

SEAFOOD, A WINNER IN LOW ENVIRONMENTAL FOOD PRODUCTION IMPACTS



Ray Hilborn
School of Aquatic and Fishery Sciences
and Center for Sustaining Seafood
University of Washington



Keynote address to 2023 Symposium on Seafood Production
16 February 2023, Wellington, New Zealand

Quantitative Fisheries Stock Assessment

Choice, Dynamics
& Uncertainty

• Ray Hilborn/Carl J. Walters



Photo Jason Ching



Markus Borner's dilemma



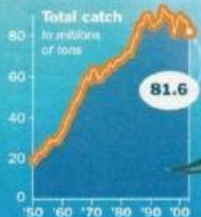
Environmental costs of food production

- Water use
- Pollution, fertilizer and pesticides
- Antibiotics and resistance
- Soil erosion
- Petroleum usage and greenhouse gas
- Biodiversity loss
 - Land conversion, exotic species, pollution

Our Network



The world is consuming more fish...



... which could lead to the extinction of many species



A LOOK AT WHO DOES THE MOST FISHING

Total marine harvest '84 '04
In millions of tons



STURGEON

This ancient fish was around at the time of the dinosaurs. Its eggs (true caviar) are a gourmet delicacy, but sturgeons of the Caspian Sea are nearing extinction.

SWORDFISH

It was overfished in the late 1990s, but public pressure led to tighter regulations, which helped the species rebound. Today most of the swordfish Americans eat is imported.

ATLANTIC COD

Its abundance attracted European settlers to America, but recent overfishing has altered the ecosystem. Scientists say we are fishing the last 10% of this species.

CHILEAN SEA BASS

The trendiness of this fish, also called the Patagonian toothfish, could be its downfall. The fish is often caught illegally, especially in the remote waters of the Antarctic.

PACIFIC SALMON

Nearly 30 runs of salmon in Washington and Oregon are endangered due to construction of dams and habitat loss. However, Alaska's salmon population thrives.

GROUPE

These sedentary, long-living fish dwell in deep waters and reproduce for short periods. They're overfished in the Gulf of Mexico near Florida's west coast and in Hawaii.

RED SNAPPER

Not to be confused with "Pacific red," they are heavily fished in the Gulf of Mexico, exported by Mexico and Brazil and listed as overfished by the U.S. since 1980.

BLUEFIN TUNA

One of the world's most valuable fish, these 300-lb. giants are favored for sushi. The Atlantic population has declined almost 90% since the 1970s.

SHARKS

Almost all are in trouble in part because they mature slowly and bear few offspring. They are being hunted to extinction, often to make traditional delicacies like shark-fin soup.

OCEANS OF NOTHING

A study says overfishing will soon destroy the seafood supply

By UNMESH KHER

FISHERMEN ON THE HIGH seas have plenty of worries, not the least of which are boat-tossing storms, territorial squabbles and even pirates. Now Boris Worm, a marine biologist at Dalhousie University in Halifax, Canada, has added another. After studying, among other things, global catch data over more than 50 years, he and a team of 13 researchers in four countries have come to a stunning conclusion. By the middle of this century, fishermen will have almost nothing left to catch. "None of us regular working folk are going to be able to afford seafood," says Stephen Palumbi, a Stanford University marine biologist and co-author of the study published in *Science*. "It's going to be too rare and too expensive."

Don't tell that to your local sushi chef. Over the past three decades, the fish export trade has grown fourfold, to 30 million tons, and its value has increased ninefold, to \$71 billion. The dietary attractiveness of seafood has stoked demand. About 90% of the ocean's big predators—like cod and tuna—have been fished out of existence. Increasingly, fish and shrimp farms are filling the shortfall. Though touted as a solution to overfishing, many of them have—along with

rampant coastal development, climate change and pollution—devastated the re mangroves and seagrass beds where many commercially valuable fish hatch.

Steven Murawski, chief scientist at U.S. National Marine Fisheries Service, finds Worm's headlining prediction far too pessimistic. Industry experts are even more skeptical. "There's now a global effort to reduce or eliminate fishing practices that are unsustainable," says industry analyst How Johnson. "With that increased awareness, these projections just aren't realistic."

Perhaps. Still, the destructive fishing practices that have decimated tuna and cod have not declined worldwide, as Johnson suggests. Up to half the marine life caught by fishers is discarded, often dead, as is catch, and vibrant coral forests are still being stripped bare by dragnets. Worm argues that fisheries based on ecosystems strip of their biological diversity are especially prone to collapse. At least 29% of fish species have already collapsed, according to the study, and the trend is accelerating.

So what's a fish eater to do? "Vote with your wallet," says Michael Sutton, who runs the Monterey Bay Aquarium's Seafood Watch program in California. Since 1999, the aquarium has handed out pocket guides listing sustainably harvested seafood. The Marine Stewardship Council has partnered with corporations to similarly certify wild and farm-raised seafood. Some 370 products in more than two dozen countries bear the British group's "Fish Forever" label of approval. Wal-Mart and Red Lobster, among others, have made commitments to sell sustainably harvested seafood.

