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The Aquatic Wild Meat Database: a useful tool for monitoring small cetaceans illegally exploited for food and other purposes

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The Aquatic Wild Meat Database: a useful tool for monitoring small cetaceans illegally exploited for food and other purposes

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ABSTRACT

Aquatic wild meat is defined as the products derived from aquatic megafauna (e.g., aquatic mammals) that are used for food and other purposes (e.g., bait). It is obtained through illegal or unregulated hunts as well as from stranded (dead or alive) or bycaught animals. This activity constitutes a serious threat to many species of aquatic mammals around the world. Understanding the drivers of the use of aquatic mammals is of paramount importance to implement effective conservation measures and management programmes to monitor these activities. The Aquatic Wild Meat Database aim is to centralise available data on aquatic mammal utilisation at a global scale, making it possible to detect understudied areas and those of greater concern. This open access, online application was created in using the R package *shiny*. The data is obtained by contacting authors specialised in the field, as well as from scientific articles and grey literature such as reports and newspaper articles. The application can also be used to collect anecdotal records that are rarely published, by allowing users to contribute using a simple form. The data is displayed as a global interactive map and trends graphs per country, which can help identify areas where opportunistic utilisation led to directed catches. There are currently 91 data points from 26 countries. Future work includes continue to populate the database and expanding to other taxa. The Aquatic Wild Meat Database is expected to be a useful tool for the scientific community and the public at large, and help implement conservation measures in the areas of greater risk.

KEYWORDS: Conservation, Direct capture, Incidental catches, Sustainability, Whaling - Small type

INTRODUCTION

The utilisation of small cetaceans for human consumption and other non-food uses constitutes a substantial and immediate threat to many species worldwide (e.g., Robards and Reeves, 2011). This activity has so far been referred to as 'marine bushmeat' by the scientific community (e.g., Alfaro and Waerebeek, 2001; Clapham and Van Waerebeek, 2007). A recent document drafted by the Convention on the Conservation of Migratory Species of Wild Animals – CMS – (CMS 2017) introduces the term 'aquatic wild meat' instead, moving away from the term 'bushmeat' and recognising that the issue extends beyond the marine realm as, for example, river dolphins are also utilised (e.g., Flores *et al.* 2008; Swan *et al.* 2017).

Aquatic wild meat is defined as the products derived from aquatic megafauna (e.g., aquatic mammals) that are used for food and other purposes, including bait, traditional medicine, and religious ceremonies. It is obtained through illegal or unregulated hunts as well as from stranded (dead or alive) or bycaught animals (CMS, 2017).

Although cetaceans are generally obtained opportunistically (e.g., Ayissi *et al.* 2011), being and were originally taken for local consumption only. However, their utilisation has grown considerably and expanded even to areas far from the coast. This growing demand led to deliberate hunts in some communities, at often high and unsustainable levels (van Waerebeek *et al.* 2009, 2014; Debrah *et al.* 2010; Collins 2015). It is widely recognised that the utilisation of small cetaceans takes place in many countries around the world; however, the global impact remains unknown. This is mostly because obtaining data on this utilisation is intrinsically difficult given that much of the processing occurs offshore, illicitly, or away from centralised food markets. Additionally, although this activity is illegal in many countries, the locals are not always aware of it or do not condemn it.

Aquatic wild meat is currently a priority topic for many conservation organisations and international conservation treaty bodies, including the IWC and CMS. An increase knowledge and better understanding of the illegal and unregulated utilisation of aquatic mammals is needed in order to implement local and international management programmes for the effective monitoring and mitigation.

