Report of the

Study Group on Salmon Scale Readings

Stockholm, Sweden
16–17 October 2002

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1   Introduction

1.1   Main tasks

The **Study Group on Salmon Scale Readings** (SGSSR) (Chair: E. Ikonen, Finland) met in Stockholm, Sweden from 16–17 October 2002 to:

a)   investigate the possibilities to utilise the new technology in the image analysis methodology for the examination of the scales;

b)   meet the members of the Workshop on Usefulness of Scale Growth Analyses and Other Measures of Condition in Salmon and discuss among others the usefulness of the scale growth pattern in the beginning of the post-smolt phase for the estimation of the pre fishery abundance of the Baltic salmon; also the possible relationships of the scale patterns and the post-smolt feeding areas could be considered;

c)   take a closer view to the preparation of salmon otoliths for age analysis;

d)   discuss the situation in the planned centralization of collecting offshore fishing samples of the Main Basin from the fish harbours in Bornholm, Denmark.

1.2   Participants

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Addresses of the participants are given in Appendix 1.

2   Utilisation of the image analysis methodology for the examination of the salmon scales and otoliths

The Group did not have any updated review available on the present status of the image analysis methodology. However, a number of presentations were given to describe the status of development in each Baltic Sea country.

Finland

An old image analysis system that has been used for more than 10 year is available (Anon. 1991). The system consists of a video camera and image analysis PC-card together with an image capture program. This system is mainly a measuring aid facility that makes a preliminary suggestion for places of circuli based on visual contrast. Usually the user has to make a lot of corrections to the proposal by the system and in addition the annuli has to be marked by the user (the system can not distinguish between circuli and annuli). Once the user has confirmed the corrections, the measures are recorded to the database. The system has been used during 15 years for ageing and for measurements. A total of about 100 000 scale samples, mainly from North-Atlantic salmon, have been aged and about one third of those scales have additionally been measured. The system has found to be slow and clumsy by some users, and therefore it has not been used to age and measure all salmon scale samples in the country.

In Finland there is a need for an updated system. The maintenance of the present system have some risks. The technology is already out of date, and e.g., if a PC-card malfunctions it is no longer possible to replace it. Moreover the

present program does not allow any updating of the hardware. The required know-how for the development of an state of the art image analysis system (probability based system consisting of self learning features) is available in the country, but such a work would require considerable resources. To allocate resources to such development is, however, inappropriate if corresponding systems are available somewhere else. Therefore the reviews on image analysis applications on scale/otolith reading available worldwide are needed in Finland.

Sweden

An image analysis system was developed in the late 1980s at the Institute of Freshwater Research (IFR), Stockholm, and it was used to measure fish bones (operculum, etc) mainly from perch.. The system worked well until it broke down in 1996. At that time is proved to be impossible to repair, as the program didn't work together with updated versions of operative systems and hardware.

A few years ago, the IFR bought a French image analysis application to age and measure fish. However, despite several attempts the system did never work properly and the Institute has so far postponed further attempts to get a functioning system. Swedish laboratories are looking forward to find a working image analysis system as an aid in age determination of fish scales, otoliths and bones. There are no concrete plans to develop such a system in Sweden at present. A simpler digital measuring scale is used as an aid when measuring growth zones for later back calculation. It is primarily used for work on perch.

Russia

No image analysis systems has been used to age salmon samples.

Estonia

No image analysis systems has been used to age salmon samples.

Denmark

A team at Danish Fisheries Research (Copenhagen) has utilised image analysis systems to measure and study the features of otoliths to improve the age determination mainly of cod and herring. Detailed information of the system was not available to the Group.

Latvia

Not present in the meeting.

Lithuania

Not present in the meeting

Poland

Not present in the meeting.

In general it was concluded that institutions in all Baltic countries would welcome an easy-to-use image analysis system to aid in the age determination of salmon catch samples and to measure scales and otoliths.

The group set an objective to provide with a review of the available image analysis systems, in particular those, which are planned for the age determination of fish. The review should consist of the descriptions on how these possible devises have been utilised in fisheries research laboratories. Also the prospects of the development should be described. Lars Karlsson, Erkki Ikonen and Tapani Pakarinen were given the responsibility to compile the review by the next meeting.

3   Possibilities to utilise otoliths in ageing of Baltic salmon

At the Institute of Freshwater Research otoliths have been used to age fish for many years. The technique that is used at present is advanced including otholith sawing facilities. The most studied species are roach, pike and perch. However, also some salmon otoliths have been collected at the institute.

The entire ageing procedure was demonstrated to the Group in several steps:

1)   the preparation of otoliths for sawing,
2)   sawing of them and
3)   reading by microscope.

Ageing of salmon from the otolith was found very promising. However, the whole process from the preparation of the samples to the reading requires a thorough training of the personnel. Establishment of an otolith preparation and sawing laboratory requires expertise and do-it–your-self skills, because the many prerequisites are needed besides the precision sawing machine. Institutions are encouraged to exchange the theoretical and practical knowledge regarding otolith reading techniques. The institutions which have already working otolith-sawing laboratories (Sweden and Finland) should consider giving laboratory time to institutions initialising t age determination of Baltic salmon from otoliths.

