

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

B. S. Graham

Department of Oceanography, Univ. of Hawaii, Honolulu, HI

B. N. Popp and T. Rust

Department of Geology and Geophysics, Univ. of Hawaii, Honolulu, HI

K. Holland, D. Grubbs, D. Itano

Hawaii Institute of Marine Biology, Univ. of Hawaii, Honolulu, HI

V. Allain

Secretariat of the Pacific Community, Noumea Cedex, New Caledonia

R. Olson

Inter-American Tropical Tuna Commission, La Jolla, CA

F. Galvan

CICIMAR-IPN, Baja California, Mexico

B. Fry

Coastal Ecology Institute, Louisiana State Univ., Baton Rouge, LA



Trophic Dynamics and Migration Behavior of Tuna in the Equatorial and Sub-Tropical Pacific.



$\delta^{13}\text{C}$ Values: Source Information

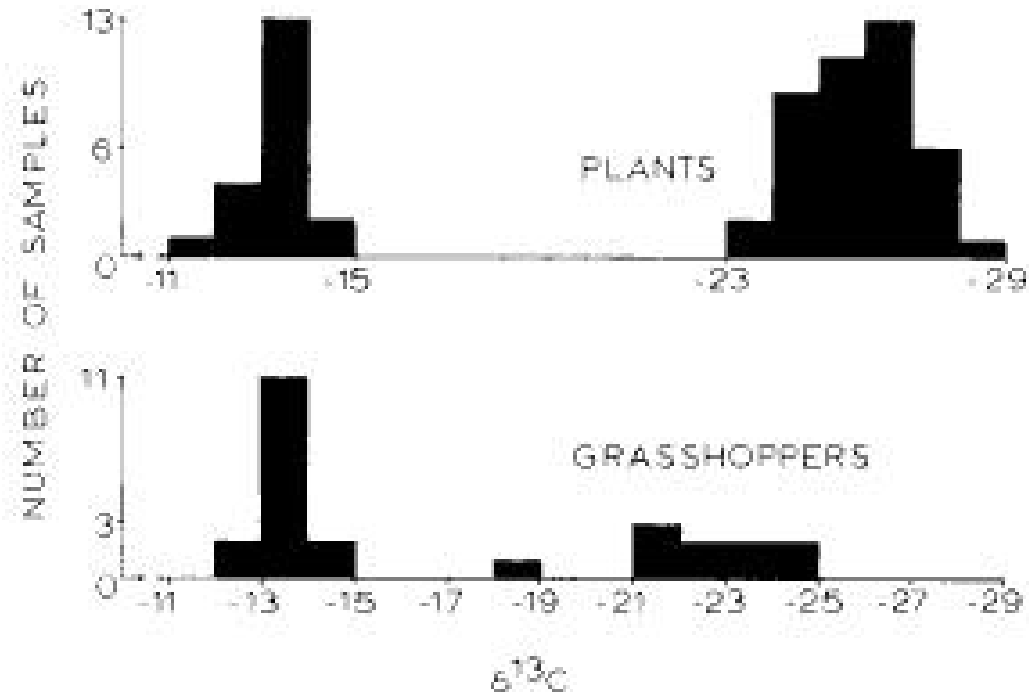
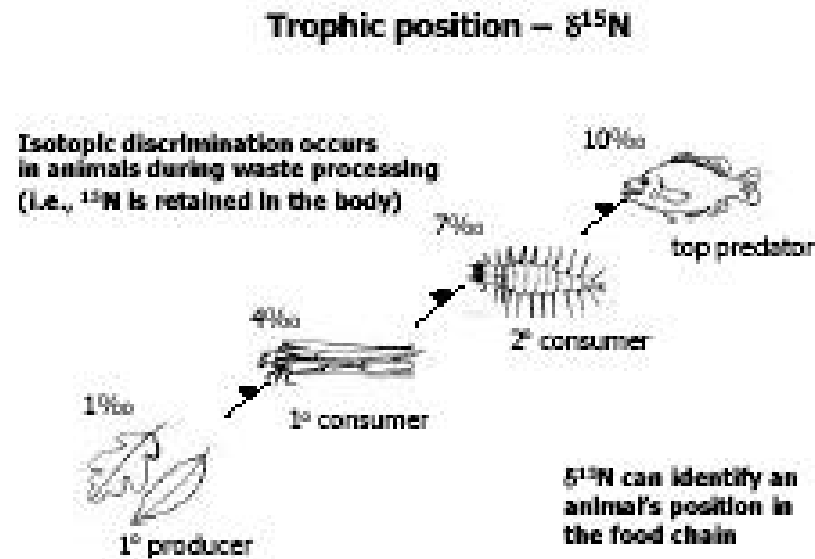


