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Building evidence around ghost gear: Global trends and analysis for sustainable solutions at scale

Kelsey Richardson[a,*], Regina Asmutis-Silvia[b], Joan Drinkwin[c], Kirsten V.K. Gilardi[d], Ingrid Giskes[e], Gideon Jones[f], Kevin O'Brien[g], Hannah Pragnell-Raasch[h], Laura Ludwig[i], Kyle Antonelis[c], Susan Barco[j], Allison Henry[k], Amy Knowlton[l], Scott Landry[i], David Mattila[i], Kristen MacDonald[d], Michael Moore[m], Jason Morgan[n], Jooke Robbins[i], Julie van der Hoop[m,o], Elizabeth Hogan[p]

[a] University of Tasmania, Commonwealth Scientific and Industrial Research Organisation (CSIRO), 3-4 Castray Esplanade, Hobart, TAS 7000, Australia
[b] Whale and Dolphin Conservation, 7 Nelson Street, Plymouth, MA 2360, USA
[c] Natural Resources Consultants, Inc., 4039 21st Ave. West, Ste. 404, Seattle, WA 98199, USA
[d] Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California, Davis, 1 Shields Avenue, Davis, CA 95616, USA
[e] World Animal Protection, Level 2, 120 Christie Street, St Leonards, NSW 2065, Australia
[f] Emerald Sea Protection Society, 3144 West 7th Avenue, Vancouver, BC V6K2A1, Canada
[g] NOAA Pacific Islands Fisheries Science Center, Joint Institute of Marine and Atmospheric Research, NOAA Inouye Regional Center, 1845 Wasp Blvd., Bldg. #176, Honolulu, HI 96818, USA
[h] Project AWARE®, 30151 Tomas Suite 200, Rancho Santa Margarita, CA 92688, USA
[i] Center for Coastal Studies, 5 Holway Avenue, Provincetown, MA 02657, USA
[j] Virginia Aquarium and Marine Science Center, 717 General Booth Blvd, Virginia Beach, VA 23451, USA
[k] NOAA Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543, USA
[l] New England Aquarium, 1 Central Wharf, Boston, MA 02110, USA
[m] Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543, USA
[n] Northwest Straits Foundation, 1155 N. State Street Ste. 402, Bellingham, WA 98225, USA
[o] Zoophysiology, Department of Bioscience, Aarhus University, C. F. Møllers Alle 3, 8000 Aarhus C, Denmark
[p] World Animal Protection, 450 7th Ave., 31st Floor, New York, NY 10123, United States

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ABSTRACT

Abandoned, lost or discarded fishing gear (ALDFG) comprises a significant amount of global marine debris, with diverse impacts to marine environments, wildlife, and the fishing industry. Building evidence on ALDFG is critical to holistically understand the marine debris issue, and to inform the development of solutions that reduce amounts of ALDFG sources and recover existing gear. Substantial work has been and continues to be undertaken around the world to collect data on ALDFG, much of which remains unpublished. To provide a global picture of data on ALDFG, we organized a technical session that brought together seven ALDFG leaders to share their expertise in data collection, retrieval, and awareness-raising. This paper summarizes the technical session to highlight: 1) case studies that feature innovative approaches to ALDFG data collection and retrieval; 2) examples of opportunities to fill data gaps and improve our understanding of wildlife ingestion of and entanglement in ALDFG; and 3) awareness-raising through the development of a publicly accessible global ALDFG database.

* Corresponding author.
E-mail addresses: Kelsey.Richardson@csiro.au (K. Richardson), regina.asmutis-silvia@whales.org (R. Asmutis-Silvia), jdrinkwin@nrccorp.com (J. Drinkwin), kvgilardi@ucdavis.edu (K.V.K. Gilardi), IngridGiskes@worldanimalprotection.org (I. Giskes), gideon@emeraldseasociety.ca (G. Jones), kevin.obrien@noaa.gov (K. O'Brien), hannah.pragnell-raasch@projectaware.org (H. Pragnell-Raasch), lludwig@coastalstudies.org (L. Ludwig), kantonelis@nrccorp.com (K. Antonelis), SGBarco@virginiaaquarium.com (S. Barco), allison.henry@noaa.gov (A. Henry), aknowlton@neaq.org (A. Knowlton), sclandry@coastalstudies.org (S. Landry), dmattila@coastalstudies.org (D. Mattila), mmoore@whoi.edu (M. Moore), morgan@nwstraitsfoundation.org (J. Morgan), jrobbins@coastalstudies.org (J. Robbins), jvanderhoop@whoi.edu (J. van der Hoop), ehogan@worldanimalprotection.org (E. Hogan).

