The Iberian Orca Interaction Crisis: Disentangling Wild Marine and Human Lives — A Call for Managed Co-existence

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Abstract. First observed in 2020, a phenomenon of increasingly damaging proportions has surfaced in need of both emergency managers and seafarers' attention: Some members of the Iberian Residential Orca population have been interacting with and damaging human-operated seagoing vessels mainly in the Western entrance to the Strait of Gibraltar and the Gulf of Cádiz as well as along vast stretches of the Atlantic Iberian coastline. So far no human losses have been recorded despite the sinking of several sailboats by these orcas. However, it appears only as matter of When rather than of If that such fatalities will be recorded, which will then transfer this particular wild-animal-human interaction onto a new level of urgency and directly into the realm of emergency management. As an effective self-help mechanism recreational sailors have created social-media groups, which report the location of orca sightings and interactions in almost real time. Local authorities in Portugal, Morocco, and Spain are also on the alert providing advice to the fishing and recreational sailing communities. In this article, a multidisciplinary approach is undertaken that aims at improving the situational awareness of both emergency responders and sailing/fishing communities. It further attempts to identify a pathway towards developing appropriate measures of preparedness, mitigation, response, and recovery.

Keywords: Emergency management, safety at sea, wildlife protection, Orcinus orca, killer whales, Iberian cetaceans, blue-fin tuna, orca attack patterns, situational awareness and preparedness, attack prevention, attack mitigation, attack response, recovery from attack, legal and illegal countermeasures, common operating picture, Madrid workshop, resilience.

1 Introduction

1.1 The Orca/Human Interaction Crisis

Orca-human interactions in the waters around the Western Iberian peninsula must nowadays be seen as a severe emergency and safety crisis in the making. This particularly human-centric view reflects current and future effects on human life and safety at sea; however, on part of the wild animals this crisis might be equally, or even more, severe, which adds to the complexity of adequately managing the situation at hand.

The Iberian Residential Orca population has recently been classified as a "critically endangered species" [1], and it is highly protected by both Spanish [2] and Portuguese [3, 4] laws and regulations. Local and international teams have researched whale populations of the Mediterranean Sea and the Eastern Atlantic for decades.

Historically, orcas and humans coexisted relatively peacefully in Iberian and Mediterranean waters. Ancient accounts, such as those by Strabo [5] and Philostratus [6], depict orcas as large and powerful creatures, but their interactions with humans were infrequent and largely benign. Only one exception is found in historical records: In the Bosphorus and adjacent waters near Constantinople during the reign of emperor Justinian (527-565 CE), a single large whale known under the name of Porphyrios scared fishermen and seafarers by indiscriminately attacking and sinking numerous fishing and merchant vessels in the span of half a century. Justinian found himself pushed to mobilize Eastern Roman naval forces to find and kill the animal in order to reestablish safety at sea, however, to no avail. The wild animal finally stranded in pursuit of a dolphin unable to retreat from the mud to the safety of open waters, when it was hauled ashore by humans and killed. So far it has not been confidently established that Porphyrios was a supersized orca, although its mammal-hunting behavior serves as an indicator [7]. With this one exception, these early observations suggest that orcas posed little threat to maritime activities, and their presence was more perceived as a curiosity rather than a danger.

However, the contemporary situation paints a starkly different picture. While some Iberian orcas have interacted with fishing vessels for the better part of three decades, sailboats and other non-fishing-related smaller boats, both professional and pleasure, only became targets as late as May of 2020 [8, 9]. Interactions between orcas and human-operated vessels have since escalated dramatically, leading to significant damage and even the sinking of several sailboats [9]. While no human fatalities have been reported so far, the increasing frequency and intensity of these interactions suggest that such an outcome is only a matter of time. The situation has reached a critical juncture, necessitating immediate attention from emergency management professionals and the maritime community.

1.2 Measures to Increase Situational Awareness

Sailors have reacted by forming self-help groups via Social Media channels (groups on Telegram, Facebook, as well as dedicated websites), which report sightings and interactions in real-time inside the community. Also, research groups and governmental and non-governmental organizations have been providing online information to seafarers.

In October of 2022, the website orcas.pt began logging and showing incidents/interactions of sailing vessels with orcas in the Atlantic waters of the Western Iberian Peninsula including the Strait of Gibraltar (SoG). In May of 2023, when incidents and interactions had become more frequent, a Telegram chat channel ("Orcas Locations") was established, whose membership quickly grew up close to 2,000 subscribing members. Subscribers were summoned to strictly report on orca sightings and interactions, if any, as well as provide the exact location along with photo evidence, if possible. Later, another Telegram chat channel was established ("Orca Discussions") with some 1,600 subscribing members, which allowed members to exchange experiences, provide advice, make recommendations, and discuss matters of preparedness and response. Also, a Facebook channel was established with some 500 subscribers. The orcas.pt website and the related social media channels were recognized and awarded in November of 2023 for their contributions by the Germany-based non-government organization (NGO) Trans-Ocean e.V., which honored the organizer, Rui Alves, and the supporting marine biologist Renaud de Stephanis of CIRCE, Algeciras, Spain, for their voluntary services. Other organizations, such as the UK-based Cruising Association (https://www.theca.org.uk/orcas) are also tracking and reporting interactions (https://www.theca.org.uk/sites/all/misc/orcas/Orca-historical-interaction-location-data.pdf). In Portugal, the Instituto Hidrográfico provides overview maps and advice, which incorporates and consolidates data from the national navigational warning system (ANAV) as well as from

orcas.pt and gtiberica.com. In Spain, the inter-organizational working group GT Orca Atlántica provides updates on location and makes recommendations to seafarers (https://www.orcaiberica.org/en). However, these groups and initiatives are still only loosely interconnected, and parts of the seafaring population in the danger zones are still unaware of both aforementioned recommendations as well as the orcas' real-time locations, seasonal migration paths, and avoidance tactics. In other words, situational awareness is dangerously incomplete, and matters of preparedness, mitigation tactics, response behavior in case of an attack, as well as recovery and survival procedures are not comprehensively established and trained.

