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The Important Marine Mammal Area Network: A Tool for Systematic Spatial Planning in Response to the Marine Mammal Habitat Conservation Crisis

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The Important Marine Mammal Areas (IMMAs) initiative was launched by the Marine Mammal Protected Areas Task Force of the International Union for the Conservation of Nature in 2016, as a response to a conservation crisis in the protection of marine mammals and wider global ocean biodiversity. IMMAs identify discrete portions of habitat that are important for one or more marine mammal species, and that have the potential to be delineated and managed for conservation. They are identified by scientific experts during regional workshops, on the basis of satisfying one or more of eight criteria that capture critical aspects of marine mammal biology, ecology and population structure. Candidate IMMAs undergo independent scientific review prior to being accepted, and then are publicly available via a searchable and downloadable database and a dedicated online e-Atlas. Between 2016 and 2021, eight expert workshops - engaging more than 300 experts - have resulted in the identification of 173 IMMAs located in 90 countries or territories, across a third of the globe. IMMAs identified to date provide important habitats for 58 of the 131 recognized marine mammal species. Around two-thirds of all IMMAs (65%) were identified on the basis of important habitat for a marine mammal species that is threatened on the IUCN Red List. Approximately 61% of IMMA surface areas occur within Exclusive Economic Zone waters, while 39% fall within areas beyond national jurisdiction. The Task Force undertook implementation planning exercises for IMMAs in Palau (Micronesia), the Andaman Islands (India) and the Bazaruto Archipelago and Inhambane Bay (Mozambique), engaging with a range of stakeholders including government and management bodies. IMMAs are increasingly being utilized in environmental impact assessments, marine planning exercises and in international, national and supra-regional conservation, policy and management initiatives, including the Convention on Migratory Species and Convention on Biological

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Diversity, as well as the design and management of Marine Protected Areas (MPAs) and the extension of MPA networks. The Task Force is working toward completing a global network of IMMAs that will contribute the scientific information needed to fulfill the current collective goal of protecting 30% of the ocean by 2030.

Keywords: ecologically or biologically significant marine areas, convention on biological diversity, convention on migratory species, key biodiversity areas, conservation, management, marine policy

INTRODUCTION

The Important Marine Mammal Areas (IMMAs) initiative began in 2013 and was officially launched in 2016 as a strategic response to the conservation crisis in ocean biodiversity, and specifically the insufficient protection of marine mammals and their habitats (Hoyt, 2011, 2018; Notarbartolo di Sciara et al., 2016). Compilation and evaluation of the world's marine mammal protected areas (MMPAs) in the 1990s-2000s showed clearly that the current global network of MPAs was failing to provide even modest habitat protection for the 131 extant species of marine mammals (Hoyt, 2005).

Existing MMPAs were: (1) too few in number; (2) too small in size; (3) located mainly in restricted coastal and inshore habitats while pelagic waters were left out; (4) protecting relatively few marine mammal species; and (5) often poorly designed, adopting arbitrary or political boundaries with little attention to the specific habitats of marine mammals (Notarbartolo di Sciara et al., 2016; Hoyt, 2018).

At the same time these shortfalls in marine mammal habitat protection were identified, Important Bird and Biodiversity Areas (IBAs) were being developed by BirdLife International (Donald et al., 2019). IBAs were quickly put to use in spatial planning and the design of marine protected areas around the world, including, for example, in Europe where most IBAs became either Special Areas of Conservation (SACs) under the European Habitats Directive, or Special Protection Areas (SPAs) under the European Birds Directive (Ramirez et al., 2017). There was no equivalent European marine mammal directive, much less a global marine mammal habitat protection initiative. IBAs were contributing, and continue to contribute, to the Convention on Biological Diversity (CBD) regional workshops to identify Ecologically or Biologically Significant Marine Areas (EBSAs) (Johnson and Weaver, 2014; Johnson et al., 2018), as well as to the use of the IUCN standard for the identification of Key Biodiversity Areas (KBAs) and identification efforts made by the KBA Partnership (Langhammer et al., 2007; IUCN, 2016), both ongoing initiatives that use different approaches to identify areas of biological importance. By contrast, marine mammals featured only occasionally in these efforts (Corrigan et al., 2014; Agardy et al., 2019) and were falling through the protection net. This is partly due to the nature of the animals, and the challenges and costs of studying species that are wide ranging, often occurring at low density, but it is also a result of the dispersed and non-cohesive data available for marine mammal protection planning (often unpublished, inconsistent in terms of methodology and dispersed among numerous individuals and institutions). A systematic method of collating and presenting data on marine mammal habitat use was clearly needed if marine mammals were going to be part of global marine conservation planning and protection efforts.

During the 2009, 2011, and 2014 conferences of the International Committee on Marine Mammal Protected Areas (ICoMMPA) it was determined that broad scientific agreement on the global identification of important habitats for marine mammals was needed. The ICoMMPA conferences provided the impetus for the creation, in 2013, of the Marine Mammal Protected Areas Task Force (hereafter referred to as "the Task Force"), as part of both the IUCN Species Survival Commission and the World Commission on Protected Areas, to address the problem of inadequate habitat protection for marine mammals (Hoyt, 2015).

The IMMA program was launched in 2016 and aims to identify discrete portions of habitat, important for one or more marine mammal species, and that have the potential to be delineated and managed for conservation (Hoyt and Notarbartolo di Sciara, 2014, 2021; Notarbartolo di Sciara et al., 2016). IMMAs are identified as part of a robust, expert-based process using standard criteria applied to all recognized marine mammal species and populations in their full range of habitat types. The strength of IMMAs is that they are identified independently of any political, social, economic or management influences, being purely science based, and are peer-reviewed. IMMAs are not MPAs and do not include specific measures for protection. IMMAs are intended to function as a tool to focus the conservation spotlight on the places that most matter to marine mammals and to broader marine biodiversity, also taking advantage, where relevant, of the umbrella or indicator role of these species.

In this paper, we summarize the status of the IMMA program, including ongoing progress in identifying IMMAs, disseminating information about IMMAs and illustrating the various ways this is being harnessed for conservation and management.

IMPORTANT MARINE MAMMAL AREA SELECTION CRITERIA AND IDENTIFICATION PROCESS

Important Marine Mammal Area Selection Criteria

In the context of IMMAs, "important" refers to any ecological property or value of the location, which extends to the marine mammals within the IMMA, necessary to maintain or improve their conservation status (Agardy et al., 2019; Notarbartolo

di Sciara and Hoyt, 2020). The IMMA selection criteria were developed after an extensive scientific and public consultation undertaken between 2013 and 2015. The eight criteria and sub-criteria were designed to capture important aspects of marine mammal biology, ecology and population structure and to encompass multiple aspects of species vulnerability, distribution, abundance, and key life cycle activities, as well as areas of high diversity (Corrigan et al., 2014; Hoyt and Notarbartolo di Sciara, 2014; IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2021). Any candidate IMMA needs to satisfy at least one of the criteria or sub-criteria to qualify for IMMA status, in a similar manner to conservation priority classifications such as IBAs, KBAs and EBSAs (Huang et al., 2020; IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2021). Furthermore, although the IMMA selection criteria do not require the mandatory use of thresholds of a numerical value (i.e., x number of individuals in a population), the use of the KBA identification standard (IUCN, 2016) was supplied along with the IMMA selection criteria as benchmarks for each workshop participant group to use when assessing best available evidence on the qualification of candidate IMMA proposals.

The detailed descriptions of IMMA selection criteria can be found in **Supplementary Information** and below we present a short summary in **Box 1**. For specific examples of how the IMMA criteria have been applied to individual IMMAs refer to the IMMA portfolio pages on the IMMA e-Atlas[1].

[1]https://www.marinemammalhabitat.org/imma-eatlas

BOX 1 | Important Marine Mammal Areas Selection Criteria

Criterion A: Species or Population Vulnerability

Areas containing habitat important for the survival and recovery of threatened and declining species. Threatened is defined as any marine mammal species, subspecies or subpopulation that has been formally assessed by IUCN in a threatened category.

Criterion B: Distribution and Abundance

Sub-criterion B1: Small and Resident Populations. Areas supporting at least one resident population, containing an important proportion of that species or population, that are occupied consistently.