There are over 75 described species of small cetaceans worldwide, many of which are susceptible to being exploited. Of these, the International Union for Conservation of Nature (IUCN) has listed three as "critically

endangered” (CR), two as “endangered” (EN), four as “vulnerable” (VU) and two as “near threatened” (NT). Additionally, two species are “conservation dependent” (CD) and 17 are of “least concern” (LC). More importantly, , due to the rarity of sightings, over 55% of all species (n = 43) are listed as “data deficient” (DD) and five as “not evaluated” (NE). Therefore, it is likely that some of these species may actually qualify for a threatened status should data become available (Bland *et al.* 2015). Furthermore, many species need taxonomic revision, such as *Tursiops truncatus*, which can result in the recognition of new, and potentially threatened, species. In addition, small cetaceans are listed under at least Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and both CMS Appendices. Many species are also protected by various national and international legislations and agreements. Despite this, virtually all species are vulnerable to being caught, intentionally or opportunistically, to be used as wild meat. This paper presents an online application/interface titled “Aquatic Wild Meat Database”¹, the idea for which was presented at SC66b (IWC, 2016). The database, as well as the application are in its early stages, and we expect feedback from the scientific community to help us continue its development.

METHODS

The application was created in the environment R, using RStudio version 1.0.136, making use of the package “shiny”, which allows interactive web applications to be built with R. The database itself is an SQLite database. SQLite is a self-contained, high-reliability, embedded, full-featured, public-domain, SQL database engine, which allows to store millions of records.

Data collection

The database aims to bring together data that have already been collected opportunistically and systematically anywhere in the world. The nature of the database means it will contain data of different type or quality and collected in a variety of ways (see below). These data can, and must, be used to answer different questions. The fields in the database represent the minimum information it is necessary to ensure consistency in the data input, and thus to subsequently carry out studies that can provide meaningful conclusions. Fields marked with * are mandatory. These fields are: *city/area*, *state*, *country**, *species*, *scientific name*, *genus*, *family*, *order* (we understand that the species may be unknown in many cases, therefore we allow the user to complete the form with the information that applies). *class*, *origin** (i.e., how the animal was obtained), *main use** (i.e., how the animal was utilised - e.g., food), *number** (of animals used), *year** (of the event), and year when the record was published. Additionally, there are a set of fields aim to gather information on whether there was trade of small cetacean products (i.e., yes/no, local, regional or international). If international trade* is taking place, then the country of origin and country of destination are also recorded. In order to clearly separate between opportunistic and systematically collected data, the database contains a *source* field that specifies whether the event the user is reported corresponds to opportunistic or systematically collected data. The user can choose from the following options: *in Opportunistic observation*, *Published scientific paper*, *Published report*, *Unpublished report*, *Systematic survey*, *Online news*, *Other*. The user is also required to provide a link or a reference*, and can upload documents and images that support the record. Lastly, the user must provide a name* and email*. The ownership of the data is recorded in the field *Ownership** (see *Data ownership and utilisation*), as the user is asked to provide the name of the person or organisation the data belongs to. In the case of data obtained from the news, if pictures are available (which is usually the case) it is considered that the data belongs to the person who took the picture.

Literature reviews

There are at least two ways in which the data from the available literature can be extracted. The main one is to contact the individual authors and invite them to contribute (see *Contributors*). When this is not possible, it would require someone to extract individual values and enter them into the database using the online form. . Please see *Data validation* and *Challenges*, specifically *Funding*.

Citizen science

The application includes a simple form that anyone, including researchers and the public, can use to contribute to the project. The form is placed in the tab ‘Forms’, which in turn has three subtabs: *Single records*, *Ancient records*, and *Contact person*. *Single records* allows users to submit information about individual events (from 1945 onwards) in which small cetaceans were utilised as wild meat. The tab *Contact person* allow users, to provide contact details of themselves or other individuals that they know are working or have worked in areas where they encounter (regularly or occasionally) utilisation of small cetaceans. This will help create a network of different stakeholders working on aquatic wild meat. The tab *Ancient records* is currently under construction.

¹ <https://aquaticbushmeat.shinyapps.io/wildmeat/>

Contributors - Researchers and organisations

Contributors can provide data in different ways, either via the online form as explained above, or by sending their own database to the application managers, who will adapt it to the SQLite database format (see *Data ownership and utilisation*).

Data validation

Currently, when a record is submitted online, it is automatically added to the database and requires the application managers (i.e., the authors of this manuscript) to manually check the database in search for duplicates and for validation purposes. The authors are now looking into applying a system where the data submitted online are saved into a 'temporary' database until the data are validated, after which it would be stored in the 'permanent' database. The permanent database would be the one displayed online.

