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What's at Play: Humpback Whale Interaction with Seaweed Is a Global Phenomenon

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Abstract: The use of objects by cetaceans is well known, and their ability to interact with their environment in complex behaviours has been demonstrated previously. However, baleen whales, including humpback whales (*Megaptera novaeangliae*), are less often observed to perform object use, but this behaviour might be more common than previously thought. Only a few isolated observations of interactions with seaweed have been reported in the scientific literature to date. The recovery of humpback whale populations, as well as the rise of technology such as unmanned aerial vehicles (UAVs) and the use of social media, allow for a new assessment of this object interaction. Here, we describe in detail three instances of "kelping" on the east coast of Australia derived from aerial observations. A summary of over 100 separate and unrelated events drawn from social media, documented by photographs and videos, suggests that this form of interaction with seaweed is observed across different populations. The form of interaction with seaweed is similar between regions, predominantly displayed between the rostrum and dorsal fin. This behaviour may be playful but could also serve additional benefits in the context of learning and socializing, as well as ectoparasite removal and skin treatment by utilizing brown algae's antibacterial properties. Establishing this type of behaviour as distributed across different populations is important to better understand the species' habitat preferences.

Keywords: whales; seaweed; kelping; humpback whales; novel behaviour; self-medication; UAVs

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1. Introduction

The cognitive abilities of whales and dolphins is well recognised [1], leading to complex interactions and feeding strategies [2,3]. Cetaceans frequently engage in playful ways, indicating innovation and creativity [4,5]. Playful activity is prevalent among various species and can be exhibited by all age classes [6,7]. It has been suggested that play behaviour may facilitate an individual's ability to acquire knowledge, adapt to changing environments, contribute to species survival, and provide young animals with an avenue to cultivate important relationships [4,8]. Most information about play activities amongst cetaceans to date is derived from dolphin research [9]. Object play in dolphins allows young dolphins to explore and learn about their environment, develop problem-solving skills, and practice social interactions. Through object play, dolphins can improve their physical coordination, spatial awareness, and cognitive abilities [4]. Dolphins in the wild may encounter various objects, such as seaweed, shells, sponges, and debris, and interacting with these objects through play can offer, for example, sensory stimulation, contributing to their overall well-being [10,11]. Engaging in playful interactions with objects can serve as a way for dolphins to establish and maintain social relationships within their groups. It can also convey information and facilitate communication among individuals [12]. Nonetheless, defining what play represents in animals is difficult and remains a subject of ongoing debate [13].

Humpback whales have been observed interacting with seaweed off the east coast of Australia in the past [14] and anecdotally from the east and west coast of North America. The behaviour is also described as "kelping" or "kelping play" when whales are seeking floating seaweed or kelp beds and then roll and rub against it.

Humpback whales (*Megaptera novaeangliae*) are a widespread baleen whale [15]. They have adapted to a range of environmental conditions, migrating annually from polar feeding to tropical breeding grounds [16,17]. Each population has separate breeding and feeding regions and seasonal migration routes passing through coastal waters [18].

Kelping has been observed in other baleen whales, such as gray whales (*Eschrichtius robustus*), a species that has been reported to consume seaweed and seagrass [19], and the behaviour is known in northern and southern right whales (*Eubalaena glacialis* and *E. australis*) [6,20]. While there are anecdotal reports and observations documenting whales' interactions with seaweed, there is limited research focused on this behaviour. Only a few references mention the behaviour to date [14,20] and other forms of object use, such as logs [21] or jellyfish [22].

The exact reasons for this behaviour are not fully understood. One possibility is that whales engage in kelping play for sensory stimulation, as the seaweed may provide tactile sensations when touching the whales' sensory hairs along their jaws and head [7]. Another theory suggests that kelping may serve as a form of communication between whales or as a way to remove parasites, dead skin, and bacteria from their bodies [14,22].

Humpback whales host a range of parasites and bacterial and viral communities on their skin [23], including a host-specific whale louse (*Cyamus boopis*) [24], barnacles (*Coronula diadema*) [25], and, in rare cases, larger parasites such as Pacific lamprey (*Entosphenus tridentatus*) [26]. Skin infections of humpback whales can be a sign of deteriorating health conditions [27,28] but can also occur when whales travel between polar feeding and tropical breeding grounds, with tropical waters generally increasing bacterial growth on their skin [28].