Sub-criterion B2: Aggregations. Areas with underlying qualities that support important concentrations of a species or population.

Criterion C: Key Life Cycle Activities

Sub-criterion C1: Reproductive Areas. Aquatic or land-based areas that are important for a species or population to mate, give birth, and/or care for young until weaning, considered important to the health and long-term survival of species and populations whose life history strategies involve distinct areas and times (sometimes seasons) for reproductive activities.

Sub-criterion C2: Feeding Areas. Areas used regularly and intensively, though sometimes seasonally, by marine mammals, and that have habitat conditions that provide an important nutritional basis on which a species or population depends.

Sub-criterion C3: Migration Routes. Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.

Criterion D: Special Attributes

Sub-criterion D1: Distinctiveness. Areas that sustain populations with important genetic, behavioral or ecologically distinctive characteristics.

Sub-criterion D2: Diversity. Areas containing habitat that supports an important diversity of marine mammal species.

Important Marine Mammal Area Identification Process

The identification of IMMAs occurs during dedicated regional expert workshops. For each regional workshop, marine mammal ecology experts are selected based on their region-specific knowledge, and marine mammal information is compiled by engaging with experts and other holders of scientific data. The experts present hold a substantial part of the regional knowledge but it is important that they also have access and are ready to consult and gain cooperation from other experts and data sources during the workshop. A four-stage process is used to identify, review, and accept or reject IMMAs, as follows:

Stage 1: Nomination of Preliminary Areas of Interest

The starting point in the process is the nomination of preliminary Areas of Interest (pAoI). Anyone may propose a pAoI by completing a simple template detailing the supporting evidence. The submission of pAoI is solicited publicly via "call for information" announcements made up to six months prior to regional expert workshops. Participants invited to attend workshops are encouraged to submit pAoI in advance of the workshops.

Stage 2: Development of Candidate Important Marine Mammal Areas

All pAoI, along with existing place-based conservation areas (e.g., MPAs, EBSAs, KBAs and other spatial tools) that include marine mammal habitat, are presented and evaluated at the workshops, and participants determine whether they meet one or more of the IMMA criteria and whether their boundaries coincide with those of the important habitat for marine mammal populations in the area in question. Participants of workshops review the pAoI submitted in advance or generated during the workshop itself, to produce cIMMA proposals that: (a) include the delimitation of boundaries and the rationale for such delimitation, (b) provide the scientific rationale to support the notion that one or more of the IMMA criteria are met, (c) include relevant scientific supporting evidence, and (d) identify already existing spatial conservation measures within the areas proposed.

For every workshop, the goal has been to maintain the consistency of the approach to identify cIMMAs. This has been achieved through consistent application of the criteria and the kind of data requested. At each workshop at least one day was focused on instruction, and on subsequent days the IMMA team carefully guided participants through the process of developing cIMMA proposals, applying the criteria consistently and in delineating boundaries. There has been some streamlining in terms of the circulation of advance materials to workshop participants (videos, guidance documents, compendium of pAoI and background data available) and in the forms for gathering the cIMMA nominations, but otherwise the process has been consistent over time.

Stage 3: Review Process and Important Marine Mammal Area Status Classification

An independent review panel is nominated in consultation with IUCN (e.g., through the Chairs of the relevant specialist

groups), and charged with assessing the scientific robustness of the cIMMAs, to determine whether the information provided adequately satisfies the criteria. Until now, the review panel has been led by the Chair of the IUCN Cetacean Specialist Group. Each cIMMA is reviewed independently by each member of the panel, making a final recommendation regarding whether the IMMA should be rejected if the supporting information is very weak, or whether the information requires minor or major revisions. The chair of the panel then makes a final decision for each cIMMA considering the independent reviews of each panel member.

Previous workshops have resulted in 60 to 70% of the cIMMAs submitted being approved by the review panel. Some cIMMAs sent to the panel which require minor changes or additional data that are not subsequently addressed by the points of contact will remain as cIMMAs on the e-Atlas until the changes or data are provided.

Stage 4: Reporting and Important Marine Mammal Area Status Communication

Those IMMAs accepted via the review process are made publicly available on the Task Force's website[2] through a searchable and downloadable database and a dedicated online e-Atlas. Portfolio pages providing key information on every individual IMMA, and information on how to obtain the GIS shapefiles, are accessible from the e-Atlas and downloadable fact sheets for each IMMA are posted in PDF format. Areas that are not accepted as IMMAs because they do not satisfy the criteria or are not supported by enough robust scientific information remain as either cIMMAs or Areas of Interest (AoI). Both are included in the database and displayed on the e-Atlas with a different coloration, recognizing their potential as future IMMAs. For a cIMMA to become an IMMA, it is sufficient to ensure that certain requirements, missing at the time of submission, have been satisfied. By contrast, for an AoI to become an IMMA, it will have to undergo consideration at a new workshop and review process.

IMPORTANT MARINE MAMMAL AREA NETWORK SUMMARY STATISTICS

Between 2016 and 2021 several expert IMMA workshops were conducted engaging over 300 experts worldwide. The workshops covered the South Pacific, southeast Asia, the Indian and Southern oceans, as well as the Mediterranean, Black and Caspian Seas. In 2018 an extraordinary Mediterranean monk seal workshop was held, in addition to the above regional workshops, and two additional IMMAs were described for that species in the North East Atlantic (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2018a).

This effort, as of December 2021, has resulted in the identification of 173 IMMAs, 23 candidate IMMAs (cIMMAs), and 140 Areas of Interest (AoI) (see **Table 1** and **Figure 1**).

[2]www.marinemammalhabitat.org

Species Represented in Important Marine Mammal Areas

The foundational basis of the identification of each IMMA is the list of the "qualifying marine mammal species" that satisfies one or more of the IMMA criteria. "Supporting species", that have been documented to have regular presence within the IMMA but that do not satisfy one of the IMMA criteria, are also included in the description of an IMMA. Species that may have occupied an area historically but no longer occur, vagrants, single sightings or strandings of species that normally occur in habitat outside the IMMA boundary are not listed as supporting species. The majority of IMMAs were identified on the basis of important habitat for one (n = 62 IMMAs, 36% of the total), two (n = 45 IMMAs, 26% of the total) or three (n = 27 IMMAs, 16% of the total) marine mammal species. In total, 58 marine mammal species feature as qualifying species in the 173 IMMAs identified. This is close to half (44.2%) of the 131 species of cetaceans, pinnipeds, sirenians, sea otters and the polar bear recognized by the marine mammal taxonomic authority (Committee on Taxonomy, 2021).

A total of 43 cetaceans (47.3% of the 91 recognized cetacean species), 14 pinnipeds (42.4% of all recognized pinniped species), and 1 sirenian (25% of recognized sirenian species) have been used as qualifying species in IMMAs. Polar bears (*Ursus maritimus*), sea otters (*Enhydra lutris*) and marine otters (*Lontra felina*) do not yet occur in any IMMAs because workshops have not yet been conducted within these species' ranges.

The species most frequently featured as IMMA qualifying species are humpback whales (*Megaptera novaeangliae*) (n = 46), dugongs (*Dugong dugon*) (n = 32), sperm whales (*Physeter macrocephalus*) (n = 25) and Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) (n = 25) (**Figure 2**).

Of the 40 marine mammal species (as of October 2021) that are listed in a threatened category on the IUCN Red List (CR, EN, or VU), nearly half (n = 18) serve as qualifying species in IMMAs. Around two-thirds of all IMMAs (113/173, or 65%) were identified on the basis of important habitat for a marine mammal species that is threatened on the Red List.

The 70 marine mammal species that have not yet been used as qualifying species in IMMAs fall into two categories: (1) species that occur only in the northern hemisphere or other waters not yet covered by an IMMA workshop (e.g., *Eubalaena glacialis, Phocoena spinipinnis*, *Delphinapterus leucas*), and will likely be added when future workshops are held covering their range; or (2) species that are extremely poorly known or are naturally rare (e.g., some beaked whales), and as a result will be unlikely candidates to be used as the qualifying species in any IMMA.

The majority of IMMAs (62%) have been identified on the basis of important habitat for only cetaceans, 10% for pinnipeds alone and 5% for sirenians alone. Mixed categories of two or more species groups accounted for 23% of all IMMAs (**Figure 3**).

