

1 First observed wild birth and acoustic record of a possible infanticide attempt on a common
2 bottlenose dolphin (*Tursiops truncatus*)

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24 We observed the birth of a common bottlenose dolphin (*Tursiops truncatus*) followed
25 immediately by a possible infanticide attempt in the estuary near Savannah, Georgia. Our report
26 is unique in several ways: first, we witnessed the birth of the calf; second, we observed
27 infanticidal behavior almost immediately afterward; and third, we obtained acoustic recordings
28 concurrent with the possible infanticidal behavior. Our observations provide insight into
29 aggressive, possible infanticidal, behavior in bottlenose dolphins.

30 Births of wild cetaceans have only been documented in the literature for a few species.
31 These include several mysticetes [right whale (*Eubalaena glacialis*): Zani *et al.* 2008, Foley *et al.*
32 *al.* 2011; humpback whale (*Megaptera novaeangliae*): Ferreira *et al.* 2011, Faria *et al.* 2013; and
33 gray whale (*Eschrichtius robustus*): Balcomb 1974, Leatherwood and Beach 1975, Mills and
34 Mills 1979] and odontocetes [sperm whale (*Physeter catodon*): Gambell *et al.* 1973, Weilgart
35 and Whitehead 1986; beluga whale (*Delphinapterus leucas*): Beland *et al.* 1990; false killer
36 whale (*Pseudorca crassidens*): Notarbartolo-di-Sciara *et al.* 1997; and killer whale (*Orcinus*
37 *orca*): Stacey and Baird 1997]. Surprisingly, although they are among the most-studied cetacean
38 species, there are no observations in the primary literature of wild bottlenose dolphin births.

39 Infanticidal behavior, whereby individuals kill conspecific infants, is widespread in the
40 animal kingdom and has been described in several mammalian species (Hrdy 1979), including
41 the common bottlenose dolphin (*Tursiops truncatus*; Patterson *et al.* 1998, Dunn *et al.* 2002,
42 Kaplan *et al.* 2009, Robinson 2014). Initial records of infanticide in dolphins were from post-
43 mortem examinations (Patterson *et al.* 1998, Dunn *et al.* 2002). The few field observations of
44 infanticidal behavior (Kaplan *et al.* 2009, Robinson 2014) involved calves whose ages were
45 estimated to range from a few days old (Robinson 2014) to less than one year (Patterson *et al.*

46 1998, Dunn *et al.* 2002) to at least a year old (*i.e.*, 2/3 the size of adults in the group; Kaplan *et*
47 *al.* 2009). There have been no previous reports of a calf being attacked within minutes of birth.

48 On August 23, 2013, as part of an intensive research project, researchers on three vessels
49 were searching for common bottlenose dolphins. There were multiple groups of dolphins spread
50 over a wide area near the northwest corner of Tybee Island, Georgia (Fig. 1). At 1145 we
51 encountered a group of five dolphins, and shortly thereafter (1153) observed thrashing, followed
52 by a newborn sighted in the group. Within the next minute, we observed red fluid in the water,
53 assumed to be blood from the placenta, and around this time four additional individuals joined
54 the group. Four minutes after the birth (1157), we witnessed extremely active behavior at the
55 surface, including the neonate being pushed underwater by other animals and then being carried
56 to the surface on the back of its mother. At 1159 we observed the umbilical cord still attached to
57 the mother (Fig. 2).

58 The mother had been previously identified as part of an ongoing photo-identification
59 effort; she had been previously sighted with a calf in 2010 (R. Perrtree and T. Cox, unpub. data).
60 Two other group members had also been previously identified and had been together in all four
61 of their previous sightings (in 2010 and 2011), during which neither was ever seen with a calf. In
62 this sighting both were identified as males based on observations of penises observed, followed
63 by a surfacing in which the dorsal fin was photographed. Therefore, they were presumed to be a
64 male pair. Male pairs, or alliances, are a well-known social unit in other dolphin populations
65 (*e.g.*, *Tursiops truncatus* in Sarasota, FL: Owen *et al.* 2002; *Tursiops aduncus* in Shark Bay,
66 Australia: Connor *et al.* 1992). Researchers on one of our other vessels observed this pair
67 flanking the mother at 1012, approximately 1.5 h before the birth, and the pair was heavily
68 involved in the presumed infanticidal behavior, as described in greater detail below.

