INTERNATIONAL SYMPOSIUM

DRIVERS OF DYNAMICS OF SMALL PELAGIC FISH RESOURCES

S3	Mar. 9-10	The role of small pelagic fish in food web dynamics between plankton and top predators

Including fishers

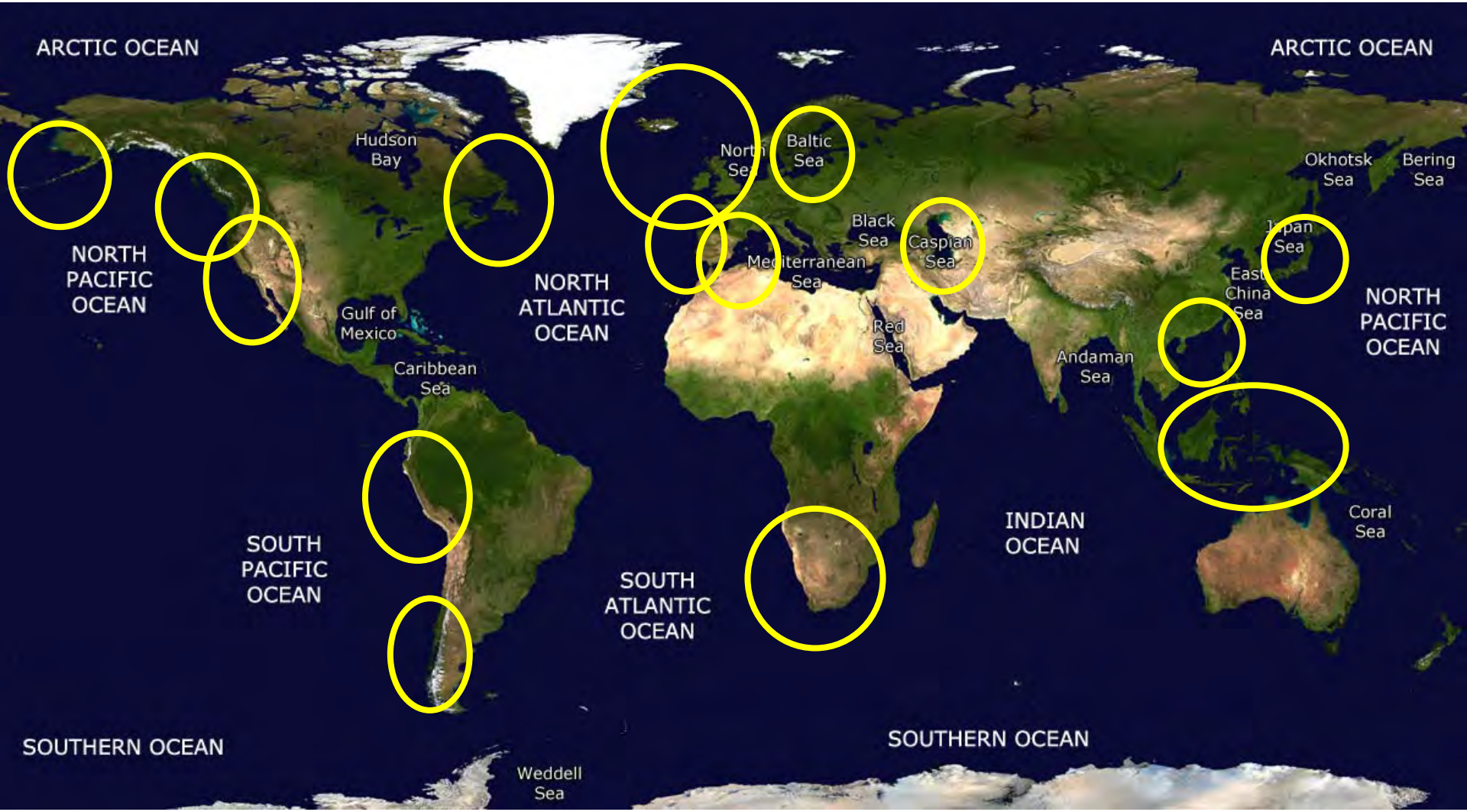
Small pelagic fish as prey or predator

TO EAT, TO BE EATEN, AND A LOT OF QUESTIONS

Susana Garrido

Small pelagic can act as prey, predator, competitor and even…. cannibal

Case study from a variety of ecosystems

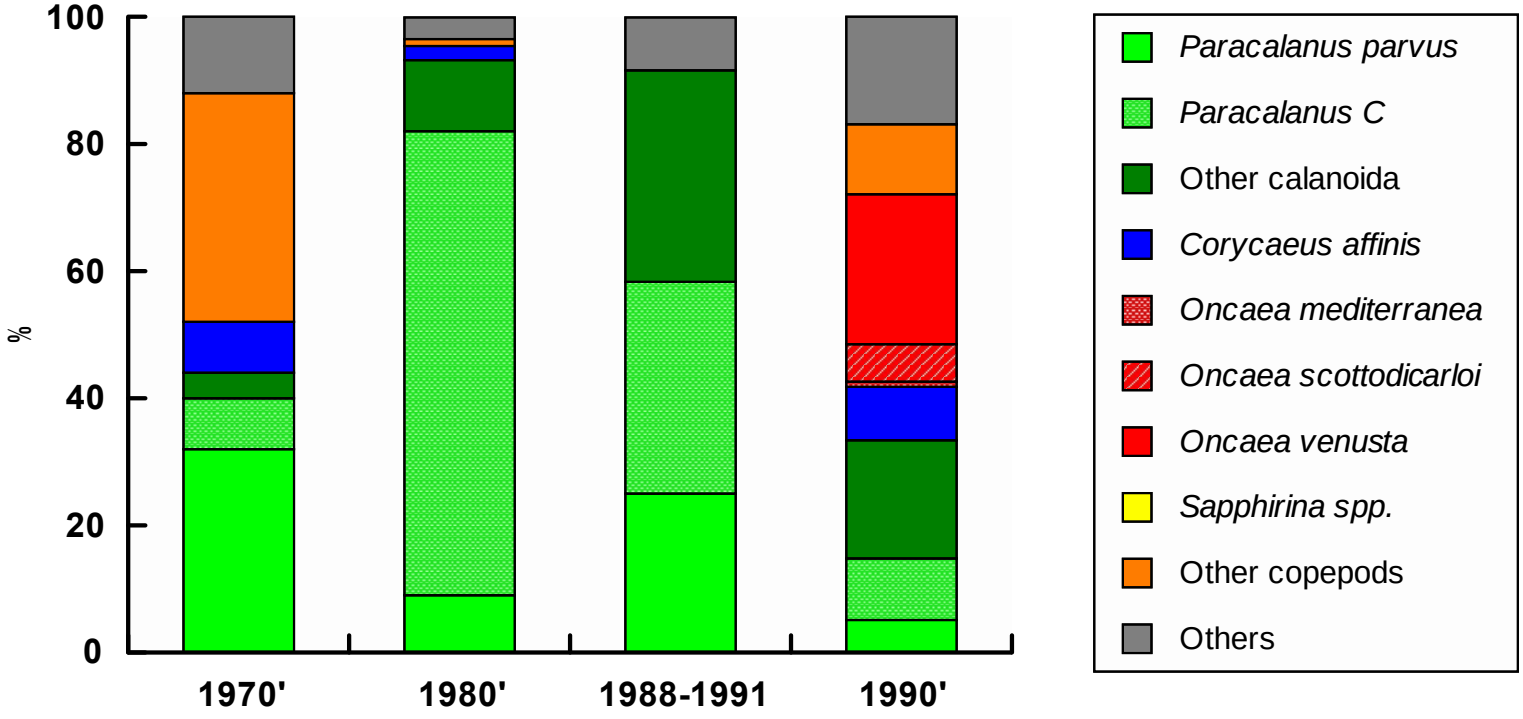


Small pelagic fish as predator

Gaps (S. Garrido): lack of knowledge on larvae feeding

Yuji Okazaki et al. recovered historical samples in the Kuroshio-Oyashio and provide a time series 1970s - 1990s

Larvae

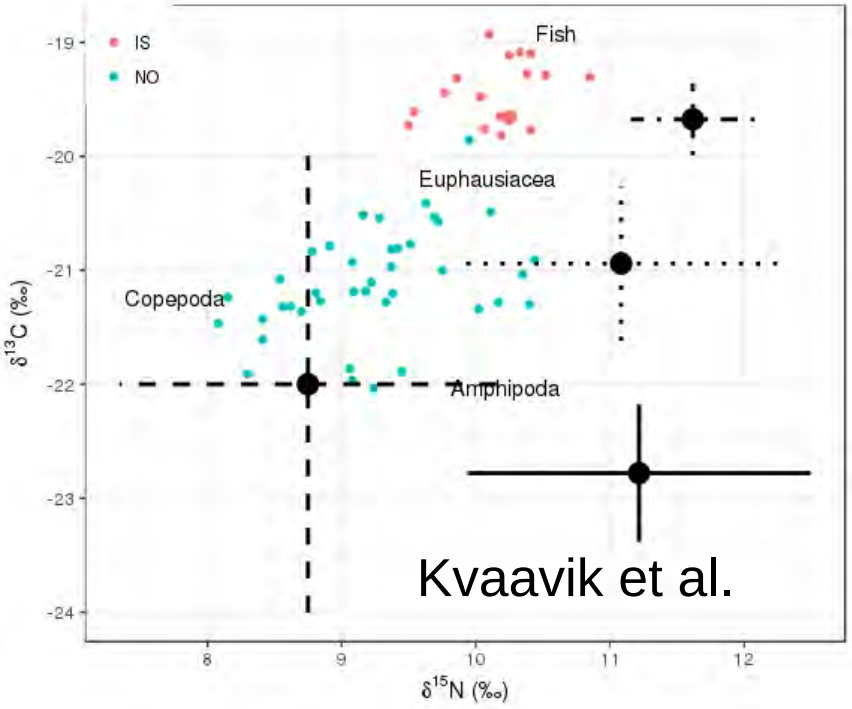


Small pelagic fish as predator

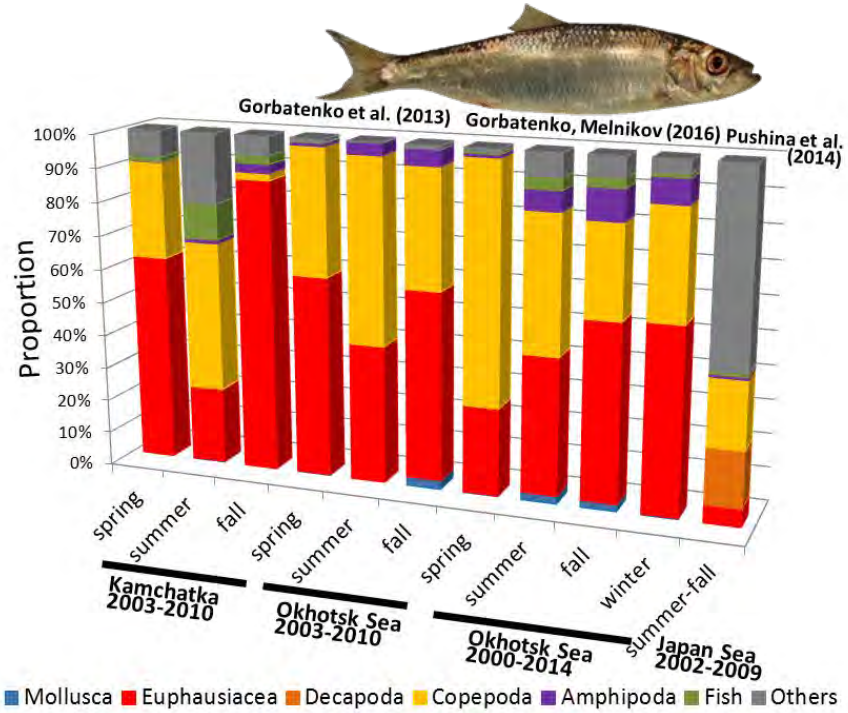
Variety of works focused on SPF prey composition using a different methods

Pakhomov et al..

Stable isotopes analysis



Kvaavik et al.



