Meta-Database of Marine Research in Mexico: Trends and Applications

Draft

Palacios-Abrantes, J; Arreguín-Sánchez, F; Cisneros, A; Cisneros-Mata, M.A; Rodríguez, L.

4/12/2017

# Introduction

Climate change is globally reshaping the marine ecosystem for the last century [Poloczanska, et al., 2013; Weatherdon et al 2016]. Increase on surface temperature has been linked to biomass change [Arreguín-Sánchez et al., 2016], and distribution shifts of marine fishes [Cheung et al., 2015], coral bleaching on most reefs in the world [cita], and tropic mismatch in the water column [Edwards and Richardson, 2004]. Such effects are projected to continue and intensify if anthropogenic emissions are not mitigated [IPCC, william 1.5, Gatuso et al., 2015].

These ecosystem change is already having repercussions on human populations, specially on those who directly relies on natural marine resources [Pershing et al., 2015; Weatherdon et al 2016]. Some coastal communities depending on fish have see their catch change [Arreguín-Sánchez et al., 2016]; and global projections are also expected to change (Cheung et al., 20XX). This projected change in catch will impact both economic and food security of coastal communities, particular those on developing nations [Lam et al., 2016; Vermeulen et al., 2014]. Climate change is also expected to reduce ecosystem services provided by already weakened "ecosystems". Mangrove forests and coral reefs provide coastal protection to rising oceans and storm events [cita]. Changes in climate will increase pressure in these ecosystems, diminishing their mitigation efficiency, hence, increasing the risk of natural catastrophes in coastal communities [cita]

These sociology-ecological relations are particularly important for coastal nations like Mexico. With over 11 thousand kilometers of coastline, Mexico's coast houses XXX families [INEGI]. Communities that live in the coast directly depend on landings for food [cita], coral reefs and marine protected areas for tourism [Alburto et al., 2011], and ecosystem services like protection from storms trough mangrove forests [Lee et al., 2011], among many other benefits [Palumbi et al., 2009]. It is essential that Mexico incorporates climate change to the political agenda in order to foster adaptive capacity while incorporating sounding adaptation and mitigation plans [Mertz et al., 2009; Pershing et al., 2015; Rice and Garcia, 2011].

Adaptive capacity, as defined by the Intergovernmental Panel on Climate Change (IPCC) is the "The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences." There are several research-based frameworks on climate change adaptation [cita]. Generally speaking, adaptation can be achieved in two non-exclusive ways: (i) building capacity among local communities to adjust, moderate and even take advantage of environmental changes and (ii) trough the implementation of policies that foster that adaptive process [Adger et al., 2005; IPCC, 2016]. In 2016 Mexico's government worked with the UNFCCC to produce a climate change mitigation strategy for mid-century. Mexico basically settled two main objectives: (i) promote the strengthening of institutional and population capacities, and (ii) the design, prioritization and implementation of actions to reduce the vulnerability of different systems [SEMARNAT-INECC, 2016]. This strategy is supported by a Climate Change Law (*Ley General de Cambio Climatico*). Created in 2012, it creates a framework for the development and implementation of public policies for adaptation to climate change and the mitigation of greenhouse of gases [DOF, 2012].

The production and availability of natural and socio-economic data is a key component of the actions needed to achieve those goals [Mertz et al., 2009; Moser et al., 2010]. As a result, data availability has been identified as a common barrier in many steps of the adaptive management process, from the planning stage to outcome evaluation [Moser et al., 2010].

In Mexico, numerous information covering the seas and coasts can be found in academic institutions (UNIMAR; UCSD) and NGOs (COBI; TNC) located (physically) both inside and outside the country, as well as government agencies (CONABIO; CONAPESCA). However, there is an overall assumption that in developing nations data is often limited and perceived as lacking [cita]. In many cases, this is largely a result of the lack of knowledge about the availability of these data (or partially), rather than a complete lack of it [cita]. Data availability is key not only to better understand Mexico's marine and coastal environments, but to identify knowledge gaps so that research can be prioritized [Reichman et al., 2011]. This will facilitate furnishing management and conservation policies for marine and coastal habitats, and fisheries resources vulnerable to climate change.

Data management is a huge step to ensure proper preservation, stewardship, and access to data [Vincent et al., 2010]. And while diverse barriers often compromise the exchange of data among stakeholders [Reichman et al., 2011], having publicly accessible description on existing data is a huge step towards increasing collaboration for innovative research [Michener et al.,m 2006].