69 Four minutes after the birth (1157) one video clip was recorded (55 s duration, video file
70 can be accessed in the supplemental materials). This video has been evaluated by four people,
71 one of whom was not on the boat during the event. The video began with the mother pushing the
72 neonate to the surface several times, the two identified males surfaced approximately one body
73 length behind the mother. The two males then approached from behind, both mother and neonate
74 submerged, and then the mother carried the calf to the surface on her back. Next the two males
75 surfaced on opposite sides of the pair, ventral sides up with penises visible as they leapt out of
76 the water and on top of the calf. Subsequently, surface activity increased with flukes splashing,
77 after which the mother resurfaced with the calf on her head again. All other visual observations
78 were made in the field or determined from photographs.

79 Throughout the initial 30 min period of observations after the new animals joined the
80 group, there were five recorded bouts of surface active behavior. The mother was observed
81 engaged in various active behaviors, including thrashing her flukes through the air, lunging, and
82 a high-arch dive. Overall, the surface behavior was chaotic with considerable thrashing and
83 white water. Aggressive behaviors were apparently being directed at the newborn calf, including
84 what appeared to be forcible submergence of the neonate by the presumed male pair during at
85 least four bouts over a 23 min period. The observation of submergence behaviors contrasts with
86 previous literature on infanticidal behavior, which describes aggressive activities visible above
87 the surface, such as “calf tossing” and “aerial flip rams” (Dunn *et al.* 2002, Kaplan *et al.* 2009,
88 Robinson 2014).

89 We observed the animals for almost three hours, leaving them at 1430 to return to our
90 previously scheduled research activities. We did not witness any activity indicative of aggression
91 towards the neonate after the initial 30 min, although we have reason to believe that aggression

92 may have continued based on the acoustic recordings (described below). At the beginning of the
93 sighting, we were within 10-50 m of the dolphins, but then moved to approximately 100-300 m
94 away so as to not affect the mother's interactions with her calf. It is likely that at these greater
95 distances we were too far away to observe aggressive activities, especially if they were occurring
96 beneath the surface.

97 Because there was vigorous activity and dorsal fins were not always visible, we could not
98 positively identify all of the animals submerging the calf in every bout of surface active
99 behavior; however, the two males were clearly identified in four of the bouts. We believe that the
100 presumed male pair were the primary aggressors during the infanticidal behavior because their
101 fins were the only ones identified in images just before, during, and after the bouts of aggressive
102 activity, other than that of the mother. This pair continued to flank the mother and neonate for
103 most of the 2.5 h after the initial attack. It is intriguing that they had also been sighted with the
104 mother 1.5 h prior to the birth, possibly indicating they were tracking the birth in preparation for
105 the infanticide attempt.

106 It is possible that the intention of the males was to mate with the mother rather than to act
107 aggressively towards the calf. However, the immediate impression of the researchers in the field
108 and analysis of the video was that this was an infanticide attempt. In addition, this alternate
109 hypothesis is not supported by our multiple observations of individuals submerging the calf,
110 followed by the mother raising the calf out of the water. It is clear that even if the males were
111 targeting the mother, the neonate was in immediate danger as it was leapt upon by the males, and
112 the mother frequently surfaced with the neonate on her head or back. Mating and infanticide are
113 not mutually exclusive – in fact, one would expect them to coincide, since they may be trying to
114 kill the infant in order to make the mother receptive.

115 We observed the neonate with its mother in a group of eight dolphins the following day
116 (August 24, 2013). The group included four additional individuals from the previous day, two of
117 which were the presumed male pair. Long-term survival of the calf after that time cannot be
118 confirmed as the mother has not been subsequently re-sighted. We were able to find only one
119 previous field observation of infanticidal behavior in dolphins that reported on survival of the
120 calf. Robinson (2014) stated that the calf survived for eight months but was found to have acute
121 scoliosis upon its death, which he speculated was due to injuries sustained during the attack.

