Received: 15 August 2023 | Revised: 7 December 2023 | Accepted: 26 January 2024

DOI: 10.1002/aqc.4100

SHORT COMMUNICATION

WILEY

First assessment of passive acoustics as a tool to monitor the endangered Mediterranean monk seal in the Madeira Archipelago (Portugal)

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Funding information
Fundação para a Ciência e a Tecnologia, Grant/Award Numbers: UIDP/04292/2020, UID/MAR/04292/2020, LA/P/0069/2020, UID/BIA/00329/2020; FCT Scientific Employment Stimulus - Institutional Call, Grant/Award Number: CEECINST/00037/2021; MIMAR+, Grant/Award Number: MAC2/4.6.d/249;

Abstract

1. The rarest seal and the world's most endangered pinniped species, the Mediterranean monk seal (*Monachus monachus*), has a small and isolated population in the Madeira Archipelago (Portugal). This species tends to be extremely wary of humans and, therefore, very difficult to approach and study.
2. Passive acoustic monitoring (PAM) is a non-invasive, cost-effective tool that can be a valuable complement for the traditional monitoring methods, providing insight for effective conservation of the seal in the Madeira Archipelago.
3. In this pilot study, custom-designed autonomous underwater recorders were deployed in two marine protected areas (Garajau Partial Nature Reserve and the Desertas Islands Nature Reserve) to assess the potential of PAM to detect and monitor this elusive and endangered species in the Madeira Archipelago.
4. Two call types putatively produced by *M. monachus* were detected in a subsample of audio files recorded over a 3-month acoustic deployment; these call types share similarities with the /growl/ and /hiccup/ recently described for *M. monachus* in a Mediterranean population. The most common sound type detected was the low-frequency growl. No obvious pattern was found in the abundance of sounds according to sampling date, and no significant difference was found in the abundance of sounds in different periods of the day.
5. The ability to detect the species' underwater vocalizations with PAM opens the possibility of future monitoring plans based on data obtained from audio recordings. These data can provide relevant information for conservation, namely, on the presence and abundance of the seals.

KEYWORDS
conservation, Lobo-Marinho, Mediterranean monk seal, passive acoustic monitoring, Pinnipedia, underwater vocalization

PLASMAR+, Grant/Award Number: MAC2/1.1a/347; EU Horizon Europe project CLIMAREST: Coastal Climate Resilience and Marine Restoration Tools for the Arctic Atlantic basin, Grant/Award Number: 101093865

1 | INTRODUCTION

Ocean dynamics and anthropogenic related information can be acquired from the soundscape, which is composed of a collection of sounds originating from multiple sources (Miksis-Olds et al., 2018). Marine underwater soundscapes encompass contributions from human activities (anthropophony), natural abiotic or geophysical processes (geophony) and marine life sounds (biophony). Because of the vast distances travelled by underwater sound compared to any other cues, chemical or visual, soundscape studies with passive acoustic monitoring (PAM) are particularly useful in marine ecosystems. PAM enables assessment of soundscapes over extended temporal periods with minimal environmental disturbance (Milne et al., 2023) and can provide round-the-clock long-term robust data regardless of weather conditions and other logistically challenging situations (e.g. monitoring remote areas) with minimal or no interference with the behaviour of the individuals (Deichmann et al., 2018; Spence, 2017). PAM takes advantage of the fact that many animals produce acoustic signals that encode information about their presence and activities (Bradbury & Vehrencamp, 1998), allowing to detect and monitor soniferous species and communities (Carriço et al., 2020; Davis et al., 2020; Sueur & Farina, 2015). In addition, PAM has been applied in marine environments to estimate population sizes, measure home ranges, determine movement routes (Mellinger et al., 2007), assess fine-scale animal movements and evaluate the behavioural context of their calls (Stanistreet et al., 2013).

