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Armed Escorts: Dusky Dolphin (*Lagenorhynchus obscurus*) Interactions with Octopuses (*Pinnoctopus cordiformis*) in New Zealand

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Abstract

Between October 2011 and December 2013, three interactions between dusky dolphins (*Lagenorhynchus obscurus*) and common New Zealand octopuses (*Pinnoctopus cordiformis*) were witnessed and photographed off Kaikoura, New Zealand. In two interactions, an octopus was attached to a dusky dolphin; and in a third interaction, dusky dolphins appeared to be playing with an octopus. The attachment might have been an escape tactic for the octopuses. This is the first published record of interactions between dusky dolphins and octopuses in New Zealand. The few anecdotal reports of octopuses attached to dolphins are limited to species that commonly prey on octopuses. The evidence for dusky dolphins foraging on octopuses off Kaikoura is weak. The two species have different habitats but could come into initial contact through shallow nearshore dives performed by the dusky dolphins or by other species observed in the area, including New Zealand fur seals (*Arctocephalus forsteri*), humpback whales (*Megaptera novaeangliae*), or fishermen retrieving craypots. When the dusky dolphins encountered this unusual object in their environment, they may have initiated exploratory or playful behavior, which changed to distressed or defensive behavior upon the attachment of the octopuses. The erratic behaviors of the dolphins, including tail thrashes, rolling over, and rapid changes in swimming speed and direction, indicate they were disturbed by the presence of the affixed octopus. The dolphins did not perform acrobatic leaps, which are predicted to remove or reposition large "hitchhikers."

Key Words: play behavior, object interactions, Kaikoura, New Zealand, dusky dolphin, *Lagenorhynchus obscurus*, common New Zealand octopus, *Pinnoctopus cordiformis*

Introduction

Animal play with objects may have multiple functions including the development and enhancement of motor, problem-solving, and social skills, and the exploration of items in the environment (reviewed in Fagen, 1974, 1981; Bekoff & Byers, 1998; Spinka et al., 2001; Burghardt, 2005). Although play can be difficult to define, and it is unclear how and why it evolved, it is prevalent among cetaceans (reviewed in Paulos et al., 2010). Free-ranging cetaceans have been reported playing with inanimate natural objects such as logs (e.g., bowhead whales [*Balaena mysticetus*]; Würsig et al., 1989), sand (e.g., Atlantic spotted dolphin [*Stenella frontalis*]; Greene et al., 2011), seaweed, and seagrass (e.g., Hector's dolphin [*Cephalorhynchus hectori*]; Slooten, 1994; Indo-Pacific bottlenose dolphins [*Tursiops aduncus*]; Mann & Smuts, 1999; rough-toothed dolphin [*Steno bredanensis*]; Kuczaj & Yeater, 2007). Cetaceans also play with non-prey animals in their environment (reviewed in Paulos et al., 2010). For example, free-ranging bottlenose dolphin species and long-finned pilot whales (*Globicephala melas*) have been reported playing with birds (Hewitt, 1986; Mann & Smuts, 1999; Heubeck, 2001), rough-toothed dolphins with a loggerhead sea turtle (*Caretta caretta*; Ritter, 2002a), and common bottlenose dolphins (*T. truncatus*) with jellyfish (Bel'kovich et al., 1991).

Some interactions between cetaceans and non-prey organisms can potentially harm the objects of the interactions. The mortalities of several cetacean species are attributed to aggressive encounters with bottlenose dolphins (Ross & Wilson, 1996; Barnett et al., 2009; Cotter et al., 2012). Indo-Pacific bottlenose and rough-toothed dolphins carry, push, or toss pufferfish they may kill but not consume (Steiner, 1995; Whitehead & Mann, 2000). Cetaceans can also incur potential costs from interactions with biotic non-prey objects. Biotic organisms capable of attaching to cetaceans can increase the marine mammals' energetic costs of swimming by

increasing hydrodynamic drag forces (Félix et al., 2006). Energetically expensive behaviors may be needed for cetaceans to remove large "hitchhikers," which include remoras (*Echeneidae* sp.; Fertl & Landry, 2002), sea lampreys (*Petromyzon marinus*; Nichols & Hamilton, 2004; Samarra et al., 2012), cookie cutter sharks (*Isistius* sp.; reviewed in Heithaus, 2001; Dwyer & Visser, 2011), and Portuguese dogfish (*Centroscymmus coelolphis*; reviewed in Heithaus, 2001).

