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# A Descriptive Breakdown of Pre- and Post-Nursing Behavioral Sequences in Humpback Whale Mother-Calf Pairs on a Calving Ground

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Nursing, the behavior associated with the transfer of milk to another individual (Hall et al. 1988), is one of the main components of mammalian maternal care (Balshine 2012). From the nursed individual's perspective, i.e., the young, it is referred to as suckling (Hall et al. 1988) and it is essential for the survival and development of young mammals during their early life stage. Nursing serves as a primary source of food and water, provides immunity, and is among the first intimate social interactions that help establish and strengthen the mother–young bond, while also being one of the earliest social experiences for young mammals (Clark and Odell 1999; Lent 1974; Nowak et al. 2000; Oftedal 2012).

For baleen whales (Mysticetes), understanding nursing behavior has long been challenging due to the inherent difficulties in studying them within their natural habitats. Past studies have often relied on observations in the wild from sea surface or subsurface (using a boat, an aerial vehicle, or by diving) (Clapham and Mayo 1987; Glockner-Ferrari and Ferrari 1985; Glockner and Venus 1983; Hain et al. 2013; Morete et al. 2003; Thomas and Taber 1984; Videsen et al. 2017; Würsig et al. 1985; Zoidis and Lomac-MacNair 2017). However, surface or subsurface observations may not always allow for the observation of nursing behavior because of unfavorable observation angles and because nursing often occurs at depth, in short bouts, and can be

performed while moving (Ratsimbazafindranahaka et al. 2022; Tackaberry et al. 2020). Advancements in technology, particularly the development of camera-equipped animal-borne multi-sensor tags, allowed a significant stride forward in studying nursing behaviors, particularly in species like the humpback whale, *Megaptera novaeangliae* (Ratsimbazafindranahaka et al. 2022, 2023; Tackaberry et al. 2020). For instance, a camera positioned on the back (pointing forward) of calves allows for the direct confirmation of nursing events (i.e., intervals in which the calf engages in uninterrupted attachment to a single teat of the mother; Ratsimbazafindranahaka et al. 2022; Tackaberry et al. 2020) from calf point-of-view images. Such an approach, however, primarily results in fine-scale descriptions focused on the calf (i.e., suckling behavior) and limited insight into the mother's behaviors.

A pioneering tag effort by Tackaberry et al. (2020) managed to simultaneously deploy camera-equipped tags on both mother and calf in humpback whale mother-calf pairs and thus study nursing behaviors from both the mothers' and the calves' vantage by analyzing data corresponding to suckling events visually identified in calf video data. However, in Tackaberry et al. (2020), the sample size remained relatively limited (three nursing events with data from the mother), and the data corresponded to pairs with non-neonate calves (> 6 months old). The

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datasets presented in Ratsimbazafindranahaka et al. (2023) included simultaneous Acousonde tags placed on humpback whale mother-calf pairs (six pairs) with young calves (< 3 months old) off Sainte Marie, Madagascar, Southwestern Indian Ocean, and constitute a unique opportunity to study both the mother and the calf during the early development of the calf. While these simultaneous deployments lacked video data, suckling events were successfully identified using an innovative method based on kinematic signatures. The method was developed using video-equipped data from other tagged calves (CATS cam tag data from 11 calves, 79 suckling events). The simultaneous deployment dataset with automatically detected suckling events offers the possibility of simultaneously observing the time sequences of the mothers' and the calves' behaviors. The automatic identification was estimated to have an average precision (proportion of true positives among all positives identified) of 0.82, an average sensitivity (proportion of true positives detected among all actual positives) of 0.75, and an average false events rate of about one false event detected per 3 h of data (Ratsimbazafindranahaka et al. 2023).

Humpback whales are known to nurse in bouts of up to six nursing events (Ratsimbazafindranahaka et al. 2022, 2023). In this short note, we describe the behaviors displayed by humpback whale mothers and calves before, during, and after nursing bouts (i.e., series of nursing events; Ratsimbazafindranahaka et al. 2022, 2023; Russell et al. 1997) using the six previously collected simultaneous mother-calf Acousonde deployment data from Ratsimbazafindranahaka et al. (2023). We mainly focus on the termination and initiation of nursing bouts. Insights gained from these data can help clarify the behaviors of humpback whale pairs in the field and help understand how mother and calf coordinate their behaviors.