Under the auspices of the Spanish Government, a workshop on the orca/human interactions was conducted in early February of 2024 that assembled 29 national and international researchers (including representatives from Morocco, Portugal, Argentina, Canada, France, Iceland, Taiwan, UK, United States, and Venezuela) as well as administrators and government officials (including members of the Spanish Coast Guard and the Portuguese Navy) who provided updated recommendations for mariners [10]. Yet, representatives from important stakeholder groups (recreational sailors, whale watch operators, and local fishermen associations) were not included in that workshop.

1.3 Context and Paper Organization

This paper aims to address this looming crisis by adopting a disaster information management perspective. While acknowledging the plight of the critically endangered Iberian orca population and the anthropogenic factors contributing to their constrained situation, the primary focus is on enhancing the safety and preparedness of sailors and fishermen. By improving situational awareness, providing guidance on preventive measures, and outlining response and recovery strategies, this paper seeks to empower the maritime community to navigate this challenging environment more safely and effectively.

The paper organization is as follows: The next section presents the extant related literature succeeded by the methodology section and the research questions. Thereafter, the findings are presented for each research question, which then are discussed. Finally, future research avenues and concluding remarks are presented, which also detail the particular contributions of this research.

2 Literature Review

The Iberian orca population, once considered a rare visitor to the Mediterranean [11, 12], has undergone significant changes in recent decades. While early accounts portray them as infrequent and largely harmless [5, 6], contemporary research paints a more complex picture of a critically endangered population facing numerous threats [13].

The Strait of Gibraltar, a vital migratory corridor for Atlantic bluefin tuna (ABFT), has become a focal point for orca activity. These apex predators have developed a specialized hunting technique, the "endurance-exhaustion" method, to capture these fast-swimming fish [14]. However, the decline of ABFT stocks due to overfishing has put significant pressure on the orca population, potentially leading to nutritional stress and reduced reproductive rates [15].

Human activities have further exacerbated the challenges faced by Iberian orcas. Vessel traffic, noise pollution, and chemical contamination have all been identified as contributing factors to their declining population and altered behavior [13, 16-18]. Moreover, interactions with fishing vessels, particularly the drop-line fishery targeting ABFT, have created a complex dynamic between orcas and humans [19]. While some orca pods have learned to exploit this fishery technique for easy

access to larger tuna, this orca behavior has also led to conflicts with fishermen and potential risks to the smart predators themselves [20].

The complex interplay between ecological factors, anthropogenic pressures, and orca behavior has resulted in a highly differentiated social structure within the Iberian population [21]. Different pods exhibit distinct foraging strategies and social interactions, highlighting the adaptability and cultural transmission within these intelligent creatures [22]. Understanding these nuances is crucial for developing effective conservation and management strategies that address both the immediate safety concerns and the long-term viability of this critically endangered population.

As mentioned above, in February of 2024, a workshop [10] sponsored by the governments of Spain and Portugal convened in Madrid to address the escalating interactions between Iberian orcas and vessels, primarily sailboats, resulting in rudder damage and even vessel sinking. The workshop aimed to understand this phenomenon and develop management recommendations. The primary recommendation for mariners was to avoid hotspots and, in case of encounters, move away quickly towards the coast or a rescue area, while immediately alerting authorities. The use of harmful deterrents was discouraged, emphasizing their ineffectiveness and potential to reinforce the behavior. Importantly, the workshop speculated that these interactions were not aggressive but rather a fad or social behavior, likely influenced by increased prey availability and reduced lethal and hurtful interactions with fisheries.

Other recommendations included: (1) Increased cooperation and consistent advice/reporting systems across the region, along with an international advisory group to provide scientific and technical guidance; (2) improved cetacean stranding responses with rapid necropsies by specialized experts to understand causes of death; (3) Consolidation of existing datasets and research proposals to understand orca movements, vessel overlap, and behavioral variations; (4) development of a Conservation Management Plan for the critically endangered Iberian orca population, considering national plans and involving range states and relevant bodies; and (5) a comprehensive communications strategy targeting all stakeholders, emphasizing the non-aggressive nature of interactions and providing clear guidance on avoidance and mitigation measures [10].

While the workshop emphasized the urgency of addressing this issue through a multi-faceted approach, combining research, mitigation, and education to protect both mariners and the endangered Iberian orca population, it remained unclear what actions were supposed to be taken by whom, and how the funding of whatever actions and measures would be secured. Moreover, notably absent from the workshop were key stakeholders: sailboaters, whale watch operators, and fishermen (through their respective local organizations), as well as the Portuguese and Moroccan Coast Guards, potentially limiting the perspectives considered.

The absence of both sailboaters' self-help groups and whale watch operators and their datasets from this workshop is particularly concerning since the vast majority of sighting/interaction data along with photographic documentation has been collected in real time by these stakeholder groups. As Díaz López and colleagues observed, Citizen Science is essential for marine conservation by providing a large amount of data that help understand marine life and their environments. Mobile technology, especially smartphones and apps, has made it easier for volunteers to collect and share observations. Such collaborative approach generates massive datasets and allows for data collection on a much larger scale than would be possible otherwise [23]. Other Iberian orca-related research has equally heavily relied on datasets mostly provided by Citizen Scientists [17, 18].