But that's just a spit in the ocean unless consumers in Japan, India, China or Europe join the chorus for change. "Everyone in the U.S. started eating sustainable seafood," says Worldwatch Institute senior researcher Brian Halweil, "it would be wonderful, but it wouldn't address the global issues. We're at the very beginning of this." —With reporting by Kathleen Kingsley

TIME Graphic by Ed Gubel and Lori Thornton
Written by Kristina Dell

SPECIES DIVERSITY

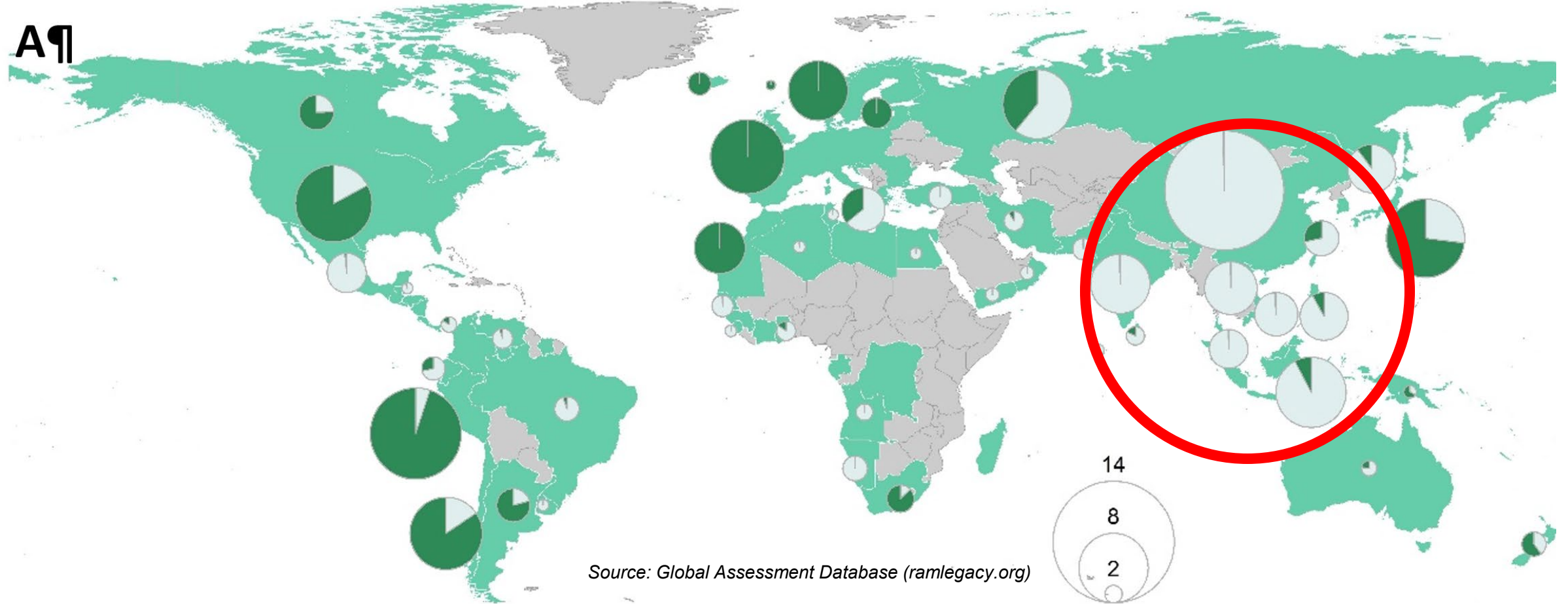
LOW RISK High diversity
HIGH RISK Low diversity

Analyzing more than 50 years of data, researchers found that collapses in ecosystems occur faster and recovery is slower in areas with low species diversity (red) than in areas with high diversity (light yellow).

Sources: Sea Around Us; Fisheries Center, University of British Columbia; Vancouver; Food and Agriculture Organization of the United Nations; Monterey Bay Aquarium; NOAA Fisheries Service

We know the status of fish stocks in much of the world, but not all

A9



Source: Global Assessment Database (ramlegacy.org)

