



Gaping in Humpback Whales, A Unique Behavior Documented Through Citizen Science

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Abstract – Humpback whales (*Megaptera novaeangliae*) are arguably the most frequently observed whale species in the world. Their coastal habits, tolerance of boats, and rapid recovery post-whaling has resulted in this species dominating whale-watching vessel operations and in-water swim-with tourism in all major ocean basins. Observations by tourists, i.e., citizen scientists, are often shared via social media providing an opportunity to document otherwise rarely seen whale behavior. We present evidence gathered through citizen science via social media of gaping by humpback whales. Gaping is a common form of behavior in many animals, wherein an animal opens its mouth widely, displaying the interior, but it may have various functions. Gaping is therefore defined by form, and here we refer to gaping not associated with feeding and observed only outside known feeding areas. A desktop search of the internet returned a total of 66 social media observations of gaping collected from vessels (gaping above water, n=36), from swim-with operations (gaping fully submerged, n=24, including jaw popping – clapping of their mouth with the production of a sound); and from drone observations (n=6). We suggest several possible interpretations including; 1) playful/social behavior and communication; 2) general jaw stretching and post/pre suckling (calves only); 3) playing with debris (calves only), and 4) natural separation of mandible (due to gravity) as a result of surface-active behaviors, e.g., chin slapping/head lunging - picked up from the search. This paper further illustrates how citizen science and social media can document rarely seen whale behavior.

Keywords – Humpback whale, Tourism, Citizen science, Gaping, Mouth open, Behavior, *Megaptera novaeangliae*

Marine citizen science involves the general public, or non-scientists, collecting information about marine life in a variety of ways (Garcia-Soto et al., 2021; Vohland et al., 2021). Observations of the marine environment may be recorded through individual recreational activities such as boating or diving, by naturalist groups (Pirotta et al., 2022), or via commercial tourism such as dive or whale-watching tours (Lodi et al., 2023). Imagery data, in the form of videos or photographs, may be made available to scientists through direct contact (provided to scientists), via the media (e.g., TV reports, radio), and/or social media platforms, e.g., YouTube, Instagram, Facebook, TikTok, X, Bluesky (Nascimento et al., 2024; Pirotta et al., 2022; Sullivan et al., 2019). Access to high-quality recording technologies, such as smartphones, commercial drones (Unmanned Aerial Systems; UASs), and underwater cameras, together with storytelling via social media platforms, is helping bring novel awareness to the marine environment, thereby strengthening marine conservation efforts (Wu et al., 2018). Already, marine science has benefited from several marine-focused citizen science efforts coupled with social media, for example, coral reef restoration (Hesley et al., 2017), monitoring of fish distributions (DiBattista et al., 2021), estimating trends in emperor

penguin abundance (La Rue et al., 2024), and documenting range recovery for the world's most endangered pinniped, the Mediterranean monk seal *Monachus monachus* (Adamantopoulou et al., 2023).

Cetaceans are a prominent feature of wildlife shared on social media platforms, largely due to their high profile and concomitant popularity, moderate accessibility, and intense and relatively lucrative tourism efforts (Bandara et al., 2019; Gómez et al., 2024; Kessler & Harcourt, 2010; Lodi et al., 2023,). Citizen science efforts via social media are even helping document the range distribution for some species e.g., Bryde's (*Balaenoptera edeni*) and blue whales (*Balaenoptera musculus breviceuda* and *B. m. intermedia*) in Australia (Pirotta & Harcourt 2021; Pirotta et al. 2024). In some cases, the combination of access to high-tech observation tools (e.g., UASs, smartphones, professional cameras) and sharing on social media has enabled marine mammal scientists to incorporate data collected by citizen scientists into their research (Nowacek et al., 2016, Pirotta et al., 2022). Social media and citizen science have documented rarely seen southern right whales around mainland New Zealand (Cranswick et al., 2022), and whale fluke photographs have been fed into artificial intelligence algorithms to identify individual whales and their movements via *Happywhale* (Cheeseman et al., 2017).

