

Towards elucidating the role of larval fish in the planktonic food web

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Background

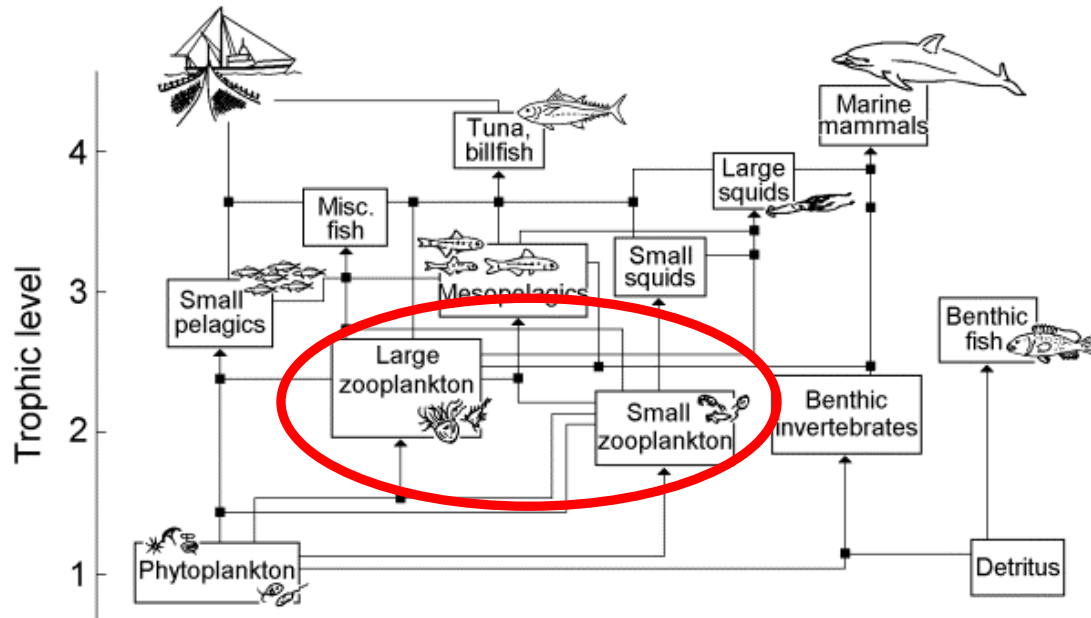
- Fish reproduction: **High fecundity** with **high mortality** during early life stages

Slight survival fluctuations → Recruitment level implications

- Larval feeding: **Starvation mortality** and effects on **condition** and **growth rate** (i.e. duration of vulnerability)

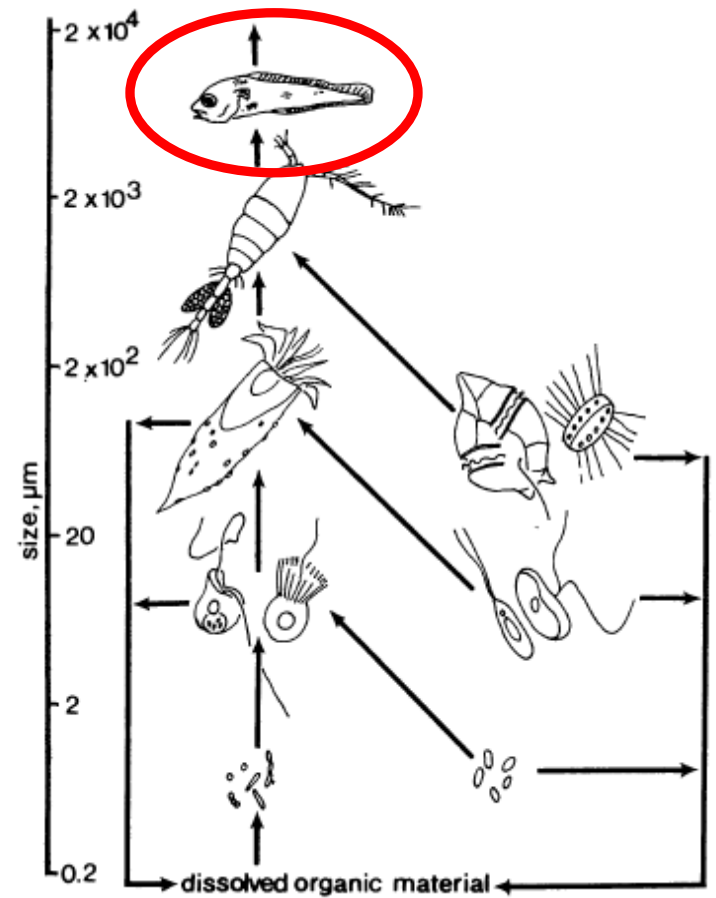
- **Essential (Larval) Fish Habitat:** The poorly understood planktonic ecosystem of lower latitudes

General marine food webs



Pauly 1999

Plankton food webs



Fenchel 1988

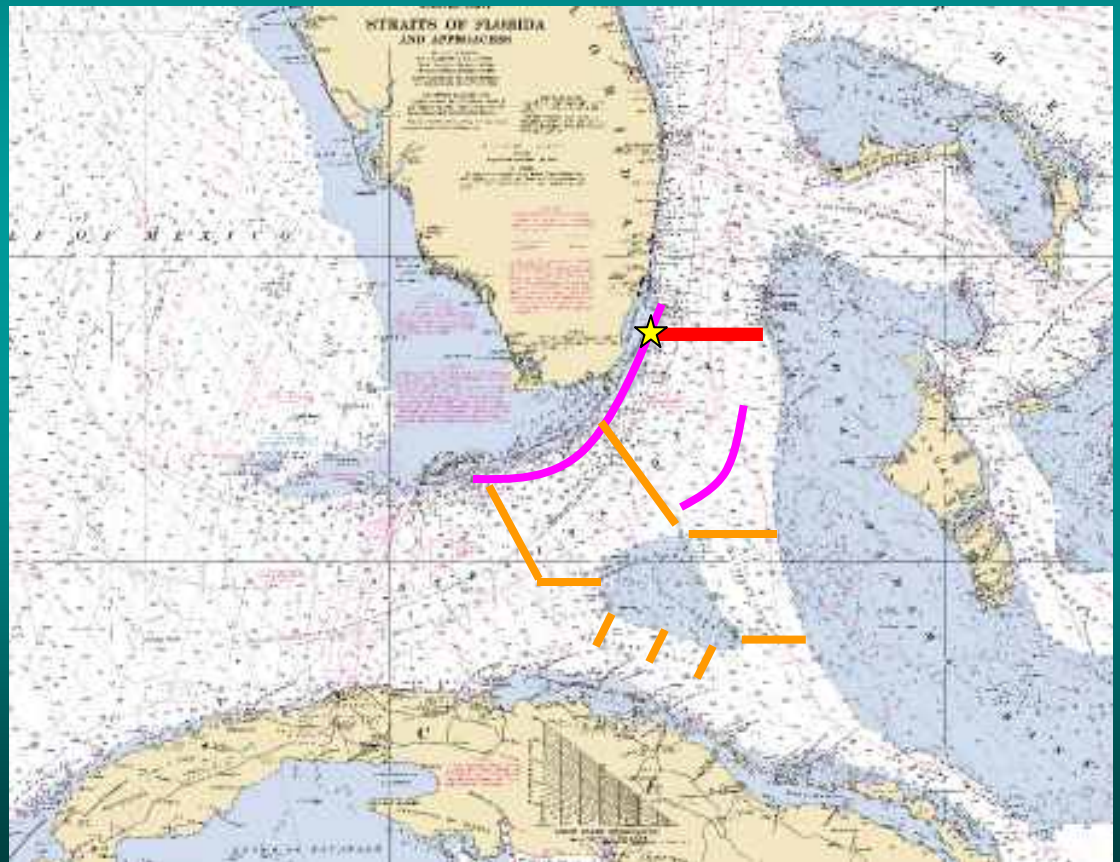
Larval Billfish Project

- Document spawning grounds (**adult EFH**)
- Understand the influence of the planktonic environment (**early life history EFH**)
- Can be applied to all taxa collected

