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Short Note

Surface and Underwater Observation of a Humpback Whale (*Megaptera novaeangliae*) Birth in Progress off Lahaina, Maui, and Subsequent Encounter of the Female with a Healthy Calf

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Humpback whales (*Megaptera novaeangliae*) migrate between summer high latitude feeding grounds and winter tropical breeding areas where they mate and calve (Nishiwaki, 1959; Dawbin, 1966). The winter breeding areas, often nearshore and accessible to researchers and whale watchers, have made humpback whales arguably the best known and most watched large whale species worldwide (Hoyt, 2001). Many of the breeding season behavior patterns, including singing, male–female pairings, multiple male–single female competitive groups, and mothers with newborn calves, with or without male escorts, are common sights (e.g., Darling, 2009; Clapham & Baxter, 2013). However, even though whaling data show a clear peak of parturition in winter (Chittleborough, 1958), and successful births are clearly a common occurrence as many populations are expanding worldwide (Bettridge et al., 2015; Cooke, 2018), observations of an actual birth are rare.

To our knowledge, there are three published accounts of humpback whale birth. The circumstances, including the view of the observers, the moment in the event it was encountered, and the length and completeness of the observations, all vary but provide rare insight into the activity. The first account, in 1994 from Hawaii, reported a highly active lone adult who then sounded for about 8 min and, upon surfacing, appeared with a very small calf. A placenta was discovered in the vicinity, later confirmed to be from a humpback whale (Silvers et al., 2002). In 2007, off the north coast of Brazil, a lone humpback whale was observed repeatedly making shallow dives, followed by a pool of blood with a neonate surfacing in its midst (Ferreira et al., 2011). And, lastly, off Isle Saint Marie in Madagascar in 2010, a female was first sighted in a competitive group with five escorts, but within an hour was down to three escorts. The mother gave birth in a circle of blood with her calf appearing minutes later, with escorts circling (Faria et al., 2013). We are aware of additional unpublished accounts of humpback whale births, some appearing in social media but without extended or detailed observations (e.g., from a drone in Hawaii ["Rare Video of Newborn Humpback Whale," 2019]). Herein, we restrict discussion to published materials with a high interest in seeing other accounts reported formally.

Hawaii, with its high density of breeding humpback whales and often calm seas, is one of the best whale research and whale-watch locations in the world. The rarity of birth observations has been puzzling despite decades of research and whale-watch activity during 5 to 6 mo each year, including dozens of whale-watch boats and multiple, ongoing research projects, all leading to thousands of hours of observations annually. This has led to speculation that the majority of births might occur elsewhere, at night, at depth, quickly, or in any combination of these scenarios. On 3 February 2020, sea conditions, whale behavior, and the presence of experienced observers all aligned to produce a close and extended observation of a birth in progress off Lahaina, Maui, Hawaii. The birth was confirmed as successful several weeks later when the female was respotted with her healthy calf.

Location, Observers, and Circumstance

This observation occurred in the Auau Channel near Lahaina on the west coast of Maui, Hawaii (approx. 20' 52" 49° N, 156' 44" 02° W; Figure 1). West Maui, in the lee of trade winds, is a popular tourist and whale-watching destination.

Humpback whales are present in the waters off the Hawaiian Islands from November through May, with peak numbers in late January through mid-March, and with highest density on the relatively shallow banks (*ca* 200 m) linking the four-island group of Maui, Molokai, Lanai, and Kahoolawe. Research and whale watching has occurred in the area since the 1970s (Hoyt, 2001; Darling, 2009).

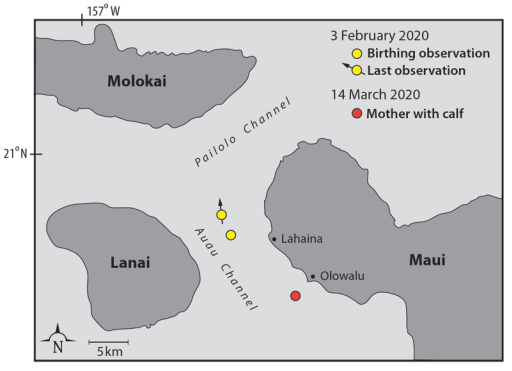

Figure 1. The partial birth was observed approximately 3 km west of Lahaina, Maui, on 3 February 2020. After an hour's observation, the female moved north toward the Pailolo Channel. The subsequent sighting of the female accompanied by a calf occurred 40 d later on 14 March 2020, approximately 1.6 km west of Olowalu, Maui, just 10 km from the initial sighting.

In 1997, much of this area was formally designated as the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) by the U.S. Federal Government and the State of Hawaii.