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1. Background

Abandoned, lost, or discarded fishing gear (ALDFG) comprises a significant amount of global marine debris, with a wide range of environmental and economic impacts. A recent study from the 'Great Pacific Garbage Patch' plastic accumulation zone in the North Pacific Ocean determined that abandoned, lost or discarded fishing nets alone represent 46% of the 79,000 tons of plastic observed within the 1.6 million km^2 region surveyed (Lebreton et al., 2018). Abandoned, lost or discarded fishing gear can travel long distances via winds and ocean currents before either sinking or accumulating along shorelines around the world (Brown et al., 2005; Macfadyen et al., 2009).

When fishing gear is lost, abandoned or discarded in the marine environment, it can continue to ensnare and capture marine wildlife, earning the moniker 'ghost gear' (NOAA Marine Debris Program, 2015). Marine wildlife are particularly at risk for ingestion of, or entanglement in, fishing gear, which can lead to injury and death (Laist and Wray, 1995; Gilardi et al., 2010). For example, 870 'ghost nets' recovered in the coastal waters of Washington, USA contained more than 32,000 individual marine animals, including more than 500 birds and 23 mammals (Good et al., 2009). Abandoned, lost or discarded fishing gear can also cause significant damage to marine ecosystems and benthic habitats through smothering, act as a navigation hazard, and compromise yields and income in fisheries (Gilman, 2015; Macfadyen et al., 2009; NOAA Marine Debris Program, 2015).

Research has been conducted around the world since the 1970s on the sources, amounts, fates and impacts of ALDFG (Breen, 1989; FANTARED 2, 2003; Gilman et al., 2016; Matsuoka et al., 2005; Macfadyen et al., 2009). Because most fishing gears are specific to target species, which vary across diverse geographies, ALDFG data are frequently limited in scope and are specific to local geographies, fisheries and gear types (Al-Masroori et al., 2009; Ayaz et al., 2010; Bilkovic et al., 2014; Carr and Cooper, 1987; Hareide et al., 2005; Maufroy et al., 2015; Santos et al., 2003; Uhrin, 2016; Webber and Parker, 2012). In addition to published literature, significant ALDFG data has emerged from ALDFG retrieval efforts undertaken around the world, particularly in the last few years. However, much of this work, and the resulting data, are still unpublished, and in many cases, ongoing (Global Ghost Gear Initiative, 2018; Project AWARE, 2018).

To identify and communicate the current global state of knowledge around ALDFG data and research, the Global Ghost Gear Initiative (GGGI)'s Build Evidence Working Group invited speakers from around the world to share their work around ALDFG data collection at a technical session during the 6th International Marine Debris Conference. Seven speakers presented on a range of ALDFG-related topics, including: ocean retrieval, data collection, impacts from both active gear and ALDFG, the importance of clearly differentiating between active gear and ALDFG in the marine debris context, and how data collection efforts are informing the development of solutions to and awareness-raising of the ALDFG issue. This paper summarizes the technical session to frame a global snapshot of unpublished ALDFG data. Novel approaches to building evidence on ALDFG are shared in three key areas: 1) case studies that highlight innovative approaches to ALDFG data collection and retrieval, 2) examples of opportunities to fill data gaps and improve our understanding of ALDFG ingestion by and entanglement of wildlife, and 3) the development of a publicly accessible global database for compiling, communicating and sharing ALDFG data, best practices and solutions.

2. Data on Abandoned, Lost or Discarded Fishing Gear: retrieval, impacts, communication and collaborative partnerships

2.1. Case studies that highlight innovative approaches to ALDFG retrieval and data collection

Innovative approaches to ALDFG retrieval and data collection are highlighted through three main case studies: 1) on a local scale in Washington State, USA; 2) on a remote, regional scale in the Northwestern Hawaiian Islands (NWHI), USA; and 3) on a global scale through the work of the nonprofit organization Project AWARE®. These case studies were chosen because they represent ongoing efforts to collect informative and relevant data about ALDFG on local, regional and global scales through retrieval approaches that have been tested and refined over time. While ALDFG retrieval efforts are recognized as curative measures, they are highlighted in this paper because of the information they provide on ALDFG sources, amounts and impacts. This information can be used to inform the development of ALDFG preventative measures.

