A spatiotemporal model for snow crab (Chionoecetes opilio) stock size in the southern Gulf of St. Lawrence

We develop a high-resolution spatiotemporal model of stock size and harvest rates for snow crab (Chionoecetes opilio) in the southern Gulf of St. Lawrence, which supports an economically important fishery off the east coast of Canada. It is a spatial and weekly model during 1997–2014 that utilizes within-season depletion based on catch per unit of effort (CPUE; kg·pot⁻¹) and also biomass values from a survey designed specifically for this stock. The model is formulated in a state-space framework. The main contribution of the model is to provide a better understanding of fishery-dependent factors that affect CPUE. There is strong evidence of density dependence in the relationship with CPUE and stock biomass, in addition to a general increase in CPUE catchability over time that may be related to changes in gear soak time and spatial variation in catchability. We also find that a natural mortality rate of 0.4 provides a better fit to survey results. Model results suggest that there is no evidence of effort saturation in the fishery.
Choosing the observational likelihood in state-space stock assessment models

Data used in stock assessment models result from combinations of biological, ecological, fishery, and sampling processes. Since different types of errors propagate through these processes it can be difficult to identify a particular family of distributions for modelling errors a priori. By implementing several observational likelihoods, modelling both numbers- and proportions-at-age, in an age based state-space stock assessment model, we compare the model fit for each choice of likelihood along with the implications for spawning stock biomass and average fishing
mortality. We propose using AIC intervals based on fitting the full observational model for comparing different observational likelihoods. Using data from four stocks, we show that the model fit is improved by modelling the correlation of observations within years. However, the best choice of observational likelihood differs for different stocks, and the choice is important for the short-term conclusions drawn from the assessment model; in particular, the choice can influence total allowable catch advise based on reference points.

**General information**

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Authors: Albertsen, C. M. (Intern), Nielsen, A. (Intern), Thygesen, U. H. (Intern)
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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
Scopus rating (2010): SJR 1.425 SNIP 1.118
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.451 SNIP 1.196
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.589 SNIP 1.379
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.621 SNIP 1.236
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.354 SNIP 1.267
Connecting single-stock assessment models through correlated survival

Fisheries management is mainly conducted via single-stock assessment models assuming that fish stocks do not interact, except through assumed natural mortalities. Currently, the main alternative is complex ecosystem models which require extensive data, are difficult to calibrate, and have long run times. We propose a simple alternative. In three case studies each with two stocks, we improve the single-stock models, as measured by Akaike information criterion, by adding correlation in the cohort survival. To limit the number of parameters, the correlations are parameterized through the corresponding partial correlations. We consider six models where the partial correlation matrix between stocks follows a band structure ranging from independent assessments to complex correlation structures. Further, a simulation study illustrates the importance of handling correlated data sufficiently by investigating the coverage of confidence intervals for estimated fishing mortality. The results presented will allow managers to evaluate stock statuses based on a more accurate evaluation of model output uncertainty. The methods are directly implementable for stocks with an analytical assessment and do not require any new data sources.

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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
Validation of ecological state space models using the Laplace approximation

Many statistical models in ecology follow the state space paradigm. For such models, the important step of model validation rarely receives as much attention as estimation or hypothesis testing, perhaps due to lack of available algorithms and software. Model validation is often based on a naive adaptation of Pearson residuals, i.e. the difference between observations and posterior means, even if this approach is flawed. Here, we consider validation of state space models through one-step prediction errors, and discuss principles and practicalities arising when the model has been fitted with a tool for estimation in general mixed effects models. Implementing one-step predictions in the R package Template Model Builder, we demonstrate that it is possible to perform model validation with little effort, even if the ecological model is multivariate, has non-linear dynamics, and whether observations are continuous or discrete. With both simulated data, and a real data set related to geolocation of seals, we demonstrate both the potential and the limitations of the techniques. Our results fill a need for convenient methods for validating a state space model, or alternatively, rejecting it while indicating useful directions in which the model could be improved.

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Department of Applied Mathematics and Computer Science
Authors: Thygesen, U. H. (Intern), Albertsen, C. M. (Intern), Berg, C. W. (Intern), Kristensen, K. (Intern), Nielsen, A. (Intern)
Pages: 317-339
Publication date: 2017
Main Research Area: Technical/natural sciences

Publication information
Journal: Environmental and Ecological Statistics
Volume: 24
Issue number: 2
Ratings:
Accounting for correlated observations in an age-based state-space stock assessment model

Fish stock assessment models often rely on size- or age-specific observations that are assumed to be statistically independent of each other. In reality, these observations are not raw observations, but rather they are estimates from a catch-standardization model or similar summary statistics based on observations from many fishing hauls and subsamples of the size and age composition of the data. Although aggregation mitigates the strong intra-haul correlation between sizes/ages that is usually found in haul-by-haul data, violations of the independence assumption can have a large impact on the results and specifically on reported confidence bounds. A state-space assessment model that allows for correlations between age groups within years in the observation model for catches and surveys is presented and applied to data on several North Sea fish stocks using various correlation structures. In all cases the independence assumption is rejected. Less fluctuating estimates of the fishing mortality is obtained due to a reduced process error. The improved model does not suffer from correlated residuals unlike the independent model, and the variance of forecasts is decreased.

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources
Authors: Berg, C. W. (Intern), Nielsen, A. (Intern)
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Main Research Area: Technical/natural sciences

Publication information
Journal: ICES Journal of Marine Science
Volume: 73
Fish stock assessment under data limitations developing a new method based on a size-structured theoretical ecology framework

Fish stock assessment is an integral part of every fisheries management system. Modern assessment methods require data about the fishery and the stock, such as catches, survey estimates, aging information and life history parameters, all of which is difficult and expensive to gather. However, the majority of global fish catches comes from species that lack an
Ontogeny and growth of early life stages of captive-bred European eel

Captive breeding of European eel, Anguilla anguilla is challenged by the complex hormonal control of Anguillid eel reproduction and the distinctive ontogeny of the leptocephalus larvae that are unique to the Elopomorph superorder. Recent experimental research has succeeded in the production of viable eggs and larvae of European eel, providing the basis for studies on early life stages of this species in captivity. In this study, we describe and illustrate morphological characteristics of eggs, embryos, and larvae from fertilization to termination of the yolk sac stage and provide a comparison with additional commercially important eel species. Furthermore, we model growth during the critical first phase in larval ontogeny, i.e., the yolk sac stage, and test for maternal effects. The eggs of A. anguilla typically have numerous oil droplets that coalesce into a single large oil droplet, while the yolk forms a large perivitelline space, reaching an egg diameter of 1.45 ± 0.12 mm at 3.0 to 3.5 h post fertilization. Embryonic development from fertilization to larval hatch lasted ~46–48 h at 20 °C with the larvae emerging in a relatively undeveloped stage with a protuberant yolk sac. During the period of yolk and oil absorption, the larvae undertook significant changes in head and body morphology. At the completion of yolk sac absorption, the largely transparent larvae had a set of protruding teeth, pigmented eyes and tail, and a simple alimentary tract. Larvae appeared capable of feeding at ~12 days post hatch at 20 °C, and were able to survive another ~10 days without feeding. Larval length approached and symptotic maximum of 6.8mma round day 10 in non-fed larvae. Larval batches from different maternal origins varied in yolk sac size and the extent of yolk sac resources influenced larval size at the end of the yolk sac stage. The ontogenetic description presented here fills a gap in knowledge about the yet undiscovered early life stages of native European eel, which can provide a framework of reference for the development of hatchery technology. Such progress is urgently needed for a self-sustained aquaculture of this high-value and critically endangered species. Statement of relevance: European eel is a high-value species in reference for the development of hatchery technology. Such progress is urgently needed for a self-sustained aquaculture and larval culture of this species in aquaculture and aid establishing hatchery technology of this species.
Main Research Area: Technical/natural sciences

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BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.75 SJR 1.101 SNIP 1.524
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.103 SNIP 1.254 CiteScore 2.12
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.002 SNIP 1.34 CiteScore 2.16
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.136 SNIP 1.3 CiteScore 2.18
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.212 SNIP 1.487 CiteScore 2.32
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.294 SNIP 1.542 CiteScore 2.39
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.151 SNIP 1.394
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.941 SNIP 1.263
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.909 SNIP 1.173
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.019 SNIP 1.318
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.008 SNIP 1.689
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.915 SNIP 1.236
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.016 SNIP 1.627
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.121 SNIP 1.926
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.992 SNIP 1.418
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.049 SNIP 1.317
TMB: Automatic differentiation and Laplace approximation