3 Methodology and Research Questions

3.1 Research Questions

Based on the review of the literature on wild animal behavior, official recommendations, and the still pending integration of crisis management efforts, the location data collected by sailboaters' self-help groups and their discussions of preparedness and mitigation measures, as well as response and recovery approaches are important sources of data. In this study a combined dataset of anonymized chat protocols of the "Orca Locations" and "Orca Discussions" Telegram groups is used:

Research Question #1 (RQ #1): *How has the Telegram/orcas.pt group contributed to sailors' situational awareness regarding actual locations of orcas?*

Research Question #2 (RQ #2): *According to the "Discussions," how has the Telegram/orcas.pt sailor self-help group adjusted their behavior and understanding relative to the group's evolved situational awareness?*

3.2 Conceptual Instruments

This study has been conducted by employing the so-called "information perspective," which is a human actor and human action-centric approach to investigating challenges of coordination procedures, processes, and structures as facilitators of human information needs, information behaviors, and information flows, which then lead to decision and actions. In crisis management, when looking at challenges in terms of coordination and collaboration, the information perspective allows a detailed investigation of actions and interactions of responders and communities as they are mediated via the existing and emerging information infrastructures and their various aforementioned elements [24, 25]. In the context of this study, the concept of Information Infrastructures is particularly relevant as it helps understand the effectiveness of communication and information-sharing practices among sailors responding to orca interactions. The principles of redundancy, resourcefulness, robustness, and rapidity as advanced in [25] have been used to analyze how the two Telegram Orcas Locations and Discussions groups have developed strategies to manage and mitigate orca-related risks, contributing to the overall resilience of the sailing community in the face of escalating incidents.

3.3 Data Selection and Analysis

Data selection, extraction, and preparation. In this study the anonymized chat protocols of the "Orca Locations" and "Orca Discussions" Telegram groups have been used as complete datasets. The data range of extracted chat data ranged from the start date in May of 2023 to the end of July of 2024. The data were anonymized

Data analysis. The researcher who is member of the two Telegram groups conducted a chronological and thematic context analysis identifying major observations, topical threads, concerns, and their occurrence and reoccurrence over the 14 months of chat history. Along the lines of [25] the researcher also identified aspects of information infrastructure redundancy, resourcefulness, robustness, and rapidity (that is, for example, how fast did the community react to a given interaction). The researcher performed a careful manual read-through the entire dataset to get a feel for the overall conversation and to identify potential themes. Thereafter, a subset of the data was manually coded, labeling individual messages with relevant keywords and categories. This manual coding helped develop a preliminary understanding of the major themes and patterns in the discussions. Based on this manual coding automated techniques (Python) were then used to analyze the entire dataset. The Natural Language Toolkit (NLTK) was utilized for text preprocessing tasks such as tokenization, stemming, and lemmatization. Gensim then was used for topic mod-

	January					February					March					April					May					June				
	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024
Marbella - Gibraltar	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0
Gibraltar - Cadiz / Tangier	#	0	3	3	0	#	2	1	3	2	#	1	0	3	1	#	7	8	10	5	#	2	8	20	21	#	13	13	21	11
Cadiz - Cabo S Vicente (Sagres)	#	0	0	1	0	#	1	0	0	0	#	0	1	1	1	#	0	0	2	1	#	0	0	1	2	#	6	5	13	4
Cabo S Vicente - Cascais	#	0	0	0	1	#	0	0	3	1	#	0	0	1	2	#	0	0	0	0	#	0	0	0	1	#	2	1	0	6
Cascais - Viana do Castelo	#	0	0	0	0	#	0	0	0	0	#	0	0	1	1	#	0	0	1	0	#	0	0	0	0	#	0	0	0	0
Viana do Castelo - Galicia coasts	#	0	0	0	0	#	1	0	0	0	#	0	0	0	0	#	0	0	0	4	#	0	0	0	0	#	0	0	0	2
Bay of Biscay	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0
Tangier towards Atlantic Islands	#	1	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0	#	0	0	0	0
Total per month per year	0	1	3	4	1	0	4	1	6	3	0	1	1	6	5	0	7	8	13	10	0	2	8	21	24	0	21	19	34	23
Total per month overall	9					14					13					38					55					97				

	July					August					September					October					November					December				
	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024	2020	2021	2022	2023	2024
Marbella - Gibraltar	0	0	0	11	0	0	2	0	1	-	0	0	0	0	-	0	0	0	1	-	0	0	0	0	-	0	0	0	0	-
Gibraltar - Cadiz / Tangier	6	36	1	20	15	0	24	1	4	-	0	0	0	0	-	0	0	1	2	-	0	0	0	4	-	0	0	0	0	-
Cadiz - Cabo S Vicente (Sagres)	0	0	0	2	0	2	0	0	3	-	0	8	0	1	-	0	0	3	0	-	0	0	0	1	-	0	0	0	0	-
Cabo S Vicente - Cascais	0	0	3	1	0	5	0	3	6	-	0	9	2	5	-	4	4	6	0	-	2	0	6	2	-	0	0	2	1	-
Cascais - Viana do Castelo	0	0	3	0	0	0	0	0	0	-	0	9	2	2	-	2	0	1	1	-	0	2	0	1	-	0	0	0	2	-
Viana do Castelo - Galicia coasts	0	4	6	5	0	2	0	28	10	-	20	2	17	4	-	2	7	0	3	-	0	0	4	0	-	0	0	0	0	-
Bay of Biscay	0	1	3	1	2	0	0	7	4	-	0	1	1	3	-	0	0	2	0	-	0	0	0	0	-	0	0	0	0	-
Tangier towards Atlantic Islands	0	0	0	0	0	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	1	1	-	0	0	0	0	-
Total per month per year	6	41	16	40	17	9	26	39	28	0	20	29	17	15	0	8	11	13	7	0	2	2	11	9	0	0	0	2	3	0
Total per month overall	120					102					81					39					24					5				