The local case study from Washington State, USA highlights rigorous scientific data collection that informs a publicly accessible statewide reporting database. The regional case study from the NWHI demonstrates innovative approaches to ALDFG retrieval and data collection in remote geographies with limited access to clean-up personnel and resources. The global case study from Project AWARE shows retrieval and data collection methods that empower citizen science recreational divers working to inform knowledge of and mitigate impacts from ALDFG.

2.1.1. Case study 1: local ALDFG removal and data collection in the Salish Sea, Washington, USA

Since 2002, in the inland waters of the Salish Sea in Washington State, a concerted effort by the Northwest Straits Initiative has removed lost fishing nets and net remnants and quantified their negative impacts on species and habitats. The ALDFG data collection and removal efforts by the Northwest Straits Initiative, in collaboration with local fishers, other marine users, and the Washington Department of Fish and Wildlife, have been instrumental in informing knowledge of the amounts, types and impacts of ALDFG in this region; success and influence of removal efforts over time; and the continued development of ALDFG reporting mechanisms and management measures.

Through 2016, 5784 lost fishing nets and net remnants have been removed from marine waters to a depth of 100 ft (30 m) (Washington State Derelict Fishing Gear Database, 2018). The removal protocols established for retrieval activities include rigorous scientific data collection including but not limited to: removal and disposal methods employed; gear type, length, weight, shape, and estimated age; degree of incorporation of the gear into the environment; a list of entrapped, entangled or dead animals; threat of the gear to humans, animals and surface craft; the environmental impact of removal; and cost of removal and disposal. All animals found entangled in retrieved nets were identified to the lowest possible taxon via on-board observation, laboratory identification of bones and carcasses, or DNA analysis (Washington State Department of Fish and Wildlife, 2002).

To ensure effective subsequent analysis, all data are stored in a publicly available online database (Washington State Derelict Fishing Gear Database, 2018). The database was created on a Structured Query Language (SQL) platform and is partitioned. Public users can access non-confidential data, such as location of removed gear and species impacts. Only a select group of users may access confidential data related to locations of unremoved gear, the identity of who reported the gear, and the identity of the gear owner. All users are approved by the Northwest Straits Foundation and given unique login credentials. The current total of unique database records is 60,357, including both gear item and species impact entries combined (Washington State Derelict Fishing Gear Database, 2018).

The work by the Northwest Straits Initiative to collect and disseminate this data through publications and presentations to policy makers led the Washington state legislature to develop mandatory reporting requirements for lost commercial fishing nets, which was adopted by the Washington Department of Fish and Wildlife in 2012. This new fisheries management rule has resulted in the reporting and removal of more than 60 newly lost fishing nets, eliminating sources of

entanglement and likely mortality to marine mammals, birds, fish and invertebrates.

2.1.2. Case study 2: regional ALDFG removal and data collection in the Northwestern Hawaiian Islands (NWHI)

The remote archipelago of the Northwestern Hawaiian Islands (NWHI), designated as the Papahānaumokuākea Marine National Monument (PMNM), is home to numerous endangered, endemic, threatened, and protected species, including seabirds, green sea turtles, and Hawaiian monk seals (PMNM, 2018). Despite its remote location, this important and fragile marine ecosystem faces serious threats from extremely high quantities of ALDFG, which accumulate on its reefs and shorelines from throughout the Pacific Ocean (Dameron et al., 2007; Donohue et al., 2001). Abandoned, lost or discarded fishing gear in the NWHI presents an immediate threat to wildlife, and can scour, break, smother, and otherwise damage critically important coral reef habitats (Dameron et al., 2007; Donohue et al., 2001).

In response to the serious threats posed by ALDFG to the region's wildlife and habitats, since 1996 NOAA's Pacific Islands Fisheries Science Center (PIFSC) Marine Debris Project and multi-agency partners have conducted large-scale ALDFG removal operations from the reefs and shorelines of the remote NWHI (NOAA Marine Debris Program, 2018). To date PIFSC has removed more than 1.9 million pounds (848 m tons) of ALDFG in an effort to mitigate the hazards that this marine debris presents to this important ecological community (PIFSC Marine Debris Project, unpublished data).

