Aquatic Mammals 2009, *35*(1), 43-47, DOI 10.1578/AM.35.1.2009.43

A Novel Case of Non-Offspring Adoption in a Free-Ranging Atlantic Bottlenose Dolphin (*Tursiops truncatus*) Inhabiting the Indian River Lagoon, Florida

Elisabeth M. Howells,[1] John S. Reif,[1, 2] Sarah E. Bechdel,[1] M. Elizabeth Murdoch,[1] Gregory D. Bossart,[1, 3] Stephen D. McCulloch,[1] and Marilyn S. Mazzoil[1]

[1]*Center for Marine Ecosystem Health, Marine Mammal Research and Conservation, Harbor Branch Oceanographic Institute at Florida Atlantic University, 5600 U.S. 1 North, Ft. Pierce, FL 34946, USA; E-mail: ehowells@hboi.fau.edu*
[2]*Colorado State University, Department of Environmental and Radiological Health Sciences, Fort Collins, CO 80523, USA*
[3]*The Correll Center for Aquatic Animal Health, Georgia Aquarium, 225 Baker Street NW, Atlanta, GA 30313, USA*

Abstract

Wild and captive epimeletic care has been reported worldwide in many different species of cetaceans. Epimeletic care can be described as nurturant or succorant in nature. While adoption can be considered an example of nurturant behavior, to date there have been no reported cases of permanent adoption among wild cetaceans. During routine photo-identification surveys, an adult female bottlenose dolphin (*Tursiops truncatus*) was found in the presence of a young calf that was not her own. This mother-calf-like relationship lasted nearly 2 y until the death of the allomother. This paper documents a novel case of free-ranging bottlenose dolphin adoption that occurred in the Indian River Lagoon, Florida.

Key Words: adoption, epimeletic care, nurturant behavior, succorant behavior, allomaternal care, allomother, alloparental, Atlantic bottlenose dolphin, *Tursiops truncatus*, Indian River Lagoon, stingray

Introduction

Epimeletic behavior involves the giving of care or attention to another and can be described as nurturant (care-giving behavior directed towards young) or succorant (supportive, care-giving behavior by an adult in response to distress of another adult) (Caldwell & Caldwell, 1966; Riedman, 1982). Nurturant behavior has been documented in a variety of species such as sperm whales (*Physeter macrocephalus*), killer whales (*Orcinus orca*), and common dolphins (*Delphinus* sp.) (Caldwell & Caldwell, 1966; Riedman, 1982). This behavior has also been described frequently in bottlenose dolphins (*Tursiops truncatus*), both in the wild and in captivity, particularly in cases of calf death where the cow and or a conspecific carries or "stands by" the deceased offspring (Cockcroft & Sauer, 1990; Connor & Smolker, 1990; Harzen & dos Santos, 1992; Fertl & Schiro, 1994; Mann & Barnett, 1999). Allomaternal care is the interaction between infants and non-mothers (Mann & Smuts, 1998) and can be extended to include actual adoption of another individual's young (Riedman, 1982). This adoptive behavior can be considered an extreme example of nurturant behavior.

Adoption, as both a trained and spontaneous behavior, has been documented in captive dolphins (McBride & Kritzler, 1951; Smolders, 1988; Kastelein et al., 1990; Ridgway et al., 1995). Possible adoption in wild cetaceans has been suggested, but the observations were only sustained for < 1 d (Karczmarski et al., 1997; Simard & Gowans, 2004). An unsuccessful case (< 20 d) of short-term free-ranging marine mammal adoption has been reported in sea otters (*Enhydra lutris*) (Staedler & Riedman, 1989), and a 1-mo account exists for polar bears (*Ursus maritimus*) (Atkinson et al., 1996). The Indian River Lagoon (IRL), Florida population is comprised of long-term, multigenerational, resident communities (Howells et al., 2008; Mazzoil et al., 2008b).This paper describes the permanent adoption of a free-ranging calf in the IRL that lasted nearly 2 y without any known apparent benefit to the allomother. This is the first reported case of adoption occurring in the IRL or in a wild dolphin population.

