REVIEW OF APPENDICULARIAN BIODIVERSITY IN THE ADRIATIC

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Abstract
Until 2007 continuous monitoring of appendicularians in the Adriatic was not conducted except few isolated annual series. Since 2007 eleven appendicularian species were recorded in the Adriatic for the first time while three species recorded in previous investigations were not found. Due to infrequent sampling of appendicularians it is hard to determine if this sudden increase of species number is the result of prior inadequate samplings or if it is related to hydroclimatic changes. Here we try to assess status of newly recorded appendicularian species in the Adriatic by using their population dynamics and by revising historical samples.

Keywords: Biodiversity, South Adriatic Sea, Zooplankton , Tunicata

Introduction

In the last 20 years an increase of biodiversity is recorded in many gelatinous zooplankton groups in the Adriatic [1] while appendicularians were not investigated. The last basin-scale investigation of appendicularians was conducted from 1974 to 1976, more than 30 years ago [2], while yearly cycles were investigated in 1989/1990 and 1996/1997 in coastal South Adriatic [3,4] and from 1999 to 2002 in the North Adriatic.

In 2009 species *F. aequatorialis* was recorded in open waters off Albania [5] and a new species to science *Fritillaria ragusina* [6] was described from samples collected in the open Adriatic waters in 2008. Here we present a review of the status of Adriatic appendicularian biodiversity with nine new appendicularian records for the Adriatic. We also try to assess which species were possibly overlooked in previous investigations and which could be promising candidates for indicator species of different water masses.

Materials and methods

From 2007 onwards appendicularians were sampled bimonthly on 4 stations from the coast to the open sea along transect from 42°38'N, 18°02'E to 42° 20'N, 17°43'E. A 100 m deep costal station off Dubrovnik was sampled twice per month. All stations were sampled using Nansen closing nets with 53-µm, 200-µm and 250-µm mesh. A limited number of historical samples from 1974-1976, 1987 and 1996 was examined for possibly overlooked species.

Results and discussion

From 2007 onwards we recorded nine more species in addition to *F. aequatorialis* and *F. ragusina* in the Adriatric for the first time: *Oikopleura villafrancae*, *Folia gracilis*, *Appendicularia tregouboffi*, *Fritillaria formica tuberculata*, *F. formica digitata*, *F. charybdae*, *F. lucifer*, *Tectillaria fertilis* and *Kowalevskia oceanica*.

Based on presence of species in historical samples and their abundance patterns in recent samples six species were overlooked in previous investigations: *Oikopleura villafrancae*, *Folia gracilis*, *Fritillaria ragusina*, *F. formica digitata*, *Appendicularia tregouboffi* and *Kowalevskia oceanica*. During the revision of historical samples from 1970s, *O. villafrancae* was regularly found in deep sea samples. This species was probably overlooked in earlier investigations due to its poor preservation in net tows and typical depth of occurence of more than 300 m.Species *Folia gracilis*, *Fritillaria ragusina*, *Appendicularia tregouboffi* are open sea species which are found in 53-µm mesh net, but rarely in 200/250-µm mesh nets. These species were also found in historical open sea samples taken with 53-µm mesh net in 1980s suggesting that they were probably overlooked due to inadequate sampling techniques. Species *Fritillaria formica digitata* and *Kowalevskia oceanica* were found in samples from 1990s. Species *K. oceanica* was probably overlooked because of its similarity to *K. tenuis* while species of *F. formica* group were never determined to the *formica* or *tuberculata* species level in previous investigations. The declining abundance pattern is registered in species *K. oceanica* and *F. formica digitata* from 2007 onwards suggesting that they migh have interrmittent occurence in the Adriatic, possibly related to entering currents. Similar declining patttern from 2007 onwards is also found in species *F. aequatorialis* and *O. intermedia*. Species *F. aequatorialis* hasn't been found in examined samples from years prior to 2007, while species *O. intermedia* is regarded as accidental Adriatic species [2]. Species *O. intermedia* was recorded in late 1970s but never afterwards, until 2007. This species likely also belongs to species with intermittent occurence in the Adriatic and future investigations might confirm the same for species *F. aequatorialis*. Species *Fritillaria formica tuberculata* was found in many samples throughout the years and should be regarded as common member of Adriatic appendicularian fauna.

Species *T. fertilis* and *F. charybdae* are rare species even in the Mediterranean and their presence might indicate influence of Atlantic waters on deep layers. In September 2011 a single specimen of recently described *Fritillaria lucifer* [7] was found in the tow from 300 m to the surface. This is first finding of this species since its description from Monterey Bay (Pacific Ocean). The pecularity of this isolated specimen was presence of two ovaries while holotipic individuals caught in pristine condition had only one ovary (Fig. 1).

Three appendicularian species have not been found since 1970s in the Adriatic: *Oikopleura rufescens*, *Megalocercus abyssorum* and *Fritillaria fagei*. These species are probably extinct from the Adriatic.

Even though the majority of newly recorded species were overlooked in previous investigations, there are notable changes in appendicularian species composition in the Adriatic. This corrensponds to recorded changes in other gelatinous zooplankton groups [1]. Future investigations will determine the value of species with intermittent occurence as indicator species of different circulation regimes in the Adriatic.

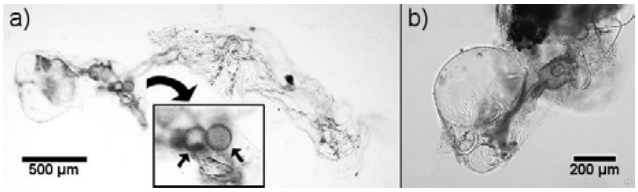

Fig. 1. *Fritillaria lucifer*. a) The whole animal with enlarged detail showing two ovaries; b) lateral view of the anterior part of trunk.

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