Ecological importance of *Auxis* spp. as prey for Dolphin and Wahoo

DEPARTMENT OF ENVIRONMENTAL QUALITY

Marine Fisheries

SAFMC Dolphin/Wahoo Committee| Steve Poland | 12/3/2018

Overview

Background
- MAFMC request

Pelagic Food Web in the SAB
- *Auxis* spp.

Important prey in Dolphin/Wahoo diets
- Poland thesis – seasonal and size contribution
- Rudershausen – annual contribution

Questions?

MAFMC Unmanaged Forage Omnibus Amendment

"To prohibit the development of new and expansion of existing directed commercial fisheries on unmanaged forage species … until the Council has had an adequate opportunity to assess the scientific information relating to any new or expanded directed fisheries and consider potential impacts to existing fisheries, fishing communities, and the marine ecosystem."

Major Actions

- Designate taxa included in the amendment as EC species
- Manage chub mackerel under discretionary authority
- Require EFPs for new fisheries and require comm vessels to be permitted if landing EC species

Request to South Atlantic

NMFS disapproved measures

- Determined inclusion of *Auxis* spp as a EC species is inconsistent with NS2
- Did not demonstrate the *Auxis* spp are important forage for MAFMC managed species

MAFMC felt that *Auxis* still warranted protection within its management region

- Sent request to SAFMC to consider management of *Auxis* under its Dolphin/Wahoo FMP

Dolphin/Wahoo management unit extends from FL Keys through NY

Prey Groups

1. Sargassum associated prey
   - Filefish, pufferfish, juvenile jacks, swimming crabs

2. Surface schooling prey
   - Flying fish

3. Schooling prey not assoc. with surface
   - Bullet tuna, round herring, jacks, cephalopods

4. Small aggregations of crustaceans
   - Amphipods, stomatopods, isopods

Auxis spp.

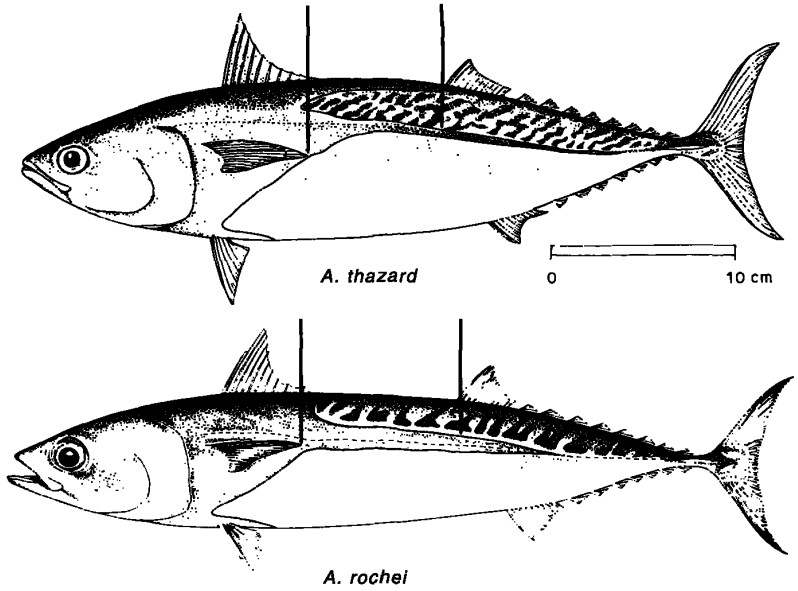
Two species occur in the Atlantic:

- *A. thazard* (Frigate tuna)
- *A. rochei* (Bullet tuna)

Life history information is limited

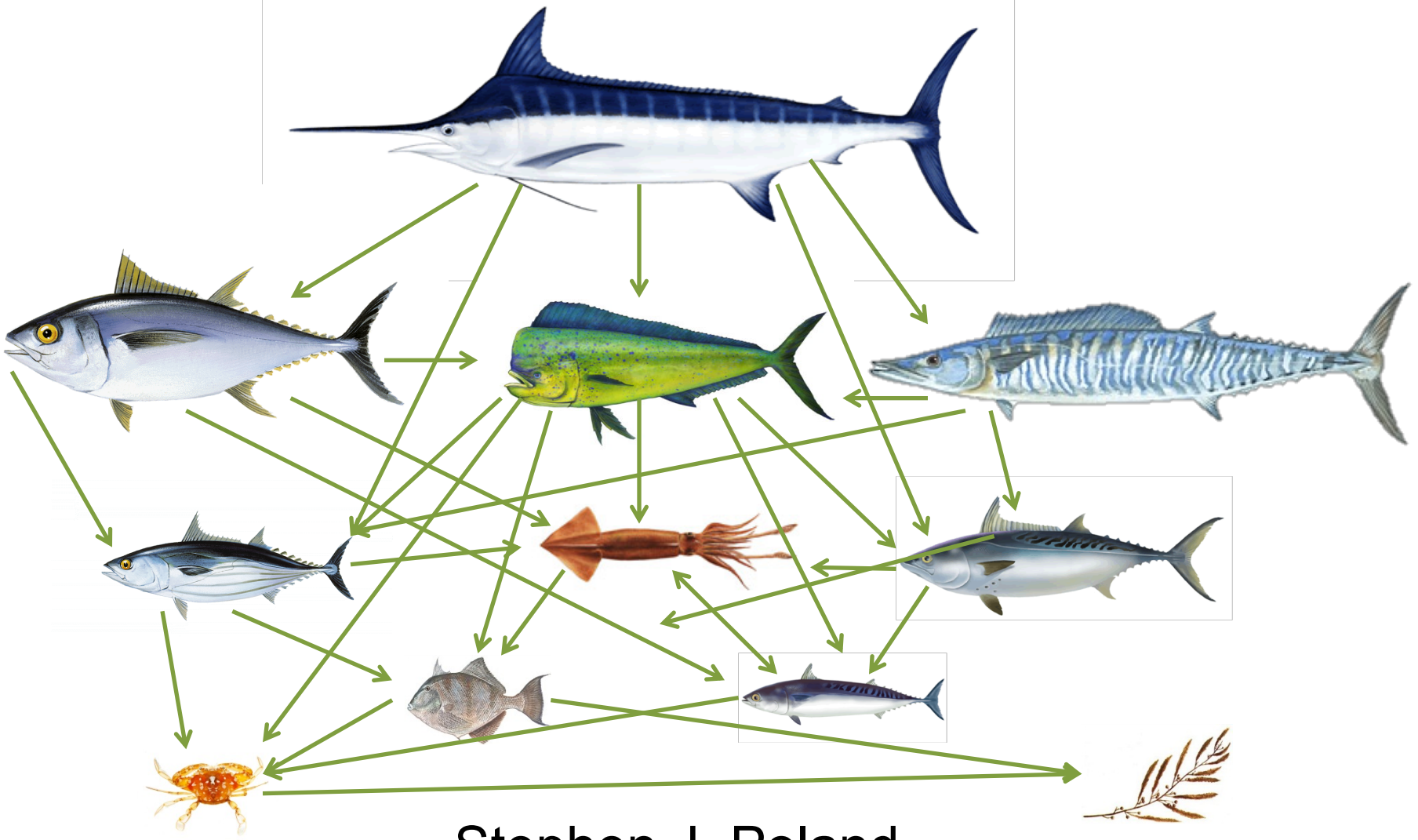
- Up to 50 cm; typically <35 cm
- Schooling fish, feeds on invertebrates and small fish

Stock size and dynamics is unknown



Collette and Aadland, 1996

Trophic Dynamics of Large Pelagic Fish Predators in the U.S. South Atlantic



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Objectives

1. Describe the diet of each species

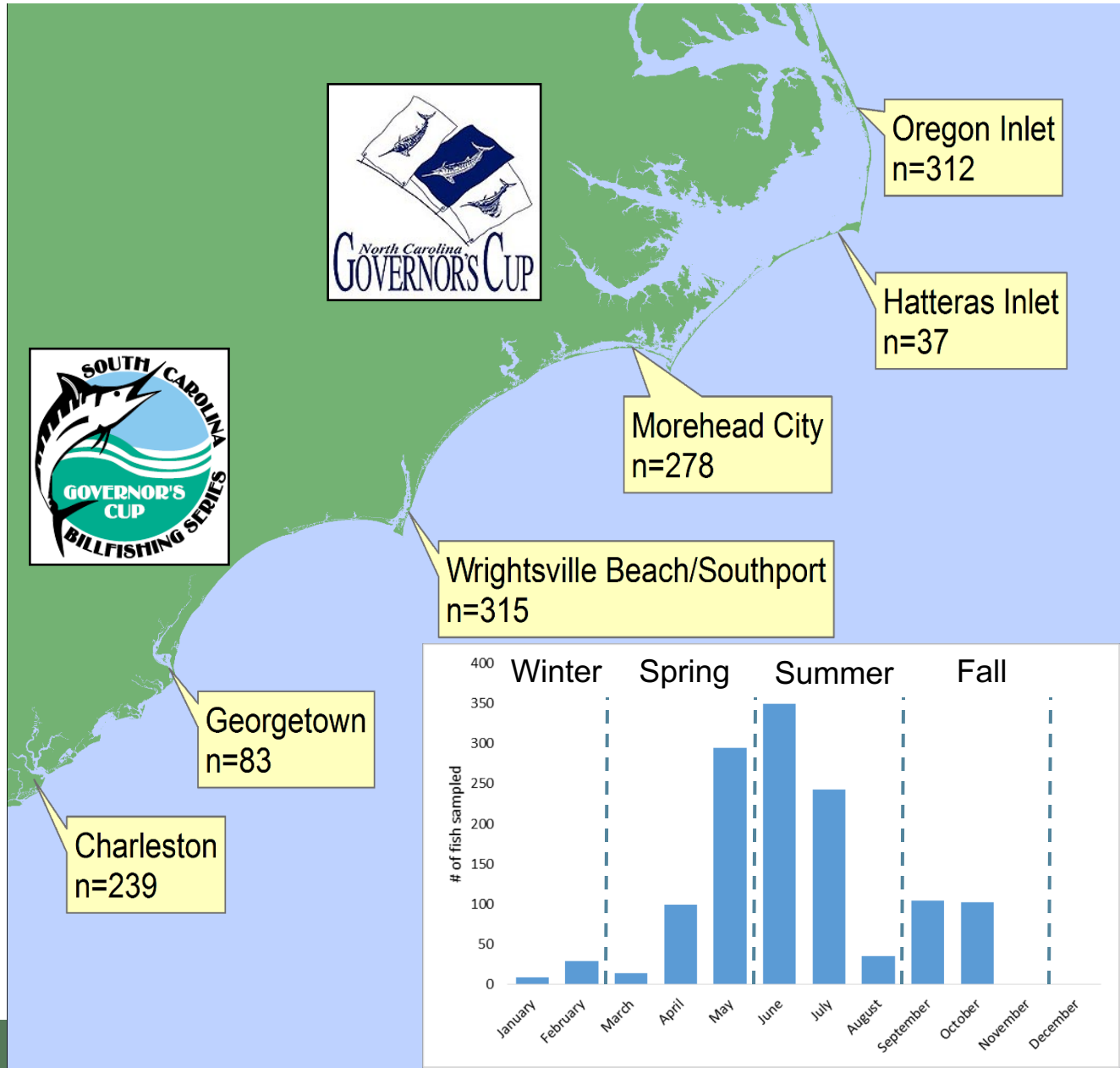
2. Examine predator/prey size based trophic niches