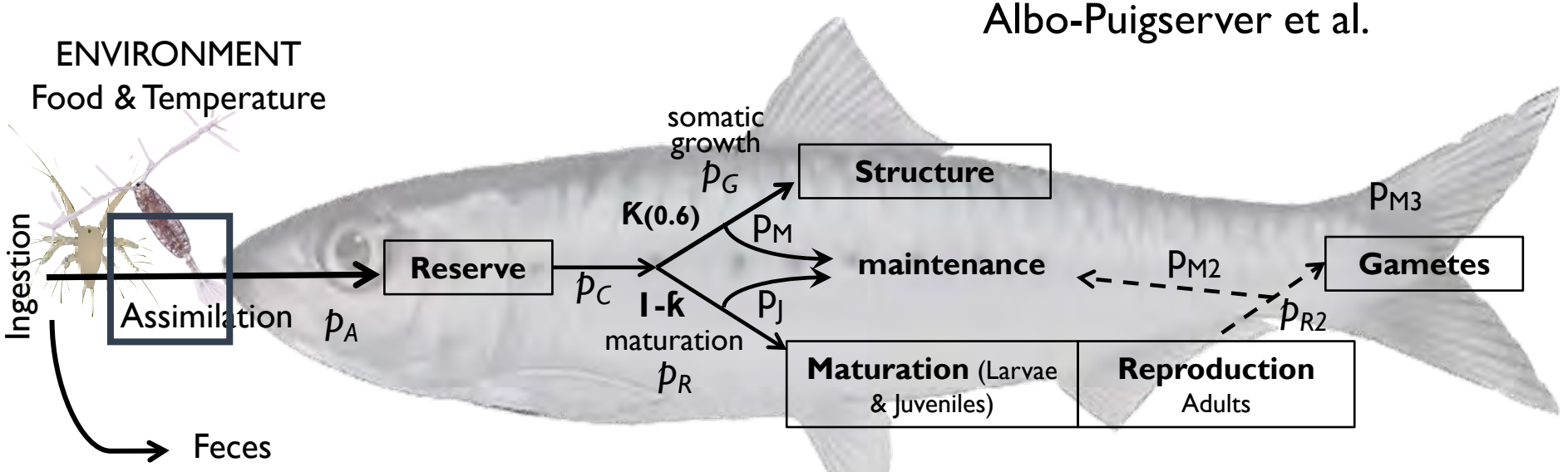
→ **Enormous spatiotemporal variability in SPF diet**

→ **Be cautious with constant diet in trophic models**

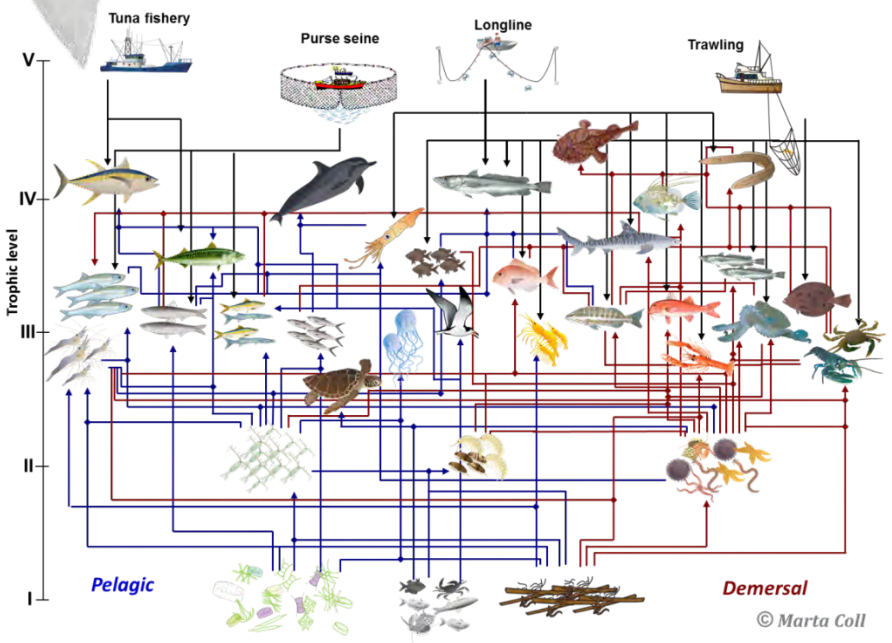
Trophic interaction and energy budget

Dynamic Energy Budget Model

Albo-Puigserver et al.

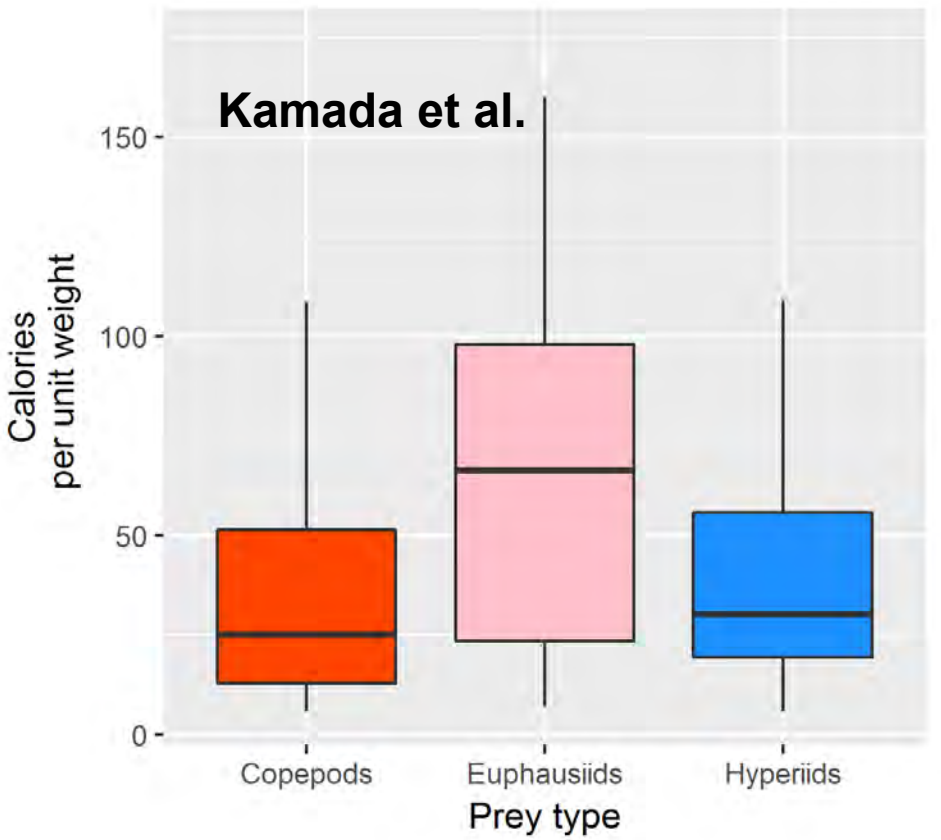


Trophic models



Small pelagic fish as predator

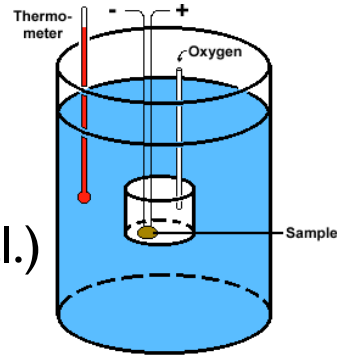
SPF prey are not energetically equal



Energy Density

Bomb calorimetry

(e.g. Albo-Puigserver et al.)



Yona et al.

Prey sources impact omega 3 content → impact on reproduction, etc.

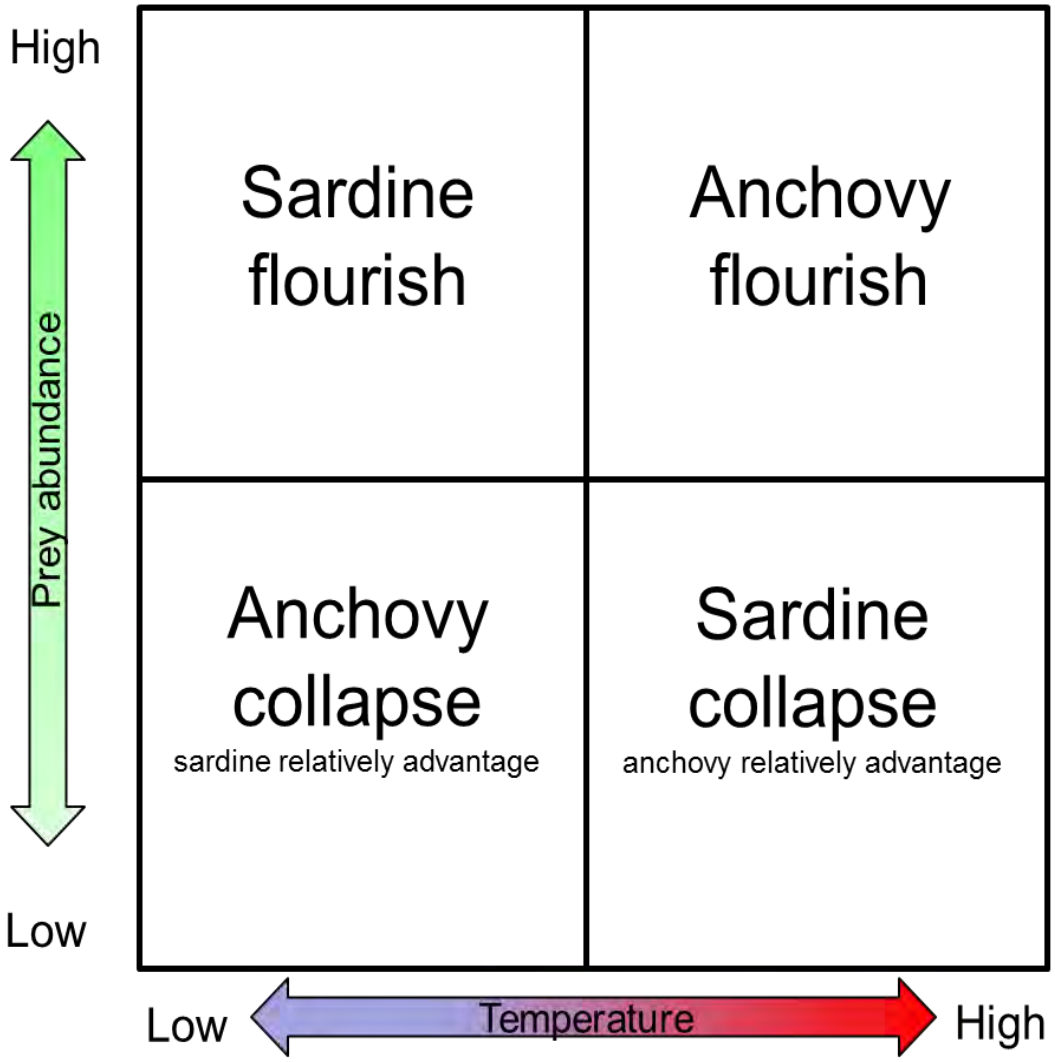
→ Environmentally driven changes in prey composition impact SPF (see other sessions)

Small pelagic fish as predator

Yuji Okazaki et al. in the Kuroshio-Oyashio system

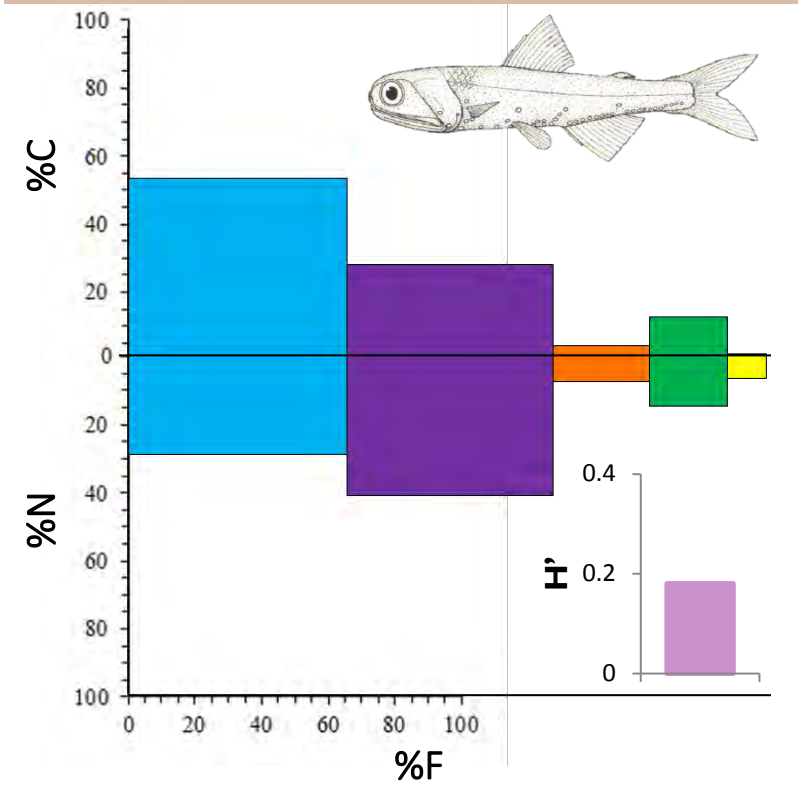
Large scale environmental impacts

Interaction between Temp. and prey abundance

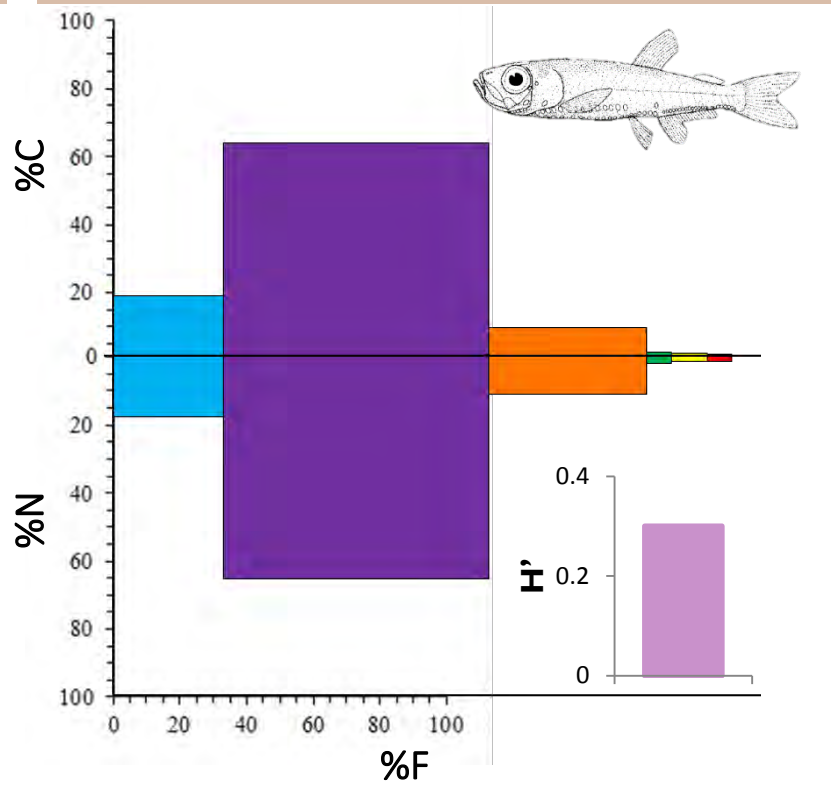


Oceanic small pelagic fish

Lanternfish



Lightfish



Krill
Copepods
Amphipods (Sm.)
Amphipods (Lg.)
Fish eggs
Mollusc larvae

Tyler et al.