To accomplish this significant level of ALDFG removal, particularly in light of the inherent challenges in working in remote locations with limited access to personnel and resources, PIFSC's Marine Debris team has employed and continues to develop novel ALDFG retrieval and data collection methods through in-water survey and removal methods. Survey transects are obtained by targeting historically high-density reef areas and creating survey polygons of approximately 0.5×0.5 km (Fig. 1c). The Marine Debris team utilizes two methods for the in-water survey and removal of ALDFG: free dive towboarding and swim surveys. Towboarding allows for rapid visual surveys in shallow water (less than 30 ft) and maximum area coverage (Fig. 1a). This unique method requires divers to use breath-holding techniques while being towed behind a 17–18 ft. inflatable boat at 1–2 kn. Snorkel (swim) surveys are primarily used around reticulated reefs or in areas which are too shallow or intricate to conduct towboard operations effectively (Fig. 1b). With both methods, divers survey until ALDFG is located on the reef, at which time a waypoint is taken and various data are collected (Fig. 1c). This typically represents about 1 day of effort for one boat engaged in towed diver surveys. Fishing gear type, colour, depth, level of bio-fouling, as well as dimensions and estimated volume of ALDFG are recorded for each ALDFG point. Substrate classification data are collected to best approximate benthic composition at the ALDFG location and to record interaction with live corals, including establishment of corals to the ALDFG surface. Upcoming research using Structure from Motion (SfM) photomosaic surveys (Burns et al., 2015) aims to better quantify the ecological impacts of ALDFG on the benthos. Determining the feasibility of remote sensing and geolocation of ALDFG from the air to improve survey and removal efficiency is also a research priority.

2.1.3. Case study 3: global ALDFG removal and data collection

On a global scale, Project AWARE®, a global not-for-profit organization, is building evidence on underwater marine debris, including ALDFG, through the use of citizen science to identify sustainable solutions that address not only the global ghost gear issue but also the marine debris issue more broadly. Significant data gaps exist with regards to quantitative information on the extent of marine debris, particularly for the underwater realm. In order to help close that data gap, Project AWARE developed Dive Against Debris®, a global marine debris survey focused explicitly on yielding data on underwater debris from the seafloor (Project AWARE, 2018).

Through Dive Against Debris, citizen scuba divers are empowered in the removal and reporting of marine debris items encountered at dive sites across the globe. The debris that is collected, including ghost gear, is sorted and disposed of accordingly, and wherever possible, items are recycled. Project AWARE is additionally currently exploring connections with a variety of upcycling initiatives around the world so that when possible, the debris removed can be re-used prior to being either recycled or appropriately disposed of.

By reporting the marine debris encountered and recovered, critical quantitative evidence is gathered regarding the types and quantities of marine debris items found underwater, on the seafloor, including ALDFG. Information concerning the impacts marine debris has on marine life is also captured including entanglement, injury and death. Debris-free sites are also recorded.

Since the program's launch in 2011, over 5600 marine debris surveys have been submitted through Dive Against Debris (Project AWARE, 2018). This represents almost 50,000 divers from 114 countries and more than 600 dive shops and resorts who have spent 8000 h completing surveys of the seafloor (Fig. 2). To date over one million marine debris items have been removed from the seafloor and reported through Dive Against Debris. This includes over 12,000 fishing nets, over 178,000 pieces of fishing line, more than 42,000 hooks, lures and sinkers and almost 3000 traps and pots, all of which has helped to prevent the continuation of ghost fishing by many of these pieces of lost gear. In addition, over 400 debris-free sites have been recorded (Project AWARE, 2018). Project AWARE has committed to remove and report one million more items by the end of 2020, using lessons learned to accomplish in a little over 2 years what was achieved over the last seven. To support a diverse global community, Project AWARE has developed online and offline tools to educate and train participants from varying geographies and cultures. Program materials are available in different languages.

Recognizing the importance of this global dataset, Project AWARE has shared the Dive Against Debris dataset with the Global Ghost Gear Initiative's Build Evidence Working Group to support the development of the group's global ALDFG database. This data has helped inform where ALDFG has and has not been recorded at various dive sites across the globe. The geographic scope and diversity of the Dive Against Debris dataset provides unique insights to the global ALDFG issue. Additionally, the data generated through Dive Against Debris provides one of just a few sources of absence data to inform where ghost gear has *not* been found. This is an essential component for identifying true ghost gear hotspots where management efforts should be prioritized.

2.2. Examples of opportunities to fill data gaps around and improve our understanding of wildlife ingestion and entanglement impacts

While there are a wide range of ALDFG impacts and data gaps, a systematic review of their entirety is beyond the scope of this paper. This paper chose to highlight two wildlife impact examples because of their novel approaches to filling data gaps and the importance of differentiating between sources and types of ALDFG.

