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Genetic stock identification of Atlantic salmon caught in the Faroese fishery

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ABSTRACT

At present there is no fishery for Atlantic salmon (*Salmo salar* L.) in the Faroes Exclusive Economic Zone. However, where national or stock-complex management units can achieve their Conservation Limits, there is potential for there to be a managed exploitable surplus in the area. In order to inform management decisions a study was undertaken to extract DNA from historical scale samples caught in the Faroes long-line fishery and, using microsatellites, to perform genetic assignments to estimate the historical stock composition of the catch. Two genetic reference baselines were used. An Atlantic-wide cross-range baseline using six microsatellite loci was established using 1930 fish from 12 regions on the western Atlantic and the same number of fish from 34 sites on the eastern Atlantic. An eastern Atlantic baseline was developed using 14 microsatellites and the same 1930 fish from the 34 eastern Atlantic sites. Mixed stock fishery analysis was based on 656 scale samples collected during two fishing seasons, 1993/4 and 1994/5 and assigned to a both the cross-range and European reference baselines. This study provides the first direct measure of the proportion of North American salmon in catches within the Faroes EEZ, with overall 16% of the total samples being identified as of North American origin and 84% as European. Of the European fish, 62% were identified as coming from the Northern Europe (Russia, Finland, Norway and Sweden), 37% from Southern European (UK, Ireland, France and Spain) and 1% from Iceland. The study also found significant variation in stock proportions across years and through seasons. This study has provided useful estimates of historical fishery composition in the absence of contemporary samples.

1. Introduction

Physical tagging studies have shown that salmon from rivers in both northern and southern Europe were exploited as one-sea-winter (1SW) and multi-sea-winter (MSW) adults in the long-line fishery that operated within the Faroes Exclusive Economic Zone (EEZ, Fig. 1) in the 1980s and 1990s (Jacobsen et al., 2012) although no salmon fishery has operated in Faroes waters since 2001. ICES (2016) has advised that there are currently no catch options for a Faroes fishery that would allow all national or stock complex management units to achieve their Conservation Limits. Nevertheless, if stocks improve there is potential for there to be an exploitable surplus in the area and it is important to have an agreed management framework in place before this occurs. ICES (2013) has also recently provided NASCO with proposals for a risk-framework for the provision of catch advice for the Faroes fishery, but this has not yet been formally adopted. The application of this framework to national management units requires detailed information on the expected stock composition of the catches in the fishery, and there is therefore an urgent need to obtain such information.

Advances in microsatellite DNA profiling methodologies and statistical genetics approaches have made it possible to identify, with a good degree of accuracy, salmon caught at sea to their natal region (e.g. Gilbey et al., 2005; Koljonen et al., 2005; Griffiths et al., 2010, 2011; Moore et al., 2014; Bradbury et al., 2015, 2016). Such approaches can be used with DNA extracted from contemporary

