



future ocean
KIEL MARINE SCIENCES

Sustainable Fisheries Short Report

UNDERSTANDING THE OCEAN MEANS SHAPING THE FUTURE

The Cluster of Excellence “The Future Ocean”

The ocean. It covers more than two thirds of our planet and plays a central role for the future of humanity. How does the ocean influence the climate and our environment in the course of ongoing global warming? How can living and non-living resources be used sustainably? How can we balance conservation and use?

In the Cluster of Excellence “The Future Ocean” scientists from eight faculties of Kiel University (CAU) and three partner institutions study these and other questions. They study changes of the ocean and its coasts with an interdisciplinary approach and a unique scope: Scientists from marine science and geosciences work closely together with researchers from environmental economics and law, from medical science, mathematics, information technology, as well as from political and social sciences, and the humanities.

The Cluster of Excellence “The Future Ocean” supports the dialogue and the collaboration with decision-makers and civil society in the fields of knowledge exchange, public relations and international activities, with the Graduate School ISOS and the postdoc network IMAP.

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Sustainable fisheries management – is that possible at all?

Considering the almost daily new reports about the depletion of the fish stocks in the world's oceans and an increasingly growing world population, the recovery of the worldwide fish stocks and thereby a sustainable, environmentally friendly use of marine resources seems hardly possible.

In order to prevent a collapse of the fish stocks, researchers from Kiel University in the working group "Sustainable Fisheries" of the Cluster of Excellence "The Future Ocean" and the fisheries and evolutionary biologists from the GEOMAR Helmholtz Centre for Ocean Research Kiel see an institutional change which significantly improves the effectiveness of fisheries management, in particular for fish species living in the wild, as the only solution. The most recent reform of the Common Fisheries Policy of the European Union is already a step in the right direction. It is planned, for example, to introduce perennial multispecies management plans for stocks of popular food fish which take both ecological as well as economic aspects into account. Moreover, researchers see an urgent need for action in high-seas fisheries. In particular, better international coordination in regard to the stipulation and enforcement of restrictive catch quotas should be achieved.

The present short report summarizes the research approach in regard to sustainable fisheries management, as well as the essential challenges in implementation and highlights the successful interdisciplinary collaboration of scientists in Kiel's Cluster of Excellence "The Future Ocean".



RESEARCH AT KIEL UNIVERSITY ON NEW CONTROL MECHANISMS FOR SUSTAINABLE FISHERIES

Impacts of overfishing from a biological, economic and legal perspective

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Fish is an important basis of life for many people. On the one hand, as food, because fish is a major part of the diet in many regions of the world, on the other hand, as the economic livelihood of fishers in coastal regions. Some numbers: about 34,000 fish species are known, 18,000 of these live in the sea. Presumably, there are many more, and all of them are a part of an ecosystem and, in this manner, interwoven with species in a food web.

In total about 800 million people are directly or indirectly dependent on fisheries. The number of fishers amounts to 38 million, with 87% of these working in Asia alone. In Bangladesh, Cambodia and Ghana fish provides about 50% of the animal protein. Humans consume about 140 million tons of fish and seafood every year; about 90 million tons of these are wild catches from the ocean.

Between 1950 and 1990 the amount of fish caught yearly has quintupled.

Since 1990 it has not been possible to further increase the amount of catches, except in fish farms. No other field of food production has been growing so exponentially the last 20 years. Around 6000 animal species are already reared in aquaculture. In 2010 alone, 60 million tons of fish, mussels and crabs were farmed and more than 18 million people are

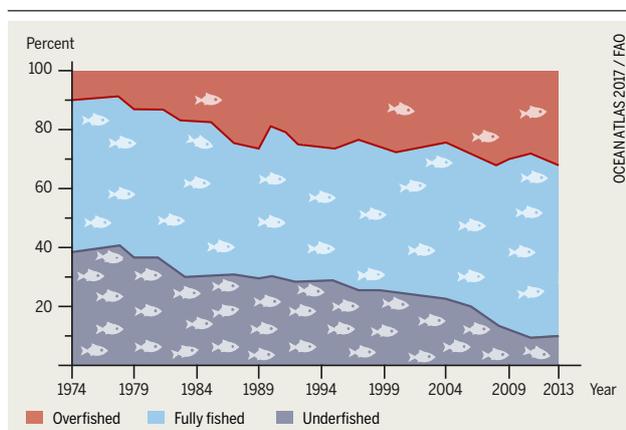
currently employed in this sector. The sad downside of the wild catches is: more than a quarter of the worldwide fish stocks are overfished or depleted. The deep sea is particularly susceptible to overfishing. The huge bottom trawlers which are brought out in depths up to 2000 meters are destroying the sensitive ecosystem. The species which are located in the deep sea grow slowly, become sexually mature quite late, reach an old age and have only few offspring. They are not able to compensate for the intense fishing.

