UNUSUAL PRESENCE OF BLUEFIN TUNA IN THE GULF OF ADEN AND IN THE INDIAN OCEAN

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SUMMARY

The unusual presence of an adult bluefin tuna individual, fished off the coast of Yemen in May 2021, stimulated a discussion among several fishery scientists. This is the third event in the Indian Ocean concerning vagrant adult bluefin tunas in recent times and this paper is proposing various hypotheses about the possible species concerned. The most probable seems the Pacific bluefin tuna, but this is not the only possible option, at least for the latter event. This paper also reports some old catches of bluefin tuna juveniles between the Gulf of Aden and the Arabian Sea, in the NW Indian Ocean. All these events should induce initiatives by the IOTC for improving the knowledge on recent distribution changes of bluefin tunas in the Indian Ocean.

RÉSUMÉ

La présence inhabituelle d'un individu adulte de thon rouge, pêché au large des côtes du Yémen en mai 2021, a stimulé une discussion entre plusieurs scientifiques des pêches. Il s'agit du troisième événement dans l'Océan Indien concernant des thons rouges adultes vagabonds ces derniers temps et cet article propose diverses hypothèses sur les possibles espèces concernées. La plus probable semble être le thon rouge du Pacifique, mais ce n'est pas la seule option possible, au moins pour le dernier événement. Cet article rapporte également d'anciennes captures de juvéniles de thon rouge entre le golfe d'Aden et la mer d'Arabie, dans le nord-ouest de l'océan Indien. Tous ces événements devraient encourager la CTOI à prendre des initiatives pour améliorer les connaissances sur les récents changements de distribution du thon rouge dans l'océan Indien.

RESUMEN

La inusual presencia de un individuo adulto de atún rojo, pescado frente a la costa de Yemen en mayo de 2021, estimuló un debate entre varios científicos pesqueros. Se trata del tercer acontecimiento en el Océano Índico relacionado con atunes rojos adultos vagabundos en los últimos tiempos y en este documento se proponen varias hipótesis sobre las posibles especies en cuestión. La más probable parece ser el atún rojo del Pacífico, pero no es la única opción posible, al menos para este último evento. Este documento también informa de algunas capturas antiguas de juveniles de atún rojo entre el Golfo de Adén y el Mar de Arabia, en el NO del Océano Índico. Todos estos sucesos podrían inducir iniciativas por parte de la IOTC para mejorar el conocimiento de los cambios recientes en la distribución del atún rojo en el Océano Índico.

KEYWORS

Pacific bluefin tuna, Thunnus orientalis, Atlantic bluefin tuna, Thunnus thynnus, southern bluefin tuna, Thunnus maccoyii, Yemen, Oman, Sri Lanka, Somalia, Red Sea, Arabian Sea, Indian Ocean, migrations, distribution range, climate change, historical data, fishery.

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1. Introduction

The distribution of all tuna and tuna-like species shows always different temporal and spatial patterns, being most of these species large migratory ones. What we are learning from the studies on Atlantic bluefin tuna (*Thunnus thynnus*, Linnaeus, 1758) and particularly thanks to the results provided by ICCAT GBYP, it seems very clear that we are able to discover just some of the distribution changes over the centuries, while we are surprised about its capacity to immediately respond to environmental changes, taking all opportunities for adapting its behavious to new situations and taking advantage of them (Di Natale *et al.*, 2016).

Therefore, we suppose that all other large pelagics can do the same, even if we have not so many tools for studying all species in real time, mostly due to funding limitations.

But, following an anciet tradition, we usually take advantage of all the information coming from the fishery sources, because they are able to provide real-time data, which can improve our scientific understanding or provide imputs for developing new research activities in a changing environment.

2. The event

On 14 May 2021 we have been informed that two Yemenite fishermen caught a large bluefin tuna by hand line some miles offshore, in an undefined location. Due to the size of the fish (total length 227.5 cm and 375 kg RW), (**Figure 1** and **Figure 2**) it was impossible for the fishermen to bring it on board and they kept the tuna alongside, navigating slowly for 4 hours, bringing it into the harbour of Ash Shihr (Yemen) (14°45'04 N, 49°36'36 E), in the Gulf of Aden, a very important fishing harbour, where many small-scale and artisanal fishing vessels are based or mored.