TMB is an open source R package that enables quick implementation of complex nonlinear random effects (latent variable) models in a manner similar to the established AD Model Builder package (ADMB, http://admb-project.org/; Fournier et al. 2011). In addition, it offers easy access to parallel computations. The user defines the joint likelihood for the data and the random effects as a C++ template function, while all the other operations are done in R; e.g., reading in the data. The package evaluates and maximizes the Laplace approximation of the marginal likelihood where the random effects are automatically integrated out. This approximation, and its derivatives, are obtained using automatic differentiation (up to order three) of the joint likelihood. The computations are designed to be fast for problems with many random effects (approximate to 10(6)) and parameters (approximate to 10(3)). Computation times using ADMB and TMB are compared on a suite of examples ranging from simple models to large spatial models where the random effects are a Gaussian random field. Speedups ranging from 1.5 to about 100 are obtained with increasing gains for large problems.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, University of Washington, University of Bergen
Authors: Kristensen, K. (Intern), Nielsen, A. (Intern), Berg, C. W. (Intern), Skaug, H. J. (Ekstern), Bell, B. (Ekstern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.71 SJR 5.139 SNIP 4.619
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.03 SNIP 3.741 CiteScore 5.02
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 6.047 SNIP 5.084 CiteScore 6.37
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 5.792 SNIP 4.401 CiteScore 7.12
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 3.31 SNIP 3.43 CiteScore 4.93
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 2.429 SNIP 3.366 CiteScore 4.59
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.98 SNIP 2.121
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.331 SNIP 1.247
Validation of state-space models using Template Model Builder

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Section for Ecosystem based Marine Management
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Publication: Research › Conference abstract for conference – Annual report year: 2016

Accounting for correlated observations in an age-based state-space stock assessment model

General information
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Authors: Berg, C. W. (Intern), Nielsen, A. (Intern)
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Publication: Research › Conference abstract for conference – Annual report year: 2015

 Archived DNA reveals fisheries and climate induced collapse of a major fishery

Fishing and climate change impact the demography of marine fishes, but it is generally ignored that many species are made up of genetically distinct locally adapted populations that may show idiosyncratic responses to environmental and anthropogenic pressures. Here, we track 80 years of Atlantic cod (Gadus morhua) population dynamics in West Greenland using DNA from archived otoliths in combination with fish population and niche based modeling. We document how the interacting effects of climate change and high fishing pressure lead to dramatic spatiotemporal changes in the proportions and abundance of different genetic populations, and eventually drove the cod fishery to a collapse in the early 1970s. Our results highlight the relevance of fisheries management at the level of genetic populations under future scenarios of climate change

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Section for Ecosystem based Marine Management, Greenland Climate Research Centre, WSL Swiss Federal Research Institute, Stanford University,
Choosing the observational likelihood in state-space stock assessment models

By implementing different observational likelihoods in a state-space age-based stock assessment model, we are able to compare the goodness-of-fit and effects on estimated fishing mortality for different model choices. Model fit is improved by estimating suitable correlations between agegroups. We show by simulations that modelling catch as numbers-at-age is more suitable than proportions if the uncertainty of age-classifications is small.

General information

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Department of Applied Mathematics and Computer Science
Authors: Albertsen, C. M. (Intern), Nielsen, A. (Intern), Thygesen, U. H. (Intern)
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Main Research Area: Technical/natural sciences

Bibliographical note
Fast fitting of non-Gaussian state-space models to animal movement data via Template Model Builder

State-space models (SSM) are often used for analyzing complex ecological processes that are not observed directly, such as marine animal movement. When outliers are present in the measurements, special care is needed in the analysis to obtain reliable location and process estimates. Here we recommend using the Laplace approximation combined with automatic differentiation (as implemented in the novel R package Template Model Builder; TMB) for the fast fitting of continuous-time multivariate non-Gaussian SSMs. Through Argos satellite tracking data, we demonstrate that the use of continuous-time t-distributed measurement errors for error-prone data is more robust to outliers and improves the location estimation compared to using discretized-time t-distributed errors (implemented with a Gibbs sampler) or using continuous-time Gaussian errors (as with the Kalman filter). Using TMB, we are able to estimate additional parameters compared to previous methods, all without requiring a substantial increase in computational time. The model implementation is made available through the R package argosTrack.

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Dalhousie University, University of Windsor
Authors: Albertsen, C. M. (Intern), Whoriskey, K. (Ekstern), Yurkowski, D. (Ekstern), Nielsen, A. (Intern), Flemming, J. M. (Ekstern)
Pages: 2598-2604
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BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.8 SJR 3.255 SNIP 1.76
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.934 SNIP 1.931 CiteScore 5.24
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.694 SNIP 1.987 CiteScore 5.09
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.679 SNIP 2.071 CiteScore 5.43
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 4.041 SNIP 2.107 CiteScore 5.38
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 4.242 SNIP 1.934 CiteScore 5.03
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 4.001 SNIP 2.048
Limits to the reliability of size-based fishing status estimation for data-poor stocks

For stocks which are considered “data-poor” no knowledge exist about growth, mortality or recruitment. The only available information is from catches. Here we examine the ability to assess the level of exploitation of a data-poor stock based only on information of the size of individuals in catches. The model is a formulation of the classic Beverton–Holt theory in terms of size where stock parameters describing growth, natural mortality, recruitment, etc. are determined from life-history invariants. A simulation study was used to compare the reliability of assessments performed under different information availability scenarios, from data-limited, where none of the parameters are known beforehand, to different degrees of information availability cases where one or more parameters are known. If no parameters are known it is possible to correctly assess whether the fishing mortality is below Fmsy in more than 60% of the cases, and almost always correctly assess whether a stock is subject to overfishing. Adding information about age, i.e., assuming that growth rate and asymptotic size are known, does not improve the estimation. Only knowledge of the ratio between mortality and growth led to a considerable improvement in the assessment. Overall, the simulation study demonstrates that it may be possible to classify a data-poor stock as undergoing over- or under-fishing, while the exact status, i.e., how much the fishing mortality is above or below Fmsy, can only be assessed with a substantial uncertainty. Limitations of the approach are discussed.
Optimal bæredygtig udnyttelse af tilgængelige torskebestande for dansk fiskeri

General information
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Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Marine Living Resources, Section for Marine Ecology and Oceanography, Centre for Ocean Life
Authors: Eero, M. (Intern), Hansen, J. H. (Intern), Hüssy, K. (Intern), Huwer, B. (Intern), Berg, C. W. (Intern), Mariani, P. (Intern), Mosegaard, H. (Intern), Nielsen, A. (Intern), Eg Nielsen, E. (Intern), Rindorf, A. (Intern), Ulrich, C. (Intern), Vinther, M. (Intern), Worsøe Clausen, L. (Intern)
RevFisk – et projekt som kvantificerer stenrevs betydning for fisk

General information
State: Published
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Robust statistical method in a single species age-structured state-space assessment model

General information
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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources
Authors: Nielsen, A. (Intern), Berg, C. W. (Intern)
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Event: Abstract from ICES Annual Science Conference 2015, Copenhagen, Denmark.
Main Research Area: Technical/natural sciences
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Bibliographical note
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Publication: Research › Conference abstract for conference – Annual report year: 2015
Simulation testing the robustness of stock assessment models to error: some results from the ICES strategic initiative on stock assessment methods

The World Conference on Stock Assessment Methods (July 2013) included a workshop on testing assessment methods through simulations. The exercise was made up of two steps applied to datasets from 14 representative fish stocks from around the world. Step 1 involved applying stock assessments to datasets with varying degrees of effort dedicated to optimizing fit. Step 2 was applied to a subset of the stocks and involved characteristics of given model fits being used to generate pseudo-data with error. These pseudo-data were then provided to assessment modellers and fits to the pseudo-data provided consistency checks within (self-tests) and among (cross-tests) assessment models. Although trends in biomass were often similar across models, the scaling of absolute biomass was not consistent across models. Similar types of models tended to perform similarly (e.g. age based or production models). Self-testing and cross-testing of models are a useful diagnostic approach, and suggested that estimates in the most recent years of time-series were the least robust. Results from the simulation exercise provide a basis for guidance on future large-scale simulation experiments and demonstrate the need for strategic investments in the evaluation and development of stock assessment methods.

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Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
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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
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Scopus rating (2012): CiteScore 2.35
Sustainable development of the Nephrops fishery in the Kattegat-Skagerrak region

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Number of pages: 23
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Publication: Research › Report – Annual report year: 2015
The history of cod in Greenland: A major fishery collapse explained by archived DNA

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Depth preference in released juvenile turbot Psetta maxima
Hatchery-reared juvenile turbot Psetta maxima were tagged with Passive Integrated Transponder (PIT) tags and released at three different depths in a sandy bay in Denmark. About 2–7% of the released fish were registered daily to monitor their distribution using a tag antenna mounted on a modified beam trawl, thus avoiding actually sampling the fish. The change in distribution of the three groups was adequately represented by a twodimensional movement model. Movement along the shore was described by a Brownian motion with group specific drift. Movement perpendicular to the shore was described by a Cox–Ingersoll–Ross process with a group specific attraction point. All three groups exhibited similar depth preferences of 1.7 m. Immediately after the release, fish were concentrated around the release points but after one day, fish had moved to the preferred depth and subsequently maintained their position at this depth. Farmed turbot exhibited strong site fidelity and an innate behaviour for selecting a preferred depth.