We appreciate that members of both the general public and the scientific community can incur in data fabrication that could end up in the database. We expect, however, that this would represent a negligible percentage of the data. In cases where the event reported is real, there are still room for error that need to be identified and addressed, such as duplication, species identification, and incorrect number of animals utilised. The database managers (currently, the authors of this paper) access it weekly to check for new records and search for potential errors. Whenever a potential case of an invalid record is detected, the contributors are contacted using the contact details provided when submitted the form. Records with invalid contact details (e.g., non-existing email address) of the contributor are deleted.

Data ownership and utilisation

The database will not be available for download and it will not be distributed to third parties. If a third party is interested in the data displayed in the application and approaches the managers to request access, these will act as intermediaries with the contributor. We are committed to not share data with third parties, however, contributors that provide a large amount of data are encouraged to sign a data use agreement where the aims as well as the time frame for the agreement are clearly stated (i.e., the agreement lasts indefinitely and the contributor has the right to rescind the agreement at any time). The data will only be used for the purpose of centralising the data in a single database and display it in the Aquatic Wild Meat Database application online.

As more data accumulates, there will be opportunities for both regional and worldwide studies, as well as at different time scales. For example, data collected from online news do not usually make it to a scientific publication and can be used to detect utilisation of small cetaceans in areas where research is lacking, as well as where it is thought that utilisation has stopped. For example, two fishermen were arrested in Chile in 2014 for butchering dolphins, likely to be used as bait². These data points, however, might not be good enough to answer other questions, such as whether the utilisation of given species constitute a conservation threat in a particular, for which more systematically collected data would be needed, that we expect to also be part of the database.

Projects that might derived from this would require approval from all contributors.

RESULTS

The application is currently hosted in a portal that hosts application developed using the R package shiny, however, it is possible to host it elsewhere. In its current form, the application has six tabs to navigate through (more can be added to suit one's interests): *Map*, *Trends*, *Forms*, *About this project*, *Contributors*, and *About us* (Fig. 1). The home page shows a world map that displays as default the total number of animals hunted (*Hunts*) in each country, as a colour gradient. There are currently 91 'single records' from 26 countries.

² <http://www.aqua.cl/2014/02/20/region-del-maule-detienen-pescadores-que-filetearon-delfin-chileno/#>

Aquatic Wild Meat Database

Global database of aquatic mammal utilisation

Map Trends Forms About this project Contributors About us

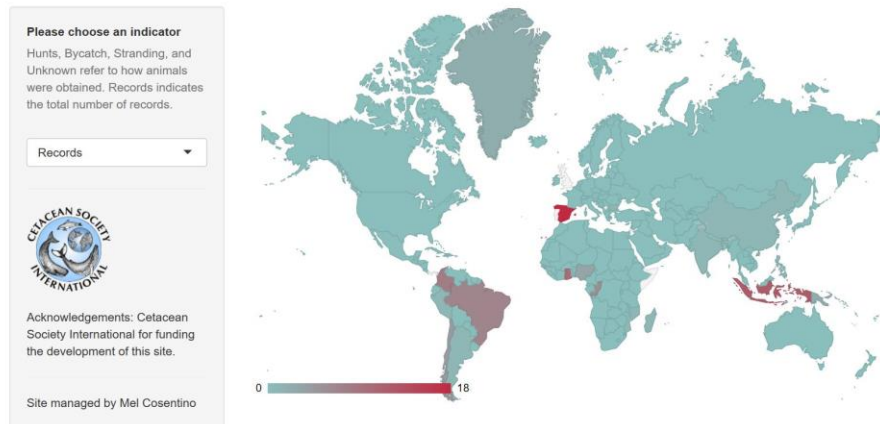


Figure 1: Aquatic Wild Meat Database home page. The image shows a world map colour-coded by number of records per country. The user can select between five indicators: *Hunts*, *Bycatch*, *Stranding*, and *Unknown* that refer to how the animals were obtained, and *Records*.