The observation platform, *Canefire II*, an 11-m rigid hull inflatable (RIB), is a dedicated whale-watch vessel owned by Captain Steve's Rafting Adventures, operating since 1986—one of the longest running wildlife viewing and education operations in the area (Figure 2). The vessel carries 32 passengers for typically four 2-h whale-watch trips daily, and it would be rare not to sight whales on any day from December to April. On 3 February 2020, *Canefire II* was skippered by SL, who has 35 y of experience guiding trips to observe Hawaii's humpback whales. DP, with over 20 y of experience, served as the onboard naturalist. Both of us were very familiar with typical social groups, behavior patterns, and interactions of the humpback whales.

We immediately recognized the rarity of the encounter and, amidst a full boat of passengers, worked to document the activity as thoroughly as possible. The nearly hour-long observation occurred with the vessel stopped and engines off. A GoPro 4, attached to a meter-long pole, and iPhone video captured both underwater and surface images and sound (including whale vocalizations) during the majority of the encounter. The water was very clear (visibility 30 m) and quite calm with some rolling waves. The whales passed repeatedly within meters of the stationary vessel and were easily seen from the surface as well as underwater.

Following the initial encounter, the mother's fluke photo-identification (photo ID) was sent to *Happywhale* (n.d.), a computerized fluke-matching program that includes identification photographs from across the North Pacific (Cheeseman et al., in press). The photo ID was also distributed to whale-watch companies and researchers in Maui with the hope of follow-up encounters and observations. The female had a distinctive black dot in the middle of a large white section on the left side of the underside of the tail, making it relatively easy to identify her.

Narrative: Whale Watch, 3 February 2020, 0730 h

Our first encounter came an hour into the morning tour when, at 0830 h, a group of whales was sighted approximately 3 km west of Lahaina. On approach, we found three adult humpback whales surfacing, and SL observed a bubble blast—a cloud of bubbles made by one of the whales underwater that burst at the surface.

Our initial assessment of this group was that it was comprised of one female accompanied by two male escorts with some level of competition between the males—a common occurrence in the Hawaii breeding grounds (e.g., Tyack & Whitehead, 1983; Baker & Herman, 1984). It was assumed the two accompanying whales were both males due to their behavior patterns directed at the female and each other. Typically in these situations, the male closest to the female, the primary escort, is most active in defending his position, with bubble streams and charges toward the secondary or challenger male(s), while at the same time pursuing the female. At times, when the female does not welcome this male attention, one of her strategies is to approach a vessel, presumably to "lose," "shake off," or otherwise hinder or complicate close approaches by the escorts (Glockner-Ferrari & Ferrari, 1985). We believe the female was doing just that.

Figure 2. Observation platform, *Canefire II* (*Photo credit:* Jennifer Starr)

In this case, however, we soon realized the female was in the midst of giving birth. The following is a description of key firsthand observations supplemented by frames taken from the video recording (Figure 3A-D) (the highlights of the 45 min of video can be seen in the "Supplemental Material" section of the *Aquatic Mammals* website: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147).

Beginning of the Encounter
We stopped approximately 100 m from the activity and turned off our engines. Within a few minutes, the whales approached our vessel close enough that a camera could be lowered into the water on a meter-long pole to videorecord the encounter (see excerpted frames in Figure 3A-D).

On this first approach, the female swam one loop (approximately 10 s of meters) around the vessel trailed by one male, her primary escort. About a minute later, the lead whale (the female) again appeared below the vessel and circled the vessel once by herself. A minute or so later, we observed all three whales together under the vessel, and they started to circle around the stern, with the female leading, the primary escort close (under her tail stock to less than one whale length) behind her, and the secondary escort following. During this last circle was the first time we observed the primary escort blowing bubbles when next to the vessel. The whales were about 5 m below the surface and about 10 m from the vessel. The whales finished the circle and headed away. At about 100 m distance (as estimated from the video), the female made an abrupt 180º turn and returned to the stationary vessel. Both escorts turned and followed her.

Throughout Encounter: Female Oriented to the Vessel, with Escorts Following
Over the next 50 min of our observation, the female repeated, with some minor variation, the pattern described above, approaching, closely circling (3 to 10 m), passing under the stationary vessel, moving away, and then making abrupt turns to return to the vessel with the males following. The primary escort usually followed her very closely (sometimes almost touching her) with its rostrum pointed at her tail stock, while the secondary escort was generally behind or below the pair, at times out of our sight. There were 30 such approaches and circles under and around the vessel. Rather than repeating here a description of this pattern for each pass, the following are specific observations made during these close passes as the encounter proceeded.

Recurring Behavior – Bubbles and Social Sounds
Throughout most of the observation period, the primary escort produced bubble blasts and bubble streams, at times nearly continuously (Figure 3B & C). In a typical competitive group with multiple males chasing and competing for the female, it is common for the primary escort to emit long, powerful bubble streams (e.g., Tyack & Whitehead, 1983). Presumably, this is a competitive behavior, although the exact purpose and intended recipient(s) remain speculative. In this observation, it appeared that at least some of the bubble streams were directed at the female; however, the location of the secondary escort was not always known.