FIG. 1. $\delta^{13}\text{C}$ values of plants and grasshoppers at a West Texas study site. Values are expressed as ‰ (see text for explanation).

Fry et al. 1978

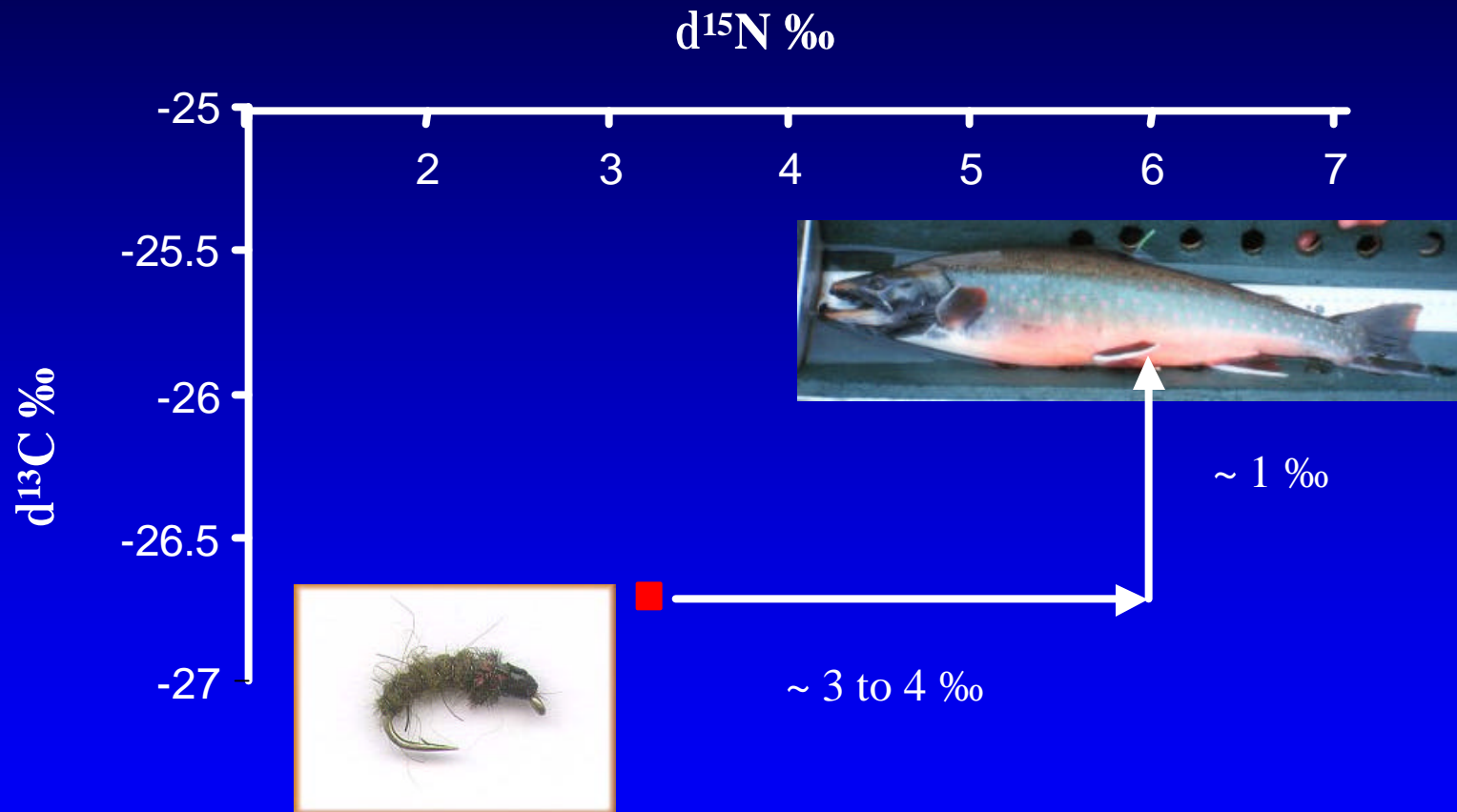
$\delta^{15}\text{N}$ Values: Trophic Information