122 Acoustic recordings began about one minute after the birth and continued throughout
123 most of the observation period, for a total of approximately 2 h 10 min (occasionally recordings
124 were stopped to make announcements or to replace media). This event was a rare opportunity to
125 record dolphins during a known aggressive context. Although several studies of captive
126 common bottlenose dolphins have documented various pulsed sounds associated with aggressive
127 contexts (*e.g.*, Overstrom 1983, McCowan and Reiss 1995, Blomqvist and Amundin 2004), it is
128 challenging to document context-specificity of sounds in wild dolphins, given that they spend
129 most of their time out of sight of researchers. Connor and Smolker (1996) documented a “pop”
130 sound associated with aggressive herding of females by a provisioned coalition of male Indo-
131 Pacific bottlenose dolphins (*Tursiops aduncus*); however, no sounds definitively associated with
132 aggressive contexts have yet been documented in wild common bottlenose dolphins.

133 Broadband, burst-pulsed sounds, similar to those that have been attributed to aggressive
134 interactions between captive dolphins (*e.g.*, Blomqvist and Amundin 2004), were recorded
135 during aggressive behavior toward the neonate (Fig. 3). However, another sound type (a low
136 frequency tonal sound) was much more common throughout the recording (occurring
137 approximately 6 times more often than burst-pulsed sounds: 834 *vs.* 142; Fig. 4). These low

138 frequency tonal sounds shared at least superficial similarities with those reported in several other
139 studies. For example, “low frequency, narrow band” (LFN) sounds were described by Schultz *et*
140 *al.* 1995 and Simard *et al.* 2011, “thunks” were described by McCowan and Reiss 1995, and
141 “gulps” were described by dos Santos *et al.* 1995. However, comparisons are difficult without
142 standardization of spectral parameters among studies. McCowan and Reiss (1995) found
143 “thunks” to be “maternal aggressive contact vocalizations” in their study of captive dolphins. In
144 studies of wild dolphins (dos Santos *et al.* 1995, Schultz *et al.* 1995, and Simard *et al.* 2011) only
145 correlative contexts could be proposed. While dos Santos *et al.* (1995) speculated a feeding
146 context for “gulps,” both Schultz *et al.* (1995) and Simard *et al.* (2011) ascribed LFN sounds to
147 loosely defined social contexts, although whether or not they were aggressive was not
148 determined. As we were not able to confirm or refute whether the sounds we recorded during the
149 infanticide attempt were the same as those described previously, we refer to them simply as “low
150 frequency sounds.”

151 During the initial approximately four minutes of aggressive behaviors, low frequency
152 sounds occurred at a rate of 31.9/min, along with body contact sounds (intense impact-like
153 sounds; 3.7/min), burst-pulsed sounds (8.0/min), buzzes (4.3/min), and whistles (17.1/min).
154 Although data are sparse for call rates in the wild, Cook *et al.* (2004) reported whistle rates of
155 common bottlenose dolphin groups containing mother-calf pairs in Sarasota, Florida of only
156 0.38/min. The initial group whistle rate of 17.1/min is high even when compared to those for
157 socializing groups, for which Cook *et al.* (2004) reported group rates of 2.4/min and Quick and
158 Janik (2008) reported rates of 0.6/animal/min. During this initial period, 89% of whistles were of
159 the same type (see examples in Fig. 4) and contained features possibly related to stress, such as
160 amplitude modulation and increased loop number, as well as high rates of production (Esch *et al.*

161 2009). A total of 315 whistles of this type occurred throughout the recording session. Low
162 frequency sounds occurred in bouts, which were defined as occurrences separated by at least 10
163 s. A total of 834 low frequency sounds occurred in 35 bouts consisting of 3 to 85 sounds each
164 (mean = 23.8, std dev = 20.3). Bouts occurred throughout the recording session, with the last one
165 only 4 min before we left the group. Thus, although we were too far away at this point for visual
166 observations, the continued occurrence of low frequency sounds may indicate that aggressive
167 behaviors continued throughout (and possibly beyond) our recording session.