Important Marine Mammal Area Size and Location

The cumulative marine surface area covered by the IMMAs identified as of December 2021 is 21.2 million km^2 (about 17%

TABLE 1 | Summary of the number of IMMAs, cIMMAs and AoI by workshop region across the IMMA Network (n = 336).

Region	Workshop year	IMMA	cIMMA	AoI	Reference
Mediterranean Sea (MEDSEA)	2016	26	4	34	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2017a
Pacific Islands (PACISL)	2017	20	4	20	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2017b
North East Indian Ocean and South East Asian Seas (NIOSEA)	2018	30	6	32	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2019a
Extraordinary Mediterranean monk seal workshop covering the Mediterranean Sea (MEDSEA) and North East Atlantic Ocean	2018	2	2	0	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2018a
Extended Southern Ocean (EXSOOC)	2018	13	1	7	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2020a
Western Indian Ocean and Arabian Seas (WIOCAS)	2019	37	3	23	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2019b
Australia-New Zealand and South East Indian Ocean (ANSEIO)	2020	31	2	13	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2020b
Black Sea, Turkish Straits System and Caspian Sea (BSCSEA)	2021	14	1	11	IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2021
Total		173	23	140	

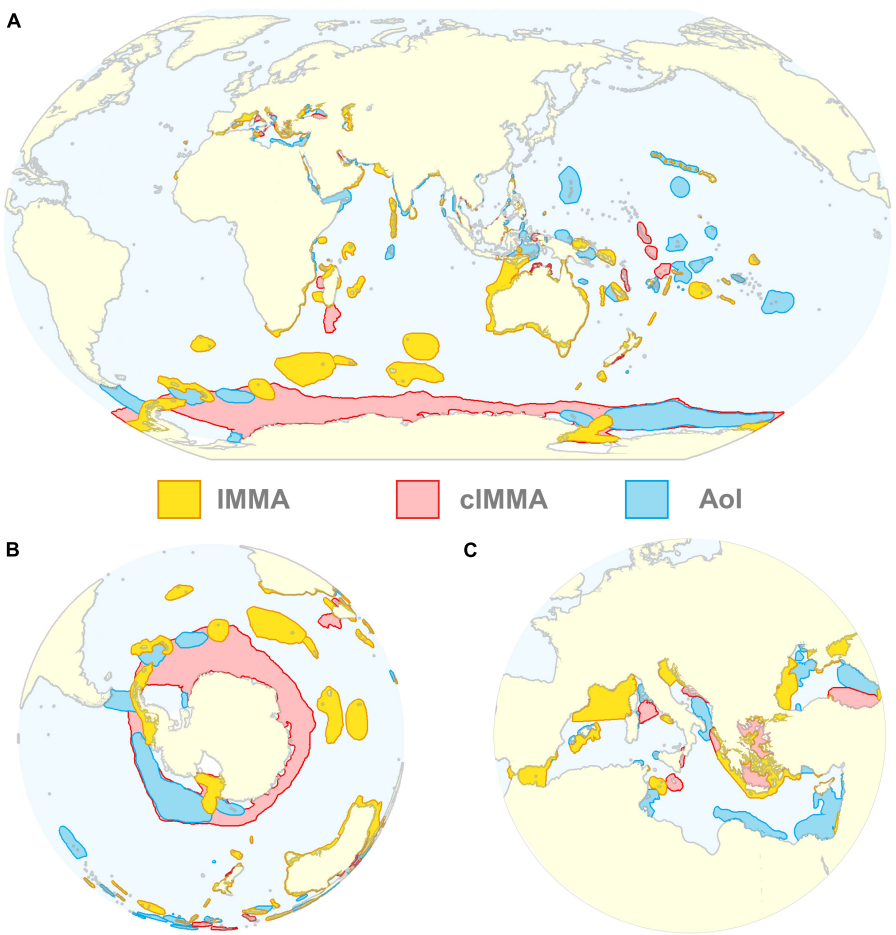

FIGURE 1 | The IMMA Network as of December 2021 displayed in both a Global **(A)**, Orthographic South Polar **(B)**, and Mediterranean **(C)** projection. Important Marine Mammal Areas (IMMAs) are displayed in gold, while candidate IMMAs (cIMMA) are red and Areas of Interest (AoI) are shown in blue.

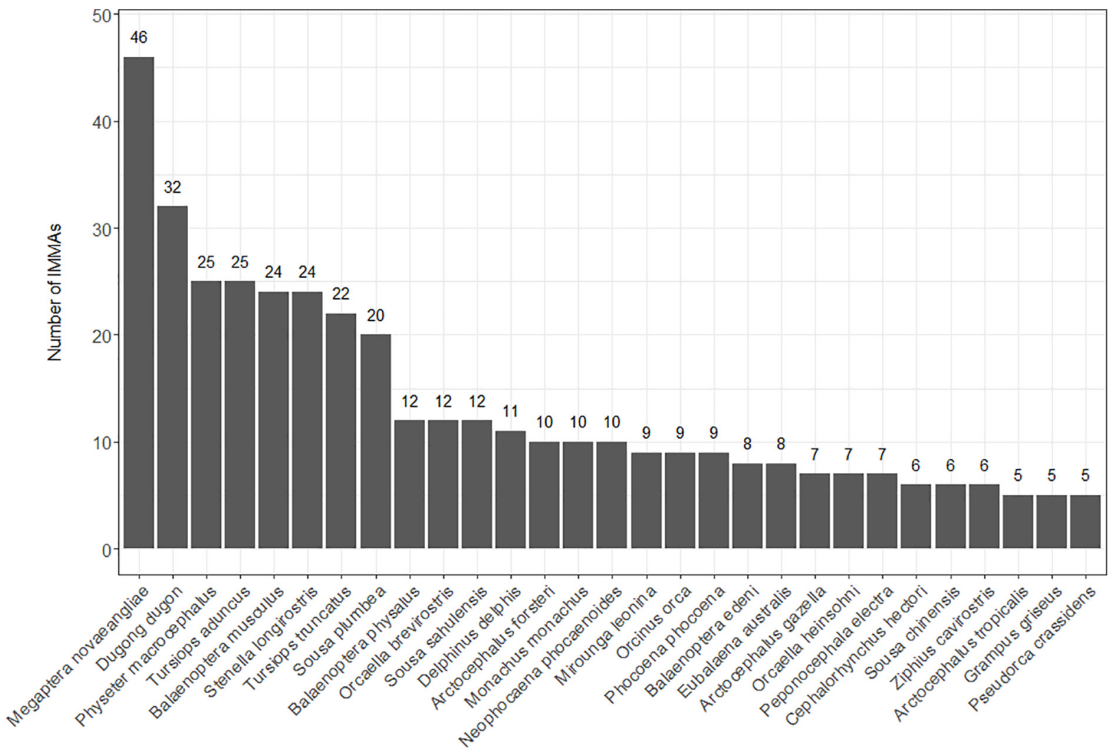

FIGURE 2 | Marine mammal species most frequently used as qualifying species in identification of the 173 IMMAs identified by the Marine Mammal Protected Areas Task Force as of December 2021.

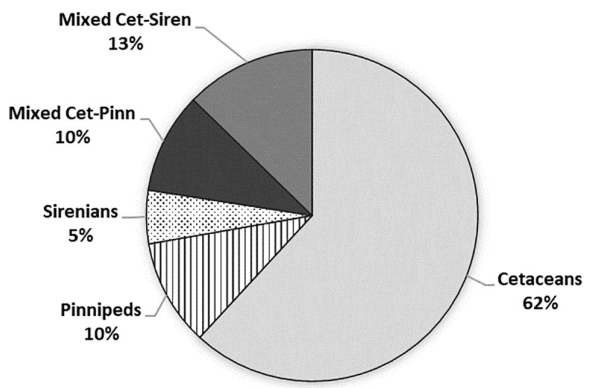

FIGURE 3 | Number of IMMAs defined on the basis of cetaceans, sirenians, or pinnipeds as qualifying marine mammal species, or the mixed presence of cetaceans and pinnipeds (mixed cetaceans/pinnipeds) or cetaceans and sirenians (mixed cetaceans/sirenians).

of the examined regions' total surface). Approximately 61% of IMMA surface areas fall within Exclusive Economic Zone (EEZ) waters, while 39% are within areas beyond national jurisdiction (ABNJ). IMMAs occupy 9.2% of global EEZ waters and 3.8% of global ABNJ waters. 45.6% (n = 90, including Antarctica) of the world's 197 recognized sovereign nations host IMMAs in their territorial waters.