3. Evaluate competitive interactions among the predators

4. Describe the structure of the U.S. South Atlantic

Methods-Fish Collection

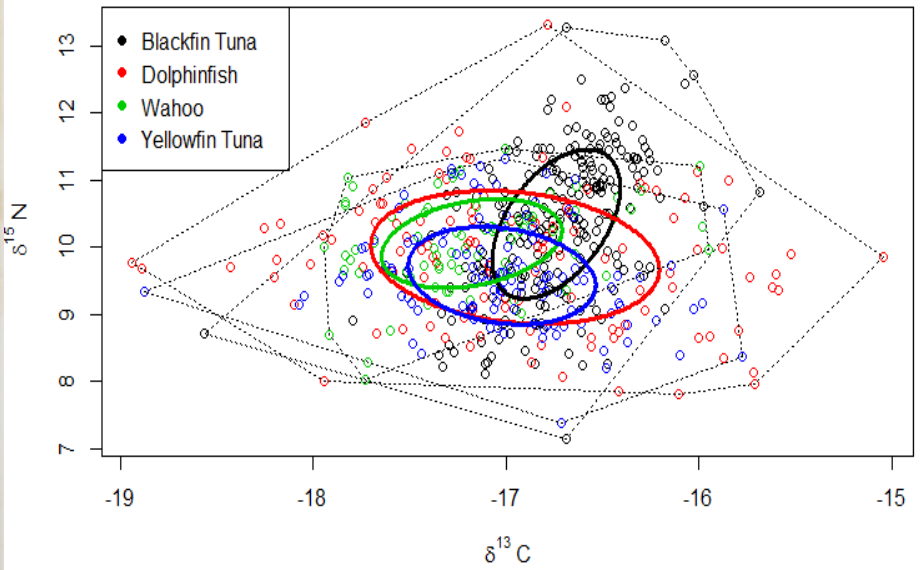
- Logistics and costs necessitate the use of fishery-dependent sampling
- Collection from regional billfish tournaments, charter and commercial operations



Methods – Stomach Content & Stable Isotope Analysis

- Stomach content analysis to describe seasonal, otogentic, and competitive relationships
- Individual prey counted, weighed and measured
- Analysis:
  - Diet indices and overlap, quantile regression

- SIA to evaluate community structure
- $\delta^{13}C$ and $\delta^{15}N$ values of predator and prey tissue
- Analysis:
  - Isotopic bi-plot and niche space, cluster analysis



Stomach contents

1,119 diets sampled

Fish

- 91 spp in 37 families

Cephalopods

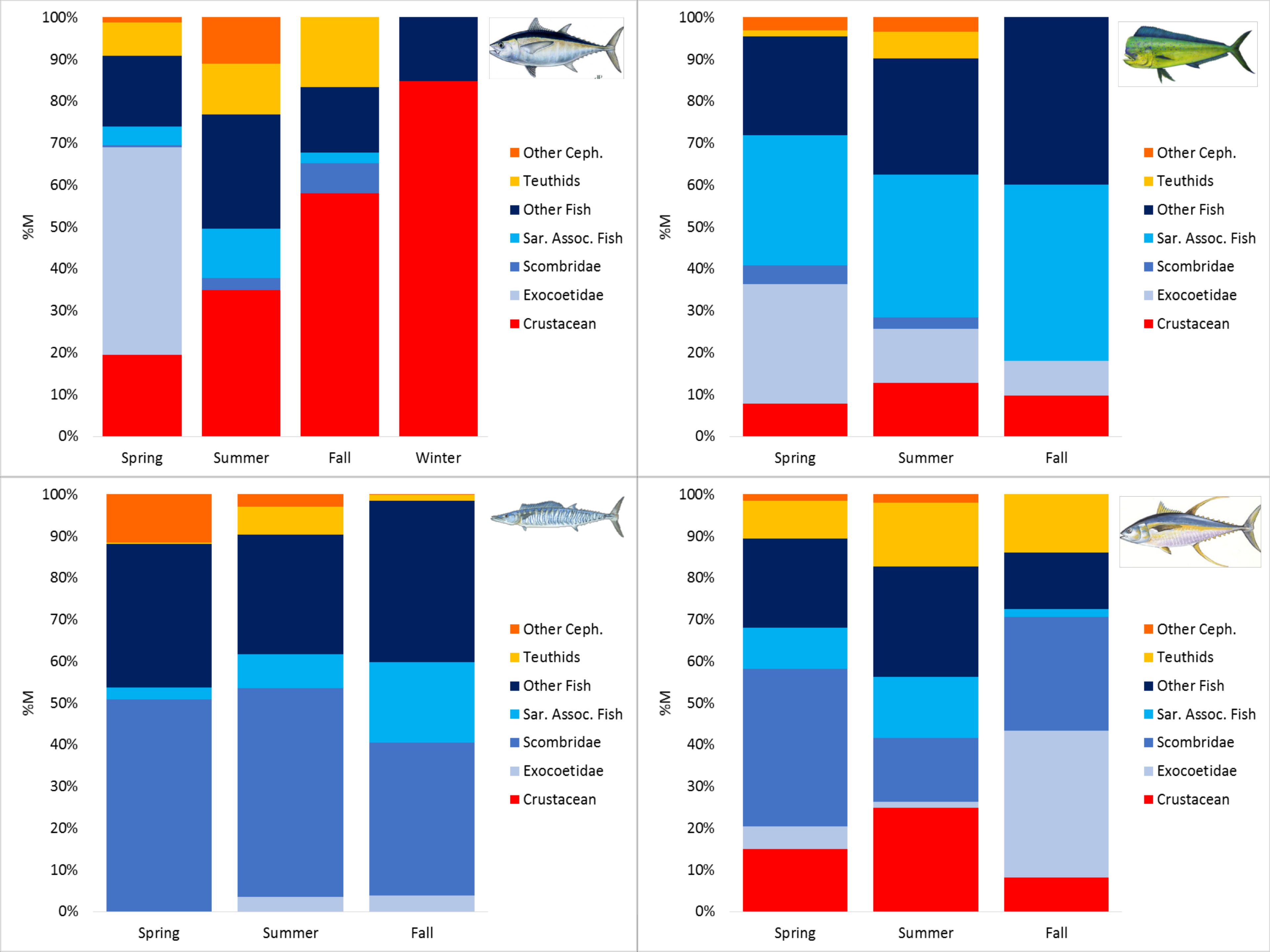
- 21 spp in 14 families

Crustaceans

- 11 spp in 8 families

Gastropods

- 3 families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60%
50%
40%
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0%
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Spring
Summer
Fall
Winter
Other Ceph.
Teuthids
Other Fish
Sar. Assoc. Fish
Scombridae
Exocoetidae
Crustacean
100%
90%
80%
70%
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Scombridae
Exocoetidae
Crustacean

