

Review of Rügen herring larvae survey project 2011.

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Summary

At the request of the Johann Heinrich von Thünen Institut (vTI), IOR Rostock, a return review of the German Rügen herring larval survey (RHLS) project took place on the 24th to 26th January 2011, following on from a similar review in November 2006. Mark Dickey-Collas (Wageningen IMARES) and Richard D.M. Nash (IMR, Norway) lead the review. This report represents the opinions of these two external reviewers. The current aim of the programme is to maintain and develop the time series of ichthyoplankton surveys in the spring and summer in the Greifswalder Bodden and stimulate spin off research. The review was designed to address the role of the survey in the framework of providing both management advice and research outputs. The external reviewers were given documents on the current survey. They also viewed presentations from research students and staff on their work and the proposed direction of the programme. The review included a "brainstorming" session on future research and potential gaps in the project.

The reviewers were impressed by the development of the project since the last review in 2006. Both operationally and in terms of the science, the project had moved forward greatly. The survey effort had been rationalised and various assumptions in the sampling design had been tested. The survey had become adaptive and flexible in both space and time. The N20 index of larval abundance is now used in the stock assessment for Western Baltic Spring Spawning herring and high quality research papers had been published by the team in recent years.

This report contains recommendations on the operation of the survey and the provision of information for management of the marine environment and fish stocks. It also looks to the future by suggesting relevant research directions, potential outputs from the programme and prioritisation of resources.

There is a need for an overview and a strategy for progress. Maintaining and developing the index used in the stock assessment must go hand in hand with underpinning an active research programme. The review highlighted the need for stronger synthesis. The reviewers felt that there was still, and probably always will be, some tensions between the research agenda and the provision of the N20/recruitment index. But they were convinced that the current team would work to make these tensions productive and use the creative friction to increase our understanding of western Baltic spring spawning herring and the ecology of the Greifswalder Bodden.

1. Introduction

At the request of the Johann Heinrich von Thünen Institut (vTI), a return review of the German Rügen herring larval survey (RHLS) project took place on the 24th to 26th January 2011. This review followed a similar review in November 2006. Two external reviewers were invited to join and lead the review of the project and consider the progress made since 2006. The review was held in an informal manner with the RHLS project manager, current research scientists, the director and deputy director of the Baltic Sea Fisheries Institute all taking part. This report represents the opinions of the two external reviewers.

The current aim of the RHLS project is to maintain and develop the time series of ichthyoplankton surveys in the spring and summer in the Greifswalder Bodden and stimulate spin off research. The review was designed to address the role of the survey in the framework of providing both management advice and research outputs. The agenda was drawn up by the external reviewers and the scientists at the Baltic Sea Fisheries Institute involved in the project.

The external reviewers were given documents on the current survey. They also viewed presentations from research students and vTI staff on their work and the proposed direction of the project. The review included a "brainstorming" session on future research and potential gaps in the project.

This report describes the recommendations and comments from the external reviewers rather than a documentation of the actual process of the review.

Participants of the Review

Mark Dickey-Collas	External Reviewer
Richard D.M. Nash	External Reviewer
Paul Kotterba	Research Student
Matthias Paulsen	Research Student
Robert Bauer	Research Student
Patrick Polte	vTI
Daniel Stepputtis	vTI
Rainer Oeberst	vTI
Tomas Gröhsler	vTI
Christopher Zimmermann	vTI
Cornelius Hammer	vTI

2. Progress since the last review

The reviewers were impressed by the development of the project since the last review in 2006. Both operationally and in terms of the science, the project had moved forward greatly. The survey effort had been rationalised and various assumptions in the sampling design had been tested. There is now a more robust approach to the survey and analysis. The project team appeared to be very dynamic and full of energy. Fresh ideas were being introduced into the project.

The N20 index of larval abundance was now used within the stock assessment for Western Baltic Spring Spawning herring and research papers had been published by the team in recent years. The project team acknowledged that maintaining the survey for the survey's sake was not good enough in a research environment with competing claims on resources. The survey must provide the foundation for research and lead to outputs, such as peer reviewed publications. The execution of the survey was greatly improved and efforts had been successfully made to make the time series operational in the stock assessment of Western Baltic Spring Spawning herring.

3. Operation of the survey

The survey design had been tested and refined. It is now adaptive and flexible in time and space. The research scientists were aware of the potential challenges to the survey design and output (changes in spawning behaviour, changes in the transport of larvae, changes in larvae mortality etc.). The performance of the strata in reducing variance in abundance estimates had been tested. The scientists were aware, and have plans for the change in survey vessel which will occur in the near future. Quality of data appeared high on the scientists' agenda, which the reviewers considered a very positive aspect of the survey.

There are still a few underlying challenges to the operation of the survey.

