J. Black Sea/Mediterranean Environment
Vol. 17(3): 223-233 (2011)

RESEARCH ARTICLE

A tale of two Atlantic fish migrants: records of the lesser amberjack *Seriola fasciata* and the African hind *Cephalopholis taeniops* from the Maltese Islands

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Abstract

The Mediterranean Sea is witnessing an unprecedented influx of non-indigenous species from contiguous marine areas. The influx of Atlantic species is gaining attraction, although it has been overshadowed in terms of species numbers by the Lessepsian migration, with the number of Atlantic additions to the Mediterranean marine biota on the increase. This study documents records of the lesser amberjack (*Seriola fasciata*) and the African hind (*Cephalopholis taeniops)* made in Maltese waters in recent years, with findings suggesting that the range of these two Atlantic migrants in the Mediterranean is expanding.

Keywords: Atlantic, Mediterranean, fish, migration, global warming

Introduction

The arrival and establishment of Non-Indigenous Species (NIS) in the Mediterranean Sea is a continuous process which seems to have accelerated in the last decades (Galil 2008; Golani *et al*. 2007). Although there is a lack of consensus about the current actual number of NIS in the Mediterranean, with estimates ranging from 573 (Galil, 2009) to 955 (Zenetos *et al*. 2010), it is generally accepted that such a phenomenon is on the increase. This invasion has been mainly attributed to the general warming trend currently being experienced by the Mediterranean (e.g. Bianchi 2007; Occhipinti-Ambrogi 2007). Quignard and Tomasini (2000) coined the term 'demediterraneization' to underscore the homogenization of Mediterranean marine biota as a result of the influx of exotic species. In terms of species, fish comprise a significant portion of the Mediterranean marine alien species list, with the rate of introduction into the basin of such species being significantly high and not finding any equivalent in other regional seas (Zenetos *et al*. 2010).

The Maltese Islands have not been spared the consequences of such an influx, witnessing an increasing trend in the number of marine alien species since the 1900's (Sciberras and Schembri 2007). Fishes have long been used as indicators of environmental change, since their high dispersal potential, ecological differentiation, general non-resilience, sensitivity to temperature, large size and ease of identification makes them excellent candidates for the study of the effects of climate variability (Wood and McDonald 1997; CIESM 2008).

The lesser amberjack *Seriola fasciata* (Bloch, 1783) (Perciformes: Carangidae) is a subtropical fish distributed in the eastern Atlantic in Madeira, where it is locally abundant; in the western Atlantic, it is recorded from the Gulf of Mexico, Cuba, Puerto Rico and Bermuda. Juveniles are epipelagic under floating objects in oceanic or offshore neritic waters, whilst in shelf waters juveniles are benthopelagic; adults apparently are mostly demersal (Froese and Pauly 2011). *S. fasciata* feeds on squids and fishes (Fischer *et al*. 1981; Smith-Vaniz 1986) and, according to stomach content analysis conducted by Andaloro *et al*. (2005), even on crustaceans (including pelagic ones such as hyperiids).

The African hind *Cephalopholis taeniops* (Valenciennes, 1828) (Serranidae: Epinephelinae) was classically reported from the eastern Atlantic coasts of Africa, from Angola to Morocco (south to the Gibraltar Strait), including the Islands of Cape Verde, Principe and Sao Tomé (Heemstra and Randall 1993), being reported from a variety of benthic habitats ranging from sandy to rocky bottoms and within a wide bathymetric range (i.e. 20–200 m; Ben Abdallah *et al*. 2007). This fish species is reported to achieve a maximum size of 70 cm total length (TL) but it seldom exceeds 40 cm TL (Heemstra and Randall 1993). This species is mostly fished and used for human consumption locally in the distribution area (Ben Abdallah *et al*. 2007) although from Senegal this fish is exported to France (Heemstra and Randall 1993).

Besides the native *S. dumerili* (Risso, 1810), three other non-native *Seriola* species have been recorded from the Mediterranean to date. For instance, Pizzicori *et al*. (2000) report a large school of *S. carpenteri* Mather, 1971 from Lampedusa Island and later Castriota *et al*. (2002; 2004) reported a specimen of *S. rivoliana* Valenciennes, 1833 from the same area on two separate occasions, whilst *S. fasciata* has been recorded from several different locations within the Western Mediterranean, including Sicily and Lampedusa (Andaloro *et al*. 1999). The vicinity of the island of Lampedusa to the Maltese Islands has prompted Sciberras & Schembri (2007) to include *S. fasciata* and *S. carpenteri* within the list of marine non-indigenous species for the Maltese Islands, albeit with a degree of uncertainty since the two *Seriola* species in question were never actually reported from the Maltese Islands.

