Alien species among Chironomids: a new topic on which direct our interest

Boggero A.[1,2], V. Lencioni[3] and B. Rossaro[4]

[1]*LifeWatch Italy* and [2]*CNR - Institute of Ecosystem Study (ISE), Verbania Pallanza, Italy*

[3]*MUSE - Museo delle Scienze, Trento, Italy*

[4]*Dept. Agrifood and Urban Systems Protection, University of Milano, Italy*

Freshwater alien species

Alien species are considered one of the main threats to biodiversity all over the world, and their negative ecological and economic effects have been extensively documented. They are also the second main cause of biodiversity loss (IUCN- The World Conservation Union, 2000).

The definition of alien species adopted is a very general one, and is available in the Alien Species Thesaurus produced by LifeWatch Italy (http://thesauri.lifewatchitaly.eu/alienspecies/index.php):

Any species deliberately or inadvertently introduced in an area by human activities before the discovery of the New World by Columbus in 1492, and with a distribution not including the territory under study (Boggero et al., 2014)), analogue to what plant invasion biologists call "neophytes" (Pyšek, 1998).

The situation in Italy

Italy is considered one of the European countries with a very diverse topography and many habitat types maintaining a high biodiversity, with particularly suitable climate conditions and a geographical strategic position within Europe, Asia and Africa. Therefore is particularly vulnerable to the arrival of alien species.

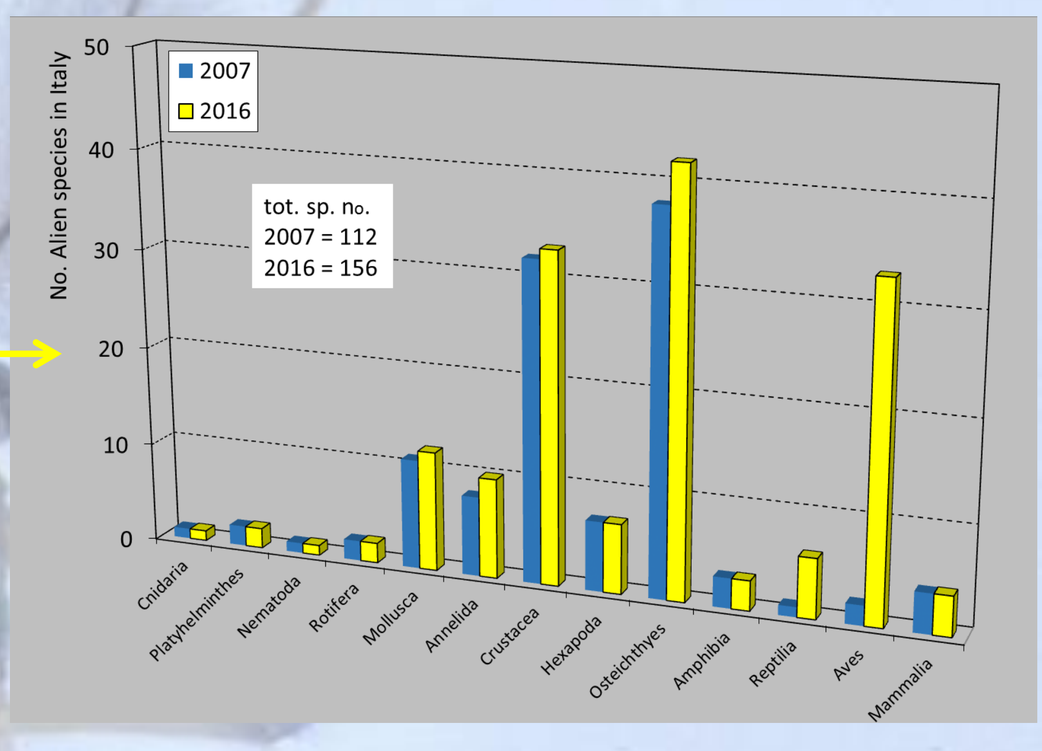
Italy counts 156 freshwater alien species (Tricarico et al., 2010, pers. comm.), most of which are arthropods including many potential carriers of infections.

Unfortunately, in Italy, many habitats are not adequately monitored for the presence of alien species, such as lakes in the Mediterranean area, or high altitude streams and lakes in the Alpine zone.

Why chironomids?

Usually, researches on alien and invasive species in aquatic ecosystems were mainly directed towards the study of economically important and larger species, whereas small taxa or groups have rarely been considered.

Non-biting midges (Diptera, Chironomidae), inhabiting in relatively large number different type of habitats (mainly freshwaters, but also brackish and marine waters, as well as terrestrial lands) are well studied under the morphological, ecological, physiological and molecular point of view and often dominate the aquatic insect community. Unfortunately, very few studies concerning their alien character has been carried out so far. Their natural distribution is difficult to determine because the larvae are difficult to identify at species level and the adults are short-living.



Potential impacts

The potential impact of chironomids as nuisance pest during swarms, as vectors of pathogenic species or of allergy, as threat to agriculture in newly flooded rice-fields, or as competitors with native species is well known (Failla et al., 2015). Among them, examples of alien species around the world are present, but very few is known about Italy.

