84 x 119 cm

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Estimating the ratio of river- and seaspawning whitefish in catches at the Gulf of Bothnia (Baltic Sea) by gill raker counting, genotyping and otolith chemistry analysis

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Introduction

European whitefish (*Coregonus lavaretus*, Fig. 1) is a commercially and recreationally important species in the Gulf of Bothnia (Baltic Sea, Fig. 2). Two sympatric ecotypes with similar outer features occur: sea spawning and anadromous river spawning whitefish. The two types form mixed populations in the sea outside breeding grounds and period. River spawning whitefish migrate long distances, e.g. between Torne River in the north and Åland Islands/Archipelago Sea in the south (>700 km). River spawning whitefish abundantly occur at feeding grounds in the south where they stay for years, until maturing. Mainly due to anthropogenic destruction of spawning rivers the river spawning whitefish has diminished during last decades and is presently listed among endangered species. In order to manage whitefish stocks, identification of different whitefish ecotypes and populations is a prerequisite. Therefore, we undertook gill raker (Fig. 3) counting (Himberg et al. 2015), genotyping (Ozerov et al. 2015), and otolith chemistry analysis (Lill et al. 2015, Hägerstrand et al. 2015) on river and sea spawning whitefish . In this study results from the gill raker count analyses are presented.

Materials and Methods

Analysis on gill raker number of river spawning (n= 480) and sea spawning (n=456) whitefish from twelve locations (Fig. 2) at the Finnish west coast and the Åland Islands was performed.

Fig 1 . Whitefish.

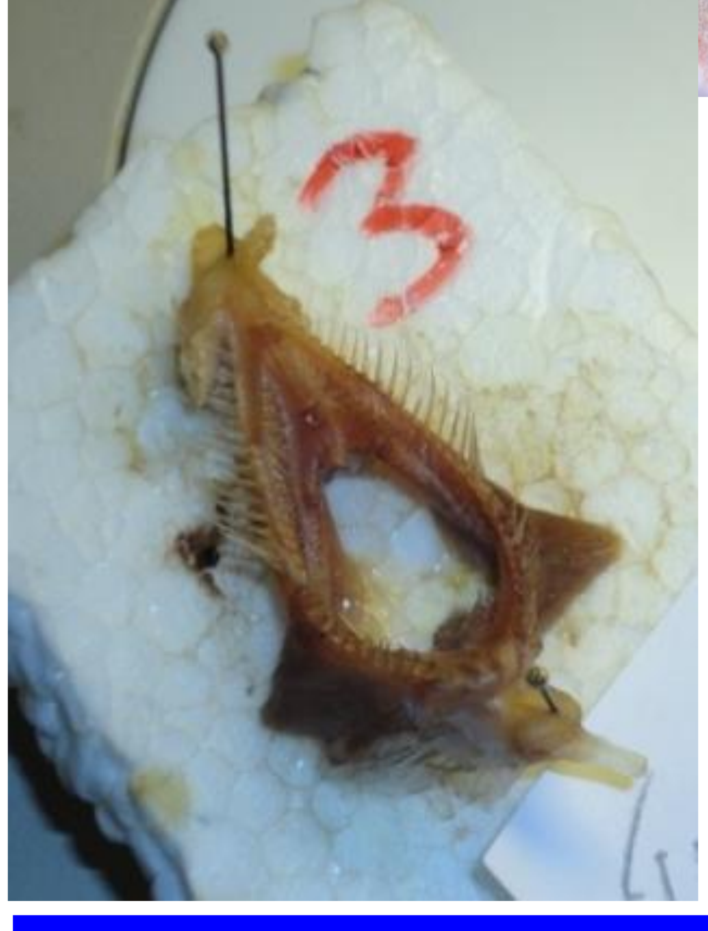

Fig. 3. Gill raker.

