

Navigating transformations of marine social-ecological systems in Latin America: new incentives in reforming fisheries management

Sebastián Villasante¹²

¹ Centro Nacional Patagónico (CENPAT) (Argentina)

² The Beijer Institute of Ecological Economics –
The Royal Swedish Academy of Sciences (Sweden)

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Incentive Measures

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Outline of the talk

- Status quo of worldwide fisheries
- Harmful incentives
- Situation in Latin America
 - Industrial fisheries
 - Development of aquaculture
 - Artisanal fisheries
- Key messages
- Challenges and opportunities

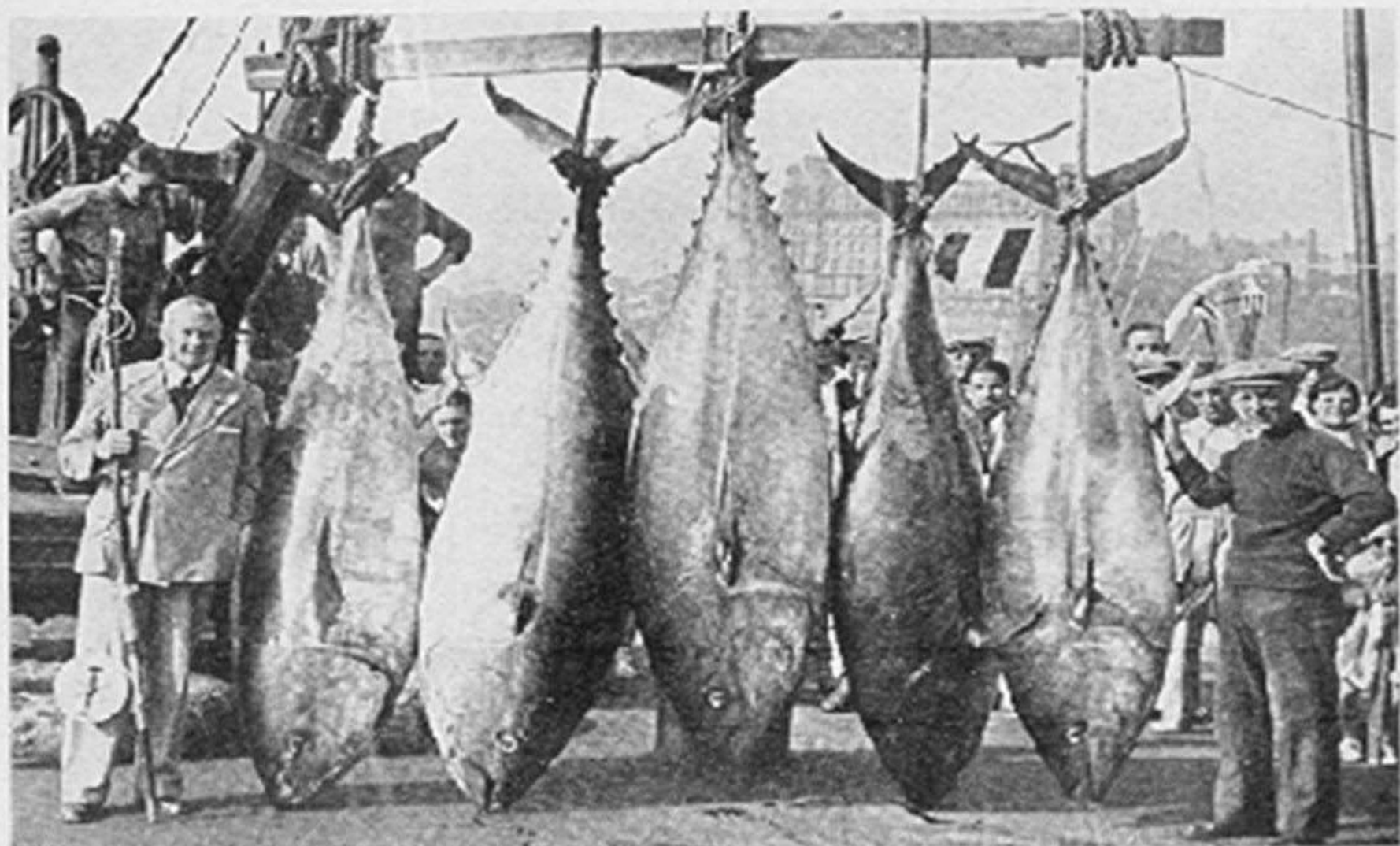
Global drivers and implications

- Human activity has become a major driving force in the history of the planet: *Antropocene* (Rockström et al. 2009)
- Increase of human population (9 billion 2050) (Steffen et al. 2011)
- Reduction of ecosystem services (MEA, 2005)
- Annual fish harvesting has increased by a multiple of 35 in the last 100 years (Arrow et al. 2004)
- A highly interconnected and faster world, with cascading social-ecological interactions and planetary boundaries that create vulnerabilities (Folke et al. 2011)

Contribution of fisheries and aquaculture

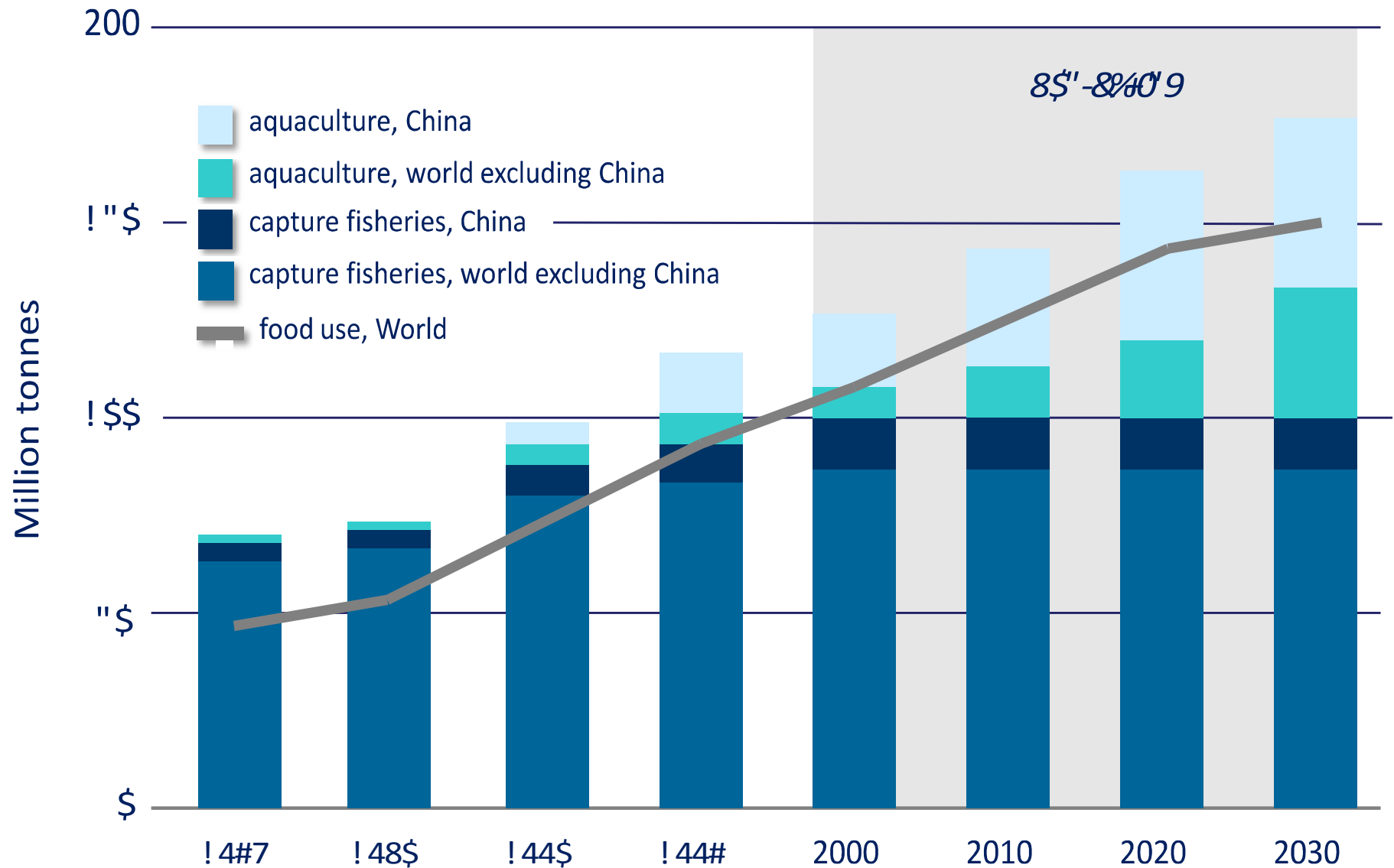
- Global food fish supply has increased at an annual rate of 3.1% since 1961, while the world population has increased by 1.7% per year for the same period (Hall et al. 2011)
- Fish provides more than 1.5 billion people with almost 20% of their average per capita intake of animal protein, and 3 billion people with 15% of such protein (FAO, 2010)
- Fish is also preeminent as an internationally traded animal source food. Seafood exports from wild fisheries and aquaculture in 2008 had a combined value of US\$102 billion (Bené et al. 2011)

TUNNY SEASON, 1938



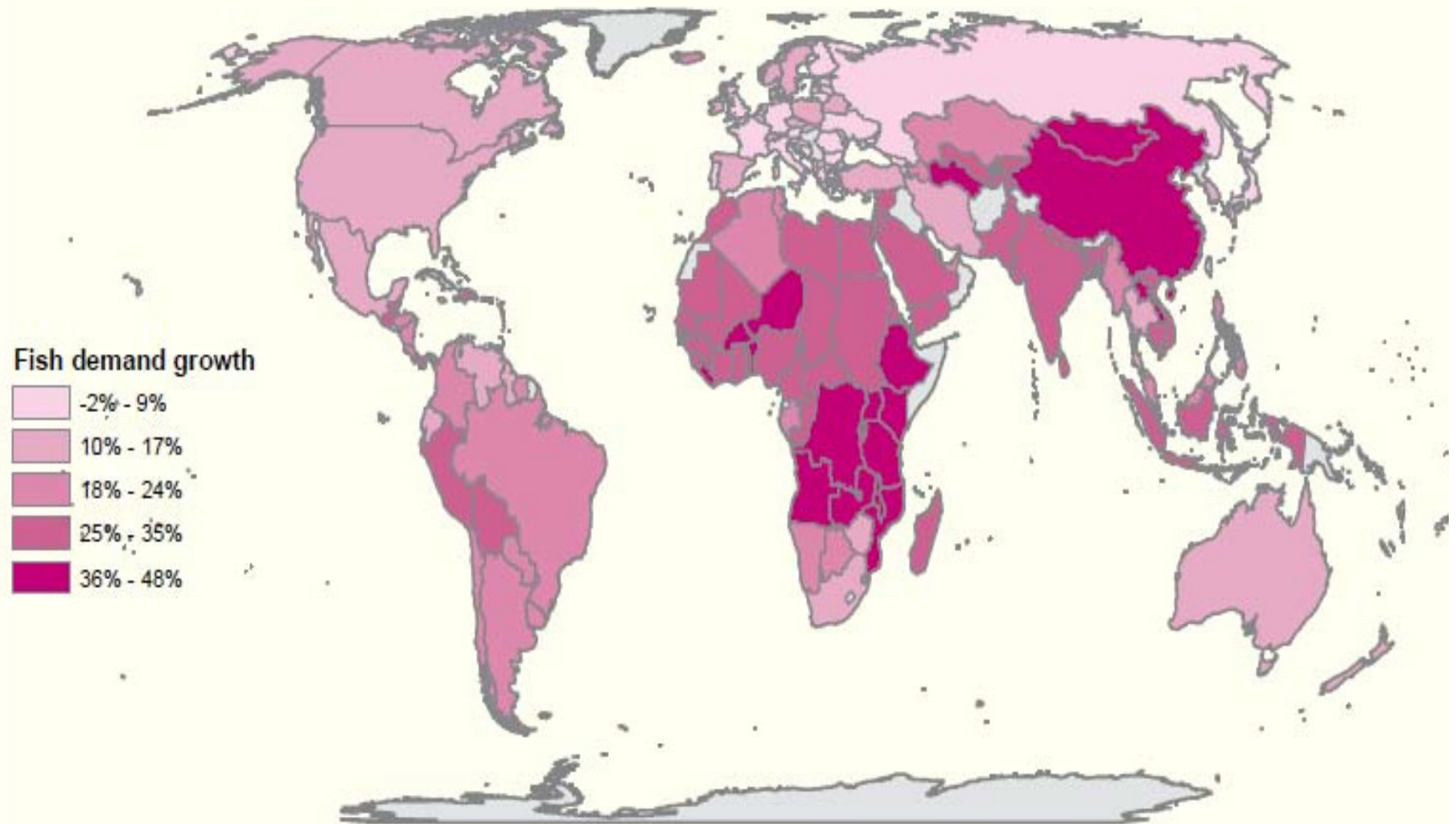
World Record catch of five Tunny at Scarborough, in one day, by Capt. C. H. Frisby, V.C. These fish weighed respectively 621 lbs., 527 lbs., 461 lbs., 658 lbs. and 545 lbs.

