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Variety and use of objects carried by provisioned wild Australian humpback dolphins (*Sousa sahalensis*) in Tin Can Bay, Queensland, Australia

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## **Preliminary Report of Object Carrying Behavior by Provisioned Wild Australian Humpback Dolphins (*Sousa sahulensis*) in Tin Can Bay, Queensland, Australia**

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Object use by cetaceans has been associated with complex cognitive processes, social relations, play and tool use. A comparative approach of how cetacean species use objects will increase our understanding of this behavior. This study reports on observations of object use by a small group of provisioned wild Australian humpback dolphins (*Sousa sahulensis*) in Tin Can Bay, Australia. Preliminary data were collated from attendance records, interviews and photographs and classified by dolphin, object type and possible motive. Up to 29 separate occasions of object carrying behavior over seven years were documented, characteristics of which are summarized. A variety of objects biological ( $n = 6$ ), artificial ( $n = 5$ ) and live ( $n = 4$ ) were carried or used by three male dolphins in intraspecific and interspecific interactions. Interactions were operationally defined and categorized as play ( $n = 4$ ), show ( $n = 17$ ), or give ( $n = 10$ ). Object play was more frequent with the juvenile male. Object carrying or showing was associated with the adult males and may be related to male social behavior similar to that seen in Amazon River dolphins (*Inia geoffrensis*). Relinquishment of objects may be unique to interactions with people as seen during provisioning situations with bottlenose dolphins (*Tursiops* sp.). The behavior presented in the current study indicates further variations of object use within the species, as objects were not associated with probable foraging as has been observed elsewhere in the wild.

Baleen and toothed whales have been observed interacting with various objects reports of which are given in the literature (for an overview see Kuczaj & Highfill, 2005; Mann & Patterson, 2013; Paulos, Trone & Kuczaj, 2010; see Table 1). Objects chosen are usually part of the environment or natural habitat and are predominantly of biological material, including seaweed, sand, sponges, lumps of clay, sticks, rocks, shells, a variety of live and dead fish or other animals, pieces of plastic and other artificial objects (Paulos et al., 2010; see Table 1). Cetaceans also manipulate parts of the environment by making water jets, bubbles, expelling water (spitting) and using waves, sand and mud (Paulos et al., 2010; see Table 1).

Objects may be used in solitary play (Hain et al., 1982; Kuczaj & Highfill, 2005; Kuczaj & Yeater, 2007; Mann & Smuts, 1999; Mann et al., 2008; Owen et al., 2012; Würsig et al., 1989) or in interactions with conspecifics (Araujo & Wang, 2012; Greene et al., 2011; Kuczaj & Yeater, 2007; Martin et al., 2008; Pitman & Durban, 2012). Some cetaceans have also been observed with objects during interactions with humans (Herzing et al., 2012; Holmes & Neil, 2012; Kuczaj et al., 2006).

Determining exact reasons for object use can be challenging and should be done with caution, as observations can be sporadic and infrequent. Various explanations for object manipulation by cetaceans have been offered and include foraging, exhibited by bottlenose dolphins (*Tursiops* sp., Allen et al., 2011; Mann et al., 2008; Smolker et al., 1997) and Australian humpback dolphins (*Sousa sahulensis*; Parra, 2007); social and social-sexual interactions by Amazon River dolphins (*Inia geoffrensis*; Araujo & Wang, 2012; Martin et al., 2008); giving or sharing by bottlenose dolphins (Holmes & Neil, 2012); and play exhibited by numerous species including bottlenose dolphins (Herzing et al., 2012; Holmes & Neil, 2012), rough-toothed dolphins (*Steno bredanensis*; Kuczaj & Yeater, 2007; Ritter, 2002; Steiner, 1995), Atlantic spotted dolphins (*Stenella*

*frontalis*; Greene et al., 2011; Herzing et al., 2012), bowhead whales (*Balaena mysticetus*; Würsig et al., 1989) and humpback whales (*Megaptera novaeangliae*; Deakos et al., 2010).

Table 1  
*Cetacean Species and Objects (Including Environmental Manipulation) within the Literature*

Species	Object	Reference
Rough-tooth dolphins ( <i>Steno bredanensis</i> )	Plastic; plastic bags; turtles; puffer fish	Kuczaj & Yeater, 2007; Ritter, 2002; Steiner, 1995
Bottlenose dolphins ( <i>Tursiops</i> sp.; <i>Tursiops truncatus</i> )	Sponges; various species of fish live and dead; puffer fish; conch shells; biological debris; mud banks; artificial objects; seagrass/weed; balls; scarf	Allen, Bejder, & Krutzen, 2011; Greene, Melillo-Sweeting, & Dudzinski, 2011; Herzing, Delfour, & Pack, 2012; Holmes & Neil, 2012; Kankudti, 2014; Kuczaj, Makecha, Trone, Paulos, & Ramos, 2006; Lewis & Schroeder, 2003; Mann & Smuts, 1999; Smolker, Richards, Connor, Mann, & Berggren 1997; Torres & Read, 2009
Atlantic Spotted dolphins ( <i>Stenella frontalis</i> )	Biological debris; inanimate & artificial objects; seaweed; scarf	Greene et al., 2011; Herzing et al., 2012
Orca whales ( <i>Orcinus orca</i> )	Waves	Pitman & Durban, 2012
Irrawaddy dolphins ( <i>Orcaella brevirostris</i> )	Water spitting	Stacey & Hvenegaard, 2002
Boto or Amazon River dolphins ( <i>Inia geoffrensis</i> )	Sticks; mud & leaf balls	Araujo & Wang, 2012; Martin, Da Silva, & Rothery, 2008
Australian Humpback dolphins ( <i>Sousa sahulensis</i> )	Sponge	Parra, 2007
Humpback whales ( <i>Megaptera novaeangliae</i> )	Seaweed; bubble nets; dolphins	Deakos, Branstetter, Mazzuca, Fertl, & Mobley, 2010; Hain, Carter, Kraus, Mayo, & Winn, 1982; Owen, Dunlop, & Donnelly, 2012; Wiley et al., 2001
Bowhead Whales ( <i>Balaena mysticetus</i> )	Large logs	Würsig, Dorsey, Richardson, & Wells, 1989

*Note.* This is not an exhaustive list; see Paulos et al. (2010) for a more comprehensive outline including objects used by captive cetaceans which was beyond the scope of the current paper.

It cannot be assumed that object use is comparable across or even within species. For example, object use in foraging is well documented for bottlenose dolphins (*Tursiops* sp.) of Shark Bay, Western Australia (Mann et al., 2008; Sargeant & Mann, 2009), yet little is known about other species such as the Australian humpback dolphin who have been seen using similar objects (Parra, 2007). Within species, bottlenose dolphins in Western Australia use sponges in one location (Smolker et al., 1997) while another group use conch shells in a different area (Allen et al., 2011). Despite the challenges, learning more about why cetaceans use objects is worthwhile and would give further insight concerning the development of complex cognitive processing with which the behavior has been linked (Galef & Giraldeau, 2001; Greene et al., 2011; Laland, 2004; Laland & Hoppitt, 2003).