Materials and Methods

The Indian River Lagoon system extends 250 km, north to south, covering one third of Florida's east coast. The IRL ecosystem was divided into six segments based on hydrodynamics and geographic features for purposes of characterization and

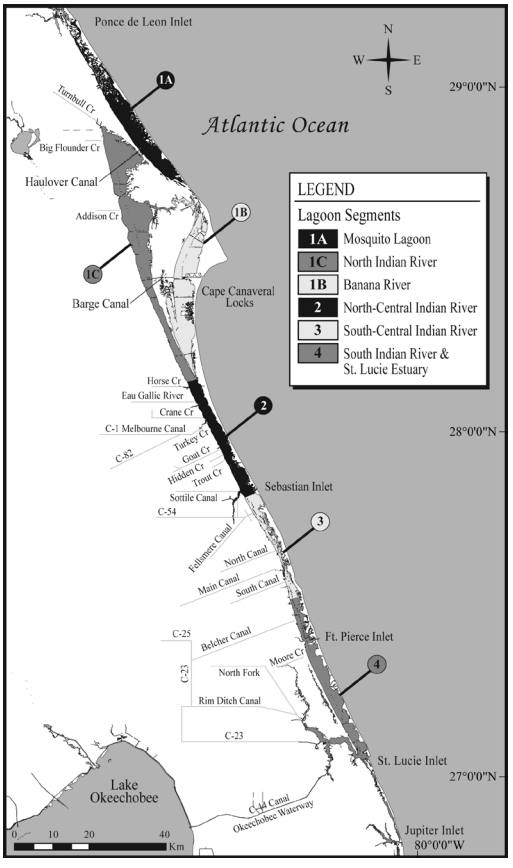

Figure 1. Study area—The Indian River Lagoon broken into six segments, subdivided based on hydrodynamics and geographic features

management (Woodward-Clyde Consultants, 1994; Mazzoil et al., 2008b) (Figure 1).

Data were collected in a primary study area (Mazzoil et al., 2005) and during routine, monthly photo-identification surveys of the entire IRL (Mazzoil et al., 2008b) using a Canon EOS 1D Mark II digital camera system with a 100- to 400-mm lens, aboard 6- to 8-m outboard motorized vessels. Environmental and behavioral data were collected for each dolphin encounter using methods described by Urian & Wells (1996). Photo-identification analyses were conducted as described by Mazzoil et al. (2004).

Mother-calf pairs were assigned when dolphin calves measuring < 75% of the total length of a presumed cow were observed by one of three conditions: (1) as a pair with no other dolphins present, (2) in a group where all accompanying dolphins were confirmed males (from capture/release studies) and/or were accompanied by previously identified cows with their associated calves in attendance, or (3) together in three sequential sightings when seen in a group of dolphins of unknown gender.

Results

Using photo-identification records from 1996 to 2006, over 200 mother-calf pairs were identified in the IRL (Howells et al., 2008). In one case, a female dolphin (CLIF) was first observed in the IRL on 19 September 2001 with a young calf (c1CLIF). She reared this calf for approximately 2 y until he was found dead on 8 May 2003, entangled in recreational fishing gear (HBOI-0310). On 7 July 2003, a Florida Fish and Wildlife Conservation officer reported a dolphin pushing a severely decomposed calf. CLIF and a dead newborn calf (c2CLIF), < 1 wk of age, were identified from photographs obtained from the Southeast Regional Stranding Network (EAI-0305). The following week, on 14 July 2003, CLIF was captured and released as part of a Bottlenose Dolphin Health and Risk Assessment Project (Fair et al., 2006). She had engorged mammary glands, an indication of recent lactation, further supporting her identity as the mother of the dead newborn.