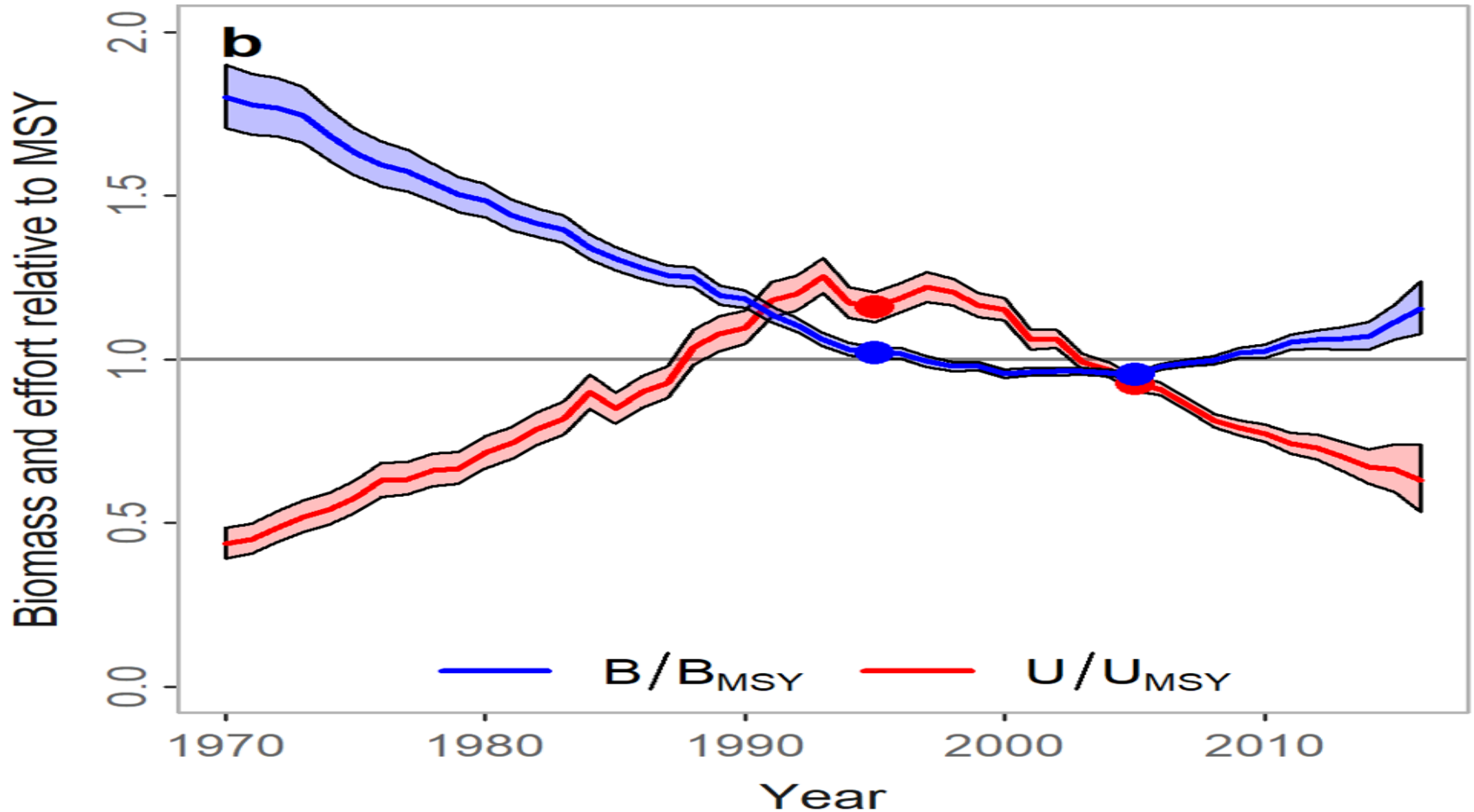
www.ramlegacy.org

RAM Legacy Stock Assessment Database version 4.44 (www.ramlegacy.org)

Average catch
2011-2015 (MMT)

■ Covered in RAM
■ Not covered in RAM

Trend in abundance and harvest rate



Summary of stock status I

- Some places never overfished
- Some were overfished and now recovering
- Some continue to be overfished

Summary of stock status II

- Where we don't have assessment data we generally believe status is poor
- Even in well managed places there are stocks in poor condition due to ineffective management and natural variability

**Fisheries can be, and are
being sustainably managed**

**What about the
environmental impact of
fishing?**

Threats to the ocean

**SCIENTIFIC
REPORTS**

nature research

OPEN

Recent pace of change in human impact on the world's ocean

Benjamin S. Halpern^{1,2}, Melanie Frazier¹, Jamie Afflerbach¹, Julia S. Lowndes¹,
Fiorenza Micheli^{3,4}, Casey O'Hara², Courtney Scarborough¹ & Kimberly A. Selkoe^{1,2}

STRESSOR

Temperature

Ocean acidification

Sea-level rise

Shipping

Nutrient pollution

Organic chemical pollution

Direct human

Light pollution

Destructive seabed

Seabed (high)

Seabed (low)

Surface (high)

Surface (low)

Artisanal

Intertidal ecosystems

Places affected by tides are particularly at risk from sea-level rise and encroaching coastal development.

Rocky intertidal

Beach

Mudflats

Salt marsh

Mangrove

Nearshore ecosystems

Shellfish and rocky reefs are among the nearshore areas vulnerable to dredging, trawling, and other fishing practices.

Seagrass

Shellfish reef

Coral reef

Rocky reef

Kelp forest

Shallow sandy

Offshore ecosystems

Many species in the deep sea are accustomed to stable conditions. Even small changes in ocean acidity can wreak havoc on species living around underwater mountains called seamounts.

Surface water

Soft shelf

Hard shelf

Soft slope

Hard slope

Soft benthic

Hard benthic

Deep water

Seamount

Greater impact

Less impact



Marine Estate
Management Authority

NSW Marine Estate Threat and Risk Assessment

BACKGROUND ENVIRONMENTAL INFORMATION

Greatest threats

- urban and rural discharges or runoff
- climate change
- disturbance to habitat and species from estuarine entrance modification, harbour maintenance, foreshore development

Biodiversity in Aotearoa

an overview of state, trends and pressures

2020

The pressures on marine ecosystems are varied and include sedimentation, fishing, mining, input of nutrients and contaminants, plastic pollution, noise and climate change... Habitat loss is particularly severe in coastal ecosystems subjected to intense human pressures and can have cascading and long-lasting effects on ecosystem services.



Biodiversity in Aotearoa

an overview of state, trends and pressures

2020

Experts have identified ocean acidification as the greatest threat to the country's marine habitats, with rising sea temperature the second.

**To save the coastal
marine ecosystems
look to the land and
global climate!**

FOREWORD BY
PRESIDENT BILL CLINTON

THE PERFECT



PROTEIN

The Fish Lover's Guide to Saving the
Oceans and Feeding the World

ANDY SHARPLESS, CEO OF OCEANA
AND SUZANNAH EVANS

With Sustainable Seafood Recipes from 21 Top Chefs

“Imagine there was a healthy animal-sourced protein that could be enjoyed without draining the life from the soil, without drying up our rivers, without polluting the air and the water and without causing the planet to warm even more, without plaguing communities with diabetes, heart disease and cancer?”