Humpback whales (*Megaptera novaeangliae*) are found in all oceans globally (Clapham, 1999). The strong recovery of most populations post-whaling (Seyboth et al., 2023), combined with their proximity to shore during migration, and at some calving/breeding areas, enhanced by their tolerance of vessels and swimmers (Kessler & Harcourt, 2010; Kessler et al., 2013), makes them a popular target for increasing whale tourism and social media (Barra et al., 2020; Orams, 2002; Pirotta et al., 2022). Tourism operations usually watch humpback whales from vessels, but increasingly people also interact with humpback whales from within the water, e.g., the Kingdom of Tonga, Australia, French Polynesia, Dominican Republic, and Reunion Island in the southwest Indian Ocean (Barra et al., 2020; Fiori et al., 2019; Kessler et al., 2013; Orams, 2001; Stack et al., 2021). Both observation platforms provide an opportunity for the general public or citizen scientists (non-scientists collecting information for scientists) to document what they see either above e.g., breaching (jumping out of the water), spy hop (when a whale assumes a vertical posture and brings its mouth and eye above the surface of the water) and/or below the water.

In recent years, distinctive humpback whales (i.e., those with easily identifiable features) have gained popularity on social media, and citizen scientists are increasingly confident in identifying these individuals without the assistance of scientists. Examples include all white humpback whales (Cortez-Casamayor et al., 2024), including the albino male, 'Migaloo' in Australia (Pirotta et al., 2023), as well as those with visible propeller scarring such as 'Bladerunner', an Australian female humpback whale part of the Australian east coast population (Pirotta et al., 2020). Humpback whale behavior has also been documented and discussed widely via social media (Barra et al., 2020), pointing to the potential use of whale tourism and citizen science to document unusual or rarely seen whale behavior that may be difficult to quantify in a more formal scientific manner (Morais et al., 2021).

In this paper, we investigate *gaping* in humpback whales using reports from tourism and recreational UAS users via social media. We define gaping here as observations of humpback whales opening their mouths (either above or below the water), with variations in both the extent of the gape and its duration, but not during lunging or gulping events, as the latter are associated with feeding. We use this example to illustrate how whale tourism operations and social media may contribute more broadly to documenting whale behavior globally.

Methods

Ethics Statement

Ethical review of this research was sought from Macquarie University, Australia, which determined that no ethics review was required for this research as all data were assessed from citizen science observations only.

Procedure

A search of humpback gaping behavior was conducted across the internet and social media platforms between August and October 2025. The sources included: Instagram, Facebook, TikTok, YouTube, X, and Bluesky. Keywords were used to help identify examples of gaping behavior based on colloquialisms and descriptive terms, these included; “mouth open humpback whale”, “humpback whale mouth open”, “whale mouth open”, “whale mouth open underwater”, “mouth opening whale”, “whale gaping”, “whale gape”, “humpback whale gape”, “humpback whale gaping”. Use of hashtags to refine searches included: “#mouthopenwhale”, “#whalemouth”, “#humpbackwhalemouth”, “#humpbackwhalemouthopen”, “#gape”, “#whalegape”, “#whale gaping”, and “#gaping”.

Videos and photographs were collected from known humpback whale calving/breeding grounds and migratory corridors with the help of social media descriptions, acknowledging that feeding can occur outside traditional feeding grounds (Pirotta et al., 2021). To ensure gaping was not representative of actual feeding, clips where humpback whales were directly observed feeding were excluded. Specifically, all side lunges or photographs representative of feeding from known feeding locations, and/or where fish or krill were visible in images or video were omitted. Any clips where gaping was observed but the location and a clear description were not provided were excluded from this study.

Results

A total of 66 social media videos and photographs posted between 2014 and 2025 documenting gaping by humpback whales were collated, representing animals across all age classes (Table 1).

