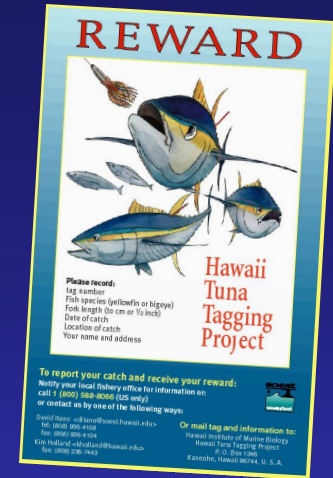


Tuna Tagging Programs undertaken by the *Pelagic Fisheries Research Program* around Hawaii



David Itano

*Kim Holland, Laurent Dagorn, Shiham Adam,
Dean Grubbs, Kevin Weng, Jeff Muir*

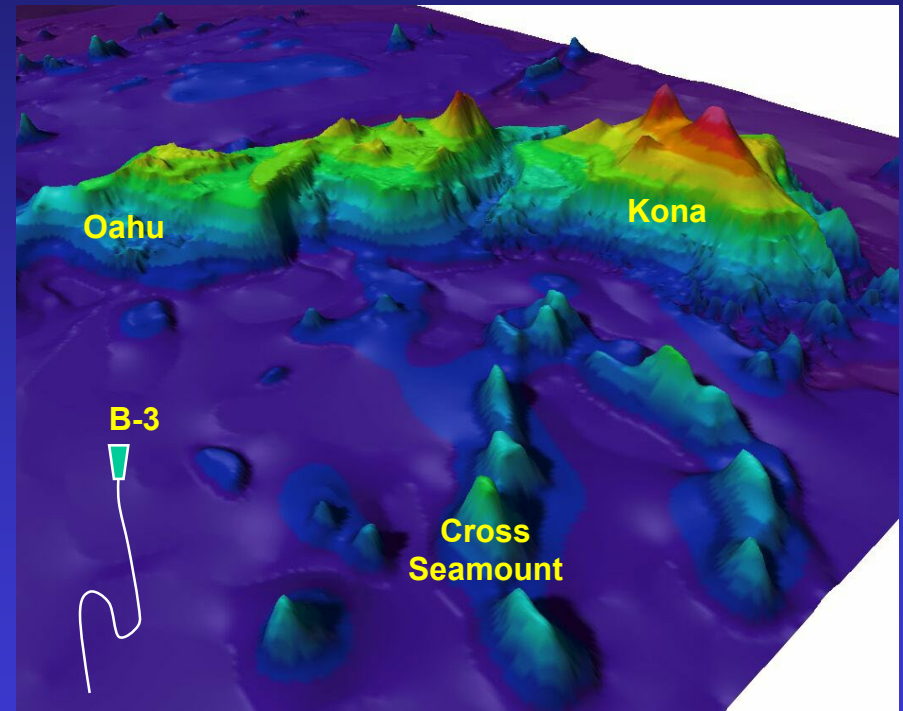
Hawaii-based Tagging programs and projects

Pelagic Fisheries Research Program

- 1) *Tag release program for Hawaiian Seamount YFT and BET tuna handline and troll fisheries (1995)*
- 2) *Hawaii Regional Tuna Tagging Project (HRTTP) (1996-2000)*
- 3) *Instrumented Buoys as Autonomous Observatories of Pelagic Ecosystems (2004-2009)*
- 4) *Investigation of Aggregation Behavior of FAD-Associated Tuna and Size Dependant Vertical Stratification (2005)*
- 5) *Scaling Up: Linking FAD-associated Local Behavior of Tuna to Regional Scale Movements and Distributions (2006-2010)*
- 6) *Hawaii Tuna Tagging Project 2 (2008-2010)*

*(1) Tag release program for Hawaiian Seamount YFT and BET tuna
handline and troll fisheries (1995)*
<Holland>

- Location: Cross Seamount
- Motivation: fishermen
- Objectives:
 - Movement
 - Residence times
 - Interaction: surface and longline fisheries



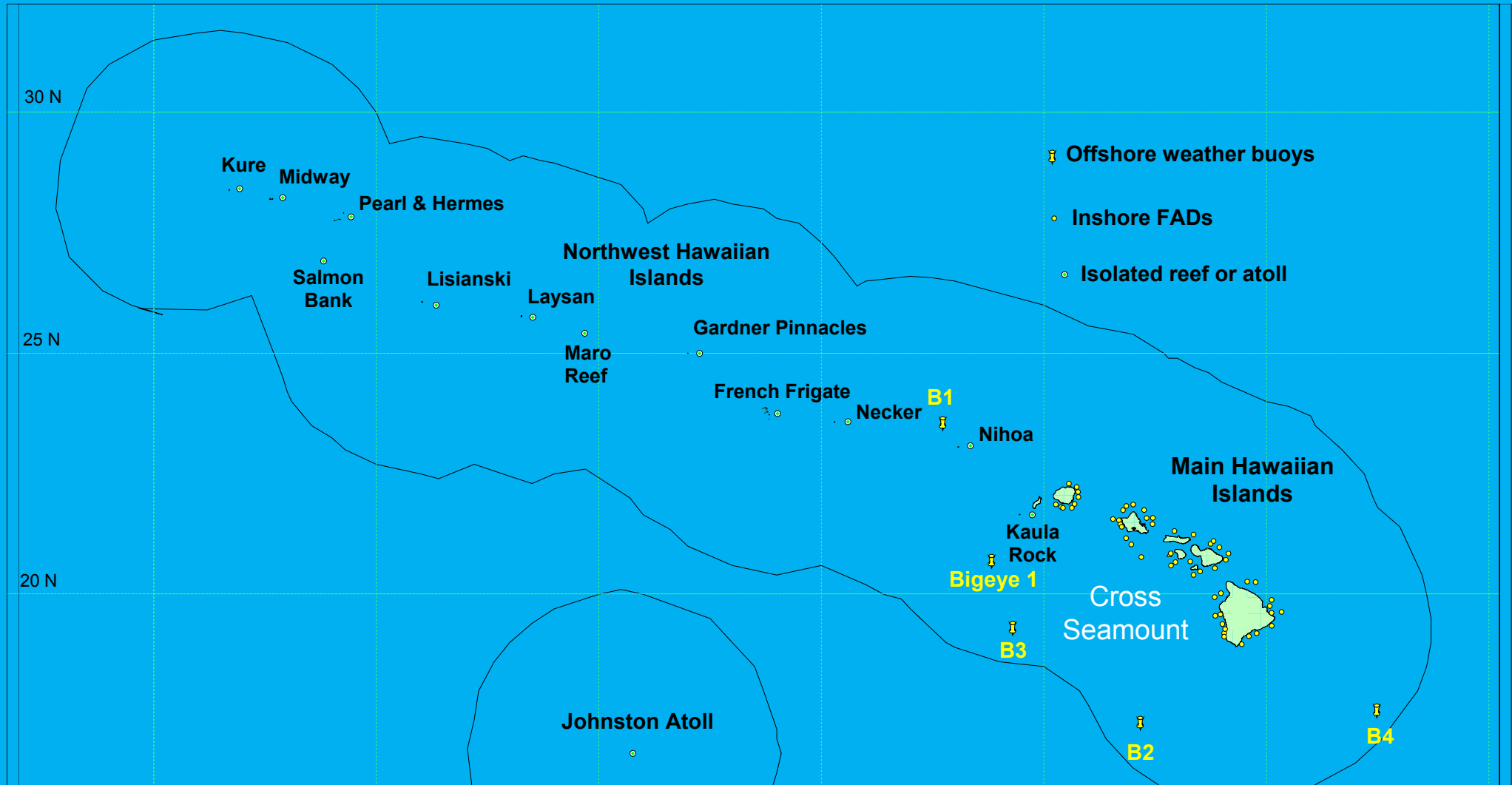
(2) Hawaii Tuna Tagging Project (HTTP) (1996-2000)
<Holland and Itano>

