Fishackathon 2016 Problem Statements

Organized by the Secretary's Office of Global Partnerships
U.S. Department of State

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1. Billfish Foundation

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Problem Statement: Despite advances in marine science and the increasing importance of marine fish to a healthy, growing human population, we lack even basic scientific data for half the global fish catch. Accurate and detailed data is of paramount importance as sustainable fisheries management and stock assessment is underpinned by timely and accurate biological species data, consequently Biologists urgently need more innovative and cost effective approaches to fisheries data collection to enable fish stock assessments and effective management so fishermen can continue to sustainably provide seafood for future generations.

The key biological measurements required for fish stock assessment are:

- **Different types of Fish Species Caught**
- **Number of each fish species caught**
- **Length of individual fish within a species**

This data, known as Length/Frequency data, underpins the majority of statistical analysis required for fish stock assessment and therefore effective sustainable management of global fish resources and seafood.

Traditional approaches to collecting such data rely on the manual measurement of individual fish whilst at sea by a human observer or scientist which can be invasive to the fishermen and constrained by time and financial resource as it's a costly endeavour. Thus there is a need for all fishermen to be empowered to easily and accurately identify, measure, collect, and report their fish quickly and safely. At the moment, due to changing species ranges and the vast majority of species caught, even some of the most experienced crews may not always recognize what species of fish they encounter, or precisely estimate their size. Currently, there isn't a truly accurate solution for doing this without costing valuable time or killing the (potentially endangered) fish and bringing them back to shore.

To meet the challenges of fisheries stock data gaps and to build capacity within the fishing community we require a new set of tools for data collection.

The use of cameras on board fishing vessels for compliance and biological monitoring (as replacement for observers) has been tested and the technology exists to collect large numbers of images during normal fishing operations. Previous Fishackathon winners, the Fish-o-tron, demonstrated that it is possible to rapidly derive accurate Length/Frequency data from images opening the door to what could be a revolutionary new approach to automated fisheries data collection.

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FISHACKATHON 2016

fishackathon

We urgently need a tool that can streamline the fisheries data collection process, and enable fishermen to play a role in data collection. If such a tool can be produced this will be a game-changer for fisheries management and food security globally. Fishermen, both recreational and commercial, have a long history of collaboration with scientists and have a desire to play central role in the solution for the data collection problem.

Solution: We need a tool that can enable non-experts to carry out fisheries data collection from measurement to statistic without human intervention and internet access.

The previous Fishackathon winners' Fish-o-tron, and access to cheap but powerful computing platforms in the form of smartphones and tablets equipped with quality cameras, provides the basis to making this an achievable goal. Such a tool needs to incorporate each of the key steps:

1. **Image capture** from either video or still camera
2. **Identification of fish species** (automated/user input)
   Potentially also Record sex (easily done for certain species such as sharks (elasmobranchs) and crabs/lobsters (crustaceans) (automated/user input)
3. **Automated measurement** of biometric data (Length, breadth) Option for recording of individual weights (automated/user input)
4. **Append records with position, time, date** (*Geostamping*)
5. **Record User/ Fishing Vessel/ Fishing Gear** data possibly as a user account (Metadata)
6. **Transfer/Upload of data when internet access available**
7. **A cache to store and export the data to fisheries management agencies and fisheries scientists** – These are currently available, TBF currently has one. ***Potentially*** create an API to upload to the TBF's database.

We have no clear vision of what form the tool should take but practical considerations of working at sea (Harsh environment for tech, water, salt corrosion, extremes of temperature, vibration, UV exposure, harsh conditions for human user, limited space), widespread availability of technology and technical ability need to be considered. *Experts will be available for questioning at the event.*

The Gold Standard for such a tool would be one that includes a means to automate fish species ID, number and length but realistically we acknowledge that this may be outside what is possible in a hackathon. However, a function that helps non-experts to identify species correctly would be extremely valuable.

Resources

- A suite of example images will be made in order to aid the development of the fish ID element- http://www.billfish.org/education/what-are-billfish/
- Fish-O-Tron: http://devpost.com/software/fish-o-tron

2. FINFO- *Fisheries Data Interoperability*
National Oceanic and Atmospheric Administration (NOAA)

Organization: National Oceanic and Atmospheric Administration (NOAA)
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Problem Statement: Fisheries information is collected and stored in disparate, proprietary formats and software that prevent immediate interoperability. This forces fisheries data users to spend significant time manipulating data to combine, for instance, fisheries research data collected on the west coast with similar data collected on the east coast. The data challenges include different data formats, collection techniques/protocols, units of measurements, and semantic definitions. However, the data is fundamentally similar; after all, there are only so many ways that one can weigh and count fish.

This initiative seeks to prototype mobile applications and associated web services to demonstrate a capability for capturing the key elements of this fishing data and transmitting that to well-defined web services and persistent storage infrastructure for storing the information. As part of this, some working data interoperability standards would need to be specified to inform the mobile app and web services development.

Proposal: Develop key software reference implementations for fisheries data mobile capture devices, associated web services infrastructure for receiving and storing the fisheries data, and data interoperability standards that include operations, catch, and specimen records as the core data element types.

Description: Fisheries information is collected by a disparate group of entities to include government researchers, federally-mandated observers on-board commercial vessels monitoring the catch, recreational fisherman, commercial fisherman, non-profit entities, and academic researchers to name just a few. Despite the very different purposes of these groups, nevertheless, much of the key information collected share a lot in common. At a macro level, these components could be distilled down to the following:

- **Operation** - Details specifying information about the vessel operation such as start/end date, time and latitude/longitude (or possibly an entire trackline), name of vessel, vessel operator, gear used, permit numbers, etc.