World fish production and uses



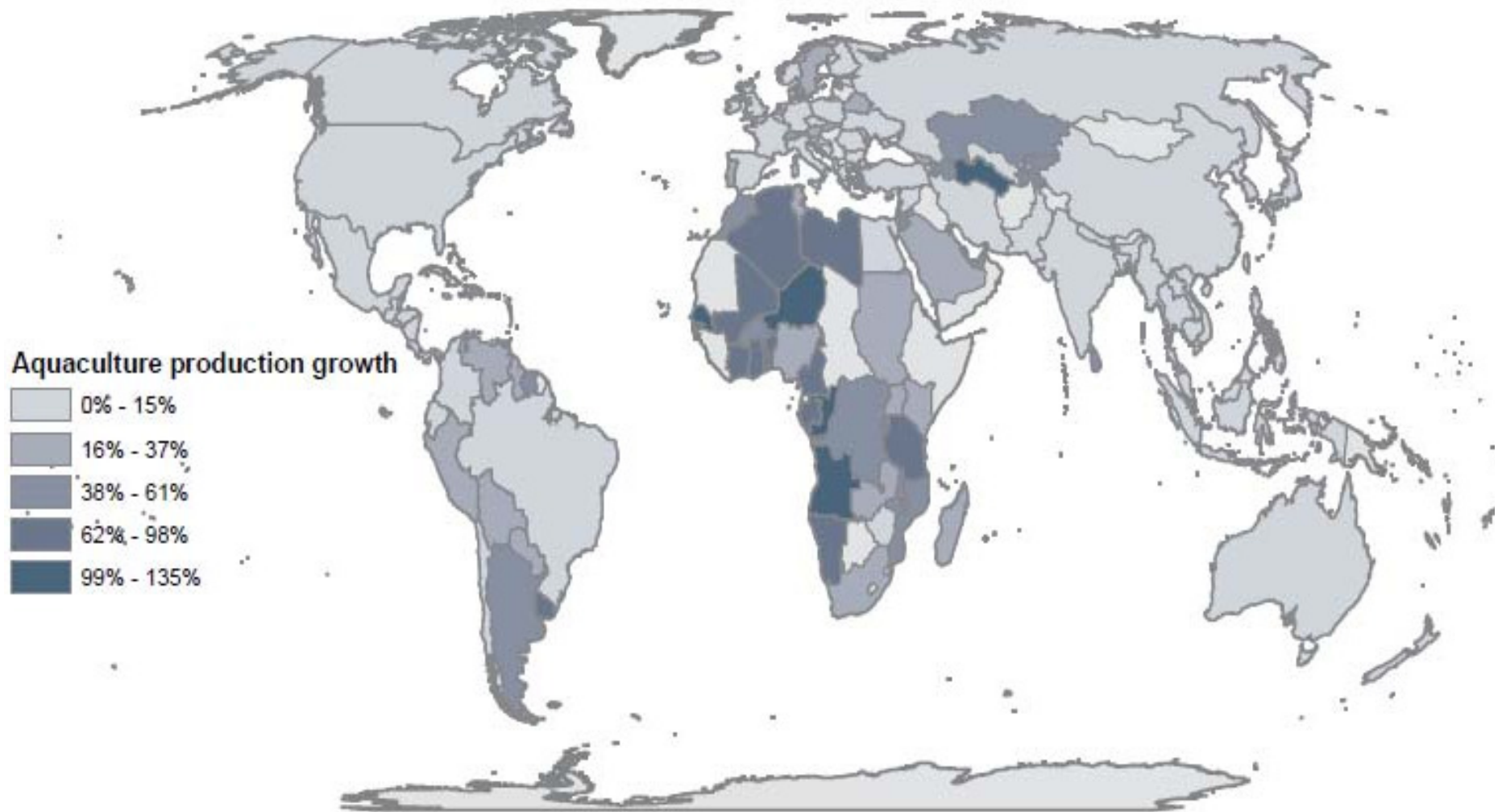
From: FAO (2010)

Fish demand growth rate (2007-2015)



From: Cai (2011)

Annual growth rate of aquaculture needed to satisfy fish demand (2015)

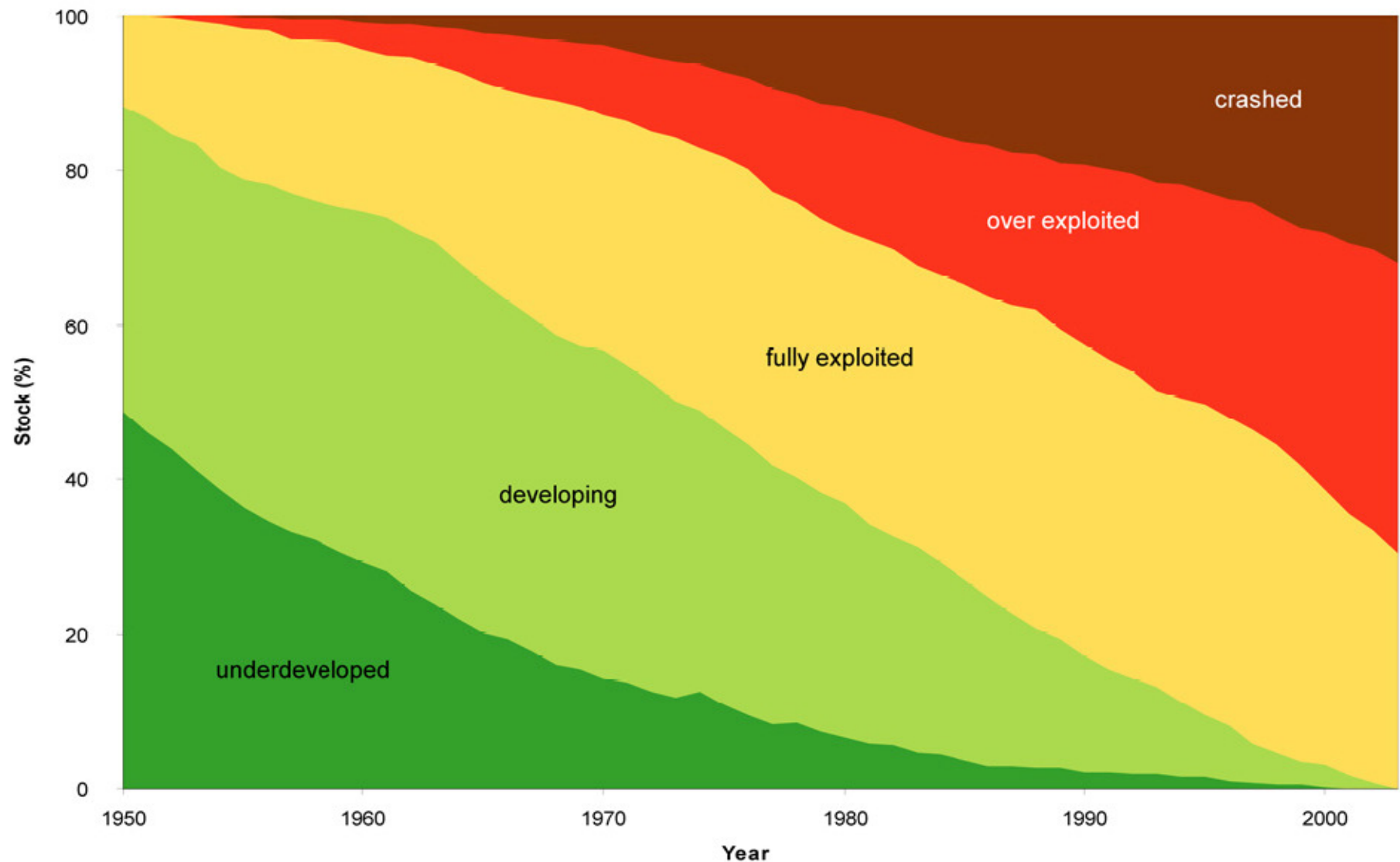


From: Cai (2011)

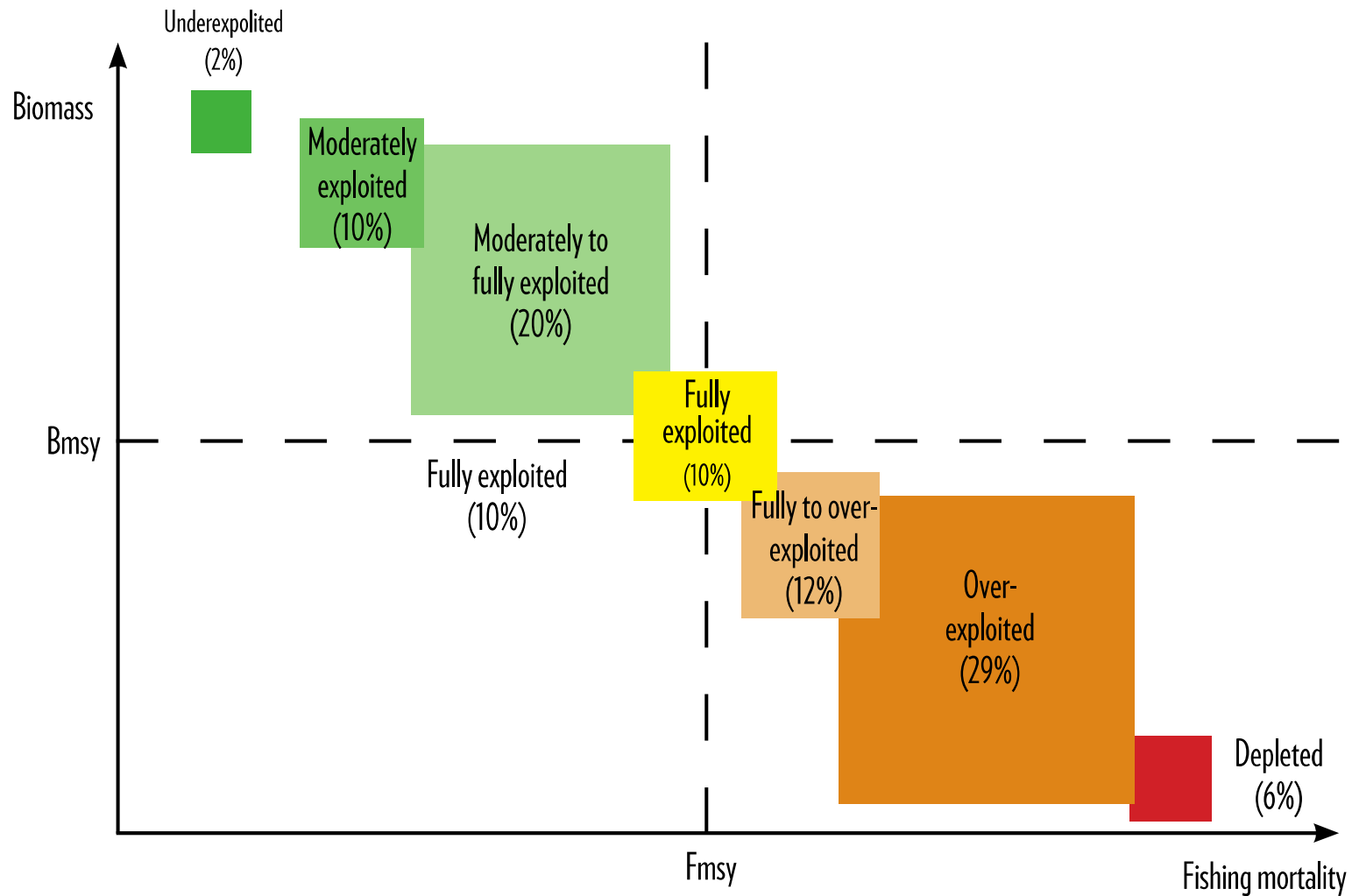
Global pattern of marine fisheries

Stock Exploitation

Stock = (Family, Genus, Species) by FAO areas, max annual catch $\geq 1000t$ and year count ≥ 5