- Justification
 - SPC tagging focused on Equatorial resources, not addressing Hawaii's situation
 - Focus on archipelagic scale study
- Background and support
 - Seamount tagging program (pilot study)
 - Tag-recapture design study (PFRP)
- Hawaii Tuna Tagging Workshop (Nov 1996)
 - Design, structure, implementation of “ideal” tagging project for HI and central Pacific

HTTP (1996-2000)

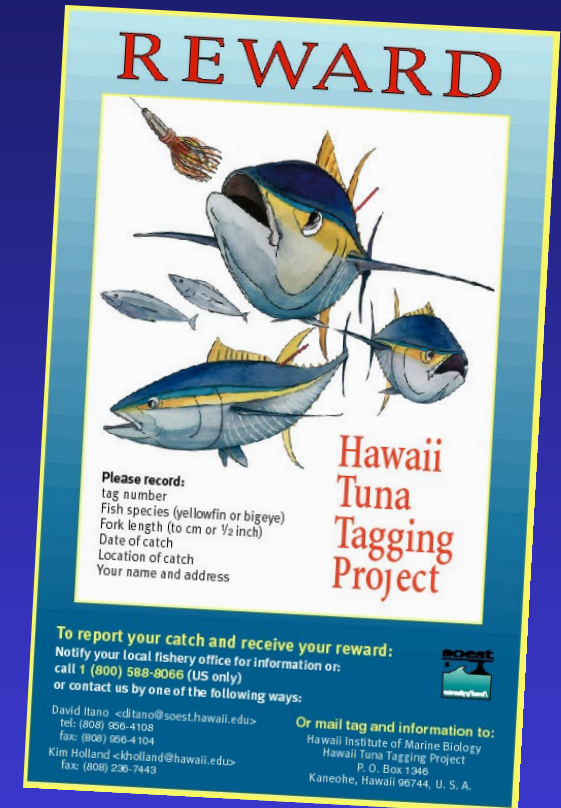
- Objectives (Bigeye, Yellowfin, Seamount HL fishery, dart tags)
 - Movement within Hawaii fishing grounds
 - Interaction: direct gear, growth, spatially segregated
 - Exploitation rates/differential vulnerability – seamounts and FADs
 - Aggregation effects, retention rates, residence times
- Secondary objectives
 - Long distance movement, interaction
 - Stock structure, mixing rates
 - Biological parameters (age, validation, growth)
 - Life history information, habitat utilization

Fishing/Tagging grounds - the Hawaiian Archipelago



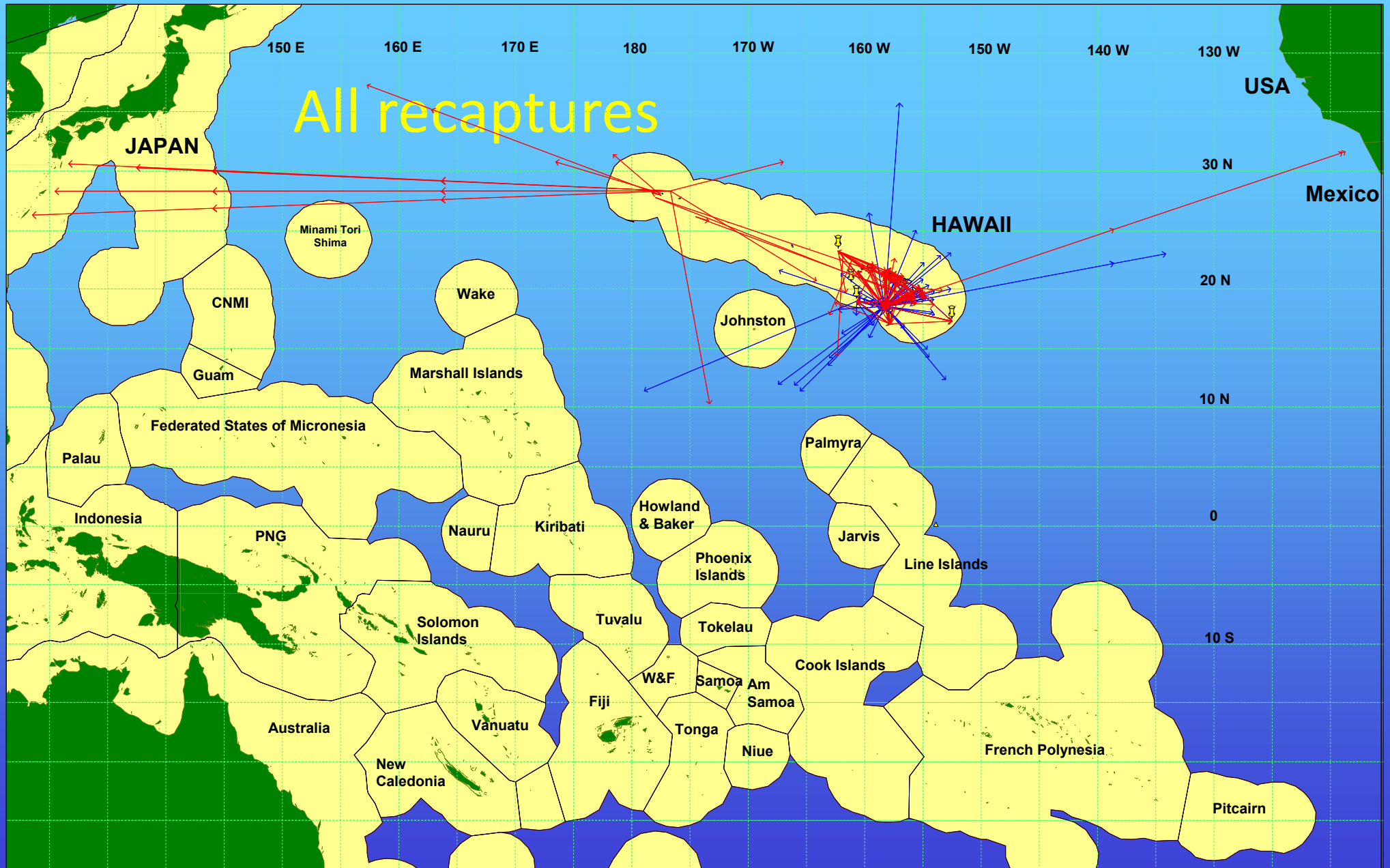
HTTP (1996-2000)