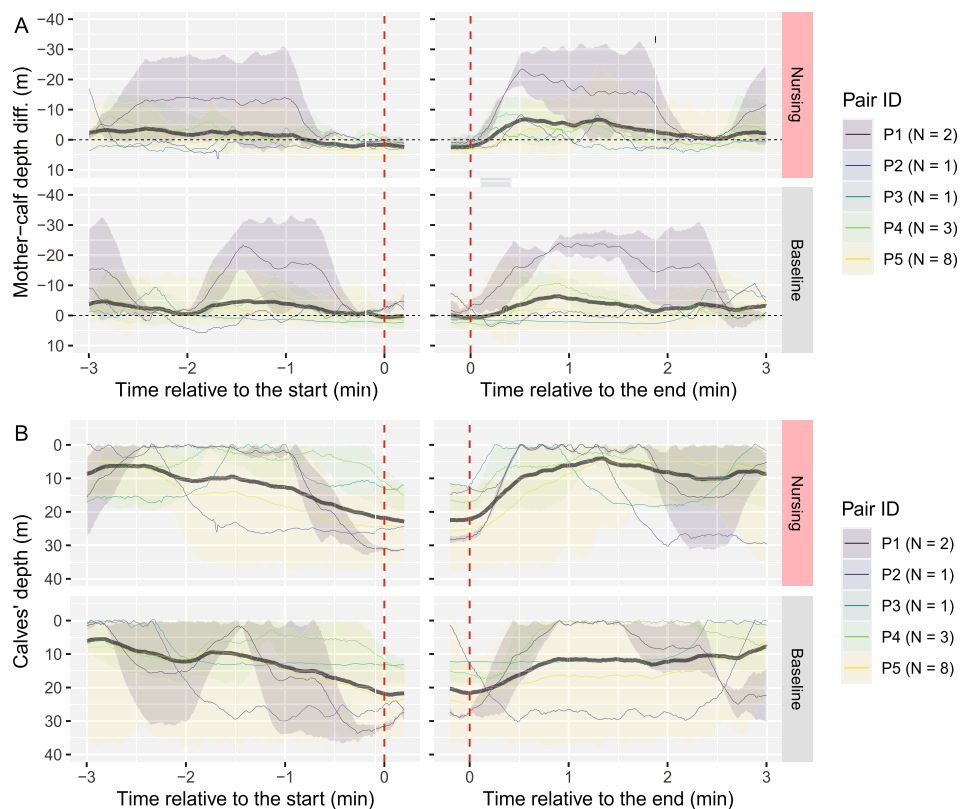
One of the simultaneous Acousonde tag deployments did not contain any nursing events. The remaining simultaneous Acousonde tag deployments contained 32 nursing events in total. Since we were interested in how the bouts are initiated and terminated, we analyzed only nursing events that were at least 3 min apart from the previous nursing event (i.e., considered to be the initial nursing event of a bout) for the examination of the sequence of behavior before nursing bouts ( $N=15$  bouts from the five mother-calf pairs) and only nursing events that were at least 3 min away from the next nursing event (i.e., considered to be the terminal nursing event of a bout) for the examination of the sequence of behaviors after nursing bouts (also  $N=15$  bouts from the five mother-calf pairs). For uniformity, we considered only the first 12 s of the initial nursing events and the last 12 s of the terminal nursing events, as these periods approximately represented the lowest nursing event duration observed. We operationally chose a conservative threshold of 3 min to isolate initial and terminal events (and thus separate bouts), as previous studies defined bouts as successive nursing events separated by < 1 min—with a high proportion of inter-event intervals indeed < 1 min (Ratsimbazafindranahaka et al. 2022, 2023), but a 3-min gap is long enough to require postural readjustment (e.g., for breathing in the case of the calf or for communication) and therefore provides a more conservative and biologically meaningful unit of study for how nursing interactions are initiated and terminated.

From the pressure and 3D acceleration data of the tags, we extracted the depth (in m), the depth rate (vertical speed, in m/s), the pitch (in degrees), the roll (in degrees), the relative speed ( $z$ -scored flow noise), and the normalized Overall Dynamic Body Acceleration (nODBA) (details in Ratsimbazafindranahaka et al. 2023), sampled at 10 Hz. We then aligned the analyzed nursing events relative to their start and end times. As a baseline reference, we randomly selected a point at the same depth as the start of each nursing initiation or the end of terminal nursing. These points marked the beginning or termination of the non-nursing data reference. From each, we extracted data for 3 min before or after, mirroring the nursing data. Dives were only used once in the process and excluded if they were nursing dives.