Table 1

Summary of Social Media Evidence Documenting Humpback Whale Gaping (Mouth Opening) by Adults and Calves Across Media Types, Outside of Feeding Grounds

| | Number of Videos | | | | Number of Photos | | | | Total |
|---|------------------|--------|----------|--------|------------------|--------|----------|--------|-------|
| | Alone* | | In a pod | | Alone* | | In a pod | | |
| Vessel based observations (above water) | 5 | | 8 | | 11 | | 12 | | 36 |
| | Adults | Calves | Adults | Calves | Adults | Calves | Adults | Calves | |
| | 5 | 0 | 8 | 0 | 9 | 10 | 2 | 2 | |
| Swim-with tourism (underwater) | 3 | | 8 | | 5 | | 8 | | 24 |
| | Adults | Calves | Adults | Calves | Adults | Calves | Adults | Calves | |
| | 2 | 1 | 3 | 5 | 2 | 3 | 4 | 4 | |
| UAS (aerial observations) | 2 | | 3 | | 1 | | 0 | | 6 |
| | Adults | Calves | Adults | Calves | Adults | Calves | Adults | Calves | |
| | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | |
| Total | 29 | | | | 37 | | | | 66 |

Note. *Possibly within a pod, other whales present may not be captured in the photo/video.

The videos included observations from: 1) whale watching vessels documenting gaping at or above the water’s surface (n= 36), 2) swim-with tourism documenting gaping underwater (n=24), and 3) UAS observations, which showed gaping both below and at the surface of the water (n=6) (Table 1). All observations were from known breeding/calving grounds, migratory corridors, and outside of known feeding areas.

Most videos/photographs of humpback whales were taken in a social setting, i.e., more than one whale was present (59%). However, in 41% of all imagery, only a single whale was observed gaping. Due to the nature of the sourcing of the observations, it is not possible to quantify how many whales were present

during individual observations (i.e., the data may only show one individual but there may be others also present, just not visible in the photo/video). In addition to observations from social media, co-author I. A. R. Taylor provided two unpublished observations (Figures 1b and 1d).

A total of 29 videos of gaping were collected from above and below water, including via UASs (Table S1). We were unable to quantify the duration of gaping as some videos did not include the entire gape, i.e., from the moment the mouth was opened until it fully closed (a similar method used by Pirootta et al., 2024). Some videos were slowed down deliberately and had been edited, hindering the complete observation. Of those with complete gape documented, the duration ranged from 1 to 36 s.

We found 37 still photographs containing observations of gaping. Photographs varied in the angle between the observer and the animal displaying the gape, and the angle at which humpback whales were gaping. Some were presented in a sequence showing the behavior. The use of hashtags helped to identify additional images. Social media commentary and captions were used to support online posted observations.

Vessel-based Observations

Observations of gaping at or above the water surface were gathered from vessel-based whale watching operations from Australia (Queensland, New South Wales, Western Australia) and the United States of America (Hawai'i and California) (Figure 1). This comprised 13 videos (all from adult humpback whales) and 23 photographs, with a mixture of subadults/adults (48%) and calves (52%) (Table 1).