Marine mammals use underwater acoustic communication in many contexts such as feeding, mating and rearing of young, among other social functions (Erbe et al., 2016). In this group, PAM can be particularly important for monitoring species difficult to detect visually, for example, because of short surfacing times (Charrier et al., 2023). In the case of pinnipeds (seals, fur seals, sea lions and walruses), PAM has proved very useful in remote areas, where visual observations are rare, difficult or very expensive to obtain (Klinck et al., 2010; Mouy et al., 2012; Rogers et al., 2013; Thomas & Demaster, 1982; Van Parijs & Clark, 2006). It can provide information not only on the presence, abundance and distribution of a species but also about spatial/temporal habitat use, habitat quality, age-related distribution (Rogers et al., 2013) and physiological cycles, including reproduction (Sills et al., 2021). PAM methods can thus be applied to marine mammal research and conservation and as a complement or even as an alternative to real-time monitoring of marine mammals by human observers (Fleishman et al., 2023).

The Mediterranean monk seal, *Monachus monachus*, is the rarest seal species (Bundone et al., 2019) and the most endangered pinniped in the world (Karamanlidis et al., 2021). The Madeira Archipelago (Portugal) has a small population of this species, and, although they were once abundant on Madeira Island (during the 15th century when the Portuguese first colonized the island), human activity led to a sharp decline of this species and restricted its presence to the remote Desertas Islands (Neves & Pires, 1998, 1999). The urgent need to protect the small colony of Mediterranean monk seals led to the creation of the Desertas Islands Special Protection Area in 1990. Recently, monk seal sightings have become more frequent in the main island of Madeira (Hale et al., 2011), where suitable habitat for the species still exists (Karamanlidis et al., 2003).

In 2012, the monk seal population in the Madeira Archipelago was estimated at 17 individuals and in 2018 at 21 individuals. During that period of 7 years 11 new individuals were incorporated into the population (individuals that survived their first year of life), and the average recruitment rate was 1.6 individuals per year, showing a positive trend (Pires et al., 2020). After centuries of exploitation, monk seals are extremely wary of humans, making them difficult to approach and study (Karamanlidis et al., 2015). Their low abundance and elusive behaviour make standard visual surveys technically and logistically difficult (Charrier et al., 2017). Thus, PAM can be a valuable tool for long-term monitoring of monk seals with reduced human effort (Van Parijs & Clark, 2006). However, to use passive acoustics, details of the vocal behaviour must be available for the species (Sills & Reichmuth, 2022). Recently, Charrier et al. (2023) published a comprehensive analysis of the underwater vocal repertoire of *M. monachus* in a Mediterranean population, providing crucial baseline data and information that can be used as reference for underwater acoustic monitoring of this endangered marine mammal. Phocids, like other pinnipeds, are highly vocal during the breeding season, producing vocalizations usually associated with territory defence by males, mate selection and mother–pup interactions (Charrier, 2021; Charrier & Casey, 2022), including the production of underwater vocalizations (Charrier et al., 2023). Vocalizations in pinnipeds are not limited to the breeding season; for instance, there are records of a male Hawaiian monk seal (*Neomonachus schauinslandi*), which is the closest extant relative to the *M. monachus* (Rule et al., 2020; Scheel et al., 2014), producing underwater vocalizations outside this period (Sills et al., 2021). As suggested by Muñoz et al. (2011), for a better understanding of the overall vocal behaviour of the Mediterranean monk seal, populations other than the eastern one, namely, the ones from the Archipelago of Madeira and Cabo Blanco region, as well as vocalizations outside of the breeding season, should be studied. The present study assesses, for the first time, the potential of PAM technology to detect and monitor the presence of Mediterranean monk seals through their underwater vocalizations in the Madeira Archipelago. This pilot study in the region provides important baseline information for future PAM projects and monitoring plans focused on the Mediterranean monk seal presence and distribution in the region.