Chart 1: Cruising Association, July 2024 - Orca - historical interaction location data around the Iberian Peninsula — www.theca.org.uk/orcas

eling, specifically the Latent Dirichlet Allocation (LDA) algorithm, to identify clusters of words that frequently appeared together in the messages. This helped identify the major topics of discussion and to group messages into relevant categories. TextBlob was used for sentiment analysis, specifically the PatternAnalyzer algorithm to assess the overall tone and sentiment of the discussions. This way emotional responses of the sailors to the orca interactions were captured, and patterns in sailors' reactions were identified. This content analysis was an iterative process, with manual and automated techniques informing each other. The manual coding helped refine the automated analysis, and the automated analysis helped identify patterns that might have been missed in the manual coding. To validate the findings of the content analysis, a combination of qualitative and quantitative techniques was used, in which the coherence and relevance of the identified themes and patterns was qualitatively assessed, and the frequency and distribution of these themes and patterns was quantitatively determined across the dataset. This validation process helped ensure that the findings of the content analysis were accurate and reliable.

4 Findings

Below the findings are presented in the order of the research questions.

4.1 Ad RQ #1 (*How has the Telegram/orcas.pt group contributed to sailors' situational awareness regarding actual locations of orcas?)*

Overview. Both orcas.pt, the Telegram Orcas Locations chat group along with various smartphone apps, and the British Cruising Association (CA) provide updates on orca locations on a regular basis, the former ones almost in real time. Between the location-focused chats and apps, the updates vary in frequency and precision. The Telegram Orcas Location and Telegram Orcas Discussions groups are closely linked to the orcas.pt website. For all practical purposes, the host/owner decided early on to separate discussions from basic location information, which took members some time to absorb and respect. With growing membership numbers, both the Location and Discussions groups have seen a steady increase in daily posts, which have reached forty to sixty posts a day in peak orca season. Members there-

fore have to expend some time and care to stay abreast understanding the overall situation and then calibrating the information to their area of operation.

While the website orcas.pt provides a frequently updated overview of orca location information, here and for presentation purposes only, the Cruising Association's overview (see Chart 1) is used, which offers compact insights into the trends of frequency and distribution of sailor-reported orca interactions with sailboats across different regions around the Iberian Peninsula from 2020 to July 2024.

The majority of interactions, including both sightings and attacks, are concentrated in the Gibraltar-Cadiz/Tangier region. This area has consistently experienced a high number of interactions throughout the years, indicating its significance as a hotspot for orca activity. The Cadiz-Cabo S Vicente (Sagres) region also shows a notable increase in interactions, particularly in 2023 and 2024. This may suggest a potential shift or an expansion in orca activity towards this area. The Cabo S Vicente-Cascais region has also seen a steady increase in interactions, particularly in 2023 and 2024. In contrast, regions such as Marbella-Gibraltar, Cascais-Viana do Castelo, Viana do Castelo-Galicia coasts, Bay of Biscay, and Tangier towards Atlantic Islands have experienced relatively fewer interactions. The Bay of Biscay

Sailboat Name / Flag	Date of Incident	Time of Incident	Location	Damage	# Humans (Perished/ Rescued)	Type of Keel/ length (m)
Name ot known/ P	31-Jul-22	1200 h	Cabo S Vicente / Cascais	Sunk (Sines, P)	(0/5)	mono/10.2m
Smousse/F	1-Nov-22	1200 h	Galicia	Sunk (Viana do Castelo, ES)	(0/4)	Fin w/bulb & spade rudder/12 m
Champagne/CH	4-May-23	0550 h	SoG	Sunk (Barbate, ES)	(0/5)	mono/15
Grazie Mamma II/ PL	31-Oct-23	2300 h	SoG	Sunk (Tangier-Med, Morocco)	(0/6)	mono/13.4
Alboran Cognac/ ES	12-May-24	0943 h	SoG	Sunk (near Tangier, Morocco)	(0/2)	mono/15.75
Bonhomie William, GB	26-Jul-24	2200 h	SoG	Sunk (near Barbate, ES)	(0/3)	mono/12 m

Table 1: Orca-sunk Sailboats as of July 31, 2024

stands out with a very low number of interactions, indicating a limited presence of orcas in this area.

The data also reveal a concerning trend of increasing interactions over time. The total number of interactions per month has risen significantly from 2020 to 2024, with a particularly sharp increase observed in 2023 and the first half of 2024. The months of May through October appear to be the most active period for orca interactions, suggesting a seasonal pattern in their behavior.

Overall, while the Cruising Association's overview provides valuable information about the spatial and temporal distribution of orca interactions around the Iberian Peninsula over time, the Telegram Orcas Location chat channel provides almost real-time updates, which are daily consolidated in orcas.pt maps with monthly breakdowns of interaction locations. The data highlight a certain seasonality pat-

tern with areas of highest orca activity during certain months when sailors have to exercise increased caution. It is noteworthy that despite the increasing situational awareness on part of at least the self-help group members, interactions with serious outcomes (including sinking of sailboats) are on the rise. The increasing trend in interactions underscores the need for continued research and the development of effective mitigation strategies to ensure the safety of both sailors and orcas. As Table 1 shows, each year since 2022, at least two sailboats were sunk as a result of orca interaction, most of which occurred in the Strait of Gibraltar (SoG).

Summary of Findings (ad RQ#1). The Telegram Orcas Locations chat log provides real-time information on orca sightings, interactions, and also absence of such occurrences, which in turn is compiled into historical interaction location data presented at orcas.pt or the CA' overview (Chart 1). A strict separation of orca location-related information only and certain, but limited, follow-up exchanges appears to have become the Locations group's norm. However, while the location focus has cleaned up the chat channel from noise, it also demonstrates the need for further informational and contextual exchanges, which add to deeper understanding of the seafaring challenge at hand. The chat log also highlights the importance of community-driven information sharing and collaboration in mitigating the risks associated with these encounters.