- **Catch -** Details concerning the biological species sampled/collected during the operation. This will usually contain information about the species themselves such as scientific and common names, weight, and possibly count. It may also contain details about the environment such as the water temperature, depth, salinity, and dissolved oxygen levels and details about the gear parameters used (e.g. net width/height for a trawling operation)

- **Specimen** - When detailed specimen collection is performed, this will contain information about the individual specimens themselves, such as age, length, weight, sex, maturity, and more. This often involves specimen dissection and sample capture.

Deliverables: The goal behind this project is to devise reference software implementations and a set of possible data interoperability standards as well as:

- **Reference Software Implementations** - A number of reference implementations should be established as well in commonly-used software languages that could be readily leveraged by existing organizations to assist with organizational adoption and to provide foundations upon which to build for further integration. Target environments should include:
  - Mobile Application Operating Systems
    - Android
    - iOS
    - Windows 10
  - Web Service Reference Implementation (a simplified RESTful-based system for catching and storing this information)
    - Web Services Framework
      - Python-based (ala Falcon or Flask), or
      - NodeJS-based
    - Persistent Storage
      - Postgresql, or
      - MongoDB

  All of the software should be licensed under a liberal open source license such as MIT, BSD, or Apache and hosted on github.com to promote widespread adoption.

- **Data Interoperability Standards** - The standards should define the vocabulary, data types, acceptable ranges/enumerated values, structure, and the formats for the different content types. It should be noted that the specifications should provide room for custom expansions by different providers as well, and these expansions could become candidates for future enhancements to the standards. Details of these components are as follows:
  - Content Types
    - Operation
      - Fisherman/Scientist Details - Name, Address, Phone, Email, etc.
      - Permits / Registrations / Licenses Numbers / Gear Endorsements - i.e. legal permissions to be catching fish
      - Vessel Details - Name, Gear Type, Vessel characteristics, etc.
      - Dealer/Buyer Information - Dealer #, Name, Address, etc. if fish is sold to market
      - Trip - Start / End date/times of the trip, locations of the trip, etc.
    - Catch - Species, weight, counts, and if sold to market, state, fish ticket type, fish ticket #, LBS caught/species, amount paid by the buyer per LBS/species, etc.
    - Specimen - Length, Age, Weight, Sex, Maturity, Individual Sample Details
  - Data Formats - One of the following data formats should be used for the standard: JSON, XML

3. Fisheries and Oceans Canada

Organization: Fisheries and Oceans Canada
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Problem Statement: Aquatic invasive species present a major ecological and economic threat throughout the world. In North America, a group of four large and voracious fish species collectively known as the Asian carps are currently threatening to invade the Great Lakes. The Great Lakes are the world's largest freshwater system and are home to more than 100 species of native fishes and a multi-billion dollar fishing industry. Canada and the United States are working together to prevent Asian carps (Bighead Carp, Silver Carp, Grass Carp and Black Carp) from entering the Great Lakes. Prevention is more effective and much less costly than trying to control an invasive species after it arrives. Asian carps have already caused great ecological and economic damage in the Mississippi River basin where they have already invaded. A 2011 'Binational Ecological Risk Assessment for Bigheaded Carps in the Great Lakes' showed that the Great Lakes are at high risk of invasion by Asian carps and that ecological consequences could be high. In this risk assessment, high risk tributaries were identified by computer modelling and many of these tributaries have been sampled for Asian carps between 2013 and 2015 as part of Fisheries and Oceans Canada's early detection surveillance program. No Bighead Carp, Silver Carp or Black Carp have been observed. In 2013, two triploid sterile Grass Carp were caught in Grand River, a tributary of Lake Erie. In 2014, one triploid Grass Carp was caught in the Grand River. In 2015, six diploid (reproductive) Grass Carp were caught in Lake Ontario and an adjacent pond, and three other triploid or undeterminable ploidy were caught Lake Ontario, Lake Erie and the lower Niagara River. Given the discovery of diploid, or potentially reproductive, Grass Carp in Lake Ontario in 2015, managers need to expand surveillance to include early life stages (fish eggs and larvae). The issue is to determine the specific time of year to target surveillance efforts for spawning adults and early life stages in high risk tributaries of the Great Lakes so that we can best prevent spawning and control populations. This time window may change from year to year and tributary to tributary. A real-time tool to help field staff determine when to visit high risk areas would be helpful.

Solution: Given the vast scale of the Great Lakes and limited on-the-ground resources, we need a program/application using online real-time temperature and flow data determine the most high risk areas to sample and the times of years during which these areas should be sampled. Specifically, we would like an application or tool that could be used by field staff and managers to determine when Asian carps would be entering individual streams to spawn each summer. Water temperatures and flows vary inter-annually and it is difficult to predict when field crews should be searching for staging individuals. It is thought that Asian carps require a certain water flow and minimum water temperature or accumulated growing degree days to move towards and aggregate in spawning streams. These aggregations of Asian carp individuals provide both an elevated risk of reproduction and an opportunity to control and remove large portions of an invading population. This real-time tool could be made flexible enough to predict spawning times of different fish species that spawn in streams (e.g., Asian carps, salmonids).