Maternal Grandfather

**Family history says
he was the first
Agricultural
Extension Agent in
Iowa**

How I spent the “summer of love” 1967



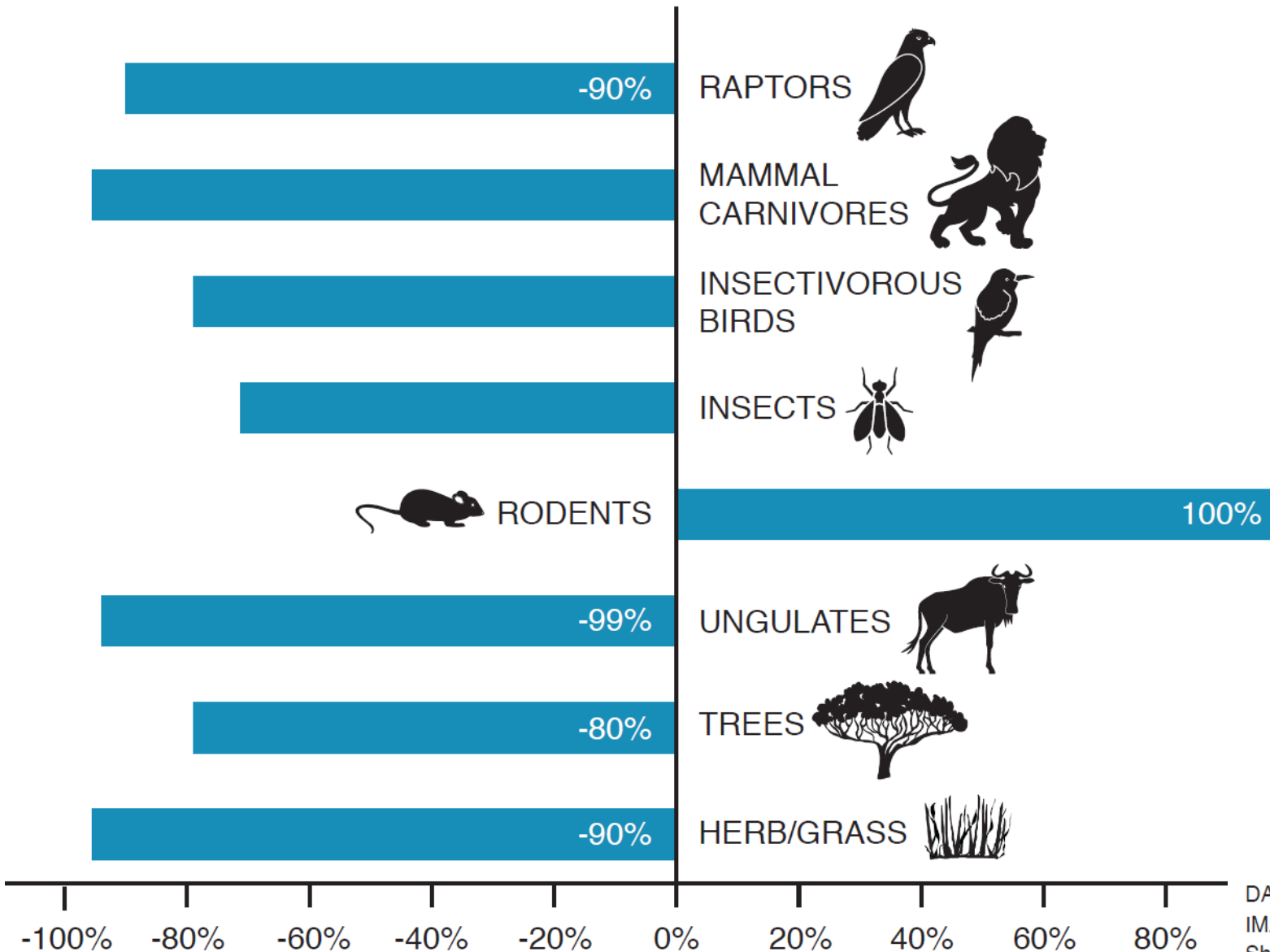
Our son and some of 2500 dairy heifers



My wife and part of her organic vegetable business



% LOST/GAINED OUTSIDE PARK



Terrestrial parks protect the plants (trophic level 1) from elimination

% abundance outside the park

DATA: from A.R.E. Sinclair

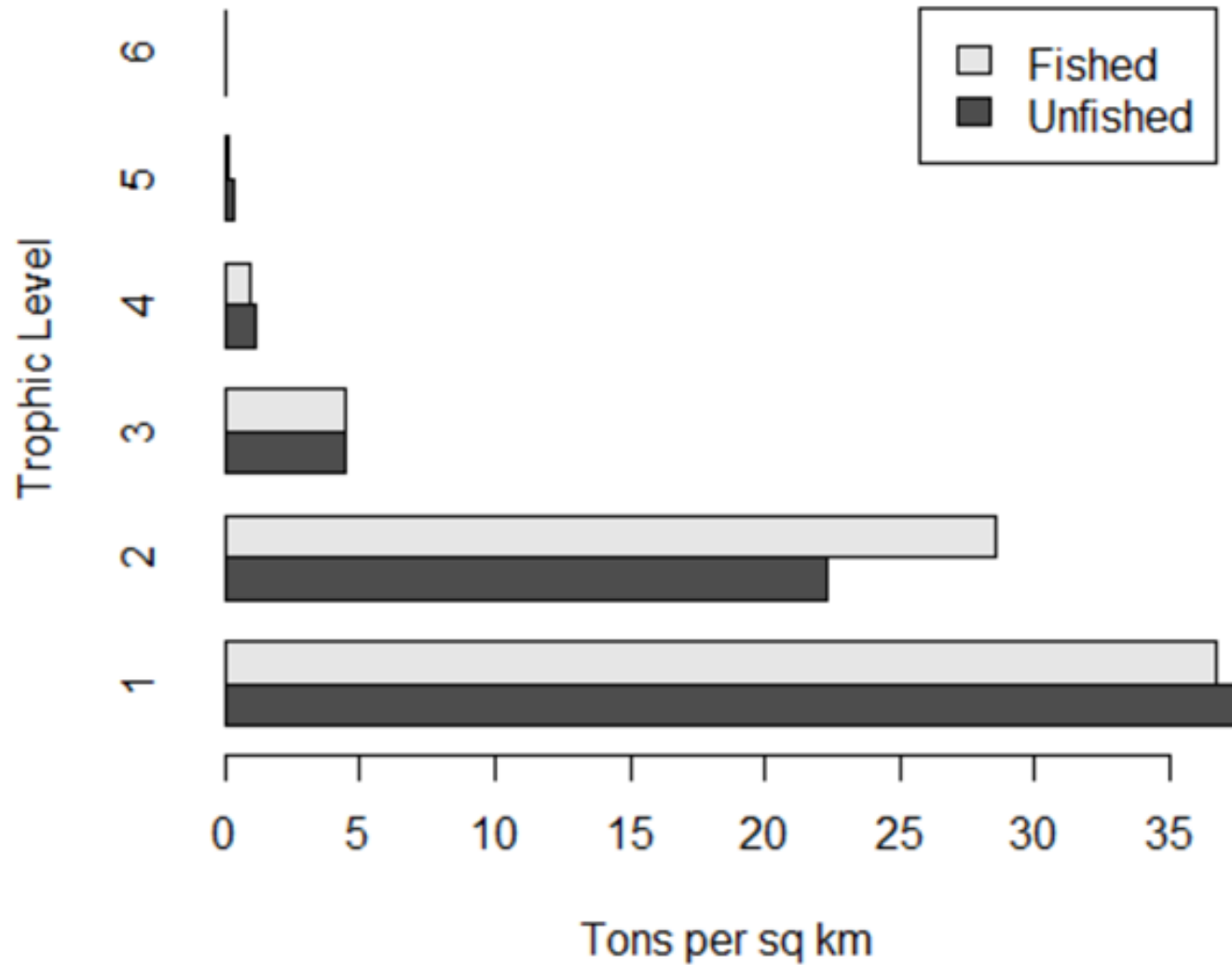
IMAGES: Adapted from illustrations & photos from iStock/Thinkstock by: alexandragl1, ShowVectorStudio, StockPhotoAstur, Kauriana, Katsiaryna Pleshakova, SkyWayx