The problem of illegal fishing further aggravates the problem. Their gains are estimated at about at least 11 million tons annually. Illegal fishery is attractive to fishers because

» *Since 1950 the amount of fish caught yearly has quintupled.* «

they neither need to adhere to catch restrictions, nor to pay duties or taxes on their revenues. Moreover, many of them remain unpunished, since there is insufficient monitoring in many areas of the ocean. Trade winds and the weather phenomenon El Niño influence the productivity of areas of upwelling off South America and Africa. Fish no longer find sufficient nutrition here and can no longer produce enough offspring. That means that when a stock collapses, there are often two causes: Overfishing and changing environmental conditions. Even though a vast number of national as well as international control mechanisms exist, they do not restrict the use of the resource fish sufficiently enough to sustain the fish stocks also for future generations.

Fewer Fish Than Ever Before



58% of global marine fish stocks are fully fished and 31% are overfished; only 10% are not at or over their limits.

Graph: Fewer Fish Than Ever Before, from: oceanatlas.org

MODELS FOR SUSTAINABLE FISHERIES MANAGEMENT (P.3)

The working group "Sustainable Fisheries" in the Cluster of Excellence "The Future Ocean" at Kiel University starts out here. Under the direction of economist Professor Martin Quaas, they work closely with fisheries biologists, mathematicians, lawyers and environmental ethicists. The scientists develop models for sustainable fisheries management. They want to contribute to achieving optimal management, which sustains the stocks and secures the yields in the long run.

In the previous two funding phases of the Cluster "The Future Ocean" the group around Martin Quaas formed a team working in an interdisciplinary manner, in which each member understands the language of the others. "We are particularly well-equipped for this type of work in Kiel," emphasizes the economist. According to Quaas there are only a handful of working groups worldwide which are working in a comparable way and whose results are internationally renowned.

INTERPLAY BETWEEN ECOLOGY AND ECONOMICS

The key role of the interplay between ecology and economics also becomes apparent during the conversation with two of the postdoctoral scientists, Dr. Jörn Schmidt and Dr. Rudi Voss, both fisheries biologists. Smart management methods could only be developed through effective collaboration, says Jörn Schmidt. "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" is the wording of sustainable development goal No. 14 of the United Nations. Jörn Schmidt is happy that the conservation of the ocean has been established as a UN Development Goal and sees it as a great challenge for science.

Overuse of marine resources, biodiversity, climate change – these are only some of the research fields which he studies, in order to be able to calculate ecological-economic models. In order to be able to predict fish stock development in future, economic change is observed in one study. The increase in the demand for fish, through population and economic growth, as well as improvements in fisheries technology, has a great influence on the fisheries. Climate change also has an impact. "The higher the number of factors to be taken into account, the more complex the model calculations become, of course," explains Schmidt.

Currently, the scientist is in charge of two projects in West Africa and works as well in Senegal and on the Cape Verde Islands.

In both projects the Kiel scientist cooperates in particular with local sociologists and biologists in order to ask the fishers themselves how often they take their boats out to the sea, what they catch, which regulations they are subjected to. Conversations with the fish-processing industry supplement the data collection to understand the system and make eco-



▲ The fish stocks in the Baltic Sea are regularly monitored.