The other indicators the user can select are: *Stranding*, *Bycatch* and *Unknown* that refer to how the animals were obtained. The last option is *Records*, which refers to how many records exist in the database for each country. More indicators can be added, such as the number of species utilised in each country. In the tab *Trends* the user can select a country and an indicator, which is plotted against time (Fig. 2). A smoother method is used to visualise the temporal trend. The indicators are the same as in the world map.

Aquatic Wild Meat Database

Global database of aquatic mammal utilisation

Map Trends Forms About this project Contributors About us

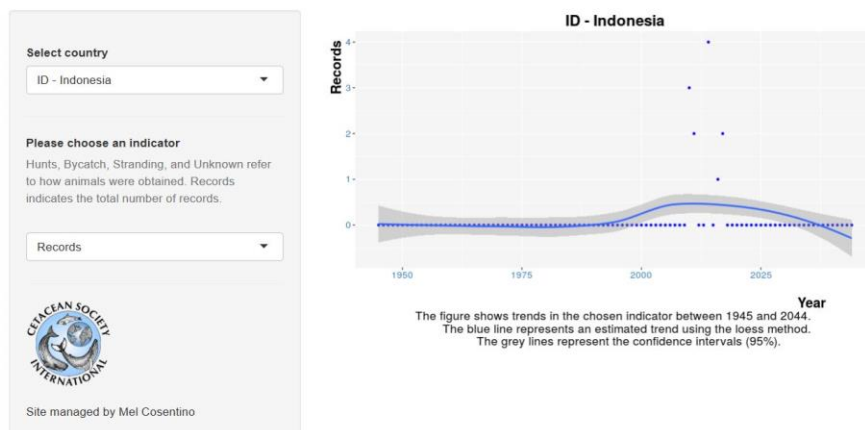


Figure 2: Aquatic Wild Meat Database *Trends* tab. In this tab, the user can select a country and an indicator, which is plotted against time. A smoother method is used to visualise the temporal trend.

Two reviews on the use of small cetaceans as aquatic wild meat were presented in the 2016 annual meeting of the Scientific Committee of the International Whaling Commission (SC66b) (Cosentino and Fisher, 2016; Cosentino *et al.* 2016). All peer-reviewed publications, as well as reports and other unpublished work found during the literature review are stored in a Mendeley account, which continues to grow. These material can be made available to anyone interested in the topic by contacting the application managers.

DISCUSSION

The currently available literature on small cetaceans utilisation shows it is a conservation threat to many species around the world. This includes species that are listed by the International Union for Conservation of Nature (IUCN) as 'endangered', such as the South Asian river dolphin and its two subspecies, and the Irrawaddy dolphin that is listed as 'critically endangered'. Aquatic mammals are especially susceptible to exploitation due to low reproductive rates and the many other threats they face, including anthropogenic noise, pollution, habitat loss and degradation, and climate change (Braulik *et al.* 2015; Avila *et al.* 2018). The global extent of aquatic mammal utilisation remains widely unknown.

Understanding the drivers of this utilisation is of paramount importance to implement effective conservation measures. Traditions and values vary markedly between areas, even within the same country, as seen in Indonesia between Lamalera and Lamakera villagers (Mustika, 2006). A recent study on the consumption of terrestrial wildlife in Vietnam, for example, showed that wealthy classes eat 'wild meat' to secure business and social advantage, while individuals of lower status consume it when out for casual eating and drinking. The authors concluded that it would be relatively easy to substitute 'wild meat' with farmed meat for the poorest communities, but not for those from higher classes, as the higher the individual status the rarer the meat they want to consume (Shairp *et al.* 2016).

Outreach and education programmes through local organisations, in collaboration with relevant authorities, have shown to be effective in reducing the hunting pressure on local populations of marine mammal in some regions in South America and West Africa, yet these programmes remain rare (e.g., Fundación Natütama 2013). These studies highlight the importance of applying a multidisciplinary approach and seeking international collaboration, while also working with local communities for the effective monitoring and mitigation of unsustainable and illegal hunting and utilisation of aquatic mammals.