**Total loss of native biodiversity in my
wife's organic vegetable field**





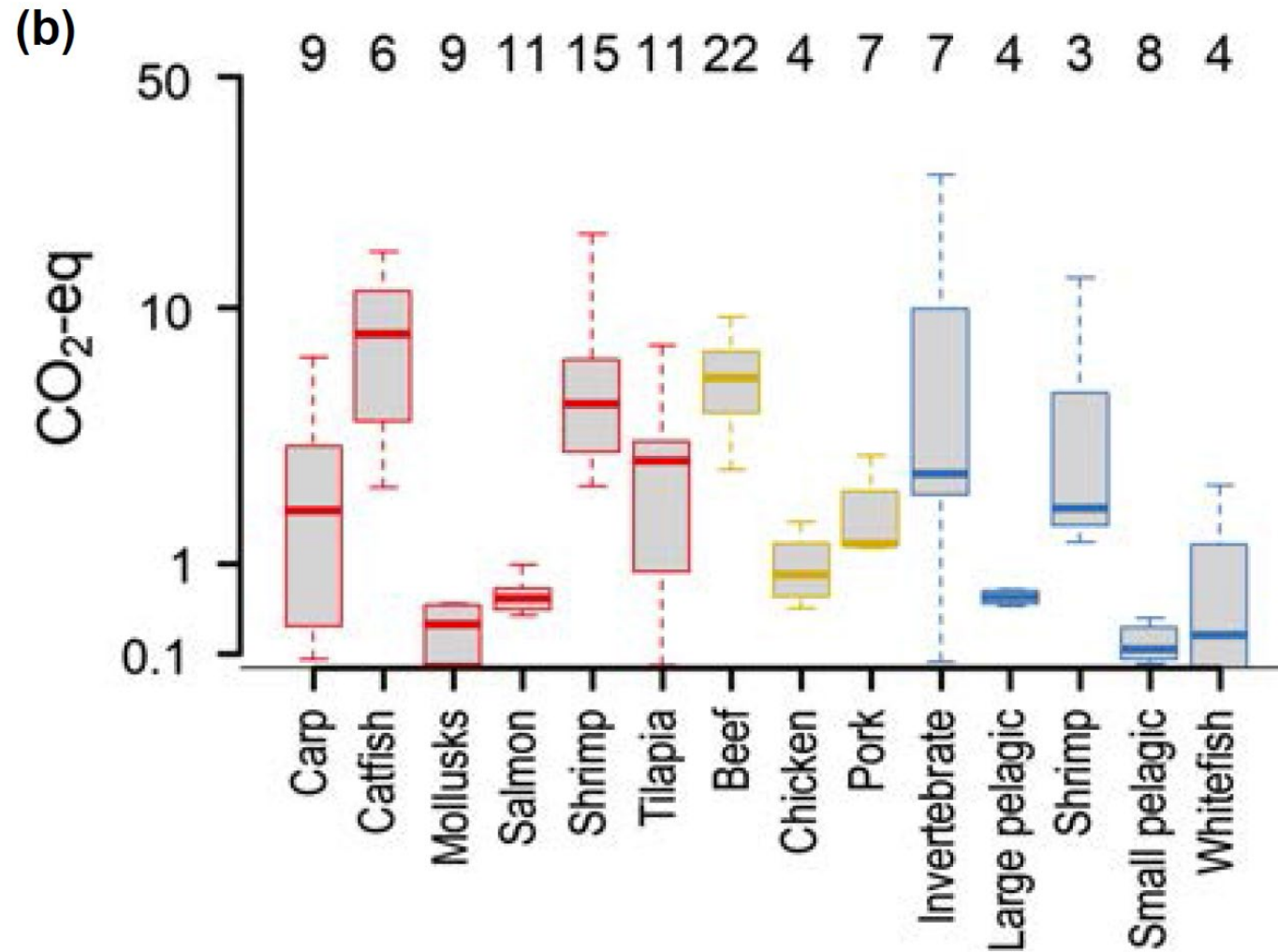
Impacts of Fishing in 26 Marine Ecosystems