IMMAs vary in size, with the median size around 18,000 km^2. Six IMMAs (3.5% of the total) are greater than one million km^2 in size, while 71 IMMAs (41% of the total) are smaller than 10,000 km^2 and 94 (54.3% of the total) are smaller than 20,000 km^2 (**Figure 4**).

The largest IMMA is 2,861,819 km^2 encompassing the area of Prince Edward Island and Western Oceanic Waters in the Southern Ocean, which is feeding and breeding habitat for southern elephant seals (*Mirounga leonina*), Antarctic fur seals (*Arctocephalus gazella*), and Subantarctic fur seals (*Arctocephalus tropicalis*). The smallest IMMA, the Akrotiri IMMA in Cyprus, is only 45 km^2, which includes small but important breeding caves for the Mediterranean monk seal (*Monachus monachus*).

Considering the median values of the IMMA area size on the basis of the qualifying species, the larger IMMAs are those identified for cetaceans and pinnipeds, followed by areas identified on the basis of providing important habitats for qualifying species of pinnipeds. IMMAs including sirenians (the dugong) as qualifying species are also generally smaller (**Table 2** and **Figure 5**).

Criteria Used to Identify Important Marine Mammal Areas

All eight criteria were used to identify IMMAs, and many IMMAs were identified on the basis of multiple criteria. In total, the IMMA selection criteria were successfully satisfied on 620 occasions across the 173 IMMAs that were identified. With the

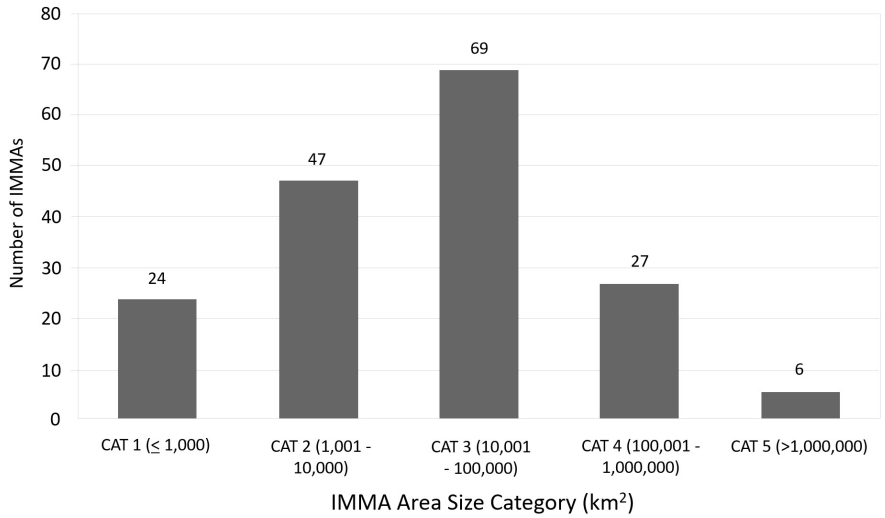

FIGURE 4 | The frequency of IMMA area size categories observed across the IMMA Network where CAT 1 (≤ 1,000 km^2) = 14% of total area; CAT 2 (1001 – 10,000 km^2) = 27% of total area; CAT 3 (10,001 – 100,000 km^2) = 39% of total area; CAT 4 (100,001 – 1,000,000 km^2) = 15% of total area; CAT 5 (>1,000,001 km^2) = 6% of total area.

exception of five IMMAs which were identified on the basis of a single criterion, almost every IMMA satisfied 2 or more criteria - either for the same species or for multiple species (see **Figure 6**). No IMMAs qualified for all eight selection criteria or sub-criteria in the present network of 173 identified sites. The most frequently occurring criterion used to identify IMMAs across the network of 173 areas was Criterion A – Species or Population Vulnerability (n = 144, 83%); followed by Key Life Cycle Attributes sub-criteria C2: Feeding Areas (n = 107, 62%) and C1: Reproductive Areas) (n = 106, 61%); followed by Criterion B - Distribution and Abundance sub-criteria B2: Aggregations (n = 77, 45%) and B1: Small and Resident Populations (n = 68, 39%) (see **Figure 7**). Although fewer IMMAs were identified on the basis of Criterion D - Special Attributes (including D2: Diversity (n = 48, 28%) and D1: Distinctiveness (n = 39, 23%) the least frequently used criterion across the network of 173 IMMAs was the sub-criterion C3: Migration Routes (n = 31, 18%). A similar pattern can be observed when considering criteria and sub-criteria by qualifying species categories (see Table 1 in **Supplementary Materials**).

Notable differences include the smaller influence of the A Criterion (vulnerability) in contrast to the greater occurrence of the C2 sub-criterion (feeding areas) in the Extended Southern Ocean (EXSOOC), the wide occurrence of sub-criterion C1 (reproductive areas) in the Mediterranean Sea (MEDSEA) where sub-criteria B2 (aggregations) and D2 (diversity) are less frequent, and the higher incidence of sub-criterion D2 (diversity) in the Pacific Islands (PACISL) and the Western Indian Ocean and Arabian Seas (NIOSEA). All these differences can be traced back to the different geomorphology and ecological characteristics of the involved region, e.g., including semi-enclosed seas (MEDSEA), or areas that typically include feeding destinations at one end of migratory routes (EXSOOC), or regions known to host higher levels of biodiversity (PACISL and NIOSEA).

TABLE 2 | Descriptive statistics of the size of IMMAs.

Categories	N. IMMA	Total area (km^2)	Minimum area (km^2)	Maximum area (km^2)
All IMMAs	173	21,231,017	45	2,861,819
Mixed Cet-Pinn	17	8,487,194	5,902	2,861,819
Cetaceans	107	8,478,700	93	1,767,353
Pinnipeds	18	3,519,719	45	1,431,225
Mixed Cet-Siren	22	685,652	393	278,494
Sirenians	9	59,752	759	20,663

Statistics are shown for IMMAs cumulatively, as well as on the basis of the categories of qualifying marine mammal species for which they were identified: cetaceans, sirenians, pinnipeds, the mixed presence of cetaceans and pinnipeds (mixed cetaceans/pinnipeds) and cetaceans and sirenians (mixed cetaceans/sirenians).

ACTIONING KNOWLEDGE TO SUPPORT CONSERVATION AND MANAGEMENT

In the five years since the 2017 online release of the first identified IMMAs in the Mediterranean Sea, IMMAs have been broadly welcomed and adopted by a diverse range of relevant authorities and stakeholders.

The Task Force has received requests for IMMA boundary information and GIS data, as well as supporting information and metadata, at a rate which is nearly doubling year-on-year. This provides an indication of demand for this information, as well as evidence that IMMAs are being applied toward, or at least considered as a tool in, the conservation of marine mammals (Notarbartolo di Sciara and Hoyt, 2020). As of mid-November 2021, 298 users had requested IMMA shapefiles. Of those

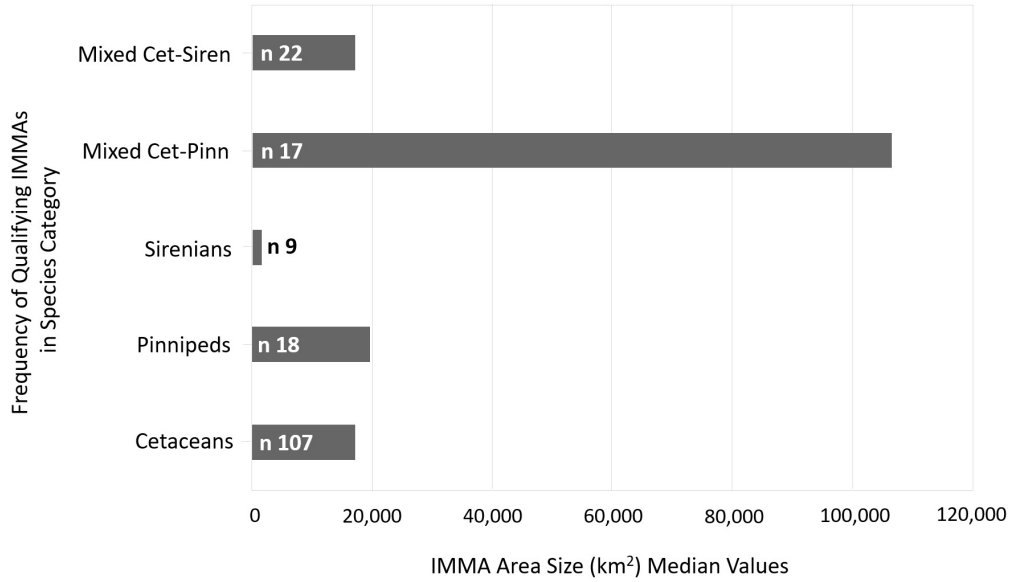

FIGURE 5 | Median values of the IMMA area size on the basis of qualifying species of cetaceans, sirenians, pinnipeds and mixed taxa (cetaceans and pinnipeds; cetaceans and sirenians). Numbers indicates the total number of IMMAs by category.