▶ Plaices are measured and categorized

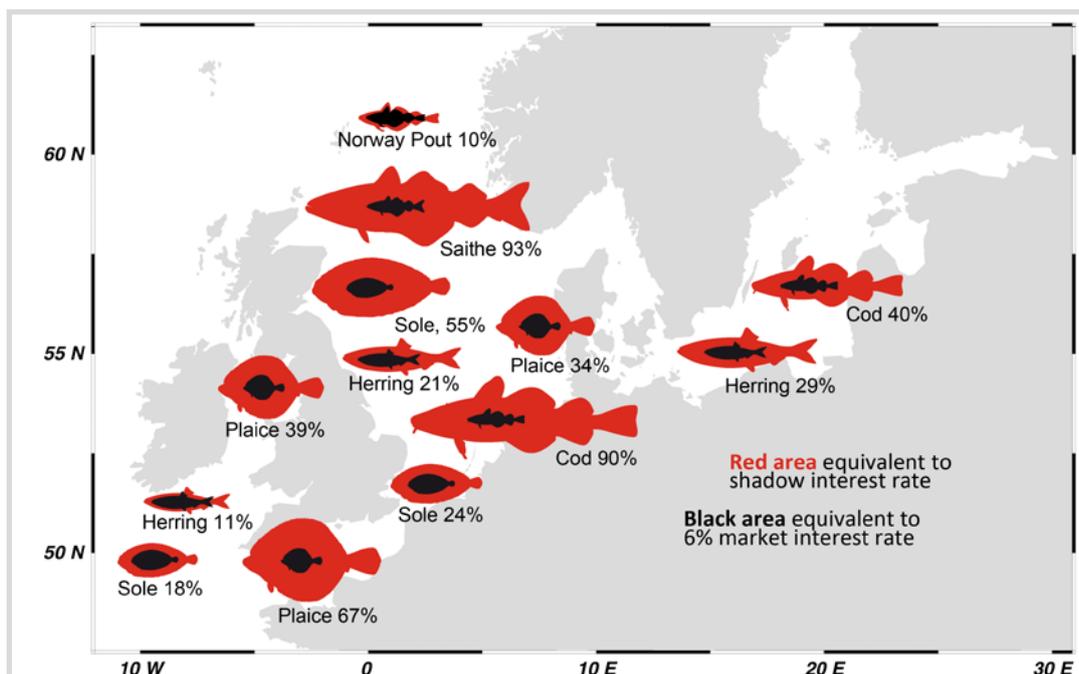
conomic model calculations possible. The implementation of the results, emphasizes Schmidt, however, cannot be managed through the research project. For this purpose, collaboration with local institutes and authorities is needed.

THE BALTIC SEA AS A RESEARCH FIELD (P.4)

Rudi Voss's focus of attention is on European fisheries policy. The Baltic Sea, effectively on the doorstep, is a particularly suitable research field. Broad knowledge on it has been and is locally available; it is a manageable spatial system and provides a habitat to known fish species.

Economically significant are in particular cod, herring and

sprat. Using Baltic Sea fisheries as an example, research has shown that sustainable fishing does not necessarily have to be an economic disadvantage. Over the short term ecologically sustainable use leads to a decreasing income because the stocks have to be conserved in order for them to recover. In the long run, the fishing companies will even be able to increase their revenue in this manner. The reason for this is the so-called "resource rent". This is what economists call the difference between the market value of the fish and the costs of catching the fish. If the stocks recover, the catch will become easier and the costs will decrease. Seen from a political perspective, there is however also a downside: Fewer workers will be needed in the fisheries.



Graph: Shadow interest rate ▶
Dr. Jörn Schmidt,
Kiel University / Future Ocean



It becomes more complicated when the interaction between species is included. Cod is a predator and consumes mainly sprat.

Fisheries either have to limit the catch of sprat or the stock of cod, so that profitable fisheries on sprat remain possible. Sustainability requires a weighing of different valid interests. While fisheries policy traditionally mediates between economic and ecological interests, Kiel's Cluster of Excellence mainly follows the ecosystem-based approach pursued by the United Nations, which studies social, economic and ecological aspects of sustainable resource management.

SHADOW INTEREST RATE

The marine fish stocks are still considered a community resource, meaning the fish caught belongs to the fisher, but the fish in the sea belongs to the general public. The fisher borrows the natural resource fish – up until now without appropriate interest rates being charged. Assuming that the yield will increase if less fish is being caught, this means an investment of the fisher in increasing fish stocks. The Kiel fisheries biologists and economists have now attributed a value to this growth, the so-called shadow interest rate (see graph on the left side). Shadow interest rates between 10 percent (Norway pout) and 90 percent (North Sea cod) could be identified for 13 species. The higher the percentage, the more overfished is the stock and the more an investment would be profitable for both the fishers and the stock.