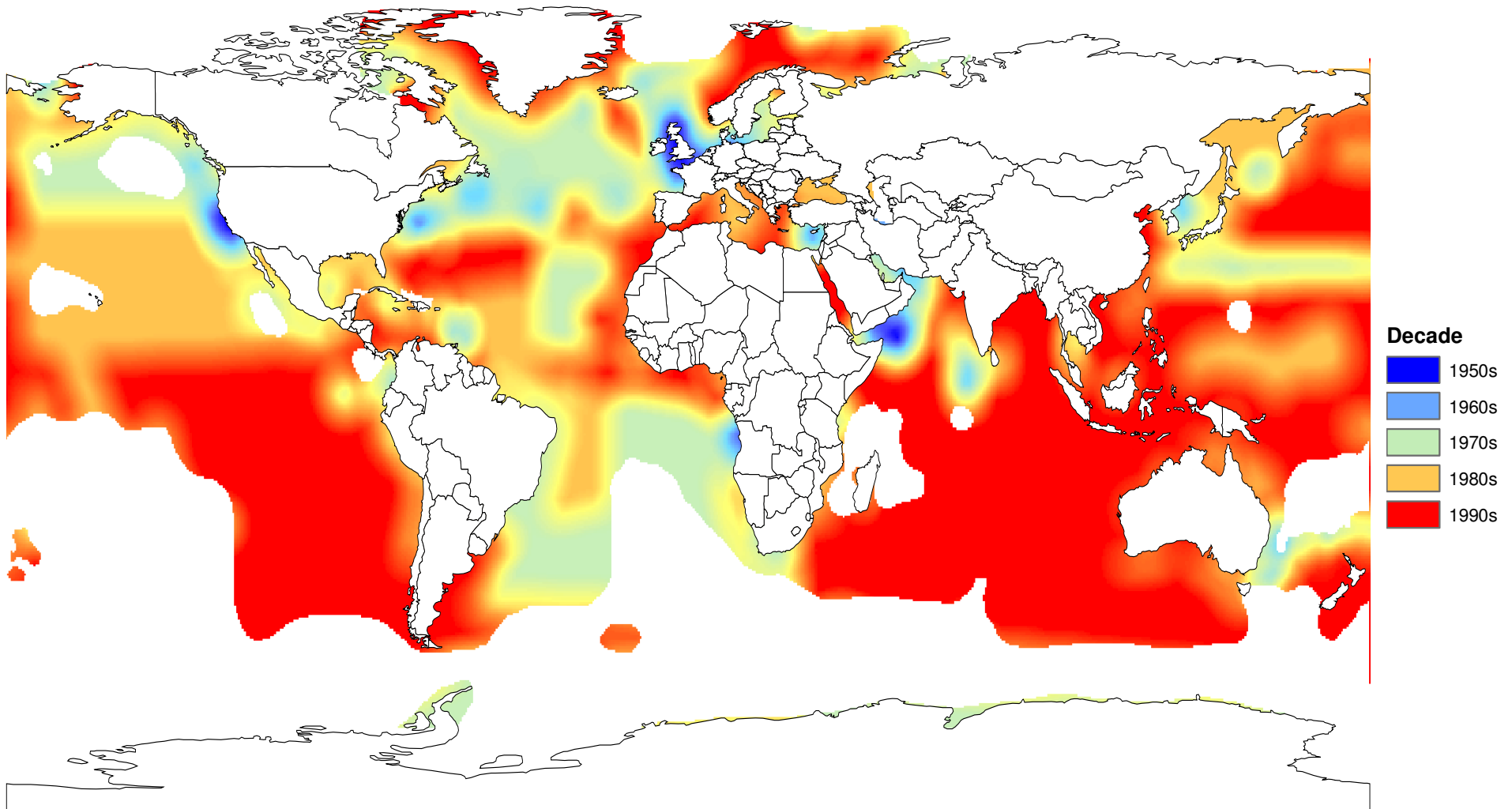


Status of Latin American fisheries



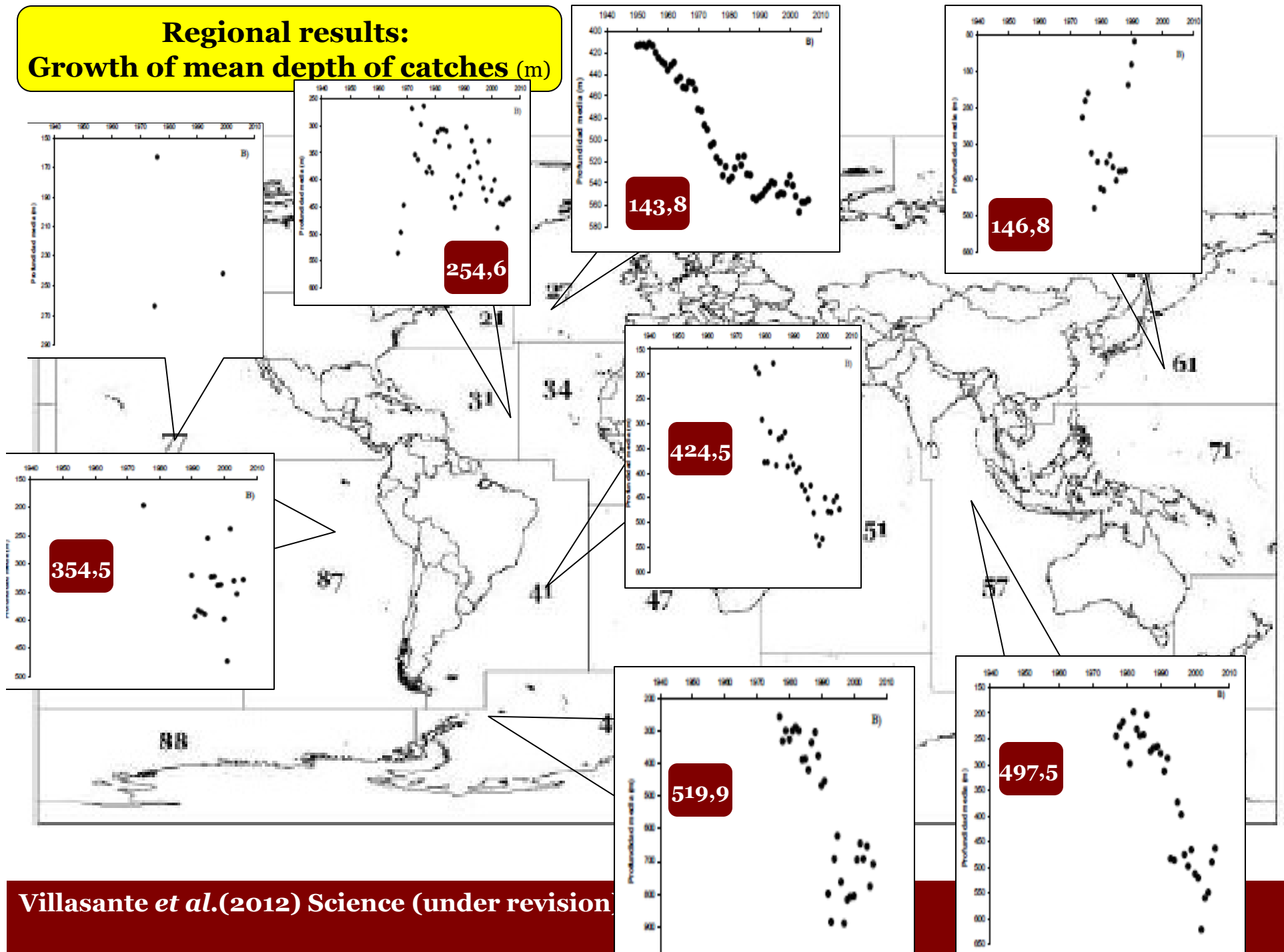
Source: Bowarnick et al. (2010)

Overexploitation of fishery resources worldwide, in particular in Southern Hemisphere



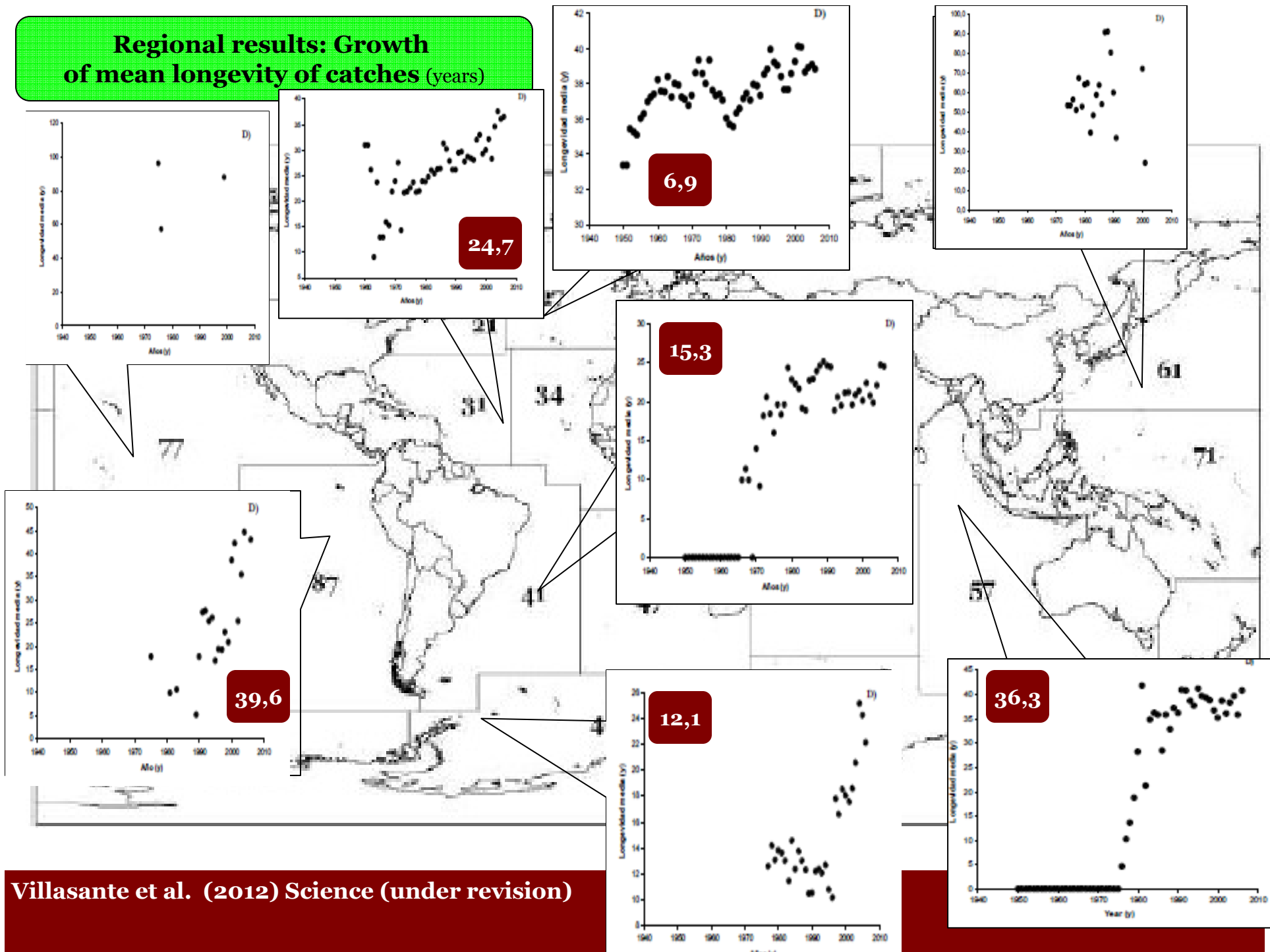
(Cortésía *Fisheries Centre*, University of British Columbia)

Regional results: Growth of mean depth of catches (m)



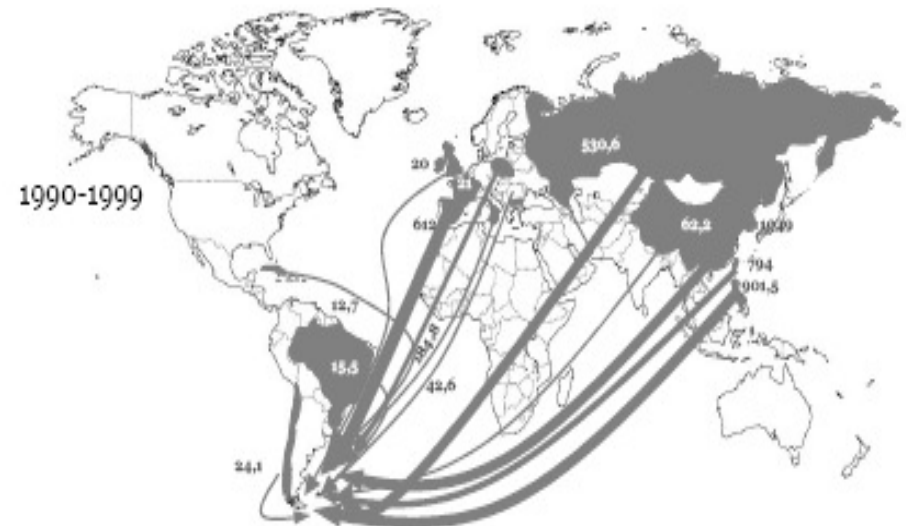
Villasante *et al.*(2012) Science (under revision)

Regional results: Growth of mean longevity of catches (years)

