trio)
Number of dolphins caught in multiples	12	3	5	5	1	7	33
Total number of dolphins caught	22	33	37	67	13	14	186
Multiple catch/total catch	0.55	0.09	0.14	0.07	0.08	0.50	0.18

We assumed that individuals retrieved from the same installation on the same day were part of the same group, even if they were caught in different nets within the installation. This is a reasonable assumption since the communication range of sounds is likely to far exceed the distance between the dolphins retrieved together (Van Parijs et al., 2002; Jensen et al., 2012). In 13 (68%) of the incidents, individuals were caught in the same net (< 200 m apart); and in three incidents (16%), the individuals were caught in adjacent nets (< 500 m apart). In only one incident, which involved the trio, were the dolphins not in the same or adjacent nets; the adult-calf pair was caught in one net and the adolescent was caught on the other side of the installation, 0.5 to 1 km away (probably still within communication range).

Half of the pairs consisted of an adult female and a calf which were likely mother-calf pairs. Unfortunately, genetic verification was not possible because samples were irretrievably damaged, but this would be critical for future studies. Adult females have a high reproductive value and are an integral part of maintaining stability in terms of population size (Begon et al., 1990; Coulson et al., 2001). Dolphins have very low intrinsic rates of population growth as a consequence of their life history characteristics: they grow slowly, mature late, and bear only one calf per pregnancy with long inter-calf intervals (Reilly & Barlow, 1986; Chivers, 2009; Jefferson et al., 2012). A humpback dolphin population could be severely affected by the loss of reproducing females and their calves.

The bycatch in the shark nets in KZN also includes Indo-Pacific bottlenose (*Tursiops aduncus*) and long-beaked common (*Delphinus capensis*) dolphins. The multiple captures of humpback dolphins (10%) are rarer than those of bottlenose (15% of bottlenose dolphin capture incidents) and common (28% of common dolphin capture incidents) dolphins as described by Cockcroft (1994). All multiple captures of bottlenose dolphins were of two dolphins, and 78% of these were considered mother-calf pairs. It is interesting that humpback dolphin calves were always caught with adult females, whereas bottlenose dolphin calves were occasionally caught with an adult male or another calf. Multiple captures of common dolphins differed, involving two to seven individuals at a time with very few considered to be mother-calf pairs. The large numbers of common dolphins caught together was attributed to their larger group size.

Given that a high proportion (36%) of the total humpback dolphin bycatch consisted of adolescent males (Atkins et al., 2013), it might have been expected that adolescent males would make up the majority of the multiple captures, yet only 7% were caught with another dolphin. Of the 22 adult females that were caught, 12 (55%) were caught with another dolphin. This rate is high and may suggest that there are different causes of single and multiple captures. The total catch of male calves was similar to that of female calves, yet the distribution of the sex of calves caught with an adult female was not random, and seven of the eight calves caught with an adult female were males ($p = 0.030$, Fisher's test). Reasons for this sex difference are unknown and could reflect idiosyncratic behaviour of the female humpback dolphins or their calves.

If age/sex segregation was the case for humpback dolphins, it would have been expected to find adolescents caught exclusively with other adolescents or, for example, adult males only with other adult males. In the small number of multiple catches, this was not the case and suggests a lack of age/sex segregation.

In conclusion, multiple captures of humpback dolphins occur in the shark nets but only rarely, and those are typically an adult female with a calf. Humpback dolphins are classified as Vulnerable to extinction in southern Africa, and the 4% annual decrease in population size contributes to this classification. Despite the small number of multiple captures in shark nets, the greater than expected incidence of mother-calf pairs is of particular concern since this will no doubt influence future reproduction and recruitment, further exacerbating the decline of this vulnerable species.

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