

ATLANTIC BONITO (*SARDA SARDA*) IN NORDIC WATERS: BIOLOGY, DISTRIBUTION AND FEEDING

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SUMMARY

The sub-tropical fish species Atlantic bonito (*Sarda sarda*, Bloch 1793) has seldom been found and reported in Nordic waters. Here we report several observations and catches of Atlantic bonito along the southern and southwestern coast of Norway and Kattegat in July-October 2010. An estimated biomass of about 1000 kg of Atlantic bonito, was caught as by-catch in the mackerel purse seine fishery, on handline, in gillnets, as well as on rod and reel in Norwegian waters. Complete biological analyses were made on 16 frozen samples collected from various fishermen. Weight, fork and total length, age, sex, maturation stage, spines, stomach content were carefully documented. The analyzed specimen was on average 51.1 cm (± 2.1) in total length, 1.57 kg (± 2.1) in weight and estimated to be 2 years of age. Sex ratio was 56% females and 44% males. They had a stomach fullness of 2.2 (± 1.3) and had juvenile herring (10-75 gram) and unidentified fish prey in their stomachs. Condition factor was on average 1.18. All analyzed fish were out spawned except one specimen with gonad maturity stage five.

RÉSUMÉ

La bonite à dos rayé de l'Atlantique (*Sarda sarda*, Bloch 1793) est une espèce de poisson sous-tropicale rarement rencontrée et signalée dans les eaux nordiques. Nous signalons plusieurs observations et captures de bonite à dos rayé de l'Atlantique le long de la côte méridionale et au Sud-Ouest de la Norvège et de Kattegat entre juillet et octobre 2010. Une biomasse estimée à environ 1.000 kg de bonite à dos rayé de l'Atlantique a été capturée en tant que prise accessoire dans la pêche ciblant le maquereau à la senne, à la ligne à main, au filet maillant ainsi qu'à la canne-moulinet dans les eaux norvégiennes. Des analyses biologiques complètes ont été réalisées sur 16 échantillons congelés recueillis par divers pêcheurs. Le poids, la longueur à la fourche et la longueur totale, l'âge, le sexe, le stade de maturité, les épines ainsi que les contenus stomacaux ont été minutieusement documentés. Les spécimens analysés mesuraient en moyenne 51,1 cm ($\pm 2,1$) de longueur totale et pesaient 1,57 kg ($\pm 2,1$) et leur âge était estimé à deux ans. Le sex-ratio était de 56% de femelles et de 44% de mâles. Ils avaient un remplissage stomacal de 2,2 ($\pm 1,3$) et leurs estomacs contenaient des harengs juvéniles (10-75 g) et des poissons-proies non identifiés. Le facteur de condition était d'environ 1,18. Tous les poissons analysés s'étaient déjà reproduits, sauf un spécimen dont la maturité gonadique était au stade cinq.

RESUMEN

La presencia de la especie subtropical bonito del Atlántico (*Sarda sarda*, Bloch 1793) se ha detectado y comunicado pocas veces en las aguas nórdicas. En este documento se informa de varias observaciones y capturas de bonito del Atlántico a lo largo de la costa sur y suroccidental de Noruega y Kattegat en los meses de julio-octubre de 2010. Se capturó de forma fortuita una biomasa estimada de en torno a 1.000 kg de bonito del Atlántico en la pesquería de cerco de caballa, así como en las pesquerías de liña de mano, redes de enmalle y caña y carrete en aguas noruegas. Se llevaron a cabo análisis biológicos completos de 16 muestras congeladas recogidas por varios pescadores. Se documentaron minuciosamente el peso, la longitud a la horquilla y la longitud total, la edad, el sexo, la fase de madurez, las espinas y el contenido estomacal. Los ejemplares analizados mostraban como promedio una longitud total de 51,1 cm ($\pm 2,1$), un peso de 1,57 kg ($\pm 2,1$) y una edad estimada de 2 años. La ratio de sexos fue de un 56% de hembras y un 44% de machos. Tenían un contenido estomacal

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de 2,2 ($\pm 1,3$) y en sus estómagos había arenque juvenil (10-75 gramos) y presas de peces sin identificar. El factor de condición fue como promedio 1,18. Todos los ejemplares analizados ya se habían reproducido con la excepción de uno de ellos que presenta una fase cinco de madurez de gónadas.