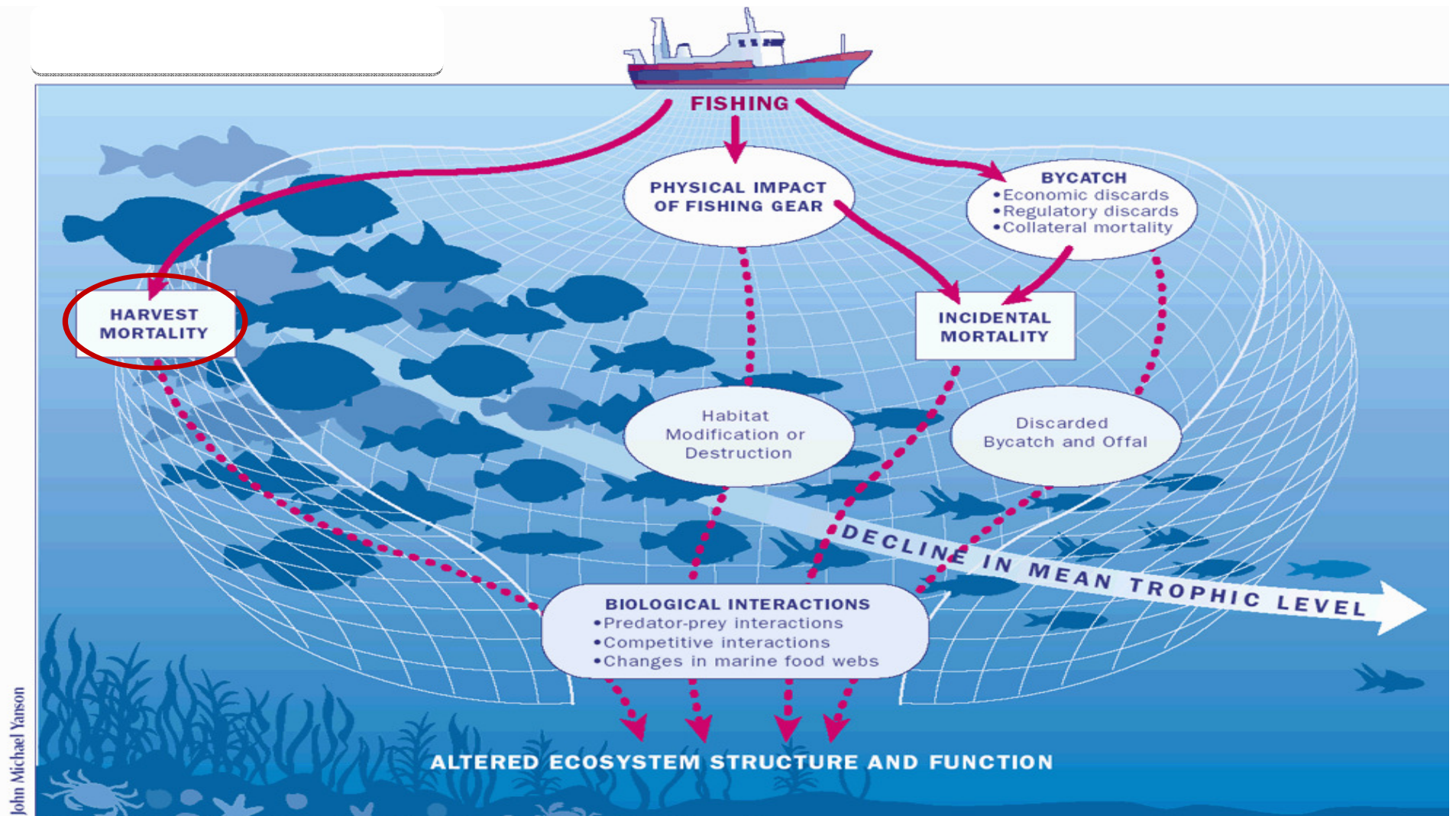


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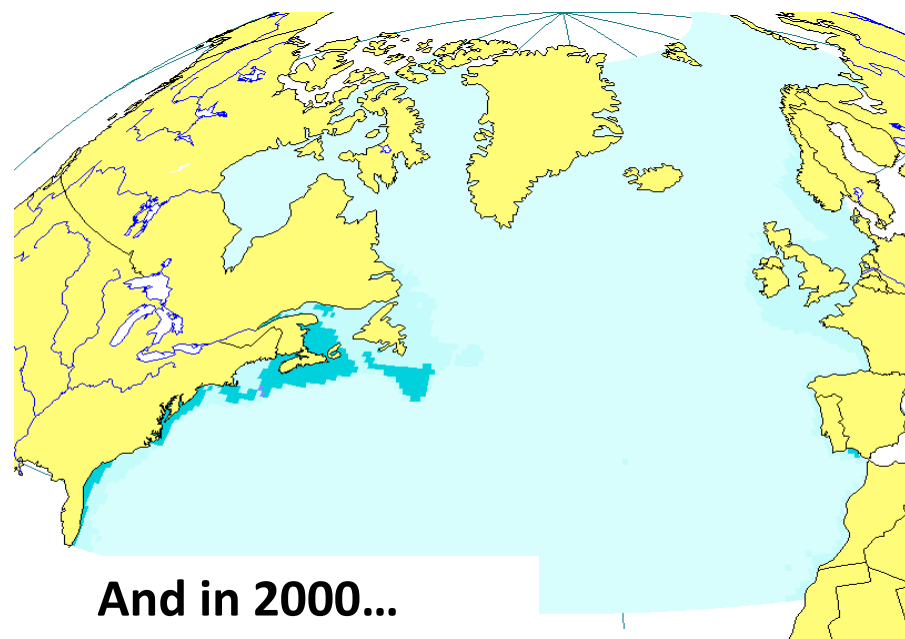
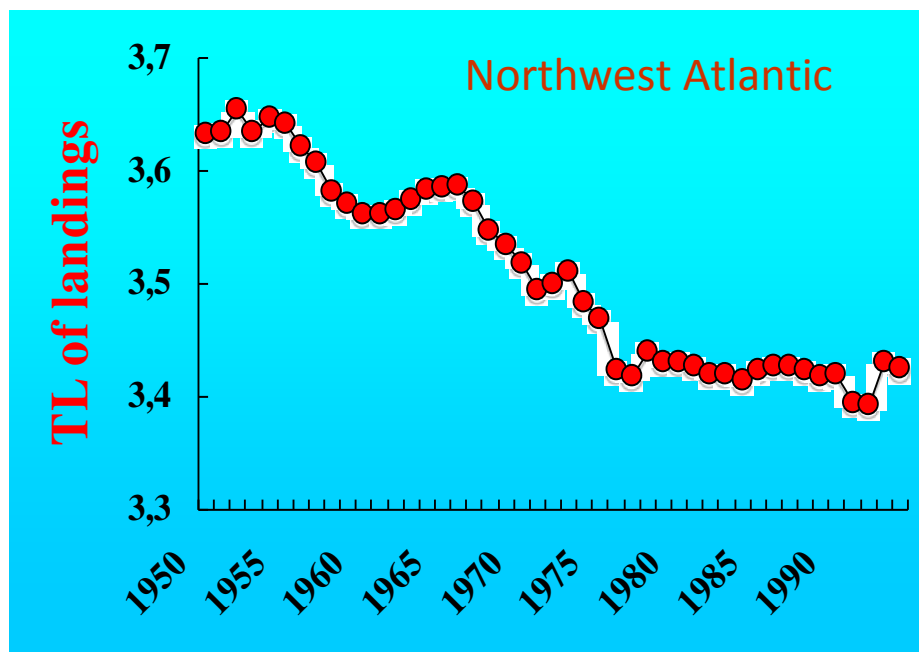
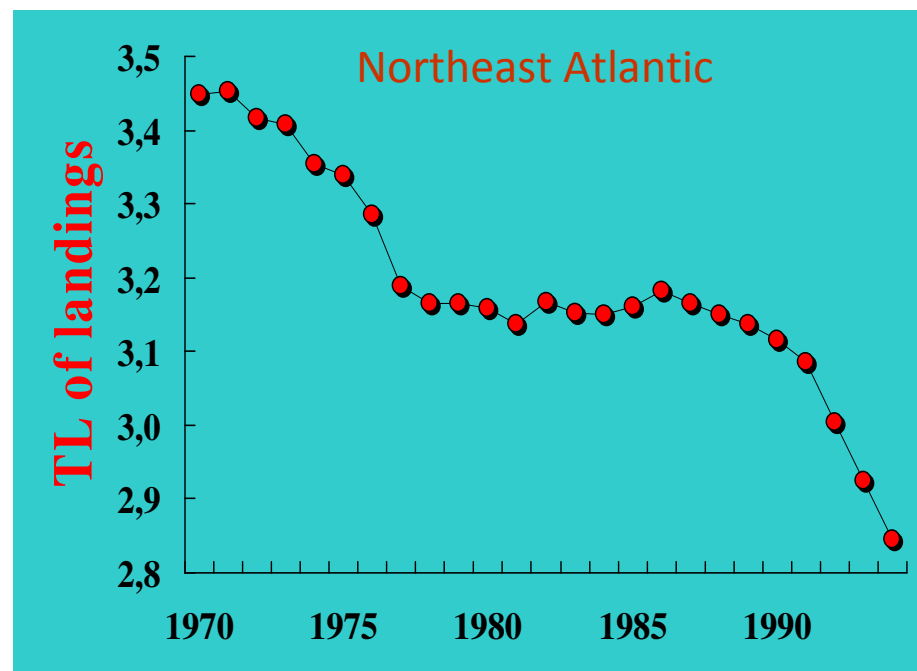
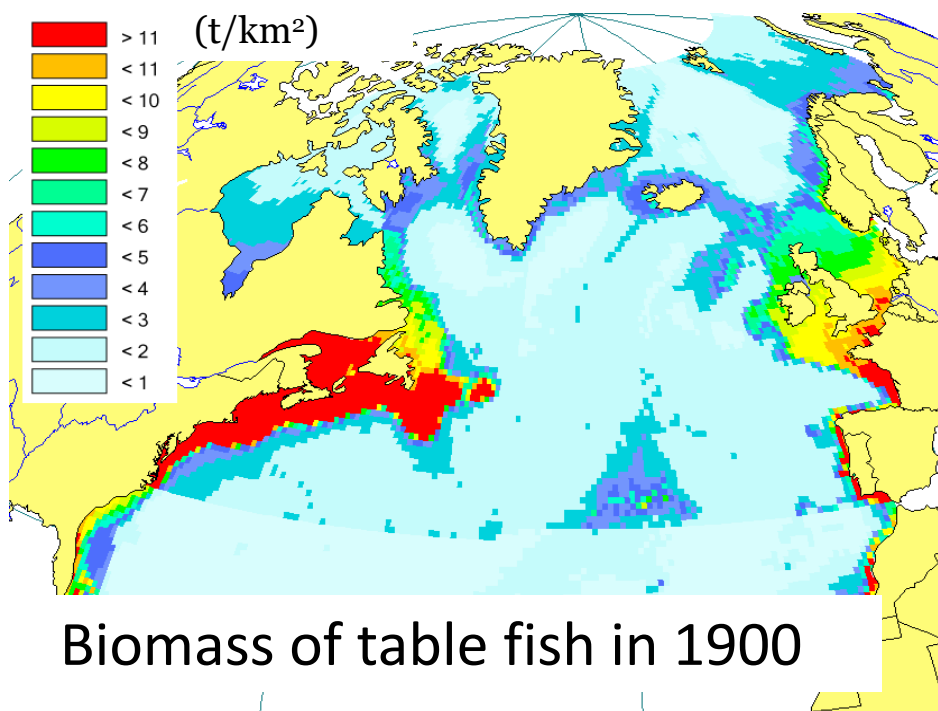
Historically, the Southern Hemisphere attracted distant-water fleets from other continents, before but also after UNCLOS Era...



Ecosystem overfishing



Pauly et al. (1998); Cristensen et al. (2003); Villasante et al. (2011, 2012)



(Christensen *et al.* 2003)

Trophic level studies in the Southern Hemisphere

Hemisferio Sur			
Argentina	1950-2007	0.067	Villasante et al. (2009a)
Bahía Blanca	1989-2007	0.152	Villasante et al. (2009a)
Comodoro Rivadavia	1989-2007	0.019	Villasante et al. (2009a)
Mar del Plata	1989-2007	0.098	Villasante et al. (2009a)
Necochea	1989-2007	0.258	Villasante et al. (2009a)
Puerto Deseado	1989-2007	0.020	Villasante et al. (2009a)
Puerto Madryn	1989-2007	0.028	Villasante et al. (2009a)
Rawson	1989-2007	0.004	Villasante et al. (2009a)
San Antonio Este	1989-2007	0.023	Villasante et al. (2009a)
San Antonio Oeste	1989-2007	0.119	Villasante et al. (2009a)
Chile			
Costa central de Chile	1992-1998	0.150	Arancibia y Neira (2005)
India	1950-1993	0.058	Bhathal (2005)
Goa	1973-1993	0.024	Bhathal (2005)
West Bengal	1967-1993	0.031	Bhathal (2005)
Andhra Pradesh	1968-1993	0.036	Bhathal (2005)
Lakshadweep	1965-1993	0.055	Bhathal (2005)
Andaman y Nicobar Islands	1950-1993	0.076	Bhathal (2005)
Gujarat	1961-1993	0.120	Bhathal (2005)
Pondicherry	1955-1993	0.123	Bhathal (2005)
Tamil Nadu	1956-1993	0.128	Bhathal (2005)
Tailandia			
Golfo de Tailandia	1963-1982	0.100	Christensen (1998)
Uruguay	1990-2001	0.030	Milessi et al. (2005)
ZCP Argentina-Uruguay	1989-2003	0.280	Jaureguizar y Milessi (2008)
Mundial		0.100	Pauly et al. (1998)

Villasante, S. (2009) PhD Thesis. University of Santiago de Compostela



The Sunken Billions

Table 4.1 Main Results—Point Estimates of Rents

Category	Units	Current		Optimal		Difference	
		Logistic	Fox	Logistic	Fox	Logistic	Fox
Biomass	Million of tons	148.4	92.3	314.2	262.9	165.8	170.6
Harvest	Million of tons	85.7	85.7	80.8	81.6	−4.9	−4.1
Effort	Index	1.00	1.00	0.56	0.46	−0.44	−0.54
Profits	US\$ billions	−5.000	−5.000	39.502	54.035	44.502	59.035
Rents	US\$ billions	−5.000	−5.000	39.502	54.035	44.502	59.035

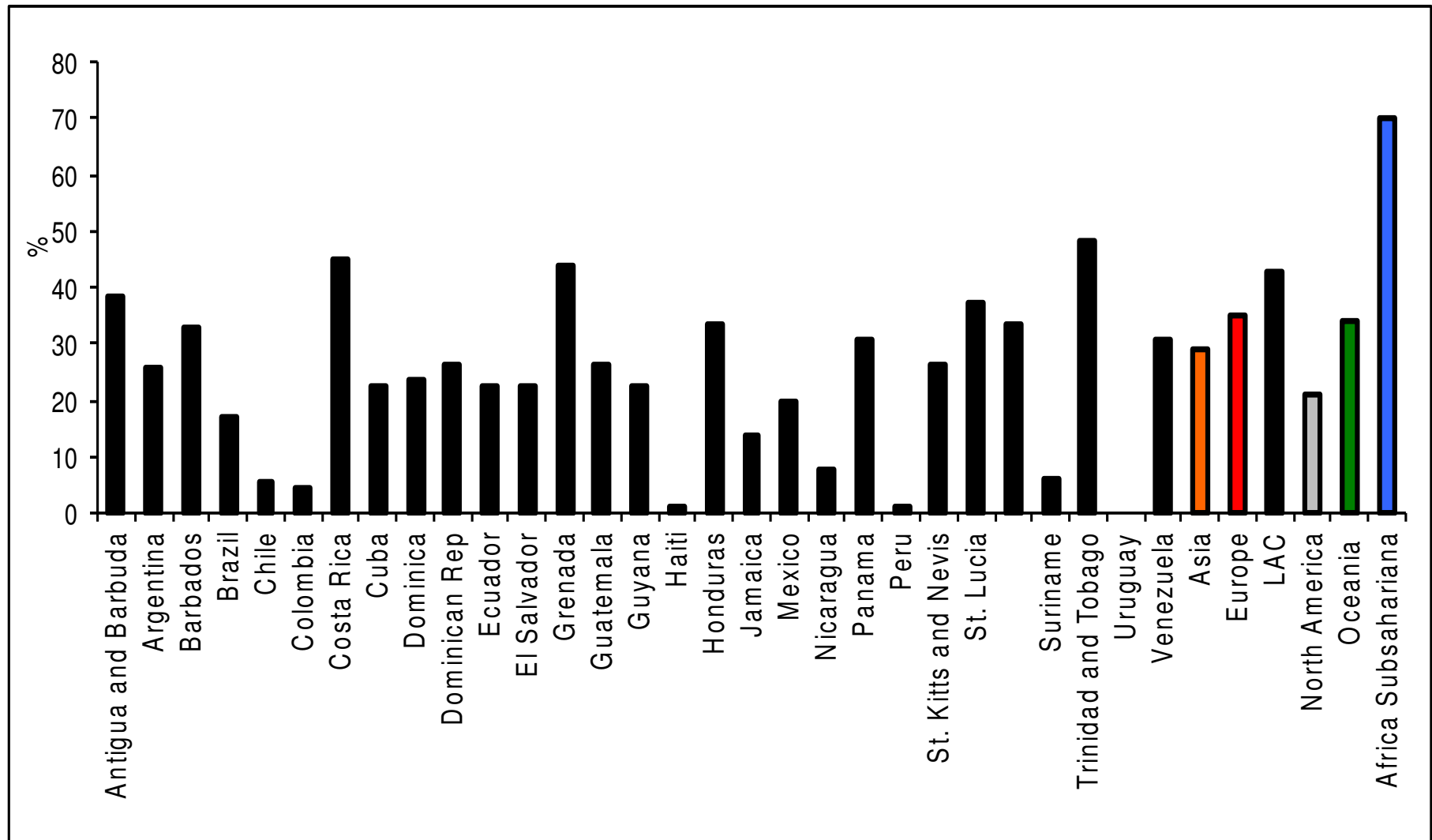
Source: Authors.

