

WORKING GROUP ON NEPHROPS SURVEYS (WGNEPS, outputs from 2022 meeting)

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Italy and Croatia : Pomo Pits, Central Adriatic Sea (GSA 17)

ADRIATIC UWTV SURVEYS and Pomo monitoring activity

Martinelli M., Medvešek D., Domenichetti F., Canduci G., Giuliani G., Zacchetti L., Pieri G., Be-lardinelli A., Chiarini M., Guicciardi S., Grilli F., Penna P., Scarpini P., Cvitanić R., Isajlovic I., Vrgoc N.

In terms of landings, from 1990 to 2015 *Nephrops norvegicus* was the second crustacean exploited in the Adriatic Sea (Mediterranean basin), then becoming the fourth in 2020; besides, it showed a steep decreasing trend passing from 2195 tonnes in 2005 to around 482 tonnes in 2020 (FAO-GFCM 2022). In the Adriatic, *N. norvegicus* lives on muddy grounds at depths from 50m to over 400m, with important concentrations off the coast of Ancona, in the Pomo Pits area, and inside the Croatian channels (Morello et al. 2007; Russo et al. 2018).

The Pomo (or Jabuka in Croatian) Pits fishing ground, located in the central Adriatic Sea (Figure 1) and historically shared by Italian and Croatian fleets (Russo et al., 2018), is characterized by peculiar oceanographic conditions (e.g. periodic water mass renewal which can have an impact on the state of local benthic communities; Marini et al., 2016; Taviani et al., 2015). Vulnerable Marine Ecosystems indicators (as sea pens, etc.) were recorded in the area (Martinelli et al., 2013); moreover, the Pomo Pits represents one of the main nursery for *Merluccius merluccius* in the Adriatic Sea (Angelini et al. 2016) and the main spawning area for *N. norvegicus* (which supports itself and the areas south-west of it; Melaku Canu et al. 2021). Despite no genetic confirmation to date (e.g. Stevens and Jenkins 2020), the area hosts a subpopulation of *N. norvegicus* which differs from others in the Northern Adriatic due to the presence of small-sized mature individuals (Colella et al. 2018; Angelini et al. 2020). Since 2015, a series of management measures was implemented in the area by the Italian and Croatian governments, and then in 2017 the General Fisheries Commission for the Mediterranean (GFCM) established there a Fishery Restricted Area (FRA; GFCM 2017; EU 2019; GFCM 2021).

From 2009 to 2019 (except 2011 and 2018), a spring UWTV survey was conducted in the Pomo Pits area jointly by CNR-IRBIM Ancona and IOF Split, on board the CNR R/V Dallaporta (Martinelli et al. 2013, 2016, 2017; Chiarini et al. 2022a). Unfortunately, due to a combination of pandemic restrictions, R/V unavailability, and lack of funding, there have been no UWTV surveys in the area in the period 2020-2022. However, taking into account the latest applied adjustments (Martinelli et al. 2022) and the outcomes of a recent study on burrow emergence rhythms (Aguzzi et al. 2021), the Pomo Pits UWTV time series has been recently included, as a tuning index, in new modeling approaches tested for the Adriatic *N. norvegicus* stock assessment (e.g. GFCM 2022). Furthermore, trials on automatic burrow tracking and counting have also been recently conducted on the Adriatic UWTV footage (Figure 2), in the framework of Task 8.5 “Automatic Image Analysis” of the EU H2020 NAUTILUS (New Approach to Underwater Technologies for Innovative, Low-cost Ocean obServation; grant n. 101000825) project (Pieri et al. 2021).