Octopuses are not commonly known to latch onto whales and dolphins. The few anecdotal descriptions of octopuses attached to cetaceans are limited to common bottlenose dolphins near Greece (Bearzi, 2010; Gonzalvo, 2012). Bottlenose dolphins in Mediterranean coastal waters have adaptable and opportunistic foraging tactics (Bearzi et al., 1999), and they forage on demersal prey species, including common octopuses (*Octopus vulgaris*; Bearzi et al., 2008). Octopuses attached to bottlenose dolphins are hypothesized to escape from the foraging dolphin by latching onto their predator's body where they are inaccessible to the dolphin's mouth (Bearzi, 2010).

Dusky dolphins (*Lagenorhynchus obscurus*) have not been described interacting or playing with octopuses. Herein, we report one account of dusky dolphins apparently playing with a common New Zealand octopus (*Pinnoctopus cordiformis*) and two accounts of octopuses attached to dusky dolphins off Kaikoura, New Zealand. At least one interaction occurred at a location with water depths exceeding the diving capabilities of the dolphins and the habitat range of the octopuses.

Methods

Study Site and Species

Kaikoura is located on the northeast coast of the South Island of New Zealand (42° 30' S, 173° 32' E). The study area is an open-ocean embayment extending from the Kaikoura Peninsula in the north to the Haumuri Bluffs 20.5 km southwest of the peninsula (Figure 1). In the embayment, nutrient-rich waters drop off to depths exceeding 1,000 m within ~2 km from shore and support an abundance of diverse trophic levels (Würsig et al., 2007).

Dusky dolphins are gregarious animals with highly fluid fission-fusion social structures. The average group size of small (< 50 dolphins), adult, non-mating groups is 8.5 individuals (Markowitz, 2012). Daytime foraging by dusky dolphins is rare in the Kaikoura region (Markowitz, 2004; Markowitz, 2012). Foraging activity occurs at night when a deep scattering layer of mesopelagic myctophids and squid rise to within 30 m of the surface (Benoit-Bird et al., 2004, 2009). Dusky dolphins dive to maximum depths of 130 m while foraging at night, although they show a preference for shallower depths (Benoit-Bird et al., 2004). Dolphin group sizes while foraging on the deep scattering layer range from one to five individuals (Benoit-Bird et al., 2004).

The common New Zealand octopus (formerly *Macroctopus maorum* or *Octopus maorum;* O'Shea, 1999) is a shallow-water benthic species found in soft-sediment shellfish beds (Anderson, 1999). It is broadly distributed around New Zealand in littoral zones ranging from 0 to 300 m in depth (O'Shea, 1999). The common New Zealand octopus can be distinguished from other regional species based on its distribution, large body size, long dorsal arms, tapering arms, ovate mantle shape, coloration, and the presence of iridescent white spots on the arms and web that are absent from the mantle (Anderson, 1999; O'Shea, 1999).

Platforms of Observations

Encounters One and Two—Boat-based dolphin viewing and swimming excursions have been conducted year-round off Kaikoura since 1991 by the local tourism company, Dolphin Encounter (Buurman, 2010). Each excursion uses vessels ranging from 10.5 to 14 m and targets large groups (> 100) of dusky dolphins. Observations and photographs of the dolphin–octopus interaction in Encounter One were made by the Dolphin Encounter crew. Observations and photographs of the dolphin–octopus interaction in Encounter Two were made by a snorkeler participating in a Dolphin Encounter tour.

Encounter Three—Boat-based surveys of dusky dolphins were conducted from a 6-m rigid-hull inflatable skiff between October 2011 through January 2012 and October 2013 through January 2014. A team of three researchers traveled parallel to shore between the Kaikoura Peninsula and the Haumuri Bluffs while scanning the area for mating dusky dolphins within 10 km from shore. A total of 126.7 h were spent on effort in 2011-2012 and 115.6 h in 2013-2014. Photographs were taken of dorsal fins for photo-identification based on notches and scars (Würsig & Jefferson, 1990) using a digital Nikon D7000 camera with a 80 to 400 mm lens. Videos were recorded using a Sony Handycam HDR-XR550V. A Garmin GPSMAP 76 GPS was used to collect travel speeds, headings, and locational data. Observations and photographs of the dolphin–octopus interaction in Encounter Three were made by onboard researchers.