Harmful incentives in industrial fisheries

Bad subsidies and overfishing

- Fishery subsidies are financial payments from public entities to the fishing sector, which help the sector make more profit than it otherwise would (Khan et al. 2006)
- Subsidies result in fishery resources being overexploited, as they contribute directly or indirectly to the build-up of excessive fishing capacity (Sumaila and Pauly, 2007)
- Total global fishery subsidies were estimated at about US\$26 billion. About 49% of this amount was provided by 38 developed countries and the remaining 51% by 103 developing countries:
 - “Bad” : foreign agreements, boat construction and modernization
 - “Good”: fisher assistance measures, fishery research and development
 - “Ugly”: Rural fishers’ community, development programs vessel buyback programs

***“Bad”* subsidies are predominant in the region**

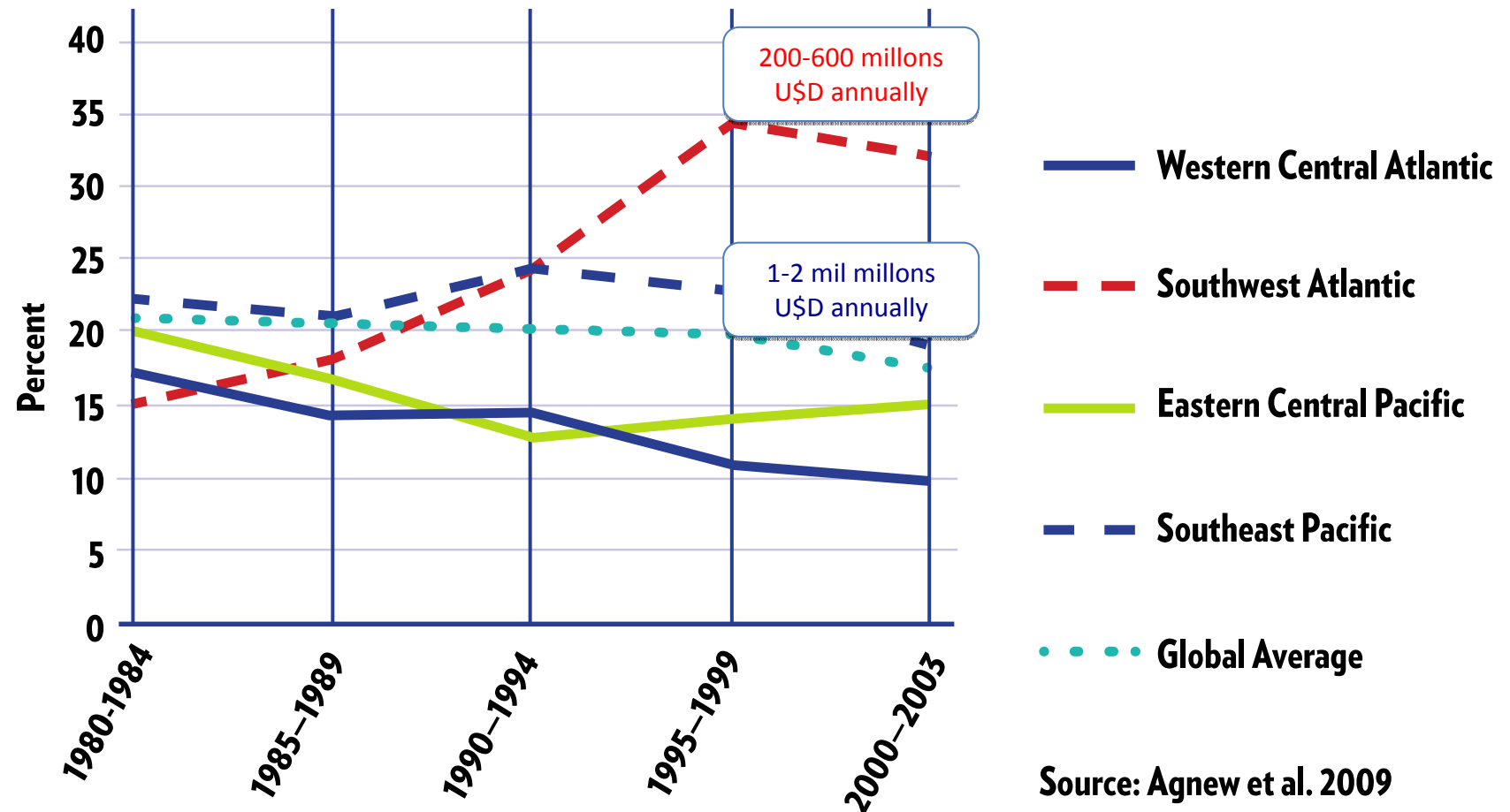


Source: Bowarnick et al. (2010)

Illegal, Unreported and Unregulated fishing activities

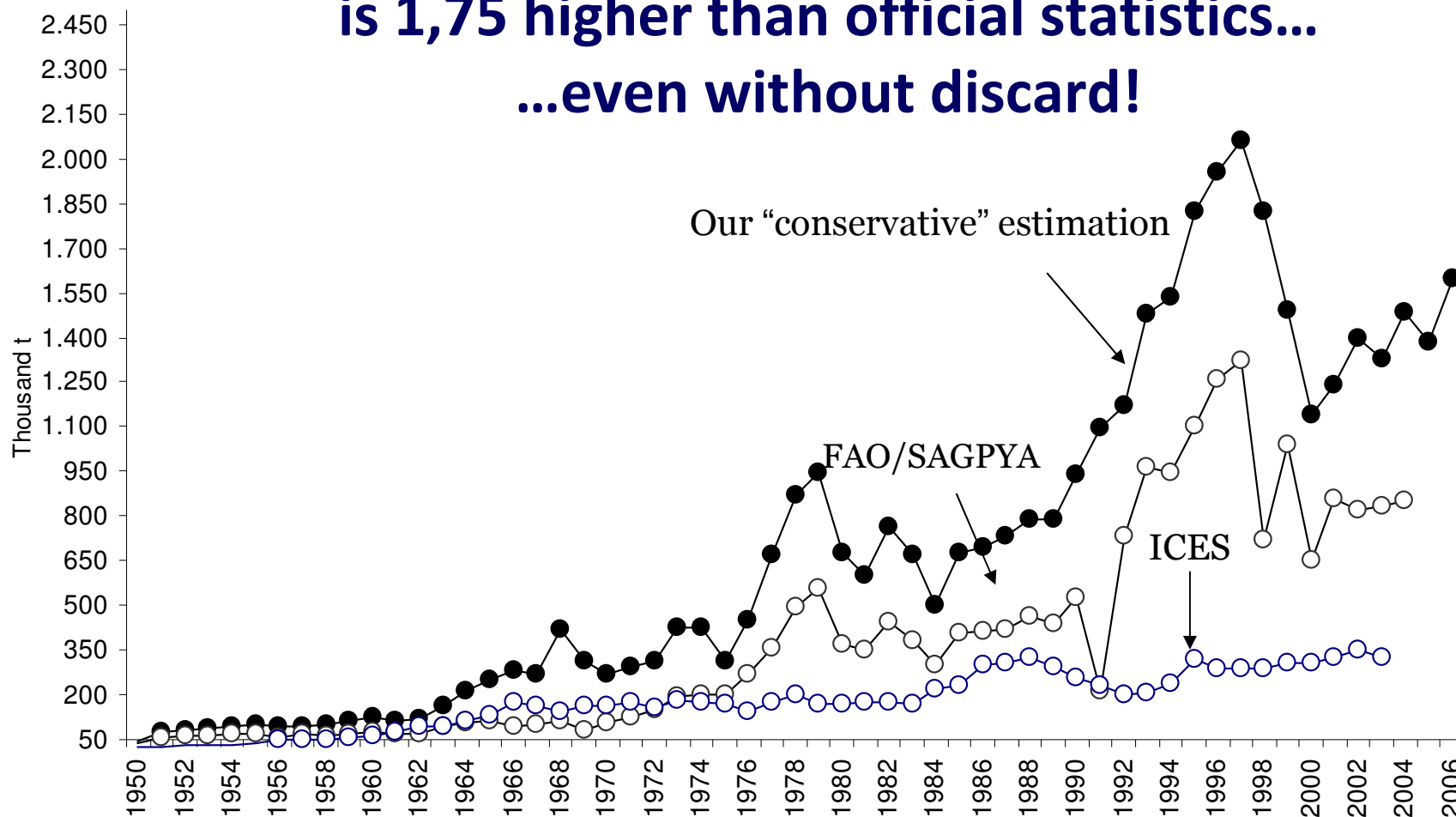
- Illegal and unreported fishing contributes to overexploitation of fish stocks and is a hindrance to the recovery of fish populations and ecosystems (Sumaila et al. 2006)
- Direct economic global losses estimated to be between US\$ 9 billion and US\$ 24 billion annually, representing between 11 and 26 million tonnes of fish — between 10 and 22 % of total fisheries production (Agnew et al. 2009)
- Indirect economic losses include impacts resulting from the loss of income and employment in fisheries and other industries and activities in the supply chain (MRAG, 2010)
- Developing countries are most at risk from illegal fishing. There is a significant link between the high levels of illegal fishing and poor governance (Agnew et al. 2009)

Illegal, Unreported and Unregulated fishing activities

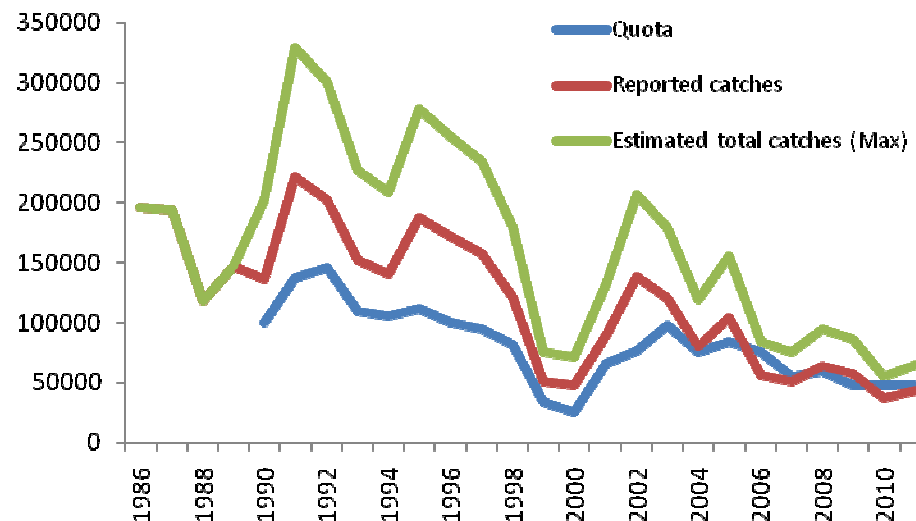
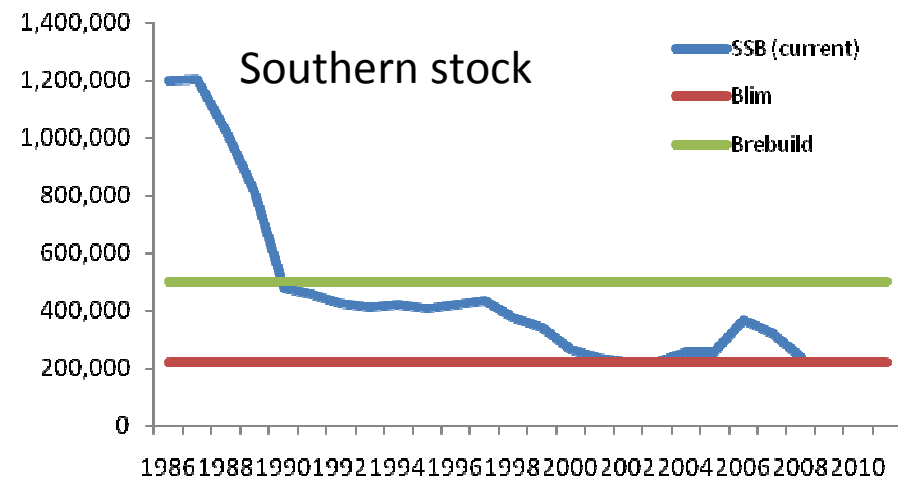
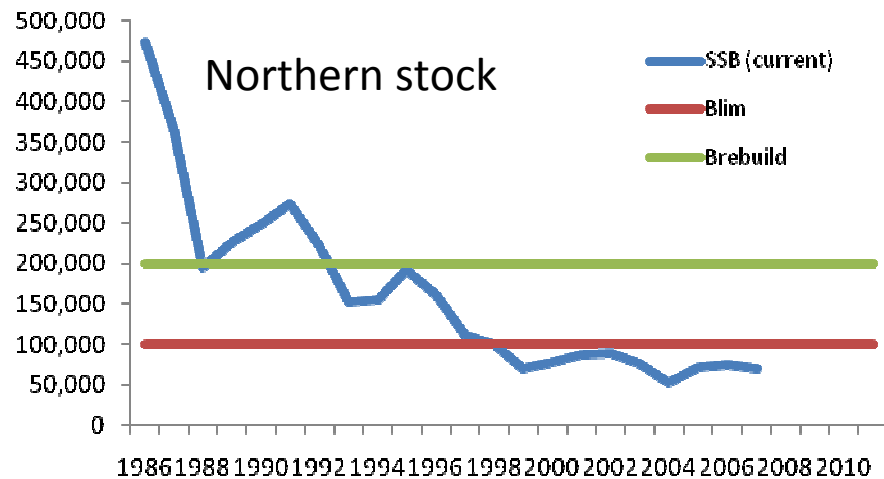


