

# Ecosystems

Research  
Consulting  
Evaluation

# IfAÖ – Institute of Applied Ecology

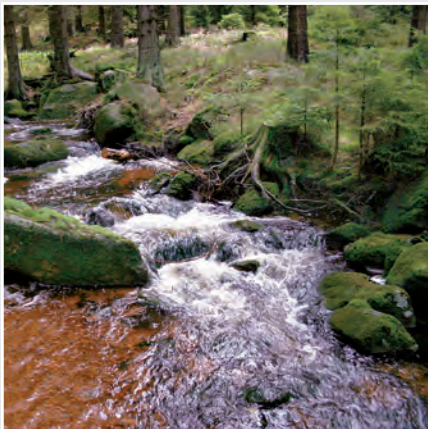


For nearly 20 years, IfAÖ – Institute of Applied Ecology – has been studying and evaluating terrestrial and aquatic biotopes and ecosystems.

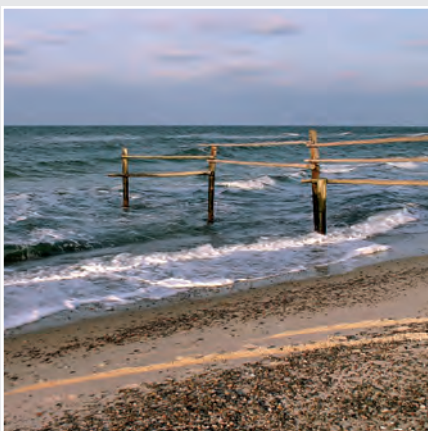
Assignments predominantly come from private enterprises, e.g. in the offshore wind sector, located throughout Germany, but IfAÖ also works closely together with regional, public clients.

A further mainstay of the more than 60 institute employees are research projects carried out in close cooperation with Rostock University as well as with public and private partners nationwide.

IfAÖ is equipped with the latest technology to carry out sophisticated scientific tasks. This includes, for example, the institute's own benthic-ecological laboratory, sediment analytics, standardised sampling equipment, a remote-controlled underwater vehicle, underwater video cameras, radar equipment and automatic camera systems to record bird migration at sea and on land. IfAÖ's archive contains nearly 12,000 archived specimens from 600 taxa. Together with the institute's powerful information technology capacity, research projects and commissioned work can be efficiently carried out at a high scientific level.



Due to its broad scientific orientation, IfAÖ is able to offer comprehensive services „from one source“, ranging from sampling to laboratory analyses, the writing of expert reports, evaluation of approval documentation (environmental compatibility, FFH compatibility studies, technical papers on species protection, landscape conservation support plans, tests pertaining to biotope protection law, etc.) to the handling of all deadlines required as part of the approval procedures for the involvement of the public and the representatives of public interests.



## Services (onshore and offshore)

- Expert reports, including sampling
  - Benthic organisms and habitats
  - Ichthyology
  - Ornithology
  - Environmental toxicology
- Environmental, spatial and landscape planning
- Laboratory (benthos/sediments/toxicology)
- Advanced training, education, consulting

# IfAO – Institute of Applied Ecology

## Benthic Organisms & Habitats



Most of the organisms present in the sea have at least one stage of their life cycle which takes place in the benthos. This demonstrates the significance of benthic communities for marine ecosystems as well as their significance in the food chain. Most of the ground-dwelling animals and plants act as bio-engineers and serve as a habitat for other organisms, such as many fish species. The main areas of research of the Benthic Organisms & Habitats Department are census taking, monitoring, and description and assessment of marine and limnic benthos. The species communities and their habitats are investigated by means of underwater video recording, research diving and ship-based sampling. The knowledge of species and the possibility of making comparisons with more than 12,000 archived specimens from IfAO's own benthic collection, as well as time series data of the institute's own benthos database (> 7,700 stations with > 33,000 hauls from the North and Baltic Seas), allows us to precisely identify the benthic communities (animals and plants) and to describe the diversity and distribution of species. The results find their way into expert reports that provide assessments of environmental impacts, and into scientific articles and publications.

