Database contents for the Abstract, Results and Tables of the accepted Fish and Fisheries paper August 2011

Abstract

Comparative analyses can provide novel insight into marine population dynamics and the status of fished species, but the world's main stock assessment database (the Myers Stock-Recruitment database) is now outdated. To facilitate new analyses, we developed a new stock assessment database, the RAM Legacy database, for commercially exploited marine fishes and invertebrates. Time series of total biomass, spawner biomass, recruits, fishing mortality, and catch form the core of the database. Assessments were assembled from 21 national and international management agencies for a total of 331 stocks (295 fish stocks representing 46 families, and 36 invertebrate stocks representing 12 families), including 9 of the world's 10 largest fisheries. Stock assessments were available from 27 Large Marine Ecosystems and 4 High Seas regions, and include the Atlantic, Pacific, Indian, Arctic and Antarctic Oceans. Most assessments came from the U.S., Europe, Canada, New Zealand, and Australia. Assessed marine stocks represent a small proportion of harvested fish taxa (16%), and an even smaller proportion of marine fish biodiversity (1%), but provide high quality abundance data for these intensively studied stocks. The database provides new insight into the status of exploited populations: 58% of stocks with reference points (n=214) were estimated to be below the biomass that results in maximum sustainable yield (B_{msy}), and 30% had exploitation levels estimated to be above the exploitation rate that results in maximum sustainable yield (U_{msy}). We anticipate that the database will facilitate new research in population and fishery dynamics and life histories and encourage further data contributions from stock assessment scientists.

Results

Summary

Total number of proper stocks assessments: 331, from 295 marine fish populations and 36 invertebrate populations.

Taxonomy

Number of species in FishBase: 12339 (from 54 orders)

Number of species in SAUP: 925 (from 36 orders)

Number of species in RAM Legacy: 163 (from 58 families and 20 orders), 147 fish species and 16 invertebrate species

RAM Legacy contains 16% of SAUP and 1% of FishBase species

Top 5 taxonomic orders in RAM Legacy: Gadiformes (n=70), Perciformes (n=65), Pleuronectiformes (n=53), Scorpaeniformes (n=41), Clupeiformes (n=36)

Timespan

Number of assessments with catch timeseries: 313.

Number of assessments with recruitment timeseries: 274.

Number of assessments with spawning stock biomass timeseries: 280.

Together these comprise time series of catch/landings for 313 stocks (95%), SSB estimates for 280 stocks (85%), and recruitment estimates for 274 stocks (83%).

The median lengths of catch/landings, SSB, and recruitment timeseries were 39, 34, and 33 years, respectively. The time period covered by 50% of assessments is: catch/landings (1966-2007), SSB (1972-2007), recruitment (1971-2006), while that covered by 90% of assessments is: catch/landings (1983-2004), SSB (1985-2005), recruitment (1984-2003)

Assessment methodologies and reference points

The three most common assessment methods were Statistical catch-at-age/length models (n=169), Virtual Population Analyses (n=92) and Biomass dynamics model (n=45). Regionally, Virtual Population Analysis (VPA) is still the most common assessment model for European stocks (71% of 63 assessments), Canada (56% of 26 assessments) and Argentina (83% of 6 assessments), whereas statistical catch-at-age and -length models are more common for the United States (67% of 138 assessments), Australia (82% of 17 assessments) and New Zealand (76% of 29 assessments).

Biomass- or exploitation-based reference points were available for 262 (82%) and 224 (69%) assessments, respectively.

Stock status

MSY-related reference points were avaialble for 112 stocks (3 invertebrates) and estimated for 102 additional stocks (15 invertebrates), for a total of 214 stocks.

Of the 214 stocks presented in the fried egg, 112 and 102 of the biomass reference points and 82 and 132 of the exploitation reference points come from assessments and from surplus production model fits, respectively.