Published data on marine wildlife morbidity and mortality caused by fishing gear ingestion and entanglement have emphasized impacts at the population level for marine mammals, seabirds and chelonians (e.g. Boren et al., 2006; Franson et al., 2003; Good et al., 2009; Hanni and Pyle, 2000; Orós et al. 2016; van der Hoop et al. 2013). Health impacts of fishing gear on marine wildlife are likely under-reported, largely because data on impacts to individual animals are collected primarily by wildlife rehabilitation organizations and are not published. Furthermore, only those organizations with access to diagnostic imaging equipment and surgery can document ingestion-related injuries, which are of particular concern because once hooks, line, nets and weights are swallowed, ingestion can lead to perforation of the gastrointestinal tract, obstruction, sepsis, toxicity and starvation, depending on what is

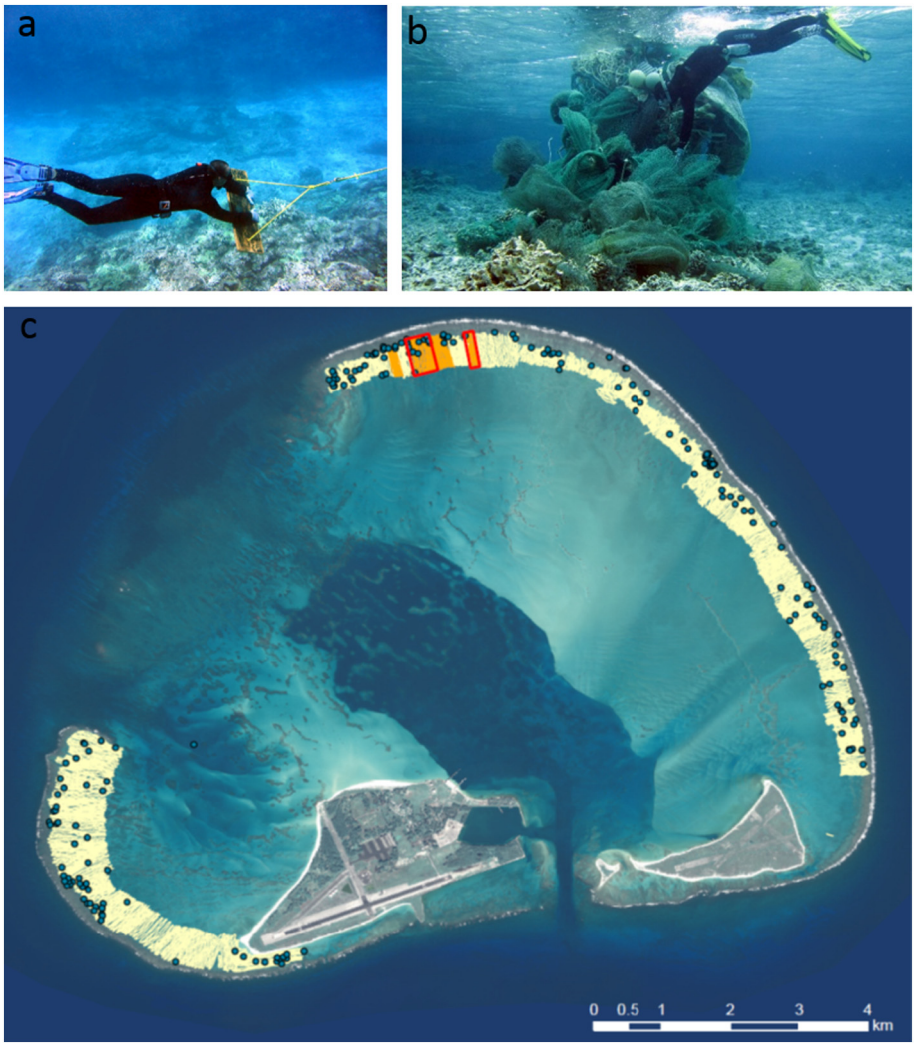

Fig. 1. Moving clockwise from top left, NOAA Marine Debris team conducts (a) freedive towboard and (b) swim surveys to collect data and (c) map ALDFG in the coastal and reef environments of the Northwestern Hawaiian Islands. Image (c) represents 2012 in-water surveys undertaken by the NOAA Marine Debris team over 13 days, by three small boats covering an area of 5.6 km^2. White lines show the total area surveyed using GPS tracking, orange lines show 1 day of surveys by three small boats, and the red boxes represent the surveys undertaken over 1 day by one small boat. Blue dots indicate waypoints taken for ALDFG identified on the reef (NOAA Fisheries, 2018). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 2. More than 5600 marine debris surveys submitted through Dive Against Debris® across 114 different countries, as of June 8, 2018 (Project AWARE, 2018).

swallowed (McCauley and Bjorndal, 1999; Moore et al. 2013; Zabka et al., 2006).