The interface is publicly available (Fig. 1), and aims to centralise the existing data on small cetacean utilisation. This is a first step to assess the extent of the problem at a global scale. It will also help to:

- a. Create an online network of different stakeholders working on aquatic wild meat (e.g., Google group).
- b. Centralise data that has been collected by researchers from all over the world, both systematically and opportunistically.
- c. Collect anecdotal records that are rarely published, by allowing users from all over the world to contribute to the database using a simple form.
- d. Identify areas where opportunistic utilisation of small cetaceans (e.g., from bycatch and stranding) led to directed catches.
- e. Identify trends in cetacean utilisation in individual countries.

Challenges

Long-term databases face many challenges that not always can be anticipated or addressed. There are other issues, however, for which measures can be taken to prevent them.

Maintenance

The worst case scenario would be that the database is lost or corrupted, for example, due to problems or errors in the dropbox account. To that end, regular backups are carried out. Another cause of concern are software and package (i.e., R and RStudio) updates which can lead to errors in the application. In this case, while the application might fail, the database would not be affected, as it is stored elsewhere, however this would require the app managers to carry out the necessary updates manually, and re-publish the application, which is a relatively easy task to perform. If updating is not possible, the database will still be available and can be accessed in other ways. We are confident, given the increasing interest in 'shiny apps', that the tools to keep these apps running will be long-lasting.

Funding

One of the biggest challenges that long-term databases face is access to funding, both to maintain the database as well as to populate it. We believe this represents a smaller challenge compared to the maintenance of other databases. Firstly, the application is held in a site for shiny apps, which offers several options, including a free option with 25 active hours per month. Additionally, they offer four plans at different monthly and annual fees, providing more active hours and a greater number of applications for the same account holder. The application is now under the Starter Plan, at an annual fee of US\$100, which provides 100 active hours per month and up to 25 applications per account holder.

Secondly, the data are gathered in different ways, some of which require little or no funding. That is the case for data obtained through citizen science, by which the public can contribute via a simple form (see *Citizen science*). The application will be advertised among different conservation organisations and bodies that can in

turn advertise it among their followers and subscribers. Another way in which contributions to the database can be done with little or no funding requirements, is by us approaching researchers who already have data to invite them to collaborate, either through the form as explained above, or by sending their existing database to the application managers. It is expected that these researchers have their own funding for data collection as part of their own research projects. A third way data can be contributed to the database is through literature searches, for which funding is needed. In these cases, literature reviews, which are of great value, are going to be encouraged when advertising the application/interface among governmental (e.g., CMS), private and non-governmental organisations, which could provide small grants, for example, to students interested in carrying out a graduate or postgraduate project on the topic. The data can be then uploaded in the ways previously described.

Future work

Future work includes:

- Continue to populate the database.
- Advertise the application among relevant organisations and bodies.
- Contact key researchers to invite them to contribute to the database.
- Extend to other taxa.
- Create a database for ancient records and data that is recorded over certain time periods (as opposed to as individual records).

CONCLUSIONS

Understanding the drivers of the use of aquatic mammals for human consumption and other purposes is crucial to implement effective conservation measures. Centralised data provides a first step to detect areas of great concern as well as those that are moving from opportunistic to directed catches. We recommend that, in order to reduce or eliminate aquatic wild meat utilisation, including in areas of greater concern, crime prosecution and punishment be complemented with international strategies for improving the livelihood of residents of these coastal communities. Outreach and education programmes through local organisations, in collaboration with relevant authorities, have shown to be effective in reducing the hunting pressure on local populations of aquatic mammals in some regions in South America and West Africa. Seeking an interdisciplinary approach and international collaboration, while also working with local communities is key for effective monitoring and mitigation of unsustainable and illegal hunting and utilisation of aquatic mammals. Moreover, we recommend that any programme that aims to reduce aquatic mammal utilisation must incorporate a combination of environmental education and awareness campaigns to different audiences, including the wealthy middle class. It is expected this application to contribute to the development of effective conservation programmes and strategies.

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