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The development of the northern European fishery for north Atlantic bluefin tuna *Thunnus thynnus* during 1900–1950

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Abstract

North Atlantic bluefin tuna, *Thunnus thynnus*, used to migrate to northern European waters (Norwegian Sea, North Sea, Skagerrak, Kattegat, and Øresund) where it supported important commercial and sportfisheries. The species disappeared from the region in the early 1960s and the species is now still extremely rare. The factors which led to the development of the fishery and its subsequent decline remain unclear and poorly documented. This investigation documents the development of the fishery in terms of landings, effort, and gears with focus on the time period from 1900 to 1950 when landings were increasing. The species was frequently sighted while fishermen were targeting other species (herring, mackerel) and occasionally was caught as bycatch with these and other species. Information from scientifically trained observers demonstrate that tuna schools were common in the North Sea for 2–3 months during the summers of 1923–1931. As fishermen realized that the species had market value, new catch methods were developed and employed. These included harpoon-rifle, improved hook and line methods, and hydraulically operated purse seines. Landings rose sharply as did the number of vessels and the capacity of processing facilities for bluefin tuna. Bluefin tuna in this area were generally medium-large (>50 kg whole weight). The most important countries which participated in bluefin tuna fisheries in this period were Norway, Denmark and Sweden, but bluefin tuna were also exploited by France, Germany, The Netherlands and the United Kingdom. Similarly sportfishing increased in popularity in some of these countries and attracted many foreign participants. The increase in landings between 1900 and 1950 was driven particularly by an increase in fishing effort and technology. We found no evidence that the increase was due to a temperature-related shift in habitat into the region. Our results demonstrate that the species was an important part of the ecosystem at least back to the early 1900s and that commercial and recreational fisheries were well established in northern European waters before official ICCAT records.

Keywords: Bluefin tuna; *Thunnus thynnus*; Fishery; North Sea; Norwegian Sea; Temperature

1. Introduction

High exploitation rates cause many changes in fish populations and marine ecosystems (Pauly et al., 1998; Jackson et al., 2001; Pikitch et al., 2004). The changes include extinctions of local populations of the targeted species, losses of geographical range, changes in size, age and genetic composition of targeted populations, and modifications of trophic pathways and ecosystem functioning. A prerequisite for the documentation of these changes is the availability of fishery and ecosystem data from different time periods which can be compared and interpreted. To provide sufficient contrast in the time series, the fishery-related data (e.g., landings, effort, gears used, mean sizes caught, habitats inhabit) should represent periods when exploitation rates were low and/or when exploitation was increasing, and the ecosystem data (e.g., temperatures, predator/prey abundances) should include a wide range of variability.

Most fishery and environmental data series have been collected only after the exploitation has been high (Jackson et al., 2001; Myers and Worm, 2003; Pikitch et al., 2004). For example, population biomass estimates commonly used for current fishery management decisions (e.g., quotas, closed areas) are based on analytical age or size-structured models and/or fisheries research surveys of species abundances which start only in the 1970s or later, even though the exploitation of the same populations may have started decades or centuries earlier. As a result,

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perceptions of population and species biology based on these estimates may misrepresent biomass levels and dynamics under scenarios of lower or no exploitation (Pauly et al., 1998; Lotze and Milewski, 2004). These observations suggest that knowledge of fishery and ecosystem dynamics during the early phases of exploitation and during periods when exploitation was much lower could be useful for understanding the causes of long-term fluctuations in population biology (Baumgartner et al., 1992; MacKenzie et al., 2002; Lotze and Milewski, 2004).

One fishery for which such a description is presently lacking is the former fishery for northern bluefin tuna in waters of northern Europe (i.e., Norwegian Sea, North Sea, Skagerrak, Kattegat, and Øresund; Fig. 1). This species supported a major commercial fishery during the 1940–1960s but disappeared from the area in the mid-1960s–early 1970s (Tiews, 1978). Many key features of the early development of the fishery (e.g., landings, gears used) for this species have not been documented and quantified. The fishery was supported by annual migrations of bluefin tuna to the area for feeding on species such as herring and mackerel (Tiews, 1978; Cury et al., 1998). Bluefin tuna usually arrived in late June–July before departing again in the autumn (Mather et al., 1995; Fromentin and Powers, 2005). However, the species has been extremely rare in the region during the last 20 years and abundances are now too low to support commercial or recreational fishing (Hareide et al., 2000; ICCAT, 2003; Fromentin and Powers, 2005).