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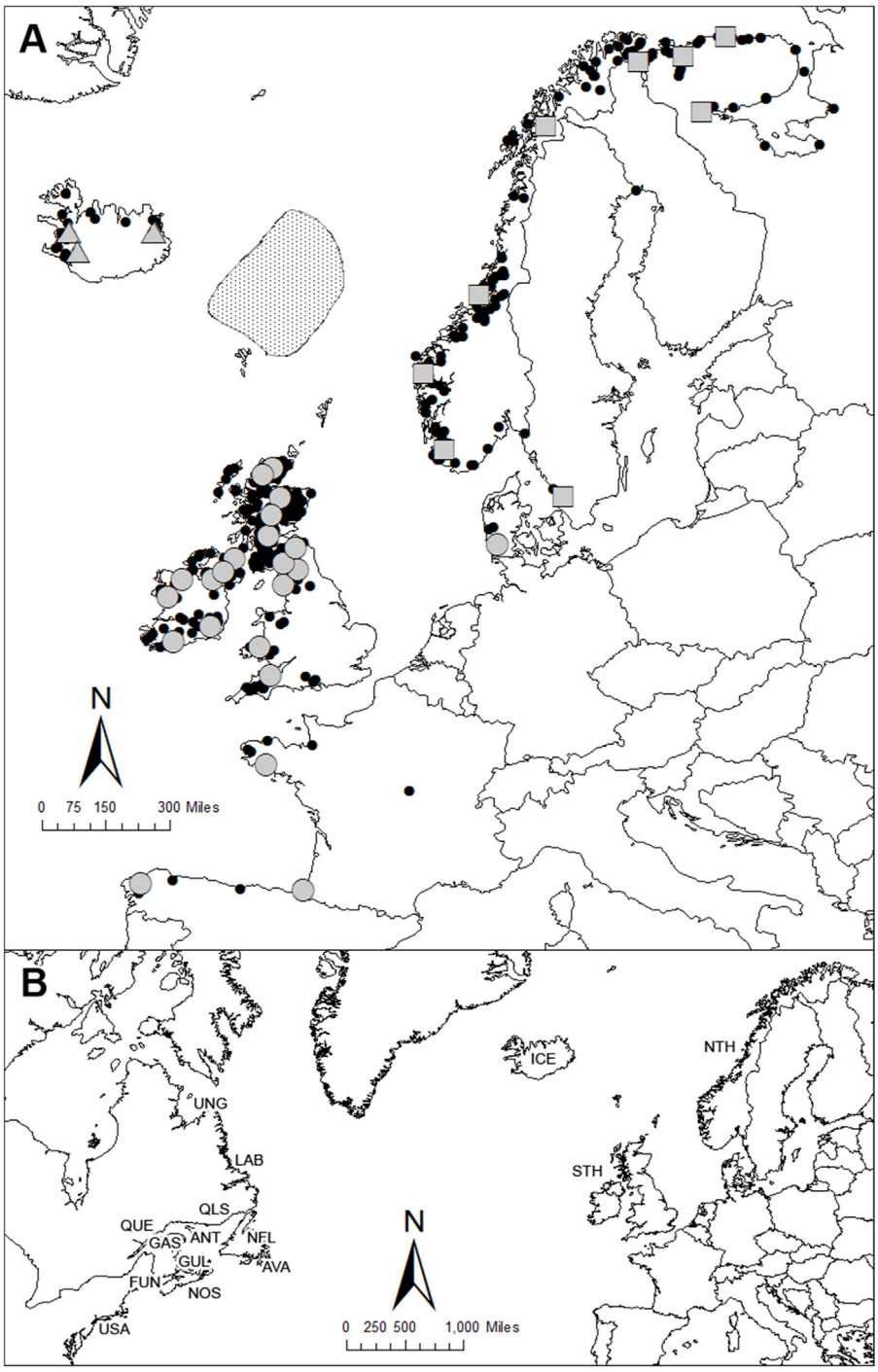

Fig. 1. A) European sites used for assignment of Faroese fish. The location of the Faroese high-seas long-line fishery is indicated on the map as a light shaded area north of the Faroes. Large grey markers show sites with the three assignment units defined by Squares for Northern, circles for Southern and triangles for Icelandic units. Smaller solid points show origins of individual fish used in the baseline assignment power determination. B) Transatlantic baseline used in identification of fish of North American origin. Northern (NTH, n = 539), Southern (STH, n = 1124) and Icelandic (ICE, n = 267) European assignment units shown together with North American units used as defined in Bradbury et al. (2016): Anticosti Island (ANT, n = 140), Avalon Peninsula (AVA, n = 163), Inner Bay of Fundy (FUN, n = 162), Gaspe Peninsula (GAS, n = 163), Southern Gulf/Cape Breton (GUL, n = 163), Central Labrador (LAB, n = 163), Newfoundland (NFL, n = 163), Nova Scotia (NOS, n = 163), Quebec Lower North Shore and Southern Labrador (QLS, n = 162), Quebec Higher North Shore and Quebec City (QUE, n = 163), Ungava Bay and Northern Labrador (UNG, n = 162), United States of America (USA, n = 163).

genetic tissue samples and archived historical material such as salmon scales (Nielsen et al., 1997; Martinez et al., 2001; Säisä et al., 2003).

Assignments to continent of origin of Atlantic salmon in order to examine stock and catch proportions in the Greenlandic fishery is carried out routinely (e.g. Reddin and Friedland, 1999; Gauthier-Ouellet et al., 2009; Sheehan et al., 2010) although there is as yet no fine-scale genetic baseline encompansing both sides of the species Atlantic range. Rivers in the western Atlantic are covered by a number of genetic baselines (e.g. Sheehan et al., 2010; Bradbury et al., 2015), including a recently developed fine-scale microsatellite baseline (Bradbury et al., 2016), allowing robust regional identification of fish from this part of the range. Although partial baselines are available for rivers on the eastern Atlantic (non-Baltic) side