Developments in analyzing the mixed-stock freshwater fishery on the Atlantic salmon populations of the large River Teno/Tana

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Atlantic salmon are exploited in mixed-stock fisheries in the River Teno/Tana main stem, which target the numerous sub-populations in the complex. Exploitation of the populations is cumulative: from the coastal fisheries, continuing in the fjord, estuary, main stem of the Teno, and further to the tributaries. Identifying the run timing and migration patterns of the different populations and thereby exploitation levels on these stocks is essential for a population-specific management plan. In addition, successful target-based management requires the estimation of the desired abundance of the spawning stock in each population. Spawning targets have recently been established for most populations in tributaries and in the main stem of the river. The mixed-stock fishery in the main stem of the river has recently been analyzed in detail by using genetic methods. Thirty-three microsatellite loci were used to analyze the genetic structure of 3500 samples of juvenile salmon, and 28 genetically different populations were defined as a baseline for the River Teno system. Based on catch statistics, catch samples and their genetic analyses, population-specific exploitation in the main stem can now be estimated in time and space, for different fishing gears and user groups and for different life histories (sea-ages, previous spawners).

Introduction

The importance of population diversity for sustainable and economically sound fisheries has been widely recognized. Taking the bio-complexity into account in management is a challenge, however, as maintaining the diversity requires ability to differentiate between distinct population segments and conserve roles of all individual units contributing to a fishery. The River Teno/Tana in the northernmost Europe is one of the few remaining large river systems that still supports multiple, diverse and abundant Atlantic salmon populations, but the poor target attainment for several stocks within the Teno necessitates an urgent construction of a genetic stock identification tool. Recently, a genetic baseline has been produced that allow characterization of the genetic structure and diversity in Teno salmon (Vähä et al 2007; Vähä et al. in prep.).

The International Council for the Exploration of the Sea (ICES) advices that salmon fisheries should exploit stocks that are at full production capacity, while exploitation of depleted stocks should be limited as much as possible. In this context, it is important to distinguish a single-stock fishery from a mixed-stock fishery. North Atlantic Salmon Conservation Organization (NASCO) defines a mixed-stock fishery as a fishery that concurrently exploits stocks from two or more rivers. A mixed-stock fishery might exploit stocks with contrasting stock status, with some stocks well above their conservation limits and others well below. The fishery in the River Teno main stem is an example of a complex mixed-stock fishery

Material and Methods

Thirty-three microsatellite loci were used to analyze the genetic structure of 3500 samples of juvenile salmon from 36 sampling locations, and 32 genetically different populations were defined as a baseline for the River Teno system. Closer inspection of the genetic structuring revealed less distinct patterns within two population groups, but strong clustering of geographically close populations and the configuration of regional groups of populations allows their proper use as reporting groups in the mixed stock analyses. Finally, 28 hierarchically structured and genetically distinct population segments (Global FST = 0.065) were defined. Assignment of mixed-stock salmon catch in the River Teno main stem to their population of origin was carried out by combining information from catch statistics, catch samples (scale samples: age groups) and their genetic analyses across five full fishing seasons, 2006-2008, and 2010-2011 (see Vähä et al. 2011).

Results and Discussion

Genetic Stock Assignment (GSI) of captured salmon in the River Teno main stem to their population of origin resulted in estimates of total catch of individuals from each population in the mixed-stock fishery. Moreover, main stem catches representing fish from each population can be separated across sea age groups, years, weeks of each fishing season, fishing areas of the main stem, gear types, user groups, and between Norway and Finland (see Fig. 1 as an example).

GSI is a routine tool to for monitoring mixed stock fisheries for Pacific salmon, providing real-time information on catch stock compositions in catches to managers and fishermen (e.g. http://pacificfishtrax.org). In contrast, GSI has rarely been used in management of Atlantic salmon mixed stock fisheries; in the few cases the focus has been in marine fisheries. The methodology presented here allows controlling the mixed-stock fishery in a large river, and tailoring of population specific management actions for individual stocks of the Teno complex.

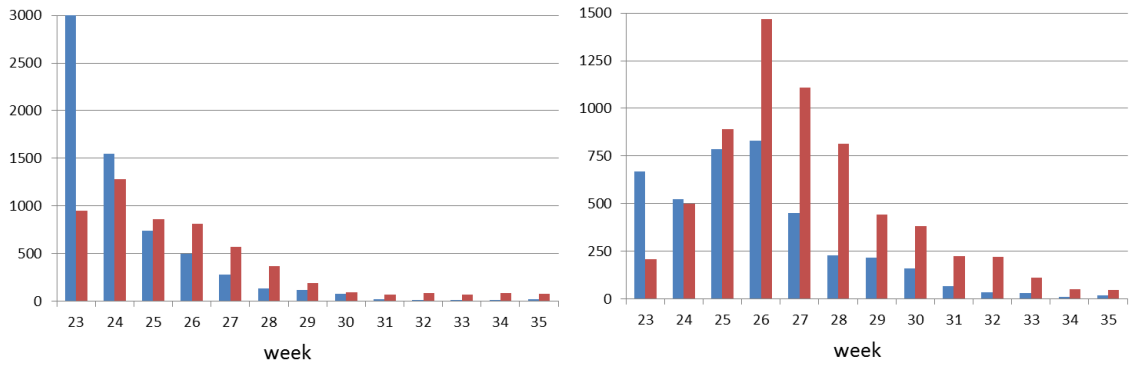

Fig. 1. Estimated weekly numbers of Multi-sea-winter Atlantic salmon caught in the main stem fishery of the River Teno in 2006-2009 and 2010-2011, assigned genetically to the origin in the headwater tributaries of the Teno, Anárjohka/Inarijoki (red) and Kárášjohka + Iešjohka (blue), caught by nets (left panel) and angling (right panel). Note the different vertical scales.

References

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