Efficiency of fisheries is increasing at the ecosystem level

Managing fisheries presents trade-offs between objectives, for example yields, profits, minimizing ecosystem impact, that have to be weighed against one another. These trade-offs are compounded by interacting species and fisheries at the ecosystem level. Weighing objectives becomes increasingly challenging when managers have to consider opposing objectives from different stakeholders. An alternative to weighing incomparable and conflicting objectives is to focus on win-wins until Pareto efficiency is achieved: a state from which it is impossible to improve with respect to any objective without regressing at least one other. We investigate the ecosystem-level efficiency of fisheries in five large marine ecosystems (LMEs) with respect to yield and an aggregate measure of ecosystem impact using a novel calibration of size-based ecosystem models. We estimate that fishing patterns in three LMEs (North Sea, Barents Sea and Benguela Current) are nearly efficient with respect to long-term yield and ecosystem impact and that efficiency has improved over the last 30 years. In two LMEs (Baltic Sea and North East US Continental Shelf), fishing is inefficient and win-wins remain available. We additionally examine the efficiency of North Sea and Baltic Sea fisheries with respect to economic rent and ecosystem impact, finding both to be inefficient but steadily improving. Our results suggest the following: (i) a broad and encouraging trend towards ecosystem-level efficiency of fisheries; (ii) that ecosystem-scale win-wins, especially with respect to conservation and profits, may still be common; and (iii) single-species assessment approaches may overestimate the availability of win-wins by failing to account for trade-offs across interacting species.
When in life does density dependence occur in fish populations?
Assumptions behind size-based ecosystem models are realistic: Comment

A recent publication about balanced harvesting (Froese et al., ICES Journal of Marine Science; doi:10.1093/icesjms/fsv122) contains several erroneous statements about size-spectrum models. We refute the statements by showing that the assumptions pertaining to size-spectrum models discussed by Froese et al. are realistic and consistent. We further show that the assumption about density-dependence being described by a stock recruitment relationship is responsible for determining whether a peak in the cohort biomass of a population occurs late or early in life. Finally, we argue that there is indeed a constructive role for a wide suite of ecosystem models to evaluate fishing strategies in an ecosystem context.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Section for Ecosystem based Marine Management, University of Tasmania, Commonwealth Scientific and Industrial Research Organisation, Wageningen IMARES
Authors: Andersen, K. H. (Intern), Blanchard, J. L. (Ekstern), Fulton, E. A. (Ekstern), Gislason, H. (Intern), Jacobsen, N. S. (Intern), van Kooten, T. (Ekstern)
Pages: 1651-1655
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Journal: ICES Journal of Marine Science
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BFI (2018): BFI-level 1
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BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.63
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.18
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.62
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.46
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.35
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.32
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
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Characteristic sizes of life in the oceans - from bacteria to whales

General information
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Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Centre for Ocean Life, Section for Ecosystem based Marine Management
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Conference: International Workshop on Trait-based approaches to Ocean Life, Copenhagen, Denmark, 26/08/2013 - 26/08/2013
Main Research Area: Technical/natural sciences

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Journal: Annual Review of Marine Science
Volume: 8
Issue number: 3
ISSN (Print): 1941-1405
Ratings:
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 12.76 SJR 6.382 SNIP 4.101
Web of Science (2016): Indexed yes
Scopus rating (2014): SJR 8.073 SNIP 5.529 CiteScore 14.2
Scopus rating (2013): SJR 10.485 SNIP 5.585 CiteScore 16.42
Scopus rating (2012): SJR 9.805 SNIP 6.475 CiteScore 16.95
Scopus rating (2010): SJR 10.409 SNIP 5.716
Original language: English
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Postprint
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10.1093/icesjms/fsv211
Source: FindIt
Source-ID: 2291718818
Publication: Research - peer-review › Journal article – Annual report year: 2016
Comparing model predictions for ecosystem-based management

Ecosystem modeling is becoming an integral part of fisheries management, but there is a need to identify differences between predictions derived from models employed for scientific and management purposes. Here, we compared two models: a biomass-based food-web model (Ecopath with Ecosim (EwE)) and a size-structured fish community model. The models were compared with respect to predicted ecological consequences of fishing to identify commonalities and differences in model predictions for the California Current fish community. We compared the models regarding direct and indirect responses to fishing on one or more species. The size-based model predicted a higher fishing mortality needed to reach maximum sustainable yield than EwE for most species. The size-based model also predicted stronger top-down effects of predator removals than EwE.