- Tag releases
 - Total tag releases: 17,986
 - Release species: Yellowfin : Bigeye @ at 53:47 ratio
 - Recapture rate: 12.5% overall
 - Juvenile releases up to ~50 lbs whole wt (100-106 cm max)
- Publicity and rewards
 - Local saturation: fishing magazines, radio, posters, fishing club visits
 - International outreach and cooperation
- Compensation for tagging and recaptures
 - Market value + fuel and food
 - Tag rewards (T shirts, coozies, hats)



Model structure and outputs

- Bulk transfer model (Adam): describe rate of loss of tagged fish by all means
- Model estimates:
 - Size and species-specific M and F rates
 - Transfer rates between model areas
- Use estimates to calculate:
 - Residence times, persistence or transience
 - Harvest rates

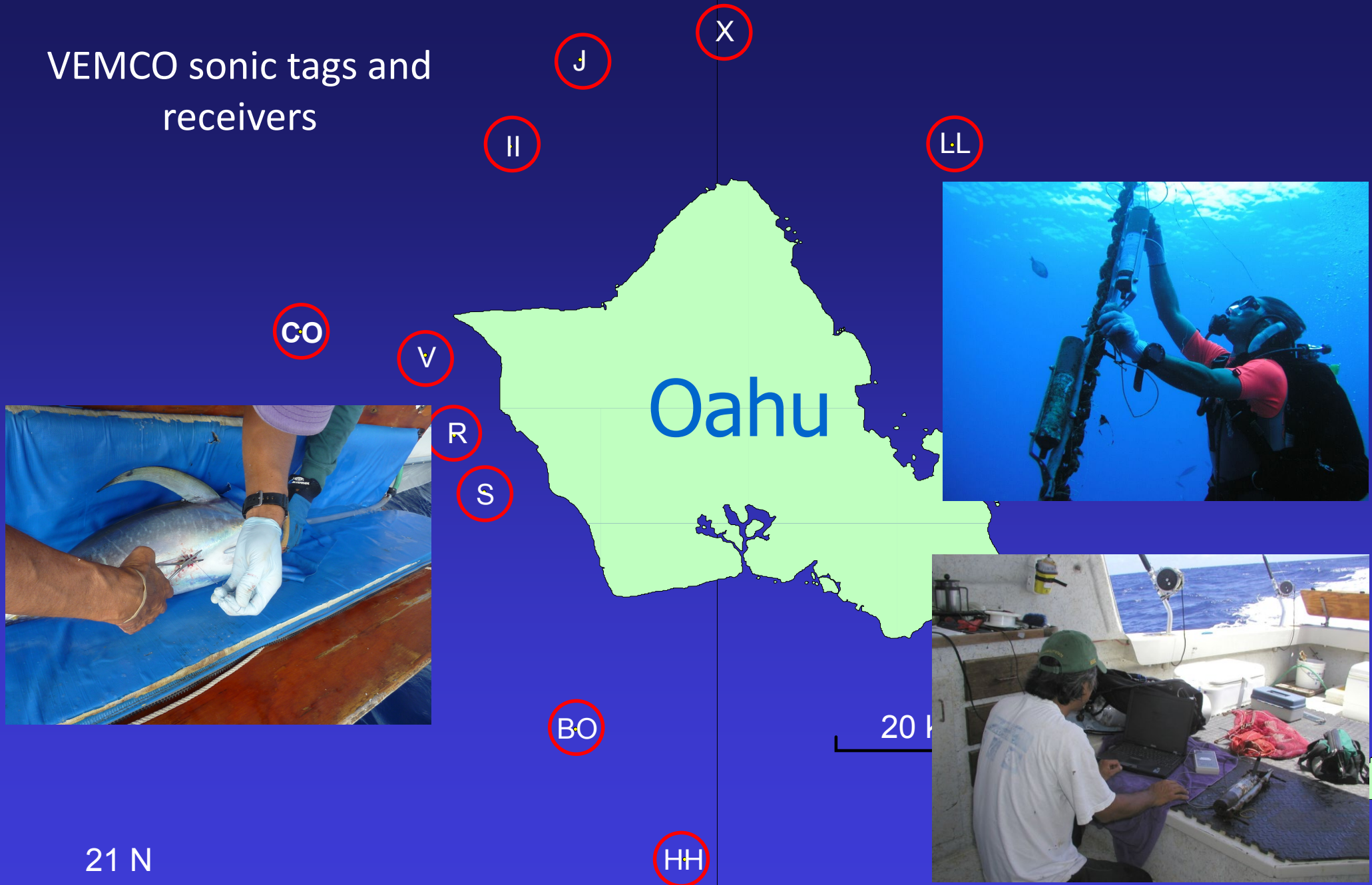


(3) Instrumented Buoys as Autonomous Observatories of Pelagic Ecosystems

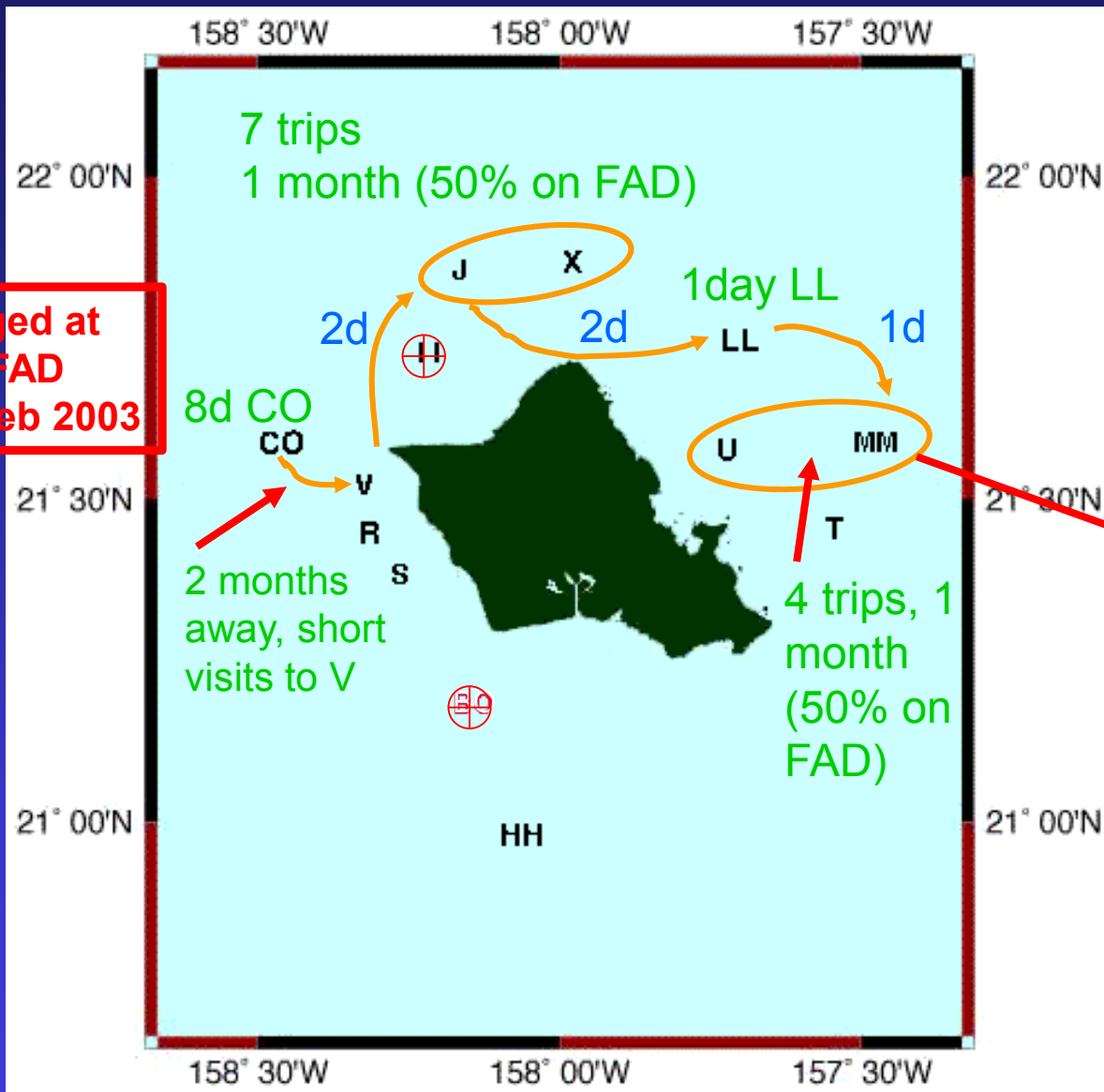
<Holland and Dagorn>

- Development of criteria for designing Ecology Tags. Identification of underwater sounds in captivity and in the pelagic environment
- Development and testing of an autonomous 360° sonar buoy to monitor FAD aggregations
- Monitoring behavior of tuna and non-tuna species associated with Hawaiian FADs