Under declaration of catches

**The reconstruction catches in Argentina
is 1,75 higher than official statistics...
...even without discard!**



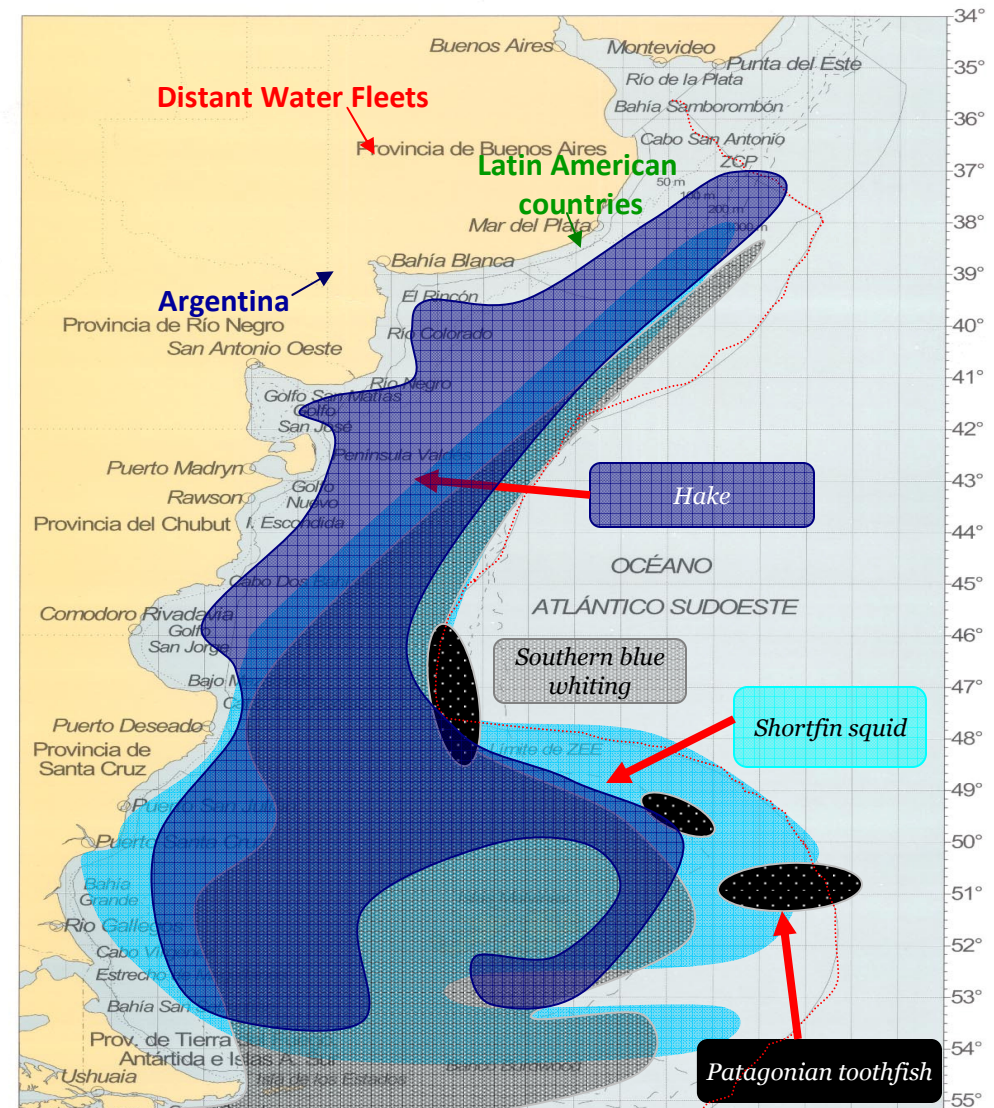
A typical case study of Business as Usual: the Argentinean Hake (*Merluccius hubbsi*)



Source: Bowarnick et al. (2010)

Level of incentives to manage *shared* fish stocks

- Shared fish stock issue arising from EEZ regime – account for up to 1/3 fishery harvests
- Two level of incentives:
 - Intra EEZ: where the incentives involved concern fishers
 - International: shared fish stocks
- Non-cooperative games: there is a serious risk that States/entities sharing a resource will be driven to adopting exploitation strategies each recognizes as undesirable, if not destructive outcome:
 - Motivated entirely by self- interest (Nash, 1950)
 - No incentives to modify strategies (Nash, 1951)
 - No lines of communication (Sumaila, 1999)
 - No possibility to achieve binding agreements (Villasante and Sumaila, 2012)

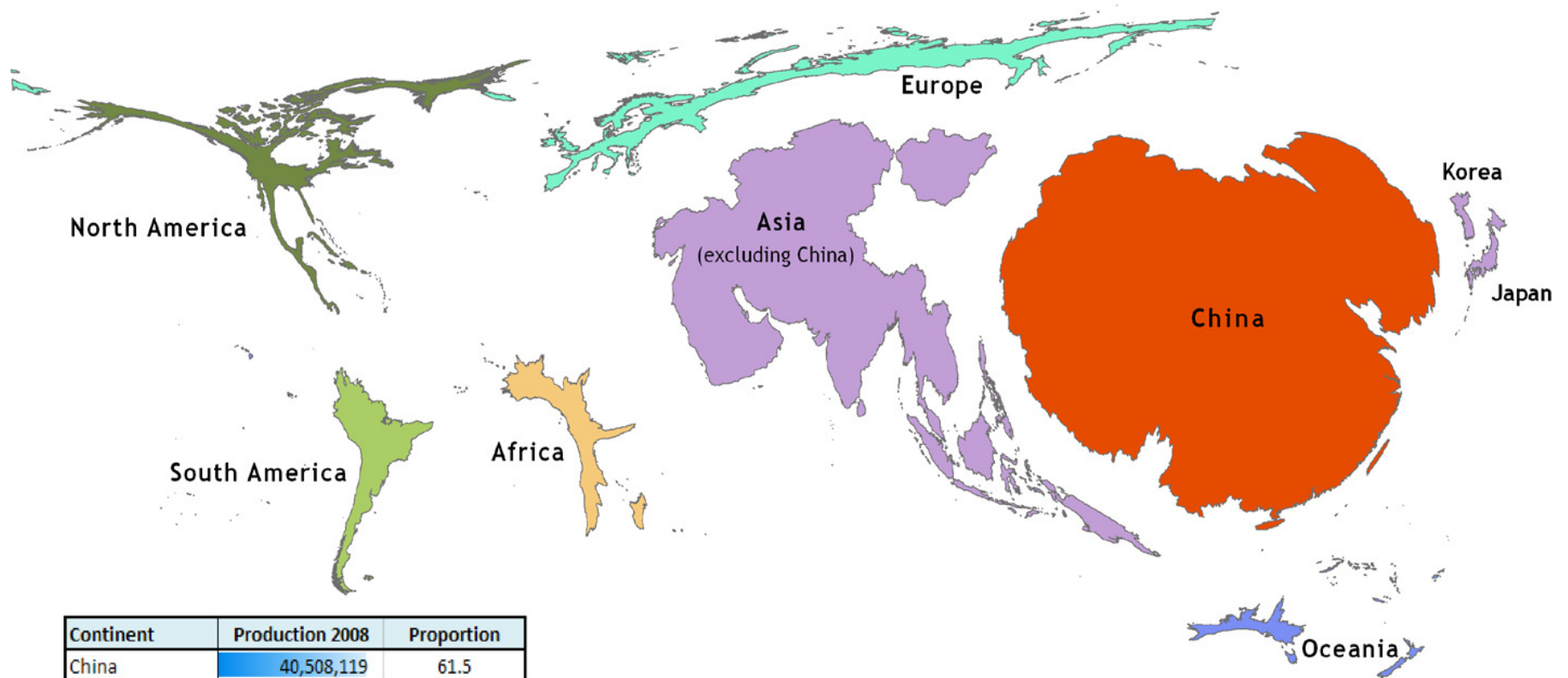


Harmful incentives in aquaculture

Growth of aquaculture development

- Aquaculture (the farming of aquatic animals and plants) is among the fastest growing food production sectors in the world and this trend is set to continue (Hall et al. 2011)
- In the period 1970–2008, the production of food fish from aquaculture increased at an average annual rate of 8.3%, while the world population grew at an average of 1.6% per year (FAO, 2010)
- Production from aquaculture is mostly destined for human consumption (FAO, 2010)
- Aquaculture is therefore widely viewed as an important weapon in the global fight against malnutrition and poverty, particularly within developing countries (Tacon et al. 2010)

The world of the aquaculture sector



Continent	Production 2008	Proportion
China	40,508,119	61.5
Asia	19,401,808	29.5
Europe	2,341,646	3.6
South America	1,461,061	2.2
North America	965,792	1.5
Africa	952,133	1.4
Oceania	176,181	0.3

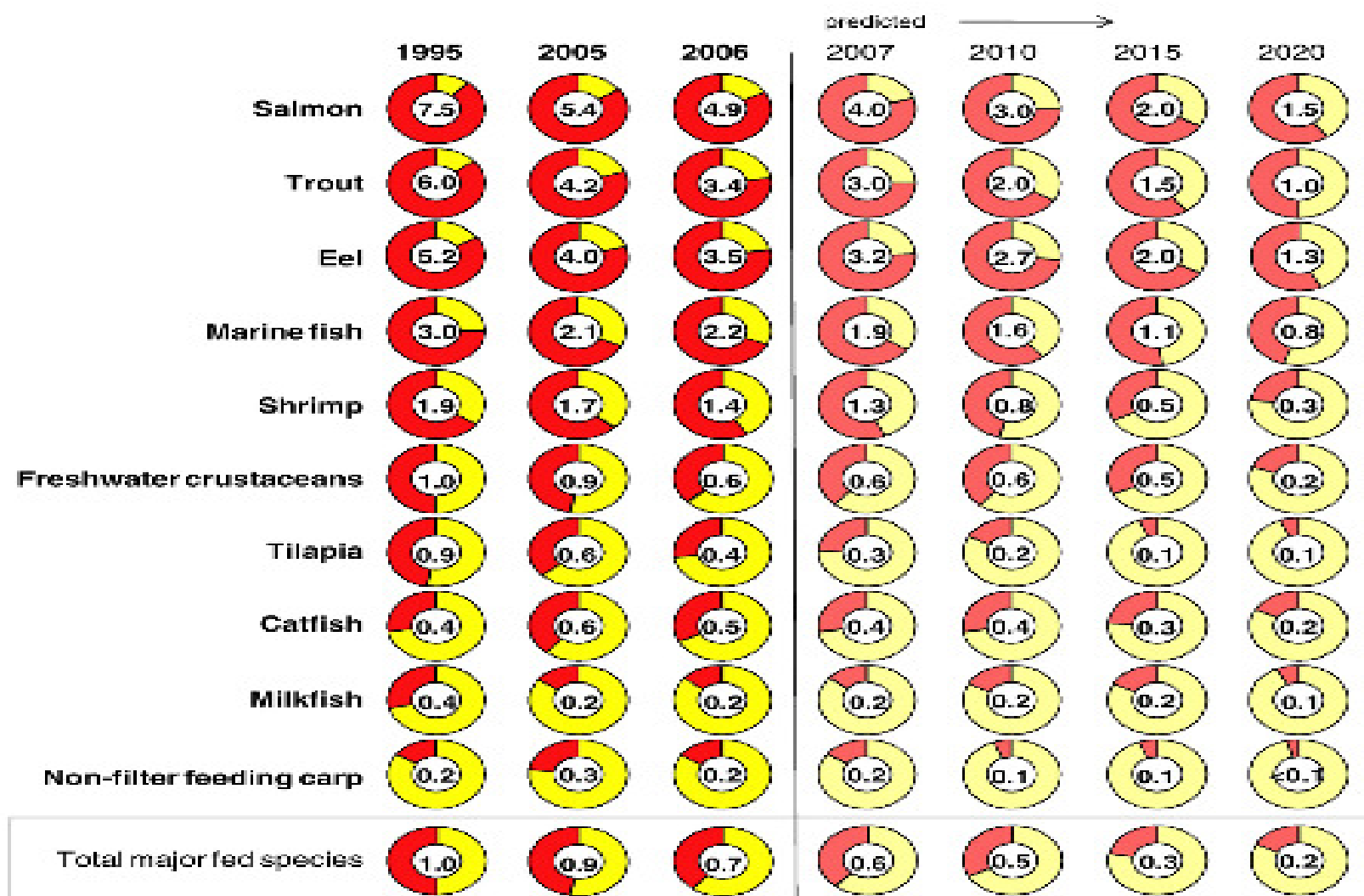
	Quantity		Value	
	(Million tonnes)	(Percentage)	(US\$ billions)	(Percentage)
Developed countries	3.92	7.50	14.42	14.60
Least-developed countries	1.90	3.60	3.01	3.10
Other developing countries	46.72	88.90	81.03	82.30
World	52.55	100.00	98.45	100.00

source: Hall et al. (2011)

Ecological limitations

- Aquaculture focus within economically developed countries has been essentially on the culture of high value, high trophic level-carnivorous species (Naylor et al. 2009)
- Small pelagic forage fish species (includes anchovies, i.e, Peru) also represent the largest landed species group in capture fisheries (27.3 million tonnes or 29.7% of total capture fisheries landings), and they primarily serve as farm feeds inputs (Tacon and Metian, 2009)
- This is a source of global concern because most of these fishery resources are either fully exploited to overexploited or are in the process of recovering from overexploitation (Alder et al. 2008)

Calculated pelagic forage fish equivalent per unit of production



Transfer coefficient
 Annual production (tonnes)
 Pelagic forage fish equivalent (tonnes)

From Tacon and Metian (2008)

Aquaculture in Southern Chile

- Chile's once-fledgling salmon aquaculture industry is now the second largest in the world. Since 1990, the industry has grown 24-fold and now annually export more than half-a-million tons of fish worth billions of dollars (Naylor et al. 2009)
- But this massive growth also generates varied environmental impacts, and interactions between different factors may produce complex changes in coastal ecosystems: introduction of exotic species of salmon, high levels of pollution, and the spread of parasites and diseases among the fish (Buschmann et al. 2008)
- A comprehensive empirical research of environmental impacts remain unstudied (Buschmann et al. 2009)