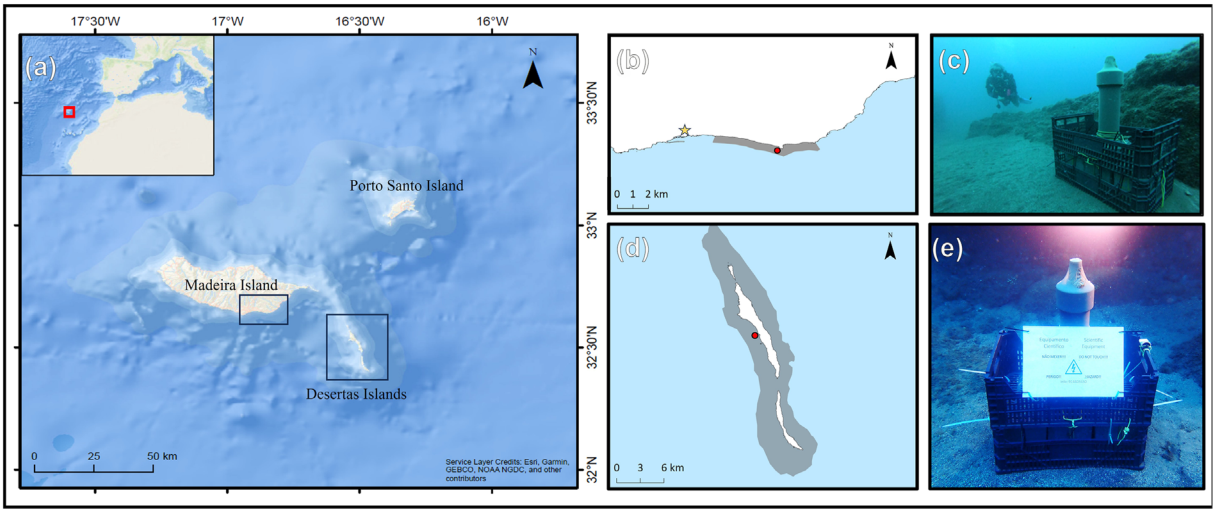

FIGURE 1 Locations of the passive acoustic datalogger deployments. (a) The Madeira Archipelago. (b) Garajau Reserve (marine delimitation shaded in grey colour), location of the city of Funchal (yellow star) and the datalogger (red dot). (c) Photo of the datalogger in Garajau Reserve. (d) The Desertas Reserve (marine delimitation shaded in grey colour) and location of the datalogger (red dot). (e) Photo of the datalogger in the Desertas Reserve.

2 | METHODS

2.1 | Study sites

The Madeira Archipelago is located in the north-eastern Atlantic Ocean and is part of the Macaronesian region (Fernández-Palacios et al., 2011). This archipelago consists of two human-populated islands, Madeira (where the capital city, Funchal, is located) and Porto Santo, and two uninhabited sub-archipelagos, the Desertas Islands and the Selvagens Islands (see Figure 1). The largest of these volcanic islands is Madeira Island, which is surrounded by the abyssal plain of Madeira and characterized by a pelagic and oligotrophic environment, with a narrow continental shelf (Geldmacher et al., 2000; Longhurst, 1995; Narciso et al., 2019). This study was carried out in two nature reserves existing in the Madeira archipelago: (1) Garajau Partial Nature Reserve (hereinafter referred to as Garajau Reserve), established in 1986 and located on the south-east slope of Madeira Island, extending from the coastline (in high tide) to a depth of 50 m along approximately 10 km between Ponta do Lazareto and Ponta da Oliveira and covering a total area of 376 ha (IFCN, 2022a), and (2) the Desertas Islands Nature Reserve (hereinafter referred to as the Desertas Reserve), classified in this category in 1995 and located southeast of Madeira Island, comprising three islands (Ilhéu Chão, Deserta Grande and Bugio), a few adjacent islets, and the surrounding marine area down to 100 m depth, with a total area of 12,586 ha (IFCN, 2022b).

2.2 | Acoustic recordings

Long-term recordings of the underwater soundscape were obtained by deploying two acoustic autonomous loggers, one in Garajau Reserve (32.636588, −16.853396; datum WGS84) and another in the Desertas Reserve (32.511966, −16.50834; datum WGS84), from mid-June to September 2021. In Garajau Reserve the deployment was at a depth of 28 m and in the Desertas Reserve at a depth of 16 m. In both cases, the logger was deployed by scientific divers on the seafloor. The substrate in the deployment areas was characterized by gently sloping rocky bottoms with sandy substrate patches (Figure 1). The custom-made acoustic loggers used for the recordings used low-cost data loggers (AudioMoth 1.2.0; Hill et al., 2018) equipped with a custom-made hydrophone (PTZ-P5 piezoelectric ceramic tubes 24 × 20 × 20 mm, connected to a 50 × custom-made pre-amplifier). Sensitivity of these custom-made recorders was not characterized, but Figure S1 compares acoustic recordings between a commercial SoundTrap logger and this custom-made logger. The acoustic loggers were programmed to record at a sampling rate of 48 kHz on a duty cycle of 10-min recording and 10-min pause, resulting in 72 10-min audio files per day. On these settings and with a battery pack, they operated for more than 3 months.