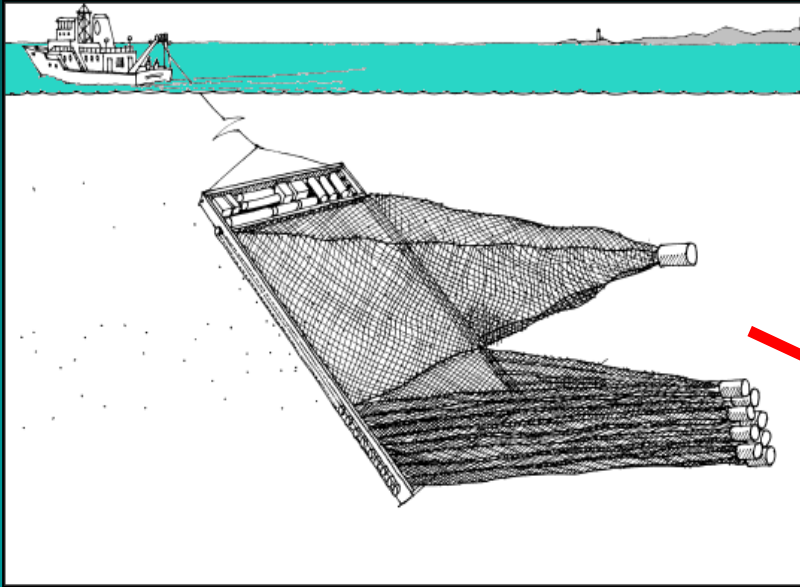


Billfish Project: Spatial Coverage

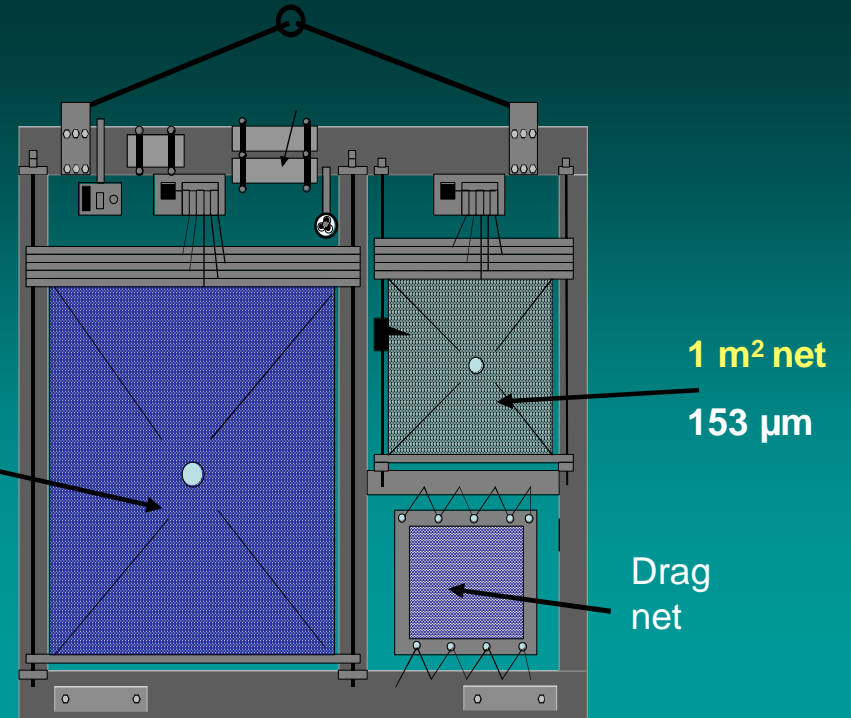
- **Transect of 17 stations across the Straits of Florida**
 - **Sampled monthly in 2003 & 2004**
 - **Sampled 5 times in 2005**
- **48 hr sampling of single station**
- **Broader spatial sampling**
- **Lagrangian sampling**



M.O.C.N.E.S.S.



4 m² net
800 μm



Guigand et al. 2005



Billfish project: Sampling strategy

- Discrete-depth, concurrent sampling of large larvae, small larvae and prey field



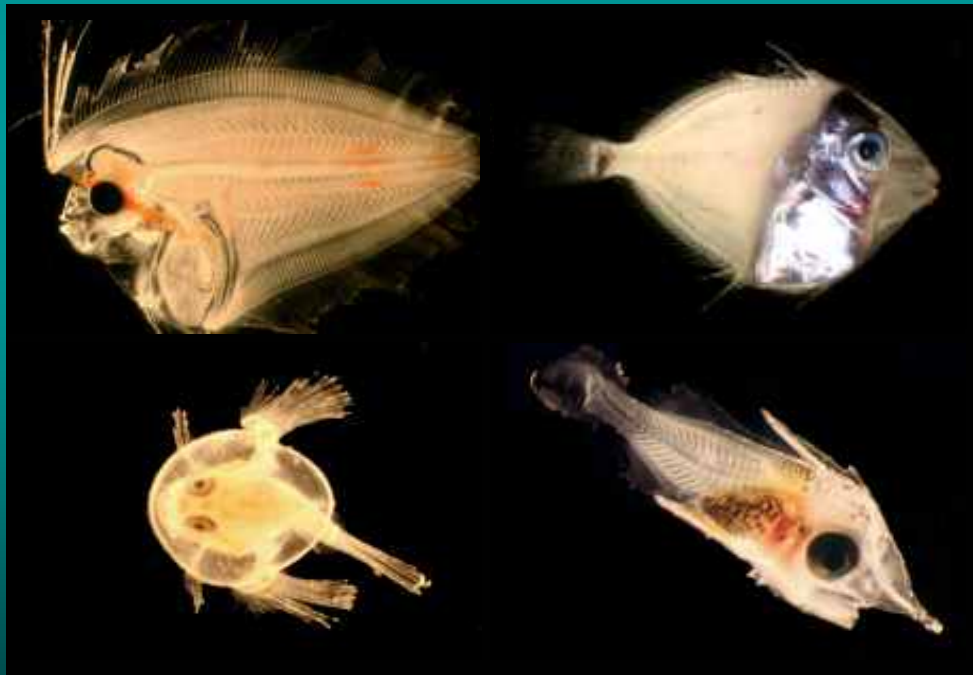
Sample Processing

	2003	2004	2005	Total
Collected	2,372	2,677	834	5,883
Sorted	2,129	1,413	0	3,542
Identified	1,412	877	0	2,289

