## USING FISH COMMUNITY TO IDENTIFY SUCCESS CRITERIA FOR SEAGRASS HABITAT RESTORATION

Scapin L.\*, Zucchetta M., Facca C., Sfriso A., Franzoi P.

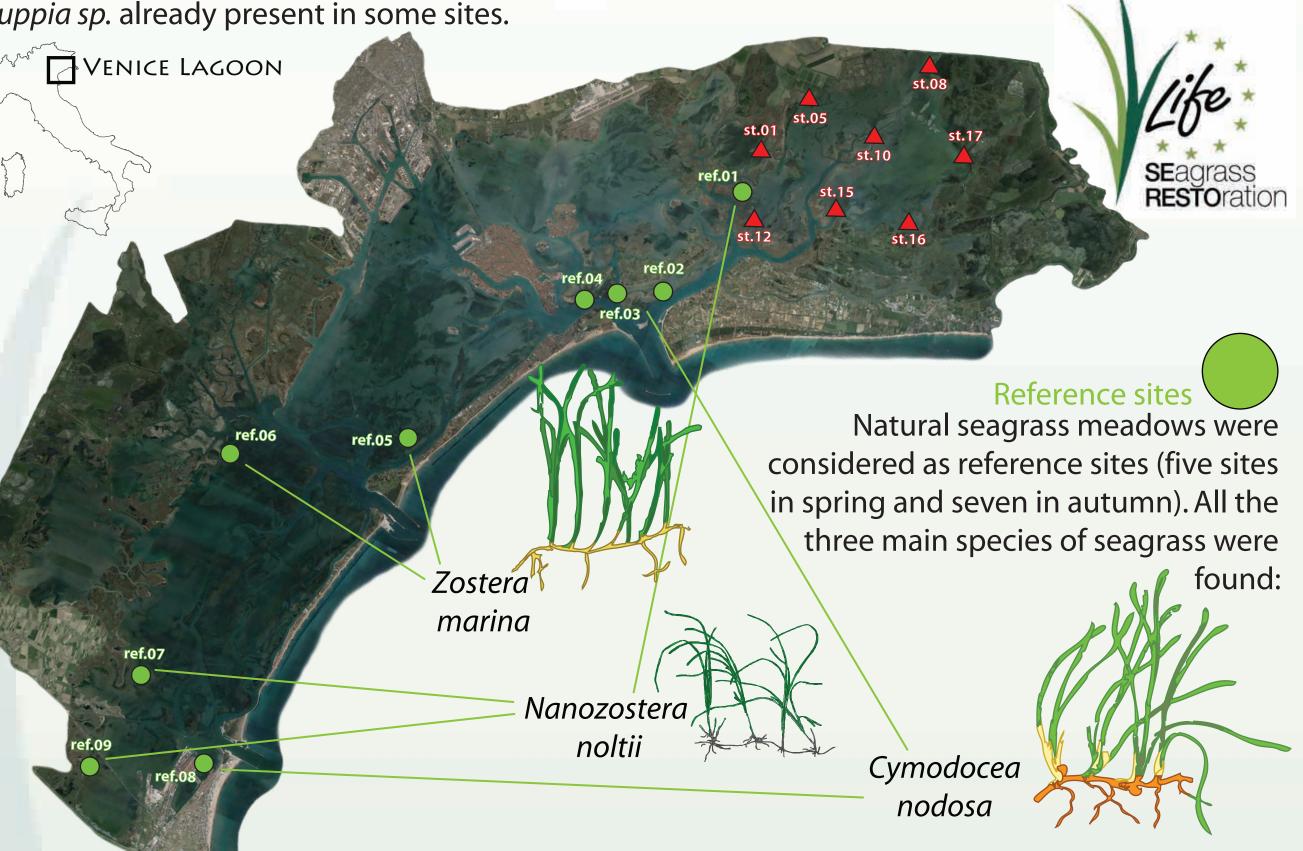
CEMAS - DAIS, Università Ca' Foscari Venezia, via Torino 155, 30170 Venezia, Italy. \*luca.scapin@stud.unive.it

**METHODS** 

The LIFE project N° LIFE12 NAT/IT/000331 - SeResto started in 2014 with the objective of restoring seagrass meadows in the northern Venice lagoon (northern Adriatic Sea, Italy). An expected goal of the project is the enhancement of the overall ecological status (sensu Dir. 2000/60/EC; WFD) of the northern lagoon, and thus also to restore the fish communities associated with seagrass meadows.