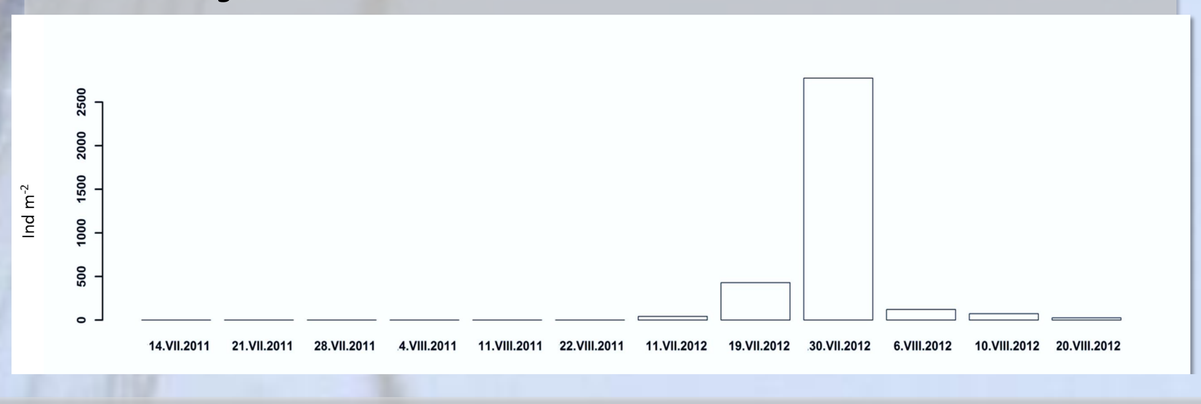
Usually, species captured and described outside the West Palearctic are potential candidates to be considered as alien, like *Polypedilum (Polypedilum) nubifer* (Skuse 1889), recently found in Italy (Rossaro & Cortesi, 2013). It is an eurytopic midge typical of Afrotropical, Palaearctic, Oriental, and Australasian regions.

P. nubifer (Skuse, 1889) is a common and widespread species of chironomid that can attain nuisance densities in some eutrophic water bodies altered or modified by human activities (rice fields, eel ponds, drainage channels, canals, and treatment ponds). The larvae are also considered a major pest of rice fields in China, damaging the roots and leaves of rice seedlings (Wang 2000).

First findings

A sampling campaign was carried out at Poiago farm in Carpiano (Milan, Italy) for studies regarding the assessment of acute toxicity of different concentrations of tricyclazole on *Chironomus (Chironomus) riparius* Meigen 1804 in a treated rice field. In 2012 several invertebrate species were found within which the presence of high numbers of *Polypedilum (Polypedilum) nubifer* was observed at temperatures up to 30°C. Its density reaches values of about 2500 individuals m^{-2} in July.

Because Italy produces 50% of the Europe rice, thus it is the biggest producer, and produces the 0.38% at world level, the rice industry is an important and economic resource and could be negatively impacted by a further range extension of *P. nubifer.*



Conclusions

- The arrival of alien chironomids is probably common, but their discovery is difficult to verify because many species have a wide distribution, and our knowledge of regional or local chironomid fauna is generally scarce. What we can do is to notice their appearance when large populations of previously uncollected species were found in a fairly well studied region (like Lombardy).
- Detailed studies on chironomids have to be performed to find out alien species presence and their spread, because chironomids are key organisms in aquatic ecosystems, so could represent a puzzle and a potential problem in the near future. Therefore, it became essential to ensure a sustained and rigorous research activity to implement effective programs of prevention, monitoring and control of their arrival.
- Traditional taxonomy is suffering a period of reduced interest, due to time-consuming difficult techniques, and the progressive reduction of specialized taxonomists; remarkable progress will be possible adopting cutting-edge molecular techniques (e.g. DNA barcoding) to identify species even at larval stage.

References

Boggero A., Basset A., Austoni M. et al. (2014) Weak effects of habitat type on susceptibility to invasive freshwater species: an Italian case study. Aquatic Conservation: Marine and Freshwater Ecosystems, 24, 841-852. DOI: 10.1002/aqc.2450

Failla A.J., Vasquez A.A., Fujimoto M., et al. (2015) The ecological, economic and public health impacts of nuisance chironomids and their potential as aquatic invaders. Aquatic Invasions, 10: 1–15. DOI: http://dx.doi.org/10.3391/ai.2015.10.1.01

Gherardi F., Bertolino S., Bodon M., et al. (2008) Animal xenodiversity in Italian inland waters: distribution, modes of arrival, and pathways. Biol. Invas., 10: 435-454.

Pyšek P., Jarošík V., Hulme P.E., et al. (2010) Disentangling the role of environmental and human pressures on biological invasions across Europe. Proceedings of the National Academy of Sciences USA, 107, 12157-12162. DOI: 10.1073/pnas.1002314107

Rossaro B., Cortesi P. (2013) The effects of tricyclazole treatment on aquatic macroinvertebrates in the field and in laboratory. Journal of Entomological and Acarological Research 2013; volume 45:e23: 128-136. DOI:10.4081/jear.2013.e23

Wang, X. 2000. Nuisance chironomid midges recorded from China (Diptera). In Hoffrichter O. (ed.), *Late 20th Century Research on Chironomidae.* 13th International Symposium on Chironomidae. Shaker, Aachen: 653-658.