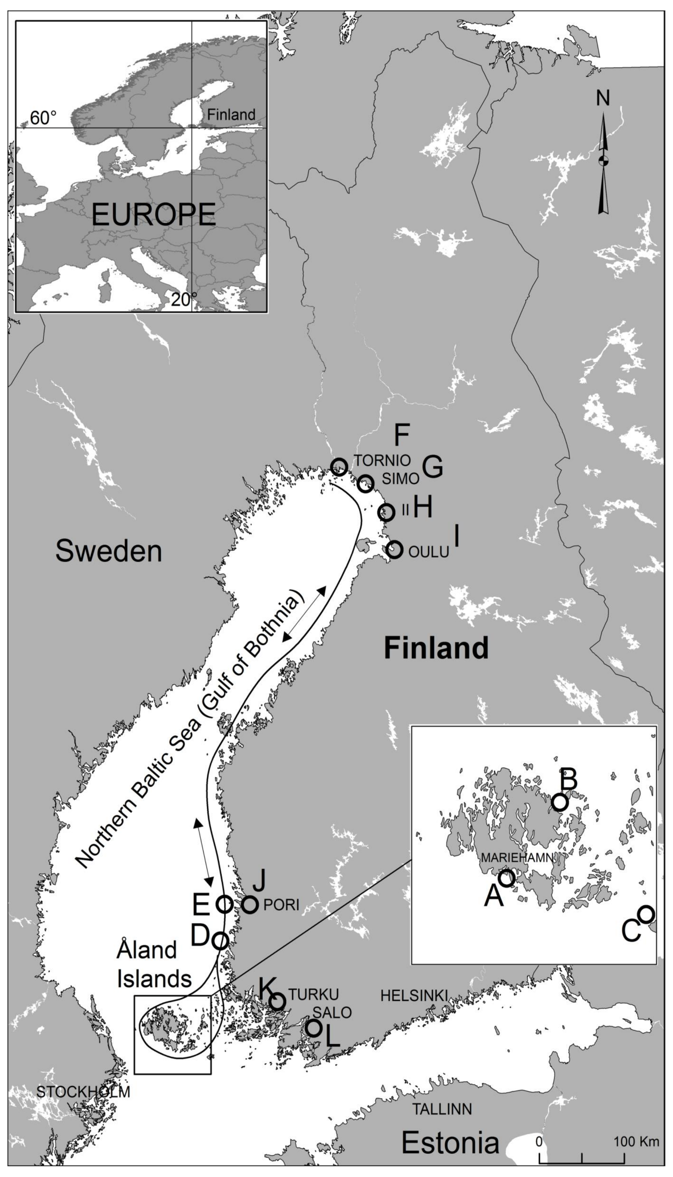

Fig. 2. Whitefish sampling sites (A-L) in the Gulf of Bothnia. The migration route for river spawning whitefish along the Finnish west coast is indicated with black line and arrows.

Results and Discussion

A marked difference in the average gill raker number of river and sea spawning whitefish stocks was observed (see also Lehtonen 1981, Lehtonen & Himberg 1992). The weighted averages of gill rakers of whitefish caught at spawning locations showed that the number of gill rakers of fish from rivers and the sea were 29.9 ± 2.14 (n=480) and 26.7 ± 2.21 (n=456), respectively. The difference between the two groups was highly significant (t=22.50, df=934, p<0.0001). The means differed by 3.20 (2.92 - 3.48, 95% CL) indicating the groups are well separated.

In whitefish sampled at feeding grounds at the Åland Islands, otolith Sr concentration was higher (t=2.09 , df=18, p=0.04) in fish having 27 gill rakers (3.86 ± 0.30 mg/g, n=10), compared to those having 30 gill rakers (3.54 ± 0.35 mg/g, n=10). Otolith Sr analysis thereby supported the utility of gill raker counting data for estimating the proportion of river and sea spawning whitefish in mixed populations.

As expected, the gill raker counting method successfully indicated temporal alterations in the proportions of river- and sea-spawning whitefish on feeding grounds (Fig. 4).

The genetic divergence observed between river and sea spawning (n=200) whitefish was low (Ozerov et al. 2015). Otolith chemistry identified river and sea spawning whitefish (n=110) on the bases of elemental (Ba, Sr) composition in the otolith core region (egg, juvenile) and also indicated whitefish geographic origin (Ba, Sr, Zn, Mn, Fe) (Lill et al. 2015, Hägerstrand et al. 2015).

Acknowledgements

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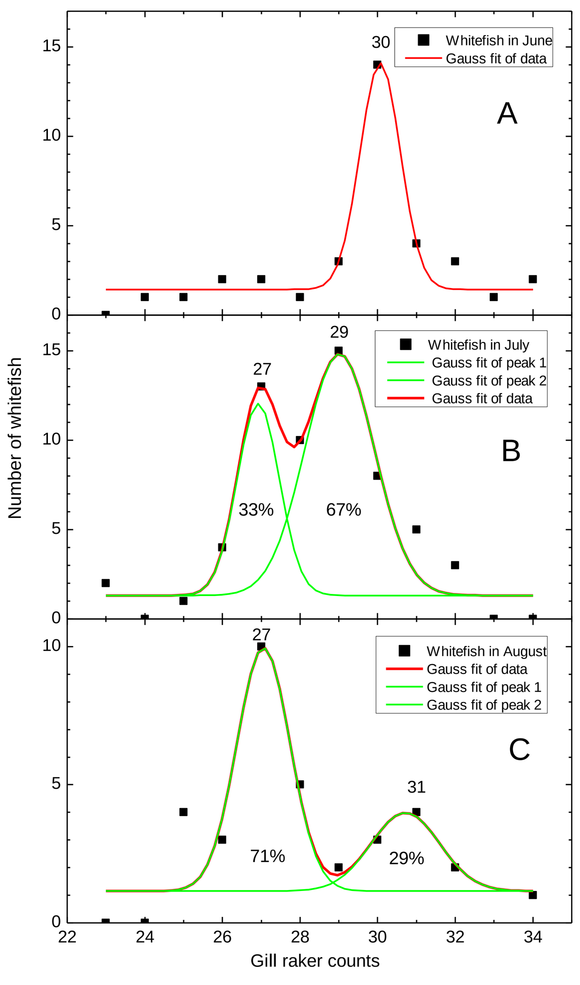
Conclusion

Gill raker counting is an easy, fast and inexpensive method that can be used to estimate the spatiotemporal occurrence and migratory patterns of river and sea spawning whitefish at the southern feeding grounds in the Gulf of Bothnia, Baltic Sea, and thereby aid in a sustainable management of whitefish stocks.