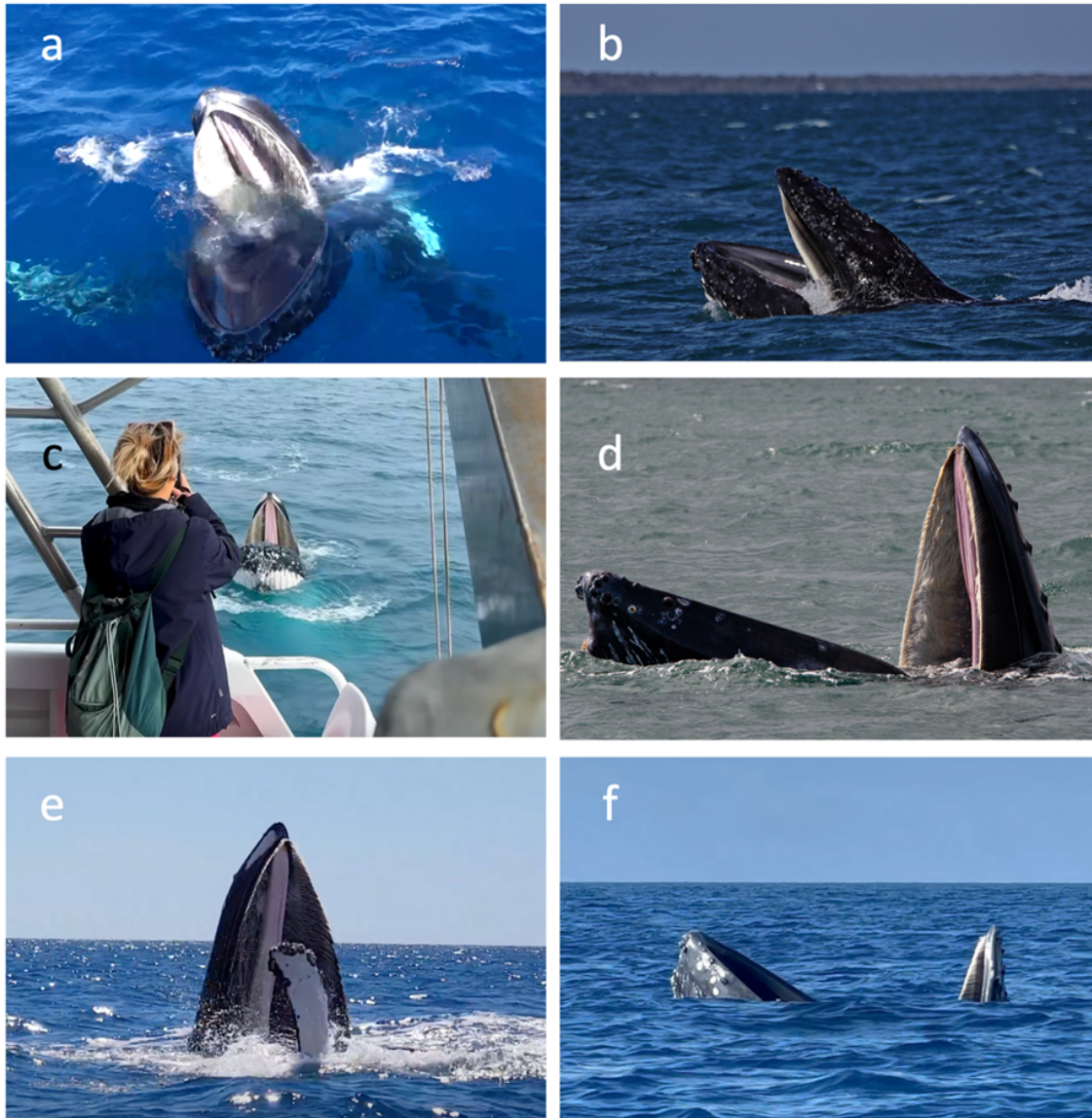
Observations via video revealed a mixture of gaping by humpback whales above the water. We were unable to reliably determine from videos if gaping occurred as either part of social groups or while solitary. These generally occurred within the vicinity of whale watching vessels. Gaping by adults (48%; Figure 1) was observed as part of a social setting, i.e., with more than one whale in proximity to whale watching boats.

Three accounts from 2025 in Hervey Bay, Australia, documented gaping during a 'mugging', a colloquial description for whales approaching and surrounding whale watching vessels for extensive periods, often displaying a range of social display behaviors. In contrast, examples from Western Australia and Hawai'i (Figure 1e and f) did not appear to be directed towards whale watching vessels.

Calves were also observed gaping above water (Table 1), photographed while opening and closing their mouths at the surface in proximity to their mothers, presumably before and after suckling. This behavior often occurred repeatedly, with some calves maintaining the gape for up to five seconds while swimming at the surface.

Figure 1

Gaping By Humpback Whales (Adult/Calves) Observed From Whale Watching Tours In Australia And Hawaii



