

Sex-Specific Social Affiliation in Captive Beluga Whales (*Delphinapterus leucas*)

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Abstract

The current study investigated the social affiliations of 21 captive beluga whales housed in two large social groups at a facility in North America. The results revealed that adult male belugas were found in the proximity of other adult males seven times more often than they were found in the proximity of females. By contrast, adult female belugas were almost always found alone. These findings suggest that the male-male associations stem from internally motivated social preferences rather than from ecological constraints or migratory tendencies.

Key Words: beluga, *Delphinapterus leucas*, sex segregation, social affiliation

Introduction

Belugas (*Delphinapterus leucas*) inhabit Arctic and sub-Arctic waters where they are often seen near the edge of polar ice (Braham et al., 1984). Based on genetic information, foraging preferences, and behavior, 19 beluga subpopulations have been identified (Laidre et al., 2015). At least five populations inhabit the Bering, Chukchi, Beaufort, and East Siberian Seas; three populations live in the Hudson Bay area (Colbeck et al., 2013); two geographically isolated (and threatened) populations inhabit the Cook Inlet and the Gulf of St. Lawrence (Jefferson et al., 2012); and the rest of these subpopulations are scattered across the circumpolar region (Jefferson et al., 2012; Laidre et al., 2015).

Information about this species in their natural habitat has been limited to general inferences from data aggregated across direct observations, genetic samples, satellite telemetry, and traditional knowledge from subsistence hunters. Based on these sources, belugas are considered to be highly gregarious animals that congregate at times into very large, mixed sex and age herds

($N = 1,000$ s) (Michaud, 2005; Chernetsky et al., 2011). They appear to be seasonal breeders, with mating occurring during March through April, and births in July through August (Michaud, 2005). Belugas are also seasonally migratory, with movements seemingly tied to the seasonal expansion and contraction of sea ice (Michaud, 2005) and prey distribution (Chernetsky et al., 2011).

Based primarily on evidence collected during subsistence harvests, wild belugas seem to display sex-segregated social groups during much of the year (Kleinenberg et al., 1964; Brodie, 1971; Sergeant, 1973; Heide-Jorgensen & Teilmann, 1994; Brown Gladden et al., 1997; O'Corry-Crowe et al., 1997; Huntington et al., 1999; Mymrin et al., 1999; Boltunov & Belikov, 2002; Michaud, 2005; Loseto et al., 2006; May-Collado et al., 2007; Chernetsky et al., 2011; Krasnova et al., 2012; Colbeck et al., 2013; Citta et al., 2017; Smith et al., 2017). There is evidence that such sex segregation occurs during periods of migration (Krasnova et al., 2006, 2009; Karenina et al., 2010, 2013), and in the summer months during which births occur (Michaud, 2005).

Observations of a free-ranging Russian beluga population indicate that juvenile animals appear to be part of the same groups as their mothers (Krasnova et al., 2006, 2009; Karenina et al., 2010, 2013)—affiliations that can doubtless be explained by the well-known benefits of maternal care in mammals. Once in their summering water, where larger groups of belugas congregate, unrelated adult females are found in proximity to one another (Colbeck et al., 2013). Beyond that, little else is known about the social behavior of belugas, especially with respect to why male belugas live separately from these female-calf groups for much of the year.

Sex segregation is not unique to belugas, and a number of accounts have been offered for interpretation of such patterns in other species. For example, sex segregation has been explained as a need for males to migrate earlier than females

to compete for prime territories; this pattern is seen in northern elephant seals (*Mirounga angustirostris*; Stewart, 1997), and it occurs commonly in many song bird species (Newton, 2008; Morbey & Ydenberg, 2001; Maggini & Bairlein, 2012). Alternatively, there is evidence that males separate from females in other species to take advantage of different food sources. For example, many seabirds (Ishikawa & Watanuki, 2002; Bearhop et al., 2006), southern elephant seals (*Mirounga leonina*; Lewis et al., 2006), and mustelid carnivores (Dayan et al., 1989) display specialized foraging differences based on sex.

In other species, sex segregation appears to be related to maternal efforts to provide neonates with optimal care. For example, both humpback (*Megaptera novaeangliae*) and gray (*Eschrichtius robustus*) whale mothers linger with their calves in warm southern waters long after the males of their species have departed for their northern feeding grounds (Jones et al., 1984; Brown et al., 1995). Access to mating has also been proposed to explain sex segregation such as when males temporarily separate themselves from females to form male-male alliances that are then used to secure females during mating through cooperative and coordinated efforts. This strategy appears to occur in chimpanzees (*Pan troglodytes*) and baboons (*Papio* spp.; Harcourt & de Waal, 1992), and in bottlenose dolphins (*Tursiops aduncus*; Connor et al., 2000, 2017).