Larvae identified so far: 198,000

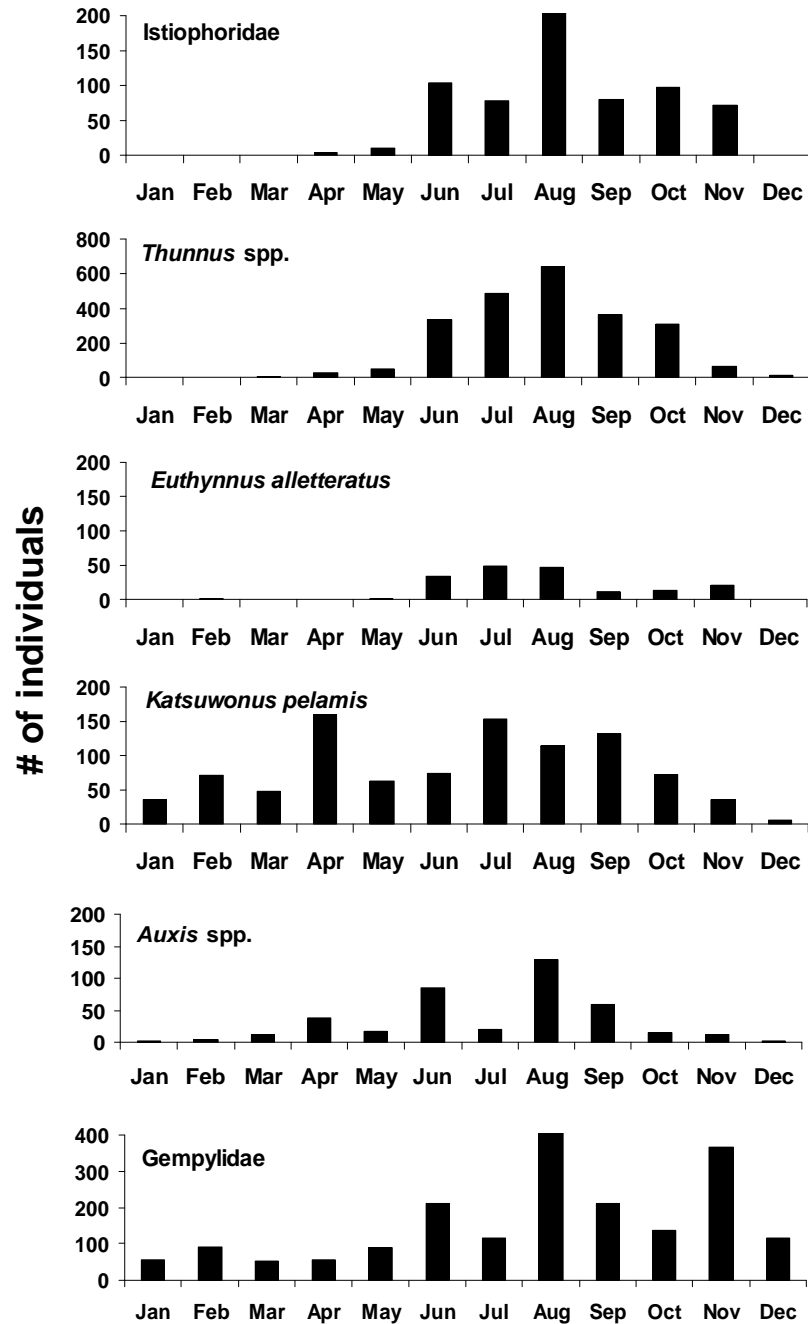
Larvae identified for 2003

(excluding 25-100 m MOC1)

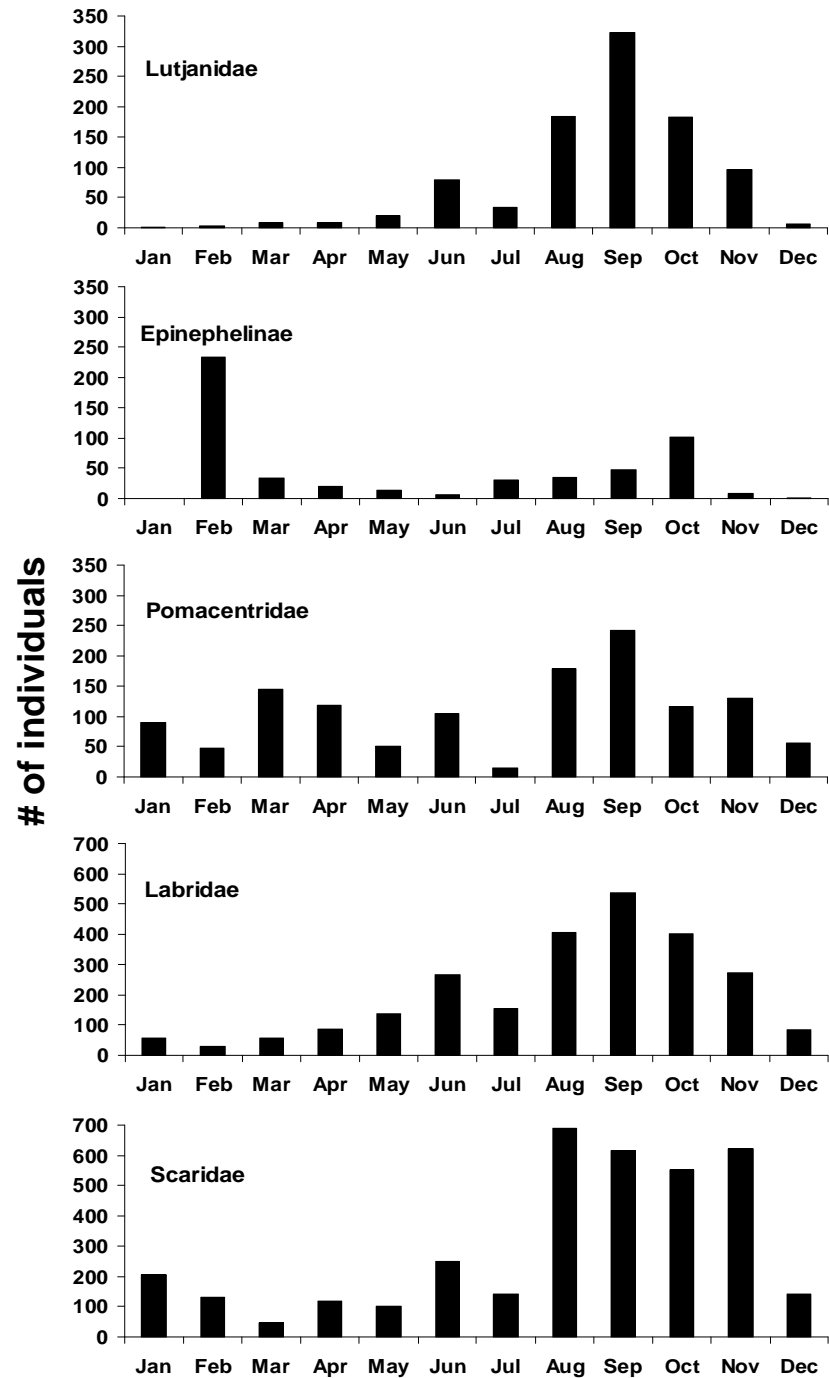


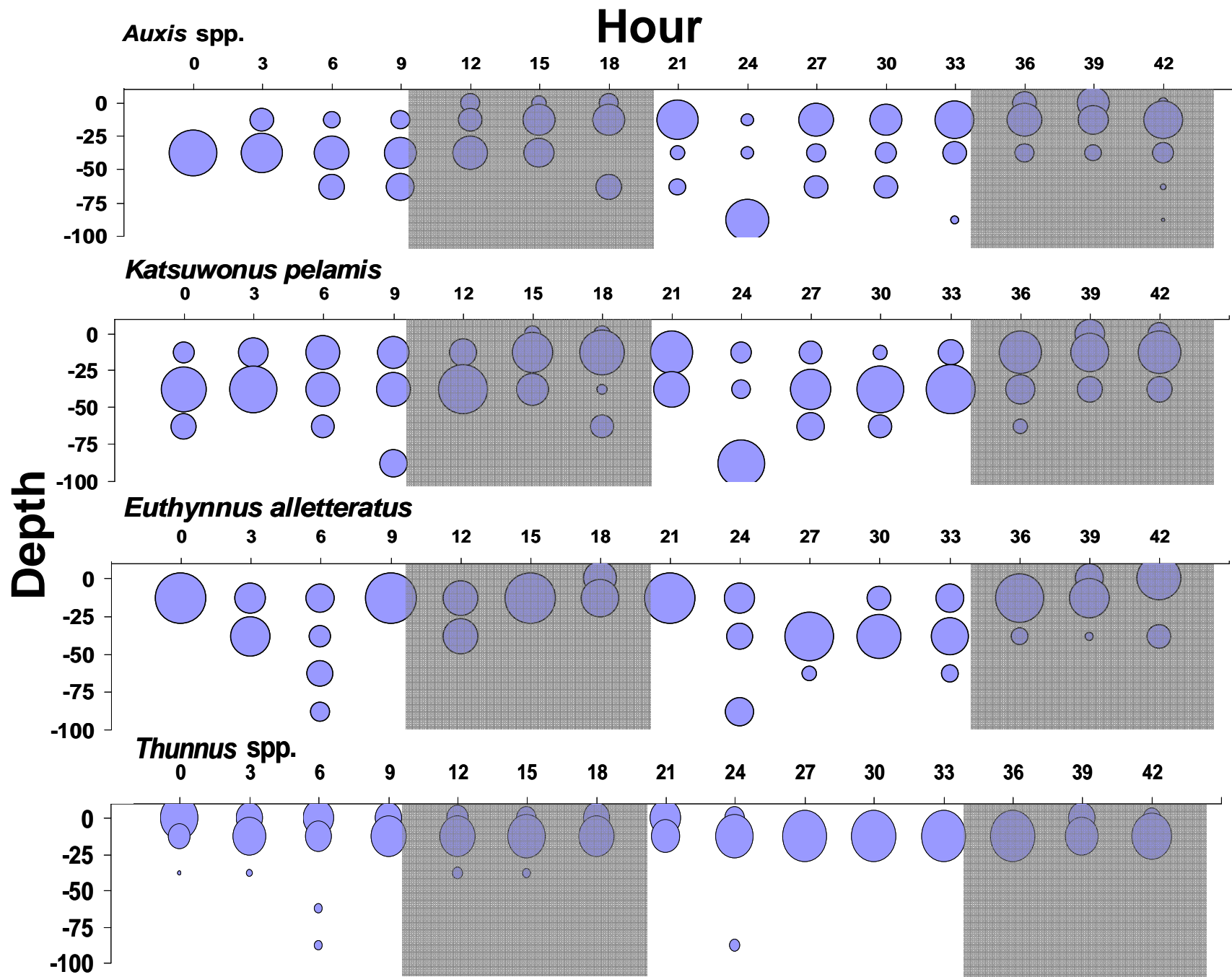
Myctophidae	15822
Mullidae	8950
Carangidae	8513
Scombridae	7493
Gonostomatidae	4394
Bothidae	3831
Scaridae	3758
Serranidae	3660
Mugilidae	2799
Paralichthyidae	2632
Labridae	2595
Gempylidae	2022
Holocentridae	1961
Exocoetidae	1703
Nomeidae	1702
Acanthuridae	1657
Scorpaenidae	1610
Gobiidae	1432
Pomacentridae	1354
Lutjanidae	1317
Bregmacerotidae	1301
Phosichthyidae	1228
Hemiramphidae	1113
Sphyraenidae	1015
Gerreidae	874
Istiophoridae	865

