Trawling: finding common ground on the scientific knowledge regarding best practices

Ray Hilborn, Simon Jennings, Michel Kaiser

Executive Summary – summary and specific request sections

One of the most contentious issues in management of marine fisheries is the use of mobile bottom contact gears, trawls and dredges. About 25% of world fish catch comes from the use of these gears and catch from trawls is an important element in food security in much of the world. At present, a continental shelf area approximately equivalent to 3 times the area of Brazil is affected by mobile bottom contact gear. Trawls can dramatically transform sensitive benthic ecosystems, eliminating much of the associated emergent surface dwelling flora and fauna especially on hard bottoms. Conversely, extensive studies have shown that there are fewer changes to less sensitive habitats, particularly in regions subject to frequent natural disturbance.

We propose to establish a working group of experts in ecology and fisheries management to provide a scientific basis for evaluating policies on trawling. The project will consist of 5 phases.

(1) The first phase will examine the extent of trawling and habitats, compiling for as much of the world as possible data on the area trawled, the habitats trawled and the intensity of trawling. Particular attention will be paid to identifying data on the trends in the extent and frequency of areas trawled, and the distribution of trawl footprint across different habitat types.

(2) The second phase will compile and evaluate data on the impact of trawling on the abundance and diversity of biota, looking especially at the key factors of intensity of trawling and type of habitat trawled. Where possible, responses of key ecosystem services to trawl disturbance will be compiled or inferred from published studies.

(3) The third phase will use information from the first and second phases to develop methods for risk assessment and conduct a risk assessment of the effects of trawling and illustrate trends in risk of change to seabed habitats and communities among fisheries and through space and time

(4) The fourth phase will look at the medium and long term impact of trawling on the productivity and sustainable yield of different target species and from the ecosystem as a whole. It seems likely that trawling benefits some species and is detrimental to others. How does trawling affect the long-term sustainable yield of aquatic resources from an ecosystem? How does trawling affect other ecosystem services?

(5) The fifth phase will identify and test a range of management options and industry practices that may improve the environmental performance of trawl fisheries; with a view to defining ‘best practice’. For each option or practice, the impact on biota, sustainable food production, ecosystems and ecosystem services will be evaluated, along with changes in fuel consumption and other costs and impacts.

The project will be conducted by a working group of 10-15 over 2 years with a series of 4 meetings. Three post-doctoral fellows will provide the major work between group meetings.

Background/Problem Definition – the context and issues underlying the proposal

This proposal emerges from the ongoing concern about the impacts of bottom contact fishing gear, and the need for a synthesis of the scientific knowledge related to the issue. For the rest of this proposal we will use the term trawl to refer to all types of bottom contact gear, including trawls, dredges, and bottom contact by gears such as Danish Seine. Historical reviews of the subject have been performed by Jennings and Kaiser (1998), Kaiser (1998), The National Research Council (2002), Collie et al (2000), Kaiser et al. (2006) and Hinz et al. (2009). The major emphasis in these reviews was on the impact of trawling on bottom flora and fauna. There is now further information on this subject, and considerably more mapping of seafloor habitats and knowledge of trawl effort distribution in a number of areas. There has been limited attempt to estimate the impact of trawl disturbance on the productivity of target species, and there have been considerable developments in trawl gear technology that need to be summarized and evaluated. None of the earlier work attempted to define the consequences of a range of definitions of "best practice."

In addition to the development of scientific knowledge of the impact of trawling over the last 10 years, there is increasing interest from a wide range of stakeholders on the impacts of trawling. In our discussions with NGOs and industry the subject of trawl impacts is almost always a major issue. Assembling the scientific information in a single data base accessible to all is of interest to all concerned. Furthermore, some major retailers now refuse to stock fish caught using trawl gears (e.g. Waitrose in the UK which accounts for 12% of UK fish retail sales).

Project Goals and Objectives – the expected result

There are three major goals and objectives

Goal #1: The first goal is to assemble data bases on the extent of trawling, habitats trawled, impacts of trawling on different biota in different habitats and impacts of trawling on ecosystem productivity and services. Once these data are assembled and analyzed these data bases will be made public.

Goal #2: Analyze the data bases to evaluate the overall extent of trawl impacts on biota, productivity and ecosystem services, to the extent possible by geographic regions.