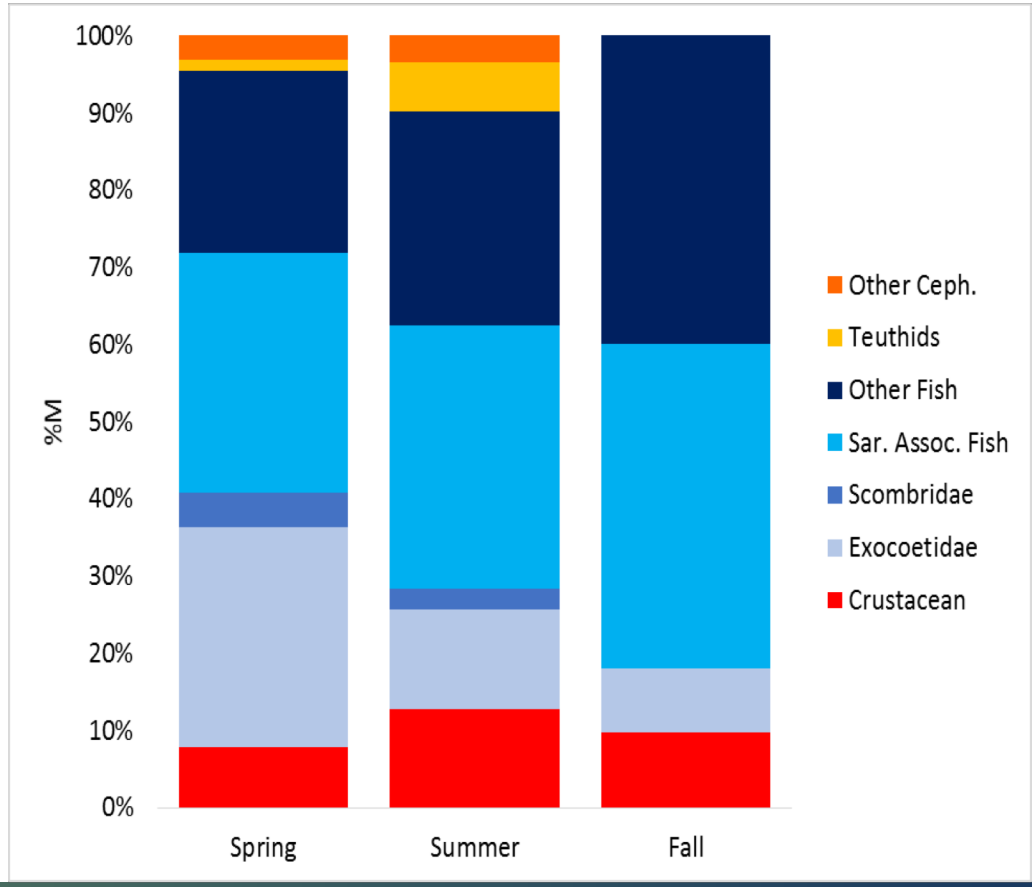
Dolphinfish

Most diverse diet among predators

- 109 genera identified

Diets dominated by fish prey

- Exocoetidae and Sargassum Assoc. species

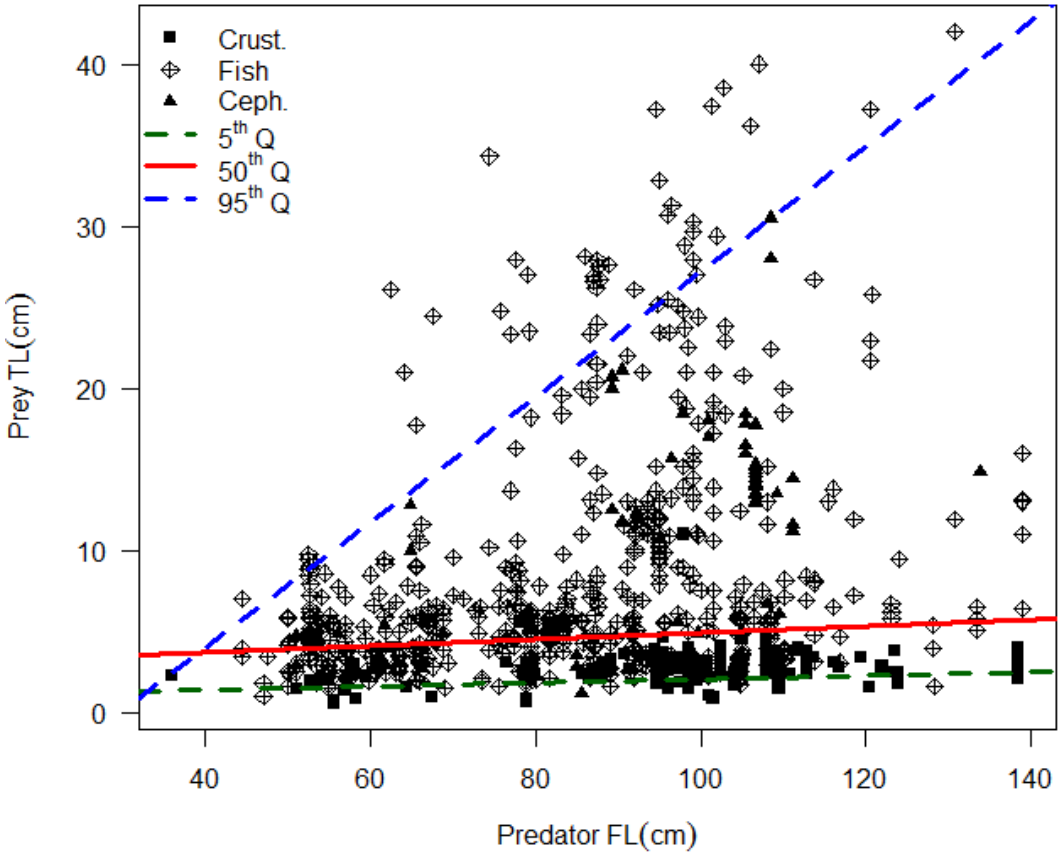


Dolphinfish

Small relative prey dominated the diets

Increase in maximum prey size

- Maintained small prey items

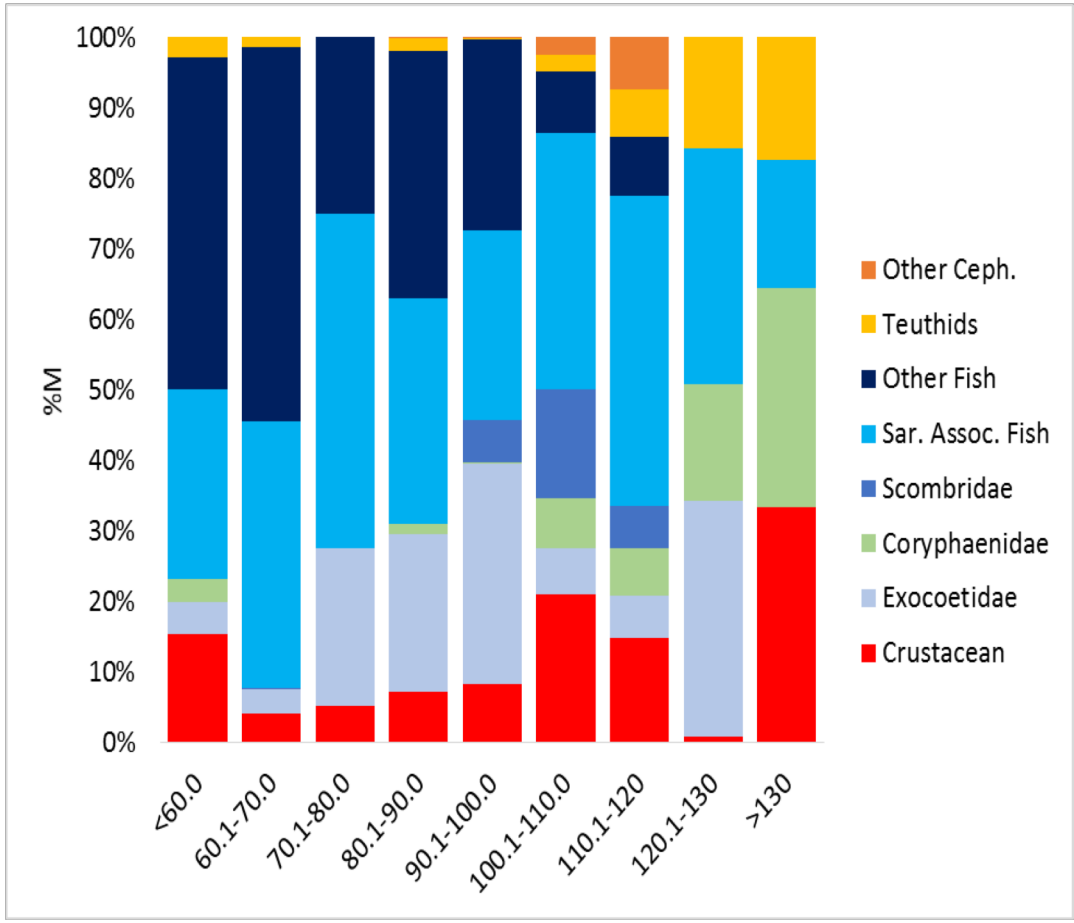


Dolphinfish

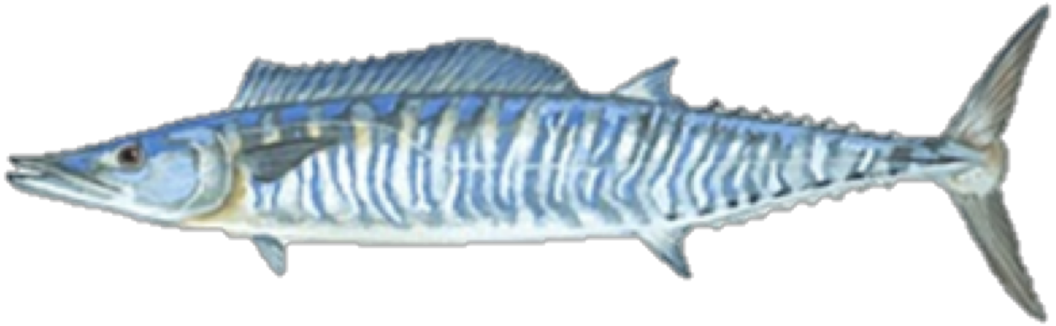