2.3 | Mediterranean monk seal acoustic analysis

Considering the time demanding nature of the visual and aural analytical process for each audio file, a subsampling scheme was applied. Pinnipeds are known to be highly vocal during the breeding season (Charrier et al., 2023), and in the case of the Mediterranean monk seal in the Madeira Archipelago, this season occurs during October and November (Pires et al., 2008). As the audio files available for the present study were recorded from mid-June to the end of September 2021, the closest month to the breeding season was selected for the analysis to optimize our likelihood of detecting vocalizations. In addition, following Muñoz et al. (2011) recommendation to analyse the vocal behaviour of

M. monachus outside of the breeding season, the month furthest from the breeding season was also selected. For each period chosen (mid-June to mid-July and full September), 4 days per period were selected, each within a different moon phase (crescent, full, waning and new moon). The moon phase was used with the aim to distribute the sampled days at approximately regular intervals, and it was in accordance with NOAA's Solar Calculator (NOAA, 2023). This resulted in a subsample with a total of 8 days for each of the two locations included in this study (i.e. 16 days in total). Four periods of 30 min (resulting from combining three 10-min audio recordings) in each selected day were used for the analysis, representing night (midnight), sunrise, day (noon) and sunset at each location. A total of 64 samples of 30-min duration were analysed. When a sound type was detected only once, an added sampling effort was made to detect more of the same type, by analysing all the audio files available for the same date and location where the sound type was originally found. These additional sounds were used for a quantitative description of those sound features but were not included in the sound abundance count.

Considering the frequency bandwidth of underwater sounds described by Muñoz et al. (2011), Sills et al. (2021) and Charrier et al. (2023) for monk seal sounds, files were downsampled to 8 kHz. The files were analysed aurally and visually using Raven Pro 1.6.3 (FFT size, 128; window size, 96 points; window type, Hanning; frequency range, up to 4 kHz). Charrier et al. (2023) was used as a reference to determine if a sound could be considered as putatively produced by Mediterranean monk seals. A quantitative description of the sound types detected was carried out using five acoustic variables: duration (s), peak frequency (Hz) and the various frequency quartiles (Q25, Q50, Q75, Hz). Values for those variables were obtained on every annotated sound using Raven Pro 1.6.3. The sound duration was manually measured from spectrograms. Although this method introduces an error dependent on the FFT segments size, it was chosen as a compromise to maximise the number of sounds analysed, as several showed a reduced signal-to-noise ratio (SNR) resulting from the distance or position of the acoustic logger in relation to the source and from masking by the background noise (i.e. motorboat and snapping shrimps). Note that no putative seal sound was excluded based on SNR. The National Institute of Standards and Technology (NIST) method, available in Raven Pro 1.6.3, was used to estimate SNR (dB). This method compares a signal (the 85th percentile) to noise (the 15th percentile) of a root mean square power histogram computed over the entire file (Szesciorka et al., 2023). In general, anthropogenic noise was low in the audio recordings analysed. Motorboat noise was present for only 7.02% of the total duration of all the audio files considered (5.02% of the Desertas Reserve audios and 9.01% of Garajau Reserve audios), and snapping shrimp noise, despite being present during all the recordings, had higher frequencies and generally had less energy than seal sounds. Peak frequency is the frequency with highest power within the selection (if an equivalent maxima occurred at more than one frequency, the lowest frequency was selected). Q25 is the frequency that divides the selection into two frequency intervals containing 25% and 75% of the energy in the selection, Q50 is the frequency that divides the selection into two frequency intervals of equal energy, and Q75 is the frequency that divides the selection into two frequency intervals, in this case, containing 75% and 25% of the energy in the selection (Charif et al., 2010).

