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COMMENT

Clarification regarding the distribution of bigeye tuna (*Thunnus obesus*) in the Atlantic Ocean, including British waters

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Powell *et al.* (2009) recently reported the occurrence of a bigeye tuna, *Thunnus obesus* found stranded on August 24th 2006 near Burry Port, Wales, UK. The authors suggest that the occurrence of a subtropical tuna that far north of its range is rare and could be related to the significant increase in ocean temperature in British waters in recent decades. Distributions of tuna catch by several fishing fleets operating in the North Atlantic, available from the ICCAT – International Commission for the Conservation of Atlantic Tunas - database show that the occurrence of *T. obesus* at latitudes as high as Burry Port is common. The flaw in Powell *et al.*'s (2009) conclusion was derived from the outdated fish range maps that they relied on to describe the distribution of *T. obesus* in the Atlantic

Ocean. Research institutes, administrations, and any organisation involved in the collection, use, and management of fish observations should ensure these data are available through free and open access worldwide via the Internet. This should help improve knowledge on fish range distributions in the world oceans.

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Powell *et al.* (2009) recently reported the occurrence of a specimen of *Thunnus obesus* (Lowe) found stranded on August 24th 2006 near Burry Port, Wales, UK (51°40' N; 4° 15' W). The authors describe the biological characteristics of the fish such as morphometric measurements and stomach contents, the diagnostic anatomical features for identifying *T. obesus*, and discuss the past occurrences of tropical and temperate tunas in the Celtic Sea and adjacent areas. Powell *et al.* (2009) finally suggest that the occurrence of tropical and sub-tropical fish species around the British Isles could be related to the significant increase in sea temperature in the recent decades. While it is accepted that changes in the geographic distribution of fish populations due to climate change are possible and an important area of research (Stebbing *et al.*, 2002; Perry *et al.*, 2005; Poulard & Blanchard, 2005), the paper of

Powell *et al.* (2009) includes several inconsistencies that severely limit the reliability of their findings and are mainly due to a lack of knowledge of the ecology and fisheries of *T. obesus*.

A large amount of biological and ecological information and fisheries data have been collected since the early 1950s by national research institutes and fisheries administrations on large pelagic species of the Atlantic Ocean and adjacent seas. The International Commission for the Conservation of Atlantic Tunas (ICCAT, 2010) is the regional marine fisheries organization in charge of the study and management of these species. The ICCAT Contracting and Cooperating non-Contracting Parties annually provide for each fleet and gear the catch composition (in weight and/or number of fish) obtained by a given amount of fishing effort in a given spatial and temporal unit. Data and associated information are freely available on-line through the ICCAT website and annually published in the ICCAT Collective Volumes of Scientific Papers, biennial reports, and statistical bulletins.

With the development and geographic expansion of tuna fisheries from the early 1950s, knowledge of the distribution of *T. obesus* has progressively extended in all oceans worldwide (Miyake *et al.,* 2004; Maguire *et al.*, 2006). The ICCAT database shows that the distribution of *T. obesus* catches derived from longline data since the 1950s extends much wider than shown in figure 1 of Powell *et al.* (2009), with the latitudinal range of adult *T. obesus* fished by longliners spreading north of 55° N and south of 45° S (Fig. 1).

