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Construction and first applications of a global cost of fishing database

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The development of a new global database of fishing cost is described, and an overview of fishing cost patterns at national, regional, and global scales is provided. This fishing cost database provides economic information required for assessing the economics of fisheries at various scales. It covers variable and fixed costs of maritime countries, representing ~98% of global landings in 2005. Linked to country and gear-type combinations, cost estimates can be mapped to a database of spatially allocated fisheries catches for future analysis in both spatial and temporal dimensions. The global average variable cost per tonne of catch in 2005 is estimated to range between US$639 and $1217, and the total cost per tonne from $763 to $1477, with mean values of $928 and $1120, respectively. The total global variable fishing cost is estimated to be in the range US$50–96 billion per year, with a mean of $73 billion per annum in 2005 dollar equivalents.

Keywords: catches, database, fisheries, fishing cost, fixed cost, fuel cost, global cost, sustainability, variable cost.

Introduction

Socio-economic indicators of fisheries such as fishing cost and gross revenue play an important role in economic analysis and ecosystem modelling, so are useful information for sustainable fisheries management, planning, and policy-making (Sainsbury and Sumaila, 2001; Le Gallic, 2002; Christensen *et al.*, 2009). These indicators have been used in monitoring and assessing the economic and social performance of fisheries and the impact of fisheries in a broader context. However, most of them are neither well documented nor readily available, which can lead to inaccurate estimation of management options.

At a global scale, researchers and intergovernmental agencies have recently put effort into collecting, compiling, analysing, and making available key economic data such as ex-vessel prices and subsidies (Sumaila and Pauly, 2006; FAO, 2009). However, the cost of fishing is still poorly documented and studied in most regions, particularly at a global scale. Fishing cost and cost structure vary depending on the type of fishery, and the gear and vessel employed. When fishing costs are known, various types of social and economic analysis on global fisheries are possible; notably, fishery managers can utilize the data to assess the current economic status of the sector. Also, socio-economic analyses that identify the most appropriate management measures by comparing the economic efficiency of fisheries under different options become feasible (Clark, 1979). Additionally, cost data are important for evaluating trends in fleet effort and the distribution of fishing fleets around ports, and researchers can use fishing cost information to study the impact of climate change on the economics of fisheries and its ripple effects on society. Therefore, to understand the economic viability of the fisheries sector, it is crucial to have information on the cost of fishing. For example, commercial fishers are likely only to fish when it is profitable to do so, so there will be no fishing or investment when stocks decline below bionomic equilibrium, unless they benefit from government subsidies (Schrank, 2003; OECD, 2005; Sumaila and Pauly, 2006).

Information on fishing cost in most countries and regions of the world is scarce, widely scattered, and incomplete. The major reason for this is the significant effort required to obtain the data in the first place, but also because private fishing enterprises are understandably reluctant to disclose information that may be exploited by their competitors (Obeng, 2003). In addition, there is seldom a requirement for government agencies to record and disseminate this information systematically (Bonzon, 2000; Whitmarsh *et al.*, 2000; Gasalla *et al.*, 2010). Moreover, the mutual trust between fishers and government agencies that would enable such information to be collected routinely is generally lacking.

Despite these challenges, at the regional scale, the 2010 Annual Economic Report on the European Fishing Fleet (European Commission, 2010) provides comprehensive cost and landing data for several different vessel types of 22 European countries. The geographic coverage of the report has increased in the past few years because of the introduction of the economic components of the European Union (EU) fisheries data collection framework (DCF) in 2008. Under this framework, there are legislative requirements for exhaustive cost-data collection on all EU Member States' fishing fleets. For countries in other regions, fishing cost data, if any, are usually collected by governments and non-governmental bodies and are available through websites or Annual Reports, e.g. Japan (Statistics Department, Ministry of Agriculture, Forestry and Fisheries, 2006) and the UK (Sea Fish Industry Authority, SeaFish, last accessed 2009; http://www.seafish.orgStatistics). In the United States, the National Oceanic and Atmospheric Administration (NOAA) provides cost and earnings data for commercial fishing vessels in several regions, e.g. the Northeast United States (Gautam and Kitts, 1996; NOAA, 2009). However, for most countries, fishing costs are not collected or not made available to the public, and only scattered information on fishing cost for particular fisheries and/or countries can be found, mainly in the grey literature, e.g. in technical papers issued by the FAO (see, for example, Lery *et al.*, 1999). The World Bank and FAO (2008) attempted to estimate the global fishing cost in the "Sunken Billions" project, which sought to evaluate the loss of economic rent attributable to the mismanagement of world fisheries. They estimated the global total fishing operating cost (including fuel and labour) to be ~\$73.3 billion in 2004. However, this figure was based only on cost data of the European fleets and India's fisheries, which jointly contributed just 9.3% of global marine fish landings in 2004 (World Bank and FAO, 2008). The global database presented here was developed to improve upon this estimate.