A column plot showing the distribution of the total abundance of the putative sounds by the sampled days was elaborated, as well as a boxplot chart representing the distribution of all the putative sounds by the four periods of the day (night, sunrise, day and sunset). Differences among the four periods of the day were evaluated with a non-parametric Kruskal–Wallis test, as data were not normally distributed (Kruskal & Wallis, 1952).

3 | RESULTS

A total of 61 putative seal sounds were identified based on the qualitative and quantitative similarity to underwater sounds reported for the Mediterranean monk seal (Charrier et al., 2023). Considering the aural and visual characteristics from the spectrograms and the values of the acoustic variables measured, the sounds were classified into two types of low-frequency noisy sounds without a clear harmonic structure and named as /growl/ and /hiccup/ (Figure 2; audio recordings are provided as Videos S1 and S2). Table 1 provides mean, standard deviation and range for the duration, peak frequency and frequency quartiles (Q25, Q50, Q75) values for /growl/ and /hiccup/ sound types. Growls were much longer than hiccups and showed a more ample range of values for all the frequency-related variables. On the other hand, hiccups were found to have higher peak frequency and frequency quartiles than growls. The mean values of all the acoustic variables evaluated for the /growl/ sound type in the present study fell within the range of values obtained by Charrier et al. (2023). In the case of the /hiccup/ sound type, its duration overlaps part of the range of values also reported by Charrier et al. (2023), while the peak frequency and frequency quartiles Q25, Q50 and Q75 fell within the range described by those authors. Both growls and hiccups presented similar SNR mean values: 16.98 ± 3.01 dB (range 11.38–26.42 dB) and 15.81 ± 2.40 dB (range 13.15–17.83 dB), respectively, and when comparing SNR for growls between locations, the mean values were 15.01 ± 2.40 (range 11.38–18.49) for the Desertas Reserve and 17.39 ± 2.99 (range 12.01–26.42), showing a slightly higher SNR at Garajau Reserve.

The most abundant sound detected within the subsampling scheme corresponded to the /growl/ type, with a total of 58 occurrences compared to only one occurrence of /hiccup/ type. Two more hiccups were identified with an additional sampling effort (described in Section 2). Note that, as these two /hiccup/ occurrences were detected outside of the subsampling scheme, they were not considered when comparing sound abundances among time periods or between locations. In terms of abundance, most of the sounds were recorded in Garajau Reserve, with a total of 48 occurrences for /growl/ type, while in the Desertas Islands Reserve 10 /growl/ and one /hiccup/ sounds were counted. The day with the highest total