Sporadically during the observation, the whales produced a range of loud social sounds (examples in video in the "Supplemental Material" section of the *Aquatic Mammals* website; full video available in Captain Steve's Rafting Adventures, 2020). We were not able to tell which whale (the female or escorts) was making these sounds. Sounds were produced over approximately 10 of the 45-min total video. The majority of sounds (4 of the 5 different sounds identified) were of the typical "social sounds" category often produced in surface active/competitive groups (Silber, 1986; Dunlop et al., 2007). In addition, there was an unusual sound we referred to as the motorboat sound due to its similarity to a putting engine. We heard this sound intermittently on seven occasions over the course of the observation with pulse trains (*ca* 230-Hz peak frequency) lasting 8 to 20 s, coincidentally occurring as the video showed the female passing close to camera. However, due to the closeness of the primary escort at all times, it was not possible to confirm the sound source. Spectrograph examples of a social sound and the motorboat sound are shown in Figure 4, with audio examples available in this short note's supplemental material.

Specific Observations/Events
0840 h: Noticed Calf Tail Protruding from Female—Ten minutes into this encounter we noticed what appeared to be a calf's tail emerging from the female's genital slit. It took another circle of the female to confirm (Figure 3A). She continued to make tight circles of the vessel—at times < 1 m from the submerged camera.

0852 h: Primary Escort Dove Deep and Female Spy Hops—The primary escort as observed on the underwater video turned rapidly and suddenly dove deeper and out of sight (apparently chasing after the secondary escort). At this time, the female did a spy hop about 5 m to the left of the vessel's bow (raising approximately half of her rostrum vertically out of the water). The female then turned and swam around the bow. The primary escort