In order to obtain demographic and biological information on *N. norvegicus* and other relevant species, trawl hauls at sunrise and sunset were also carried out by means of an experimental net during the UWTV Adriatic surveys; furthermore, the sledge was equipped with a CTD (Conductivity, Temperature, and Depth) profiler and other environmental sensors (Martinelli et al. 2017a). Since 2015, an additional autumn trawl survey has been carried out by CNR IRBIM in the western side of the Pomo Pits area (strata B, ext ITA and ext ITA north in Figure 1); in this survey the same net and sampling protocol are applied and CTD casts are as well executed (Martinelli et al. 2017b, 2019, 2020). The catch per unit effort (CPUE) datasets obtained for the period 2012-2019 were used to perform a short-term evaluation of the effects of changes in fisheries management measures that occurred in the area (Chiarini et al. 2022b). The same CPUE time

series were also used, in combination with environmental information (i.e. depth, bottom temperature, salinity, oxygen saturation), to build generalized additive models (GAMs) accounting for both environmental and fishery management factors; in fact, GAMs may allow a better understanding of the local distribution and abundance variations of *N. norvegicus*, and furthermore to obtain standardized CPUE time series to be used as input for stock assessment models (Chiarini et al. 2022a). In general, the total closure to bottom trawling in the no-take area, corresponding to FRA zone A, showed a positive, albeit mostly local, effect on the CPUE of *N. norvegicus*, while depth, bottom salinity and oxygen saturation levels revealed to be the most influential environmental parameters (Chiarini et al. 2022a,b).

Experimental spring and autumns trawl surveys in the western side of the Pomo Pits area were carried out also in 2020 and 2021 to continue the medium-term evaluation of the effects of the management measures enforced (activity carried out in the framework of an agreement between the Italian Ministry of Agriculture and Forestry and CNR-IRBIM; Martinelli et al. 2021). In 2022, CNR IRBIM conducted spring and autumn sampling in the western side under the umbrella of an agreement with the Italian Institute for Environmental Protection and Research to collect information for Descriptor 6 (Sea-floor Integrity) of the Marine Strategy Framework Directive; within the latter, the possible use of historical UWTV footage to map Vulnerable Marine Ecosystems indicators was also hypothesized (Scarcella et al. 2022).

In 2021 and 2022 IOF Split carried out summer and winter surveys in the eastern side of the Pomo Pits area, using the MEDITS (Mediterranean International Trawl Survey) experimental net, which substantially confirmed a strong increase in CPUE of *N. norvegicus* in zone A of Pomo FRA, but also showed some increases on the eastern (Croatian) side of the Pomo Pits region, in the area adjacent to the no-take zone.