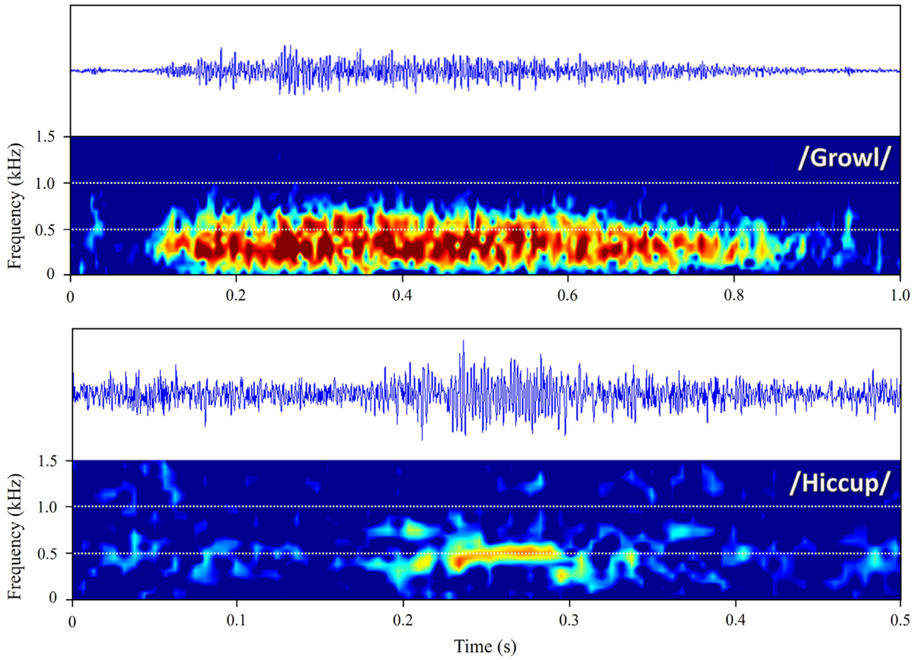

FIGURE 2 Oscillograms and spectrograms of the two putative sound types /growl/ and /hiccup/ for the Mediterranean monk seal in the Madeira Archipelago. The respective oscillogram can be found above each spectrogram (FFT size = 128, window size = 96 points, Δf = 83.3 Hz; window type, Hanning; overlap, 50% frequency range, up to 4 kHz). Warmer colours in spectrograms indicate higher sound energy.

records of sounds corresponded to June 18 with a total of 24 occurrences (Figure S2) followed by September 20 with 10 sounds. In contrast, on September 28, a single sound was detected, while on July 1, no sounds were detected. In total, 22, 19 and 14 sounds were detected during the day, sunrise and sunset, respectively, while four sounds were detected during the night. However, no significant differences in abundances were found at the different time periods of the day (Figure 3) (Kruskal–Wallis, $X^2 = 5.05$, $P = 0.17$).

4 | DISCUSSION

The use of PAM in this study allowed, for the first time, the detection of underwater sounds putatively produced by the Mediterranean monk seal in the Madeira Archipelago. These sounds resemble acoustically and aurally those described by Charrier et al. (2023) for *M. monachus*. Moreover, the values of the acoustic variables mostly fell within the range reported by the same authors, fitting the characteristics of Mediterranean monk seal's calls. Complementary information obtained, for instance, with video recordings of individuals producing vocalizations (Russell et al., 2016; Sills & Reichmuth, 2022) would allow attributing those sounds to *M. monachus* with total certainty, in addition to enabling linking sounds to specific individuals and to behaviours.

Considering the 18 call types reported in the literature for this species in a Mediterranean population (Charrier et al., 2023), at least two of them, the /growl/ and the /hiccup/ types (noisy sounds restricted to frequencies below 700 Hz) seem to be present in the Madeira Archipelago population. However, the putative growl sounds detected in the Madeira Archipelago are shorter and do not reach the higher frequency components of the Mediterranean population. Also, the /growl/ sound type described here was similar to some underwater calls recorded in a male Hawaiian monk seal (Sills et al., 2021). In the case of putative hiccups, which were detected only three times, the signal mean duration is shorter than the value reported by Charrier et al. (2023), and, similarly to the growls, the peak frequency and frequency quartile values do not reach the higher frequency component of the ones found in the Mediterranean population (although remaining inside the range reported by Charrier et al., 2023). In general, there is a wider range of values for the acoustic variables of the sounds described in the Mediterranean population by Charrier et al. (2023). The differences in the acoustic characteristics found for sounds recorded in the Madeira Archipelago seal population when compared to the sounds in the Mediterranean population could be due to geographical distance (genetic isolation). Geographical variations of vocal repertories have been reported for several pinniped species (Charrier et al., 2023). In addition, geographical variations can also occur at the sound type level, and a sound type might be found with differences in the acoustic characteristics, such as duration or frequencies (Charrier et al., 2023).

Growls were the most abundant sounds found in the Madeira Archipelago. Similarly, this type of sound was also the most abundant both in the Mediterranean population (Charrier et al., 2023) and the Hawaiian monk seal (Sills et al., 2021). However, the proportion in terms of abundance are quite different, with growls accounting for almost 100% of the total sounds in the Madeira Archipelago, in contrast, with approx. 26% in the Mediterranean population and 30% in the Hawaiian monk seal. The higher number of putative seal sounds detected in Garajau Reserve compared to the Desertas Reserve does not match the fact that most of the historical sightings registered for this seal in the last decades of the 20th century and the beginning of the 21st century have been in the Desertas Islands (Pires et al., 2008). When reviewing the sightings records, however, it was found that

TABLE 1 Duration, peak frequency and frequency quartiles (Q25, Q50 and Q75) for the sound types/growl/and/hiccup/produced by the Mediterranean monk seal and the respective values of those acoustic variables reported in the literature for this species (Charrier et al., 2023). Mean ± standard deviation (minimum value–maximum value).