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Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Section for Ecosystem based Marine Management
Authors: Albertsen, C. M. (Intern), Støttrup, J. (Intern), Nielsen, A. (Intern), Christoffersen, M. (Intern)
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Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.03 SJR 0.937 SNIP 0.914
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.043 SNIP 0.823 CiteScore 1.87
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.145 SNIP 1.045 CiteScore 2.41
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.294 SNIP 1.08 CiteScore 2.45
**Effects of dietary fatty acids on the production and quality of eggs and larvae of Atlantic cod (Gadus morhua L.)**

Cultivated Atlantic cod (Gadus morhua) entering their first year of gamete maturation were fed diets with different levels of arachidonic acid (ARA) and eicosapentaenoic acid (EPA) for 6.5 months prior to commencement of spawning. Gravid females were stripped three times: at the beginning, peak and end of spawning. Lipid composition and egg and larval quality of 34 family crosses were investigated. Results indicated that ARA uptake into eggs from broodstock diet was highly efficient achieving proportions of ARA up to 84% higher in eggs than in the diet. EPA was 42–76% higher, and DHA was 155–173% higher in eggs than in diets. Cod fed the diet with the lowest EPA/ARA ratio had the greatest egg production. Eggs from fish on a diet with high ARA level had significantly higher fertilization and hatching success than those fed low levels of ARA. This diet produced on average 71 viable eggs g⁻¹ female compared with 32.5 and 4 eggs in diet B and C, respectively. Furthermore, larval survival until 8 days posthatch was higher in diets with lower ARA levels. The combined results showed that ARA dietary supplementation and low EPA/ARA ratio yielded a greater number of viable larvae kg⁻¹ female.

**General information**

State: Published

Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, National Food Institute, Division of Industrial Food Research, Section for Marine Ecology and Oceanography, Section for Marine Living
Estimation of time-varying selectivity in stock assessments using state-space models

Time-varying selectivity is one of the main challenges in single species age-based assessment models. In classical deterministic VPA-type models the fishing mortality rates are unfiltered representations of the observed catches. As a consequence the selectivity becomes time-varying, but this representation is too fluctuating, because it includes the observation noise. In parametric statistical catch at age models a common assumption is that the selectivity is constant in all years, although time-varying selectivity can be introduced by splitting the data period in blocks with different selectivities, or by using smoothing splines and penalized time-deviances. However, these methods require subjective choices w.r.t. the degree of time-varying allowed. A simple state-space assessment model is presented as an alternative, which among other benefits offers an objective way of estimating time-varying selectivity pattern. The fishing mortality rates are considered (possibly correlated) stochastic processes, and the corresponding process variances are estimated within the model. The model is applied to North Sea cod and it is verified from simulations that time-varying selectivity can be estimated
Evaluation of alternative age-based methods for estimating relative abundance from survey data in relation to assessment models

Indices of abundance from fishery-independent trawl surveys constitute an important source of information for many fish stock assessments. Indices are often calculated using area stratified sample means on age-disaggregated data, and finally treated in stock assessment models as independent observations. We evaluate a series of alternative methods for calculating indices of abundance from trawl survey data (delta-lognormal, delta-gamma, and Tweedie using Generalized Additive Models) as well as different error structures for these indices when used as input in an age-based stock assessment model (time-constant vs time-varying variance, and independent versus correlated age groups within years). The methods are applied to data on North Sea herring (Clupea harengus), sprat (Sprattus sprattus), and whiting (Merlangius merlangus), and the full stock assessments are carried out to evaluate the different indices produced. The stratified mean method is found much more imprecise than the alternatives based on GAMs, which are found to be similar. Having time-varying index variances is found to be of minor importance, whereas the independence assumption is not only violated but has significant impact on the assessments.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, National Institute of Aquatic Resources, Section for Marine Living Resources, Statistics and Data Analysis
Authors: Berg, C. W. (Intern), Nielsen, A. (Intern), Kristensen, K. (Intern)
Pages: 91-99
Publication date: 2014
Main Research Area: Technical/natural sciences

Publication information
Journal: Fisheries Research
Volume: 151
ISSN (Print): 0165-7836
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
Introducing time-varying natural mortality in the length-based assessment model for the Pandalus Borealis stock in ICES Div. IIa and IVA east

Addressing challenges in single species assessments via a simple state-space assessment model.

A stochastic length-based assessment model for the Pandalus stock in Skagerrak and the Norwegian Deep
Size-based estimation of the status of fish stocks: simulation analysis and comparison with age-based estimations

Estimation of the status of fish stocks is important for sustainable management. Data limitations and data quality hinder this task. The commonly used age-based approaches require information about individual age, which is costly and relatively inaccurate. In contrast, the size of organisms is linked to physiology more directly than is age, and can be measured easier with less cost. In this work we used a single-species size-based model to estimate the fishing mortality (F) and the status of the stock, quantified by the ratio F/Fmsy between actual fishing mortality and the fishing mortality which leads to the maximum sustainable yield. A simulation analysis was done to investigate the sensitivity of the estimation and its improvement when stock specific life history information is available. To evaluate our approach with real observations, data-rich fish stocks, like the North Sea cod, were investigated and our estimations were compared to the ICES advice. Only size-specific catch data were used, in order to emulate data limited situations. The simulation analysis reveals that the status of the stock, i.e. F/Fmsy, is estimated more accurately than the fishing mortality F itself. Specific knowledge of the natural mortality improves the estimation more than having information about all other life history parameters. Our approach gives, at least qualitatively, an estimated stock status which is similar to the results of an age-based assessment. Since our approach only uses size-based catch data, it is a suitable tool for data-limited situations.

General information

State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Section for Marine Living Resources
Authors: Kokkalis, A. (Intern), Thygesen, U. H. (Intern), Nielsen, A. (Intern), Andersen, K. H. (Intern)
Publication date: 2013
Event: Abstract from ICES Annual Science Conference 2013, Reykjavik, Iceland.
Main Research Area: Technical/natural sciences

Bibliographical note
ICES ASC 2013 extended abstract - ICES CM H:16
Source: dtu
Source-ID: u::9830
Publication: Research › Conference abstract for conference – Annual report year: 2013

Statistical aspects of fish stock assessment

Fish stock assessments are conducted for two main purposes: 1) To estimate past and present fish abundances and their commercial exploitation rates. 2) To predict the consequences of different management strategies in order to ensure a sustainable fishery in the future.

This thesis concerns statistical aspects of fish stocks assessment, which includes topics such as time series analysis, generalized additive models (GAMs), and non-linear state-space/mixed models capable of handling missing data and a high number of latent states and parameters. The aim is to improve the existing methods for stock assessment by application of state-of-the-art statistical methodology. The main contributions are presented in the form of six research papers.

The major part of the thesis deals with age-structured assessment models, which is the most common approach. Conversion from length to age distributions in the catches is a necessary step in age-based stock assessment models. For this purpose, GAMs and continuation ratio logits are combined to model the probability of age as a smooth function of length and spatial coordinates, which constitutes an improvement over traditional methods based on area-stratification. GAMs and delta-distributions are applied for the calculation of indices of abundance from trawl survey data, and different error structures for these are investigated.

Two extensions to the state-space approach to age-structured stock assessment modelling are presented. The first extension introduces multivariate error distributions on survey catch-at-age data. The second extension is an integrated assessment model for overlapping sub-stocks subject to joint exploitation in the area of overlap. Estimation and inference is carried out using maximum likelihood.

Finally, a biomass dynamic model based on stochastic differential equations is presented. This work extends the classical approaches to biomass modelling by incorporating observation errors on the catches, and allowing for missing and non-equidistant samples in time.

General information
Strategies for fitting nonlinear ecological models in R, AD Model Builder, and BUGS

Ecologists often use nonlinear fitting techniques to estimate the parameters of complex ecological models, with attendant frustration. This paper compares three open-source model fitting tools and discusses general strategies for defining and fitting models. R is convenient and (relatively) easy to learn, AD Model Builder is fast and robust but comes with a steep learning curve, while BUGS provides the greatest flexibility at the price of speed. Our model-fitting suggestions range from general cultural advice (where possible, use the tools and models that are most common in your subfield) to specific suggestions about how to change the mathematical description of models to make them more amenable to parameter estimation. A companion web site (https://groups.nceas.ucsb.edu/nonlinear-modeling/projects) presents detailed examples of application of the three tools to a variety of typical ecological estimation problems; each example links both to a detailed project report and to full source code and data.
Does predation by grey seals (Halichoerus grypus) affect Bothnian Sea herring stock estimates?