VEMCO sonic tags and receivers



4 month history of YFT #77



FAD movements:

CO→V→CO→V→J→X→J→X→J→X→J→L
L→MM→U→MM→U→MM→Recaptured

24% on FAD (> 4 months)



Recaptured at MM FAD
July 4

what we can get from acoustic data

- residence times of tuna on FADs
- exact time of arrival at FAD and departure by species
- recapture rates on FADs
- Presence/absence data to evaluate “good” FADs from “bad” FADs by species
- understanding of how “groups” or subsets of FADs work within a larger network
- behavioral data on how tuna move between FADs
- information on school fidelity and cohesion
- post-tagging survival in relation to tagging protocols

Its size and species specific and fishery independent

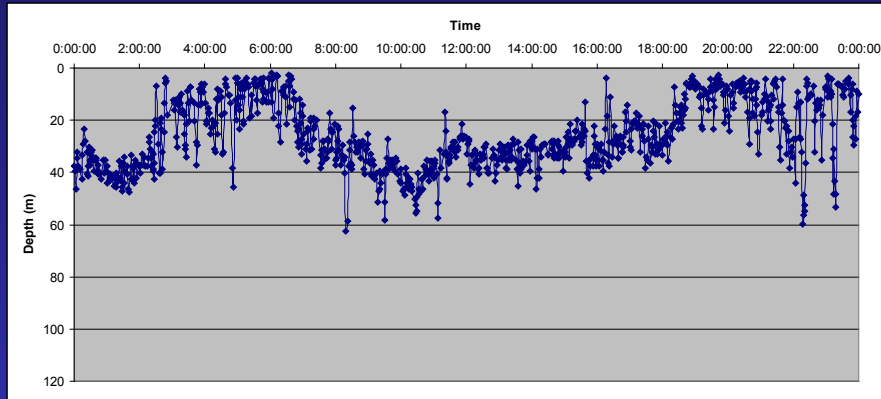
(4) Investigation of Aggregation Behavior of FAD-Associated Tuna and Size Dependent Vertical Stratification

<Holland, Itano, Dagorn, Grubbs>

- Obtain information on aggregation dynamics and structure-associated behavior in juvenile tunas
 - Size-dependent vertical stratification by species
- What are tuna (of different sizes and species) doing at FADs
 - Management implications to the purse seine fishery
- Utilization of pressure recording, depth reporting acoustic tags