LANTERNFISH

- Higher trophic position
- Diet derived TL 4.21±0.03
- Macro-zooplanktivore
- More specialized predator

LIGHTFISH

- Lower trophic position
- Diet derived TL 3.85±0.03
- Meso-zooplanktivore
- Opportunistic predator

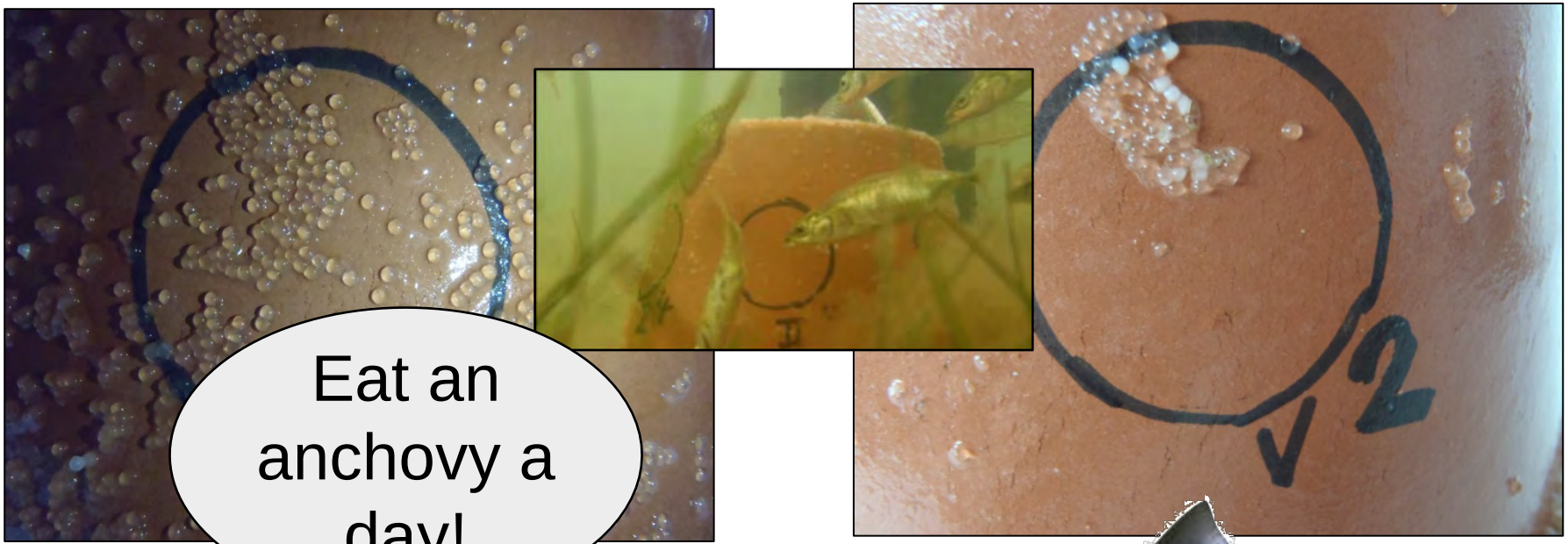
Small pelagic fish as prey

Small pelagic fish as prey

First stages

Predation on herring eggs

Kotterba et al.



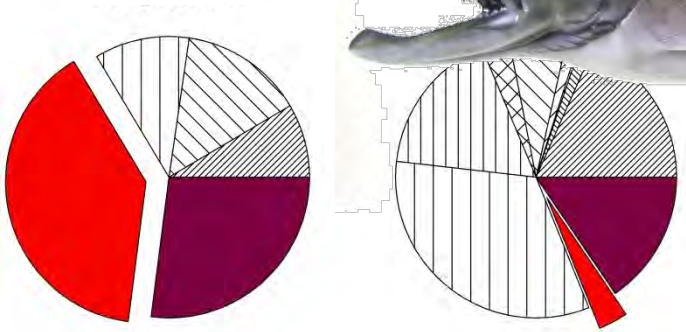
Eat an anchovy a day!

t = 0 hours **ours**

Chinook Salmon impact o

August - September

1.6 anchovy/day

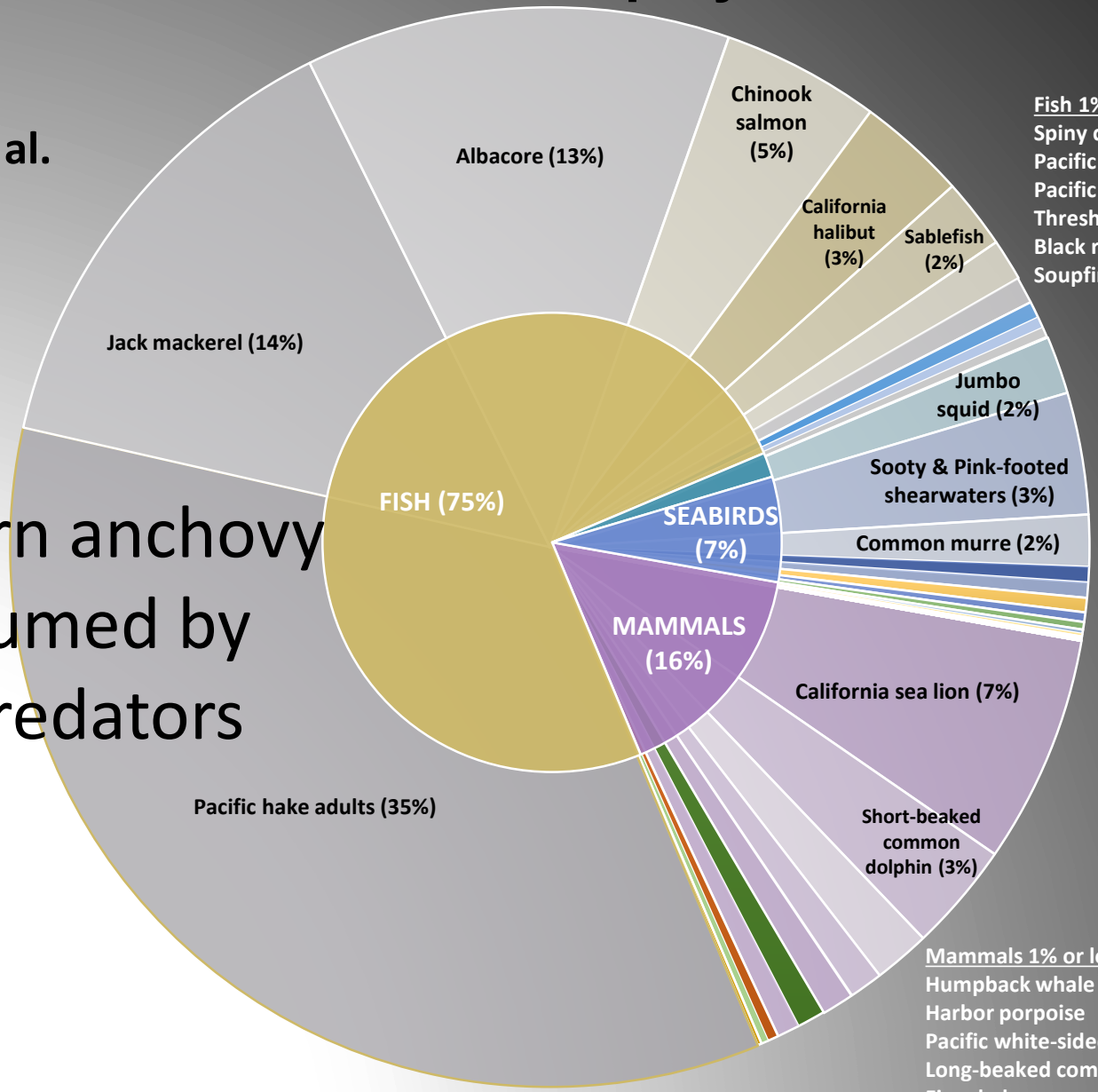


Broder et al.

SPF as prey

Thayer et al.

Northern anchovy consumed by CC predators



Fish 1% or less
Spiny dogfish
Pacific bluefin tuna
Pacific bonito
Thresher shark
Black rockfish
Soupfin shark

Seabirds 1% or less
Heermann's gull
Brown pelican
Black-vented shearwater
California gull
Brandt's cormorant
Western gull
Double-crested cormorant
Caspian tern
Xantus' murrelet
Rhinoceros auklet
Elegant tern
Least tern
Marbled murrelet

Mammals 1% or less
Humpback whale
Harbor porpoise
Pacific white-sided dolphin
Long-beaked common dolphin
Fin whale
Harbor seal
Sperm whale
Northern fur seal

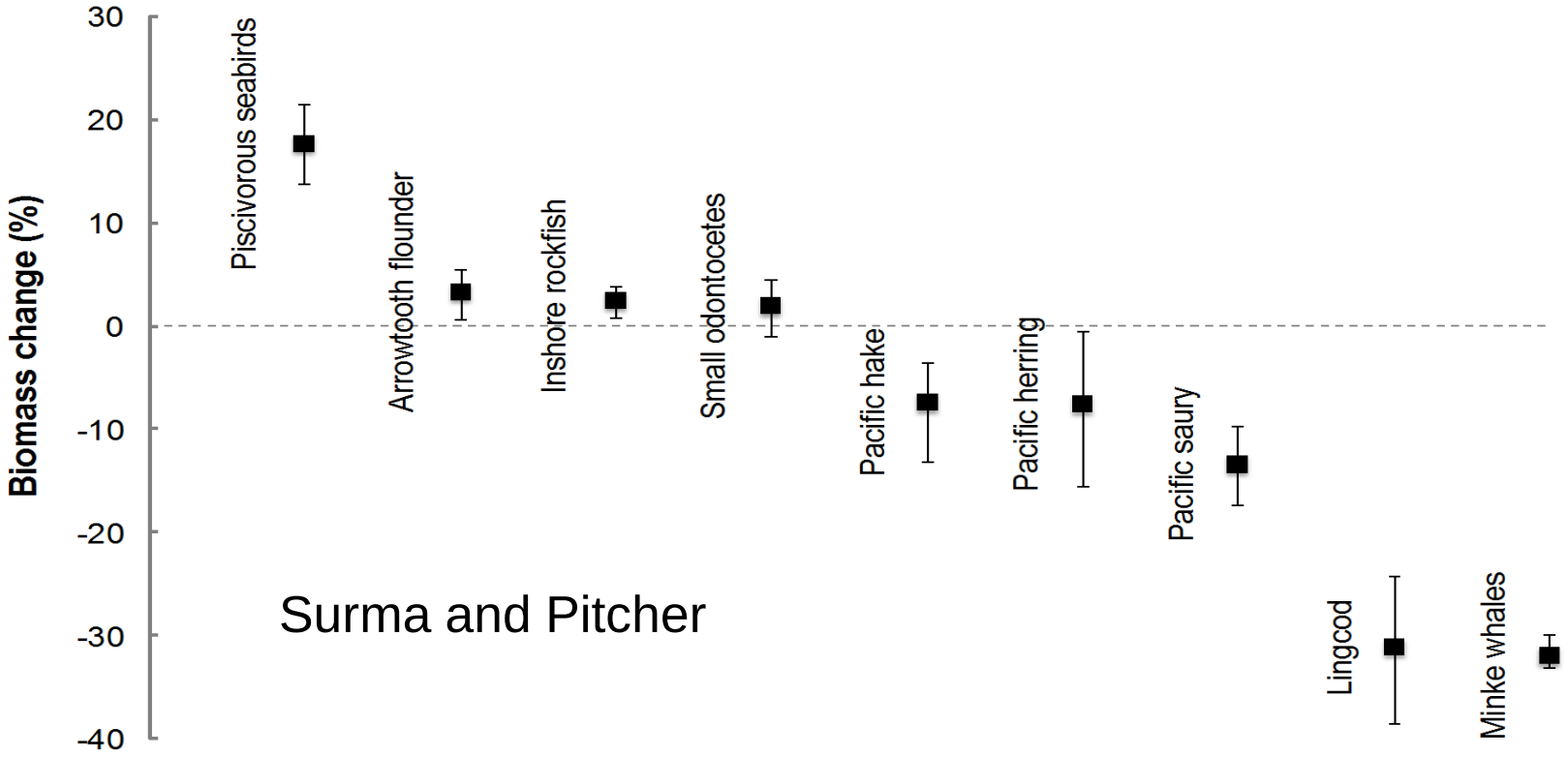
Szoboszlai et al.*in prep*

Predators

Top down effect

Whales recovery may impact:

SPF (including reproduction success see Moran et al.), some piscivores and local fisheries.



