

**Title: Global Tracking of Marine Megafauna Space Use Reveals How to  
Achieve Conservation Targets**

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684

685 **Abstract:** The recent Kunming-Montreal Global Biodiversity Framework (GBF) sets ambitious  
686 goals, but no clear pathway for how zero loss of important biodiversity areas and halting human-  
687 induced extinction of threatened species will be achieved. We assembled a multi-taxa tracking  
688 dataset (11 million geopositions from 15,845 tracked individuals across 121 species) to provide a  
689 global assessment of space use of highly mobile marine megafauna, showing that 63% of the  
690 area they cover is used 80% of the time as important migratory corridors or residence areas. The  
691 GBF 30% threshold (Target 3) will be insufficient for marine megafauna’s effective conservation  
692 leaving important areas exposed to major anthropogenic threats. Coupling area protection with  
693 mitigation strategies (e.g., fishing regulation, wildlife-traffic separation) will be essential to reach  
694 international goals and conserve biodiversity.

695 **One-Sentence Summary:** We provide a basis to design a global network of marine protected  
696 areas to conserve marine megafauna biodiversity.

697

698 **Main Text:**

699 Together with the recently finalised United Nations High Seas Treaty (1, 2), the Kunming-  
700 Montreal Global Biodiversity Framework (GBF) (3, 4) seeks to protect, conserve and manage at  
701 least 30% of oceans. This is a necessary step to support halting the loss of marine biodiversity  
702 (GBF Target 3), which has been particularly acute for large marine species (5-7). These include  
703 several iconic large marine vertebrates that have been driven to extinction by overexploitation  
704 (e.g., the Steller’s sea cow – *Hydrodamalis gigas*, the great auk – *Pinguinus impennis*, and the  
705 Japanese sea lion – *Zalophus japonicus*), and many others currently showing precipitous declines  
706 in abundance (e.g., the hawksbill turtle – *Eretmochelys imbricata*, shortfin mako shark – *Isurus*  
707 *oxyrinchus* and North Atlantic right whale – *Eubalaena glacialis*). These mobile and highly  
708 migratory marine vertebrates, hereafter marine megafauna, can act as ecosystem and climate  
709 sentinels (8; *being good surrogates for other biodiversity*) and hold key functional roles that  
710 assist in structuring and maintaining ecosystems (9-11). However, close to a third of species  
711 across marine megafauna taxa are now threatened with extinction (5, 12-18).

712 Certain characteristics of marine megafauna, such as *K*-selected life history traits, place them at  
713 priority for systematic conservation planning (i.e., high vulnerability and high irreplaceability;  
714 19), and make the ‘effective conservation’ outlined in GBF Target 3 urgently needed. Many also  
715 migrate 1000s of km crossing multiple exclusive economic zones (EEZs) and areas beyond  
716 national jurisdictions (ABNJ) presenting a challenge for area-based conservation approaches  
717 (20). Importantly, such approaches are traditionally based on known geographical ranges  
718 reflecting historically known boundaries (18) or static maps of occurrence (21). However,  
719 devising a management plan that effectively conserves migratory species within Ecologically  
720 and Biologically Significant Areas (22) requires an understanding of how the species use space.  
721 Particularly, detecting important marine megafauna areas used for key life-history events, such  
722 as breeding or feeding and migratory behaviours, henceforth IMMegAs (to use a term similar to  
723 those recognised by IUCN, such as IMMA – Important Marine Mammal Areas or ISRA –  
724 Important Shark and Ray Areas) are only tractable using telemetry data (20, 23-27). Despite the  
725 challenges associated with collating such data at global scale (28), the detection of global  
726 IMMegAs is essential to understand marine megafauna conservation needs to inform global  
727 treaties, and should therefore be prioritised for creating the network of marine protected areas  
728 aimed by GBF (i.e., the planned increase to 30% of area protection).

729 ***Using telemetry data to understand global space-use by marine***  
730 ***megafauna***

731 We assembled a telemetry dataset unparalleled in size and scope (as the result of a global effort  
732 initiated by the MegaMove project; 29) by accepting voluntary contributions of tracking data of  
733 highly mobile marine vertebrates - here referred to as marine megafauna, despite some  
734 (particularly flying birds) being under the 45 Kg threshold (10). Our dataset encompasses over  
735 three decades of tracked movements (1985 – 2018) from 15,845 individuals across 121 species,  
736 which after curation (30), resulted in 12,794 individual tracks from 111 species, covering 71.7 %  
737 of the area of the world’s oceans (Fig. 1). Species include flying birds (hereafter birds), cetaceans  
738 (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus*  
739 *maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles. See fig. S1 for latitudinal  
740 and longitudinal coverage of the dataset, and tables S1-S3, respectively, for lists of species  
741 tracked, tracking data details, and species-specific information. According to global assessments

742 by the International Union for the Conservation of Nature (IUCN; 18), of the 111 species  
743 considered, ~ 70% have decreasing (54 species) or unknown (23 species) population trends, and  
744 more than 50% (58 species) have a threatened conservation status of Critically Endangered (CR),  
745 Endangered (EN), or Vulnerable (VU) (table S4).

746 Five main regions exhibited the highest effective number of tracked species (as calculated based  
747 on the Shannon entropy; 31): the central Indian Ocean, northeast Pacific, Atlantic northeast and  
748 northwest, and around Mozambique/South Africa. A few other locations empirically known as  
749 having high animal occurrence also showed high number of species (fig. S2). Areas where more  
750 tracking data could be made available include southeast Asia, north of Europe (e.g., Spitsbergen  
751 and Greenland), Australia, central Pacific Ocean, and western Africa (particularly the southwest  
752 Atlantic and Gulf of Guinea) (Fig. 1, fig. S2).

753 Using properties of the movement detected in the tracking dataset, including speed, direction and  
754 movement coherence (30) (fig. S12-S13), we identified IMMegAs based on key behaviours  
755 reflected in residency or migratory (including nomadic or dispersive) behaviour. We did this by  
756 using an approach (30) able to evaluate these behaviours collectively across multiple tracks  
757 without relying on interpolation across highly variable sampling intervals. This is not possible  
758 with the traditionally used state-space models that are typically designed to detect behavioural  
759 states on single tracks after interpolating position estimates (e.g., 32).

760 We then assessed how much of the IMMegAs occurred within existing marine protected areas  
761 (MPA, including marine parks; 33) or exclusive economic zones (EEZs; 34) (shown in fig. S3).  
762 We used an optimization algorithm to estimate what configuration of the area covered by our  
763 tracking dataset would yield the best selection for setting protected areas for marine megafauna,  
764 giving priority to grid-cells that are used for both residency and migratory behaviours across  
765 multiple taxa (30). For comparison, we repeated this procedure after developing statistical  
766 models to predict areas likely to be used for residency or migration for each taxon within the  
767 areas covered by our tracking dataset (30). For data used as input for the models see Table 2.  
768 After this modelling procedure, we considered the priority grid-cells as those resulting in highest  
769 probabilities (i.e., >0.5 and closest to 1) of being an important area across taxa.

770 Finally, we assessed the extent to which the GBF's planned increase to 30% in area protection  
771 could assist with reducing impacts from marine megafauna's exposure to anthropogenic threats  
772 with a global footprint (35), such as fishing (36-38), shipping (39-41), warming (42-45), plastic  
773 (46, 47) and noise pollution (48, 49). We identified these as threats based on the IUCN Threats  
774 Classification Scheme (TCS) v3.3 (50) complemented with information from existing literature  
775 (12, 51-53) and expert knowledge (fig. S4, and see table S4 for details). We then obtained  
776 available global threat data for fishing intensity (54), shipping density (55), plastic density (46,  
777 56), and warming (57, 58), and considered noise to be ubiquitous (based on 59) as no noise  
778 dataset is currently available at the resolution needed for a global analyses (but see e.g., 60).

779 Known biases (61-63) associated with uneven sampling and with tagging individuals in known  
780 aggregations or colonies were reduced in our analyses as far as possible by using multiple  
781 tagging sites for each species and, where applicable, by normalising data to allow for direct  
782 comparisons across species and taxa. From specific tests to assess the influence of (i) tagging  
783 location bias, (ii) temporal resolution of tracking data (i.e., including only one location per  
784 individual per day, in addition to all locations detected), and (iii) spatial resolution (i.e., repeating  
785 all procedures at 0.5°, 1° and 2° grid-cells), we found that these potential confounding factors

786 had negligible effects on our main conclusions (fig. S5 – S8). Finally, randomisation of tracks  
787 confirmed animals are selectively using space for important behaviours (fig. S14).

788

789 ***Detected ecologically important areas for marine megafauna and extent***  
790 ***of existing threats***

791 We found that, on average, 66.1% of the total area covered by our tracking data was used as  
792 migratory corridors (50%) or residencies (44.8%) (Fig. 2A), with ~29% used for both behaviours  
793 (30); noting that for sirenians, data were insufficient to detect migratory behaviours (fig. S9).  
794 Animals spent on average 90% of their tracked time (estimated using one position per day)  
795 within areas where we detected these behaviours (Fig. 2B). Most of this time (~80%) was spent  
796 in areas used for residency (or both residency and migration) (fig. S10), with considerable  
797 overlap across both behaviours.

798 On average, only 7.5% of the entire area covered by our tracking dataset occurred inside MPAs  
799 (which currently cover ~8% of the global ocean), with ~5% corresponding to areas of detected  
800 residency or migratory behaviours (Fig. 2). Similarly, animals spent a greater amount of time  
801 outside, than inside, MPAs (on average >85%). The time spent inside MPAs corresponded, on  
802 average, to 13.6% of all time animals spent displaying residency or migratory behaviours  
803 (ranging between 0.3% for polar bears and 23.9% for penguins) (Fig. 2). The results indicate  
804 limited opportunity for significant conservation of marine megafauna within the current extent of  
805 global MPAs, which were mainly designed to protect specific habitats rather than threatened  
806 mobile marine megafauna. However, conservation efforts could be considerably improved in the  
807 future by specifically including IMMegAs in new MPA placement.

808 All space-use and identified residency and migratory behaviours occurred with a ~40-60% split  
809 respectively between EEZs and the high seas (which respectively cover 41.3% and 58.7% of the  
810 oceans) (Fig. 2). Similar split of space-use between EEZ and high seas was obtained across each  
811 taxa, with clear exceptions for sirenians and polar bears (for which most movements occurred  
812 inside EEZs). Despite this pattern of space-use slightly biased towards the high seas, most time  
813 (on average 74.1 %, of which 67.1% corresponded to detected migration or residency) was spent  
814 inside, rather than outside, EEZs, and ranged from 61.5 % for flying birds to 90.2% for cetaceans  
815 (Fig. 2). Although protection of high seas IMMegAs is urgently needed, the large proportion of  
816 time animals spend conducting important behaviours within EEZs suggests that an initial focus  
817 on enhancing protection within EEZs could provide the fastest benefits for marine megafauna  
818 conservation, particularly because implementation may be easier.

819 To identify what areas could be prioritised for protection, we used an optimisation algorithm (fig.  
820 S15 – S16) to select a total of 30% of the 71.7% area covered by our tracking dataset (i.e., 21.3%  
821 of the global ocean; Fig. 3). We did this because our tracking dataset does not cover the entire  
822 ocean, and also to allow for later additions of new protected areas if other IMMegAs are  
823 identified once new tracking data are available. The optimisation algorithm aims to highlight  
824 which areas could provide higher representativeness of IMMegAs, but also to indicate where the  
825 additional protected areas could be complementary to existing MPAs (sensu 19), which currently  
826 fail to represent marine megafauna space-use (25; Fig. 3). Our results show that 30% area  
827 protection allows coverage of only less than half of the IMMegAs we discovered (41.6% and  
828 38.8%, respectively, based on data and model predictions; fig. S17) , leaving ~60% unprotected  
829 (58.4%, and 61.2% based on data and model predictions, respectively) (Fig. 3).

830 Our complemented IUCN Threats Classification Scheme(50) (table S4) showed that commercial  
831 fishing and climate change affect more than 80% of the species included in our dataset (fig. S4).  
832 Shipping has impacts on species across all taxa, including all turtles, sirenians, polar bears, most  
833 species of cetaceans considered, plus five birds, four fishes, five seals, and one penguin. Plastic  
834 pollution is a threat for all turtles and seals (but not yet listed on IUCN for leopard seals –  
835 *Hydrurga leptonyx*), most cetaceans, and ~35% of birds. Some fishes are also listed as  
836 potentially being affected by this threat including two manta rays and five sharks. Noise is listed  
837 as affecting all cetaceans, some seals, both sirenians, and also the polar bear, but for the latter  
838 this is likely due to potential disturbance of maternal dens on land.

839 Overlaying the identified (and predicted) areas used by marine megafauna for migration or  
840 residency behaviours at a global scale with each of the major global anthropogenic threats  
841 considered here (fig. S11), we found that > 96% of IMMegAs are exposed to plastic pollution,  
842 shipping and warming, and ~75% to fishing. This exposure includes overlaps within the areas of  
843 highest pressure observed for most threats, for example, in the North Atlantic, where we detected  
844 important areas for birds, cetaceans, fishes and turtles (Fig. 2 and fig. S9).

845

846 ***Mitigation strategies will be needed in addition to the proposed increase***  
847 ***in area protection to safeguard marine megafauna***

848 Our results reveal that the 30% threshold is insufficient to encompass all IMMegAs globally  
849 (Fig. 3), leaving significant conservation risks for marine megafauna. Considering the ubiquity  
850 of existing threats, which are pervasive in the IMMegAs we detected (Fig. 3, fig. S11), and the  
851 limited scope of the 30% GBF target for area protection, attaining the goal of zero loss of  
852 important biodiversity areas and halting human-induced mortality of threatened species seems  
853 unlikely (noting some management measures already in place for some species, table S5).  
854 Shipping and fishing can in part be alleviated by increasing MPAs (particularly if the highest  
855 level of protection is afforded; 64), which can also help reduce noise pollution. However, plastic  
856 pollution or climate change impacts will not be alleviated with the planned increase in area  
857 protection (even if MPAs can assist improving species resistance and resilience; 65). Therefore,  
858 attaining the goal of zero loss of important biodiversity areas will need further action to mitigate  
859 anthropogenic pressures.

860 To reduce exposure of marine megafauna to existing threats and achieve the goals set out in the  
861 GBF, the introduction of additional forms of ocean management will be needed, including  
862 greater scrutiny of practices and additional direct management decisions with increased  
863 enforcement. For example, direct mortality can be reduced by applying fishing thresholds and  
864 enforcing standards in fishing operations (including modifications to gear) (66-70), and by  
865 developing wildlife-ship traffic separation schemes and slow-down areas (71, 72) (e.g., to 2.16  
866 Knots; 73). If applied in tandem with the increase in protected areas, such interventions will  
867 afford marine megafauna a much greater spatial protection from the major threats of  
868 industrialised fishing (23) and shipping (41) known to cause direct mortality (Table 1).

869 Our analyses show that animals spend the majority of their time within jurisdictions, which  
870 presents an opportunity for marine megafauna conservation because individual countries regulate  
871 and control most operations within their borders and are therefore able to implement mitigation  
872 measures to manage species that use their EEZs. Management of IMMegAs in the high seas,  
873 outside national jurisdictions, would benefit from better integration into the United Nations

874 Convention for the Law of the Sea (UNCLOS), and should be considered in the ongoing process  
875 to better regulate biological resources in the high seas (1, 2). For shipping threats specifically,  
876 International Maritime Organisation regulations can reduce impacts and propel conservation  
877 success. For example, the double hull policy resulted in an average reduction of up to 62% in the  
878 size of oil spills (74). Engaging (and better regulating) the private sector is another timely way to  
879 advance conservation (e.g., 75), as environmental damage is increasingly recognised as a threat  
880 to financial stability (75, 76). Past management decisions, either involving the private sector  
881 (e.g., end of the whaling industry following the moratorium by the International Convention for  
882 Regulation on Whaling; 77) or by listing species on CITES (Convention on International Trade  
883 in Endangered Species; 78) have demonstrated success by leading to populations' recovery.  
884 However, the drivers of contrasting trajectories of similar populations or species (e.g., right  
885 whales increase in the Southern Ocean *versus* decrease in the North Atlantic) are not well  
886 understood and likely relate to different exposure to anthropogenic threats.

887 Creating a larger network of marine protected areas will also greatly benefit from following a  
888 systematic conservation planning framework. Although our aim was to identify IMMegAs  
889 (rather than outlining what the final 30% of area protection should look like), we followed the  
890 initial necessary steps of that framework, including: (i) using marine megafauna biodiversity data  
891 (as surrogate for marine biodiversity), (ii) using the set targets from the GBF and UN High Seas  
892 Treaty as goal, (iii) focusing on complementing existing MPAs, and (iv) selecting IMMegAs for  
893 potential inclusion as MPAs. We then provide a scenario for up to 30% extension of MPAs to  
894 show that even if all areas selected specifically included IMMegAs, the 30% protection would  
895 still be insufficient to reach set targets, and other mitigation measures will be needed. To follow  
896 a systematic conservation planning approach, the final selection of protected areas should also  
897 take into consideration aspects not considered here, such as ecosystems of high ecological  
898 significance or habitat types that are not yet well represented, as well as considerations of equity  
899 and principles of environmental justice (79). It is, however, likely that the final selection of areas  
900 for protection will end up being designed to minimise impacts to stakeholders (including the  
901 fishing, shipping, energy production and tourism industries). Such possible result further  
902 reinforces our conclusion that relying on the 30% area protection will be insufficient to reach the  
903 goal of zero loss of important biodiversity areas and halt human-induced mortality of threatened  
904 species, and that additional mitigation measures are needed before it is too late.

905 The work we provide here shows the power of assembling tracking datasets to answer pressing  
906 conservation concerns. The continued expansion of MegaMove through voluntary contributions  
907 will foster greater collaborations allowing to fill data gaps and further reduce biases. Whereas  
908 our tracking data covers about 71% of ocean space, the tagging effort was neither random nor  
909 uniform in space and time, and 29% of the ocean space was not covered by our dataset  
910 (including the central and northwest Pacific ocean). We suggest that statistical models using  
911 existing tracking data as input could be used to develop refined global species distributions  
912 taking into account animal movements associated with short-term changes in environmental  
913 parameters to project the likelihood of encountering animals in areas underexplored by telemetry  
914 or bio-logging (80-82).

915 We also recognise that the available threat distribution data we used here are incomplete and do  
916 not include, for example, illegal or artisanal fishing fleets, nor discrimination across fishing gear  
917 (which affects species differently). This means that a more detailed spatio-temporal analysis of  
918 exposure to threats, as well as an assessment of the vulnerability of different species to specific  
919 threats, is required to quantify their potential impacts on species' life-history characteristics.

920 Consideration of the phylogenetic diversity of marine megafauna by examining evolutionary  
921 drivers could also be relevant to improve spatial maps. Nevertheless, the IMMegAs we have  
922 identified are key to inform the expansion of existing MPAs to reach the 30% target both within  
923 EEZs and in the High Seas.  
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926

## References and Notes

927

1. Editorial, How science can help fill gaps in the high seas treaty. *Nature* **615**, 373-374 (2023).

928

2. United Nations - Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction, <https://www.un.org/bbnj>.

929

3. G. Wright, J. Rochette, K. Gjerde, I. Seeger, "The long and winding road: negotiating a treaty for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction," *IDDRI Studies N°08/18* 82 p. (2018).

932

4. UN Convention on Biological Diversity, 15th Conference of Parties (COP15). <https://www.cbd.int/cop>, (2022).

933

5. D. J. McCauley *et al.*, Marine defaunation: Animal loss in the global ocean. *Science* **347**, 1255641:1255647 (2015).

934

6. C. M. Duarte *et al.*, Rebuilding marine life. *Nature* **580**, 39-51 (2020).

935

7. C. Pimiento *et al.*, Functional diversity of marine megafauna in the Anthropocene. *Sci Adv* **6**, (2020).

936

8. E. L. Hazen *et al.*, Marine top predators as climate and ecosystem sentinels. *Frontiers in Ecology and Environment* **17**, 565-574 (2019).

937

9. T. B. Atwood *et al.*, Predators help protect carbon stocks in blue carbon ecosystems. *Nature Climate Change* **5**, 1038–1045 (2015).

938

10. J. A. Estes, M. Heithaus, D. J. McCauley, D. B. Rasher, B. Worm, Megafaunal impacts on structure and function of ocean ecosystems. *Annu Rev Env Resour* **41**, 83-116 (2016).

939

11. J. Roman *et al.*, Whales as marine ecosystem engineers. *Front Ecol Environ* **12**, 377-385 (2014).

940

12. M. P. Dias *et al.*, Threats to seabirds: A global assessment. *Biological Conservation* **237**, 525-537 (2019).

941

13. G. T. Braulik *et al.*, Red-list status and extinction risk of the world's whales, dolphins, and porpoises. *Conservation Biology* **37**, (2023).

942

14. N. K. Dulvy *et al.*, Overfishing drives over one-third of all sharks and rays toward a global extinction crisis (vol 31, pg 4773, 2021). *Current Biology* **31**, 5118-5119 (2021).

943

15. M. J. Juan-Jordá, I. Mosqueira, A. B. Cooper, J. Freire, N. K. Dulvy, Global population trajectories of tunas and their relatives. *P Natl Acad Sci USA* **108**, 20650-20655 (2011).

944

16. A. D. Mazaris, G. Schofield, C. Gkazinou, V. Almpanidou, G. C. Hays, Global sea turtle conservation successes. *Sci Adv* **3**, (2017).

945

17. W. J. Ripple *et al.*, Are we eating the world's megafauna to extinction? *Conservation Letters* **12**, e12627 (2019).

946

18. International Union for Conservation of Nature, The IUCN red list of threatened species. <https://www.iucnredlist.org/en>.

947

19. C. R. Margules, R. L. Pressey, Systematic conservation planning. *Nature* **405**, 243-253 (2000).

948

20. A. L. Harrison *et al.*, The political biogeography of migratory marine predators. *Nature Ecology & Evolution* **2**, 1571-1578 (2018).

949

21. AquaMaps, Standardised distribution maps for fishes, marine mammals and invertebrates. <https://aquamaps.org/>.

950

- 969 22. D. C. Dunn *et al.*, The Convention on Biological Diversity's Ecologically or Biologically  
970 Significant Areas: origins, development, and current status. *Marine Policy* **49**, 137-145  
971 (2014).
- 972 23. N. Queiroz *et al.*, Global spatial risk assessment of sharks under the footprint of fisheries.  
973 *Nature* **572**, 461-466 (2019).
- 974 24. M. Beal *et al.*, Global political responsibility for the conservation of albatrosses and large  
975 petrels. *Sci Adv* **7**, (2021).
- 976 25. M. G. Conners *et al.*, Mismatches in scale between highly mobile marine megafauna and  
977 marine protected areas. *Frontiers in Marine Science* **9**, 897104 (2022).
- 978 26. C. Johnson *et al.*, "Protecting Blue Corridors, Challenges and Solutions for Migratory  
979 Whales Navigating International and National Seas," (WWF International, Switzerland,  
980 2022).
- 981 27. N. E. Hussey *et al.*, Aquatic animal telemetry: A panoramic window into the underwater  
982 world. *Science* **348**, 1255642 (2015).
- 983 28. A. M. M. Sequeira *et al.*, A standardisation framework for bio-logging data to advance  
984 ecological research and conservation. *Methods in Ecology and Evolution* **12**, 996-1007  
985 (2021).
- 986 29. Marine Megafauna Movement Global Initiative, MegaMove. <https://www.megamove.org>.  
987 30. Materials and methods, Available as supplementary materials.
- 988 31. C. E. Shannon, A Mathematical Theory of Communication. *Bell Syst Tech J* **27**, 379-423  
989 (1948).
- 990 32. T. Patterson, L. Thomas, C. Wilcox, O. Ovaskainen, J. Matthiopoulos, State-space  
991 models of individual animal movements. *Trends in Ecology and Evolution* **23**, 87-94  
992 (2008).
- 993 33. UNEP-WCMC and IUCN, U.-W. a. IUCN, Ed. ( Available at: [www.protectedplanet.net](http://www.protectedplanet.net),  
994 Cambridge, UK, 2021).
- 995 34. Flanders Marine Institute. (Available online at <https://www.marineregions.org/>.  
996 <https://doi.org/10.14284/382>, 2019).
- 997 35. A. M. M. Sequeira *et al.*, Overhauling Ocean Spatial Planning to Improve Marine  
998 Megafauna Conservation. *Frontiers in Marine Science* **6**, 639 (2019).
- 999 36. B. Worm, D. P. Tittensor, Range contraction in large pelagic predators. *Proceedings of*  
1000 *the National Academy of Sciences* **108**, 11942-11947 (2011).
- 1001 37. R. L. Lewison *et al.*, Global patterns of marine mammal, seabird, and sea turtle bycatch  
1002 reveal taxa-specific and cumulative megafauna hotspots. *Proceedings of the National*  
1003 *Academy of Sciences* **111**, 5271–5276 (2014).
- 1004 38. T. A. Clay, S. Opper, J. L. Lavers, R. A. Phillips, M. d. L. Brooke, Divergent foraging  
1005 strategies during incubation of an unusually wide-ranging seabird, the Murphy's petrel.  
1006 *Marine Biology* **166**, 8 (2019).
- 1007 39. J. M. Aschettino *et al.*, Satellite Telemetry Reveals Spatial Overlap Between Vessel  
1008 High-Traffic Areas and Humpback Whales (*Megaptera novaeangliae*) Near the Mouth of  
1009 the Chesapeake Bay. *Frontiers in Marine Science* **7**, (2020).
- 1010 40. M. F. McKenna, J. Calambokidis, E. M. Oleson, D. W. Laist, J. A. Goldbogen,  
1011 Simultaneous tracking of blue whales and large ships demonstrates limited behavioral  
1012 responses for avoiding collision. *Endangered Species Research* **27**, 219-232 (2015).
- 1013 41. F. C. Womersley *et al.*, Global collision-risk hotspots of marine traffic and the world's  
1014 largest fish, the whale shark. *Proceedings of the National Academy of Sciences USA* **119**,  
1015 e2117440119 (2022).

- 1016 42. C. A. Bost *et al.*, Large-scale climatic anomalies affect marine predator foraging  
1017 behaviour and demography. *Nature Communications* **6**, (2015).
- 1018 43. L. A. Rutterford *et al.*, Future fish distributions constrained by depth in warming seas.  
1019 *Nature Climate Change* **5**, 569-574 (2015).
- 1020 44. A. M. M. Sequeira, C. Mellin, D. A. Fordham, M. G. Meekan, C. J. A. Bradshaw,  
1021 Predicting current and future global distributions of whale sharks. *Global Change*  
1022 *Biology* **20**, 778–789 (2014).
- 1023 45. E. L. Hazen *et al.*, Predicted habitat shifts of Pacific top predators in a changing climate.  
1024 *Nature Climate Change* **3**, 234-238 (2013).
- 1025 46. M. Eriksen *et al.*, Plastic pollution in the world’s oceans: more than 5 trillion plastic  
1026 pieces weighing over 250,000 tons afloat at sea. *PLoS ONE* **9**, e111913 (2014).
- 1027 47. M. R. Gregory, Environmental implications of plastic debris in marine settings—  
1028 entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. *Phil.*  
1029 *Trans. R. Soc. B* **364**, 2013-2025 (2009).
- 1030 48. S. E. Nelms, W. E. D. Piniak, C. R. Weir, B. J. Godley, Seismic surveys and marine  
1031 turtles: An underestimated global threat? *Biological Conservation* **193**, 49-65 (2016).
- 1032 49. J. C. D. Gordon *et al.*, Review of the effects of seismic survey on marine mammals.  
1033 *Marine Technology Society Journal* **37**, 14-32 (2004).
- 1034 50. International Union for Conservation of Nature, I. U. f. C. o. Nature, Ed.  
1035 (<https://www.iucnredlist.org>, [https://www.iucnredlist.org/resources/threat-classification-](https://www.iucnredlist.org/resources/threat-classification-scheme)  
1036 [scheme](https://www.iucnredlist.org/resources/threat-classification-scheme), 2023).
- 1037 51. I. C. Avila, K. Kaschner, C. F. Dormann, Current global risks to marine mammals:  
1038 Taking stock of the threats. *Biological Conservation* **221**, 44-58 (2018).
- 1039 52. B. Würsig, W. F. Perrin, J. G. M. Thewissen, *Encyclopedia of marine mammals*.  
1040 (Academic Press, 2009).
- 1041 53. B. P. Wallace *et al.*, Impacts of fisheries bycatch on marine turtle populations worldwide:  
1042 toward conservation and research priorities. *Ecosphere* **4**, (2013).
- 1043 54. Global Fishing Watch, <https://www.globalfishingwatch.org>.
- 1044 55. Marine AIS Data, <https://www.exactearth.com>.
- 1045 56. E. van Sebille *et al.*, A global inventory of small floating plastic debris. *Environ Res Lett*  
1046 **10**, (2015).
- 1047 57. J. Hansen, R. Ruedy, M. Sato, K. Lo, Global surface temperature change. *Reviews in*  
1048 *Geophysics* **48**, 1-29 (2010).
- 1049 58. NASA Goddard Institute for Space Studies, GISS Surface Temperature Analysis  
1050 (GISTEMP). <https://data.giss.nasa.gov/gist>, (2021).
- 1051 59. C. M. Duarte *et al.*, The soundscape of the Anthropocene ocean. *Science* **371**, 583-+  
1052 (2021).
- 1053 60. The UK Acoustics Network, [https://acoustics.ac.uk/open-access-underwateracoustics-](https://acoustics.ac.uk/open-access-underwateracoustics-data/)  
1054 [data/](https://acoustics.ac.uk/open-access-underwateracoustics-data/).
- 1055 61. B. A. Block *et al.*, Tracking apex marine predator movements in a dynamic ocean.  
1056 *Nature* **475**, 86-90 (2011).
- 1057 62. N. Queiroz *et al.*, Global spatial risk assessment of sharks under the footprint of fisheries.  
1058 *Nature* **572**, 461-466 (2019).
- 1059 63. M. O’Toole, N. Queiroz, N. E. Humphries, D. W. Sims, A. M. M. Sequeira, Quantifying  
1060 effects of tracking data bias on species distribution models. *Methods in Ecology and*  
1061 *Evolution* **12**, 170–181 (2020).
- 1062 64. K. Grorud-Colvert *et al.*, The MPA Guide: A framework to achieve global goals for the  
1063 ocean. *Science* **373**, (2021).