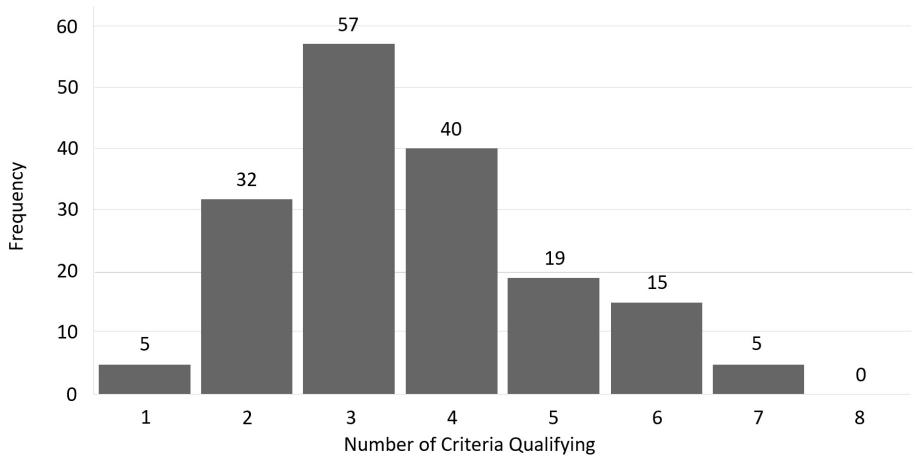

FIGURE 6 | Frequency of multiple IMMA selection criteria being observed to be used in any single IMMA identified (5 IMMAs identified on basis of single criterion, 168 IMMAs identified using between 2 and 7 different criteria, and no IMMAs identified on the basis of all 8 different selection criteria).

who provided details (n = 295), 39% (n = 114) worked in academia, 22% (n = 64) were commercial organizations, 21% (n = 63) were non-governmental organizations, 16% (n = 48) were governmental institutions, and 2% (n = 6) were inter-governmental organizations. Meanwhile, where the intended use was stated (n = 297), 36% (n = 106) were for research, 34% (n = 101) for conservation activities, 21% (n = 61) were by commercial organizations typically involved in conducting activities such as impact assessments, and 10% (n = 29) were for educational purposes.

To investigate how IMMAs might be employed to drive the implementation of conservation measures and policy directives, and to increase local awareness about their availability and usefulness, the Task Force conducted implementation site visits (2017-19) in three locations: Palau, Micronesia (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2017c); the Andaman Islands, India (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2018b); and the Bazaruto Archipelago and Inhambane Bay, Mozambique (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2019c; Notarbartolo di Sciara and Hoyt, 2020). The Task Force engagement with conservation efforts in Mozambique was particularly relevant considering that the "Bazaruto Archipelago to Inhambane Bay IMMA" hosts the last viable dugong population in Africa, which is under threat from bycatch in illegal fishing activities and planned hydrocarbon exploration and exploitation. As a

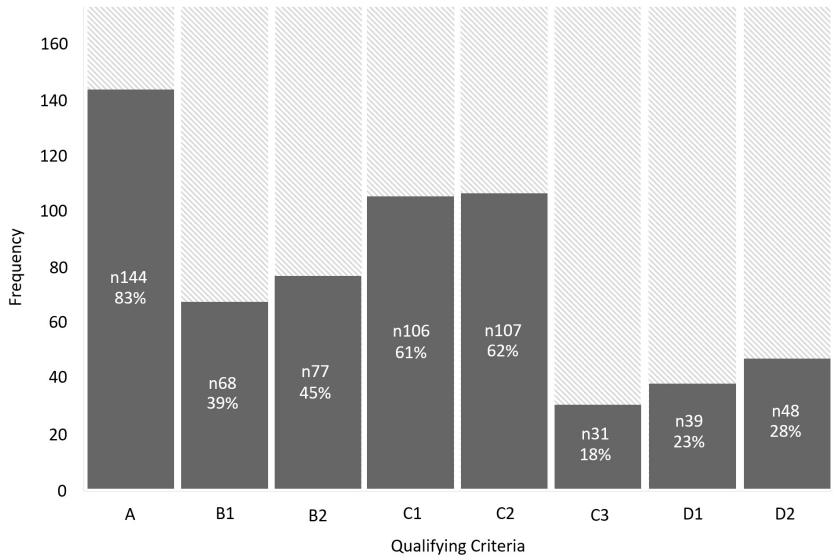

FIGURE 7 | Frequency of IMMA selection criteria and sub-criteria used to identify IMMAs across the network of 173 identified areas (Criterion A: Species or Population Vulnerability; Criterion B: Distribution and Abundance, Sub-criterion B1: Small and Resident Populations, Sub-criterion B2: Aggregations; Criterion C: Key Life Cycle Activities, Sub-criterion C1: Reproductive Areas, Sub-criterion C2: Feeding Areas, Sub-criterion C3: Migration Routes; Criterion D: Special Attributes, Sub-criterion D1: Distinctiveness, Sub-criterion D2: Diversity).

result of consultations with local stakeholders in 2020, including consideration of the IMMA, plans for oil and gas exploration in the area were re-evaluated, with the leases returned to the Mozambican government (Carnie, 2020).

Important Marine Mammal Areas are supporting marine mammal, as well as the wider marine biodiversity, conservation in many ways. IMMAs are contributing to national coastal zoning and spatial planning processes, including in Indonesia, where the Balikpapan Bay IMMA is contributing to coastal zonation plans and protection for endangered Irrawaddy dolphins *Orcaella brevirostris* (Kreb et al., 2020); Malaysia, where IMMAs have been included in the revised National Policy on Biological Diversity 2021-2030, the Perlis Integrated Shoreline Management Plan (ISMP), and the Mersing Special Area Plan (Fairul Izmal, pers. comm.). IMMAs have also supported the refinement of national spatial planning and design of biodiversity denominations such as Australia's Biologically Important Areas (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2020b). Although IMMAs have not yet (to the authors' knowledge) been used to establish new marine protected areas, their inclusion in these national plans is an important first step toward meaningful habitat protection. While no IMMAs have proceeded immediately to stimulate the proposal and designation of an MPA, some IMMAs were already largely or entirely MPAs. For IMMAs outside MPAs, creating an MPA is a multi-year process usually involving stakeholders coming to agreement, gaining the support of government, and sometimes preparation of a management plan. IMMAs are still fairly new with the first ones only becoming available in 2017. However, because IMMAs result from international scientific agreement, they have added substantial impetus to existing MPA proposals that are being considered.

At the regional level, the CMS Special Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) is incorporating IMMAs into their Cetacean Critical Habitat denomination (ACCOBAMS, 2017). Furthermore, during regional expert workshops, IMMAs have provided insights for the identification of marine and coastal KBAs. In some cases, marine mammal populations featured as qualifying species in IMMA identifications using the quantitative thresholds required for KBA identification (e.g., Mediterranean and Hawaiian monk seals, and dugongs in Mozambique and northern Australia) (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2020b).