### Research Diving

This technique of gathering samples is an important research method at IfAO and allows biological sampling from biotopes that are hard to access. IfAO research divers can selectively take samples and thus can work even in sensitive habitats without causing any major disturbance.

### Research Areas

- Ecology of the marine and limnic benthos
- Description of seasonal and interannual variability of benthic communities exposed to environmental change
- Description of anthropogenic influences (e.g. offshore wind turbines, deepening of fairways, cable routes, pipelines, sediment extraction and the dumping of dredged material) on the benthos





The North and Baltic Seas as well as the limnic region are home to a large number of different species of fish. This includes very rare species as well as those that are extremely abundant. The different fish populations represent an important resource. Due to the comparatively high pressure on fish stocks by fishing in the last decades, the demands placed on the marine environment by different anthropogenic influences (shipping, military, wind power, marine construction and the like), but also by the ongoing warming of the oceans, many fish species are under massive threat or on the brink of extinction. This applies not only to commercially exploited species of fish but also to those that end up as bycatch in the nets of professional fishing enterprises or those species whose habitats are being destroyed or put at risk by anthropogenic use.



That is why anthropogenic impacts on fish communities of the North and Baltic Seas are a central issue of the Ichthyology Department at IfAÖ. Using selected ecological parameters, changes of fish communities are recorded by several different methods and analysed using modern statistical software. This enables the Department to predict changes of fish zoonoses in regional marine areas of Germany to be made in the form of impact forecasts or trends and ecological risks.

At the same time, the department is also involved in national and international re-search projects. Of interest are issues pertaining to the biology of fishing (population dynamics) and fish ecology (availability and use of food, influence of pollutants).

### Research Areas

- Inventory and evaluation of fish communities in the North and Baltic Seas as well as in fresh water
- Description of seasonal and interannual changes of various fish species subject to environmental influences, adverse anthropogenic effects, ocean warming and fishing activities
- Scientific studies relating to fish communities
- Description and evaluation of fishing in the North and Baltic Seas as well as in fresh water systems
- Special reports, e.g. fish passability, EU Water Framework Directive
- Species of fish and Cyclostomata in Annex II of the FFH directive





With about 10,000 species, birds colonize a wide range of ecosystems – from the wilderness of the tropics and polar regions to the civilisation of our cities. Migratory birds are exposed to many natural hazards on their long-distance flights between continents. If mankind introduces additional sources of danger, the long-term consequences for bird populations have to be objectively assessed.

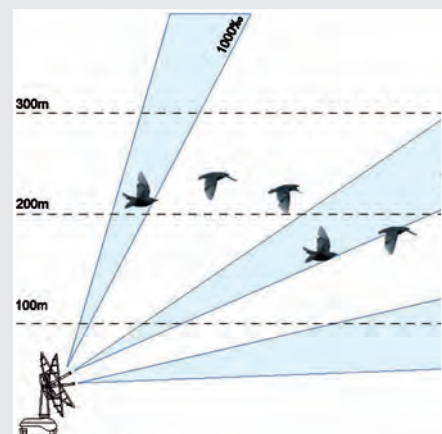
The Department of Ornithology at IfAÖ studies the biological diversity and ecology of birds against the backdrop of anthropogenic environmental changes at sea and on land. In order to determine the number, occurrence and distribution of birds, IfAÖ employs a variety of standardised observation techniques, such as transect counts from ships and planes.

One research focus lies on the analysis of bird migration over the North and Baltic Seas in order to assess the problem of bird strikes caused by offshore wind turbines. Because the majority of birds migrate by night, IfAÖ uses specially developed radar and night-vision systems to visualise the unseen.

Through scientific expertise and methodological progress, IfAÖ is setting new standards in the analysis and evaluation of the effects of environmental impacts on bird populations and species communities.