KEYWORDS

*Atlantic bonito, *Sarda sarda*, distribution, feeding, Norwegian coast*

1. Introduction

Atlantic bonito (*Sarda sarda*) is a small tuna species with maximum length of 91.4 cm fork length and 5.4 kg in the Atlantic Ocean (Collette and Nauen 1983). Common size is 50 cm fork length and about 2 kg. The maximum reported age is 5 years. They are distributed in both sides of the tropical and subtropical Atlantic Ocean, from Oslo in Norway to Port Elisabeth in South Africa in the Eastern Atlantic (Collette & Chao, 1975). Little is known about bonito migration patterns (Rey et al. 1984). Atlantic bonito is an epi-pelagic marine species which lives in schools along the neritic area and may enter estuaries. It can be found from 80 to 200 m depth. They can adapt to temperatures from 12°C to 27°C and salinities 14 to 39 (Bianchi et al. 1999). Adult bonitos prey on schooling sardine, anchovy, mackerel and other small pelagic species (Yoshida 1980).

Age determination and growth have been studied by means of different methodologies: otoliths, vertebrae, spines and size frequency (Valeiras et al. 2008; Rey et al. 1986; ICCAT 2010). The first application of otolith growth structure analysis was developed by Pannella (1971; 1974; 1980). First sexual maturity has been estimated to be reached at 38 and 39 cm FL (males and females respectively) in the Mediterranean Sea and Atlantic Morocco (Rey et al. 1984). There is little information available to determine the stock structure of Atlantic bonitos. Atlantic bonito is mainly exploited by coastal fisheries and often by artisanal fisheries.

The major aim of this study was to sample as many available specimen of Atlantic bonito as possible during summer and autumn 2010, and find out important aspects of the geographical distribution, time period, length/weight relationship, condition factor, age and stomach content.

2 Material & Methods

Atlantic bonito were sampled based on catch information available on the internet, by phone calls to commercial and recreational fishermen and contact with fishing plants. A selected number of Atlantic bonito caught as unintended by-catch by professional fishermen and coming from recreational fishing along the coast of Norway and Kattegat were frozen for later scientific analyses. The fish were taken by gillnet, rod and reel and purse seine. The samples were either sent as frozen sample to the Institute of Marine Research in Bergen, Norway, or collected directly from the people with frozen fish samples. Body length, wet weight, sex, degree of stomach fullness (1-5), age from otoliths and condition factor (CF) were determined. Stomach fullness was defined according to standard categories for stomach fullness at the Norwegian Institute of Marine Research as 1) empty, 2) so little content that it is not visible prior to opening the stomach, 3) content easily visible prior to opening, but stomach not full, 4) stomach full, but not stretched, and 5) stomach bursting, wall lining the stomach is stretched and thin. Feeding incidence was calculated as the ratio in percentage between number of sampled fish with any stomach content and total number of sampled fish. Condition factor was calculated according to, $CF = W / L^3 \times 100$, where W is the fish wet weight (g) and L the fish length (cm). All biological data were sampled and recorded according to standardized procedures described by Mjanger et al. (2007). Altogether 16 samples from the flesh and dorsal fin were taken for genetic analyses, which are not analyzed yet.

3. Results

Length-weight relationships were calculated for 71 individuals of Atlantic bonito (*Sarda sarda*) along the coast of southern Norway and Kattegat in July-October 2010 (**Figure 1**). The analyzed specimen was on average 51.1 cm (± 2.1) in total length, 1.57 kg (± 2.1) in weight and estimated to be 2 years old. Sex ratio was 56% females

and 44% males. They had a stomach fullness of 2.2 (± 1.3) and had juvenile herring (10-75 gram) and unidentified fish prey in their stomachs. Condition factor, $CF = W / L^3 \times 100$ was on average 1.18. All analyzed fish were out spawned except one specimen with gonad maturity stage 5, and they had on average 53.0 (± 0.5) spines.

4. Discussion

The sudden appearance of Atlantic bonito in Nordic waters is probably linked to a combination of favorable water temperatures and available prey species. The bonito is an epi-pelagic, neritic, schooling species that can adapt to gradual but not sudden changes in the environment and may occur in water temperatures between 12° and 27° C and salinities between 14 and 39, entering estuaries such as Miramichi and the Gulf of St. Lawrence. In most parts of the Mediterranean spawning occurs between May and July, but off Algeria it extends from March to May. In the eastern Atlantic, it occurs from December to June, including peaks in January and April, off Dakar, and from June to July in Moroccan waters. In the northwestern Atlantic, bonitos spawn in June and July. Herring as a schooling planktivorous fish dominated as prey found in the stomachs of Atlantic bonito found in Norwegian waters in 2010. Adults have previously been found to prey primarily on small schooling fishes, the choice of species depending on the locality. In the Gulf of Mexico, it was also found to feed on a number of invertebrates like squid and shrimps. It can swallow relatively large prey, and both the juveniles and the adults are known to be cannibalistic.