Systematic studies that evaluate the degree of proximity, synchrony, and coordinated swim patterns between pairs and groups of belugas are needed to better understand the affinity of belugas to affiliate and interact with others (e.g., Carter et al., 2013; Menz et al., 2017). Observations made in captive social groupings can sometimes provide the opportunity to do just that in ways that can inform observations made in wild settings as has already been demonstrated for socio-sexual behavior, maternal care behavior, and calf behavioral development in the beluga (Hill, 2009; Glabicky et al., 2010; Hill et al., 2013, 2015). From this perspective, the goals of the present study were to determine if evidence for the sex segregation that is characteristic of wild belugas was also present in captive belugas and, if so, what insights into the underlying nature of sex segregation could be gleaned.

Methods

Subjects

Twenty-one belugas housed at Marineland of Canada served as the subjects of this investigation: 14 belugas (4 males, 10 females) were previously

wild caught from the Chukchi Sea. At the time of this study, they were estimated to be between 11 and 25 y of age, based on their sizes and time in captivity (8 to 13 y). Seven belugas (2 males, 5 females) were born at the Marineland facility and ranged in age between 6 and 10 y old.

Throughout the period of observation, the belugas were housed in two separate pools that also included juvenile animals (ranging between 0 and 5 y of age). Pool One (9 million liters) included four adult males (2 wild born, 2 captive born), five adult females (all captive born), and also two juvenile males and four juvenile females (all captive born). Pool Two (5.5 million liters) contained two adult males (both wild born), ten adult females (9 wild born, 1 captive born), and also two juvenile males and five juvenile females (all captive born).

Procedure

Between September and December of 2016, a scan-sample procedure was used to repeatedly assess the social state of each adult male and female whale. These observations were always made between 0700 and 0800 h, in only one pool on any given day, and only on days when no other research or husbandry procedures were taking place. At intervals of approximately 9 min, each adult male and female whale successively became the focal whale, and the identity of any whales within one body length of the then-focal whale was recorded. The number of days per pool was evenly distributed across months, but the number of observation days per pool differed due to availability. In Pool One, 108 scans were conducted across 15 separate days. In Pool Two, 59 scans were conducted across 12 separate days.

Data Analyses

The scan data were summed for each animal and converted into proportions by dividing the total number of scans in which an adult male was within one body length of the focal whale by the number of possible adult male partners, and then dividing by the number of scans. The same procedure was used to compute the proportion of scans in which each whale was within one body length of an adult female as a function of the possible number of female partners and the number of scans. To determine if the data could be collapsed across both pools and origin of animal (wild born vs captive born), a two-way between-subjects ANOVA was performed. No significant effects emerged, and the data were collapsed. A mixed-model two-way ANOVA was performed to examine the effect of sex of the focal individual (between-subjects variable) and partner sex (within-subjects variable) on the proportion of swims in proximity with another

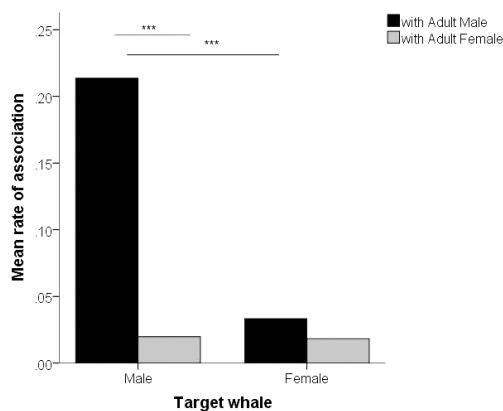


Figure 1. Sex-specific associations in captive beluga whales (*Delphinapterus leucas*). Adult male belugas associate with other males more often than with females, and more often than females associate with either sex. *** indicates significant differences, $p < 0.001$.

animal. One-way ANOVAs were performed to test any significant interaction effects.