## Foraging: Objects as Tools

Tool use in aquatic animals is defined as the use of an object from the environment, which is directly manipulated in a specific way to achieve a goal, usually foraging (Mann & Patterson, 2013). There has been extensive research into tool use in discrete cetacean populations in Australia, providing some good observational data (Mann et al., 2008; Sargeant & Mann, 2009; Smolker et al., 1997). However, few studies exist for different populations, limiting comparisons of similar tool use behavior across species.

Some female bottlenose dolphins in Shark Bay, Western Australia are well known for their *sponging*, the use of sponges worn over the end of their rostrums as protection while foraging (Krutzen et al., 2005; Mann et al., 2008; Sargeant & Mann, 2009; Smolker et al., 1997). Sponging is thought to have developed from intraspecific competition and ecological opportunity, to be learnt socially though vertical transmission predominantly through matrilineal lines and has been described as evidence for cetacean culture (Ackermann, 2008; Bacher, Allen, Lindholm, Bejder, & Krutzen, 2010; Krutzen et al., 2005; Patterson & Mann, 2011; Smolker et al., 1997; Whitehead & Rendell, 2015).

Another subset of bottlenose dolphins in the Western Gulf of Shark Bay has been observed using conch shells in association with foraging behavior (Allen et al., 2011). Even after extensive study, Allen et al. (2011) found it difficult to determine the exact purpose of the behavior, as the conch shell use was not frequently displayed and instances were challenging to observe (Allen et al., 2011). Anecdotal evidence of sponge carrying by Australian humpback dolphins in Western Australia and Queensland has also been suggested as possible tool use (Parra, 2007). Dolphin surveys in northeast Queensland observed one humpback dolphin carrying a sponge on its rostrum and diving with the sponge in a way known to relate to foraging (Parra, 2007). Without further observations it is difficult to determine how these dolphins are using these sponges.

A less well-defined use of tools is the manipulation of the environment to assist in foraging, such as using water jets, bubbles, mud, or waves. A review by Mann and Patterson (2013) found that a large percentage of tool use by aquatic animals involved water as a tool. Humpback whales' (*Megaptera novaeangliae*) use of bubbles to catch prey provides an example of such behavior. Bubble-feeding behaviors vary between individuals and regions and are used as foraging techniques (Wiley et al., 2011). Humpback whales in the Gulf of Maine produce bubble clouds (single or multiple bursts of bubbles never seen used by Alaskan humpback whales), and bubble nets (rings of bubbles in a circle or figure 9; Wiley et al., 2011). Other behaviors which utilize the environment include mud-ring fishing by bottlenose dolphins in Florida in which the dolphins use the shallows to create mud-rings to encircle and capture fish (Lewis & Schroeder, 2003; Torres & Read, 2009). Irrawaddy dolphins (*Orcaella brevirostris*) spit water in conjunction with feeding, but little has been reported on this behavior otherwise (Stacey & Hvenegaard, 2002).

## Object Use in Play

When object use is not seen in association with foraging, it may be explained as play behavior. Play is well documented in human and non-human animal species, including cetaceans (Fagen, 1981). Despite this, a universal definition has been difficult to establish due to the various motivations thought to drive play (Barber, 1991; Burghardt, 2005; Fagen, 1981; Kuczaj & Horback, 2013; Martin & Caro, 1985; Paulos et al., 2010; Smith, 1982). Burghardt's (2005) criteria for play includes: behaviors which are not associated with any other function; are spontaneous and voluntary; repeated but not stereotyped in form; different in form, duration, and frequency from other behaviors; and occur in healthy animals free from stress (Burghardt, 2005; Kuczaj &

Horback, 2013). For young animals, play can take the form of practice and development of predatory or foraging behaviors, but this practice is not essential in the development of these skills (Fagen, 1981). Play also appears to be important for exploration, social bonding, behavioral flexibility and innovation (Caro, 1995; Fagen, 1981; Hall, 1998; Mann & Smuts, 1999). For adult animals, play is less frequently observed and its function is less clear (Hall, 1998). To interpret the function of a play bout, knowing the context in which the behavior occurs is essential. For example, many instances of play behavior often appear agonistic (Fagen, 1981; Kuczaj & Horback, 2013). Play has also been observed in non-aggressive behavior between species, giving information about the type of association and intent (Herzing et al., 2012; Mitchell, 1991). As Kuczaj and Horback (2013) point out, play is important for “flexible thought and flexible communication” (p. 101) and is also often associated with positive affect (Bekoff, 2007).

Object play by cetaceans is usually given as an explanation when other possible conclusions are not apparent or do not correlate with known behavior such as foraging. The play behavior includes objects being thrown into the air, draped around the body, splashing, aerial displays, posturing, chasing or capturing, shaking, or biting (Herzing et al., 2012; Kuczaj & Horback, 2013; Kuczaj & Yeater, 2007; Mann & Smuts, 1999; Ritter, 2002). For example, young bottlenose dolphins have been seen carrying seaweed in their mouths, chasing each other and grabbing the seaweed (Mann & Smuts, 1999). Rough-toothed dolphins have been observed displaying cooperative play by throwing plastic to each other (Kuczaj & Yeater, 2007), pushing tortoises and inflated puffer fish, carrying plastic bags on their fins, and pushing plastic bags out of the water with their rostrum (Ritter, 2002; Steiner, 1995). Interspecies play interactions have been observed between humpback whales and bottlenose dolphins (Deakos et al., 2010) as well as between an Atlantic spotted dolphin and a bottlenose dolphin (Herzing et al., 2012). Play of this type involves the correct interpretation of responses by and toward participants and demonstrates complex communication (Mitchell, 1991).

### **Object Use in Non-Play Social Situations**

Many instances of object play can be social, including some form of cooperation, but play is not the only time objects have been observed in social interactions or in a social context. Social interactions involving objects may evolve through social transmission, or observational learning including imitation, and may be socially reinforced or influenced (Galef & Giraldeau, 2001; Kuczaj & Yeater, 2006; Lanland, 2004). The river dolphin has been regularly observed with objects during social interactions, some of which may be part of social-sexual behavior (Araujo & Wang, 2012; Martin et al., 2008). The behavior is seen year round with peaks in March and July (Martin et al., 2008). Objects used by the river dolphins included sticks, branches, floating grass and vegetation, leaf litter balls, and clumps of hard clay (Araujo & Wang, 2012; Martin et al., 2008). The objects are thrashed or thrown by the dolphins as they spin around with their heads out of the water and the object in their mouth (Martin et al., 2008). Objects have also been observed lifted or dragged through the water or on the surface, usually in the presence of other dolphins (Araujo & Wang, 2012). Initially the behavior was considered as possibly play however this was soon discarded. The context, group size, and composition (females and males) and that it was primarily an adult male behavior which took place in conjunction with male aggression (biting, striking with the tail, leaps or lunges on top of another dolphin), lead Martin et al. (2008) to conclude it was an important part of socio-sexual displays. Further observations by Araujo and Wang (2012) of four river dolphins in a geographically separate location concur that the behavior was more likely to be socially motivated rather than part of play or foraging. An important element of the behavior seen by Martin et al. (2008) was that adult males predominantly carried objects; only a small number of adult female carriers were observed. Araujo and Wang (2012) also suspected three of the four dolphins they observed were male due to coloration, size and appearance. Positive identification of the fourth dolphin observed was not possible (Araujo & Wang, 2012).