To identify potential biases arising from using BRPs derived from surplus production models we computed a contingency table of status classification for stocks that have both assessment- and Schaefer-derived BRPs (Table S2). Surplus production models correctly classified ratios of current biomass to BRPs in 77% of cases (for 60 of 78 assessments) and 64% of cases for exploitation BRPs (for 28 of 44 assessments).

Overall, 58% of stocks are estimated to be below their biomass-related MSY BRP, that is $B_{curr} < B_{msy}$, and 30% are estimated to be above their exploitation-related MSY BRP, $U_{curr} > U_{msy}$ (n=214 stocks total. Of the stocks for which biomass is currently estimated to be below B_{msy}, 54% have had their exploitation rate reduced below U_{msy}, suggesting potential for recovery. The remaining 46% of these stocks however, still have excessive exploitation rates. On a positive note, 42% of all stocks are estimated to be above B_{msy}, and 91% of the stocks above B_{msy} also have $U_{current}$ below U_{msy}.

Global fisheries

Management bodies and geography

Number of assessments from NMFS: 138 (81 with reference points, 41 (51 %) are below B_{msy}, 63 (78 %) are below U_{msy},)

Number of assessments from ICES: 63 (48 with reference points, 39 (81 %) are below B_{msy}, 22 (46 %) are below U_{msy},)

Number of assessments from ICES: 63 (23 with Blim and Flim reference points, 7 are below B_{lim} and above F_{lim}, 1 are above B_{lim} and above F_{lim}, 11 are above B_{lim} and below F_{lim} and 4 are below B_{msy} and below F_{lim}.

Number of assessments from MFish: 29 (28 with reference points, 11 (39 %) are below B_{msy}, 22 (79 %) are below U_{msy},)

Number of assessments from DFO: 26 (13 with reference points, 11 (85 %) are below B_{msy}, 13 (100 %) are below U_{msy},)

Number of assessments from AFMA: 17 (11 with reference points, 7 (64 %) are below B_{msy}, 7 (64 %) are below U_{msy},)

Number of assessments from DETMCM: 14 (6 with reference points, 3 (50 %) are below B_{msy}, 5 (83 %) are below U_{msy},)

The status of exploited marine stocks, as estimated from biomass- and exploitaion-BRPs, varied widely depending on the management body. Most European stocks (managed by ICES) have biomasses less than B_{msy} (81%), and over half of these stocks (59%) still have exploitation rates exceeding U_{msy}. Canadian stocks (managed by DFO) also had low biomass ($85\% < B_{msy}$), but all but one of these has had its exploitation rate reduced below U_{msy}. In contrast, about half (49%) of U.S. stocks (managed by NMFS) are estimated to still be above B_{msy}, and of the 41 stocks that are below B_{msy} 63% have exploitation rates below U_{msy}. In the New Zealand and Australian waters, stocks managed by MFish and AFMA are above B_{msy} in 61% and 36% of cases, respectively.

For the stocks grouped as ''Atlantic'' in the fried eggs we found that 6 of the 10 ICCAT stocks and 6 of the 10 of NAFO stocks were below B_{msy} .

Assessments were available for 27 LMEs, with the greatest number of assessed stocks coming from Northeast U.S. Continental Shelf (n=59), California Current (n=35), New Zealand Shelf (n=29), Gulf of Alaska (n=27), Celtic-Biscay Shelf (n=26), East Bering Sea (n=21) and Southeast U.S. Continental Shelf (n=20).

The proportion of stocks below B_{msy} and below U_{mys} varies considerably by management body.

ICES has 48 assessments in Table 4, 39 (81%) of which are below B_{msy} and 22 are below U_{msy}.

Stock status by taxonomic orders

Of the 48 stocks for Gadiformes, 15 are below B_{msy} and above U_{msy}, 2 are above B_{msy} and above U_{msy}, 9 are above B_{msy} and below U_{msy} and 22 are below B_{msy} and below U_{msy}.