At an international level, IMMAs support the continued effort to identify EBSAs within the framework of the Convention on Biological Diversity (CBD) (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2019b), and the Convention on Migratory Species (CMS) has recognized the value of IMMAs and encouraged member parties to engage in the IMMA process through the adoption in 2017 of Resolution 12.13 (Convention on Migratory Species, 2017).

In 2018, a workshop was jointly hosted by the International Whaling Commission (IWC), the IUCN and ACCOBAMS to evaluate how the data and process used to identify IMMAs could assist the IWC to identify areas of high risk for ship strike, using the Mediterranean Sea as a test case. High risk areas are defined as "the convergence of either areas of high volume of shipping and whales, or high numbers of whales and shipping." Following on from discussions at the workshop there was a recommendation for the ACCOBAMS Secretariat and ACCOBAMS Parties to further develop the process for the designation of a Particularly Sensitive Sea Area (PSSA) under the

framework of the International Maritime Organization (IMO) at a scale that includes the North West Mediterranean Sea, Slope and Canyon IMMA, plus potentially the Spanish corridor, using ship strike mitigation tools such as speed reduction and routing measures as part of Associated Protective Measures (IWC, 2019, 2020).

Important Marine Mammal Areas are already being used by stakeholders to identify areas where precautionary or mitigating measures may need to be taken to avoid negative impacts to marine mammals. IMMAs have been assessed as "Offshore Biologically Important Areas" by the US Navy, in relation to the use of naval sonar ("Surveillance Towed Array Sensor System Low Frequency Active Sonar") which has been subjected to special precautionary measures based on U.S. legislation (Department of the Navy, 2019; NMFS, 2019). IMMA spatial layers are also being utilized by industry regulators and ocean business stakeholders to determine where their activities may overlap with important marine mammal habitat. This includes the members of the Proteus Partnership, initiated in 2003 to provide companies with the biodiversity information needed for informed decisions about planned activities that may impact biodiversity, and to support the development, improvement and dissemination of global biodiversity data and information (Addison et al., 2018). Companies are requesting and consulting IMMAs data layers to ensure that developments undertaken in or near IMMAs meet the World Bank's International Finance Corporation Performance Standard 6. This standard recognizes that biodiversity conservation enables the maintenance of ecosystem services, and that managing living natural resources is fundamental to sustainable development (Murphy et al., 2019). Finally, IMMA layers are being distributed through the Integrated Biodiversity Assessment Tool (IBAT) to enable users to make informed decisions in policy and practice using information from the IUCN and the UN Environment Program's World Conservation Monitoring Center (Rodríguez et al., 2015).

DISCUSSION

The identification of IMMAs across the world ocean has been ongoing for more than five years since the first regional workshop, and although during this time the results obtained were substantive, we cannot consider that the value of this effort will have been fully attained until global coverage will be completed. As the IMMA effort has steadily gained in traction and publicity, there have been numerous calls for IMMAs to be identified in the remaining two thirds of the world's ocean habitats and in relevant inland waters (e.g., Matear et al., 2019). Two new regions are expected to be addressed in the near future: the South East Temperate and Tropical Pacific Ocean and the South West Atlantic Ocean. Once these two regions have been completed (anticipated to be by the end of 2023), work will proceed on the various Northern Hemisphere regions with an aim toward completing the IMMA global network. This, however, will take several more years and will only happen if the funds needed for such completion will be successful. The IMMA identification process, as it was devised before the start, as well as the criteria adopted, have turned out to function well and have been a key element of success; however, details and rules have had to be continuously refined as we have progressed, as also testified by the many versions of the Guidance (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2021), a living document.

To date, the overall IMMA surface spans in excess of 21.2 million km^2, corresponding to approximately 17% of the ocean surface examined during the workshops. The dearth of marine mammal ecological data necessary to satisfy the criteria over a large portion of the ocean means that the percentage of global ocean habitat that is truly important for marine mammals is likely to be substantially higher. Ideally, regions will be re-examined periodically, so that IMMAs can be refined and updated based on changes in the animals' environment and ecology and newly acquired scientific knowledge. In the meantime, however, the lack of data in many areas means that extreme caution must be taken by users, and the conduct of human activities likely to have a negative impact on marine mammals should be discouraged even outside IMMAs.

While 39% of the total surface area of IMMAs falls within "high seas", or ABNJs, this percentage would be much lower if IMMAs in the Extended Southern Ocean region south of 60° S (which are all designated as high seas based on the Antarctic Treaty), were not included. Under the assumption (to be demonstrated) that IMMAs are evenly distributed throughout the global ocean, 64% of which is in the high seas, this disparity–explained by the difficulty of collecting relevant ecological data in the open ocean–is particularly significant given the urgency of identifying pelagic marine mammal habitats (De Santo, 2018). A dedicated session held December 2019 at the World Marine Mammal Conference in Barcelona (Spain) brought together experts who described a wide variety of scientific tools which can be employed to gather data, including satellite imagery (Cubaynes et al., 2019), acoustic-based monitoring through ocean bottom-mounted hydrophones (Clark and Gagnon, 2002), and ocean gliders (Baumgartner et al., 2013). Significant investment in high seas research will be needed to apply these and other technologies to the collection of marine mammal ecological data to allow a more representative identification of IMMAs in areas beyond national jurisdiction (Gjerde et al., 2018).

Several IMMAs have been identified based on criterion C3 (migration routes), e.g., in the Western Indian Ocean and Arabian Seas region and in the Australia, New Zealand and South East Indian Ocean region, in large part due to the presence of well-identified humpback whale and southern right whale migratory corridors. However, the challenge of using IMMAs to describe the importance of corridors for some migratory species is still proving to be an elusive task. Further efforts to incorporate the concept of migratory connectivity in the design of IMMA networks will be needed, e.g., by integrating IMMAs within the framework of the Migratory Connectivity in the Ocean (MiCO) database, or developing and applying a standard to tracking data similar to the track2KBA package (Lascelles et al., 2016; Beal et al., 2021), to allow the implementation of measures to conserve marine mammals along their migratory paths, often connecting feeding and reproductive IMMAs (Dunn et al., 2019). Networks

of MPAs inspired by IMMAs, which include areas for feeding, reproduction and, where relevant, rest stops, will help extend recognition of migratory habitat and the need for its protection.

In a rapidly changing ocean, it is essential that the information about IMMAs reflects current conditions in order to be useful for supporting conservation management and providing a foundation for marine spatial planning, systematic conservation planning, and protected areas or special spatial regulations (e.g., Bonizzoni et al., 2019). To address changing marine mammal distributions or decreasing populations, the devising of an "early warning system" was suggested, based on a set of indicators to flag the need for management interventions (Agardy et al., 2019; Albouy et al., 2020). Such indicators could include alerting information derived from visual or acoustic surveys, satellite imagery analysis, reports from whale-watching operations, or unusual mortality events reported through stranding networks. Marine mammal populations under threat within an IMMA could, over time, decrease or change their distribution patterns to the extent that the original criteria that supported the identification of that IMMA may no longer be met. Adapting specific criteria from the UN World Heritage Sites which may be given an "in danger" status, IMMAs, too, could be listed in an "IMMAs in Danger List" thus triggering efforts to mitigate or eliminate the threatening factors and to restore the area to its original condition (Brown et al., 2019).

The science-based process of identifying IMMAs is relatively agile and rapid, in contrast to systems that require lengthy political or legal negotiations and extensive public consultation. The aggregation of marine mammal ecological knowledge openly available to, and readily actionable by, non-specialists, allows it to be easily used by management, policy and industry processes, to contribute to the foundation of a global network of priority marine areas requiring our immediate conservation attention (Halpern et al., 2015; Brum et al., 2017). From a top-down perspective, multiple international conventions, organizations and competent authorities have clearly set the global conservation agenda for the coming decades, with newly remodeled frameworks for the protection and management of the marine environment (UN General Assembly, 2015; Neumann and Unger, 2019). The IMMA network adds greater capacity to this global effort, and can contribute to the building of future MPA networks, inclusive of MMPAs. Although IMMAs *per se* are not legally established protected areas, they are at minimum markers of areas to be monitored with selective threat-avoidance actions (e.g., reducing noise, avoiding ship strikes and bycatch), and they could be an extension of MMPA networks providing a further hedge against climate change.