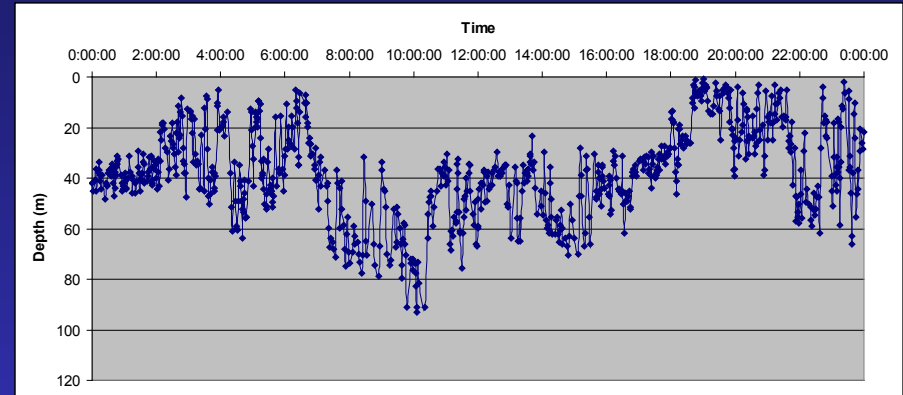
Concurrent residence and vertical behavior on CO FAD

Depth recording sonic tags

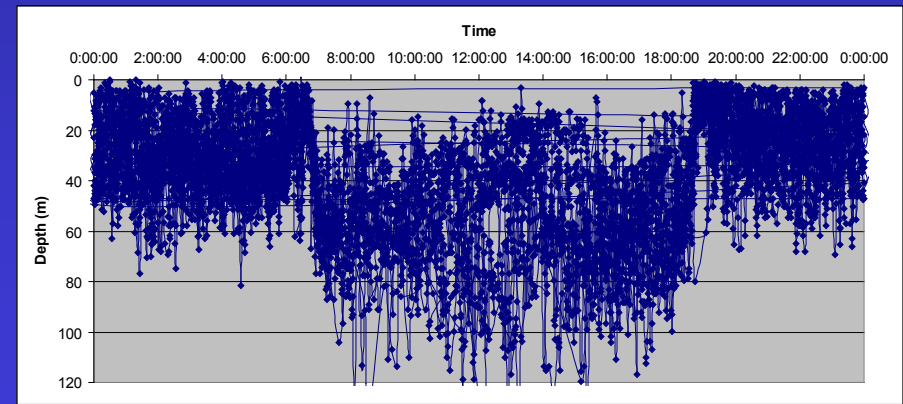
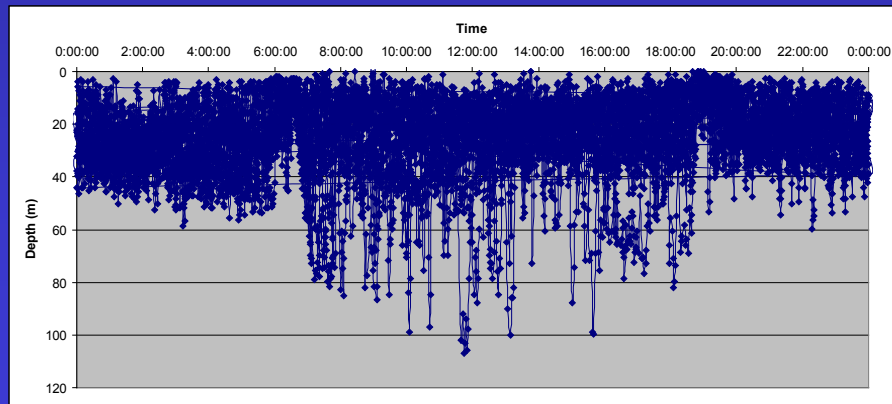


Yellowfin (40 cm)

10 February 2005



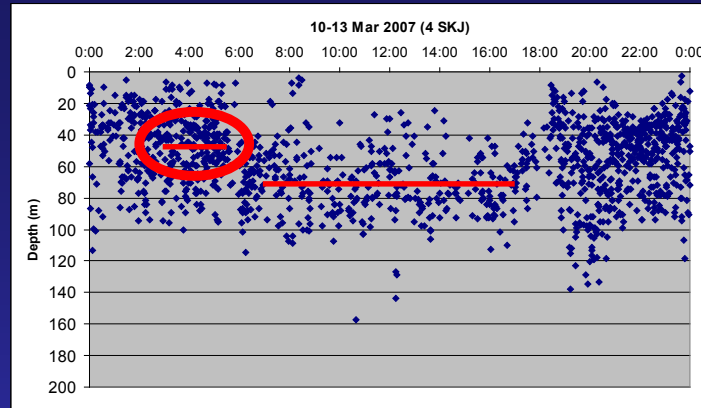
Bigeye (38 cm)



10 – 19 February 2005 : Ten days of concurrent FAD behavior

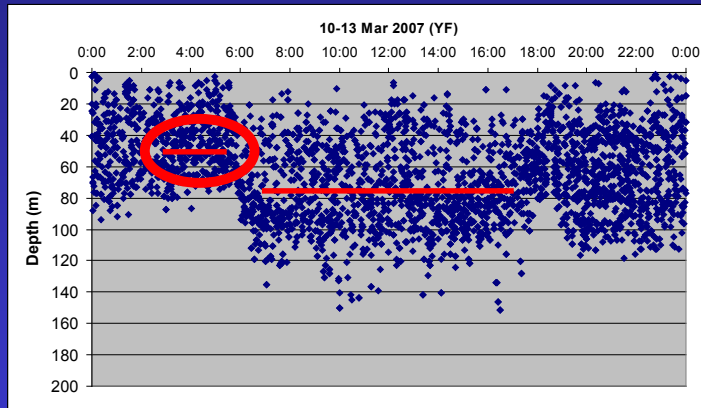
concurrent depth records from depth recording acoustic tags and FAD-mounted receivers