Seaweed or brown algae (Phaeophyta) are a diverse group of marine macroalgae and are widely distributed in temperate coastal areas between low and mid latitudes (30–60°) [29]. There are approximately 19 species of temperate *Sargassum*, including widely distributed species such as *Sargassum natans* and brown algae such as *Phyllospora comosa* that can grow up to 3 m in height [30,31]. The vulnerability of fucoid forests known as kelp or brown seaweed to various human-induced stressors has been brought into focus due to recent declines, fragmentation, and losses of *Phyllospora*, *Scytothalia*, and *Sargassum* spp. [32]. They are known for their bioactive compounds, including fucoidan, phlorotannins, and laminarin, that exhibit antibacterial properties. For example, a study by Ayrapetyan et al. [33] found that fucoidan extracted from Bladderwrack (*Fucus vesiculosus*) showed significant antibacterial activity against *Escherichia coli*. Phlorotannins (a class of polyphenolic compounds) and laminarin (a type of β-glucan polysaccharide) are also known for their antioxidant and antibacterial properties [34]. However, the antibacterial activity of brown algae is not fully understood and likely varies with the species and geographical location.

Studying the interaction between whales and seaweed is difficult, because the interactions are likely of short durations and limited to regions where seaweed is accessible for whales. Social media has shown promise as a valuable tool for studying data-deficient species [35]. Social media platforms offer a unique opportunity to engage a large network of individuals with its widespread reach and the ability to rapidly share information and observations. Members of the public can assist with collecting data and generating knowledge about species with limited scientific information to fill in knowledge gaps [36]. Researchers can then validate and verify social media observations through rigorous data verification processes and incorporate the data into scientific studies. However, the information is often biased and limited to regions where social media and mobile networks are widely available and in use [37].

Here, we provide an overview and assessment of humpback whales displaying interactions with seaweed and analyse the behaviour with seaweed. The possible function of this behaviour is further discussed in the context of enhanced antibacterial properties of seaweed or forms of stimulation and socialising. Documenting this type of behaviour is relevant for an improved understanding of the species behaviour and habitat needs [38]. Understanding the role of different habitats that influence humpback whale behavioural modes is important for conservation, particularly in regard to the expected changes in environmental conditions for marine environments under climate change.

2. Materials and Methods

A search was conducted on three popular social media platforms: Facebook, Instagram, and Flickr to gain a snapshot and non-representative sample of the interaction between humpback whales and seaweed. The search targeted these platforms using general keywords such as "kelping", "humpback whale", "whale", "seaweed", and "object". The date and time of each entry, along with the location and source, were extracted for analysis for posts up to 15 June 2023.

To ensure a level of accuracy and reliability, only posts containing photos or videos showing whales in contact with seaweed were considered. Each entry was carefully verified to confirm the whale species and the interaction with seaweed, relying on the posted images for species and object-type identification. Additionally, locations based on the comments in the posts were cross-checked to eliminate duplicates, and entries with the same dates or identical images were removed to focus solely on organic posts representing a single event for each location [39]. Humpback whales were identified by their tubercles on their rostrum and the large pectoral fins, right whales by their callosities, and gray whales by their dorsal knuckles instead of a fin.

We focused on classifying the presence of seaweed by dividing the whale's body into three similar-sized parts that represent different functionalities (Figure 1): (1) seaweed from rostrum to pectoral fins containing most of the sensory systems (excluding pectoral fins); (2) seaweed from pectoral fins to dorsal fin containing the core body part (excluding the dorsal fin); and (3) seaweed from dorsal fin to fluke with the peduncle muscle (including the fluke). For the classification, if any part of the seaweed was observed touching a particular section of the whale's body, we considered it as present on that body part. For each social media post, multiple images per entry were assessed if available.