First, we describe the procedure for creating the global cost of fishing database and its structure, then discuss the preliminary results obtained with the help of this database, providing an overview of fishing cost patterns among countries and gear types.

Methods

Developing a global fishing cost database

The database was created through three major steps: first, we categorized the different types of fishing costs and designed the structure of the database. Second, we collected cost data ("observed cost") from different sources. Finally, we filled in gaps in the database by interpolation.

Data categorization and database design

The economic costs of fishing (rather than accounting cost) are the focus of this study. Economic costs represent the value of inputs at the next alternative best use (Reid *et al.*, 2003). Our categorization of cost is based on the "Economic performance of selected European fishing fleets—annual report" (European Commission, 2006), because it provides the most comprehensive definitions of different fishing cost categories found in the literature. Two types of cost, variable (operating) and fixed, were distinguished. Costs associated with operating fishing vessels were categorized as variable costs because they vary with the level of fishing activity. The major items under variable costs include fuel, salaries for crew, repair and maintenance costs of vessels and gear, and the cost of selling fish via auction, of fish handling and processing (e.g. the purchase of ice). Fixed costs do not vary with the level of fishing activity and are usually regarded as "sunk" and consist mainly of the amount invested in vessels, i.e. their capital value. However, investment in a vessel does not necessarily represent a "sunk" cost if the vessel can be used in other fisheries or economic pursuits, i.e. implies that they are malleable. Interest and depreciation costs fall into this category. Under the DCF, depreciation and interest (whether actual or opportunity costs) are referred to as "capital costs". Interest cost reflects the opportunity cost of capital, and depreciation cost is the replacement cost for normal wear and tear of the fishing vessels. Cost components such as license fees, which are considered as the economic profit-sharing between fishers and resource owners, are not included in this study. Other than the cost of fishing, we also compiled data (by country) on gear and vessel types used, vessel length category, the weight of fish caught, and the reported value of landings, if they were available.

Each record in the database represented each country and gear-type combination. Gear types included in the database were based on the gear categorization system of the *Sea Around Us* project (http://www.seaaroundus.org/).

Data collection

Following Sumaila *et al.* (2007), we focused on collecting secondary data for vessels operating in major fisheries and in major fishing nations in each of the six FAO regions of the world: (1) Africa; (2) Asia; (3) Europe; (4) North America; (5) Oceania; and (6) South and Central America, including the Caribbean. The first step was to identify the sources of fishing cost data, mainly secondary sources, i.e. websites and grey literature, such as government, FAO, and consultant reports. Next, we contacted partners around the world to help us locate additional data sources. To facilitate their input, a survey form was widely distributed and used for feedback.

Data-collection effort was targeted on major fishing countries in each of the six FAO regions (i.e. continents, with North and South America counted separately), with a combined total catch of >98% of global landings in 2005. Using this approach, the cost data for most fisheries in each region were captured, thereby ensuring a representative sample of the world's marine fisheries.

To include as many values of observed cost as possible, access was sought to all available sources, irrespective of publication year, so extending our efforts in collecting cost data from 1950 to the most recent year for which data were available. The data were then converted to 2005 real values using the consumer price index for each country, obtained from the World Bank (2007). To facilitate the comparison of fishing cost among different regions and countries, all fishing costs were converted from local currencies to US dollars (US\$) using currency exchange rates provided by the World Bank (2007), and the original cost was standardized to the annual average weighted cost per tonne of catch (US\$ per tonne), i.e. total cost/total landings. Expressing fishing costs in $\$\,t^{-1}$ facilitates the combination of this database with other data sources such as the *Sea Around Us* project catch database which is used in the analysis.

Progressive refinement process for filling data gaps

To estimate the cost of all gear types in each fishing country from the observed cost we collected, we adopted a process of progressive refinement (Tyedmers *et al.*, 2005; Watson *et al.*, 2006; Sumaila *et al.*, 2007), in which more-specific estimates for a given region and gear type are computed to replace the average cost values computed in the previous step. Therefore, all gear types in each maritime country of the world were assigned a cost, either the observed value where available, or an appropriate estimate.

