First records of two large pelagic fishes in the Red Sea: wahoo (*Acanthocybium solandri*) and striped marlin (*Kajikia audax*)

Collin T. Williams1, Martin C. Arostegui2, Camrin D. Braun2, Peter Gaube3, Marwan Shriem4 and Michael L. Berumen1

1Division of Biological and Environmental Science and Engineering, Red Sea Research Center, King Abdullah University of Science and Technology, Thuwal 23955-6900, Kingdom of Saudi Arabia; 2Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA; 3Applied Physics Laboratory, Air-Sea Interaction & Remote Sensing Department, University of Washington, Seattle, WA 98195, USA and 4Jordan National Fishing Team, Aqaba, Jordan

Abstract

This report provides the first confirmed identifications of wahoo (*Acanthocybium solandri*) and striped marlin (*Kajikia audax*) in the Red Sea, expanding the known ranges of these species into the basin. Potential mechanisms responsible for the lack of regional documentation of the two species are further discussed. These findings illustrate the need for systematic biodiversity surveys of pelagic fish assemblages in the Red Sea.

Introduction

The Red Sea is a semi-enclosed marine basin. Its connection to other bodies of water is limited to two shallow, narrow passages: the Bab el-Mandeb Strait and the Suez Canal, which connect to the Indian Ocean and Mediterranean Sea, respectively. This partial physical isolation corresponds to marked biogeographic patterns among marine organisms in the Red Sea (e.g. endemism and reduced gene flow) and the basin is widely considered a distinct ecological unit (Spalding et al., 2007; DiBattista et al., 2016, 2020; Bogorodsky & Randall, 2019). It is therefore critical to understand the composition of biological assemblages within the Red Sea when developing localized frameworks for management and ecological functioning. Here, we contribute to the current knowledge of pelagic ichthyofauna in the Red Sea by providing evidence of range extensions for wahoo (*Acanthocybium solandri* (Cuvier, 1832)) and striped marlin (*Kajikia audax* (Philippi, 1887)) into the basin.

Methods and Results

Three specimens (two *A. solandri* and one *K. audax*) were captured in the Red Sea using conventional hook-and-line gear and then photographed (Figures 1–3). One *A. solandri* specimen was captured near an offshore reef north-west of Thuwal, Saudi Arabia (22.55389203N 38.915995E) on 19 March 2022. Another *A. solandri* and one *K. audax* specimens were captured off the Jordanian coast of the Gulf of Aqaba, an embayment at the northern extent of the Red Sea, during August 2015 and August 2021, respectively. Exact coordinates of Jordanian collections are unavailable, although the territorial waters of Jordan constitute a relatively small area (20 × 5 km). No tissues were available for genetic analysis, and species were identified based on distinct morphological characteristics.

The *A. solandri* specimens documented from the Red Sea in this study were identified by their elongated fusiform body, sharply pointed head, a very long dorsal fin with XXIII–XXVII spines and 12–16 rays, 8–9 finlets dorsally and ventrally along the caudal peduncle, vertically aligned second dorsal and anal fins, and dark vertical bars along the body (Figure 2) (Fischer & Bianchi, 1984b; Collette & Graves, 2019). Specimens were distinguished from the morphologically similar narrow-barred Spanish mackerel (*Scomberomorus commerson* (Lacepède, 1800)) by a longer first dorsal fin (XXIII–XXVII versus XV–XVIII spines), lateral line curving abruptly downward below middle of the first dorsal fin (versus lateral line distinctly sloping ventrally below second dorsal fin in *S. commerson*), and a pre-orbital length (i.e. distance from the tip of the snout to the anterior edge of the eye) approximately the same length as the rest of the head (i.e. distance from the anterior edge of the eye to the posterior edge of the opercle), whereas the snout is shorter than the rest of the head in *S. commerson* (Figure 2) (Fischer & Bianchi, 1984b; Collette & Graves, 2019).

The *K. audax* specimen captured in the Red Sea possessed several morphological characteristics consistent with this species that differentiate it from other Indo-Pacific istiophorids (Fischer & Bianchi, 1984a; Collette & Graves, 2019), including a long, round bill (distinguishing it from shortbill spearfish [*Tetrapturus angustirostris* Tanaka, 1915]), sharply pointed, elongate pectoral fins that fold against the body and are non-sickle shaped (distinguishing it from black marlin [*Istiompax indica* (Cuvier, 1832)]), a pointed first anal fin, moderately...
Fig. 1. Documented locations of wahoo (*Acanthocybium solandri*) and striped marlin (*Kajikia audax*) from the north-western Indian Ocean derived from the Ocean Biodiversity Information System (OBIS; 30 March 2022) and records described in the current study.