Andaloro *et al*. (2005) reported *Seriola fasciata* from the Maltese Islands but they provide no details in view of the anecdotal nature of the report. Sammut (2001) reports observing fry for *S. samstriata* (presumably *S. fasciata* in view of the description provided by the author, who considers it as a recent Atlantic

migrant, and since *S. samstriata* is neither listed in Eschmeyer (1998), nor in Froese and Pauli (2011) sheltering amongst the tentacles of the fried-egg jellyfish *Cotylorhiza tuberculata*.

C. taeniops was first recorded from the Mediterranean off the Libyan coast, when two individuals were caught on rocky bottoms at a depth of 45-50m (Ben Abdallah *et al*. 2007). In June 2009, a single *C. taeniops* individual was spear-fished off the coast of Israel (Salameh *et al.* 2009), whilst in July 2009, another African hind individual was observed on two different occasions at the island of Lampedusa (Guidetti *et al*. 2010). The species has, to date, never been recorded from the Maltese Islands.

Materials and Methods

All reported sightings or landings of *S. fasciata* and *C. taeniops* made from Maltese waters during the past three years were recorded, by interviewing local professional and sports fishermen, fishing authorities and SCUBA divers. In the case of sightings, only reports substantiated by accompanying video footage or photography or by a detailed description of the fish species in question were considered.

Results

Since 2008, four new records of *S. fasciata* have been made in the Maltese coastal waters (Table 1).

Table 1. Details of different records of landings and observations of *Seriola fasciata* in Maltese coastal waters made in recent years.

Date	Location	Number of individuals	Caught/ observed	Fishing Technique and other details
October 2008	35°54'28''N 14°30'10''E	1	Caught	Spinning fishing technique from shore
September 2009	Ca. 20-25 nautical miles off the south-east of Malta	2	Caught	Lampuki fish-aggregating device (FAD)
September 2009	35°58'11''N 14°22'47''E	1	Observed	Sheltering amongst tentacles of *Cotylorhiza tuberculata*
September 2010	35°54'28''N 14°30'10''E	1	Caught	Trolling line – individual caught was shoaling with a group of *Seriola dumerili*

S. fasciata has been sporadically caught in Maltese coastal waters in the last three years, primarily beneath fish-aggregating devices (FAD's), such as palm fronds deployed in dolphin fish (*Coryphaena hippurus*) fishery, through trolling lines or through angling from the shoreline. None of the *S. fasciata* individuals caught were available to the authors for morphometric measurements, with approximations of TL (ranging from 15cm to 25cm) being made from the available photographs.

In August 2009, a single individual of *C. taeniops* (Figure 1) was observed at a depth of 40m over an artificial reef consisting of a number of concrete blocks deployed in 2006 at the following coordinates: 35°55'14''N, 14°29'50''E. The same individual had an approximate TL of 35-40cm and exhibited the orange-reddish livery typical for the species. In January 2011, a second individual of *C. taeniops* was photographed off Cirkewwa in Malta (coordinates: 35°59'11''N, 14°19'41''E) at a depth of ca. 35m. This individual exhibited similar dimensions and livery to the first individual recorded for this species in Maltese waters.

Figure 1a. *Cephalopholis taeniops* photographed with flash at 40m in Maltese coastal waters in August 2009 (photo courtesy of Mr. Shaun Arrigo, Malta).

Discussion

The additional records of *S. fasciata* from the Maltese coastal waters given in this study further reinforce the impression that the species should no longer be considered as rare in the Mediterranean Sea (Golani *et al*. 2002) but rather as an established NIS. This conclusion is further supported by a considerable range

Figure 1b. *Cephalopholis taeniops* photographed under natural light conditions at 40m in Maltese coastal waters in August 2009 (photo courtesy of Mr. Shaun Arrigo, Malta).

expansion within the Mediterranean since its appearance within the basin in 1989. In fact, *S. fasciata* was caught for the first time in 1989 in the Balearic Islands (Massutí and Stefanescu 1993) and from the same area in 1993 (Riera *et al*. 1995). It was successively recorded in the Ionian and southern Tyrrhenian Sea (Costa 1999; Andaloro *et al*. 2002, 2003), along the north coast of the western basin, in the Gulf of Lion (Quignard and Tomasini 2000), in the Gulf of Gabes (Bradai 2000), in the East Tunisian coast near Monastir (Bradai *pers. comm*. 2002) and under FADs in Sardinia and Sicily in 2001 and 2002 (Andaloro *et al*. 2005). The species has recently been recorded as far east as Rhodes (Corsini *et al*. 2006) and even from Haifa Bay in Israel (Sonin *et al*. 2009). This conclusion is also embraced by Andaloro *et al*. (2005) who state that, despite *S. fasciata* being reported as rare in the Mediterranean, frequent catches for the species, its continuous observation under FADs and the broad range of sizes recorded for the species suggest that the same species has in recent times established stable populations, at least in the western and central parts of the Mediterranean.