To build evidence for the health impacts of fishing gear on marine wildlife, medical records held by wildlife rehabilitation organizations from all ocean basins on admissions of select marine mammals, birds and turtles for fishing gear ingestion injuries from 2012 to 2017 are being systematically reviewed in a retrospective cohort study. Data on region, taxon, sex, age class, type of gear ingested, location of ingested gear in gastrointestinal tract, nature of injury, cause of death, and evidence for external entanglement are being collated. Previously, this

approach was taken to better understand impacts of fishing gear on marine wildlife in California, which determined that more than 10% of animals admitted for care were presenting with fishing-gear related morbidities (Kaplan Dau et al., 2009). Utilizing similar methods for data retrieval and analyses, the Global Ghost Gear Initiative's Build Evidence Working Group is compiling data from unpublished records at wildlife rehabilitation organizations to enable an epidemiologic evaluation of the scale at which fishing gear ingestion impacts the health of marine wildlife.

This evaluation will undoubtedly be a conservative estimate because marine wildlife suffering fishing gear ingestion injuries likely die in the wild, never to be observed or measured. While random sampling of healthy wild marine mammals, seabirds and chelonians would ensure a more representative estimate of wildlife mortality at population levels, such an approach would be unethical. The Global Ghost Gear Initiative's Build Evidence Working Group acknowledges the potential for reporter bias by only using medical records from wildlife rehabilitation organizations. However, these methods provide valuable, conservative measures of the scope of the problem, and set baselines for gauging trends in populations.

Entanglement of marine wildlife by fishing gear is additionally recognized as a significant conservation and welfare issue and is limiting the recovery of a number of marine species, including marine mammals (e.g., Reeves et al., 2013; Rojas-Bracho and Reeves, 2013; van der Hoop et al., 2013). It is therefore important to reliably identify the causes of entanglement events, including the nature of the entangling gear in order to reduce or prevent them in the future. A recently published review of marine debris assessed 76 publications and attributed a total of 1805 cases of cetacean entanglements in “ghost gear”, of which 78% ($n = 1413$) were extracted from 13 peer-reviewed publications (Stelfox et al., 2016). Asmutis-Silvia et al., 2016 examined the 13 publications cited in the review and found that none of the publications reviewed specifically attributed entanglements to “ghost gear”. In fact, the specific gear type or status of gear involved in the reported events was rarely mentioned beyond the fact that it was fishing related. This is likely due to the fact that determinations of debris as the entangling material are very difficult. An initial effort to quantify debris entanglement for large whales, however, found that ghost gear accounted for a small percentage of entanglements detected in Hawaiian waters (Lyman, 2014).

While determinations of ALDFG as an entangling material are difficult and evidence surrounding the impact of ALDFG to whales is limited, actively fished gear is widely recognized as a major source of entanglement risk to large whales (Benjamins et al., 2012; Mattila and Lyman, 2006; Johnson et al., 2005). The assumption that entangling gear is ghost gear/ALDFG unless otherwise stated has the potential to impact efforts to modify or restrict risk-prone fishing in key marine mammal habitats, misdirect resource managers from addressing entanglement issues arising from active gear, and contribute to public misperceptions about the different roles that ghost gear and active gear can play in marine wildlife entanglements. Asmutis-Silvia et al., 2016 strongly support the examination of entangling gear to determine if it was active gear or ALDFG when the entanglement occurred. Reducing gear loss will only reduce large whale and other marine wildlife entanglements if ALDFG is determined to be the cause of entanglements. By contrast, in the case of active gear entanglements, gear modifications or fishing area restrictions are typically more effective and relevant solutions. When and where possible, clearly distinguishing sources of marine wildlife entanglement between active fishing gear and ALDFG can better inform and direct management interventions designed to reduce entanglements at source.

2.3. Abandoned, lost or discarded fishing gear awareness raising: the development of a global ALDFG database

Recognizing the wide range of risks and impacts from ALDFG, in 2015 the not-for-profit organization World Animal Protection launched the Global Ghost Gear Initiative (GGGI), bringing together a critical group of stakeholders and experts to collaboratively address the issue of ghost gear on local, regional and global scales. The GGGI is comprised of a diverse variety of participants that include the fishing industry, fishing gear manufacturers, the seafood industry, researchers, governments, intergovernmental and non-governmental organizations. The formation of the GGGI was predicated on the concept that industry engagement and the formulation of effective solutions – whether prevention, mitigation or cure-based – must be built upon solid evidence of the prevalence and impacts of ALDFG.