Supporting Data/Information:
A graduate student at the University of Toronto Scarborough is working on models to predict when and where Asian carps would spawn in the Great Lakes using information on their behaviours in their native and invaded ranges, as well as local environmental conditions in the Great Lakes. The proposed application would tie in closely with this student's work.
Background information on Asian carps and links to risk assessments: http://www.dfo-mpo.gc.ca/science/coe-cde/ceara/AIS-EAE/asian_carp-carpe_asiatique-eng.htm

Required Steps and Data Sources
1. Using online, real-time water temperature data, provide real-time growing-degree days (base 15) using following equation: ∑(Mean Daily water temperature -15 if >0) starting January 1.
When sum = 650 then onset of Asian Carp is expected
When sum = 900 then mass spawning of Asian Carp is expected

Here is an online data source: http://www.trcagauging.ca/xcreports/ui/index_main.asp

2. Using online, real-time water temperature data, graph stream velocity on a daily basis. The online data are in m3/sec, which needs to be converted to m/sec. Here are the conversion equations.

y = Velocity
x = Discharge

Spring Creek North
y = -0.0288x2 + 0.4097x + 0.1393

Krosno Creek
y = 0.2692x + 0.0984

Don at Glenshields
y = 0.2717x + 0.148

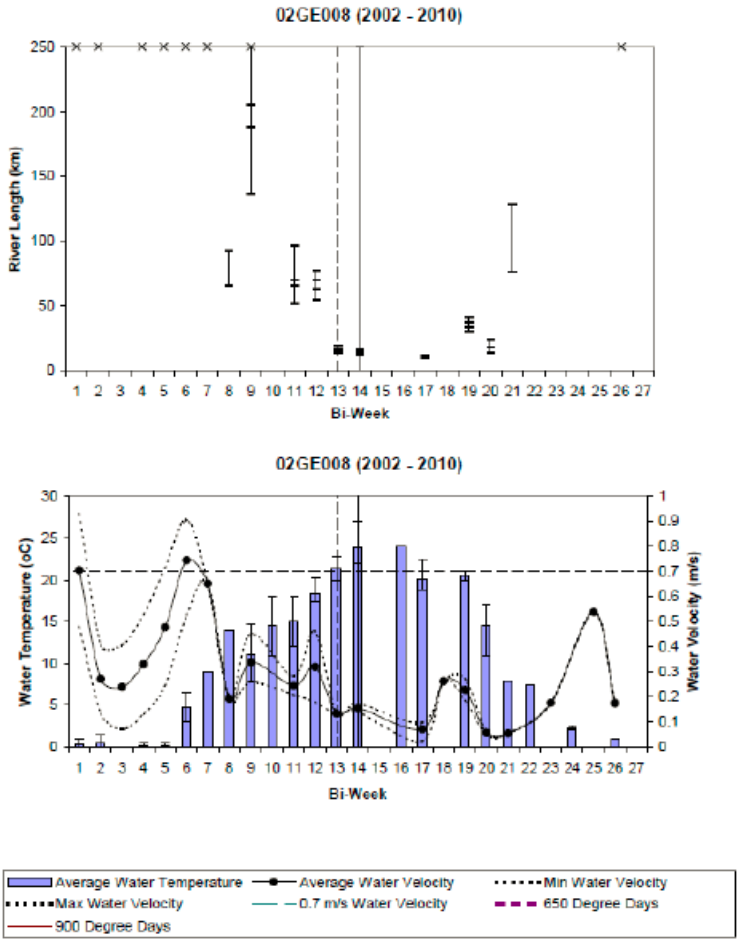
3. Using the temperature and flow, predict and graph daily the length of stream required for Asian Carp spawning using this equation: D=3.6*V*I
V=stream velocity (m/s)
I=estimated incubation time (h)

I is based on any one of these equations:

Table 1. Hatching rates for Asian carp eggs. y – hatching time (h); x – water temperature (ºC). The equations are not significantly different (ANOVA; F=0.38, p=0.77).