4.2 Ad RQ #2 (*According to the "Discussions," how has the Telegram/orcas.pt sailor self-help group adjusted their behavior and understanding relative to the group's evolved situational awareness?)*

The discussions in the Telegram Orcas Discussions chat channel reveal an evolving dialogue among sailors and marine enthusiasts regarding the increasing frequency and severity of orca interactions with vessels, particularly in the Strait of Gibraltar and surrounding areas.

Orca attack frequency and locations. The group members actively shared information about orca attacks and sightings, including the date, time, and location of each incident. The frequency of attacks varied throughout the 14 months, with periods of increased activity followed by periods of relative calm (see Chart 1) probably due to both seasonal migratory passings of orcas and lower frequencies of sailboat passings by known hotspots. As seen, while the attacks were concentrated in certain of these hotspots, primarily around the Strait of Gibraltar and the coast of Portugal and Spain, the Telegram Orcas Discussion group also discussed the possibility of orcas expanding their range and attacking boats in other areas.

Attack countermeasures and self-defense. Animated discussions flared up occasionally about the right to (violent?) self-defense. Said one member in response,

> "There is no law that denies me the right to defend myself if I consider my life to be in imminent danger. No Spanish law, no Portuguese law, no American law, no European law. None. It matters not what is putting my life in imminent danger." <quote #01>

And another member responded,

> "The legal case for self-defense is strong, but only if lives are at stake, not if property is at stake. I may be wrong, but I think 0 sailors have died so far due to "interactions" from orcas?" <quote #02>

Various strategies for deterring orca attacks were discussed, including using noise-making devices such as pingers, oikomi pipes, and underwater firecrackers, deploying sand or other substances in the water, and modifying the boat's rudder, or other underwater appendages. The effectiveness of these countermeasures was debated, with some members reporting success and others expressing skepticism:

> “We [have been] using the pinger since Biscay. Currently we are in Lisbon on the way to Almerimar. We put 6 kg diving weights on the pinger with 5m rope to keep it in about 1m depth [at] 5 knots speed. We have had no Orca interaction, and we have [heard] from only one case where a boat with pinger was attacked”. <quote #03>

> “The general opinion is that pingers don't work. There are boats attacked with pingers, and there are some studies that proves that they don't work”. <quote #04>

The legality of some of these measures, particularly the use of underwater firecrackers, was also a topic of discussion.

Sightings and interaction behavior. Members shared their observations of orca behavior, including the wild animals’ movements, feeding patterns, and interactions with boats. They also discussed the possibility of orcas communicating with each other and learning new behaviors, such as attacking rudders. A range of emotions towards the orcas was expressed, from fear and frustration to admiration and respect:

> “I wan[t] to sail and cruise the coast of Portugal for fun this summer. I am starting to have 2nd thoughts. Doesn't sound like fun to live in fear of being attacked”. <quote #05>

> “We are all smart human beings and we live the seas and all that is in it. I figure therefore we can find a solution that does not hurt these stunningly beautiful animals”. <quote #06>

Speculations about orca attack motivation. The group members discussed various theories about why orcas were attacking boats, including the possibility that they were just playing, or practicing hunting techniques, or protecting their territory.

> “They play also with the propeller, and use it as a spa. We have several underwater videos with such a behavior”. <quote #07>

The group also discussed the potential impact of human activities, such as fishing and shipping, on orca behavior. The lack of a definitive answer to this question was a source of frustration for many members.

Recommendations and good practices. Advice was shared on how to minimize the risk of orca attacks, including staying in shallow water inside the 20m bathymetric line, avoiding fishing areas, and being prepared to take evasive action if necessary. The group also discussed the importance of reporting orca sightings and attacks to the authorities and to the orcas.pt platform. Also emphasized was the importance of responsible sailing practices and respecting the orcas' natural habitat. This following exchange between two members illustrates this particular notion,

> "...Humans think they are above them. Apparently humans made them starting to attack boats. The ocean is their habitat and feeding zone. So, if we can use it both by simply avoiding them, what’s the problem?" <quote #08>

> "I want to sail as well. But I do think avoiding the orcas is a better solution instead of being stubborn and have a god complex [and] go straight through the area where they are fishing, and then think I have the right to harm them." <quote #09>

Technology in orca monitoring and mitigation. The use of technology was discussed, such as tagging animals and using GPS trackers as well as acoustic deterrents, to monitor and deter orca interactions. Members also discussed the potential benefits and challenges of using such technologies. The development of new tech-

nologies, including the Orcinus app, was seen as a positive step towards improving the safety of both sailors and orcas. However, one member also reported concerns,

> "Interesting to see that the platforms displaying the maps differ from each other. Also interesting that in Orcinus you can see info about the interaction but in GT orcas you can only see the date. I like the map display of Orcinus but I'm missing more updates". <quote #10>

Government authorities in addressing the orca/human interaction issue. The group members discussed the role of government agencies and also research organizations in addressing the orca/human interaction issue. Some members expressed frustration with the lack of action by the authorities, while others emphasized the importance of collaboration between sailors, scientists, and policymakers to find effective solutions. Said one member,

> "[Governments] do not seem to do their job by completely ignoring an obvious problem and danger to humans". <quote #11>

And another stated,

> "It seems necessary that some important politician or government minister would be interested in supporting our class of sailors and obtaining state funds and resources to find a solution to these "interactions/attacks". Without government support we will forever be trying to find ways to protect ourselves but without an effective solution". <quote #12>

The work of organizations such as CIRCE and the GTOA was recognized as being crucial in understanding orca behavior and developing mitigation strategies.

These were *major and recurring* discussion topics that arose in the Orcas Discussion group over the 14 months. The conversations were often lively and passionate, reflecting the complex and challenging nature of the orca/human interaction issue. Most group members demonstrated a strong commitment to finding solutions that would benefit both sailors and orcas, and their discussions provided valuable insights into the challenges and opportunities associated with orca/human interactions.