Fedorowicz, Beard and Connor (2003) give an example of another type of social interaction involving objects, that of resource sharing. The researchers describe a fish being shared between a male and female bottlenose dolphin for 30 minutes before being consumed. Connor and Norris (1982) note other instances of resources sharing by false killer whales (*Pseudorca crassidens*) and rough-toothed dolphins. Brower and Curtsinger (1979) observed rough-toothed dolphins passing a fish to other conspecifics with one dolphin appearing to be the keeper of the fish.

Less frequently seen is interspecific resource sharing which may overlap with possible play (Fagen, 1981; Holmes & Neil, 2012). One study by Holmes and Neil (2012) describes the behavior of provisioned wild bottlenose dolphins, which brought fish to staff on 23 occasions across 13 years. The frequency of bringing staff fish increased in later years. Holmes and Neil (2012) attribute this to a more established relationship between the dolphins and staff, possibly indicating a level of trust from the dolphins towards the staff (Holmes & Neil, 2012). Holmes and Neil (2012) term this behavior as *gift giving*. There were no gender or age preferences in the dolphins that presented the fish, however two females presented 35% of the fish (these dolphins did not engage in the behavior when lactating; Holmes & Neil, 2012). The researchers found that gift giving was likely influenced by attendance rates, seasonality, social and sexual activity. Gift giving occurred more frequently in winter and autumn (March to August), times inversely related to prey availability. During spring and summer social and sexual activity was observed, calves were born between August and January. Gift giving was reduced at these times. Holmes and Neil (2012) suggest the dolphins may have had less energy to invest in the gift giving and play behaviors over spring and summer due to courtship, mating and caring for young.

Despite the sporadic reports and limitations in observing object use, the literature presents ample evidence that cetacean species are seen with and use objects for a variety of reasons. Examples have been seen of Australian humpback dolphins and provisioned bottlenose dolphins using objects. These reports are of particular interest to the present study, which focuses on provisioned wild Australian humpback dolphins. Object play and giving were described as an established yet infrequent part of a provisioning program involving bottlenose dolphins and was thought to indicate a bond between the dolphins and the humans (Holmes & Neil, 2012). Studies describing Australian humpback dolphins show objects in conjunction with foraging, indicating possible complex foraging processes (Parra, 2007). Whether or not these examples are isolated cases deserves further investigation to determine if object use is common to provisioned dolphins and Australian humpback dolphins elsewhere.

## **Present Study**

The present study explores object use by provisioned wild Australian humpback dolphins. Observational data from anecdotal evidence was used to describe objects carried by provisioned wild Australian humpback dolphins and offer some preliminary reasons as to why this behavior may occur. Object type, dolphin, behavior, date and photographic records were collated from daily attendance data, staff interviews and anecdotal records. It was hypothesized that the behavior would be associated with social interactions rather than foraging. This aligns with observations of other provisioned dolphins and wild dolphins in non-foraging object interactions. As the study dolphins are observed during a provisioning interaction, foraging as a motivation for the object use was less likely to be expected.



## Method

### Study Animals and Site

This study focused on a small group of provisioned wild Australian humpback dolphins. Little is known about this newly listed species of humpback dolphin, *Sousa sahulensis*, (Jefferson & Rosenbaum, 2014). These dolphins are found in small groups in the waters of northern Australia and New Guinea, ranging from southern Queensland, northern Australia to Western Australia and as south as Ningaloo Reef (Brown et al., 2016; Parra, Corkeron, & Marsh, 2004). This species was previously classified as the Indo-Pacific humpback dolphin (*Sousa chinensis*) and listed as *Near Threatened* in the Red List assessment by the International Union for Conservation of Nature (IUCN; Reeves et al., 2008). *Sousa sahulensis* are not currently under any international listing, but in Queensland have been reclassified as *Vulnerable* under the Queensland Nature Conservation Act 1992 (Queensland Government, 1992). A detailed outline of their conservation status can be found in Parra and Cagnazzi (2016).

The study animals are part of a resident population of 68 to 78 Australian humpback dolphins found in the southern end of the Great Sandy Strait (Cagnazzi, Harrison, & Ross, 2011), located between southeast Queensland's mainland and Fraser Island. The Great Sandy Straits is 70 km long with approximately 1000 square kilometres of marine, estuarine, and intertidal wetlands divided into two main bodies of water (the Northern Great Sandy Strait and the Southern Great Sandy Strait). These are connected by a central section of tidal channels and mangrove islands. The study dolphins are part of a provisioning program in Tin Can Bay, which had its beginnings in the 1970's when fishers would throw left over fish to dolphins (McLeod, 2012). By the 1990s attempts to manage the feeding were being made as it drew in tourists (Garbett & Garbett, 1997), and in 2005 it was licensed by the Queensland state government (McLeod, 2012). Tin Can Bay is a small seaside town along the Coolooloa coast within the southern end of the Great Sandy Strait with a population of around 1,994 inhabitants (Australian Bureau of Statistics, 2011). The provisioning takes place in Snapper Creek, at Norman's Point, approximately ten kilometers from the nearest opening to the Pacific Ocean. The feeding area is in front of Barnacles Café, on a small beach of sandy mud substrate. The feeding is overseen by the Barnacles Dolphin Feed Staff and takes place in water approximately waist to ankle depth depending on the tide. Water visibility is good to poor depending on weather conditions (T. Barber, personal observation).

Five dolphins, four adults and one juvenile participate in the daily provisioning. Not all five dolphins will attend at once (T. Barber, unpublished data). The dolphins are known as Mystique, Patch, Harmony, Ella, and Squirt (see Table 2 for demographic characteristics of the dolphins based on anecdotal evidence). Mystique and Patch (both male) visit and feed more often than the other dolphins and usually arrive and leave together (T. Barber, unpublished data). Adult dolphins (greater than 10 yrs or of adult size) are fed a maximum of three kilograms of fish per day, juveniles (4 to 10 yrs) are fed a maximum of two kilograms per day. Dolphins less than two years of age are not permitted to be fed. The provisioning takes place every morning at 0800 hrs. Dolphins will arrive up to two hours before the beginning of the provisioning and leave shortly after provisioning ends around 0830 hrs (T. Barber, unpublished data). From 0700 until when the dolphins leave, tourists enter the area, before this time only staff are in attendance.