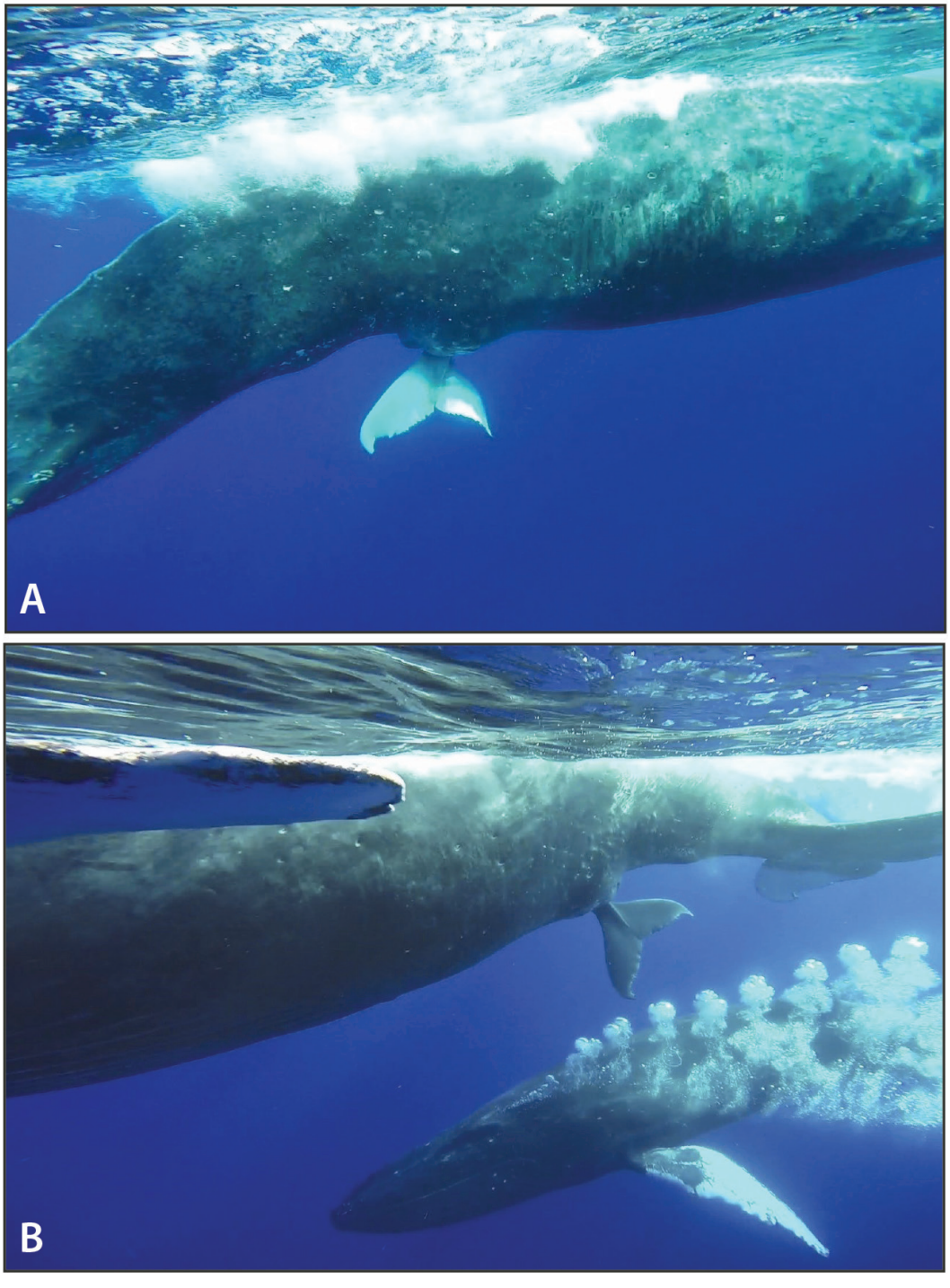

Figure 3A & B. Underwater views of the partial birth. These are frames taken from the 45 min of GoPro 4 video (Captain Steve's Rafting Adventures, 2020): (A) calf's tail emerging from the female; (B) primary escort streaming bubbles as it passes under the female—it seemed, at times, the bubbles were directed at the female; other times, they were directed at the second, apparently challenging, male. (*Photo credits:* Deborah Patton ©2020)

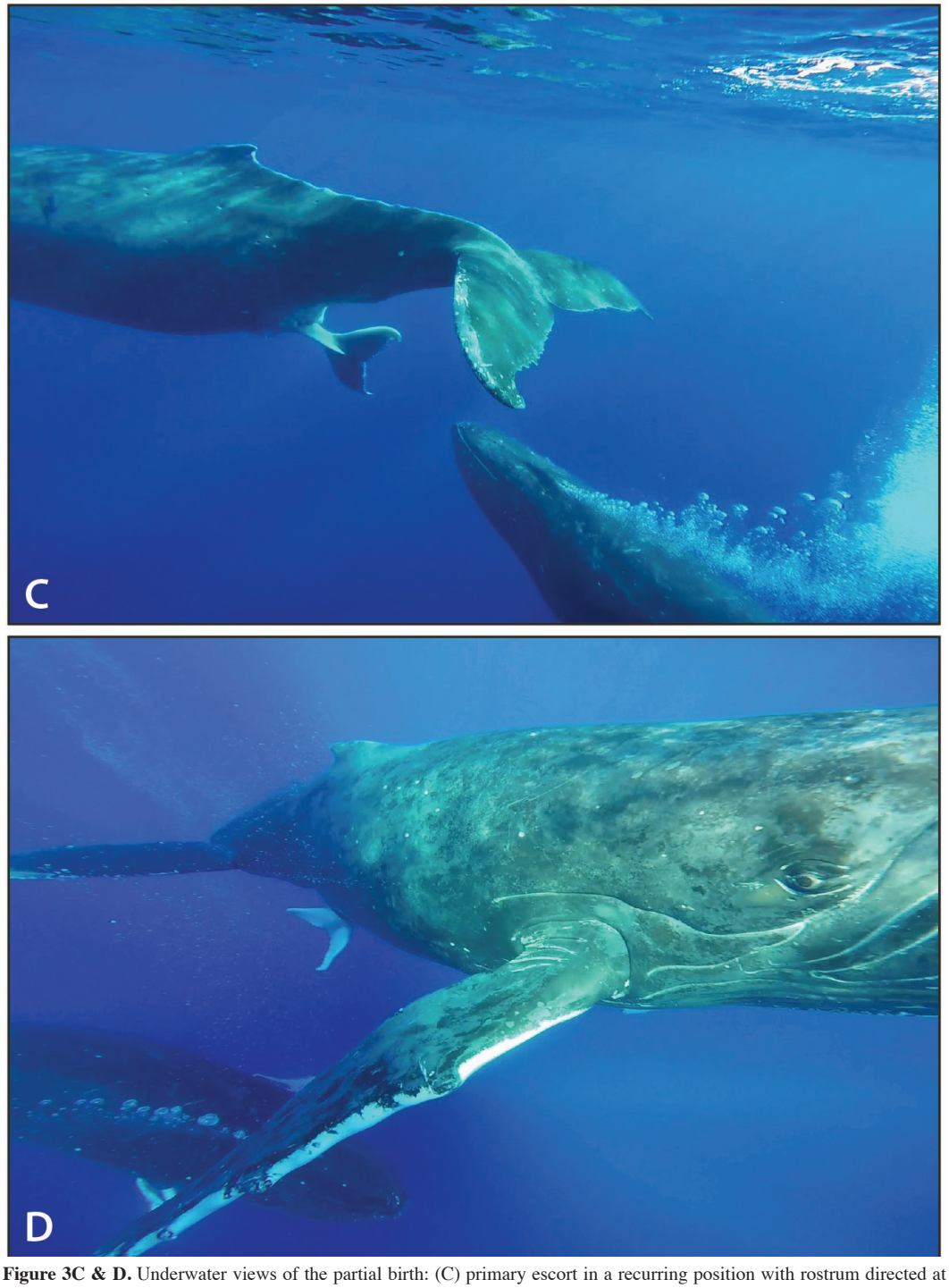

Figure 3C & D. Underwater views of the partial birth: (C) primary escort in a recurring position with rostrum directed at female's genital area and the birth underway, and bubbles streaming from primary escort's blowhole; and (D) female passing the boat within a meter, with the primary escort streaming bubbles below. Although not in the photograph, it is likely the second male is deeper, below the primary escort, which was positioned between it and the female. (*Photo credits:* Deborah Patton ©2020)

soon appeared again directly underneath her and then surfaced right next to her.