Apart from the major discussion topics above, several other interesting and relevant subtopics emerged during the 14-month period.

Media and public perception. Frequently discussed was how the media portrays orca interactions and the impact of this portrayal on public perception of both orcas and sailors. There was concern that sensationalized reporting could lead to negative consequences for both groups. Members also discussed the importance of educating the public about orcas and promoting responsible sailing practices.

Orca interactions impact. The economic impact of orca interactions on the sailing and tourism industries in the Iberian Peninsula was discussed in lively exchanges. Concerns were raised that the fear of orca attacks could deter sailors from visiting the area and negatively impact local businesses. As seen reported before, likewise in this particular context the need was discussed for government support to address the orca/human interaction issue and mitigate its economic impact.

Ethics. Discussants also engaged in lively debates about the ethics and legality of using various deterrents and mitigation measures, such as firecrackers and other more assertive measures, which could potentially create discomfort in the wild animals. Some members argued that these measures were necessary to protect boats and crews, while others expressed grave concern about the potential harm to orcas and the environment. Again, the legality of these measures was also a topic

of discussion, with some members arguing that they were justified under the principle of self-defense.

Collaboration and information sharing. Sailors, scientists, and policymakers it was discussed had to collaborate and share information to address the orca/human interaction issue. The orcas.pt platform was seen as a valuable tool for facilitating this collaboration and providing sailors with up-to-date information about orca activity. The group members showed much interest for more research to better understand orca behavior and develop effective mitigation strategies.

Need for coexistence. Some members shared stories of positive encounters with orcas, while others expressed concern about the high potential for conflict between humans and orcas. The need for coexistence between humans and orcas and the importance of finding solutions that benefit both groups appeared to prevail in the discussions.

Adjustment of Group Member Behavior. While members appeared to be split over the nature of preferred self-defense measures (aggressive/non-aggressive), they seemed to converge on the “stay-inside-the-20m-bathymetric-line” recommendation whenever safely possible. However, group members also adjusted their behavior in terms of postings to the two Telegram chat channels. In members’ chat behavioral adjustment, Rui Alves, the moderator has played a decisive role in admonishing and cajoling members into, for example, staying away from offensive speech and politics and focusing rather sharply on location information for sightings and interactions, and for orca/human interaction-related discussions, which made the two chat channels readable and maintainable despite its constantly growing membership numbers.

Information dissemination. The moderator consistently and proactively shared updates on orca sightings, attacks, and research findings, often drawing from various sources, including direct communication with sailors, researchers, and authorities. He also created and maintained the orcas.pt website, which served as a central repository for information about orcas, including maps, safety protocols, and educational resources.

Research collaboration and advocacy. The moderator actively collaborated with researchers, such as Renaud de Stephanis from CIRCE, also a member of both Telegram groups, to gather and disseminate accurate information about orca behavior and develop effective mitigation strategies. Also, both the moderator and de Stephanis advocated for increased government support and action to address the orca/human interaction issue and ensure the safety of both sailors and orcas.

Community building and support. The moderator further fostered a strong sense of community among the group members, encouraging them to share their experiences, offer support to each other, and work together to find solutions. He also organized events and initiatives, such as the "one flag one member" project, to strengthen the bonds within the community and promote awareness of the orca/human interaction issue.

In summary, the moderator played a multifaceted and indispensable role in the Telegram chat groups. Clear dedication, moderating leadership, and unwavering commitment to the safety of both sailors and orcas were instrumental in creating a widely appreciated platform for information sharing, collaboration, and community building. While no scientific proof can be provided it is highly likely that the moderator's efforts have contributed to reducing the number of orca incidents and to promoting a more harmonious coexistence between humans and orcas in the marine environment.

Summary of findings (ad RQ#2). Over time the Telegram/orcas.pt sailor self-help group has adjusted its behavior and understanding of orca/human interactions in

several ways. Members actively share information about attacks and sightings, discuss countermeasures and orca behavior, and speculate about motivations behind the interactions. The group also shares recommendations for minimizing risks (<20m rule) and emphasizes the importance of reporting incidents and responsible sailing. Technology for monitoring and mitigation has been embraced. The moderator has been found crucial in shaping group behavior, information dissemination, research collaboration, advocacy, and community building.

5 Discussion, Recommendations, and Concluding Remarks

Lack of a common operating picture. While platforms like orcas.pt, the two Telegram groups, GTOA, Orcinus, the Cruising Association, and various Portuguese and Spanish government agencies all provide updates of various kinds and at various frequencies on the orca/human interaction issue around the Iberian peninsula, these efforts have not yet amounted to what has been defined as a Common Operating Picture (COP) as defined below.

> "A common operation picture (COP) is a continuously updated overview of an incident compiled throughout an incident's life cycle from data shared between integrated communication, information management, and intelligence and information sharing systems. The goal of a COP is real-time situational awareness across all levels of incident management and across jurisdictions" (https://www.dhs.gov/publication/common-operating-picture-emergency-responders - accessed Aug 1, 2024).

Sometimes it appears as if these information services rather compete for attention than collaborate on the issue by cross-verifying and vetting the information available to them. What may help overcome this situation is an intergovernmentally sponsored and staffed clearing house/pilot center (for example, jointly funded by the European Union, Morocco, Portugal, and Spain), which systematically collects, verifies, and disseminates relevant information to all stakeholders (including sailors, fishermen, whale watch operators, conservationists, marine biologists among others) in real time. Sailboaters that enter national waters of Iberian and Moroccan waters may need to be required to install and constantly operate Automatic Identification System (AIS) equipment. In this way, it would not only be the sailboaters duty to manage their own passage according to available information, but the pilot center could also send targeted warnings to individual vessels in case of orca sightings and interactions including no-passage warnings. Moreover, such clearing house/pilot center could be connected to a to-be-installed network of passive acoustic monitoring devices as has been used in the Pacific Northwest (see https://www.fisheries.noaa.gov/alaska/marine-mammal-protection/passive-acoustic-monitoring-marine-mammals-alaska — accessed Aug 1, 2024). This might not only greatly help reduce the number of satellite tags necessary for marking (while potentially compromising the health [17] of) Iberian orcas, but rather also benefit both marine scientists and seafarers in their respective endeavors alike. Orca pod locations and seasonal geographic distribution would be much better known.