In this study, we examine the development of the fishery during the early decades of the 1900s. Our objectives are to quantify the total international landings by all countries in northern Europe during 1900–1950 and to describe the fishing fleets and gears used during this period. The synthesis uses published national and historical fishery information which is not presently compiled in the major fishery agencies of the northeast Atlantic (i.e., ICCAT, ICES) and which is not easily available in existing bluefin tuna fishery literature. We also use our data to conduct a preliminary analysis of the role of sea temperature on the development of the fishery.

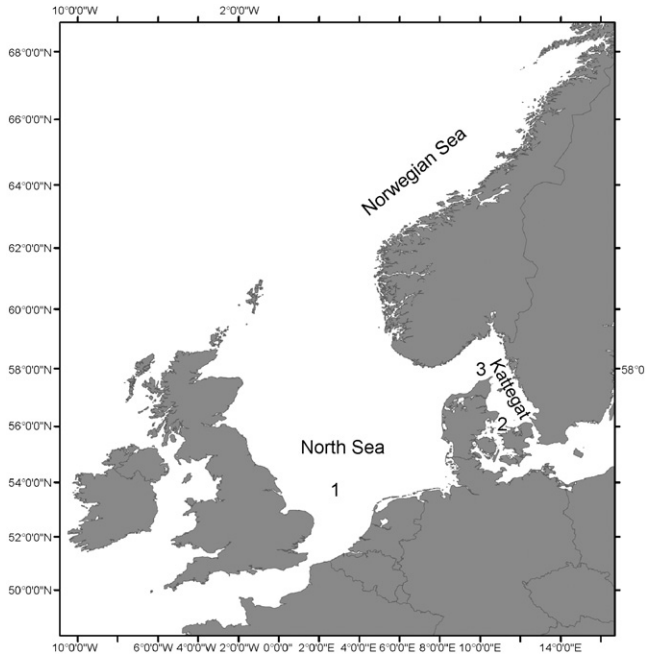

Fig. 1. Map of northern Europe with main sea regions referred to in the text. Numbers refer to Dogger Bank (1), Sjællands Odde (2), and Skagen (3).

2. Methods

2.1. Assembly of fishery data

Landings of bluefin tuna and descriptions of fishing gears and fleets were extracted from a variety of sources. The main source of landings data was the International Council for the Exploration of the Sea (ICES) which has been compiling fishery statistics in the northeast Atlantic since 1904. The data received and maintained by ICES are provided by individual countries and therefore represent official national statistics. The data provided by the countries are resolved by geographic area where catches were made (e.g, North Sea, Skagerrak).

However, ICES' data are available electronically only from 1972 onwards. Data prior to 1972 are available in annual ICES Statistical Bulletins. Data for the years 1927–1939 were entered manually from these bulletins. Prior to 1927, there are no bluefin tuna landings reported in the ICES Bulletins for the regions of interest by any country. Data from before 1927 were obtained from other sources, such as national fishery yearbooks, fishing industry newspapers or annual reports, and historical accounts based on fishermens' sales records (Svendsen, 1949; Pedersen, 1997; Tangen, 1999). Some catch data were available in published scientific literature. These sources which provided landings data sometimes provided information about the fishing gears used and how bluefin tuna were caught. This information is summarized below. The landings data and sources are described in Section 3 for each country participating in the fishery at this time (Denmark, France, Germany, The Netherlands, Norway, Sweden, United Kingdom).

Fisheries landings data themselves are not necessarily indicative of the biomass of a population. Trends and variability in landings data can differ significantly from trends in biomass because of temporal changes in fishing effort, catchability, migration patterns and fishing technology. In addition, landings data assume reliable reporting; if landings are not reported or misreported (e.g., as a different species, or a different species is reported landed as bluefin tuna), then additional uncertainties and potential biases can occur. It is preferable therefore that analyses of trends in biomass or distribution of fish populations use either true biomass estimates (e.g., as derived from analytical models and calibrated with fishery-independent data such as a research survey), or an effort-standardized landings index (i.e., catch per unit of fishing effort).

For the period of consideration in this study, neither of these options are available. Biomass data only start in 1970 (ICCAT, 2003). Effort data (e.g., number of fishers, nets, boats, etc.) during 1900–1950 are either non-existent, unreliable or uncomparable because the fishery at this time was not regulated and the technology to catch bluefin tuna was only starting to be developed (see below for details). In addition, fishers participated in this fishery initially on a part-time basis (e.g., seasonally,