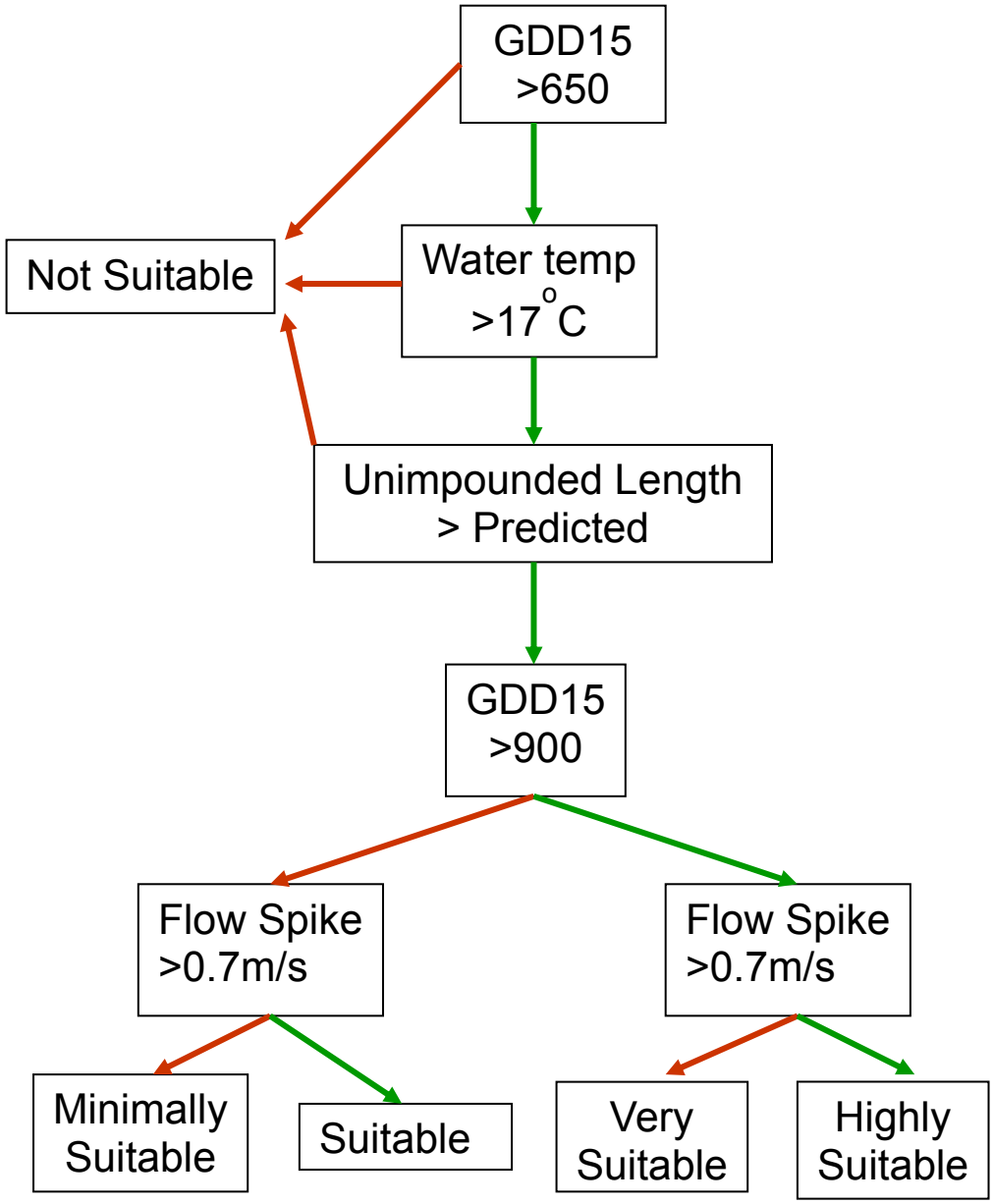
Species	Equation	R^2	Reference
C. idella	$y=233855x^{-2.4915}$	0.9902	Anonymous 1970
	$y=18779x^{-1.979}$	0.9736	Guo 1980
H. molitrix	$y=22456x^{-2.0989}$	0.988	Guo 1980
	$y=21311x^{-2.8057}$	0.9539	Tsuchiya 1980
M. piceus	$y=233855x^{-2.822}$	0.9736	Chang 1966

Here are example graphs.



4. Compare the required river length to the actual river length to the first barrier. The Mandrak lab can provide data.

5. Use this decision tree to determine the likelihood of Asian Carp spawning on any given day.



4. FishFace App
The Nature Conservancy Indonesia Fishery Conservation

Organization: The Nature Conservancy Indonesia Fishery Conservation Program
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Background: Fish stocks around the world are declining, and 90 percent of the world's assessed fisheries are over- or fully exploited. In developing countries like Indonesia, the decline of a fishery has severe consequences, as fishing is an important source of animal protein for millions of people. While some fisheries in developed countries are slowly improving, it will take time and effort to bring stocks back to healthy levels. One key challenge in addressing overfishing is the scarcity of data on the condition of fish stocks. More than 95% of the world's fisheries are not assessed because of lack of data on stock condition, species composition, fishing effort and other key pieces of information essential for sound fisheries management. In developed countries, the status of major commercial fisheries is usually known, but data on many inland and near-shore commercial and recreational fisheries is still lacking. In the developing world most fisheries fall into the unassessed category. In complex multi-species fisheries, like those in Indonesia and in many other tropical developing countries, lack of data on species and size composition of catches makes sound management almost impossible.

Conventional stock assessment methods are prohibitively expensive and time-consuming, but there are cost-effective assessment methods that can be used right now to start putting management measures in place. One of these methods is based on the analysis of the size composition of catches.. The challenge in applying this cost-effective method is that it is difficult to get reliable data on the species and size composition of the catch. Small-scale and recreational fishers land fish at unpredictable times and in many and dispersed places along beaches and ports. This makes it almost impossible to get a professional surveyor to the right place at the right time to record the catches. A common way to address this problem is through logbooks, which are filled in by fishers themselves. The disadvantage is that such logbooks are often cumbersome and many fishers in developing countries may find manual data entry challenging. Furthermore, logbook data can not be verified with actual catches and data transfer is often slow and filled with errors.

Solution: Our challenge to the fishackathon is to develop a smartphone app that captures data on fishing practices and catch composition with the least amount of manual data entry, and with feedback to the fisher, in the same spirit as activity trackers such as Strava, Runtastic, or Endomondo.

The app would use the smartphone's camera to take and upload pictures of each fish caught, and it would use the smartphone's GPS receiver to get information on fishing location as well as time spent fishing. In "tracking mode", the app would log GPS positions, and it would enable the fisher to take standardized pictures of any fish caught. In "reporting mode", the app would give an overview of fishing trips, an overview of the catch, it may also provide a "leaderboard", and it may give the fisher the opportunity to invite friends who can look at more detail of recent fishing trips.

A critical component needed in the system is the recognition of species and estimation of size of individual fish from the uploaded pictures. The Nature Conservancy is currently working with a technology provider (Refind, Sweden) to develop software (named "FishFace") that recognizes species and estimates size from the deepwater snapper and grouper fishery in Indonesia. We expect to be able to use the FishFace software to provide this capacity to the app. The FishFace software is still in development, but preliminary results are promising. To facilitate image analysis, the app would need to control camera settings, and we may have to ask the fishers to put the fish on a standard backdrop with a size reference. The fishers could even participate in the training of the software; the software may come up with a guess, and the fisher may opt to correct the species.

