Drones Assist in the First Report of a Mixed-Species Group of *Tursiops truncatus* (Common Bottlenose Dolphin) and a *Stenella frontalis* (Atlantic Spotted Dolphin) Along the Southeast Florida Coast

Cassandra Volker[1,*], Jessica Pate[2], Denise Herzing[1,3], and Bethany Augliere[1]

Abstract - Cetacean mixed-species groups are common around the world, but little is known about how and why they occur. *Tursiops truncatus* (Common Bottlenose Dolphin) and *Stenella frontalis* (Atlantic Spotted Dolphin) are delphinidae species that have been sighted, separately, along the southeast coast of Florida. Although these species are observed interacting together in other portions of their range, this is the first report of a known mixed-species group of Atlantic Spotted Dolphins and Common Bottlenose Dolphins off the southeast Florida coast. We observed both foraging and social behaviors using a DJI Mavic Pro 2 drone. The function of mixed-species groups is understudied, yet Florida may provide opportunities for future research.

A mixed-species group (MSG) for cetaceans forms when individuals of 2 or more species are found in close proximity for possible evolutionary grouping benefits such as defense from predators, improved foraging, or social interaction (Syme et al. 2021). While MSGs among cetaceans are common and occur around the world (Frantzis and Herzing 2002, Psarakos et al. 2003), large gaps remain in both how and why they form (Syme et al. 2021). Two species of dolphins commonly sighted along the southeast coast of Florida are *Tursiops truncatus* (Montagu) (Common Bottlenose Dolphin) and *Stenella frontalis* (Cuvier) (Atlantic Spotted Dolphin). Few published studies exist on these 2 species on this part of the coast, though both Herzing and Elliser (2016) and Boehning (2022) have reported sighting data for both species in the area.

The Wild Dolphin Project (WDP) has performed 63 surveys along the southeast Florida coast since 2009. WDP's permit stretches from the Martin County line south along the southeast Florida coast down to the Florida Keys; however, most of our survey concentration is between Martin County and southern Palm Beach County. WDP has reported seeing both species on the same day and in close proximity, but never engaging with one another. Boat surveys from other research groups, as well as opportunistic sighting data from divers and boaters, indicate the presence of these 2 species year-round, with anecdotal evidence of an interspecies interaction from another institution (S. Burton, Florida Atlantic University, Harbor Branch Oceanographic Institute, Fort Pierce, FL, unpubl. data; D. Herzing, unpubl. data.; J. Pate, unpubl. data). Reports of MSGs between Atlantic Spotted Dolphins and Common Bottlenose Dolphins exist throughout other portions of their range: the Azores (Clua and Grosvalet 2001), the Gulf of Mexico (Maze-Foley and Mullin 2006), oceanic waters off the coast of southeastern and southern Brazil (de Lima et al. 2021), and many reports in the Bahamas (Cusick and Herzing 2014, Eireman et al. 2019, Elliser and Herzing 2015, Herzing 1996, Herzing and Johnson 1997, Herzing et al. 2003, Melillo et al. 2009, Volker and Herzing 2021). Until now, to our knowledge, there have been no reported observations

[1]The Wild Dolphin Project, 1208 US Highway 1, Suite G, North Palm Beach, FL 33408. [2]Marine Megafauna Foundation, 7750 Okeechobee Boulevard, Suite 4-3038, West Palm Beach, FL 33411. [3]Florida Atlantic University, Dept of Biological Sciences, 777 Glades Road, Boca Raton, FL 33431. *Corresponding author- cassie@wilddolphinproject.org.

Manuscript Editor: Matthew Kimball

of these types of interactions along the southeast Florida coast in the literature. This note reports the first observation, via drone, of an interaction between these 2 species along the coast of southeast Florida, and discusses possible functions of the mixed-species group.

At 0945 EDT on 11 September 2020, we documented a MSG of Common Bottlenose Dolphins and an Atlantic Spotted Dolphin using a DJI Mavic Pro 2 drone. The DJI Mavic Pro 2 drone has a maximum flight time of 31 minutes without any wind and has a maximum flight distance of 18 km at a consistent speed of 50 kph (Mavic 2- DJI 2023). The video camera on the drone has an ISO spanning 100–6400 and the capability of recording in 4k resolution (Mavic 2- DJI 2023).

