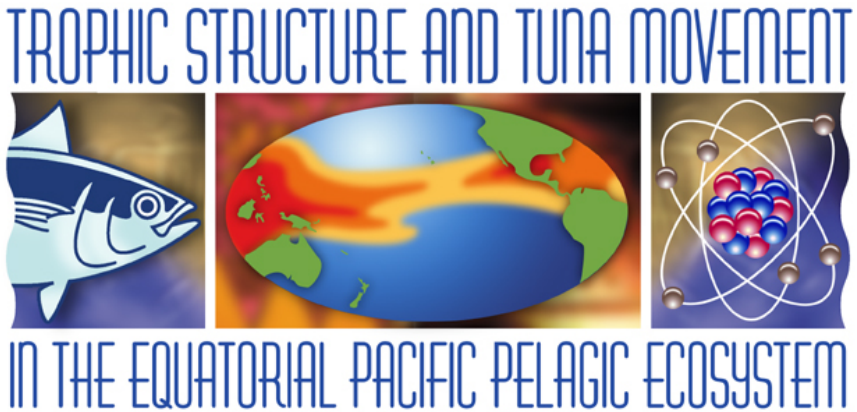
TUNA trophic structure in the Pacific Ocean

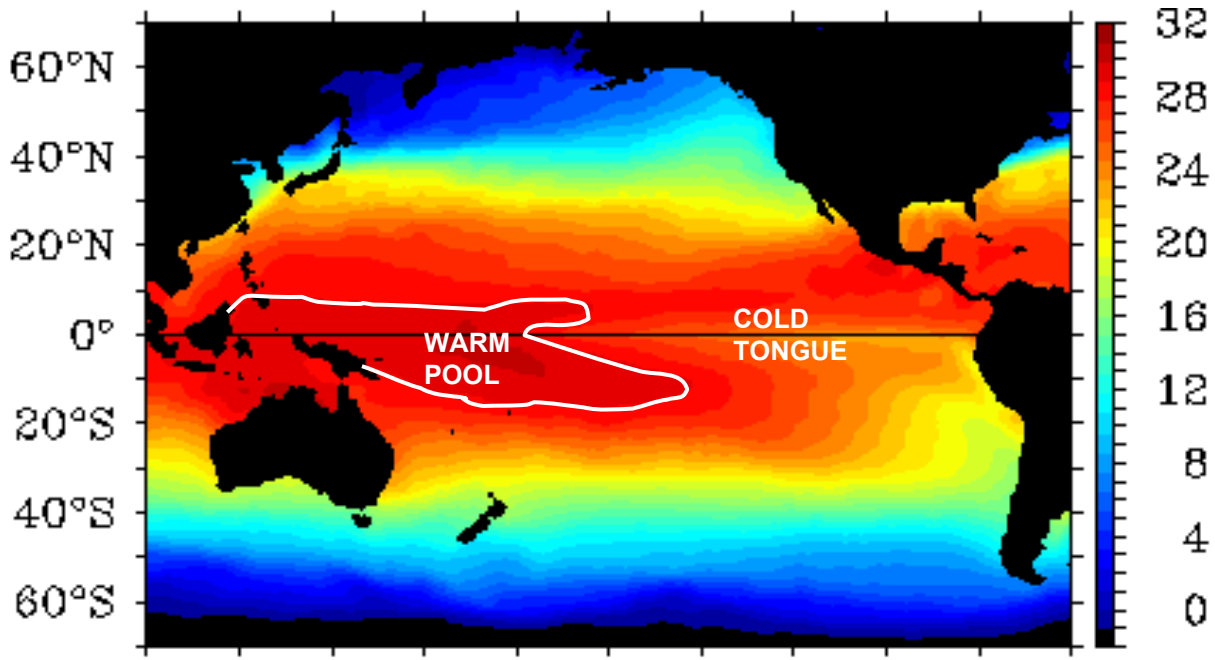
Valerie ALLAIN – SPC Noumea
Brian POPP – UH Honolulu
Felipe GALVAN – CICIMAR La Paz
Brittany GRAHAM – UH Honolulu
Bob OLSON – IATTC San Diego
Brian FRY – LSU Baton Rouge



PFRP funded project

OBJECTIVE 1

Define the trophic structure of the pelagic ecosystems in the different areas of the tropical Pacific ocean