Small relative prey dominated the diets

Increase in maximum prey size

- Maintained small prey items
- Consume more prey not assoc. with Sargassum



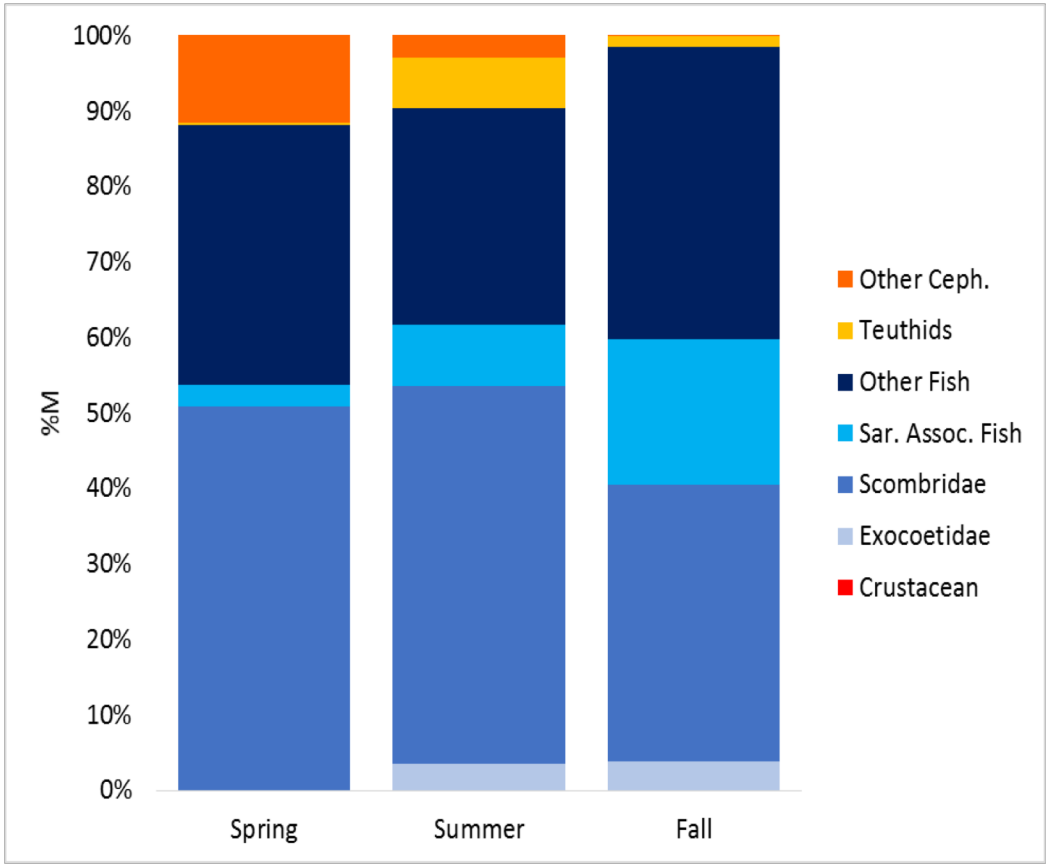
Wahoo



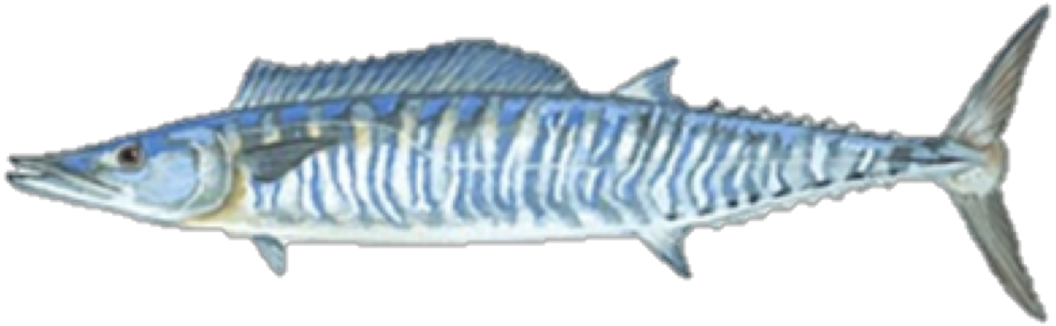
Fish occurred in 97% of stomachs

Scombrids were dominant prey

- Mostly bullet tuna



Wahoo

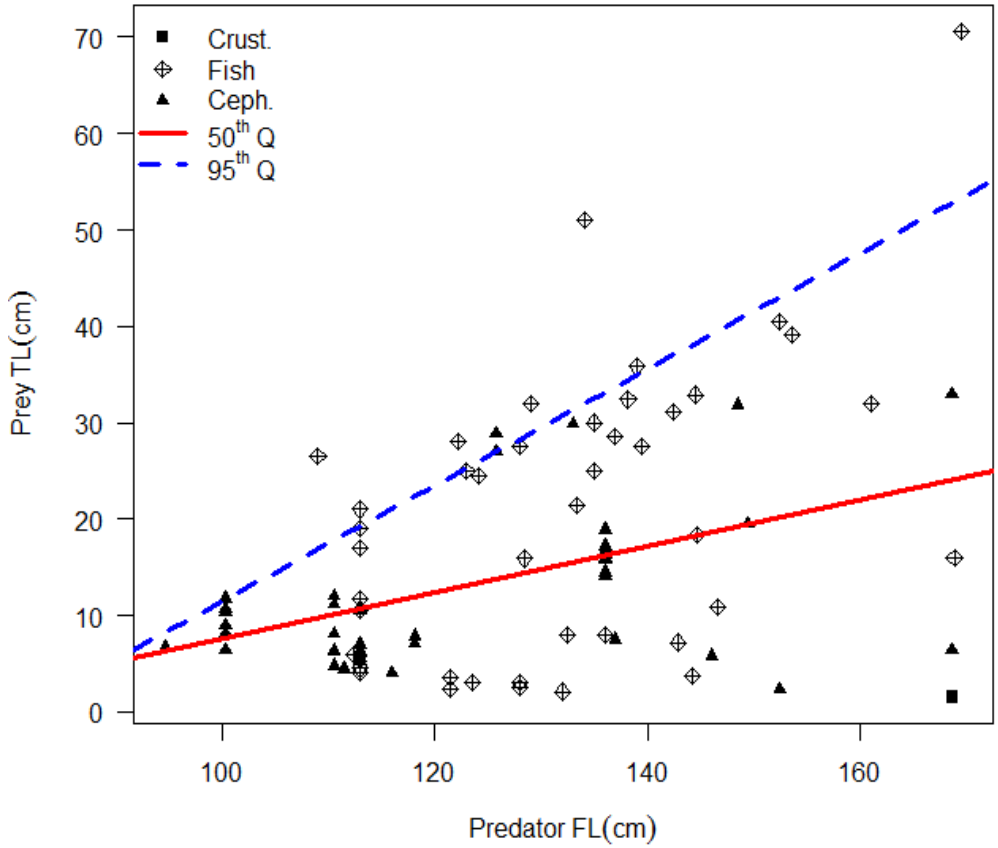


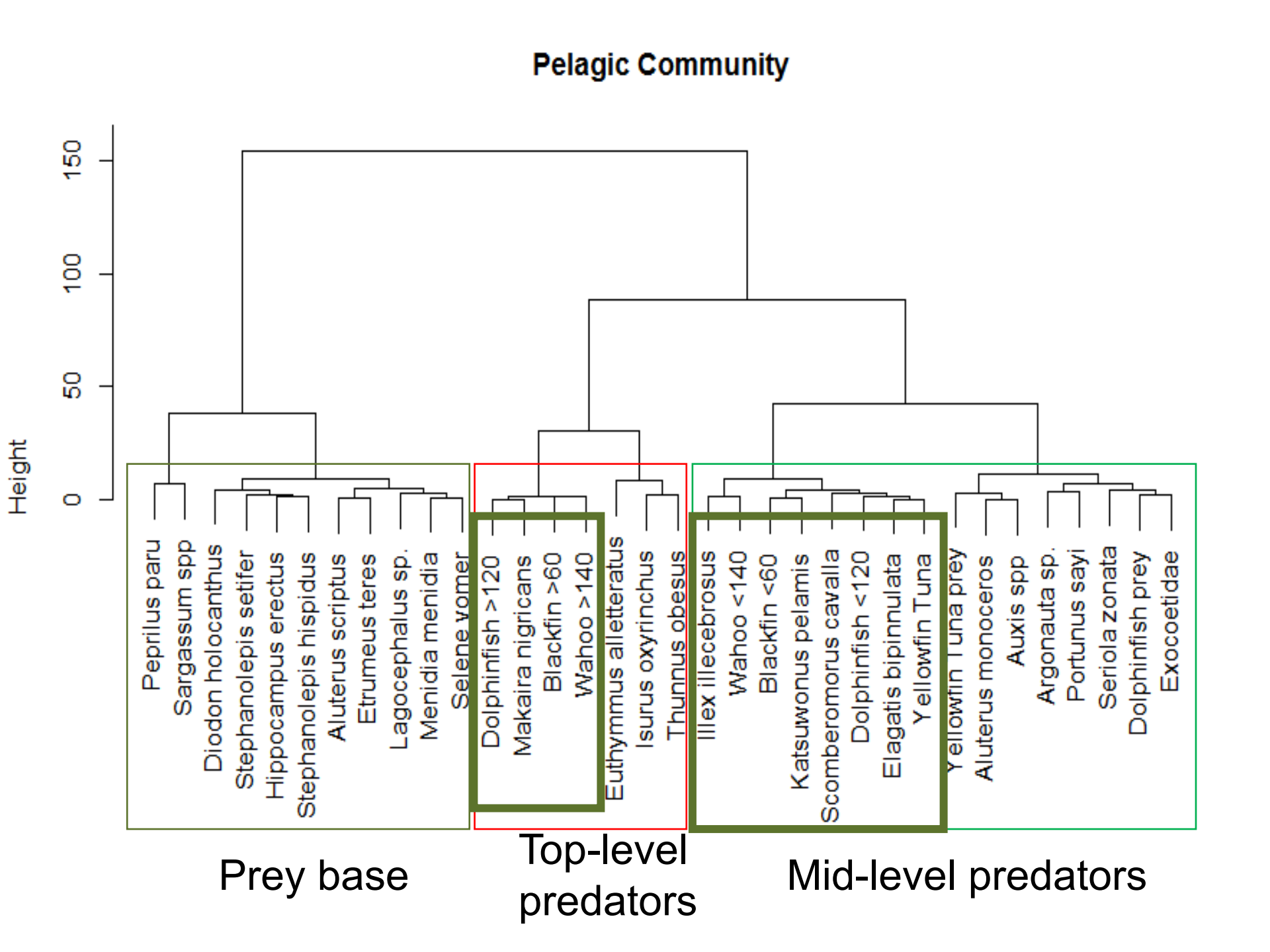
Consumed the largest prey relative to body size