Sound type	Duration (s)	Peak frequency (Hz)	Q25 (Hz)	Q50 (Hz)	Q75 (Hz)
Growl ($n = 58$)	0.89 ± 0.64 (0.13–3.68)	359 ± 131 (125–687)	234 ± 59 (63–375)	325 ± 77 (125–500)	426 ± 90 (188–625)
Charrier et al., 2023 ($n = 442$)	1.14 ± 0.62 (0.26–4.27)	648 ± 412 (29–1785)	541 ± 249 (63–1806)	920 ± 389 (172–2175)	1399 ± 662 (416–2952)
Hiccup ($n = 3$)[a]	0.08 ± 0.03 (0.06–0.11)	417 ± 36 (375–438)	396 ± 36 (375–438)	479 ± 36 (437–500)	521 ± 95 (438–625)
Charrier et al., 2023 ($n = 210$)	0.18 ± 0.04 (0.09–0.28)	395 ± 110 (226–882)	353 ± 82 (209–861)	422 ± 99 (258–899)	567 ± 120 (366–942)

[a]Two sounds detected with an added sampling effort were considered for analysis (see Section 2).

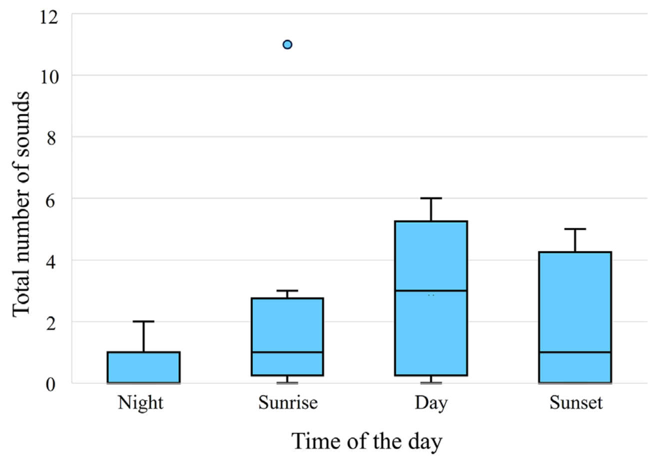

FIGURE 3 Boxplot chart of the abundance of sounds in different periods of the day. An outlier can be observed corresponding to a value of 11; all those occurrences were detected in the sunrise of 18 June (nine of them at Garajau Reserve).

there is one male seal that has been mostly observed in the southern coast of Madeira Island and some of the sightings were nearby Garajau Reserve area (Pires, 2011) and two females have been registered regularly in Madeira Island, one of them mostly in the southern east coast, including the area of Garajau Reserve (Pires et al., 2020). It could be that the sounds registered are associated to that individual but note that the use of PAM to distinguish among individual animals remains difficult (Fleishman et al., 2023), and so further analysis complemented with other methods (e.g. video cameras, acoustic tags) could help to confirm that possibility. Another aspect to consider is that Garajau Reserve is a popular area for scuba diving; sounds associated with diver presence such as bubble production and air inhalation with the diving regulator were also registered in one of the analysed audio files. Those sounds were clearly identifiable and did not resemble aurally and spectrally the putative seal sounds described here. Additionally, those sounds were not associated with the occurrence of putative seal growls or hiccups.

As mentioned, pinnipeds are known to be acoustically active during the breeding season, and in the case of the Mediterranean monk seal, this is not an exception (Charrier et al., 2023). The results of the present study, in which putative seal sounds were found almost in all the evaluated days, suggest that this species can also produce underwater sounds outside the breeding season. Nonetheless, there is not a clear pattern in the abundance of sounds found in the evaluated days, irrespective of being closer or more distant from the breeding season. Extending the study to include more days outside and during the breeding season and more sampling places could clarify this subject. Putative seals' calls were detected in all the periods of the day, indicating the occurrence of underwater sound production (and seal activity) at both daytime and nighttime in the Madeira Archipelago. Charrier et al. (2023) also detected vocalizations throughout the day, and Sills et al. (2021) reported the detection of calls during day and night for the Hawaiian monk seal. The different particularities of the sampling scheme in the different studies do not allow to compare the daily distribution in sound abundance. Charrier et al. (2023) reported that the time periods with the lowest number of detected calls were between 04:00 and 07:00 and 11:00 and 13:00 for the Mediterranean monk seal, while Sills et al. (2021) found that the vocal behaviour was generally highest near dawn for the Hawaiian monk seal.