2003 Scombroids

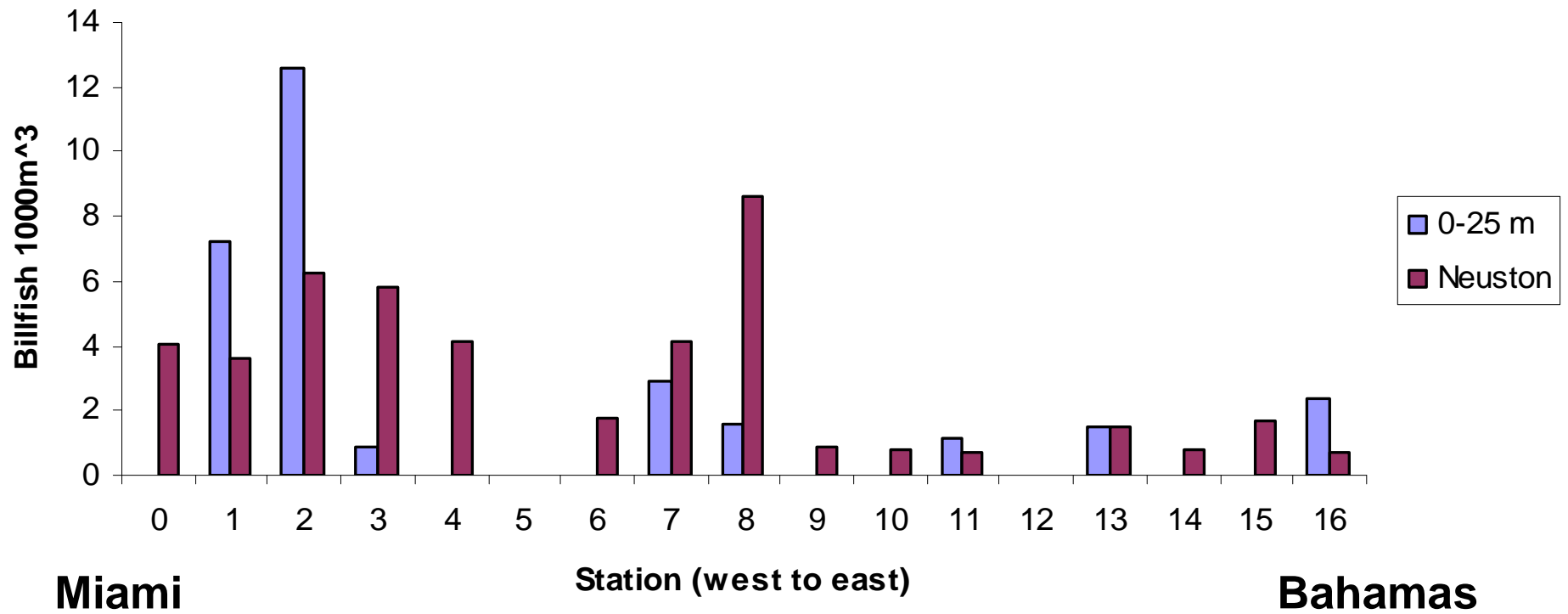


2003 Reef fishes

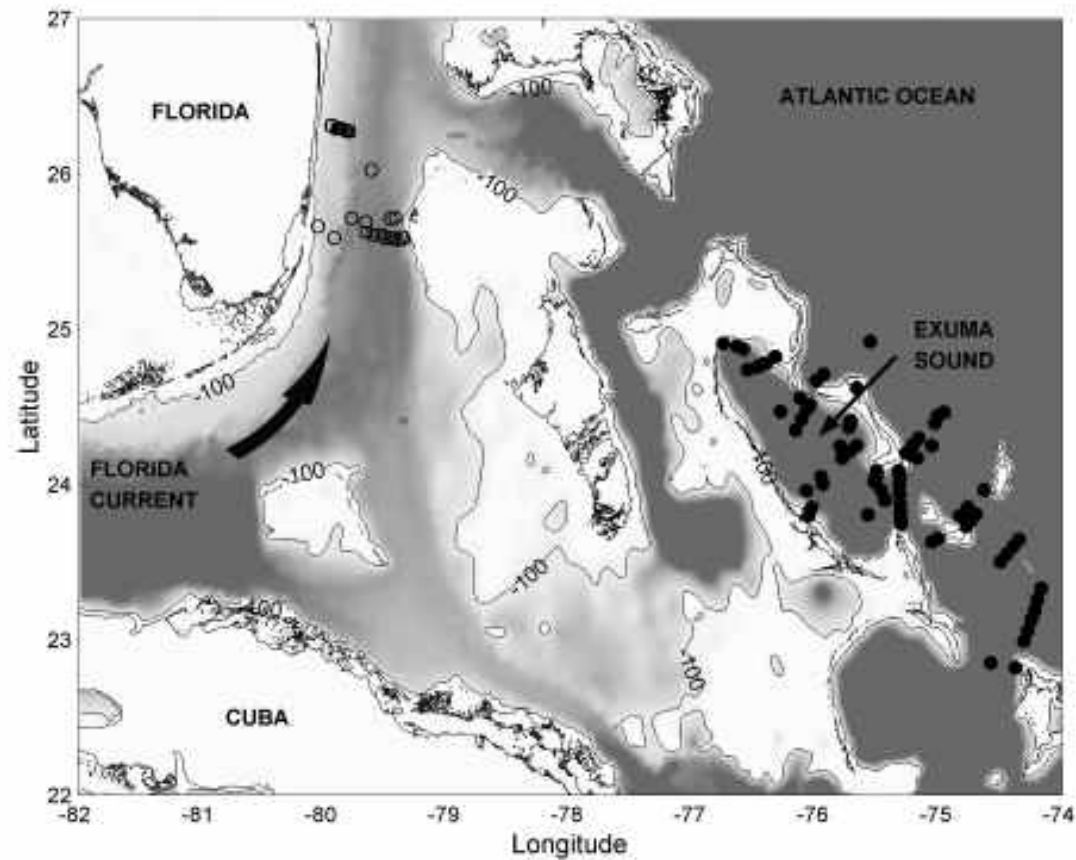




June 03 total billfish densities

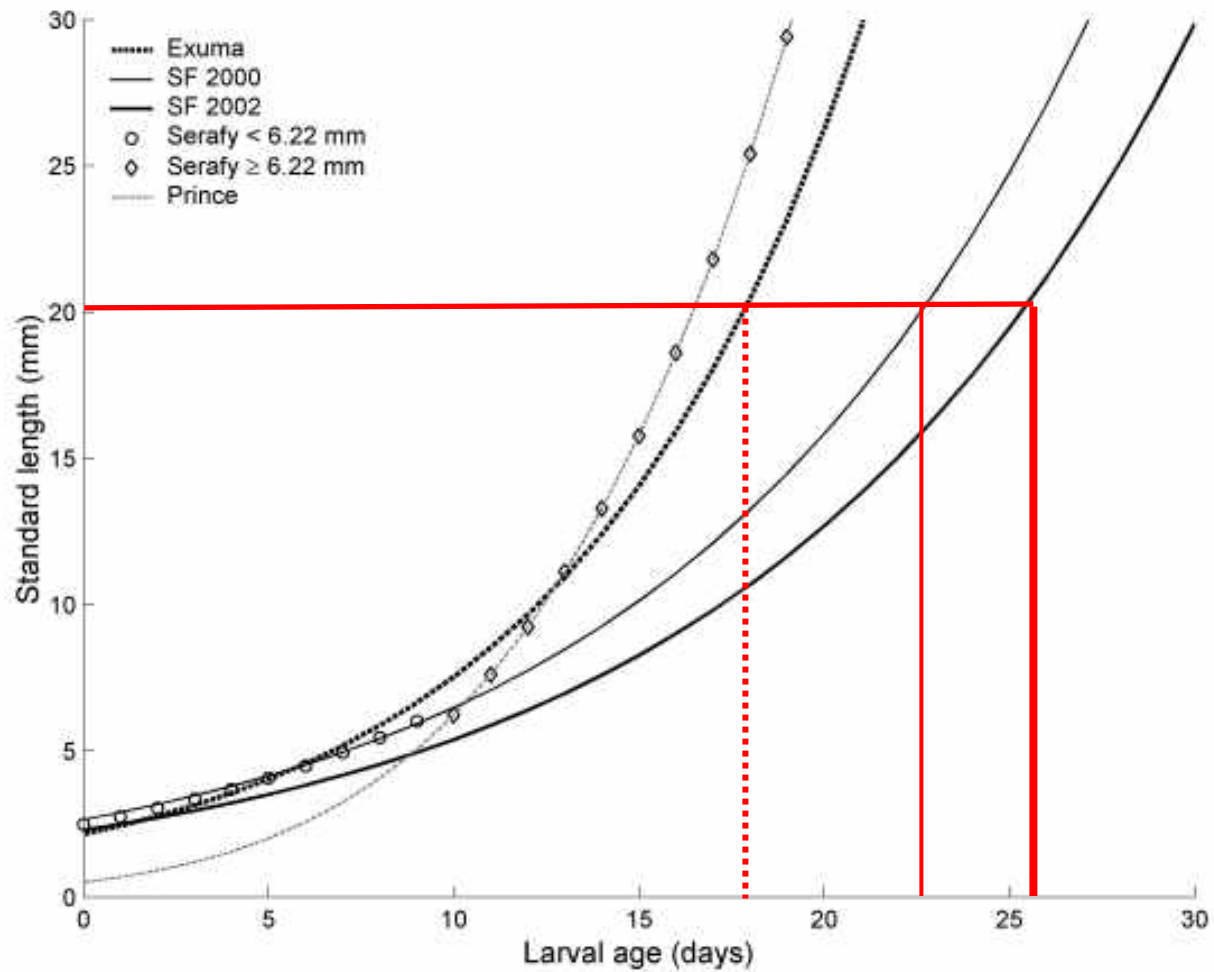


Spatially explicit growth rates: Blue marlin



Sponaugle et al. 2005

Spatially explicit growth rates: Blue marlin



Sponaugle et al. 2005

Larval piscivores



Billfishes

- Sailfish
- Blue marlin
- White marlin
- Swordfish

Tunas and mackerels

- Yellowfin tuna
- Blackfin tuna
- Bluefin tuna
- Bigeye tuna
- Albacore
- Little tunny
- Skipjack
- Bullet mackerel
- Frigate mackerel
- Wahoo
- King mackerel
- Spanish mackerel
- Cero

Snake mackerels

- Escolar
- Black gemfish
- Snake mackerel

Barracudas

Larval fish trophodynamics: Objectives

- Document trophic ecologies of predominant **scombroids** and **reef fishes**