168 We examined the tendency for whistles to co-occur with low frequency sounds by
169 counting the number of times whistles of a given type occurred within 10 s of the beginning or
170 ending of a bout of low frequency sounds. Of approximately 685 total whistles in the overall
171 recording, there were at least six whistle types visually identified according to contour shape (as
172 in Sayigh *et al.* 2007). The predominant type (see Fig. 4), which comprised 46% of whistles
173 (315/685) was significantly more likely to co-occur with bouts of low frequency sounds (32 of
174 35 bouts) than a comparable sample size ($n=314$) of four other whistle types (18 of 35 bouts;
175 Fisher exact test $P < 0.001$).

176 Overall, acoustic data from the infanticide event support the idea that low frequency
177 sounds were associated with aggressive behaviors. These sounds contained features
178 characteristic of aggressive motivation as described by Morton's classic "motivation-structural
179 rules" (Morton 1977), including low frequencies, downswept contours, and overall "harsh"
180 characteristics (Fig. 4, supplemental materials). High rates of one whistle type may reflect the
181 stressful nature of the situation (Esch *et al.* 2009). Based on these high rates, and the co-
182 occurrence of this whistle type with low frequency sounds, we speculate that it may be the
183 signature whistle of the mother. This idea is also supported by one instance when the mother was

184 very close to the boat, at which time we recorded very loud whistles of this type. We further
185 speculate that the low frequency sounds may be aggressive signals produced by the males.
186 However, given our inability to positively identify all aggressors or the identities of the
187 vocalizing individuals, other scenarios are possible as well. Further studies are needed to
188 determine if low frequency sounds are associated with aggressive contexts.

189 Our study provides unique insights into several aspects of bottlenose dolphin behavior.
190 First, this is the only published report of a live birth of a wild bottlenose dolphin in the literature,
191 indicating that bottlenose dolphin births are inconspicuous. Second, males may be monitoring the
192 reproductive state of females as evidenced by the fact that the males were observed with the
193 mother 1.5 h before the calf was born, in combination with the immediacy of the infanticidal
194 behavior. Third, attacks may be conducted underwater, without tossing calves into the air; thus,
195 infanticidal behavior may occur at a higher rate than previously indicated by the literature. Since
196 we observed an aggressive interaction and submergence of the calf almost immediately after the
197 birth, we believe it was more likely an infanticide attempt than a mating event. Although there is
198 no way to know the intention of the males, the result was imminent danger to the neonate.
199 Finally, the finding that low frequency tonal sounds are used in an aggressive context may
200 enhance interpretations of acoustic recordings of wild dolphins for which contexts are usually
201 ambiguous or unknown. The concurrent acoustic recording further substantiated an aggressive
202 event while providing evidence that the encounter lasted much longer than our surface
203 observations indicated. Despite the inability to definitively determine the purpose of the low
204 frequency sounds, the visual observations and limited supporting literature seem to indicate that
205 an aggressive interaction with the neonate occurred – highlighting the importance of coupling

206 visual and audio recordings in the field to corroborate surface behavior with what occurs
207 underwater.