The possibility that the occurrence in Maltese coastal waters of *Seriola fasciata* is under-reported could be attributed to two major reasons. Firstly, the species is occasionally misidentified by fishermen as a pilot fish (*Naucrates ductor*) or amberjack (*Seriola dumerili*) juvenile (Mark Gatt *pers. comm*.). Secondly, despite capture fisheries management authorities in Malta keep records of

annual landings statistics for a number of commercial fish species, none are kept for *S. fasciata* since any individuals of this fish species which are landed are bundled and considered in conjunction with *S. dumerili* individuals. Hence, no ad hoc landing statistics for *S. fasciata* are kept in the Maltese Islands. Andaloro *et al.* (2005) postulate that the increasing frequency of *S. fasciata* in the central Mediterranean could be mediated by an increased deployment of dolphin fish FADs in Sicily and Sardinia in recent years, with such FADs being intensively deployed in the Maltese Islands for a number of years.

The *C. teaniops* records reported in this study could signal a gradual expansion within the Mediterranean of the species, whose range already spans the entire basin, in a similar chronological pattern to that shown by *S. fasciata* since its first entry into the basin. A number of Atlantic migrants have undergone such an eastward expansion in the Mediterranean subsequent to their entry in the basin, with the grapsid crab *Percnon gibbesi* exhibiting the most spectacular spread ever since its first recorded entry in 1999 (Katsanevakis *et al.* 2010). Within the Mediterranean, *C. taeniops* could potentially be described as an '*unestablished alien*' (defined by Occhipinti-Ambrogi and Galil 2004, as '*an alien lacking self-maintaining populations outside its natural range, either because it were unable so far to settle, or is too newly arrived*'), since, to date, there have only been a few records of the species in the Mediterranean.

In contrast, *S. fasciata* fits the description of an '*established alien*' (defined by Occhipinti-Ambrogi and Galil (2004) as '*an alien that is reproducing in the wild and has established a durable population outside its natural range*'). As highlighted by Andaloro *et al*. (2005), *S. fasciata* could alternatively also be described as a '*recent colonist*', which, according to the Joint Nature Conservation Committee classification (Eno *et al.* 1997) is a '*a species which, without any human intervention, has extended its natural geographical range in recent times and which has established new self-maintaining and self-regenerating populations in the wild*'.

The first record of *C. taeniops*, a tropical species, from Maltese coastal waters is further evidence to the phenomenon of tropicalisation, which involves the geographical spread of species of non-indigenous species of warm water affinity within the Mediterranean (e.g. CIESM 2008). Conversely, the increasing occurrence of *S. fasciata*, a sub-tropical species which was, until recently, almost exclusively restricted to the western Mediterranean, is further evidence of the process of meridionalisation, which involves the geographical spread of non-indigenous species within the same basin, Zenetos *et al*. (2010) report a total of 149 exotic fish species in the Mediterranean, with 25 new exotic fish species (*Selene dorsalis, Tetrapon theraps, Vanderhorstia mertensi* and *Elates ransonnetii*) being recorded from the Mediterranean since April 2008 (Zenetos *et al.* 2008). *S. fasciata* is an epipelagic species, whilst *C. taeniops* is a demersal species, suggesting that the phenomenon of tropicalisation does not discriminate between different ecological traits.

Findings from this study may also further reinforce the hypothesis, introduced by Andaloro and Azzurro (2004) (and further reiterated by subsequent authors, including Guidetti *et al.* (2010) that the Sicily Channel is a biogeographical and hydrological crossroads for the inter-basin spread of allochtonous marine species entering the Mediterranean. Conversely, some authors, most notably Quignard and Tommasini (2000), consider the Sicily Channel as more of a barrier than a crossroads to such an expansion. For instance, the number of exotic species of Erythrean and Atlantic affinity recorded from the Sicily Channel has increased in the recent years, with Guidetti *et al*. (2010) recording a total of 10 Indo-Pacific and 13 Atlantic (including *S. fasciata*) exotic species from this area. The current range of some of these invaders further supports the "crossroad" hypothesis, with the blue-spotted cornet fish (*Fistularia commersonii*) and the lesser amberjack (*Seriola fasciata*) being just two examples of fish species whose current distribution straddles over both major basins of the Mediterranean.

Of the 116 exotic fish present in the Mediterranean, at least 33 are of Atlantic origin (Golani *et al.* 2002, 2004; Ben Soussi *et al.* 2005). Currently, the number of alien fish species in the Mediterranean is presumed to have reached the 149 threshold (Zenetos *et al.* 2010), with a parallel increase in the number of the Atlantic migrant fish species. Such a trend is further confirmed by the findings of this study, which suggest that the warming of the Mediterranean Sea is also facilitating the colonization of tropical/subtropical Atlantic species in the Mediterranean. The increasing frequency and biomass of the Atlantic migrant species in the Mediterranean in turn suggest that these species warrant greater attention by the scientific community.

Acknowledgements

The authors are grateful to Mr. Anthony Sant, Mr. Rio Sammut and to the Malta Sea-Spinning Group for sharing their records.

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Received: 23.08.2011
Accepted: 20.10.2011