This MSG was observed ~1 km from shore in 29 °C water at a bathymetric depth of ~8 m, engaging in prey chases and aggression or mating behavior in an outgoing tidal flow from the Jupiter Inlet (26°55'58"N, 80°3'29"W). We initially noted 23 individuals, including at least 1 Atlantic Spotted Dolphin. We analyzed the behaviors captured in the video recording of the observation, which lasted for 21 min and 54 sec. A single Atlantic Spotted Dolphin was seen interacting with the Common Bottlenose Dolphin group for a cumulative duration of 11 min and 32 sec. During the MSG interaction, the dolphins were at the surface for a cumulative duration of 4 min and 49 seconds where specific behaviors were decipherable from the drone footage, while at other times the dolphins were too deep under the surface to adequately document behaviors. In the Bahamas, WDP has observed and recorded both species using a drone, and species identification along with behavioral activity has proven discernable and reliable from the drone footage (D. Herzing and L. McPherson, Wild Dolphin Project, North Palm Beach, FL, unpubl. data).

The drone operator noted that play/mating behavior could be seen from the surface. Our analysis noted that the behavior observed resembled the side-mounting/copulation behavior that has been well documented in the Bahamas between male Common Bottlenose Dolphins and male Atlantic Spotted Dolphins (Cusick and Herzing 2014, Herzing 1996, Herzing and Elliser 2013, Volker and Herzing 2021). However, analysis of this interaction revealed only intraspecific side-mounting between Common Bottlenose Dolphins (Fig. 1). The video reviewers did note that the single Atlantic Spotted Dolphin appeared to try to engage the Common Bottlenose Dolphins (Fig. 2) by swimming ahead in an inverted position, thought to often indicate a solicitation (Herzing 1996, 2000), and by occasionally tail-slapping the water surface, which is often interpreted as an attention-getting signal (Herzing 2000).

Aside from the social behavior, the drone also recorded footage of Common Bottlenose Dolphins tail-whacking fish 3 separate times while feeding in a tidal line (Fig. 3). Our analysis of the video noted that the fish were thrown out of the water after the Common Bottlenose Dolphins' activity. The observed foraging behavior was only performed by the Common Bottlenose Dolphins and was a solitary activity. There was no cooperative feeding among the Common Bottlenose Dolphins, and no Atlantic Spotted Dolphins were observed foraging in the tidal line.

This is the first time that interspecies interactions, similar to those described for Atlantic Spotted Dolphins and Common Bottlenose Dolphins in the Bahamas, have been noted in waters along the southeast Florida coast. With their increasing popularity in wildlife research, drones provide relatively non-invasive opportunities to collect data on marine animal behavior that was previously impossible or difficult to do (Butcher et al. 2021, Oleksyn et al. 2021, Schofield et al. 2019).

According to Syme et al. (2021), MSGs occur because of 3 main benefits: enhanced foraging, social interactions, and better protection against predators. During this MSG, we observed both social and foraging behaviors, but we did not witness any antipredator behavior nor observe any predators, such as sharks.

In the Gulf of Mexico, aggressive behaviors such as jaw snaps and head-butting have been observed within MSGs of Atlantic Spotted Dolphins and Common Bottlenose Dolphins during 2 of 9 sightings (Maze-Foley and Mullin 2006). In the Bahamas, WDP has observed MSGs composed of Atlantic Spotted Dolphins and Common Bottlenose Dolphins engaged in social behavior, such as aggression, including behaviors such as side-mounting