Ethics—The boats adhered to the operating rules stipulated in the Marine Mammals Protection Act of 1978, the Marine Mammal Protection Regulations 1992, and local New Zealand dolphin conservation guidelines (Childerhouse & Baxter, 2010). For Encounters One and Two, the boats operated under the New Zealand Department of Conservation Permit Numbers NM-27526-MAR, NM-27525-MAR, and NM-27434-MAR. For

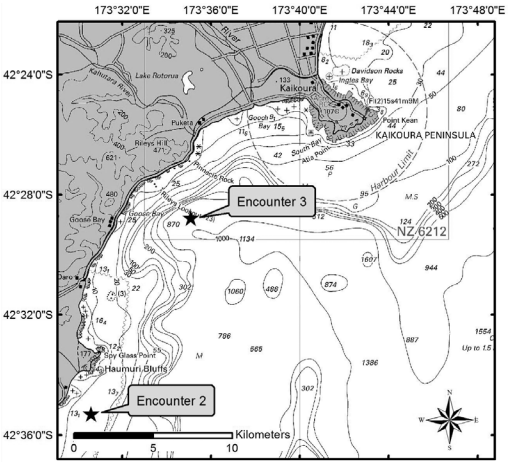

Figure 1. Locations of two interactions between common New Zealand octopuses (*Pinnoctopus cordiformis*) and dusky dolphins (*Lagenorhynchus obscurus*) (Encounters Two and Three) off Kaikoura, New Zealand; geospatial data by CC-By Land Information New Zealand.

Encounter Three, the boat operated with permission from the New Zealand Department of Conservation, but no written numbered permit was required for the observational study.

Results

Encounter One

On 20 October 2011 at 1110 h, the crew and customers aboard a Dolphin Encounter boat observed a common New Zealand octopus attached to a dusky dolphin's dorsal area (Figure 2). GPS coordinates and information on other species in the vicinity were not recorded. The octopus was red in coloration and remained attached to the dolphin's dorsal area amid an increase in activity from nearby dolphins. The dolphins were not reported biting the octopus. The octopus-bearing dolphin was described as agitated.

Figure 2. A common New Zealand octopus attached to the dorsal region of a dusky dolphin on 20 October 2011 off Kaikoura, New Zealand (Encounter One); a crew member of a Dolphin Encounter boat took the photograph.

Encounter Two

On 21 January 2012 at 1050 h, a snorkeler participating in a Dolphin Encounter excursion observed a group of four to six dusky dolphins that appeared to be playing with a common New Zealand octopus. The location where dolphins were first approached by Dolphin Encounter was 42° 35.3' S, 173° 30.6' E. The bottom depth was between 10 to 20 m, and the closest distance to shore was 1.9 km (*ArcMap*, Version 10.1; Figure 1). No GPS coordinates were marked at the point of encounter with the octopus. The snorkeler followed the group of dusky dolphins for approximately 10 min at a maximum distance of 3 m before returning to the boat. Weather conditions were poor and consisted of rain, wind, and water visibility ranging from 1 to 3 m.

The octopus was yellow, brown, and orange in color. The dusky dolphins continuously circled around the octopus within a 1 to 2 m radius. The octopus was floating in depths of 1 to 2 m. Individual dolphins broke away from the circle and approached the octopus, while the remainder of the group continued circling. The dolphins were observed pulling and biting chunks from the octopus's arms but not from its mantle (Figure 3). It was unclear if the tissue was consumed. When the octopus attempted to escape to greater depths, the dolphins pulled it back to shallower water by its arms. After several minutes of observation, the octopus released a cloud of blue-tinted ink. The dolphins did not appear to alter their behavior following the octopus's release of ink. The octopus was not observed to latch itself onto any dolphin.