CONTACT WITH POLITICAL DECISION-MAKERS

“Sustainable use of wild living fish stocks can only be achieved through far more effective fisheries management”, says Rudi Voss. According to Voss, recommendations on a biological basis are still the standard so far. Voss calls for the ecological-economic results of the research to become the standard and basis for recommendations to the European Fisheries Policy. For this purpose, he and his colleagues repeatedly look for direct contact with political decision-makers – through fisheries talks and dialogue with fisheries consultants in the respective ministries and agencies. Voss believes core messages of the Kiel research are being taken note of in Brussels. The researchers believe that one important component for the solution of the overfishing problem is institutional change. Here law comes into play.

Erik van Doorn, a young law of the sea scholar, works at the Walther Schücking Institute for International Law at Kiel University together with Professor Nele Matz-Lück. An open call for applications brought the Dutchman to Kiel. He focuses on International Law and its possibilities. The basis is the United Nations Convention on the Law of the Sea, explains van Doorn, which entered into force in 1994 and was extended for far migrating fish species in 1995. 167 states have ratified the convention, which, among other things, stipulates the Exclusive Economic Zone (EEZ) – 200 miles off the respective coast. Regional fisheries management organizations are in charge of the regulation of this zone, in which about 90% of the fish catches take place. According to van Doorn, only 10% are caught on the High Seas. But especially in focus is, for example, the coveted tuna, which swims from one EEZ through the High Seas into the next. There the coveted prey is intercepted by ships which sail under flags of convenience.

THE LAW OF THE SEA CONVENTION IS ONLY A FRAMEWORK CONVENTION (P.6)

Monitoring is difficult, sanctions as well, because the Law of the Sea Convention is only a framework convention. The ratification is only the first step; the implementation into national law is often enough where the difficulty lies.

In the South China Sea, an area of the highest marine biodiversity, there is not even a regional fisheries management organization, explains van Doorn. Since it does not exist up to now, it is a declared objective of law of the sea scholars to study whether it would be possible to declare the High Seas fish stocks a common heritage of humanity, as the maritime law convention has already stipulated for the resources on the sea floor.

RESEARCHERS ARE STRIVING FOR A NORMATIVE FRAMEWORK OF A COMMON HERITAGE OF HUMANITY

A position paper with the title "Future Ocean Synthesis Proposal," written by Martin Quaas together with colleagues from law (Nele Matz-Lück), from geochemistry (Andreas Oschlies, GEOMAR Helmholtz Centre for Ocean Research Kiel) and evolutionary ecology (Thorsten Reusch, GEOMAR) for the hoped for third funding phase of the Cluster follows exactly this approach.

Martin Quaas criticizes: "Even within the EU, the fish stocks are not as well-managed as they could actually be." The economist sees as the reason the quotas, which are set by politicians less according to economic advantages and ecological sustainability and more for preserving jobs in the fisheries in the short run. Quaas also sees the annual negotiation of the quotas as an impediment to sustainable fisheries management. When negotiations take place annually, the quotas are too high, according to Quaas.

But what should the normative framework look like? The researchers propose a framework which is based on the fundamental idea of the oceans as the common heritage of humanity. For this a balance between use and conservation of the stocks would be required. Moreover, the researchers from Kiel propose applying key characteristics of human heritage – namely the just distribution of the yields. Both the access to resources and the allocation of the yields would have to be regulated by a binding framework. In the coming years the Kiel scientists want to increasingly focus on the

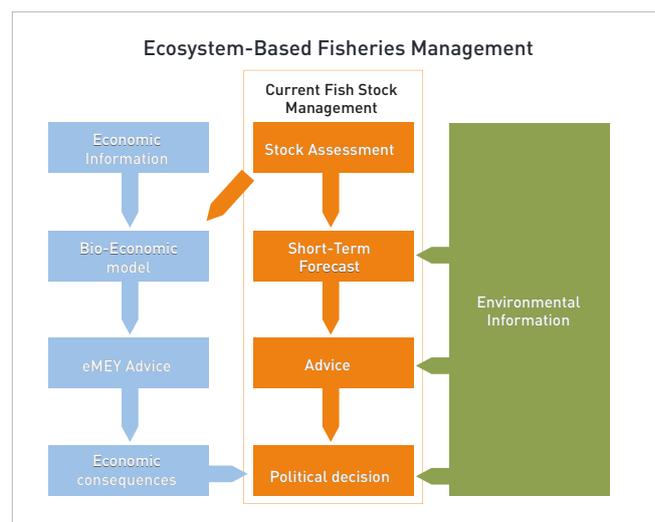
» *Sustainability requires the weighing of interests.* «

global questions of sustainability, underlines Martin Quaas.

