The Case of a Rudderfish Highlights the Role of Natural History Museums as Sentinels of Bio-invasions

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The Case of a Rudderfish Highlights the Role of Natural History Museums as Sentinels of Bio-invasions

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In September 2013 fishermen captured a rudderfish—*Kyphosus vaigiensis*—off Favignana Island, one of the islands of the Egadi Islands Marine Protected Area (MPA) in western Sicily (Mannino et al., 2015). This species is rarely sampled in the Mediterranean Sea.

Like the whole area surrounding Sicily, the Aegadian archipelago is a crossroad of marine animal species which live in the Mediterranean Sea and whose populations or specimens, respectively, expand or just pass through these waters. They can be categorized as native, allochthonous invasive or vagrant species, but the case of the rudderfish *Kyphosus vaigiensis* remains unresolved.

After its capture in Favignana Island (Mannino et al., 2015), in the central Mediterranean Sea, *Kyphosus vaigiensis* has been subsequently recorded in Maltese waters (Vella et al., 2016) and in the Levantin basin (Goren et al., 2016), the easternmost Mediterranean areas of its occurrence, where it has hitherto never been recorded. Indeed, Mannino et al. (2016) cautiously defined this species as a cryptogenic species (sensu Carlton 1996), i.e. “a species which is not demonstrably native or introduced”.

The name rudderfish encompasses all those species belonging to the perciform fish family Kyphosidae (common name sea-chubs), a name which derives from their habit of following vessels (Nelson, 1994). Thus, their entry into the Mediterranean basin, or swimming routes, can be indirectly considered as human-mediated.

The specimen collected in Favignana waters was identified as *Kyphosus vaigiensis* (Quoy & Gaimard, 1825), a species belonging to the most diverse kyphosid genus, whose taxonomy is still debatable. Kyphosids are herbivorous, moderate to large in size and occur in shallow waters associated with rocky shores and reefs, and are widely distributed in the Atlantic, Indian and the Pacific Oceans (Knudsen & Clements, 2013). Recent revisions (Knudsen & Clements, 2013, 2016; Sakai & Nakabo, 2014) have proposed two different taxonomic arrangements, still requiring morphological and molecular validation. The papers regarding this debate include disagreements relating to the identification of the species occurring in the Mediterranean, misleading information relating to nomenclature and conflicting meristic data (Gilbert, 2015). The papers also differ in their taxonomic conclusions, and the revision by Sakai & Nakabo (2014), relating to Mediterranean species, has not been accepted by several authors (e.g. Knudsen & Clements, 2013, 2016; Mannino et al., 2015; Gilbert, 2015). Such conflicts regarding these rare captures from the Mediterranean basin have led to incorrect identifications by those working in the field. Furthermore, the paper by Mannino et al. (2015) has demonstrated that very possibly that only two kyphosid species—*K. sectatrix* and *K. vaigiensis*—have occasionally been recorded in the Mediterranean, even if records of kyphosids in the Mediterranean Sea date back more than one century.

In chronological order, the Mediterraneanc captures of *K. sectatrix* are the following:
- November 1846, the first record in the Mediterranean Sea, caught in Trieste, Italy, northern Adriatic basin (Šoljan, 1963), deposited in the Natural History Museum of Wien, Austria (voucher code NMW-12488) (Dulčić and Ahnelt, 2006);
- November 1883, the second capture, in the Gulf of Palermo, Italy, southern Tyrrenian (Doderlein, 1883; Fig. 1), preserved as a stuffed specimen in the Museum of Zoology of the University of Palermo, Italy (voucher code MZPA P-247; Fig.2);
- 1903, one specimen from the Gulf of Genoa, Italy, northern Tyrrenian (Ariola, 1904);
- September 1996, a single specimen, Mallorca Island, Spain, western Mediterranean (Merella et al. 1998);
- June 2003, several specimens, erroneously named *K. sectator*, Annaba, Algeria, central Mediterranean (Hemida et al. 2004);
- January 2005, one specimen, Salakta, Tunisia, central Mediterranean (Hattour, 2006);
- November 2006, a single specimen, erroneously named *K. sectator*, Saint-Tropez, France, northern Tyrrhenian (Francour & Mouine, 2008), deposited in the fish collection of the Monaco Oceanographic Museum (voucher code POI-0004820);
- September 2010, three specimens, Galite Islands, Tunisia, central Mediterranean (Lelong, 2012);
- November 2010, one specimen, erroneously named *K. saltatrix*, Benghazi, Libya, central Mediterranean (Elbaraasi et al., 2013);
- January 2011, one specimen, erroneously named *K. saltatrix*, Strofades Islands, Greece, eastern Mediterranean (Kiparissis et al., 2012).