Encounter Three

On 2 December 2013 at 1052 h, an adult dusky dolphin was observed with a common New Zealand octopus attached to its caudal peduncle during a

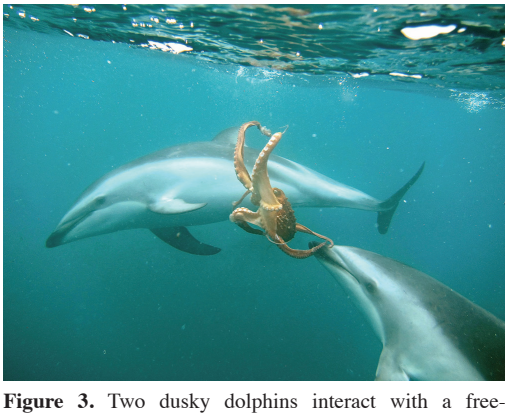

Figure 3. Two dusky dolphins interact with a free-swimming common New Zealand octopus off Kaikoura, New Zealand (Encounter Two). The photograph was taken in the water by a snorkeler on a Dolphin Encounter expedition on 21 January 2012.

routine boat-based survey (42° 28.773' S, 173° 35.089' E; Figures 4 & 5). The dolphin traveled a minimum distance of 270 m during the 23-min follow, and the boat was continuously within 5 m of the dolphin. The bottom depth during the encounter ranged from 500 to 1,000 m and the closest distance to shore was 3.3 km (*ArcMap*, Version 10.1; Figure 1). The water visibility was

Figure 4. A common New Zealand octopus attached to the dorsal region of a dusky dolphin on 2 December 2013 off Kaikoura, New Zealand (Encounter Three); observers on the research boat took the photograph.

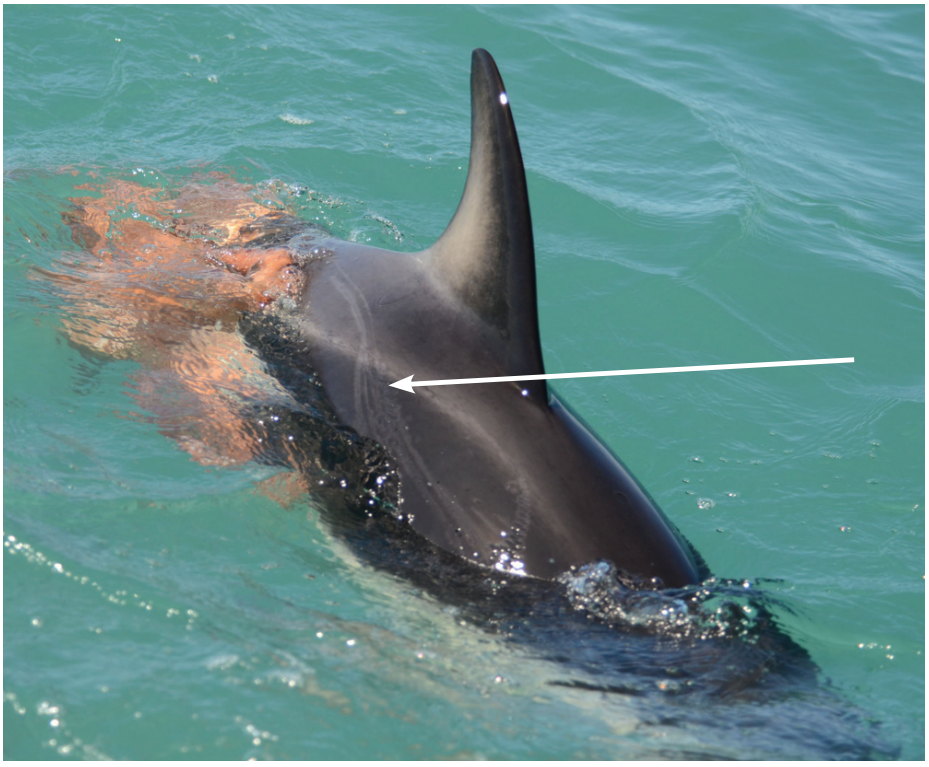

Figure 5. A common New Zealand octopus attached to the right caudal region of a dusky dolphin on 2 December 2013 off Kaikoura, New Zealand (Encounter Three); suction marks from the octopus are visible along the right side of the dolphin. Observers on the research boat took the photograph.