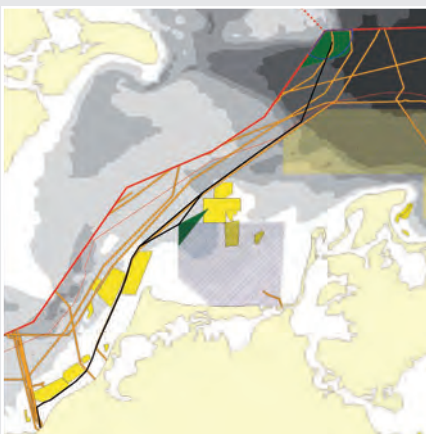
### Research Areas

- Census and mapping of breeding and staging birds in marine, limnic and terrestrial habitats
- Analyses of bird migration (fly ways, flight heights, phenology, migration rates)
- Development of systems to automatically record nocturnal bird migration around technical installations and buildings (fixed-beam radar, infrared videography)
- Modelling the impacts of anthropogenic environmental changes on bird populations and behaviour
- Expert reports according to national and international guidelines (e.g. species conservation, EU Birds Directive)





IfAÖ has special expert knowledge when it comes to giving environmental planning support with regard to offshore wind farms, the deepening of fairways, coastal protection systems, road and track-laying plans, the laying of cables and pipelines in the sea as well as plans to extend harbours, redundant and the planning of recreational facilities. IfAÖ carries out project management and moderation as well as environmental monitoring. For onshore and offshore projects, the staff of the Environmental, Spatial and Landscape Planning Department carries out environmental compatibility studies, FFH compatibility studies, LBP (landscape management support planning), LAP (landscape management implementation planning), tests relating to biotope protection law and special tests or technical reports relating to species protection. Furthermore, nature protection statements on specific issues or special reports on certain species groups are drawn up. Mapping of animal species in Annex II of the FFH directive or training courses on, for example, how to take samples in bodies of flowing water are all part of the service portfolio of the department of Environmental, Spatial and Landscape Planning.



## Main Areas of Work

- Environmental compatibility investigations and studies (environmental impact assessments, environmental impact studies)
- Landscape planning, contributions to master landscape planning and to the landscape programme
- FFH compatibility studies (FFH compatibility assessment, FFH compatibility study)
- FFH management planning (MaP)
- Fauna reports e.g. on ground beetles, locusts, freshwater macrozoobenthos, dragonflies, wood beetles
- Mapping of animal species in Annex II and Annex IV of the FFH directive
- Expert opinions in line with PHYLIB, PERLODES, saprobic index, lake mapping using macrophytes and macrozoobenthos
- Use and place-based analyses
- Regional planning/spatial planning (various contributions)
- Services for land use planning
- Town planning and open space planning, project management and moderation
- Environmental controlling, ecological site supervision
- Tests pertaining to biotope protection law, expert articles on species protection
- Advanced training, education, advice



The coastal regions and inland waters are some of the most anthropogenically affected habitats. This is where the demands placed on them by sewage treatment plants, the production of raw materials and energy, fishing, shipping and tourism are generally increasing. Overall, this exposes aquatic organisms to a variety of pollutants and stressors.

The Environmental Toxicology department at IfAÖ mainly focuses on monitoring and evaluating the effects of anthropogenic stressors on aquatic organisms in marine and limnic ecosystems. In order to ascertain the harmful effects of chemical and environmental stressors, the state of health of indicator organisms (bioindicators) is investigated in order to derive statements concerning the extent to which the aquatic environment is polluted.

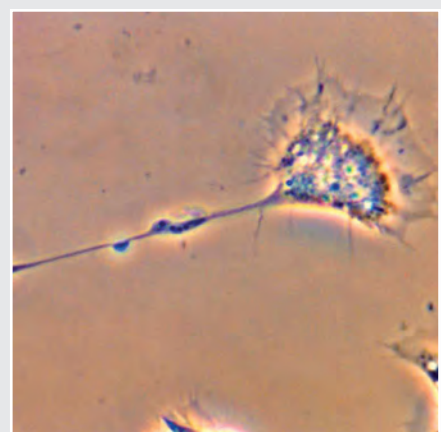
So-called biomarkers are used as instruments of aquatic environmental diagnostics and serve as indicators to reveal the effects of harmful substances. In contrast to chemical analytics, a combination of several biomarkers can be used to record the reactions of a single bioindicator to all pollutants present.