As part of the legacy of the Task Force regional workshops, a total of 16 regional coordinators have been appointed in the seven main regions to date. Cooperating with the IMMA Secretariat, these regional coordinators are available to train groups of species experts in the use and application of the IMMA methodology and criteria, as well as to help monitor and implement protection measures in that region's IMMAs (IUCN Marine Mammal Protected Areas Task Force [MMPATF], 2021). The Task Force thus hopes to consolidate regional communities of practice as a further legacy by the region-based expert workshops, allowing for the continued advocacy and refinement of IMMA information available in that region. The preparation of ever more finely detailed global and regional maps showing the range of human threats across the ocean (e.g., Halpern et al., 2008), matched to the global EBSA, KBA, and IMMA maps, will make it possible to identify and monitor habitats requiring conservation attention and action in a more systematic way. The IMMA identification process is thus adding significant information, expertise, and global strategic direction to the development of spatially explicit marine mammal conservation measures—as well as to overall biodiversity conservation and planning (Hoyt, 2018). IMMAs may help to allow a future ocean in which marine mammals, by recognizing their important habitats, are awarded their safe place.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: The data presented in this manuscript is available to view and download via the IMMA digital e-Atlas https://www.marinemammalhabitat.org/imma-eatlas/.

AUTHOR CONTRIBUTIONS

MT wrote the manuscript with additional contributions provided by GB, CL, GM, SP, EP, MZ, GNS, and EH. The manuscript describes the work conducted by MT, GB, CL, GM, SP, EP, MZ, GNS, and EH for the creation of the IMMA selection criteria and the reported process to identify the IMMA network as of 2021. MT, CL, and GB produced the figures and tables. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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REFERENCES

ACCOBAMS (2017). "Inputs to the ACCOBAMS ongoing effort to map human threats to cetaceans in the Mediterranean and Black seas," in *Proceedings of the Report of the workshop, 31st ECS Conference, Middelfart, Denmark, 30 April 2017*, Middelfart, 19.

Addison, P. F. E., Carbone, G., and McCormick, N. (2018). *The Development and Use of Biodiversity Indicators in Business: An Overview*, Vol. vi. Gland: IUCN, 16.

Agardy, T., Cody, M., Hastings, S., Hoyt, E., Nelson, A., Tetley, M. J., et al. (2019). Looking beyond the horizon: an early warning system to keep marine mammal information relevant for conservation. *Aquat. Conserv.* 29, 71–83. doi: 10.1002/aqc.3072

Albouy, C., Delattre, V., Donati, G., Frölicher, T. L., Albouy-Boyer, S., Rufino, M., et al. (2020). Global vulnerability of marine mammals to global warming. *Sci. Rep.* 10:548. doi: 10.1038/s41598-019-57280-3

Baumgartner, M. F., Fratantoni, D. M., Hurst, T. P., Brown, M. W., Cole, T. V. N., Van Parijs, S. M., et al. (2013). Real-time reporting of baleen whale passive acoustic detections from ocean gliders. *J. Acoust. Soc. Am.* 134, 1814–1823. doi: 10.1121/1.4816406

Beal, M., Oppel, S., Handley, J., Pearmain, E. J., Morera-Pujol, V., Carneiro, A. P. B., et al. (2021). track2KBA: an R package for identifying important sites for biodiversity from tracking data. *Methods Ecol. Evol.* 12, 2372–2378. doi: 10.1111/2041-210X.13713

Bonizzoni, S., Furey, N. B., Santostasi, N. L., Eddy, L., Valavanis, V. D., and Bearzi, G. (2019). Modelling dolphin distribution within an Important Marine Mammal Area (IMMA) in Greece to support spatial management planning. *Aquat. Conserv.* 29, 1665–1680. doi: 10.1002/aqc.3148

Brown, N. E., Liuzza, C., and Meskell, L. (2019). The politics of peril: UNESCO's list of world heritage in danger. *J. Field Archaeol.* 44, 287–303. doi: 10.1080/00934690.2019.1600929

Brum, F. T., Graham, C. H., Costa, G. C., Blair Hedges, S., Penone, C., Radeloff, V. C., et al. (2017). Global priorities for mammal conservation. *Proc. Natl. Acad. Sci. U.S.A.* 114, 7641–7646. doi: 10.1073/pnas.1706461114

Carnie, T. (2020). *Greens Victorious as Sasol Ditches Africa Sea Paradise Gas-Drilling Plan*. Johannesburg: Daily Maverick.

Clark, C. W., and Gagnon, G. J. (2002). Low-frequency vocal behaviors of baleen whales in the North Atlantic: insights from Integrated Undersea Surveillance System detections, locations, and tracking from 1992 to 1996. *U.S. Navy J. Underw. Acoust.* 52, 609–640.

Committee on Taxonomy (2021). *List of Marine Mammal Species and Subspecies*. Society for Marine Mammalogy. Available onlilne at: www.marinemammalscience.org (accessed November, 23 2021).

Convention on Migratory Species (2017). *Resolution 12.13: Important Marine Mammal Areas (IMMAs)*. Bonn: CMS.

Corrigan, C. M., Ardron, J. A., Comeros-Raynal, M. T., Hoyt, E., Notarbartolo di Sciara, G., and Carpenter, K. E. (2014). Developing important marine mammal area criteria: learning from ecologically or biologically significant areas and key biodiversity areas. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 24(Suppl. 2), 166–183. doi: 10.1002/aqc.2513

Cubaynes, H. C., Fretwell, P. T., and Jackson, J. A. (2019). Whales from space: spectral and visual description of four mysticete species using VHR satellite imagery. *Mar. Mam. Sci.* 35, 466–491. doi: 10.1111/mms.12544

De Santo, E. M. (2018). Implementation challenges of area-based management tools (ABMTs) for biodiversity beyond national jurisdiction (BBNJ). *Mar Policy* 97, 34–43. doi: 10.1016/j.marpol.2018.08.034

Department of the Navy (2019). *Potential Marine Mammal Offshore Biologically Important Areas for Surveillance Towed Array Sensor System Low Frequency Active Sonar: Marine Areas under Consideration*. Washington, DC: Chief of Naval Operations, 175.

Donald, P., Fishpool, L., Ajagbe, A., Bennun, L., Bunting, G., Burfield, I., et al. (2019). Important Bird and Biodiversity Areas (IBAs): the development and characteristics of a global inventory of key sites for biodiversity. *Bird Conserv. Int.* 29, 177–198. doi: 10.1017/S0959270918000102

Dunn, D. C., Harrison, A. L., Curtice, C., DeLand, S., Donnelly, B., Fujioka, E., et al. (2019). The importance of migratory connectivity for global ocean policy. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 286:20191472. doi: 10.1098/rspb.2019.1472

Gjerde, K., Boteler, B., Durussel, C., Rochette, J., Unger, S., and Wright, G. (2018). *Conservation and Sustainable use of Marine Biodiversity in Areas Beyond National Jurisdiction: Options for Underpinning a Strong global BBNJ Agreement through Regional and Sectoral Governance. STRONG High Seas Project. 2018*. **CPQ. doi: 10.2312/iass.2018.015

Halpern, B. S., Frazier, M., Potapenko, J., Casey, K. S., Koenig, K., Longo, C., et al. (2015). Spatial and temporal changes in cumulative human impacts on the world's ocean. *Nat. Commun.* 6:7615. doi: 10.1038/ncomms8615

Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D'Agrosa, C., et al. (2008). A global map of human impact on marine ecosystems. *Science* 319, 948–952. doi: 10.1126/science.1149345

Hoyt, E. (2005). *Marine Protected Areas for Whales, Dolphins and Porpoises*, 1st Edn. London: Earthscan.

Hoyt, E. (2011). *Marine Protected Areas for Whales, Dolphins and Porpoises*, 2nd Edn. London: Earthscan.

Hoyt, E. (2018). "Marine protected areas," in *Encyclopedia of Marine Mammals*, 3rd Edn, eds B. Würsig, J. G. M. Thewissen, and K. M. Kovacs (San Diego, CA: Academic Press), 569–580.

Hoyt, E. (ed.) (2015). "ICMMPA 3: important marine mammal areas —a sense of place, a question of size," in *Proceedings of the Third International Conference on Marine Mammal Protected Areas (ICMMPA 3), Adelaide, Australia, 9-11 Nov. 2014*, Adelaide, SA.