Goal #3: Identify a range of "best practices" for trawling and determine the consequences of adoption of different best practices on biota, sustainable food production, ecosystems and ecosystem services.

Grant Term – expected start and end dates for the project

15 October 2012 – 14 October 2014

Project Activities and Timelines

Activity 1: Development of an international scientific team. Fall 2012

This project will be modeled on the "Finding Common Ground in Marine Fisheries Management" project sponsored by the National Center for Ecological Analysis and Synthesis that resulted in the Worm et al. 2009 paper in Science "Rebuilding Global Fisheries." We would aim for 10-15 participants drawn from a range of geographic regions and expertise. We would plan on meeting 4 times for 2-3 days over a period of 2 years. In the previous project the data base assembly, and analysis was largely conducted by post-doctoral fellows, and we suggest that three post-docs would be needed to complete this work.

This international team would not only perform this particular study, but would provide the basis for a long-term project that would maintain the data base and advance scientific knowledge of trawl impacts.

Activity 2: Expansion, development and maintenance of data bases on trawl distribution and impacts. Fall 2012-2013

Analyses will be based on three databases that describe (1) impact and recovery following trawl disturbance (2) the distribution of habitats that may be impacted by trawling and (3) the distribution and intensity of trawling pressure. The linking of these databases will provide a unique evidence-base from which to develop best-practice or guidance to minimize the effects of trawling on secondary production and ecosystem services. Each of these data bases is described below. The long-term relevance of these databases will require that they can be easily updated with new data as it emerges.

Data base # 1 Impact and recovery

A database will be constructed that integrates global quantitative measures of the direct response of benthic biota and biological habitat components to direct physical impact by towed bottom-fishing gear. There are presently >110 empirical peer-reviewed publications from which the data can be harvested. The following fields will be included: 'Gear type' (subdivided into different fishing activities according to differences in their mode of action – beam trawls, otter trawls, scallop and clam dredges). 'Regime' describes the number of discrete periods of disturbance. We also distinguish the acute disturbance of experimental fishing impact studies from comparisons of fished (chronically disturbed) and unfished areas. 'Size' of experimental plot will be included as the minimum dimension of any disturbed area because this is the smallest distance over which adults or larvae need to migrate to recolonize an area. 'Habitat' will be classified as mud, muddy sand, sand, gravel and biogenic. The biogenic category includes seagrass meadows or reef forming organisms such as mussel beds, sponge or coral reefs. The remaining variables are 'geographic region', 'water depth' of the study, and 'taxonomic grouping' (phylum, class, genus). The team will follow systematic review methodology as used to assess the performance of drug trials in the medical field (see Stewart et al. 2009 for an example). In addition, the team will harvest data from studies that focus on 'recovery' and those that have studied the response of communities to commercially relevant scales of fishing and that have quantified a gradient of fishing impact.

Data Base #2 Habitat

A database holding collated data on the spatial distribution of marine habitats on continental shelves and in the deep sea to the extent possible. Habitat classification would be consistent with the habitat classification defined to assess impacts and recovery (Database 1). The spatial resolution of data would be at nested scales, with scale reflecting the quality of habitat information available, from high resolution on continental shelves of some wealthy nations to lower resolution in other areas. Fields would be grid cell reference, latitude, longitude, cell area, classification.

Data Base #3 Fishing pressure

A database holding collated data on the distribution of trawl impacts in space and time. The primary aim would be to collate data for the time period from 2008-2010, with a secondary aim of establishing a time series for preceding years. The spatial resolution of data would be at nested scales, with scale reflecting the resolution of fishing effort data, from high resolution when VMS data are available to coarse resolution when aggregate statistics are available. Fields would be grid cell reference, latitude, longitude, cell area, year, fleet

classification, gear classification, data source (VMS, logbooks etc) and hours trawling. The database would be publicly available after quality control and within two years.

Data base access: Made public in October 2014

Prof. Kaiser currently has a data base on impact and recovery, and at the end of this project this data base will be made public. The intention is to follow the principle of public access in which the existing version is available at http://www.ecoserve.ie/costimpact/data_impst.html. The data bases on impact and fishing pressure are generally held by fisheries management agencies, and some of the information, especially about fishing locations, is often confidential and access is restricted in various ways. At this point we cannot say how much of the information will be able to made publically available. We can certainly provide meta-data to point to the individual data bases and researchers.