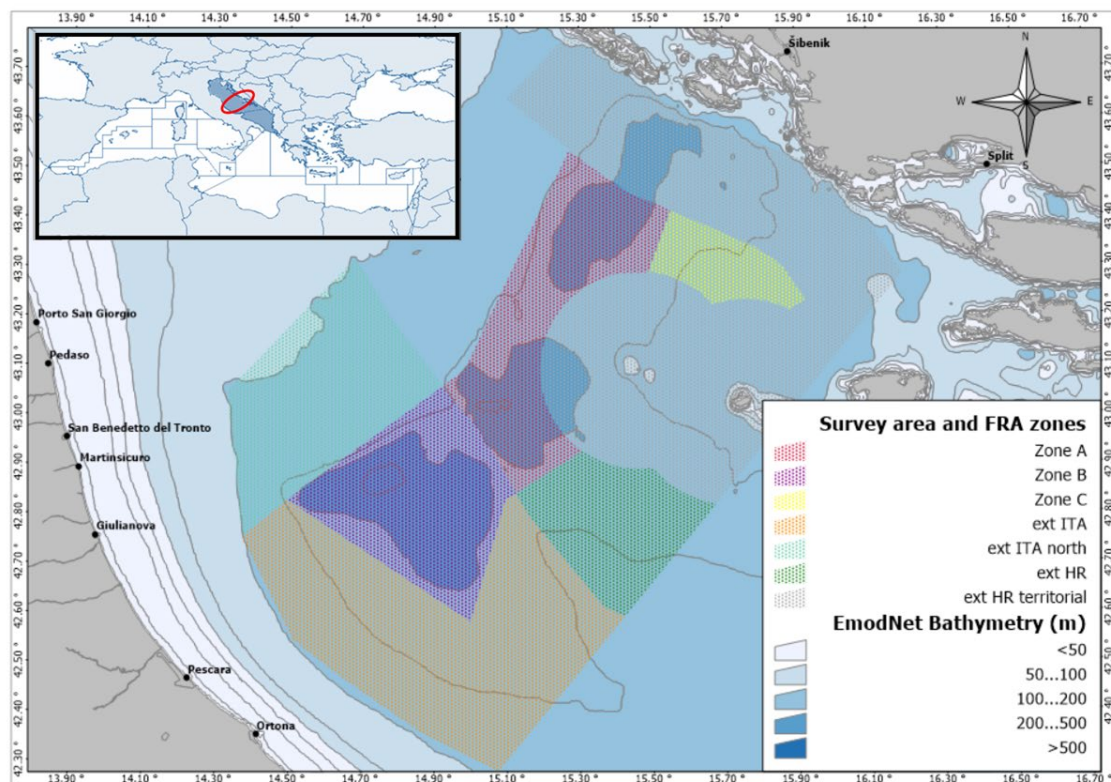


Figure 1: Map of the Pomo (Jabuka) Pits area with indication of bathymetry (EMODnet 2016) and sampling strata (including FRA zones: zone A closed to fishing activity, zones B and C subject to fisheries limitations).

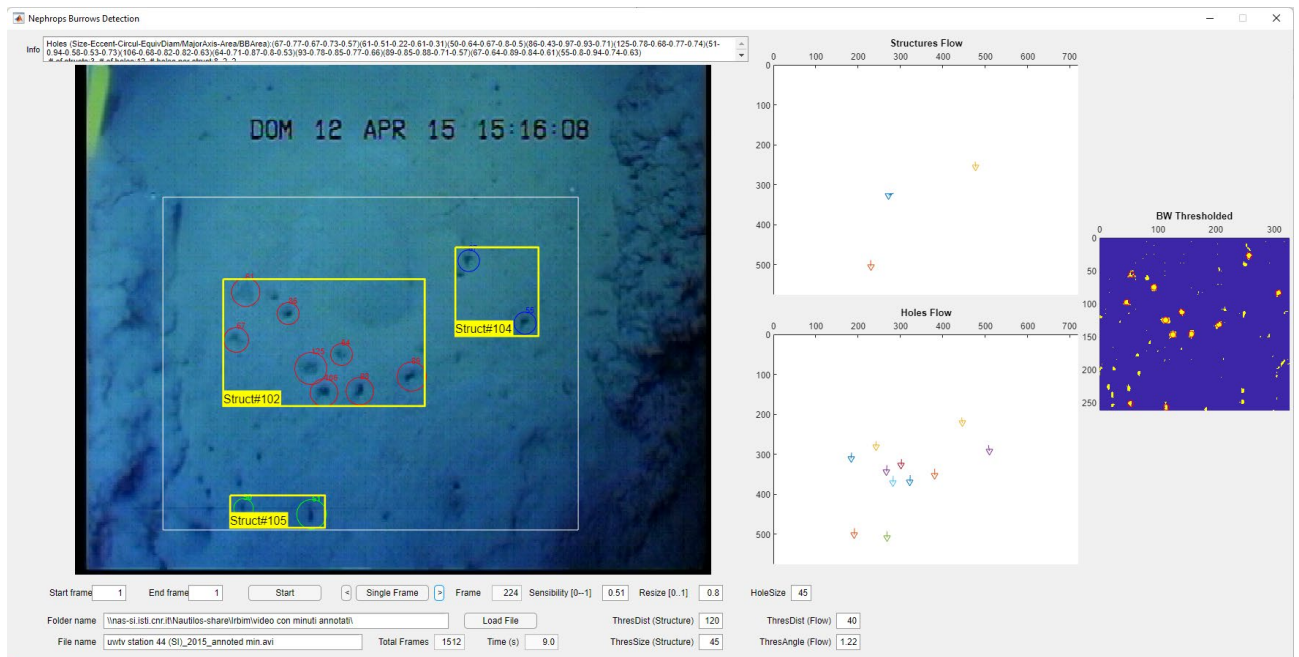


Figure 2: NAUTILOS Graphical User Interface and trials of structure detection based on optical flow and image tracking carried out on Pomo Pits UWTV footage.

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