0855 h: Brown Liquid from Genital Slit—At this point, visible in the underwater footage, a brownish liquid, presumably blood, was seen seeping from the mother's genital slit around the calf's tail. At the same time, the primary escort swam off almost beyond visibility (approximately 25 m) but then turned abruptly and swam back toward the vessel. The female whale headed away from him and swam under the boat. The primary escort followed under her while blowing more bubbles.

08:55 h: Calf's Tail Appeared Lifeless – Stillborn Question?—During the entire observation, both from the surface and underwater video observations, the calf's tail appeared lifeless (see Figure 3A-D). It appeared the calf might be stillborn.

0903 h: Calf's Tail Protruded Farther—During another instance of the primary escort apparently chasing off the second male, the female stayed immediately alongside the vessel, within 1 m of the camera. She turned and swam under the vessel from the port side. Several of us (DP, SL, and passengers) saw a greater portion of the calf's body emerge so that roughly a third of the body was visible as the female passed directly underneath the vessel. She was dorsal side up (as in Figure 3) but very close, and the calf's tail/body was clearly visible. We thought we were going to see the birth. At this particular moment, in the video, the secondary escort was below (deeper than) the primary escort who was directly below the female whale. The female surfaced on the starboard side, and the calf's body retracted back into where it had been with just the fluke protruding. For the next few minutes, the female whale kept circling and reversing direction.

0930 h: Our Departure and Additional Observation—Our entire encounter with the female humpback whale in labor lasted just about 1 h. At the time we departed, the calf's tail was still protruding from the female, and we were unable to determine if the calf would be delivered healthy or stillborn.

By 1000 h, when we left the dock with our next group of whale watchers, the female whale in labor was being observed by numerous other vessels, including our second vessel, *Canefire*. It was reported to us that the whales had stopped their repetitive circling behavior. The HIHWNMS research vessel, *Kohola*, arrived at 1050 h.

1145 h: Final observation – Female Alone; Calf Not Yet Born—Approximately 3 h 15 min after our first encounter and 2 h 15 min after we had left the whales the first time, the final sighting of this female with the calf still only partially exposed was reported by the HIHWNMS's *Kohola* (see Figure 1). Operators of this vessel made the decision to cease observation of the female whale, concerned about impeding the birth as she was travelling now and had moved

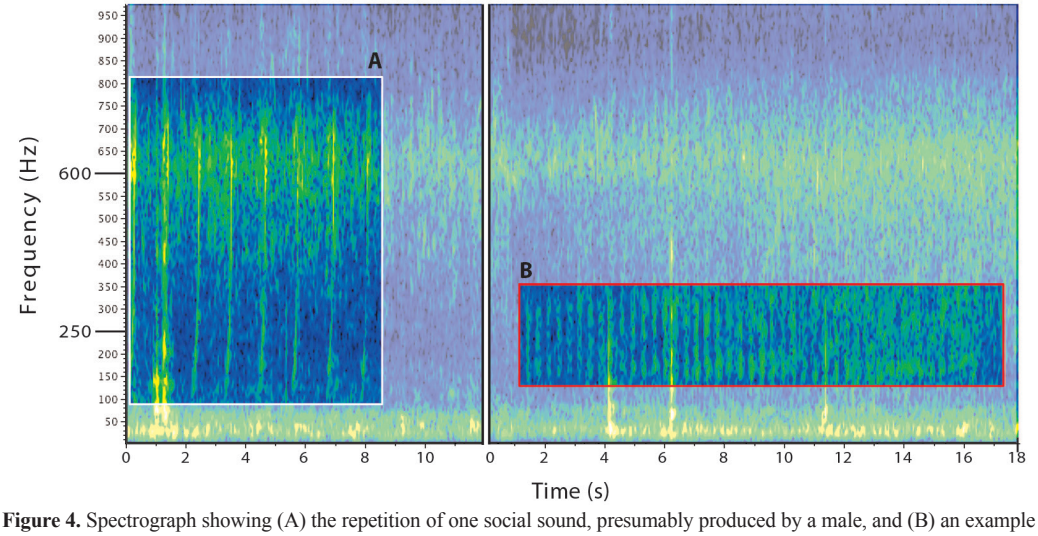

Figure 4. Spectrograph showing (A) the repetition of one social sound, presumably produced by a male, and (B) an example of the motorboat sound. The source whale for (B) is unknown, but the production of the sound seemed to be correlated with the close pass of the female (although the escort was very close). The recording, taken off the GoPro 4 video, was noisy with both water and surface sounds. This spectrograph's audio is available in the supplemental material for this short note. Other examples of both types of sounds can be heard on the video in the supplemental material (Hann window, 50% overlap, FFT/DFT 8,192). (Spectrograph courtesy of J. Darling, Whale Trust)

northwards into rougher water in the Pailolo Channel (Figure 1). At that time, this female no longer had any male escorts with her, and a newborn calf had not been seen (E. Lyman, pers. comm., 3 February 2020).