Before interpolation, the observed data were examined for outliers, because estimated cost can be influenced heavily by the extreme values. Rather than removing outliers, we applied the method known as Winsorization, an approach that replaces extreme datapoints with values from within a predetermined acceptable range before estimating the population mean (Gwet and Rivest, 1992). In this study, all outliers were set to a specified percentile of the data. An 80% Winsorization was used, i.e. all values below the 10th percentile were set equal to the value corresponding to the 10th percentile, and correspondingly for values above the 90th percentile. The mean squared error of the Winsorized sample mean was smaller than that of the full sample mean (Searls, 1966; Ernst, 1980; Fuller, 1991).

After filling the database with observed costs, global fishing costs were estimated using a three-step progressive refinement process (Supplementary material). First, the overall weighted-by-catch average cost based on all the observed data disregarding gear type and country was calculated. Second, we assumed that vessels using the same gear type had similar fishing costs regardless of the FAO region in which they operated. Under this assumption, if a type of fishing gear in a specific FAO region did not have an observed fishing cost, then it was assigned the weighted average fishing cost of the same gear type for all other FAO regions combined. These estimates were refined further using the overall average fishing cost ratio for each cost component between FAO regions and were then used to replace the more general estimate from the previous step. Finally, it was assumed that vessels with the same gear type incurred similar fishing costs within the same region, so a more specific estimate was assigned to a particular gear type in a country without observed cost. This last step was followed to obtain the weighted-by-catch average costs of each gear type from all observed cost values for the same gear type in each FAO region. This value was then assigned to the same gear type of all countries in the same FAO region where observed cost data were not available. At this point, every gear type in each fishing country was assigned a more-specific cost estimate if an observed cost was not available.

A scoring system was used to indicate the quality of the cost estimates. In such a system, a score was assigned to the cost in each of the above steps to indicate whether the cost data were observed or estimated. This scoring system reveals the quality of the cost data reported and areas where future efforts need to be concentrated. Table 1 provides a summary of the quality of the cost data in the current version of the database, by showing the match between country and gear type at each level of uncertainty for each type of fishing cost. A score of 1 was assigned to records with data from secondary sources, i.e. an exact match of country and gear type. A score of 2 means that the data were assigned from records with the same gear type in the same region (i.e. matching region and gear type). A score of 3 means that the cost data were the weighted average of the cost from all other FAO regions using the same gear type (i.e. matching gear type only). The records with the highest score (i.e. 4) are those with the lowest quality in the database. The cost data of these records are the weighted average from all countries and gear types. Some 98% of the global catch was assigned fishing cost data for each cost type based on a match either for country or gear type (or both). Among different cost types, fuel cost data had the best quality (i.e. ~10% of records had exact matches in country and gear type). Although only some 7–10% of the country and gear

Table 1. Quality score of fishing cost data.

Data quality score	Description	Matching spatial scale?	Matching gear types?	Number of records	Percentage of records	Catch (million t)	Percentage of global catch
Fuel cost							
1	Exact match of country and gear type	Country	Yes	157	10.0	44.2	46.5
2	Match region and gear type	Region	Yes	804	51.4	44.3	46.6
3	Match gear type only and from all other regions		Yes	395	25.2	5.1	5.4
4	Average from all countries and gear types		No	209	13.4	1.4	1.4
Running cost							
1	Exact match of country and gear type	Country	Yes	140	9.0	40.0	42.1
2	Match region and gear type	Region	Yes	795	50.8	48.3	50.8
3	Match gear type only and from all other regions		Yes	421	26.9	5.4	5.6
4	Average from all countries and gear types		No	209	13.4	1.4	1.4
Repair cost							
1	Exact match of country and gear type	Country	Yes	148	9.5	42.2	44.4
2	Match region and gear type	Region	Yes	810	51.8	44.6	46.9
3	Match gear type only and from all other regions		Yes	398	25.4	6.9	7.2
4	Average from all countries and gear types		No	209	13.4	1.4	1.4
Labour cost							
1	Exact match of country and gear type	Country	Yes	155	9.9	42.2	44.4
2	Match region and gear type	Region	Yes	803	51.3	44.6	46.9
3	Match gear type only and from all other regions		Yes	398	25.4	6.9	7.2
4	Average from all countries and gear types		No	209	13.4	1.4	1.4
Depreciation cost							
1	Exact match of country and gear type	Country	Yes	138	8.8	41.4	43.6
2	Match region and gear type	Region	Yes	764	48.8	44.9	47.4
3	Match gear type only and from all other regions		Yes	436	27.9	7.2	7.6
4	Average from all countries and gear types		No	227	14.5	1.5	1.6
Interest							
1	Exact match of country and gear type	Country	Yes	108	6.9	31.2	32.8
2	Match region and gear type	Region	Yes	803	51.3	50.5	53.1
3	Match gear type only and from all other regions		Yes	548	35.0	11.8	12.4
4	Average from all countries and gear types		No	227	14.5	1.5	1.6

type combinations had observed values for at least one cost type in this version of the database (i.e. an exact match in country and gear type), they took 33–47% of the global catch.

