Global Fishery Declines
and the Fate of Human Nutrition

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Environmental Change as Public Health Risk
The Importance of Animal Source Foods
Fish Catch Declines and Micronutrient Nutrition

Environmental Change
- Fish population declines

Changes in Food Supply
- Reduced access to animal-source foods

Changes in Nutrient Intake
- Micronutrient and vitamin intake decreases

Health Impacts
- Increased incidence of micronutrient deficiencies and NCDs
The World Is Running Out of Fish Faster Than We Thought

Death of coral reefs could devastate nations

As studies predict that vital coral reefs are headed for extinction worldwide, experts say hunger, poverty, and political instability could ensue.

By Brian Skoloff, AP | March 26, 2010

Global warming could cause fishing to decline by millions of tons each year, study says

The San Diego Union-Tribune
THETIS: Tracking Health and Ecosystem Transformation in the Seas

Planetary Health (PI)  Ecosystem Services  Nutritional Epidemiology  Human Geography  Complex Systems

Climate Impacts  Ocean Health  Fisheries Ecology  Catch Histories  Fisheries Economics  Fisheries Governance
Declining Fish Catch

Aquaculture/Fisheries Management

Alternative Foods

Nutritional Vulnerability

Dietary Change
Declining Fish Catch

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Dietary Change
CHANGE IN MAXIMUM FISH CATCH POTENTIAL
2041-2060 relative to 1981 – 2000

Cheung et al. update of IPCC (2014) AR5 WGII
Declining Fish Catch

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Nutritional Vulnerability

Dietary Change

Alternative Foods
Predicting nutrient content of ray-finned fishes using phylogenetic information

Bapu Vaitla¹, David Collar², Matthew R. Smith³, Samuel S. Myers³,⁴, Benjamin L. Rice⁵ & Christopher D. Golden¹,³
Declining Fish Catch

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Dietary Change
Three Typologies

- Unaffected wealthy nations
- Increasing undernutrition
- Acceleration of nutrition transition
Declining Fish Catch

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Alternative Foods

Dietary Change

Nutritional Vulnerability
Nutrition: Fall in fish catch threatens human health


In the low-latitude developing nations, human nutrition is most dependent on wild fish, and fisheries are most at risk from illegal fishing, weak governance, poor knowledge of stock status, population pressures and climate change. These countries urgently need effective strategies for marine conservation and fisheries management to rebuild stocks for nutritional security.

TRoubLED WATERS

Most reliant on fish and most vulnerable to micronutrient malnutrition

Reliant on fish and vulnerable to micronutrient malnutrition

Less reliant and less vulnerable

No data

In Bangladesh, much farmed high-value fish is exported to wealthier nations. Smallholder systems, including fish farmed in flooded rice fields, have improved local food security.

In developing small island states of the Pacific, wild fisheries will move poleward because of a rise in sea temperature, and aquaculture in deltas and floodplains will be affected by rising sea levels.

Projected percentage change in maximum marine catch potential by 2050 relative to 2000 levels

<-20% -20% to 0% 0% to 20% >20%
Aquaculture/Fisheries Management

- Declining Fish Catch
- Alternative Foods
- Nutritional Vulnerability
- Dietary Change
Does Aquaculture Support the Needs of Nutritionally Vulnerable Nations?

Christopher D. Golden, Katherine L. Seto, Madan M. Dey, Oai L. Chen, Jessica A. Gephart, Samuel S. Myers, Matthew Smith, Bapu Vaitla, and Edward H. Allison

**Types of Aquaculture**
- **Type: Produce little or no aquaculture**
  - Likelihood to benefit nutrition: Most unlikely
- **Type: Export-oriented aquaculture**
  - Likelihood to benefit nutrition: Unlikely
- **Type: Domestic-oriented aquaculture**
  - Likelihood to benefit nutrition: Possible
Fisheries Management and Marine Conservation as a Nutritional Intervention

Costello et al. 2016
Increasing Fish Catch

Strengthening Resilient Food Systems

Aquaculture/Fisheries Management

Nutritional Security

Positive Dietary Change
An Environment of Chronic Undernutrition

Stunting prevalence (%)

- Burundi
- Timor-Leste
- Niger
- Madagascar
- Nepal
- Guatemala
- India

Map showing countries with high stunting prevalence.
Benefits of wildlife consumption to child nutrition in a biodiversity hotspot

Christopher D. Golden\textsuperscript{a,b,c,1}, Lia C. H. Fernald\textsuperscript{b}, Justin S. Brashares\textsuperscript{c}, B. J. Rodolph Rasolofoniaina\textsuperscript{d}, and Claire Kremen\textsuperscript{c}

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Overall Diet by Weight

- Rice: 57.81%
- Staples and bananas: 15.92%
- Vegetables, greens, and palm hearts: 10.25%
- Fruits and nuts: 3.51%
- Bushmeat, insects, wild birds: 4.57%
- Beef and pork: 1.61%
- Seafood and freshwater fish (fresh and dried): 1.33%
- Poultry and eggs: 1.09%
- Beverages: 0.02%
- Misc: 3.89%
- Overall Diet by Weight: 100%
Some are eating 70kg of wildlife in a year, the equivalent of a single household receiving 12 quarter-pounder burgers per week from the forest.
Seasonal trends of nutrient intake in rainforest communities of north-eastern Madagascar

Christopher D Golden¹,²,³, *, Bapu Vaitla¹, Laurent Ravaoliny³, Miadana A Vonona³, EJ Gasta Anjaranirina³, Hervet J Randriamady³, Raymond P Glahn⁴, Sarah E Guth², Lia CH Fernald⁵ and Samuel S Myers¹,²
Study Design

Prospective cohort study, $n=1009$; 3 years from 2014-2017

High frequency diet, health, and economic data

Weekly fish catch data

Management systems:

Locally managed marine area (LMMA) 1 2

Traditionally managed area 3 4

Marine National Park (MNP) 5
In Madagascar, the fishing agreement with China caught in the nets of the presidential

Signed by an adviser to the outgoing head of state, the contract would lead, according to critics, to a hoarding of fisheries resources.
Interactive Dynamics of Reef Fisheries and Human Health in Kiribati
Nutrition Transitions

From least to most developed countries: overweight is on the rise

Percentage of population

As countries develop, they face many of the problems common in industrialized nations. Obesity is one of the most worrisome.

Top 10 Most Obese Nations (%)

1. American Samoa: 74.6%
2. Nauru: 71.1%
3. Cook Islands: 63.4%
4. Tokelau: 63.4%
5. Tonga: 57.6%
6. Samoa: 54.1%
7. Palau: 48.9%
8. Kiribati: 46%
9. Marshall Islands: 45.4%
10. Kuwait: 42%
Health assessment

Fingerstick of blood (Point of Care)

- Metabolic disease markers (total cholesterol, HDL and LDL, triglycerides, and glucose)
- Hemoglobin A1c (diabetes)
- Hemoglobin (anemia)
- Fatty acid profiles of 23 different fatty acids incl. DHA & EPA

Anthropometry and Diagnostics

- Blood pressure
- Standard anthropometry (height/length, weight)
- Abdominal circumference
Reef Health
UC
Santa Barbara

Pathways
and international collaborators

Stakeholders

Governance
Secretariat of the Pacific Community

UC
Santa Cruz

Human Health and Nutrition
Harvard School of Public Health

Kiribati Ministry of Health and Medical Sciences
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