Examining Tuna Trophic Dynamics Using Stable Isotope Analysis: “The Hawaiian Template”

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Trophic Dynamics and Migration Behavior of Tuna in the Equatorial and Sub-Tropical Pacific.
\( \delta^{13}C \) Values: Source Information

**FIG. 1.** \( \delta^{13}C \) values of plants and grasshoppers at a West Texas study site. Values are expressed as \( \%/o \) (see text for explanation).

Fry et al. 1978
δ¹⁵N Values: Trophic Information

“you are what you eat + 3 ‰”

Courtesy of Dr. R. Doucett
An example: Southeast Alaska

\[ \delta^{15}N \%o \]

\[ \delta^{13}C \%o \]

~ 1\%o

~ 3 to 4\%o
Two PFRP Projects: The objectives

ECOSYSTEM MODELS

- Pacific Tuna Biogeography
- Migration Patterns
- Equatorial-Pacific Tuna Trophic Dynamics
- Hawaii-Associated Tuna Trophic Dynamics
Measure *in situ* δ^{13}C and δ^{15}N to address:
- Individual Isotopic Variability
- Size or Ontogenic Variability
- Species differences
- FAD vs. Seamount Differences

Mesocosm Experiments/Feeding Trials:
- Isotopic Pulse-Chase Experiments
  - Elucidate information on tissue turnover rates, metabolism, and tuna energetics.
Diet experiments: Revealing important isotopic information for trophic ecology studies.

Tominaga et al. *In Press.*
$\delta^{15}N$ vs. $\delta^{13}C$ of different tissue types in Hawaiian Yellowfin Tuna

Liver

White Muscle Tissue

Red Muscle Tissue

- $FL = 39.0cm$
- $FL = 33.5cm$
- $FL = 28.5cm$
δ¹⁵N of Yellowfin Tuna from Hawaiian FADs

δ¹⁵N %e

10/1/02 10/11/02 10/21/02 10/31/02 11/10/02

Red Muscle Tissue
White Muscle Tissue
Mantis Shrimp
δ¹⁵N Variability Among Yellowfin Tuna

- Hawaiian Waters
- New Caledonia

Juvenile Yellowfin (FL ~ 30cm)
Equatorial Yellowfin (FL ~ 125)
Future Research

Hawaiian Tuna PFRP Project

- Laboratory studies/Feeding experiments
- Systematic sampling of FADs and Cross-seamount
  - Sample one cohort over time?
- Analyze stomach contents of individuals
Future Research

Equatorial Pacific Tuna PFRP Project

Contrast tuna between non-upwelling and upwelling areas by:

– Characterizing the base of the food web (i.e. primary producers) and prey base in the two areas.
  • $\delta^{13}C$ and $\delta^{15}N$ of tissues
  • $\delta^{13}C$ of lipid classes (i.e. compound specific isotope analysis).

– Determine trophic relationships

– Characterize tuna movements based on isotopic signatures.