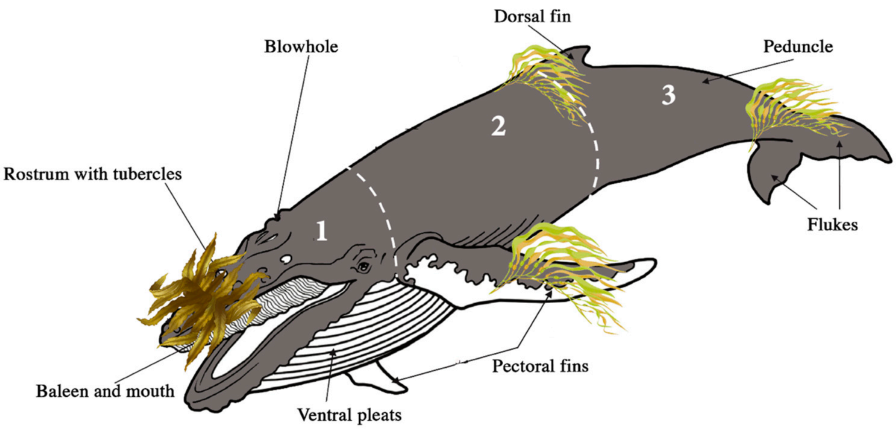

Figure 1. Body parts of a humpback whale, as well as the body sections used to categorise the contact with seaweed. (1) seaweed from rostrum to pectoral fins containing most of the sensory systems (excluding pectoral fins); (2) seaweed from pectoral fins to dorsal fin containing the core body part (excluding the dorsal fin); and (3) seaweed from dorsal fin to fluke with the peduncle muscle (including the fluke). Image adopted from NOAA, 2022 (https://coast.noaa.gov/data/SEAMedia/Lessons/ accessed on 10 June 2023).

To gather the necessary data for analysis, we visually examined both photos and video entries, paying particular attention to the behavioural state of the whales. We extracted relevant information, including the species of the whale; the date and time of the interaction, as per comments in social media posts; the location; the number of whales involved; the age class based on the relative sizes of the accompanying whales (adult, juvenile, or calf); and the body part in contact with the seaweed. For interactions captured on videos, we also assessed the duration of the encounters. We defined an interaction as any visible contact between a whale and seaweed that required the whale to angle its body to maintain the contact. An assessment of the frequency or duration was possible for the videos and multiple photos of the same event.

In three instances, the interactions were documented using available videos from UAVs provided by Wild Ocean Tasmania, Prolightmedia and A. E. Saner, allowing for a more detailed analysis of the behaviour. We visually assessed the videos, counting and describing the type of seaweed interaction and direction of movement.

3. Results

A total of 105 social media posts were assessed in more detail for whale and seaweed interactions. Five of these posts were disregarded due to missing location information. No posts prior to 2007 were found from the social media search. The majority of posts came from the Northern Hemisphere (67), and all but one of the remaining 100 posts were derived from three countries (Canada, the USA, and Australia; Figure 2). One interaction was documented in French Polynesia, where a humpback whale moved through a patch of *Turbinaria* spp. This is the only seaweed contact that our search revealed for tropical waters. Social media posts were made by whale watch companies (51%), members of the public (41%), and citizen scientists (4%). In total, the documented interactions included 163 baleen whales, with humpback whales the most prevalent (95 separate events), with documentation also found of seaweed interactions amongst gray whales (2), southern right whales (2) and northern right whales (1) (Figure 3). Adults formed the largest group of documented interactions (53%), then calves (14%), subadults (1%), and unidentified sizes (32%). The number of posts per year increased continuously—in particular, within the past 5 years (Supplementary Table S1).

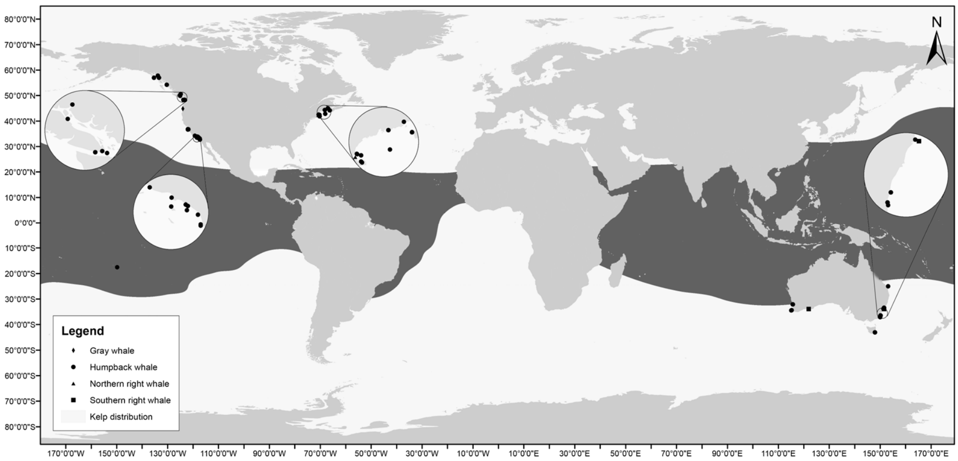

Figure 2. Map of locations showing observations of baleen whale interactions with seaweed extracted from social media. Extent of the estimated kelp distribution indicated in light grey.