In contrast, EwE predicted stronger bottom-up effects of forage fisheries removal. In both cases, the differences are due to the presumed degree of trophic overlap between juveniles of large-bodied fish and adult stages of forage fish. These differences highlight how each model’s emphasis on distinct details of ecological processes affects its predictions, underscoring the importance of incorporating knowledge of model assumptions and limitation, possibly through using model ensembles, when providing model-based scientific advice to policy makers.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, University of Washington
Authors: Jacobsen, N. S. (Intern), Essington, T. E. (Ekstern), Andersen, K. H. (Intern)
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Main Research Area: Technical/natural sciences

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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.56 SJR 1.322 SNIP 1.163
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.256 SNIP 1.051 CiteScore 2.22
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.443 SNIP 1.379 CiteScore 2.6
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.421 SNIP 1.081 CiteScore 2.25
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.324 SNIP 1.196 CiteScore 2.29
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.423 SNIP 1.09 CiteScore 2.13
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Maximizing fisheries yields while maintaining community structure

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Wageningen IMARES, University of Bergen
Authors: Kolding, J. (Ekstern), Jacobsen, N. S. (Intern), Andersen, K. H. (Intern), van Zwieten, P. A. (Ekstern)
Pages: 644–655
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BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.56 SJR 1.322 SNIP 1.163
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.256 SNIP 1.051 CiteScore 2.22
Web of Science (2015): Indexed yes
Remaining questions in the case for balanced harvesting
Balanced harvesting – harvesting all species and sizes in an ecosystem in proportion to their productivity – is a fisheries management strategy that has been suggested recently to increase yields, while reducing overall ecosystem impact. However, some aspects of balanced harvesting are controversial, including its call for extensive harvesting of juveniles and forage fish. Balanced harvesting also calls for targeting species and size-classes that are not currently marketable, possibly at a significant economic cost. Some have argued that this cost is outweighed by the ecological benefits of maintaining the ecosystem size and trophic structures and by the benefits of extra yield for food security. There is broad
consensus that balanced harvesting would require major changes to fishery management institutions and consumer behaviour, and it is unclear to what extent it is physically possible with current technologies. For this reason, we argue that steps to implement balanced harvesting are difficult to justify until the case for it is more clearly resolved. We outline some of the pivotal questions that must be answered to make a convincing case for or against balanced harvesting, many of which can be answered.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, University of California, Santa Barbara
Authors: Burgess, M. G. (Ekstern), Diekert, F. K. (Ekstern), Jacobsen, N. S. (Intern), Andersen, K. H. (Intern), Gaines, S. D. (Ekstern)
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.7 SJR 3.606 SNIP 3.245
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.668 SNIP 3.034 CiteScore 7.05
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.462 SNIP 3.327 CiteScore 7.13
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.488 SNIP 3.12 CiteScore 6.19
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.565 SNIP 2.852 CiteScore 6.14
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 4.025 SNIP 2.854 CiteScore 6.2
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 3.456 SNIP 2.434
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.617 SNIP 2.61
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.714 SNIP 2.712
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.887 SNIP 2.786
Scopus rating (2006): SJR 2.869 SNIP 3.161
Scopus rating (2005): SJR 2.394 SNIP 2.519
Scopus rating (2004): SJR 1.883 SNIP 1.483
Scopus rating (2003): SJR 1.33 SNIP 1.463
The theoretical foundations for size spectrum models of fish communities

Size spectrum models have emerged from 40 years of basic research on how body size determines individual physiology and structures marine communities. They are based on commonly accepted assumptions and have a low parameter set, which make them easy to deploy for strategic ecosystem oriented impact assessment of fisheries. We describe the fundamental concepts in size-based models about food encounter and the bioenergetics budget of individuals. Within the general framework three model types have emerged that differs in their degree of complexity: the food-web, the trait-based and the community model. We demonstrate the differences between the models through examples of their response to fishing and their dynamic behavior. We review implementations of size spectrum models and describe important variations concerning the functional response, whether growth is food-dependent or fixed, and the density-dependence imposed on the system. Finally we discuss challenges and promising directions.