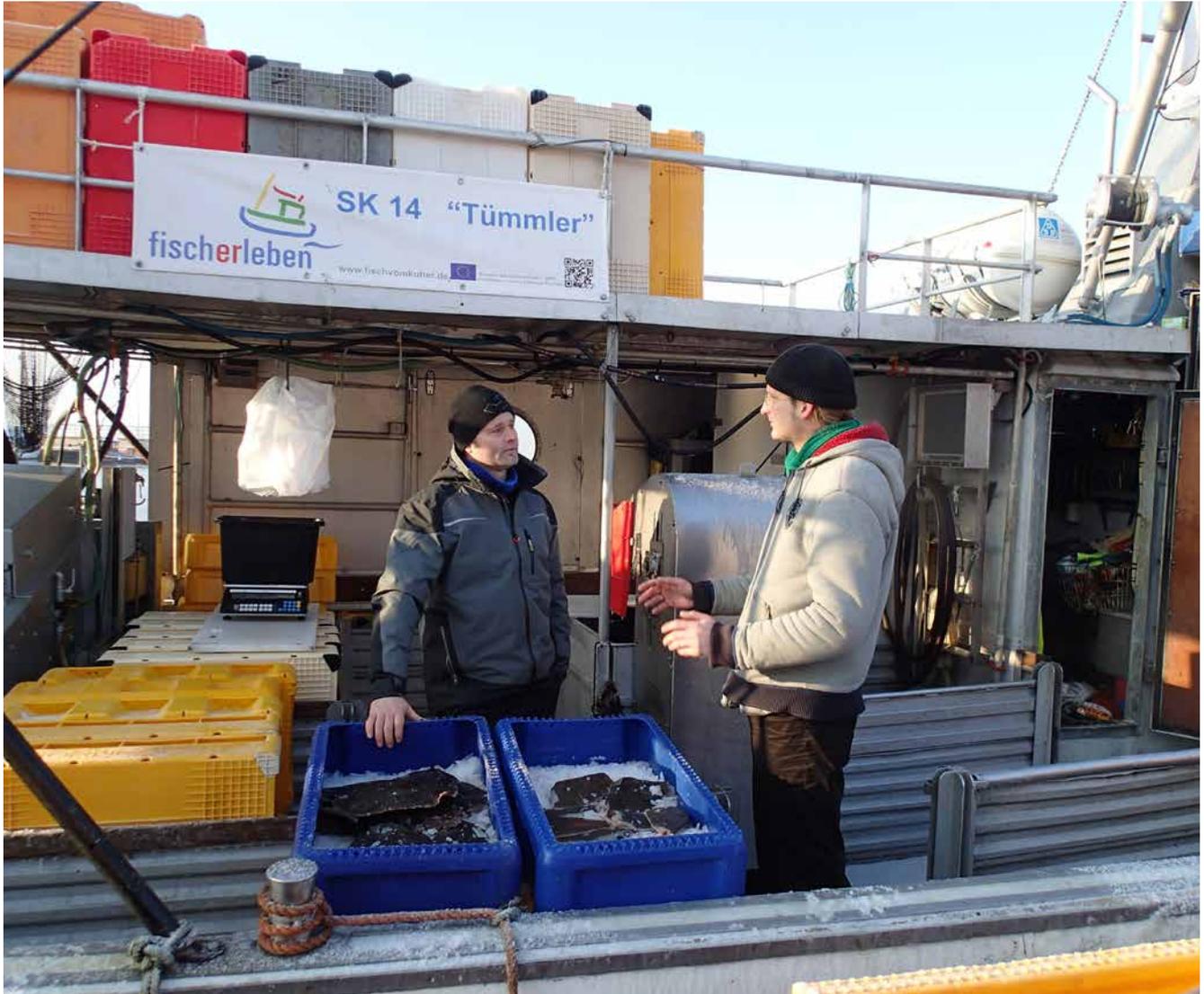
Subproblems, such as food security, in particular also in poor countries, progressing climate change or sea level rise need to be tackled in an integrated manner. According to Quaas, not catching more fish than will regenerate, cannot be accomplished with regard to all the fish stocks at the same time. He emphasizes that there is a conflict of objectives between job security and the preservation of stocks, as well as between food security and the good condition of the ecosystem.