Before nursing bouts, calves were generally at shallower or similar depths compared to their mothers (Figure 1A), though two pairs—each with only one observed nursing bout—did not follow this pattern. For instance, the average vertical distances between 0.5 to 1 min prior to nursing showed no statistically significant difference from the baseline data ( $V=94$ ,  $p=0.055$ , paired Wilcoxon signed-rank test). However, within the 0.5 min before nursing, calves tended to be below their mothers, unlike when not nursing ( $V=107$ ,  $p=0.005$ , paired Wilcoxon signed-rank test). Similar to when not nursing, calves sometimes presented periods of separation (up to more than 10 m distance) from the mothers before arriving at the suckling depth and were the ones going toward the mothers. The mothers did not seem to be more stable regarding depth compared to when not nursing (difference in average absolute depth rate between nursing and baseline data, 0 to 0.5 min prior:  $V=66$ ,  $p=0.762$ ; 0.5 to 1 min prior:  $V=81$ ,  $p=0.252$ , paired Wilcoxon signed-rank test). Nevertheless, compared to the depth rate within the 0 to 0.5 min prior to nursing, the absolute depth rate is lower during nursing (i.e., relatively stable as the nursing started) ( $V=15$ ,  $p=0.008$ , paired Wilcoxon signed-rank test). These observations are consistent with earlier studies showing that mothers initiate dives and generally reach depth before their calves (Huertz et al. 2022; Tyson et al. 2012). Specifically, our results support that this pattern extends to the initiation of nursing dives. Our observations are also consistent with previous reports that calves then actively position themselves below their mothers to suckle (Ratsimbazafindranahaka et al. 2022; Tackaberry et al. 2020; Zoidis and Lomac-MacNair 2017).

After nursing, although the average depth rate was similar to the baseline data for calves (0 to 0.5 min after:  $V=32$ ,  $p=0.121$ ; 0.5 to 1 min after:  $V=61$ ,  $p=0.978$ , paired Wilcoxon signed-rank test), calves consistently ascended to the surface within about 1 min, whereas they sometimes remained at depth when not suckling (Figure 1B). This pattern reflects their need to breathe at the end of a nursing bout due to limited apnea performance in young calves (Cartwright and Sullivan 2009; Ejrnaes and Sprogis 2021).

Regarding pitch, we found no statistically significant difference from the baseline data for either mothers (during nursing:  $V=36$ ,  $p=0.188$ ; 0 to 0.5 min prior:  $V=60$ ,  $p=1$ ; 0.5 to 1 min prior:  $V=49$ ,  $p=0.561$ , paired Wilcoxon signed-rank test) or calves (during nursing:  $V=66$ ,  $p=0.762$ ; 0 to 0.5 min prior:



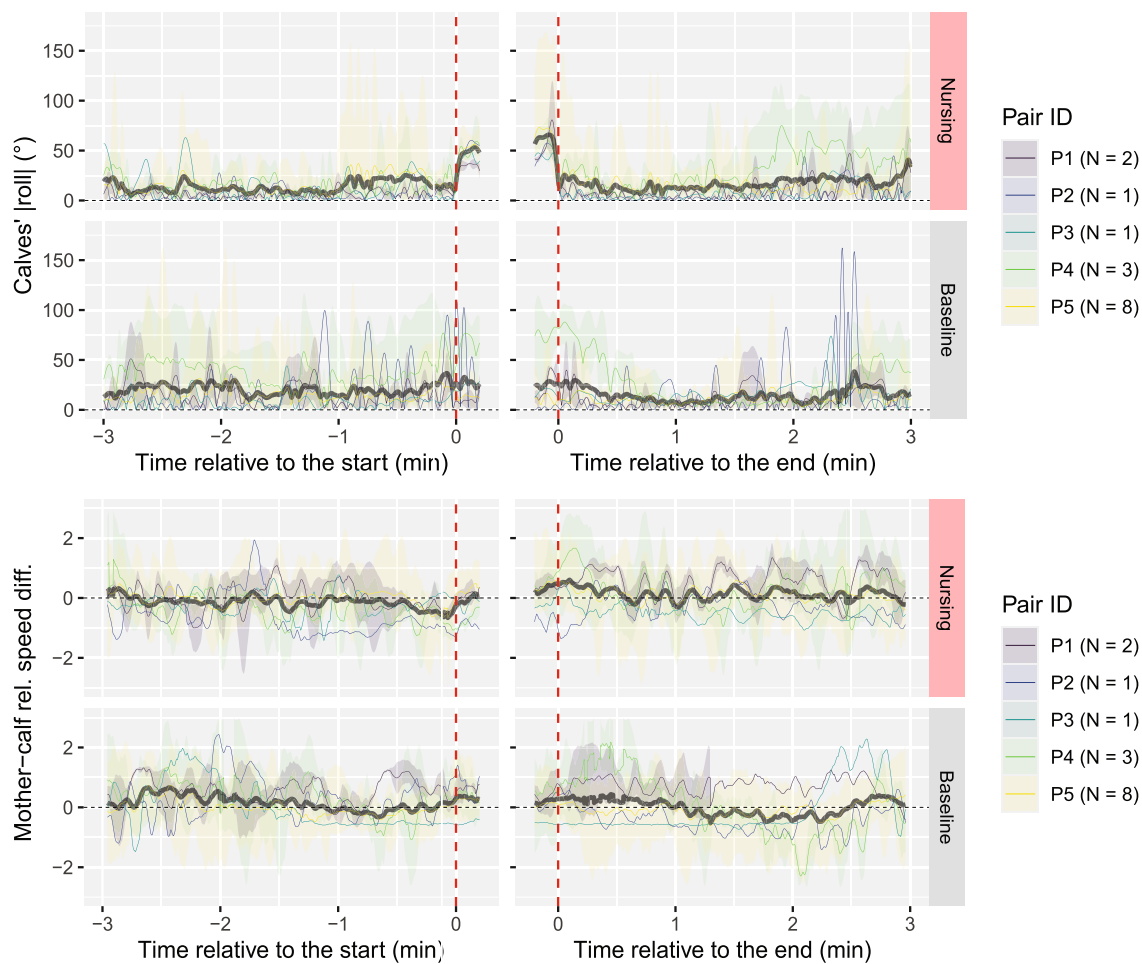
**FIGURE 1** | Mother-calf depth differences (vertical distance, A) and calves' depth (B) prior to (left) and after (right) nursing bouts in six hump-back whale mother-calf pairs. Baseline data for non-nursing periods are shown below the nursing data for reference. Negative values for the depth differences indicate calves positioned above their mothers. Colored lines represent the average across events for each pair, with shaded bands indicating the range (min-max). The thick gray line represents the average across all pairs. Data after the start of nursing bouts correspond to the initial nursing event (first 12s). Data prior to the end of nursing bouts correspond to the terminal nursing event (last 12s). *N* indicates the number of analyzed nursing bouts for each pair.

$V=65$ ,  $p=0.804$ ; 0.5 to 1 min prior:  $V=62$ ,  $p=0.934$ , paired Wilcoxon signed-rank test). The average pitch difference between mothers and calves during nursing was also relatively small, barely exceeding  $25^\circ$ , and not statistically different from the baseline data ( $V=75$ ,  $p=0.421$ , paired Wilcoxon signed-rank test). The mostly horizontal pitch of calves during suckling, together with the small difference in pitch between mother and calf, contrasted with calf-perspective video reports of a  $\sim 30^\circ$ – $45^\circ$  angle difference attributed to the mother leaning downward (Ratsimbazafindranahaka et al. 2022, 2023) and with in-water observations (i.e., from a boat or by divers) describing mothers oriented vertically or nearly horizontally with calves in vertical or semi-vertical postures beneath them (Glockner-Ferrari and Ferrari 1985; Glockner and Venus 1983; Zoidis and Lomac-MacNair 2017). This discrepancy highlights uncertainty about nursing postures. One possibility is that when both mother and calf are almost horizontal, mothers create the relative angle through subtle dorsoventral adjustments, such as caudal peduncle lift or body curvature. More broadly, differences between tag-based and in-water observations may reflect complementary perspectives: in-water studies capture only a subset of contexts, whereas tags show that suckling mostly occurs at depth and during movement, beyond the reach of divers and boat-based observations (Ratsimbazafindranahaka et al. 2022, 2023; Tackaberry et al. 2020). Together, these perspectives underscore a potentially broader repertoire of nursing postures than previously described.

As previously described (Ratsimbazafindranahaka et al. 2022, 2023), calves clearly rolled either to the left or right (resulting in an elevated absolute roll) during nursing events to access the corresponding teat (while the mother remained level) in contrast to when not suckling (Figure 2A,  $V=105$ ,  $p=0.008$ , paired Wilcoxon signed-rank test). The distinct rolling behavior was mainly observed during suckling events, but for some calves, it also appeared to begin in the minute leading up to nursing. In these cases, the absolute roll increased, then decreased momentarily before increasing again during nursing (Figure 2A). This fluctuation likely reflects the calf's maneuvering period as it positions itself beneath the mother to suckle.