Table 2  
*Demographic Characteristics of the Study Dolphins from Anecdotal Records*

Dolphin	Gender	Age/D.O.B.	Attended since	Other
Mystique	Male	Adult/D.O.B. 1992	Early 1990's	Calf of original provisioned dolphin Scarry. Attends regularly
Patch	Male	Adult/D.O.B. unconfirmed	2005	Attends regularly with Mystique
Harmony	Unknown	Adult/D.O.B. 2006?	2008	Irregular attendance
Ella	Female	Adult/D.O.B. unconfirmed	Early 2000s?	Calved Squirt
Squirt	Male	Juvenile/D.O.B. March 2012	2012	Calf of Ella

## Data Collection

The data on object carrying reported for this study were aggregated from three sources:

**Daily provisioning records.** A standardized method to record daily attendance data has been undertaken by staff since 1 March 2010. Data collected includes dolphins attending, date, time of arrival, time of feed start, time of feed end, departure time, amount of fish fed, numbers of tourists observing and feeding as well as other observations. These accounts are completed when the dolphins arrive, during or shortly after the end of provisioning.

**Photo evidence.** Photographs taken periodically from 2009 to 2016 and stored by staff into personal collections were accessed. The available photographs were categorized by date taken, dolphin identified, object observed, and photographer. All photographs were released to T. Barber for data collection and publication.

**Staff interviews and personal records.** Interviews were conducted in October 2015 by the author, with three full time staff that had regular interactions with the provisioned dolphins for 7 to 11 years. While these individuals were not scientists, they were highly experienced in identifying the study dolphins. Each staff member consented to be interviewed and were independently asked the same questions regarding personal accounts of objects observed to be brought in by the dolphins to the provisioning area. Questions included the type of object, date observed, identity of the dolphin, activities with the object, and any other personal records (anecdotal notes that may have been kept) of object carrying/use instances. Anecdotal notes were released to T. Barber for data collection and publication.

## Data Analysis

Each individual observation of a dolphin with an object was recorded from the three sources and logged as an interaction into a Microsoft Excel database. Frequencies for each dolphin were totaled noting date, object type seen with, and behavior of dolphin (if known). Objects were listed as either biological (e.g., leaves, rocks, seaweed or live fish) or artificial (e.g., bottles or other human-made objects). Behaviors were assigned to categories of play, foraging or social as defined from the literature (see Table 3 for definitions of behavior categories). Within the social category were subcategories of showing (when a dolphin would bring an object into the fed area but not relinquish the object), and giving (where an object was presented to a person and was relinquished). These categories were further defined as solo, intraspecific or interspecific to designate the behavior between two dolphins versus that between a dolphin and a person.

## Results

Thirty-two events of object use were recorded. Three of these interactions were duplicate records (referring to the same events observed by two of the interviewees in which responses were consistent) and excluded. Twenty-nine unique interactions of object carrying was identified between November 2009 and April 2016 (see Table 4). Twenty-eight interactions occurred when only staff were in attendance, before the public feeding commenced; one interaction was seen during the provisioning. The majority of the records were from staff interviews including personal anecdotal records ( $n = 22$ ). Photographs and interview data ( $n = 4$ ), and photograph only ( $n = 2$ ), and the daily attendance data ( $n = 1$ ) provided the rest of the data. Seventeen interactions had confirmed dates; one occurred in 2009 (photograph), three in 2014 (attendance data and interview data), eight in 2015 (photograph and interview data), and six in the first half of 2016 (photograph and interview data). The majority of records were in 2015 with none between 2009 and 2014. Reported objects were more frequent between November to April; the greatest frequency occurring between December and February (four events per month). See Table 4 for objects listed in chronological order and further details on type, dolphins seen, context, behavior category and data sources.



Table 3  
*Behavior Categories Based on Descriptions From the Literature*

Category	Description	Reference
Play	Objects thrown into air; draped around the body; splashing, aerial displays, posturing, chasing or capturing, shaking, biting, carrying object in mouth or on fin; grabbing object from conspecific; pushing object around in water; throwing object to conspecific; manipulation of another conspecific; repeated actions; seen across age, gender & species; spontaneous & voluntary; often associated with positive affect	Bekoff, 2007; Burghardt, (2005); Deakos et al., 2010; Kuczaj & Horback, 2013; Kuczaj & Yeater, 2007; Mann & Smuts, 1999; Mitchell, 1991; Ritter, 2002
Foraging	Placing object over rostrum while foraging to assist in manipulation of environment & protection of rostrum; diving with object on rostrum during foraging; carrying object on rostrum during foraging activities; using water, bubbles, mud or waves to manipulate prey	Allen et al., 2011; Krutzen et al., 2005; Lewis & Schroeder, 2003; Mann & Patterson, 2013; Mann et al., 2008; Parra, 2007; Sargent & Mann, 2009; Smolker et al., 1997; Torres & Read, 2009; Wiley et al., 2011
Social	Showing- presenting object, objects thrown, dragged, lifted out or thrashed at surface of water; object in mouth; in the presence of mix gender conspecific group; possibly primarily male behavior; associated with aggression; can be socio-sexual display; objects presented but not relinquished	Araujo & Wang, 2012; Martin et al., 2008
	Giving - bringing fish; chewed, passed back & forth; intraspecific tossing of fish; interspecific reciprocal altruism- bringing of fish to human, both genders; objects presented and relinquished	Connor & Norris, 1982; Fedorowicz et al., 2003; Herzing et al., 2012; Holmes & Neil, 2012; Pitman & Stinchcomb, 2002

Table 4

*Chronological Order of Objects Both Live and Inanimate, Including Dolphin, Context, Behavior Category and Data Source*

No.	Date	Dolphin	Object	Source	Context	Behavior Category
1	Unknown	M & P	2 live stingray	Interview	In front of dolphins who swam over to staff travelling slowly keeping rays just below surface (interspecific)	Social – show
2	Unknown	M & P	10-15 unknown fish approx. 12 cm in length	Interview	Brought to staff's feet & kept there btwn dolphins who were tail to tail to form circle, fish between them, clicking btwn dolphins, fish not consumed but released (interspecific)	Social – show
3	Unknown	M & P	Live puffer fish	Interview	P squeezed fish in mouth then M took & squeezed fish; then P took & swam to staff with fish in mouth face on, staff verbal response, P tossed fish at staff, fish bounced off, P grabbed fish (intra & interspecific)	Play Social – give
4	Unknown	S	Branches	Interview	Carried on rostrum into feed area	Social – show
5	Unknown	P	Flowers	Interview	On surface of water flicked around on rostrum (solo play)	Play
6	Unknown	M	Rock 9.3 kg	Interview	Carried on rostrum dropped at staff's feet (interspecific)	Social – give
7	Unknown	M	Beer bottle	Photo & interview	Carried on rostrum & in mouth; held in mouth under water than threw water from in bottle up into the air water sprayed over staff; (interspecific)	Social – show
8	Unknown	M	Brick less speckled	Photo	Carried on rostrum into feed area (interspecific)	Social – show
9	Unknown	M	Rock	Interview	Nudged rock along bottom of the creek in the feed area (solo)	Play
10	Unknown	M	Lrg beer bottle with weed on it	Photo & interview	Carried on rostrum into feed area	Social – show
11	Unknown	M	Live squid	Interview	Carried in mouth put into staff hands who let it go; M grabbed it and bit it, let it go, grabbed it, let it go again then ate it (interspecific)	Social – give
12	Unknown	M	Glass bottle	Interview	Carried on rostrum & presented to staff; bottle was full of sand; staff put hands down & bottle was rolled off rostrum into hands (interspecific)	Social – give
13	11 Nov 2009	M	Brick	Interview	Carried on rostrum into feed area swam around with it approx. 5 min. Then dropped outside feed area	Social – show