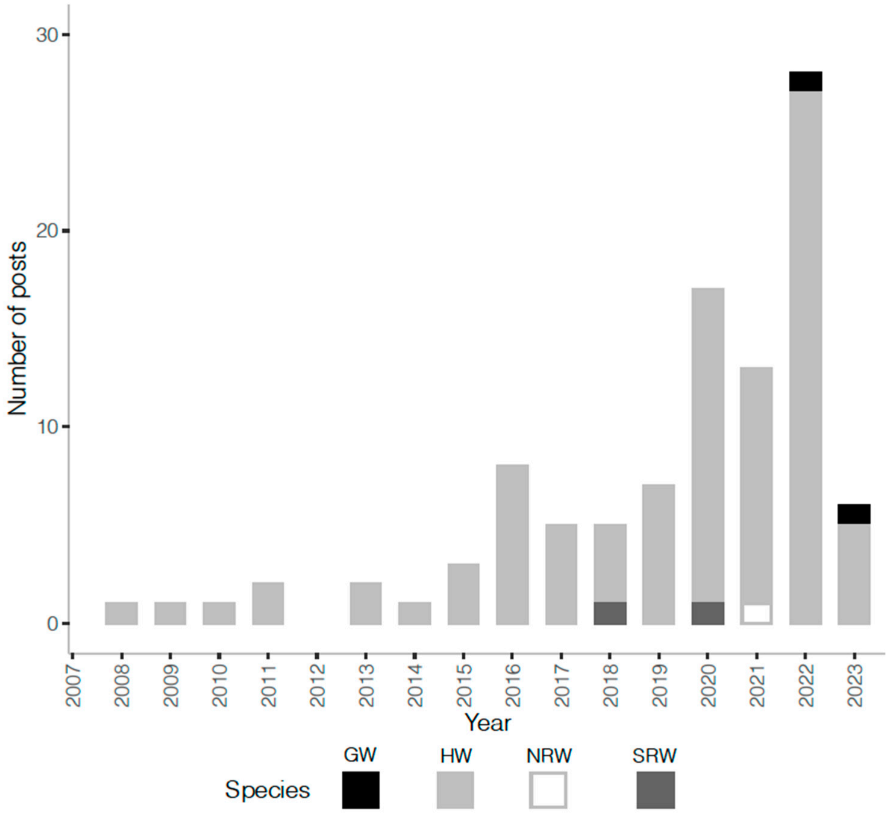

Figure 3. Number of social media posts and the respective whale species (GW—gray whales, HW—humpback whales, NRW—northern right whales, and SRW—southern right whales) interacting with seaweed for a search until June 2023. A social media post can represent multiple individual whales.

3.1. Body Part Interactions

Interactions with seaweed were assessed based on contact with different body parts as documented by available photos from social media posts. The most common area of contact was between rostrum and the pectoral fin, representing body part 1 (56%), then the area between the pectoral fin to dorsal fin (24%), and last, the body part from the dorsal fin to fluke (20%). Body part 2 between the pectoral fin and dorsal fin accounts for about 40% of the whale's body but for only one-quarter of the counted contact with seaweed. The majority of contacts showed no splashes or fast movements during the interaction with seaweed. However, some events clearly showed the whale throwing seaweed with their fluke and pectoral fin, indicating rapid moves.

When splitting up the body parts in more detail, the rostrum was the body part most often brought into contact with seaweed, then the pectoral fin and central body. The dorsal, peduncle, and fluke were less often in contact with seaweed. Documentation of the mouth were visible in five instances (Table 1). Humpback whales have been documented lifting seaweed on their rostrum, wrapping it around their fluke, swimming through it, and having the seaweed attached to the dorsal fin, as well as moving their pectoral fins through seaweed (Figure 4).

Table 1. Seaweed presence on different body parts of whales based on available photos from social media entries derived from a search until 15 June 2023. If seaweed was touching any part of the section, it was counted as present in that section. Multiple body parts might be covered by seaweed and were counted separately.