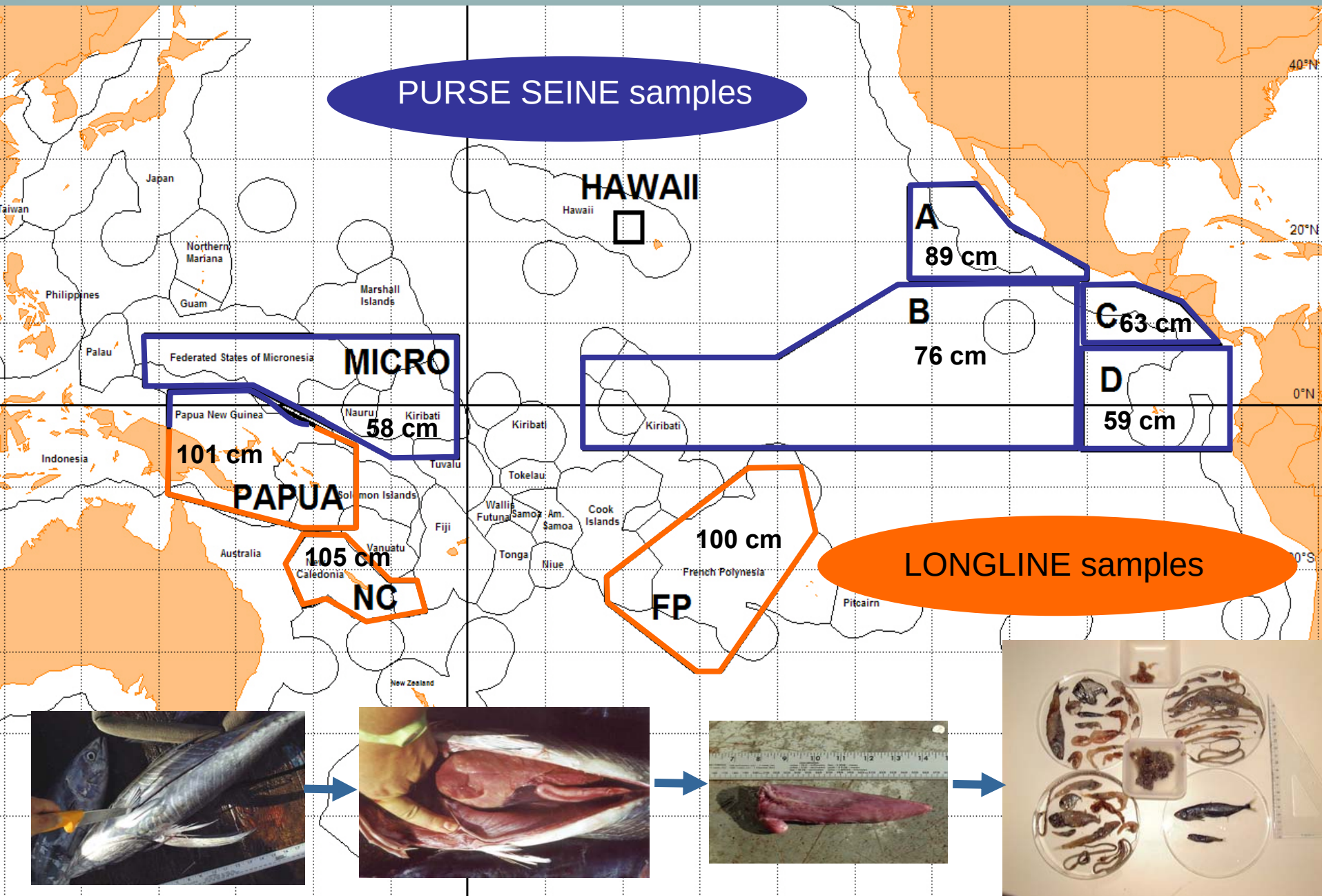
WARM POOL

warm water
low primary productivity
TUNA MAXIMUM BIOMASS

COLD TONGUE

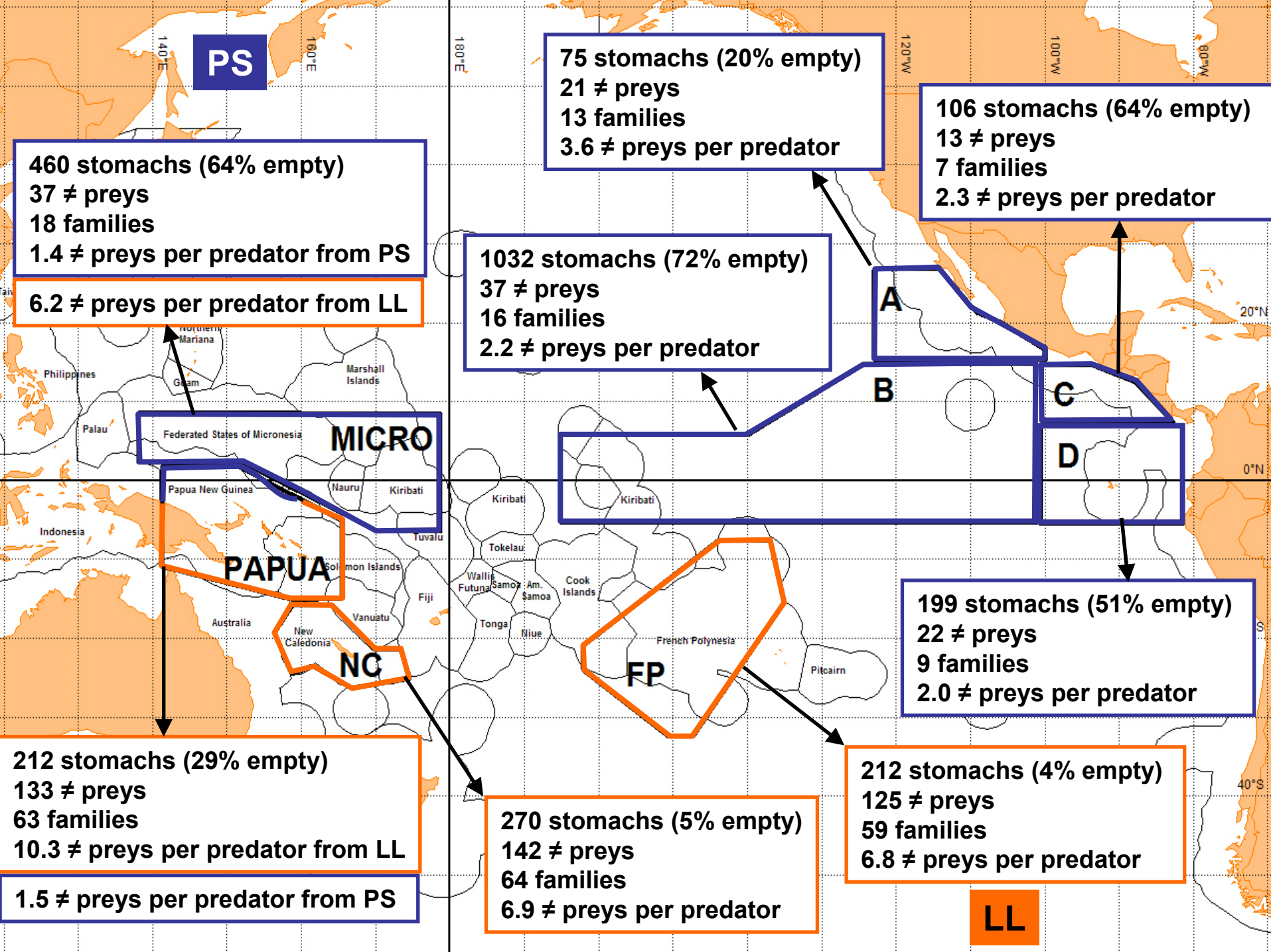
strong divergent equatorial upwelling
high primary production