Surma and Pitcher

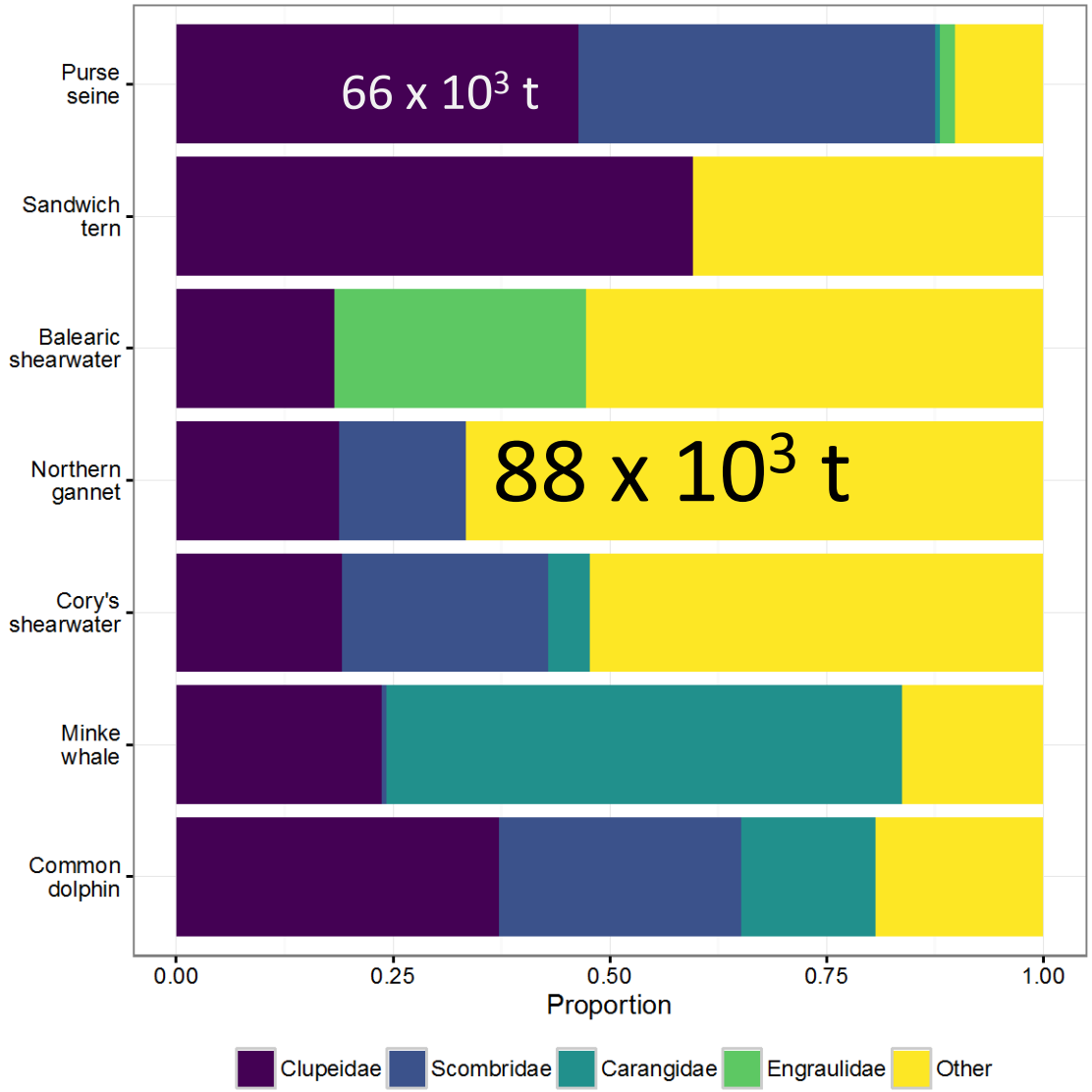
Predators (SPF a prey)

Competition between top predators and fisheries

Natural top predators and fishers do forage on the same prey

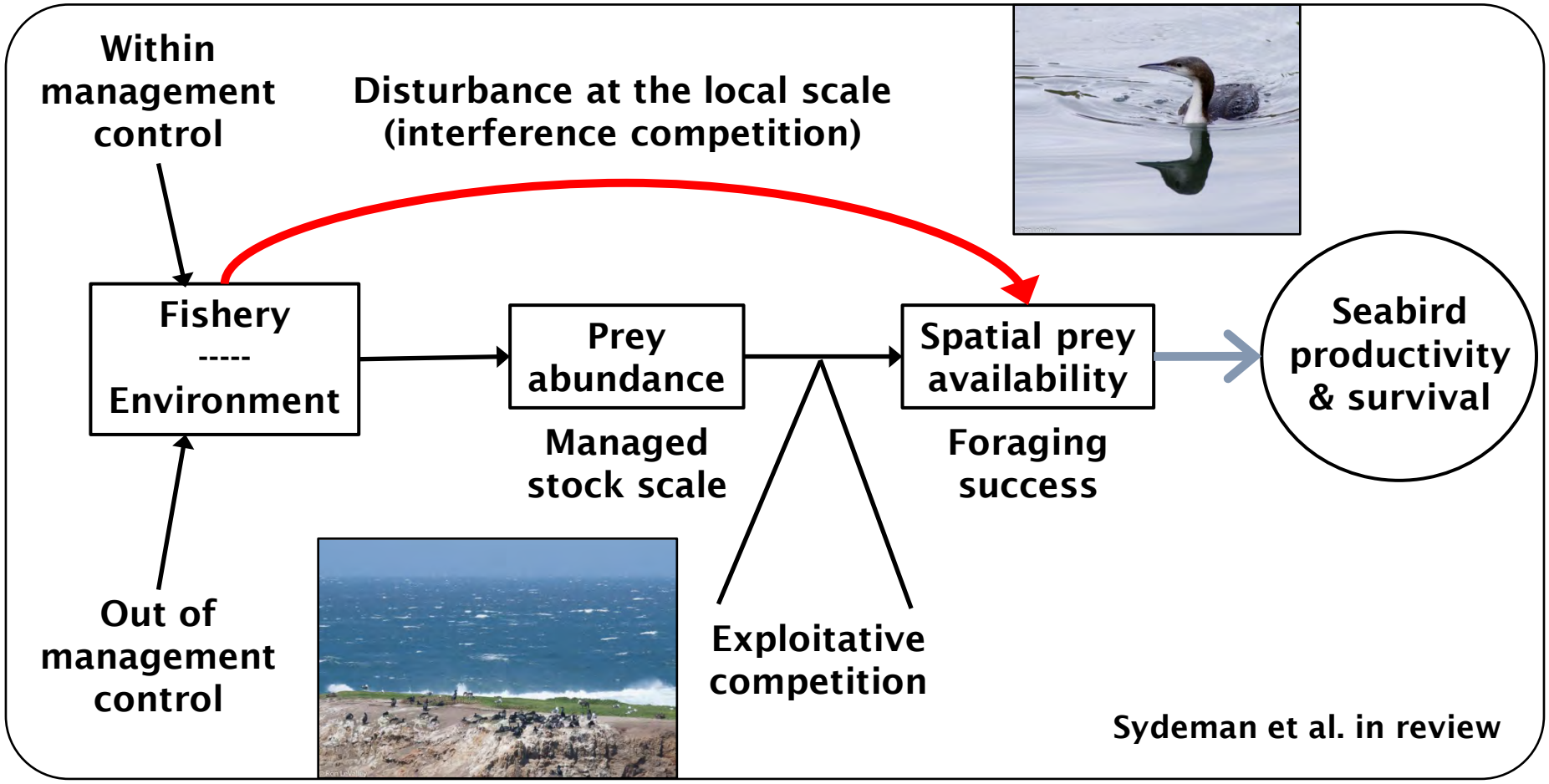
SPF percentage in the diet or landings

Wise et al.



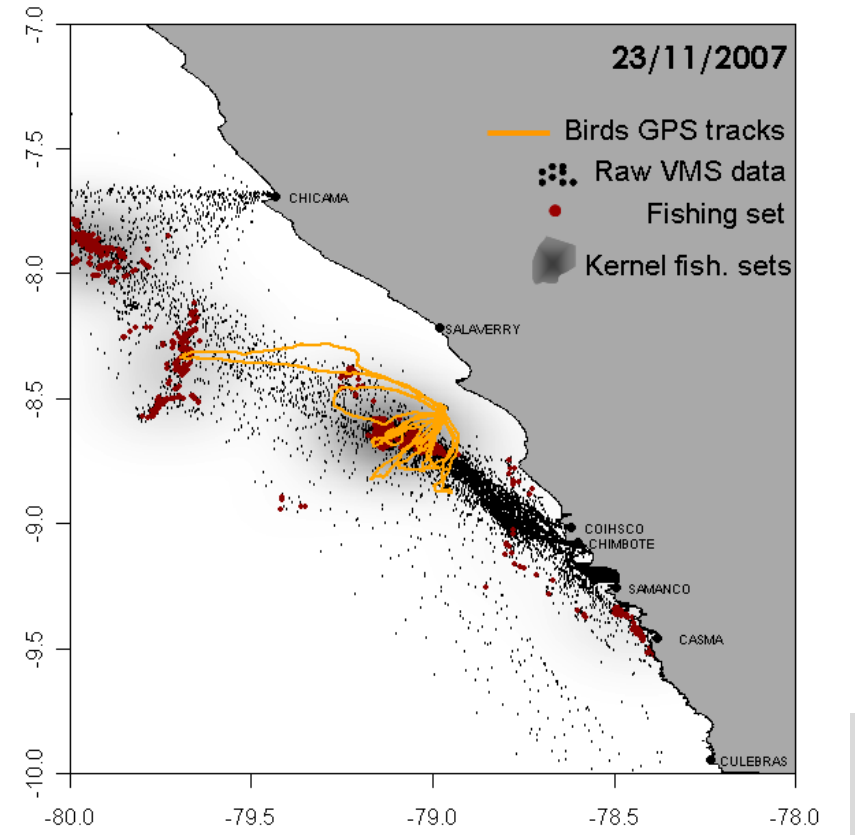
Predators (SPF a prey)

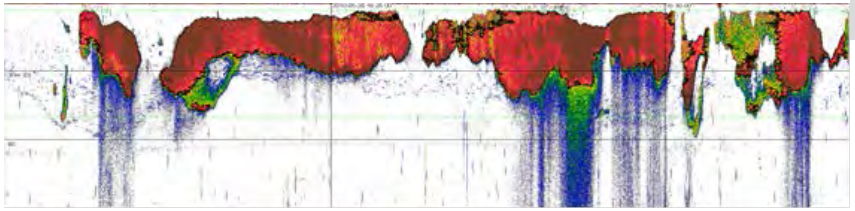
Competition between seabirds and fisheries: framework

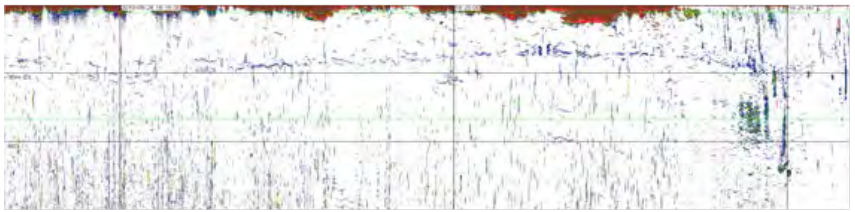


Predators (SPF a prey)

Competition between seabirds and fisheries (local scale)