Body Part	**Seaweed Contact per Body Part**				
	HW	**GW**	**NRW**	**SRW**	**Total**
Rostrum	66	1	1	2	70
Pectoral fin	25	1	-	-	26
Pectoral fin to dorsal fin ***	22	1	-	-	23
Rostrum to fin **	20	-	-	-	20
Dorsal fin	16	-	-	-	16
Peduncle	15	1	-	-	16
Fluke	14	-	-	-	14
Mouth	4	-	-	1	5

** Includes ventral plates and head. *** Back and underside.

Figure 4. Humpback whale seaweed interaction showing different body parts in contact with seaweed. Humpback whale rostrum with brown algae (*Sargassum* spp.) near Perth, Western Australia ((**a**) credit Whale Watch Western Australia); fluke with kelp (*Nereocystis luetkeana*) near Newport, California ((**b**) credit Kristin Campbell); dorsal and back with kelp (*N. luetkeana*) near Ventura, California ((**c**) credit Loriannah Hesper); and pectoral fin with kelp (*Macrocystis pyrifera*) near Monterey Bay, California ((**d**) credit Randy Straka Photography).

3.2. UAV Videos

On 24 July 2020, a single adult humpback whale was observed north of Sydney about 1 km from the coast with a UAV. The observation lasted for 6.30 min, and during this time, the whale was rolling and swimming on its back while interacting with a number of smaller (1 m $\times$ 1 m) patches of seaweed. The head and rostrum were pushed against the seaweed (four times), wrapped around the fluke twice, and touched with the pectoral fin once. Interestingly, the humpback whale was also grabbing seaweed with its mouth twice to take it underwater, then releasing it again while blowing bubbles.

On 8 October 2022, three adult humpback whales were filmed using a UAV when interacting with seaweed about 4 km of Cape Hauy, Tasmania, in calm weather conditions. The interaction lasted for approximately 40 min, according to the observer, of which 3.20 min were filmed and assessed. The whales were observed to roll on the surface in a patch of seaweed (possibility *Ecklonia radiata*) of about 6 m in length and 2 m in width.

Contact with the seaweed was made under the rostrum (10 times), followed by diving through the seaweed head-first repeatedly and wrapping the seaweed around the pectoral fin (4 times) and back, dorsal, and peduncle (1). The pectoral fin was moved forward with seaweed wrapped around it. All individual whales interacted with the seaweed equally. Another two adult humpback whales joined briefly but did not participate in the seaweed interaction and left after 30 s.

On 19 August 2023, a single subadult humpback whale (based on the size estimate) was filmed for 7.39 min about 1 km offshore from Forrester Beach, North of Sydney. The whale was using its pectoral fins to move a small patch of seaweed and perform multiple touches with the right pectoral fin (eight times), left pectoral fin (three times), and rostrum (five times). The humpback whale repeatedly returned to the seaweed and could be seen to focus on it while rolling and swimming on its back. The head and rostrum were pushed against the seaweed very similar to the previous two observations from UAV videos (Supplementary Video S1).

For all described interactions filmed with a UAV, the whales were moving actively towards the seaweed, maintaining prolonged and constant contact.

4. Discussion

We established humpback whale interactions with seaweed to be present in different populations. This behaviour has been documented in social media posts both in the Southern and Northern Hemispheres for the North-East Pacific, North Atlantic, and west and east coasts of Australia, covering four distinct humpback whale populations. The frequency of occurrence with over 30 documented separate events in 2022 alone suggests this to be a more common behaviour than previously thought. Reports of kelping coincide with the distribution of kelp (Figure 2).

By providing descriptions and summaries of the behaviour, we were able to recognise different categories of close encounters with seaweed based on body parts and three main body sections. Analyses of UAV videos have confirmed that the whales were approaching or placing seaweed on body parts that required active engagement to maintain the seaweeds' position. Avoidance behaviour towards seaweed was not documented. In fact, the videos showed extended (several minutes) engagement with patches of seaweed in a highly coordinated effort to repeat seaweed touches. Seaweed touches may be relevant for the well-being of humpback whales and other baleen species for which similar behaviour has been documented.

Two theories derived from other cetacean studies are plausible that might explain the observed behaviour of humpback whales. The whales are using seaweed solely for a playful interaction that enhances motoric abilities and stimulates their senses, or seaweed touches provide the benefit of ectoparasite removal and skin treatment.