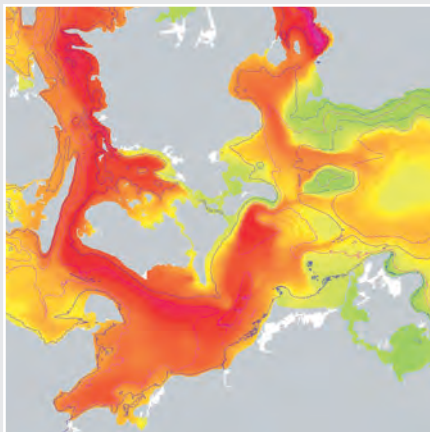
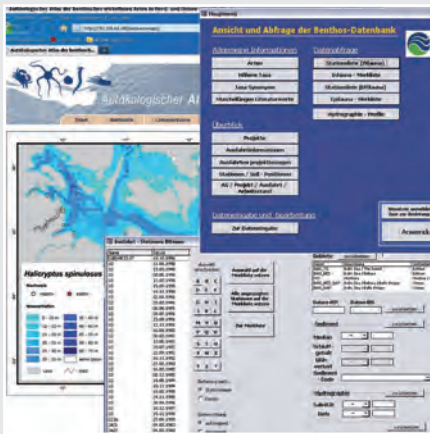
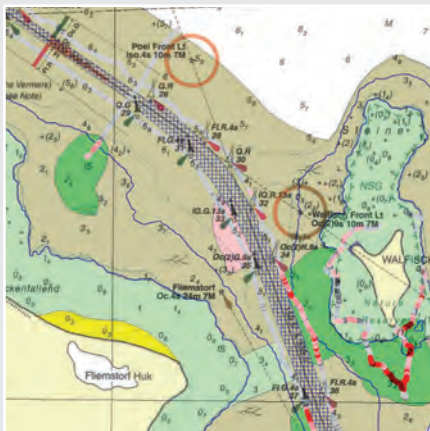
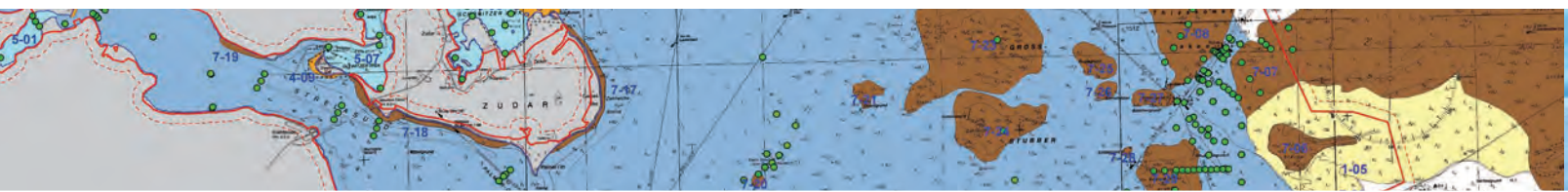
Molecular and cellular changes induced by pollutants can be assessed with the biomarkers applied by IfAÖ. The pathological states of cells are analysed using histological techniques. Special emphasis is given to the evaluation of reproductive disorders as they may have detrimental consequences for populations.



### Research Areas

- Biological effect monitoring in coastal and inland waters
- Cell biological and histological biomarker studies on fish and invertebrates
- Investigations on fish health
- Chemical-analytical contaminant monitoring of sediment and biota (mussels, fish)
- Shipworm (*Teredo navalis*): groyne monitoring and testing of hardwoods for resistance to *Teredo*





The availability of meaningful environmental data is a prerequisite for addressing scientific questions and forming expert opinions. On the one hand, the wealth of available data is growing, but on the other hand, incompatible data formats and missing meta-information is making it harder to access and exchange information. IfAÖ responds to these challenges by consulting its own internal database and by implementing open interfaces to other database providers and users.