- Recording sample, ship and environmental data directly into the database on-board the vessel would improve data quality, avoid potential transcription errors and rationalise operations.
- Further efforts should be made to find appropriate methods for the subsampling of large catches of larvae.
- The recording of by-catch needs to be standardised.
- Potential integration with oceanographic studies needs to be explored.
- In the longer term, consideration should be given to developing new approaches for sample analysis and *in situ* measurements of environmental data and ichthyoplankton abundances.

4. Considerations for Researchers

The reviewers were impressed by the energy and enthusiasm of the new research team. However, the team must make sure that it considers the following issues:

- Many processes are not linear, so stop thinking only in a linear manner and consider limiting factors, alternate states and other potential ecological dynamics in the marine system.
- Only certain types of plankton are successfully fixed in formalin, thus consider fixing additional samples in other fixatives, and stop assuming that herring larvae only eat *Crustacea*.
- More detail may not provide more insight.
- Collecting data for data's sake is not research, it is monitoring.
- Is the Greifswalder Bodden unique or does it have similar dynamics to other spawning areas that are related to the western Baltic?

5. Providing information for management

The survey does and can provide valuable information to the management of the marine environment and fisheries. Several factors need to be considered to maintain the utility of the survey.

Single species stock assessment (Western Baltic Spring Spawners, WBSSH)

Ensure that all the assumptions in methods are documented and that changes to protocols are also clear. It would be helpful to produce a brief report of the annual execution of the survey. Never assume the system or processes are static and maintain the adaptive and flexible approach, especially in terms of the survey design (time and space). Also the team must continue research and development of the larval index but never apply changes until an ICES benchmark of the assessment or a fundamental flaw/error is found.

Maximum sustainable yield targets (MSY)

MSY targets may be affected by changes in productivity and carrying capacity of the system. This survey provides a useful tool for the monitoring of these factors. It would also be useful to include MSY targeted

research such as understanding variability in natural mortality and cannibalism thus informing appropriate MSY targets.

Marine strategy framework directive (MSFD)

The survey and associated research programme can feed directly into the MSFD via the following descriptors:

- 1: Biological diversity is maintained
- 2: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem
- 3: Populations of all commercially exploited fish and shellfish are within safe biological limits
- 4: Marine food webs structure
- 5: Human-induced eutrophication is minimised
- 6: Sea-floor integrity

Data collection framework (DCF)

Try to combine multiple science monitoring objectives into the survey. The intensity of the survey makes it a strong basis for commenting on human activities in the area. It would also be useful for the survey team to participate in ICES groups on quality assurance of ichthyoplankton surveys (e.g. Study Group on Standards in Ichthyoplankton Surveys, SGSIPS).

6. The future

Research priorities

The reviewers consider the following appropriate and interesting research directions for the team:

- The hatching dynamics of larvae, and associated drivers (spatially and temporally).
- The potential loss of larvae out of the Greifswalder Bodden.
- The growth of herring larvae.
- Habitat and utilisation of potential spawning areas in the Greifswalder Bodden.
- Variability in larval mortality, and associated drivers.
- Spawning dynamics of herring in the western Baltic.
- Attempt to retrieve the data from the earlier survey (1977- 1987).
- Assess the relative importance of the herring production in the Greifswalder Bodden relative to the rest of the IIIa herring stock.

Outputs

The reviewers also thought that the following outputs should be considered by the team:

- Literature review of the reproductive dynamics and larval ecology of western Baltic spring spawning herring.
- Spatial characteristics of the hatching of herring in the Greifswalder Bodden, the influence of salinity and temperature.
- Year and cohort effect in growth of herring larvae in the Greifswalder Bodden.
- Year and cohort effect in mortality of herring larvae in the Greifswalder Bodden.
- Early life history dynamics in spring spawning herring; a case study of western Baltic herring.
- Relationship between macrophyte abundance and the hatching of herring in the Greifswalder Bodden.
- The importance of herring spawning for the transfer of carbon into the Greifswalder Bodden.

- Drift and retention of herring larvae in the Greifswalder Bodden, a major hatching ground for western Baltic spring spawning herring.

Prioritisation of Resources

The reviewers felt that following components of the current programme should be supported:

1. The supply of a robust N20 recruitment index.
2. Analyses of the current long-term data series.
3. Synthesize programme, and determination of clear milestones.
4. Support for current and on-going additional process studies.

It was clear that the maintenance of existing levels of personnel and equipment is a minimum requirement for the success of the programme. The team should try to investigate the use of new technology for both the monitoring and the research into process drivers. There is still a need to develop expertise in the analysis of the long time series, and in general larval ecology (e.g. mortality and growth) to ensure that the larval index remains robust and useful.

7. Conclusions and generic recommendations

Huge progress has been made in terms of the research, the operation and utility of the survey and larvae index. There is however a need for an overview and a strategy for progress. Maintaining the index used in the stock assessment must go hand in hand with maintaining an active research programme. The review highlighted the need for stronger synthesis. Collecting data does not equal scientific research. Being data rich aids science, but it is not science. Science is about exploring ideas and hypothesis testing.