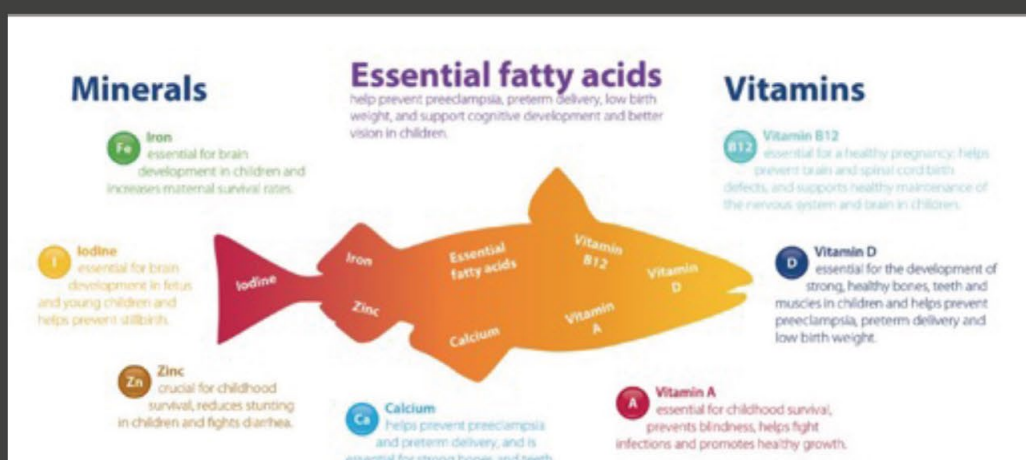


Beth Fulton,
CSIRO

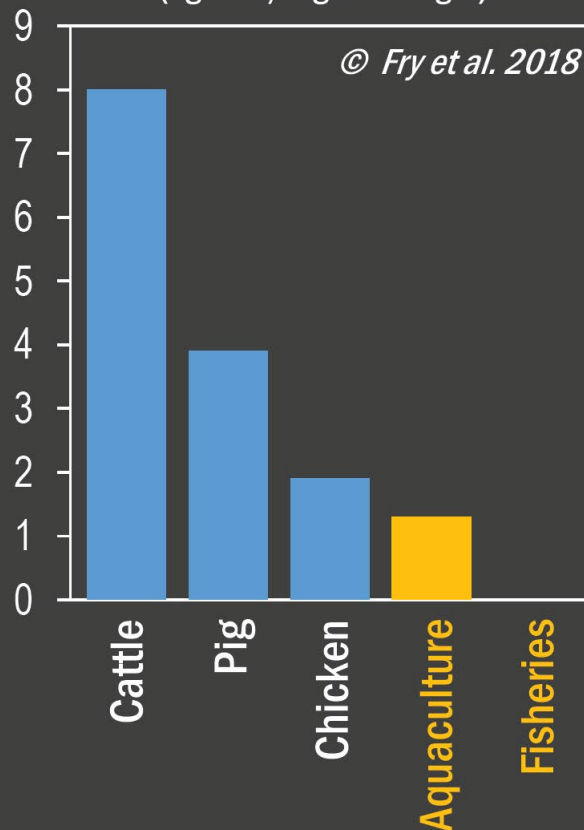
The environmental cost of animal source foods

Ray Hilborn^{1*}, Jeannette Banobi¹, Stephen J Hall², Teresa Pucylowski³, and Timothy E Walsworth¹

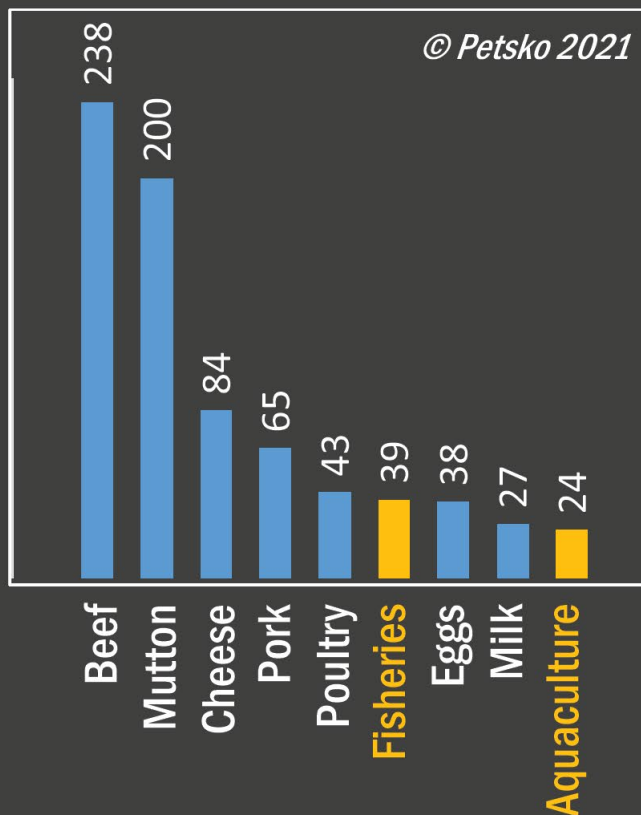




Conversion Efficiency
(kg feed/ Kg live weight)



GHG Emissions Intensity
(g CO2 eq./g protein)



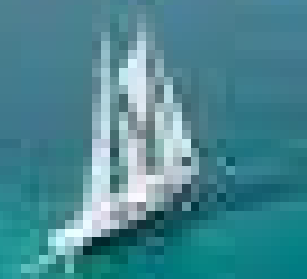
Slide from Manuel Barange,
Director Fisheries Division
of FAO