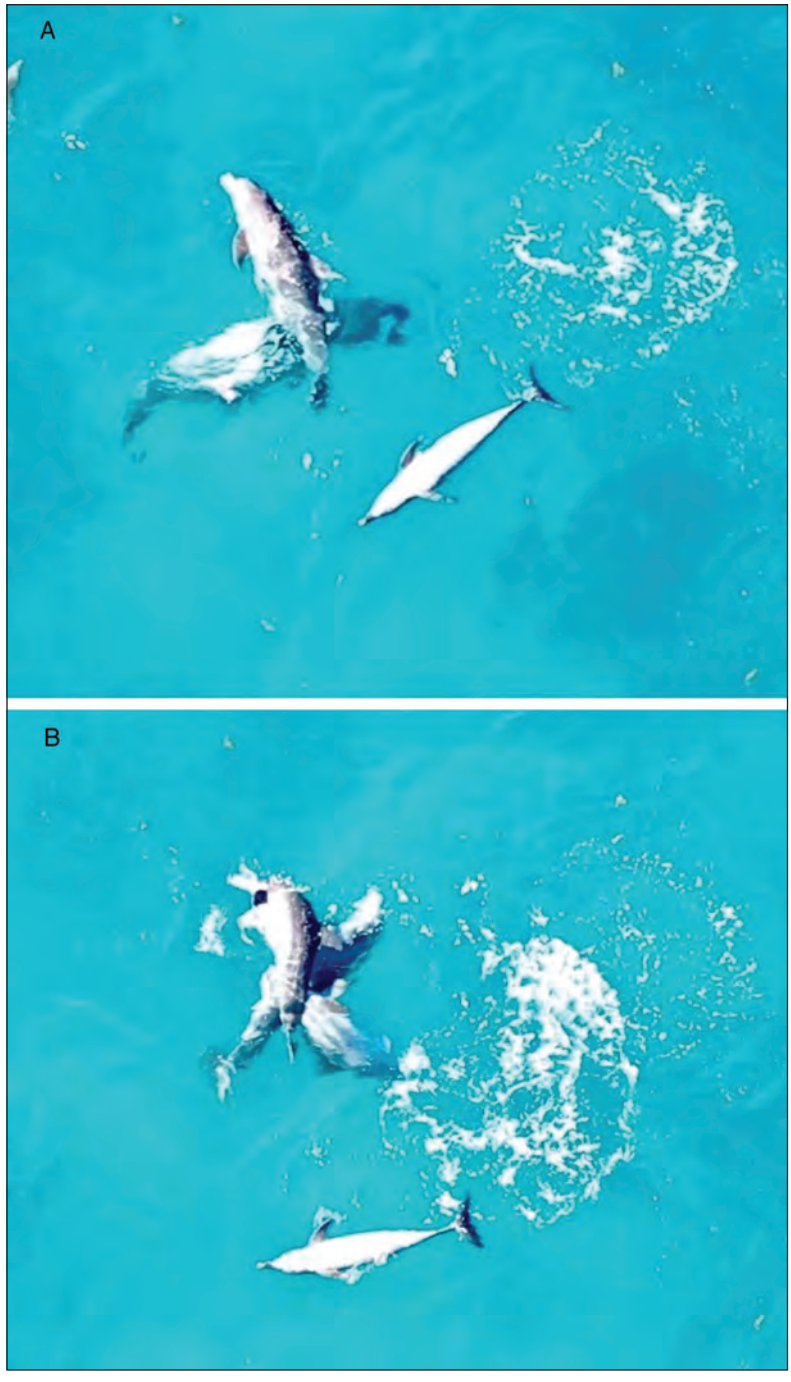

Figure 1. (A) One Common Bottlenose Dolphin lying passive at the surface. (B) A second Common Bottlenose Dolphin approaches from underneath to side-mount the passive dolphin. The dolphin that is inverted in both of the images is an Atlantic Spotted Dolphin. Images captured from drone footage off Florida coast on 11 September 2020.