Over the next 18 mo, CLIF was observed and photographed 17 times without a calf through 28 December 2005. One month later, on 24 January 2006, she was observed with a calf (DANE) that was < 75% of her size, in echelon position, that appeared to be < 1 y of age. This calf did not have fetal folds and did not portray any other characteristics of a newborn calf. Furthermore, this calf had not been sighted with another previously identified female dolphin in the IRL. An adult female dolphin was found severely decomposed on 5 December 2005 (HBOI-0518) and was presumed to be the most likely candidate as the biological mother of DANE. After the initial sighting of CLIF and DANE, the relationship was sustained for 22 mo. They were observed during 11 sequential sightings (Figure 2) until CLIF's death on 18 November 2007 from a penetrating stingray barb to the heart (HBOI-0711). DANE has not been seen since her death. For the duration of this time, neither CLIF nor the adopted calf was seen without the presence of the other. Thus, the assumption is made that CLIF adopted the young calf and provided it with the utmost nurturant care.

Discussion

CLIF was a multiparous, reproductive female first observed in 2001. DANE, swimming in echelon with her in January 2006, was too large to be a newborn and did not exhibit any of the characteristics of newborns such as size, coloration, presence of fetal folds, or "popping" out of the water to

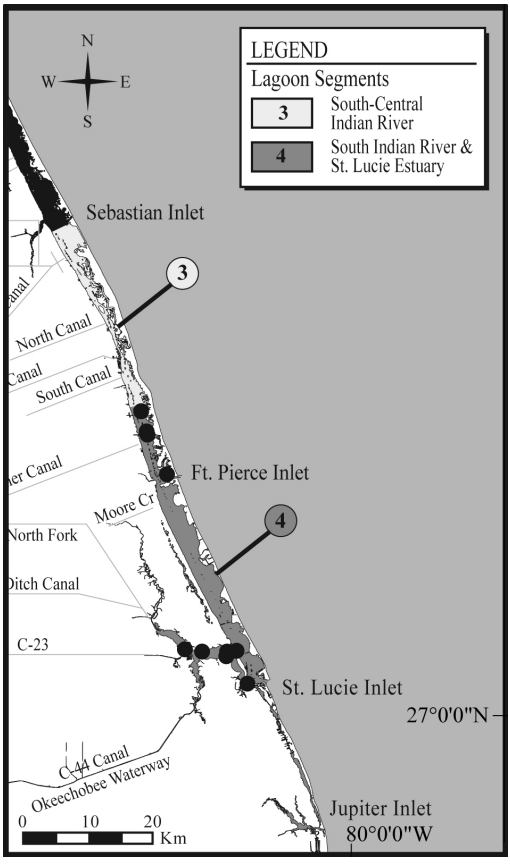

Figure 2. Joint sighting history of CLIF and DANE

breathe (Mann & Smuts, 1999; Mann et al., 2000; Whitehead & Mann, 2000). CLIF provided care to the presumed orphaned calf for nearly 2 y, and a necropsy revealed that she had a first trimester fetus *in utero* at the time of her death. This dependency period is similar to those reported in the IRL, where females become pregnant during the second year of calf rearing (Howells et al., 2008).

Dolphins in the IRL maintain relatively stable, small, home ranges (Mazzoil et al., 2008b). CLIF primarily inhabited the southern Indian River (segment 4), where she was observed in 36 of 39 (92%) sightings. The presumed mother of DANE (ZODI) was recovered dead within this same segment. ZODI was first identified in 2001 and was primarily seen in segment 3 (43%), with four sightings each in segments 2 and 4 (28.5%). Due to advanced decomposition, it was not possible to obtain samples (e.g., milk) or make a positive identification. Skin and teeth were collected for future kinship and age determinations. ZODI was last observed in "emaciated" body condition (Mazzoil et al., 2008a) on 10 August 2005. Although ZODI and CLIF were never seen together, they both utilized segment 4. Further, her first calf, ARIE, dispersed in May of 2004, making the birth of another calf likely during the interim. During the 4-mo lapse in sighting history of ZODI and her presumed death, surveys did not extend beyond segment 3. Therefore, it is feasible that DANE was never seen with its biological mother prior to being adopted by CLIF. During this time, two other previously identified, multiparous females, WTIP (HBOI-0513) and DING (HBOI-0514), were recovered dead within segments 2, 3, and 4. Each cow had been sighted just prior to its death in the presence of their older calves. Their estimated ages were 3 y and 4 y, respectively. These two calves were sufficiently marked and were later seen following the deaths of their mothers. All other calves of known females were accounted for within the three segments. As an interesting side note, DING's calf was seen the day after her mother's death swimming with CLIF in a large group of cows and calves. There is a slight chance that CLIF had recently lost a newborn prior to adopting DANE and was still prepared to provide parental care behaviorally and psychologically (Riedman, 1982), making this chance event more probable. However, it is also possible, although unlikely, that CLIF stole the calf from another female, or that the calf simply became lost and never reunited with its biological mother.