Second Encounter, 14 March 2020 – The Female Accompanied by a Calf

On 14 March 2020, 40 d after the initial encounter described above, our company's second vessel, *Canefire* (Captain Alex Siddons and marine biologist Maureen Lare) sighted this female, now a mother with a calf, at approximately 1530 h and ~1.6 km west of Olowalu, Maui (Figure 1). This location is approximately 10 km southeast of the initial encounter on 3 February 2020. A comparison of the photo IDs between the first and second encounters confirmed this was the same female (Figure 5). Both the mother and calf appeared healthy, and the calf's size was appropriate for that of a 1- to 2-mo-old (Glockner & Venus, 1983; Cartright & Sullivan, 2009).

Birth Female's Sightings History

Photographic comparisons (via *Happywhale*, n.d.) determined that the female had been identified previously on one occasion, on 22 September 2010, off the southwestern coast of Bering Island (Commander Islands), Russia, by the Russian Cetacean Habitat Project (ID RCHP 10RUCO715). Hence, the female was a minimum of 10 y old. Humpback whales that feed in the Russian Far East in the summer are a component of the Hawaii winter assembly (Titova et al., 2017).

Context

This partial birth observation (resulting in a successful birth) with video documentation provides several new insights into the birthing process and related social interactions in Hawaii. First, if what was observed is typical, the birthing process in humpback whales does not necessarily occur quickly, with the event occurring over at least 2.5 to 3 h. Hard evidence of a birth date—3 February 2020 or soon thereafter—could also be determined, as well as that once born, the mother and calf remained in the area for at least 5 to 6 wks.

The difference between this and other published humpback whale birth observations is the stage of the process observed. This encounter included underwater views of a birth in progress, but the actual birth was not witnessed. The other accounts begin with the moment of birth, including the appearance of a circle of blood, a neonate rising to the surface, finding of an umbilicus, and newborn/mother behavior (Silvers et al., 2002; Ferreira et al., 2011; Faria et al., 2013). However, several comparisons can be made.

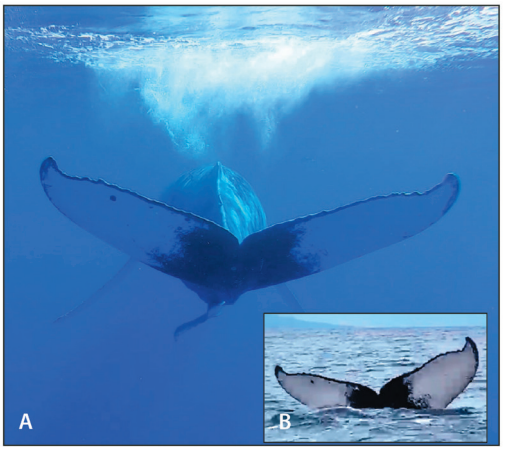

Figure 5. Photo-identifications: (A) initial sighting of birthing female on 3 February 2020 near Lahaina, Maui (*Photo credit:* Gina Clapp); and (B) subsequent sighting of the same female (with a calf) on 14 March 2020 near Olowalu, Maui (*Photo credit:* Maureen Lare).

First, impressions from the other published reports are that humpback births are quick events, completed in minutes, vs the prolonged labor we observed. However, there is no indication in the other accounts of observations of the female's ventral surface prior to the birth. So, it is possible that, similar to our observation, the calf was partially protruding for some time before the actual birth. That is, there are no data to indicate whether the prolonged labor was atypical or not.

Second, it was also clear that even female humpback whales in labor are not free from male attention and pursuit. Typically, in Hawaii, this attention and pursuit is directed both at females present to mate and mothers with newborn calves (Glockner-Ferrari & Ferrari, 1985; Jones, 2010). That this female took shelter under the vessel suggests that this male attention was unwanted. While the motivation of the males cannot be known, it is possible that some of their activity was a result of stimulation from the birth activity rather than typical pursuit. It is also unclear how much of the primary escort's behavior was in response to the nearby challenging male. Since the males left the female before she gave birth, it is unlikely that they were present to protect her or provide assistance.

