水研センター研報，第38号，105－107，平成26年
Bull. Fish. Res. Agen. No. 38, 105–107, 2014

What can stable isotope studies tell us about early life trophic pathways of top predator larvae: Case study of bullet tuna larvae

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Abstract : Naturally occurring stable isotopes are commonly used to elucidate the origins of organic matter and food web complexity within marine communities. Given the utility of these natural dietary tracers, few studies have attempted to use stable isotopes to examine the early life feeding ecology of pelagic fishes in offshore marine ecosystems (Bode *et al*, 2007; Pepin and Dower, 2007). Food web tracers, such as the stable isotopes of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$) were used to determine the extent to which fish larvae rely on different components of the ecosystem. Stable nitrogen isotopes becomes enriched at successive trophic levels, resulting from the greater concentration of the light isotope (^{14}N) than the heavy isotope, leaving the animal enriched in ^{15}N relative to its food source. Stable carbon isotopes can indicate feeding and carbon flow because there is limited fractionation from prey to predator, and different energy sources provide distinctive $\delta^{13}C$ values.

The Balearic Sea (NW Mediterranean) is characterized by the encounter of waters masses

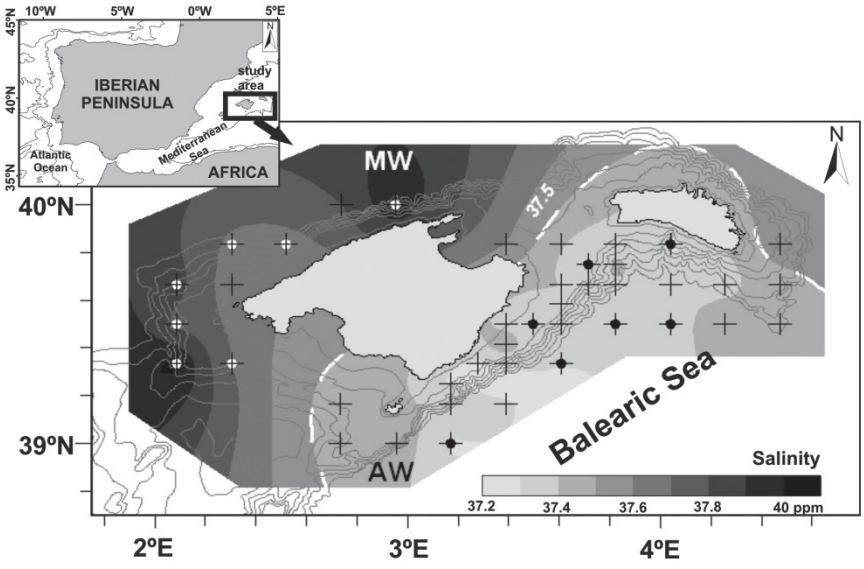

Fig. 1. Selected stations sampling distribution according to the PCA analysis (Pearson linear correlation coefficient). Temperature, salinity and mesozooplancton biomass were linear factors (86.6% representation within two factors). Mediterranean-MW (○) and Atlantic-AW (●) overlapped to salinity (ppm) contours in the study area.

2013年9月5日受理（Received on September 5, 2013）
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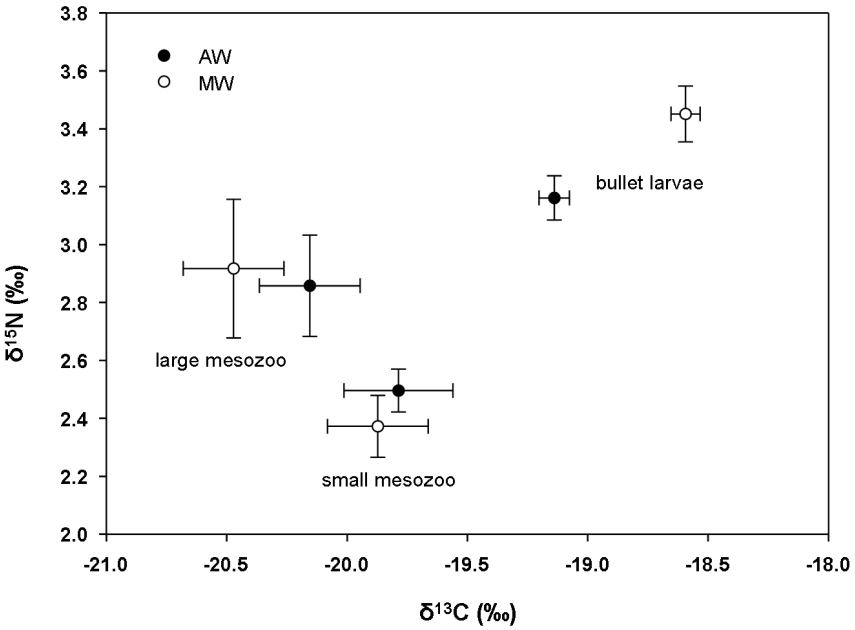

Fig. 2. δ^{13}C and δ^{15}N values (mean ± standard error ‰) for small and large mesozooplankton size fractions and for *A. rochei* larvae in both Mediterranean water (○, MW) and Atlantic water (●, AW) of Balearic Sea.

of Atlantic origin with the Mediterranean waters (Jurado *et al*., 1995) which as a consequence cause an intense hydrographic circulation which bring about important mesoscale features, as fronts and gyres (Vélez-Belchí and Tintoré, 2001). Incoming Surface Atlantic water masses are characteristically nutrient poor in comparison to the more saline and nutrient-rich Mediterranean waters. The extent of mixing of water masses in the area influences the degree of zooplankton variability (Fernández de Puelles *et al*., 2007). This oceanographic scenario provides a suitable spawning habitat for various tuna species, among which the medium sized bullet tuna (*Auxis rochei*) is the most abundant, and the target of seasonal artisanal fisheries in the NW Mediterranean (Sabatés and Recasens, 2001). The species possibly plays a keystone role in the NW Mediterranean as a consequence of their abundance and their early trophic piscivorous diet (Morote *et al*., 2008).

Bullet tuna larvae were simultaneously sampled with zooplankton in the Balearic Sea within differentiated salinity/temperature Mediterranean (MW) and Atlantic (AW) water masses (Fig. 1). A faster growth was observed in larvae from MW. To investigate on the environmental causes that determine growth variability, δ^{13}C and δ^{15}N were used to elucidate whether these differences may be attributed to differences in the planktonic food web that characterize each water mass.

Bullet tuna larvae from MW had significantly higher values in the δ^{15}N than those from AW (Fig. 2) indicating a greater trophic specialization in MW larvae. From the perspective of trophic level enrichment of the stable isotope of nitrogen through the early life trophic food web, it can be inferred that bullet tuna larvae essentially prey upon the small mesozooplancton size fraction. Since δ^{15}N values do not show significant differences between AW and MW in the small mesozooplankton size fractionation, the faster growth of MW bullet tuna larvae may be attributed to a greater trophic specialization of MW bullet tuna.. Thus, this study shows that stable isotope studies are useful tools in distinguishing the trophic pathways that affect the early life stages of the bullet tuna larvae inhabiting the Balearic oceanic

marine ecosystems.

Key words : Bullet tuna larvae, daily growth, stable isotope, trophism, C:N ratio, Balearic Sea

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