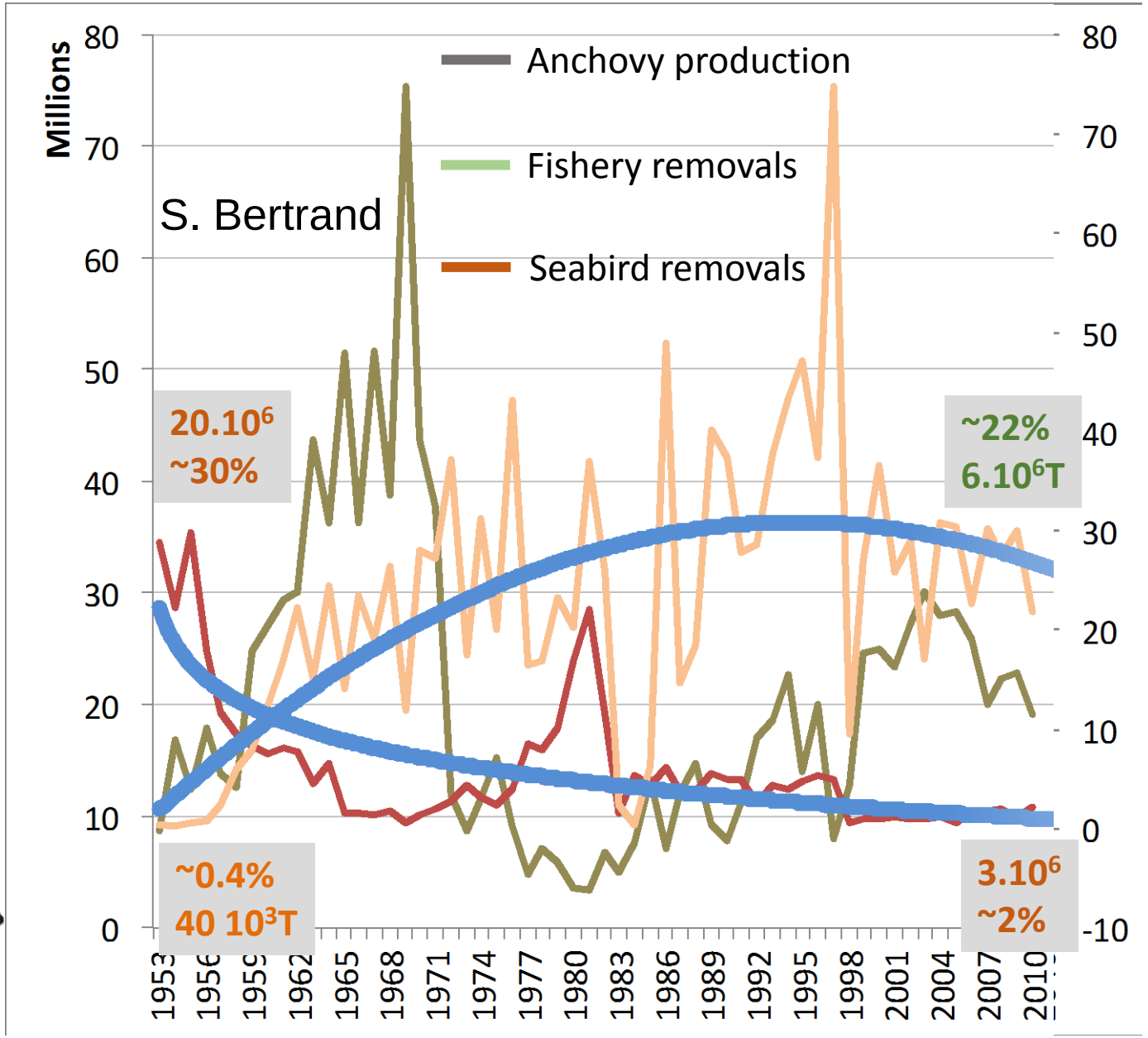
S. Bertrand et al. (2012) JAE

Competition seabirds / fishery
Localized depletions

Management recommendation:
Temporal closures around colonies
(reproductive season)

Predators (SPF a prey)

Competition between top predators and fisheries (large scale)

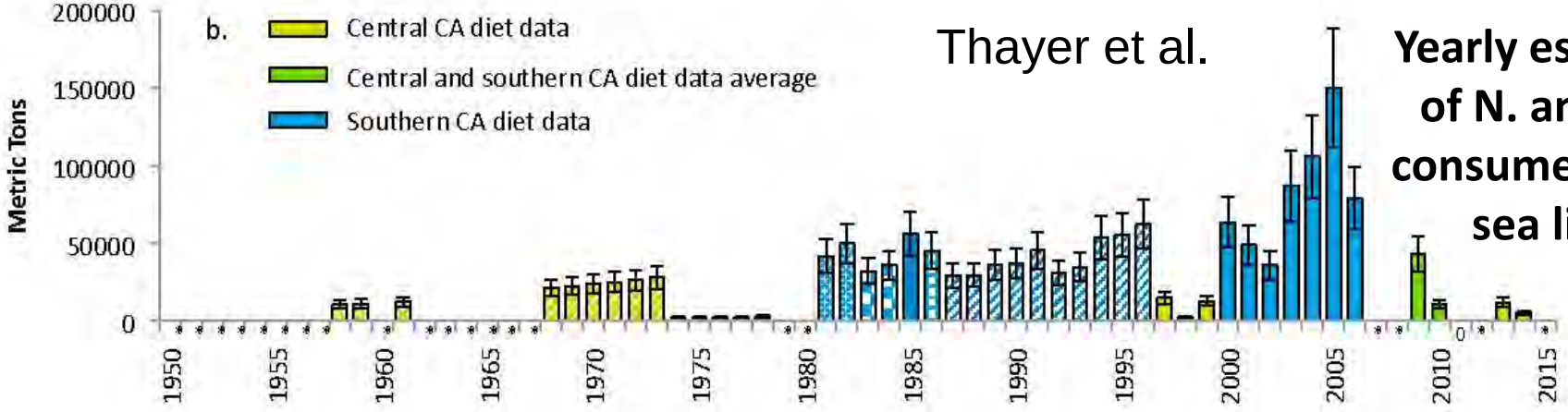


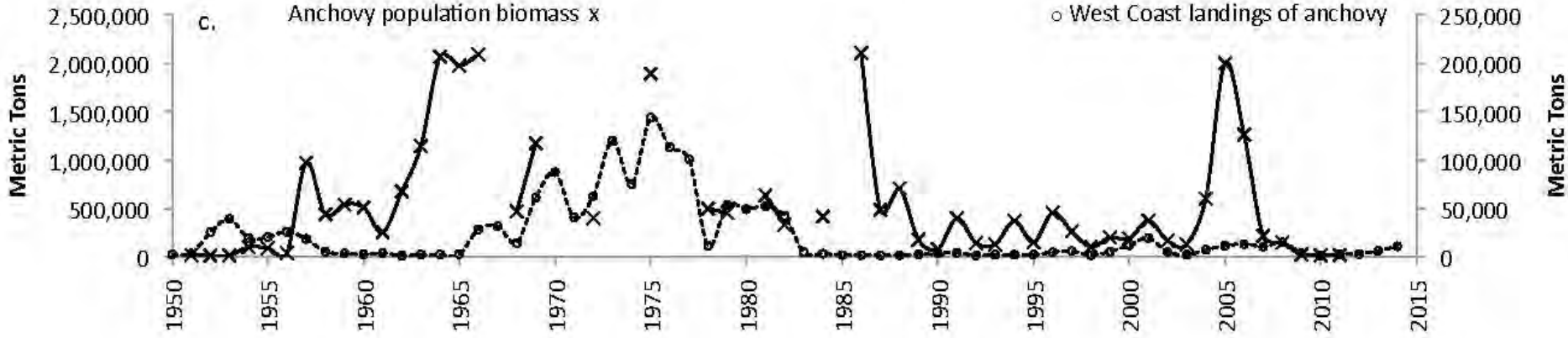
Predators (SPF a prey)

Competition between top predators and fisheries (large scale)

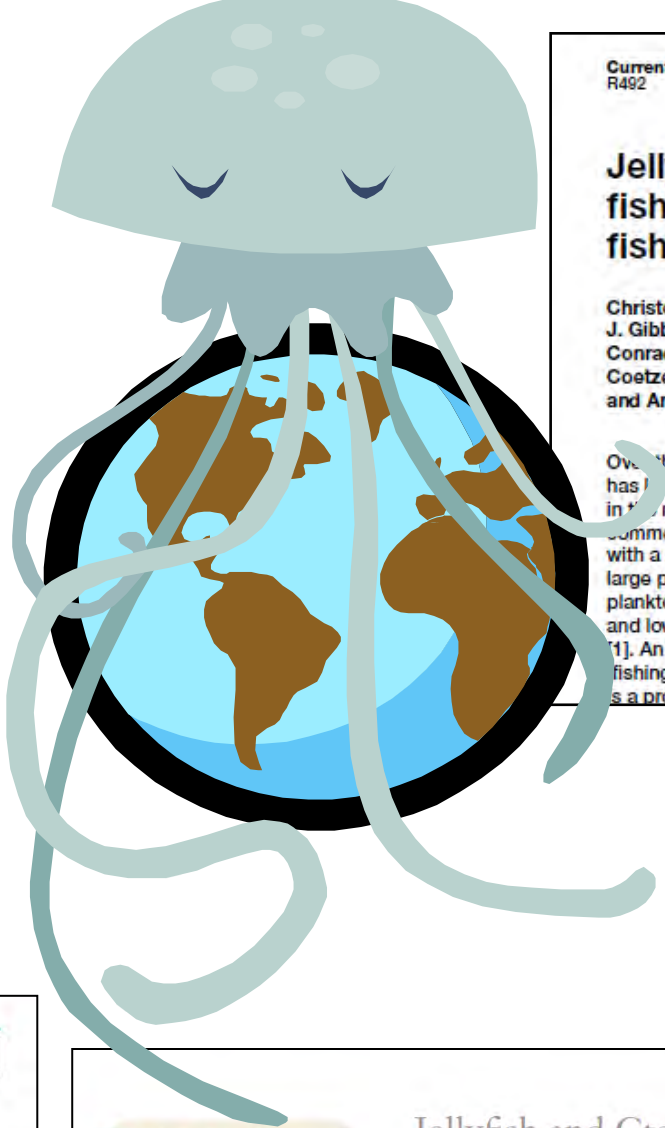
Thayer et al.

Yearly estimates of N. anchovy consumed by CA sea lions





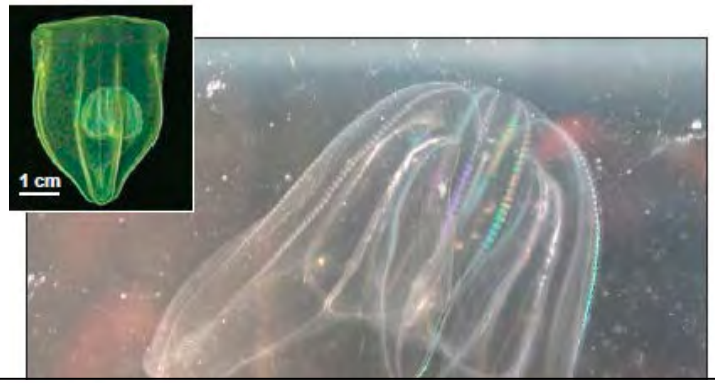
PLANET OF THE Jellyfish



PERSPECTIVES: ECOLOGY

Fall and Rise of the Black Sea Ecosystem

Ahmet E. Kideys



Current Biology Vol 16 No 13
R492

Jellyfish overtake fish in a heavily fished ecosystem

Christopher P. Lynam[1,6], Mark J. Gibbons[2], Bjørn E. Axelsen[3], Conrad A. J. Sparks[4], Janet Coetzee[5], Benjamin G. Heywood[1] and Andrew S. Brierley[1,7]

Ov[illegible]he past half century fishing has l[illegible]d globally to a reduction in [illegible] mean trophic level of commercially landed species, with a significant decline from large predatory fish toward plankton-eating pelagic species and low trophic-level invertebrates [1]. An implied endpoint of this 'fishing down marine food webs' is a proliferation of previously

Review

Cell Press

The jellyfish joyride: causes, consequences and management responses to a more gelatinous future

Anthony J. Richardson[1,2,3], Andrew Bakun[4], Graeme C. Hays[5] and Mark J. Gibbons[6]

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[2] School of Mathematics and Physics, The University of Queensland, St Lucia, QLD 4072, Australia
[3] The Ecology Centre, The University of Queensland, St Lucia, QLD 4072, Australia
[4] Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Miami, FL 33149, USA
[5] Institute of Environmental Sustainability, Swansea University, Singleton Park, Swansea SA2 8PP, UK
[6] Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Jellyfish and Ctenophore Blooms Coincide with Human Proliferations and Environmental Perturbations