~1 m and deemed poor for local conditions. The Beaufort rating was 1. A New Zealand fur seal (*Arctocephalus forsteri*) and a juvenile humpback whale (*Megaptera novaeangliae*) were observed within 100 and 300 m proximity, respectively, of the afflicted dusky dolphin group.

The octopus changed from a salmon to a rusty brown/purple color and alternated between a smooth and stippled texture. Photographs collected during the encounter were used to estimate the mantle height of the octopus to be approximately 15 cm. The mantle of the octopus was located on the right side of the dolphin. Throughout the observation, the octopus moved laterally along the dusky dolphin's body. Its arms were occasionally wrapped around the dolphin's peduncle and tail flukes. The octopus was not observed anterior to the trailing edge of the dolphin's flippers. Near the end of the follow, one of the five on-board observers noticed the octopus free-floating before reattaching to the same dolphin.

The dusky dolphin was identified as a female based on the visibility of mammary slits when she turned ventrum-up. She displayed unusual behaviors, including thrashing her tail at and below the water surface, rolling her body along her longitudinal axis, and rapidly changing swimming speeds. She also was observed performing multiple spy-hopping behaviors in which her rostrum pointed vertically in the air above the surface of the water. While dusky dolphins off Kaikoura commonly perform acrobatic leaps and flips, the focal animal was not observed performing any aerial displays. There were sucker marks from the octopus on her body (Figure 4). Her dorsal fin did not possess any unique identifying marks for reliable photo-identification.

Six other adult dusky dolphins were in the immediate vicinity of the octopus-bearing dolphin and were considered part of the same group. The sex of the remaining group members was unknown. The heading of the group appeared to be dictated by the octopus-bearing dolphin. They appeared to center their behaviors around her. The inter-individual spacing of the group was tight compared to other surveys, with at least one dolphin remaining within one body width of the octopus-bearing dolphin at all times. The group remained near the surface of the water and displayed erratic and nondirectional movements in addition to very short dives throughout the encounter. None of the dolphins in the group performed any aerial displays. The dolphins approached and circled around the octopus-bearing female, thrashed their tails, rolled onto their sides, and occasionally rubbed against her. Some group members produced bubbles, which may be a sign of aggression among cetaceans (Pryor, 1990; Slooten, 1994). Some dolphins pointed their rostra toward and in close proximity to the octopus.

Discussion

For the first time, common New Zealand octopuses are reported and photographed attached to dusky dolphins. Interactions between the two species may be more common than previously recognized. The encounters may have commenced as exploratory behavior by the dusky dolphins of an unusual object in their environment followed by object-oriented play (Spinka et al., 2001). Dusky dolphins are known to engage in playful behavior while socializing, including balancing kelp on their bodies (Würsig & Würsig, 1980; Würsig, 2008). Dusky dolphins have also been observed pulling kelp gulls (*Larus dominicanus*) and brown-hooded gulls (*L. maculipennis*) 60 cm beneath the surface of the water before releasing them (Würsig, 2008), similar to pulling the octopus by its arms to shallower water depths in Encounter Two.

Two of the three encounters escalated to apparent negative interactions for the dusky dolphins when the octopuses affixed themselves to the dolphins' bodies in positions inaccessible to the octopus-bearing dolphins' teeth. The octopuses appeared to exhibit self-preservation behaviors from perceived predators. The inking by the octopus in Encounter Two and evidence of suction and scrape marks along the body of the dolphin in Encounter Three indicate threat-response behaviors from the octopuses. Biting behaviors by the dusky dolphins (e.g. Encounter Two) may not be indicative of predation. Stomach content analyses of dusky dolphins off Kaikoura do not support the hypothesis that the dolphins prey on octopuses (Gaskin, 1972; Cipriano, 1992; Duffy & Brown, 1994). However, we caution that stomach content analyses may be insufficient to detect rare foraging events. To our knowledge, octopuses are prey for dusky dolphins only in Argentina, where the Tehuelche octopus (*O. tehuelchus*) comprises < 1% of prey items (Alonso et al., 1998). The offshore nighttime foraging patterns of dusky dolphins off Kaikoura also generate a spatio-temporal constraint on foraging interactions between the two species (Benoit-Bird et al., 2004, 2009).