Aim of this work was to identify characteristics of the fish assemblage most associated with reference habitats, and test them as potential indicators to track restoration progress towards desired conditions. Restoration sites

Eight newly-transplanted sites from the SeResto project were monitored in spring and autumn 2014. Bare substratum was the main habitat type, with scattered natural patches of *Z. marina*, *N. noltii* and *Ruppia sp.* already present in some sites.



Fish were caught by seine nets and compared between seagrass restoration and natural meadow sites, using the latter as reference. Both spring and autumn 2014 observations were considered. Natural habitat typology (either *C. nodosa*-meadow, *Z. marina*-meadow, *N. noltii*-meadow, *Ruppia sp.*-meadow or bare bottom) was recorded.

A fish-based multimetric index was developed and applied to assess the ecological status. A 2-way PERMANOVA based on Bray-Curtis similarity was employed to test the effect of seasonality and site typology on community structure.

Fish species mostly associated with reference seagrass meadows were then identified, and a set of metrics was computed considering both the whole community and indicator species. The effects of site and habitat typology were studied on each metric separately by means of a univariate PERMANOVA using Euclidean distance.

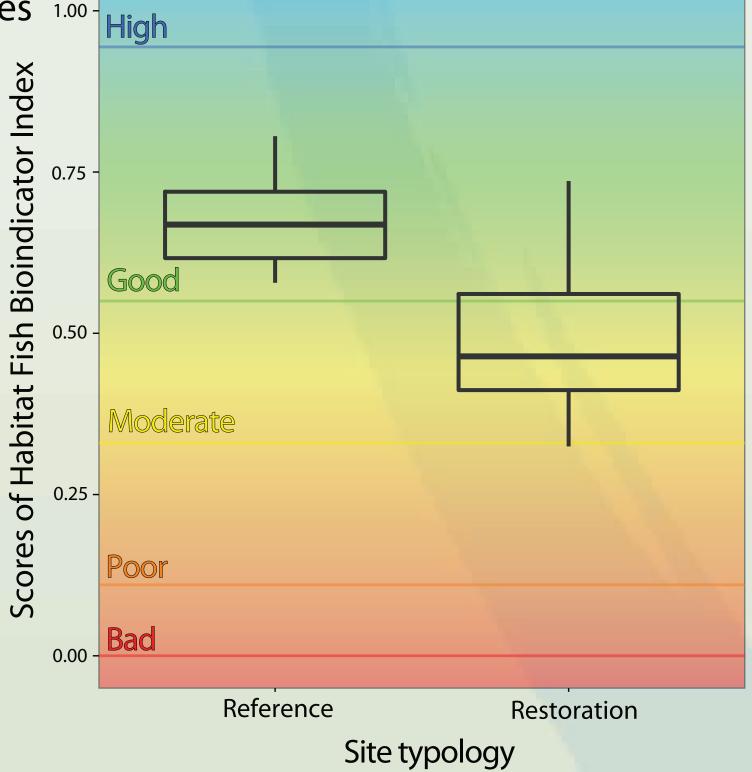
## RESULTS

**#1.** Margalef's richness of hyperbenthivorous/zooplanctivorous/piscivorous species (calculated on biomass)

**#2.** Total density of biomass

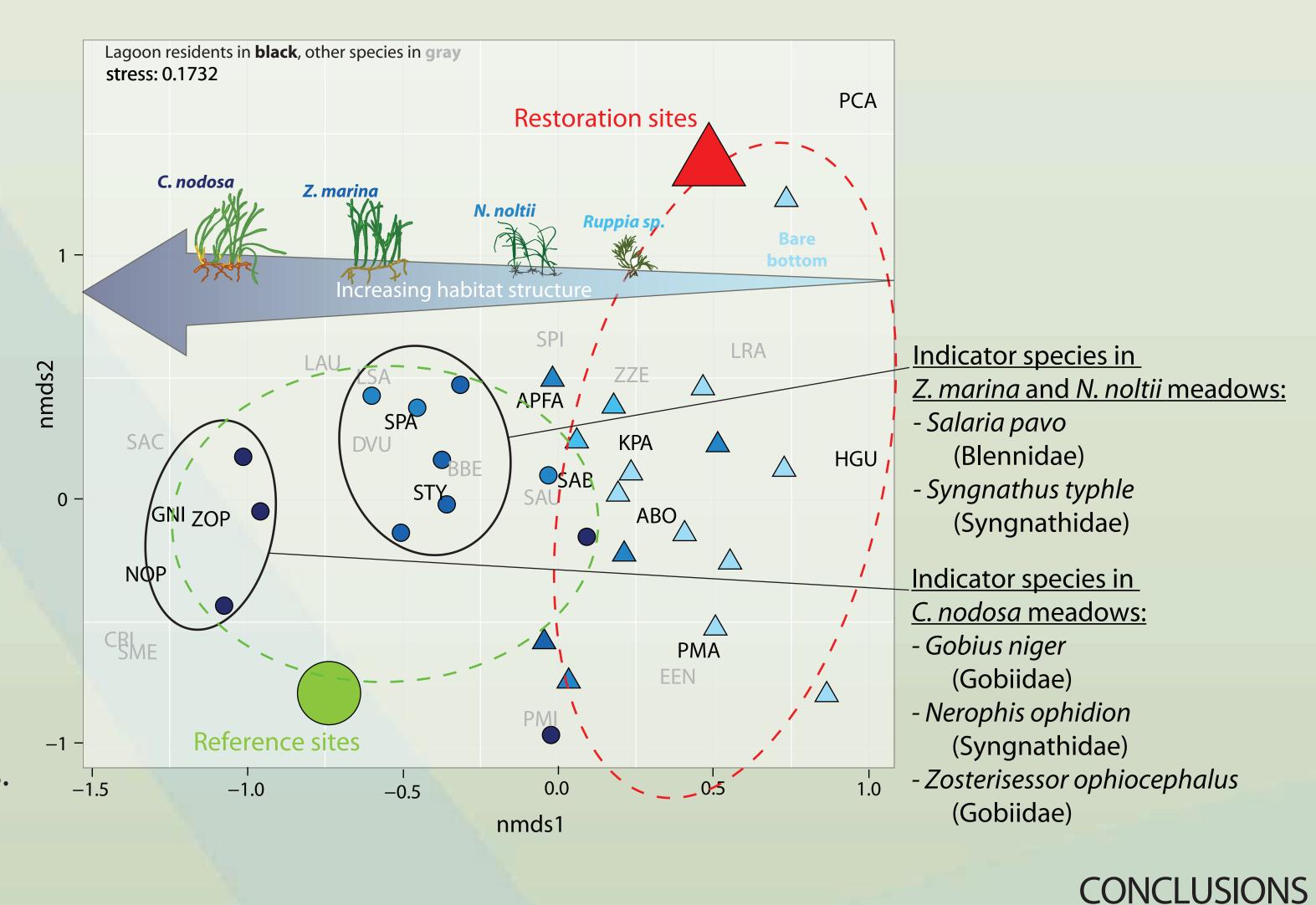
#3. Number of lagoon resident species 1.00-High

**#4.** Mean individual weight of benthivorous species



Four attributes of fish community were selected for their sensitiveness to anthropogenic pressures and aggregated in the *Habitat Fish Bioindicator Index*, a habitat-, season- and water body-specific multimetric tool to assess the ecological status of Venice lagoon in compliance with Water Framework Directive (Zucchetta et al., in preparation).