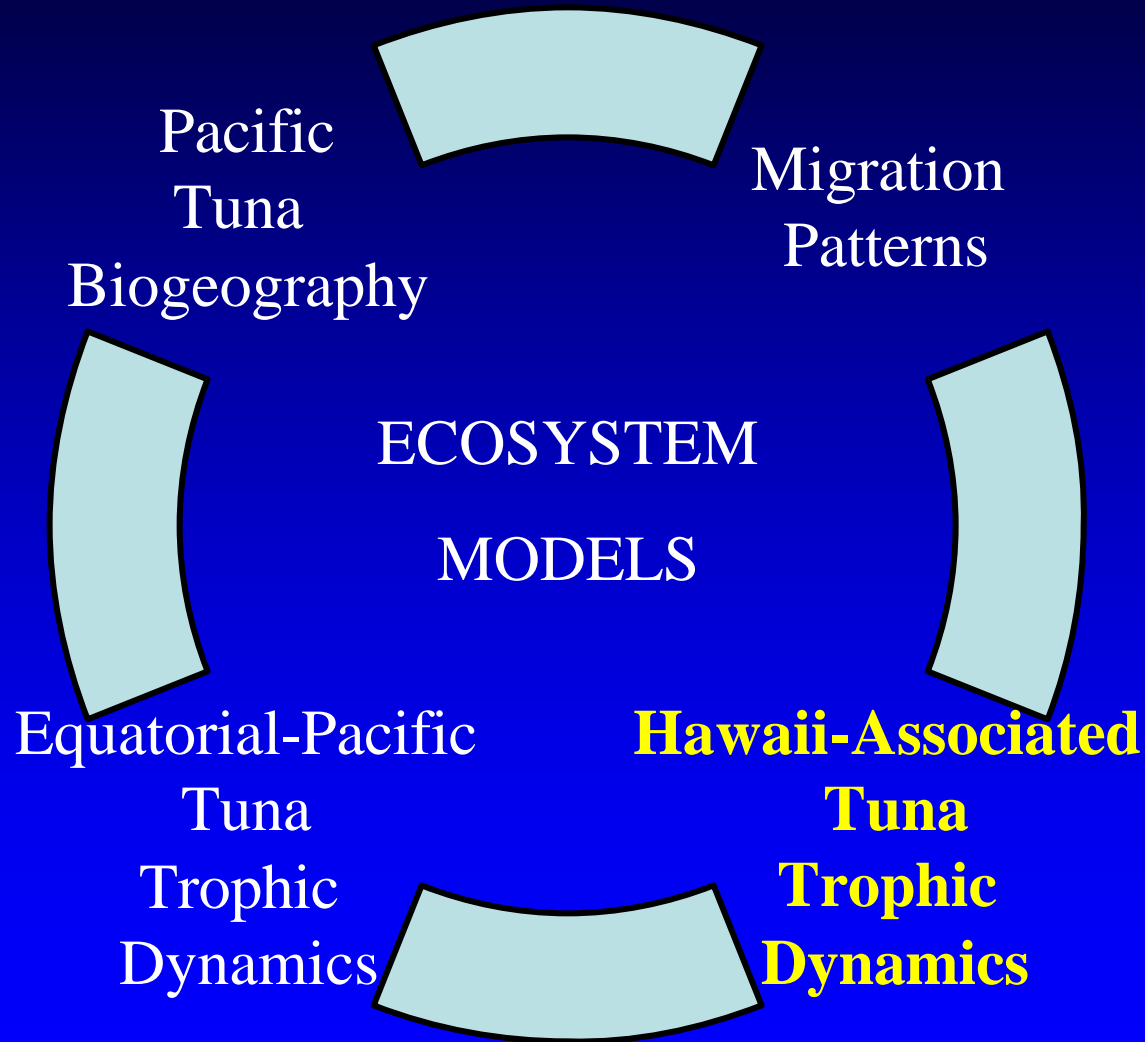
Courtesy of Dr. R. Doucett

“you are what you eat + 3 ‰”

An example: Southeast Alaska



Two PFRP Projects: The objectives