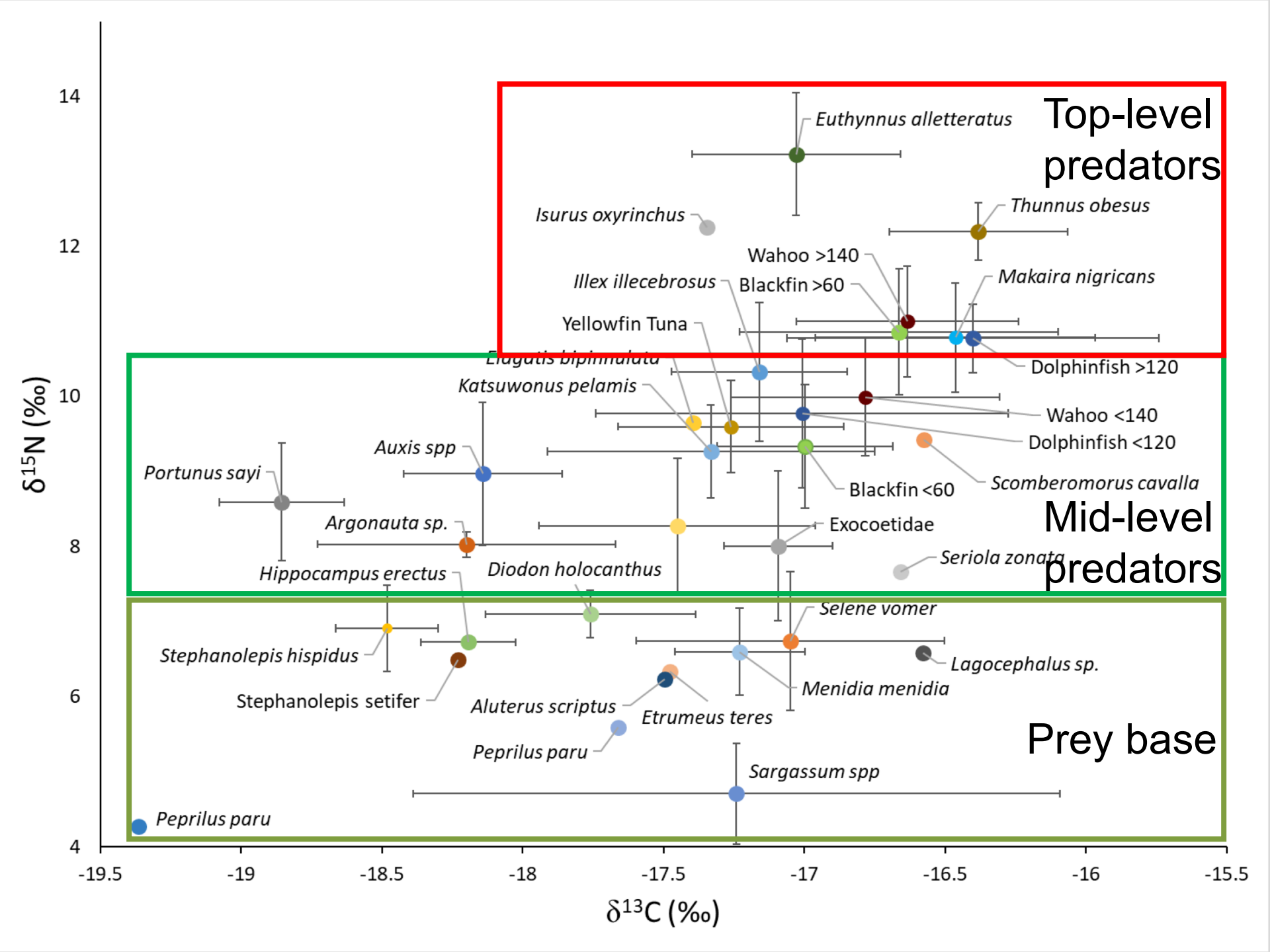
- Mean prey length 15.7 cm

Increase in median and maximum prey

- Large gape size and fast swim speed




Pelagic Community
Height
0
50
100
150
Peprilus paru
Sargassum spp
Diodon holocanthus
Stephanolepis setifer
Hippocampus erectus
Stephanolepis hispidus
Aluterus scriptus
Etrumeus teres
Lagocephalus sp.
Menidia menidia
Selene vomer
Dolphinfish >120
Makaira nigricans
Blackfin >60
Wahoo >140
Euthynmmus alletteratus
Isurus oxyrinchus
Thunnus obesus
Illex illecebrosus
Wahoo <140
Blackfin <60
Katsuwonus pelamis
Scomberomorus cavalla
Dolphinfish <120
Elagatis bipinnulata
Yellowfin Tuna
Yellowfin Tuna prey
Aluterus monoceros
Auxis spp
Argonauta sp.
Portunus sayi
Seriola zonata
Dolphinfish prey
Exocoetidae
Prey base
Top-level predators
Mid-level predators


Top-level predators
Mid-level predators
Prey base
Euthynnus alletteratus
Isurus oxyrinchus
Thunnus obesus
Wahoo >140
Illex illecebrosus
Blackfin >60
Makaira nigricans
Yellowfin Tuna
Dolphinfish >120
Katsuwonus pelamis
Wahoo <140
Dolphinfish <120
Auxis spp
Portunus sayi
Scomberomorus cavalla
Blackfin <60
Argonauta sp.
Exocoetidae
Seriola zonata
Hippocampus erectus
Diodon holocanthus
Selene vomer
Stephanolepis hispidus
Lagocephalus sp.
Menidia menidia
Stephanolepis setifer
Aluterus scriptus
Etrumeus teres
Peprilus paru
Sargassum spp
Peprilus paru
14
12
10
8
6
4
-19.5
-19
-18.5
-18
-17.5
-17
-16.5
-16
-15.5
δ15N (‰)
δ13C (‰)

Conclusions

Evidence of generalist foraging behavior among the predators

- limited resources

However, a few prey species contributed disproportionally higher to the diets

- Shortfin squid, flying fish and bullet tuna
- May indicate key forage base in pelagic habitats

Rudershausen et al. 2010

Objectives

Interspecific comparisons – diet overlap

- Blue marlin, wahoo, yellowfin tuna, & dolphin

Temporal comparisons

- Interannual variation in diet
- Historic vs present diets

Spatial comparisons

- North Atlantic with other oceans

Rudershausen et al. 2010

Methods

Four apex predators sampled from Big Rock fishing tournament (BRT)

- Large total length
  - (marlin=~3.6m; wahoo=~1.3m; YFT=1.1m; dolphin=1.3m)