From the year 2000 onwards the fishery for *T. obesus* was mainly composed of longliners, purse seiners, and bait boats that landed an average catch of about 83,000 t during 2000-2007. In the western Atlantic, *T. obesus* are currently caught at latitudes reaching 50°N from August to September, in the Gulf Stream waters and North Atlantic Drift, by U.S. longliners primarily targeting swordfish, *Xiphias gladius* L. (Fig. 2a). *Thunnus obesus* are also caught between September and December by Japanese longliners targeting northern bluefin tuna, *Thunnus thynnus* (L.) in the central and north-west Atlantic (Fig. 2b). *Thunnus obesus* was a common species of this fishery during 1992-2008, as this species reached 42% of the total Japanese tuna catch (in number) at latitudes between 40-45°N, and 5% of total tuna catch in the 45-55°N latitudinal range (ICCAT, 2010). In the eastern Atlantic, *T. obesus* have also been commonly caught as by-catch at latitudes north of 50°N by the summer troll and bait boat Spanish fisheries targeting albacore, *Thunnus alalunga* (Bonnaterre) in the Bay of Biscay (Ortiz de Zarate *et al.*, 2008). Data have been collected since 1998 for this fishery and show a latitudinal range extending as far as 52°N in 2004 (Fig. 2c). During 2002-2005, the fork length of *T. obesus* caught varied according to fishing months and gears (i.e. trollers and bait boats), and spanned a wide range in size from 45 to more than 170 cm, overlaying the 134.4 cm length observed for the individual found near Burry Port (Ortiz de Zarate *et al.*, 2005; 2008).

In latitudes higher than 40°N in the Atlantic Ocean, *T. obesus* are likely caught at sea surface temperatures around 15-18°C that are considered to be in the lower preferred temperature range of adult *T. obesus* (Holland *et al.*, 1990; Boggs, 1992; Song *et al.*, 2009). However *T. obesus* show physiological adaptations to strong changes in water temperature and can make excursions to cold waters. The efficacy of vascular countercurrent heat exchangers allows individuals of *T. obesus* to expand their foraging space into otherwise prohibitively cold waters and maintain body temperature well above ambient temperature (Brill, 1994; Holland *et al.*, 1992; Holland & Sibert, 1994). Hence, the classification of *T.*

obesus as a "temperate" or a "tropical" species is quite problematic given their particular physiological and biochemical adaptations that allow them to sustain temperature changes of up 20°C during their daily vertical movements (Brill *et al.*, 2005). Based on archival tagging and ultrasonic transmitter data acquired in the equatorial and tropical waters of the Pacific, *T. obesus* have been shown to conduct extended dives to 300-600 m, subsequently followed by returns to surface layers to regenerate their internal body temperature (Dagorn *et al.*, 2000; Musyl *et al.*, 2003; Brill *et al.*, 2005). Such diving patterns seem mainly related to feeding behaviour and can exceed depths of 1600 m where water temperature can be as low as 3°C (Schaefer *et al.*, 2009). Similar vertical excursions to cold waters have recently been shown in the Atlantic Ocean (Matsumoto *et al.*, 2005; Arrizabalaga *et al.*, 2008).

Based on the thermoregulatory abilities of *T. obesus* and the northern limits of their range in the Atlantic Ocean obtained from ICCAT fishery datasets, it is suggested here that the limited observations discussed by Powell *et al.* (2009) are insufficient in terms of spatial and temporal coverage to draw any conclusion about changes in the distribution of *T. obesus* as a consequence of global warming. In addition, environmental data for the area apparently do not support such conclusions. Recent positions of summer surface isotherms in the North Atlantic have not moved markedly northward beyond the window of previous years (Hobson *et al.*, 2008).

It is recognised that tolerance to low temperatures might not restrict the geographical distribution of *T. obesus*. Obtaining solid conclusions on this issue would require analysing the wide range of fishery data available in the ICCAT database since the 1950s and the multiple sources of environmental data available within the distribution area of *T. obesus* in the North Atlantic. The major flaw of Powell *et al*.'s (2009) report comes from the outdated fish range maps they relied on to describe *T. obesus* distribution in the world oceans (Collette & Nauen, 1983; Maguire *et al.*, 2006). Scientists involved in tuna Regional Fisheries Management Organisations should provide available data on large pelagic fish occurrences to international organisations dedicated to the collection and management of biodiversity data, such as the Global Biodiversity Information Facility (GBIF, 2010) and the Ocean Biogeographic Information System (OBIS, 2010) data portals. A common effort by all data handlers to make data available through free and open access web portals should greatly improve information transfer and delivery, and benefit eventually science and society. Publication of extreme records at the periphery of species range, such as Powell *et al.* (2009), is an important step to make such data available to the scientific community.

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