Whereas, the Mediterranean captures of *K. vaigiensis* are the following:

- June 1998, the first record, identified as *K. incisor* (Cuvier, 1831) (syn. *K. vaigiensis*), Almuñécar, Spain, western Mediterranean (Azzurro *et al.*, 2013);
- July 2009, two specimens, identified as *K. incisor* (syn. *K. vaigiensis*), Camogli, Italy, northern Tyrrhenian (Orsi-Relini *et al.*, 2010);
- August 2009, one specimen, erroneously identified as *K. saltatrix*, Livorno, Italy, northern Tyrrhenian (Ligas *et al.*, 2011);
- May 2013, one specimen, identified as *K. incisor* (syn. *K. vaigiensis*), Almuñécar, Spain, western Mediterranean (Peña-Rivas & Azzurro, 2013), deposited in the Marine Fauna Collection of the Instituto Español de Oceanografía of Málaga (voucher code IEOM-2630);
- September 2013, one specimen, Favignana, Italy, central Mediterranean (Mannino *et al.*, 2015) deposited, with archival organic DNA, at the Museum of Zoology of the University of Palermo (voucher code MZPA PL-391), and sequences uploaded to GenBank (accession numbers KR013046, KR013047);
- January 2015, one specimen, Malta, central Mediterranean (Vella *et al.*, 2016), with other occasional visual records, suggesting an established permanent population (Vella *et al.*, 2016);
- 2016, one specimen, Israel, eastern Mediterranean (Golan *et al.*, 2016).

The chronology of the findings of the two kyphosid species in the Mediterranean Sea demonstrates an important aspect of biogeographical history which can only be supported by scientific collections in museums: the oldest species dwelling in the Mediterranean sea is *K. sectatrix* while the presence of *K. vaigiensis* seems to be a recent phenomenon, perhaps invasive.

Without wishing to be distracted by scientific details, it may be appropriate here to reflect on one matter. Recent discoveries have led us to suppose the presence of kyphosids as alien species in the Mediterranean (Mannino *et al.*, 2015).
references therein), whereas by checking the historical literature and museum specimens we discover that rudderfishes have lived for extensive periods of time in the Mediterranean, probably attracted by the boats they follow.

And it is in this context that museum collections can be re-evaluated, not only to gather exemplars but also to historically reconstruct the dispersal processes which can be considered natural in certain species, and not strictly determined by human activity. For instance, the case of *K. sectatrix* which has been swimming in the Mediterranean Sea for a long time.

Whilst the role of monitoring biodiversity is today entrusted to newly-founded institutions, it can be said that many natural history museums have always had this role (Krishthaka & Humphrey, 2000). It is critical that the zoological community fully comprehend the potential of natural history museums: they should be able to deploy their enormous store of biodiversity knowledge for the benefit of science and society and expand their descriptive, systematics enterprise into the predictive and prescriptive. After habitat destruction, the invasion of alien species is currently considered one of the most serious threats to biodiversity and natural ecosystem functioning (Galil et al., 2016). Marine alien species may become invasive and have significant effects on the environment, economy and human health, thereby raising serious concerns to the scientific community.

The major difficulties encountered are in objectively assessing whether the spread of taxa is due to natural dispersal or human activities. A conspicuous increase in the rate of the introduction of marine alien species has been noticed during recent decades but it is possible to better assess the extent of the phenomenon by analyzing historical collections. Efforts to understand the real extent of invasions and validate what is natural or human-mediated should be undertaken by a close cooperation between specific institutions dedicated to IAS (Invasive Alien Species) and Natural History Museums.

The case of *K. vaigiensis*, prudently defined as a cryptogenic species by Mannino et al. (2016), can be herein solved: the species could be considered alien to the Mediterranean Sea, as it has only been recently collected for the first time (1998), and occurring in consecutive geographical areas which follow a west-to-east direction; *K. vaigiensis* can be supposed to be a migrant from the Atlantic.

References