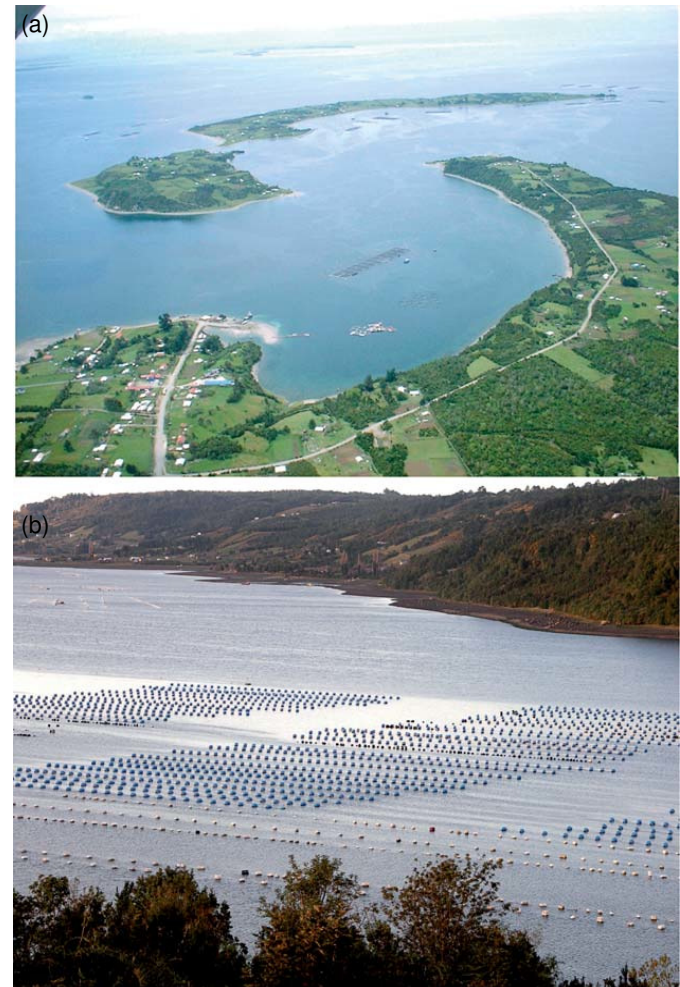
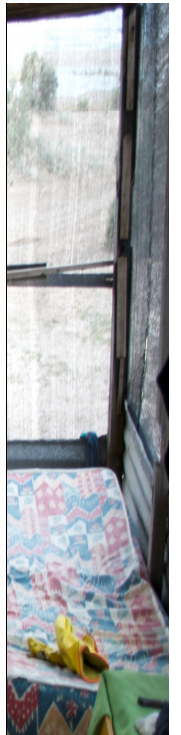
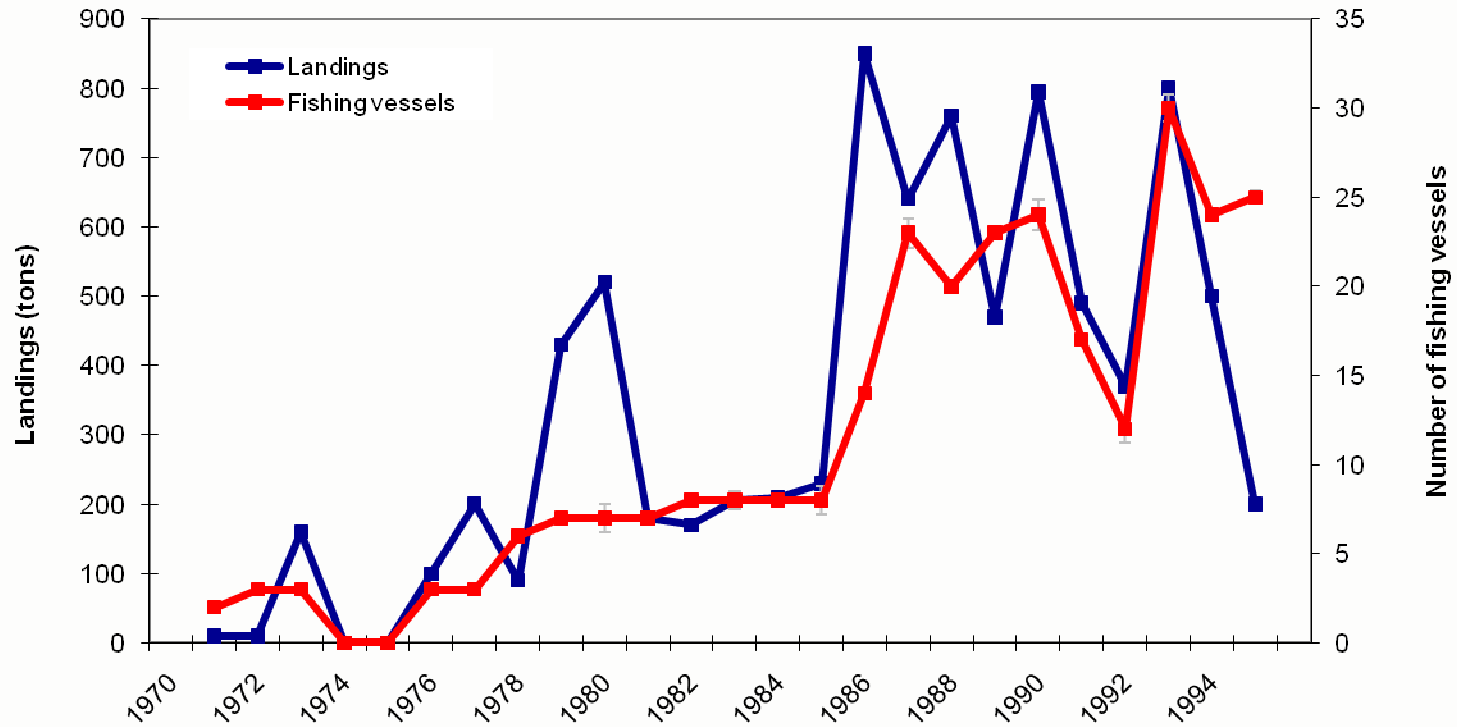


Figure 1 Aquaculture in southern Chile. (a) Aerial photograph showing multiple salmon cage culture systems in one bay in Chiloé Island. (b) The Huito channel in Calbuco with intensive large-scale mussel culture.

**But not all are bad news..
We have successful incentives
in artisanal fisheries!**

Why the *Tragedy of Commons*?