Hawaii-Associated Tuna Trophic Dynamics

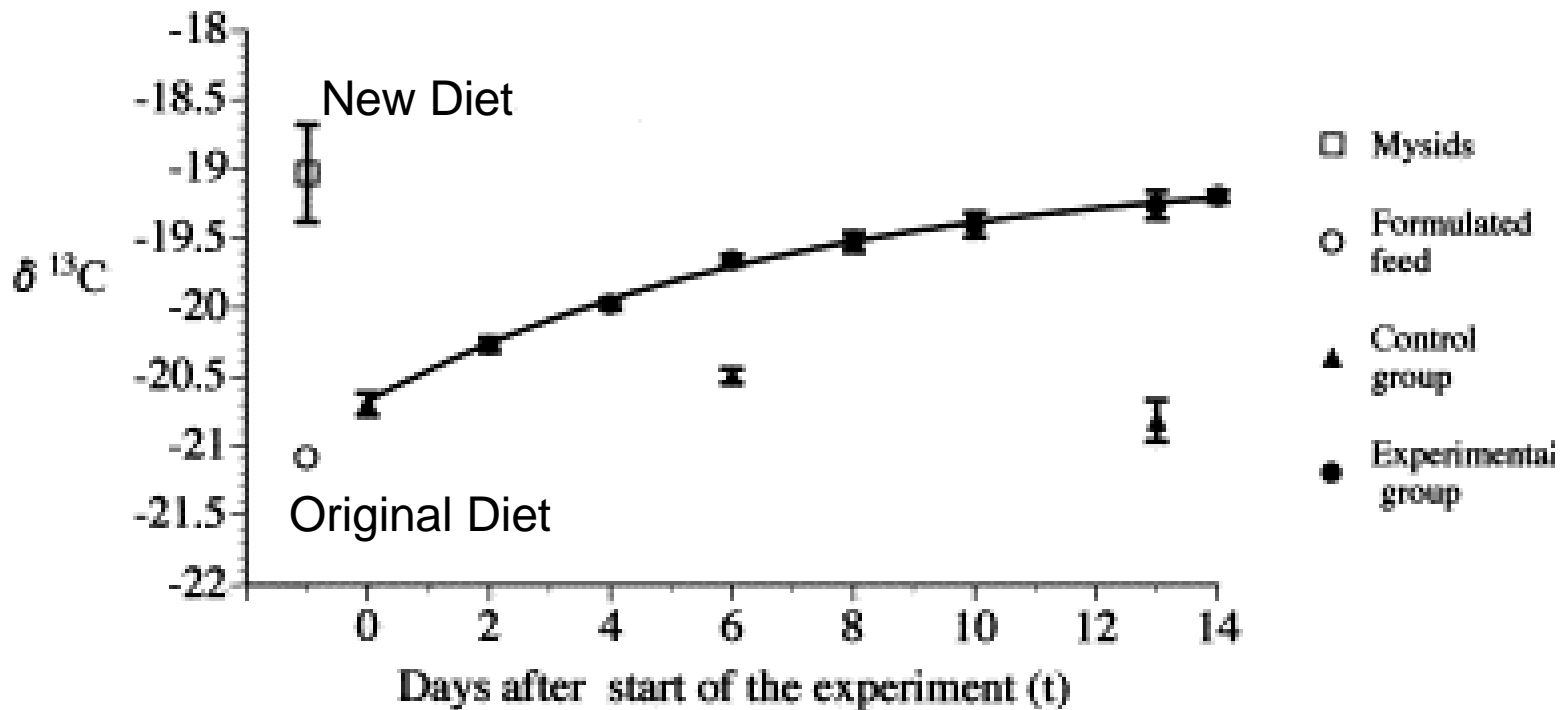
Measure *in situ* $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ to address:

- Individual Isotopic Variability
- Size or Ontogenic Variability
- Species differences
- FAD vs. Seamount Differences

Mesocosm Experiments/Feeding Trials:

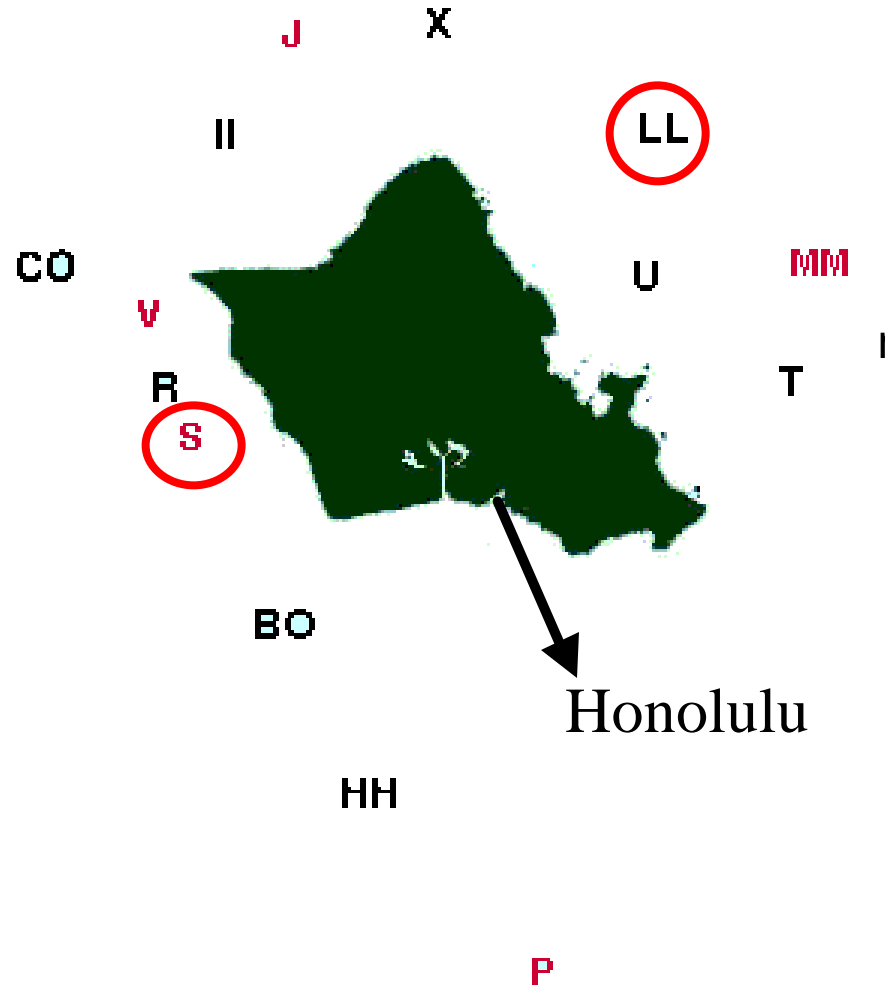
- Isotopic Pulse-Chase Experiments
 - Elucidate information on tissue turnover rates, metabolism, and tuna energetics.

Diet experiments: Revealing important isotopic information for trophic ecology studies.