SAMPLING OF STOMACH AND MUSCLE SAMPLES IN THE WESTERN, CENTRAL AND EASTERN PACIFIC



PREY DIVERSITY in stomach contents

Stomach content of a BET caught by a LL in French Polynesia


PS
460 stomachs (64% empty)
37 ≠ preys
18 families
1.4 ≠ preys per predator from PS
6.2 ≠ preys per predator from LL
MICRO
PAPUA
NC
212 stomachs (29% empty)
133 ≠ preys
63 families
10.3 ≠ preys per predator from LL
1.5 ≠ preys per predator from PS
75 stomachs (20% empty)
21 ≠ preys
13 families
3.6 ≠ preys per predator
1032 stomachs (72% empty)
37 ≠ preys
16 families
2.2 ≠ preys per predator
A
B
C
D
106 stomachs (64% empty)
13 ≠ preys
7 families
2.3 ≠ preys per predator
199 stomachs (51% empty)
22 ≠ preys
9 families
2.0 ≠ preys per predator
FP
212 stomachs (4% empty)
125 ≠ preys
59 families
6.8 ≠ preys per predator
270 stomachs (5% empty)
142 ≠ preys
64 families
6.9 ≠ preys per predator
LL
140°E
160°E
180°E
120°W
100°W
80°W
20°N
0°N
40°S
Philippines
Northern Mariana
Guam
Marshall Islands
Palau
Federated States of Micronesia
Papua New Guinea
Nauru
Kiribati
Indonesia
Tuvalu
Tokelau
Solomon Islands
Wallis Futuna
Samoa
Am. Samoa
Cook Islands
Fiji
Vanuatu
Tonga
Niue
Australia
New Caledonia
French Polynesia
Pitcairn