Due to the turbid nature of the water in the IRL, it was not possible to visually confirm if CLIF provided nutritional support by lactation and nursing. However, during CLIF's necropsy, 5 ml of milk was collected which suggests nursing live young. Suckling suppression of estrus does occur, yet there is a minimum stimulus threshold that must be maintained for a female not to go back into estrus (Robeck et al., 2001). Once below this threshold stimulus, a dolphin can return to estrus. It is believed that CLIF was still providing some nutrition to DANE through lactation, but the frequency of suckling dropped below the minimal threshold, enabling CLIF to become pregnant again. Spontaneous lactation has been described in adoptive situations while in captivity (Smolders, 1988; Ridgway et al., 1995; Gaspar et al., 2000). However, captive lactation is offset by food availability (Packer et al., 1992; Gaspar et al., 2000), so there is little to no cost to the allomother. It is possible, given its small size, that CLIF's adoptive calf was not yet surviving entirely on solid food. Wild dolphin calves begin to practice hunting as early as 3-wks-old, and they begin catching small fish between 4 to 6 mo of age (Mann, 1997). In contrast, captive dolphins begin accepting fish between 6 to 12 mo (Caldwell & Caldwell, 1972; Cockcroft & Ross, 1990; Mann, 1997). In Sarasota, Florida, dolphins have been found still lactating with calves

as old as 4.5 y (Wells, 1991). While dolphins begin ingesting fish prior to 1 y, nutrition in the young continues to be augmented by nursing up to 3 to 6 y of age (Wells, 1986; Mann, 1997).

One of the benefits to raising adopted young may be inclusive fitness if there is a high degree of kinship between the allo- or foster parent and the fostered young (Riedman, 1982). In addition to energy expended on lactation, CLIF's maternal fitness may have been further compromised as her own estrus was likely suppressed for a period of time while providing care and protection to DANE. If there was indeed a degree of kinship, then caring for this calf could have contributed to the overall fitness of CLIF and the presumed dependent orphan. At least two orphaned IRL calves, ages 14 and 15 mo, respectively, were not adopted by other dolphins and did not survive abandonment beyond 3 wks (Mazzoil et al., 2008a).

Another benefit of adoption is increased parental experience (Riedman, 1982). Rearing an unrelated calf may have increased the parenting skills of CLIF as she was known to have birthed at least two previous calves that did not survive to dispersal. An understanding of relatedness would help determine the potential fitness sacrifices made by CLIF to raise a calf that was not her own. A comparison of mitochondrial DNA could be used to determine the relationship between CLIF and the presumed dead mother, adding insight as to the costs and benefits of raising this adopted calf.

Although nurturant and succorant behavior has been reported over a wide range of cetacean species, the adult female-calf relationship described here, to the best of our knowledge, represents the first case of long-term offspring adoption in free-ranging bottlenose dolphins.

Acknowledgments

We would like to acknowledge Erik Martin of the Southeast Marine Mammal Stranding Network (SEMMSN) for providing photos of CLIF pushing the deceased newborn calf and all the dedicated staff and volunteers for their time and efforts. Data were collected under National Marine Fisheries Service General Authorization 32 issued to Marilyn S. Mazzoil and Scientific Research Permit No. 998-1678 issued to Dr. Gregory D. Bossart. Funding was provided by the Florida "Protect Wild Dolphins" license plate fund. This publication is HBOI contribution no. 1730.