Mortality of small pelagic fish due to marine mammals is generally considered to be low compared with other sources of mortality. With recent recoveries of marine mammal predators worldwide, this may no longer hold. The grey seal (Halichoerus grypus) population in the Bothnian Sea has increased fivefold since 1985. Its main prey, herring (Clupea harengus), is a key species for fisheries in the region. Yet, current stock assessments assume constant natural mortality, leading to a risk of biased stock estimates with increasing predation and misleading analyses of herring population dynamics. We estimated grey seal predation from diet data and reanalysed herring spawning stock biomass (SSB) during 1973–2009. Accounting for predation increased the herring SSB 16% (maximum 19%), but this was within the confidence intervals when ignoring predation. Although mortality in older individuals was inflated when accounting for seal predation, this did not change the conclusions about drivers of herring dynamics. Accounting for grey seal predation is important for abundance estimates of old herring, but currently not for SSB estimates, given the great uncertainties in the standard assessment. The grey seal impact on Bothnian Sea herring will need to be reassessed if stock age composition, grey seal feeding preferences, or total stock development change.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Population Ecology and Genetics, Department of Informatics and Mathematical Modeling, Lund University, Swedish Museum of Natural History, Finnish Game and Fisheries Research Institute
Authors: Gårdmark, A. (Ekstern), Östman, Ö. (Ekstern), Nielsen, A. (Intern), Lundström, K. (Ekstern), Karlsson, O. (Ekstern), Pönni, J. (Ekstern), Aho, T. (Ekstern)
Pages: 1448-1456
Publication date: 2012
Main Research Area: Technical/natural sciences

Publication information
Journal: I C E S Journal of Marine Science
Volume: 69
Issue number: 8
ISSN (Print): 1054-3139
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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
AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models

Many criteria for statistical parameter estimation, such as maximum likelihood, are formulated as a nonlinear optimization problem. Automatic Differentiation Model Builder (ADMB) is a programming framework based on automatic differentiation, aimed at highly nonlinear models with a large number of parameters. The benefits of using AD are computational efficiency and high numerical accuracy, both crucial in many practical problems. We describe the basic components and the underlying philosophy of ADMB, with an emphasis on functionality found in no other statistical software. One example of such a feature is the generic implementation of Laplace approximation of high-dimensional integrals for use in latent variable models. We also review the literature in which ADMB has been used, and discuss future development of ADMB as an open source project. Overall, the main advantages of ADMB are flexibility, speed, precision, stability and built-in methods to quantify uncertainty.

General information
State: Published
Organisations: Section for Population Ecology and Genetics, National Institute of Aquatic Resources
Authors: Fournier, D. A. (Ekstern), Skaug, H. J. (Ekstern), Ancheta, J. (Ekstern), Ianelli, J. (Ekstern), Magnusson, A. (Ekstern), Maunder, M. (Ekstern), Nielsen, A. (Intern), Sibert, J. (Ekstern)
Pages: 233-249
Publication date: 2011
Main Research Area: Technical/natural sciences
Depleted marine fish stocks and ecosystem-based management: on the road to recovery we need to be precautionary
Effects of mammal predation on small pelagic fish

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Population Ecology and Genetics
Authors: Gårdmark, A. (Ekstern), Östman, Ö. (Ekstern), Lundström, K. (Ekstern), Karlsson, O. (Ekstern), Pönni, J. (Ekstern), Lindegren, M. (Intern), Nielsen, A. (Intern), Kaljuste, O. (Ekstern), Aho, T. (Ekstern)
Publication date: 2011
Event: Abstract from ICES Council Meeting 2011, Gdansk, Poland.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 314451
Publication: Research › Conference abstract for conference – Annual report year: 2011

Estimation methods for nonlinear state-space models in ecology
The use of nonlinear state-space models for analyzing ecological systems is increasing. A wide range of estimation methods for such models are available to ecologists, however it is not always clear, which is the appropriate method to choose. To this end, three approaches to estimation in the theta logistic model for population dynamics were benchmarked by Wang (2007). Similarly, we examine and compare the estimation performance of three alternative methods using simulated data. The first approach is to partition the state-space into a finite number of states and formulate the problem as a hidden Markov model (HMM). The second method uses the mixed effects modeling and fast numerical integration framework of the AD Model Builder (ADMB) open-source software. The third alternative is to use the popular Bayesian framework of BUGS. The study showed that state and parameter estimation performance for all three methods was largely identical, however with BUGS providing overall wider credible intervals for parameters than HMM and ADMB confidence intervals.

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling, Section for Population Ecology and Genetics
Pages: 1394-1400
Publication date: 2011
Main Research Area: Technical/natural sciences
Publication information
Journal: Ecological Modelling
Volume: 222
Issue number: 8
ISSN (Print): 0304-3800
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.43 SJR 0.941 SNIP 1.089
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.087 SNIP 1.112 CiteScore 2.43
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.135 SNIP 1.353 CiteScore 2.7
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.153 SNIP 1.329 CiteScore 2.53
ISI indexed (2013): ISI indexed yes
Fishing power increases from technological development in the Faroe Islands longline fishery

**General information**

State: Published  
Authors: Eigaard, O. R. (Intern), Thomsen, B. (Ekstern), Hovgard, H. (Ekstern), Nielsen, A. (Intern), Rijnsdorp, A. D. (Ekstern)  
Pages: 1970-1982  
Publication date: 2011  
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Canadian Journal of Fisheries and Aquatic Sciences  
Volume: 68  
Issue number: 11  
ISSN (Print): 0706-652X  
Ratings:  
BFI (2018): BFI-level 2  
Web of Science (2018): Indexed yes
Postrelease survival, vertical and horizontal movements, and thermal habitats of five species of pelagic sharks in the central Pacific Ocean

From 2001 to 2006, 71 pop-up satellite archival tags (PSATs) were deployed on five species of pelagic shark (blue shark [Prionace glauca]; shortfin mako [Isurus oxyrinchus]; silky shark [Carcharhinus falciformis]; oceanic whitetip shark [C. longimanus]; and bigeye thresher [Alopias superciliosus]) in the central Pacific Ocean to determine species-specific movement patterns and survival rates after release from longline fishing gear. Only a single postrelease mortality could be unequivocally documented: a male blue shark which succumbed seven days after release. Meta-analysis of published reports and the current study (n=78 reporting PSATs) indicated that the summary effect of postrelease mortality for blue sharks was 15% (95% CI, 8.5-25.1%) and suggested that catch-and-release in longline fisheries can be a viable management tool to protect parental biomass in shark populations. Pelagic sharks displayed species-specific depth and temperature ranges, although with significant individual temporal and spatial variability in vertical movement patterns, which were also punctuated by stochastic events (e.g., El Nino-Southern Oscillation). Pelagic species can be separated into three broad groups based on daytime temperature preferences by using the unweighted pair-group method with arithmetic averaging clustering on a Kolmogorov-Smirnov Dmax distance matrix: 1) epipelagic species (silky and oceanic whitetip sharks), which spent >95% of their time at temperatures within 2 degrees C of sea surface temperature; 2) mesopelagic-I species (blue sharks and shortfin makos, which spent 95% of their time at temperatures from 9.7 degrees to 26.9 degrees C and from 9.4 degrees to 25.0 degrees C, respectively; and 3) mesopelagic-II species (bigeye threshers), which spent 95% of their time at temperatures from 6.7 degrees to 21.2 degrees C. Distinct thermal niche partitioning based on body size and latitude was also evident within epipelagic species.

**General Information**

State: Published
Organisations: Section for Population Ecology and Genetics, National Institute of Aquatic Resources
Authors: Musyl, M. K. (Ekstern), Brill, R. W. (Ekstern), Curran, D. S. (Ekstern), Fragoso, N. M. (Ekstern), McNaughton, L. M. (Ekstern), Nielsen, A. (Intern), Kikkawa, B. S. (Ekstern), Moyes, C. D. (Ekstern)
Pages: 341-368
Publication date: 2011
Main Research Area: Technical/natural sciences

**Publication information**

Journal: Fishery Bulletin
Volume: 109
Issue number: 4
ISSN (Print): 0090-0656
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.554 SNIP 0.692 CiteScore 1.12
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.054 SNIP 1.093 CiteScore 1.77
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.091 SNIP 1.162 CiteScore 2.02
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.145 SNIP 1.083 CiteScore 1.6
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.758 SNIP 1.055 CiteScore 1.56
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.782 SNIP 0.795 CiteScore 1.17
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.725 SNIP 0.647
BFI (2009): BFI-level 1
Ecological forecasting under climate change - the case of Baltic cod

Good decision making for fisheries and marine ecosystems requires a capacity to anticipate the consequences of management under different scenarios of climate change. The necessary ecological forecasting calls for ecosystem-based models capable of integrating multiple drivers across trophic levels and properly including uncertainty. The methodology presented here assesses the combined impacts of climate and fishing on marine food-web dynamics and provides estimates of the confidence envelope of the forecasts. It is applied to cod (Gadus morhua) in the Baltic Sea, which is vulnerable to climate-related decline in salinity owing to both direct and indirect effects (i.e. through species interactions) on early-life survival. A stochastic food web-model driven by regional climate scenarios is used to produce quantitative forecasts of cod dynamics in the twenty-first century. The forecasts show how exploitation would have to be adjusted in order to achieve sustainable management under different climate scenarios.

Ecological forecasting under climate change: the case of Baltic cod

Good decision making for fisheries and marine ecosystems requires a capacity to anticipate the consequences of management under different scenarios of climate change. The necessary ecological forecasting calls for ecosystem-based models capable of integrating multiple drivers across trophic levels and properly including uncertainty. The methodology presented here assesses the combined impacts of climate and fishing on marine food-web dynamics and provides estimates of the confidence envelope of the forecasts. It is applied to cod (Gadus morhua) in the Baltic Sea, which is vulnerable to climate-related decline in salinity owing to both direct and indirect effects (i.e. through species interactions) on early-life survival. A stochastic food web-model driven by regional climate scenarios is used to produce quantitative forecasts of cod dynamics in the twenty-first century. The forecasts show how exploitation would have to be adjusted in order to achieve sustainable management under different climate scenarios.
Movements of olive ridley sea turtles Lepidochelys olivacea and associated oceanographic features as determined by improved light-based geolocation

Lessons from a prototype geolocation problem

This paper establishes simple and general expressions for the accuracy of geolocation, which may be obtained by optimal filtering of measurements from archival tags. We investigate an idealized geolocation problem where the animal performs a random walk. We derive simple closed-form expressions for the steady-state variance and for the characteristic time scale of the filter, i.e. the smoothing horizon. This leads to temporal and spatial scales defining the limit of resolution and explains the difference between what can be obtained for fast-moving and slow-moving animals. Using frequency-domain methods, we consider the effect of adding additional sensors, and examine the substitution of the random walk model with anomalous diffusion, e.g. a Levy flight. We also discuss time variations in the accuracy near start and end of the time series, and due to holes in the data stream which e.g. arise in the tidal method for geolocation when the animal is pelagic. Our results are particularly useful to the planning of a tagging study, because our estimates of accuracy can be computed using only three parameters: the swimming speed of the animal, the sample interval, and the variance on the
measurement error.

**General information**

State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Thygesen, U. H. (Intern), Nielsen, A. (Intern)
Number of pages: 452
Pages: 257-276
Publication date: 2009

**Host publication information**

Title of host publication: Tagging and Tracking of Marine Animals with Electronic Devices
Volume: Part 2: Geolocation Methods
Publisher: Springer
ISBN (Print): 14-02-09639-9

Series: Reviews: Methods and Technologies in Fish Biology and Fisheries
Volume: 9
ISSN: 1571-3075
Main Research Area: Technical/natural sciences

**Preventing the collapse of the Baltic cod stock through an ecosystem-based management approach**

**General information**

State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Lindegren, M. (Intern), Möllmann, C. (Ekstern), Nielsen, A. (Intern), Stenseth, N. C. (Ekstern)
Pages: 14722-14727
Publication date: 2009
Main Research Area: Technical/natural sciences

**Publication information**

Volume: 106
Issue number: 34
ISSN (Print): 0027-8424

Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.56 SJR 6.321 SNIP 2.629
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 6.767 SNIP 2.682 CiteScore 8.84
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 6.853 SNIP 2.725 CiteScore 8.86
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 6.989 SNIP 2.73 CiteScore 9.5
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Removing bias in latitude estimated from solar irradiance time series

General information
State: Published
Organisations: University of Hawaii, Secretariat of the Pacific Community, CSIRO Marine and Atmospheric Research
Authors: Sibert, J. R. (Ekstern), Nielsen, A. (Intern), Musyl, M. (Ekstern), Leroy, B. (Ekstern), Evans, K. (Ekstern)
Pages: 311-322
Publication date: 2009

Host publication information
Title of host publication: Tagging and Tracking of Marine Animals with Electronic Devices : Geolocation Methods
Volume: 2
Publisher: Springer
ISBN (Print): 978-1-4020-9639-6
Main Research Area: Technical/natural sciences
Links:
http://www.springerlink.com/content/q5q51u4l71515u7q/fulltext.pdf
State space model for light based tracking of marine animals: validation on swimming and diving creatures

General information
State: Published
Organisations: University of Hawaii
Authors: Nielsen, A. (Intern), Sibert, J. (Ekstern), Kohin, S. (Ekstern), Musyl, M. (Ekstern)
Pages: 295-309
Publication date: 2009

Host publication information
Title of host publication: Tagging and Tracking of Marine Animals with Electronic Devices: Geolocation Methods
Volume: 2
Publisher: Springer
ISBN (Print): 978-1-4020-9639-6
Main Research Area: Technical/natural sciences
Links:
http://www.springerlink.com.globalproxy.cvt.dk/content/j6j5w656p22011jt/?p=bb44d67f4d634a96be30520662ac5e31&pi=17

Improving light and temperature based geolocation by unscented Kalman filtering

General information
State: Published
Organisations: University of Hawaii, University of Southern California
Authors: Lam, C. H. (Ekstern), Nielsen, A. (Intern), Sibert, J. R. (Ekstern)
Pages: 15-25
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Fisheries Research
Volume: 91
Issue number: 1
ISSN (Print): 0165-7836
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.21 SJR 1.12 SNIP 1.136
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.067 SNIP 1.133 CiteScore 2.01
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.105 SNIP 1.312 CiteScore 2.17
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.037 SNIP 1.173 CiteScore 1.85
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Indirect observation of fish movements: a general methodology applied at different scales

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries- and Monitoring Technology, Section for Fisheries Advice, Mathematical Statistics, Department of Informatics and Mathematical Modeling
Authors: Thygesen, U. H. (Intern), Karlsen, J. (Intern), Nielsen, A. (Intern), Pedersen, M. W. (Intern)
Publication date: 2008
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 238777
Publication: Research - peer-review › Journal article – Annual report year: 2008

10.1016/j.fishres.2007.11.002
Source: orbit
Source-ID: 229070
Publication: Research › Paper – Annual report year: 2008
Reconstructing migrations of individual cod (Gadus morhua L.) in the Baltic Sea by using electronic data storage tags

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Neuenfeldt, S. (Intern), Hinrichsen, H. (Ekstern), Nielsen, A. (Intern), Andersen, K. H. (Intern)
Pages: 526-535
Publication date: 2007
Main Research Area: Technical/natural sciences

Publication information
Journal: Fisheries Oceanography
Volume: 16
Issue number: 6
ISSN (Print): 1054-6006
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.19
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.4
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 2.61
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.61
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.21
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.42
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Web of Science (2008): Indexed yes
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.704 SNIP 0.987
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.139 SNIP 0.231
A state-space model for light-based tracking of marine animals

A coherent model is presented to estimate the most probable track of geographic positions directly from a series of light measurements. The model estimates two geographic positions per day, without reducing the daily light data to two threshold crossing times, its covariance structure is designed to handle high correlations due to, for instance, local weather conditions, and it can estimate the yearly pattern in latitudinal precision by propagating the data, uncertainties through the geolocation process. The model is applied to one mooring study, one GPS drifter buoy study, and numerous simulated cases. The simulations are performed with realistic assumptions about the relationship between solar altitude and light and with realistic uncertainty parameters (all taken from real data). The simulations showed that all model parameters were identifiable, and that all tracks could be reconstructed within 1 degrees or 2 degrees latitude and 0.5 degrees or 1 degree longitude. The mooring and drifter buoy data showed that the tracks could be reliably estimated, even in cases where the other methods had completely failed.

General information
State: Published
Organisations: University of Hawaii
Authors: Nielsen, A. (Intern), Sibert, J. R. (Ekstern)
Pages: 1055-1068
Publication date: 2007
Main Research Area: Technical/natural sciences

Publication information
Journal: Canadian Journal of Fisheries and Aquatic Sciences
Volume: 64
Issue number: 8
ISSN (Print): 0706-652X
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
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
Using the particle filter to geolocate Atlantic cod (Gadus morhua) in the Baltic Sea, with special emphasis on determining uncertainty

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Population Ecology and Genetics
Authors: Andersen, K. H. (Intern), Nielsen, A. (Intern), Thygesen, U. H. (Intern), Hinrichsen, H. (Ekstern), Neuenfeldt, S. (Intern)
Pages: 618-627
Publication date: 2007
Main Research Area: Technical/natural sciences

Publication information
Journal: Canadian Journal of Fisheries and Aquatic Sciences
Volume: 64
Issue number: 4
ISSN (Print): 0706-652X
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Geolocation of tagged Baltic Cod using the particle filter
Improving light-based geolocation by including sea surface temperature

General information
State: Published
Organisations: National Oceanographic and Atmospheric Administration, University of Hawaii
Authors: Nielsen, A. (Intern), Bigelow, K. A. (Ekstern), Musyl, M. K. (Ekstern), Sibert, J. R. (Ekstern)
Pages: 314-325
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: Fisheries Oceanography
Volume: 15
Issue number: 4
ISSN (Print): 1054-6006
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.19
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.4
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 2.61
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.61
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Interannual variation in large-scale movement of Atlantic bluefin tuna (Thunnus thynnus) determined from pop-up satellite archival tags

General information
State: Published
Organisations: Hubbs-Sea World Research Institute, University of New Hampshire, Durham, Virginia Institute of Marine Science, University of Hawaii
Authors: Sibert, J. R. (Ekstern), Lutcavage, M. E. (Ekstern), Nielsen, A. (Intern), Brill, R. W. (Ekstern), Wilson, S. G. (Ekstern)
Pages: 2154-2166
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: Canadian Journal of Fisheries and Aquatic Sciences
Volume: 63
Issue number: 10
ISSN (Print): 0706-652X
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
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
Hvor har fisken været før den blev fanget?

General information
State: Published
Organisations: Section for Fisheries Advice, National Institute of Aquatic Resources
Authors: Nielsen, A. (Intern)
Pages: 54-59
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
A method to geolocate eastern Baltic cod by using Data Storage Tags (DSTs)

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Neuenfeldt, S. (Intern), Hinrichsen, H. (Ekstern), Nielsen, A. (Intern)
Pages: 1-14
Publication date: 2004
Main Research Area: Technical/natural sciences

Estimating fish movement

General information
State: Published
Organisations: Section for Fisheries Advice, National Institute of Aquatic Resources
Authors: Nielsen, A. (Intern)
Number of pages: 119
Publication date: 2004

Stock dynamics of sandeel in the North Sea and sub-regions including uncertainties

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Lewy, P. (Intern), Nielsen, A. (Intern), Gislason, H. (Intern)
Pages: 237-248
Publication date: 2004
Main Research Area: Technical/natural sciences
Modelling stochastic fish stock dynamics using Markov Chain Monte Carlo

General information
State: Published
Organisations: Section for Population- and Ecosystem Dynamics, National Institute of Aquatic Resources, Section for Fisheries Advice
Authors: Lewy, P. (Intern), Nielsen, A. (Intern)
Pages: 743-752
Publication date: 2003
Main Research Area: Technical/natural sciences

Publication information
Journal: ICES Journal of Marine Science
Volume: 60
Issue number: 4
ISSN (Print): 1054-3139
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2016): CiteScore 2.63
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
BFI (2010): BFI-level 1
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Comparison of the frequentist properties of Bayes and the maximum likelihood estimators in an age-structured fish stock assessment model

General information
State: Published
Organisations: Section for Fisheries Advice, National Institute of Aquatic Resources, Section for Population- and Ecosystem Dynamics
Authors: Nielsen, A. (Intern), Lewy, P. (Intern)
Pages: 136-143
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Canadian Journal of Fisheries and Aquatic Sciences
Volume: 59
Issue number: 1
ISSN (Print): 0706-652X
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
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
Diffusion of fish from a single release point

In a field experiment, 3529 turbot (Psetta maxima) were released in order to estimate and describe the movements of hatchery-reared fish by applying diffusion theory. After liberation, the development of the population density was estimated during the following 9 days, and from that, the rate of diffusion and the advection were determined. Two approaches were followed to describe the data: a normal distribution approximation (NDA) model and a partial differential equation (PDE) model. In the latter, it was possible to include the effect of sampling. The two models gave similar results, indicating that the sampling of fish during the experiment did not have any detectable effect on the population density. The activity of the released turbot resulted in an individual daily displacement of 151 m\text{-}day^{-1}, except for the first 2 days at liberty, where the displacement was estimated to be considerably lower. Advection was significant and was related to the displacement of the water body. Further, it was possible to estimate the postrelease mortality as 14\%.\text{-}day^{-1} and the catchability of the turbot when caught with a young fish trawl as 28\%.
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
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
Scopus rating (2010): SJR 1.425 SNIP 1.118
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.451 SNIP 1.196
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.589 SNIP 1.379
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.621 SNIP 1.236
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.354 SNIP 1.267
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.558 SNIP 1.553
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.744 SNIP 1.542
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.097 SNIP 1.622
Scopus rating (2002): SJR 1.909 SNIP 1.457
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.769 SNIP 1.46
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.5 SNIP 1.464
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.928 SNIP 1.436

Original language: English
DOIs:
10.1139/F02-059
Projects:

Assessment and management of linked stocks (39325)
The purpose of this project is to develop operational models for linked stocks.

Fish stocks are not isolated units. Fish eat, and are eaten, by fish from other stocks. The definition of fish stocks is often arbitrary or determined by management considerations. The bottom line is that some linkage must be expected between the defined stocks. For some stocks these effects are essential to give reliable assessment and management.

Single species assessment and management does not include effects from linked stocks.

Ecosystem and multi-species assessment models are not practically operational for assessment and management. These models are designed to describe all interactions between all important species in an ecosystem. These models often attempt to estimate detailed effects between all length- or age groups. These models often require data, which are not routinely available.

This project will develop models, which are directly applicable in the scientific advice. The aim is not to describe all interactions, but simply to harvest the main benefits of considering two or more stocks in a joint model. The aim is to identify few links between the stocks, which describes the main part of the interaction, and to base the models only on standard data sources.

The models will be developed to be generally applicable, but applied to two important cases (Cod EB and WB, and Cod stocks around Kattegat).

Final tool will be available via stockassessment.org, so it can easily be applied to any stocks defined there.

This project is coordinated by DTU Aqua.

The project is funded by the Ministry of Environment and Food of Denmark and the European Maritime and Fisheries Fund (EMFF).

National Institute of Aquatic Resources
Section for Marine Living Resources
Period: 14/12/2015 → 13/12/2017
Number of participants: 5
Research area: Marine Living Resources
Project participant:
Berg, Casper Willestofte (Intern)
Kristensen, Kasper (Intern)
Thygesen, Uffe Høgsbro (Intern)
Phd Student:
Albertsen, Christoffer Moesgaard (Intern)
Project Coordinator:
Nielsen, Anders (Intern)

State-Space Modelling in Marine Science
National Institute of Aquatic Resources
Period: 01/12/2014 → 30/11/2017
Number of participants: 6
Phd Student:
Albertsen, Christoffer Moesgaard (Intern)
Supervisor:
Thygesen, Uffe Høgsbro (Intern)
Main Supervisor:
Nielsen, Anders (Intern)
Boulder reefs as spawning and nursery areas for fish (RevFisk) (39144)

The project aimed to build knowledge about marine boulder reefs and their biological function for fish as spawning and nursery areas.

The field work was conducted on a stone reef, Hatter Barn at two depths 6-12 m and 13-17 m. These two depths were chosen to provide information on fauna and flora in the upper photic zone and a deeper zone. The dominant fish were labrids, which also spawned in the area and juvenile cod. Acoustic tagged cod provided information on their presence around the reef. Many exhibited a diurnal rhythm, concentrating on the reef during nighttime, although some cod were stationary on the reef the whole time. The deeper reef was more frequently visited (fourfold) by cod than the shallower reef.

Experimental work conducted at the Blue Planet aquarium revealed that corkwing wrasse are highly territorial and able to prevent juvenile cod from occupying their crevices. Goldsinny wrasse showed little interaction with cod and generally utilized very small crevices. Both labrids and cod utilized shelter from current flows provided by the structures and cod were often seen in high concentrations near the bottom where the current flows were laminar.

The results are useful for further developing models that quantify boulder reefs impact on fish (larvae, juvenile, adult) as a function of the reefs condition, size and depth location. The results are useful in helping plan and design the restoration of destroyed boulder reefs but also to manage existing boulder reefs.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
DHI Denmark

Aarhus University
Period: 01/12/2013 → 01/02/2015
Number of participants: 7

Research areas: Coastal Ecology & Marine Living Resources & Oceanography

Initiative to improve mackerel assessment via tagging data (39080)

The assessment of NEA mackerel had issues with this assessment related to the data. The most problematic data issue for NEA mackerel is the unknown amount of unreported catches in the past. The single index was available only every third year, which caused substantial revision of the perceived stock each time a new survey point was incorporated. Furthermore, the uncertainty in the stock estimate in the terminal assessment year increased as one moved away from the last available egg survey point.

This project extended the state-space assessment model SAM (developed at DTU-Aqua) to use tag-recapture information. This was done in order to correctly propagate uncertainties associated with the tag-recapture data. In preparation of the
benchmark two meetings were held with the objective to analyze the information given by the tagging data and write the code for the model extension.

The model was extended and accepted as the primary model for NEA mackerel at the following benchmark assessment meeting.

This project was coordinated by Danish Pelagic Producer Organization.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

Optimal sustainable use of cod stocks accessible for Danish fisheries (DEL-TORSK) (39147)

Optimal sustainable utilization of cod stocks that contain several biological sub-populations requires taking population structure into account in stock assessment and management. The aim of this project was to develop scientific basis for cod management decisions in the North Sea and the Baltic that takes biological units of cod and their dynamics into account.

Methodological challenges concerning advising on stocks that contain sub-populations with differences in dynamics and biological parameters are common for North Sea and the Baltic. Therefore, the project considered both seas, in terms of developing methodological basis for addressing population structure in management advice. The results were presented at ICES benchmarks for North Sea and Baltic Sea cod in 2015, and used to developing further the management basis for optimal use of cod stocks.

The project included mapping of distribution of sub-populations using genetic analyses and modelling of transport of early life stages. These results were combined with existing knowledge on cod population structure both in the Baltic and North Sea, to identify distribution areas of sub populations. This information was then incorporated in area-specific stock assessment analyses.

This project was coordinated by DTU Aqua.

Assessment of a mixed hake stocks off Namibia
The project aimed at:
- Establishing a platform where the industry, the science, and the managers could work together to identify the challenges that restrain an optimal exploitation of the Nephrops resource
- Establishing a knowledge based collaboration to identify low impact fishing methods that may lead to future economically sustainable growth in the KASK region
- Improving the biological knowledge on which the stock assessment is based - Increasing the reliability of the stock assessment.

The project was coordinated by DTU Aqua.

The project was funded by EU, InterReg (regional collaboration).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Institute of Marine Research
Lund University
Aalborg University

Economically sustainable fishery for Nephrops in Skagerrak and Kattegat (ØBJ-FISK) (38865)
Optimizing the exploitation of the resources of the sea areas Skagerrak and Kattegat is central to promote an economically sustainable development in the region. Norway lobster or Nephrops is one of the economically most important resources for the majority of the commercial fishery in the Kattegat-Skagerrak (KASK)-region where the annual first value was app. 350 million DKR in 2011. Nephrops are mainly caught in bottom trawls (95 % of the total landings), where other species such as cod and sole constitute part of the by-catch. A minor fishery with creels – partly commercial and partly recreational – takes place along the Swedish and Norwegian coast in areas that are generally inaccessible to the trawlers. Taking into account the majority of the Nephrops landings in the KASK region are sold directly to the local fish processing industry or are sold directly in the local areas, the total socio-economic value is much higher than the first value.

In later years, there has been a shift towards an ecosystem-based management e.g. through the NATURA2000 regulations or the Community Action in the field of Marine Environmental Policy. The consequence of this shift is that the focus is no longer on the state of single species but on the entire marine ecosystem. This has led to regulations aiming at reducing discard of unwanted catch as well as reducing the impact of fishing on vulnerable habitats. Regulations that among other things include a discard ban (implemented for Skagerrak by Norway, Denmark and Sweden in 2013), area closures, reductions in number of days at sea, and minimization of unwanted by-catch, have caused uncertainty in the fishing industry and limits the possibilities of exploiting the resource maximally. To ensure an economically sustainable growth of the Nephrops fishery in the KASK region, an increased collaboration between science and industry is needed as is innovation in the design of low impact fishing gears and a reliable stock assessment.
Grey-box methods for size-based estimation of fish stocks

National Institute of Aquatic Resources
Period: 01/03/2012 → 02/06/2016
Number of participants: 7
PhD Student:
Kokkalis, Alexandros (Intern)
Supervisor:
Nielsen, Anders (Intern)
Thygesen, Uffe Hægsbro (Intern)
Main Supervisor:
Andersen, Ken Haste (Intern)
Examiner:
Mosegaard, Henrik (Intern)
Fernández, Carmen (Ekstern)
O'Brien, Carl Michael (Ekstern)

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

Maximizing yield of fisheries while balancing ecosystem, economic and social concerns (MYFISH) (38850)
The European Common Fisheries Policy has made a commitment to direct management of fish stocks towards achieving Maximum Sustainable Yield (MSY) by 2015 (or no later than 2020 in special cases). Attaining this goal is complicated by lack of common agreement on the interpretation of both ‘sustainability’ and ‘yield’, and because achieving MSY for one stock may affect the possibility of achieving MSY for other stocks and compromise ecological, environmental, economic, or social aims.
The objective of MYFISH was to face these difficulties and provide definitions of MSY variants, evaluations of the effect on ecosystems, economy and social aspects of attaining these variants, their social desirability and an operational framework for their implementation.

This was achieved through cases addressing a range of fisheries in all European regional areas. The cases cover situations ranging from data-poor to the most studied and well-understood marine ecosystems in EU waters. The suggested implementation of MSY builds on the existing ecosystem and fisheries models in the cases, modified to perform the maximization of the relevant yield measure operationally. Social aspects were integrated throughout the project by active involvement of stakeholders in the definition and evaluation of MSY variants. Global experience was engaged through associated partners and communication of results was enhanced through two major events, a dedicated MYFISH/ICES symposium in 2015 and a targeted policy meeting in 2016. More details can be found at www.myfishproject.eu.

The project was coordinated by DTU Aqua.
The project was funded by EU, Framework Programme 7.

National Institute of Aquatic Resources
Optimal sustainable exploitation of Nephrops norvegicus in Kattegat and Skagerrak (38909)

The scientific advice on management of fisheries is primarily aiming at avoiding overfishing of the fish and shellfish stocks and only to a very limited extend addresses how the utilisation of the resources can be optimised within a sustainable ecosystem framework. An example is the regulation of the demersal trawl fisheries in the Skagerrak and the Kattegat which to protect the cod stock is sub-optimal in relation to the utilisation of the Norway lobster (Nephrops) stocks. The project takes a new approach to the management and aims at optimising the utilisation of Nephrops stocks without compromising the protection of cod.

The Nephrops fishery is one of the economically most important fisheries in Denmark. In the Kattegat and Skagerrak, Nephrops catches accounted in 2010 for 53 % and 25 % of the total value of fish and shellfish, respectively, landed by Danish fishermen. Cod is taken as by-catch in the Nephrops fishery and it has been necessary to introduce measures to limit the by-catches of cod, which is currently below agreed reference points for stock size. These measures have had a negative impact on Nephrops catches.

The project addressed four objectives: (i) development of advice on the fishing mortality for the Nephrops stocks, which is consistent with maximum sustainable yield; (ii) mapping of the distribution of Nephrops in Skagerrak and Kattegat; (iii) development of a new trawl concept optimising the catchability on Nephrops while limiting the by-catches of cod and impact on the sea bed; and (iv) evaluating alternative fishing methods for Nephrops including fishing with pots.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries through the Green Development and Demonstration Program (GUDP).

National Institute of Aquatic Resources

Section for Ecosystem based Marine Management
Geographical distribution of fish resources and optimizing of fishery practice in the north-eastern North Sea (RESOURCE) (38878)

RESOURCE is a collaborative fishermen-scientist project in direct continuation of the REX projects in the north-eastern North Sea conducting small-scale scientific surveys, but only with one commercial trawler, encompassing also geographical distributional aspects as in OSKAR.

The REX project showed that changes in the biomass densities of cod differ between bottom types (and may depend on stock size) and the proportion of the cod population found on smooth bottoms is not constant. However, due to scaling problems and too short a time series the achieved results have so far had no impact on the assessment procedure or any (measurable) effect on the TAC’s (but the RAC discussions may have affected decisions by the European Commission). Continuation of the field work with the trawler in 2010-12 in the RESOURCE project should produce a sufficient time series for supplementing the abundance indices for the older ages in the assessment, which at present are based only on the catch rates in the international scientific surveys (IBTS). This total REX-RESOURCE time series will be used in the state space assessment of North Sea cod (SAM) and various other approaches applied to document how commercial CPUE may be used in the tuning procedure. Particular attention will be given to evaluate the size of the spawning stock of cod.

Mechanistic knowledge on vital rates together with REX, RESOURCE, OSKAR and IBTS (and possibly also UK) survey data will be used as input to the geostatistical tool GeoPop to estimate the temporal and spatial dynamics of the size distribution of the cod stock. This part of the project will represent a direct continuation of OSKAR principles including considerations to how to design an operational fishery-forecast system for North Sea cod.

The project is coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Marine Ecology and Oceanography
Danish Fishermen's Association
Period: 01/01/2010 → 30/09/2012
Number of participants: 13
Research area: Marine Populations and Ecosystem Dynamics
Project participant:
  Andersen, Niels Gerner (Intern)
  Pedersen, Eva Maria (Intern)
  Andersen, Bo Selgaard (Intern)
  Hüsey, Karin (Intern)
  Kristensen, Kasper (Intern)
  Nielsen, Anders (Intern)
  Stage, Bjarne (Intern)
  Mosegaard, Henrik (Intern)
  Christensen, Asbjørn (Intern)
  Mariani, Patrizio (Intern)
  Madsen, Niels (Intern)
  Beyer, Jan (Intern)
  Wieland, Kai (Intern)

Sustainable shrimp fishery in Skagerrak (38994)
The main objective of the Norwegian-Swedish-Danish research project “Sustainable shrimp fishery in the Skagerrak” was to clarify whether there are one or more shrimp stocks in the Skagerrak. The management of shrimp fishing in the Skagerrak and Norwegian Deep is based on the perception of the shrimp resource as one large population. However, biological differences between shrimps (e.g. the size at sex change) indicate that there may be several stocks in the area. The question of one or more stocks was answered by collecting and genetically analyzing several thousand shrimp from Skagerrak and northern Kattegat, Norwegian Channel and the Norwegian fjords. The analyzed shrimps came both from research cruises and commercial fisheries. The kinship of the collected shrimp was examined with modern DNA technique and the results compared with existing knowledge of the biology of the species. This knowledge was obtained from scientific sources as well as from the fishing industry in terms of skipper interviews. The genetic analyses revealed that shrimps in Skagerrak and Norwegian Deep all belong to the same stock, but also that some of the fjord-populations are
genetically distinct (can be considered separate stocks). These results are published in ICES Journal of Marine Science in 2015.