The octopuses in Encounters One and Three may have demonstrated ectoparasitic behaviors in which they intentionally sought out and clung onto the dusky dolphins. By affixing to the dolphins, the octopuses could reduce the energetic costs of traveling and gain a "free ride." As the habitat range of the dusky dolphins is much larger than that of the octopuses and includes deeper offshore waters, this alternative hypothesis to why the octopuses affixed themselves to the dolphins seems less plausible.

It is unclear how the octopuses and dusky dolphins came into initial contact. We hypothesize the dolphins encountered the octopuses while diving in the nearshore littoral zone and had moved offshore with the octopuses still attached at the time they

were observed. Dusky dolphins off Kaikoura generally rest and socialize inshore in the mornings and move offshore toward their foraging habitat as the day progresses (Markowitz, 2004). Alternatively, New Zealand fur seals or humpback whales, which were observed in the area during Encounter Three, could have encountered the octopuses on the seafloor during nearshore dives and brought them to the surface where they escaped/dislodged themselves, either inshore or offshore. New Zealand fur seals are known predators of octopuses off Kaikoura (Carey, 1992). Another possibility is the octopuses attached themselves to craypots deployed in shallow waters and were subsequently released offshore by the fishermen retrieving the craypots. The octopuses could have attached themselves to craypot boats during retrieval of the inshore craypots and released themselves from the boats offshore. It is also possible that the habitat of the common New Zealand octopus may extend to deeper ranges and further offshore than previously recognized.

The octopus-bearing dolphins appeared agitated by the attachment of the octopuses. Cetaceans with remoras attached to them have been reported jerking, rolling over, and swimming erratically with abrupt changes in direction (Notarbartolo di Sciara & Watkins, 1980; Fertl & Landry, 2002), suggesting they were irritated by the fish (Weihs et al., 2007). The octopus-bearing dolphins performed similar movements in an apparent effort to dislodge the octopuses. The spinning behaviors commonly observed in spinner dolphins (*Stenella longirostris*) are predicted to remove remoras by creating sufficient drag forces on the parasites to dislodge them upon re-entering the water (Norris et al., 1994; Fish et al., 2006). Similarly, jumps by blacktip sharks (*Carcharhinus limbatus*) are hypothesized to dislodge remoras (Ritter, 2002b; Ritter & Brunnschweiler, 2003). An aerial leap may successfully relocate affixed organisms to different and potentially less sensitive attachment sites along the host's body or to attachment sites where drag forces are reduced (Silva-Jr. & Sazima, 2008). It is unclear why the octopus-bearing dusky dolphins did not perform aerial leaps. It is possible the dolphins attempted to leap and dislodge the octopuses before they were encountered by observers. Alternatively, the dolphins may have been energy-constrained from their exertions against the octopuses or from increased drag forces from prolonged interactions. It is also possible the octopuses' arms constrained the dolphins from leaping.

The other dusky dolphins in the groups also appeared agitated by the affixed octopuses. Wedekin et al. (2004) reported that a rough-toothed dolphin removed a remora from a humpback whale calf and consumed this atypical prey item. The dusky dolphin groups in Encounters One and Three were not observed biting the octopuses or pulling at their arms. It is possible the dolphins did not perceive the octopuses as prey items or they had unsuccessfully attempted to remove the octopuses with their teeth before the groups were encountered by observers. As the dusky dolphins in Encounter Two were observed biting the arms of the octopus, we reject the hypothesis that the group members in the other two encounters avoided physical contact with octopuses due to risks of the animals affixing to a different host.

Conclusions

Interactions between dusky dolphins and common New Zealand octopuses have not been reported before. The octopuses are benthic, while the dolphins are pelagic; the two species have different habitat ranges, and the octopus is not a known prey item for the dolphins. During rare encounters, octopuses could elicit predatory, exploratory, or playful behaviors from dolphins. Play behaviors may teach individuals how to cope emotionally with unforeseen distressing situations due to the sudden loss of control (Spinka et al., 2001). The attachment of the octopuses to the dolphins resulted in agitated behaviors by the dolphins that appeared directed toward regaining control of the situation. The dolphins exhibited a diverse behavioral repertoire in response to the free-swimming and affixed octopuses. Our opportunistic observations of dusky dolphins interacting with atypical biotic objects contribute to understanding the behavioral adaptability of these dolphins in changing environmental conditions.

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