Obviously, the app would give fishers the option to share their data with scientists and others.

Technical notes: One of the critical elements of a smartphone app would be its ability to take standardized pictures of fish. The following needs consideration in development:

- Image repeatability between different mobile platforms, means of unifying various camera outputs to a unified setting
- Manual or smart white balance/exposure/focus
- Size/width adjustment
- Dynamic range and noise compensation
- Dynamic range allocation (i.e., a function to allocate the full dynamic range of the camera to the fish instead of distributing the dynamic range over the entire picture)
- Lens artifacts and fish eye adjustments
- Background removal and contouring
- Use of libraries for image enhancements and processing (noise reduction, angle and geometry correction, reference object detection and camera-to-object calculations)
- Warning when there is fish slime or other dirt on lens (as detected by the software)
- Warning when low-light/movement ratio is exceeded leading to blurry images

Of course, it is probably not feasible or even necessary to address all of the considerations above. For the fishackathon, an "80% solution" would already be a remarkable achievement!

Supporting information
See the following link for a summary of FishFace:
http://www.nature.org/ourinitiatives/habitats/oceanscoasts/howwework/fishface.xml

5. Global Ghost Gear Initiative I

Organization: Global Ghost Gear Initiative
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Problem Statement: Every year 640,000 tons of fishing gear is lost or abandoned in our oceans. This 'ghost' gear compromises yields and income for fishermen, trapping fish that are then unavailable for harvest and repopulation, contributing to global food loss and fish stock degradation. It also costs governments and the fishing industry hundreds of millions of dollars annually in recovery, clean-up, lost fishing time, and gear replacement. One of the most horrific impacts of ghost gear is the entanglement of marine wildlife: hundreds of thousands of whales, dolphins, seals, and sea turtles are killed each year due to entrapment in lost gear, and their migratory nature and capacity for lost gear to drift cause entanglement on a global scale. The economic impact is likewise global in nature. For small-scale fishermen in the developing world, the loss of gear and reduced fish catch impacts their very livelihood. In order to prevent gear loss, the teams that recover ghost gear must be able to identify the types of gear that are getting lost and where they come from. A universal guide to gear types would enable valuable traceability data to be collected not just from participating fishermen and scientists, but anyone who participates in beach cleans or gear removal projects, allowing a much greater role for the public. Ultimately, establishing traceability for lost gear will allow global "hotspots" of gear loss, and fisheries that experience higher than normal rates of loss, to be identified, and tailored solutions to be established.

Solution: We propose a solution in the form of an app that would allow anyone who finds any form of ghost gear to enter identifying features into a centrally held data portal. Ideally the user could take a photo of any found ghost net. In the absence of a photo (or accompanying one) the user would be able to enter identifying features of the gear such as color, mesh size, twine width, etc. in addition to the GPS location where the gear was discovered and whether wildlife (live, complete carcass, or remains) was entangled in the gear upon discovery. The app should be able to both guide the user through the process of identifying the gear and if possible return an ID (gear type, fishery type, and location if possible) to the user. Ghost nets should be identified by the original intended use of the net (see attached guides) and fishery/country of origin as closely as possible. Tracing the gear to its point of origin will allow the Global Ghost Gear Initiative to either:

a) Identify a particular gear type causing a high proportion of marine mammal entanglements, allowing us to trace that gear to the manufacturer of origin and modify the gear accordingly so the fisheries can still perform but wildlife will not be harmed; and/or
b) Identify fisheries that experience higher than normal rates of loss, to establish protocols that mitigate gear loss – saving time and money for the fisheries, increasing safety of the fishermen, and preventing unnecessary loss of non-target marine wildlife.

Supporting Data/Information: Please provide supporting information including links to data sets, news articles, and relevant databases:

The key to making the app functional and user-friendly will be to categorize gear types in a broad enough manner that users will not have to sort through hundreds of options (and wind up getting bored/losing interest and picking something "close enough" just to be done), yet still accurate. This data set: http://awsassets.wwf.org.au/downloads/mo001_the_net_kit_1dec02.pdf provides many valuable specifics for us to use on the backend, but if presented at the front end for users to scroll through would be overwhelming. A more functional data set for front-end users would resemble this: http://www.seafish.org/geardb/

Another element that is essential to capture is GPS location. This tool on our website would be a good starting point but must be able to function on a phone app: http://www.worldanimalprotection.org/sea-change-map

In addition to documenting where the gear was found/reported (easy enough to drop a GPS pin), we'd ideally like to be able to estimate where it originated, based on multiple variables including ocean currents and location of fisheries which make use of the gear type in question:

Source of fishery locations, fishery types, and gear types: www.fishsource.com
Global Ocean Currents Database: https://www.nodc.noaa.gov/gocd/index.html
Real Time Fishing Activity: http://globalfishingwatch.org/ , http://www.marinetraffic.com/en

Once the photo and characteristics of the found ghost gear have been submitted along with the GPS location where it was found, the tool should be able to send a response to the user, providing them with some information on the gear they just reported.

Additional Data Sets:

- Source of data for categorizing net types and reporting found gear: http://www.ghostnets.com.au/database/recording-information/
- Source of data for categorizing net types and reporting found gear: http://oliveridleyproject.org/found-a-ghost-net/ghost-net-data-input/
- Net identification data: http://www.ghostnets.com.au/database/recording-information/
- Net identification data: http://awsassets.wwf.org.au/downloads/mo001_the_net_kit_1dec02.pdf

6. Global Ghost Gear Initiative II

Organization: Global Ghost Gear Initiative
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Background: Abandoned, lost and derelict fishing gear ('ghost gear') is a major global problem. Though it is lesser known issue compared to over-fishing and bycatch, it is being increasingly recognized as a problem of serious concern because of its detrimental impacts to marine animals, ecosystems and fisheries. The United Nations Environment Programme (UNEP) estimated 640,000 tonnes of lost, discarded or abandoned fishing gear end up in our oceans every year, accounting for 10% of all marine debris.