- **Understand the influence of:**
 - Ontogeny
 - Time of day
 - Time of year
 - Year
 - Location in the Straits of Florida (spawning locations)
 - Prey spectra and densities
- **Interactions**
 - Competition and niche separation
 - Piscivory
 - reliance upon a dilute resource
 - reliance upon the spawning of other fish
 - predatory impact
 - Physical environment: turbulence, light, fronts, eddies

Larval billfishes: Feeding incidence

(proportion of feeding larvae >1 hr after sunrise)

Sailfish

Size class	<i>n</i>	Feeding incidence
2 – 3 mm	88	0.81
3 – 8 mm	266	0.99
> 8 mm	34	0.85
Total	388	0.94

Blue marlin

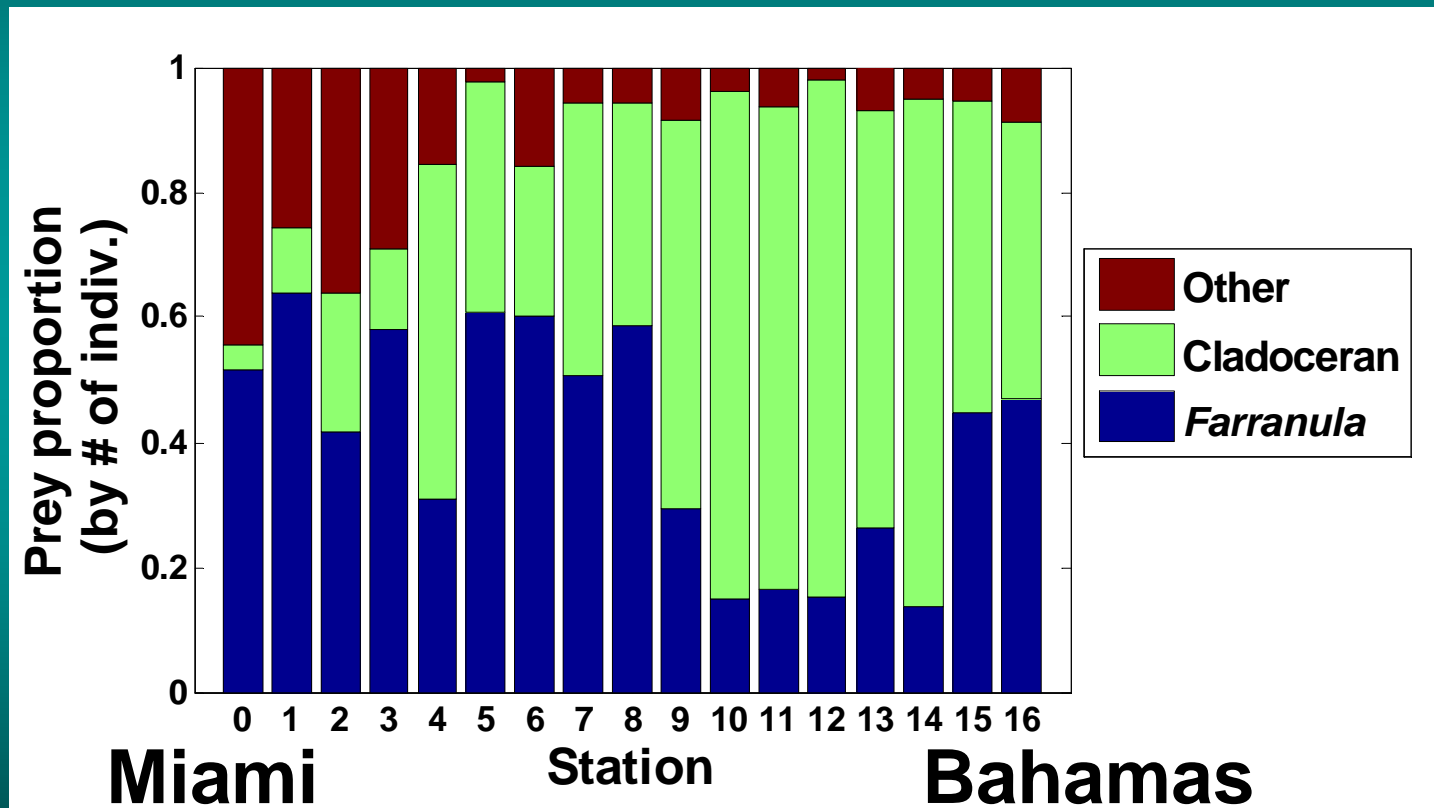
Size class	<i>n</i>	Feeding incidence
2 – 3 mm	61	0.97
3 – 8 mm	221	0.99
> 8 mm	47	1.00
Total	329	0.99