Fishing costs analysis

Although both variable and fixed costs were collected in the database, focus was mainly on variable costs in the analyses that follow. Fixed costs were not given as much weight as variable costs in the analyses because the former are only incurred once by vessel owners and fishers, so can be considered as "sunk" costs if they are non-malleable. Therefore, once the investment on vessels and gears has been made, variable cost is the only cost that fishers and vessel owners need to consider when they decide whether or not to continue fishing (Clark, 2006).

Using interpolated cost data, fishing costs were compared across countries and FAO regions; the spatial distribution of variable fishing cost was plotted to assess the pattern of fishing costs on a global scale. We also compared the difference in fishing cost across different gear types, allowing assessment of the cost effectiveness of different gear types. Finally, a global weight-by-catch average variable fishing cost in 2005 was estimated using all cost data regardless of gear type, country, and year. Combining the average cost data with the total global landings, it was possible to compute the total variable fishing cost of 144 maritime countries.

Table 2. Observed cost records for countries in FAO regions of the world, covering 46 of 144 maritime countries.

Region	Country	Number of records
Europe	Belgium	18
	Denmark	52
	Estonia	23
	Finland	25
	France	41
	Germany	22
	Greece	12
	Iceland	24
	Ireland	8
	Italy	41
	Latvia	12
	Lithuania	16
	Netherlands	25
	Norway	37
	Poland	12
	Portugal	27
	Spain	31
	Sweden	51
	UK	36
North America	Canada	5
	USA	250
Oceania	Australia	7
South and Central America and Caribbean	Antigua and Barbuda	5
	Argentina	6
	Barbados	2
	Brazil	9
	Chile	9
	Dominica	4
	Peru	12
	Trinidad and Tobago	3
Africa	Ghana	13
	Namibia	8
	Senegal	37
	South Africa	4
Asia	Bangladesh	1
	China Main	4
	India	28
	Indonesia	13
	Japan	18
	Korea Rep	18
	Malaysia	10
	Sri Lanka	5
	Taiwan	11
	Thailand	9
	Vietnam	1

Results

Observed fishing cost in the database

The number of observations collected from each country in the cost of fishing database is summarized in Table 2.

Observed cost is available for 46 of 144 maritime countries, covering the years 1985–2009. These 46 countries in the database contributed nearly 80% of the global landing volume in 2005. Each FAO region of the world is represented in the observed data (Table 2), but most observed data records were derived from Europe. Countries with data are highlighted in Figure 1 and the percentage of catch contributed by those countries to regional and global landings is also provided. Those countries jointly contributed 76% of the global landed value in 2005 (Figure 2); among them, 32 were categorized as developed and 14 as developing countries, based on the UN's Human Development Indicator (UNDP, 2008).

The database includes observed fishing cost for 14 of 18 gear types, which were identified according to the gear categorization system of the *Sea Around Us* project (Von Brandt, 1984; see Table 3). Bottom trawls, which contributed some 11% of the total catch in 2005, represented 40% of the observations, and seines and gillnets contributed some 30% of observed cost data and together contribute 50% of the world catch.

Fishing cost analysis using estimated data

Developed vs. developing country fishing cost

The combination of observed and interpolated cost data yields an estimate of global average variable cost per tonne of catch in 2005 of US$928, and $192 for fixed cost. The weighted mean of all cost types in the database, lower and upper bounds, computed based on a 90% confidence interval, are listed in Table 4. Among the 62 developed countries, which have an HDI score $\geq$0.8 (UNDP, 2008), the weighted average real (2005) variable cost per tonne of catch was estimated to be $1181, and the weighted average real (2005) fixed cost per tonne of catch was $198. In comparison, of 82 developing countries, with an HDI score $<$0.8 (UNDP, 2008), the weighted average real (2005) variable cost per tonne of catch was estimated to be $724 and the weighted average real (2005) fixed cost per tonne of catch $187.

