Estimating global fish biomass

Olaf Jensen
Department of Marine and Coastal Sciences
Rutgers University
Four general approaches

• Scaling up density estimates
• Energetic approaches
• Size-based models
• Stock assessment data
Scaling up densities

• Get an areal density estimate – multiply it by area
Scaling up densities

From siphonophores to deep scattering layers: uncertainty ranges for the estimation of global mesopelagic fish biomass

Roland Proud\textsuperscript{1\*}, Nils Olav Handegard\textsuperscript{2}, Rudy J. Kloer\textsuperscript{3}, Martin J. Cox\textsuperscript{4}, and Andrew S. Brierley\textsuperscript{1}

\textsuperscript{1}Pelagic Ecology Research Group, Gatty Marine Laboratory, Scottish Oceans Institute, University of St Andrews, St Andrews, Fife KY16 8LB, UK
\textsuperscript{2}Institute of Marine Research, PO Box 1870, Nordnes, 5817 Bergen, Norway
\textsuperscript{3}CSIRO Oceans and Atmosphere Flagship, GPO Box 1538, Hobart, TAS 7001, Australia
\textsuperscript{4}Australian Antarctic Division, 203 Channel Highway, Kingston, Tasmania, 7050 Australia

\*Corresponding author: tel: +44 (0)1334 46 3401; e-mail: rp43@st-andrews.ac.uk.


“Estimates of global mesopelagic fish biomass vary substantially (between 1 and 20 Gt).”
Energetic approaches

- Primary Producers
  - 10% to Primary Consumers
- Primary Consumers
  - 10% to 4
  - 10% to 3
- 3
  - 10% to 4
Energetic approaches

Photosynthesis and Fish Production in the Sea

The production of organic matter and its conversion to higher forms of life vary throughout the world ocean.

John H. Ryther

Primary production required to sustain global fisheries

D. Pauly* & V. Christensen

International Center for Living Aquatic Resources Management, MCPO Box 2631, 0718 Makati, Metro Manila, Philippines
* Present address: Fisheries Centre, University of British Columbia, 2204 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada.

The mean of reported annual world fisheries catches for 1988–1991 (94.3 million t) was split into 39 species groups, to which fractional trophic levels, ranging from 1.0 (edible algae) to 4.2 (tunas), were assigned, based on 48 published trophic models, providing a global coverage of six major aquatic ecosystem types. The primary production required to sustain each group of species was then computed based on a mean energy transfer efficiency between trophic levels of 10%, a value that was re-estimated rather than assumed. The primary production required to sustain the reported catches, plus 27 million t of discarded bycatch, amounted to 8.0% of global aquatic primary production, nearly four times the previous estimate. By ecosystem type, the requirements were only 2% for open ocean systems, but ranged from 24 to 35% in fresh water, upwelling and shelf systems, justifying current concerns for sustainability and biodiversity.
Size-based models

• Size structures food webs
• The slope of the size spectrum is predictable
• The proportion of fish at each size in the size spectrum can be estimated

Predicting Consumer Biomass, Size-Structure, Production, Catch Potential, Responses to Fishing and Associated Uncertainties in the World’s Marine Ecosystems

Simon Jennings*, Kate Collingridge
Stock assessment data
Stock assessment data
Stock assessment data

Status and Solutions for the World's Unassessed Fisheries

Christopher Costello, Daniel Ovando, Ray Hilborn, Steven D. Gaines, Olivier Deschenes, Sarah E. Lester

Applying a New Ensemble Approach to Estimating Stock Status of Marine Fisheries around the World

Suggestions

• Still much debate about the best method and different methods yield very different estimates

• Expanding your focus from fish to “consumers” or large “consumers” could reduce one source of uncertainty: the fraction of biomass at a given trophic level or size that is made up of fish

• Use different existing estimates to bound the problem