The reviewers felt that there is still some tension between the research agenda and the provision of the N20/recruitment index. The institute should also be aware that they are not a university, so they must make provision for research students (PhD/MSc) and strive to give the students a vibrant and innovative environment (possibly through greater collaboration with academic institutes).

8. Acknowledgements

The reviewers wish to thank Patrick Polte for organising the review and providing copies of the background documents. They also wish to thank Nils Hammer and Christopher Zimmermann for the invitation to review the programme again.

9. Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 57846-2009-AQ-NLD-RvA). This certificate is valid until 15 December 2012. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

Justification

Report number: C069/11
Project Number: 4301000003

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Harriet van Overzee
Researcher, Department of Fisheries



Signature:

Date: 9 June 2011

Approved: Dr Tammo Bult
Head of the Fisheries Department

Signature:

Date: 14 June 2011

Appendix A. Proposed Outputs from the vTI-OSF WBSS Herring recruitment Group, provided to the Reviewers.

Intended output:

Until 31.12. 2012:

Life history ecology of Western Baltic spring spawning herring on the major spawning grounds- a review
Spatial and temporal dynamics of Western Baltic herring recruitment based on multivariate modeling (i.e. PCA, GAM)

Drivers and Stressors of Western Baltic herring recruitment on major estuarine spawning grounds- a model approach based on Path Analysis and experimentation

Investigation of spawning ground origin of young of the year herring rearing on the transition of North Sea/ Baltic ecoregions

Role of inshore rearing habitats for Ichthyoplankton dynamics in inshore Baltic ecosystems

Regional shifts of seasonal temperature regimes highly exceed predicted global climate change effects in shallow Baltic inshore systems (Oeberst & Polte in prep.)

Life stage and size related mortality of herring larvae in major Western Baltic retention areas

Ph.D. Thesis Paul Kotterba

Until 2012

Review -Predation impacts on early herring life stages

Development of Baltic Estuarine Rectangular Net Device (BERND) and its applicability for relative abundance estimates of larvae predators (to be publicised in 2011, non peer reviewed paper)

Paper on the biodiversity of the small fish community in relation to extreme temperature conditions in the GWB area (results of a pilot study (conducted in August 2010) on the applicability of beach seine tows for estimates on predator abundances at certain standard sampling sites within the study area, to be publicised in 2011)

Preying of adult herring on larvae of its own species (in relation to the question of temporal and density dependent larvae mortality (may include implications for the MSY))

Characterisation of distinct spawning cohorts and their relative contribution to the total offspring production (in the framework of optimum spawning time)

Mortality of herring eggs due to predation, particularly considering the temporal variability within a spawning season (□ optimum spawning time frame in relation to Predation)

Mortality of herring larvae due to predation, particularly considering the temporal variability within a larvae season (□ optimum spawning time frame in relation to Predation)

Ph.D. Thesis Matthias Paulsen

Just possible titles – I do NOT promise that I'll be able to write 6 papers in 2 years... □

Comparison of growth and performance in Western Baltic larval herring (*Clupea harengus* L.) in different spawning areas

Methods: RNA/DNA in all 5 Strata of the GWB, in Kiel Fjord and Kiel bight from the whole season 2010

Essential fatty acids (EFA) docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) affect RNA/DNA ratio of larval herring *Clupea harengus* L.

Methods: Experiment: 6 treatments (3 replicates each DHA, EPA and a similar saturated fatty acid constantly over 30 days, 3 replicates DHA, EPA and a similar saturated fatty acid with a switch after 15 days) RNA/DNA and fatty acids measured in the same individual larvae

Docosahexaenoic acid (DHA) content of prey affects RNA/DNA ratio of herring larvae in the field (in prep.)

Methods: Sampling in Kiel Canal in spring 2009, measurement of fatty acids in seston, potential prey and larval herring, RNA/DNA in larval herring

Protozoans play an important role as prey items for first feeding western Baltic herring (*Clupea harengus* L.) larvae

Methods: Protozoan abundance, fatty acids in seston, mesozooplankton, herring larvae, RNA/DNA
Comparison of productivity and growth conditions for western Baltic herring (*Clupea harengus* L.) in different spawning areas

Methods: Nutrients, chl a, mesozooplankton abundance, RNA/DNA

Recruitment failure in 2008 in WBSS herring was caused by low conditional values in larval stages compared to a year with normal recruitment

Methods: RNA/DNA, EFA

Robert Bauer & Daniel Stepputtis:

Until late 2011

Modeling larval dispersal of Baltic Herring in Greifswald Bay and its implications on survey design.

[Annexes should be provided with a page numbering x of n in the footer (may start a new numbering) and report number.]