Fishing costs across FAO regions

Figure 3 compares the average variable cost per tonne of catch across all FAO regions. The FAO region with the highest average

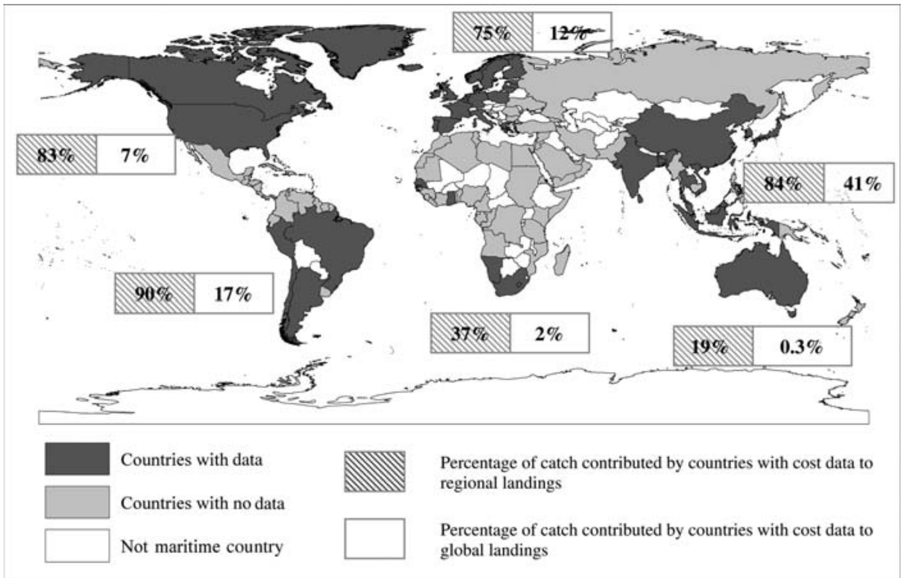

Figure 1. Countries with fishing cost data in the database, and the percentage of catch contributed by these countries to regional and global landings.

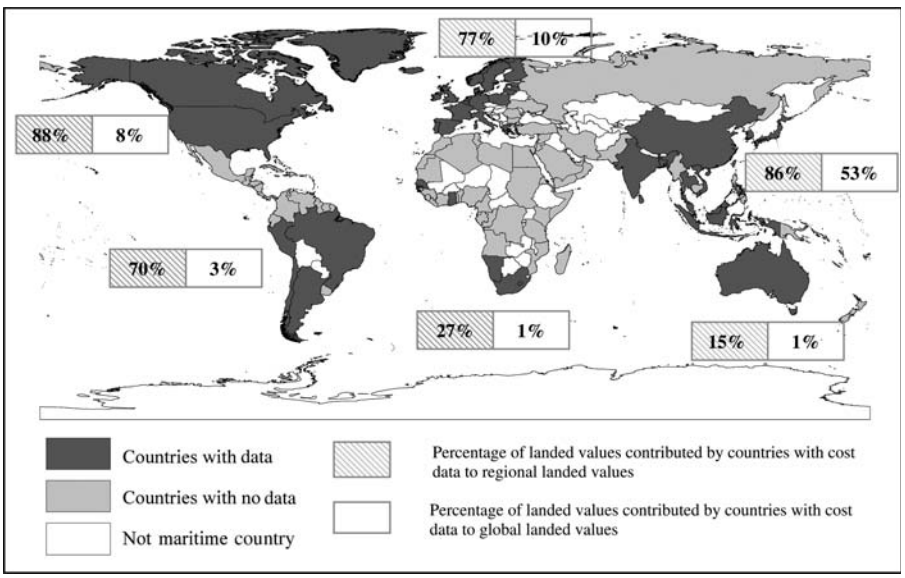

Figure 2. Percentage of landed values contributed by the countries with cost data to regional and global landed values.

cost per tonne of catch is Oceania ($2508 per tonne). Landings there were taken mainly with bottom trawls (some 30% of the total catch in Oceania), which have a relatively high variable cost ($1969 per tonne) in the region. The fishing costs of such other gear types as trammelnets, tuna longlines, shrimp trawls, and hook and line were extremely high there. These exceptionally high cost values (>$4000 per tonne) elevate the weighted average cost in Oceania. However, the cost of fishing in the waters of (mostly developing) Pacific Island states were estimated using the data in developed countries in the same region, because observed costs from the small states were not available. Therefore, there is a real possibility that fishing costs in Oceania were overestimated. From Figure 3, it is clear that South and Central America including the Caribbean had the lowest average variable cost per tonne of catch, i.e. $344 per tonne. This finding can be explained by the large proportion (95%) of the world's small-scale fishers being based in developing countries (FAO, 2010). The low variable fishing cost in that region may put further stress on fisheries by encouraging more people to enter fisheries and reinforcing the likelihood of fisheries acting as "the occupation of last resort", a known characteristic of small-scale fisheries.