- 1064 65. C. M. Roberts *et al.*, Marine reserves can mitigate and promote adaptation to climate  
1065 change. *P Natl Acad Sci USA* **114**, 6167-6175 (2017).
- 1066 66. A. C. Godin, J. K. Carlson, V. Burgener, The Effect of Circle Hooks on Shark  
1067 Catchability and At-Vessel Mortality Rates in Longlines Fisheries. *Bulletin of Marine*  
1068 *Science* **88**, 469-483 (2012).
- 1069 67. E. Gilman *et al.*, Reducing sea turtle interactions in the Hawaii-based longline swordfish  
1070 fishery. *Biological Conservation* **139**, 19-28 (2007).
- 1071 68. G. Sales *et al.*, Circle hook effectiveness for the mitigation of sea turtle bycatch and  
1072 capture of target species in a Brazilian pelagic longline fishery. *Aquatic Conservation:*  
1073 *Marine and Freshwater ecosystems* **20**, 428-436 (2010).
- 1074 69. S. D. Goldsworthy *et al.*, Assessment of Australian sea lion bycatch mortality in a gillnet  
1075 fishery, and implementation and evaluation of an effective mitigation strategy. *Frontiers*  
1076 *in Marine Science*, 53 (2022).
- 1077 70. L. D. Jenkins, Reducing sea turtle bycatch in trawl nets: a history of NMFS turtle  
1078 excluder device (TED) research. *Marine Fisheries Review* **74**, 26-44 (2012).
- 1079 71. C. Chion *et al.*, A voluntary conservation agreement reduces the risks of lethal collisions  
1080 between ships and whales in the St. Lawrence Estuary (Quebec, Canada): From co-  
1081 construction to monitoring compliance and assessing effectiveness. *PLoS One* **13**,  
1082 e0202560 (2018).
- 1083 72. A. S. M. Vanderlann, C. T. Taggart, Vessel collisions with whales: the probability of  
1084 lethal injury based on vessel speed. *Marine Mammal Science* **23**, 144-156 (2007).
- 1085 73. J. Hazel, I. Lawler, R. , H. Marsh, S. Robson, Vessel speed increases collision risk for the  
1086 green turtle *Chelonia mydas*. *Endangered Species Research* **3**, 105-113 (2007).
- 1087 74. T. L. Yip, W. K. Talley, D. Jin, The effectiveness of double hulls in reducing vessel-  
1088 accident oil spillage. *Marine Pollution Bulletin* **62**, 2427-2432 (2011).
- 1089 75. A. M. M. Sequeira, U. R. Sumaila, A. A. Rogers, Ecosystem services “on the move” as a  
1090 nature-based solution for financing the Global Biodiversity Framework. *npj Ocean*  
1091 *Sustainability* **3**, 38 (2024).
- 1092 76. Insight Report In partnership with Marsh & McLennan and Zurich Insurance Group,  
1093 "World Economic Forum, The Global Risks Report," (2020).
- 1094 77. International Whaling Commission, in *ICRW Convention*, I. W. Commission, Ed.  
1095 (International Whaling Commission, 1946).
- 1096 78. CITES, C. o. t. Parties, Ed. (Conference of the Parties, Washington, 1973).
- 1097 79. M. S. Chapman *et al.*, Promoting equity in the use of algorithms for high-seas  
1098 conservation Comment. *One Earth* **4**, 790-794 (2021).
- 1099 80. G. Hays *et al.*, Translating marine animal tracking data into conservation policy and  
1100 management. *Trends in Ecology and Evolution* **34**, 459-473 (2019).
- 1101 81. M. A. Hindell *et al.*, Tracking of marine predators to protect Southern Ocean ecosystems.  
1102 *Nature* **580**, 87–92 (2020).
- 1103 82. A. M. M. Sequeira, Predators on track for ocean protection around Antarctica. *Nature*  
1104 **580**, 34-35 (2020).
- 1105 83. A. M. M. Sequeira, J. P. Rodriguez, Dryad: Global Tracking of Marine Megafauna  
1106 Space-Use Reveals How to Achieve Conservation Targets: v1.  
1107 <https://doi.org/10.5061/dryad.x95x69pty>. (2024).
- 1108 84. S. Jenouvrier *et al.*, Climate change and functional traits affect population dynamics of a  
1109 long-lived seabird. *Journal of Animal Ecology* **87**, 906-920 (2018).
- 1110 85. L. M. Martinez-Levasseur *et al.*, Acute sun damage and photoprotective responses in  
1111 whales. *Proceedings of the Royal Society B: Biological Sciences* **278**, 1581-1586 (2011).

- 1112 86. G. J. Osgood, E. R. White, J. K. Baum, Effects of climate-change-driven gradual and  
1113 acute temperature changes on shark and ray species. *Journal of Animal Ecology* **90**,  
1114 2547-2559 (2021).
- 1115 87. L. Kruger, M. F. Huerta, F. Santa Cruz, C. A. Cardenas, Antarctic krill fishery effects  
1116 over penguin populations under adverse climate conditions: Implications for the  
1117 management of fishing practices. *Ambio* **50**, 560-571 (2021).
- 1118 88. K. L. Laidre *et al.*, Range contraction and increasing isolation of a polar bear  
1119 subpopulation in an era of sea-ice loss. *Ecology & Evolution* **8**, 2062-2075 (2018).
- 1120 89. S. Volzke, C. R. McMahon, M. A. Hindell, H. R. Burton, S. J. Wotherspoon, Climate  
1121 influences on female survival in a declining population of southern elephant seals  
1122 (*Mirounga leonina*). *Ecology & Evolution* **11**, 11333-11344 (2021).
- 1123 90. R. Nowicki *et al.*, Indirect legacy effects of an extreme climatic event on a marine  
1124 megafaunal community. *Ecological Monographs*, e01365 (2019).
- 1125 91. M. P. Jensen *et al.*, Environmental warming and feminization of one of the largest sea  
1126 turtle populations in the world. *Current Biology* **28**, 154-159 e154 (2018).
- 1127 92. K. E. Pierce, R. J. Harris, L. S. Larned, M. A. Pokras, Obstruction and starvation  
1128 associated with plastic ingestion in a Northern gannet *Morus Bassanus* and a greater  
1129 shearwater *Puffinus Gravis*. *Marine Ornithology* **32**, 187-189 (2004).
- 1130 93. J. K. Jacobsen, L. Massey, F. Gulland, Fatal ingestion of floating net debris by two sperm  
1131 whales (*Physeter macrocephalus*). *Marine Pollution Bulletin* **60**, 765-767 (2010).
- 1132 94. E. S. Germanov, A. D. Marshall, L. Bejder, M. C. Fossi, N. R. Loneragan, Microplastics:  
1133 no small problem for filter-feeding megafauna. *Trends Ecol Evol* **33**, 227-232 (2018).
- 1134 95. M. L. Brandão, K. M. Braga, J. L. Luque, Marine debris ingestion by Magellanic  
1135 penguins, *Spheniscus magellanicus* (Aves: Sphenisciformes), from the Brazilian coastal  
1136 zone. *Marine Pollution Bulletin* **62**, 2246-2249 (2011).
- 1137 96. C. W. Fowler, Marine debris and Northern fur seals: A case study. *Marine Pollution*  
1138 *Bulletin* **18**, 326-335 (1987).
- 1139 97. F. L. N. Attademo *et al.*, Debris ingestion by the Antillean Manatee (*Trichechus manatus*  
1140 *manatus*). *Marine Pollution Bulletin* **101**, 284-287 (2015).
- 1141 98. C. Wilcox, M. Puckridge, Q. A. Schuyler, K. Townsend, B. D. Hardesty, A quantitative  
1142 analysis linking sea turtle mortality and plastic debris ingestion. *Sci Rep-Uk* **8**, (2018).
- 1143 99. P. Schwemmer, B. Mendel, N. Sonntag, V. Dierschke, S. Garthe, Effects of ship traffic  
1144 on seabirds in offshore waters: implications for marine conservation and spatial planning.  
1145 *Ecological Implications* **21**, 1851-1860 (2011).
- 1146 100. L. Pichegru *et al.*, Maritime traffic trends around the southern tip of Africa – Did marine  
1147 noise pollution contribute to the local penguins' collapse? *Sci Total Environ* **849**, 157878  
1148 (2022).
- 1149 101. D. D. W. Hauser, K. L. Laidre, H. L. Stern, Vulnerability of Arctic marine mammals to  
1150 vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route.  
1151 *Proceedings of the National Academy of Sciences USA* **115**, 7617-7622 (2018).
- 1152 102. J. K. Olson *et al.*, Trends in propeller strike-induced mortality in Harbor seals (*Phoca*  
1153 *vitulina*) of the Salish Sea. *Journal of Wildlife Distribution* **57**, 689-693 (2021).
- 1154 103. S. Aipanjiguly, S. K. Jacobson, R. Flamm, Conserving Manatees: Knowledge, Attitudes,  
1155 and Intentions of Boaters in Tampa Bay, Florida. *Conservation Biology* **17**, 1098-1105  
1156 (2003).
- 1157 104. J. Denkinger *et al.*, Are boat strikes a threat to sea turtles in the Galapagos Marine  
1158 Reserve? *Ocean & Coastal Management* **80**, 29-35 (2013).

- 1159 105. H. B. Blair, N. D. Merchant, A. S. Friedlaender, D. N. Wiley, S. E. Parks, Evidence for  
1160 ship noise impacts on humpback whale foraging behaviour. *Biology Letters* **12**, (2016).  
1161 106. R. R. Wilson, G. M. Durner, Seismic survey design and effects on maternal polar bear  
1162 dens (vol 84, pg 201, 2020). *Journal of Wildlife Management* **84**, 1022-1024 (2020).  
1163 107. E. L. Jones *et al.*, Seals and shipping: quantifying population risk and individual exposure  
1164 to vessel noise. *Journal of Applied Ecology* **54**, 1930-1940 (2017).  
1165 108. J. L. Miksis-Olds, P. L. Donaghay, J. H. Miller, P. L. Tyack, J. A. Nystuen, Noise level  
1166 correlates with manatee use of foraging habitats. *Journal of the Acoustic Society of*  
1167 *America* **121**, 3011-3020 (2007).  
1168 109. S. J. Allen *et al.*, Patterns of dolphin bycatch in a north-western Australian trawl fishery.  
1169 *PLoS One* **9**, e93178 (2014).  
1170 110. S. Curtis, S. H. Elwen, N. Dreyer, T. Gridley, Entanglement of Cape fur seals  
1171 (*Arctocephalus pusillus pusillus*) at colonies in central Namibia. *Marine Pollution*  
1172 *Bulletin* **171**, 112759 (2021).  
1173 111. A. Alvarez-Alemán *et al.*, Causes of Mortality for Endangered Antillean Manatees in  
1174 Cuba. *Frontiers in Marine Science* **8**, (2021).  
1175 112. S. Lisovski, S. Hahn, GeoLight-processing and analysing light-based geolocator data in  
1176 R. *Methods in Ecology and Evolution* **3**, 1055-1059 (2012).  
1177 113. R Core Team, R. F. f. S. Computing, Ed. (<https://www.R-project.org/>, Vienna, Austria,  
1178 2023).  
1179 114. K. A. Booth Jones *et al.*, Widespread gene flow between oceans in a pelagic seabird  
1180 species complex. *Molecular Ecology* **26**, 5716-5728 (2017).  
1181 115. M. A. C. Nicoll *et al.*, Contrasting effects of tropical cyclones on the annual survival of a  
1182 pelagic seabird in the Indian Ocean. *Global Change Biology* **23**, 550-565 (2017).  
1183 116. D. S. Johnson, J. M. London, M. A. Lea, J. W. Durban, Continuous-time correlated  
1184 random walk model for animal telemetry data. *Ecology* **89**, 1208-1215 (2008).  
1185 117. G. M. Durner *et al.*, Increased Arctic sea ice drift alters adult female polar bear  
1186 movements and energetics. *Global Change Biology* **23**, 3460-3473 (2017).  
1187 118. D. C. Douglas *et al.*, Moderating Argos location errors in animal tracking data. *Methods*  
1188 *in Ecology and Evolution* **3**, 999-1007 (2012).  
1189 119. K. L. Scales *et al.*, Scale of inference: on the sensitivity of habitat models for wide-  
1190 ranging marine predators to the resolution of environmental data. *Ecography* **40**, 210-220  
1191 (2017).  
1192 120. A. Sequeira *et al.*, Convergence of marine megafauna movement patterns in coastal and  
1193 open oceans. *Proc Natl Acad Sci U S A* **115**, 3072-3077 (2018).  
1194 121. T. Louail *et al.*, From mobile phone data to the spatial structure of cities. *Sci Rep-Uk* **4**,  
1195 (2014).  
1196 122. J. P. Rodríguez *et al.*, Big data analyses reveal patterns and drivers of the movements of  
1197 southern elephant seals. *Sci Rep-Uk* **7**, 1-10 (2017).  
1198 123. P. Jaccard, The distribution of the flora in the alpine zone 1. *The New Phytologist* **XI**,  
1199 (1912).  
1200 124. E.U. Copernicus Marine Service Information (CMEMS) Marine Data Store (MDS)  
1201 Global Ocean Physics Reanalysis. (DOI: 10.48670/moi-00021, accessed Dec 2020).  
1202 125. CMEMS Global Ocean Biology Hindcast replaced in July 2022 by the Global Ocean  
1203 Biogeochemistry Hindcast. (DOI: 10.48670/moi-00019, accessed Dec 2020).  
1204 126. NASA Ocean Biology Distributed Active Archive Center, NASA Ocean Biology  
1205 Processing Group Level-3 SeaWiifs (1998-2003) Ocean Color Data.  
1206 <https://oceandata.sci.gsfc.nasa.gov/opensap/SeaWiFS/L3SMI/>; accessed Dec 2020.

- 1207 127. NASA Ocean Biology Distributed Active Archive Center, NASA Ocean Biology  
1208 Processing Group Level-3 Modis-Aqua (2003-2018) Ocean Color Data.  
1209 <https://oceandata.sci.gsfc.nasa.gov/opensap/MODISA/L3SMI/contents.html>; accessed  
1210 Dec 2020.
- 1211 128. European Centre for Medium-Range Weather Forecasts (ECMWF), ERA-Interim  
1212 Reanalysis product. [https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-](https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-interim)  
1213 [interim](https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-interim); accessed Dec 2020.
- 1214 129. D. P. Dee *et al.*, The ERA-Interim reanalysis: configuration and performance of the data  
1215 assimilation system. *Q J Roy Meteor Soc* **137**, 553-597 (2011).
- 1216 130. K. P. Burnham, D. R. Anderson, Multimodel inference: understanding AIC and BIC in  
1217 model selection. *Sociological Methods & Research* **33**, 261-304 (2004).
- 1218 131. J. Cohen, A coefficient of agreement for nominal scales. *Educational and Psychological*  
1219 *Measurement* **20**, 37-46 (1960).
- 1220 132. J. R. Landis, G. G. Koch, The measurement of observer agreement for categorical data.  
1221 *Biometrics* **33**, 159-174 (1977).
- 1222 133. Commonwealth of Australia, "Recovery plan for marine turtles in Australia," *Australian*  
1223 *Government Department of the Environment and Energy* (Australian Government,  
1224 Australia, 2017).
- 1225 134. V. S. Karpouzi, R. Watson, D. Pauly, Modelling and mapping resource overlap between  
1226 seabirds and fisheries on a global scale: a preliminary assessment. *Marine Ecology*  
1227 *Progress Series* **343**, 87-99 (2007).
- 1228 135. C. N. Jenkins, K. S. Van Houtan, Global and regional priorities for marine biodiversity  
1229 protection. *Biological Conservation* **204**, 333-339 (2016).
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### 1735 **Supplementary Materials**

1736 The PDF includes:  
1737 Materials and Methods  
1738 Figs. S1 to S17  
1739 References (112-135)  
1740

1741 **Fig. 1. Tracked movements of marine megafauna at the global scale.**

1742 A) Map of the total number of 12,794 unique individual track locations in the global dataset at 1°  
1743 resolution showing the global coverage of 71.7% of the global ocean. B) Maps per taxon  
1744 showing the number of unique individual track locations within each 1° grid-cell. From top left  
1745 to bottom right, maps per taxon show 6324 individual tracks for 39 species of flying birds, 749  
1746 for cetaceans including 11 whales and 3 delphinid species, 1760 for fishes including 23 shark  
1747 species, 2 manta rays, and 1 ocean sunfish, 1324 for 6 species of penguins, 65 for polar bears,  
1748 1698 for 16 species of seals, 28 for sirenians including dugongs and West Indian manatees, and  
1749 846 for all 7 sea turtles. The latitudinal and longitudinal coverage of tracked data is displayed in  
1750 fig. S1. For reference, the first position obtained for each tracked individual (i.e., representing  
1751 tagging locations), as well as captured and expected global biodiversity are given in fig. S2.  
1752 Maps showing the spatial extent of space use per species at 1° resolution can be seen in the data  
1753 repository.  
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**Fig. 2. Global space-use of marine megafauna and time spent in different behaviours.**

Fractions of area (A) and time (B) used by animals globally (left plots), within and outside exclusive economic zones (EEZs) (middle plots), and within and outside existing marine protected areas (MPAs) (right plots), showing how much of the movements corresponded to detected migratory corridors or residency. Results are shown across all species together (top bar) and for each taxon (as displayed in legend). For each taxon, the light grey portion in the bars indicates movement where no behaviours were detected. Species in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles. C) Map of detected migratory corridors, residence areas and both corridors and residencies across taxa. Grey indicates grid-cells where tracking data were available but no specific behaviour was identified for any taxon. Light blue areas depict regions where we did not have tracking data. Maps of detected behaviours per taxon can be seen in fig. S9.

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1770 **Fig. 3. Increase in area protection to 30% will leave ~60% of IMMegAs exposed to major**  
1771 **anthropogenic threats.**

1772 A) Maps depicting average threat intensities for major anthropogenic threats with a global  
1773 footprint: (from top to bottom) fishing, shipping, plastic pollution and sea surface temperature  
1774 (SST) warming. Displayed with an orange colour palette are the threat intensities occurring  
1775 inside IMMegAs, while a grey colour palette is used to show the threat intensities outside  
1776 IMMegAs. Note that we considered noise to be ubiquitous, as no noise dataset is currently  
1777 available at the resolution needed for a global analyses. B) Maps showing how much the increase  
1778 in marine protected areas (MPAs) from the current 8% (purple) to 30% (green) would cover  
1779 from our prioritization of IMMegAs detected from movement data (top map) and from our  
1780 model predictions (bottom results). Note that coverage by MPAs only translates into protection  
1781 from the anthropogenic threats considered if they are designated with the highest level of  
1782 protection (i.e., with no activities allowed), and even then MPAs could only be effective for  
1783 protection from fishing and shipping, leaving plastic and warming threats to continue to affect  
1784 species. In addition to the increase in the current extent of MPAs, the introduction of mitigation  
1785 strategies will assist in reducing the impact of existing threats and therefore the likelihood of  
1786 human-induced extinctions.

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**Table 1. Evidence of impacts from overlap of marine megafauna with anthropogenic threats.** Examples of the range of impacts derived from the overlap of marine megafauna with anthropogenic threats such as climate warming, plastic pollution, shipping, noise pollution, and fishing. SST: sea surface temperature; UV: ultraviolet.

	<b>BIRDS (FLYING)</b>	<b>CETACEANS</b>	<b>FISHES</b>	<b>PENGUINS</b>	<b>POLAR BEAR</b>	<b>SEALS</b>	<b>SIRENIANS</b>	<b>TURTLES</b>
<b>CLIMATE</b>	<b>Decreased survival</b>	<b>UV damage</b>	<b>Habitat shift</b>	<b>Reduced prey</b>	<b>Habitat contraction</b>	<b>Habitat shift</b>	<b>Reduced food</b>	<b>Sex bias</b>
	Impacted survival & population growth rate of black-browed albatross juveniles with SST changes (84)	Increased skin lesions on whale related with increased UV irradiance (85)	Reduced counts of Scalloped hammerhead sharks <i>Sphyrna lewini</i> associated with rise in SST (86)	Decreased population size for penguin prey species with climate change (87)	Contraction of polar bear's habitat in the Arctic linked to long-term sea ice loss (88)	Decreased survival of southern elephant seal due to effects of sea ice dynamics on access to foraging (89)	Reduced dugong density by ~70% due to seagrass die-off triggered by an extreme heat wave (90)	Female-biased turtle populations linked to warming temperatures (91)
<b>PLASTIC</b>	<b>Ingestion</b>	<b>Ingestion</b>	<b>Ingestion</b>	<b>Ingestion</b>	-	<b>Entanglement</b>	<b>Ingestion</b>	<b>Ingestion</b>
	Death of shearwater and northern gannet due to plastic ingestion (92)	Stranded sperm whale stomachs with large amounts of plastic debris (93)	Threatened filter-feeding elasmobranchs by microplastic (94)	Plastic ingestion may have caused death (95)		Mortality of fur seals due to entanglement in marine debris (96)	Death of West Indian manatees from ingestion of plastic debris (97)	50% probability of mortality when turtles ingest pieces of plastic (98)
<b>SHIPPING</b>	<b>Habitat loss</b>	<b>Ship strike</b>	<b>Ship strike</b>	<b>Noise effects</b>	<b>Ship strike</b>	<b>Propeller strike</b>	<b>Ship strike</b>	<b>Ship strike</b>
	Habitat loss for Common Eider's avoiding shipping traffic (99)	Increased ship strikes with humpback whales in shipping lanes (39)	Mortality of whale sharks correlated with risk of collision with ships (41)	Population collapse concomitantly with increase in noise (100)	Increased vulnerability of polar bears to vessel strike (101)	Propeller strikes affect harbor seals (102)	Death of manatees due to boat collisions (103)	Decreased survival of green turtles due to boat strikes (104)
<b>NOISE</b>	-	<b>Behav. change</b>	-	-	<b>Disturbance</b>	<b>Physical damage</b>	<b>Behav. change</b>	-
		Change in humpback whales foraging activity due to ship noise (105)			Disturbance of maternal dens due to seismic surveys (106)	Temporary hearing loss of grey and harbor seals around the British Isles (107)	Reduced foraging habitat for manatees due to boat noise (108)	
<b>FISHING</b>	<b>By-catch</b>	<b>By-catch</b>	<b>Mortality</b>	<b>Reduced prey</b>	-	<b>Entanglement</b>	<b>Entanglement</b>	<b>By-catch</b>
	High bycatch of seabirds in longline fisheries (38)	Higher rates of dolphin bycatch in a trawl fishery (109)	Greater mortality of pelagic sharks where sharks have higher exposure to longline fisheries (62)	Decreased population size of prey species with increased fishing of Antarctic Krill (87)		Increased entanglement of Cape fur seals associated with fishing (110)	Manatee mortalities from entanglement in fishing gear (111)	High levels of turtle bycatch in fishing gear hotspots (37)

**Table 2. Summary of the logistic modelling inputs and results per taxon**

Results of the generalized linear models relating the probability of a grid-cell to be used as residence or for migratory behaviours with the set of environmental variables included in each model. Shown are the results for the highest ranked model according to the weight of the Akaike's Information Criteria (*wAIC*), as well as the number of parameters (*k*), the percentage of deviance explained (*pcdev*) and *Kappa*. Grey indicates the models not used to estimate the important marine megafauna areas (IMMegAs) derived from our modelling predictions (as presented in Fig. 3 and fig. S11). Species in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.

Taxon	Input			Results									
	Number of grid-cells with:			Residence Behaviour					Migratory Behaviour				
	Presence	Residency	Migration	Model	<i>k</i>	<i>wAIC</i>	<i>pcdev</i>	<i>Kappa</i>	Model	<i>k</i>	<i>wAIC</i>	<i>pcdev</i>	<i>Kappa</i>
<b>Birds</b>	35,875	13,448	9,128	2	19	1.000	4.13	0.22	2	19	1.000	11.19	0.33
<b>Cetaceans</b>	4,397	1,501	1,758	2	19	1.000	16.52	0.44	2	19	0.980	12.62	0.29
<b>Fishes</b>	15,648	4,346	4,252	2	19	1.000	14.44	0.38	2	19	1.000	12.56	0.30
<b>Penguins</b>	1,385	446	452	1	17	1.000	13.62	0.4	2	19	1.000	40.16	0.56
<b>Polar bear</b>	1,124	451	803	2	14	0.995	24.78	0.33	2	14	1.000	27.78	0.48
<b>Seals</b>	11,358	5,510	7,175	2	19	1.000	3.12	0.22	2	19	1.000	14.91	0.30
<b>Sirenians</b>	114	27	0	-	-	-	-	-	-	-	-	-	-
<b>Turtles</b>	10,360	3,462	3,370	3	7	1.000	7.71	0.28	2	19	1.000	5.18	0.17

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## Supplementary Materials for

### Global Tracking of Marine Megafauna Space Use Reveals How to Achieve Conservation Targets

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1843 Hamer<sup>164</sup>, Keith C. Hamer<sup>165</sup>, Neil Hammerschlag<sup>166,167</sup>, Mike O. Hammill<sup>168</sup>, Luke Harman<sup>57</sup>,  
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1845 Hazin<sup>65†</sup>, Matt Heard<sup>129,174</sup>, Alex R. Hearn<sup>39,175</sup>, Mads Peter Heide-Jørgensen<sup>176</sup>, Leeann Henry<sup>103</sup>,  
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1848 Hoyos Padilla<sup>187,188</sup>, Luis A. Huckstadt<sup>100,125</sup>, Robert E. Hueter<sup>92,146</sup>, Paulo H. Lara<sup>189</sup>, Nigel E.  
1849 Hussey<sup>190</sup>, Charlie Huveneers<sup>129</sup>, Kevin Hyland<sup>52</sup>, Dylan T. Irion<sup>191,192</sup>, David M. P. Jacoby<sup>193</sup>,  
1850 Audrey Jaeger<sup>194</sup>, Mohammed Y. Jaidah<sup>45</sup>, Mark Jessopp<sup>57,58</sup>, Oliver J. D. Jewell<sup>2,195</sup>, Ryan  
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1852 Akiko Kato<sup>33</sup>, James T. Ketchum<sup>39,187,200</sup>, Alexander S. Kitaysky<sup>201</sup>, A. Peter Klimley<sup>39,202</sup>, Alison  
1853 A. Kock<sup>115,203</sup>, Pieter Koen<sup>204,205</sup>, Felipe Ladino Archila<sup>64</sup>, Fernanda O. Lana<sup>65,206</sup>, Jude V. Lane<sup>207</sup>,  
1854 Matthieu Le Corre<sup>194</sup>, Mary-Anne Lea<sup>181,208,209</sup>, James Lea<sup>11,78</sup>, Eliza H. K. Leat<sup>210</sup>, Olivia A.  
1855 Lee<sup>211</sup>, J. Jacob Levenson<sup>108,172,212</sup>, César P. Ley-Quñonez<sup>213</sup>, Fiona Llewellyn<sup>214</sup>, Gwen  
1856 Lockhart<sup>215,216</sup>, Gustave G. Lopez<sup>217</sup>, Milagros Lopez Mendilaharsu<sup>189,218</sup>, Andrew D. Lowther<sup>28</sup>,  
1857 Paolo Luschi<sup>90</sup>, Molly E. Lutcavage<sup>219,220</sup>, Warrick S. Lyon<sup>221</sup>, Bruno C. L. Macena<sup>26,27,65</sup>, Alice I.  
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1859 Manning<sup>145†</sup>, Kate L. Mansfield<sup>224</sup>, David March<sup>125,225</sup>, Adolfo Marco<sup>226</sup>, Marianne Marcoux<sup>142</sup>,  
1860 David Acuña-Marrero<sup>227</sup>, Helene Marsh<sup>148</sup>, Heather Marshall<sup>162,228,229</sup>, Bruce Mate<sup>121,230</sup>, Jaime D.  
1861 McAllister<sup>181</sup>, Rebecca L. McGuire<sup>231</sup>, Jane McKenzie<sup>232</sup>, Lachlan McLeay<sup>46,47</sup>, Clive R.  
1862 McMahon<sup>181,233,234</sup>, Michelle Modest<sup>100</sup>, John Morris<sup>92</sup>, Mônica M. C. Muelbert<sup>235,236</sup>, Naveen  
1863 Namboothri<sup>237</sup>, Wallace J. Nichols<sup>238†</sup>, Malcolm A. C. Nicoll<sup>214</sup>, Bradley M. Norman<sup>239,240</sup>, Ken  
1864 Norris<sup>241</sup>, Erik Olsen<sup>242</sup>, Steffen Ooppel<sup>243</sup>, Sabine Orłowski<sup>194</sup>, Anthony M. Pagano<sup>244</sup>, Brad  
1865 Page<sup>232</sup>, Vitor H. Paiva<sup>245</sup>, Daniel M. Palacios<sup>121,230,246</sup>, Yannis P. Papastamatiou<sup>247</sup>, Denise M.  
1866 Parker<sup>248</sup>, Charitha Pattiaratchi<sup>9</sup>, Hoyt Peckham<sup>249,250</sup>, Cesar R. Peñaherrera-Palma<sup>39</sup>, Julian G.  
1867 Pepperell<sup>251</sup>, Richard A. Phillips<sup>59</sup>, Simon J. Pierce<sup>183,252</sup>, Stephen K. Pikesley<sup>125</sup>, Nicolas J.  
1868 Pilcher<sup>253</sup>, Patrick Pinet<sup>254</sup>, Matt Pinkerton<sup>145</sup>, Enrico Pirotta<sup>255</sup>, Virginia Plot<sup>194</sup>, Abby N.  
1869 Powell<sup>256</sup>, Kevin D. Powers<sup>257</sup>, Clare E. M. Prebble<sup>252</sup>, Tiana J. Preston<sup>97</sup>, Rui Prieto<sup>26,27</sup>, Laura  
1870 Prosdociimi<sup>258</sup>, John L. Quinn<sup>57</sup>, Lina Maria Quintero<sup>39</sup>, Thierry Raclot<sup>259</sup>, Iván Ramirez<sup>260</sup>, Dení  
1871 Ramírez-Macías<sup>261</sup>, Jaime A. Ramos<sup>91</sup>, Andrew J. Read<sup>262</sup>, Rolf Ream<sup>263</sup>, ALan F. Rees<sup>125,264</sup>,  
1872 Richard D. Reina<sup>97</sup>, Ryan R. Reisinger<sup>265</sup>, Ohiana Revuelta<sup>266</sup>, Samantha D. Reynolds<sup>239,240,267</sup>,  
1873 Anthony J. Richardson<sup>267,268</sup>, Leena Riekkola<sup>269</sup>, Federico G. Riet-Saprizza<sup>270</sup>, David P.  
1874 Robinson<sup>45,52,271</sup>, Patrick W. Robinson<sup>178</sup>, Carlos F. D. Rocha<sup>272</sup>, Tracey L. Rogers<sup>273</sup>, Christoph A.  
1875 Rohner<sup>252</sup>, Yan Ropert-Coudert<sup>33</sup>, Monica Ross<sup>274</sup>, David R. L. Rowat<sup>275</sup>, Kevin Ruhomaun<sup>276</sup>,  
1876 Paul M. Sagar<sup>277</sup>, Melita A. Samoily<sup>278</sup>, Sonia Sanchez<sup>47</sup>, Alejandra G. Sandoval-Lugo<sup>213,279</sup>, Erik  
1877 A. P. dos Santos<sup>280</sup>, António M. Santos<sup>13,281</sup>, Kylie L. Scales<sup>183</sup>, Gail Schofield<sup>282†</sup>, Jayson M.  
1878 Semmens<sup>181</sup>, Edy Setyawan<sup>283</sup>, Scott A. Shaffer<sup>284</sup>, Kartik Shanker<sup>237,285</sup>, Marcus Sheaves<sup>148</sup>,  
1879 George L. Shillinger<sup>39,70,286</sup>, Mahmood S. Shivji<sup>287</sup>, Abraham Sianipar<sup>239,283</sup>, Janet R. D. Silk<sup>59</sup>,  
1880 Mónica A. Silva<sup>26,27</sup>, Jolene Sim<sup>210</sup>, Samantha J. Simpson<sup>17</sup>, Gregory Skomal<sup>288</sup>, David J.  
1881 Slip<sup>234,289</sup>, Malcolm J. Smale<sup>290</sup>, German A. Soler<sup>64,181</sup>, Marc Soria<sup>113</sup>, Lara L. Sousa<sup>291</sup>, Emily J.  
1882 Southall<sup>17</sup>, Jean-Claude Stahl<sup>292</sup>, Kilian M. Stehfest<sup>181,293</sup>, Jeremy T. Sterling<sup>263</sup>, John D.  
1883 Stevens<sup>294</sup>, Guy M. W. Stevens<sup>12</sup>, Joshua D. Stewart<sup>12,121,230</sup>, Adhith Swaminathan<sup>237</sup>, Akinori  
1884 Takahashi<sup>295,296</sup>, Vikash Tatayah<sup>198</sup>, Jean-Baptiste Thiebot<sup>295,297</sup>, Paul M. Thompson<sup>134</sup>, Simon R.  
1885 Thorrold<sup>76</sup>, Michele Thums<sup>143</sup>, Jesús Tomás<sup>225</sup>, Leigh G. Torres<sup>121</sup>, Alison Towner<sup>154,298</sup>, Philip N.  
1886 Trathan<sup>59</sup>, John P. Tyminski<sup>92,146</sup>, Ricardo Sagarminaga van Buiten<sup>299</sup>, Robert P. Van Dam<sup>300</sup>,  
1887 Frederic Vandeperre<sup>26</sup>, Nuria Varo-Cruz<sup>301,302,303</sup>, Jeremy J. Vaudo<sup>287</sup>, Michel Vely<sup>151</sup>, Stella  
1888 Villegas-Amtmann<sup>178</sup>, Cecile Vincent<sup>304</sup>, David Waayers<sup>305</sup>, Sarah Wanless<sup>306</sup>, Yuuki Y.

