Project summary: Fish for the Wealthy: Pike Trade in the Baltic Sea Region (500-1600 AD)

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Introduction

Although both historical and archaeological evidence (Jonsson 1986, Hoffmann 2009, Kivikero 2019) point to a substantial trade in pike products in the medieval and early modern Baltic Sea region, pike has been largely neglected by bioarchaeological studies, in favour of cod and herring (Orton et al. 2011, 2019; papers in Barrett & Orton 2016). This project will address this gap, using a combination of zooarchaeological methods and a novel application of oxygen isotope analysis on pike teeth, alongside carbon, nitrogen and sulphur isotope analyses on bone to analyse pike fishing and trade in the Baltic Sea region. The research will provide evidence for the nature of pike consumption and the timing and extent of the trading network, which had profound social, economic and environmental implications. In addition, the project will assess the potential of oxygen isotope analysis from pike teeth, potentially adding a valuable new tool for research on historic fish trade.

Background

The northern pike (*Esox lucius*) was a vital food fish in Europe since at least the Neolithic (Makowiecki et al. 2021), particularly in the Baltic Sea region, where it inhabits both freshwater and brackish coastal waters. Large pike are often considered a sign of wealth, yet prevalence of smaller pike even at low-status settlements around the Baltic points to a role as a staple (Hoffman 2005). Both historical and archaeological data indicate the emergence of an extensive trade in preserved pike across and beyond the Baltic by the late medieval period, thought to have played a significant part in economic development and 'Europeanisation' (Hoffmann 2009, Kuusela 2020). Production apparently concentrated in the northern Baltic, notably modern-day Finland and Sweden, with pike travelling as far south as Hungary (Hoffmann 2005). Historical sources, however, reveal little about specific catch locations and trade routes. Despite pike's prominence in the Baltic Sea archaeological record, few studies have analysed archaeological evidence for its trade (e.g. Lõugas and Bläuer 2021, Kivikero 2019, Jonsson 1986) and none have attempted molecular provenancing, with such efforts almost exclusively focused on less frequent finds of cod (Barrett et al. 2008, Orton et al. 2011; 2019, Makowiecki et al. 2016; Star et al. 2017).

Isotope analysis is well suited to address this gap, but has yet to be applied to this issue. Carbon, nitrogen and sulphur isotope values ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) in fish bones variously reflect climate, salinity, foodweb complexity, primary producers and geology, and have been successfully used to provenance cod remains (e.g. Orton et al. 2011; Nehlich et al. 2010). As pike can be caught in both freshwater and brackish coastal waters within the Baltic Sea region, $\delta^{13}C$ and $\delta^{15}N$ are used as ecological proxies to distinguish riverine from coastal catches, while all three values are expected to vary with the Baltic's marked salinity, temperature, and depth gradients.

The remarkable temperature gradient of the Baltic Sea — c.5°C between average sea surface temperatures of the Bay of Gdańsk in the south and Gulf of Bothnia in the north (Stramska & Białogrodzka 2015) — confers potential to refine estimates of catch location using $\delta^{18}O$ in enamel. This takes advantage of pike's teeth which, in contrast to most fish, are both large and frequently recovered in situ within jaws. The handful of past $\delta^{18}O$ studies on fish teeth, all in the eastern Mediterranean region, have thus been restricted to taxa with large and firmly-rooted teeth (Dufour et al. 2007, Sisma-Ventura et al. 2018; 2019). Pike is unique among the major food fish of northern Europe in having teeth suitable for oxygen isotope analysis, but this has yet to be attempted.

In addition to the requested samples from Turku, Naantalin luostari and Raisio Mulli, samples from the northern Gulf of Bothnia (Luleå), the Åland Islands, Latvia (Cēsis, Dinaburgas), Lithuania (Klaipėda, Vilnius), Poland (Gdańsk, Lubin) and Germany (Lübeck) will be used to capture the extent of variation in isotope values due to temperature and salinity.

Aims and questions

This project aims to understand the economic roles of pike in the 6th-17th century Baltic Sea region. How did the prevalence and social status of pike consumption vary across the region and through time? Was status linked primarily to fish size and source, or to changes in local availability? How were pike processed? When did long-range trade in preserved pike emerge, and what were the main source regions?

Objectives

- Address the limited research of the fishing and trade in pike in the Baltic Sea region.
- Track the importance of pike through time, across the region, and between site types.
- Assess pike preservation methods via zooarchaeological analysis.
- Infer catch locations and detect non-local fish via stable isotope analysis.
- Assess the potential of oxygen isotope analysis from pike teeth in inferring catch locations and provide a new toolkit for analysing fish trade in the region.

Methods

1. Synthesis of zooarchaeological data, including metrical, anatomical, and butchery-mark data.
2. Isotope analysis of carbon, nitrogen and sulphur from pike remains to distinguish between coastally caught and river-fished pike.
3. Oxygen isotope analysis from pike tooth enamel is used as a proxy for water temperature and salinity, and is used in combination with carbon, nitrogen and sulphur isotope analysis from bone to refine catch locations.

Sampling

The requested samples are from:

- *Katedraalikoulu:* 20 samples from KSK M051 (samples 4, 10 and 11) and KSK M129 (samples 3 and 81)
- *Naantalin luostari:* 20 samples from M978
- *Raisio Mulli*: 10 samples

The samples will be stored and analysed at the BioArCh facility. Acquiring $\delta^{18}O$ values from pike teeth and $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ values from dentary bones requires destructive sampling of both tissues. Damage to the samples will be minimised by removing the least amount of material needed for analysis from locations with minimal impact on future study. For oxygen isotope analysis this means one tooth from each dentary.

Whole dentaries will be transported to York, where they will be subsampled under laboratory conditions. After sampling, $\delta^{13}C$ and $\delta^{15}N$ values will be analysed in-house at the University of York, while $\delta^{18}O$ and $\delta^{34}S$ analysis will be externally contracted through Iso-Analytical.

Presentation of results

The results will be presented in publications resulting from the PhD thesis.

Team

All sampling and analysis will be supervised by Professor Michelle Alexander and Dr David Orton at the University of York.