Sharing data and resources on global ALDFG abundance, causes, impacts and trends has been critical in driving interest and meaningful action from the international community, including the prioritization of this issue within the framework of the United Nations Sustainable Development Goals (SDGs). By 2025, countries and other stakeholders will be asked to report back to the United Nations and one another on their progress to significantly reduce amounts of marine debris, including ALDFG, under SDG 14.1 (United Nations Sustainable Development Goals, 2018). Global ALDFG data collection and monitoring efforts are essential to ensure that governments and inter-governmental organizations are substantially addressing marine debris reduction, including efforts to reduce ALDFG, in the most relevant geographies and hotspot areas. Despite the global importance of ALDFG data collection, ALDFG data has sometimes been difficult to obtain due to a lack of record keeping and monitoring on the issue, a lack of uniform data sharing systems and the transboundary nature of the problem.

To combat these challenges, the GGGI created tools and methods that both work with existing data and improve the way that data is collected. In September 2017, the GGGI designed and implemented a new global ALDFG database, to act as a repository for existing and new ALDFG data (Fig. 3). The design focuses on flexibility with respect to potential data submissions, allowing for partial records to be created that may nevertheless be useful (e.g. a report of unidentified gear, at a known place and time). It also supports complete and detailed reports of gear characteristics. The design aims to support submission of data commonly reported alongside or even in preference to gear related events – such as ingestion or entanglement data. This allows for a wide range of valuable information about impacts relating to ALDFG to be captured. By allowing submission from multiple sources (i.e. beach survey teams, NGOs, commercial fishers, fishery observers, and more), the rate of data capture is increased across diverse stakeholders.

One example of a database submission tool is the GGGI Gear Reporter app. This user-friendly, innovative tool was custom-designed by the GGGI Build Evidence Working Group in conjunction with the global ALDFG database, to provide complete records relating to ALDFG. The app is designed to allow users on-the-go access to ALDFG reporting by providing a range of information to report on from the simple presence of ALDFG sighted, through to detailed characteristic data.

At this early stage in development and distribution, the app is only available in English. In the future, the app will be expanded to include more languages. For users with limited internet access, data can be collected using the app offline and uploaded later online. In areas without access to the app, data collected through other means can be sent to the GGGI and later manually uploaded to the data portal. The GGGI has existing data partners in under-resourced areas of the world, and recognizes the importance of fostering relationships that ensure data collected in these regions can be identified, supported, and shared with the larger global community. To identify any biases due to greater reporting from well-resourced regions, data can be disaggregated using user identification. This will ensure unbiased representation of ALDFG hotspots. For more information on the app and how it works, please refer to the video narrated by the app developer (https://youtu.be/_i5HDcasXoA).

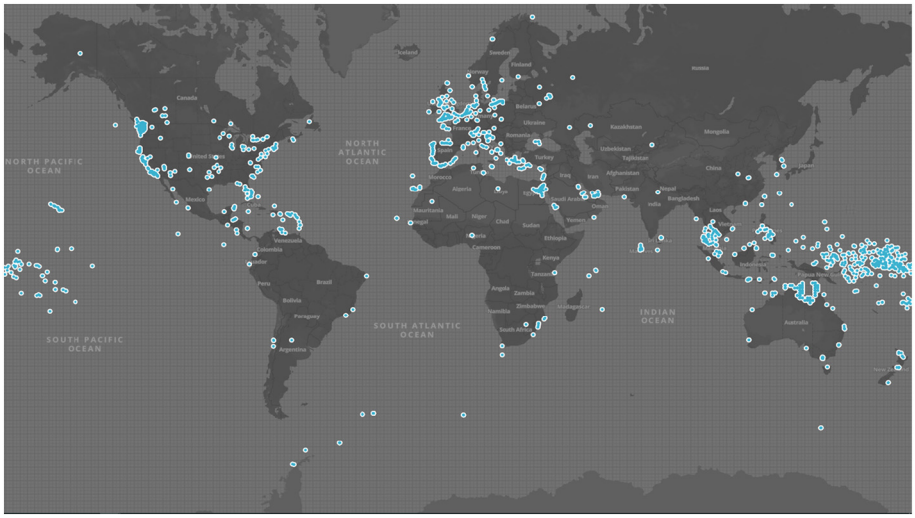

Fig. 3. Blue dots depict observations of abandoned, lost or discarded fishing gear (ALDFG) that have been contributed to the global ALDFG database. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