The pairs were not stationary during nursing and presented relative speeds comparable to the baseline data (for instance for the mothers during nursing:  $V=75$ ,  $p=0.421$ ; 0 to 0.5 min prior:  $V=78$ ,  $p=0.330$ ; 0.5 to 1 min prior:  $V=76$ ,  $p=0.389$ , paired Wilcoxon signed-rank test). Nevertheless, the gap between calves' and mothers' relative speeds tended to increase within the 0.5 min prior to nursing (corresponding to calf deceleration) before converging again, a pattern statistically different from the baseline (Figure 2B,  $V=21$ ,  $p=0.025$ , paired Wilcoxon signed-rank test). The deceleration likely reflects the calf aligning its snout with its mother's teats as she continues moving forward.

Regarding the nODBA, prominent peaks were observed in mothers and calves before and after nursing, likely associated with



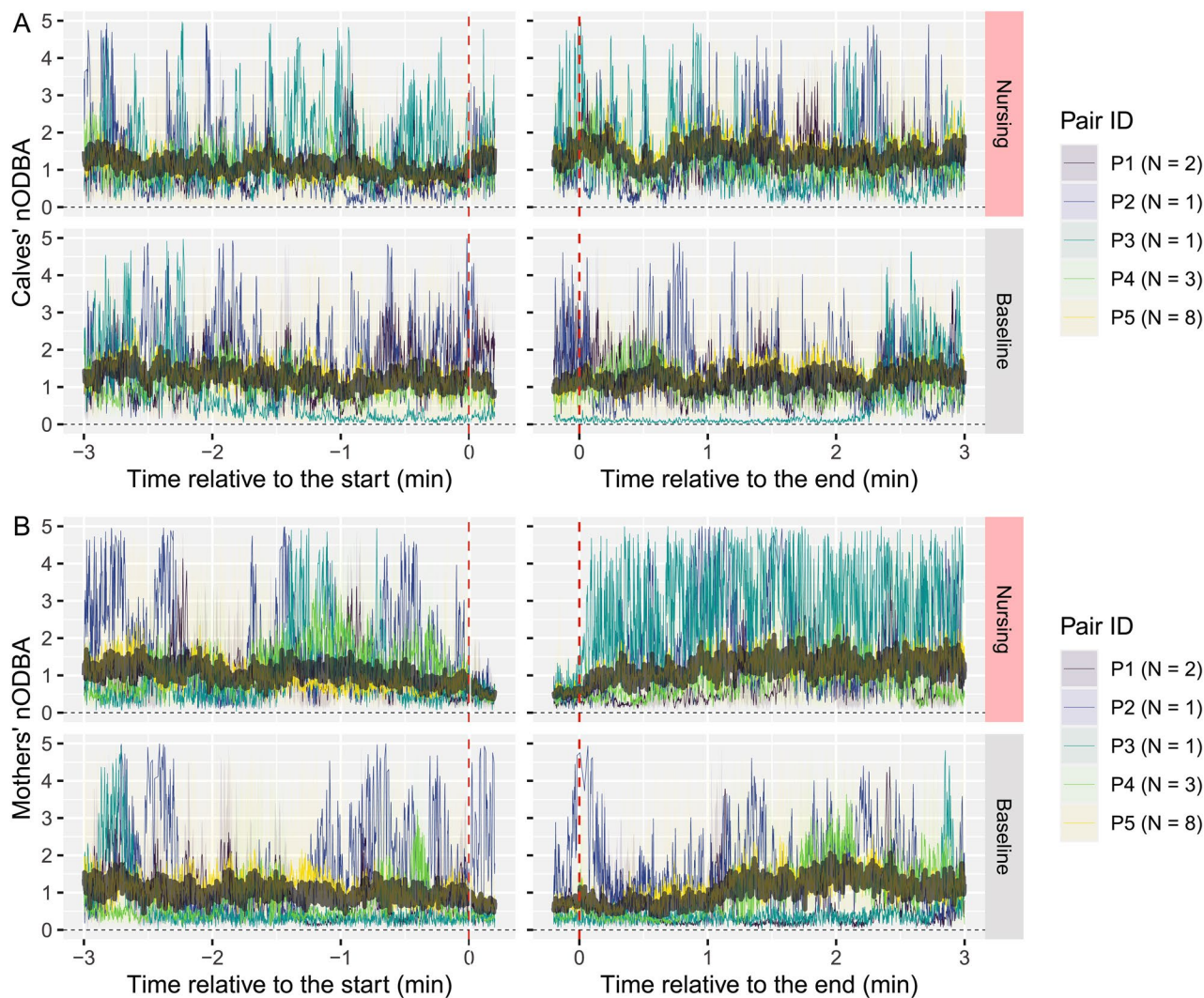
**FIGURE 2** | Calves' absolute roll (A) and mother-calf relative speed differences (B) prior to (left) and after (right) nursing bouts in six humpback whale mother-calf pairs. Baseline data for non-nursing periods are shown below the nursing data for reference. Colored lines represent the average across events for each pair, with shaded bands indicating the range (min–max). The thick gray line represents the average across all pairs. Data after the start of nursing bouts correspond to the initial nursing event (first 12 s). Data prior to the end of nursing bouts correspond to the terminal nursing event (last 12 s). *N* indicates the number of analyzed nursing bouts for each pair. In one P1 event, maternal relative speed data were missing, beginning ~1.5 min into the randomly selected post-nursing baseline period.