Note. a) A humpback whale adult approaches a vessel in Hervey Bay, Queensland, Australia, with its mouth open and then closed. This whale had been part of the group of three logging (laying at the surface), spy-hopping (vertical orientation with mouth and eye above the water surface) and mugging (surrounding the vessel) the boat prior to mouth opening, 8/20/2025, video credit: Brett Lakey and Kevin Hill, Lady Musgrave Experience. This observation prompted an investigation of this behavior more broadly. b) A humpback whale calf observed opening its mouth in Hervey Bay, Queensland, Australia. It swam linearly, while simultaneously holding its mouth open for approximately 15 min. It would occasionally close it, only to resume swimming with its mouth open. This mouth opening behavior was not observed in a stationary/milling state, 8/24/2024, photo: co-author I. A. R. Taylor, Pacific Whale Foundation Eco Adventure Australia. c) humpback whale mouth open behavior, with small rotation in Hervey Bay, Queensland, Australia, 8/12/2025, photo credit: Tasman Venture Hervey Bay, Hervey Bay, Australia. d) humpback whale (adult) in stationary position when it suddenly opened up its mouth and held it open for around 3 s, Hervey Bay, Queensland, Australia, 8/8/2024. Photo: by co-author I. A. R. Taylor, Pacific Whale Foundation Eco Adventure Australia, e) humpback whale (adult) with mouth open, pirouetting and use of pectoral flippers as part of behavior near whale watching vessel offshore of Fremantle, Western Australia, 10/1/2018, video credit: Korin George, onboard Jet Adventures, Fremantle, Western Australia. f) mouth opening behavior observed by an adult on a whale watch offshore of Maui, Hawaii, 1/27/2023, video credit: Hannah Pittore Smith (@hannah_in_hawaii) via Ultimate Whale Watch Maui Hawaii.

Swim-with Observations

A total of 24 examples, including 11 videos and 13 photographs (Figure 2, Table 1), were obtained of subadults/adults and calves gaping underwater.

Figure 2

Underwater Gaping (Mouth Opening Behavior) By Humpback Whales Observed From Swim-With Tourism



Note. a) Calf opening and closing its mouth pre-feed. Kailua-Kona, Hawaii, 10/29/2024, Video courtesy of Kayleigh Grant, Kaimana Expeditions. b) Calf mouth opening post feed by calf in Vava'u, Kingdom of Tonga, 9/24/2023, photo: Cassie Jensen Photography. c) Calf returning from feeding under its mother in the waters of Mauritius, 8/6/24, Photo: by @uzeykamora. d) Mother humpback whale opening mouth taken in Vava'u, Kingdom of Tonga. This same mother was documented with its mouth open several times via social media. Tongue visible and no extension of the throat pleats. This photo was captured on 9/13/25 by Lee Edgy, (@edgy_freediving). e) Adult humpback whale in Ha'apai, Kingdom of Tonga. This whale and another spent half an hour swimming around guests, turning upside down, with their bellies up. At the end of the swim, one of the two whales came up vertically and opened its mouth twice. Photo: 9/23/25, Niko Panagis, (@nikos_images). f) Adult female in the breeding grounds of Moorea, French Polynesia opened its mouth wide, 9/25/25, Philip Au and @taotaotasiexpeditions.

These were collected from known calving/breeding grounds in the Kingdom of Tonga, French Polynesia, Mauritius, South Africa, Hawaii, and Silver Bank in the Dominican Republic. Adults were observed gaping alone, without calves (two photographic and video examples, respectively), and with calves (i.e., mother-calf pairs, three photographic and video examples, respectively). Of the videos of adults without calves, gaping can be seen while swimming below the surface. Mothers were also observed gaping independent of their calves, with four independent social media examples of what appears to be the same mother-calf pair documented off Vava'u, Kingdom of Tonga in the 2025 season. This particular individual was seen swimming with its mouth wide open and at times, the tongue was visible without expansion of the ventral throat pleats.

Observations of calves accounted for the remaining underwater observations by citizen scientists. Calves were observed opening their mouths and extending their mandible pre-/post-feeding from their mother. Observations also occurred just under the surface, with or without the mother adjacent (the mother was either resting below or was not visible within the imagery). In one example from Vava'u, Tonga, a calf

was observed ‘jaw clapping’ multiple times, also known as a *jaw pop*, where the calf would open and close its mouth rapidly, making a distinct sound (supplementary video, Cassie Jensen). This calf also produced bubbles in the presence of its mother and an escort. In another example, gaping occurred repeatedly while a calf was active near the surface.

Drone Observations

Gaping was also observed by UAS, with video of two adults and four calves. In the case of the adult observations (one example where the location is not provided), head lunges were observed, with the mandible separating from the maxilla. In the calf observations, all calves exhibited socially active behaviors, with two examples of gaping occurring at the surface.