Results

There was a significant two-way interaction between sex of focal animal (male or female) and partner sex (with adult male or with adult female) ($F_{(1, 19)} = 35.22$, $p < 0.001$, $\eta_p^2 = 0.65$; Figure 1). One-way post hoc ANOVAs, with Bonferroni correction ($\alpha = 0.03$), indicated that adult males were more often in the presence of other adult males (*Male rate* = 0.21, $SD = 0.12$) than with adult females (*Female rate* = 0.03, $SD = 0.04$) ($F_{(1, 19)} = 28.87$, $p < 0.001$). The rates with which females were found in the proximity of any other whales were much lower overall and did not differ significantly by partner sex (see Figure 1). A significant main effect reflected the fact that male belugas were in the presence of other belugas of either sex (*Male rate* = 0.09, $SD = 0.11$) significantly more than female belugas (*Female rate* = 0.02, $SD = 0.01$) ($F_{(1, 19)} = 47.96$, $p < 0.001$, $\eta_p^2 = 0.72$).

Discussion

A clear pattern emerged in the findings from this investigation. The rate at which adult males were in proximity to other adult males was seven times greater than the rate at which males were in the proximity of females, and the male-male rate was nearly 12 times greater than the rate at which females were with males or females. Despite having access to partners of either sex, the males displayed a consistent preference to associate with

other males. In contrast, the adult females showed a very low same level of social affinity and were within one body length of another adult on only about 3% of the observations. Both of these findings appear to match the broad social patterns exhibited by wild belugas (reviewed by Michaud, 2005; May-Collado et al., 2007), and they emphasize a sharp contrast between belugas and the much higher levels of association seen in dolphins (Wells et al., 1987; Smolker et al., 1992; Connor et al., 2017).

The present investigation, therefore, adds to a growing list of studies in which research conducted with socially appropriate, captive populations find behavioral repertoires and patterns that conform to the behavior of wild populations. For example, various primates display species-typical behaviors when provided with environments that include foraging challenges and appropriate group size (Price & Stoinski, 2007; Yamanashi & Hayashi, 2011). Similarly, bottlenose dolphins in captive settings display repertoires across a number of different behavioral aspects (i.e., maternal care, calf development, play, and pectoral fin contact) that are similar to their wild counterparts (e.g., Reid et al., 1995; Dudzinski, 1998; Gubbins et al., 1999; Mann & Smuts, 1999; Connor et al., 2000; Hill et al., 2007; Dudzinski et al., 2009, 2010; Greene et al., 2011; Kuczaj & Eskelinen, 2014; Dudzinski & Ribic, 2017). Since the pattern of male-male associations observed for belugas in the present study was evident in a captive environment in which an artificial/continuous food supply was provided and in which long-distance travel was not possible, explanations associated with alternative feeding strategies and/or migratory seasons do not appear to account for the social pattern observed.

Although formal assessments of the whales' ongoing behavior were not obtained during the scan-sample protocol used in the present study, casual observation strongly suggested that the observed pattern derived from a male preference to associate with one another (rather than from a tendency for females to avoid the males). During the observation period, multiple instances were observed in which males swam past females in an evident effort to maintain their associations with other males. In many instances, the male-male pairings were associated with the types of social-sexual pelvic thrusting described in Glabicky et al. (2010). Several researchers have reported the same behavior with wild belugas (Michaud, 2005; Lomac-Macnair et al., 2015), except that in the case of one set of observations, the researchers interpreted the behavior as sexual between male and female belugas despite not being able to visually confirm the sex of the two animals involved (Lomac-Macnair et al., 2015). We contend that

this possibility was highly unlikely given that (1) the observations occurred outside the beluga mating period, (2) wild belugas are usually sex segregated at the time of observations, and (3) the behavior photographed conforms closely to the male-male pelvic thrusting described in Glabicky et al. (2010). Ideally, researchers examining wild beluga populations with known sex information will be able to clarify these patterns of behavior.

Ultimately, the benefits experienced by individuals socializing with others must be translated into differences in fitness (Grafen, 1991). In this respect, the male-male associations in belugas may be comparable to those observed in wild dolphin populations (Wells et al., 1987; Smolker et al., 1992; Connor et al., 2000; Gibson & Mann, 2008). As fission-fusion societies, many species of dolphins form temporary sex-segregated groups in which males begin to roam in dyads, triads, or larger groupings that represent alliances that follow females for breeding (Connor et al., 2000, 2017). While belugas also form fission-fusion based social groups, there is no evidence yet that similar male-male alliances play any role in beluga mating behavior.

It is hoped that future research will further illuminate the beluga whale sex-specific social preferences by examining the nature of the interactions between specific adults. Surely the adult males should be examined for the degree to which inter-individual preferences are shown and whether any evidence of male-male cooperation can be seen during the mating season. Lastly, while females may not appear to socialize with other adult females as frequently as do males with males, perhaps the quality and nature of their interactions will be revealed by other measures such as physical contact or the type of social interactions beyond the simple measure of spatial proximity.

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