Touching the seaweed with various body parts, particularly with the rostrum that has rostral hairs, might be a welcome sensation. The tubercles of humpback whales are equipped with 1–3 cm long fragile hairs that are innervated with 300–400 nerves per follicle [40]. Similar hairs are also on gray whales and right whales [41–43]. Our study showed that the majority of interactions with seaweed involve the rostrum, which includes body part 1 (56% of all counted touches). Whales undertaking seaweed interactions did this together with other humpback whales but also by themselves. This suggest that seaweed interactions can be a social construct (Supplementary Video S1) but also a solitary activity. The majority of the whales were identified as adults (53%), showing that kelping is not limited to calves or a particular cohort.

The UAV videos showed that seaweed was approached and shared with multiple whales (video from 8 October 2022) but also touched multiple times by single whales (videos from 24 July 2020 and 19 August 2023). In addition, the UAV videos allowed for an estimation of the duration, with the videos covering several minutes and observers reporting 30–40 min in total for each documented event.

The behaviour displayed in the photographs and videos by whales fulfills three criteria proposed by Burghardt [13] to classify it as play in animals: (1) it was voluntary and seemed to be enjoyable or rewarding to the individual; (2) it differed from more serious behaviours, as it was exaggerated or incomplete in nature; and (3) the whales did not appear to be stressed or hungry and appeared to be in good health.

Humpback whales, along with other mysticetes, have been observed engaging in various forms of play [5,44,45]. This playful behaviour includes documented instances of playing with objects like cargo netting and rope [5], interacting with jellyfish [22], and playing with logs or driftwood [21]. Similar encounters with driftwood were also documented from Merimbula, Australia, and Bute Inlet, Canada (Supplementary Table S1). The driftwood was placed between the blowhole and dorsal fin but also touched the rostrum. Additionally, there have been reports of humpback whales interacting with other species, such as dolphins and seals [46,47]. The existence of these playful behaviours suggests that humpback whales have complex interactions with their environment. Therefore, it is possible and likely that their interaction with seaweed is a form of playful stimulation.

The interaction with seaweed may also be beneficial for the removal of ectoparasites and treating or preventing skin conditions from microbial infections, in addition to playful interactions. The body parts subjected to repeated touches with seaweed were the rostrum, pectoral, and dorsal fin. There could be therapeutic benefits through prolonged seaweed contact of body parts particularly vulnerable to microbial infections and ectoparasites, such as the fluke, dorsal, and rostrum [48]. Humpback whales harbour a variety of skin bacteria [23], which can become a potential risk if they proliferate in significant quantities and infect open wounds. Brown algae contain a wide range of bioactive compounds, such as terpenes, sterols, and polyphenols, which have been shown to possess antibacterial properties. Further research is needed to explore the full potential of brown algae and their bioactive compounds as antibacterial agents and whether seaweed contact has any impact on the microbial communities on whale skin.

Other cetaceans such as bottlenose dolphins (*Tursiops aduncus*) have been interacting with sponges and corals through rubbing in the Red Sea [49]. This type of behaviour was attributed to active metabolites in the selected coral and sponge species potentially helping to treat microbial infections or act as a preventative.

Skin care is also evident in other marine mammals. Sea lions rub against rocks [50], and some baleen whales, such as bowhead whales (*Balaena mysticetus*), use rocks for the possible facilitation of their moulting [51]. Sand rolling of humpback whales on sandy substrate has been described as possible assistance in excess skin removal [52], and there are reports emerging of gray whales seeking humans for possible ectoparasite removal (https://www.theguardian.com/environment/2023/jul/06/grey-whales-seen-seeking-human-help-to-remove-parasites accessed on 15 June 2023). Pitman et al. [53] described the skin removal and moulting of cetaceans as an essential part of their migration.

None of the humpback whales in the photos or videos in our study had obvious signs of skin conditions and appeared to be in healthy condition. Unwell humpback whales are often recognised by their deteriorated skin [54]. There was also no obvious preference for a particular species of seaweed. Some of the seaweed species for Australia included *Phyllospora comosa* (up to 3 m in height) and smaller species *Sargassum* spp. (e.g., *S. dorycarpa*), and for the USA and Canada, they included larger kelp such as *Nereocystis luetkeana* and *Macrocystis pyrifera*. This suggests that contact with seaweed is unlikely to be used as a cure for treating existing skin conditions or that there may be specific species of seaweed targeted over others.