208

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216

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309

310 Figure 1. Initial sighting location of common bottlenose dolphins (*Tursiops truncatus*) near
311 Savannah, Georgia.

312

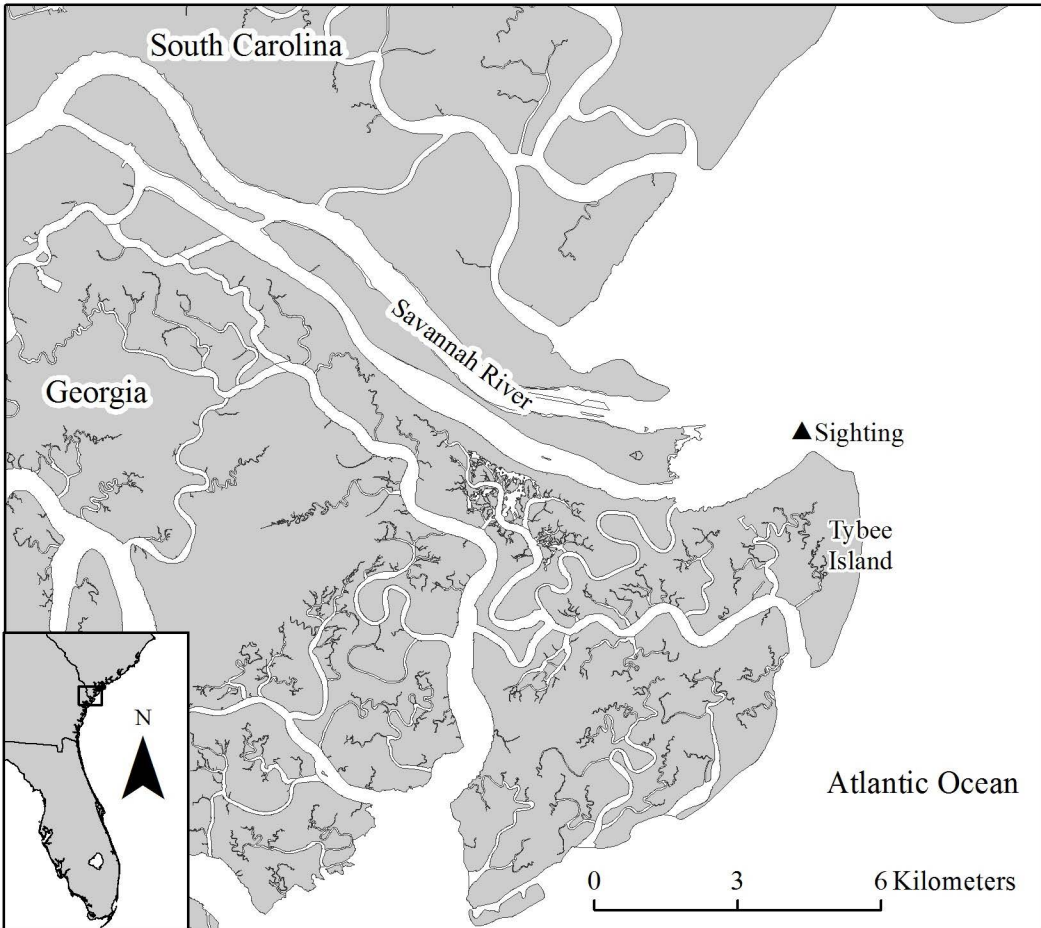
313 Figure 2. Photograph of the mother common bottlenose dolphin (*Tursiops truncatus*) with the
314 umbilicus still attached.

315

316 Figure 3. Examples of various sounds that occurred during the possible infanticide attempt by
317 common bottlenose dolphins (*Tursiops truncatus*), including burst-pulsed (BP) sounds, body-
318 contact (BC) sounds, buzzes (BZ; evident at approximately 3 s and also in the bracketed area),
319 and whistles (W). Low frequency sounds are shown in Fig. 4. Sound file can be accessed in the
320 supplemental materials.

321

322 Figure 4. Low frequency tonal sounds and whistles that commonly co-occurred with the sounds
323 recorded during the possible infanticide attempt by common bottlenose dolphins (*Tursiops*
324 *truncatus*). A 1.5 s segment is enlarged in the inset to provide a closer look at the structure of the
325 low frequency sounds. Note high repetition rate of whistles and multiple repetitive whistle
326 loops, suggested by Esch *et al.* 2009 to be indicative of stress. Sound file can be accessed in the
327 supplemental materials.



Source data: USGS National Hydrography Dataset. Projection: Transverse Mercator, UTM 17N, NAD 1983