1889 Watanabe<sup>307</sup>, Cortney A. Watt<sup>142,308</sup>, Sam B. Weber<sup>125,210</sup>, Nicola Weber<sup>125,210</sup>, Michael J. Weise<sup>309</sup>,  
1890 Linda Welch<sup>310</sup>, Randall S. Wells<sup>311</sup>, Jonathan M. Werry<sup>312,313</sup>, Bradley M. Wetherbee<sup>287,314</sup>,  
1891 Timothy D. White<sup>315</sup>, Scott D. Whiting<sup>10</sup>, Andrea U. Whiting<sup>316</sup>, Annelise Wiebkin<sup>232</sup>, Barbara  
1892 Wienecke<sup>126</sup>, Natalie E. Wildermann<sup>317</sup>, David N. Wiley<sup>318</sup>, Alexis Will<sup>201,319</sup>, Sean Williams<sup>79,185</sup>,  
1893 Marie Windstein<sup>175,239</sup>, Saskia Wischnewski<sup>57,207</sup>, Matthew J. Witt<sup>320,321</sup>, Freya C. Womersley<sup>17,265</sup>,  
1894 Andrew G. Wood<sup>59</sup>, Lucy J. Wright<sup>207</sup>, José C. Xavier<sup>59,245</sup>, Takashi Yamamoto<sup>322</sup>, David J.  
1895 Yurkowski<sup>142</sup>, Patricia M. Zarate<sup>39,323</sup>, Alan Zavala-Norzagaray<sup>213,324</sup>, Alexandre N. Zerbini<sup>32,48,263</sup>,  
1896 Daniel P. Costa<sup>100</sup>, Rob Harcourt<sup>233,234</sup>, Mark G. Meekan<sup>325</sup>, Graeme C. Hays<sup>326</sup>, David W.  
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Materials and Methods:

- Fieldwork and deployment of tracking devices
- Animal ethics information
- Tracking data collection and processing
- Addressing tracking data biases
- Detection of key movement behaviours
- Statistical modelling
- Optimisation algorithm

Supplementary Acknowledgements

Supplementary Author Contributions

Figs. S1 to S17

References (112-135)

1921 **Materials and Methods**1922 **Fieldwork and deployment of tracking devices**1923  
1924 Birds

1925 Birds were all caught at nest sites either whilst incubating or attending chicks, except for some  
 1926 northern gannets (*Morus bassanus*, immature birds at the main colony), Trindade petrels  
 1927 (*Pterodroma arminjoniana*, non-breeding adult birds resting at the main colony), and great  
 1928 shearwaters (*Ardenna gravis*, attracted to a vessel at-sea using bait). Birds were captured using  
 1929 noose poles, crook poles, drop traps, net launchers, nets (landing, mist, purse or handheld), or  
 1930 removed by hand from their burrows. Tags were typically attached to the auxiliary leg band or  
 1931 taped to the mantle, scapular, dorsal contour, or tail feathers. Chest or leg-loop harnesses were  
 1932 used for herring gulls (*Larus argentatus*), ivory gulls (*Pagophila eburnea*), some Ross's gulls  
 1933 (*Rhodostethia rosea*), and some northern fulmars (*Fulmarus glacialis*). For great shearwaters,  
 1934 tags were attached dorsally using four subcutaneous Prolene sutures. In all cases, total instrument  
 1935 mass was <5% of body mass to minimise effects on flight efficiency and all birds were handled  
 1936 for less than 20 minutes.

1937  
1938 Cetaceans

1939 Smaller cetaceans (e.g., beluga - *Delphinapterus leucas*, bottlenose dolphins - *Tursiops*  
 1940 *truncatus*, narwhal - *Monodon monoceros*) were captured using seine or stationary nets. The  
 1941 animals were then brought to the surface, disentangled, and secured using hoop nets and loop  
 1942 ropes. In the case of bottlenose dolphins, animals were brought aboard the research vessel as part  
 1943 of capture-release health assessments. Tags were attached using nylon pins attached to the dorsal  
 1944 ridge or fin. Killer whales (*Orcinus orca*) were targeted from shore using crossbows and tags  
 1945 were attached to the dorsal fin using subdermal darts. Other cetaceans, such as blue -  
 1946 *Balaenoptera musculus*, bowhead - *Balaena mysticetus*, gray - *Eschrichtius robustus*, humpback  
 1947 - *Megaptera novaeangliae*, pilot - *Globicephala macrorhynchus* and *G. melas*, right - *Eubalaena*  
 1948 *glacialis* and *E. australis*, and sei whales - *Balaenoptera borealis*, were approached using a small  
 1949 research vessel. Tags were deployed using crossbows, air-powered applicator systems, or long  
 1950 fibreglass poles. Tags were attached to the dorsal fin (either anterior-to or at-the-base-of) using  
 1951 subdermal anchors or barbs and petals, which were sterilised and/or treated with antibiotic  
 1952 coatings prior to deployment.

1953  
1954 Fishes

1955 Fish, mostly sharks, were typically captured with baited hooks, bagan lift nets, or in purse-seine  
 1956 nets, then brought alongside the vessel and restrained in a sling or with straps, secured to a  
 1957 raisable platform, or taken aboard for tagging. If brought aboard, fish were on deck an average of  
 1958 approximately 3 minutes; the exceptions to this were white sharks - *Carcharodon carcharias*  
 1959 (average duration of restraint: 12 mins) and tiger sharks - *Galeocerdo cuvier* (some were placed  
 1960 in tanks with running seawater and moved to deeper isobaths as part of a shark attack mitigation  
 1961 strategy). Manta rays - *Mobula birostris* and *M. alfredi*, and some copper - *Carcharhinus*  
 1962 *brachyurus*, Galapagos - *Carcharhinus galapagensis*, scalloped hammerhead - *Sphyrna lewini*,

1963 whale - *Rhincodon typus*, and white sharks were tagged whilst free-swimming in the water  
1964 column using pneumatic spear guns or rubber-propelled hand spears. The majority of sunfish  
1965 (*Mola mola*) and some porbeagle sharks (*Lamna nasus*) were captured as bycatch in fisheries  
1966 targeting tuna. Tags were typically attached using a tether affixed to a dart, which was implanted  
1967 in the dorsal musculature or anchored to the first (or second in bluefin tuna - *Thunnus thynnus*;  
1968 removed from analyses) dorsal fin. For some sunfish, tags were attached to the base of the caudal  
1969 fin. For some of the blue - *Prionace glauca*, bull - *Carcharhinus leucas*, mako - *Isurus*  
1970 *oxyrinchus* and *I. paucus*, sandbar - *Carcharhinus plumbeus*, scalloped hammerhead, silky -  
1971 *Carcharhinus falciformis*, tiger, whale, and white sharks, tags were attached to the first dorsal fin  
1972 using metal bolts, neoprene and high-carbon steel washers, and steel nuts. For some white  
1973 sharks, tags were mounted on a custom-built spring clamp that was placed on the first dorsal fin.

1974  
1975 Penguins

1976 Penguins were captured and released on land at nesting sites. Tags were attached to the dorsal  
1977 plumage using waterproof tape and/or epoxy glue, and in some cases secured under a bed of  
1978 feathers using a small cable tie.

1979  
1980 Polar bears

1981 Adult female polar bears (*Ursus maritimus*) were located via helicopter and immobilised with a  
1982 rapid-injection dart. Tags were attached using satellite collars.

1983  
1984 Seals

1985 Seals were approached whilst onshore or in shallow waters surrounding haul-out sites and  
1986 captured using hoop nets, tangle nets, beach seine nets, and/or remote syringe darts. Once  
1987 captured, seals were manually restrained, sedated, or anaesthetised. Tags were attached to the  
1988 head or along the dorsal midline using quick-setting epoxy glue.

1989  
1990 Sirenians

1991 Manatees (*Trichechus manatus*) were located via an aerial observer and individuals were  
1992 captured in a net deployed from a specialised capture boat. Dugongs (*Dugong dugon*) were  
1993 captured using a 'rodeo' technique, where a personal watercraft is used to closely pursue an  
1994 individual dugong until fatigued. The dugong is then caught around the peduncle region by a  
1995 catcher leaping off the boat, and the animal is restrained at the water surface by several people.  
1996 For all sirenians, tags were tethered to the animal using a peduncle belt.

1997  
1998 Turtles

1999 Turtles were primarily adult females captured at nesting beaches after a successful nesting event.  
2000 In some cases, adult and juvenile turtles were captured at sea (both in the vicinity of nesting  
2001 beaches or at foraging grounds) using tangle nets, dip nets, a "rodeo" technique, or by hand as  
2002 they rested at the surface. Some turtles were found stranded or were incidentally captured by  
2003 local fishers, then handed into conservation organisations for tagging and release. For hard-  
2004 shelled turtles, tags were attached to the carapace or head with quick-setting epoxy glue, a

2005 fiberglass and polyester resin, or in the case of flatback turtles (*Natator depressus*), by using a  
2006 specially-designed harness. Leatherback turtles (*Dermochelys coriacea*) were tagged via direct  
2007 attachment surgical technique (tags were directly attached by drilling into the central-dorsal ridge  
2008 and affixing with nylon or metal ties), tow technique (hole drilled in caudal peduncle and tag  
2009 towed), or harness technique. Where post-hatchlings were used, they were collected from the  
2010 nest, reared by head-starting programs, and then selected for tagging based on their size and  
2011 swimming abilities. Post-hatchlings were tagged using an acrylic-silicone-neoprene attachment  
2012 method, which for larger individuals sometimes also included drilling through the keratin part of  
2013 the carapace crest and securing the tag with nylon ties.

2014 **Animal ethics information**

2015 Data providers obtained all licenses and ethical permissions required for data collection in their  
2016 jurisdictions and ensured that each animal was handled and tagged by trained personnel. Details  
2017 per taxon are presented below with name initials indicating the responsible co-author.

2018  
2019

## Birds (flying)

2020 Tagging of black-browed albatrosses (*Thalassarche melanophris*) at Diego Ramirez Islands was  
2021 conducted under a permit provided by the Chilean Antarctic Institute (**J.A.A.**).

2022 Audouin's gull (*Ichthyaetus audouinii*) tagging was conducted with permission from the Catalan  
2023 and Balearic Islands Governments, and Scopoli's shearwater (*Calonectris diomedea*) tagging  
2024 was conducted with permission from the Balearic and Valencian Governments, as well as the  
2025 Spanish Government (**J.M.A.**).

2026 The sooty tern (*Onychoprion fuscatus*) tracking project in Seychelles was approved by the  
2027 Seychelles Bureau of Standards and supported by the owners of Bird Island (**C.F.**).

2028 Tagging procedures on little penguins (*Eudyptula minor*), crested terns (*Thalasseus bergii*), and  
2029 short-tailed shearwaters (*Ardenna tenuirostris*) off South Australia were conducted under  
2030 approval by the South Australian Department of Primary Industry and Regions (PIRSA) Animal  
2031 Ethics Committee (32-12) and the South Australian Department for Environment and Water  
2032 (DEW) (Scientific Permit A24684) (**S.D.G.**).

2033 Broad-billed prion (*Pachyptila vittata*) fieldwork on Rangatira was conducted with the  
2034 permission and cooperation of the New Zealand Department for Conservation and would not  
2035 have been possible without the support of the Chatham Island Area Office. Northern gannets  
2036 were ringed and loggers deployed with permits and approval from the British Trust for  
2037 Ornithology (BTO) and Scottish Natural Heritage (**W.J.G.**).

2038 All tracking of northern gannets, razorbills (*Alca torda*), Atlantic puffins (*Fratercula arctica*),  
2039 and Manx shearwaters (*Puffinus puffinus*) in the Republic of Ireland were approved by the  
2040 University College Cork (UCC) Animal Ethics Committee (2013/032 and 2019/001) and  
2041 conducted under permits by the BTO (C/6143) and Irish National Parks and Wildlife Service  
2042 (26/2010, 011/2013, 018/2014, 016/2015, 025/2016, 082/2017, C051/2011, C116/2012,  
2043 C039/2013, C075/2014, C087/2015, C100/2016, C87/2017) (**M.J.**).

2044 Barau's petrel (*Pterodroma barau*) tracking work was authorized by Centre de Recherches sur  
2045 la Biologie des Populations d'Oiseaux (CRBPO) permit number PP609, Ethic Committee of  
2046 Réunion Island, Parc National de La Réunion, and direction de l'environnement, de  
2047 l'aménagement et du logement de La Réunion (DEAL-Réunion). Red-tailed tropic bird  
2048 (*Phaethon rubricauda*) tagging was authorized by Permit Le Corre PP616, Terres Australes et  
2049 Antarctiques Françaises (TAAF), Mauritius National Park, and Madagascar National Parks.  
2050 White-tailed tropicbird (*Phaethon lepturus*) tracking was conducted with research approval by  
2051 CRBPO (PP616) and the Seychelles Bureau of Standard (SBS). Sooty tern tagging was  
2052 authorized by PP616 M. Le Corre, Seychelles Bureau of Standard, and TAAF. Wedge-tailed  
2053 shearwater (*Ardenna pacifica*) tagging was authorized by CRBPO permit PP616, Ethical  
2054 committee of Réunion Island, Institutional Authorizations from DEAL-Réunion, Conservatoire

2055 du Littoral Réunion, Mauritius National Parks and Conservation Service, and Seychelles Bureau  
2056 of Standard (**M.L.C.**).

2057 Common eider (*Somateria mollissima*) tagging was conducted under Environment Canada  
2058 (ECCC) Animal Care Permits, Canadian Wildlife Service (CWS) Scientific Permit NUN-SCI-  
2059 04-02, and Nunavut Wildlife Research Permit WL1028. Herring gull tagging was conducted  
2060 under Nunavut Wildlife Research Permit WL2008–1028; CWS Scientific Permit NUN-SCI-08-  
2061 04, SC2761; and ECCC Animal Care permits EC-PN-08-026. Ivory gull tagging was conducted  
2062 under CWS Banding Permit number 10694; CWS Scientific Permit NUN-SCI-09-02; and  
2063 Nunavut Wildlife Research License WL2010-032. Northern fulmar collections were in  
2064 accordance with Canadian Council on Animal Care guidelines, and were conducted under the  
2065 following permits: research (NUN-SCI-03-02, WL000190, WL000714), animal care  
2066 (2003PNR017, 2004PNR021, 2005PNR021), and land use (59A/7-2-2). Parasitic jaeger  
2067 (*Stercorarius parasiticus*) tagging was conducted under CWS Banding Permit 10694; Animal  
2068 Care EC-PNR-11-020, Scientific Permit NUN-SCI-09-01, and Territorial Permit WL 2010-042.  
2069 Ross’s gull tagging was conducted under CWS Banding Permit 10694; Animal Care Permit EC-  
2070 PNR-11-020; Scientific Permit NUN-SCI-09-01; and Territorial Permit WL 2010-042. Sabine’s  
2071 gull (*Xema sabini*) tagging was conducted under permits CWS Animal Care EC-PN-11-020,  
2072 CWS Scientific Permit NUN-SCI-09-01, Government of Nunavut Wildlife Research Licence  
2073 WL 2010-042, Nunavut Water Board licence 3BC-TER0811, Indian and Northern Affairs Land  
2074 Use Reserve 068H16001, and CWS Banding Permit 10694. Thick-billed murre (*Uria lomvia*)  
2075 tagging was conducted under Canadian scientific and access permits (NUN-SCI-08-55, NUN-  
2076 MBS-12-03, NUN-SCI-12-04, WRP2013040), banding permit (10694, 10322), and animal care  
2077 (0800AG01) (**M.L. Mallory**).

2078 Tagging work followed the ethical standards set out by the Mauritian Wildlife Foundation and its  
2079 partner and consulting organisations, the North of England Zoological Society, the Durrell  
2080 Wildlife Conservation Trust, and the International Zoo Vet Group (**M.A.C.N.**).

2081 Permission to capture and tag Ascension frigatebirds (*Fregata aquila*) was granted by the  
2082 Conservation Department of the Ascension Island Government. The attachment of devices met  
2083 the ethical guidelines of the Special Methods Panel of the BTO. King eiders (*Somateria*  
2084 *spectabilis*) were handled with approval by the University of Alaska Fairbanks Institutional  
2085 Animal Care and Use Committee (IACUC) (protocol #05-29) and CWS Animal Care Committee  
2086 (permit #PNR007). Masked booby (*Sula dactylatra*) tagging was carried out under permission  
2087 and with collaboration of the St Helena Environmental Management Directorate. The capture  
2088 and handling of birds and attachment of unconventional marks was carried out under licence  
2089 from the BTO. Permission to capture and tag birds was granted by the Environmental  
2090 Management Directorate on St Helena. The attachment of GPS devices met the ethical guidelines  
2091 of the Special Methods Panel of the BTO. Tagging of Murphy’s petrels (*Pterodroma ultima*)  
2092 followed all applicable international, national, and/or institutional guidelines for the care and use  
2093 of animals. Permission to access Henderson Island in order to conduct scientific research in 2015  
2094 was granted by the Government of the Pitcairn Islands (**S. Opper**).

2095 Tagging work was conducted under approval by the Portuguese Government Instituto de  
2096 Conservação da Natureza e Florestas (ICNF) under licenses 188/2010/ CAPT, 152/2011/CAPT,  
2097 101/2012/CAPT, 99/2013/CAPT, 203/2014/CAPT, 169/2015/CAPT, and 89/2011/CAPT  
2098 (**V.H.P.**).

- 2099 Tagging work was authorized by the Government of South Georgia and the South Sandwich  
2100 Islands (**R.A.P.**).
- 2101 Tagging procedures were conducted under approval by the Portuguese Government ICNF  
2102 (permit 89/2011/CAPT) and in compliance with Portuguese laws No. 140/99, No. 49/2005, No.  
2103 316/89, and No. 180/2008 (**J.A.R.**).
- 2104 Buller's albatross (*Thalassarche bulleri*) tagging was approved by the Southland Conservancy,  
2105 Department of Conservation, New Zealand (**P.M.S.**).
- 2106 Sooty shearwater (*Ardenna grisea*) ethics was approved by the IACUC at the University of  
2107 California Santa Cruz and approval for the research was provided by the Whenua Hou  
2108 Management Committee, Rakiura Titi Islands Administering Body, and Southland Department  
2109 of Conservation in New Zealand. Black-footed (*Phoebastria nigripes*) and Laysan albatross  
2110 (*Phoebastria immutabilis*) tagging in the Hawaiian Islands was approved by the University of  
2111 California Santa Cruz and San Jose State University IACUCs under Master Bird Banding permit  
2112 23411. Laysan albatross tagging on Guadalupe Island, Mexico was approved by University of  
2113 California Santa Cruz IACUC under Master Banding Permit 20768. Western gull (*Larus*  
2114 *occidentalis*) tagging was conducted under permission granted by Año Nuevo State Park,  
2115 California State Parks, California Department of Fish and Wildlife, and the US Fish and Wildlife  
2116 Farallon Islands National Wildlife Refuge (SUP# 81641). All research protocols were approved  
2117 by the San Jose State University IACUC (protocol 979) (**S.A.S.**).
- 2118 Common murre (*Uria aalge*) field work was conducted under Kukulget Inc. land crossing  
2119 permits, University of Alaska Fairbanks IACUC protocol #471022, US Fish and Wildlife Service  
2120 (USFWS) scientific collection permit #MB70337A, A. Kitaysky's Master Banding permit  
2121 #23350, and Alaska Department of Fish and Game's permits #19-140, 18-131, 17-104, 16-089.  
2122 Streaked shearwater (*Calonectris leucomelas*) tagging procedures were approved by the Animal  
2123 Experimental Committee of the University of Tokyo and conducted in accordance with the  
2124 Guidelines for the Care of Experimental Animals, with fieldwork conducted under permits from  
2125 the Ministry of the Environment and the Agency for Cultural Affairs. Thick-billed murre tagging  
2126 was conducted under Kukulget Inc. land crossing permits, UAF IACUC protocol #471022,  
2127 USFWS scientific collection permit #MB70337A, A. Kitaysky's Master Banding permit #23350,  
2128 and Alaska Department of Fish and Game's permits #19-140, 18-131, 17-104, 16-089. (**A.**  
2129 **Takahashi**).
- 2130 Capture and tagging of Northern fulmar in Scotland was carried out under licences from the  
2131 BTO (Licence No: AO/4939) and UK Home Office (Licence No: PIL 60/698) following review  
2132 by the University of Aberdeen ethics committee (**P.M.T.**).
- 2133 Northern gannet capture and tagging on St Kilda was carried out with permission from the  
2134 National Trust for Scotland and Scottish Natural Heritage and under licence from BTO (Licence  
2135 No: A2332 with a specific unconventional methods endorsement) (**S. Wanless**).
- 2136 Tagging procedures were conducted with approval from the US Department of the Interior  
2137 #21963, Massachusetts Division of Fisheries and Wildlife #058.19SCB, Stellwagen Bank  
2138 National Marine Sanctuary Permit # SBNMS-2019-001, and the Long Island University IACUC  
2139 (**D.N.W.**).
- 2140 Northern gannet capture and tagging was carried out under licences from the BTO and Natural  
2141 England, with approval of the Royal Society of the Protection of Birds (**L.J.W.**).

2142 Tagging work was conducted with permits from the Ministry of the Environment: No.060609001  
2143 for Sangan Island and No.18–340 for Mikura Island (**T.Y.**).

2144

2145 Cetaceans

2146 Tagging was undertaken under US National Marine Fisheries Service (NMFS) Scientific  
2147 Research Permits No. 17096, 731-1774, and 15330. Tagging was undertaken under protocols  
2148 approved by the Cascadia Research Collective IACUC (**R.W.B.**).

2149 Tagging was conducted under University of Auckland Animal Ethics AEC001587, New Zealand  
2150 Department of Conservation Permit #44388-MAR, and approval from local Maori tribes (iwi)  
2151 Ngāti Kuri and Te Aupōuri (**R.C.**).

2152 Tagging was undertaken with the permission of the Environment Department of the province  
2153 Sud of New Caledonia and of the Government of New Caledonia under permits 383-2010/ARR/  
2154 DENV, 33313-2010/ARR/DENV, 3616-2011/ARR/DENV, 3157-2012/ARR/DENV, 1045-  
2155 2014/ARR/DENV, 151-2015/ARR/DENV, 1105-2016/ARR/DENV, 899-2017/ARR/DENV,  
2156 2220-2018/ARR/DENV, 2016-1391/GNC, 2017-1107/GNC and 2018-923/GNC (**C. Garrigue**).

2157 Tagging procedures were approved by Fisheries and Oceans Canada (DFO) Freshwater Institute  
2158 Animal Care Committee (AUP # FWI-ACC-2002, 2003, 2004, 2005, 2006 and 2007) and under  
2159 DFO License to Fish for Scientific Purposes #S-02/03 to 05/06-1019-NU and #S-12/13-1024-  
2160 NU, S-13/14-1009-NU and S-16/17 1005-NU (**S.H.F.**).

2161 Tagging was conducted under permits 11-101/VP/MPEEIA:SG and 12-100/VP/MPEEIA:SG  
2162 issued by the Secretary-General of the Union of the Comoros, permits 105/DEAL//SEPR/2012  
2163 and 148/DEAL/SEPR/2012 issued by Direction de l'Environnement, de l'Aménagement et du  
2164 Logement de Mayotte, and permit FR1397600001-E issued by Direction de l'environnement, de  
2165 l'aménagement et du logement (DEAL) Mayotte (**S.F.**).

2166 Tagging was conducted under NMFS permits (numbers 14907, 14809, and 14856) and ACA  
2167 Permits (2009-013 and 2015-011). All animal work was approved and conducted under Duke  
2168 University IACUC A049-122-02 and the Oregon State University Animal Care and Use Protocol  
2169 (ACUP) 4513 (**A.S.F.**).

2170 Beluga tagging was carried out with Animal Care Approval and Research Permits issued by the  
2171 Canadian Government (**M.O.H.**).

2172 Deployment of satellite tags on southern right whales at the Head of Bight, South Australia were  
2173 conducted under approval by the South Australian Department of Primary Industries and  
2174 Regions (PIRSA) Animal Ethics Committee (32-12), and under the following permits: PIRSA  
2175 Fisheries Exemption (ME9902712), Department of Environment Water and Natural Resources  
2176 (DEWNR) Permit and Licence to Undertake Scientific Research (A24684-12), Environment  
2177 Protection and Biodiversity Conservation Act Cetacean Permit (20014-0004), Access to  
2178 Biological Resources in a Commonwealth Area for Non-commercial Purposes (AU-COM2014-  
2179 248), Approval for Activity in Commonwealth Marine Reserve (CMR-14-000196) and DEW  
2180 Marine Parks Permit (MO00024-2) (**A.I.M., S.D.G., and R.H.**).

2181 Beluga tagging was carried out under Animal Use Protocol permit number FWI-ACC-2015-018  
2182 and DFO license S-12/13-1022-NU. Narwhal tagging was carried out under Animal Use  
2183 Protocol number FWI-ACC-2016-030 from the DFO Animal Care Committee (under the

2184 Canadian Council on Animal Care) and a DFO License to Fish for Scientific Purpose License S-  
2185 16/17-1037-NU (**M. Marcoux**).

2186 Sei whale fieldwork and tagging was approved by the Regional Directorate of the Environment/  
2187 Regional Government of the Azores under research permit 7/CN/2005, issued to the Department  
2188 of Oceanography and Fisheries of the University of the Azores (**E.O.**).

2189 Whale tagging was authorized by the NMFS under permit numbers 841 (for blue, bowhead,  
2190 gray, and humpback whales), 369-1440 (for blue, fin - *Balaenoptera physalus*, gray, humpback  
2191 and northern right whales), and 369-1757 (for blue, gray, and southern right whales). Tagging in  
2192 Mexican waters was conducted under permits issued by the Secretaría de Medio Ambiente y  
2193 Recursos Naturales, Mexico (permit number DOO 02.8319 and SGPA/DGVS 0576). Southern  
2194 right whale tagging was also authorised under a permit issued by the South African Department  
2195 of Environmental Affairs and Tourism in terms of Regulation 58 of the Marine Living Resources  
2196 Act (no. 18 of 1998). Sperm whale (*Physeter macrocephalus*) tagging was conducted under  
2197 permits # 08159 and SGPA/DGVS 01102 by the Secretaría de Medio Ambiente y Recursos  
2198 Naturales of Mexico, and the NMFS under permit numbers 369-1757. For all eight species,  
2199 research was approved by the Oregon State University IACUC (**D.M. Palacios** and **B.M.**).