Larval billfishes: Prey types and numerical percentages

Prey type	% composition, All cruises, both spp. (6160 prey items)
Cladoceran (<i>Evadne</i>)	47%
<i>Farranula</i> copepod	42%
<i>Corycaeus</i> copepod	4.6%
Larval fish	2.1%
Gastropod	1.7%
Copepod nauplius	0.3%
Calanoid copepod	0.2%
Other/Unknown	1.4%

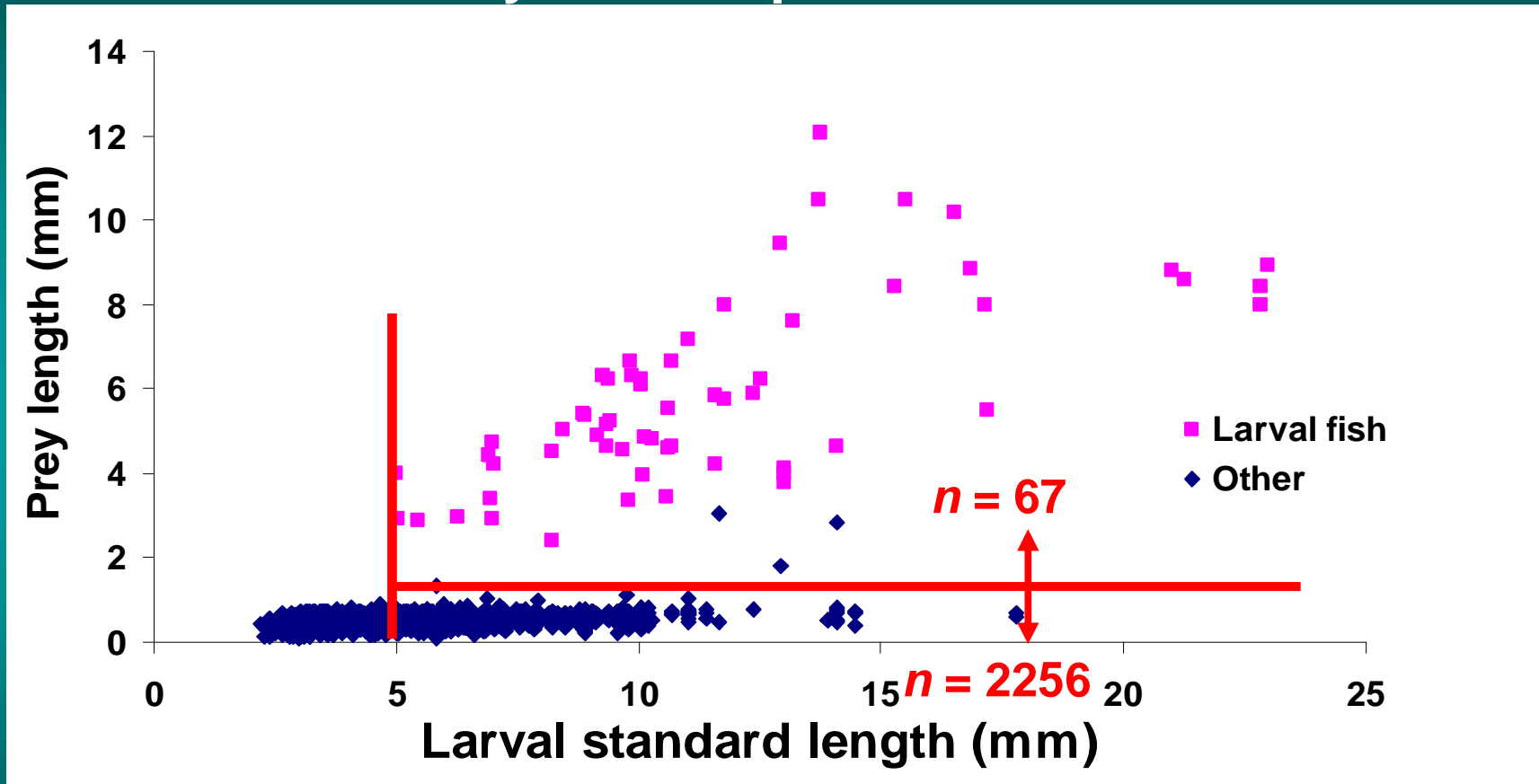
Larval billfishes: Spatial variation in prey types

All cruises & all larvae



prey $n = 6160$

Prey size vs. predator size



11.8 mm SL
blue marlin



8.0 mm SL
tuna

Piscivory

Identifiable larval prey

Sailfish

– 25 of 56 (45%)

- 6 mullids
- 5 hemiramphids
- 5 exocoetids
- 5 scombrids
- 3 carangids

Blue marlin

– 39 of 69 (57%)

- 19 scombrids
 - 12 *Thunnus*
- 7 gempylids
- 4 istiophorids
- 3 myctophids

Future products and importance

- **Specific trophic pathways to larval fishes**
- **Description of EFH for larvae in terms of feeding and the prey environment**
 - Spatiotemporal variation in feeding and growth
 - Potential influence upon recruitment strength
- **Link to S. Atlantic**
 - Reproductive migrations
 - Source larvae
 - Use of data
 - Application of methods

Acknowledgements

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Kelly Denit
All other sorters!
R/V Walton Smith captain
and crew!