**Fisheries can be, and are
being sustainably
managed**

At low environmental cost

SIGN THE PETITION

SAVE THE HAURAKI GULF MARINE PARK **BAN BOTTOM TRAWLING**



GREENPEACE

Guardian

ed by readers

The Guardian

ion

Sport

Culture

Lifestyle

More ▾

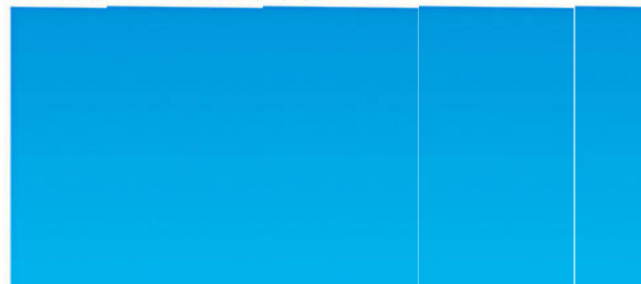
Climate crisis Environment Science Global development Football Tech Business Obituaries

🕒 This article is more than **1 year** old

Bottom trawling releases as much carbon as air travel, landmark study finds

Advertisement

*Plastic straws suck, these are paper.












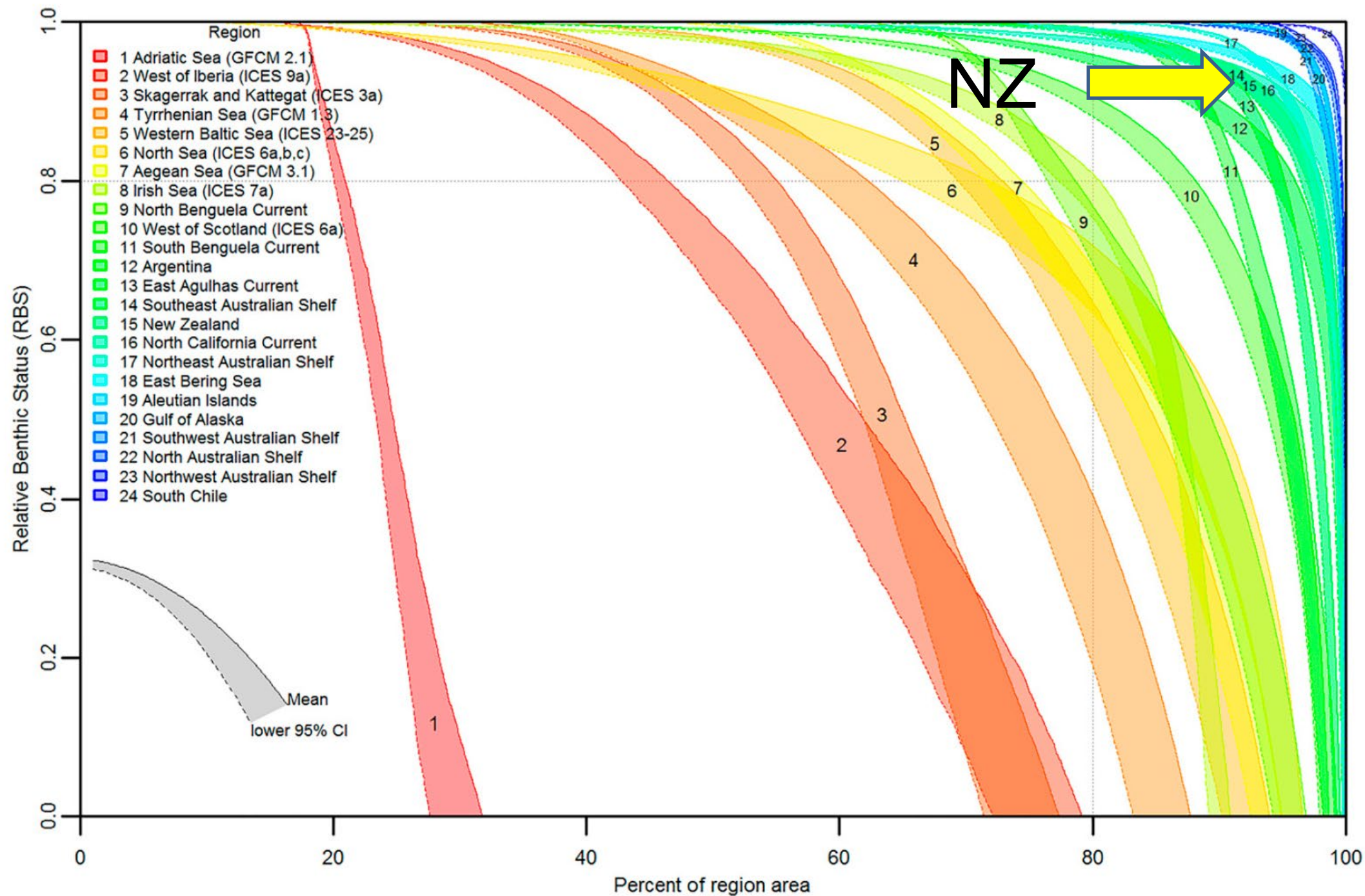


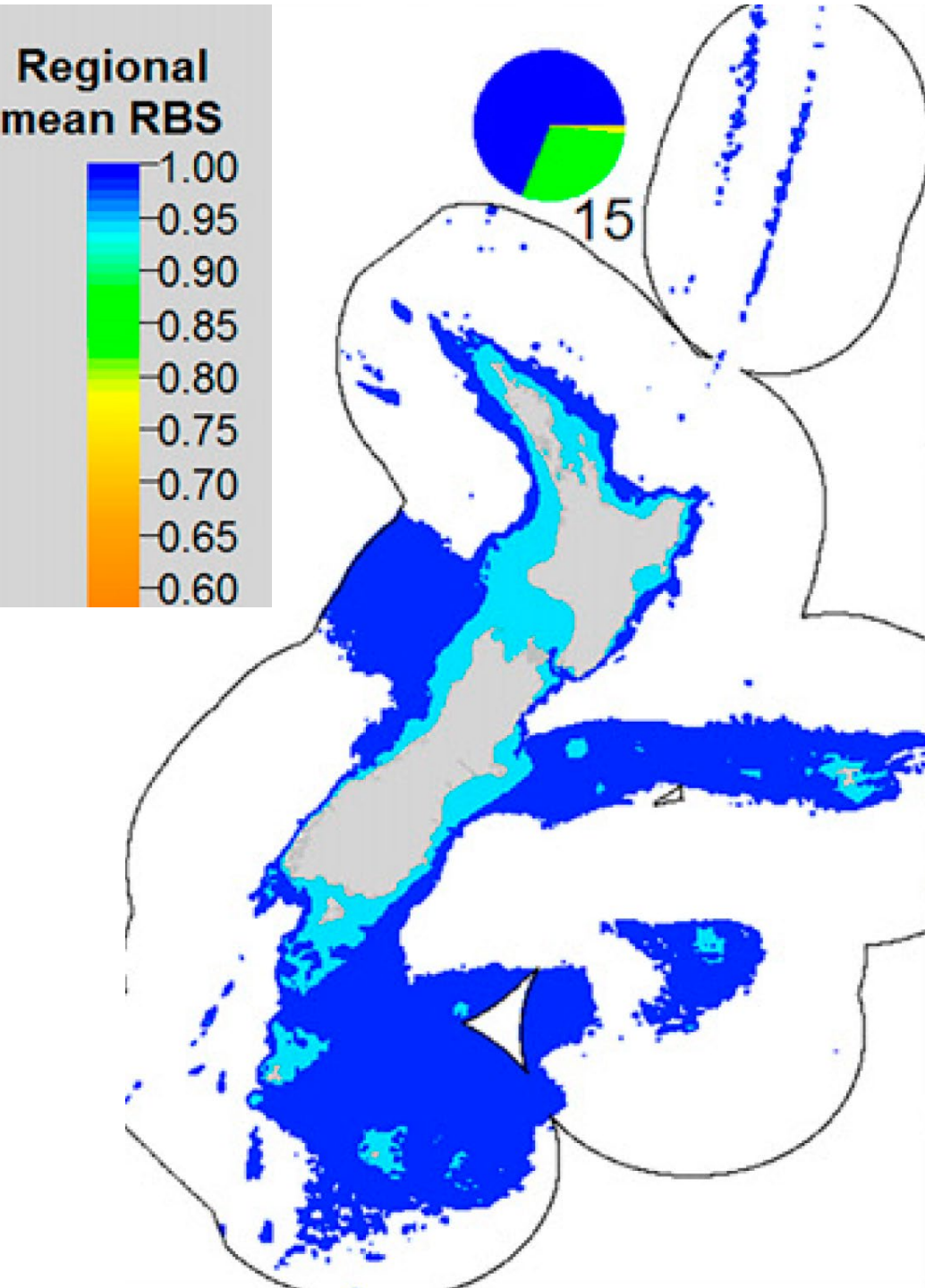
PNAS

Proceedings of the
National Academy of Sciences
of the United States of America

Trawl impacts on the relative status of biotic communities of seabed sedimentary habitats in 24 regions worldwide

C. Roland Pitcher^{a,1} , Jan G. Hiddink^b , Simon Jennings^c, Jeremy Collie^d , Ana M. Parma^e , Ricardo Amoroso^f ,
Tessa Mazor^{a,g}, Marija Sciberras^{b,h}, Robert A. McConnaugheyⁱ , Adriaan D. Rijnsdorp^j , Michel J. Kaiser^{b,h} ,
Petri Suuronen^{k,l}, and Ray Hilborn^f 





- The impacts depend on substrate and the intensity of trawling
- Globally most trawling takes place on mud and sand whose biota recover very quickly from trawling