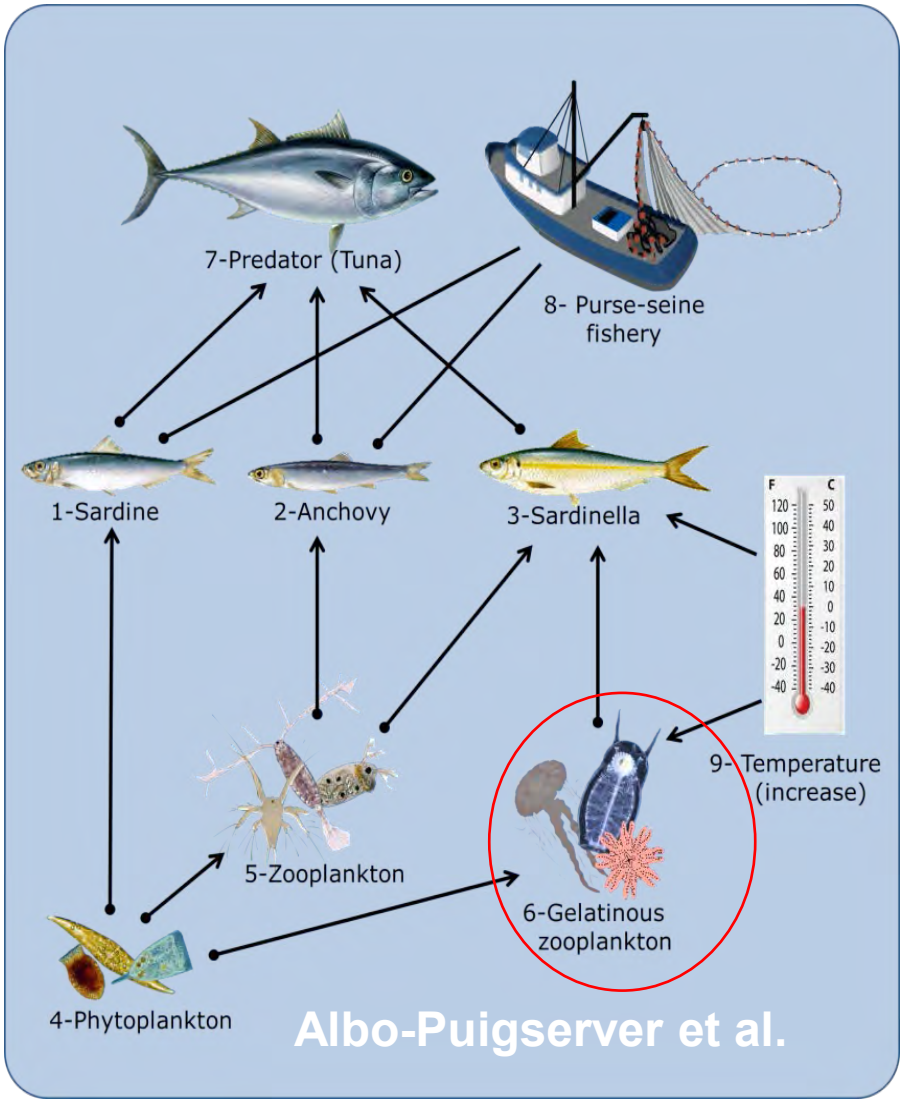
Jennifer E. Purcell

Shannon Point Marine Center, Western Washington University, Anacortes, Washington 98221; email: purcelj3@wwu.edu

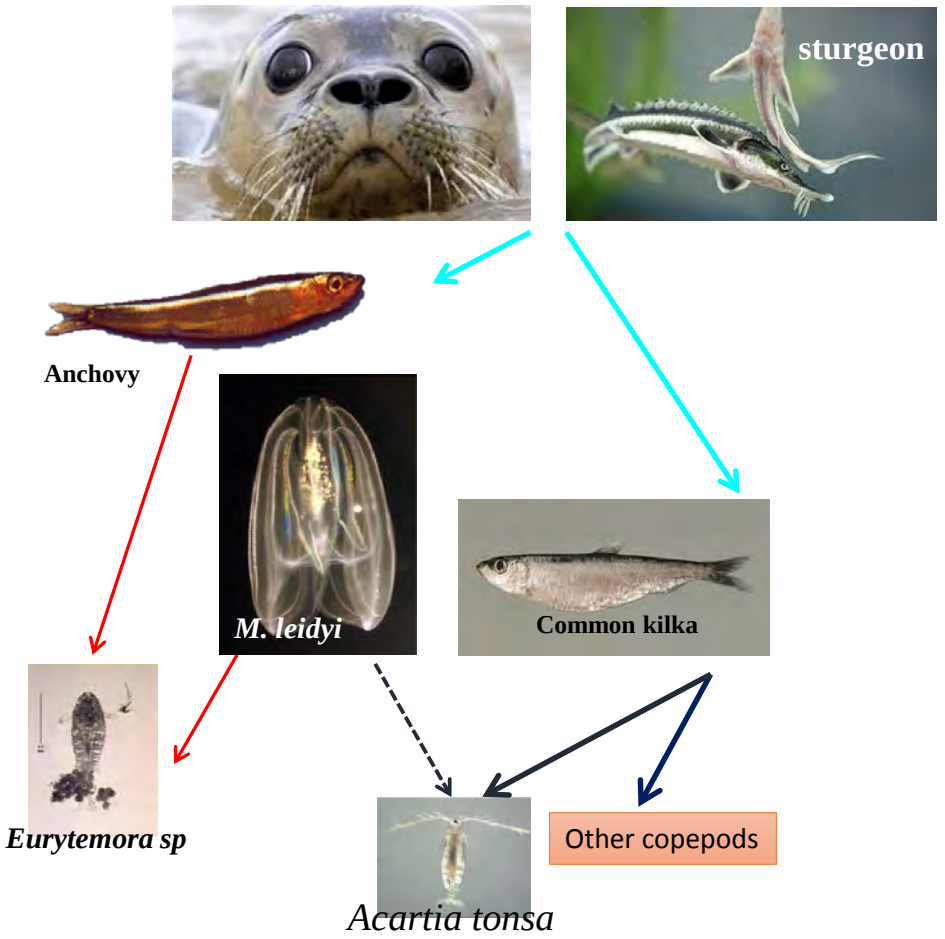
Gelatinous

Increasing role/interest of gelatinous in ecosystem function

Western Mediterranean



Caspian sea

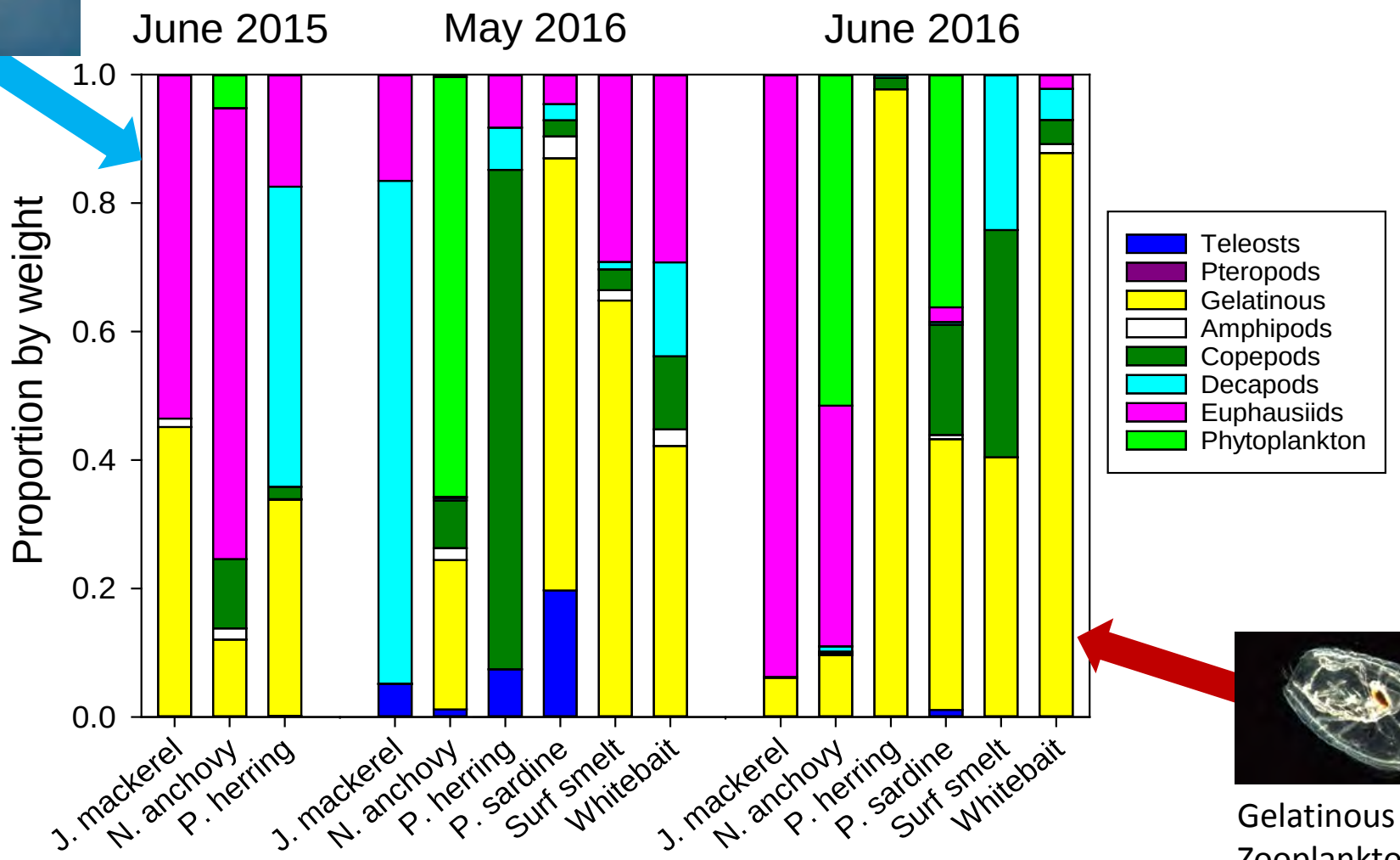


Gelatinous

Northern California CS - SPF diet

Euphausiids

Cold Period Prey Items



Gelatinous Zooplankton

Hunsicker et al.

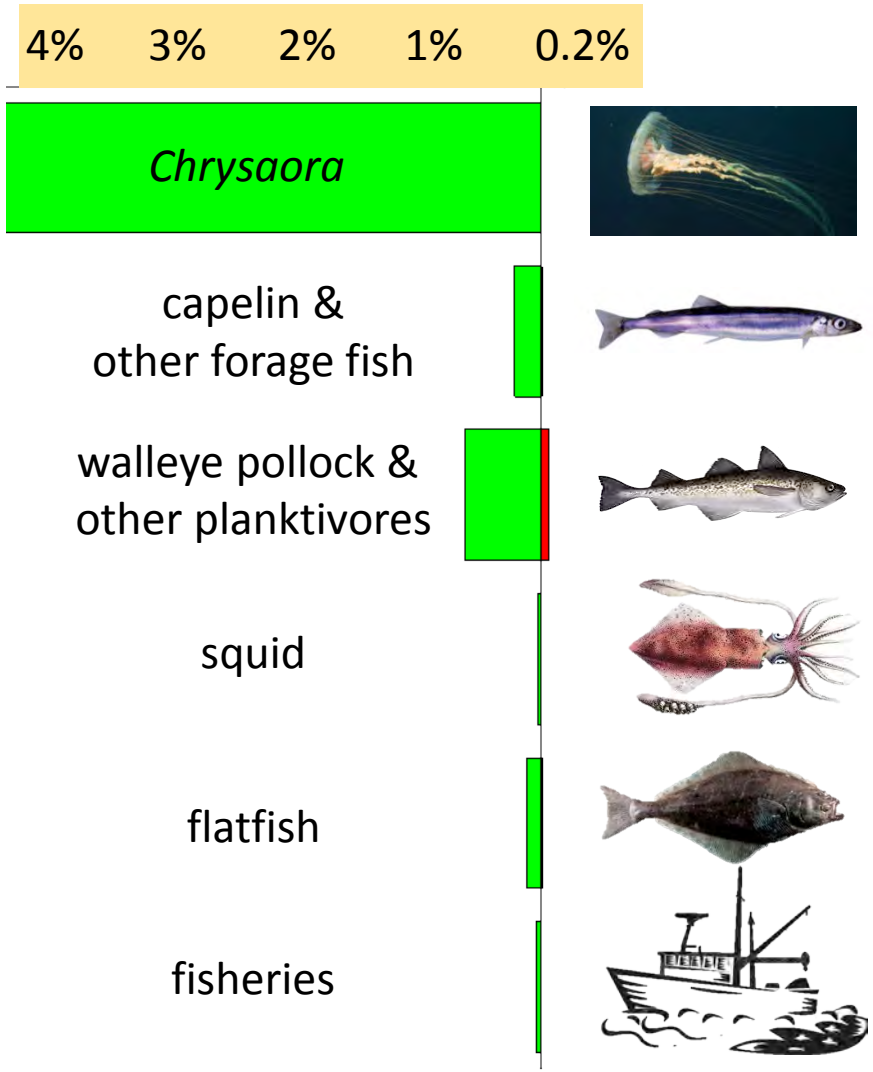
Warm Period Prey Items

Gelatinous

Eastern Bearing sea (modelling approach)

←footprint reach→

(% of all ecosystem production used) (% of all consumer production contributed)



Ruzicka et al.