2200 Tagging was approved by the University of Pretoria's Ethics Committee (EC023-10; EC077-15)  
2201 and permitted by the Prince Edward Islands Management Committee (PEIMC 17/12, 1/2013 and  
2202 1/2014) (**R.R.R.** and **P.J.N.B.**).

2203 Blue, fin and sei whale fieldwork and tagging were approved by the Regional Directorate of the  
2204 Environment/Regional Government of the Azores, under research permits: 20/2009/DRA (blue,  
2205 fin and sei whales), 16/2010/DRA (blue and fin whales), 51/2011/DRA (blue and fin whales),  
2206 30/2015/DRA (blue whale), 37/2016/DRA (blue whale), 31/2012/DRA (fin whale),  
2207 20/2013/DRA (fin whale), 34/2014/DRA (fin whale), 76/2007/DRA (sei whale) (**M.A. Silva**).

2208 Short-finned pilot whales were tagged under authorization from NMFS. Bottlenose dolphin  
2209 tagging was conducted under NMFS Scientific Research Permit No. 15543 and approved by  
2210 Mote Marine Laboratory's IACUC (**R.S.W.**).

2211  
2212

#### Fishes

2213 Tagging procedures were approved by the Committee on Ethics for the Use of Animals of the  
2214 Universidade Federal Rural de Pernambuco (CEUA #23082.009679/2009 and  
2215 #23082.025519/2014). Work permits granted by the Instituto Chico Mendes para a Conservação  
2216 da Biodiversidade (ICMBio #43305-6 and #15083-8) (**A.S.A.**).

2217 Tagging in the Philippines was performed in collaboration with the respective Regional Offices  
2218 of the Department of Environment and Natural Resources, the Department of Agriculture-Bureau  
2219 of Fisheries and Aquatic Resources and the Palawan Council for Sustainable Development  
2220 (Wildlife Gratuitous Permit 2017-13). All research in Tubbataha Reefs Natural Park was done in  
2221 collaboration with the Tubbataha Management Office (**G.A.**).

2222 Tagging procedures in the Bay of Biscay followed established guidelines that met ethical  
2223 reviews, with scientists limiting handling time and stress as much as possible during attachment  
2224 (**I.A.**).

2225 Tagging procedures were approved and conducted under Australian Fisheries Management  
2226 Authority Scientific Permit #901193 and Great Barrier Reef Marine Park Authority G11/33231.1  
2227 (**A. Barnett**).

2228 All procedures for whale shark tagging in the Red Sea were approved by the Institutional  
2229 Biosafety and Bioethics Committee (IBEC) of the King Abdullah University of Science and  
2230 Technology. KAUST IBEC serves as the registered (HAP-02-J-042) local committee for all  
2231 National Committee of Bioethics (NCBE)-regulated activities including animal-related research.  
2232 (**M.L. Berumen** and **J.E.M.C.**).

2233 Tagging was conducted with the permission of Chico Mendes Institute for Biodiversity  
2234 Conservation (number 50119-1), of the Brazilian Ministry of the Environment. Shark capture  
2235 and tagging methods were approved by the Commission of Ethics on the Usage of Animals of  
2236 Federal Rural University of Pernambuco (licence number 054/2013, protocol number  
2237 23082.022567/2012) (**N.P.A.B.**).

2238 Tagging procedures were approved by Stanford University IACUC, the National Oceanic and  
2239 Atmospheric Administration (NOAA), and the California Department of Fish and Wildlife  
2240 (**B.A.B.**).

2241 Tagging of blue, porbeagle and shortfin mako sharks in the northwest Atlantic was conducted in  
2242 accordance with the animal care guidelines of DFO and the Canadian Council on Animal Care  
2243 (**S.E.C.**).

2244 Tagging was conducted with approval by the Province Sud of New Caledonia under permit  
2245 6024-4916/DENV/SMer and authorization issued by Affaires Maritimes for Chesterfield field  
2246 trips (C110-3510-263/MM) (**E.E.G.C.**).

2247 Tagging was conducted with approval by South African Institute for Aquatic Biodiversity  
2248 Animal Ethics (Ref#25/4/1/7/5\_2019-04) (**R.D.**).

2249 Whale sharks in Madagascar were tagged by Centre National de Recherches Océano- graphiques  
2250 (CNRO) in July 2016 under permit number No 16-12-CNRO-N (**S. Diamant**).

2251 Tagging was conducted under permit from the St Helena Government (SHG 20-SRE-01)  
2252 (**A.D.M.D.**).

2253 Blue sharks (tagged in Irish waters) were tagged under license AE191130/I007 AE19130/P002  
2254 and issued by the Irish Health Products Regulatory Authority (HPRA) and complied with the EU  
2255 Directive 2010/63/EU for scientific research on animals (**T.K.D.**).

2256 Manta ray tagging procedures were approved by the Raja Ampat Marine Protected Area  
2257 Management Authority and were in accordance with the protocols established by Conservation  
2258 International Indonesia's and University of Auckland's Animal Ethics Committees (University of  
2259 Auckland AEC approval #002228). Whale shark tagging was conducted under permits issued by  
2260 the Cendrawasih Bay National Park Authority (SIMAKSI SI.18/BBTNTC-2/TEK/2015,  
2261 SIMAKSI SI.46/BBTNTC-2/TEK/2015, and SIMAKSI SI.05/BBTNTC-2/TEK/2016). Tagging  
2262 procedures were approved by the Cenderawasih Bay National Park Authority and are in  
2263 accordance with the protocols established by Conservation International Indonesia's animal  
2264 ethics review committee (**A. Sianipar, E.S. and M.V.E.**).

2265 Great white sharks were tagged in New Zealand waters according to the protocols specified in  
2266 Department of Conservation Animal Ethics Committee approvals AEC278, AEC216 and

- 2267 AEC260. Mako and porbeagle sharks were tagged according to the code of practice for ethical  
2268 conduct of tagging carried out by the National Institute of Water and Atmospheric Research  
2269 (NIWA Animal Ethics Committee 2009) (**M.P.F., B.F. and C.A.D.**).
- 2270 Tagging was approved by Griffith University ethics (ENV/16/08/AEC) and Ocean and Coast  
2271 Research animal ethics approval (CA 2010/11/482), with fieldwork conducted under permits  
2272 6024-4916/DENV/SMer (New Caledonia), G10 33187.2 (Great Barrier Reef Marine Park  
2273 Authority), 143005 (Queensland Fisheries), QS2010 GS065 (Great Sandy Marine Park) and  
2274 LHIMP/R/2012/009 (Lord Howe Island) (**J.G. and J.M.W.**).
- 2275 Tagging was conducted under permit MAF/LIA/22 to conduct scientific marine animal research  
2276 supplied by the Department of Marine Resources, Bahamas to Bimini Biological Field Station  
2277 Foundation (**T.L.G.**).
- 2278 Tagging was conducted under permits from the NMFS Highly Migratory Species Division and  
2279 under the University of Miami IACUC. Additionally, blacktip shark tagging was conducted  
2280 under permits from Florida Fish and Wildlife, Everglades National Parks; bull shark tagging was  
2281 conducted under permits from the Florida Keys National Marine Sanctuary, Florida Fish and  
2282 Wildlife, and the Biscayne and Everglades National Parks; and great hammerhead shark and  
2283 tiger shark tagging was conducted under permits from the Florida Keys National Marine  
2284 Sanctuary, Florida Fish and Wildlife, Bahamas Department of Marine Resources, and the  
2285 Biscayne and Everglades National Parks (**N.H.**).
- 2286 Tagging procedures were conducted under Galapagos National Park Permits PC-13-01, PC-37-  
2287 11. PC-01-14, PC-51-15, PC-69-16, PC-34-17, and MAE-PNG/CDS-2012-0020. Field methods  
2288 were also approved under University of California, Davis IACUC #16022 (**A.R.H.**).
- 2289 Tagging procedures were approved by the University of Windsor Animal Care Committee with a  
2290 permit through Coastal Oceans Research and Development – Indian Ocean (CORDIO) (**N.E.**  
2291 **Hussey**).
- 2292 Tagging was conducted under Flinders University Animal Welfare Ethics Permits E349 and  
2293 E360, and was authorised by the Victorian Department of Primary Industries under General  
2294 Research Permit RP1048 and PIRSA Ministerial Exemptions Section 115: 9902064 and 9902094  
2295 (**C.H.**).
- 2296 Tagging procedures for scalloped hammerhead and Galapagos sharks were approved by the  
2297 Zoological Society of London’s ethics committee under the project code BPE/0708. Research  
2298 tagging activities around Mikomoto Island, Japan, were communicated to and approved by  
2299 fisheries officers within the Japanese government (a formal research permit was not required)  
2300 (**D.M.P.J.**).
- 2301 For South African white sharks, all research methods were approved and conducted under the  
2302 South African Department of Environmental Affairs: Oceans and Coasts permitting authority  
2303 (Permit #RES2012/OCEARCH/umbrella-project) (**A.A.K.**).
- 2304 Tagging was conducted with the full approval of the Instituto Chico Mendes de Conservação da  
2305 Biodiversidade of the Brazilian Ministry of the Environment (permit no. 14124) (**B.C.L.M.**).
- 2306 Tagging procedures were reviewed and approved by the Seychelles Bureau of Standards, the  
2307 Seychelles Ministry of Environment, Energy and Climate Change, and The University of  
2308 Western Australia (RA/3/100/1480) (**L.R.P.**).

- 2309 Tagging was conducted under Direcção-Geral de Alimentação e Veterinária ethics approvals  
2310 from Decreto-lei N° 129/92 (6 de julho); Portaria N° 1005/92 (23 de outubro) (**N.Q.**).
- 2311 Tagging was carried out under the general auspices of Consejo Nacional de Ciencia y Tecnología  
2312 (CONACYT), Dirección General de Vida Silvestre (DGVS), Secretaría del Medio Ambiente y  
2313 Recursos Naturales (SEMARNAT), and Comisión Natural de Áreas Naturales Protegidas  
2314 (CONANP). These are the relevant Mexican authorities governing all research actions on  
2315 wildlife and protected animals and areas in Mexico. CONACYT registration: RENIECYT No.  
2316 030 (currently 1602199) and 13920. DGVS authorization numbers are: SGPA/DGVS/02677/08,  
2317 SGPA/DGVS/02888/09, SGPA/DGVS/03848/10, SGPA/DGVS/03155/11,  
2318 SGPA/DGVS/03362/12, SGPA/DGVS/05555/16 and SGPA/DGVS/05970/17 (**D.R.**).
- 2319 All tagging was conducted under animal ethics approvals from Murdoch University's Animal  
2320 Ethics Committee (permit numbers: W2058/7; W2402/11; R2926/17) and an animal ethics  
2321 permit from The University of Queensland: SBS/085/18/WA/INTERNATIONAL. Permits to  
2322 conduct research on wildlife in Western Australia were issued by the Western Australian  
2323 Department of Environment and Conservation (DEC) (permit numbers: SF007471; SF007949;  
2324 SF008572) and Department of Parks and Wildlife (DPaW) (permit numbers: SF009184;  
2325 SF009897; SF010414; SF010781; 08-000533-2; 08-002082-2) (**S.D.R.**).
- 2326 Tagging was conducted with permission by the Qatar Ministry of Environment (**D.P.R.**).
- 2327 Tagging in Mozambique was compliant with ethics guidelines from the University of  
2328 Queensland's Animal Ethics Committee and was conducted under their approval certificate  
2329 GPEM/186/10/MMF/WCS/SF. Madagascan fieldwork was conducted with the approval of and  
2330 in partnership with the CNRO in Madagascar. Filipino fieldwork was performed in collaboration  
2331 with the respective Regional Offices of the Department of Environment and Natural Resources,  
2332 the Department of Agriculture-Bureau of Fisheries and Aquatic Resources and the Palawan  
2333 Council for Sustainable Development (Wildlife Gratuitous Permit 2017-13) (**C.A.R.**).
- 2334 Tagging methods for broadnose sevengill sharks (*Notorynchus cepedianus*) were approved by  
2335 the University of Tasmania Animal Ethics Committee (Approval No A0011590) (**J.M.S.**).
- 2336 Tagging procedures were approved by the Marine Biological Association of the UK (MBA)  
2337 Animal Welfare Ethical Review Body (AWERB) and licensed by the UK Home Office through  
2338 Personal and Project Licences under the Animals (Scientific Procedures) Act 1986 (**D.W.S.**).
- 2339 Smooth hammerhead shark (*Sphyrna zygaena*) tagging was approved by the Massachusetts  
2340 Division of Marine Fisheries. Porbeagle shark tagging was approved by the University of  
2341 Massachusetts, Dartmouth IACUC (Protocol #05-07). White shark tagging was conducted under  
2342 Exempted Fishing Permits (SHK-EFP-11-04, SHK-EFP-12-08, SHK-EFP-13-01, SHK-EFP-14-  
2343 03) issued to the Massachusetts Division of Marine Fisheries by the NMFS Highly Migratory  
2344 Species Management Division (**G. Skomal**).
- 2345 Tagging procedures were approved by the University of California, San Diego IACUC (protocol  
2346 S12116) (**J.D. Stewart**).
- 2347 Whale shark tagging procedures were approved by the University of Western Australia  
2348 (RA/3/100/1110; RA/3/100/1437), University of Adelaide (S-2009-109), or Charles Darwin  
2349 University Animal Ethics Committees (**M.T.** and **M.G.M.**).

2350 Tagging data according to protocols approved by the South African Department of  
2351 Environmental Affairs: Oceans and Coasts (now the Department of Forestry, Fisheries and the  
2352 Environment) and adhered to the legal requirements of South Africa. All research methods were  
2353 approved and conducted under the South African Department of Environmental Affairs: Oceans  
2354 and Coasts permitting authority (Permit #RES2012/OCEARCH/KOCK) (**A. Towner**).

2355 Tagging procedures were approved by the Nova Southeastern University IACUC (#064-398-15-  
2356 0203) (**B.M.W.**).

2357 Tagging was conducted under permits given by the Subsecretaría de Pesca y Acuicultura de  
2358 Chile. Resolución exenta (Undersecretary of Fishing and Aquaculture) (**P.M.Z.**).

2359  
2360 Penguins  
2361

2362 Tagging procedures for little penguins from Montague Island were approved by the Macquarie  
2363 University Animal Ethics Committee (Animal Research Authority 2014/057), and work was  
2364 conducted under Office of Environment and Heritage NSW Scientific Licence SL100746 (**G.C.**  
2365 and **R.H.**).

2366 Tagging procedures were conducted under approval from Monash University Animal Ethics  
2367 Committee (approval numbers BSCI/2006/12, BSCI/2010/22, BSCI/2011/33), Phillip Island  
2368 Animal Experimentation Ethics Committee (approval numbers 3.2007, 2.2010, 3.2011, 2.2014,  
2369 7.2017), and research permit issued by the Department of Sustainability and Environment of  
2370 Victoria, Australia (permit numbers 10003848, 10004360, 10005601, 10005605, 10006148,  
2371 10007320, 10008506) (**A. Chiaradia**).

2372 Tagging procedures on little penguins off South Australia, were conducted under approval by the  
2373 South Australian Department of Primary Industries and Regions (PIRSA) Animal Ethics  
2374 Committee (32-12), and Department for Environment and Water (DEW) (Scientific Permit  
2375 A24684) (**S.D.G.**).

2376 Tagging procedures were approved by the Australian Animal Ethics Committee (Department for  
2377 the Environment and Heritage) and the University of Tasmania Animal Ethics Committee Work  
2378 was carried out under Macquarie Island special permits M1/3/95 and MI/13/96 (**M.A.H.**).

2379 Tagging procedures were permitted under US Antarctic Conservation Act Permits (Permit  
2380 #2017-012). Field protocols were approved by the University of California San Diego IACUC  
2381 (S05480) (data used courtesy of Jefferson T. Hinke).

2382 Adelle penguin (*Pygoscelis adeliae*) tagging procedures were approved by the TAAF ethic  
2383 committee and the French regional ethic committee. King penguin (*Aptenodytes patagonicus*)  
2384 handling procedures were approved by the Ethical Committee of the French Polar Institute  
2385 (Institut Polaire Paul-Emile Victor). Authorizations to enter the king penguin breeding site  
2386 (permits nos. 2005–191, 2006–67) and handle birds (permits nos. 99/346/AUT, 00/240/AUT,  
2387 01/315/AUT, 01/322/AUT, 2003–113, 2003–114, 2004–182, 2004–183, 2005–203 and 2006–73)  
2388 were delivered by the French Ministère de l'Aménagement du Territoire et de l'Environnement  
2389 (MATE) and TAAF (**Y.R.**).

2390 Animal handling procedures were approved by the joint University of Cambridge / British  
2391 Antarctic Survey Animal Ethics Committee (**P.N.T.**).

2392 Tagging procedures were approved by the Animal Ethics Committee of the Australian Antarctic  
2393 Division (ATEP-12-13-4086-4088-SUMMER) (**B.W.**).

2394  
2395 Polar bears

2396 Tagging procedures were conducted under USFWS research permit MA 690038 Animal Care  
2397 and Use Committees of the US Geological Survey (assurance no. 2010-3) (**A.M.P.**).

2398  
2399 Seals

2400 Tagging was permitted by the Russian Federal Veterinary and Agricultural Control Service  
2401 (Rosselkhoznadzor, Kamchatka and Koryakia regions, Permit No. 1194) and was approved by  
2402 the Alaska Sea Life Center IACUC (**R.D.A.**).

2403 Tagging procedures were approved by the Adelaide University Animal Ethics (permit S80-2004)  
2404 and South Australia Department for Environment and Heritage (permit A24684-3) (**A.M.M.B.**).

2405 Weddell seals (*Leptonychotes weddellii*) tagged in Dumont d'Urville, Adélie Land by LOCEAN  
2406 laboratory were treated in accordance with the Institut Paul-Emile Victor (IPEV) ethical and  
2407 Polar Environment Committees guidelines (**J. Charrassin**).

2408 Animal use protocols for northern elephant seal tagging was reviewed and approved by the  
2409 University of California at Santa Cruz IACUC and followed the guidelines established by the  
2410 ethics committee of the Society of Marine Mammalogy. Research was carried out under NMFS  
2411 permits: #786-1463 and #87-143. Southern elephant seal (*Mirounga leonina*) captures were  
2412 conducted under NMFS permit No. 87-1851-00. All animal procedures were approved by the  
2413 IACUC at University of California Santa Cruz. Weddell seal handling protocols were approved  
2414 by the University of Alaska Anchorage and University of California Santa Cruz's IACUCs.  
2415 Research and sample import to the United States were authorized under the Marine Mammal  
2416 permit No. 87-1851-04 issued by the Office of Protected Resources, NMFS. Research activities  
2417 on southern elephant seals and Weddell seals were also approved through Antarctic Conservation  
2418 Act permits while at McMurdo Station (**D.P.C.** and **P.W.R.**).

2419 Ringed seal (*Pusa hispida*) handling and tagging was approved by the University of Windsor  
2420 Animal Care Committee (AUPP #12-12,13-10) and a DFO License to Fish for Scientific  
2421 Purposes (S-12/13-1019-NU) (**S.H.F.** and **D.J.Y.**).

2422 Australian sea lion (*Neophoca cinerea*) tagging procedures were approved by the PIRSA Animal  
2423 Ethics Committee (32-12), South Australian DEW (Scientific Permit A24684), and Western  
2424 Australian Department of Environment and Conservation (Licence to Take Fauna for Scientific  
2425 Purposes SF009529). Long-nosed fur seal tagging procedures were approved by the PIRSA  
2426 Animal Ethics Committee (32-12) South Australian DEW, Scientific (Permit A24684) (**S.D.G.**).

2427 Tagging procedures for Australian fur seal (*Arctocephalus pusillus doriferus*) and New Zealand  
2428 fur seal (*Arctocephalus forsteri*) were approved by the Macquarie University Animal Ethics  
2429 Committee (Animal Research Authority 2014/057), and work conducted under Office of  
2430 Environment and Heritage NSW Scientific Licence SL100746. Weddell seal tagging procedures  
2431 were approved by Macquarie University (#3223) ARA 2014\_057 (**R.H.**) or approved by the  
2432 New Zealand Department of Conservation, Ministry of Foreign Affairs and Trade, and NIWA  
2433 Animal Ethics Panel (DOC-69331-MAR) (**M.P.**).

2434 Animal Ethics were obtained from NIWA to manipulate New Zealand sea lions (*Phocarctos*  
2435 *hookeri*) at Campbell Island, with the proviso that all work was undertaken with approval from  
2436 the Department of Conservation and the NZ Department of Conservation permit issued under the  
2437 Marine Mammal Protection Act (1978). Southern elephant seal tagging procedures were  
2438 approved by University of Tasmania Animal Ethics (permit A0014523) (**M.A.H.**).

2439 All animal captures and procedures were authorised under NMFS permits (numbers 87-1593 and  
2440 87-1851-00) and approved by the University of California, Santa Cruz IACUC. Fieldwork in  
2441 Antarctica was approved by the Antarctic Conservation Act (**L.A. Huckstadt**).

2442 Tagging procedures were approved by the UCC Animal Ethics Committee, Irish National Parks  
2443 & Wildlife Service, and HPRA (**M.J.**).

2444 Southern elephant seals, Antarctic fur seals (*Arctocephalus gazella*), Weddell seals, crabeater  
2445 seals (*Lobodon carcinophaga*) and leopard seals (*Hydrurga leptonyx*) were tagged under ethics  
2446 and permits provided by the Brazilian Antarctic Programme "in lieu" of SCAR as their local  
2447 representatives for all the field work conducted on pinnipeds at Elephant Island, South Shetlands  
2448 (**M.M.C.M.**).

2449 Tagging procedures were conducted under the permit #572/208 approved by the National  
2450 Administration of Aquatic Resources, Ministry of Livestock, Agriculture and Fisheries  
2451 (DINARA), Uruguay (**F.G.R.**).

2452 Tagging procedures were approved by the Dirección Nacional del Antártico, Buenos Aires,  
2453 Argentina, and were carried out according to the Scientific Committee on Antarctic Research  
2454 Code of Conduct for Animal Experiments under University of New South Wales Animal Care  
2455 and Ethics Committee (Protocols 08/103B and 11/112A), and the Animal Care and Ethics  
2456 Committee of the Antarctic Science Advisory Committee (permit number 1144) (**T.L.R.**).

2457 Northern fur seal (*Callorhinus ursinus*) tagging in the Pacific North East and Pacific East Central  
2458 was conducted in accordance with and under the authority of the United States Marine Mammal  
2459 Protection Act (NMFS Permits 782–1455 and 782–1708). At the time this work was conducted  
2460 there was no additional requirement for review of these procedures by an institutional review  
2461 board or ethics committee. In 2010, a NMFS IACUC was established for the Alaska Fisheries  
2462 and Northwest Fisheries Science Centers and the capture and handling protocols were reviewed  
2463 and approved by this committee (**J.T.S.** and **R.R.**).

2464 Harbor seal (*Phoca vitulina*) studies in Scotland were carried out under UK Home Office licence  
2465 under the Animal (Scientific Procedures) Act 1986 (PIL nos. 60/3303, 60/4009 and 70/7806),  
2466 following approval by the University of St Andrews animal welfare and ethics committee.  
2467 Licences to capture and release animals in the wild for research were also granted by Marine  
2468 Scotland Licensing (**P.M.T.**).

2469 Animal handling and instrumentation complied with animal care regulations and applicable  
2470 national laws of Ecuador. This research was approved by the Chancellor's Animal Research  
2471 Committee at University of California, Santa Cruz. The appropriate animal use and care  
2472 committee of Ecuador (Parque Nacional Galapagos) approved all research protocols. This work  
2473 was performed under the permit No PC-11-08 and PC-043-09 and authorization No. 084/06  
2474 PNG of the National Park service, Galapagos (**S.V.**).

2475 Grey (*Halichoerus grypus*) and harbor seals were caught under licenses Number 05/475/AUT,  
2476 05/485/AUT, 06/82/AUT, 07/481/AUT, 08/346/DEROG, 08/347/DEROG, 10/102/DEROG,

2477 11/873/DEROG, 11/874/DEROG, and 13/422/DEROG delivered by the French ministry of the  
2478 environment (**C.V.**).

2479 California sea lion (*Zalophus californianus*) capture and procedures were approved by the  
2480 University of California Santa Cruz Chancellor's Animal Research Committee (CARC) protocol  
2481 (COST 01.10) and authorized under National Marine Fisheries Service permit number 87-1593-  
2482 05 (**M.J. Weise**)

2483  
2484 Sirenians

2485 Dugong tagging was conducted under the conditions of ethics permit DEC AEC 2009/11  
2486 (**R.A.C.**).

2487 Permits required to capture and satellite track dugongs were obtained from the James Cook  
2488 University Animal Ethics Committee (Permits A1735 and A1936) and the North (60912155-  
2489 2013/JJC) and South (3157- 2012/ARR/DENV) Provinces of New Caledonia (**C.C.**).

2490 Tagging procedures were approved by the Charles Darwin University Animal Ethics Committee  
2491 and wildlife research permits were obtained from the Parks and Wildlife Commission of the  
2492 Northern Territory (**S.D.W.**).

2493 Manatee tagging procedures were carried out in accordance with the USFWS Permits  
2494 MA107933-1 and MA37808A-0, Alabama Department of Conservation and Natural Resources,  
2495 and Alabama Division of Wildlife and Freshwater Fisheries annual permits. Approvals obtained  
2496 by the University of South Alabama IACUC for protocols 581568 and 1038636 (**R.H.C.**).

2497  
2498 Turtles

2499 Tagging was conducted under permits from Dirección General del Medi Natural de la  
2500 Generalitat Valenciana, Generalitat de Catalunya, Consejería de Medio Ambiente y Ordenación  
2501 del Territorio de la Junta de Andalucía, and Región de Murcia. A general permit for tagging  
2502 adult females was obtained from Ministerio para la Transición Ecológica y el Reto Demográfico  
2503 (GPM/BDM/AUTSPP/23/2020) (**S.A.** and **E.J. Belda**).

2504 The Indonesian Institute of Sciences provided research permits for telemetry deployments at the  
2505 nesting beaches. Telemetry deployments at California foraging grounds were conducted under  
2506 Endangered Species Act permit nos. 1159, 1227, and 1596 (**S.R.B.**).

2507 Queensland Scientific purposes permit and a University of Queensland Animal Ethics permit  
2508 (**H.A.C.**).

2509 Tagging procedures were conducted under permits granted by the Commonwealth of Dominica  
2510 Ministry of Agriculture and Forestry to Domenicia's Sea Turtle Conservation Organisation Inc  
2511 (**R.W.C.**).

2512 Green turtle (*Chelonia mydas*) tagging procedures were carried out in compliance with Mexican  
2513 regulations (permit SGPADGVS/SEMARNAT, Mexico, No.09583/15). Hawksbill turtle  
2514 (*Eretmochelys imbricata*) tagging was carried out in compliance with Mexican regulations  
2515 (permit SGPADGVS/SEMARNAT Mexico, No.09583/15) (**E. Cuevas-Flores**).

2516 Loggerhead turtles (*Caretta caretta*) were handled under license "Nº 04/IFCN/2018- FAU  
2517 MAO" and previous licenses issued by the Government of the Autonomous Region of Madeira  
2518 (**T.D.**).

- 2519 Leatherback turtle tagging procedures were conducted under NMFS Endangered Species Act  
2520 Section 10 Permits #1557 and #15672, University of New Hampshire IACUC #060501 and  
2521 #090402, and University of Massachusetts IACUC #2010-0019. Turtle disentanglement was  
2522 conducted under the authority of NOAA 50 CFR Part 222.310 (**K.L.D.**).
- 2523 All sea turtle research was conducted under NMFS Permit 1260 and 16733 to take protected  
2524 species for scientific purposes and USFWS permits TE-676379-4 and TE676379-5 issued to the  
2525 NMFS Southeast Fisheries Science Centre (SEFSC) and according to IACUC-reviewed  
2526 procedures outlined in the NMFS SEFSC Sea Turtle Research Techniques Manual (**L.L.D.**).
- 2527 Loggerhead and green turtle tagging procedures were conducted under permit issued by the  
2528 wildlife agencies of Buenos Aires and Río Negro provinces and the National Wildlife Agency of  
2529 Argentina (**V.G.C.**).
- 2530 Green turtle tagging procedures were conducted within the Statia National Marine Park  
2531 programme and complied with all relevant national legislation. Hawksbill turtle tagging was  
2532 conducted within the Statia National Marine Park and St Maarten Marine Park programmes and  
2533 complied with all relevant national legislation (**N.E.**).
- 2534 Leatherback turtle tagging procedures were reviewed by the University of New Hampshire  
2535 IACUC (060501) (**B.J.G.**).
- 2536 Leatherback turtle were tagged under permit number SGPA/DGVS/08562/17. Green and  
2537 hawksbill turtle tagging procedures were authorized by the SEMARNAT (permit numbers  
2538 150496-213-03, 280597-213-03, 190698-213-03, 280499-213-03, SGPA/DGVS/002m  
2539 SGPA/DGVS/05137/12, SGPA/GDVS/02259/14, and SGPA/DGVS/04478/15) (**C.E.H.**).
- 2540 Tagging procedures were approved by Swansea University and Deakin University Ethics  
2541 Committees and the British Indian Ocean Territory (BIOT) Administration of the UK Foreign  
2542 and Commonwealth Office. Research was endorsed through research permits (0002SE12,  
2543 0007SE15, 0002SE17, 0006SE18) from the Commissioner for BIOT and research complied with  
2544 all relevant local and national legislation (**G.C.H.**).
- 2545 Sea turtle tagging procedures and fieldwork were directly approved by the Centro  
2546 TAMAR/IBAMA/ICMBio. Fundação Projeto TAMAR has MMA/IICMBio/SISBIO N° 42760  
2547 permit (**P.H.L.** and **E.A.P.S.**).
- 2548 Tagging procedures for rehabilitated loggerhead sea turtles were conducted under the  
2549 authorization of blanket permit from USFWS to NOAA NMFS. Loggerhead sea turtles acquired  
2550 via capture or incidental capture were taken under the authority of NMFS Research permit 16134  
2551 (**G.L.**).
- 2552 Green turtle tagging procedures were conducted with permission from the Administrator of  
2553 Ascension Island. Leatherback turtle tagging was conducted under permits from Ezemvelo  
2554 KwaZulu Natal Wildlife. Loggerhead turtle tagging was conducted with approval from the  
2555 ethical committee of the University of Pisa (**P.L.**).
- 2556 Tagging procedures were authorized under the Peru Instituto Nacional de Recursos Naturales  
2557 (INRENA) permits 015-2002-INRENA-J-DGFFS-DCB, 070-2003-INRENA-IFFS-DCB, 068-  
2558 2004-INRENA-IFFS-DCB, 025-2005-INRENA-IFFS-DCB and 002-2006-INRENA-IFFS-DCB  
2559 (**J.C.M.**).