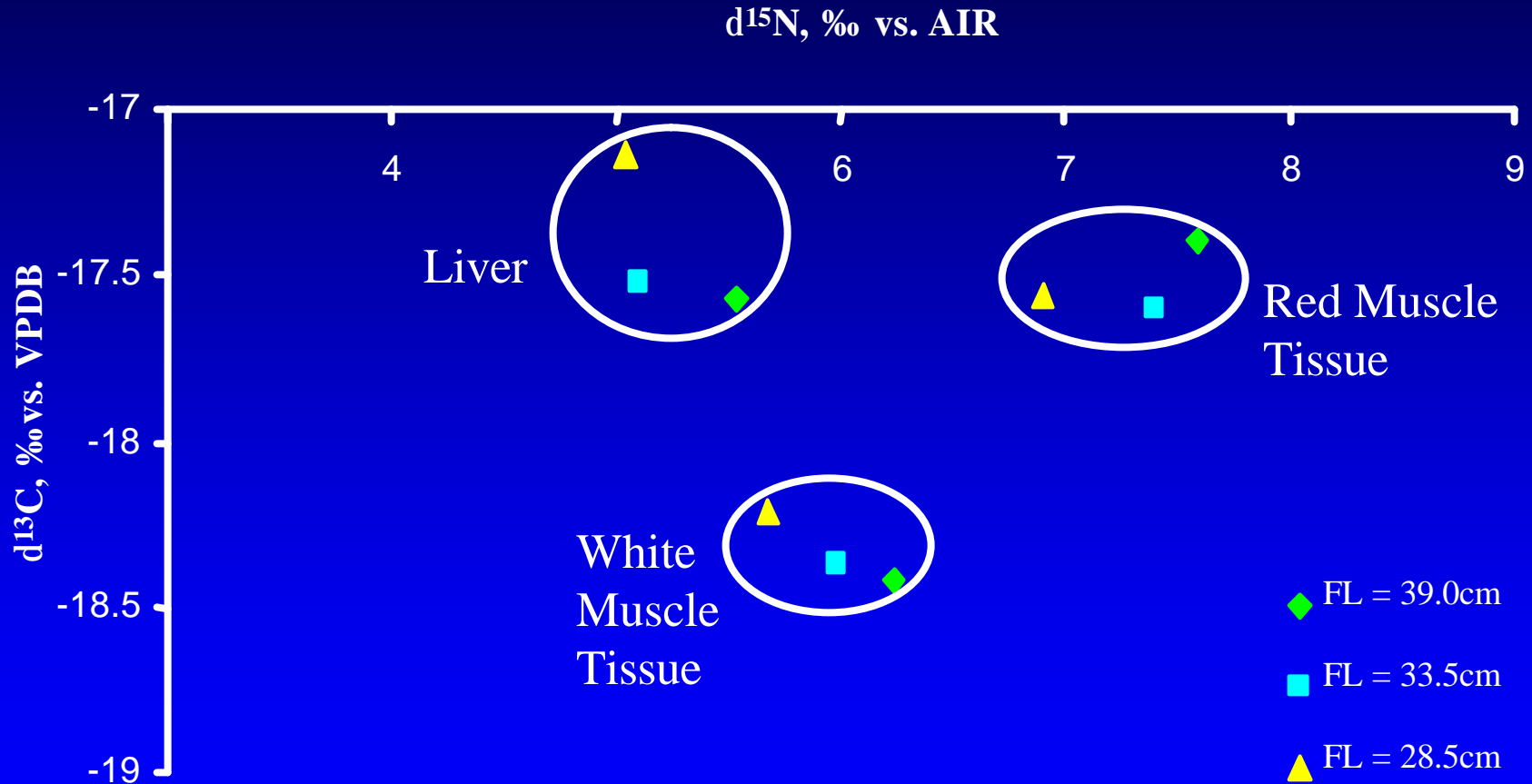


Tominaga et al. *In Press*.