Thanks to the social media, the information arrived in a very short time to one of us, able to discuss in Arabic. We immediately reacted, asking the fisherman to possibly collect at least a small tissue sample for genetic analyses, providing the instructions for preserving it. Initially, it seemed possible but, thanks to the high price on the local market for this unusual and rare species (18 US\$/kg, an incredibly high price in Yemen), the fish was suddenly sold to a local trader and moved away from the harbour, preventing any possible sampling.

Therefore, we started a discussion with several colleagues, namely Dr. Paul De Bruyn (IOTC), Dr. Alain Fonteneau (IRD, France), Dr. Ziro Suzuki (Japan), Dr. Hiromu Fukuda (AFFRC, Japan), Dr. Yosuke Tanaka (AFFRC, Japan), Dr. Evgeny Romanov (CAP RUN – CITEB), Dr. Emmanuel Chassot (IRD, La Reunion) and Dr. Bruce Collette (SNMNH, USA), for sharing the information and discussing the various hypothesis.

3. Possible hypothesis about the species

Immediatelly after the event, and after discovering that it was impossible getting any tissue sample for genetic analyses, it was decided to share all pictures and information, also for trying to find any additional catch or other data from the Indian Ocean or from the Red Sea. For the most recent information about the distribution and other fearures of all tuna species, we referred to Collette and Graves (2019). We discussed the following hypothesis about the species:

a) Atlantic bluefin tuna (*Thunnus thynnus*, Linnaeus, 1758)

The Atlantic bluefin tuna (BFT) is largely distributed in the entire Atlantic Ocean (with a higher presence in the northern Atlantic), in the Caribbean Sea, in the North Sea, in the southern part of the Arctic Ocean, at the entrance of the Baltic Sea, in the Mediterranean Sea and in the Black Sea.

The size, the body shape, the colour and the most evident morphological characteristics (using the photos) of the individual fished in Yemen are compatible with those of an Atlantic bluefin tuna.

The hypothesis of a BFT was the first one considered. If the individual that was fished in Yemen was a vagrant Atlantic bluefin tuna, the only explanation about its presence in the Gulf of Aden might be an inverse incidental migration from the Mediterranean Sea to the Red Sea, through the Suez Canal. Usually, the migration of Lessepsian species (of which there are many) takes place in the opposite direction, from the Red Sea into the Mediterranean Sea.

In theory, the inverse migration it is not impossible, also because the current in the central part of the Suez Canal is mostly from North to South (Dalton, 1870) but it is surprising how few studies on the currents in this Canal are available. The Suez Canal current entering into the Mediterranean is the responsible for the presence of many Lessepsian species (Hornell, 1935; Golani, 1998). According to Elzeir and Hibino (1999), the direction of the main current is confirmed, even if there are additional tidal current, sometimes very strong. But Wüst (1934) showed a more complex situation of the water masses in the Suez Canal, with different directions and strength between the surface and the middle layer, a strong influence of the Bitter Lakes and differences between seasons. Por (1978) provides a list of species, including several fishes, originating from the Mediterranean Sea and found in the Red Sea; he also discussed the reasons why the inverse Lesseptian migration can occur. Golani and Appelbaum-Golani (2010) and Golani *et al.* (2020) also reported inverse Lesseptian fish movements into the Red Sea.

Therefore, due to the presence of currents in both directions in the Suez Canal, it is theoretically possible for a strong migratory species like an Atlantic bluefin tuna to incidentally move into the Red Sea and then become a vagrant able to reach the Gulf of Aden. From a physiological point of view, even if the salinity of the two Seas is different and the environmental and ecological conditions are different, the Atlantic bluefin tuna already demonstrated its high adaptive capacity and these are not limits for living in a tropical sea.