Third, the social circumstances around a humpback whale giving birth varied across the observations. In two of the cases, Hawaii 1994 (Silvers et al., 2002) and Brazil 2007 (Ferreira et al., 2011), the female was alone prior to the birth observation; while in the other two, Madagascar 2010 (Faria et al., 2013) and this observation, multiple males were present either during the period

leading up to the birth, the birth, or after. During the Madagascar observation, the female was part of a pre-birth competitive group with five, then three, males following her just 45 min before the birth. This, combined with our observation, suggests that females can be pursued by males near and even during labor. However, it is noteworthy that the Madagascar males did not appear to close on or chase the female after the birth occurred, circling at 25 m. And, in our observation, even though pursuit occurred during labor, by the final observation, the males had left the female alone—with the birth not yet completed.

Sounds were recorded during both the Madagascar and this encounter. The Madagascar observation included sounds attributed to the mother and neonate, including a unique click series that the authors compared to "megapclicks" (Stimpert et al., 2007). In our case, the sounds were recorded during male–male competition, a male attending a female, and a birth in progress. Sounds during this encounter included social sounds common in competitive groups and generally presumed to be made by competing males (Silber, 1986; Dunlop et al., 2007) and a motorboat sound. Although the source whale for the latter sound is unknown, it coincided with close passes by the female, but with the escort very close behind. The motorboat sound is not the same as the clicks referred to in the Madagascar report (Faria et al., 2013) nor does it obviously match any of the 34 different call types from humpback whales identified in waters off Australia (Dunlop et al., 2007). These motorboat sounds were four to five times higher in peak frequency than the pulse trains reported by Darling (2015) that were recorded in the vicinity of humpback whale females accompanied by multiple males.

We have been conducting whale-watch trips in this location off Maui for 35 y. While sightings of very young newborn calves are common, this is the first birth, however partial, we have observed to date. Males in pursuit of, and competing for access to, a female is a common occurrence, and the strategy of females using vessels as a shield in avoidance is well known in the Hawaii whale-watch community. The unprecedented event here was that the female was birthing at the time of this other familiar activity and that a second sighting followed, over 5 wks later, this time with her healthy calf. This second sighting was even more remarkable since it occurred 3 d before Hawaii shut down most boating activity due to the coronavirus pandemic, after which any additional observations or resightings of these whales by whale-watch or other boats would not have been possible.

Acknowledgments

The Lahaina, Maui, whale-watching community rallied together following the initial observation in an effort to locate this female whale again to determine if the birth had been successful before she returned to her feeding grounds. Community members distributed photo-ID pictures of this female's tail so that many of us on the ocean in the Maui area could be searching for her. We thank all those who contributed to this observation in Maui, including Ed Lyman, HIHWNMS, Happywhale, Alex Siddons, and Maureen Lare. We thank Gina Clapp and Jennifer Starr for permission to use their photographs, and the Russian Cetacean Habitat Project for the sighting history information. We greatly appreciate comments and suggestions on the drafts from Meagan Jones and Ed Lyman. Erin Linn McMullan edited drafts of the manuscript, and Barbara Schramm produced the graphics. Jim Darling, Whale Trust, assisted with the writing and production of the short note. Whale Trust supported the publication costs.

Literature Cited

Baker, C. S., & Herman, L. M. (1984). Aggressive behavior between humpback whales (*Megaptera novaeangliae*) wintering in Hawaiian waters. *Canadian Journal of Zoology*, *62*, 1922-1937. https://doi.org/10.1139/z84-282

Bettridge, S., Baker, C. S., Barlow, J., Clapham, P. J., Ford, M., Gouveia, D., Mattila, D. K., Pace III, R. M., Rosel, P. E., Silber, G. K., & Wade, P R. (2015). *Status review of the humpback whale (*Megaptera novaeangliae*) under the Endangered Species Act* (NOAA Technical Memo NMFS-SWFSC-540). U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Captain Steve's Rafting Adventures. (2020, February). *Captain Steve's 2-3-20 7:30 whale watch partial birth videos*. https://www.facebook.com/watch/179797987635/515522402694455

Cartright, R., & Sullivan, M. (2009). Behavioral ontogeny in humpback whale (*Megaptera novaeangliae*) calves during their residence in Hawaiian waters. *Marine Mammal Science*, *25*, 659-680. https://doi.org/10.1111/j.1748-7692.2009.00286.x

Cheeseman, T., Southerland, K., Park, J., Olio, M., Flynn, K., Calambokidis, J., Jones, L., Garrigue, C., Frisch, A., Howard, A., Reade, W., Neilson, J., Gabriele, C., & Clapham, P. (In press). Advanced image recognition: A fully automated, high-accuracy photo-identification matching system for humpback whales. *Mammalian Biology*.

Chittleborough, R. G. (1958). The breeding cycle of the female humpback whale, *Megaptera nodosa* (Bonnaterre). *Australian Journal of Marine and Freshwater Research*, *9*(1), 1-18. https://doi.org/10.1071/MF9580001

Clapham, P., & Baxter, C. (2013). *Winged leviathan: The story of the humpback whale*. Colin Baxter Photography Ltd.