Of the 46 stocks for Perciformes, 15 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 17 are above B_{msy} and below U_{msy} and 13 are below B_{msy} and below U_{msy}.

Of the 38 stocks for Pleuronectiformes, 14 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 18 are above B_{msy} and below U_{msy} and 5 are below B_{msy} and below U_{msy}.

Of the 24 stocks for Scorpaeniformes, 1 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 14 are above B_{msy} and below U_{msy} and 8 are below B_{msy} and below U_{msy}.

Of the 23 stocks for Clupeiformes, 4 are below B_{msy} and above U_{msy}, 2 are above B_{msy} and above U_{msy}, 7 are above B_{msy} and below U_{msy} and 10 are below B_{msy} and below U_{msy}.

Of the 12 stocks for Decapoda, 5 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 2 are above B_{msy} and below U_{msy} and 4 are below B_{msy} and below

U_{msy}.

Stock status by Mean Trophic Level

Of the 26 stocks of MTL between 2 and 3 , 10 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 7 are above B_{msy} and below U_{msy} and 8 are below B_{msy} and below U_{msy}.

Of the 93 stocks of MTL between 3 and 4 , 18 are below B_{msy} and above U_{msy}, 3 are above B_{msy} and above U_{msy}, 38 are above B_{msy} and below U_{msy} and 34 are below B_{msy} and below U_{msy}.

Of the 91 stocks of MTL above 4 , 27 are below B_{msy} and above U_{msy}, 4 are above B_{msy} and above U_{msy}, 35 are above B_{msy} and below U_{msy} and 25 are below B_{msy} and below U_{msy}.

Stock status by Functional Grouping

Of the 146 demersal stocks, 39 are below B_{msy} and above U_{msy}, 4 are above B_{msy} and above U_{msy}, 58 are above B_{msy} and below U_{msy} and 45 are below B_{msy} and below U_{msy}.

Of the 49 pelagic stocks, 11 are below B_{msy} and above U_{msy}, 3 are above B_{msy} and above U_{msy}, 18 are above B_{msy} and below U_{msy} and 17 are below B_{msy} and below U_{msy}.

Of the 18 invertebrates stocks, 7 are below B_{msy} and above U_{msy}, 1 are above B_{msy} and above U_{msy}, 4 are above B_{msy} and below U_{msy} and 6 are below B_{msy} and below U_{msy}.

Tables

Table 1: Number of assessments included in the RAM Legacy database

Country/Ocean	*Management Body*	*Acronym*	*No. stocks*
USA	National Marine Fisheries Service	NMFS	138
Multinational	International Council for the Exploration of the Sea	ICES	63
New Zealand	Ministry of Fisheries	MFish	29
Canada	Department of Fisheries and Oceans	DFO	26
Australia	Australian Fisheries Management Authority	AFMA	17
South Africa	South African national management	DETMCM	14
Multinational	International Commission for the Conservation of Atlantic Tunas	ICCAT	10
Multinational	Northwest Atlantic Fisheries Organization	NAFO	8
Argentina	Consejo Federal Pesquero	CFP	6
Multinational	Western and Central Pacific Fisheries Commission	WCPFC	5
USA	US state-level management	US State	3
Multinational	Inter-American Tropical Tuna Commission	IATTC	2
Russia	Russian Federal Fisheries Agency	RFFA	2
Multinational	Commission for the Conservation of Antarctic Marine Living Resources	CCAMLR	1
Multinational	Commission for the Conservation of Southern Bluefin Tuna	CCSBT	1
Peru	Instituto del Mar del Peru	IMARPE	1
Multinational	Indian Ocean Tuna Commission	IOTC	1
Multinational	International Pacific Halibut Commission	IPHC	1
Iran	Iranian national management	Iran	1
Multinational	South Pacific Regional Fisheries Management Organization	SPRFMO	1
Multinational	Unknown management body	UNKNOWN	1