In order to establish practical relevance, workshops take place regularly with the participation of politicians and practitioners from fisheries management. The feedback of practice partners has also led to new research questions. For example, the Kiel researchers increasingly include the markets for fish into the model studies. The aim of future research is therefore to come closer to a fair balancing of interests with more intensive interdisciplinary collaboration. And in this manner, the aim is also to contribute to achieving the sustainable development goal No. 14 of the United Nations for the conservation and preservation of the oceans.

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Graph: *Ecosystem-Based Fisheries Management*
Dr. Rüdiger Voss, CAU / Future Ocean
published in *Front. Mar. Sci.*, 30 June 2017.



FURTHER INFORMATION

www.meeresatlas.org

The editors – The Heinrich Boell Foundation, the Cluster of Excellence “The Future Ocean” and the monthly newspaper for international politics Le Monde Diplomatique – have gathered the most important dimensions regarding the interaction of humans, the ocean and the coasts in 18 contributions.

www.worldoceanreview.de

(in particular WOR 2: The Future of Fish - The Fisheries of the Future)
The series “World Ocean Review” are thematic publications about the state of the world’s oceans and the interdependency between the ocean and ecological, economic and societal conditions. The WOR is published by maribus, the non-profit GmbH founded by the mare publishing house with the Cluster of Excellence “The Future Ocean” as a major partner.

▲ Fisheries biologist Dr. Jörn Schmidt (on the right) talking to fishers in Möltenort.

Researchers at Kiel University with a focus on sustainable fisheries management:



PROF. DR. MARTIN QUAAS

Martin Quaas graduated from the University of Duisburg-Essen with a degree in theoretical physics. In 2004 he received his doctorate in economics at the Faculty of Economics and Social Sciences at Heidelberg University. From 2004 to 2007, he worked at the Helmholtz Centre for Environmental Research in Leipzig and at Tilburg University in the Netherlands. From 2007 to 2010 he was a Junior Professor at the Faculty of Economics and Social Sciences at Kiel University and was the head of the junior research group for sustainable fisheries in the first phase of the Cluster of Excellence "The Future Ocean". Since 2010, he is a Professor of Environmental, Resource, and Ecological Economics in Kiel. Within the Cluster of Excellence he represents the research topics concerning ocean sustainability.

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DR. JÖRN SCHMIDT

After graduating from the University of Hannover in the year 2000 Jörn Schmidt earned his doctorate in fisheries biology at the former IFM-GEOMAR in Kiel in the year 2006. Since 2009 he has been working within the framework of the Cluster of Excellence "The Future Ocean" in the working group "Sustainable Fisheries" at the Department of Economics at Kiel University. He was the work package leader in several BMBF- and EU-funded projects. His research interests lie in the area of effective fisheries management and the general question of sustainability. Moreover, he has a special interest in the transfer of his results to the public, also the use of games for educational and learning purposes.

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DR. RÜDIGER VOSS

Rüdiger Voss graduated at the Institute of Marine Sciences at Kiel University in 1996. In 2002 he received his doctorate from the same institute. Starting in 2004 he worked as a project scientist, later as a project manager at the former IFM-GEOMAR. Since 2008 Voss has been a member of the team in the working group "Sustainable Fisheries" in the Cluster of Excellence "The Future Ocean" and is employed at the Department of Economics at Kiel University. His scientific interests lie, in particular, in the field of ecological-economic multispecies modeling.

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ERIK VAN DOORN

Erik van Doorn has been a doctoral candidate at the Chair of Professor Nele Matz-Lück at the Walther Schücking Institute for International Law at Kiel University since 2002. In his doctoral thesis he deals with the legal implications of the principle of the common heritage of humanity with regard to far migrating fish species.

He earned his Bachelor in the field of International Relations at the University of Groningen in 2009, the LL.M. in International Law at Utrecht University in 2011.

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