The Behavioral Conundrum. This study has been undertaken from an information scientist's academic perspective (as well as that of a sailboat owner in the Bay of Cádiz). Therefore, through the lens of an academic non-expert in the disciplines of Marine Biology, Marine Wildlife Conservation, Wild-Animal Behavioral Psychology, Fishery Economics and Regulations, the following discussion is performed with much restraint, and it is rather meant to pose questions rather than provide answers.

From the extant literature (see also above literature review section) it appears that major ecological shifts have been observed in the Strait of Gibraltar (known as the zenith orca hotspot) in the past four decades. Measurably, noise [15, 26] and pollution [16] levels have increased (in dramatic and multifold fashion) over these decades. The fierce competition for resources (that is, for example, first and foremost aggressive fishing of ABFT) has also created growing contention between the orca population and humans. While some ABFT fishing quota regulations appear to have provided potentially some short-term ease of food shortages for the orca population [10, p. 4], the extended scarcity of prey appears to have affected orca reproduction rates [13] along with the aforementioned detrimental environmental factors, which ultimately led to the declaration of a "critically endangered" species [27]. It remains unchallenged that humans and orcas are direct and fierce competitors for ABFT.

The role of various human activities imposing significant stressors on orcas and other maritime wild life, in particular, in the Strait of Gibraltar, which is utilized by humans at unprecedented frequencies, must be taken into account when it comes to considering the observed behavioral changes in orca behavior. Reportedly, as early as 2000 [28], close-by whale watching had already significantly increased, which ever since has done so even more contributing to further shrinking the wild animals' habitat despite careful and unobtrusive operations on part of the whale watch operators. However, perhaps way more impactful in the last four decades, commercial and military ship movements through the Strait have been estimated to have doubled from under 60,000 to over 110,000 annual movements (see ShipsGo Blog: https://blog.shipsgo.com/strait-of-gibraltar-ship-traffic-live-map/ accessed Aug 1, 2024). Noise levels (and with them) orcas' sensory orientation capacities can therefore be assumed to be negatively affected [26]. Besides the contamination of food sources leading to exceeding concentrations in Iberian orcas, "at which severe toxic effects are known to occur" [16 , p. 5], in its constrained environment the population is suffering from human equipment-inflicted injuries (propellers, fishing lines, gun shot wounds, among others) as well as observable diseases (emaciation, skin diseases, etc.) [17, 18]. However, despite all protective laws and conservationist regulations, the most deadly interaction for orcas still remains the interaction with fishing vessels. From the known Iberian orca pods (A1, A2, B, C, D, E, F) it was the A pods who reportedly were the first to opportunistically prey on ABFT caught by fishermen on long lines since the mid 1990s. Orcas were "stealing" some 17 percent of the catch [12]. Both Spanish and Moroccan fishermen reacted with indignation culling eight orcas in 2004/2005 [12]. It is unclear to the non-expert whether or not this enormous extraction can be attributed to the splitting of the A pod into the A1 and A2 pods. Officially, through various laws, orca culling had become illegal in 2007. Esteban's Iberian Orca catalogue lists the aforementioned pods' ancestral lineages up to 2023 [29]. Per animal, the catalogue reports on interaction behavior (fishing boat only, fishing boat and sailboats, sailboats only, and no interaction). It is interesting to notice that although sighted and identified near vessels three pods have had no interaction with humans whatsoever (the C, D, and E pods).

Between 2010 (when the catalogue's tracking started) and 2023, the non-interacting pods had a mortality rate of 18 percent, that is, 2 of 11 individuals deceased. However, the F pod consisting of 5 individuals has no known mortality since its detection. Sixty percent (3 F pod animals) are known to interact with sailboats but not with fishing boats. The mortality numbers change dramatically when looking at the A1, A2, and B pods, which reportedly interact with fishing vessels and actively prey on and caught ABFT from fishing lines. According to the Esteban catalogue, in the A1 pod, of 12 individuals 5 disappeared or were found dead (that is, a 42 percent death rate). Among the deceased orcas 1 juvenile individual had not had any interaction with fishing boats, while the four others had. None of these de-

ceased animals had any interaction with sailboats. In the A2 pod of 17 individuals, 6 orcas disappeared or were found dead (that is, a 35 percent death rate). Of the 6 deceased individuals, 5 had interactions with fishing vessels only, and not with sailboats, and the 1 deceased individual with no interaction was a juvenile. The B pod originally had 6 individuals, of which 3 have meanwhile deceased (that is, a 50 percent death rate). All 3 deceased B pod individuals interacted with fishing boats only, and not with sailboats. A total of 9 alive members of the A1 and A2 pods and 1 alive member of the B pod interact with both fishing vessels and sailboats. The high mortality in the A1, A2, and B pods is striking when compared to that in the C, D, and E pods that do not interact with fishing vessels. Likewise the F pod that only interacts with sailboats has even a mortality rate of zero. It is therefore hard to make the case that contact with fishing vessels (that is, orcas' preying on, or "stealing," fishermen's catches) should be considered totally unrelated to the respective A1, A2, and B pods' extremely high mortality rates since 2010.