tail beats (Figure 3). However, these peaks disappeared during nursing for all mothers, unlike in the baseline data, where some continue exhibiting them. Such observation suggests that mothers cease tail fluke movements when the calf begins suckling, indicating a deliberate effort to facilitate the calf's suckling process. The small delay before the prominent peaks reappeared after nursing further suggests that mothers do not abruptly or aggressively interrupt nursing bouts with tail fluke movements. In contrast, calves' nODBA peaks remained visible during nursing because they need tail fluke movements to maintain attachment to their mother's teats (Tackaberry et al. 2020).

In addition to the analysis of the simultaneous Acousonde deployment data, we examined the videos corresponding to periods prior, during, and after bouts corresponding to the 79 suckling events (37 bouts) visually identified in CATS cam tag data (details in Ratsimbazafindranahaka et al. 2023). The video observations aligned with those from the Acousonde tag deployments. Before almost all the observed nursing bouts, the calf began to slow down, either after positioning below its mother at her mid-body level or when positioned to the side and slowly descending below her as the mother continued to move forward.

This deceleration allowed the calves to align their snout with the teats for suckling. The only exception noted was in one nursing bout where the calf approached its mother from behind. In all the observed sequences, the mother refrained from making tail fluke beats during nursing and, at most, exhibited barely perceptible fluke undulations. Unfortunately, it was challenging to discern if the mother's body was curved during nursing due to the limited field of view of the camera on the tag.

In summary, the present study describes the behavioral coordination between the mother and her calf as related to nursing during the calf's development on their calving ground. Our observations suggest that the calf is active in the approaches and the nursing setup. Additionally, as would be expected during the early stages of young mammal development, our observations highlight a degree of cooperation from the mother, who adjusts her behavior to facilitate suckling, a pattern also reported in various mammalian species (Fialkovskyi et al. 2023; Lent 1974; Reid et al. 1995; Saito et al. 2020). For instance, in humpback whales, such facilitation includes interrupting tailbeats even though nursing can occur at non-stationary speeds, stabilizing depth at the onset of nursing, and not displaying obvious sign



**FIGURE 3** | Calves' (A) and mothers' (B) normalized ODBA prior to (left) and after (right) nursing bouts in six humpback whale mother-calf pairs. Baseline data for non-nursing periods are shown below the nursing data for reference. Colored lines represent the average across events for each pair, with shaded bands indicating the range (min–max). The thick gray line represents the average across all pairs. Data after the start of nursing bouts correspond to the initial nursing event (first 12 s). Data prior to the end of nursing bouts correspond to the terminal nursing event (last 12 s). *N* indicates the number of analyzed nursing bouts for each pair. In one P1 event, maternal nODBA data were missing, beginning ~1.5 min into the randomly selected post-nursing baseline period.

of nursing refusal/maternal rejection. By using simultaneous animal-borne tag data, this study offers a rare perspective on humpback whale mother–calf interactions during nursing bouts and complements previous observational findings.