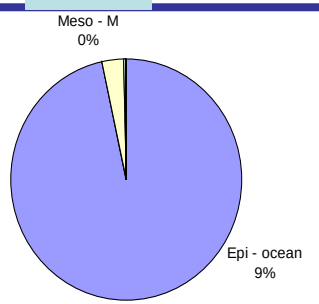
SKJ

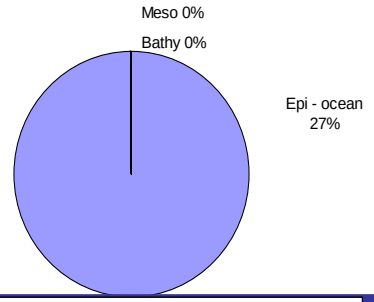
YFT

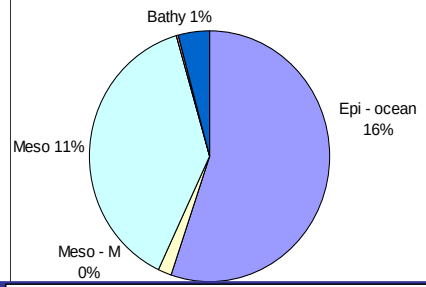
BET

MICRO

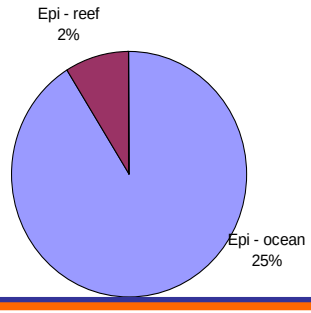
PS

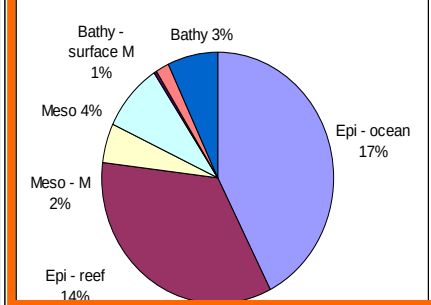


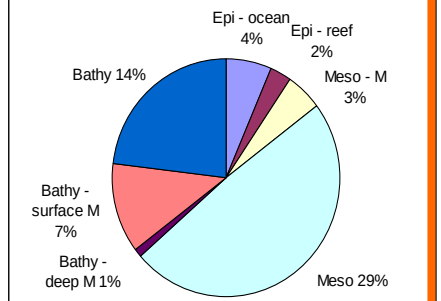




PAPUA

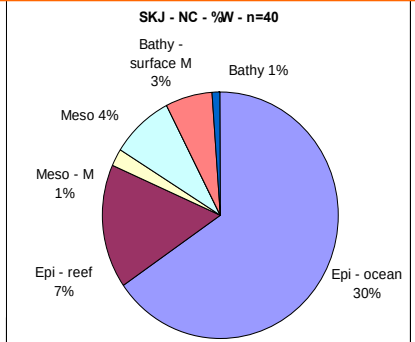


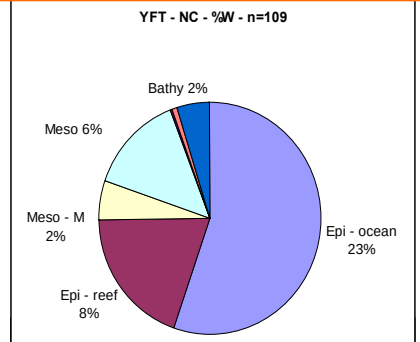


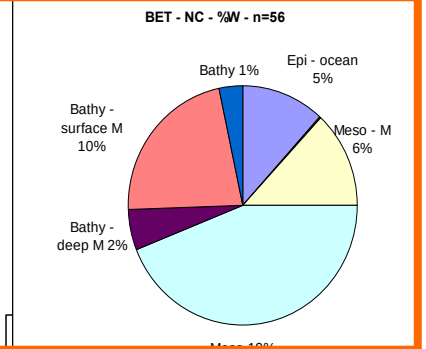


NC

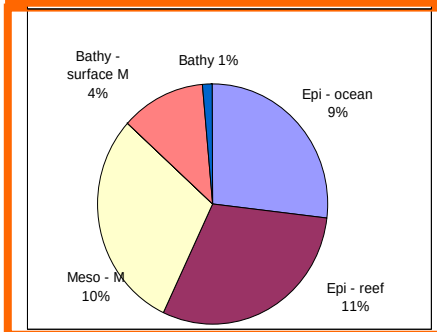
LL

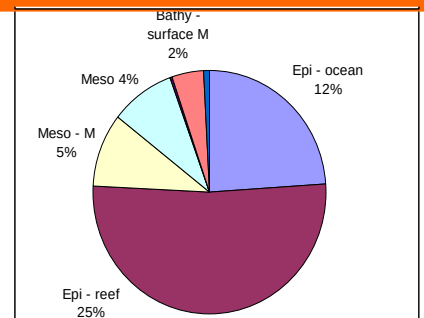


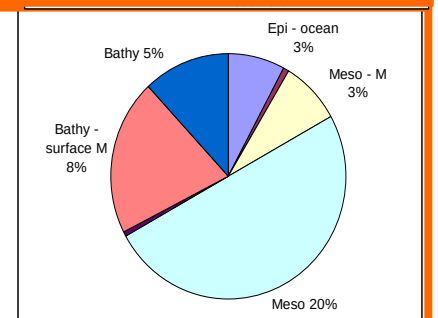




FP



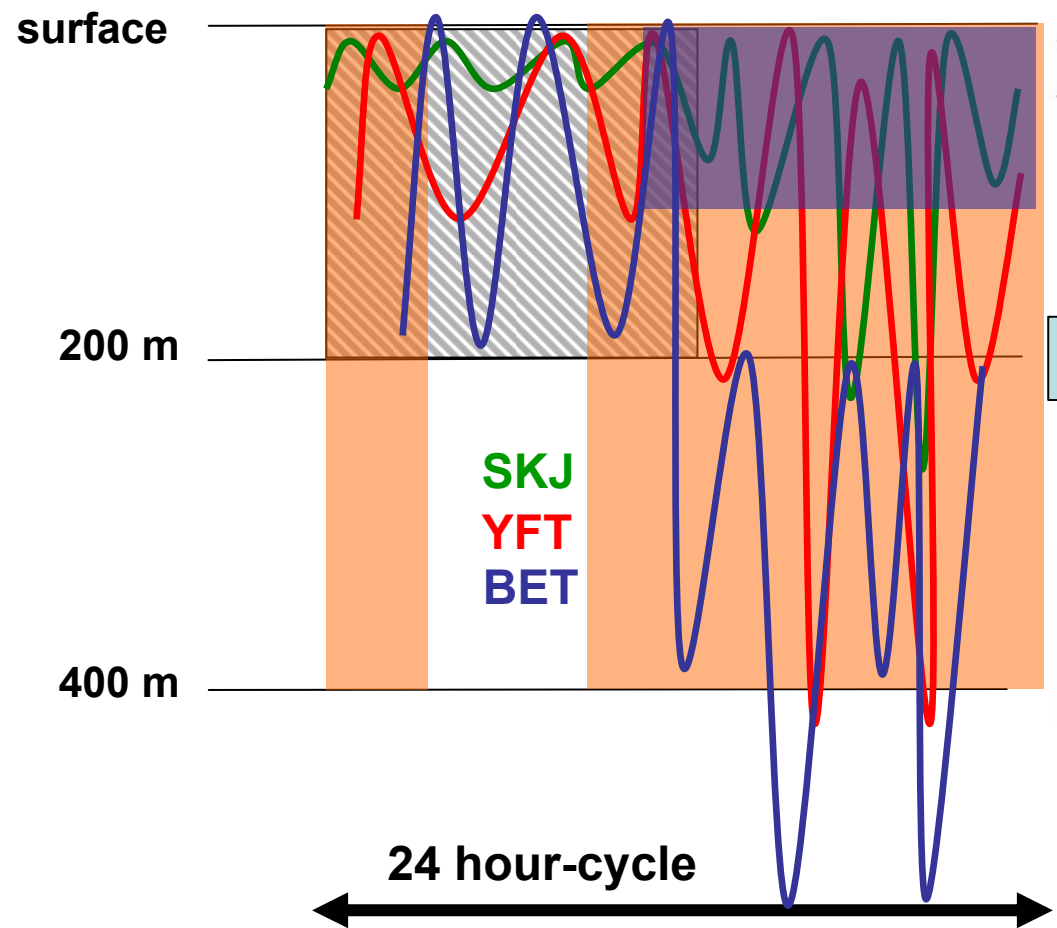




GEAR EFFECT on the stomach content

	PS	LL
% of empty stomachs	high	low
diversity in prey items	low	high
number of different prey items per stomach	low	high
species categories in the diet	few	many

Samples from different gears give a different picture of the diet as described by stomach content