(continued)

Table 4 continued

No.	Date	Dolphin	Object	Source	Context	Behavior Category
14	2 Feb 2014	P	Encrusted rock	Interview	Carried on rostrum, gave to staff who gave fish (interspecific)	Social – give
15	14 April 2014	M	Bakers tin	Interview	Brought into feed area, it had shells, sea grass & silt in it; swam around then gave to staff who gave fish (interspecific)	Social – give
16	23 Feb 2014	M	Rock 7.8 kg	Attendance records	Carried on rostrum presented for 5-10 min then dropped at staff's feet (interspecific)	Social – show & give
17	16 Jan 2015	S	Leaves	Photo & interview	On tip of rostrum, flicking around & toward staff (solo & interspecific)	Play
18	20 Jan 2015	P	Sponge	Photo	Carried on rostrum; lifted out of water; S tried to knock off rostrum (intra & interspecific)	Social – show
19	27 Jan 2015	M	Sponge	Interview	Carried on rostrum into feed area, swam around with it for approx. 5 min. Then dropped it outside feed area (interspecific)	Social – show
20	March 2015	P	Plank of wood	Interview	Wood was approx. 1 m long, balanced on rostrum, swam up to staff & dropped into hands, fish was given (interspecific)	Social – give
21	15 Oct 2015	M	Lrg beer bottle w. barnacles	Photo & interview	Carried on rostrum into feed area	Social – show
22	Dec 2015	P	Rock	Interview	Carried on rostrum into feed area	Social – show
23	Dec 2015	M	Sea grass	Interview	Sea grass draped over face; swam over to staff & lifted head out of water; would not give up the grass when verbally asked; turned head & body away from staff; swam out of feed area & dropped grass (interspecific)	Social – show
24	Dec 2015	S	Sea grass	Interview	Carried over rostrum & in mouth; swam to staff with it & tossed at staff feet; verbal response not wanting it; took into mouth & swam to another staff & placed in staff hands who took it & gave fish (interspecific)	Play Social – give
25	13 Jan 2016	S	Small rock	Interview	Carried on rostrum into feed area, swam around with it until it fell off	Social – show
26	16 Jan 2016	P	Bottle	Interview	Carried on rostrum over to staff, Squirt knocked it off (intra & interspecific)	Social – show
27	12 Feb 2016	P	Bottle	Interview	Carried on rostrum into feed area, swam around then swam out of feed area with it (interspecific)	Social – show

(continued)

Table 4 continued

No.	Date	Dolphin	Object	Source	Context	Behavior Category
28	26 Feb 2016	P	Oil filter	Interview	Carried into feed area on rostrum over to staff, dropped at staff feet who gave fish (interspecific)	Social – give
29	13 April 2016	P	Bottle	Interview	Carried on rostrum into feed area during feeding, public present, swam around then left feed area & dropped out of feed area (interspecific)	Social – show

Note. M – Mystique; P – Patch; S – Squirt; Play = 4; Social – show = 17; Social – give = 10

Of the five regularly attending and provisioned dolphins only Mystique, Patch (adult males), and Squirt (juvenile male) were observed carrying objects into or adjacent to the feed area. The adult dolphins were observed with objects most often and the juvenile less frequently (see Table 5). The adult dolphins used a greater range of objects, including larger, heavier and live objects compared to the juvenile. The juvenile male carried leaves more frequently and was not observed with live objects. Tables 4 and 5 show a record of inanimate and live objects, and the dolphins observed with the objects. Objects included biological and artificial matter with the adult males observed with rocks and bottles more frequently than any other objects (see Table 5).

Table 5

Frequencies of All Objects and Dolphins Seen with Them Nov 2009 - April 2016

	Artificial					Biological						Live			Total	
	Bottle	Brick	Wood	Bakers tin	Oil filter	Leaves	Rock	Branch	Sea grass	Flowers	Sponge	Stingray	Puffer fish	Unknown fish		Squid
Mystique	4	2	0	1	0	0	3	0	1	0	1	1	1	1	1	16
Patch	3	0	2	0	1	0	2	0	0	1	1	1	1	1	0	13
Squirt	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	4
Total	7	2	2	1	1	1	6	1	2	1	2	1	1	1	1	

Note. Frequency for stingray, puffer fish and unknown fish are counted as one instance as Mystique and Patch presented them at one event.

## Object Types and Behavior Categories

Combining all data sources, the dolphins were seen with eleven inanimate biological or artificial objects. Six biological (leaves, rocks, branches, flowers, sea grass, and sponges), and five artificial (bottles, bricks, plank of wood, bakers tin, and oil filter) were recorded. See Tables 4 and 5 for more details. The dolphins were also reported with live objects (see Tables 4 and 5) but much less frequently and with less variety (puffer fish, squid, stingray and unknown species of small fish). The interview data indicated interactions with live objects however, this was not observed in the photographic or attendance data records (see Table 4). Only the adult males were observed with fish, which they either herded into the feed area or brought in by mouth. Live fish manipulation was reported infrequently; there was one instance where a live puffer fish was thrown at staff repeatedly and another where a live squid was placed into the hands of one staff member. One interviewee reported the dolphins herding in live stingrays (see Table 4).

The behavioral categories included play and social, with sub categories of showing and giving as proposed reasons for objects being carried (see Table 3 for operational definitions of categories and Table 4 for study data within these categories). The majority of events fell within the social-show ( $n = 17$ ) or social-give ( $n = 10$ ) behavior categories. The behavior category of play was least reported ( $n = 4$ ). The foraging category was excluded as no behavior fitting this context was reported within the provisioning area. Interactions were predominately interspecific, within the feed area or targeting humans, however three included interactions between dolphins, and two solo object play events were reported (see Table 4).