The data gathered by IfAÖ through sampling are subject to strict quality control, entered into powerful database systems and can then be visualised through specially-programmed data retrieval and evaluation routines.

In addition, alongside traditional maps and diagrams, modern, web-based, interactive surfaces are used. Through its active participation in committees and networks, together with other scientists and participants, the IfAÖ plays a part in the ongoing discourse on conflicts of use in the marine environment. With its web-based data exchange platforms and practice-oriented data evaluations, IfAÖ provides the scientific basis for current discussions.

### Main Areas of Work

- Cartographic visualisations (maps, diagrams, posters for expert opinions) and research reports
- Conception, development, maintenance and evaluation of specialist databases (mysql, postgresql, Access, Excel)
- Creation of web-based information systems, particularly WebGIS and interactive online statistics
- Modelling and programming of ecological issues (JAVA, R, MARXAN, XML, HTML)
- Partially-automated image processing, e.g. to analyse staging birds
- Technical post-processing of underwater videos



# IfAÖ – Institute of Applied Ecology

## Sampling Management

To meet the demands of a scientific investigation of different habitats, the required sampling needs to be conducted at a high, standardised level.

This is what the Sampling Management Department at IfAÖ is charged with. With its extensive sampling equipment and the expertise of its experienced staff, the necessary samples can be taken and prepared and then transferred to the laboratory for further processing for both internal IfAÖ departments as well as for external clients – and all at a consistently high level of quality. One focus of the sampling lies in the field of the offshore industry. Ship-based investigations take place in the North and Baltic Seas.

The main task of the Sampling Management department is the coordination of human and technical resources. Applying for permits from the relevant authorities is also part of the package, as well as the planning and chartering of ships and the servicing of all sampling equipment at IfAÖ.

Regular training ensures a high level of expertise and safety standards of various sampling techniques.

### Technical Equipment

- Various grabbers and box corers (van Veen, Ekman Birge, Günther)
- Equipment to measure water quality
- 4 underwater video systems for various purposes
- 1 underwater robot (ROV)
- 2 boats for shallow water and limnic regions
- Beam trawls, dredges, various nets for dragnet, gillnet, fyke net and towed seine fishing
- High-resolution camera systems (VARS visual automatic recording system) to record migrating birds both by night and by day
- Radar instruments to quantify avian migration rates

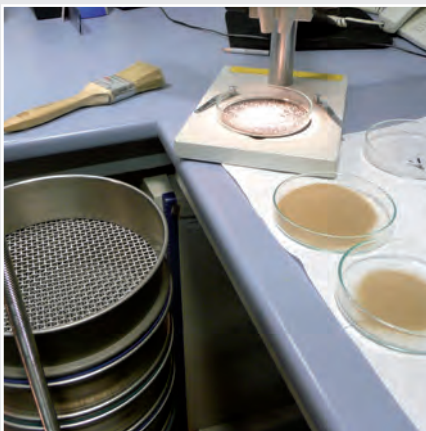




### Benthos Laboratory

The starting point of all evaluations and ecological analyses is the inventory of benthic species. The task of the Benthos Laboratory is to sort the collected organisms, identify the species, and to determine the number of individuals and biomass.

There are eight workspaces available to sort the animal material from the samples. Large sample quantities can be processed very effectively with the stereo microscope mounted on special tripods. Three of the workspaces are equipped with powerful stereo and transmitted-light microscopes, on which four experienced taxonomists can identify the species. Continually updated identification literature, participation in workshops at home and abroad, and contact with taxonomic specialists ensure the quality of the identification work. More than 12,000 specimens are stored as reference material, which is managed in a database.



### Sediment Laboratory

For all benthic organisms, the composition of the sediment in which they live is one of the most crucial ecological factors. That is why a small subsample is removed from every benthos sample for sediment analysis. In the Sediment Laboratory, the organic content (ignition loss) as well as grain size distribution is determined. The lab is equipped with three sieving machines as well as drying kilns, annealing furnaces and laboratory scales.