3. Conclusions

Data collection is critical to inform knowledge about the sources, amounts, fates and impacts of abandoned, lost or discarded fishing gear (ALDFG), a key and distinct part of the global marine debris issue. Novel approaches to ALDFG data collection, such as engaging citizen scientist snorkelers and scuba divers to collect data about underwater ALDFG, or collaborating with wildlife rehabilitation organizations to access data about fishing gear ingestion impacts, are helping to fill previous ALDFG knowledge gaps. Abandoned, lost or discarded fishing gear data can take a variety of forms, originates from different types of stakeholders around the world, and is collected using differing methodologies and units for measurement. The disparate data collection efforts described herein show the importance of and need for data communication and collaboration across the many different stakeholders involved in this issue. This is well-illustrated by the Global Ghost Gear Initiative (GGGI)'s work to develop a publicly accessible database that allows for standardization of, and comparison between, different ALDFG datasets from around the world.

Analysis and communication of ALDFG data further informs the development of solutions available to a range of stakeholders including fishers, fisheries managers, policy makers, not-for-profit and non-governmental organizations, and seafood sustainability certification organizations. Solutions include clean-up and retrieval efforts strategically aimed at ALDFG hot spot areas, fisheries management measures designed to minimize wildlife interactions with active gear and ALDFG, lost fishing gear reporting mechanisms that inform future retrieval areas, and spatial management measures that minimize gear conflict and gear loss. Mapping historic, ongoing and planned ALDFG data collection initiatives is additionally highlighting data poor regions in the world where future research efforts can be targeted. The innovative approaches to ALDFG retrieval and data collection efforts highlighted in this paper are examples of the growing momentum and collaboration across diverse stakeholders from local to global scales to raise awareness of and develop solutions to the ALDFG issue.

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Conflicts of interest

None.

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Table 1
Technical session presenters and contributors, their affiliations and presentation titles for the 6th International Marine Debris Conference technical session "Building evidence around ghost gear: Global trends and analysis for sustainable solutions at scale". (The presenting author(s) is in **bold**, with the email for the corresponding author(s) in *italics*). Presentations are listed in the order presented in the technical session.

Presentation title	Author(s) and affiliation(s)
Harnessing the power of citizen science to build evidence for sustainable solutions: Dive Against Debris®, a case study	**Hannah Pragnell-Raasch**, Project AWARE®; *hannah.pragnell-raasch@projectaware.org*
Documenting Species Impacts From Entanglement in Derelict Fishing Nets in the U.S. Salish Sea	**Joan Drinkwin**, Natural Resources Consultants, Inc.; K. Antonelis, Natural Resources Consultants, Inc.; P. Rudell, Natural Resources Consultants, Inc., J. Morgan, Northwest Straits Marine Conservation Foundation; *jdrinkwin@nrccorp.com*
Using and improving data relating to lost fishing gear	**Ingrid Giskes**, World Animal Protection; **Gideon Jones**, Emerald Sea Protection Society; *IngridGiskes@worldanimalprotection.org*; *gideon@emeraldseasociety.ca*
Building evidence for the health impacts of lost, abandoned and discarded fishing gear on marine wildlife	**Kirsten V.K. Gilardi**, Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California, Davis; K. MacDonald, Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California, Davis; *kvgilardi@ucdavis.edu*
Don't assume it is ghost gear: accurate gear characterization is critical for entanglement mitigation	Regina Asmutis-Silvia, Whale and Dolphin Conservation; S. Barco, Virginia Aquarium and Marine Science Center; T. Cole, NOAA Northeast Fisheries Science Center; A. Henry, NOAA Northeast Fisheries Science Center; A. Knowlton, New England Aquarium; S. Landry, Center for Coastal Studies; **L. Ludwig**, Center for Coastal Studies; D. Mattila, International Whaling Commission, Center for Coastal Studies; M. Moore, Woods Hole Oceanographic Institution; J. Robbins, Center for Coastal Studies; J. van der Hoop, Woods Hole Oceanographic Institution; *regina.asmutis-silvia@whales.org*
Large scale derelict gear removal in the Papahānaumokuākea Marine National Monument	**Kevin O'Brien**, NOAA Pacific Islands Fisheries Science Center, Joint Institute of Marine and Atmospheric Research; *kevin.obrien@noaa.gov*

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