Animals are critically wounded or killed by ghost gear. For example, when 870 ghost nets were recovered off Washington State in the US, they contained more than 32,000 marine animals, including more than 500 birds and mammals (Good et al., 2010). Marine environments are harmed when habitats such as spawning grounds or sensitive coral reefs are obstructed or smothered by ghost gear. Economic repercussions occur when derelict gear continues to 'ghost fish' commercially viable stocks. For example, it is estimated that one ghost net can kill almost $20,000 (USD) worth of Dungeness crab over 10 years (SeaDoc Society, 2010).

Ghost gear is caused by a number of factors, some of which include: extreme weather conditions, spatial pressures such as gear conflicts or conflicts with other industries, limited or costly disposal options at port for damaged gear or lack of room on vessel to store damaged gear.

Problem Statement Overview: The Bay of Fundy is a vibrant lobster fishing area that provides employment to thousands of New Brunswick and Nova Scotia fishers every year. It is also home to a number of other industries such as those supporting tourism, aquaculture and shipping. A common source of ghost lobster traps and other ghost gear is vessel conflict with set gear, where boat traffic from the shipping, aquaculture and tourism industries inadvertently cuts off lobster traps when transiting through fishing grounds. Fundy North has a unique ghost gear retrieval program whereby local fishers, using a specially designed grapnel, have removed over 1,000 derelict lobster traps, 23,726 feet of rope, 76 buoys, and other marine waste since 2008. In addition to retrieval, Fundy North is working on protocols to prevent gear and vessel conflict in the first place.

Solution: To prevent gear-vessel conflict, a mapping tool that would indicate the location of set lobster traps using GPS points via a GPS tag attached to the lobster traps. The information could then be uploaded to an app and/or a website so that it would be accessible to the other industries. The information would also help fishermen locate their lost gear in cases where gear is dragged to cut off and may be applicable to fishing areas beyond the Bay of Fundy.

Information to be included:

- Unique lobster trap ID number
- GPS location of set gear
- Any other info coders think might be relevant or helpful

App details:

- Gear location should be visible on an app compatible with both android and iphones The app or program would need to update the gear's location in real time since fishers often move the same trap to a different location to follow lobster migration throughout the fishing season

Extras:

- It would be helpful if that data (gear location) was also compatible/visible on an electronic nautical chart with GPS/latitude and longitude reference points so fishers and other industries/vessels could see it on their chart plotter programs. We are not sure if this is possible or not.
- There are three common chart plotter programs used by fishermen in this area: Olex, Hondex, and MaxSea. We understand that Olex is designed to allow data sharing through the internet so it might be a good starting point.
- Most fishermen have internet access only through their cell phones while at sea. Therefore there would need to be a mechanism to connect their chart plotter to the internet via their cell phone. The app would need to be flexible to allow fishers to choose which data they want to upload. They may want to keep some locations private and share others.

7. Maritime Domain Awareness

Organization: Maritime Domain Awareness Interagency Planning Team
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Problem Statement: There is a lot of data available on the internet about fishing vessels. From pictures of vessels to information about permits and quota; from owner/operator details to unique vessel identifiers. But, even though all this information exists, it doesn't exist in an integrated, standardized form that law enforcement, like the Coast Guard, can use effectively. This is a problem around the world; at-sea law enforcement teams in the Pacific and Atlantic, and everywhere in between, need a comprehensive, simple way to access all the information they need: vessel name and ID number, owner/operator information, permit types, fishing gear, and much more - in a simple, comprehensive format.

Solution: We need a webpage or app that can pull information directly from all kinds of freely available internet sources about U.S. and other coastal nations' fishing permit data and vessel data, including images; integrate the information; and then aggregate the information into a useful, easy-to-search, standardized format that can be a stand-alone output for law enforcement or others, such as responsible marketers and consumers, to use, as well as an input for future data processing, including processing of contributions of vessel data from public or private sector/all sources.

Specific Elements / Concrete Steps:

1. Identifying desired/required data fields
2. An offline database that scrapes from these sources and regularly updates when connected to the internet
    a. Identifying the low-bandwidth/storage data fields that this should include (ex: likely not images)
3. The search interface
4. The returned results interface
5. The individual entry interface
6. Any reporting functionality (to be identified but could be dictated by structure/accessibility of reporting, capacity of platform, or other inherent qualities)

Supporting Data/Information:

1. WCPFC (Western and Central Pacific Fisheries Commission) Record of Fishing Vessels: http://www.wcpfc.int/record-fishing-vessel-database
2. NOAA Fisheries Service Permit Offices (links contained on page: http://www.nmfs.noaa.gov/permits/permits.htm
3. U.S. Fishing Vessel Documentation Search: http://www.st.nmfs.noaa.gov/st1/CoastGuard/VesselByName.html