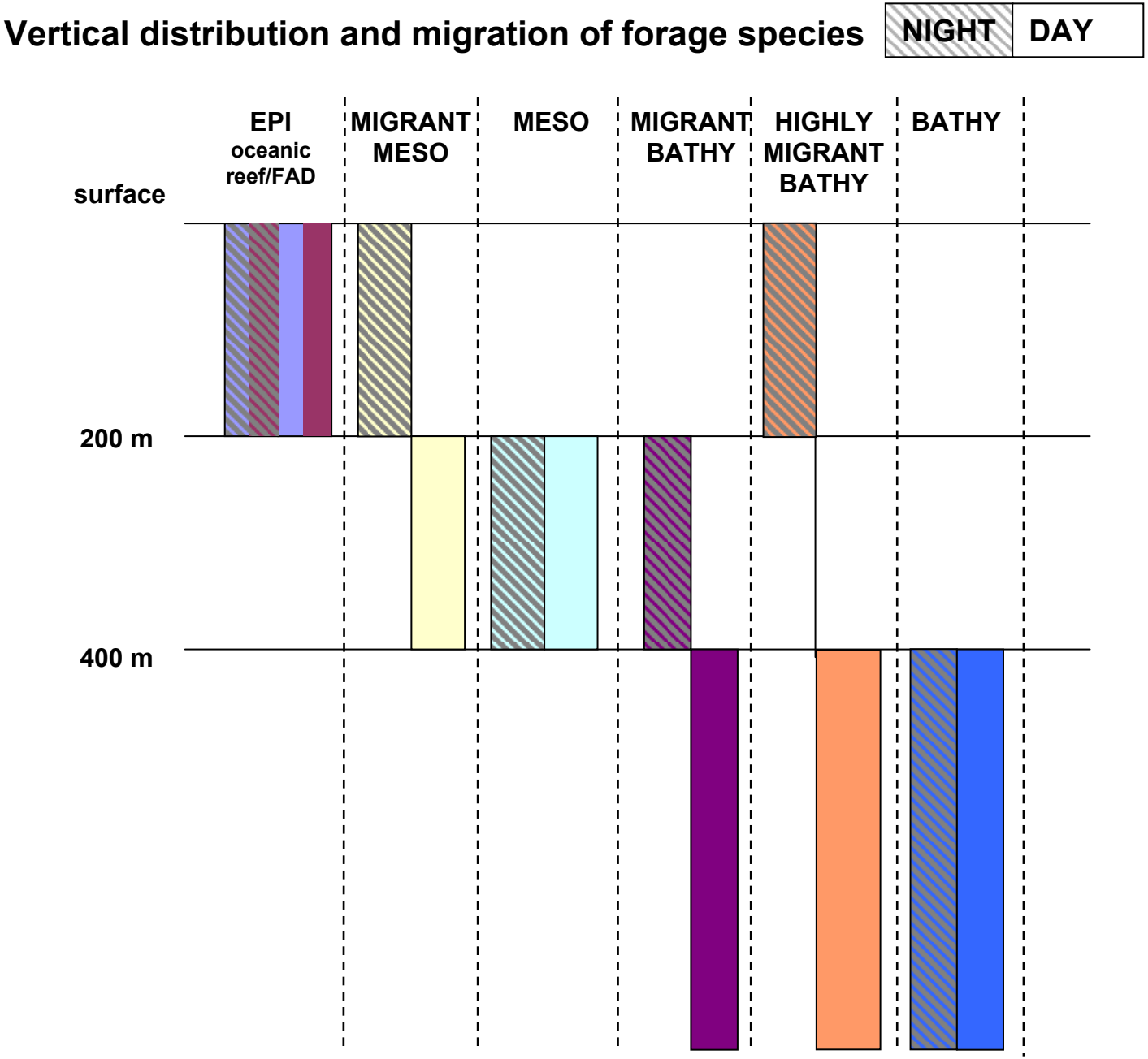
PS

LL and PS catch fish
-at different times in the 24h-cycle
-at different depths in the tuna vertical habitat
-of different sizes in the tuna population

LL

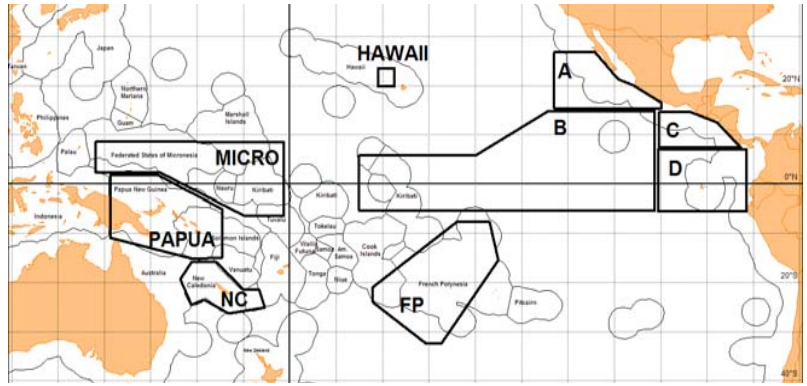
COMPARE SAMPLES COLLECTED BY SAME GEARS

COMPARING THE PREY COMPOSITION OF THE DIET



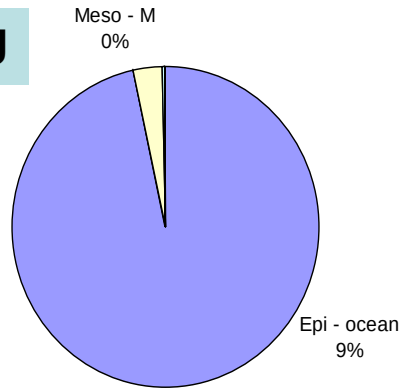
COMPARING EASTERN AND WESTERN PACIFIC TUNA DIET

- Epipelagic – oceanic
- Epipelagic – FAD/reef associated
- Mesopelagic Migrant
- Mesopelagic