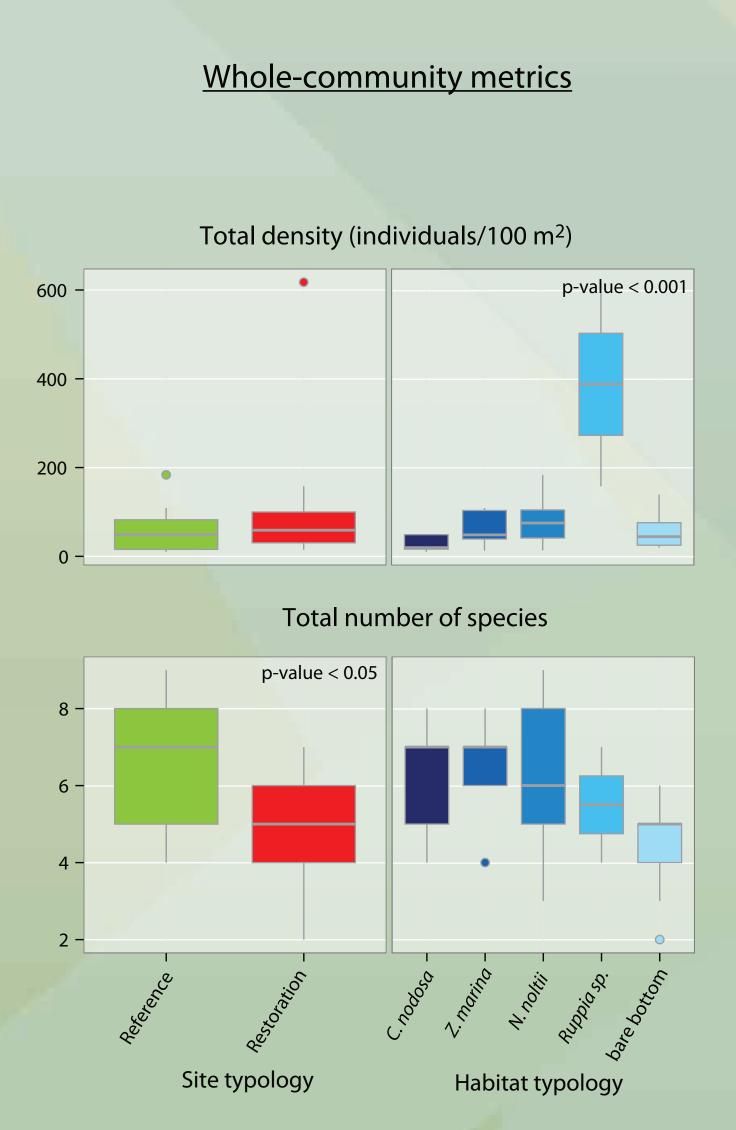
Ecological status in newly-transplanted sites is lower than that of natural meadows, suggesting that a successful restoration of seagrass habitat could increase the quality of fish assemblages in the project area.