The theories on orcas' changed behavior. Various theories have been offered (playing, fad, juvenile hunter training, malice, and revenge among others). This study is not in a position to support or refute any of these theories However, anthropomorphic explanations of wild animal behavior have repeatedly been called into question by wild animal behavioral scientists, for example, Galef ("it is probably best for scientists to be conservative, to adopt the simplest descriptions and explanations of behavioral phenomena consistent with available evidence") [30, p. 158]. Given the documented pressures and stressors in a shrinking habitat, an increasingly aggressive reaction on part of a group of endangered wild animals does not appear as overly far-fetched when observed through the lens of a non-expert colleague from elsewhere in academia.

Stakeholder tensions. Stakeholders in this orca/human interaction issue have fairly different levels of salience [31] and resulting stances [32]. As outlined before, so far not all stakeholders have been engaged and integrated in pursuit of a balanced solution, which would have the prospects to successfully disentangle the increasingly dangerous situation. While the February 2024 Madrid workshop convened 29 academic and administrative experts from around the world, it missed out on including important stakeholders (sailboaters, whale watch operators, and local fishermen associations). Stakeholders are those who can affect and/or can be affected by policy, action, regulation, or other significant outcomes of some kind [31]. So far, marine biologists, marine wildlife conservationists, behavioral ecologists, governmental officials, and other administrators had a major say in shaping recommendations and regulations. As an example, the Madrid workshop convened 11 government officials and administrators, 7 conservation biologists, 6 ecologist and environmental scientists, and 5 marine mammal biologists. It does not even need the burden of proof to detect the inescapable implicit bias in such a composition of an expert panel and its resulting recommendations. Since the aforementioned three groups were omitted from providing their perspectives, it would have been more than surprising had their views, wants, and needs been accurately represented. But they were not. Furthermore, since some conservation biologists have publicly expressed little, if any, sympathy for the causes of the three groups (see the discussion of stakeholder stances in [32]), a balance of interests and practice-ready disentanglement as a solution for de-conflicting the unfolding orca/human interaction crisis is not in sight. From the perspective of any successful and sustainable crisis management, however, such stakeholder-negligent and top-down approaches have rather been known for their systemic failure.

Measures of preparedness, mitigation, response and recovery have been discussed in the Madrid workshop recommendation. However, crisis management experts

and mariner practitioners need to develop appropriate plans, measures, and drills, which can be accepted and adopted by the seafaring communities.

Sailboaters' information infrastructures. As shown above the scientific community has already benefited from sailboaters' self-help groups as well as from whale watch operators and their massive data collections. The sailboaters' current information infrastructure, despite its dispersion and lack of integration, is already providing life-saving and damage-preventing information. In the case of the Telegram groups ("Orca Locations" and "Orca Discussions") and its affiliated orcas.pt website the community has demonstrated quite some resilience, which has been defined by the four ***R's*** in [33]. In terms of ***redundancy,*** through multiple communication channels and information sources, the group provides a good degree of redundancy, ensuring that critical information about orca sightings and interactions is disseminated even if one channel experiences disruptions. The group also relies on various external sources, such as the Orcinus app, marine traffic websites, and direct communication with researchers and authorities, further enhancing its redundancy. Members frequently cross-verify reports and share multiple sightings and experiences to create a comprehensive understanding of orca behavior. This redundancy in communication ensures that critical information is available even if one source is unreliable or delayed. When it comes to ***resourcefulness***, the group exhibits this particular capacity by actively seeking and developing strategies to manage orca/human interactions. This includes brainstorming sessions, sharing personal experiences, and discussing potential solutions like the use of deterrents or modifications to boat design. The group's willingness to explore new ideas and adapt its strategies in response to evolving orca behavior also demonstrates its resourcefulness. For example, recommendations to stay within the less than 20-meter bathymetric line emerged as a key strategy to reduce the risk of orca encounters. This advice was reinforced by members sharing their experiences and outcomes, allowing the group to refine and disseminate effective tactics quickly. With respect to ***robustness*** the group demonstrated its ability to maintain functionality and cohesion despite challenges and disagreements. The presence of clear rules and moderation helped ensure that discussions remained focused and productive, even when faced with differing opinions or contentious topics. Despite the escalation in the severity of orca attacks, including the sinking of two more sailboats in summer of 2024, the group continued to develop and share robust non-aggressive strategies to minimize risk. Finally, in terms of ***rapidity***, the disseminate information about orca sightings and attacks had been crucial for its effectiveness in mitigating risks. The use of real-time communication platforms like Telegram has allowed for the quick sharing of critical information, enabling sailors to make informed decisions and take evasive action when necessary. Members promptly reported orca sightings, attacks, and near-misses, allowing others to make real-time decisions about their own routes and actions. This rapid dissemination of information contributes to the group's overall resilience, enabling them to respond swiftly to new threats and adjust their strategies as needed.
In summary, while still too loosely integrated and coordinated, the sailboaters' self-help groups and websites provide a remarkable resilience in their information infrastructure.

Conclusion and Outlook. It has been the object of this study to identify obstacles to coordination and collaboration of efforts in the response to the unfolding orca/human interaction crisis and to identify pathways for recommendations, which help mitigate the negative outcomes of those interactions for both, the wild animals and humans. In so doing, the study contributes to both the academic understanding of the complexities of managing a crisis response and to the practical understanding of measures and choices available to response planners. Marine biologists, conservationists, ecological scientists, government officials, administrators, fishermen

associations, whale watch operators, sailboaters, and their various associations will benefit massively when collaborating and more closely communicating in an integrated fashion, which will finally help produce a 24/7 authoritative common operating picture, from which all interested parties and stakeholders can draw, and which allows anticipative mitigation measures. Disentanglement may be manageable ahead of time, when datasets are better integrated and AI tools support the proactive management of sailboat passages and whale watch parties. Future investigations will follow up with assessing and evaluating the practical measures taken and the choices made by responders.

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