Jellyfish consume about 20x as much food as forage fish, but contribute only 1/10th as much energy to upper trophic levels

Opdal et al.

H1: are jellyfish and pelagic fish competing for a limited resource

H2: has jellyfish functionally replaced pelagic fish?

H3: do jellyfish constrain pelagic fish recruitment?

- It's easier to come up with hypothesis that to test them
- Jellyfish have an observable effect on early life stages of certain SPF species in certain areas or periods, but is difficult to find these effects at larger (population/functional) scales

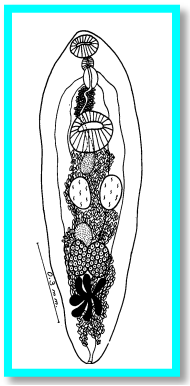
Many pending questions on the role of gelatinous: energetic content, predators, competitor, prey…

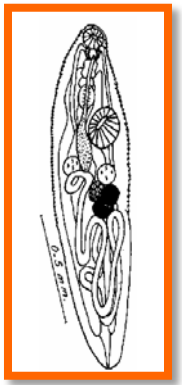
Parasites!

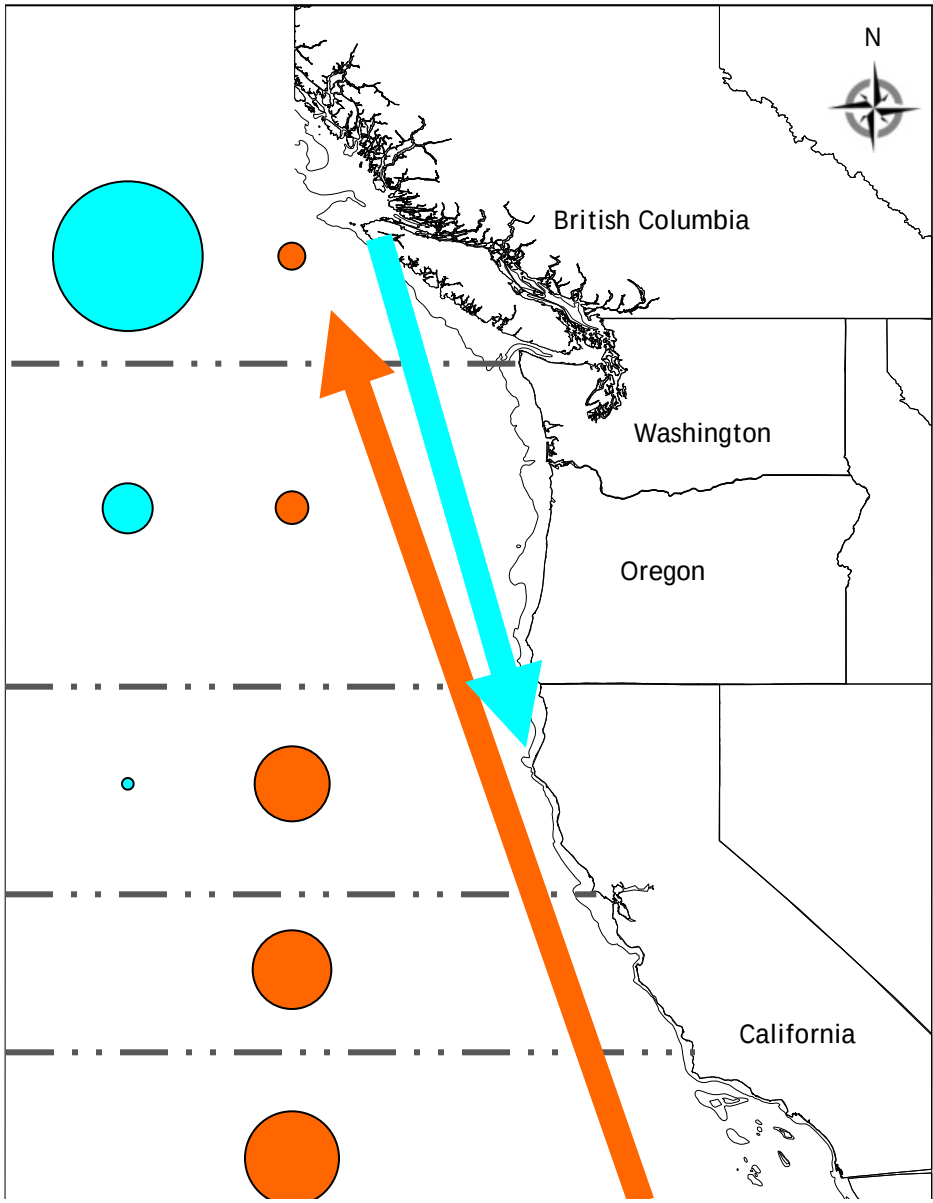
Utility of parasites in food web studies or as biological tags for fish movement & stock structure (Jacobson et al.):

Distribution of trematodes suggest that Pacific sardine from BC were not returning to S. California spawning grounds

Lecithaster ***Myosaccium***







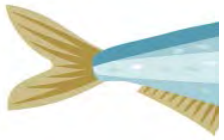
Too few works on parasites in general and in this symposium in particular

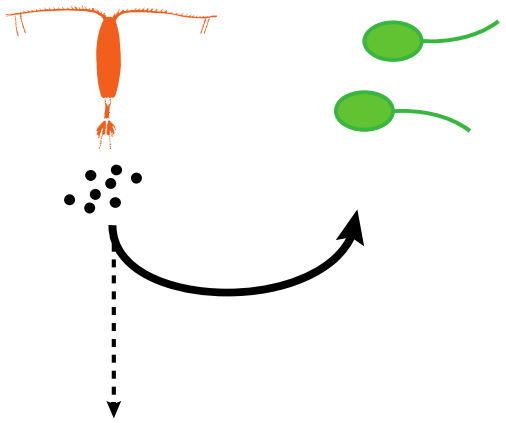
SPF and biogeochemical cycles

Fait of faecal pellets
of fish and zooplankton

Tore Johannessen

Large stocks of planktivorous fish contribute to export of nutrients to deeper waters and thus lower primary productivity



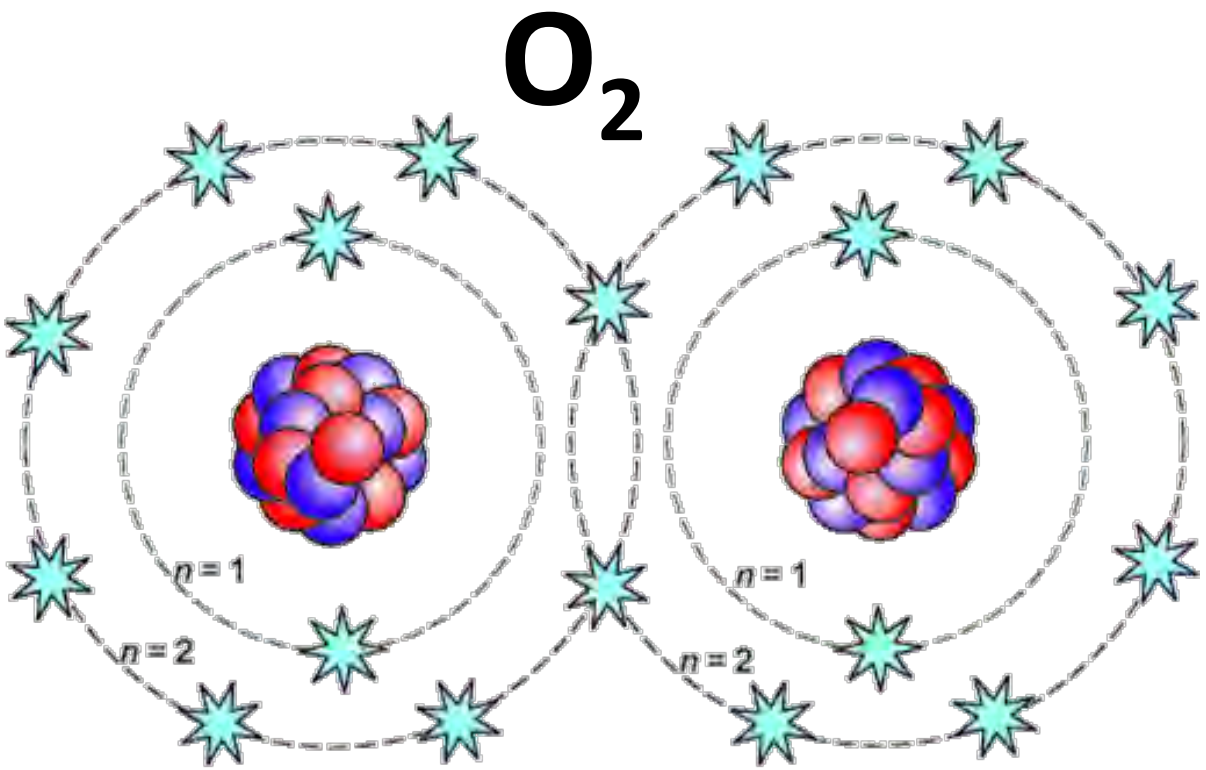


- zooplankton faecal pellets	- phytoplankton
- fish faecal pellet	- zooplankton

SPF and biogeochemical cycles

Oxygen impacts SPF

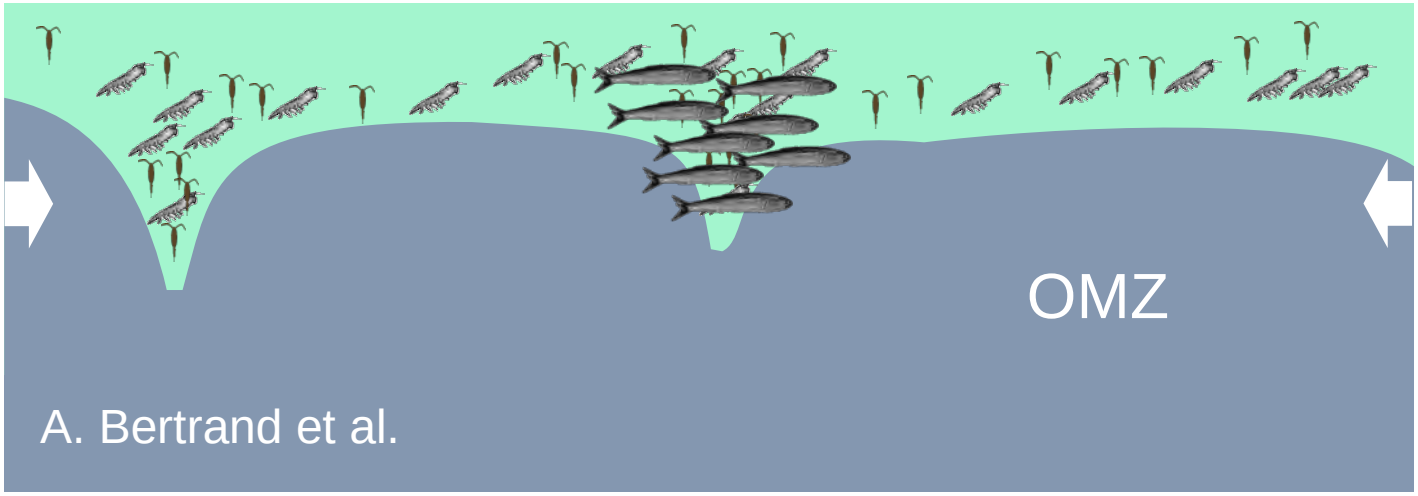
Fish need sufficient amounts of both food and oxygen, but the latter might be more difficult to obtain than the former
(Pauly, 2010)

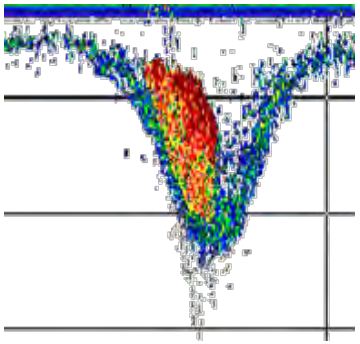


SPF and biogeochemical cycles

Oxygen impacts SPF

Vertical and horizontal contraction of the habitat: increase prey density then trophic transfer efficiency