- The most sensitive habitats and species occur on hard substrate



A land trawler

Rich countries are exporting their environmental impact by restricting fishing and importing fish

- The U.S. and Australia are probably the most “protected” marine environments
- Essentially, they export the environmental impact of blue foods by importing their fish largely from less protected places.



Are plant-based foods better?

The environmental cost of replacing fish will be very high





3.4 kg CO₂ per kg
2.5 m² land per kg
107 l water per kg

Fish burger



0.8 kg CO₂ per kg
0.0 m² land per kg
1.5 l water per kg

Environmental impacts from food production

	Beef	Chicken	Pork	Soy	Capture fish
Water	Lots	Lots	Lots	Lots	None
Pesticides	Lots	Lots	Lots	Lots	None
Antibiotics	Lots	Lots	Lots	None	None
Soil Erosion	Lots	Lots	Lots	Lots	None
Carbon	Huge	Some	Some	Lowest	Variable
Biodiversity loss	Lots	Lots	Lots	Lots	Little

We need all forms of food production

- The standards set of “sustainability” of fisheries should be on the same scale as other forms of food production

Commissioned by



HIGH LEVEL PANEL for
**A SUSTAINABLE
OCEAN ECONOMY**

BLUE PAPER

The Future of Food from the Sea

LEAD AUTHORS

Christopher Costello, Ling Cao and Stefan Gelcich

OXFORD



OCEAN RECOVERY

**A SUSTAINABLE FUTURE
FOR GLOBAL FISHERIES?**



Ray Hilborn and Ulrike Hilborn