Despite Garajau Reserve being closer to the capital city of Funchal, to marine traffic lanes, as well as having regular visits by divers and more motorboat presence (also detected in the analysed audio files analysed), SNR values were higher than in the Desertas Reserve. This is most likely related to the depth at which loggers were deployed. The logger in the Desertas Reserve was deployed at shallower depths, with more wave exposition and noise from water moving against rocks and boulders, thus decreasing the SNR of registered biological sounds.

4.1 | Implications for conservation

Effective conservation requires understanding species' abundance patterns and demographic rates across space and time (Farr et al., 2022). Despite the fact that those are aspects difficult to estimate from PAM data due to the lack of simple relationships between call counts and animal density (Gibb et al., 2018), different methods have been developed to overcome that limitation by using, for example, multisensory arrays and networks (Stevenson et al., 2015) and other methods that rely upon the adjustment of the detected call density estimates (Thompson et al., 2010; Ward et al., 2012) (for more methods and information, see the review by Marques et al., 2013). Passive acoustic data can support the estimation of other ecological metrics, such as detection-weighted occupancy, population viability and structure or behaviour, providing data that can complement traditional monitoring methods (Fleishman et al., 2023). In addition, PAM creates permanent records that can be reused when new analytical tools become available, when additional research questions arise, or to compare past to present conditions (Deichmann et al., 2018).

Emerging opportunities can strengthen PAM applications and its scope for the Mediterranean monk seal conservation in the Madeira Archipelago. One is the use of automatic identification of sounds, which may present considerable difficulties in the initial stage (Stowell et al., 2016), but has shown a fast improvement in recent years (Gibb et al., 2018). Such methods can help to considerably speed up the analysis of long-term sound recordings when compared with the highly time-consuming process normally involved in manual analysis. Another one is using low-cost acoustic recorders, such as the one used in this work, which could allow extensive PAM networks and reduce costs. Those opportunities can offer large quantities of detailed data derived from PAM that, combined with classical monitoring strategies, could help to complement and improve the management and conservation of the Mediterranean monk seal in the Madeira Archipelago.

ACKNOWLEDGEMENTS

This study had the support of the MARE Mini Grants 2020 program through Fundação para a Ciência e a Tecnologia (FCT) strategic project UIDP/04292/2020 awarded to MARE. Likewise, the FCT strategic projects UID/MAR/04292/2020 and LA/P/0069/2020 of the Associate Laboratory ARNET also funded M.C.P.A. and M.F. by MARE; and the strategic project UID/BIA/00329/2020 funded P.J.F. by cE3c. FCT Scientific Employment Stimulus - Institutional Call (CEECINST/00037/2021) supported J.G.M. Thanks are also given to the projects MIMAR+ (MAC2/4.6.d/249) and PLASMAR+ (MAC2/1.1a/347) for partially funding this study in the framework of the INTERREG MAC 2014-2020 Program. Similarly, thanks are given to the EU Horizon Europe project CLIMAREST: Coastal Climate Resilience and Marine Restoration Tools for the Arctic Atlantic basin, with grant agreement 101093865 for R.S. Finally, it is greatly appreciated the logistic support provided by the company Madeira Sea Emotions. This study was carried out in marine protected areas under permits issued by IFCN – Instituto das Florestas e Conservação da Natureza.

CONFLICT OF INTEREST STATEMENT

The authors claim no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article (Data S1).

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SUPPORTING INFORMATION

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How to cite this article: Muñoz-Duque, S., Vieira, M., Fonseca, P.J., Quintella, B., Charrier, I., Monteiro, J.G. et al. (2024). First assessment of passive acoustics as a tool to monitor the endangered Mediterranean monk seal in the Madeira Archipelago (Portugal). *Aquatic Conservation: Marine and Freshwater Ecosystems*, 34(2), e4100. https://doi.org/10.1002/aqc.4100