Hoyt, E., and Notarbartolo di Sciara, G. (2021). Important marine mammal areas: a spatial tool for marine mammal conservation. *Oryx* 55:330. doi: 10.1017/S0030605321000272

Hoyt, E., and Notarbartolo di Sciara, G. (eds). (2014). *Report of the Workshop for the Development of Important Marine Mammal Area (IMMA) Criteria*. Marseille: IUCN Marine Mammal Protected Areas Task Force and International Committee on Marine Mammal Protected Areas.

Huang, H., Tang, D., Chen, B., Li, W., Ou, D., Wang, L., et al. (2020). Short comments on the application of criteria for identifying Ecologically or Biologically Significant Marine Areas (EBSAs). *Sustainability* 12:130. doi: 10.3390/su12010130

IUCN (2016). *A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0, IUCN-2016-048.vi.37*, 1st Edn. Gland: IUCN.

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2017c). *Working to Implement Important Marine Mammal Areas (IMMAs) in the Republic of Palau*. Available online at: https://www.marinemammalhabitat.org/downloads (accessed October 30, 2017).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2017a). *Final Report of the Workshop: First IMMA Regional Workshop for the Mediterranean*. Chania. Available online at: https://www.marinemammalhabitat.org/downloads (accessed October 24-28, 2016).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2017b). *Final Report of the Workshop: IMMA Regional Workshop for the Pacific Islands*. Apia. Available online at: https://www.marinemammalhabitat.org/downloads (accessed March 27-31, 2017).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2018a). *Final Report of the IMMA Extraordinary Workshop for the Mediterranean Monk Seal*. La Spezia. Available online at: https://www.marinemammalhabitat.org/downloads (accessed April 5, 2018).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2018b). *Working to Implement Important Marine Mammal Areas (IMMAs) in the Andaman Islands (India)*. Available online at: https://www.marinemammalhabitat.org/downloads (accessed November 12-18, 2018).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2019a). *Important Marine Mammal Area Regional Workshop for the North East Indian Ocean and South East Asian Seas: Final Report of the Third IMMA Workshop*. Kota Kinabalu. Available online at: https://www.marinemammalhabitat.org/downloads (accessed March 12-16, 2018).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2019b). *Final Report of the Fifth IMMA Workshop: Regional Workshop for Western Indian Ocean and Arabian Seas*. Salalah. Available online at: https://www.marinemammalhabitat.org/downloads (accessed March 4-8, 2019).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2019c). *Working to Implement Conservation Actions in the Bazaruto Archipelago to Inhambane Bay Important Marine Mammal Area (IMMA). Mozambique*. Available online

at: https://www.marinemammalhabitat.org/downloads (accessed November 16-24. 2019).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2020b). *Final Report of the Sixth IMMA Workshop: Important Marine Mammal Area Regional Workshop for Australia-New Zealand and South East Indian Ocean*. Perth, WA. Available online at: https://www.marinemammalhabitat.org/downloads (accessed February 10-14, 2020).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2020a). *Final Report of the Fourth IMMA Workshop: Important Marine Mammal Area Regional Workshop for Extended Southern Ocean*. Brest. Available online at: https://www.marinemammalhabitat.org/downloads (accessed October 15-19, 2018).

IUCN Marine Mammal Protected Areas Task Force [MMPATF] (2021). *Guidance on the Identification of Important Marine Mammal Areas (IMMAs). Version*. 87. Available online at: https://www.marinemammalhabitat.org/downloads (accessed February, 2021).

IWC (2019). *A Joint IWC-IUCN-ACCOBAMS Workshop to Evaluate How the Data and Process used to Identify Important Marine Mammal Areas (IMMAs) can Assist the IWC to Identify Areas of High Risk for Ship Strike. SC/68A/HIM/07/Rev1*. Gland: IUCN, 65.

IWC (2020). *A Geospatial Analysis of Vessel Traffic in Important Marine Mammal Areas. OceanMind, WWF, IUCN and IWC. SC/68B/HIM/03*. Gland: IUCN, 409.

Johnson, D. E., Barrio Froján, C., Turner, P. J., Weaver, P., Gunn, V., Dunn, D. C., et al. (2018). Reviewing the EBSA process: improving on success. *Mar. Policy* 88, 75–85. doi: 10.1016/j.marpol.2017.11.014

Johnson, D., and Weaver, D. (2014). "Ecologically or biologically significant marine areas," in *Applications of Key Biodiversity Areas: End-User Consultations*, eds N. Dudley, J. L. Boucher, A. Cuttelod, T. M. Brooks, and P. F. Langhammer (Gland: IUCN), 22–24.

Kreb, D., Lhota, S., Porter, L., Redman, A., Susanti, I., and Lazecky, M. (2020). Long-term population and distribution dynamics of an endangered Irrawaddy Dolphin population in Balikpapan Bay, Indonesia in response to coastal development. *Front. Mar. Sci.* 7:533197. doi: 10.3389/fmars.2020.533197

Langhammer, P. F., Bakarr, M. I., Bennun, L. A., Brooks, T., Clay, R., Darwall, W., et al. (2007). *Identification and Gap Analysis of key Biodiversity Areas: Targets for Comprehensive Protected Area Systems*. Gland: IUCN. doi: 10.2305/IUCN.CH.2006.PAG.15.en

Lascelles, B. G., Taylor, P. R., Miller, M. G. R., Dias, M. P., Oppel, S., Torres, L., et al. (2016). Applying global criteria to tracking data to define important areas for marine conservation. *Divers. Distrib.* 22, 422–431.

Matear, L., Robbins, J., Hale, M., and Potts, J. (2019). Cetacean biodiversity in the Bay of Biscay: suggestions for environmental protection derived from citizen science data. *Mar. Policy* 109:103672. doi: 10.1016/j.marpol.2019.103672

Murphy, L., Knox, J., Dawkins, K., and Jones, M. (2019). *International Finance Corporation Performance Standard 6: Implications of the Updated Guidance Note 6*. Cambridge: UNEP-WCMC.

Neumann, B., and Unger, S. (2019). From voluntary commitments to ocean sustainability. *Science* 363, 35–36. doi: 10.1126/science.aav5727

NMFS (2019). *Biological Opinion on (I) United States Navy's Surveillance Towed Array Sensor System Low Frequency Active Sonar Routine Training and Testing Activities in the Western and Central North Pacific and Eastern Indian Oceans from August 2019 and Continuing into the Reasonably Foreseeable Future (2) National Oceanic and Atmospheric Administration's National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division's Promulgation of Regulations and Issuance of a Letter of Authorization for the United States Navy to "take" marine Mammals incidental to Surveillance Towed Array Sensor System Low Frequency Active Sonar Routine Training and Testing Activities in the Western and Central North Pacific and Eastern Indian Oceans from August 2019 to August 2026*. Silver Spring, MD: National Marine Fisheries Service. doi: 10.25923/ftj1-yj21

Notarbartolo di Sciara, G., and Hoyt, E. (2020). Healing the wounds of marine mammals by protecting their habitat. *Ethics Sci. Environ. Polit.* 20, 15–23. doi: 10.3354/esep00190

Notarbartolo di Sciara, G., Hoyt, E., Reeves, R., Ardron, J., Marsh, H., Vongraven, D., et al. (2016). Place-based approaches to marine mammal conservation. *Aquat. Conserv.* 26, 85–100. doi: 10.1002/aqc.2642

Ramirez, I., Tarzia, M., Dias, M. P., Burfield, I. J., Ramos, J. A., Garthe, S., et al. (2017). How well is the EU protecting its seabirds? Progress in implementing the Birds Directive at sea. *Mar. Policy* 81, 179–184.

Rodríguez, J., Keith, D., Rodríguez-Clark, K., Murray, N., Nicholson, E., Regan, T., et al. (2015). A practical guide to the application of the IUCN Red List of Ecosystems criteria. *Philos. Trans. R Soc. Lond. B Biol. Sci.* 370:20140003. doi: 10.1098/rstb.2014.0003

UN General Assembly (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development, 21 October 2015, A/RES/70/1*. Available online at: https://www.refworld.org/docid/57b6e3e44.html (accessed September 24, 2021).

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