## Discussion

The provisioned dolphins of Tin Can Bay present a unique opportunity to witness a behavior rarely observed in wild Australian humpback dolphins, an understudied species of cetacean. This study contributes to the limited knowledge on Australian humpback dolphins by reporting instances of object carrying behavior seen in optimal conditions where the participating dolphins are well known and observations are ongoing. While the dolphins here represent a subset of a small group of provisioned dolphins (three of the five dolphins), the data collected is the largest representation of object carrying behavior by Australian humpback dolphins. Several findings are of particular importance: Only the male dolphins were reported to engage in the object carrying behavior; the behavior was not restricted by age but differed in frequency (adult males were seen more frequently with objects); there were a wide range of objects both inanimate and live; the objects were seen in social situations and included interactions with people; and there were instances of object play, but no instances of objects used during foraging.

### Significance of the Behavior

Observations of object carrying and use were recorded from 2009 to 2016 with most in 2015 over the months November to April with a peak in December to February. Peak times of object carrying were also found in other studies of cetacean object use (Holmes & Neil, 2012; Martin et al., 2008). Martin et al. (2008) hypothesized a possible link between particular peak times and breeding cycles. It is currently unknown if Australian humpback dolphins have specific breeding seasons as life history data are almost non-existent (Parra & Cagnazzi, 2016). Squirt was believed to be born in March (see Table 2) and if the gestation is 11 to 15 months as with other small odontocetes (Martin et al., 2008), then breeding may coincide with the majority times dolphins were seen with objects. This explanation remains speculative however, as only Squirt's birthdate has been confirmed.

The peak object carrying months of December to February in the current study coincide with warmer weather, during which warmer water and fish spawning increase prey availability (Blaber & Blaber, 1980). This differs to what was found at Tangalooma (Holmes & Neil, 2012), where peak records were in colder months. Why the Tin Can Bay dolphins carry more objects into the feed area in warmer months is unknown. It may be that more abundance of prey results in less effort foraging and more time focused on other objects within the environment. It is also important to consider that the data in the current study is preliminary and that almost half of the object use events were without confirmed dates, which may change patterns of majority and peak times seen.

Why only male dolphins were seen with the objects is also unclear. Gender bias has been reported in Amazon River dolphins, with objects being used primarily by males in social-sexual displays (Araugo & Wang, 2012; Martin et al., 2008). Gender bias in other provisioned dolphins is not noted in the literature, but

two females favored the behavior at the Tangalooma provisioning site (excluding lactation periods; Holmes & Neil, 2012). It may be that the number of the provisioned wild dolphins is smaller at Tin Can Bay (Tangalooma has up to 12 dolphins attending; Holmes & Neil, 2012) and is predominately visited by males, or that female dolphins attending may be lactating and pre-occupied with caring for the calves that usually attend with them (T. Barber, unpublished data). Therefore it is possible that the scope of the data collected in this study did not capture occasions of object use by the female dolphins. As the study only looked at a small group of provisioned dolphins during particular times, any object use by these or other non-provisioned dolphins outside of the study location or time is unknown. Australian humpback dolphins seen with objects are rarely reported in the literature. There are only a few confirmed sightings of unidentified adult humpback dolphins with sponges during foraging, and their gender was not noted (Parra, 2007).

## **Object Type**

While the majority of objects carried and used by wild cetaceans reported in the literature have been biological, the dolphins in the current study displayed a wider preference, with use of artificial objects such as bottles, tins, and an oil filter (Table 5). Why the dolphins carried a wider range of artificial objects compared to other wild cetaceans described in the literature is unknown. It may be that the Southern Great Sandy Strait contains a high number of artificial objects, increasing availability. A wide range of objects has also been observed with Amazon River dolphins, although those objects were biological in nature (Martin et al., 2008). Like other cetaceans, the dolphins in the current study appeared to be taking advantage of items located in the immediate environment, including live fish. They favored larger items (a relinquished rock kept by staff weighed 9.3 kg and bottles were large beer bottles) and seemed to prefer inanimate objects. They also carried larger numbers of harder rather than softer objects (see Table 5). It is unknown why the dolphins chose the items they did, there may be some association with weight, sound or sensation, but without further observations no conclusions of why object types were chosen can be made. Along with the type of object, what they did with the object was considered to determine possible motivations for carrying the items.

## **Tool Use? Likely Not.**

Both adult male dolphins in this study were observed carrying sponges. Unlike other dolphins that use sponges as tools (Krutzen et al., 2005; Parra, 2007; Smolker et al., 1997), these humpback dolphins differed. Sponges were brought into the provisioning area, carried on the rostrum then taken out of the feed area and dropped; they were not seen in conjunction with deep dives, or other foraging behaviors (Parra, 2007). Research shows dolphins may use sponges as protection while foraging (Smolker et al., 1997). Australian humpback dolphins are known to prey on bottom dwelling species of fish (Parra & Cagnazzi, 2016), where using sponges as protection in rocky substrate would be beneficial. Some female bottlenose dolphins of Shark Bay, Western Australia use sponges in this way to protect their rostrums as they forage in rocky terrain (Patterson & Mann, 2011; Smolker et al., 1997). One Australian humpback dolphin in northeast Queensland has been seen in what appeared to be similar behavior (Parra, 2007). Use of sponges in this manner seems unlikely for the dolphins in the current study, given the predominately muddy sand substrate and shallow water in the provisioning area and lack of diving and foraging behavior.

Another confounding variable is the dolphins in the study are given food, and are not frequently seen engaging in foraging in the feed area or during the time they are present. While some foraging has been seen adjacent to the feed area in deeper waters (T. Barber, personal observation), and the dolphins have brought in live squid infrequently which were consumed, foraging within the feed area has not been reported. Therefore it



is not likely to be observed with object use within this context but may occur elsewhere reflecting that reported in the literature (Parra, 2007). The use of sponges as tools therefore remains unconfirmed for observations seen in this study.

While there was no evidence showing sponges as tools, a tool is defined as an object used to achieve a goal (Mann & Patterson, 2013). The dolphins in this study are seen with objects in their interactions with people. One interviewee commented: “The bottle was carried on his rostrum and then in his mouth. He held it in his mouth under water then threw water from in the bottle up into the air so water sprayed over us.” What the dolphins were trying to achieve (if anything) by this action is unknown. The behavior was done close enough to people to wet them, but this may not have been the intention but rather an indirect outcome of another purpose. Behaviors such as these deserve further investigation to determine if they are a form of object use with a goal, play, or something else.

## **Object Play**

Play seems a plausible explanation for some instances of the observed object carrying seen in this study. As described in the literature (Burghardt, 2005; Hall, 1998; Kuczaj & Horback, 2013; Mann & Smuts, 1999), play behavior is often repeated with no apparent other function. The dolphins in the study were seen flicking leaves (often repeatedly), tossing or bringing objects toward other dolphins and people, nudging rocks, and grabbing or knocking off objects from other dolphins (see Table 4). One such example was of Squirt flicking leaves with his rostrum, retrieving them, and repeating the behavior (see Figure 1). He was seen doing this by himself as well as flicking the leaves towards staff (see Table 4 and Figure 1). Squirt was also observed in a playful manner knocking objects out of the reach of other dolphins or off their rostrums (see Table 4 for more details). Play occurs less frequently with adult animals (Hall, 1998); a pattern that also occurred in the current study. Squirt had a total of four events of object carrying, half of which were categorized as possible play (see Table 4). The adult males Mystique and Patch, were seen up to four times more with objects, (see Table 5) with the majority of their interactions classified in the social behavior categories rather than the play category (see Table 4). It appears that at least for Squirt, objects were being used for play.

