TROPHIC DYNAMICS AND MOVEMENTS OF TUNA IN THE TROPICAL PACIFIC OCEAN INFERRED FROM STABLE ISOTOPE ANALYSES

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ABSTRACT

Due to the mobility of marine vertebrates and their vast pelagic habitat, researchers have had to develop novel methods to determine the distribution, movements, and foraging behavior of top predators. The aim of this study was to apply bulk and compound-specific stable isotope analysis (CSIA) to examine the trophic dynamics and movements of tunas in the equatorial Pacific Ocean (eqPac). Yellowfin tuna collected around Hawaii displayed a rapid diet shift between 45-50 cm forklength. The trophic level (TL) was similar for the small (<45cm) and large (>50cm) size classes of yellowfin. Due to differences in the nitrogen source and biological transformations of this nitrogen, baseline $\delta^{15}N$ values are lower in the surface mixed layer (SML) than below the thermocline. Thus, the rapid ontogenetic shift in tuna did not a reflect a TL shift, but rather, a shift in vertical foraging habitat. I hypothesized that small juveniles are physiologically confined to the SML and larger tuna forage over a greater vertical range. Throughout the eqPac, the TL of larger size classes of yellowfin was consistent (4.2 ±0.4). Establishing the TL of tuna in the eqPac provides a reference point to examine historical and future changes in tuna trophic dynamics.

$\delta^{15}N$ and $\delta^{13}C$ values of animals can be used as natural tags to trace their movements through ecosystems. This method to studying animal movements requires isotopic variation at the base of the food web. Baseline $\delta^{15}N$ values show strong geographical patterns in the eqPac. If tuna migrated extensively within these isotope gradients, little isotopic variation would be observed in tuna because baseline $\delta^{15}N$ values

would be integrated. $\delta^{15}N$ values of yellowfin, bigeye, and skipjack tuna showed ca. 12‰ variation, but spatially coherent structure in the eqPac. CSIA results revealed that this $\delta^{15}N$ variation relates more to tuna movements than differences in their TL. Thus, the high isotopic variation observed in tuna reflects their restricted movements in the EqPac and differences between the species indicate different movement rates. In summary, this study established that isotope values of tunas are indicators of their foraging behavior, habitat utilization, and movements.