#### Author Contributions

**Maevatiana N. Ratsimbazafindranahaka:** conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, validation, visualization, writing – original draft, writing – review and editing. **Chloé Huetz:** conceptualization, investigation, methodology, supervision, validation, writing – review and editing. **Anjara Saloma:** conceptualization, funding acquisition, investigation, methodology, project administration, writing – review and editing. **Aristide Andrianarimisa:** conceptualization, investigation, methodology, project administration, supervision, writing – review and editing. **Isabelle Charrier:** conceptualization, funding acquisition, investigation, methodology, project administration, supervision,

validation, writing – review and editing. **Olivier Adam:** conceptualization, funding acquisition, investigation, methodology, project administration, supervision, validation, writing – review and editing.

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#36/19-MAEP/SG/DGPA, #30/21-MAEP/SG/DGPA, and #54/22-MPEB/SG/DGPA and comply with the European Union Directive on the Protection of Animals Used for Scientific Purposes (EU Directive 2010/63/EU).

### Conflicts of Interest

The authors declare no conflicts of interest.

### References

- Balshine, S. 2012. "Patterns of Parental Care in Vertebrates." In *The Evolution of Parental Care*, edited by N. J. Royle, P. T. Smiseth, and M. Kölliker. Oxford Academic. <https://doi.org/10.1093/acprof:oso/9780199692576.001.0001>.
- Cartwright, R., and M. Sullivan. 2009. "Behavioral Ontogeny in Humpback Whale (*Megaptera novaeangliae*) Calves During Their Residence in Hawaiian Waters." *Marine Mammal Science* 25, no. 3: 659–680. <https://doi.org/10.1111/j.1748-7692.2009.00286.x>.
- Clapham, P. J., and C. A. Mayo. 1987. "Reproduction and Recruitment of Individually Identified Humpback Whales, *Megaptera novaeangliae*, Observed in Massachusetts Bay, 1979–1985." *Canadian Journal of Zoology* 65, no. 12: 2853–2863. <https://doi.org/10.1139/z87-434>.
- Clark, S. T., and D. K. Odell. 1999. "Nursing Behaviour in Captive False Killer Whales (*Pseudorca crassidens*)." *Aquatic Mammals* 25: 183–191.
- Ejrnæs, D. D., and K. R. Sprogis. 2021. "Ontogenetic Changes in Energy Expenditure and Resting Behaviour of Humpback Whale Mother: Calf Pairs Examined Using Unmanned Aerial Vehicles." *Wildlife Research* 49, no. 1: 34–45. <https://doi.org/10.1071/WR20186>.
- Fiialkovskiy, P., J. Cassinello, K. Brandlová, and F. Ceacero. 2023. "Evidence of Three Distinct Lactation Stages in Nursing Gazelles: Implications on Maternal Behaviour Assessment." *Applied Animal Behaviour Science* 258: 105814. <https://doi.org/10.1016/j.applanim.2022.105814>.
- Glockner, D. A., and S. C. Venus. 1983. "Identification, Growth Rate, and Behaviour of Humpback Whale (*Megaptera novaeangliae*) Cows and Calves in the Waters off Maui, Hawaii, 1977–79." In *Communication and Behavior of Whales*, edited by R. Payne, 223–258. Westview Press.
- Glockner-Ferrari, D. A., and M. J. Ferrari. 1985. *Individual Identification, Behavior, Reproduction, and Distribution of Humpback Whales, Megaptera novaeangliae, in Hawaii*. US Marine Mammal Commission.
- Hain, J. H. W., J. D. Hampp, S. A. McKenney, J. A. Albert, and R. D. Kenney. 2013. "Swim Speed, Behavior, and Movement of North Atlantic Right Whales (*Eubalaena glacialis*) in Coastal Waters of Northeastern Florida, USA." *PLoS One* 8, no. 1: e54340. <https://doi.org/10.1371/journal.pone.0054340>.
- Hall, W. G., R. Hudson, and S. C. Brake. 1988. "Terminology for Use in Investigations of Nursing and Suckling." *Developmental Psychobiology* 23, no. 1: 89–91. <https://doi.org/10.1002/dev.420210107>.