When comparing the cost structure across FAO region (Figure 4), labour costs constitute the largest proportion of operating costs in all regions except Africa and South and Central America and the Caribbean, where both labour and fuel costs constitute the largest shares of fishing cost. Labour costs

Table 3. Observed cost records by gear type.

Gear type	Number of records	Percentage of global catch
Seine	100	29
Gillnet	193	21
Midwater trawl	85	16
Bottom trawl	400	11
Hook and line	107	8
Longline tuna	7	3
Shrimp trawl	7	3
Trap	48	2
Net	8	2
Dredge	37	2
Pole and line tuna	4	1
Purse-seine tuna	8	1
Hand	0	1
Spear	0	<0.5
Castnet	0	<0.5
Liftnet	1	<0.5
Trammelnet	1	<0.5
Bomb/chemical	0	<0.5

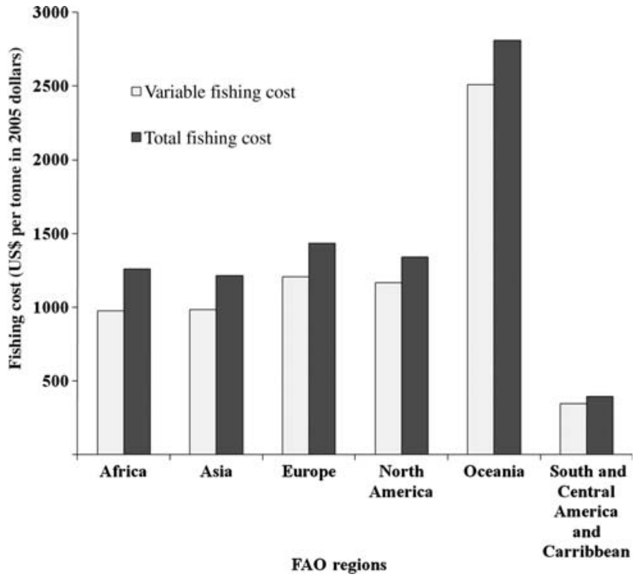

Figure 3. Comparison of the average variable and total fishing cost per tonne of catch across FAO regions.

Table 4. Summary statistics of all cost types in the cost of fishing database based on all data (both observed and interpolated; US$ per tonne of catch in 2005 real value).

Cost type	Weighted mean	Lower bound	Upper bound
Variable cost			
Fuel	210	152	268
Running[a]	194	130	258
Repair	131	92	171
Labour	393	265	521
Fixed cost			
Depreciation	114	68	161
Interest	77	56	99
Total fishing cost	1 120	763	1 477

Lower and upper bounds are calculated based on the 90% confidence interval.
[a]The running cost includes costs dependent on vessel activities, excluding fuel, e.g. the cost of selling fish via auction, cost of treatment of fish (e.g. ice), and food.

relative to the total variable cost is highest in North America (57% of total variable cost) compared with other regions (Figure 4), which is not surprising given the high gross national product (GNP) per capita of two (United States and Canada) of the three countries in the region (World Bank, http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf; last accessed 2009).