Literature Cited

Atkinson, S. N., Cattet, M. R. L., Polischuk, S. C., & Ramsay, M. A. (1996). A case of offspring adoption in free-ranging polar bears (*Ursus maritimus*). *Arctic*, *49*, 94-96.

Caldwell, M. C., & Caldwell, D. K. (1966). Epimeletic (care-giving) behavior in cetacea. In K. S. Norris (Ed.), *Whales, dolphins and porpoises* (pp. 755-789). Berkeley: University of California Press.

Caldwell, D. K., & Caldwell, M. C. (1972). *The world of the bottlenose dolphin.* New York: J. B. Lippincott Company. 157 pp.

Cockcroft, V. G., & Ross, G. J. B. (1990). Observations on the early development of a captive bottlenose dolphin calf. In S. Leatherwood & R. R. Reeves (Eds.), *The bottlenose dolphin* (pp. 461-485). New York: Academic Press. 653 pp.

Cockcroft, V. G., & Sauer, W. (1990). Observed and inferred epimeletic (nurturant) behaviour in bottlenose dolphins. *Aquatic Mammals*, *16*(1), 31-32.

Connor, R. C., & Smolker, R. A. (1990). Quantitative description of a rare behavioral event: A bottlenose dolphin's behavior toward her deceased offspring. In S. Leatherwood & R. R. Reeves (Eds.), *The bottlenose dolphin* (pp. 355-360). New York: Academic Press. 653 pp.

Fair, P. A., Adams, J. D., Zolman, E., McCulloch, S. D., Goldstein, J. D., Murdoch, M. E., et al. (2006). *Protocols for conducting dolphin capture-release health assessment studies* (NOAA Technical Memorandum NOS NCCOS 49). 83 pp.

Fertl, D., & Schiro, A. (1994). Carrying of dead calves by free-ranging Texas bottlenose dolphins (*Tursiops truncatus*). *Aquatic Mammals*, *20*(1), 53-56.

Gaspar, C., Lenzi, R., Reddy, M. L., & Sweeney, J. (2000). Spontaneous lactation by an adult *Tursiops truncatus* in response to a stranded *Steno bredanensis* calf. *Marine Mammal Science*, *16*(3), 653-658.

Harzen, S., & dos Santos, M. E. (1992). Three encounters with wild bottlenose dolphins (*Tursiops truncatus*) carrying dead calves. *Aquatic Mammals*, *18*(2), 49-55.

Howells, E. M., Reif, J. S., Mazzoil, M. S., Murdoch, M. E., Bechdel, S. E., Ziemann, S., et al. (2008). Use of photo-analysis of mother-calf pairs to determine reproductive rates in the Indian River Lagoon, Florida. *Proceedings of the Florida Marine Mammal Health Conference*. Marineland, FL. 68 pp.

Karczmarski, L., Thornton, M., & Cockcroft, V. G. (1997). Description of selected behaviours of humpback dolphins *Sousa chinensis*. *Aquatic Mammals*, *23*(3), 127-133.

Kastelein, R. A., Dokter, T., & Zwart, P. (1990). The suckling of a bottlenose dolphin calf (*Tursiops truncatus*) by a foster mother, and information of transverse birthbands. *Aquatic Mammals*, *16*(3), 134-138.

Mann, J. (1997). Individual differences in bottlenose dolphin infants. *Family Systems*, *4*, 34-38.

Mann, J., & Barnett, H. (1999). Lethal tiger shark (*Galeocerdo cuvier*) attack on bottlenose dolphin (*Tursiops* sp.) calf: Defense and reactions by the mother. *Marine Mammal Science*, *15*(2), 568-575.

Mann, J., & Smuts, B. (1998). Natal attraction: Allomaternal care and mother-infant separations in wild bottlenose dolphins. *Animal Behavior*, *55*, 1097-1113.