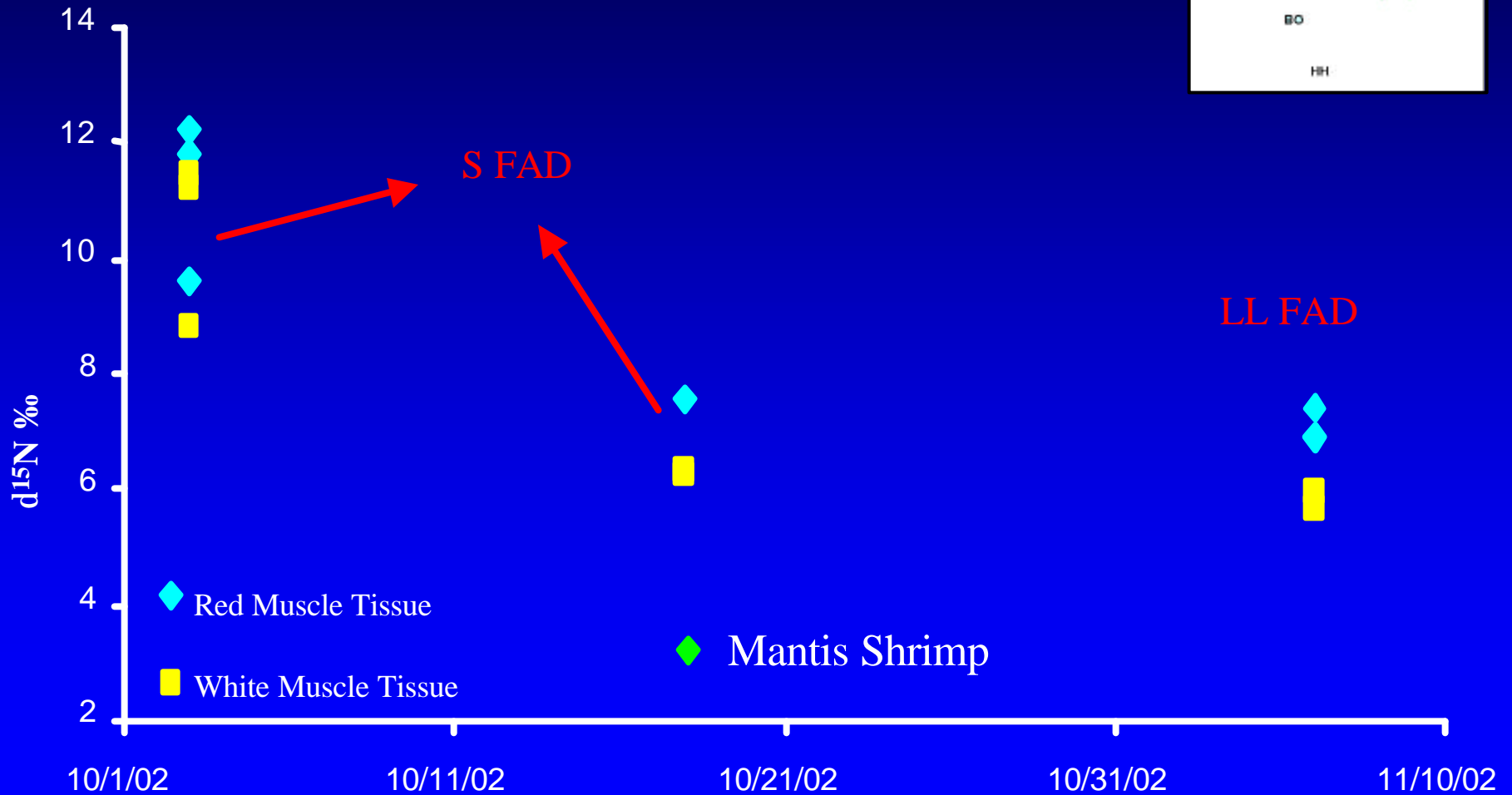
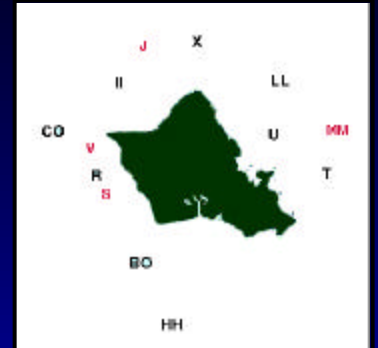
Hawaii FAD Program