Discussion

This paper documents gaping behavior in humpback whales observed during tourism activities. We highlight how the ever-increasing whale-watching industry provides opportunities for citizen scientists to record the behavioral repertoire of highly mobile marine fauna and share less-frequently documented events via social media. With growing accessibility and affordability, the recreational use of UASs also contributes to these observations.

Lunge Feeding versus Gaping

Mouth opening by humpback whales is more commonly associated with lunge feeding during foraging events, where humpback whales invest energy for the purpose of acquiring resources (Goldbogen et al., 2008). To lunge feed, rorquals, such as humpback whales, accelerate toward prey, angle their body, lower their mandibles, expose the oral cavity to oncoming flow, close their mouth around a large volume of water containing prey, and expel water through their baleen plates trapping prey (Goldbogen et al., 2007, 2008). This sequence of events was not observed here. Gaping events documented in this paper appear unrelated to feeding (prey capture) or indicative of gulping (swallowing). Gulping may indicate a behavioral display, as documented in underwater observations of other baleen whales, i.e., dwarf minke whales expelling water (Arnold et al., 2005). Gulping may not involve swallowing, but rather, just expansion of the throat pleats (oral cavity only, not allowing water to progress to the oesophagus). If so, it may make the whale appear bigger, and thus be a visual social cue. Videos were the only reliable source for determining gulping behavior. Below, we provide several possible interpretations of humpback whale gaping recorded here.

Gaping Related to Social Behavior and Communication

Mouthing or gaping behavior has been documented in a range of cetaceans, for example, belugas whales (*Delphinapterus leucas*) display mouth to mouth interactions similar to shaking hands (Ham et al., 2023), bottlenose dolphins (*Tursiops truncatus*) produce mouth actions while vocalising in aggressive/non-aggressive contexts (Overstrom, 1983; Perazio & Kuczaj, 2017) and are known to display yawn-like behaviors, which are similar to yawning in humans (Enokizu et al., 2021). In the majority of observations described in this paper, gaping appeared to occur in a social context. Mugging of whale watching vessels in areas such as Hervey Bay, Australia, observed in 2025 (the catalyst for documenting these behaviors) appeared to occur when whales appeared relaxed and engaged in social behavior. One reason may be a possible behavioral display towards other whales, as previously documented in other humpback whales but with no gulping (Goldbogen et al. 2007). In one example from a whale in Western Australia, mouth opening while pirouetting was observed with the movement of its pectoral fins as it turned, in what appears to be a behavioral demonstration in a social setting with other whales (<https://www.youtube.com/watch?v=17rKnsRhZo>; Figure 1e). Gaping was also at times accompanied

by bubble production. Humpback whales are known to create bubbles, or “bubble clouds”- a cluster of tiny bubbles emitted orally, in both play and in aggression (Reidenberg & Laitman, 2007) however, gaping discussed in this paper was not compared to bubbling in these contexts (e.g. within competition pods).

In addition to the gape, we highlighted observations described as “jaw popping,” “clapping,” or “lip smacking,” which may indicate a means of non-vocal communication. While this behavior was observed in both calves and more mature individuals, in the cases involving calves it could serve to gain the attention of the mother, potentially in addition to or as a compensatory measure for the vocal mother-calf communication described in feeding contexts (Ratsimbazafindranahaka et al., 2024).

General Jaw Stretching (Post/Pre Sucking and/or Playing with Debris)

Underwater observations of calves gaping may indicate that the behavior helps to stretch the anatomical structure of their mouths in response to pre-/post-suckling. Calves were also documented gaping when debris was present in the water column, suggesting potential play, exploratory behavior and/or possible cleaning off baleen from caught debris. Aerial observations off Sydney have also shown a calf gaping while interacting with an unknown object at the surface.