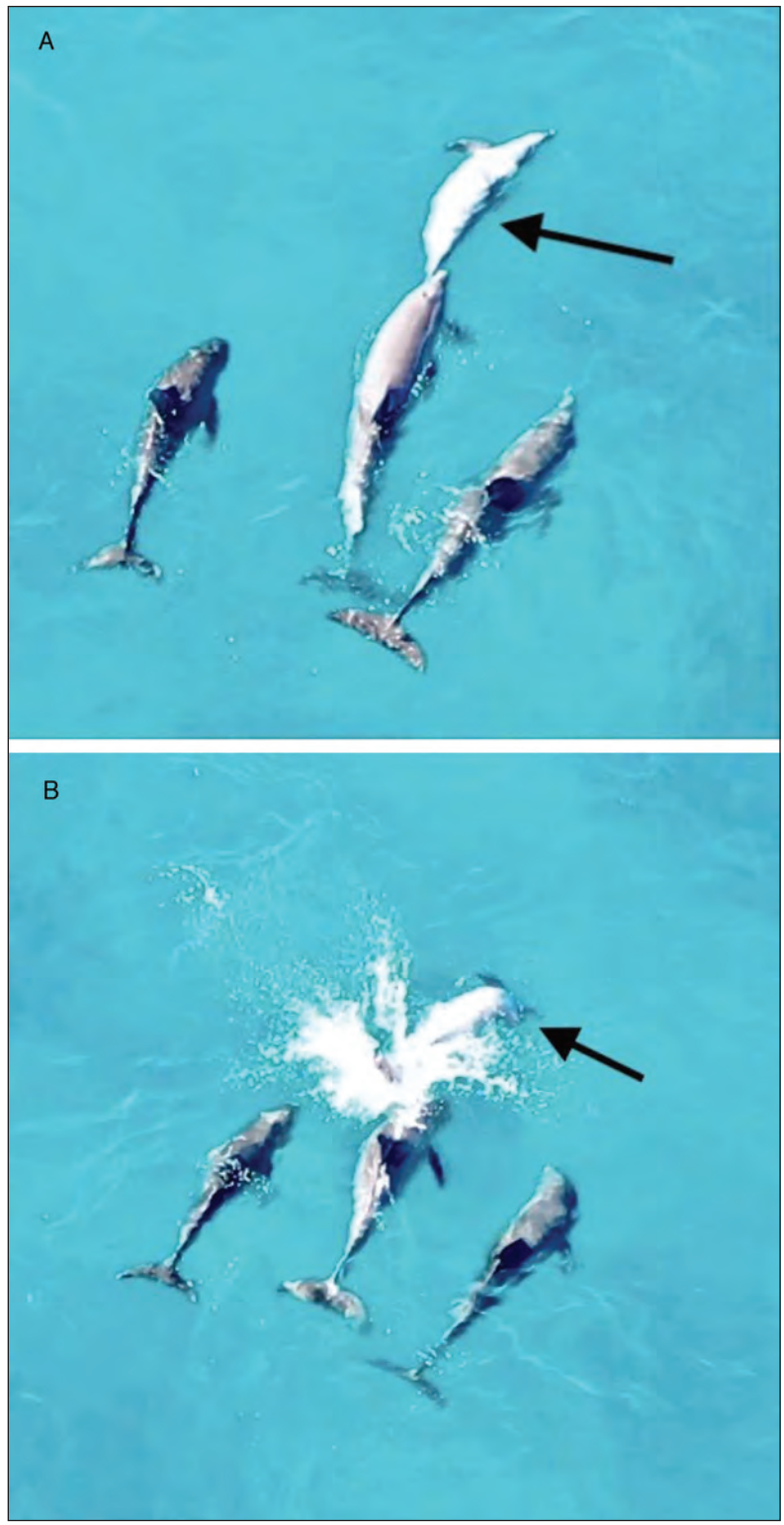

Figure 2. The arrow indicates the Atlantic Spotted Dolphin in both images. (A) An Atlantic Spotted Dolphin swimming in an inverted position ahead of 3 Common Bottlenose Dolphins. (B) The same Atlantic Spotted Dolphin tail-slapping the water surface in front of the 3 Common Bottlenose Dolphins. Images captured from drone footage off Florida coast on 11 September 2020.

and copulation between males of both species (Cusick and Herzing 2014, Volker and Herzing 2021). This behavior is hypothesized to be a dominance display (Herzing and Elliser 2013, Herzing and Johnson 1997). Mating between male Common Bottlenose Dolphins and female Atlantic Spotted Dolphins has also occurred in the Bahamas, and a visual observation of a potential hybrid has been noted (Herzing et al. 2003). Bottlenose Dolphins have been documented to mate with more than 13 species in captivity, and in some cases, produce fertile offspring (e.g., Sylvestre and Tasaka 1985). Therefore, social MSG interactions between these 2 species could provide reproductive opportunities and other benefits associated with social interactions, such as learning (De Brabanter et al. 2017, Syme et al. 2023) and forming relationships (Ellizer and Herzing 2015).

During this particular drone observation, foraging behavior was also captured on video. Documentation exists for both Atlantic Spotted Dolphins (Fertl and Wursig 1995) and Common Bottlenose Dolphins (Bel'kovich 1991, Leatherwood 1975, Shane 1990) collaborating with conspecifics to herd, contain, and share a school of prey fish (Herzing and Johnson 1997). In the Azores, both of these species have also been involved in feeding aggregations together (Clua and Grosvalet 2001). On Little Bahama Bank in the Bahamas, scientists have observed Atlantic Spotted Dolphins and Common Bottlenose Dolphins foraging together about 15 percent of the time, yet the 2 species clearly practice distinct foraging strategies (Herzing and Elliser 2014, Herzing and Johnson 1997, Malinowski 2011, Rossbach and Herzing 1997). During this MSG observation on 11 September 2020, we did not see

Figure 3. A Common Bottlenose Dolphin curves its body to tail whack fish at the surface, sending them flying out of the water. Images captured from drone footage off Florida coast on 11 September 2020.

any Atlantic Spotted Dolphins involved in the feeding bout with the Common Bottlenose Dolphins; therefore, we do not think the 2 species were foraging in close proximity or cooperatively during this MSG interaction.