SKJ n=4
50 – 53 cm



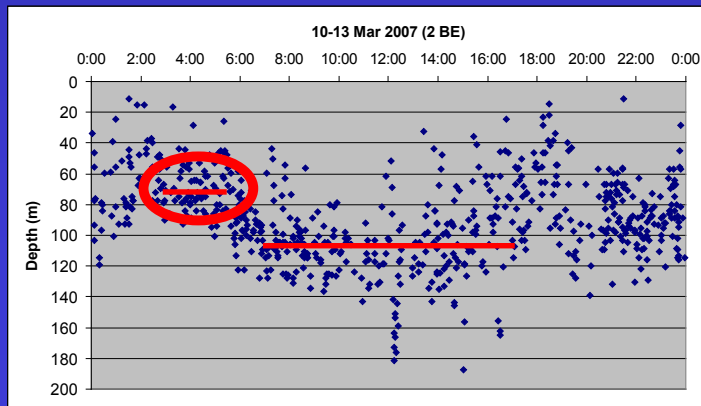
Daytime depth
mean 72 m

YFT n=6
48 – 57 cm



Daytime depth
mean 76 m

BET n=2
60 cm



Daytime depth
mean 105 m

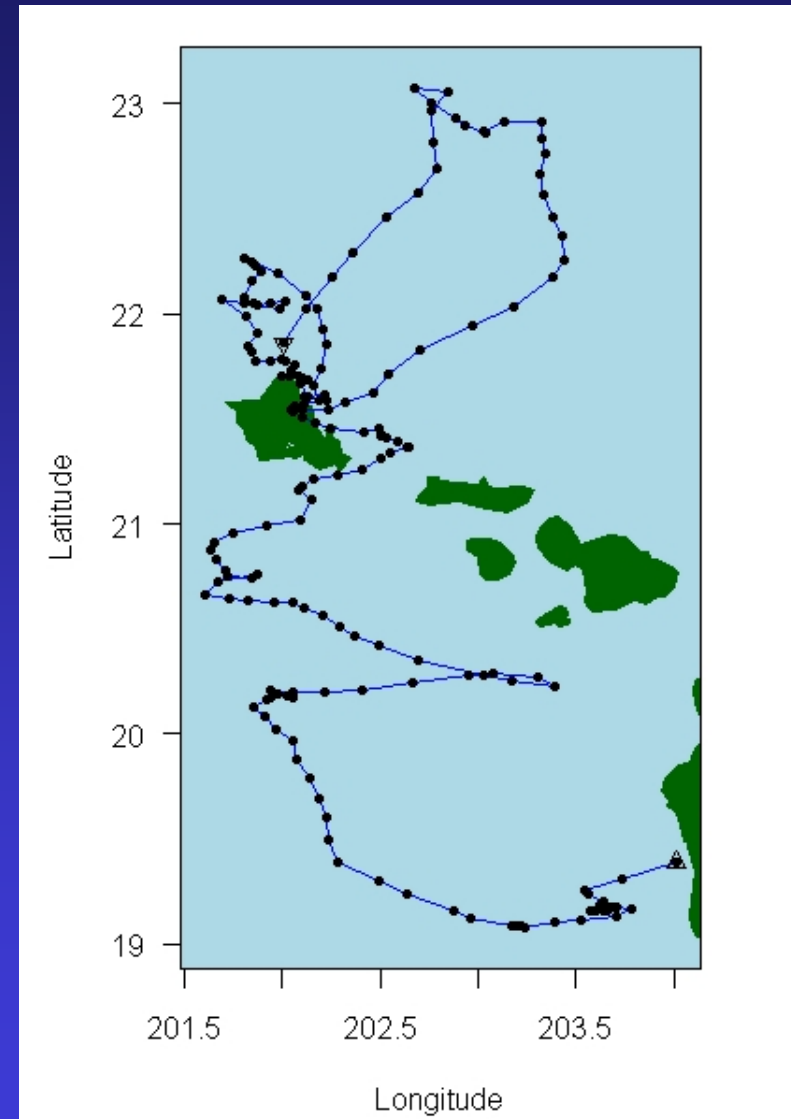
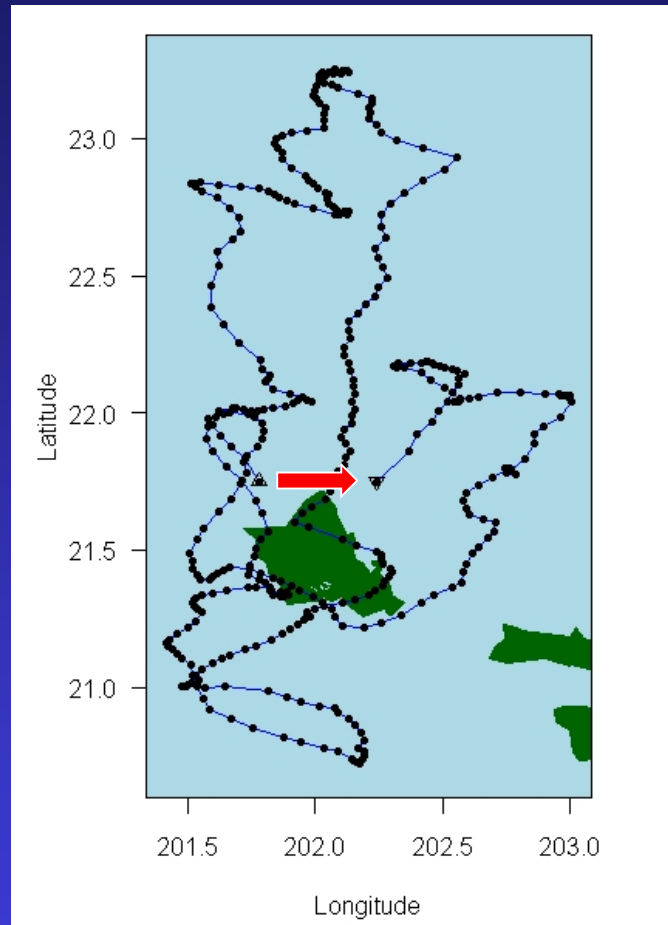
(5) Scaling Up: Linking FAD-associated Local Behavior of Tuna to Regional Scale Movements and Distributions

<Holland and Dagorn>

Question: What is the functional size of the environment for pelagic species caught by Hawaii's pelagic fisheries?