The only previous paper concerning the supposed presence of Atlantic bluefin tuna in the eastern Indian Ocean and in the East-southern Pacific Ocean is the one from Nakamura and Warashina (1965) but, two years later, Gibbs and Collette (1967) demonstrated that the species was errously reported as *T. thynnus*, while it was (at that time) *T. thynnus orientalis*, therefore it was a PBF and not a BFT.

However, we consider the hypothesis of Atlantic bluefin tuna as unlikely, although not implausible or impossible.

b) Pacific bluefin tuna (Thunnus orientalis) (Temminck & Schlegel, 1844)

The Pacific bluefin tuna (PBF) is distributed throughouth the Pacific Ocean, marginally entering in the eastern Indian Ocean, ranging from northern cold waters to tropical areas.

Its distribution could potentially allow vagrants to enter other parts of the Indian Ocean, but we cannot exclude that this species might expand its usual distribution range due to climate change.

There was a recent finding of a Pacific bluefin tuna in the western Indian Ocean, between the Arabian Sea and the Sea of Oman, in the Sultanate of Oman (Zaki *et al.*, 2017). It was a male of 250 cm TL, weighting 217 kg, fished by a longline on 11 May 2017 off the harbour of Sur (**Figure 3**). In this case, the morphometric characteristics, the meristic charactes and particularly the genetic analyses (mDNA), all together confirmed the individual as Pacific bluefin tuna, the first one found in this part of the Indian Ocean.

Another individual that was initially attributed to a southern bluefin tuna (*Thunnus maccoyii*) was reported by Florian Giroux (IOTC, pers.com.). This specimen was possibly fished by a longline on May 2020 in Sri Lanka, but all further details are missing and no biological samples were collected. Furthermore, this tuna was never officially published. According to the available pictures and a video, the tuna was more than 2 m TL and should possibly have a weight over 200 kg (**Figure 4**, left). Even if size and weight are compatible with a southern bluefin tuna, looking carefully at the video it is very clear that the caudal keels are dark (like in BFT and PBF) and not yellow, a peculiar characteristic of the SBT (**Figure 4**, image at right).

Therefore, considering the location of this catch, it is possible that this specimen was another vagrant Pacific bluefin tuna.

The individual caught in Yemen, in the Gulf of Aden, has external characters, size and weight which are compatible also with a Pacific bluefin tuna and even in this case the fish was fished around mid-May.

Taking into account the well-identified individual reported in 2017, the other probable individual in 2020 and considering the many and complex effects of the climate change in the Indian Ocean, we tend to regard as more plausible the hypothesis that the latter fish may be a Pacific bluefin tuna and also consider it possible that these three occasional catches may indicate the beginning of a wider distribution range, although obviously further confirmation will be needed.

c) Southern bluefin tuna (Thunnus maccoyii) (Castelnau, 1872)

The Souther bluefin tuna (SBT) is distributed is distributed in the southern part of the Indian, Pacific and Atlantic Oceans, moving also to sub-tropical waters to spawn. Besides the invidual caught in 2020 and possibly erroneously attributed to a SBT (that is considered by us a possible PBF), as previously described and reported in the previous section, it seems that southern bluefin tuna were never reported in the scientific literature in the north-western Indian Ocean or in the Red Sea.

When discussing the latest bluefin tuna individuals, a well-known tuna entrepreneur, Dr. Adolfo Valsecchi, reported some unknown fishery events, happened between 1966 and 1972. At that time, there were three big facilities for frozen storage of fish species (including tunas) based in Cape Guardafui (Gees Gardafuul in Somali language) in Somalia, the eastern tip of Africa, in the southern part of the Gulf of Aden and also some fish factories. At that time, there were several local vessels fishing for tunas with longlines and many catches were traded by Italian companies, including the one operated by Dr. Valsecchi.

He remembers very well some unusual catches of big quantities (between 2 and 5 thousand tons per year) of small tunas (having an average weight of 10-15 ks, reaching a maximum individual weight of 30-35 kg) that were not yellowfin tunas, skipjack or other common tuna species which are usually found in that area of the Indian Ocean, but they were classified always by the traders as southern bluefin tuna (SBT). The fishing season for these tunas was from September to March every year and they were moving northwards along the eastern African coast, apparently coming from Madagascar or the Mozambique Channel.