We hypothesize that the main reason for this MSG was social interaction, since no sightings were made of the Atlantic Spotted Dolphin foraging. To provide more insight into the reasons behind MSGs in southeast Florida, we suggest additional research utilizing drones and traditional behavioral observation techniques to answer why these groups form and their functions.

Acknowledgments. This work was conducted under a NMFS Letter of Confirmation No. 22291 under Jessica Pate.

Literature Cited

Bel'kovich, V.M. 1991. Herd structure, hunting, and play: Bottlenose Dolphins in the Black Sea. Pp. 17–78, *In* K. Pryor and K.S. Norris (Eds.). Dolphin Societies. University of California Press, Berkeley, CA. 405 pp.

Boehning, G.D. 2022. Abundance, site-fidelity, and association patterns of coastal Bottlenose Dolphins (*Tursiops truncatus*) off southeast Florida. M.Sc. Thesis. Nova Southeastern University, Fort Lauderdale, FL. 41 pp.

Butcher, P.A., A.P. Colefax, R.A. Gorkin III, S.M. Kajiura, N.A. López, J. Mourier, C.R. Purcell, G.B. Skomal, J.P. Tucker, AJ. Walsh, J.E. Williamson, and V. Raoult. 2021. The drone revolution of shark science: A Review. Drones 2021 5(1):8. 28 pp.

Clua, É., and F. Grosvalet. 2001. Mixed-species feeding aggregation of dolphins, large tunas, and seabirds in the Azores. Aquatic Living Resources 14(1):11–18.

Cusick, J.A., and D.L. Herzing. 2014. The dynamic of aggression: How individual and group factors affect the long-term interspecific aggression between two sympatric species of dolphin. Ethology 120(3):287–303.

De Brabanter, G.L.B., D.L. Herzing, and S. Jarvis. 2017. Exploration of horizontal information transmission through social learning in juvenile Atlantic Spotted Dolphins (*Stenella frontalis*). Animal Behavior and Cognition 4(4):425–441.

de Lima, R.C., J.C. Di Tullio, E.R. Secchi, F.R. Castro, and G.C. Troina. 2021. Delphinid mixed-species associations in the oceanic waters of the western South Atlantic. Aquatic Mammals 47(1):53–62.

Eierman, L.E., K. Laccetti, K. Melillo-Sweeting, and J.D. Kaplan. 2019. Interspecies pectoral fin contact between Bottlenose Dolphins and Atlantic Spotted Dolphins off Bimini, The Bahamas. Animal Behaviour 157:167–176.

Elliser, C.R., and D.L. Herzing. 2015. Long-term interspecies association patterns of Atlantic Bottlenose Dolphins, *Tursiops truncatus*, and Atlantic Spotted Dolphins, *Stenella frontalis*, in the Bahamas. Marine Mammal Science 32(1):38–56.

Fertl, D., and B. Würsig. 1995. Coordinated feeding by Atlantic Spotted Dolphins (*Stenella frontalis)* in the Gulf of Mexico. Aquatic Mammals 21:3–5.

Frantzis, A., and D.L. Herzing. 2002. Mixed-species associations of Striped Dolphins (*Stenella coeruleoalba*), Short-beaked Common Dolphins (*Delphinus delphis*), and Risso's Dolphins (*Grampus griseus*) in the Gulf of Corinth (Greece, Mediterranean Sea). Aquatic Mammals 28(2):188–197.

Herzing, D.L. 1996. Vocalizations and associated underwater behavior of free-ranging Atlantic Spotted Dolphins, *Stenella frontalis*, and Bottlenose Dolphins, *Tursiops truncatus*. Aquatic Mammals 22:61–80.

Herzing, D.L. 2000. Acoustics and social behavior of wild dolphins: Implications for a sound society. Pp. 225-272, *In* W.W.L Au, R.R. Fay, and A.N. Popper (Eds). Hearing by Whales and Dolphins. Springer New York, NY. 485 pp.