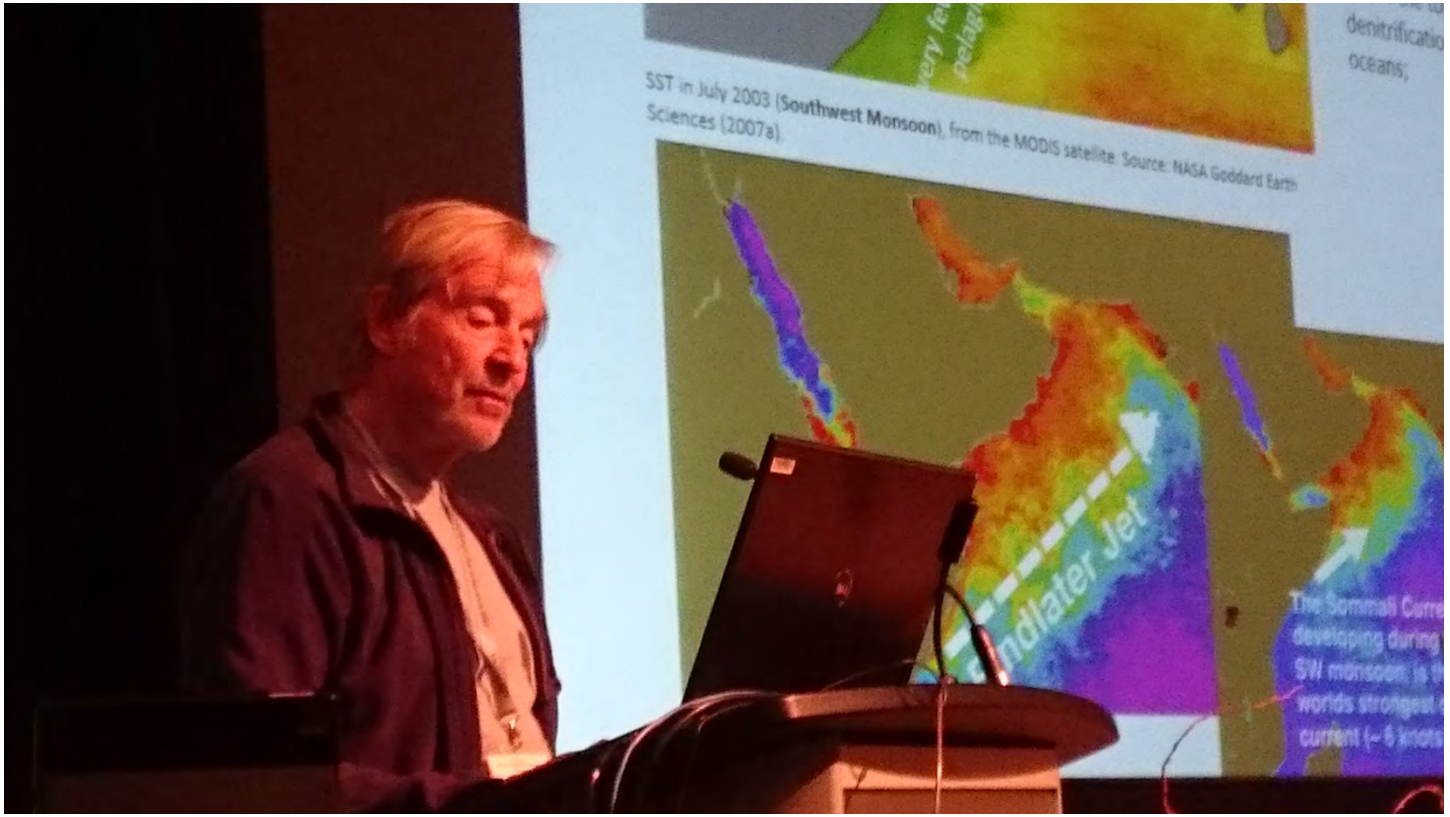


Trophic interactions do not occurs evenly in space:
Patchiness initiated by the physical forcing is transmitted up to top predators through the bottom up structuring

Role of SPF in biogeochemical cycles

SPF impact oxygen

Prof. Andy Bakun 72 slides - 15 minutes



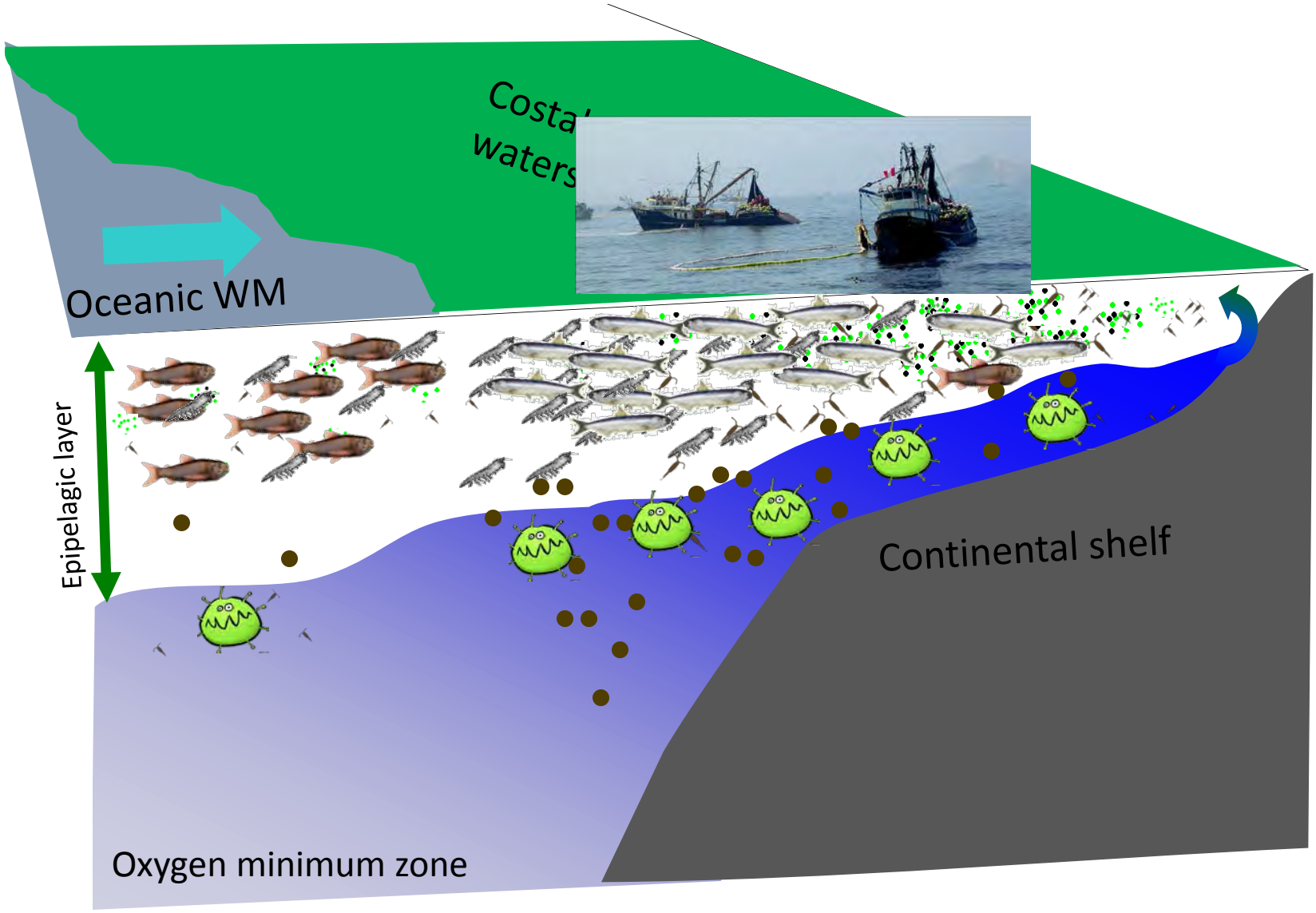
Personal interpretation…

Role of SPF in biogeochemical cycles

Prof. Andy Bakun

SPF impact oxygen

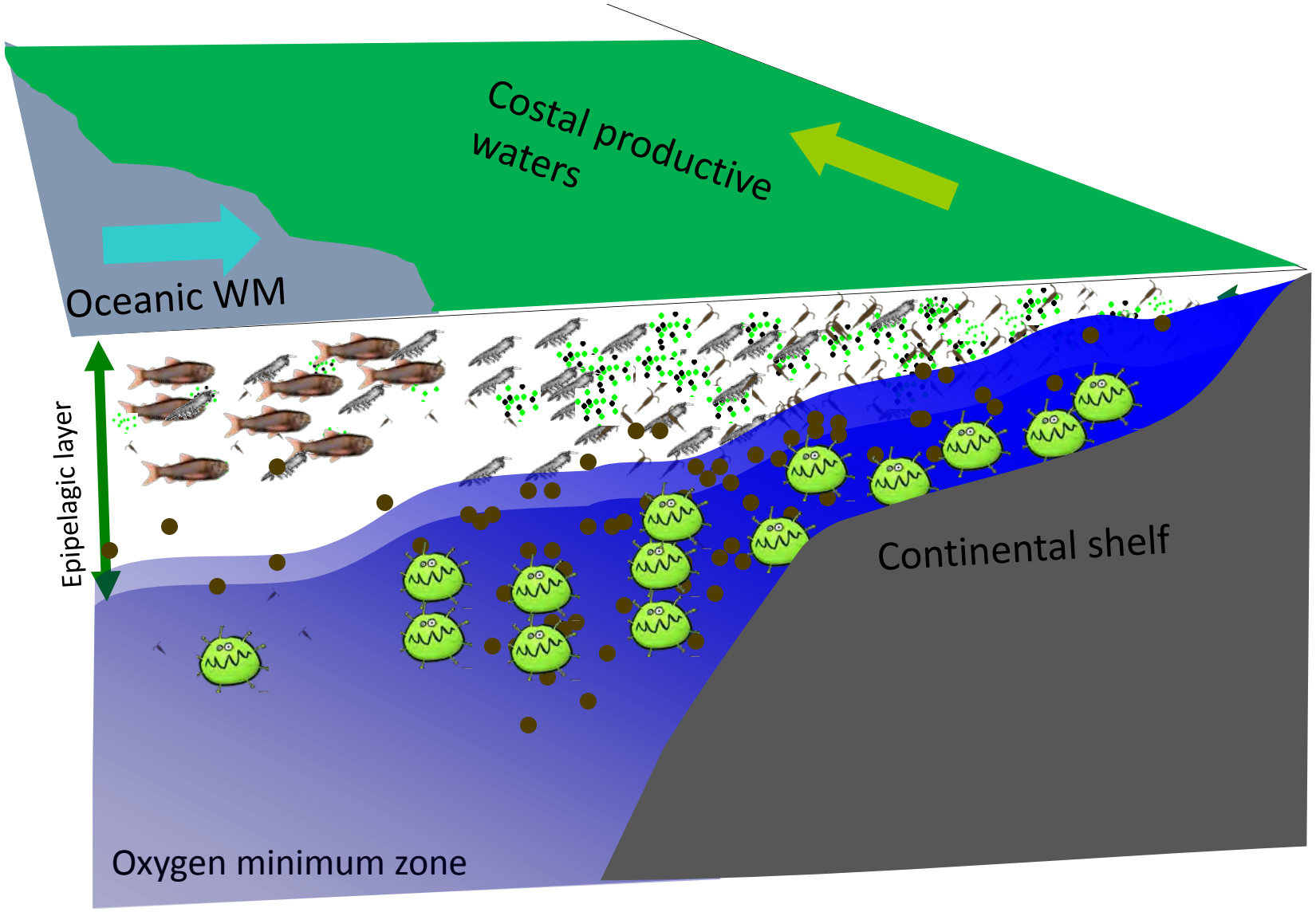
Personal interpretation



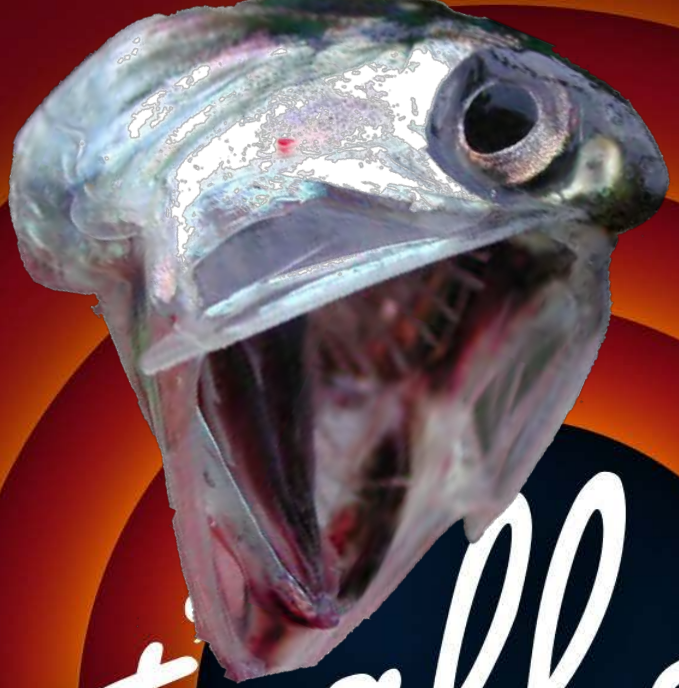
Role of SPF in biogeochemical cycles

Prof. Andy Bakun

Personal interpretation



SPF can play a role in controlling the oxygen



Thats all Folks!