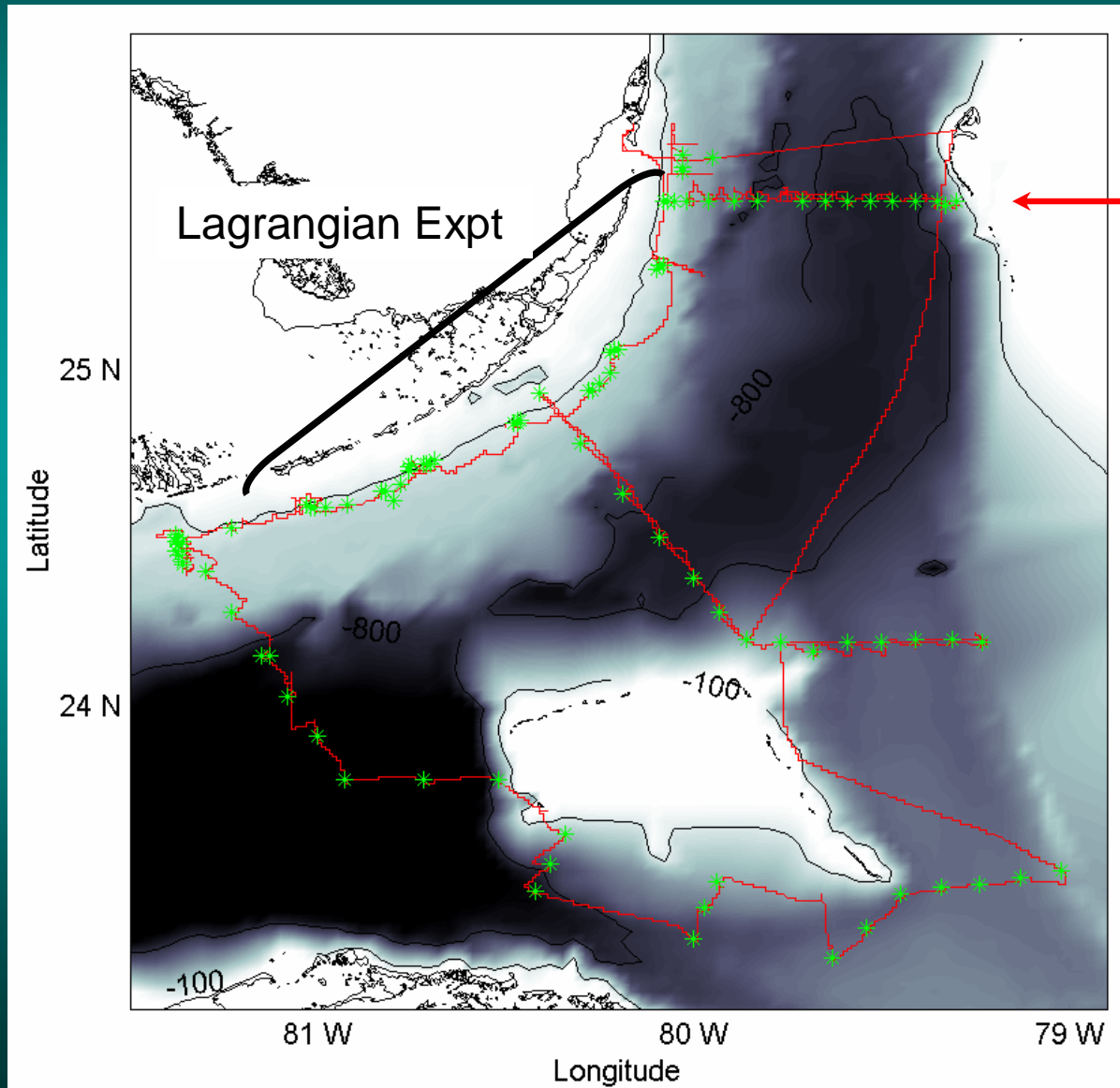




Age and Growth

- Fundamental biological measurement
- Growth can be used as a proxy for condition
- Age distribution necessary for estimating mortality rates