Mann, J., & Smuts, B. (1999). Behavioral development in wild bottlenose dolphin newborns (*Tursiops* sp.). *Behaviour*, *136*(5), 529-566.

Mann, J., Connor, R. C., Barre, L. M., & Heithaus, M. R. (2000). Female reproductive success in bottlenose dolphins (*Tursiops* sp.): Life history, habitat, provisioning, and group-size effects. *Behavioral Ecology*, *11*(2), 210-219.

Mazzoil, M. S., McCulloch, S. D., & Defran, R. H. (2005). Observations on the site fidelity of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. *Florida Scientist*, *68*(4), 217-226.

Mazzoil, M. S., McCulloch, S. D., Defran, R. H., & Murdoch, M. E. (2004). Use of digital photography and analysis of dorsal fins for photo-identification of bottlenose dolphins. *Aquatic Mammals*, *30*(2), 209-219.

Mazzoil, M. S., McCulloch, S. D., Youngbluth, M. J., Kilpatrick, D. S., Murdoch, M. E., Mase-Guthrie, B., et al. (2008a). Radio tracking and survivorship of two rehabilitated bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. *Aquatic Mammals*, *34*(1), 54-64.

Mazzoil, M. S., Reif, J. S., Youngbluth, M., Murdoch, M. E., Bechdel, S. E., Howells, E. M., et al. (2008b). Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. *EcoHealth*, *5*(3), 278-288. (doi: 10.1007/s10393-008-0194-9)

McBride, A. F., & Kritzler, H. (1951). Observations on pregnancy, parturition, and post-natal behavior in the bottlenose dolphin. *Journal of Mammalogy*, *32*(3), 251-266.

Packer, C., Lewis, S., & Pusey, A. (1992). A comparative analysis of non-offspring nursing. *Animal Behavior*, *43*, 265-281.

Ridgway, S. H., Kamolnick, T., Reddy, M., Curry, C., & Tarpley, R. J. (1995). Orphan-induced lactation in *Tursiops* and analysis of collected milk. *Marine Mammal Science*, *11*(2), 172-182.

Riedman, M. L. (1982). The evolution of alloparental care and adoption in mammals and birds. *The Quarterly Review of Biology*, *57*(4), 405-424.

Robeck, T. R., Atkinson, S. K. C., & Brook, F. (2001). Reproduction. In L. A. Dierauf & F. M. D. Gulland (Eds.), *CRC handbook of marine mammal medicine* (2nd ed.) (pp.193-236). Boca Raton, FL: CRC Press. 1,063 pp.

Simard, P., & Gowans, S. (2004). Two calves in echelon: An alloparental association in Atlantic white-sided dolphins (*Lagenorhynchus acutus*)? *Aquatic Mammals*, *30*(2), 330-334.

Smolders, J. (1988). Adoption behaviour in bottlenose dolphin. *Aquatic Mammals*, *14*(2), 78-81.

Staedler, M. M., & Riedman, M. L. (1989). A case of adoption in the California sea otter. *Marine Mammal Science*, *5*(4), 391-394.

Urian, K. W., & Wells, R. S. (1996). *Bottlenose Dolphin Photo-Identification Workshop: March 21-22, 1996* (NOAA Technical Memorandum NMFS-SEFSC-393). Charleston, SC.

Wells, R. S. (1986). *Structural aspects of dolphin societies.* Ph.D. dissertation, University of California, Santa Cruz. 234 pp.

Wells, R. S. (1991). Bringing up baby. *Natural History*, *100*(8), 56-63.

Whitehead, H., & Mann, J. (2000). Female reproductive strategies of cetaceans. In J. Mann, R. C. Connor, P. L. Tyack, & H. Whitehead (Eds.), *Cetacean societies: Field studies of dolphins and whales* (pp. 219-246). Chicago: University of Chicago Press. 448 pp.

Woodward-Clyde Consultants. (1994). *Biological resources of Indian River Lagoon* (Final Technical Report, Project Number 92F274C). Melbourne, FL: Indian River Lagoon National Estuary Program.