4. FFA (Forum Fisheries Agency) Vessel Register (link on page): http://www.ffa.int/vessel_registration link: (rimf.ffa.int/license.php)
5. IATTC (Inter-American Tropical Tuna Commission) Vessel Register: http://www.iattc.org/vesselregister/VesselList.aspx?List=RegVessels&Lang=ENG
6. Marine Traffic: http://www.marinetraffic.org/marine-traffic/
7. Vessel Finder: http://www.vesselfinder.com/
8. IHS Fairplay Vessel Data Fields and Definitions: http://www.shipfinder.org/help.aspx
9. NOAA Fisheries Vessel Finder: http://www.st.nmfs.noaa.gov/st1/CoastGuard/VesselByName.html
10. U.S. Coast Guard Maritime Information Exchange Vessel Search: cgmix.uscg.mil/PSIX/PSIXSearch.aspx
11. Example of a state commercial fishing vessel database: http://www.cfec.state.ak.us/plook/#vessels
12. Google search vessel name, MMSI, or IMO number, Google Images of vessel (construction)
13. FleetMon Vessel Finder: http://www.fleetmon.com/en/
14. European Commission Fishing Fleet Register: ec.europa.eu/fisheries/fleet/
15. FAO Fishing Vessel Finder: http://www.fao.org/figis/vrmf/finder/search/
16. National Information Exchange Model: https://www.ise.gov/mission-partners/national-information-exchange-model-niem
17. ShipSpotting: www.shipspotting.com
18. Equasis: www.equasis.org
19. ISSF Proactive Vessel Register: http://iss-foundation.org/knowledge-tools/databases/proactive-vessel-register/
20. Combined IUU Vessel List: http://iuu-vessels.org/iuu
21. Consolidated List of Authorized Tuna Vessels: http://www.tuna-org.org/GlobalTVR.htm
22. Liberia Industrial Vessel License List: http://liberiafisheries.net/vessel_license_list
23. Greenpeace International Blacklist: http://www.greenpeace.org/international/en/campaigns/oceans/pirate-fishing/Blacklist1/
24. CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) Licensed Vessels: http://www.ccamlr.org/en/compliance/licensed-vessels
25. IOTC (Indian Ocean Tuna Commission) Authorized Vessel List: http://www.iotc.org/vessels
26. ICCAT (International Commission for the Conservation of Atlantic Tuna) Record of Vessels: https://www.iccat.int/en/vesselsrecord.asp
27. SPRFMO (South Pacific Regional Fisheries Management Organization) Authorized Vessel List: https://www.sprfmo.org/Vessels/VesselSearchView.aspx
28. CCSBT (Commission for the Conservation of Southern Bluefin Tuna) Record of Authorized Vessels: https://www.ccsbt.org/en/content/ccsbt-record-authorised-vessels

8. MarViva Foundation

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Problem Statement: Seafood buyers are often deceived with regard to the fish product purchased or consumed. Seafood fraud and mislabeling are unfortunately common in the industry, out of lack of knowledge, weak traceability, or the attempt to sell low value species as higher value ones. Buyers' unawareness results in uninformed demand of endangered and vulnerable species (for example, a responsible consumer concerned about the sustainability of the marine ecosystems may unknowingly buy mislabeled sharks, rays or vulnerable bill fish products if unable to recognize the appearance of the fillets). It may also result in consumers being misled to pay higher prices/kilo of product (for example, a consumer requesting sea bass at the grocery store but unknowingly accepting shark fillets, for the significantly higher price of the sea bass).

This problem affects consumer rights, fair trade, market transparency, and the health of the marine ecosystems. It is widespread in the international realm. For instance, a seafood fraud investigation in the USA confirmed that 33% of 1,215 samples taken from 674 retail outlets in 21 states were mislabeled, according to U.S. Food and Drug Administration (FDA) guidelines (Oceana, 2010 to 2012). Some countries, like Costa Rica, have implemented an obligatory labeling regulation, but struggle with its effective implementation. Fish commercialization intermediaries and points of sale (distributors, supermarkets, restaurants) are challenged with no technical capacity to identify the product they receive from their vendors when it is no longer whole, but cut in fillets. Furthermore, the government inspectors, accountable for the enforcement and verification of the compliance on behalf of the stakeholders along the commercialization chain, also have trouble identifying and validating the species of the fillets.

Solution: Smartphone app to enable identification of fish fillets (*see section "supporting data" for additional reference):

- Justification: It is challenging for non-experts to identify fish species when the individuals are whole, much harder when the product is cut in fillets.

- Target audience: end consumers, buyers (restaurants, supermarkets, hotels/cruises...), distributors, inspectors of fish products

- Strategy: Provide a user-friendly tool enabling users to identify the product offered in the sales points along the commercialization chain.

- Integral approach: The app will inform the demand-end of the market and government authorities towards enhanced effectiveness of the efforts to promote responsible fishing and appropriate labeling of the marine products. It will complement MarViva's ongoing regional awareness campaign (Costa Rica, Panama, Colombia), encouraging responsible consumption of marine fish. It will also contribute to build inspection capacity to optimize the impact of the enforcement role of the public officers. An open source platform would allow scalability and replication beyond the region, with easy adaptation through the input of region-specific species. With presence in all three countries and partnerhips in Central and South America, the USA, and Europe, MarViva may execute extensive outreach to disseminate the tool and encourage its wide adoption.

MarViva Foundation is a regional, non-profit NGO, with mission to promote the conservation and sustainable use of coastal and marine resources in the Eastern Tropical Pacific. In alliance with government authorities, user sectors (fishing, tourism, maritime traffic, commerce, corporate…), scientific community, consumers of marine products and services, donors, media, and additional relevant stakeholders, we encourage and facilitate participatory marine spatial planning processes, the development of responsible markets and market incentives to leverage the conservation efforts, and capacity building and partnership development to enhance the effectiveness of the regulatory framework and best practices. (www.marviva.net)

Supporting Data/Information: Coders may have access to physical samples of fish products (*), as well as photos of whole individuals and fillets of different species, with the corresponding scientific and common name of the species, characteristics of the fish meat (color, odor, traits, expected fillet size), info of the species to encourage responsible consumption (i.e.: origin, vulnerability, maturity size, closure season)

-MarViva also counts on data sets and has synthesized relevant information in the "Guide to Identify Fish Fillets and Shellfish" in Costa Rica that can be adapted and applied regionally.