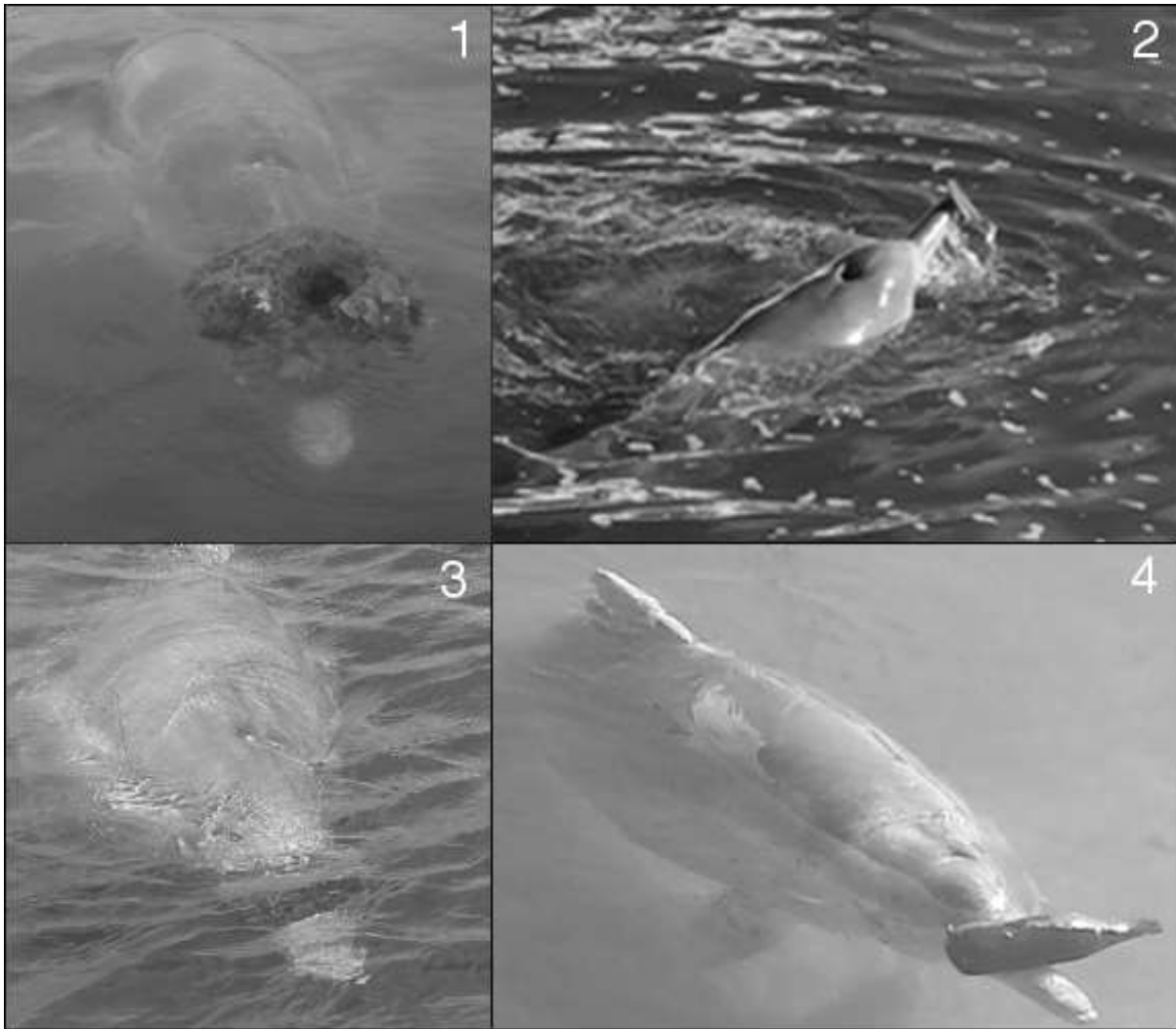


Figure 1. Study dolphins, adult and juvenile male Australian humpback dolphins, *Sousa sahalensis*, carrying 1. Sponge, 2. Leaf on tip of rostrum (juvenile), 3. Brick and 4. Bottle. (Photographs copyright 1. C. Austin; 2. T. Barber; 3. B. Lambert; 4. J. Smith.)

All male dolphins were observed at least once in possible play scenarios (see Table 4). There were more solo play and play directed toward staff than play directed to other dolphins. Play behavior between individuals of different species is rare but has been noted elsewhere and involves the correct interpretation of behavior and appropriate responses between those playing (Deakos et al., 2010; Fagen, 1981; Mitchell, 1991). Interactions between the study dolphins and staff show examples of possible interspecific play where dolphins tossed objects at staff and staff responded by throwing the object back into the water, where it was tossed back again (see Table 4). This possible play interaction indicated an exchange that was mutual with implied understanding of how to respond. Staff also reported feeling uplifted by the interactions (it is unknown what the dolphins were experiencing), another indication of play behavior as noted in the literature (Bekoff, 2007).

## Social Interactions

**Social-show.** While play interactions are one potential explanation for the object behavior seen in this study, the majority of the interactions fell within the social category descriptions. These instances differed from the play interactions in that the objects appeared to have a distinct function in social interactions. Object use in the current study was predominately seen by adult males during social situations, similar to the Amazon River dolphins (Araujo & Wang, 2012; Martin et al., 2008), but different from the bottlenose dolphins seen at Tangalooma where both genders were seen with objects (Holmes & Neil, 2012). In the current study's context, object use may be a type of male social display behavior. The category social-show was described more often than other reasons as a speculated motivation for the dolphins' object carrying behavior (see Table 4). However, unlike the river dolphins (Araujo & Wang, 2012; Martin et al., 2008), the behavior by these humpback dolphins did not seem to be associated with social-sexual displays. There was no aggressive behavior between the males reported during the object use; there was tossing of objects but no lunging or biting was reported. The two adult males who most often attended together (T. Barber, unpublished data) were rarely aggressive towards each other or other dolphins in conjunction with object carrying. It would be worth investigating further if object type and/or behavior category was positively correlated to attendance rates of female dolphins or possible breeding seasons, as these behaviors may indicate some link to social-sexual displays as seen with the river dolphins (Martin et al., 2008).

The lack of aggression seen with the dolphins in the current study is important for interpreting possible motives for the object use and indicates a positive relationship between the two males that has been ongoing, at least during the provisioning (T. Barber, unpublished data). Non-aggressive behavior was consistent also in the presence of an attending female dolphin (T. Barber, personal observation). It is not known if the affiliative behavior continued outside of the provisioning interactions, however the male dolphins were often seen arriving and leaving together without any agonistic interactions (T. Barber, personal observation).