- Use of coded acoustic, **internal archival and external satellite PAT tags**
 - Provide short, medium and long-term movement and behavioral data
- What happens when tuna leave the monitored FAD array?
- Examine vertical behavior of tunas as a proxy for associative behavior
- Develop and test new PAT tag anchor and attachment methods

On FAD and offshore behavior to examine “home range” of Yellowfin Tuna



Use of archival and PAT tag data

Vertical behavior of tuna by aggregation type



Double tagging with ACOUSTIC + ARCHIVAL TAGS

... what are other top predators doing at the FADs ?



- use of V16 sonic tags rigged externally
- trials on shortbill spearfish and striped marlin
- external attachment with steel or nylon anchors proved unsuitable



Hawaiian
striped marlin

double tagged with
sonic and satellite tags



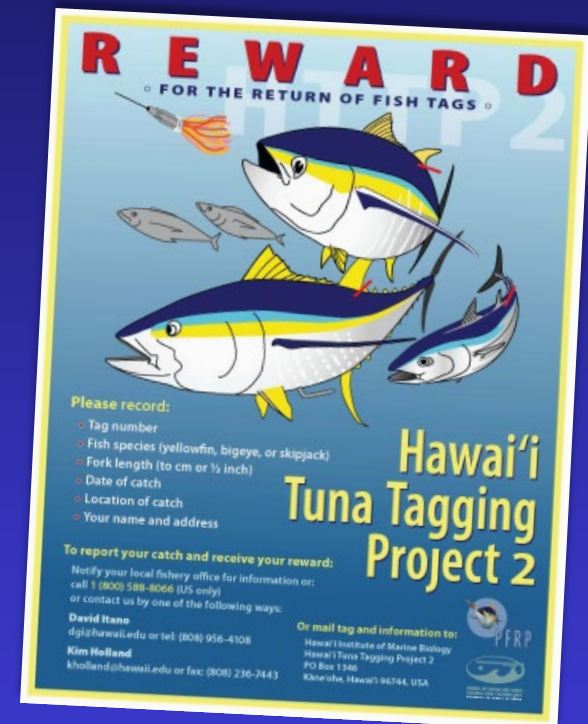
Sonic tags for local behavior, ..

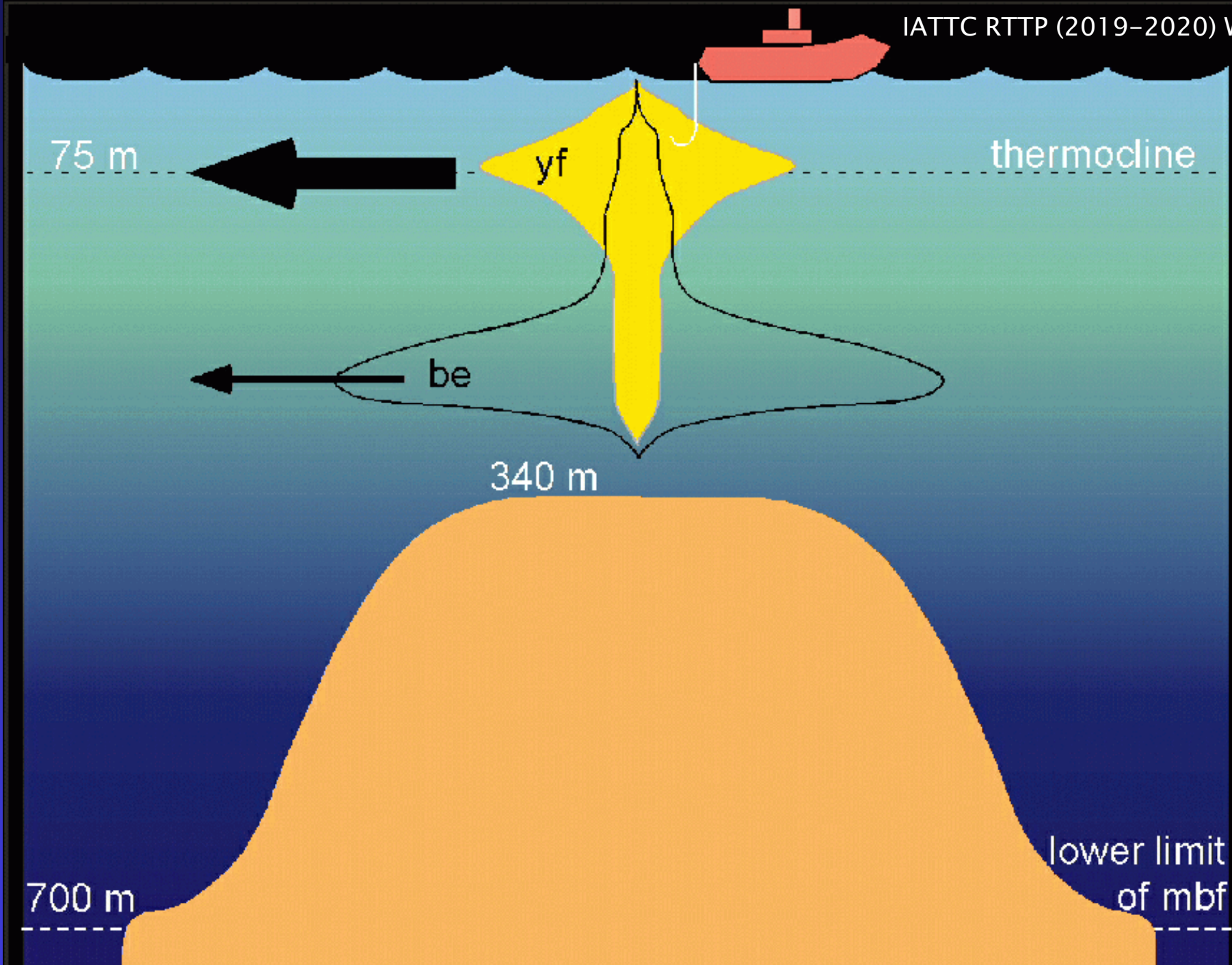
Popup satellite archival tags for long-
distance movement and stock structure

(6) Hawaii Tuna Tagging Project 2 (2008-2010)