Consistently second week of June

Sampled for ten years between 1998 & 2009

Gulf stream waters off North Carolina

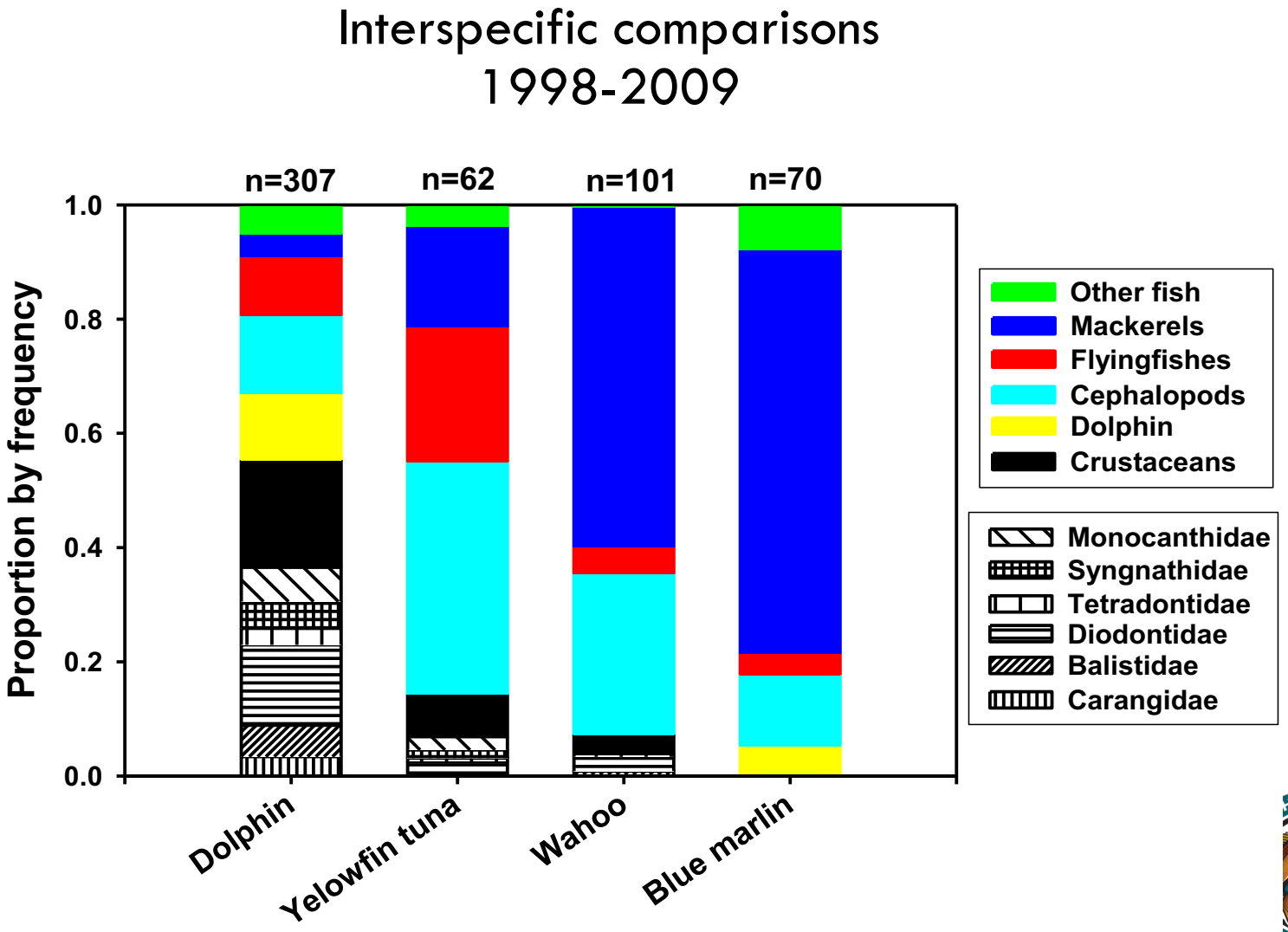
Rudershausen et al. 2010

Analyses

Principal Components Analysis (%PCA; de Crespin de Billy et al. 2000) for:

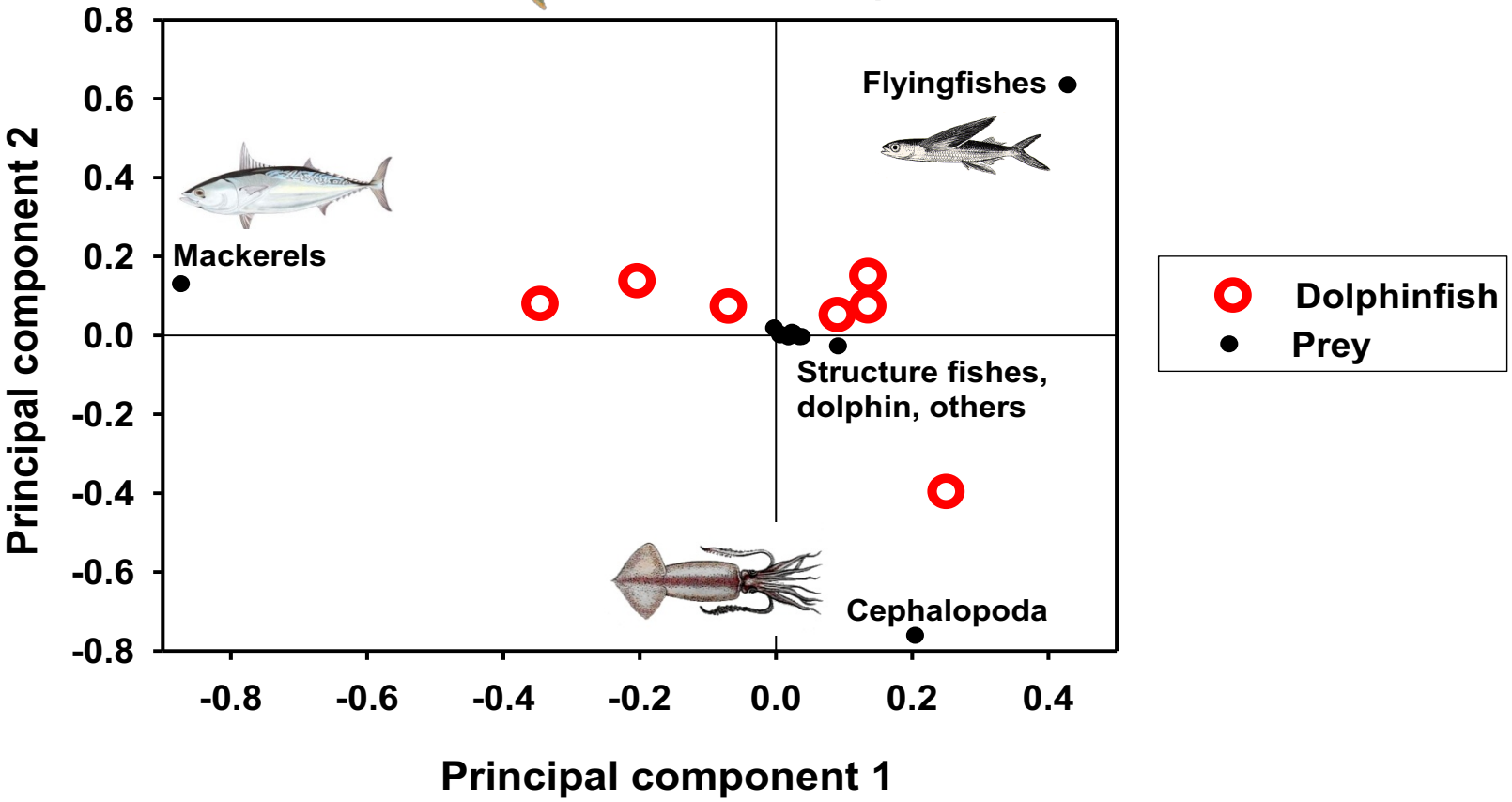
- *Temporal comparisons*
  - interannual
  - historic vs present
- *Spatial comparisons*
  - North Atlantic vs other oceans