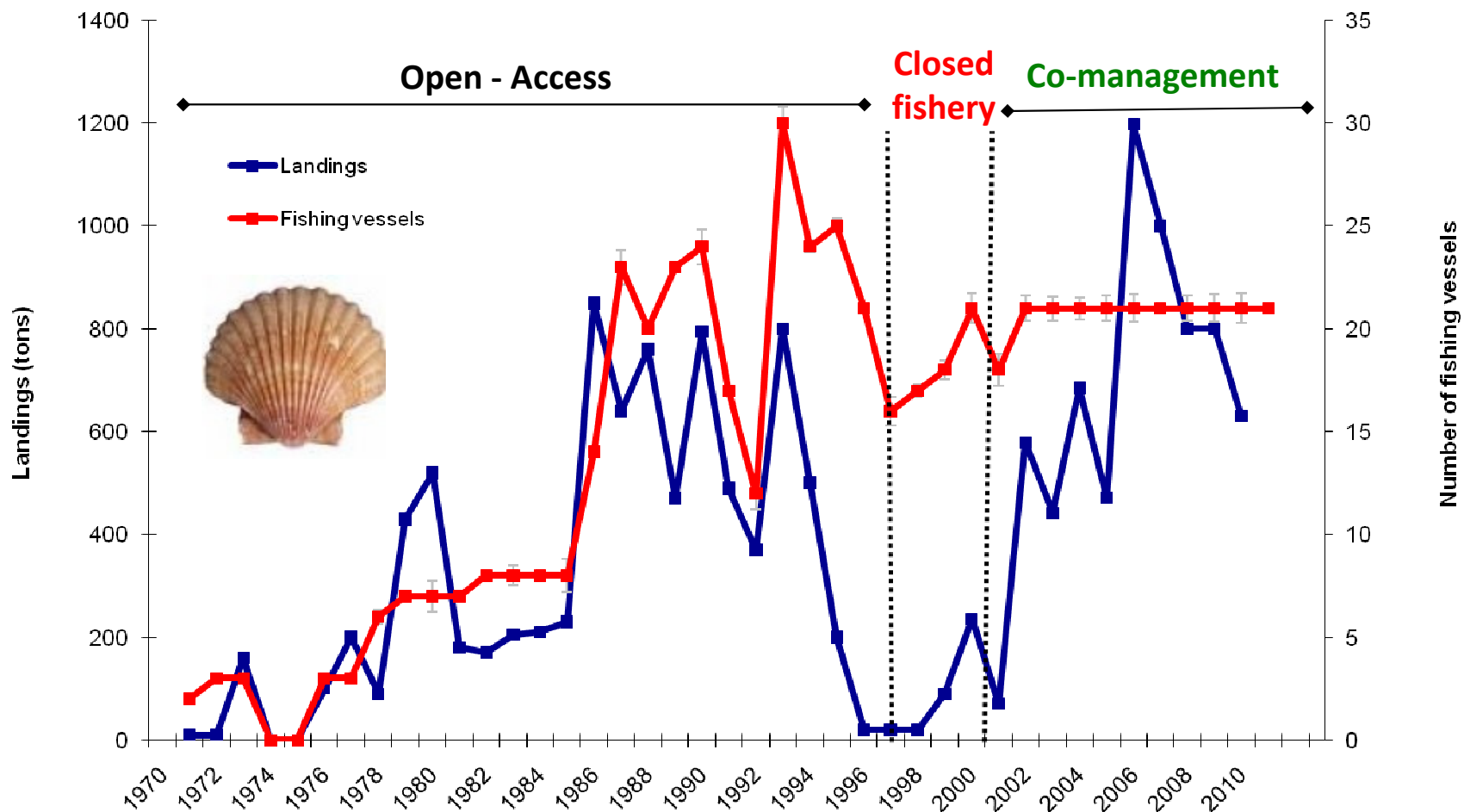
**Income (\$) below
minimun salary**

**Poor (lack)
education**

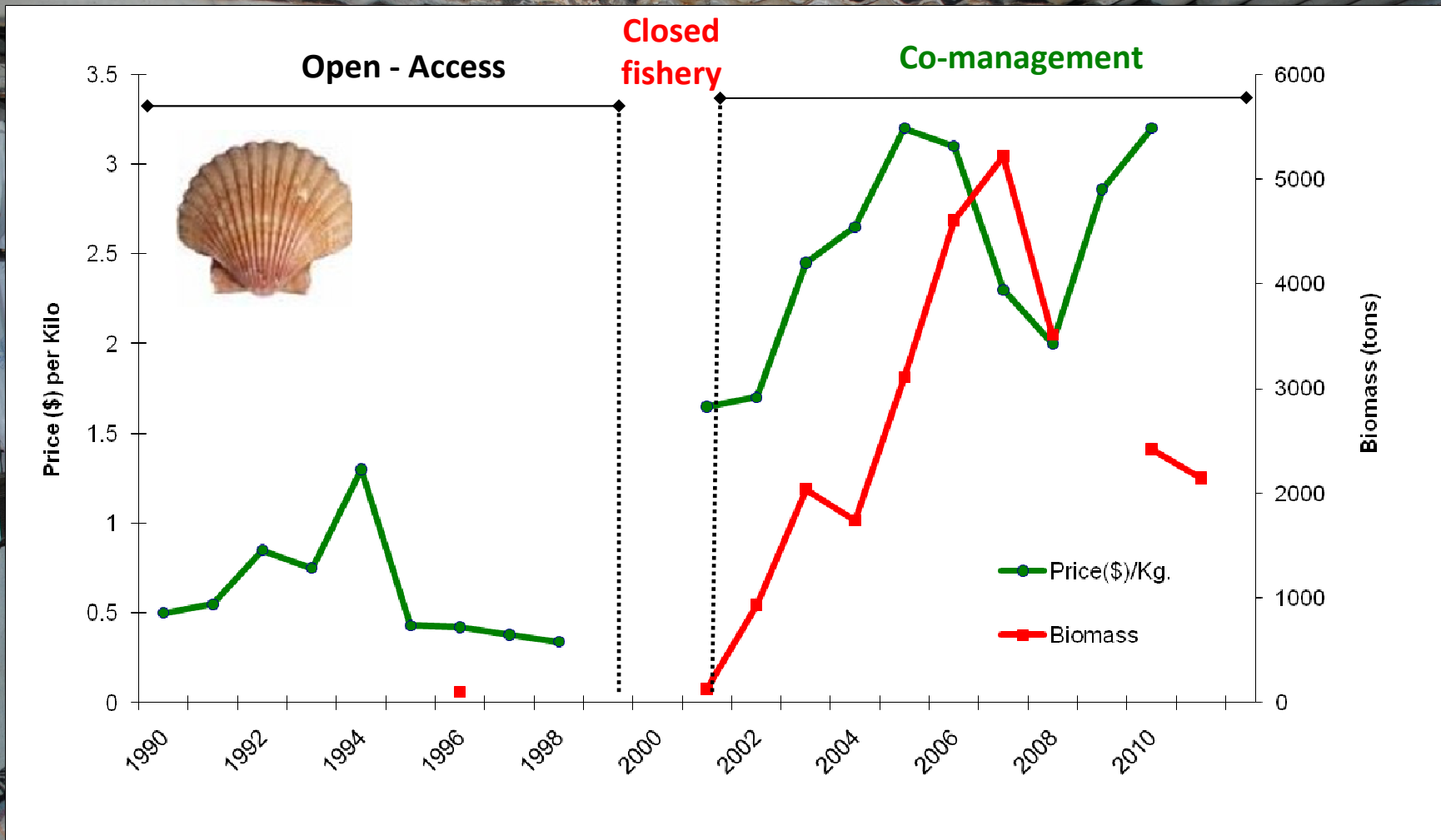
**Competitive
behavior**

**Poverty
trap**

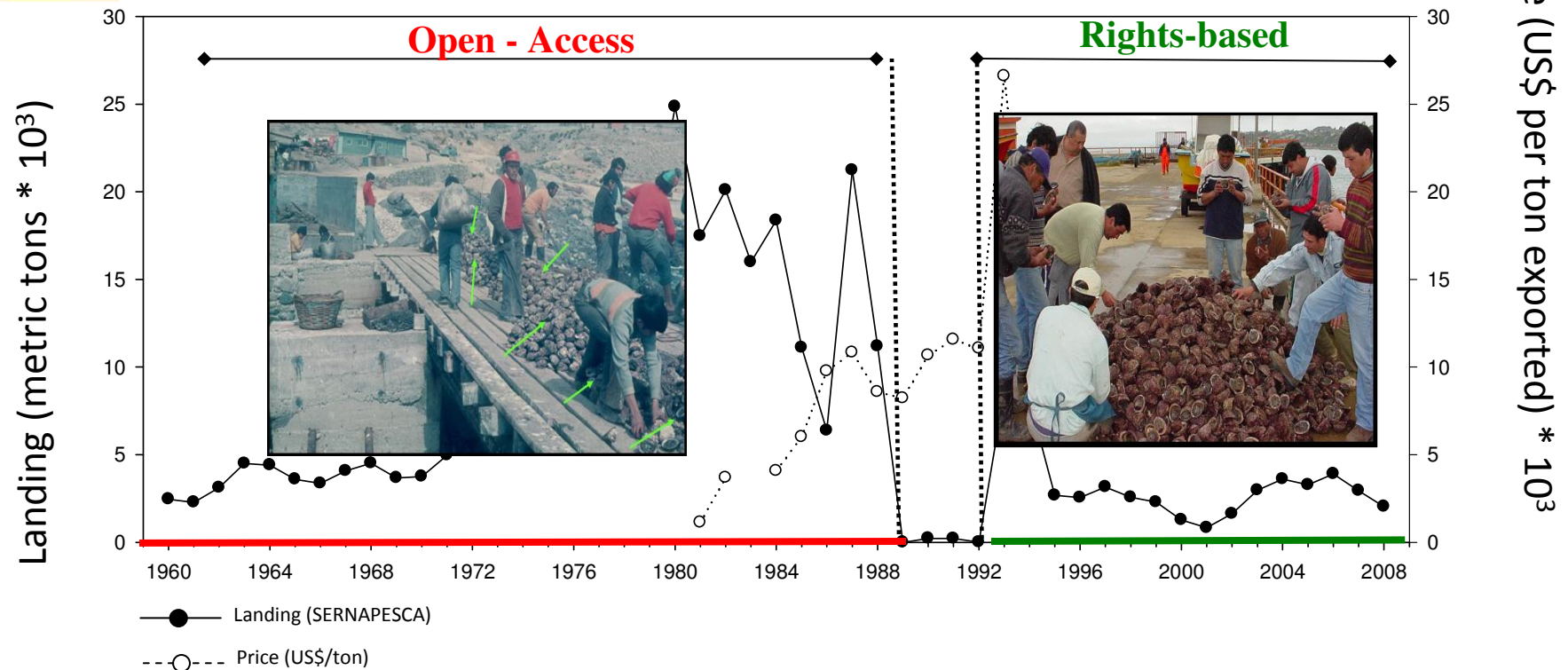
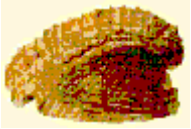
Successful results: limited entry of users and recovered landings



Successful results: biomass recovered and prices gone up



The successful story of the “Loco” fishery in Chile



Prices have gone up!
Landings have stabilized close to pre-export phase levels

Source: courtesy Stephan Gelcich

Present and future challenges

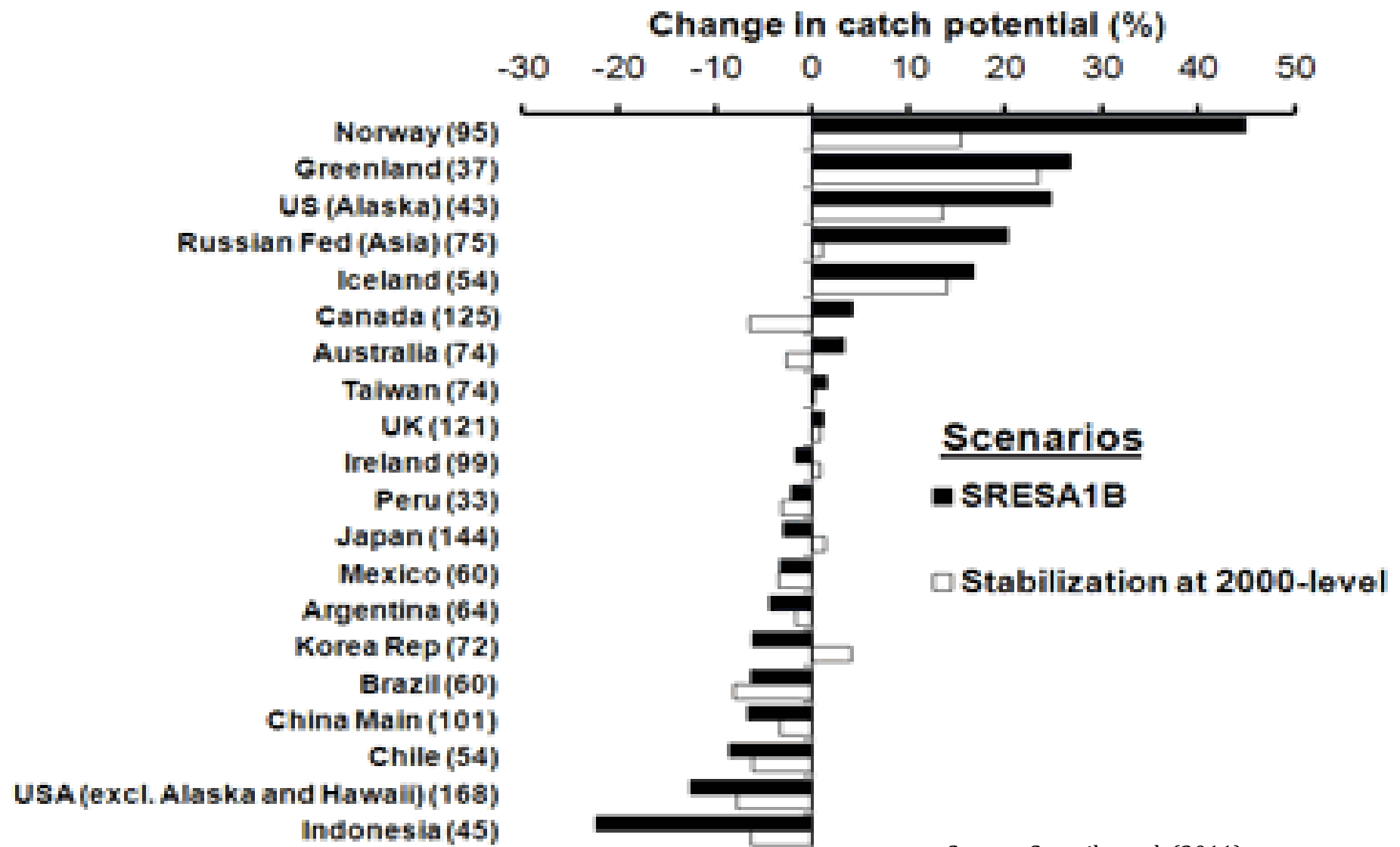
The Stockholm Memorandum

- The Stockholm Memorandum calls upon all leaders of the 21st century to exercise a collective responsibility of planetary stewardship
- It recognizes coherent global action to find emergency solutions now that begin to stop and reverse negative environmental trends
- The Memorandum recommends to achieve these solutions for:
 - a) reaching a more equitable world
 - b) managing the climate
 - c) creating an efficient revolution
 - d) ensuring affordable food for all
 - e) moving beyond the green growth,
 - f) reducing human pressure, and
 - g) strengthening Earth System governance

Potential high economic impacts of climate change in the region

- Marine social-ecological systems are in decline and climate change will complicate the challenges currently facing global fisheries (Da Rocha et al. 2012)
- Climate change is altering the behavior of commercial fisheries and productivity of the stocks and the distribution of many species of fish, including krill in the Southern Hemisphere (Cheung et al. 2010)
- Scientific evidence has predicted that El Nino events may become more frequent and severe under global warming, while others have suggested that increased upwelling in the Humboldt Current system might make El Nino less severe (Bakun and Weeks 2008)
- Recent global study identified the economies of Peru and Colombia as highly vulnerable to the impacts of climate change on fisheries (Allison et al. 2009)

Potential high economic impacts of climate change in the region



Source: Sumaila et al. (2011)

What is the best incentive?

Biological

Reduce IUU
Create marine
reserves
Protect marine
ecosystems

Economic

Increase
profitability
Eliminate
subsidies
Create
incentives

Social

Maintain
employment
Educate people
Fight poverty

Political

Reduce conflicts
Promote ITQs
TURFs,
Co-management
Improve
enforcement

Three “Is”:
Ignorance, Ideology and
Inertia

How to manage **synergies** and **trade-offs** in marine SESs?



**European
subsidized
industry**



**Artisanal
fishers**



**Japanese
seafood
market**

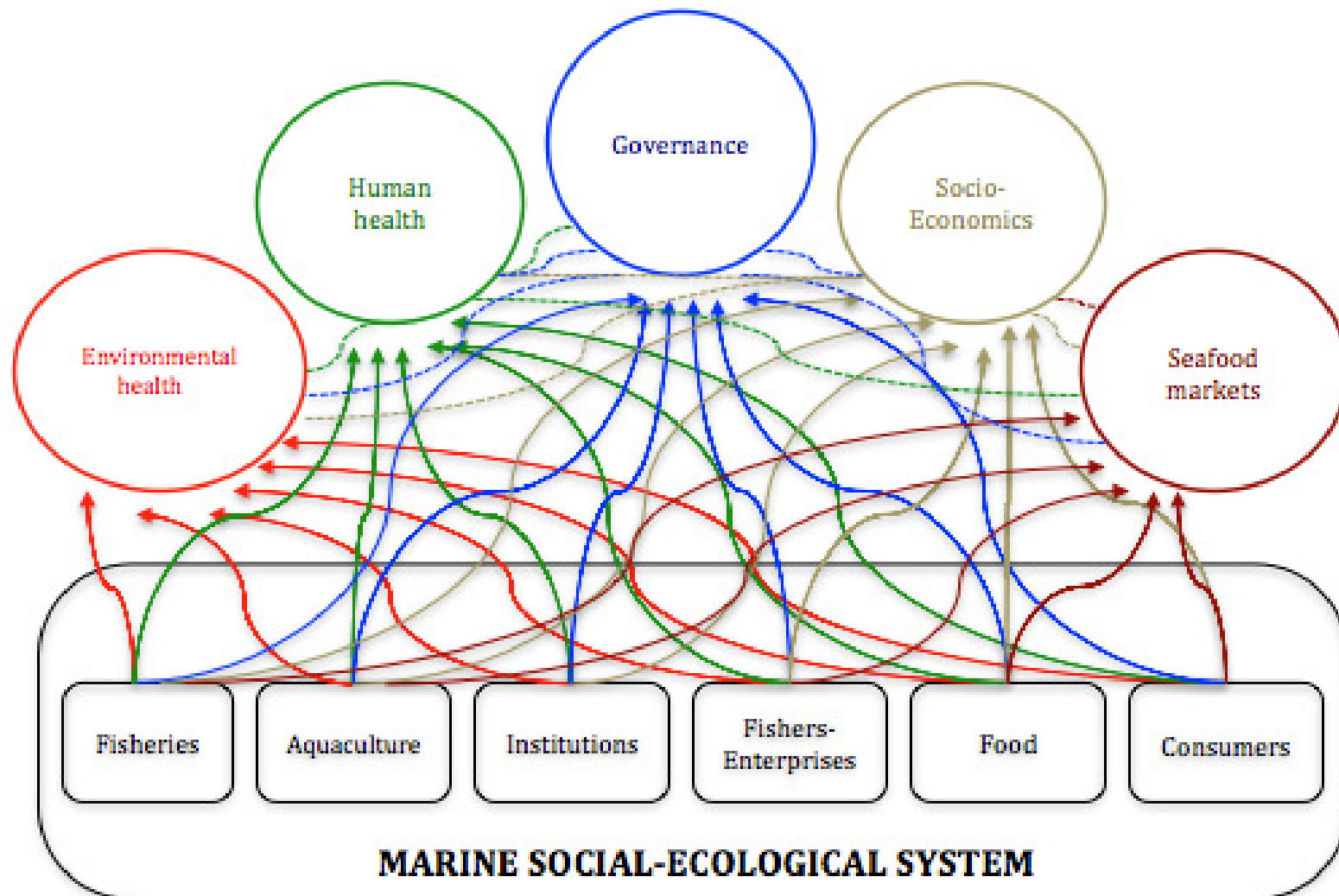


**LAC
Food
security**

Synergies and trade-offs of MES

- ES are the benefits people obtain either directly or indirectly from ecological systems (MEA, 2005)
- Interactions among different dimensions of global social-ecological systems are recognized as being important, but detailed analysis has yet to be conducted (Crépin et al. 2011)
- **Empirical studies tend to ignore the time-space relationships between ES and their beneficiaries** (Perrings et al. 2011)
- **This may lead to excessively simplifying economic analysis. We cannot assume that every hectare provides the same ES** because this implies ignoring key aspects such as diversity, spatial configuration, size, habitat quality, and the number and type of groups of beneficiaries (Tallis and Polasky, 2009)

By shifting thinking towards the resilience approach: but how should we measure this?



Source: Villasante et al. (2012)

Key messages

Potential development of fisheries and aquaculture

- Further economic growth in LAC fisheries is likely to come through rebuilding depleted fisheries, restoring essential fish habitat and ecosystem services, and improving economic efficiency
- However, a number of countries have begun to reorient their fisheries from Business as Usual (BAU) toward a Sustainable Ecosystem Management (SEM) to improve and sustain yields
- SEM reduces overfishing and overcapacity, cuts harmful subsidies, realigns incentives, and safeguards essential ecosystem services and fish habitats.
- SEM in fisheries, thus, enhances the economic contribution of fisheries through provision of food, employment, and income on a lasting basis

Acknowledgements

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Convention on
Biological Diversity

Thanks for your attention!

E-mail: sebastian.villasante@beijer.kva.se