- 2560 Tagging operations were authorized by the Dirección General de Sostenibilidad de la Costa y del  
2561 Mar (Ref DIV/BDM/AUTSSP/58/2015, Spanish Government) (**D.M.**).
- 2562 Green turtle tagging was conducted under permits of NOAA, Federated States of Micronesia,  
2563 and Republic of Marshall Islands. Hawksbill turtle tagging was conducted under permits from  
2564 NOAA, the USFWS, the Hawai'i Division of State Parks, and the Mexico Comisión Nacional de  
2565 Áreas Naturales Protegidas (**D.M. Parker**).
- 2566 Loggerhead turtles tagging procedures off of the Baja California Peninsula, Mexico, were  
2567 conducted in full compliance with CARC/IACUC protocol at UC Santa Cruz and research was  
2568 authorized by the Mexican government through SEMARNAP and SEMARNAT permits  
2569 150496- 213-03, 280597-213-03, 190698-213-03, 280499-213-03, 280700-213-03,  
2570 SGPA/DGVS/002 4661, SGPA/DGVS/10358, and SGPA/DGVS/03501/06 (**H.P.**).
- 2571 Tagging procedures were authorised by the Environment Agency Abu Dhabi, the Environment  
2572 & Protected Areas Authority, Sharjah, the Environment Studies Center at Qatar University, the  
2573 Qatar Ministry of Environment, the Oman Ministry of Environment and Climate Affairs, and the  
2574 Department of Environment, Iran (**N.J.P.**).
- 2575 Leatherback turtles tagging procedures were conducted under licence (# 27/01 and 73/08) from  
2576 the Fauna Department-Ministry of Cattle, Agriculture and Fishing of Uruguay (**L.P. and M.**  
2577 **Lopez Mendilaharsu**).
- 2578 Tagging permissions were given by Oman's Ministry for Regional Municipalities, Environment  
2579 and Water Resources (**A.F.R.**).
- 2580 Tagging was performed with the permit of the Environmental Ministry of the Dominican  
2581 Republic Government (**J. Tomás**).
- 2582 Permissions for sea turtle rehabilitation work were given by the Dubai Wildlife Protection Office  
2583 (**D.P.R.**).
- 2584 Tagging procedures were conducted under approval from the National Marine Park of Zakynthos  
2585 (permits from 2000–2012), the Animal Ethics Committee of Deakin University (BOX2015-17),  
2586 and the Greek Ministry of Environment (Permit: 151503/162) (**G. Schofield**).
- 2587 Tagging procedures were conducted under approval from the Dakshin Foundation Animal  
2588 Research Ethics Review Committee. In the Andaman and Nicobar Islands, permits were issued  
2589 to tag ten leatherback sea turtles with satellite transmitters from the Ministry of Environment and  
2590 Forests (Wildlife Division), Government of India, on 16th December 2008 (F.No.1-4/2007 WL-I  
2591 (pt-1)). Research permits from the Forest Department, Andaman and Nicobar Islands (CWLW/  
2592 WL/47/393) and other relevant permits from the Andaman and Nicobar Administration were also  
2593 obtained to carry out the field work in Little Andaman Island (**K.S.**).
- 2594 Tagging procedures were performed in accordance with the Stanford University Protocol for the  
2595 Care and Use of Laboratory Animals (APLAC no. 13848). The Costa Rican Ministry of Natural  
2596 Resources and the Environment provided research permits (**G.L.S.**).
- 2597 Green turtle tagging was conducted under permit approved by the Western Australian  
2598 Department of Biodiversity, Conservation and Attractions. Tags were deployed by RPS Group –  
2599 Perth WA (lead by former employee **D.W.**) on behalf of Woodside Energy Group Ltd.

2600 Tagging procedures were conducted under permission obtained from the Viceconsejería de  
2601 Medio Ambiente of the Gobierno de Canarias. Cape Verde did not require permission from the  
2602 government at that time (**N.V.**).

2603 Hawksbill turtle and olive Ridley turtle (*Lepidochelys olivacea*) tagging procedures were  
2604 conducted under approval from Charles Darwin University Animal Ethics Committee and  
2605 wildlife research permits (A4005) from Parks and Wildlife Commission of the Northern  
2606 Territory (**S.D.W.**).

2607 Research protocols for capturing and deploying satellite transmitters on flatback turtles were  
2608 approved by an authorised ethics committee (SA 2015/11/531) and authority under the Nature  
2609 Conservation Act 1994 (**I.B., C.A.M.H., A. Barnett, N.E.W.**).

**2610 Tracking data collection and processing**

2611 Tagging devices were deployed across more than three decades from 1985 to 2018 around the  
2612 global ocean, resulting in a total of almost 11 million positions (after data curation: 6,854,440  
2613 positions) collected with different sensor systems and technologies for transmitting data. These  
2614 included tagging devices using the Argos doppler-shift localization system (argos-system.org),  
2615 GPS (global positioning system) and Fastloc GPS, as well as light-level geolocation tags (also  
2616 termed global location sensor; GLS). Animals within taxa were captured (or tagged remotely) by  
2617 different teams using a range of methods after the responsible team leader obtained all licenses  
2618 and ethical permissions (see “Fieldwork and Data Collection”). All birds including penguins  
2619 were mostly caught at nest sites using poles, traps, or nets, and tags generally attached dorsally  
2620 or to a leg. Most cetaceans were tagged from the research vessel using crossbows, air-powered  
2621 systems or poles to get tags attached to the dorsal fin or its vicinity. Fishes were mostly captured  
2622 with baited hooks or purse-seine nets and tags typically attached to the first dorsal fin using a  
2623 tether affixed to a dart or by fixing it with stainless steel bolts. Satellite collars were used for  
2624 polar bears after immobilisation using rapid-injection darts. Seals were mostly captured with nets  
2625 and sedated before tag deployment on the head or along the dorsal midline. All sirenians were  
2626 tagged using a peduncle belt linked to the tag by a tether. Most turtles were captured at nesting  
2627 beaches or at sea using nets or the by-hand ‘rodeo’ technique and tags glued to their carapace,  
2628 except for leatherback turtles (*Dermochelys coriacea*) for which a harness (“backpack”), towed-  
2629 tag or surgical techniques were used for attachment. All animal handling and tagging procedures  
2630 were completed by trained personnel under permissions granted by ethical review bodies and in  
2631 accordance with all relevant ethical regulations in the jurisdictions in which they were performed  
2632 with specific approvals obtained by each data owner who was individually responsible for  
2633 adhering to regulations and supervision of all procedures (details provided in “Animal Ethics  
2634 Information”).

2635 Tracking datasets were collated after a lead author (representing each tagging research team)  
2636 provided three csv files, each including species metadata, tracking data, and the team description.  
2637 All datasets were requested with the least amount of processing possible, with all Argos, GPS  
2638 and fastloc GPS data (~90% of the tracking data) provided as ‘raw’ position estimates. GLS  
2639 positional data (for some birds and fishes only) were provided after estimation of longitude and  
2640 latitude from the ambient variables recorded in the device (i.e., light intensity and elapsed time,  
2641 but also depth and temperature for fishes). For birds, GLS position estimates provided were  
2642 obtained in two ways: (i) through the Geolight package(112) in R(113) after carrying out a pre-  
2643 and a post-calibration (seven days) to estimate an average value for the sun elevation parameter  
2644 needed for calculations, or (ii) through the BASTrack software suite (British Antarctic Survey)  
2645 after identifying sunrise and sunset times based on light curve thresholds and with longitude and  
2646 latitude calculated from the time of local midday and day length, respectively. The exception was  
2647 for the dataset for the hybrid complex of three *Pterodroma* species(114), referred here to as  
2648 Trindade Petrel (*Pterodroma arminjoniana*), for which the GLS positions were processed with  
2649 the R package *TripEstimation*(115). For fishes, GLS tracks were obtained using pop-up satellite  
2650 archival transmitters (PSAT) through satellite-relayed data or archived data from tags physically  
2651 recovered. Positions were obtained after data decoding using software provided by the  
2652 manufacturers (e.g., Wildlife Computers), where, similarly to bird data, longitude and latitude  
2653 are calculated from estimated local time of midnight or midday and day-length, respectively.  
2654 These PSAT GLS tracks were further processed with a continuous-time correlated random walk

(CTCRW) Kalman filter using the `crawl` package(116) in R to produce daily positions, after filtering with the unscented Kalman filter using sea surface temperature through the UKFSST package in R and applying a bathymetric correction using the `analyzePSAT` R add-on. PSAT data also included shark tracking data from the Tagging of Pacific Predators (TOPP) program which were downloaded from the Animal Tracking Network (ATN) hosted by the Integrated Ocean Observing System ([ioos.noaa.gov/project/atn/](http://ioos.noaa.gov/project/atn/), downloaded September 2017) for integration in the Global Shark Movement Project (GSMP; [globalsharkmovement.org](http://globalsharkmovement.org)). These data obtained through GSMP were processed as detailed in (62) to determine daily position data.

All data were checked for quality-control and to standardise formats of the multiple and disparate datasets received. Poor data quality, lack of metadata, misidentified or incomplete tracks, repeated tracks, or unsolicited processing before data submission (e.g., interpolation of Argos tracked positions) led to the exclusion of 3,051 tracks from 10 species prior to analyses. All datasets were run through a speed filter using the `SDAfilter` package in R to remove outlier positions. Speeds used ranged for species between 5.4 – 35 m.s<sup>-1</sup> (20 – 126 km.h<sup>-1</sup>) for birds, 1.6 – 7 m.s<sup>-1</sup> (5.8 – 25 km.h<sup>-1</sup>) for cetaceans, 0.5 – 11.9 m.s<sup>-1</sup> (1.9 – 42.8 km.h<sup>-1</sup>) for fishes, 2.1 – 4.2 m.s<sup>-1</sup> (7.5 – 15 km.h<sup>-1</sup>) for penguins, 0.75 m.s<sup>-1</sup> (2.7 km.h<sup>-1</sup>) for polar bears (but see (117)), 2.0 – 10.3 m.s<sup>-1</sup> (7.2 – 37 km.h<sup>-1</sup>) for seals, 1.1 – 2.8 m.s<sup>-1</sup> (4.1 – 10 km.h<sup>-1</sup>) for sirenians, and 1.4 – 2.8 m.s<sup>-1</sup> (5 – 10 km.h<sup>-1</sup>) for turtles (refer to table S3 for details, and also for general morphometric data per species). During this procedure, all Argos data resulting from unsuccessful satellite uplinks (i.e., with location class Z) were removed from the dataset, keeping only location classes B, A, 0, 1, 2, and 3, which have increasing accuracy from ~160 km to 0.3 km (118). Visual inspection led to further removal of unrealistic GLS locations for some bird species (e.g., longitude < 43°W or > 98°W, latitude < 8°N or > 73°N for Arctic herring gull – *Larus smithsonianus*). A land mask was applied to all data using the `rworldmap` package in R and all locations assigned to land were excluded from analyses. We created 1° grid-cells for all area included in the world’s ocean, and all grid-cells where animal tracking data were not detected have also been excluded from analyses. Because the area within each grid-cell varies considerably with latitude, all results were calculated based on area following:

$$A(\theta) = 2 \Delta\phi R^2 [\sin(\theta_{max}) - \sin(\theta_{min})]$$

where  $\theta$  is latitude,  $\phi$  is longitude and  $\theta_{max}$  and  $\theta_{min}$  are the bounding latitudes of the grid-cell, and  $R$  is the average Earth’s radius (6,371 km).

### Addressing tracking data biases

The inherent biases in tracking datasets(63), such as the different data resolution and number of positions resulting from different devices, higher number of positions commonly obtained around tagging locations, and different track lengths obtained from devices deployed at the same time, make analyses challenging. To alleviate some of these potential issues, we gridded data at 1° resolution, keeping only the counts of unique individuals per species. We chose this resolution because it encompasses most of the known accuracies for most tracking devices, including most positions obtained by PSAT GLS(62), therefore alleviating most of the effects of position error estimates on track accuracy. This resolution has also been proposed as the best resolution to use when performing statistical analyses at large spatial scale(63, 119) or when using ‘big data’ approaches(120). To further reduce any potential biases in track accuracy due to the lower

accuracy of GLS data and their limited daily locations (usually only 1 or 2), we repeated all spatial analyses using only one position per day for each individual, calculated as the centre of mass of all position estimates obtained per individual in a given day, and also used this dataset for all time-based calculations. We found these potential methodological biases led to no major differences in the pattern of results obtained (fig. S5). Furthermore, to avoid overestimating spatial overlaps due to the ‘addition’ of locations by interpolation methods – which can lead to locations being introduced where the animals were likely to have been but which were not detected by the tracking devices deployed – we considered all the positions that were detected, rather than interpolating positions for all taxa, except as detailed above (e.g., for the PSAT GLS daily position data for sharks derived from GSMP). Track interpolations, which are often calculated between positions up to 20 days apart(61) can result in an additional source of bias(63) and could inflate our globally important marine megafauna areas. By using only detected positions (rather than interpolated) and focusing on unique detections for each individual (instead of number of positions) within each  $1^\circ$  grid-cell, we conservatively estimated important marine megafauna areas that were also not affected by inflated detections around each tagging location (i.e., only one position was considered for each individual within  $1^\circ$  resolution around the tagging location). To further understand the potential effects of the tagging location bias, we also repeated our spatial analyses after removing all positions around the tagging location where the probability of finding an individual following a random trajectory from the tagging location was  $>10\%$ . We did this by estimating the characteristic daily velocity (i.e., the root mean square displacement,  $d$ ) for each species, and then using this value to estimate the diffusion constant ( $D$ ) for a Brownian random walk, as  $D = d^2/2T$  (with  $T = 1$  day). We then compared our curated tracks with those obtained from trajectories generated through a Brownian random walk with that diffusion constant, when using similar starting locations for each track. We used these trajectories to estimate the probability of an individual randomly arriving at the same distance (or further) from each tagging location as that observed in the curated tracks, and discarded all positions where this probability was  $>1\%$ . We then used our curated tracks with new starting positions matching the first location where the probability of randomly being at that location estimate was  $<10\%$ , to re-compute our spatial analyses, which resulted in similar patterns obtained (fig. S6). Finally, to study the effects of spatial resolution on all our results, we repeated all the analyses at  $0.5^\circ$  and  $2^\circ$  grid-cell resolutions and found similar patterns (see fig. S7, fig. S8). All comparisons were made using the Jaccard similarity coefficient (or Jaccard index), which is calculated by dividing the size of the intersection of two datasets by the size of their union, and results in 0 for no intersection between the sets (i.e., complete dissimilarity) and in 1 for equal sets (i.e., high similarity).

### Detection of key movement behaviours

To detect key movement behaviours such as migration (defining migratory corridors) or residence (potentially indicating feeding, mating or resting areas) throughout the three decades of tracking data in our multi-taxa global dataset, we used an algorithm based on statistical methods commonly applied to *big data* analyses. Our algorithm uses a time series of displacements calculated as the shortest great-circle distance, i.e., measured along the surface of the sphere, between two consecutive tracked locations separated by predetermined time-windows ( $Tw$ ) (as done in 120) from 1 – 10 days. We then calculated the average displacement per individual and

2742 normalised the displacements by the average displacement per species to account for disparities  
2743 in speed across the 111 species considered in our study.

2744 *Detection of migratory corridors*  
2745

2746 For detecting migratory corridors captured by our tracking dataset, we calculated how *coherent*  
2747 the movement direction was within each grid-cell for each species based on the displacements  
2748 calculated for  $T_w = 1 - 10$  days. We did this because the results obtained for movement direction  
2749 can differ for long- and short-time windows, with the former likely to reflect long term  
2750 movements in a specific direction (i.e., ignoring potential return trips or other shorter changes in  
2751 direction, such as daily trips), and the latter likely to provide displacements that are  
2752 unrepresentative of potential migration (i.e., ‘noisy’ data). We then defined *coherence* ( $c$ ) per  
2753 taxon, for each  $T_w$  and grid-cell, as the sum of the displacement vectors ( $w_d$ ) in a particular  
2754 direction (i.e., multiplied by the cosine and sine of the angle  $\varphi$ ) and then divided by all  
2755 displacements in all directions, as:

2756 
$$Coherence(T_w, c) = \frac{\sum_{d=1}^D w_d (\cos \varphi_d, \sin \varphi_d)}{\sum_{d=1}^D w_d}$$

2757 where  $D$  represents all displacements observed in each grid-cell. To scale results across taxa, we  
2758 multiplied the average monthly *coherence* by the ratio between the number of grid-cells with  
2759 observed displacements within each time window ( $C_{dm}$ ) and the maximum number of grid-cells  
2760 observed over different time windows ( $\max C_{dm}$ ) for each taxon.

2761 The selected taxon-specific displacements calculated for the  $T_w$  that resulted in the maximum  
2762 number of  $1^\circ$  grid-cells showing coherent movement for that taxon (i.e., ‘best  $T_w$ ’; refer to fig.  
2763 S12) were then aggregated at temporal scales of 1, 2, 3, 4, 5, 6 and also 12 months. Considering  
2764 multiple temporal scales was necessary due to the differences in movement behaviour across the  
2765 many species considered in our study. For example, central place foragers return to start  
2766 locations (e.g., colony) in each trip. Using multiple temporal scales is therefore useful to allow  
2767 detection of movement corridors in both directions avoiding the cancellation of the displacement  
2768 vectors occurring in opposite directions (e.g., trip from nest to foraging location cancelled by the  
2769 reverse trip). Also, because migratory behaviour is largely unknown or incomplete for many  
2770 species (e.g., sharks), we included temporal scales up to 12 months to ensure we captured any  
2771 previously undetected long-term migration if present. To automate routines, these temporal  
2772 scales were programmatically defined considering one month as  $365 \text{ days}/12$  ( $\sim 30.4$  days). We  
2773 then repeated the calculation of *coherence* at each temporal scale for each taxon to find sets of  
2774 neighbouring grid-cells where displacements obtained from the tracking dataset indicated  
2775 movement in the same direction. We did this by calculating the average direction of all observed  
2776 displacements at each grid-cell within each temporal scale (e.g., for a temporal scale of 3  
2777 months, we used displacements calculated between 0 and  $\sim 90$  days) and clustering all grid-cells  
2778 that resulted in similar average direction (i.e., for which the cosine of the angle between their  
2779 directions is  $> 0.8$ , i.e., indicating similar direction of movement).

2780 The clustering of grid-cells resulted in a high number of clusters for each taxon and temporal  
2781 scales. So, we computed the size distribution of clusters of grid-cells with similar average  
2782 direction for each temporal scale and plotted the cumulative distribution. Then using a Lorenz  
2783 curve as a parameter-free approach(121), we identified the intersection point between the slope  
2784 of the tangent line at the maximum value (i.e., the slope where the cumulative distribution equals  
2785 1) and the  $x$ -axis in the Lorenz curve plot. This intersection point defines the threshold for  
2786 minimum cluster size (i.e., minimum number of  $1^\circ$  grid-cells) defining a movement corridor at  
2787 each temporal scale for each taxon (see fig. S13). All clusters with size above the defined  
2788 threshold at any temporal scale were considered, and all  $1^\circ$  grid-cells within those clusters were  
2789 aggregated and classed as corridors. Because speed is generally expected to be faster while  
2790 “migrating”, we confirmed speed within resulting corridors was always above average for each  
2791 species.

### 2792 *Detection of residence areas*

2794 To determine residency-like behaviour indicative of areas where animals might be foraging,  
2795 feeding, mating or resting (commonly characterised by slower speeds and greater tortuosity), we  
2796 computed the z-scores (dimensionless) of the displacements starting within each grid-cell,  
2797 considering the average displacements and respective standard deviations per species for the  
2798 ‘best  $T_w$ ’ identified for each taxon. Each displacement observed in a track belonging to a species  
2799 within each grid-cell was assigned a z-score by subtracting the average global displacement of  
2800 that species from the calculated average displacement and dividing the result by the standard  
2801 deviation of the displacements of that species. We then used these values to calculate the average  
2802 z-score for each taxon in each grid-cell. If the average z-score calculated within each  $1^\circ$  grid-cell  
2803 was lower than -1 (i.e., one standard deviation below the average displacement for that taxon),  
2804 we considered it as reflecting a residency-like movement behaviour, and the corresponding grid-  
2805 cells were classed as residence area. We used this approach to calculate z-scores across the same  
2806 aggregated temporal scales used for detection of migratory corridors (i.e., using sets of 1, 2, 3, 4,  
2807 5, 6 and also 12 months) and, for a given taxon, observing residency-like movement behaviour in  
2808 any of these scales led to the classification of the grid cell as a residence area for that taxon. To  
2809 confirm that a random approach to identify areas of residence is not useful, we randomised all  
2810 tracks in the dataset by changing the sequence of displacements to break their correlation but  
2811 keeping the same start and end point of the trajectories (and therefore the same probability  
2812 distribution function) (122). We then repeated the procedure to detect residence areas and see if  
2813 they would be similar. We then used the Jaccard index(123) to measure the similarity between  
2814 each randomised set of residence areas and the original per taxa. Detection of residence areas  
2815 was substantially different after track randomisation, confirming space-use by animals was not  
2816 random (fig. S14).

### 2818 **Statistical Modelling**

2820 *Input Data*

2821 We modelled the probability of finding areas (grid-cells) used as residences or for migration  
 2822 separately for each taxon (except sirenians due to lack of data) using generalised linear models  
 2823 with a binomial error distribution and a logit link function. We develop these models considering  
 2824 as presences the locations where we have detected the described residence or migratory  
 2825 behaviours for each taxa and by randomly selecting equal number of locations where tracking  
 2826 data were available for each taxa but no behaviour was detected (see Table 2).

2827  
 2828 We then used a total of 13 environmental variables as predictors obtained from various online  
 2829 datasets (see Supplementary Acknowledgements). The predictors included monthly mean global  
 2830 sea surface temperatures (*sst*), ocean surface currents ( $\bar{u}$  and  $\bar{v}$ ; respectively, eastward and  
 2831 northward ocean currents), sea surface height (*ssh*), salinity (*sal*), and mixed layer depth (*mld*)  
 2832 collated from the E.U. Copernicus Marine Service Information (CMEMS) Marine Data Store  
 2833 (MDS) Global Ocean Physics Reanalysis(124). Dissolved oxygen ( $O_2$ ) was obtained from the  
 2834 CMEMS Global Ocean Biology Hindcast replaced in July 2022 by the Global Ocean  
 2835 Biogeochemistry Hindcast (125). Ocean turbidity (*turbidity*) and chlorophyll-*a* concentration  
 2836 (*chl<sub>a</sub>*) were obtained from NASA Ocean Biology Processing Group Level-3 SeaWifs (1998-  
 2837 2003) (126) and Modis-Aqua (2003-2018) (127) Ocean Color Data. Atmospheric temperature at  
 2838 2 m height (*temp2m*) and wind velocity at 10 m height (*u10* and *v10*, respectively representing  
 2839 eastward and northward direction) were obtained from the European Centre for Medium-Range  
 2840 Weather Forecasts (ECMWF) (128, 129). We then used ocean surface currents to calculate eddy  
 2841 kinetic energy (*EKE*) as:  $EKE = 0.5 * ((u - \bar{u})^2 + (v - \bar{v})^2)$ , where *u* and *v* are eastward- and  
 2842 northward ocean currents respectively and the bar indicates the time-average. All environmental  
 2843 data were linearly interpolated to 1° (horizontal) resolution.

2844  
2845  
2846 *Model Set*

2847 We used the following set of seven models to explain the occurrence of residences and migratory  
 2848 behaviour, each including a different set of the environmental variables we collated (as described  
 2849 in table S8) and specifically avoiding inclusion of correlated variables in the same model:

- 2850  
 2851 Model 1: *Behaviour* ~ *sst* + *u* + *v* + *mld* + *chl<sub>a</sub>* + *eke* + *bathymetry* + *Month*  
 2852 Model 2: *Behaviour* ~ *ssh* + *u10* + *v10* + *turbidity* + *salinity* + *eke* + *bathymetry* + *Month*  
 2853 Model 3: *Behaviour* ~  $O_2$  + *vel* + *vel10* + *mld* + *chl<sub>a</sub>* + *bathymetry*  
 2854 Model 4: *Behaviour* ~ *temp2m* + *u* + *v* + *mld* + *chl<sub>a</sub>* + *eke* + *bathymetry*  
 2855 Model 5: *Behaviour* ~ *mld* + *chl<sub>a</sub>* + *sst*  
 2856 Model 6: *Behaviour* ~ *u* + *v* + *eke* + *bathymetry*  
 2857 Model 7 (Null model): *Behaviour* ~ 1

2858  
 2859 The response variable “*Behaviour*” corresponded to grid-cells where residence or migratory  
 2860 behaviour has been detected plus an equal number of grid-cells where presences were available  
 2861 in our tracking dataset but no behaviour was detected. The total number of grid-cells with  
 2862 presence and each of the residence or migratory behaviours detected per taxa are shown in Table  
 2863 2. We compared the predictive ability of models containing different sets of these environmental

variables using the Akaike's information criterion(130). According to the weight of the Akaike's Information Criteria (*wAIC*), model 2 was ranked highest for the different behaviours across all taxa, with the only exception being residency for penguins and turtles (for which the highest ranked models were model 1 and 3, respectively) (table S9). On average, the highest ranked model for corridors explained 17.8 % of the deviance (ranging from 5.2 % for turtles to 40.1 % for penguins), while for residences it explained 12 % of the deviance (ranging from 3.1 % for seals to 24.8 % for polar bears) (Table 2).

### *Predictions*

We used the highest ranked model to predict which grid-cells are likely to be used as residence or for migration within the entire area where we had occurrence data for each taxon (see resulting maps in fig. S17). We did this after applying cross validation using a set of 10 (or 5 depending on available data for each taxon) iterations to assess the predictive ability of the highest ranked models for each taxon. We assessed the predictive ability using the Cohen's *Kappa statistics* (*K*), which measures the agreement between predicted and real (i.e., obtained) values(131). We then used Landis & Koch (132) criteria to class results into 'no agreement' ( $K \leq 0$ ), 'slight agreement' ( $0 < K \leq 0.2$ ), and at least 'fair agreement' ( $K > 0.2$ ). Our *K* values for corridors averaged at 0.35 (ranging from 0.17 for turtles to 0.56 for penguins) and for residences averaged at 0.32 (ranging from 0.22 for birds and seals to 0.44 for cetaceans) (Table 2). To compute the final important marine megafauna areas across all taxa and months to be considered for the 30% protection (as shown in the right panel of Fig. 3), we used our predictions results only from models for which *K* was above 0.2 before applying the optimization algorithm.

### **Optimisation algorithm**

To select important marine megafauna areas for protection, we first assigned a score to each grid-cell based on the detection of key movement behaviours reflecting migratory corridors or residency areas across taxa. To do this, we first defined *T<sub>c</sub>* and *T<sub>r</sub>*, respectively, as the number of taxa using the grid-cell as migratory corridor or residence, and then attributed a higher importance to grid-cells used as residence (i.e., where animals are likely to spend more time) when calculating the product between *T<sub>c</sub>* and *T<sub>r</sub>* to obtain each score per grid-cell, following:

$$Score = 2^{T_c} \times 3^{T_r}$$

Using this formula, grid-cells receive scores of 2 or 3 if they are, respectively, used as: migratory corridor or residence by multiple species of only one taxon, and increasingly higher scores if they are used both as corridors and residencies across multiple taxa (e.g., we obtained a maximum score of 1944, for grid-cells used by 5 taxa as residence and 3 taxa as corridors) (fig. S15). We then ordered the grid-cells by descending scores to increasingly select, according to this ranking, grid-cells currently not (or only partially) protected, until we reached the 30% target (30% of 71.1 % area covered by our tracking dataset). The resulting selected grid-cells results in the polygons shown in Figure 3 (and the results from a sensitivity analyses changing the scores provided to migratory corridors and residences is provided in fig. S16). We repeated this procedure for the detected movement behaviours based on the probability of each grid-cell to be used as residence or for migration by each taxon obtained after our modelling procedure (detailed below). We selected important marine megafauna areas in decreasing order from the

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highest probabilities (closest to 1) until the threshold of 30% was reached, and similarly created the resulting polygons shown in Figure 3 (right panels).