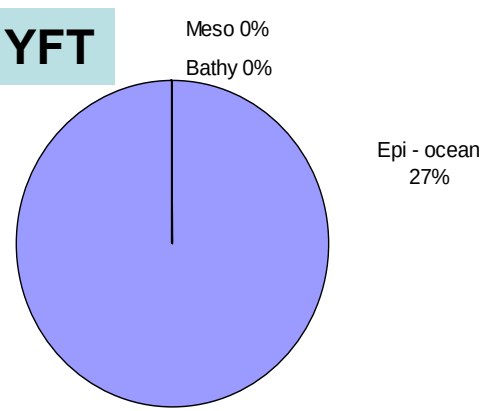


WESTERN MICRO

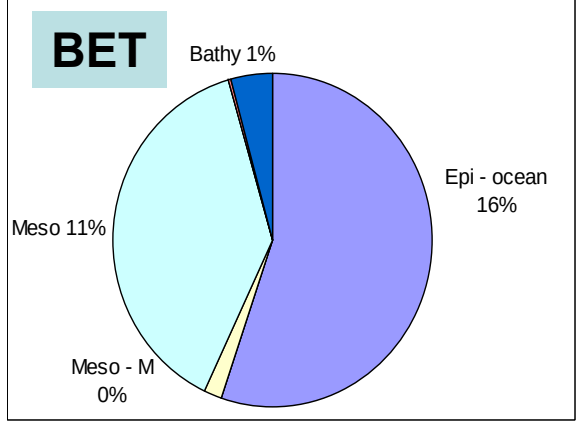
SKJ



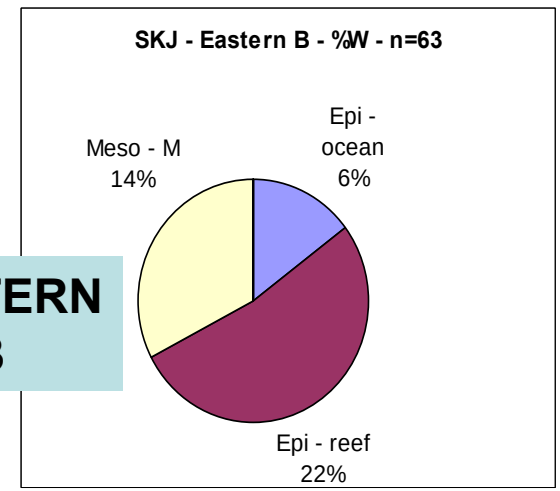
YFT

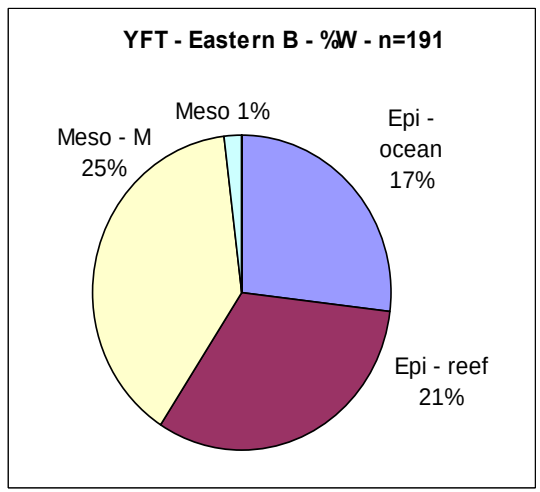


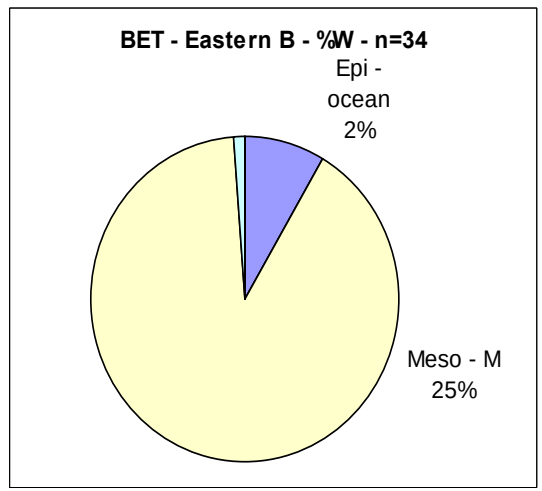
BET

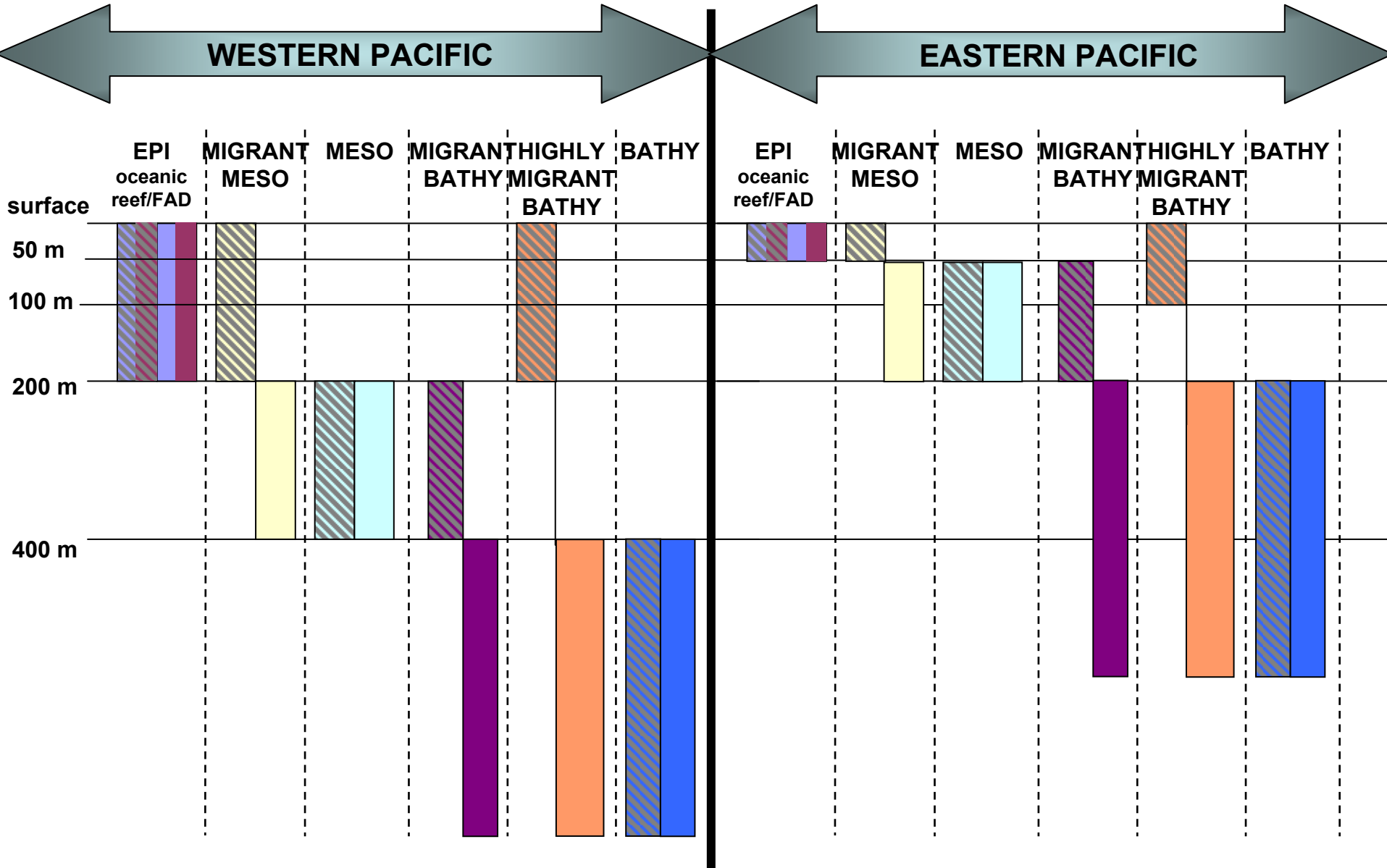


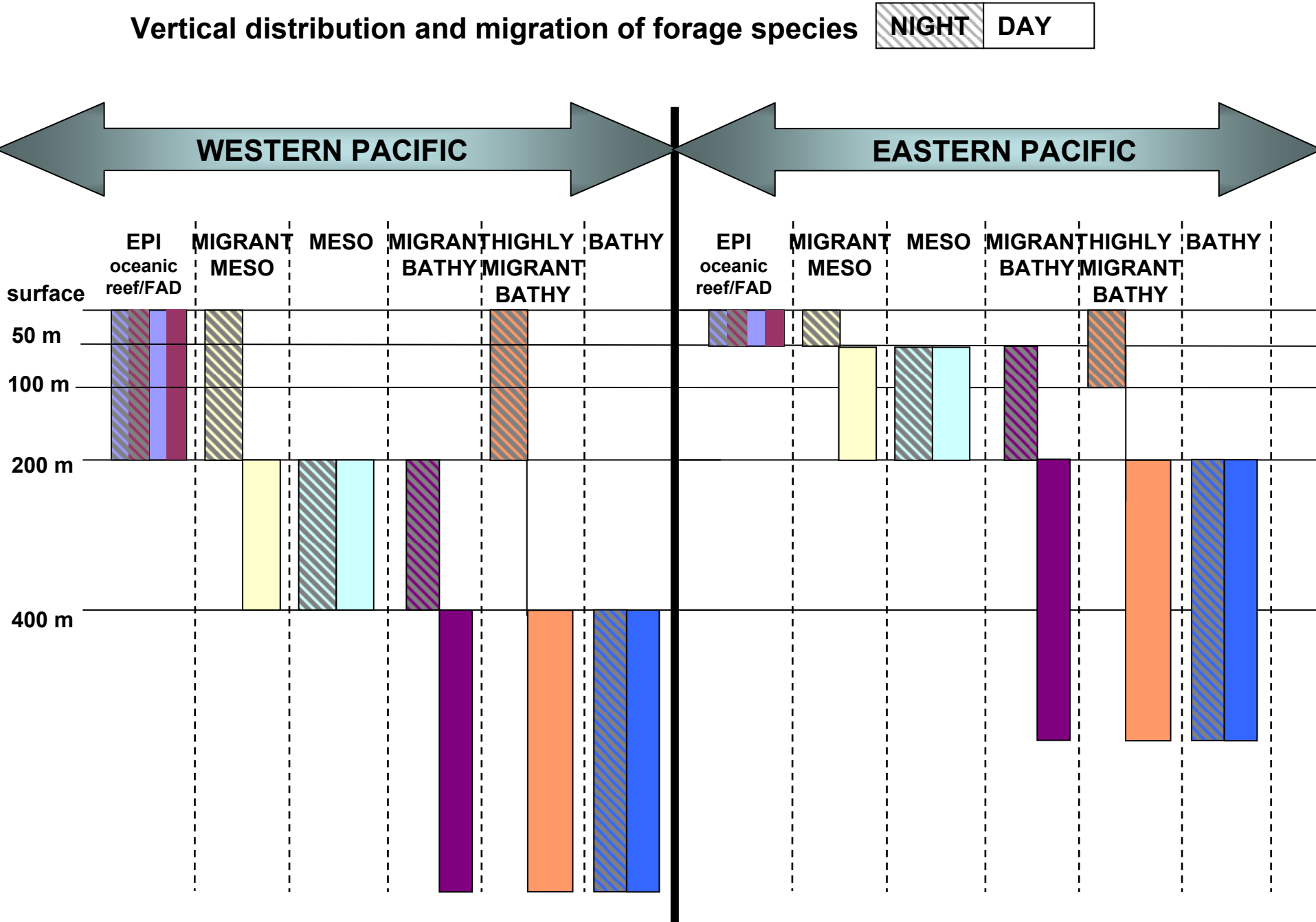
EASTERN B








WESTERN PACIFIC
EASTERN PACIFIC
EPI
oceanic
reef/FAD
MIGRANT
MESO
MESO
MIGRANT
BATHY
HIGHLY
MIGRANT
BATHY
BATHY
surface
50 m
100 m
200 m
400 m


Vertical distribution and migration of forage species
NIGHT
DAY
WESTERN PACIFIC
EASTERN PACIFIC
EPI
oceanic
reef/FAD
MIGRANT
MESO
MESO
MIGRANT
BATHY
HIGHLY
MIGRANT
BATHY
BATHY
EPI
oceanic
reef/FAD
MIGRANT
MESO
MESO
MIGRANT
BATHY
HIGHLY
MIGRANT
BATHY
BATHY
surface
50 m
100 m
200 m
400 m

DESCRIPTION OF THE DIET

STOMACH CONTENT

Probably less than 12h

Bias linked to the sampling gear (24h-cycle; habitat)