The size ranged from 51.1 cm (± 2.1) in total length and 1.57 kg (± 2.1) in weight in our study, which clearly indicate that one year class visited these northern waters in 2010. Maximum fork length in the Black Sea is 85 cm and 5 kg weight; in the western Atlantic, the largest fish caught is reported as measuring 91.4 cm fork length and weighing 5.4 kg; common to 50 cm fork length and about 2 kg weight. The all-tackle angling record is a 7.6 kg fish with a fork length of 78 cm taken in the Canary Islands in 1980. The specimen caught in Nordic waters in 2010 was predominantly adults, since minimum length at first maturity is about 39.5 cm in males and 40.5 cm in females.

We will follow the appearance of Atlantic bonito in Norwegian waters in the years to come, and aim to study their distribution, biology and prey preferences.

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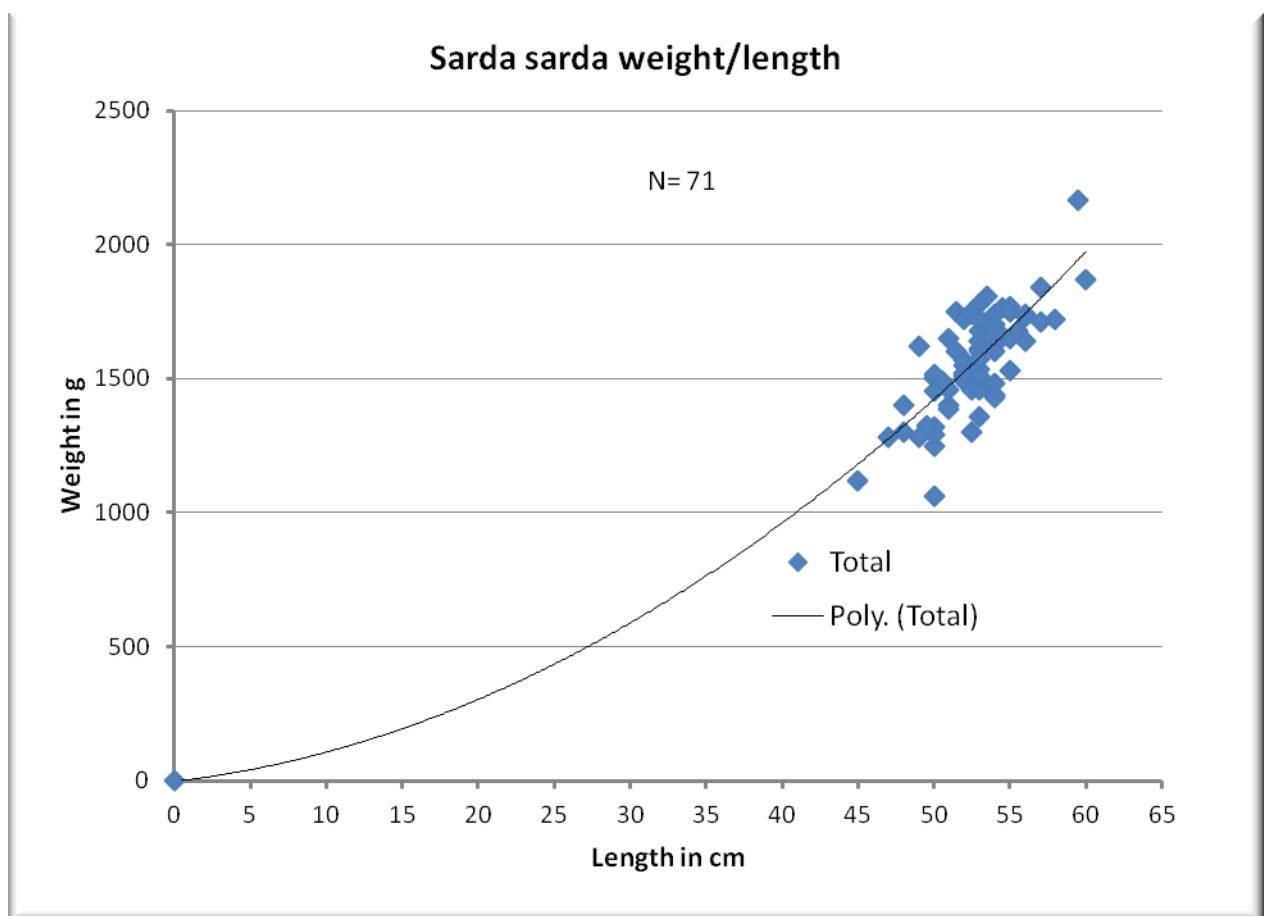


Figure 1. Length/weight relationship for Atlantic bonito (*Sarda sarda*) from the coast of Norway and Kattegat in July-October 2010.