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#### Compiled Raw Data for Contribution

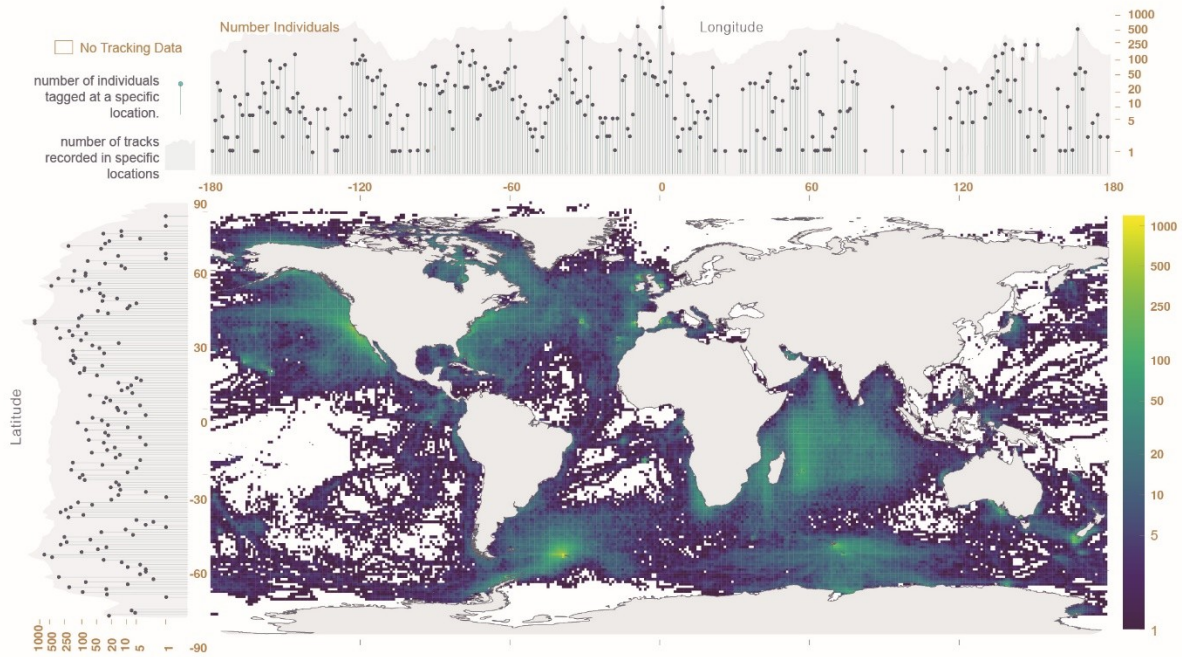
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#### Submitted Data to the MegaMove Consortium

3296 S.A., F.J.A., K.A., F.A.A., A.S.A., S.Å., R.D.A., J.A.A., G.A., I.A., H. Arrizabalaga, M. Auger-  
 3297 Méthé, F.B., R.W.B., W.B., A.M.M.B., A. Beard, J.B., A. Bennison, S.R.B., D.B., S. Bessudo,  
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3310 Sheaves, G.L.S., J.R.D.S., M.A. Silva, S.J.S., D.W.S., L.L.S., J. Stahl, J.D. Stevens, J.D.  
3311 Stewart, A. Swaminathan, A. Takahashi, V.T., M.T., L.G.T., P.N.T., J.P.T., R.P.V.D., F.V.,  
3312 N.V., J.J.V., M. Vedor, S.V., C.V., S.B.W., M.J. Weise, R.S.W., B.M.W., A.U.W., N.E.W.,  
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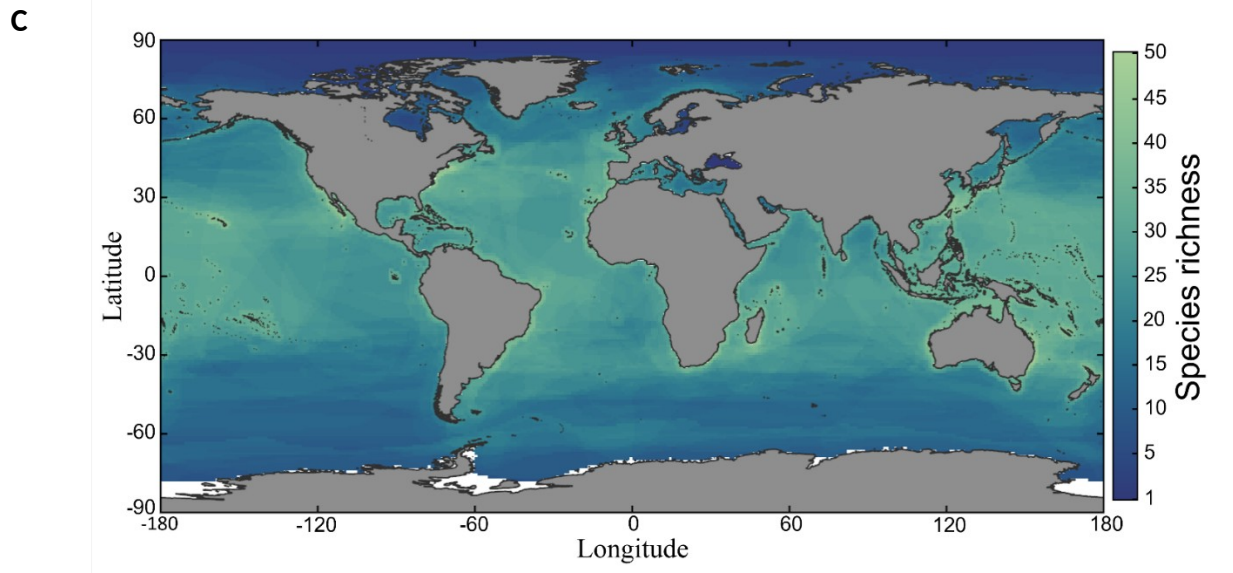
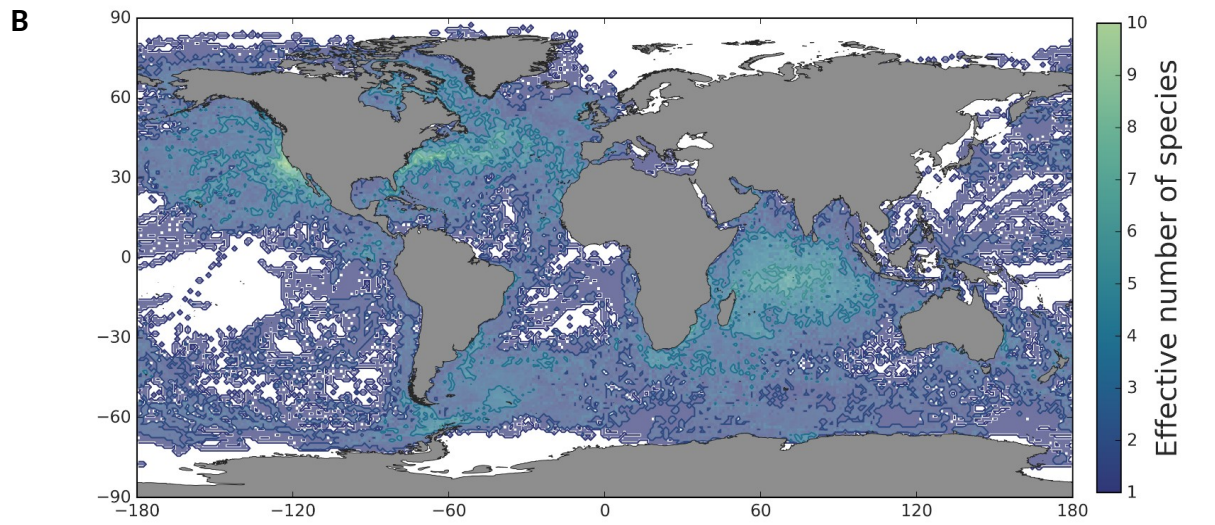
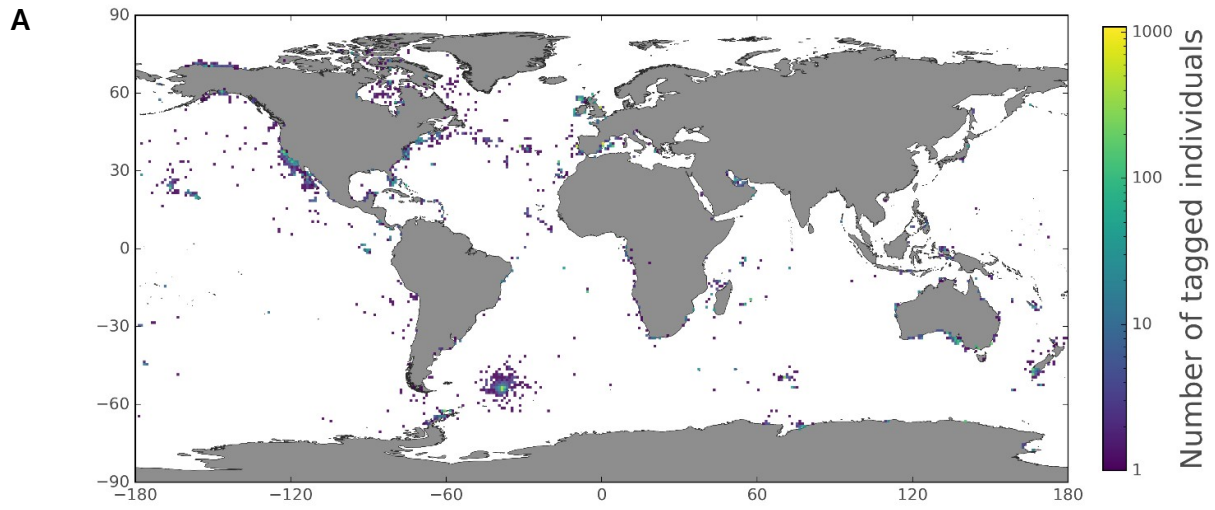


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3316 **Fig. S1. Total number of tracked individuals per latitude and longitude**

3317 Spatial extent of the marine megafauna tracking datasets including the 12,794 individuals in the  
3318 global dataset at 1° resolution, with top and left inset plots representing longitudinal and  
3319 latitudinal coverage of the curated tracks with dotted histograms showing the number of  
3320 individuals tagged (at tagging locations) and shaded areas indicating the number of individuals  
3321 with tracked positions in the same geographical locations. These plots show that a higher number  
3322 of tracked individuals is not necessarily related to tagging locations.

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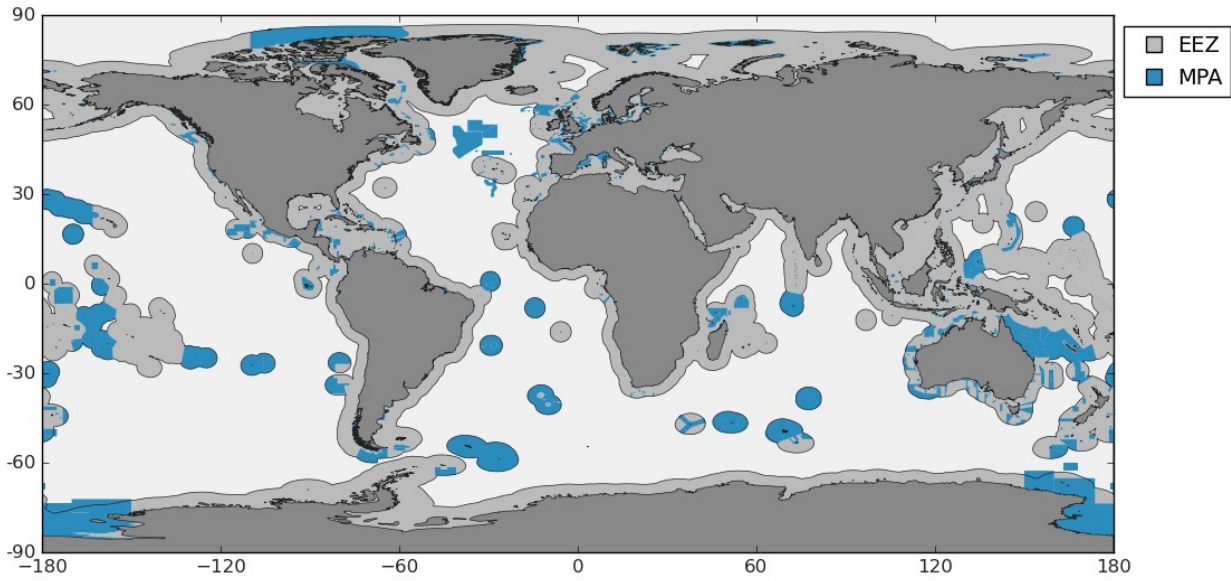
**Fig. S2. Biodiversity captured versus expected based on the 111 species considered in our dataset.**

Map shows that our dataset captures some of the known hotspots, including in the NE Pacific, NW Atlantic, and regions of the SW Atlantic, but it misses others (e.g., Indo-Pacific and Central West Pacific regions, Gulf of Guinea, and waters around Australia and Madagascar). A) Global map depicting the first locations tracked per individual, providing a visual representation of the tagging locations. B) Effective number of species ( $S_{\text{eff}}$ ) observed in each grid-cell ( $c$ ) where we had tracking data based on the Shannon entropy ( $H$ )(31).  $H$  was calculated from the probability of observing each species among all the individuals visiting each grid-cell ( $p_s(c)$ ), which in turn is the result of the fraction of tracked individuals  $f_s(c)$  of each species ( $s$ ) grid-cell with at least one location within each  $1^\circ$  grid-cell divided by the total number of tagged individuals of the same species. The resulting fraction is independent from the tagging effort excluding potential biases arising from the different number of tagged individuals of each species.

$$S_{\text{eff}}(c) = 2^{H(c)} \text{ where } H(c) = \sum_s p_s(c) \log_2 p_s(c) \text{ and } p_s(c) = \frac{f_s(c)}{\sum_s f_s(c)}$$

C) Expected richness hotspots for the species considered based on species geographical range shapefiles obtained from the [iucnredlist.org/](http://iucnredlist.org/) (accessed 24 Jan 2022) for all species, except for flatback turtles, which were obtained from the Recovery Plan for Marine Turtles in Australia (2017)(133). For comparison with global biodiversity maps see literature for birds(134), mammals(51), sharks(14), and also general marine biodiversity (i.e., also including plants, corals and non-migratory animals)(135).

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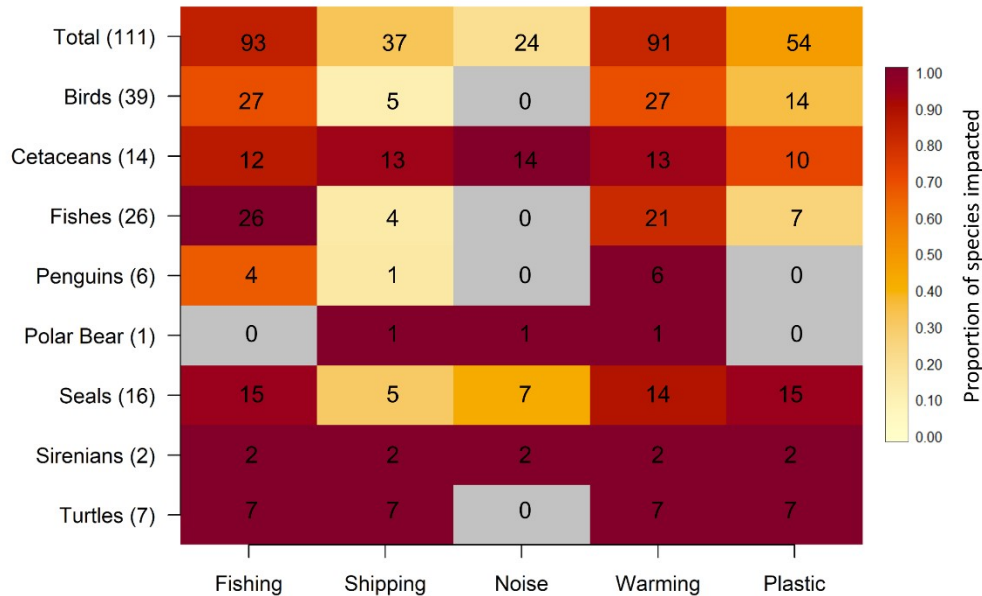
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**Fig. S3. Marine Protected Areas (MPAs) and Exclusive Economic Zones (EEZs) in the marine environment**

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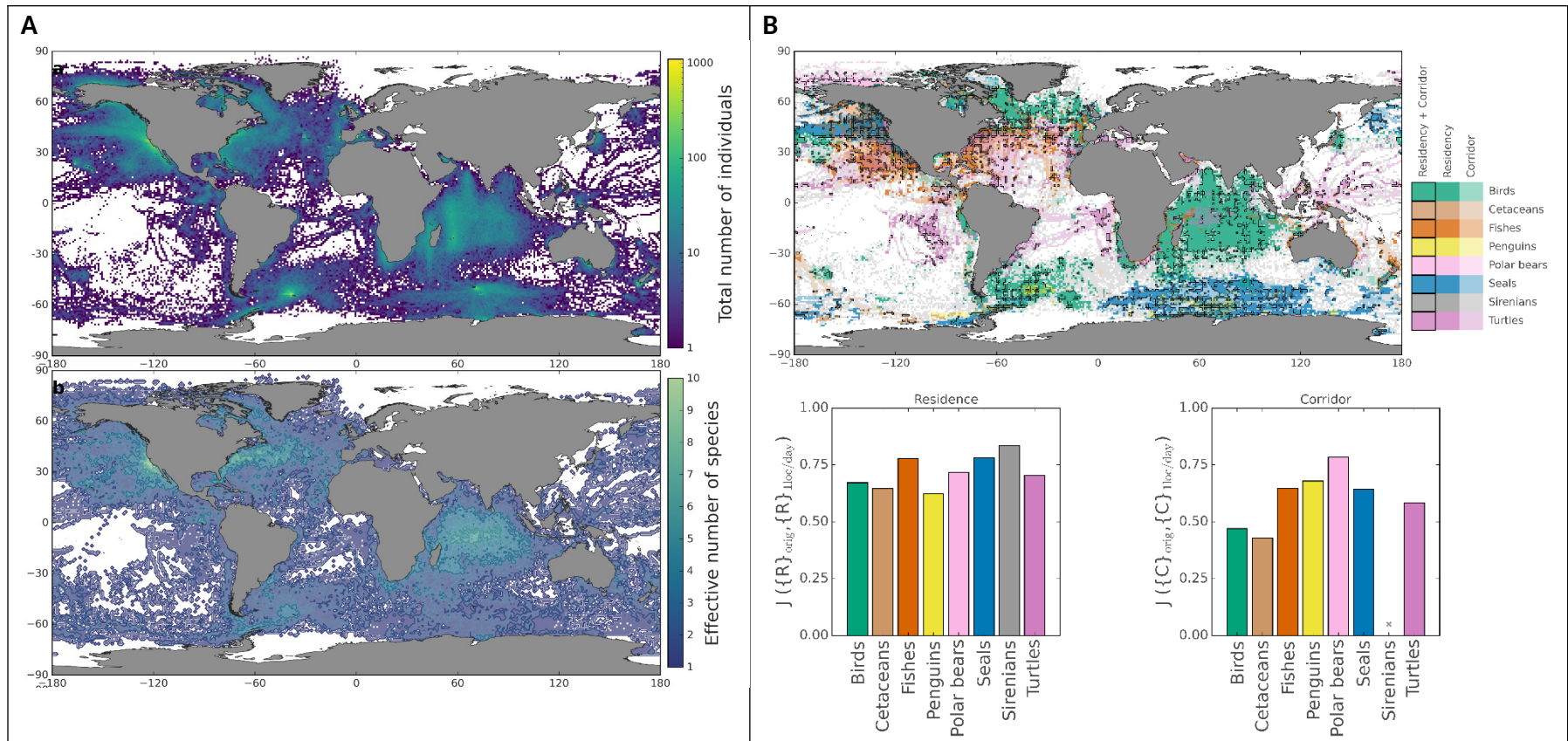
We obtained geographical information defining existing marine protected areas (MPAs, including marine parks; shown in blue) from [protectedplanet.net](http://protectedplanet.net) (accessed 10 June 2021) (33) and exclusive economic zones (EEZs; shown in grey) from [marineregions.org/](http://marineregions.org/) (accessed 28 June 2021) (34).



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**Fig. S4. Number of species affected by each anthropogenic threat considered**

Summaries of the number of species known to be impacted by each threat considered in our analyses based on the listed threats and sub-threats on the IUCN Threats Classification Scheme v3.3(50) as detailed in table S4. Figure shows commercial fishing and climate change (represented as SST anomaly) has having impacts on the highest number of species analysed in this study, and with fixed gear and longlines fishing gears listed for most species. All sea turtles, sirenians and polar bears are affected by most of the threats. A large number of birds, cetaceans and fishes are impacted by fishing and SST anomaly, with higher number of birds and fish species being impacted by plastic, and higher number of cetacean species being the most impacted by shipping and noise. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.



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### Fig. S5. Assessment of behaviours detected when using only one position per day for each individual

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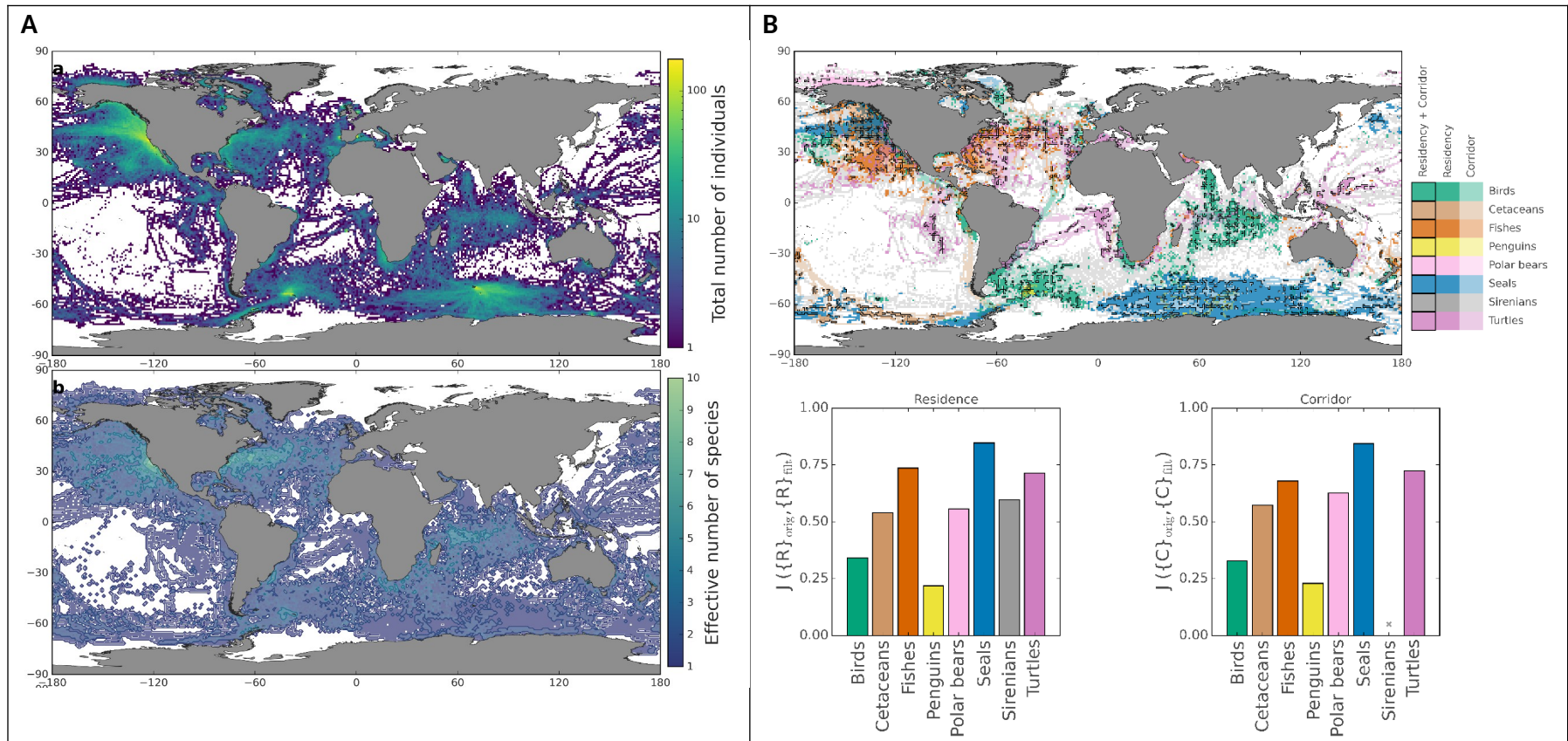
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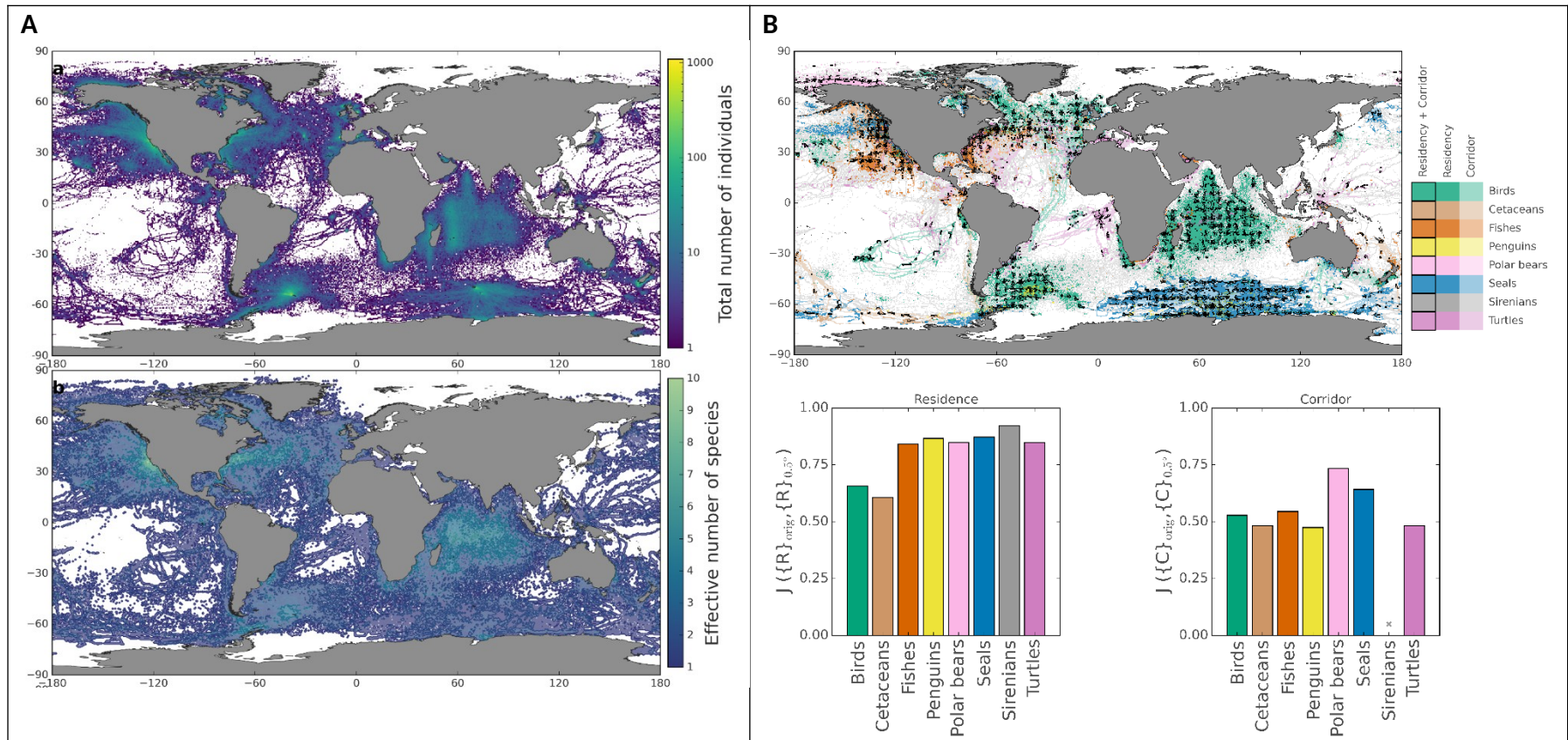
Results for the final tracking dataset when considering only one position per day per individual across all taxa. All maps show similar spatial patterns to those obtained for the complete dataset (as shown in Fig. 1 and Fig. S2). A) Top: Total number of individuals for which we have tracking data in each grid-cell; Bottom: effective number of species obtained per grid-cell. B) Top: Identified migratory and residence areas when using only one position per day per individual across all taxa (greyed grid-cells indicate that no key movement behaviour was identified); Bottom: Results obtained when using the Jaccard Index to compare the results obtained here with those obtained from the original dataset. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.



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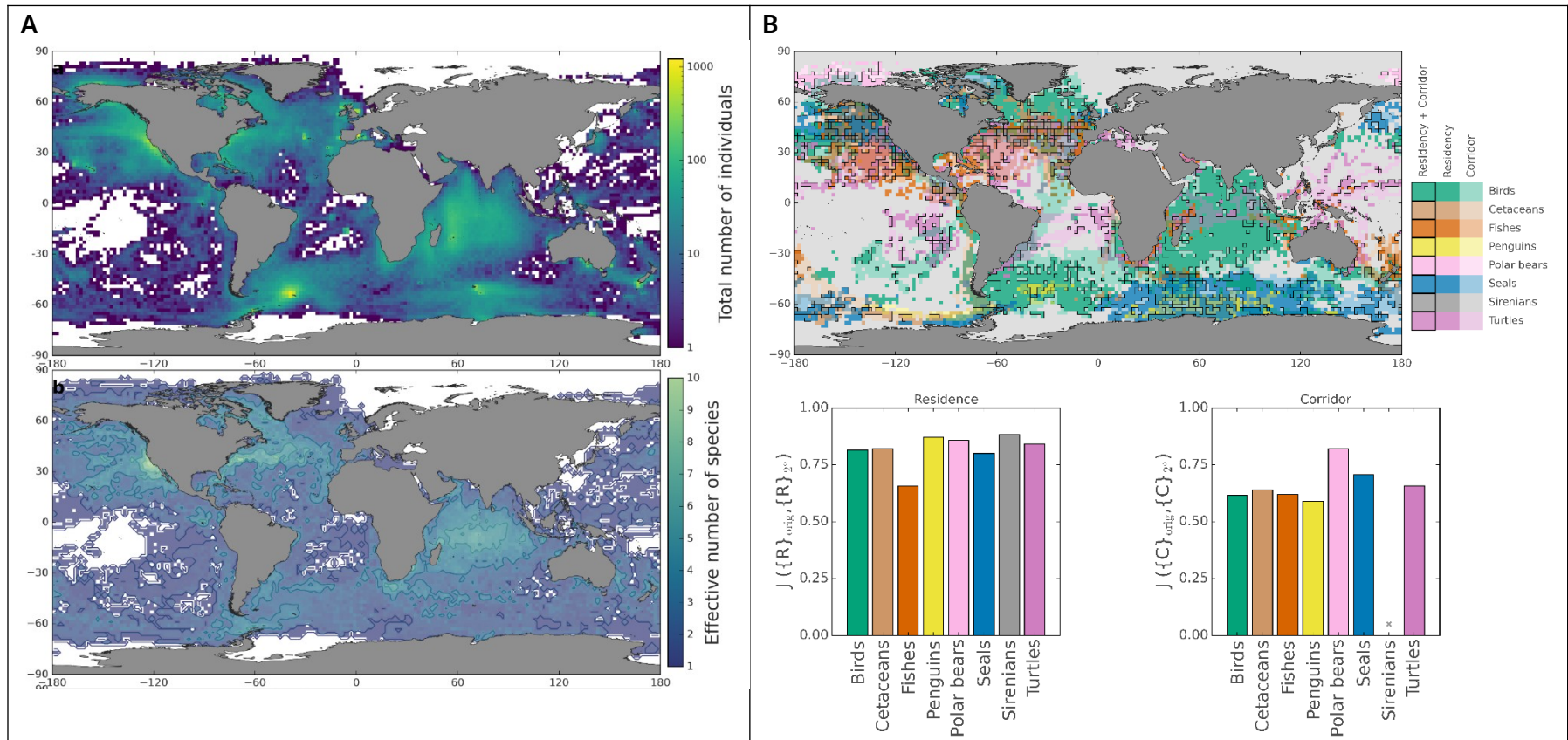
**Fig. S6. Assessment of behaviours detected when removing the tagging location bias**

Results for the final tracking dataset after removing the tagging location bias. All maps show similar spatial patterns to those obtained for the complete dataset (as shown in Fig. 1 and fig. S2). A) Top: total number of individuals for which we have tracking data in each grid-cell; Bottom: effective number of species obtained per grid-cell. B) Top: Identified migratory and residence areas when removing all locations around the tagging location for all individuals across all taxa (greyed grid-cells indicate that no key movement behaviour was identified); Bottom: Results obtained when using the Jaccard Index to compare the results obtained here with those obtained from the original dataset. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.