Comparing the cost of fishing across different fishing gears

The weighted average variable cost of the 18 gear types included in the fishing costs database are summarized in Table 5. Variable costs of several gear types exceed the value of landings (Table 5), and subsidies, misreporting, or generally poor-quality data are likely the reason for this. It is also possible that the outcome of the analysis would differ if a time-series of cost data were to be used rather than the single-year analysis undertaken here. Among gear types with observed cost, tuna longliners have the highest estimate of average variable cost ($2604 per tonne). The high cost of that gear type can be justified by the high ex-vessel price of tuna, the target species of the gear. For example, ex-vessel prices of bigeye tuna (*Thunnus obesus*) for Japanese longline fleets can be as high as $10 636 per tonne in 2001 real dollars (Reid *et al*., 2003). Trammelnets and traps follow tuna longliners in terms of highest average variable cost, with estimates of $2164 and 2040 per tonne of catch, respectively. The fourth highest average variable fishing cost gear type, dredge, is estimated to be $1879 per tonne. This category includes dragged gear, sweepnets, runnernets, and hand-, boat-, and mechanical dredges. Labour costs contributed the largest proportion of variable cost (59% of the total variable cost) for dredge gears, because this fishing method usually requires more labour for at-sea processing of meat from shellfish such as scallops. For example, dredge vessels of the mid-Atlantic sea scallop (*Placopecten magellanicus*) fishery usually operate for 24 h per day and 10–20 days per trip, so more crew are needed (Kirkley *et al*., 1995). The average variable costs of vessels using net, seine, and gillnet were the lowest of the other gear types. Vessels using static gears such as surrounding nets, beach-seines, and fixed and set gillnets generally consume less fuel, so have lower operating costs. Midwater trawls also have relatively low variable cost ($885 per tonne of catch) and they are generally towed at different depths above the bottom in the water column and towed by one (otter trawls) or two boats (pair trawls). Vessels using otter trawls consume 50% less fuel than those using other bottom trawl methods, such as beam trawls (Polet *et al*., 2006).

The global cost of fishing

The total inflation-adjusted variable cost of fishing (real 2005 US$) for 144 maritime countries is estimated to have been some $73.2 billion. This estimate is consistent with the estimate of fishing costs, $73.3 billion in 2004, calculated by the "Sunken Billions" study (World Bank and FAO 2008).

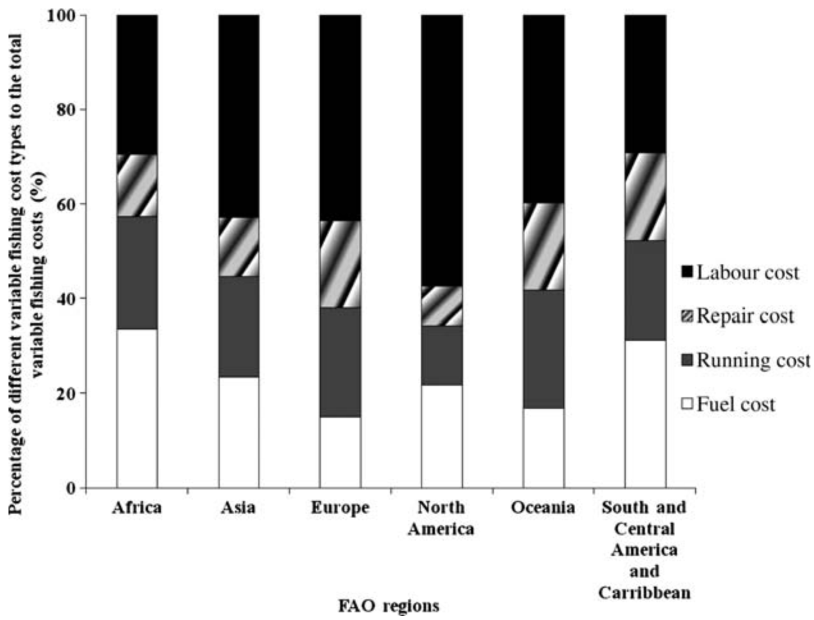

Figure 4. Percentage of different variable fishing cost types to the total variable fishing costs in the six FAO regions.

Table 5. Summary statistics for variable, total fishing costs and average ex-vessel price by gear type (US$ per tonne of catch).

Gear type	Variable cost	Total cost	Ex-vessel price[b]
Longline tuna	2 604	2 903	3 042
Trammelnet	2 164	2 292	2 644
Trap	2 040	2 378	3 333
Dredge	1 879	2 099	878
Hook and line	1 636	1 886	1 304
Shrimp trawl	1 582	1 858	3 833
Pole and line tuna	1 255	1 429	3 602
Bottom trawl	1 204	1 428	1 218
Liftnet	1 087	1 261	773
Purse-seine tuna	977	1 119	3 002
Midwater trawl	885	1 062	583
Castnet[a]	851	1 025	1 013
Spear[a]	851	1 025	582
Hand[a]	851	1 025	548
Bomb/chemical[a]	851	1 025	330
Gillnet	747	1 015	848
Seine	472	573	385
Net	180	241	2 655

[a]No raw data for these gear types. The weighted mean is based on the overall average of the raw data from other gear types.
[b]Average ex-vessel prices are extracted from the ex-vessel price database of the *Sea Around Us* project (Sumaila *et al.*, 2007).