Cooke, J. G. (2018). *Megaptera novaeangliae*. In International Union for Conservation of Nature (Ed.), *The IUCN red list of threatened species 2018*: *e.T13006A50362794*. IUCN. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T13006A50362794.en

Darling, J. (2009). *Hawaii's humpbacks: Unveiling the mysteries*. Granville Island Publishing Company.

Darling, J. D. (2015). Low frequency, ca. 40 Hz, pulse trains recorded in the humpback whale assembly in Hawaii. *The Journal of the Acoustical Society of America*, *138*(5), EL452-EL458. https://doi.org/10.1121/1.4935070

Dawbin, W. H. (1966). The seasonal migratory cycle of humpback whales. In K. S. Norris (Ed.), *Whales, dolphins and porpoises* (pp. 145-170). University of California Press. https://doi.org/10.1525/9780520321373-011

Dunlop, R. A., Noad, M. J., Cato, D. H., & Stokes, D. (2007). The social vocalization repertoire of east Australian migrating humpback whales (*Megaptera novaeangliae*). *The Journal of the Acoustical Society of America*, *122*(5), 2893-2905. https://doi.org/10.1121/1.2783115

Faria, M-A., De Weerdt, J., Pace, F., & Mayer, F-X. (2013). Observation of a humpback whale (*Megaptera novaeangliae*) birth in the coastal waters of Sainte Marie Island, Madagascar. *Aquatic Mammals*, *39*(3), 296-305. https://doi.org/10.1578/AM.39.3.2013.296

Ferreira, M. E. C., Maia-Nogueira, R., & Hubner de Jesus, A. (2011). Surface observation of a birth of a humpback whale (*Megaptera novaeangliae*) on the northeast coast of Brazil. *Latin American Journal of Aquatic Mammals*, *9*(2), 160-163. https://doi.org/10.5597/lajam00182

Glockner, D. A., & Venus, S. (1983). Identification, growth rate, and behavior of humpback whale (*Megaptera novaeangliae*) cows and calves in the waters off Maui, Hawaii 1977-79. In R. Payne (Ed.), *Communication and behavior of whales* (AAAS Selected Symposia Series, pp. 223-258). Westview Press.

Glockner-Ferrari, D. A., & Ferrari, M. J. (1985). *Individual identification, behavior, reproduction and distribution of humpback whales,* Megaptera novaeangliae*, in Hawaii* (Final Report, Marine Mammal Commission Contract MM2629752-5). Marine Mammal Commission.

Happywhale. (n.d.). *About* Happywhale. https://happywhale.com/about

Hoyt, E. (2001). *Whale watching 2001: Worldwide tourism numbers, expenditures, and expanding socioeconomic benefits*. International Fund for Animal Welfare.

Jones, M. E. (2010). *Female humpback whale (*Megaptera novaeangliae*) reproductive class and male-female interactions during the breeding season* (Unpub. doctoral dissertation). Antioch University, New England, Keene, NH. https://etd.ohiolink.edu

Nishiwaki, M. (1959). Humpback whales in Ryukyuan waters. *The Scientific Reports of the Whales Research Institute Tokyo*, *14*, 49-87.

Rare video of newborn humpback whale from UH marine mammal research. (2019, January 31). *University of Hawai'i News*. https://www.hawaii.edu/news/2019/01/31/rare-video-of-newborn-humpback-whale

Silber, G. K. (1986). The relationship of social vocalizations to surface behavior and aggression in the Hawaiian humpback whale (*Megaptera novaeangliae*). *Canadian Journal of Zoology*, *64*, 2075-2080. https://doi.org/10.1139/z86-316

Silvers, L. E., Rosel, P. E., & Salden, D. R. (2002). DNA sequence analysis of a North Pacific humpback whale (*Megaptera novaeangliae*) placenta. *Canadian Journal of Zoology*, *80*(6), 1141-1144. https://doi.org/10.1139/z02-079

Stimpert, A. K., Wiley, D. N., Au, W. W. L., Johnson, M. P., & Arsenault, R. J. (2007). "Megapclicks": Acoustic click trains and buzzes produced during night-time foraging of humpback whales (*Megaptera novaeangliae*). *Biological Letters*, *3*(5), 467-470. https://doi.org/10.1098/rsbl.2007.0281

Titova, O. V., Filatova, O. A., Fedutin, I. D., Ovsyanikova, E. N., Okabe, H., Kobayashi, N., Acebes, J. M. V., Burdin, A. M., & Hoyt, E. (2017). Photo-identification matches of humpback whales (*Megaptera novaeangliae*) from feeding areas in the Russian Far East and breeding grounds in the North Pacific. *Marine Mammal Science*, *34*(1), 100-112. https://doi.org/10.1111/mms.12444

Tyack, P., & Whitehead, H. (1983). Male competition in large groups of wintering humpback whales. *Behavior*, *83*, 132-154. https://doi.org/10.1163/156853982X00067