Mr. Valsecchi is a very well-known and reputed tuna entrepreneur, having a lot of experience in all oceans and in the fisheries, and he clearly remembers these important catches in the Gulf of Aden of a bluefin tuna species that was never found after those years. Due to the fact that these catches were possibly never reported to any scientific or management body at that time, we consider very relevant to keep track of them in this paper.

As concerns the bluefin tuna individual fished in Yemen in 2021, it is very clear that it cannot be a southern bluefin tuna, because the caudal keels are surely dark (like in BFT and PBF) and not yellow, a peculiar characteristic of the SBT. Therefore, the hypothesis that the latter bluefin tuna might be a SBT is fully discarded.

4. Discussion

There are several changes in the marine environment everywhere, since ever, but the variability increased in recent years due to the impact of the climate change. These marine environmental modifications logically affect also the tunas in the Indian Ocean (O'Shea, 2016) and in all other oceanic areas, which are linked together.

The information obtained from Dr. Valsecchi about very important small bluefin tuna catches happened in the past in the North-western part of the Indian Ocean and in the Gulf of Aden seems to us very relevant. If these small tunas were SBT, then the information will be extremely important because it would imply that huge catches for the juveniles of this species were never reported, and they were fully unknown so far. In addition, if these tunas were SBT, as they were classified at that time, then the distribution, ethology and biology of this species should be reconsidered, trying to understand what happened in the period between 1966 and 1972 along the eastern African coast.

If they were not SBT but another bluefin tuna species, then the other option is that they were PBF. Even under this perspective, our knowledge about the historical distribution, ethology and biology of this species should be revised. If these important catches of juvenile bluefin tuna were PBF, it would be important to understand the reasons why this species would no longer be reported in the Indian Ocean after 1972 and until 2017. The other hypothesys is that they could be *Thunnus tonggol* (longtail tuna, FAO code LOT), a species present in that area that was confused with SBT for many years. In an attempt to solve the problem of attributing the important catches of those years to one of these species, efforts are being made to recover some photos that may help.

As concerns specifically the bluefin tuna individual from Yemen that induced this short paper, we tent to support the hypothesis that it was a Pacific bluefin tuna, even if, due to the impossibility to get a genetic sample, we have no elements for fully discarding the hypothesis of an unusual vagrant inverse Lessepsian migratory Atlantic BFT.

Surely, this latter unusual finding (together with the previous findings reported in this paper, **Figure 5**) is pointing out the need to pay much more attention for collecting all necessary information about the presence of bluefin

tunas in the Indian Ocean and to attempt to recover historical information that is not currently included in any scientific report, for better understanding both the current distribution of the Pacific bluefin tuna and the historical distribution of the southern bluefin tuna.

Therefore, we recommend that the IOTC should promote some actions (i.e. a small dedicated awareness campaign, also for collecting biological samples) for improving the current knowledge of any bluefin tuna species in its convention area.

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Figure 1. The specimen of bluefin tuna fished off the harbour of Ash Shihr (Yemen), in the Gulf of Aden, on 14 May 2021.



Figure 2. Detail of the dark caudal keels of the bluefin tuna fished off Ash Shihr (Yemen), Gulf of Aden, in 2021.



Figure 3. The specimen of Pacific bluefin tuna fished off the harbour of Sur (Sultanate of Oman), in the Arabian Sea, on 11 May 2017 (photo from Zaki *et al.*, 2017).



Figure 4. The specimen of bluefin tuna fished off Sri Lanka, Indian Ocean, in May 2020. Left image: the individual on a transport truck; right image: detail of the tail, showing the dark caudal keels.



Figure 5. Distribution map of the bluefin tunas reported in the Indian Ocean so far : 1 - adult individual in Ash Shihr, Yemen, on 14 May 2021; 2 - adult individual in Sur, Sultanate of Oman, on 11 May 2017 ; 3 - adult individual in Sri Lanka, in May 2020 ; 4 - f isheries of juveniles off Cape Guardafui, Somalia, between September and March, in the years 1966-1972.