Fig. 2. Photographs of wahoo (*Acanthocybium solandri*) specimens captured in the Red Sea. The specimen in panel (A) was collected near Thuwal, Saudi Arabia, while panels (B, C) correspond to a collection in the Gulf of Aqaba, Jordan.
sized eyes, and vertical bars along the body (Figure 3) (Fischer & Bianchi, 1984a). The specimen was further distinguished from the morphologically similar sailfish (*Istiophorus platypterus* (Shaw, 1792)) by its first dorsal fin which is elevated anteriorly, abruptly decreasing in height backward (the first dorsal fin rays of *I. platypterus* are all quite elongate with the middle rays longest, about twice the body depth), and from the blue marlin (*Makaira nigricans* Lacepède, 1802) by the anterior part of its first dorsal fin which is elevated higher than the depth of its comparatively compressed body (fin folded back but visible in Figure 3) (Fischer & Bianchi, 1984a).

**Discussion**

The captures of two large pelagic species described in this study represent the first confirmed documentation of *A. solandri* and *K. audax* in the Red Sea. Comprehensive checklists of Red Sea fish species and the Ocean Biodiversity Information System show no evidence of these species in the basin (Golani & Fricke, 2018; OBIS, 2022a, 2022b). A school of *A. solandri* was purportedly caught in the southern Red Sea in 2012 (GBIF, 2022); however, this observation cannot be verified because no photographs or tissues are available. Similarly, the range of *K. audax* has previously been expected to extend into the southern Red Sea (Nakamura, 1985). Yet, no data have been presented to support this claim and the model-predicted distribution of *K. audax* does not include the Red Sea (Thoya et al., 2022).

There are multiple possible explanations why *A. solandri* and *K. audax* have remained undocumented in the Red Sea until now, including species misidentifications, a lack of targeted research and fishery sampling, and low regional abundances. Two common pelagic fish species in the Red Sea, *S. commerson* and *I. platypterus*, exhibit similar morphological features to *A. solandri* and *K. audax*, respectively. It is possible that misidentifications between these species have resulted in the absence of *A. solandri* and *K. audax* from scientific records in the Red Sea. Fisheries in the Red Sea also primarily harvest coastal and reef-associated species (Tesfamichael & Pauly, 2016) and, to our knowledge, no systematic surveys of large pelagic fish diversity have been conducted in the basin. Furthermore, sea surface temperatures within the Red Sea are typically above the optimal thermal niche of both *A. solandri* (18–28°C; Theisen & Baldwin, 2012) and *K. audax* (21–24°C; Boyce et al., 2008); in the central and southern portions of the basin, the mean sea surface temperature does not decrease below 28 and 29°C, respectively, except in winter (Shaltout, 2019). Thus, we expect low abundance (driven by habitat unsuitability), coupled with minimal pelagic fishing and research effort, to decrease the likelihood of detection for *A. solandri* and *K. audax* in the Red Sea.

*Acanthocybium solandri* is distributed circumglobally across tropical and sub-tropical marine environments, whereas the range of *K. audax* is restricted to the Indo-Pacific region. We can conclude that the *K. audax* specimen described in this study represents a connection to the Indian Ocean proper. However, we cannot determine whether the *A. solandri* specimens documented here are derived from Mediterranean or Indian Ocean stocks. In any case, it remains surprising that such large animals have evaded detection in close proximity to populated Red Sea coastlines until now. Our findings demonstrate how little is currently known about pelagic predators in the Red Sea and emphasize the need for biodiversity surveys of pelagic fish assemblages in this under-studied region.

**Data.** The data supporting this research are fully available within the article.

**Acknowledgements.** Foremost, a great deal of appreciation is owed to Ibrahim Alkaraki, who captured the *K. audax* specimen documented in this study and has graciously granted permission for his photographs to be published. The authors also thank Ute Langner for creating the map presented in this publication, Ashlie McIvor for editing the photographs, and Prof. Burton Jones for his insightful discussion regarding our findings. The authors further thank Sergey V. Bogorodsky (SMF) and one anonymous reviewer for their reviews of the manuscript.
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