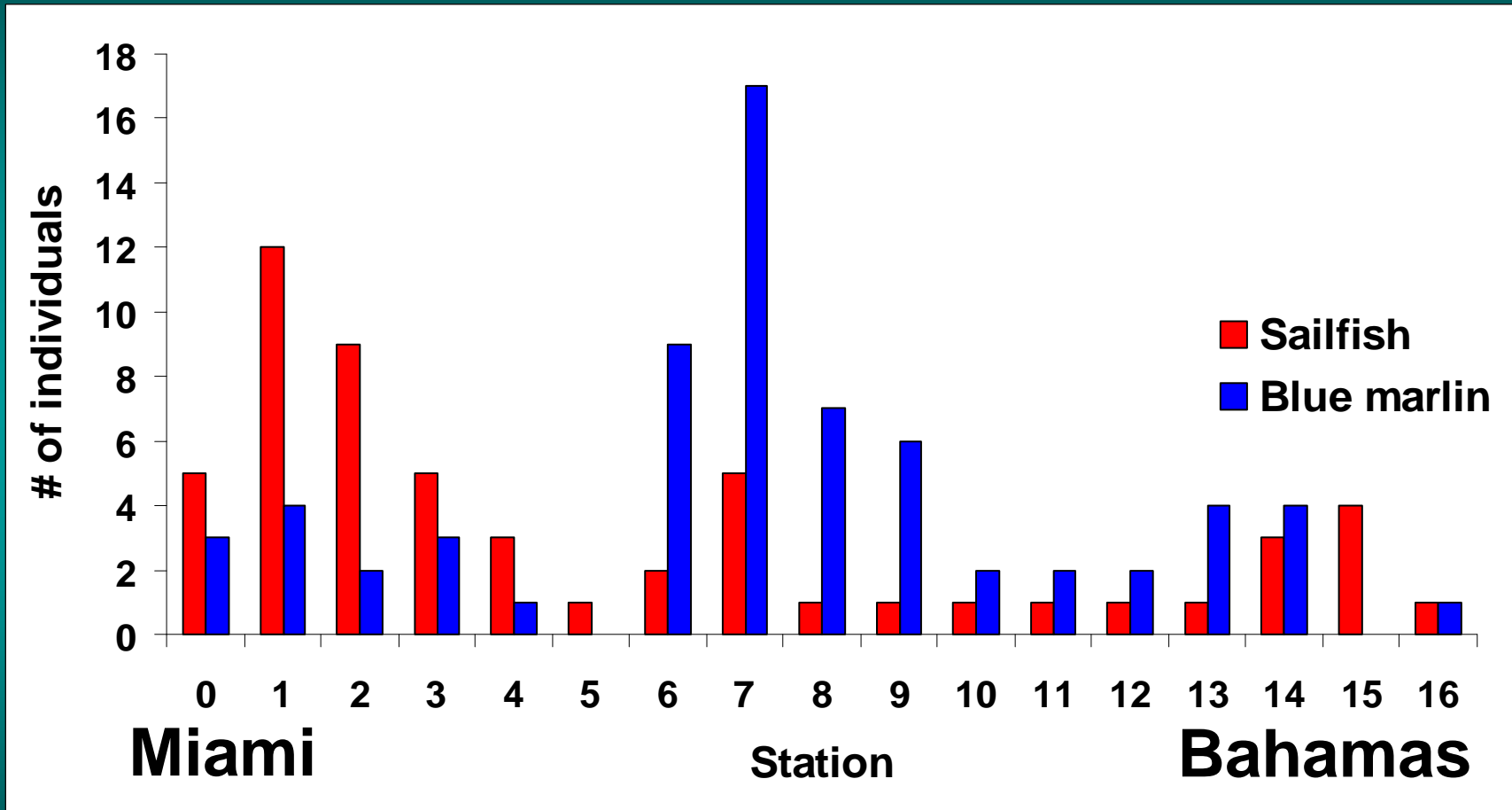
Billfish Project Spatial Coverage



Monthly transect

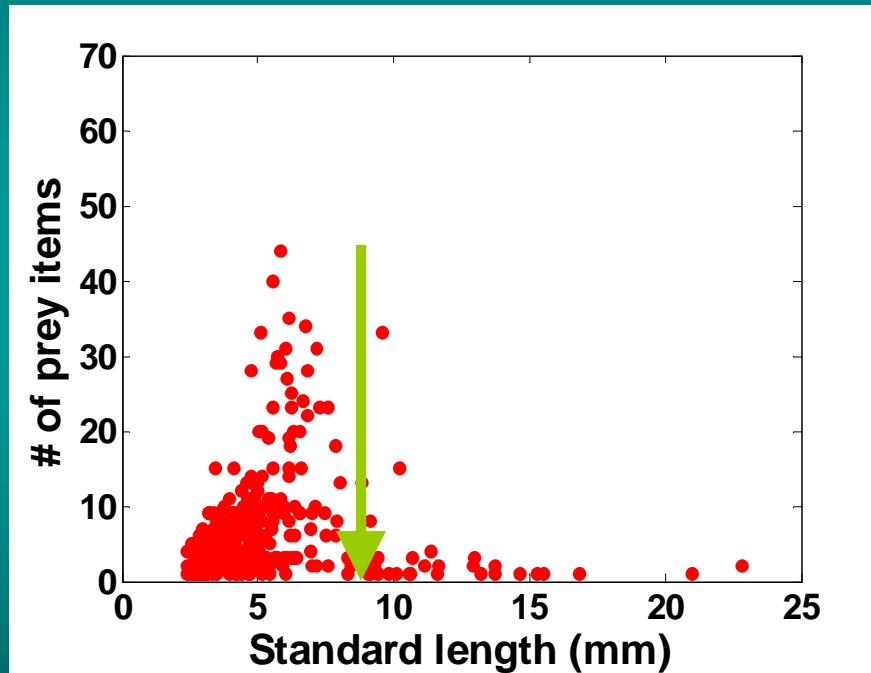
Spatial coverage

Spatial distribution of piscivorous billfish larvae

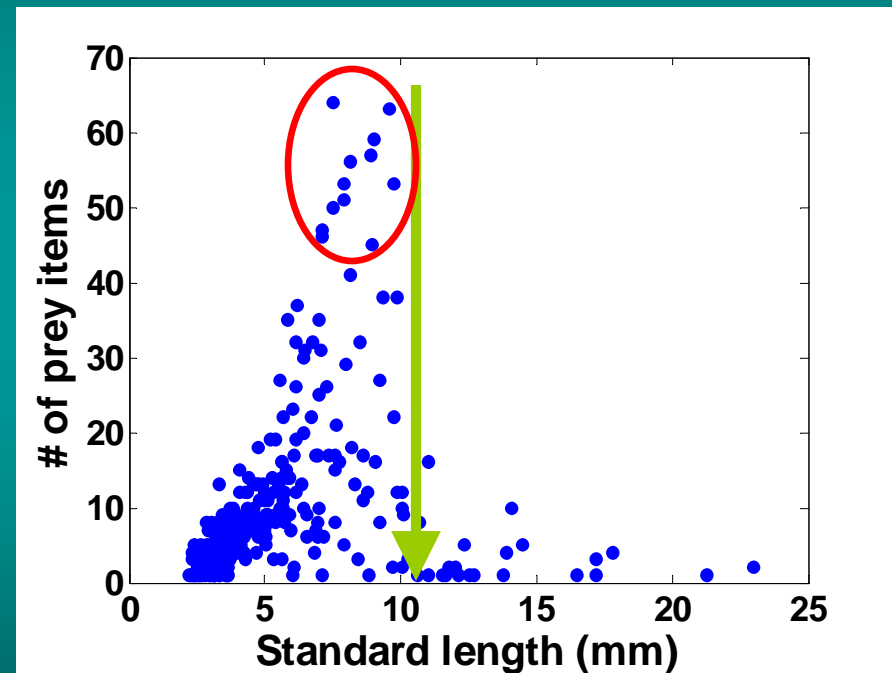


Prey items per larva

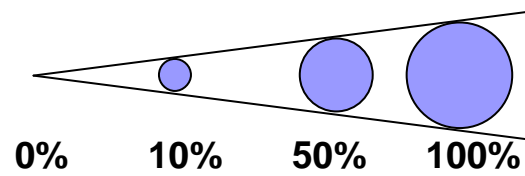
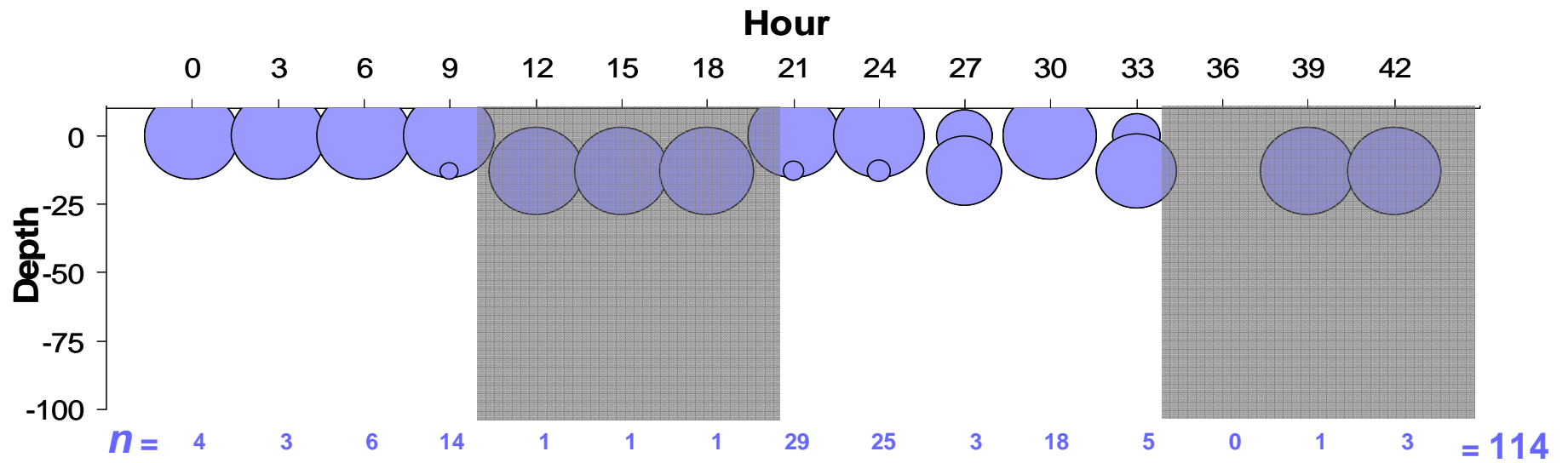
Sailfish



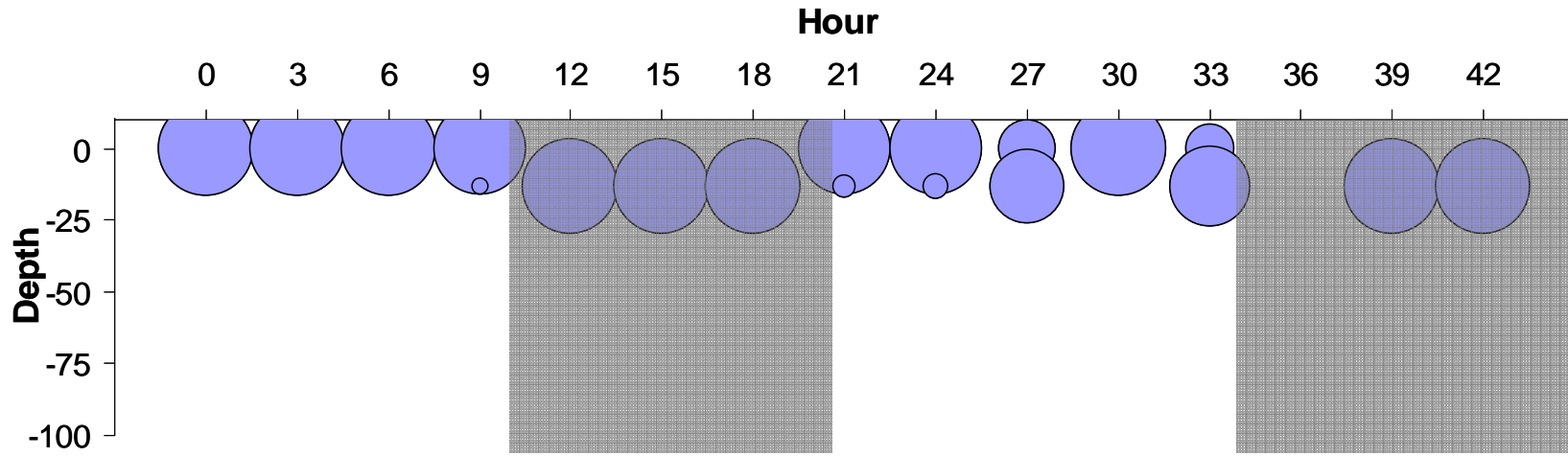
Blue marlin



Istiophorid relative vertical distribution



Istiophorids



Thunnus spp.