Importantly, we are presently working on a model where whitefish gill raker number data in catches can be converted to percent ratio river and sea spawning whitefish. This model will aid in following variations and trends in the spatiotemporal occurrence of river and sea spawning whitefish, particularly at the feeding grounds around the Åland Islands. It is our hope that the model will in aid a sustainable fisheries management. The model will come up on our homepage http://users.abo.fi/hhagerst/LAP/.

Fig 4. Variation in occurrence of whitefish ecotypes at feeding grounds in June, July and August 2012 as indicated by gill raker number alteration (Gauss fit of data)



References

Himberg M, Numers M, Vasemägi A, Wiklund T, Lill J-O & Hägerstrand H. Gill raker counts of whitefish from shallow reefs at the Åland islands – temporal alteration and stock identification. Acta Ichthyologica et Piscatoria (2015) 45 (2): 125–131. DOI: 10.3750/AIP2015.45.2.02

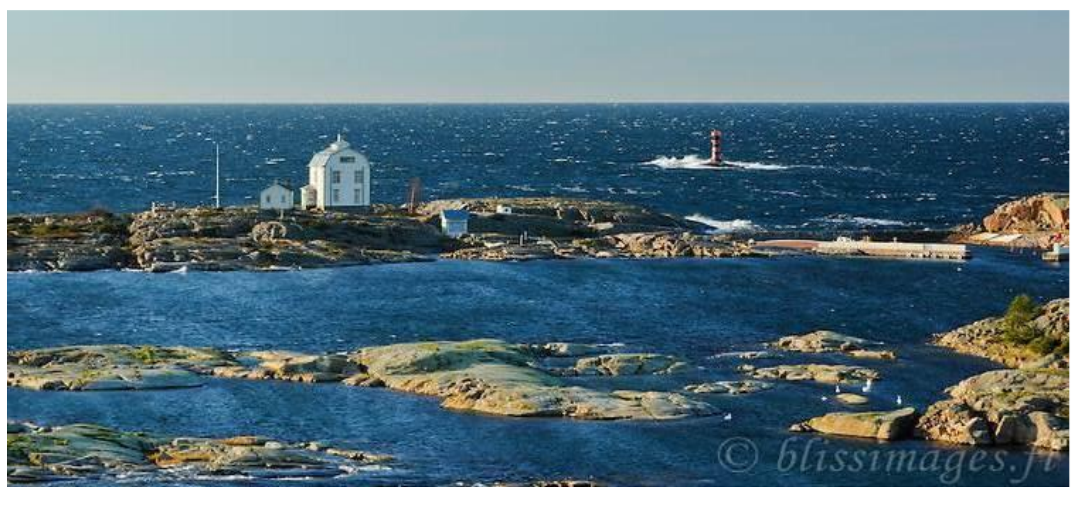
Hägerstrand H, Himberg M, Jokikokko E, Numers M, Mrowczynska L, Vasemägi A, Wiklund T & Lill J.-O. Otolith elemental characteristics of whitefish (*Coregonus lavaretus*) from brackish waters of the Gulf of Bothnia, Baltic Sea. Ecology of Freshwater Fish, In press.

Lehtonen, H. 1981. Biology and stock assessments of Coregonoids by the Baltic coast of Finland. Finnish Fisheries Series 3: 31-83.

Lehtonen, H. & Himberg, M. 1992. Baltic Sea migration patterns of anadromous, *Coregonus lavaretus (L.) s. str*., and sea-spawning European whitefish, C.l. widegreni Malmgren. Polish Archives of Hydrobiology 39: 463-472.

Lill J.-O., Heimbrand, Y., Slotte J., Himberg M., Florin, A.-B., Hägerstrand H. 2015. PIXE analyses of polished otoliths for identification of anadromous whitefish in the Baltic Sea. Nuclear Instruments and Methods in Physics Research 07/2015; DOI: 10.1016/j.nimb.2015.07.113

Ozerov M.Y., Himberg M., Aykanat T., Sendek D.S., Hägerstrand H., Verliin A., Krause T., Olsson J., Primmer C.R. & Vasemägi A. Generation of neutral FST baseline for testing local adaptation on gill raker number within and between European whitefish ecotypes in the Baltic Sea basin. Journal of Evolutionary Biology 28 (5): 1170–1183. DOI: 10.1111/jeb.12645.



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