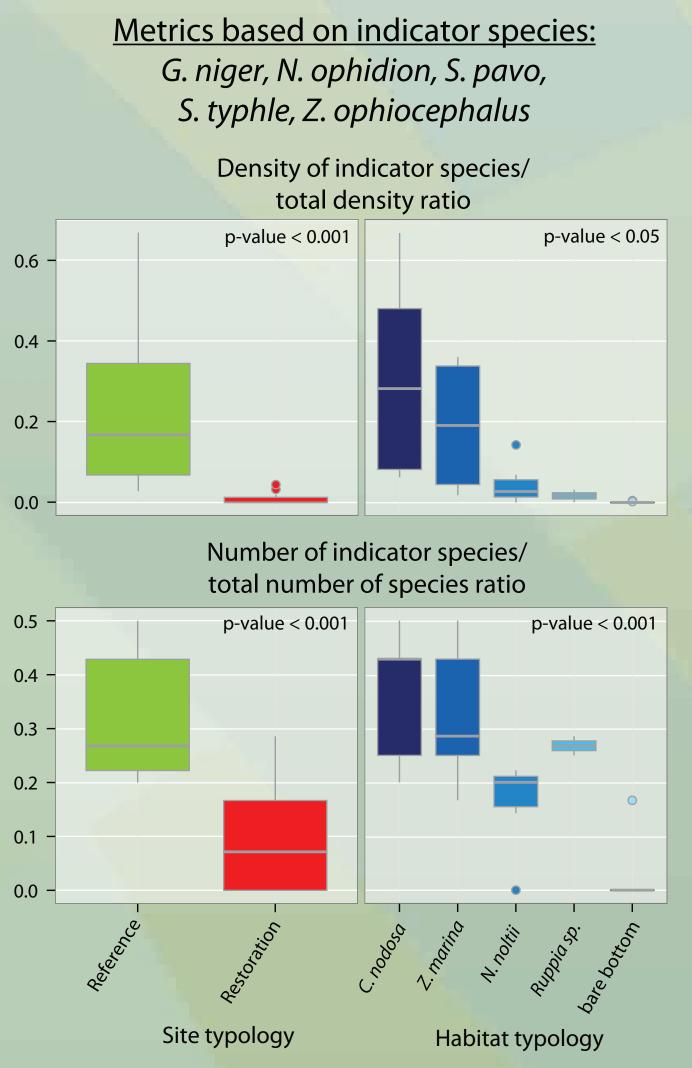


Fish community is significantly different between restoration and reference sites (p-value <0.001) and between seasons (p-value <0.05), as shown in nMDS. From bare, unstructured habitats, that are still prevalent in restoration sites and support species like *Aphanius fasciatus* (APFA), *Knipowitschia panizzae* (KPA) and *Pomatoschistus marmoratus* (PMA), fish community changes along progressively more structured habitats, i.e. from short- and narrow-leaved *Ruppia sp.* and *N. noltii* 

Pomatoschistus marmoratus (PMA), fish community changes along progressively more structured habitats, i.e. from short- and narrow-leaved Ruppia sp. and N. noltii meadows, to taller- and broader-leaved C. nodosa and Z. marina meadows. Reference sites support indeed high densities of seagrass specialists, with also Gobius niger (GNI) and Salaria pavo (SPA) being strongly linked to seagrass habitats.

Total number of species in fish community is significantly lower in restoration sites compared with natural meadows, while no significant differences are found in total density. Proportion of indicator species selected from nMDS analysis (both in terms of density and species number) is significantly related to site typology, lower values showing newly-transplanted sites. Moreover, both metrics based on indicator species show significantly increasing values at increasing levels of habitat structure.





The application of a multimetric index showed that restoring seagrass habitat in the northern Venice lagoon could enhance the ecological status of fish fauna in this area, which has undergone substantial anthropogenic alterations in last decades. In order to verify such hypothesis, monitoring of seagrass specialists such as *Syngnathus typhle*, *Nerophis ophidion* and *Zosterisessor ophiocephalus* (Franzoi et al., 2010), but also of *Gobius niger* and *Salaria pavo*, could be used to track restoration development and assess

Results also suggest that not all plant species form equivalent habitats for fish. Different fish assemblages may colonise habitats recreated with either the tall- and broad-leaved *Cymodocea nodosa* or the shorter- and narrower-leaved *Nanozostera noltii*. Hence, different endpoints in fish communities of restored habitats are expected.

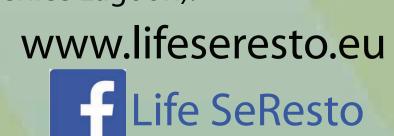
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its success.









## REFERENCES

Franzoi P., Franco A., Torricelli P. (2010). Fish assemblage diversity and dynamics in the Venice lagoon. Rendiconti Lincei, 21(3), 269–281. http://doi.org/10.1007/s12210-010-0079-z Zucchetta M., Franco A., Scapin L., Ciccotti E., Torricelli P., Franzoi P. *Uncertainty in developing fish-based multimetric indices* (in preparation).