Global pattern of fishing cost

The spatial distribution of total variable fishing cost in the world in 2005 is shown in Figure 5. The database suggests that countries in the coastal areas of Asia, North America, Europe, and West Africa have higher total variable cost of fishing than other areas. Comparing the average variable fishing cost per tonne of catch among different locations (Figure 6), the highest unit fishing cost areas are the coastal regions of Australia, the South Pacific, and Antarctica. This can be explained by the use of fishing gears with high variable fishing costs in those areas. The lowest unit fishing costs were in areas along the coasts of Perú, Chile, and India, whose catch mainly consists of small pelagic fish taken near-shore in huge schools that are relatively inexpensive to catch.

Discussion

We have presented the procedures for developing a global cost of fishing database and highlighted some of its potential applications. The database is the first version of what should be considered a “living” database, meaning that effort will be devoted to updating and improving it in future. In particular, our opinion is that focus should be on collecting cost data from countries in regions with low representation of observed data in the current version. Ideally, database users should state the quality of data from the database they are using and analysing, perhaps using the scoring system provided here (Table 1). The current version is already aiding researchers, fishery managers and other parties assess the economic status of fisheries and the impact of different management policy scenarios at different spatial scales. When combined with landed values (Sumaila *et al.*, 2007), this information will allow estimation of the economic rent from fisheries around the globe, as well as the profitability of fishing operations. As total costs exceed landed values for most gear types (Table 5), it seems clear that some fisheries would not be viable without a subsidy. The database also allows the mapping of port-based fishing effort by fleets, so can help estimate the distance travelled by fleets, and it can be used too to explore research areas such as assessment of the cost structure and efficiency of different gear types in different regions of the world and aid in developing fishing cost functions.

Supplementary material

Supplementary material is available at the online *ICES JMS* version of the manuscript as a detailed description of the progressive refinement process for filling the gaps in the fishing cost database using observed data.

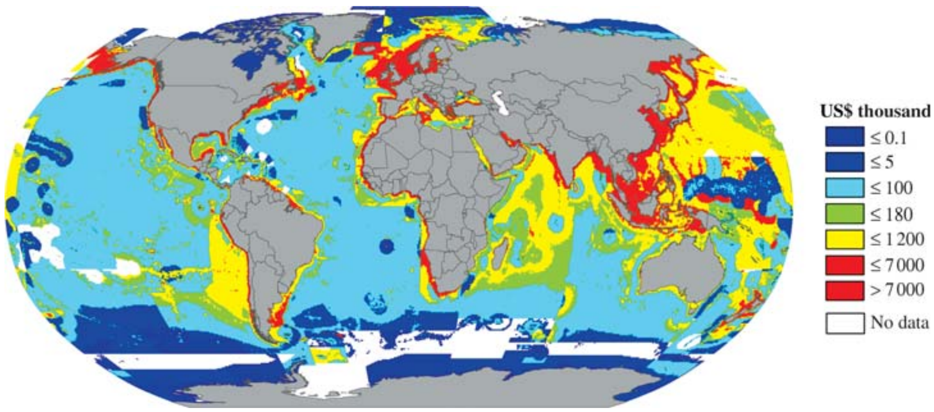

Figure 5. Total variable fishing cost (US$ thousand) in 2005.

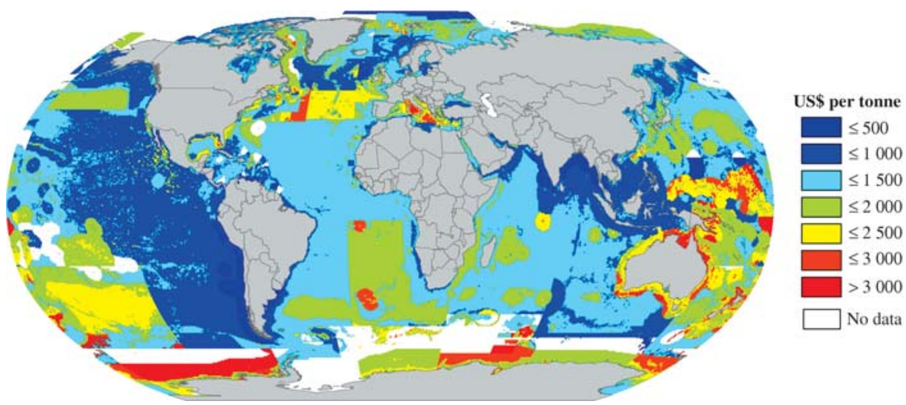

Figure 6. Average variable fishing cost per tonne of catch (US$ per tonne) in 2005.

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