<Holland, Itano, Weng>

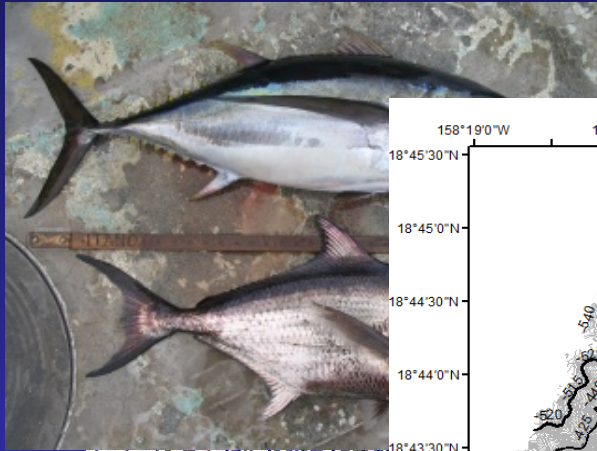
- Update estimates of M and F and movement (dispersal) parameters for yellowfin and bigeye and obtain first estimates for Hawaii **SKIPJACK**
- Continuation of existing PFRP tagging projects to define the home range for “Hawaiian” tuna *using conventional, sonic, archival and PAT tags,*
- ... with a greater emphasis on areas and species under-represented during HTTP
- ... with addition of new species not represented during HTTP, i.e.
 - Skipjack
 - Monchong (*Eumegestis illustris*)
- Integrate data with WCPFC PTPP



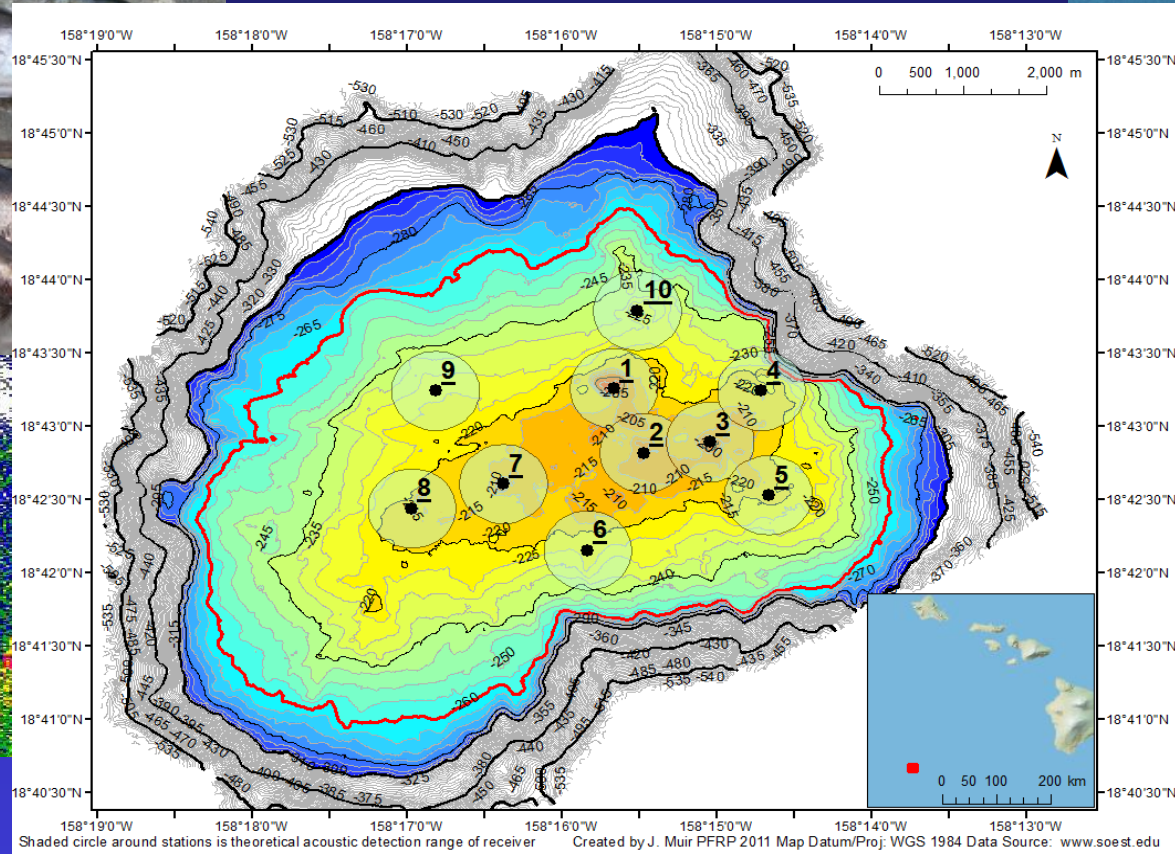
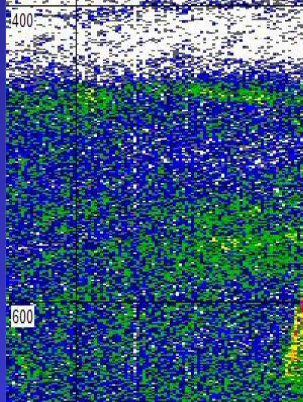


Cross Seamount acoustic tagging and imaging (2009)

<Muir>



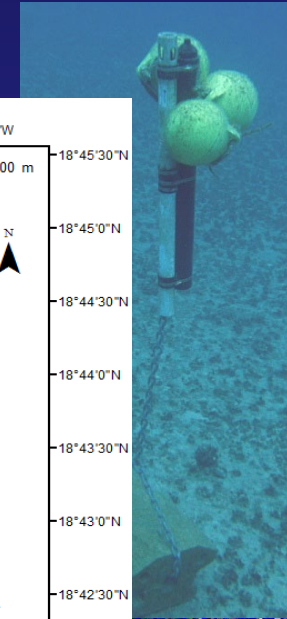
38 kHz



11:40

Study	Year	Method	Residence time (d)
Holland et al	1999	Tag-recap attrition curves	32
Sibert et al	2000	Tag-recap attrition modeling	97.6 +/-18.5
Current	2009	Ultrasonic telemetry	180 +

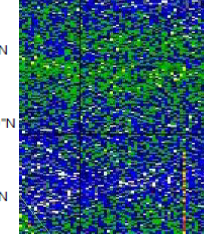
12:00



← 200m

← 400m

← 600m



Hawaii-based tagging Pros and Cons

- Positives

- Strong local cooperation
- Interested, informed fishermen
- Capable and varied scientific community
 - Design workshop
- Strong management system
- Tagging is often the solution

- Negatives

- Reward limitations
- Private FADs
- Hard to tag unassociated tuna
- Expensive fish
- Difficulty to charter vessels
- Lack of pole-and-line option
- Liability, insurance and rules

Mahalo

<http://www.soest.hawaii.edu/PFRP/biology/biology.html>