Rudershausen et al. 2010



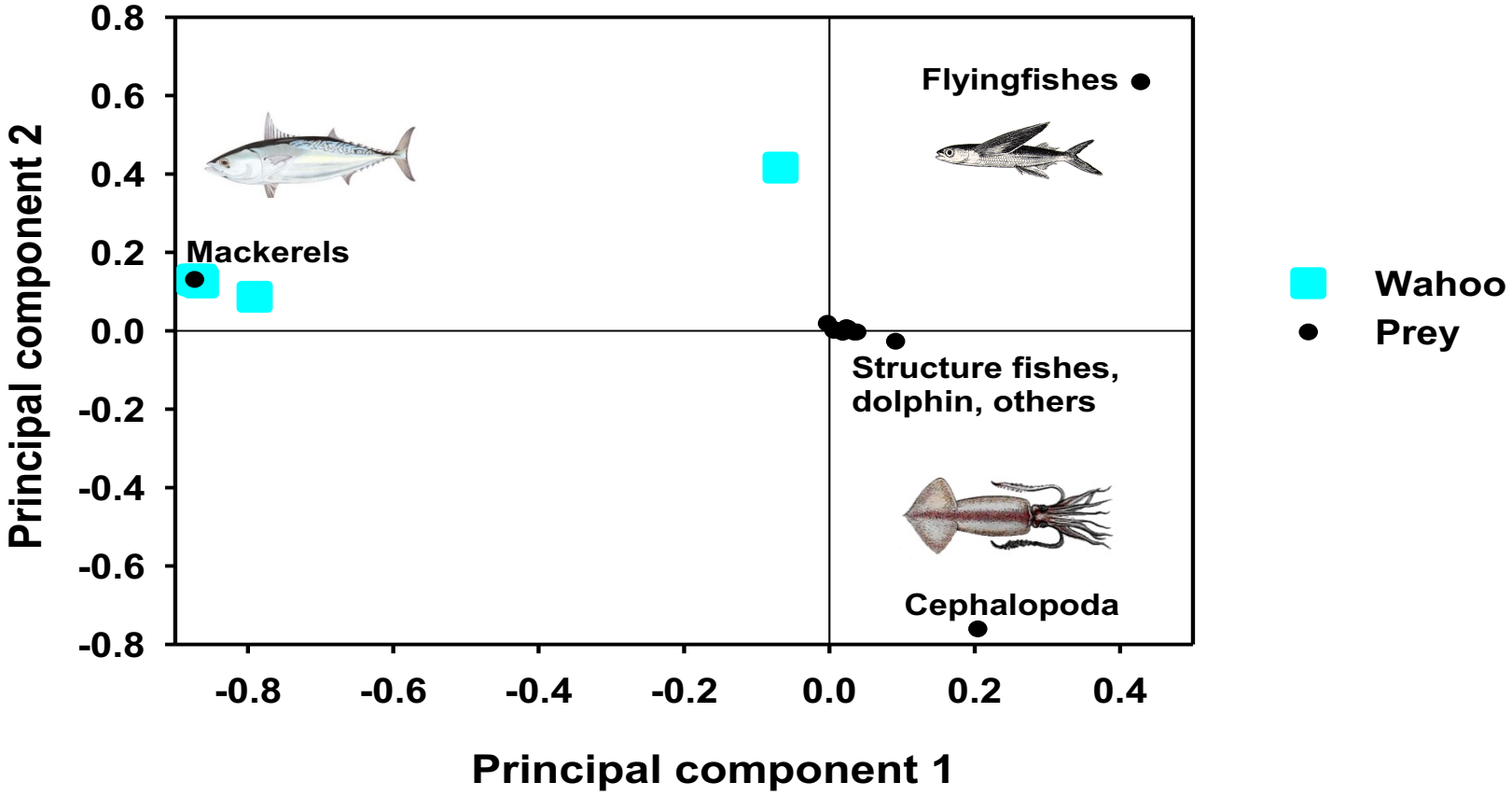
Rudershausen et al. 2010

Temporal comparisons - Interannual



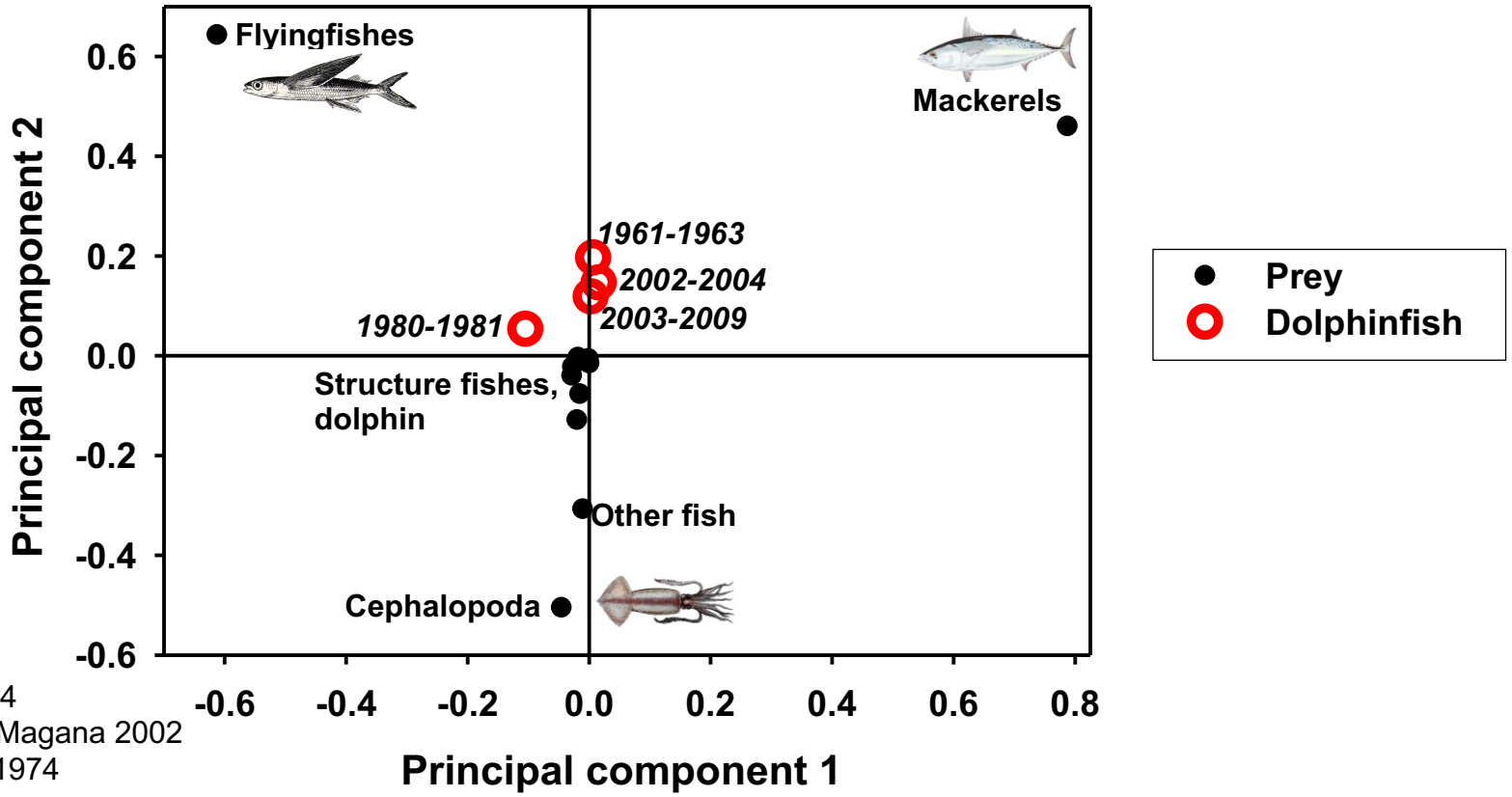
Rudershausen et al. 2010

Temporal comparisons - Interannual



Rudershausen et al. 2010

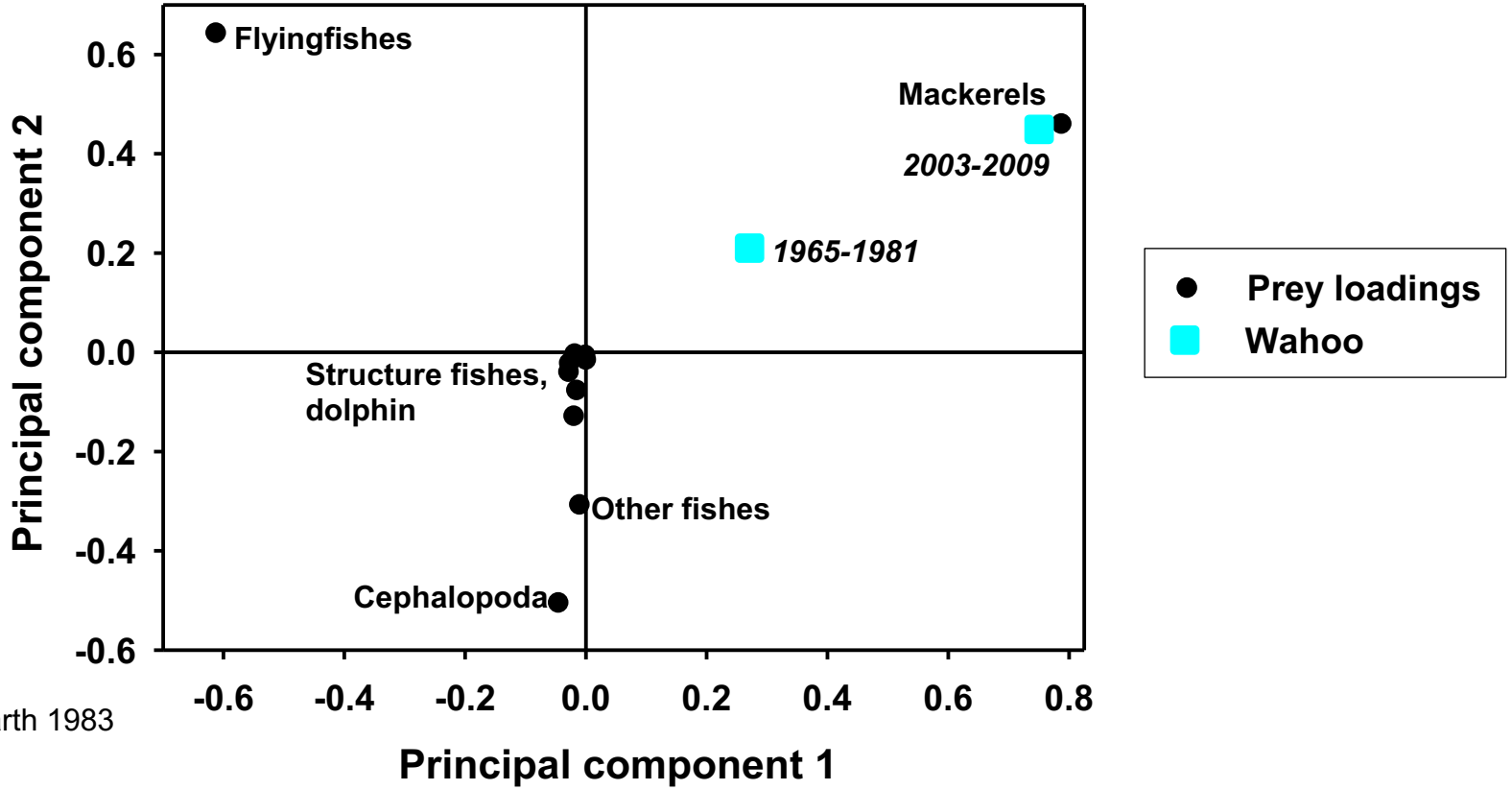
Temporal comparisons – historic vs present



Manooch et al. 1984
Olson and Galvan-Magana 2002
Rose and Hassler 1974

Rudershausen et al. 2010

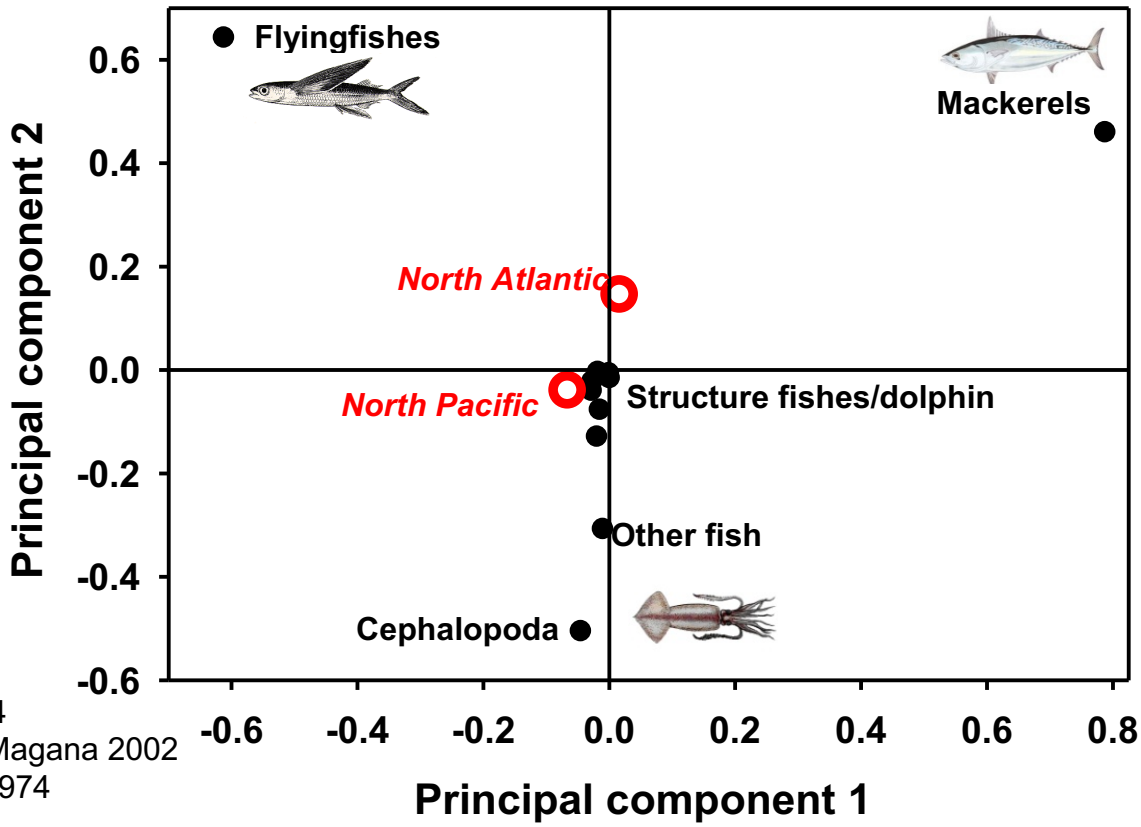
Temporal comparisons – historic vs present