### Toxicological Laboratory

The lab rooms of the Environmental Toxicology Department are equipped with instruments for conducting work in the fields of biochemistry and cell biology. A clean room bench and an incubator are available for performing work on cell cultures. The histological processing of samples comprises the preparation of tissue slices and their evaluation using a light-optical or fluorescence microscope. Investigations into the pollution of sediment and biota are done in long-standing cooperation with accredited analytical laboratories.



### Examples of R&D Projects at IfAÖ

Titles of the R&D Projects	Contents	Funding Body
Biomarkers	Use of biomarkers to record the possible effects of electromagnetic fields (part A) and temperatures (part B) on marine organisms (mussels and sand hoppers) under laboratory conditions	BMU <sup>1</sup>
Cumulative effects Birds	Determining species-related significance thresholds of migratory birds for the sea area of the south-western region of the Baltic Sea with regard to the threat to bird migration in conjunction with the risk of collision with wind turbines	BMU <sup>1</sup>
FINO 2 (2005-2009)	Ecological secondary research for the project „Construction and operation of a measuring platform for carrying out research in the western region of the Baltic Sea to support the investigation of all primary and secondary conditions for long-term energy production (FINO 2)“	BMU <sup>1</sup>
FINO 2 (2010-2012)	Further development of the technology used for long-term studies of birds using radar and automatic camera observation at the site of the offshore measuring platform FINO 2 and carrying out long-term measurements at the site for the period 2010 to 2012	BMU <sup>1</sup>
Camera development	Development and introduction of an automatic recording system to determine the number of bird strikes under field conditions on FINO 2	BMU <sup>1</sup>
VARS	StUK-plus: Recording bird collisions with the aid of the „VARS“ automatic camera system at alpha ventus offshore wind farm	BMU <sup>1</sup>
Pencil beam	StUK-plus: Recording of evasive movements of migratory birds using pencil beam radar	BMU <sup>1</sup>
IMKONOS	Establishment of an interdisciplinary association with marine research competence for model areas in the North and Baltic Seas (IMKONOS). Establishment of a cross-institutional exchange of expertise and a „platform for exchanging information“	BMU <sup>1</sup>
Autecological atlas	Creation of a GIS-based autecological atlas for the macrozoobenthos of the German sea areas	BMU <sup>1</sup>
Fast fixed beam radar	Development of a method to automatically quantify bird migration in the vicinity of offshore wind turbines and the barrier effect of technical installations on bird migration by means of fixed beam radar	BMU <sup>1</sup>
BALCOFISH	ERANET BONUS-127: BALCOFISH – Integration of gene expression and ecology with reference to coastal fishing in the Baltic Sea and its management	EU/BMBF <sup>2</sup>
BEAST	ERANET BONUS-114: BEAST – Biological impacts of anthropogenic chemical pollution (tools to assess ecosystem health)	EU/BMBF <sup>2</sup>
IKZM I and II	IKZM – Integrated coastal zone management in the Oder estuary	BMBF <sup>2</sup>
IKZM III	IKZM ODER III – Research for integrated coastal zone management in the region of the Oder estuary	BMBF <sup>2</sup>
Seabirds as bycatch	Investigation and evaluation of seabirds as bycatch from passive fishing in the Baltic Sea	BfN <sup>3</sup>
RADOST	RADOST – joint project: Regional adaptation strategies for the German Baltic Sea coast in the context of climate change	BMBF <sup>2</sup>
PPP China	Transfer and adaptation of European technology and environmentally-oriented knowledge of methodology with the aim of improving the recording of the environmental status in the Chinese maritime region development of a monitoring system of the maritime environmental situation with free accessibility	DEG

<sup>1</sup> German Environment Ministry

<sup>2</sup> Federal Ministry of Education and Research

<sup>3</sup> German Federal Agency for Nature Conservation



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