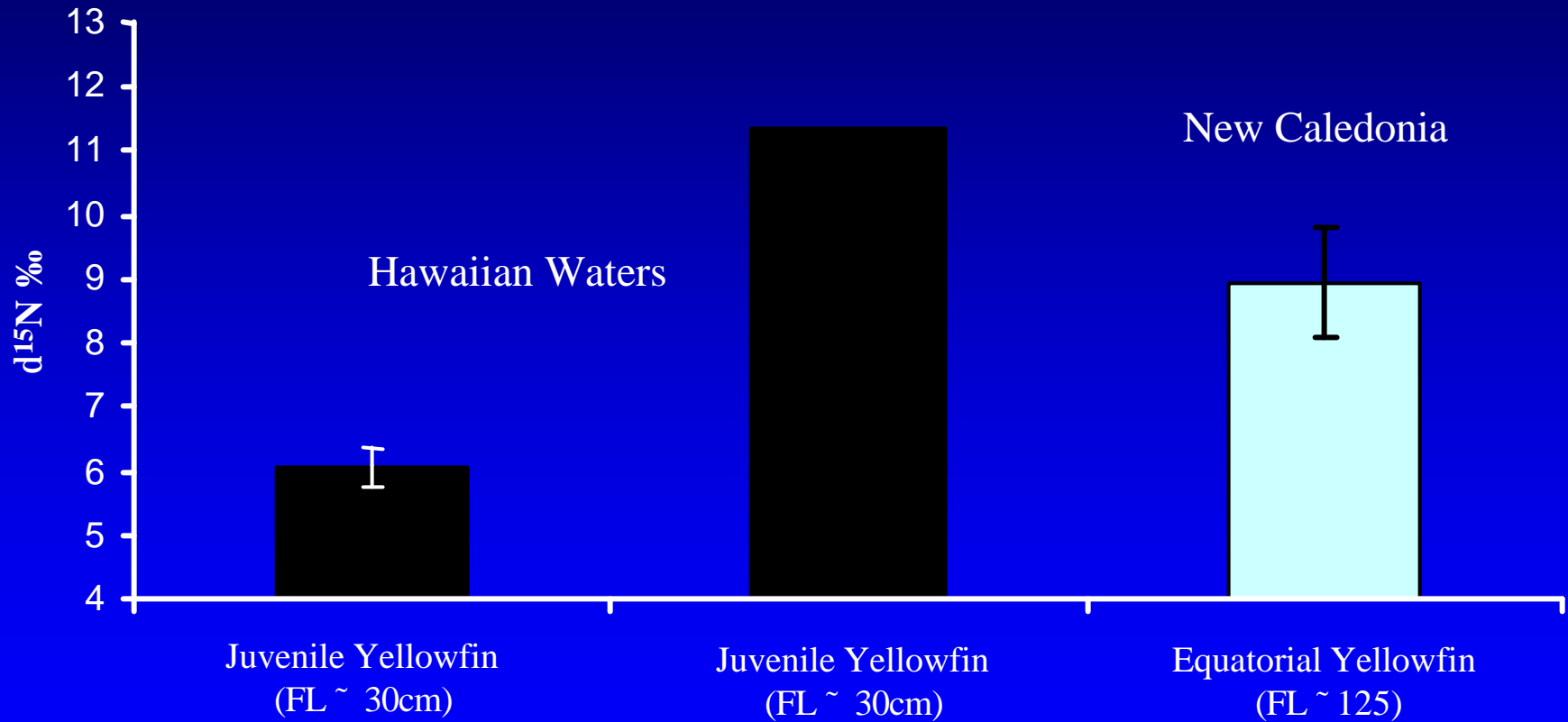
$d^{15}\text{N}$ vs. $d^{13}\text{C}$ of different tissue types in Hawaiian Yellowfin Tuna



$\delta^{15}\text{N}$ of Yellowfin Tuna from Hawaiian FADs



$\delta^{15}\text{N}$ Variability Among Yellowfin Tuna



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.
 - $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of tissues
 - $\delta^{13}\text{C}$ of lipid classes (i.e. compound specific isotope analysis).
- Determine trophic relationships
- Characterize tuna movements based on isotopic signatures.