STABLE ISOTOPE

About 3 months

No bias linked to gear

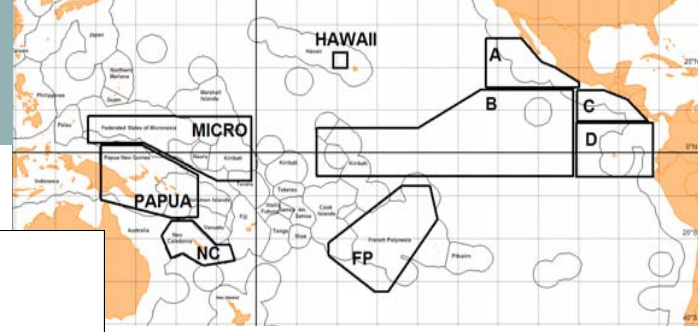
Possible to compare all areas

To compare the trophic structure using isotope values

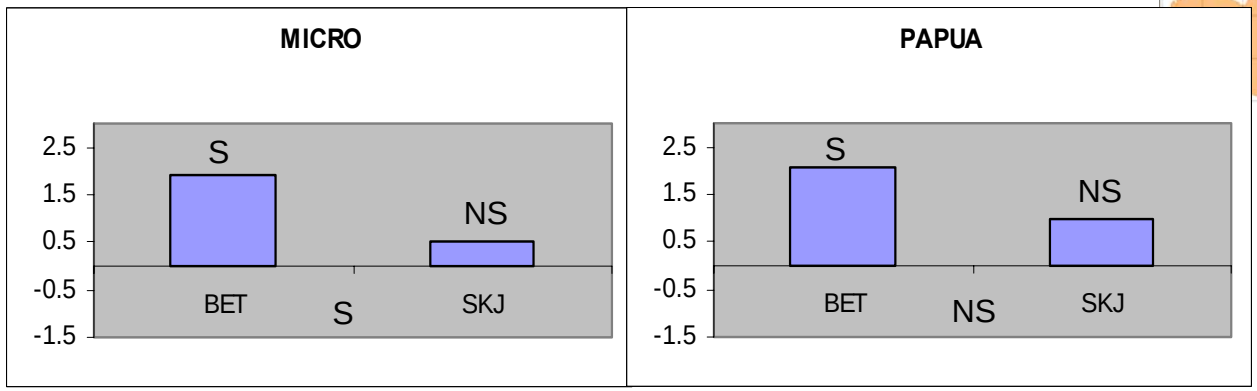
Comparison of the relative position of the tuna species

To avoid spatial differences calculation of the difference in isotope values between the species (YFT as the reference species)

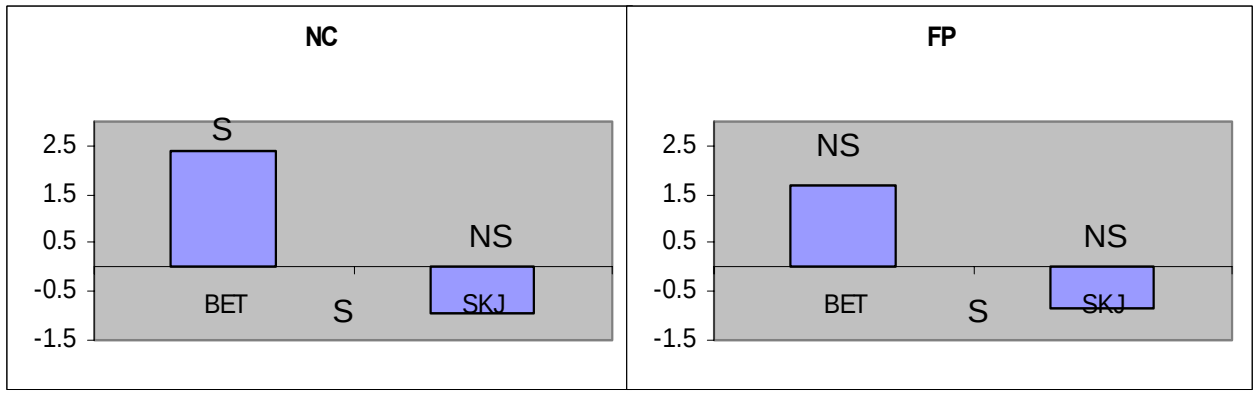
RELATIVE ISOTOPE VALUES OF THE 3 TUNA SPECIES



d15N BET – d15N YFT or d15N SKJ – d15N YFT

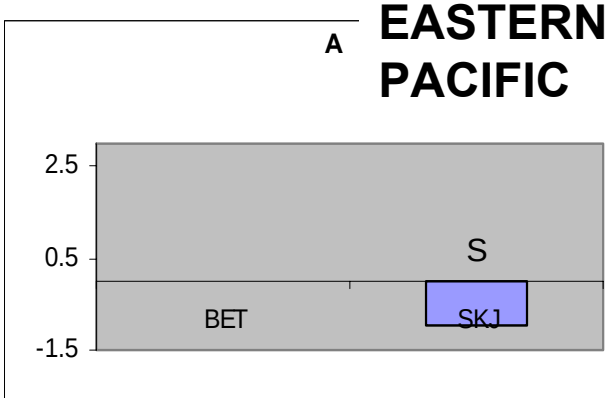


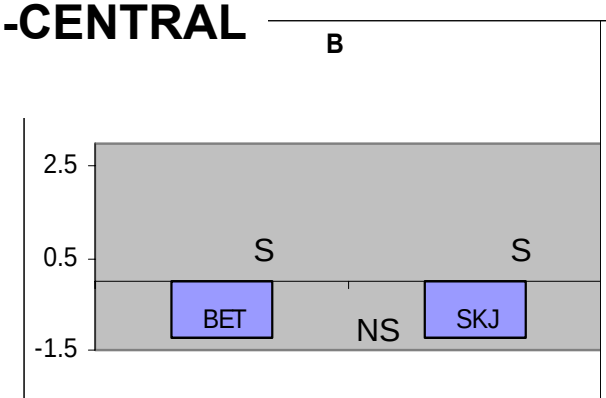
WESTERN EQUATORIAL PACIFIC

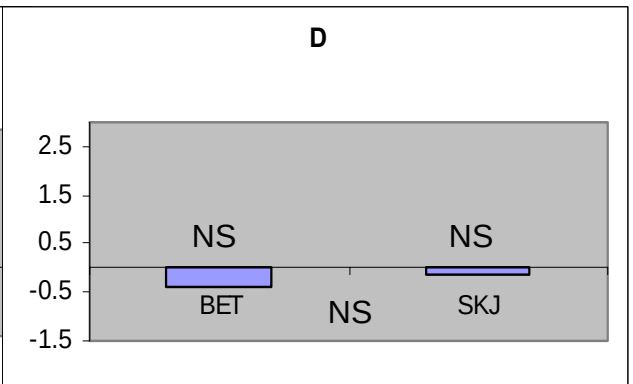


WESTERN-CENTRAL SOUTH PACIFIC

EASTERN-CENTRAL PACIFIC







MORE TO BE DONE…

-Better delimitation of the areas (based on isotopes, on stomach content)

-Study the gear effect on the diet description:

LL vs PS

FADset vs DOLPHINset vs UNASSOCIATEDset

isotope and mixing model

-Incorporate other species (mahi mahi, wahoo, marlins, sharks)

-More information needed on the prey distribution in the Eastern and Western Pacific