Metadata is the information required to understand data, including data set contents, context, quality, structure, and accessibility. In short, metadata describe the *“who, what, when, where, and how”* about every aspect of the data (Michener et al., 1997). Having proper metadata increases data longevity, foster collaboration, and help examine analysis of the data itself; all important aspect of climate change studies [Michener et al., 2006]. The standardization of information trough metadata specifications provide guidance for consistently describing data objects and data types (e.g., methods, units of measurement, and details of experimental design) [Reichman et al., 2011]. Moreover, it allows the creation of a catalog that holds data or information of different disciplines. There are several marine metadata (and data) repositories around the world. For example the Ocean Bio geographic Information System (OBIS) provides ocean biodiversity and bio geographic data; DataOne provides users with Earth and environmental data, and so on. Recent efforts to create nation-wide repositories of marine-related research have been successful in Canada [Cisneros-Montemayor, 2016].

Several initiatives in different levels of society in Mexico are currently working to bring data-sets and information in single repositories. University level projects like The Gulf of Mexico Species Interactions database [GoMexSI] and DataMares [DataMares] are collecting information from specific areas (the gulfs of Mexico and California, respectively). Non-governmental organizations are also contributing with initiatives like MonitoreoNoroeste that focus on marine monitoring data [FMCN]. Finally, the National Commission for the Knowledge of Biodiversity (CONABIO) hold an important and robust list of biological and social data related to both marine and terrestrial environments [CONABIO]. Moreover, as part of a cutting-edge initiative, Mexico has recently created an information system solely devoted to climate change [SICC].

These initiatives are a part of successful efforts to make marine data in Mexico available. However, there is still a lot of work to do since most of the n national repositories are locally or topic specific, and those that are actually national are often limited. Hence, the current project created a meta-database for oceanographic, ecological, economic, fisheries and social data for marine ecosystems and marine-related sectors of Mexico. The information collected was analyzed in order to determine trends and data gaps in Mexico. Finally, framing national fisheries we **somehow** evaluated Mexico's position in relation to climate change data and identified fields of improvement. It is worth mention that the meta-database is an open source repository for public consultation and sharing. We believe that a meta-database will help facilitate efficient use of existing information and stimulate collaboration.

# Materials and Methods

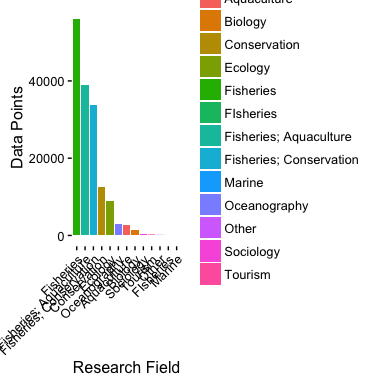
## Data Compilation

## Data Sources

# Results

## General Numbers

The meta-database has 33053 records containing information for about 157845 data points, from 38 repositories. Data gathered was on 5 major disciplines: Dis from witch *Fisheries* was the most abundant (Figure 1).



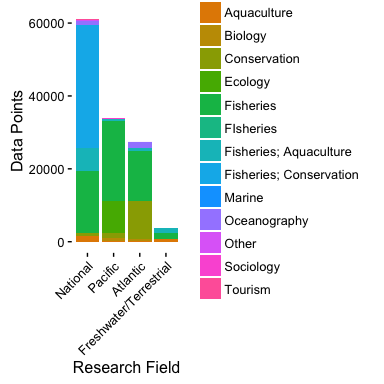
Number of data points per research field.

## Subject Analysis

There is a total of 7148 subjects in the metadata. The subject that has the most amount of data points is Species[1,1] with Species[1,2] units. However, at the species level, *Thunnus albacares* (Albacore tuna) is the most repeated one with 195 records. The data distribution is very diverse since the mean data point is 18.7393922(sd 390.6926744). This is mainly because a large amount of records are one observation of species lists.

## Geographic Analysis

In terms of regional data distribution, data points where evenly distributed between both the Pacific (33818) and the Atlantic oceans (33818). However, the great majority of data points are reported at a National level (27361). At a more detailed level we find that there is a clear dominance of data from both the Gulf of California (15387) and the Campeche Bank (15273), in respect to the other zones determined by the working group.

 # Discussion # Literature Review