- Huetz, C., A. Saloma, O. Adam, A. Andrianarimisa, and I. Charrier. 2022. "Ontogeny and Synchrony of Diving Behavior in Humpback Whale Mothers and Calves on Their Breeding Ground." *Journal of Mammalogy* 103: gyac010. <https://doi.org/10.1093/jmammal/gyac010>.
- Lent, P. C. 1974. "Mother-Infant Relationships in Ungulates." In *The Behaviour of Ungulates and Its Relation to Management*, edited by V. Geist and F. Walther, vol. 1, 14–55. IUCN Morges.
- Morete, M. E., A. Freitas, M. H. Engel, R. M. Pace III, and P. J. Clapham. 2003. "A Novel Behavior Observed in Humpback Whales on Wintering Grounds at Abrolhos Bank (Brazil)." *Marine Mammal Science* 19, no. 4: 694–707.
- Nowak, R., R. H. Porter, F. Lévy, P. Orgeur, and B. Schaal. 2000. "Role of Mother-Young Interactions in the Survival of Offspring in Domestic Mammals." *Reviews of Reproduction* 5, no. 3: 153–163. <https://doi.org/10.1530/ror.0.0050153>.
- Oftedal, O. T. 2012. "The Evolution of Milk Secretion and Its Ancient Origins." *Animal* 6, no. 3: 355–368. <https://doi.org/10.1017/S175173111001935>.
- Ratsimbazafindranahaka, M. N., C. Huetz, A. Andrianarimisa, et al. 2022. "Characterizing the Suckling Behavior by Video and 3D-Accelerometry in Humpback Whale Calves on a Breeding Ground." *PeerJ* 10: e12945. <https://doi.org/10.7717/peerj.12945>.
- Ratsimbazafindranahaka, M. N., C. Huetz, J. S. Reidenberg, et al. 2023. "Humpback Whale Suckling Behavior: an Insight Into the Mother-Offspring Strategy in Mysticetes." *Behavioral Ecology and Sociobiology* 77, no. 8: 96. <https://doi.org/10.1007/s00265-023-03369-9>.
- Reid, K., J. Mann, J. R. Weiner, and N. Hecker. 1995. "Infant Development in Two Aquarium Bottlenose Dolphins." *Zoo Biology* 14, no. 2: 135–147. <https://doi.org/10.1002/zoo.1430140207>.
- Russell, J. M., J. S. Simonoff, and J. Nightingale. 1997. "Nursing Behaviors of Beluga Calves (*Delphinapterus leucas*) Born in Captivity." *Zoo Biology: Published in Affiliation With the American Zoo and Aquarium Association* 16, no. 3: 247–262. [https://doi.org/10.1002/\(SICI\)1098-2361\(1997\)16:3<247::AID-ZOO5>3.0.CO;2-A](https://doi.org/10.1002/(SICI)1098-2361(1997)16:3<247::AID-ZOO5>3.0.CO;2-A).
- Saito, M., N. Takagi, M. Tanaka, and Y. Yamanashi. 2020. "Nighttime Suckling Behavior in Captive Giraffe (*Giraffa camelopardalis reticulata*)." *Zoological Science* 37, no. 1: 1–6. <https://doi.org/10.2108/zs190094>.
- Tackaberry, J. E., D. E. Cade, J. A. Goldbogen, D. N. Wiley, A. S. Friedlaender, and A. K. Stimpert. 2020. "From a Calf's Perspective: Humpback Whale Nursing Behavior on Two US Feeding Grounds." *PeerJ* 8: e8538. <https://doi.org/10.7717/peerj.8538>.
- Thomas, P. O., and S. M. Taber. 1984. "Mother-Infant Interaction and Behavioral Development in Southern Right Whales, *Eubalaena Australis*." *Behaviour* 88, no. 1–2: 42–60.
- Tyson, R. B., A. S. Friedlaender, C. Ware, A. K. Stimpert, and D. P. Nowacek. 2012. "Synchronous Mother and Calf Foraging Behaviour in Humpback Whales *Megaptera novaeangliae*: Insights From Multi-Sensor Suction Cup Tags." *Marine Ecology Progress Series* 457: 209–220.
- Videsen, S. K. A., L. Bejder, M. Johnson, and P. T. Madsen. 2017. "High Suckling Rates and Acoustic Crypsis of Humpback Whale Neonates Maximise Potential for Mother-Calf Energy Transfer." *Functional Ecology* 31, no. 8: 1561–1573. <https://doi.org/10.1111/1365-2435.12871>.
- Würsig, B., E. M. Dorsey, M. A. Fraker, R. S. Payne, and W. J. Richardson. 1985. "Behavior of Bowhead Whales, *Balaena mysticetus*, Summering in the Beaufort Sea: a Description." *Fishery Bulletin* 83, no. 3: 357–377.
- Zoidis, A. M., and K. S. Lomac-MacNair. 2017. "A Note on Suckling Behavior and Laterality in Nursing Humpback Whale Calves From Underwater Observations." *Animals* 7, no. 7: 51. <https://doi.org/10.3390/ani7070051>.