Activity 3: Publications and presentations on trawl impacts and best practices. Late 2014

A key activity for this proposal will be a major synthesis paper summarizing the data, analysis and conclusions. Given the high-profile nature of the subject we anticipate a good chance of publication in one of the premier scientific journals.

We know that the impacts of trawling on biota are highly variable, with almost total ecosystem transformation in some biogenic habitats to no measureable impacts in highly disturbed habitats. Thus much of the discussion of trawl impacts has been totally distorted by "cherry picking" studies of one kind or another. The publication of an authoritative paper that summarizes the total range of knowledge, and most importantly looks at where trawling currently takes place will be of major significance.

In addition to the publications, a major activity of the working group will be talks given by group members. It is too early to identify specifics, but based on past working groups, especially the group "Finding common ground in marine fisheries management" that Hilborn, Jennings and Collie participated in, we can state with confidence that presentations will be a significant activity.

Project Indicators, Outcomes and Deliverables

Outcome 1: Defining the scientific information on best trawl practices.

This will be the major outcome of this project. We do not anticipate any single definition of best practice, but what we should be able to provide is an evaluation of the consequences of different definitions of best practices. For instance the two extremes would be a total ban on bottom contact gear, and no restrictions on bottom contact gear above and beyond those that are currently in place. For each of these extremes we can estimate the biological consequences measured by biodiversity changes and impacts on fish productivity, as well as the yield consequences. There are many possible "best practices" in between these two extremes, for instance a ban on bottom contact gear in specific sensitive biogenic habitats. We anticipate being able to evaluate the yield consequences of such a ban, at least for the areas where habitat and trawl effort are well mapped. It is our expectation that there will be some very clear cases where gear restrictions may have high biological benefits with low loss of yield. Such information is of paramount importance to processors and retailers looking for robust evidence on which to base their company buying policies.

Outcome 2: Finding common ground between NGOS and Industry.

Our working group team will be composed of scientists with a proven track record in marine fisheries and trawl impacts and younger researchers. To assure that the working group answers the key scientific questions of concern to stakeholders, we will hold a series of web based conferences with stakeholders where we will invite them to provide comment on the proposed work plan and as the work progresses to discuss results and conclusions. As the data bases develop these web conferences should provide an opportunity to find common ground between some of the NGO and industry groups who are willing to use data to reach conclusions about the extent of trawl impacts. We recognize that some industry and NGO groups will selectively use data sets to meet their own agendas, but we anticipate that a common data set will provide an opportunity for common ground among many of the parties that are truly interested in achieving sustainable marine fisheries management.

This outcome will be facilitated by the working groups meetings and data base but will largely occur outside of the regular group meetings in the web conferences.

The key deliverables will be the data bases and publications.

Project Management – brief description of how the project will be managed

The three PIs, Hilborn, Jennings and Kaiser will manage the project jointly, with a general division of the workload as follows. Kaiser will coordinate the data collection of the data bases on impact and recovery. Jennings will coordinate the data collection on extent of trawling on different habitat types. Hilborn will coordinate the data collection on impacts on productivity and ecosystem services. All three will coordinate the meetings and publications.

Literature Cited –

Collie, J. S., Hall, S. J., Kaiser, M. J., and Poiner, I. R. 2000. A quantitative analysis of fishing impacts on shelf-sea benthos. J. Anim. Ecol. 69: 785-798.

Hinz H., Prieto V. & Kaiser M.J. 2009. Trawl disturbance on benthic communities: chronic effects and experimental predictions. Ecological Applications 19: 761-773

Jennings, S., and Kaiser, M. J. 1998. The effects of fishing on marine ecosystems. Advances in Marine Biology. 34: 201-352.

Kaiser M.J., Clarke K.R., Hinz H., Austen M.C.V., Somerfield P.J., & Karakassis I. 2006. Global analysis and prediction of the response of benthic biota and habitats to fishing. Marine Ecology Progress Series 311: 1-14.

Kaiser M.J. 1998. Significance of bottom-fishing disturbance. *Conservation Biology*, 12: 1230-1235

National Research Council. 2002. Effects of trawling and dredging on seafloor habitat / Committee on Ecosystem Effects of Fishing: Phase 1--Effects of Bottom Trawling on Seafloor Habitats, Ocean Studies Board, Division on Earth and Life Sciences, National Research Council. National Academy Press, Washington, D.C.