Some quick notes on the otolith techniques:

•   The growth of the fish is always visible, also the plus growth in the spawning year. Even daily growth patterns are visible.
•   The quality of the samples is usually good compared to scales, which are not always taken from the same place at the fish.
•   The structure of the growth rings is consequent; winter rings are easy to distinguish.
•   It is the only valid method if a part of the studied population is otolith marked (thermal/coloured).
•   The size of the growth zone in the otolith does not correspond to the growth of the fish and therefore back calculation of the length of the fish is not possible from otolith measures. Instead the weight of the otolith indicates the age of the fish rather well.
•   Extraction of otoliths from a salmon head requires trained personnel. It was pointed out that preparing is possible without causing any visible damages to the fish.
•   Preparation of the samples is time consuming, because the otoliths have to be laid carefully to precise rows and moulded into the polyester resin.

In addition to the notes on growth above, it was noted that there has been a rapid development of chemical methods to analyse small parts of otoliths. As the otolith can be seen as a memory of the chemistry in the water surrounding the fish in the different parts of the life, chemical methods to analyse the small parts of otoliths can sometimes be used to determine the geographical origin of fish, migration routes etc. As far known such methods have not been used in the Baltic area.

4   Usefulness of the scale growth pattern to estimate the pre fishery abundance of the Baltic salmon

The Workshop on Usefulness of Scale Growth Analyses and Other Measures of Condition in Salmon described (1999) that among others Holtby *et al.* (1990) had showed that intercirculi spacing was related to patterns of marine survival on an annual basis. By following this idea a study will be conducted to evaluate the possibilities to assess the post smolt survival rate of the latest Baltic salmon smolt year class on the basis of the scale growth pattern. The early stage indices on the marine survival would improve significantly the catch option estimation in the context of the Baltic salmon assessment. The study will be lead by a Finnish team, but also other Baltic Sea laboratories are welcomed. The preliminary results will be reported to the Group at the next meeting. In case the scale growth pattern will prove to be a good indicator for the survival rate of the most important Baltic salmon populations, it needs to be further developed. Effective image analysis tools will be needed to enable the measuring of large amounts of scales in annual monitoring programs.

5   The scale reading test

Running of the test has been postponed due to the delayed delivery of the material. At present the test and training material consists of samples from the Gulf of Bothnia and Gulf of Finland and a small sample from the Main Basin. More samples from the Main Basin would be needed. However, the Group decided not to wait any more samples but to get the test running in the beginning of December 2002 (see recommendations). The rules of the test are described in the previous report. To enable the appropriate evaluation of the test results the experience of the participants should be indicated. Therefore the countries should provide with the following information on each reader:

I.   how many years of experience in scale reading the person have
II.   which proportion of the national samples (approx) the person age annually
III.   how many scales annually and from what region of the Baltic Sea (Main Basin, GoB, GoF) the person is reading

6   Recommendations

I.   The Group recommends that the availability of different types of image analysis systems will be studied for the next meeting. The review should also include description of the purposes of the system that was utilised (scale/otolith) as well as what advantages/possibilities image analysis systems give compared to traditional scale reading. The present development of the technology and the prospects should also be reviewed.

II.   It is encouraged to continue the promising development to interpret the Baltic salmon otoliths, and in particular to study the possibilities to increase the resolution of techniques to facilitate also interpretation of otolith microstructure. Scales and otoliths from the salmon with different but known origin should be collected.

III.   The scale reading blind test will be started in the beginning of December 2002 and material will be circulated in the laboratories according to the following table.

	Country	National supervisor	Number of persons participating
December 2002	Latvia	Janis Birzaks	?
January-February 2003	Sweden	Lars Karlsson	2 – 4
March	Estonia	Triin Veber	2
April	Russia	Igor Popov	2
May	Finland	Tapani Pakarinen	2
June	Poland	Vojciech Pelzarski/ Ryszard Bartel	?
July	-	-	-
August	Denmark	Frank Ivan Hansen	1 – 2

The national supervisors are responsible to make sure that the test will be carried out according to the plan in the country concerned.

Both training and test material are circulated together and they will be available to the test participant in parallel. Results of the reading should be sent to jari.raitaniemi@rktl.fi immediately after reading. The training and test material should be sent over to the following laboratory by express mail.

IV.   The Group fully supports Lars Karlsson, Sweden, as a new Chair.
V.   The next meeting of the Group will be held at Latvian Fisheries Research Institute, Riga, either in November 2003 or February 2004 depending on the progress of the scale reading test.

7   References

Anonymous 1991. Report of the Baltic Salmon Scale Reading Workshop. ICES 1991/M:7 Anadromous and Catadromous Fish Committee.

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