The videos provided much better details of the interactions than the photos—in particular, the videos from the UAVs. They showed that seaweed patches were shared amongst whales, approached multiple times over prolonged periods (several minutes), and also taken into their mouths. This behaviour may occur more often than previously documented, as it is difficult to observe from boats.

The majority of the humpback whales slowly moved forward into the seaweed and were rolling from side to side at times (Supplementary Video S1). The whales strategically moved their heads with their rostrum forward to enable contact with the seaweed. The rostrum is known to be densely populated with ectoparasites [55]. In addition, the pectoral fins were seen to be pushed through the seaweed. These are body parts that are favourable for ectoparasites and sessile invertebrates such as the tubercles on the rostrum and flippers, and whale lice are commonly found in wounds on pectoral fins and within ventral pleats [15,55]. Rubbing against seaweed could assist in the removal of the early life stages of these ectoparasites and reduce microbial growth.

Considering the intricate nature of the behaviours observed in this species, it is plausible that humpback whales utilise supplementary behavioural tactics, like the one mentioned here, to decrease or eliminate ectoparasites and prevent excessive microbial growth, in addition to using them for play.

Role of Social Media

Kelping or seaweed interaction behaviours used to be difficult to document and observe but can now be more frequently reported through new technologies, including UAVs and the use of social media applications. Social media applications, such as Facebook, Twitter, Instagram, and online forums, provide a platform for citizen scientists, researchers, and enthusiasts to share their sightings, photographs, and other relevant information about data-deficient species or animal behaviours. Studies have demonstrated the effectiveness of social media platforms in documenting the occurrence and distribution of rare and elusive species, as well as identifying new populations or range extensions. Social media information has been used in various studies, such as in identifying the habitat use of rarely seen southern right whales in New Zealand [56]. Moreover, researchers are utilising information from social networking sites to identify behavioural changes of humpback whales in the presence of tourism operations [57] and to gather enough information to establish a dependable baseline of cetacean presence, informing conservation recommendations and guiding future research practices [37].

However, these findings only provide a snapshot. The spatial distribution of social media posts on humpback whales and seaweed interactions is biased to countries where social media platforms are widely used. The behaviour is likely to occur in similar frequency in other regions, e.g., in South America. The documentation of an interaction with a log in Colombia suggests that object use can also be observed in other areas [21].

Spatial data bias, as well as non-standardised data capture, require quality control, e.g., through the assessment of photos and videos and location validation. Social media posts cannot replace scientific research, but, for a data-deficient behaviour like the one described, can reveal some trends, preferences, and behavioural stages. By employing this approach, we aimed to gain a better understanding of the dynamics between humpback whales and seaweed, particularly in terms of the extent and patterns of their interactions. However, it is essential to acknowledge the inherent non-representativeness of sampling from social media data and consider it as a complementary source for broader research.

5. Conclusions

Assessing the observations of humpback whales interacting with seaweed revealed its occurrence across different humpback whale populations showing similar preferences for body contact. Seaweed was actively approached and engaged with, suggesting an overall positive interaction. It is likely that there is a range of benefits to this behaviour, including play, ectoparasite removal, and possibly self-medication. The extended use of UAVs can assist with observations, providing additional information. We can expect to see an increase in the documentation of kelping in the upcoming years. Future studies should investigate other regions that are not well covered by social media posts and assess the effect bioactive components from seaweed might have on whale skin bacteria. The potential benefits of seaweed for whales could be relevant for whales' well-being and may play a future role in whale conservation. The consequences of kelp dieback in some regions such as Tasmania, Australia, following the global trend of climate change-induced distribution shifts of seaweed could have an effect on humpback whales seeking interactions with kelp.

By utilising publicly shared contents, this approach helps shed light on this intriguing aspect of whale behaviour and enriches our understanding of how whales interact with their environment. Studying behavioural information can offer valuable insights into habitat preferences and the well-being of a species, which, in turn, can benefit conservation management efforts [58]. Behavioural studies on marine mammals are essential for advancing our knowledge of marine ecosystems and the relationships between marine organisms, contributing to conservation planning and ecological studies, as well as fostering public engagement in species conservation.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/jmse11091802/s1: Table S1: Summary of reported interactions with seaweed and other objects from social media platforms; Video S1: Sample of seaweed interactions in Australia by humpback whales.

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