Manooch and Hogarth 1983
Vaske et al. 2003

Rudershausen et al. 2010

Spatial comparisons



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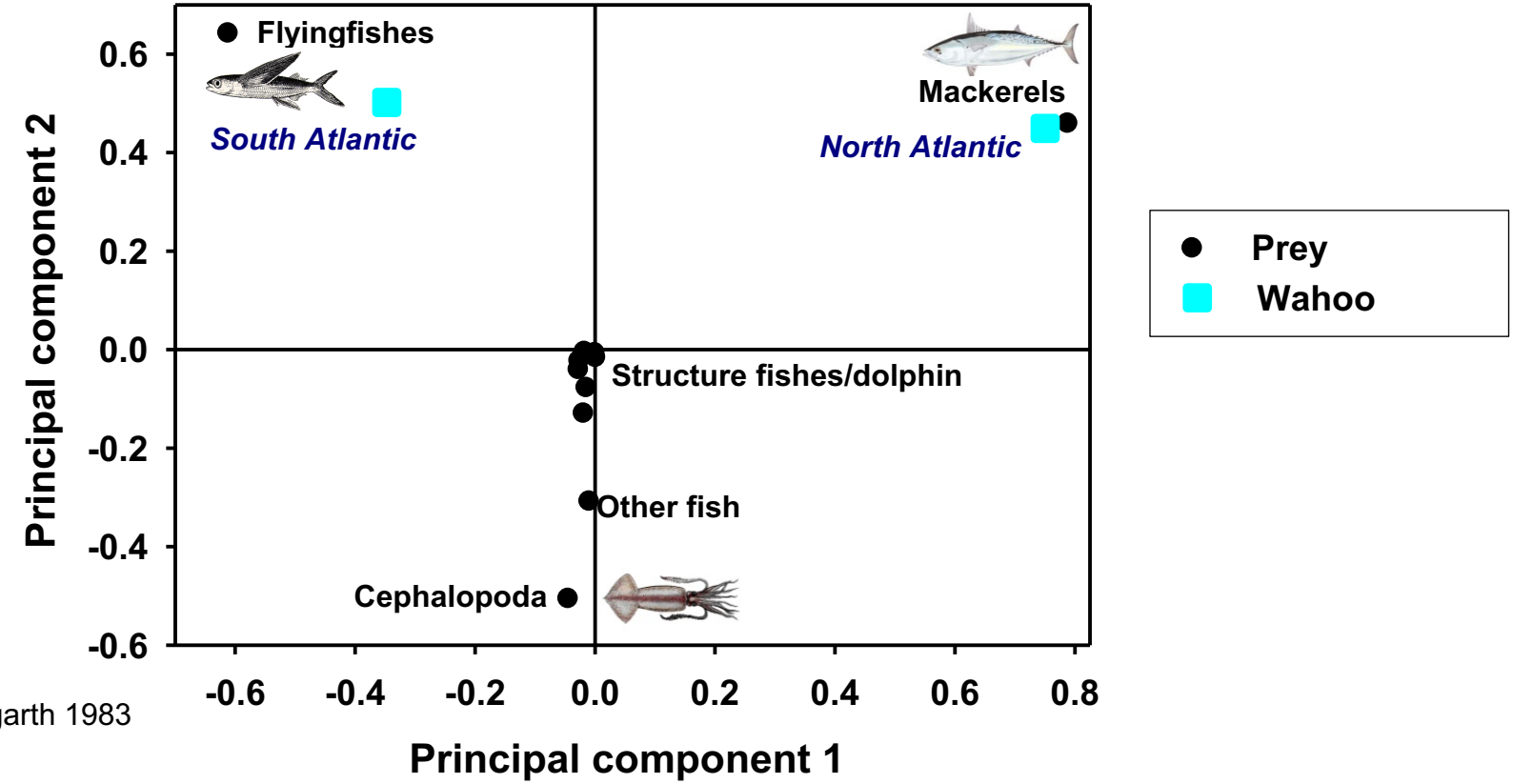
Spatial comparisons



Manooch and Hogarth 1983
Vaske et al. 2003

Rudershausen et al. 2010

Temporal comparisons

Substantial diet overlap between blue marlin and wahoo given reliance on mackerels (*Auxis* spp) across years

Consistently diverse diet from year to year and over multiple decades for dolphin

Spatial comparisons

Remarkable similarities in diet among oceans for blue marlin and dolphin

Rudershausen et al. 2010

Further support that *Auxis* spp. play important role for oceanic apex predators

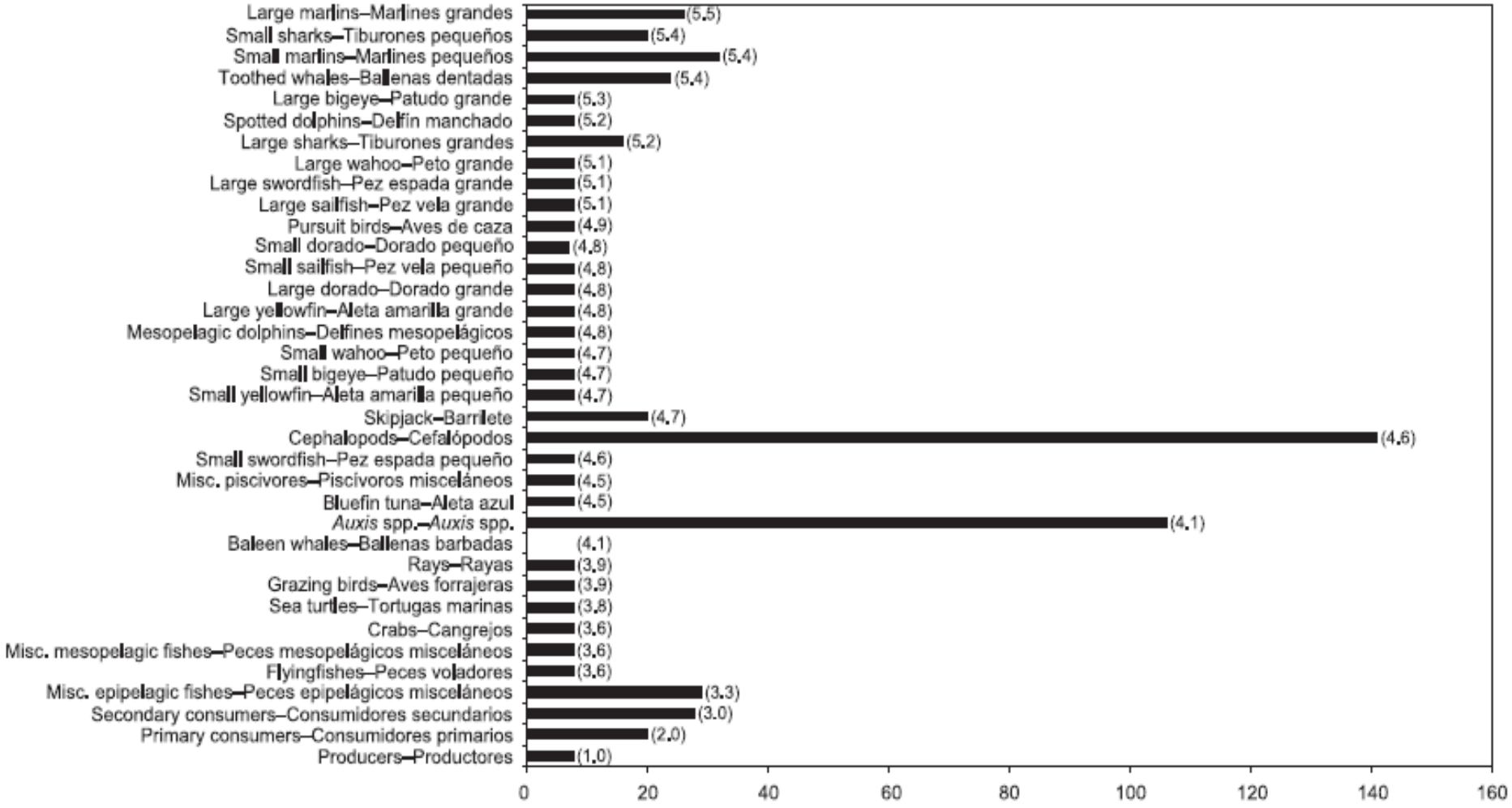
Results suggest:

- a stable pelagic food web and forage base in waters of Gulf Stream

and/or

- strong selection for particular prey types

Importance of Auxis spp. eastern Pacific EwE model




Questions?