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### Fig. S7. Assessment of behaviours detected when changing resolution to 0.5°

Results for the final tracking dataset when considering a spatial resolution of 0.5°. All maps show similar spatial patterns to those obtained for the complete dataset (as shown in Fig. 1 and fig. S2). A) Top: total number of individuals for which we have tracking data in each grid-cell; Bottom: effective number of species obtained per grid-cell. B) Top: Identified migratory and residence areas when halving the spatial resolution (greyed grid-cells indicate that no key movement behaviour was identified); Bottom: Results obtained when using the Jaccard Index to compare the results obtained here with those obtained from the original dataset. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.



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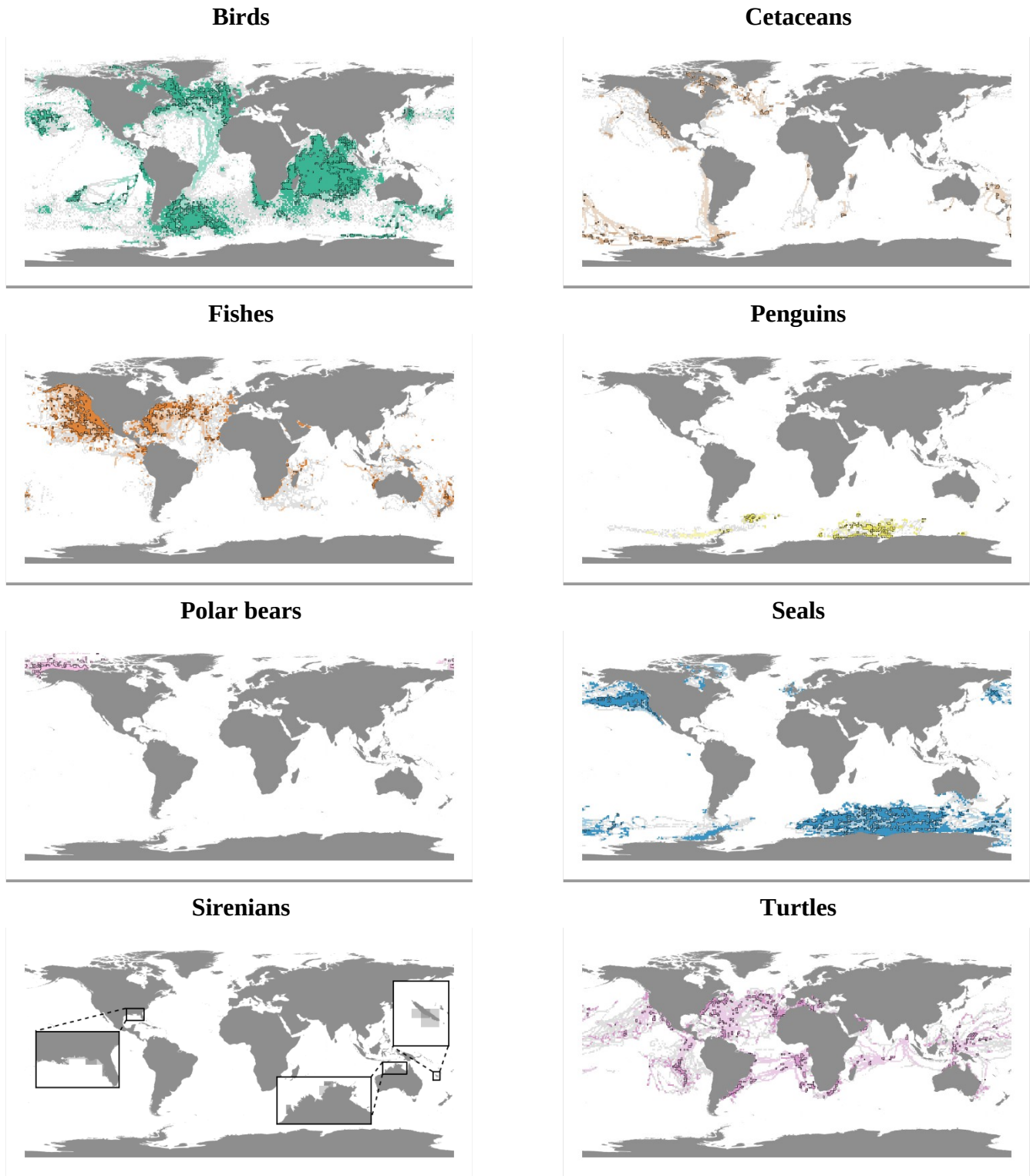
**Fig. S8. Assessment of ecological meaningful behaviour when changing resolution to 2°**

Results for the final tracking dataset when considering a spatial resolution of 2°. All maps show similar spatial patterns to those obtained for the complete dataset (as shown in Fig. 1 and fig. S2). A) Top: total number of individuals for which we have tracking data in each grid-cell; Bottom: effective number of species obtained per grid-cell. B) Top: Identified migratory and residence areas when doubling the spatial resolution (greyed grid-cells indicate that no key movement behaviour was identified); Bottom: Results obtained when using the Jaccard Index to compare the results obtained here with those obtained from the original dataset. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.

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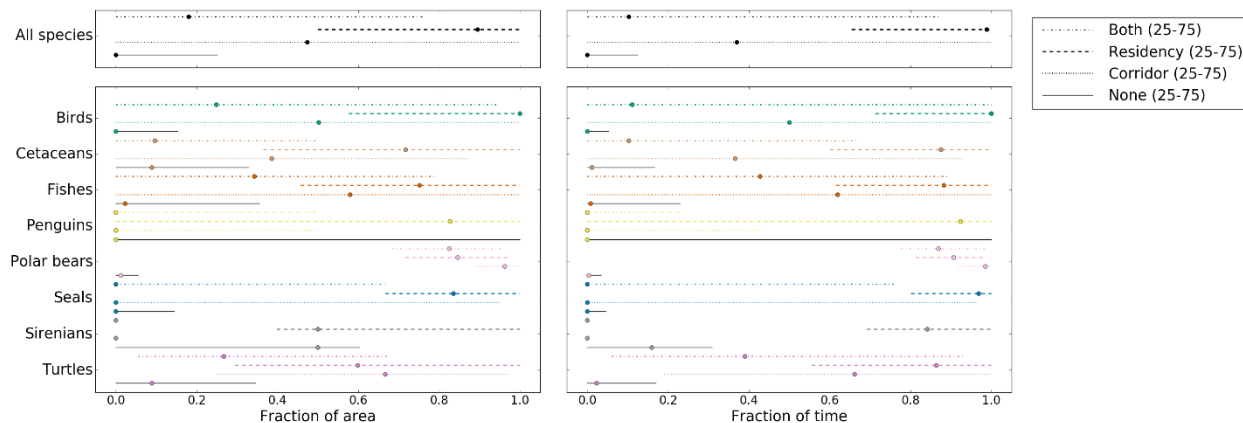


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**Fig. S9. Detected important migratory corridors and residence areas found by taxa**

Spatial representation of migratory corridors and residence areas by taxa detected based on our analyses of coherence and z-scores (Methods). Results include the migratory corridors shown with faded colours for each taxon, which were obtained after detection of the time window that

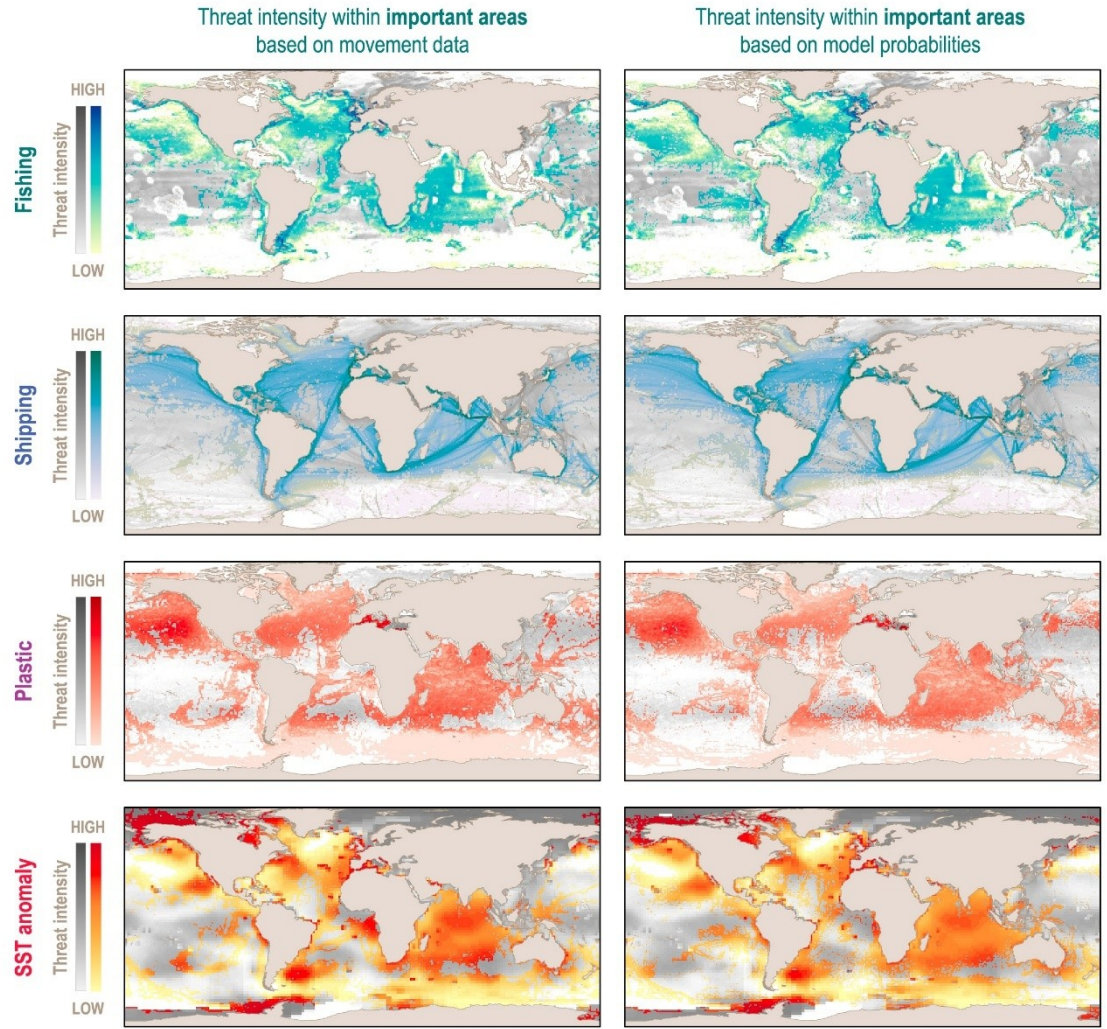
3410 resulted in the maximum number of 1° grid-cells showing coherent direction of movement  
3411 within each month for each taxon (fig. S12), and after detection of hotspots of coherence clusters  
3412 using on a Lorenz curve approach (fig. S13). Residence areas, indicated by grid-cells shown in  
3413 stronger colours, were obtained based on z-scores of one standard deviation below the average  
3414 displacement for each taxon. Where both migratory corridors and residence areas were found,  
3415 grid cells include a black outline. Grey indicates grid-cells where no specific behaviour was  
3416 identified. White areas depict regions without tracking data. Species considered in each taxon  
3417 group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes  
3418 (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and  
3419 manatees), and turtles.



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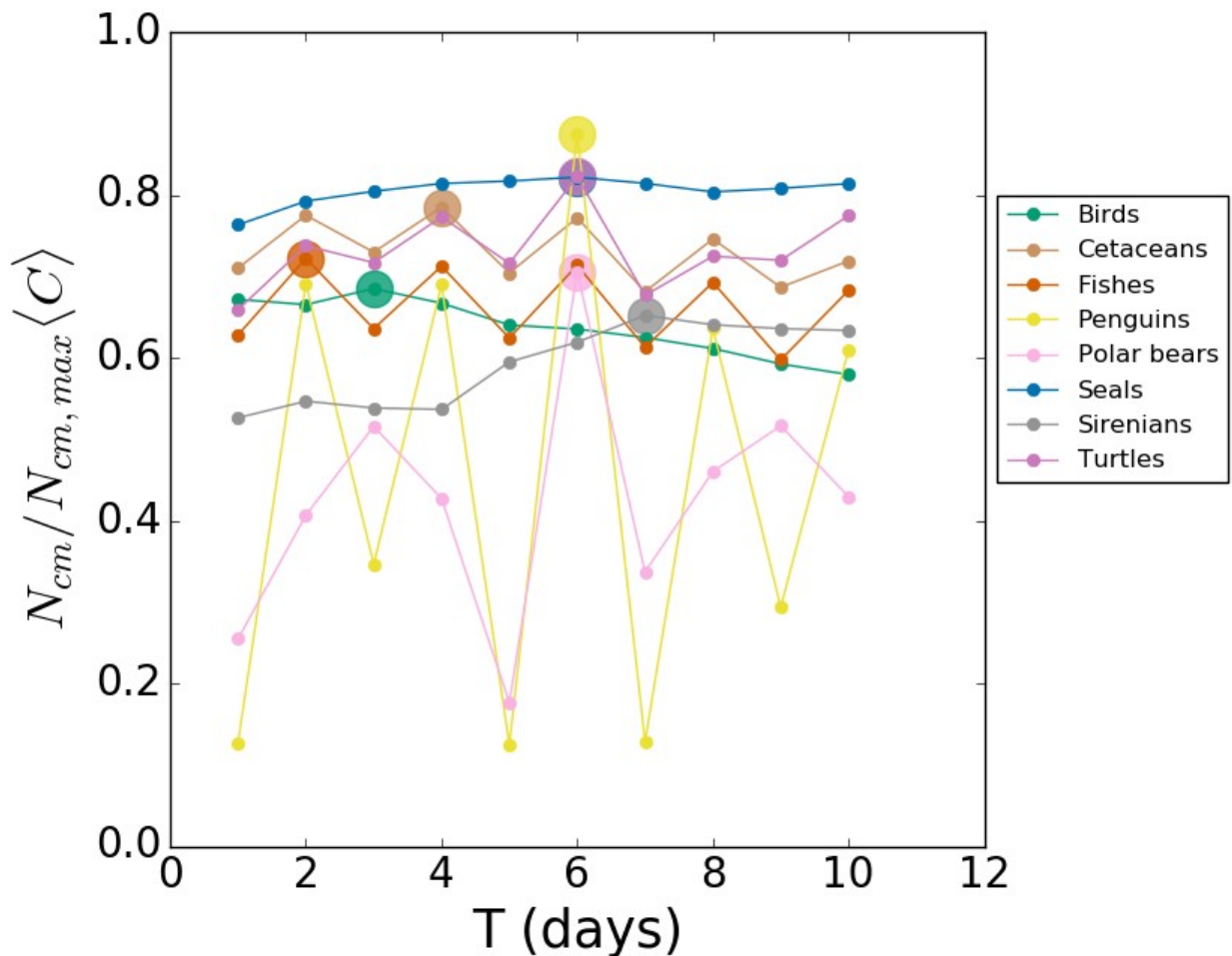
3421 **Fig. S10. Statistics of the space and time used for different behaviours per taxa**

3422 Fractions of space use (left panel) and time spent (right panel) in different behaviours calculated  
 3423 for each individual to show the distribution of the results obtained per taxa. Shown are the  
 3424 median values (percentile 50, dots) connecting the percentiles 25 and 75 obtained across  
 3425 individuals within each taxa. These values represent the most likely values on any sample of  
 3426 tracked individuals (with other values obtained outside the interval between percentiles 25 and  
 3427 75). Species considered in each taxon group include flying birds (listed as birds), cetaceans  
 3428 (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus*  
 3429 *maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.



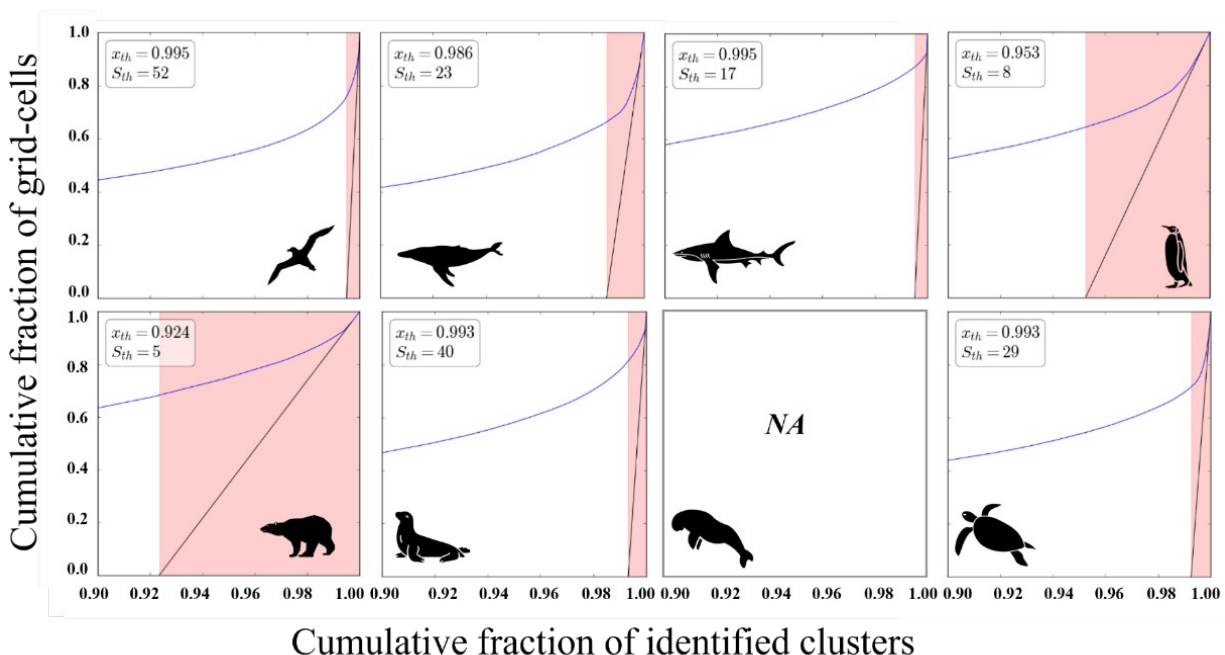
**Fig. S11. Global footprint of anthropogenic threats and intensity within important areas for marine megafauna (IMMegAs)**

The global footprint of anthropogenic threats is displayed as global averages per threat. Threat intensity outside the important marine megafauna areas identified in this study (left: based on the movement data, and right: based on model predictions) is indicated by the grey colour bar, and by the coloured bars per threat within important areas. Threats depicted include, from top to bottom: fishing intensity, shipping density, plastic density, and warming (according to anomalies to sea surface temperature; SST).



3443 **Fig. S12. Average monthly coherence results at multiple time windows for all taxa**

3444 Our analyses for detection of key movement behaviours indicated by migratory or residency-like  
 3445 behaviours showed that the maximum number of 1° grid-cells with coherent movement was  
 3446 obtained for time windows ( $Tw$ ) < 10 days for all taxa considered: 2 days for fish, 3 days for  
 3447 birds, 4 days for cetaceans, 6 days for penguins, polar bears, seals, and turtles, and 7 days for  
 3448 sirenians. Circles indicate the time at which coherence was highest for each taxon. Species  
 3449 considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales  
 3450 but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals,  
 3451 sirenians (i.e., dugongs and manatees), and turtles.



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**Fig. S13. Detection of cluster hotspots of coherence with the Lorenz curve**

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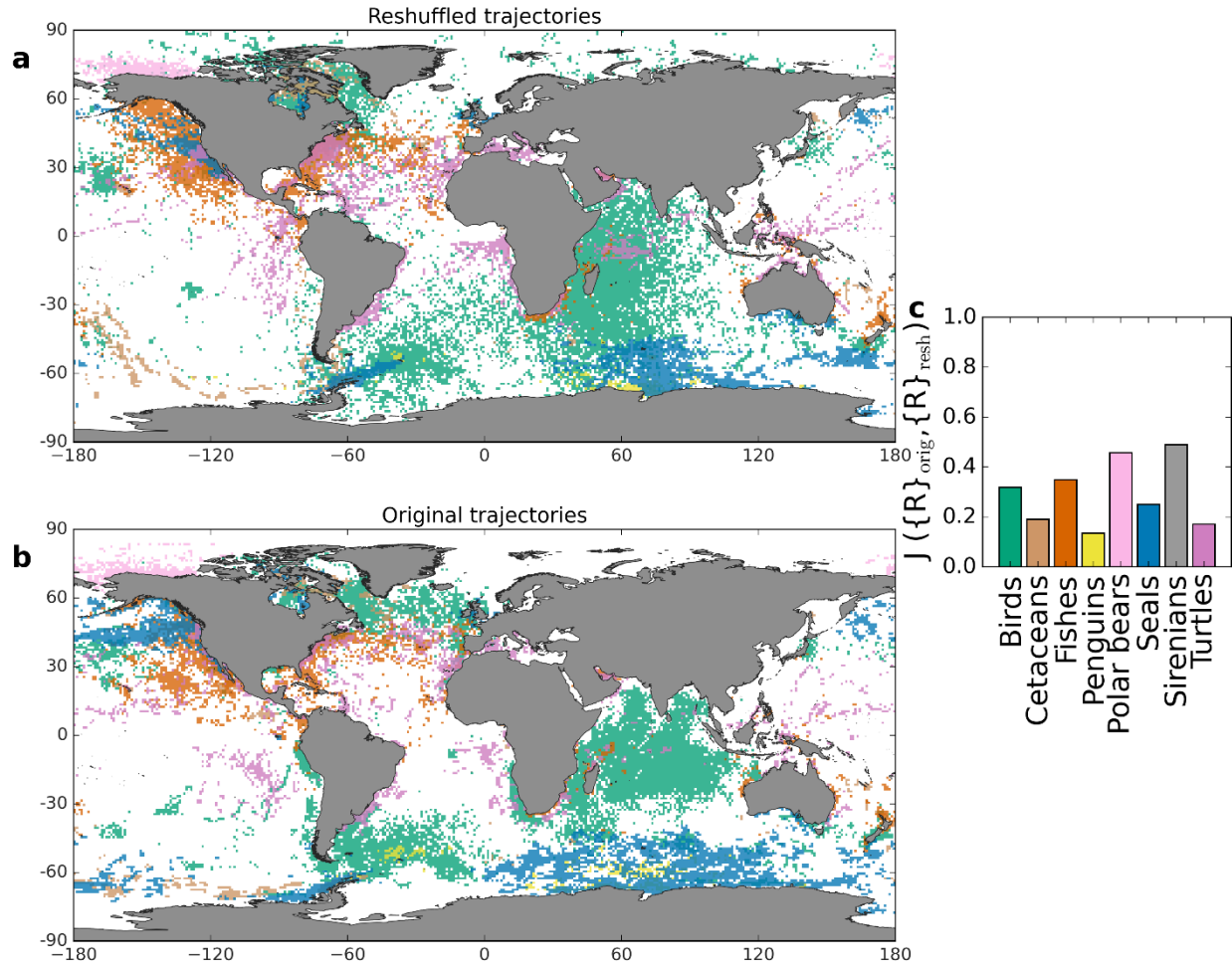
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Plots show the results obtained per taxon, when considering multiple temporal scales of 1, 2, 3, 4, 5, 6, and 12 months to identify hotspots of clusters of grid-cells with coherent movement (i.e., grid-cells for which the cosine of the angle between their average directions is  $> 0.8$ ) that resulted in the global migratory corridors shown in Figure 3 (also shown per taxon in Fig. S9). The threshold for minimum cluster size defining a migratory corridor at each temporal scale for each taxon was identified with a Lorenz curve (parameter free approach; 121). For example, for birds, the hotspots for minimum cluster size were detected at the top 0.5% of the cumulative distribution (i.e., for  $x_{th} = 0.995$ ), indicating the minimum cluster size to identify a migratory corridor was 52 connected grid-cells. Migratory corridors were therefore, defined at minimum cluster sizes ( $S_{th}$ ) of 52 grid-cells for birds, 23 for cetaceans, 17 for fishes, 8 for penguins, 5 for polar bears, 40 for seals, and 29 grid-cells for turtles. No hotspots of clusters of grid-cells with coherent movement were detected for sirenians, likely due to lack of data. Species considered in each taxon group include flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks), penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and turtles.



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**Fig. S14. Comparison of detected residency areas across taxa after randomising tracks**

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Maps show the grid-cells identified as residency areas for each taxon after (a) and before (b) one

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example of randomised tracks (see Materials and Methods) to demonstrate animals are

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selectively using space. Patterns shown on the bottom map follow those identified in the original

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dataset and displayed in Fig. 2. (c) shows the Jaccard index (i.e., area of overlap divided by area

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of union) obtained for each taxon. The low values for the index across taxa confirm the

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independence of the results before and after randomising the dataset. Colours refer to birds (light

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green), cetaceans (dark yellow), fishes (red), penguins (dark green), polar bears (orange), seals

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(blue), sirenians (purple), and turtles (pink). Species considered in each taxon group include

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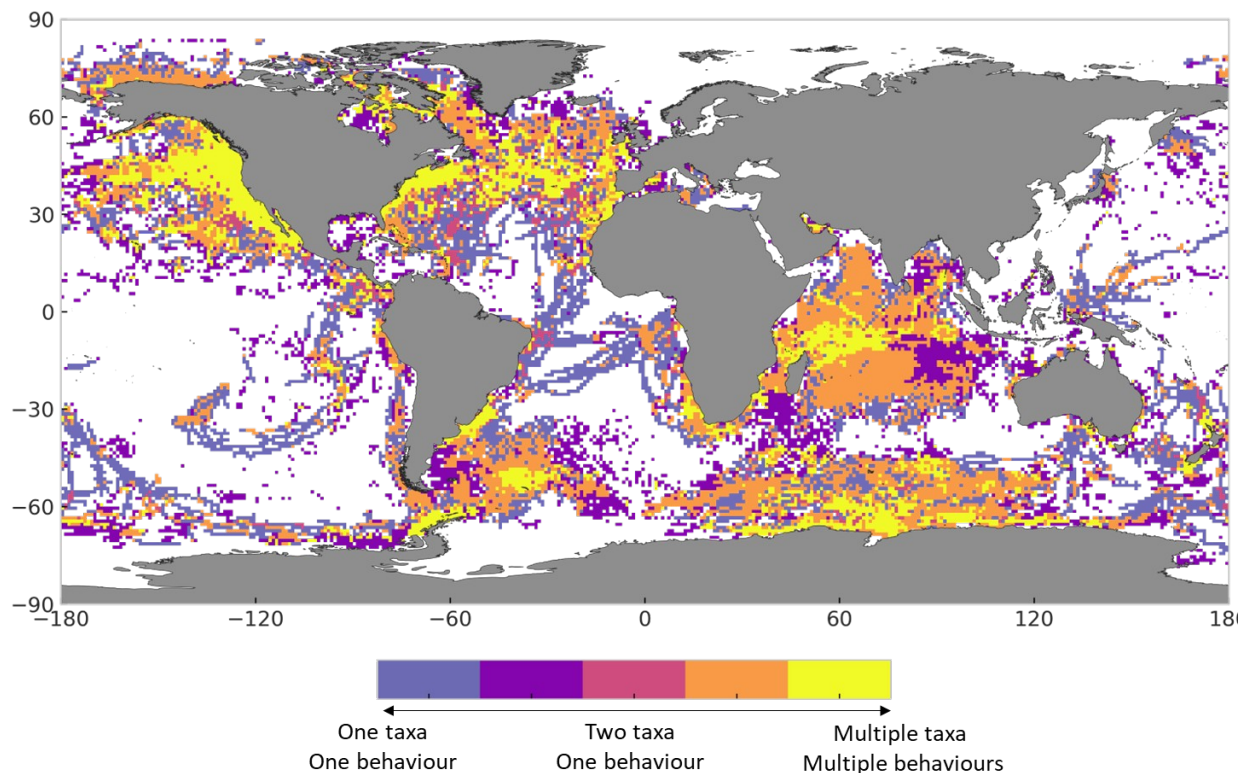
flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks),

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penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and

3481

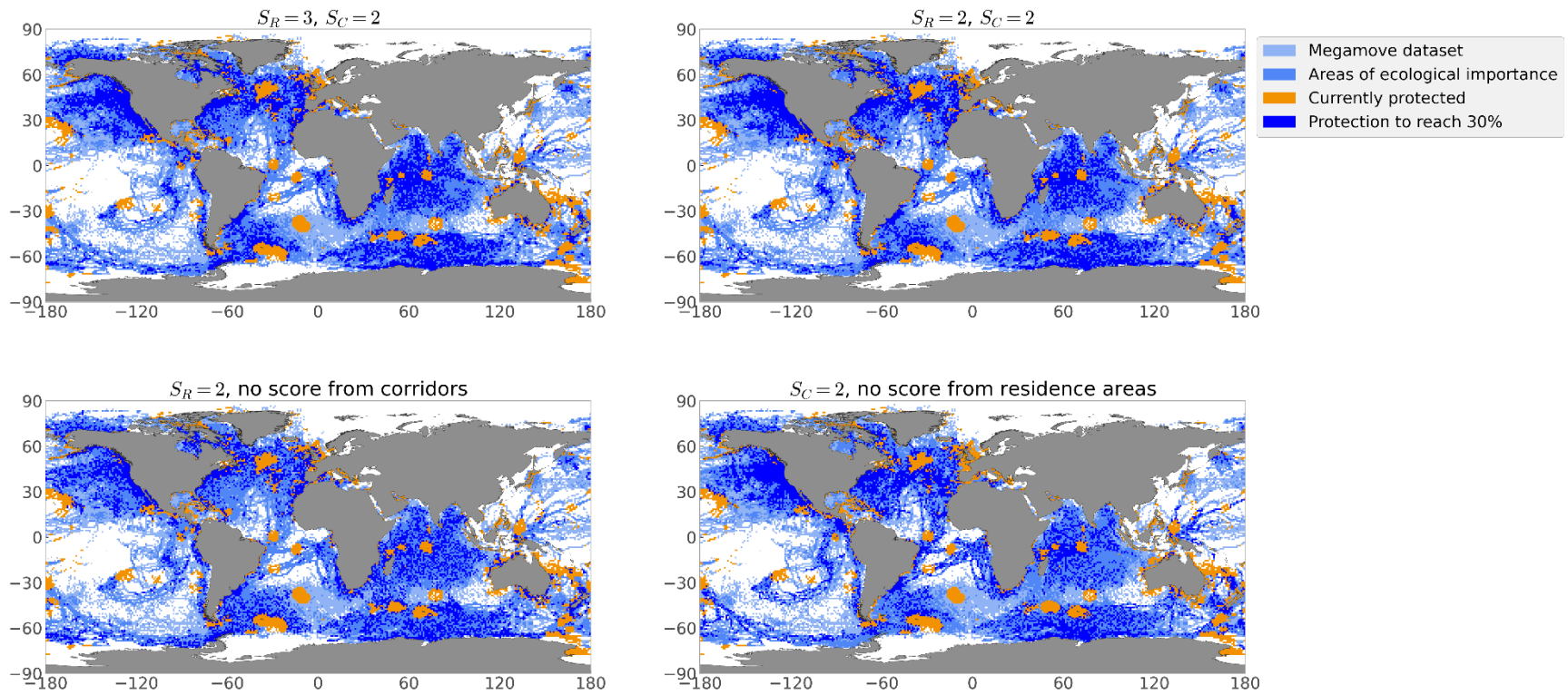
turtles.