Along with male relationships, the influence of social development and learning are factors worth considering. Squirt the juvenile male carried and manipulated objects but was not seen with objects larger than leaves or sea grass (i.e., small rock) until 2016 when he turned four. Change in object type, weight or purpose may be part of social development as a male, although caution in assuming this should be taken as this is only one account, and very little is known about the development of this species. The behavior may also have been learnt. Object use has been linked to social learning through observation (Kuczaj & Yeater, 2006). Rock carrying by Squirt may have been learnt by observing the adult males carrying rocks, although it is unknown if he was present at those times. A more likely explanation may be that the object behavior has been learnt through reinforcement from staff either from attention or fish reward. Verbal praise by the staff was often given and may have reinforced the behavior. Fish rewards were given less, but were reported (see Table 4). Even intermittent food reward could act as a reinforcer for the behavior. Both social interaction and/or fish could increase the chance of operant conditioning occurring and may have been how all three dolphins learnt to bring in objects. Additional observations are needed to tease these explanations apart.

**Social-give.** The dolphins also were described giving objects to people, similar to the Tangalooma provisioned dolphins (Holmes & Neil, 2012). Behaviors such as these may be associated with complex social relationships (Connor & Norris, 1982). The dolphins may even be treating humans as conspecifics, a phenomenon known as *assimilation tendency* (Hediger, 1964, as cited in Trone, Kuczaj, & Solangi, 2005). Trone et al. (2005) described assimilation tendency as possibly occurring between captive dolphins and humans. The dolphins in this study have had long-term regular contact with staff and giving objects may be an

indication of assimilation tendency. The dolphins carried objects to staff, placing or dropping the object onto the feet or into hands of the staff, turning their head away if the object was returned (see Table 4). Inanimate objects such as a plank of wood and bottles were given. As described by one staff member: “He carried it on his rostrum and presented it to us. The bottle was full of sand. I put my hands down in the water and the bottle rolled off his rostrum into my hands.”

Other examples included tossing or giving objects such as a puffer fish:

Patch was squeezing the fish in his mouth then Mystique took it and squeezed it. Then Patch took it and swam up to us with the fish in his mouth face on. I said I didn't want it but Patch tossed the fish at me which bounced off my chest and Patch grabbed it again.

Puffer fish carry an extremely toxic neurotoxin known as tetrodotoxin (Lago, Rodriguez, Blanco, Vieites, & Cabado, 2015), and dolphins have been seen chewing on puffer fish to become intoxicated (Kankudti, 2014). Resource sharing within species has been observed in a number of cetaceans (Fedorowicz et al., 2003; Pitman & Stinchcomb, 2002), but interspecies sharing of resources are rarely reported (Connor & Norris, 1982; Holmes & Neil, 2012). The examples from the current study could be seen as interspecific giving, and have been interpreted as such by the people receiving the objects. However, the interaction could also fall within definitions of play (see Table 4) and puffer fish have been objects of play for rough-toothed and bottlenose dolphins (Holmes & Neil, 2012; Steiner, 1995).

Gift giving was noted as an irregular but distinct component of the Tangalooma provisioned dolphins' behavior although all reports were of fish, live or dead, and not with objects, such as wood or bottles (Holmes & Neil, 2012). As Holmes and Neil (2012) concluded, an exact reason for the behavior of giving or sharing is difficult to ascertain. Dolphins are noted for their flexible adaptive behavior and learning, and responses to novel situations (Connor & Norris, 1982). There may be a range of motivations driving the behavior, including aspects of the relationship between the participating dolphins and humans where humans may be treated as conspecifics (Hediger, 1944 as cited in Trone et al., 2005; Holmes & Neil, 2012). It may also be a behavior that is associated with trust and thus takes time to develop. The first instance in the current study was recorded in 2009 but the provisioning program has existed since the 1990s (T. Barber, unpublished data). Instances of object carrying and sharing or giving (or at least the reporting of it) increased over the years. This was also observed at Tangalooma (Holmes & Neil, 2012). It should be noted that this increase seen in the current study may also reflect inconsistent reporting, particularly since the data from the standardized attendance records contributed very little of the study's data ( $n = 1$ ).

## **Confounding Factors**

This study provides a glimpse into the behavior of object use by provisioned wild Australian humpback dolphins in Tin Can Bay. However, it is only based on a limited number of infrequent anecdotal records describing a small number of male dolphins during a specific time of the day. It is unknown if these dolphins carry objects otherwise, or if non-provisioned dolphins, male and female, living in the area also carry objects. As many of the object carrying interactions did appear to be interspecific within a social context, the benefits for Australian humpback dolphins utilizing objects as a species is unclear. Although there have been observations in northeast Queensland and also in Western Australia of other Australian humpback dolphins carrying sponges (Parra, 2007), caution is recommended in attributing object carrying as a regular behavior of this species due to the preliminary nature of the data collected.

The reliability and validity of the available data within the current study needs to be considered. Object use and carrying was not always reported on the daily attendance forms but was individually recorded by the staff through photographs or diary entries. Photographic evidence is valuable but did not always have the dates associated with the event. Identification of the dolphins was accurate, as the staff knew the dolphins well and saw them on an almost daily basis, however other occurrences may have been missed and those observed may have been misinterpreted. Continued observation and standardized recording of object carrying and use is recommended, as further data may reveal additional information about the purpose of the behavior.

## Conclusions

The hypothesis that the object carrying behavior was predominantly social was supported. Unlike provisioned dolphins at other sites, only the male provisioned, Tin Can Bay Australian humpback dolphins participated in object carrying and use. While this gender bias is similar to the male Amazon River dolphins' use of non-edible biological objects, the Tin Can Bay dolphins differed in that they included people in their interactions and it is unconfirmed if the behavior was social-sexual in nature. The lack of aggression between the males and the inclusion of staff during the interactions suggest that the carrying of objects represents interspecific affiliate behavior comprising of showing or giving an object. This appears similar to the Tangalooma dolphins, although both male and female dolphins at that site did give objects. It is also likely although unconfirmed, the behavior may be developed through social learning, observation or reinforcement. Showing or giving of objects to people may be a behavior unique to provisioned wild dolphins, and therefore deserves further investigation. It does seem to be part of the behavior of the male dolphins in this study's group of provisioned wild humpback dolphins.

This study contributes to the understanding of how cetaceans use objects in a variety of ways and contexts both within and between species. Continued observations are needed to determine if the behavior is seen in both genders of the wider population of non-provisioned Australian humpback dolphins within the Great Sandy Straits. Additional research on the Australian humpback dolphin population in general is needed to determine if object use represents complex cognitive and social functioning of *Sousa sahulensis*, or in this case is simply a byproduct of the human-dolphin interactions in a provisioned area.

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