MIGRATION OF COMMON SOLE JUVENILES IN COASTAL LAGOONS ASSESSED BY OTOLITH AND STABLE ISOTOPE FINGERPRINTS (NW MEDITERRANEAN)

Jan Dierking [1], Fabien Morat [2], Yves Letourneur [3] and Mireille Harmelin-vivien [2]*

[1] Leibniz Institute of Marine Sciences (IFM-GEOMAR), 24105 Kiel, Germany

[2] Université de la Méditerranée, Centre d'Océanologie de Marseille, UMR CNRS 6540, 13007 Marseille - mireille.harmelin@univmed.fr

[3] Université de la Nouvelle-Calédonie, Laboratoire LIVE, Campus de Nouville, BP R4, 98851 Nouméa Cedex, New Calédonia

Abstract

Stable isotope ratios in muscle (C, N) and otolith (C, O), and otolith microchemistry were analysed in common soles when they entered a coastal lagoon in spring and when they returned to the sea in autumn. Fingerprints of lagoonal life were observed both in muscle and otolith, but were fixed for the whole life of fish in otoliths only.

Keywords: Coastal Systems, Fishes, Migration, Chemical Analysis, Gulf Of Lions

Introduction

In the Gulf of Lions (NW Mediterranean), population dynamics of the common sole, *Solea solea* (L., 1758), are positively correlated to the Rhone River inputs [1]. Juveniles recruit in shallow waters in spring. Part of this population then enters coastal lagoons shortly after recruitment and migrates back to the sea only in autumn [2]. This raises the question how time spent in coastal lagoon nurseries early in the lifespan influences common sole population dynamics. To address this question, we analysed changes in potential fingerprints of lagoonal life (in particular, C, N, and O stable isotope ratios and otolith microchemistry) in sole populations entering and leaving the same coastal lagoon.

Material and Methods

Soles were sampled in Mauguio lagoon in April and May 2004 (n = 47) when they entered the lagoon and in September and November 2004 (n = 42) when they returned to the sea. C and N (dorsal white muscle) and C and O (otoliths) stable isotope ratios were analysed by isotopic mass spectrometry [3] and the microchemistry of their whole otoliths was determined by LA-ICPMS [4].

Results and Discussion

Entering soles measured 10.6 ± 1.2 cm TL. They had doubled their size (20.9 ± 1.0 cm TL) when they left the lagoon in autumn. Muscle C and N stable isotope ratios increased during lagoonal life. The same trend was observed in otolith C and O stable isotope ratios (Fig. 1). Concerning otolith microchemistry, significant changes were oberved for the Sr/Ca, Mg/Ca and Fe/Ca ratios. Sr/Ca was higher in leaving than in entering soles, whereas the reverse was observed for Mg/Ca and Fe/Ca (Fig. 2).

In summary, isotopic and chemical signatures significantly differed in soles leaving Mauguio lagoon in autumn compared to individuals entering in spring. This indicates that the time spent in coastal lagoons left distinct fingerprints in different sole components.

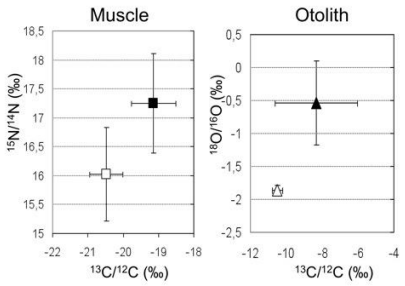

Fig. 1. Stable isotopic signatures in common soles entering (open symbols) and leaving (black symbols) Mauguio lagoon

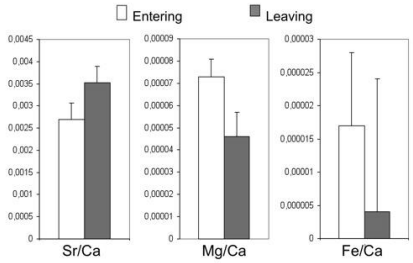

Fig. 2. Otolith chemical fingerprints in soles entering and leaving Mauguio

A likely explanation lies in the particular environmental conditions in lagoons (e.g., salinity, temperature, energy sources, contaminants). In particular, the high values in the ratio $^{15}N/^{14}N$ observed in leaving soles may be related to strong eutophication of the lagoon of Mauguio. In addition, comparison of muscle signatures with those of primary producers in the Mauguio system (own unpublished data, not shown) indicates that seagrasses (*Ruppia*,.*Potamogeton*), which were formerly common in Mauguio Lagoon but have declined precipitously [5], do not play a role as base of the common sole foodweb in the lagoon. Finally, the increase in otolith $^{18}O/^{16}O$ and Sr/Ca ratios suggests that salinity and temperature were higher in the lagoonal habitat than in the coastal habitat inhabited prior to migration. It is interesting to note that istotopic ratios in fish muscle change in a few months, which means that lagoonal signatures will disappear soon after moving back to the sea. In contrast, isotopic and chemical signals recorded in the otoliths would persist during the whole fish life, and are therefore best suited to analysing fish migrations between different environments.

References

1 - Salen-Picard C., Darnaude A.M., Arlhac D. and Harmelin-Vivien M., 2002. Fluctuations of macrobenthic populations: a link between climate-driven river run-off and sole fishery yields in the Gulf of Lions. *Oecologia*, 133: 380-388.

2 - Quignard J.P., Man Wai R. and Vianet R., 1984. Les poissons de l'étang de Mauguio (Hérault, France). Inventaire, structure du peuplement, croissance et polymorphisme des tailles. *Vie Milieu*, 34: 173-183.

3 - Dufour E. and Gerdeaux D., 2001. Apports des isotopes stables ($^{13}C/^{12}C$, $^{15}N/^{14}N$, $^{18}O/^{16}O$, $^{36}S/^{34}S$, $^{87}SR/^{86}SR$) aux études écologiques sur les poissons. *Cybium*, 25: 369-382.

4 - Campana S.E., 1999. Chemistry and composition of fish otoliths: pathways, mechanisms and applications. *Mar. Ecol. Progr. Ser.*, 188: 263-297.

5 - Anonymous., 2008. Réseau de suivi lagunaire du Languedoc-Roussillon: Bilan des résultats 2007. Rapport RSL-08/2008, Ifremer, 363 p.