3482

3483 **Fig. S15. Depiction of scores computed as part of the optimisation algorithm to select**  
3484 **priority areas for global protection of marine megafauna**

3485 Areas used by multiple taxa (noting that each taxa group includes multiple marine megafauna  
3486 species, table S1) are indicated with warmer colours (i.e., in purple, orange and red according to  
3487 an increase in taxa and behaviours observed).  
3488



**Fig S16. Sensitivity analyses on the priority areas selected by our optimisation algorithm**

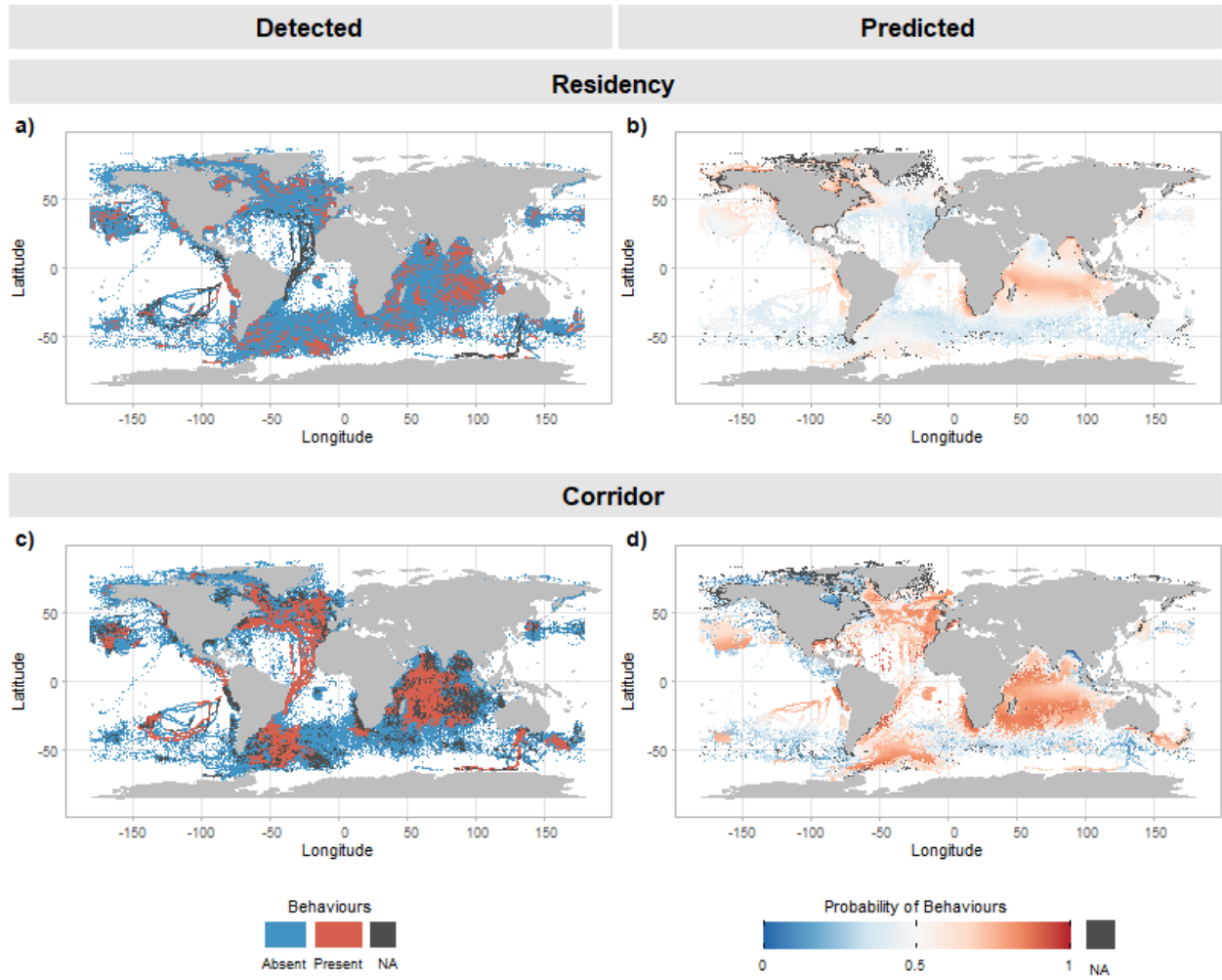
Results obtained when the scores for migratory corridors ( $S_C$ ) and for residences ( $S_R$ ) used to run the optimization algorithm were

changed: (Top left)  $S_R=3$  and  $S_C=2$  as used throughout the manuscript, (Top right)  $S_R=2$  and  $S_C=2$ , (Bottom left)  $S_R=2$  with no score

for corridors, and (Bottom right)  $S_C=2$  with no score for residence areas (and showing the most different results as expected).

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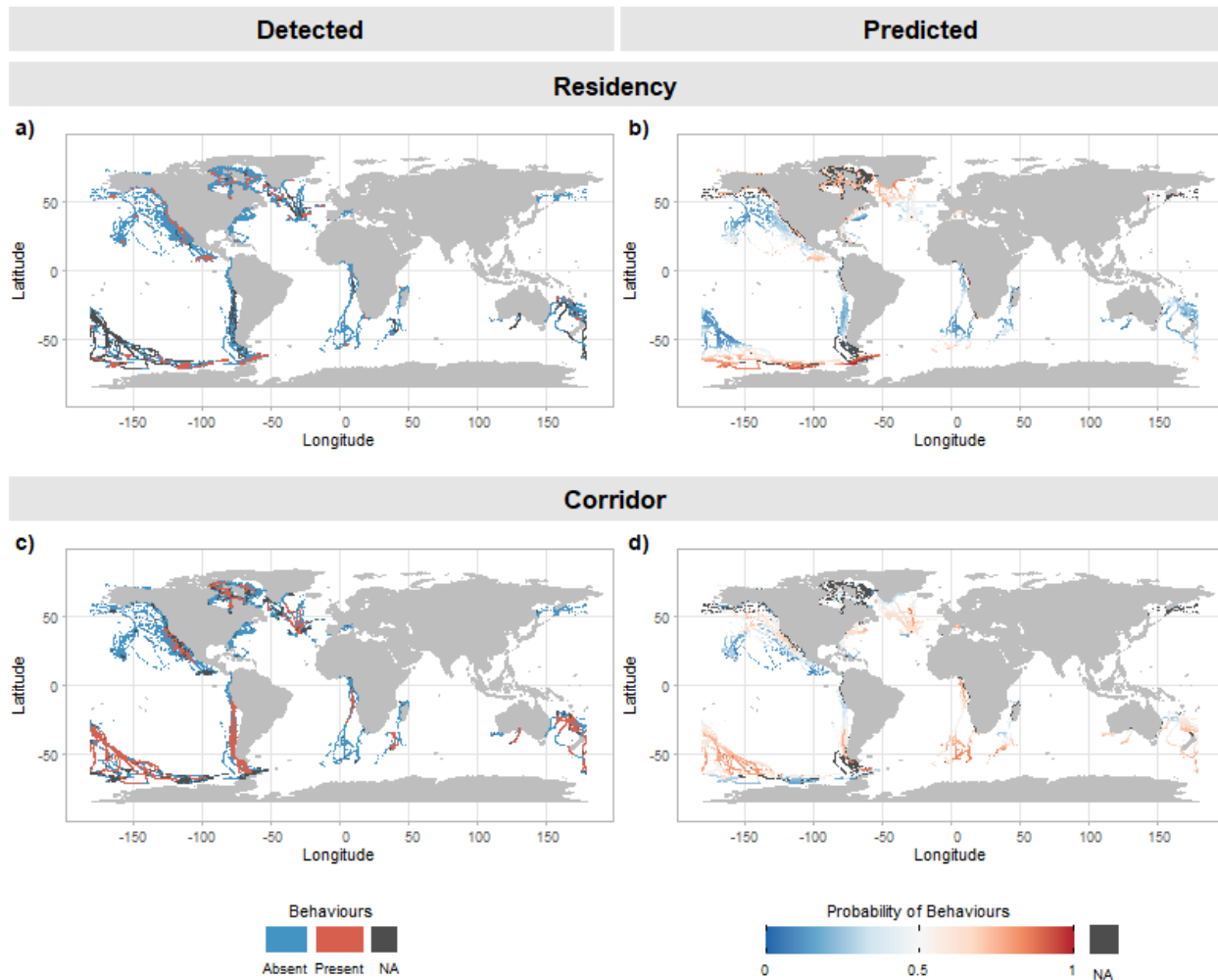
### Birds



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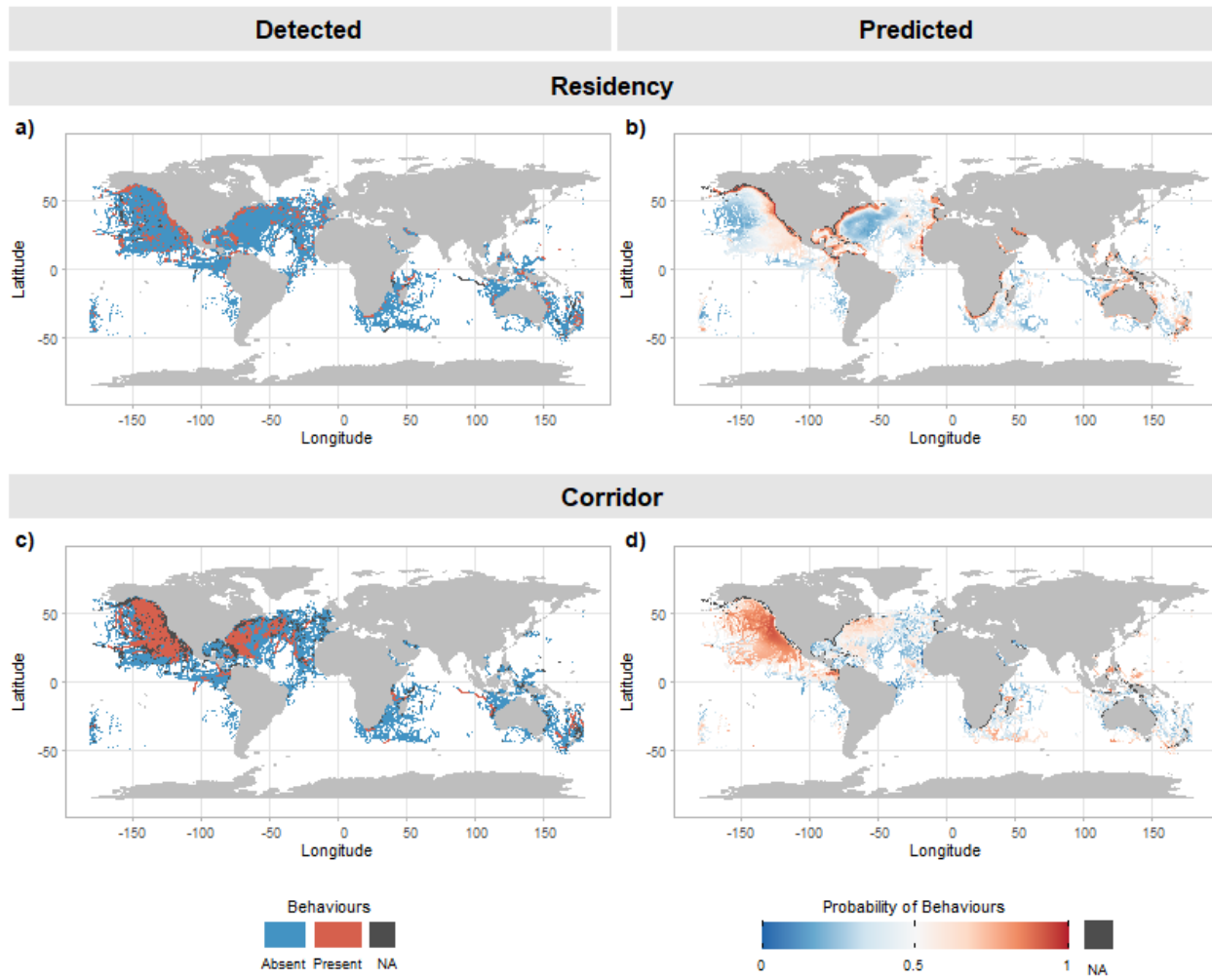
### Cetaceans



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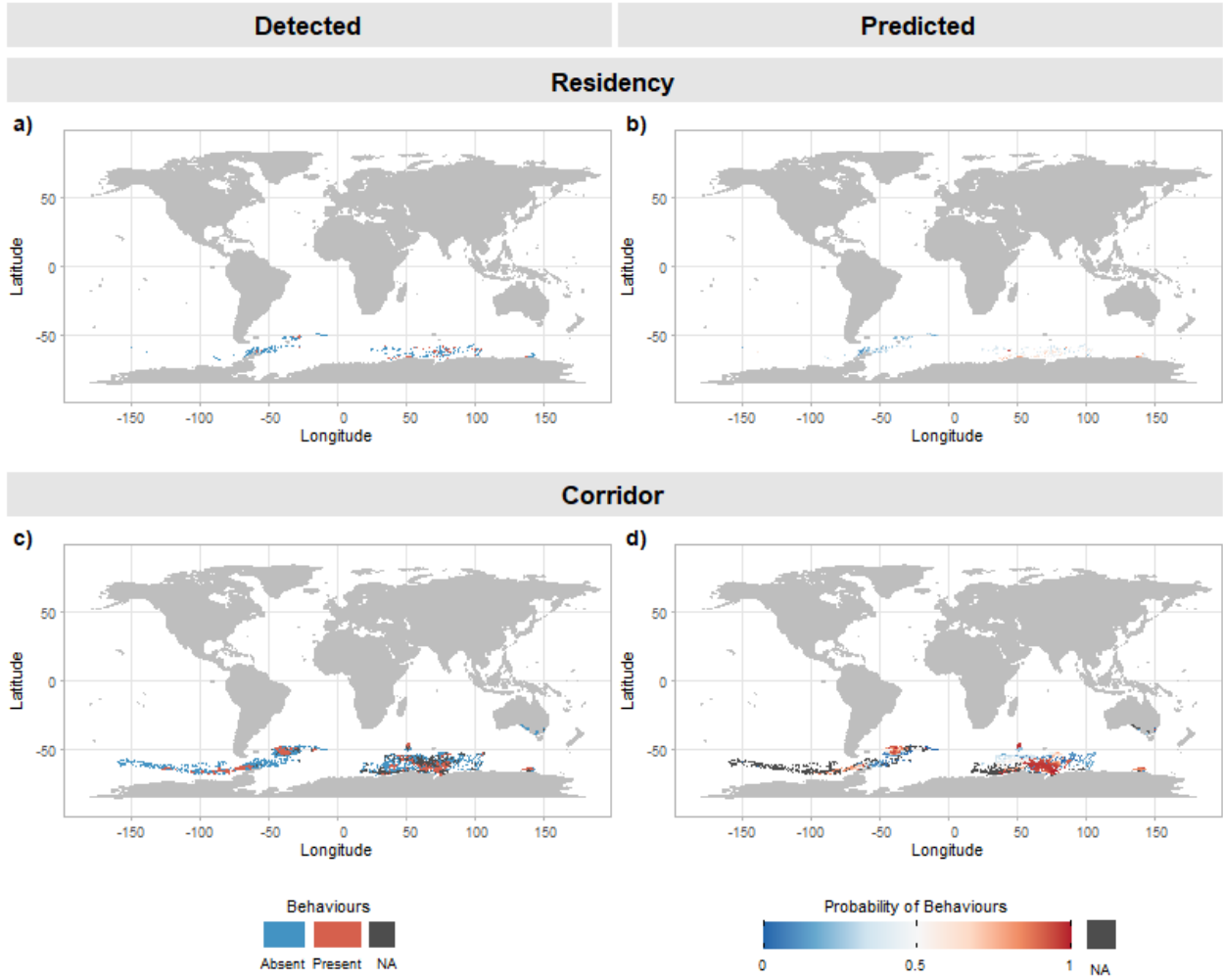
### Fishes



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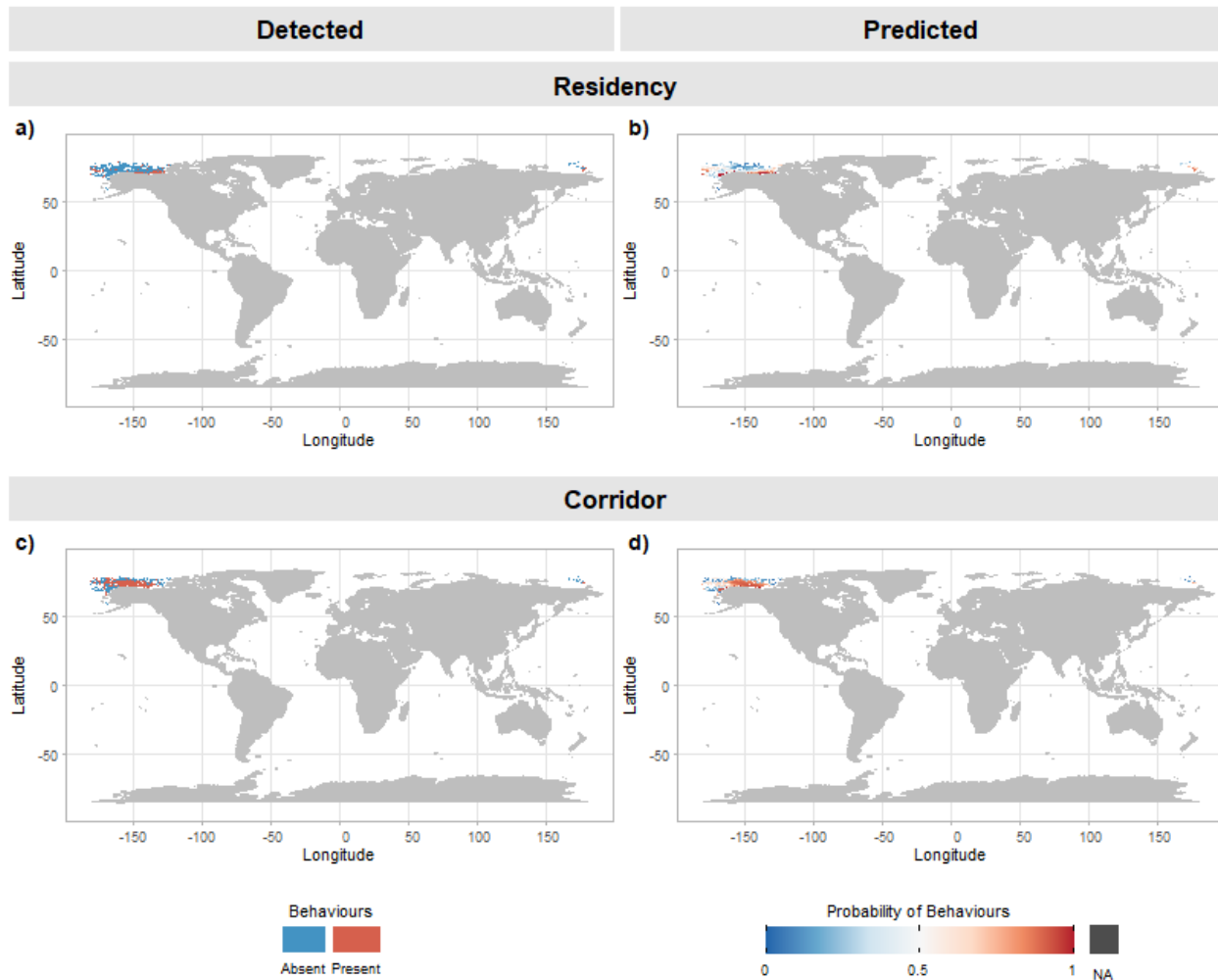
### Penguins



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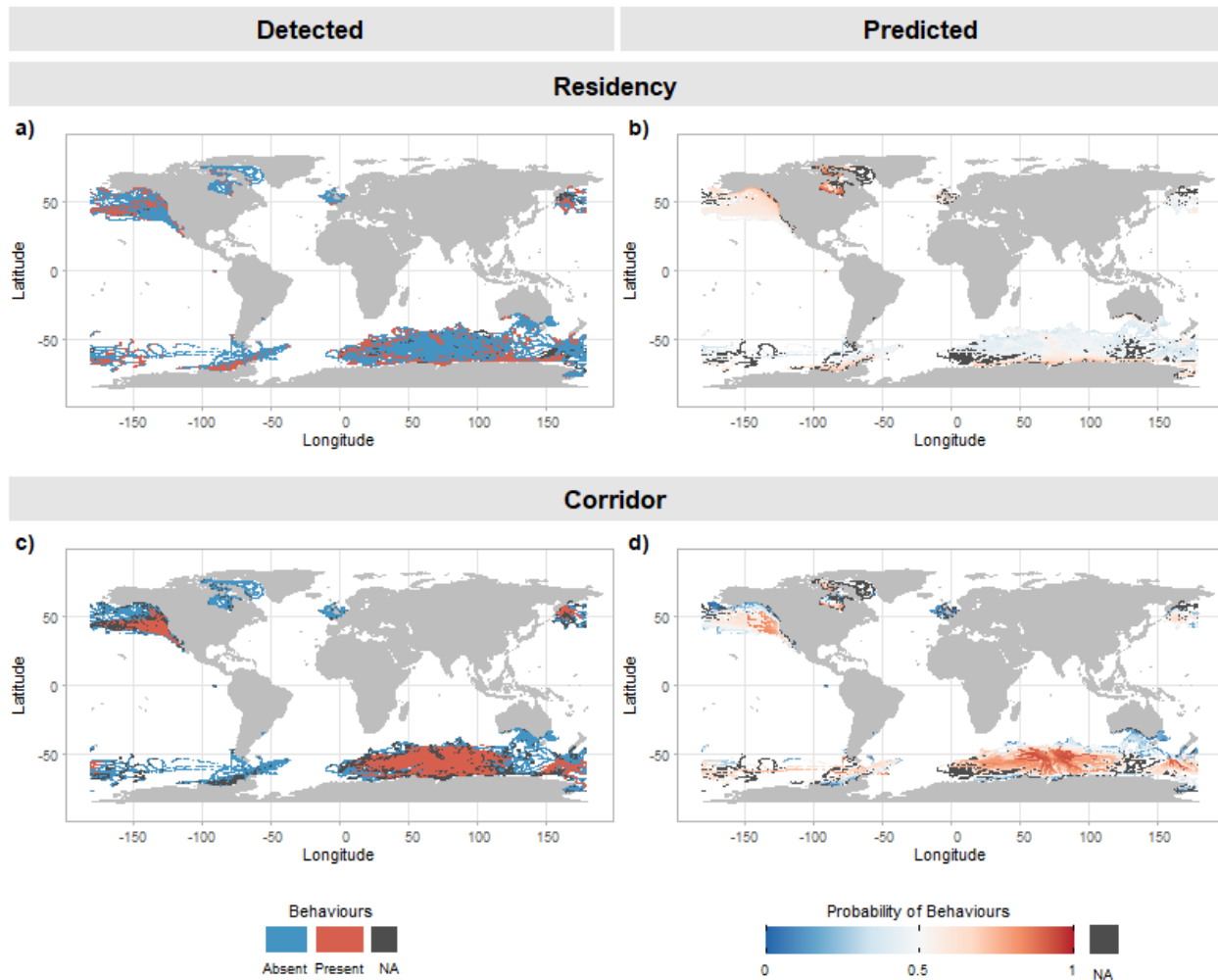
### Polar bear



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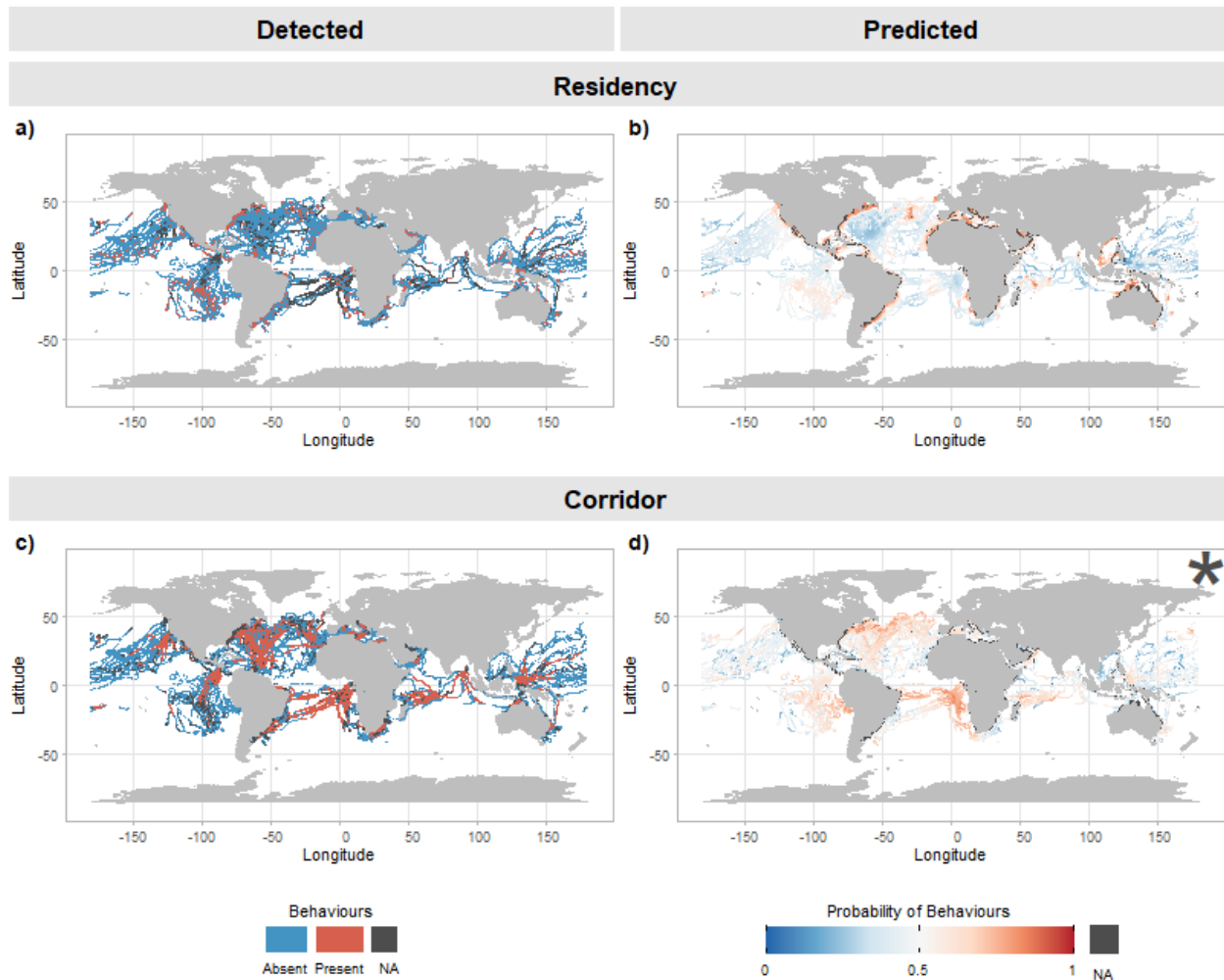
### Seals



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**Turtles**



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3509 **Fig S17. Comparison of detected and predicted areas used for important marine**  
3510 **megafauna behaviours**

3511 Shown are the maps we detected by our direct analyses of the tracking data (left) and those based  
3512 on predicted probabilities of behaviours occurring (right) for residency (top) and migratory  
3513 behaviours (bottom) for each taxon. Asterisks are included in the predicted maps for seal  
3514 residences and turtle corridors because the models leading to these predictions results in a  $K < 0.2$   
3515 and predictions were therefore, not considered when merging important marine megafauna areas  
3516 across all taxa based on modelled probabilities. Species considered in each taxon group include  
3517 flying birds (listed as birds), cetaceans (mostly whales but also dolphins), fishes (mostly sharks),  
3518 penguins, polar bears (*Ursus maritimus*), seals, sirenians (i.e., dugongs and manatees), and  
3519 turtles.