*NOTE: The below document is in Spanish only. Participants may use any other data they find online that is open source to address this problem statement.
http://www.marviva.net/Publicaciones/Guia_de_identificacion_de_filetes_de_pescado_y_mariscos.pdf

-Images of fillets: https://www.dropbox.com/s/o7fcakroak6h3pt/Fish%20Hackathon.rar?dl=0

*MarViva will provide the fillet samples for the Costa Rica venue

9. United States Mission to ASEAN (USASEAN)

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**This problem statement is applicable to all ASEAN countries (i.e. Indonesia, Cambodia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand or Vietnam)*

Partner Country: The partner country for this project is the Philippines. It is an archipelagic nation composed of 7,597 islands with a coastline that measures 36,289 km and a total territorial water area (including the EEZ) of 2,200,000 km^2. In 2009, the country ranked 6th among the top fish producers in the world, with its total fisheries production amounting to 5.08 million metric tons of fishery products [4].

The national government agency that is primarily responsible for the management of the country's fisheries resources is the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR). On the other hand, the local government units (LGU) are given the jurisdiction and management responsibilities over the utilization of municipal waters and the resources therein by virtue of the Local Government Code of 1991 and the Philippine Fisheries Code of 1998. Unfortunately, LGUs in general have limited capabilities and resources to enforce regulations in their respective localities. Moreover, if fishermen are well informed on what they can and cannot do to a particular fishing ground, region, or the nation, this may have a direct and immediate utility for LGU-based fisheries management.

Problem Statement: In general, the Philippine fisheries sector is characterized by a high degree of resource dependence and provides direct livelihoods for an estimated 2 million people [5]. To further illustrate the importance of the Philippine fisheries to supporting local livelihoods, statistics show that the municipal fisheries sector, i.e. small-scale fisheries operating within municipal waters (15 km from the shoreline), directly employs an overwhelming 85% of the total number of fishing operators in the country.

Solution: Create an app and information portal to provide a 'one-stop-shop' for tools for the fisheries sector with all necessary information such as marine protected areas, applicable fishing laws, regulations, and decrees to combat illegal, unreported, and unregulated fishing (IUU) fishing. Fishermen and local authorities should be able to access critical information from a drop down list such as a location of marine protected areas, closed areas to fishing, depending where their boat is flagged, where they fished or landed the fish.

Hackathon Workflow: During the Fishackathon, the developers must build an ecosystem that will either enhance or complement the existing operating system that should include:

- An offline map of the Philippines that can be zoomed in and out. Details are revealed or generalized depending on the zoom level. The map of terrestrial areas when zoomed in, especially the coastline, should be of sufficient detail such that its users will be able to orient themselves where they are.
- When used on a mobile device, the app must be able to use the device's sensors such as compass and GPS to locate where the user is on the map.
- Display areas of biological concern such as MPAs
- The app must have interfaces which enables a user to query the features displayed on a map. As an example, for a mobile device, when a user taps on an MPA, it will display icons or text which enables a user to discover relevant information for the MPA like ordinances, area, etc.
- A portal for legal fisheries information and appropriate interface that allows users to query for information for example fishing laws, regulations, and decrees to combat illegal, unreported, and unregulated fishing (IUU) fishing.
- During times of inclement weather, the app must be able to notify its user about possible risks and dangers - this is of course dependent on availability of cellular (SMS) /internet signal
- Log movement (in appropriate time intervals in order to reduce battery consumption) when the user is at sea.
- When present on fish landing areas, enable users to report effort data wirelessly (wifi/bluetooth)
- A system for consolidated data to be analyzed and presented to various levels and scales of fisheries stakeholders and to inform management
- A public information/education tool
- Other relevant and complementing technologies

Supporting Data/Information

- Open source maps of high detail such as OpenStreet Maps
- Georeferenced data on MPAs preferably boundary polygons
- Municipal water delineation
- Ordinances of LGUs where the fisher resides/fishes.
- Ordinances of MPAs in waters where the fisher operates
- National laws, regulations, administrative orders on fishing and coastal resource management

Supporting Infrastructure

- The Department of Transportation and Communication (DOTC) is making wifi freely available (http://icto.dost.gov.ph/wp-content/uploads/2015/03/Free-Wi-Fi-Project-TOR.pdf)
- TV White Space replicated in other areas

Additional Data Resources

- **Conservation databases from IUCN** (including Red List) https://www.iucn.org/knowledge/tools/databases/
- **Sea Around Us** http://www.seaaroundus.org/
  - Data including catch, regions, trophic level and governance regions.
- **MPA atlas**: http://www.mpatlas.org/data/
- **Food and Agriculture Organization of the United Nations**
  - FAO catch, aquaculture production and trade statistics: http://www.fao.org/fishery/statistics/en
- **Marine Ecoregions of the world** http://www.worldwildlife.org/publications/marine-ecoregions-of-the-world-a-bioregionalization-of-coastal-and-shelf-areas
- **The Nature Conservancy's core global spatial data** http://maps.tnc.org/gis_data.html (in GIS and Google Earth KML formats)
- **Ecosystem services valuation database** http://www.fsd.nl/esp/80763/5/0/50