General information
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Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Queen's University Belfast
Authors: Andersen, K. H. (Intern), Jacobsen, N. S. (Intern), Farnsworth, K. (Ekstern)
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BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.56 SJR 1.322 SNIP 1.163
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.256 SNIP 1.051 CiteScore 2.22
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.443 SNIP 1.379 CiteScore 2.6
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.421 SNIP 1.081 CiteScore 2.25
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.324 SNIP 1.196 CiteScore 2.29
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.423 SNIP 1.09 CiteScore 2.13
Size structures sensory hierarchy in ocean life

Life in the ocean is shaped by the trade-off between a need to encounter other organisms for feeding or mating, and to avoid encounters with predators. Avoiding or achieving encounters necessitates an efficient means of collecting the maximum possible information from the surroundings through the use of remote sensing. In this study, we explore how sensing mode and range depend on body size. We reveal a hierarchy of sensing modes (chemosensing, mechanosensing, vision, hearing, and echolocation) where body size determines the available battery of sensing modes and where larger body size means a longer sensing range. The size-dependent hierarchy and the transitions between primary sensory modes are explained on the grounds of limiting factors set by physiology and the physical laws governing signal generation, transmission and reception. We characterize the governing mechanisms and theoretically predict the body size limits for various sensory modes, which align very well with size ranges found in literature. The treatise of all ocean life, from unicellular organisms to whales, demonstrates how body size determines available sensing modes, and thereby acts as a major structuring factor of aquatic life.

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State: Published
Organisations: National Institute of Aquatic Resources, Department of Physics, Biophysics and Fluids, Centre for Ocean Life, Section for Marine Ecology and Oceanography
Number of pages: 9
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Publication information
Journal: Proceedings of the Royal Society B: Biological Sciences
Volume: 282
Issue number: 1815
The consequences of balanced harvesting of fish communities

Balanced harvesting, where species or individuals are exploited in accordance with their productivity, has been proposed as a way to minimize the effects of fishing on marine fish communities and ecosystems. This calls for a thorough examination of the consequences balanced harvesting has on fish community structure and yield. We use a size- and trait-based model that resolves individual interactions through competition and predation to compare balanced harvesting with traditional selective harvesting, which protects juvenile fish from fishing. Four different exploitation patterns, generated by combining selective or unselective harvesting with balanced or unbalanced fishing, are compared. We find that unselective balanced fishing, where individuals are exploited in proportion to their productivity, produces a slightly larger total maximum sustainable yield than the other exploitation patterns and, for a given yield, the least change in the relative biomass composition of the fish community. Because fishing reduces competition, predation and cannibalism within the community, the total maximum sustainable yield is achieved at high exploitation rates. The yield from unselective balanced fishing is dominated by small individuals, whereas selective fishing produces a much higher proportion of large individuals in the yield. Although unselective balanced fishing is predicted to produce the highest total maximum sustainable yield and the lowest impact on trophic structure, it is effectively a fishery predominantly targeting small forage fish.
Scopus rating (2001): SJR 2.688 SNIP 1.32
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 2.458 SNIP 1.359
Scopus rating (1999): SJR 2.434 SNIP 1.726
Original language: English
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http://rspb.royalsocietypublishing.org/content/281/1775/20132701.full
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Characteristic sizes of life in the oceans - from bacteria to whales

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Comparing ecosystem models as fisheries management tools: a case study in the California current

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Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography
Authors: Jacobsen, N. S. (Intern), Koehn, L. (Ekstern), Hodgson, E. (Ekstern), Andersen, K. H. (Intern), Essington, T. (Ekstern)
Publication date: 2013
Event: Abstract from International Workshop on Trait-based approaches to Ocean Life, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
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En revision af traditionelle koncepter i fiskeriet. Er balanceret fiskeri en mulig forvaltningsstrategi?

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Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Section for Ecosystem based Marine Management
Authors: Jacobsen, N. S. (Intern), Andersen, K. H. (Intern), Gislason, H. (Intern)
Publication date: 2013
Event: Abstract from 17. Danske havforskermøde, Roskilde, Denmark.
Main Research Area: Technical/natural sciences
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Projects:

Operationalization of trait-based modelling for an ecosystem approach to fisheries
National Institute of Aquatic Resources
Period: 01/11/2012 → 15/12/2015
Number of participants: 6
Phd Student:
Jacobsen, Nis Sand (Intern)
Supervisor:
Gislason, Henrik (Intern)
Main Supervisor:
Andersen, Ken Haste (Intern)
Examiner:
Nielsen, J. Rasmus (Intern)
Jennings, Simon (Ekstern)
Law, Richard (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

Activities:

ICES - Working Group on the Ecosystem Effects of Fishing Activities - WGECO (External organisation)
Period: 2014
Nis Sand Jacobsen (Participant)
National Institute of Aquatic Resources
Centre for Ocean Life
Degree of recognition: International

Related external organisation

ICES - Working Group on the Ecosystem Effects of Fishing Activities - WGECO
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar