Spatio-temporal variation in marine fish traits reveals community-wide responses to environmental change

Marine ecosystems are exposed to a range of environmental and anthropogenic stressors, including climate change and overexploitation. A promising way towards understanding the impacts of such stressors on community composition is by considering species traits rather than species identity. Here, we describe the spatio-temporal dynamics in fish community traits using >30 yr of species abundance data from the North Sea combined with trait information on body size, life history, growth rate, reproduction and trophic level for demersal fish species in the area. We assessed whether the derived patterns and trends in community-weighted mean traits could be explained by a range of environmental stressors and fishing. Our results revealed strong spatial structuring and long-term changes in the trait composition of North Sea fish, with temporal changes not being uniformly distributed in space. Among the environmental drivers investigated, depth was one of the best predictors, primarily explaining the spatial variation in lifespan, growth rate, trophic level and fecundity. This can be explained by variables that co-vary with depth, e.g. temperature, seasonality, salinity and productivity. Finally, we found only weak relationships between fishing and the spatial variation of traits, suggesting that the spatial trait composition of the community is mostly determined by the environment. Yet, long-term changes in trait composition, primarily in body size, have previously been shown to be affected by size-selective fishing. Our study exemplifies how traits can be used to summarize complex community dynamics and responses to environmental and anthropogenic stressors as well as their usefulness for ecosystem-based management.
Using ecological traits of marine fish to detect responses to environmental change: which traits to choose?

General information
State: Published
Organisations: Centre for Ocean Life, National Institute of Aquatic Resources, Åbo Akademi University, Instituto Español de Oceanografía, Marine Research Institute Reykjavik, University of Hamburg, Thunen-Institut
Contributors: Beukhof, E., Frelat, R., Pécuchet, L., Fock, H., Punzón, A., Sólmundsson, J., Moellmann, C., Lindegren, M.
Publication date: 2018
Peer-reviewed: No
Event: Abstract from World Conference on Marine Biodiversity 2018, Montréal, Canada.
Electronic versions:
Publishers version
Research output: Research - peer-review › Journal article – Annual report year: 2019

Marine fish traits follow fast-slow continuum along coastal-offshore gradient

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Instituto Español de Oceanografía, Marine Research Institute Reykjavik, University of Hamburg, Thunen-Institut
Contributors: Beukhof, E., Frelat, R., Pécuchet, L., Fock, H., Punzón, A., Sólmundsson, J., Moellmann, C., Lindegren, M.
Publication date: 2017
Peer-reviewed: No
Marine fish traits follow fast-slow continuum along coastal-offshore gradient

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Instituto Español de Oceanografía, Marine Research Institute Reykjavik, University of Hamburg, Thunen-Institut
Contributors: Beukhof, E., Frelat, R., Pécuchet, L., Fock, H., Punzón, A., Sólmundsson, J., Moellmann, C., Lindegren, M.
Publication date: 2017
Peer-reviewed: No

Temporal and spatial differences between taxonomic and trait biodiversity in a large marine ecosystem: Causes and consequences

Biodiversity is a multifaceted concept, yet most biodiversity studies have taken a taxonomic approach, implying that all species are equally important. However, species do not contribute equally to ecosystem processes and differ markedly in their responses to changing environments. This recognition has led to the exploration of other components of biodiversity, notably the diversity of ecologically important traits. Recent studies taking into account both taxonomic and trait diversity have revealed that the two biodiversity components may exhibit pronounced temporal and spatial differences. These apparent incongruences indicate that the two components may respond differently to environmental drivers and that changes in one component might not affect the other. Such incongruences may provide insight into the structuring of communities through community assembly processes, and the resilience of ecosystems to change. Here we examine temporal and spatial patterns and drivers of multiple marine biodiversity indicators using the North Sea fish community as a case study. Based on long-term spatially resolved survey data on fish species occurrences and biomasses from 1983 to 2014 and an extensive trait dataset we: (i) investigate temporal and spatial incongruences between taxonomy and trait-based indicators of both richness and evenness; (ii) examine the underlying environmental drivers and, (iii) interpret the results in the context of assembly rules acting on community composition. Our study shows that taxonomy and trait-based biodiversity indicators differ in time and space and that these differences are correlated to natural and anthropogenic drivers, notably temperature, depth and substrate richness. Our findings show that trait-based biodiversity indicators add information regarding community composition and ecosystem structure compared to and in conjunction with taxonomy-based indicators. These results emphasize the importance of examining and monitoring multiple indicators of biodiversity in ecological studies as well as for conservation and ecosystem-based management purposes.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Section for Oceans and Arctic, University of Copenhagen
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Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: P L o S One
Volume: 12
Issue number: 12
Article number: e0189731
ISSN (Print): 1932-6203
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.01 SJR 1.164 SNIP 1.111
Web of Science (2017): Indexed yes
Records of five bryozoan species from offshore gas platforms rare for the Dutch North Sea

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Wageningen University & Research, Wageningen IMARES, Royal Belgian Institute of Natural Sciences
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Publication date: 2016
Peer-reviewed: Yes
Spatial structuration of life history traits: congruence between multiple taxa and environmental drivers in the North Sea

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life, Section for Marine Ecology and Oceanography
Publication date: 2016
Peer-reviewed: No
Research output: Research - peer-review › Journal article – Annual report year: 2016

Spatio-temporal changes in life-history traits of the North Sea fish community under climate change and fishing

General information
State: Published
Organisations: National Institute of Aquatic Resources, Centre for Ocean Life
Contributors: Beukhof, E., Dencker, T. S., Pécuchet, L., Lindegren, M.
Publication date: 2016
Peer-reviewed: No
Electronic versions:
Publishers version

Bibliographical note
ICES CM 2016/C
Source: PublicationPreSubmission
Source-ID: 127258936
Research output: Research › Conference abstract for conference – Annual report year: 2016

Projects:

Marine management of ecosystem dynamics under climate change (MARmaED) (39300)
MARmaED is an EU Initial Training Network that unifies specific and complementary competences in marine sciences from Norway, Finland, Denmark, the Netherlands, Germany and France to investigate how the cumulative stress from biodiversity loss, climate change and harvesting will affect Europe’s complex marine systems and the consequences for
optimal resource management. MARmaED incorporates feedbacks between the socioeconomic and the ecological systems that give rise to critical transitions. This project is coordinated by University of Oslo, Norway. The project is funded by EU, Marie Curie.

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01/10/2015 → 01/10/2019
Keywords: Research area: Marine Populations and Ecosystem Dynamics
Collaborators: University of Bergen, University of Oslo, Météo-France, University of Helsinki, Åbo Akademi University, Wageningen University & Research, University of Hamburg
Project: Research

A trait-based approach for predicting fish community structure, function and services under climate change and exploitation
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Marie Curie (EU-stipendium)
15/03/2016 → 14/06/2019
Award relations: A trait-based approach for predicting fish community structure, function and services under climate change and exploitation
Project: PhD