Why adult humpback whales exhibited gaping is still not clear. Plausibly, it might be simply that they are stretching their jaw, as their mouths may not have been opened for some time due to fasting during the winter/springtime. In some cases, these individuals’ tongues were also visible (figure 2d). There are times when their tongues are visible in the mouth across still and video imagery sources, where their ventral throat pleats do not appear to be expanded to hold engulfed water as they would when feeding (Werth and Crompton 2023). In contrast, there is evidence of some underwater mouth openings where the ventral throat pleats appear partially enlarged, and is likely a result of moving through the water column with its mouth open.

Incidental Separation of Lower Mandible Due to Gravity

In some examples, gaping might not be deliberate, but simply a consequence of the whale performing a vigorous surface-active behavior such as a chin slap or a head lunge. This may result in the mouth opening due to reverberation and or gravity, rather than as a deliberate behavior but was still picked up by our desktop search. This points to a limitation of using still photographs from social media. Modern digital single-lens reflex cameras (DSLRs) can shoot as fast as 20 to 30 frames per second, making it more likely to capture momentary postures, such as a mouth slipping open. These unique images are often posted on social media; however, they may lack context and are frequently not accompanied by formal research. Additionally, the potential presence of AI-generated images/videos may also appear on social media platforms, and these synthesized images may be misinterpreted as capturing real behaviors.

Social Media Increasing Effort Around Humpback Whale Behavior

This paper illustrates how scientists can access opportunistic observational data of whales through social media derived from tourism and recreational activities. In some cases, additional effort via social media and citizen science may assist in broader attempts to learn more about wildlife populations in need of extra conservation help, by filling important monitoring gaps for rare or threatened animals (Fontaine et al., 2022). Oceania humpback whales (Oceania subpopulation) are an example of an endangered population, that is yet to recover post-whaling and remain the primary focus of swim-with-whales tourism in the Kingdom of Tonga (Constantine et al., 2012, Fiori et al., 2019). This paper demonstrates not only humpback whale popularity but also a large amount of observational effort from areas such as the Kingdom of Tonga.

The commentary and descriptions provided by citizen scientists to accompany videos and photographs (supplementary video) on social media can indicate which behaviors are relatively uncommon. In this paper, both whale-watching operators and underwater photographers commented on the unusual nature of gaping exhibited by mature humpback whales, that is rarely seen despite thousands of hours of

observation by these groups. In most cases of gaping observed from vessels, the accompanying commentary reflected the rarity of the behavior. Furthermore, time-stamped postings of gaping and online discussions within the attributed comments section also highlighted its apparent novelty. Of note, gaping by nursing calves was observed relatively more frequently compared with adult gaping.

A Cautionary Note

Observations documented in this paper arose from existing whale tourism operations, i.e., the authors specifically did not ask people to collect observations of gaping. Social media was used to facilitate the sharing of such behaviors. In some cases, some authors have posted about the same observation several times i.e., re-shared the same observation and/or additional images or video captured from the same interaction. Social media of these unique observations may contribute to setting unrealistic expectations for future whale encounters and tourism operations. People may be looking for a point of difference and as such, may want to increase their chances of capturing something unique by increasing the frequency of interactions and potential disturbance to whales. The role of social media should be considered when managing whale tourism operations to ensure unique behaviors are realistically represented. For example, the *Tongan Whale Tourism Project* in place in Vava'u, in the Kingdom of Tonga (commenced in 2025), is an example of a community (Vava'u Environment Protection Association), Government and scientific led (co-authors V. Pirotta and R. Harcourt) initiative working to understand such catalytic impacts arising from whale tourism to ensure the longevity and sustainability of swimming with whales.

Conclusions

This paper demonstrates the role of tourism and social media in providing complementary observations of whale behavior. For verifiable observations, digital media broadcast through social media can provide a record of rare behavior using a much larger platform than would otherwise be available from dedicated scientific studies. Scientists, governments, conservationists, and other stakeholders can use social media to help document humpback whale behavior efficiently through space and time. Sharing the results of studies such as this one can also be used to disseminate conservation messages, by connecting citizen scientists to an understanding of what they have documented- one of the key intentions of this paper. Given widespread use of social media and the increase in popularity of wildlife tourism, more unusual behaviors are likely to be seen and subsequently reported, helping inform scientists on the plasticity of behavior exhibited by cetaceans, and marine fauna more broadly.

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