Herzing, D.L., and C.R. Elliser. 2013. Directionality of sexual activities during mixed-species encounters between Atlantic Spotted Dolphins (*Stenella frontalis*) and Bottlenose Dolphins (*Tursiops truncatus)*. International Journal of Comparative Psychology 26(2):124–134.

Herzing, D.L., and C.R. Elliser. 2014. Nocturnal feeding of Atlantic Spotted Dolphins (*Stenella frontalis*) in the Bahamas. Marine Mammal Science 30(1):367–373.

Herzing, D.L., and C.R. Elliser. 2016. Opportunistic sightings of cetaceans in nearshore and offshore waters of southeast Florida. Journal of Northwest Atlantic Fishery Science 48:21–31.

Herzing, D.L., and C.M. Johnson. 1997. Interspecific interactions between Atlantic Spotted Dolphins (*Stenella frontalis*) and Bottlenose Dolphins (*Tursiops truncatus*) in the Bahamas. Aquatic Mammals 23:85–99.

Herzing, D.L., K. Moewe, and B.J. Brunnick. 2003. Interspecies interactions between Atlantic Spotted Dolphins, *Stenella frontalis*, and Bottlenose Dolphins, *Tursiops truncatus*, on Great Bahama Bank, Bahamas. Aquatic Mammals 29(3):335–341.

Leatherwood, S. 1975. Some observations of feeding behavior of Bottle-nosed Dolphins (*Tursiops truncatus*) in the northern Gulf of Mexico and (*Tursiops cf. T. gilli*) off southern California, Baja California, and Nayarit, Mexico. Marine Fisheries Review 37(9):10–16.

Malinowski, C.R. 2011. Nutritional and habitat driven foraging of wild dolphins in the Bahamas: A recipe for prey use. M.Sc. Thesis. Florida Atlantic University, Boca Raton, FL. 101 pp.

Mavic 2- DJI. 2023. Mavic 2: See the Bigger Picture. Available online at https://www.dji.com/mavic-2. Accessed 5 May 2023.

Maze-Foley, K., and K.D. Mullin. 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes, and interspecific associations. Journal of Cetacean Research and Management 8(2):203–213.

Melillo, K.E., K.M. Dudzinski, and L.A. Cornick. 2009. Interactions between Atlantic Spotted (*Stenella frontalis*) and Bottlenose (*Tursiops truncatus*) Dolphins off Bimini, The Bahamas, 2003–2007. Aquatic Mammals 35(2):281–291.

Oleksyn, S., L. Tosetto, V. Raoult, K.E. Joyce, and J.E. Williamson. 2021. Going batty: The challenges and opportunities of using drones to monitor the behaviour and habitat use of rays. Drones 2021 5(1):12. 15 pp.

Psarakos, S., D.L. Herzing, and K. Marten. 2003. Mixed-species associations between Pantropical Spotted Dolphins (*Stenella attenuata*) and Hawaiian Spinner Dolphins (*Stenella longitrostris*) off Oahu, Hawai'i. Aquatic Mammals 29(3):390–395.

Rossbach, K.A., and D.L. Herzing. 1997. Underwater observations of benthic-feeding Bottlenose Dolphins (*Tursiops truncatus*) near Grand Bahama Island, Bahamas. Marine Mammal Science 13(3):498–504.

Schofield, G., N. Esteban, K.A. Katselidis, and G.C. Hays. 2019. Drones for research on sea turtles and other marine vertebrates: A review. Biological Conservation 238:108214.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pp. 245–266, *In* S. Leatherwood and R.R. Reeves (Eds.) The Bottlenose Dolphin. Academic Press, San Diego, CA. 653 pp.

Sylvestre, J.P., and S. Tasaka. 1985. On the intergeneric hybrids in cetaceans. Aquatic Mammals 11:101–108.

Syme, J., J.J. Kiszka, and G.J. Parra. 2021. Dynamics of cetacean mixed-species groups: A review and conceptual framework for assessing their functional significance. Frontiers in Marine Science 8:678173.

Syme, J., J.J. Kiszka, and G.J. Parra. 2023. Multiple social benefits drive the formation of mixed-species groups of Australian Humpback and Indo-Pacific Bottlenose Dolphins. Behavioral Ecology and Sociobiology 77(4):43. 16 pp.

Volker, C.L., and D.L. Herzing. 2021. Aggressive behaviors of adult male Atlantic Spotted Dolphins: Making signals count during intraspecific and interspecific conflicts. Animal Behavior and Cognition 8(1):36–51.