The fisher information collected in the project was not only focused on shrimp biology but also addressed economical and technical aspects of the shrimp fishery. In this way, scientists have gained an understanding of both how shrimp populations are structured and distributed in the Skagerrak and of the economic importance. The exchange of knowledge between researchers and fishers was an important aspect of the project and was facilitated by regular meetings and interview schemes in all three countries.

Another primary objective of the project was to improve the current assessment of the Skagerrak shrimp stock by developing a new length-based analytical model. DTU Aqua was in charge of this part of the project and in an assessment benchmark in 2012 the developed model was accepted.

The project was coordinated by Institute for Marine Research, Norway.

The project was funded by EU, InterReg (regional collaboration).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Institute of Marine Research
University of Gothenburg
Lund University
Directorate of Fisheries
Ministry of Food, Agriculture and Fisheries
Danish Fishermen's Association
Norwegian Fishermen’s Association
Period: 01/01/2010 → 31/12/2013
Number of participants: 6
Research areas: Fisheries Management & Marine Living Resources
Project participant:
Munch-Petersen, Sten (Intern)
Nielsen, Anders (Intern)
Andersen, Bo Sølgaard (Intern)
Egekvist, Josefine (Intern)
Holm, Nina (Intern)
Project Manager, academic:
Eigaard, Ole Ritzau (Intern)

Statistisk modellering af marine økosystemer
Department of Informatics and Mathematical Modeling
Period: 01/11/2009 → 30/08/2013
Number of participants: 7
Phd Student:
Berg, Casper Willestofte (Intern)
Supervisor:
Nielsen, Anders (Intern)
Thygesen, Uffe Høgsbro (Intern)
Main Supervisor:
Madsen, Henrik (Intern)
Examiner:
Andersen, Ken Haste (Intern)
Cadigan, Noel G. (Ekstern)
Nielsen, Søren F. (Ekstern)

Financing sources
Source: Internal funding (public)
Development of a method for long term spatially resolved management of the herring fishery in the North Sea and IIa taking the migration of the primary herring stocks, the fishery pattern and by-catch of mackerel into consideration (URSIN) (38731)

The overall objective is to develop a tool to create long-term management plans for the two main herring stocks in the North Sea and IIa, which may allow the industry an optimum use of the population under safe conditions relating to population maintenance and catch of mackerel.

The project will further develop, test and optimize a method for the quantification and prediction of herring stock spatial distribution in relation to life stages that is based on existing methods. This quantification of the migration patterns will provide more solid understanding of population development under various conditions. Moreover, the method will include a modeling of the herring fleet behavior, allowing for merging of herring spatial distribution in relation to life stage and hence potential economic value of fishing pattern. The historical and current behavior of the herring fleets will be quantified in collaboration with the industry. Similarly, mackerel skull occurrence will be mapped as it is of great importance for the herring fleet behavior, due to the economic incentives to minimize this by-catch.

The objective of the project is to generate a scientifically based tool for prediction of utilization of herring that can be used in future scientific advice to management, and information on optimal harvest strategies for the fishery in collaboration with the fishing industry. This is partly to increase the transparency and credibly of the scientific work and increase security in the input data and thus reduce uncertainty in the advice given in the end. Collaboration with industry includes Pelagic PO, Skagen PO and Esbjerg Fishermen and covers all types of fishing for herring (both industrial and human consumption).

The project is coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Marine Living Resources
Danish Pelagic Producers Organisation
Danish Fishermen's Association
Period: 01/01/2009 → 31/12/2011
Number of participants: 6
Research area: Marine Living Resources
Project participant:
Payne, Mark (Intern)
Mosegaard, Henrik (Intern)
Dijkman, Teunis Johannes (Intern)
Nielsen, Anders (Intern)
Project Manager, organisational:
Ulrich, Clara (Intern)
Project Manager, academic:
Worsøe Clausen, Lotte (Intern)

Judgement and knowledge in fisheries involving stakeholders (JAKFISH) (38132)

JAKFISH aimed at developing institutions, practices and tools for dealing with scientific support to European Marine policy under high uncertainty. The objectives of JAKFISH are: (i) to examine and develop these institutions, practices and tools that allow complexity, uncertainty and ambiguity to be dealt with effectively within participatory decision-making processes, (ii) to examine how scientific information is used and what types of roles scientists play in the formulation of policies, (iii) to study how the current scientific processes take into account the multi-objective nature of fisheries management, and (iv) to synthesize the obtained views and to redefine the institutional role of science in EU polices to improve the overall governance in CFP.

Two parallel tracks were followed: First, a number of case studies involving participatory modeling processes with stakeholders involvements were developed, for support in policy decision-making: Western Baltic herring, Central Baltic herring, North Sea nephrops and Mediterranean swordfish. Second, sociological analyses of the practices and institutional forms that can most effectively involve the wider community in debates over developing science-based policies were carried in various regions both within Europe (North Sea, Baltic, Mediterranean) and outside (USA, Australia). Ultimately, both tracks were linked into a single synthesis.

The project was coordinated by IMARES, Wageningen UR, The Netherlands.
Coastal habitats (3117)
The aim of the project was to characterize coastal habitats based upon their function as optimal areas for stock enhancement projects, where artificially reared individuals are released with the purpose of increasing local stock sizes.

Towards this aim, the basic criteria for stocking were reviewed and discussed (Støttrup & Sparrevohn, 2007). Habitat suitability was examined (Carl et al. 2008) and methods for estimating mortality of newly released fish were developed together with means of securing the highest possible survival after release (Sparrevohn & Støttrup, 2007).

The potential of linking available prey items to growth of released individuals was examined together with potential for this linkage as a parameter to identify areas suitable for stock enhancement (Sparrevohn & Støttrup, 2008). Predation impact was explored through field experiments (avian predators; Sparrevohn & Støttrup, 2007; Støttrup & Sparrevohn, 2007) and theoretically using ecosystem modeling (Dalsgård et al. 2008 and Nielsen et al., 2008 (both reports)).

The project was coordinated by DTU Aqua.
Activities:

ICES - Benchmark Workshop for North Sea Stocks - WKNSEA (External organisation)
Period: 2015
Anders Nielsen (Participant)
National Institute of Aquatic Resources
Section for Marine Living Resources
Degree of recognition: International

Related external organisation
ICES - Benchmark Workshop for North Sea Stocks - WKNSEA
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - Baltic Fisheries Assessment Working Group - WGBFAS (External organisation)
Period: 2012 → …
Anders Nielsen (Participant)
National Institute of Aquatic Resources
Section for Population Ecology and Genetics
Department of Informatics and Mathematical Modeling
Degree of recognition: International

Related external organisation
ICES - Baltic Fisheries Assessment Working Group - WGBFAS
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - Inter Benchmark Protocol for Pandalus in Skagerrak and Norwegian Deep - IBPPand (External organisation)
Period: 2012 → …
Anders Nielsen (Participant)
National Institute of Aquatic Resources
Section for Population Ecology and Genetics
Department of Informatics and Mathematical Modeling
Degree of recognition: International

Related external organisation
ICES - Inter Benchmark Protocol for Pandalus in Skagerrak and Norwegian Deep - IBPPand
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - Joint NAFO/ICES Pandalus Assessment Working Group - NIPAG (External organisation)
Period: 2012 → …
Anders Nielsen (Participant)
National Institute of Aquatic Resources
Section for Population Ecology and Genetics
Department of Informatics and Mathematical Modeling
Degree of recognition: International

Related external organisation
ICES - Joint NAFO/ICES Pandalus Assessment Working Group - NIPAG
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar

ICES - Symposium on "Forage fish interactions: Creating the tools for ecosystem based management of marine resources" (External organisation)
Period: 2012 → …
Anders Nielsen (Participant)

National Institute of Aquatic Resources
Section for Population Ecology and Genetics
Department of Informatics and Mathematical Modeling
Degree of recognition: International

Related external organisation

ICES - Symposium on "Forage fish interactions: Creating the tools for ecosystem based management of marine resources"
Activity: Membership › Membership of committees, commissions, boards, councils, associations, organisations, or similar