A simple application of bioeconomics to fisheries subsidies

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OCEAN CANADA

Drivers of dynamics of small pelagic fish
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Classical Fisheries Management Problems

- Overfishing;
- Overcapacity;
- Low or negative profits.

- **Bioeconomic models predict all these results!**

These undesirable outcomes are the result of Individually Rational, but Non-cooperative Behavior

Bioeconomic Models

(1) Biological Model:

Net annual change of biomass =
Growth + Recruitment – Nat. Mortality – Catch

(2) Economic (Social) Model:

Net benefit = benefit - Cost

Solving the basic model

$R = pH - cE$

Schaefer Catch Equation: $H = qEx$ (Highly Dubious!)

Therefore $R = (pqx - c) E$

<u>Bionomic Equilibrium:</u>

Under open access, fishery reduces the stock level x until R = 0, i.e.,

$x = c/pq$

Predictions: Zero rents; overfishing (if c/p low).

Numerical example

xo = 1,000,000 t
q = .001 / vessel yr
c = $ 500,000 / vessel yr

Price p (N/tonne)	x (Bionomic Eq.)
500	1,000,000 t
1,000	500,000
5,000	100,000

Fisheries subsidies

Fisheries subsidies are financial payments from public entities to the fishing sector, which help the sector make more profit than it would otherwise.

Bionomic equilibrium with & without subsidies

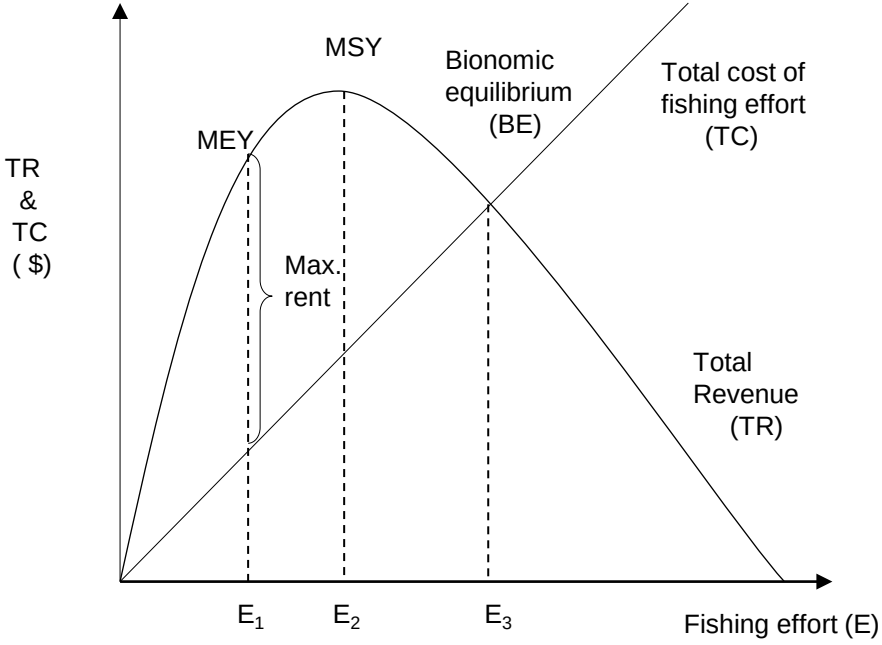
$$X = c/pq$$

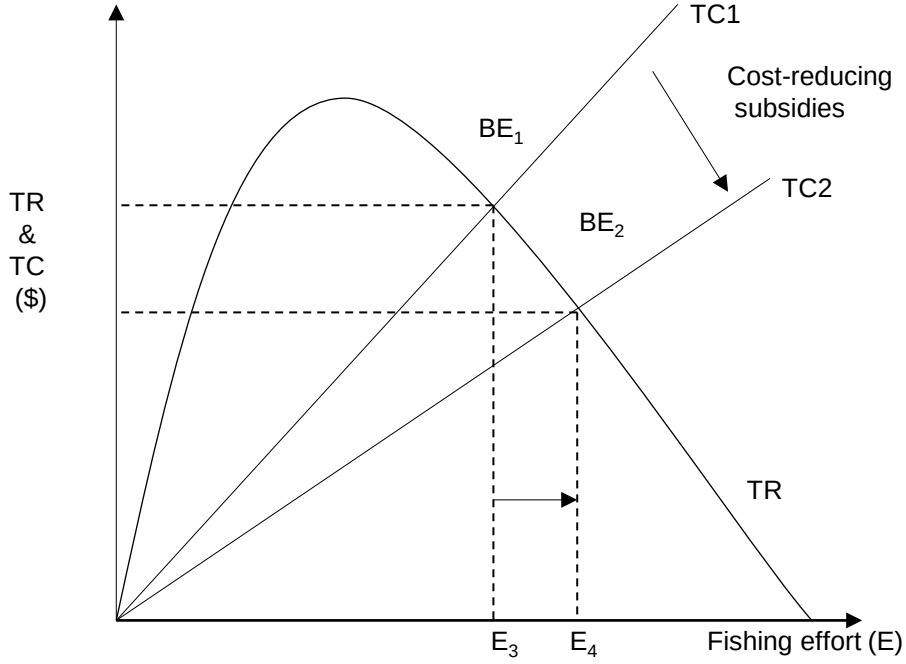
$$X' = (c-s)/pq$$

$$X'' = c/(p+s)q$$

$$X''' = c/pq(1+a)$$

How subsidies induce overfishing





Gordon Schaefer bioeconomic model

Questions addressed

- What are the types and categories of fisheries subsidies?
- What is the amount of fisheries subsidies provided by countries, regions & globally?
- What proportion of estimated national subsidies go to small scale as compared to large scale fisheries?

Categories of subsidies

- Beneficial subsidies

('investment' programs in fish stocks).

- Harmful subsidies

('disinvestment' programs in fish stocks).

- Ambiguous subsidies

(programs may benefit or harm fish stocks).

Based on work by FAO, OECD, UNEP, World Bank, WTO, UBC

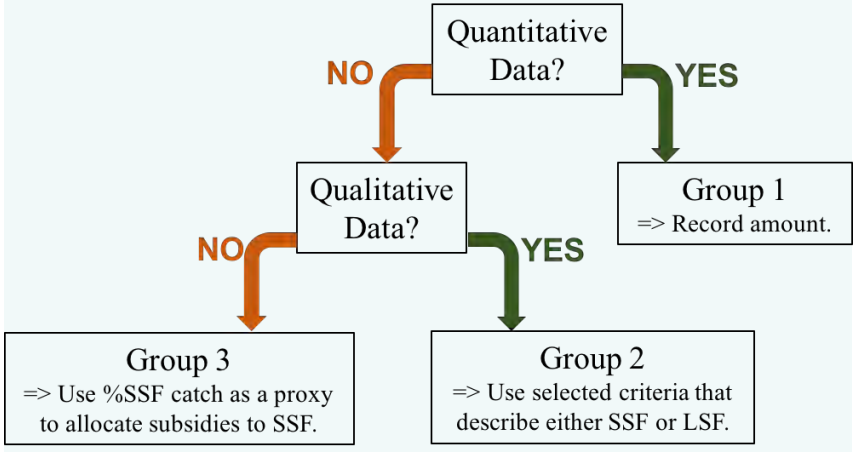
Computing subsidies

- Created a ‘living’ database of subsidies containing different types, for all maritime countries;

- The first version of the database was published in the mid-2000s (Sumaila *et al*. 2006; Khan *et al.* 2006).

Methods: splitting global subsidies into small- and large-scale fisheries

- By country and subsidy subtype;
- Data categorized into 3 groups.



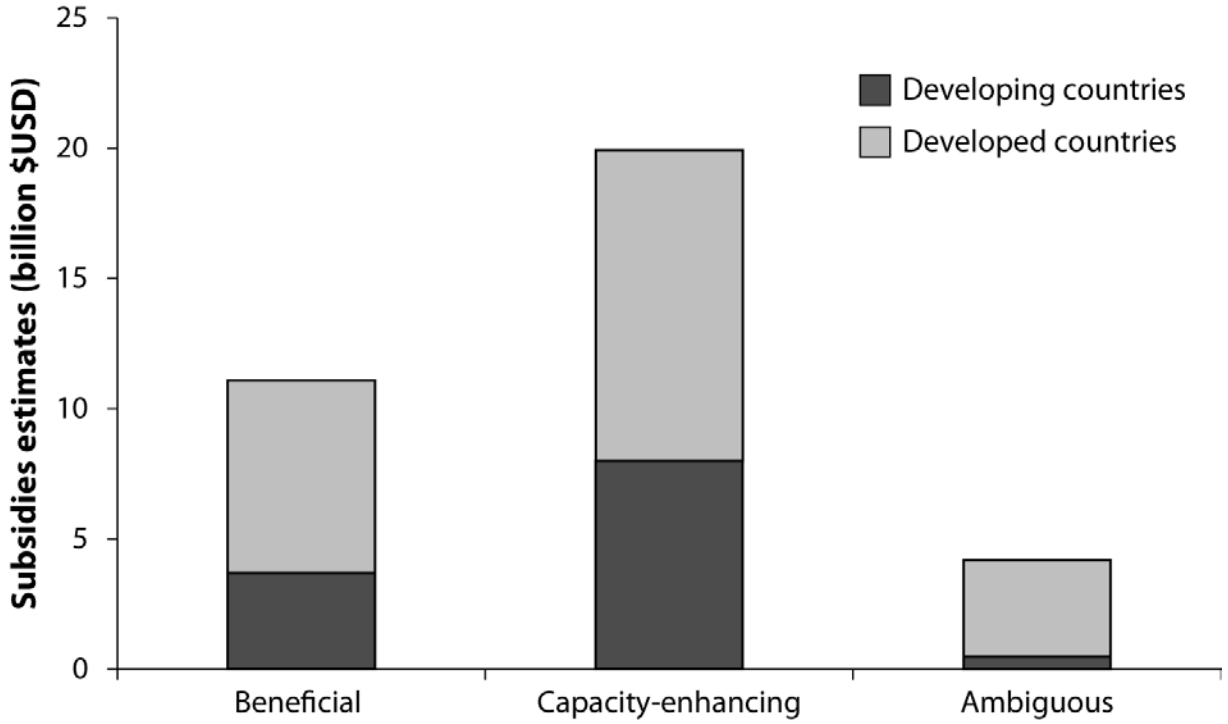
- Assessed 74 countries (out of 147), representing 97% ($34 of $35 billion) of global total subsidies;
- Remaining 3% estimated based on sub-region and subtype averages.

Schuhbauer, Sumaila *et al.* (*in prep.*)

The results

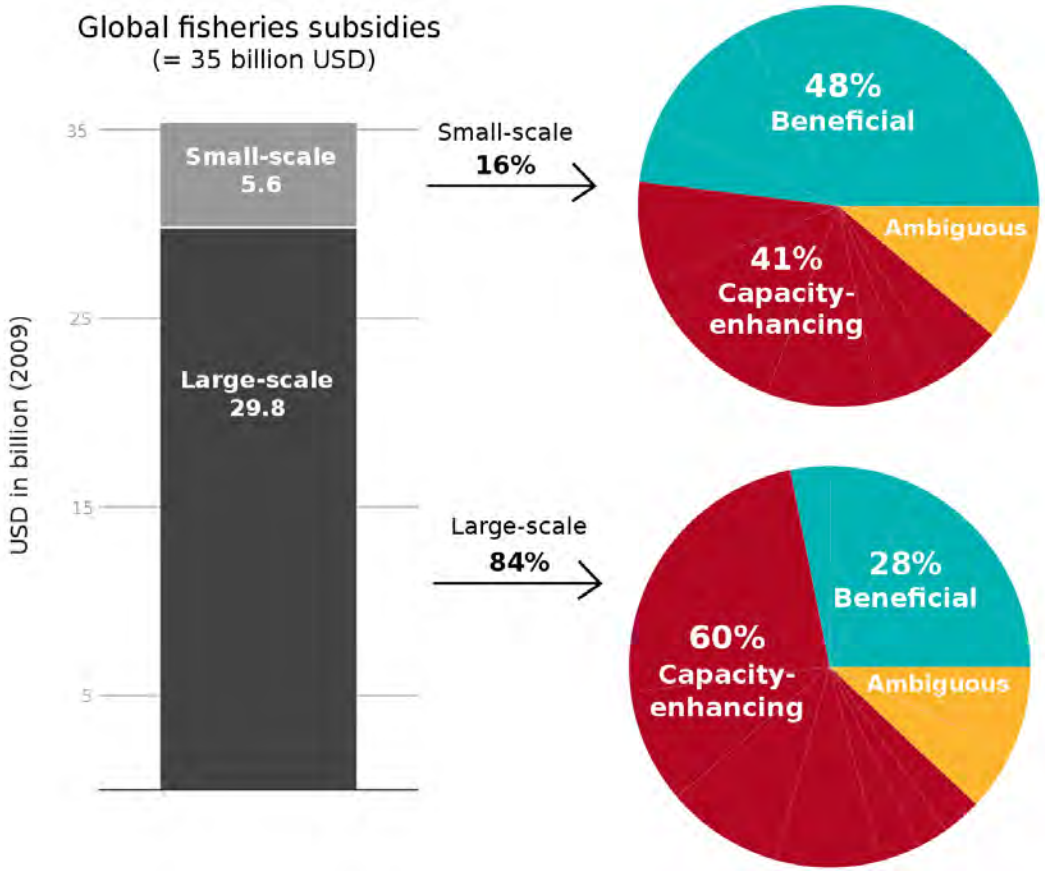
Subsidies are substantial

- Capacity-enhancing subsidies 57% of total USD 35 billion
- Subsidies to developed country fisheries at 65%.



Sumaila *et al*. (2013; 2016)

Fisheries subsidies
Small versus large scale fisheries



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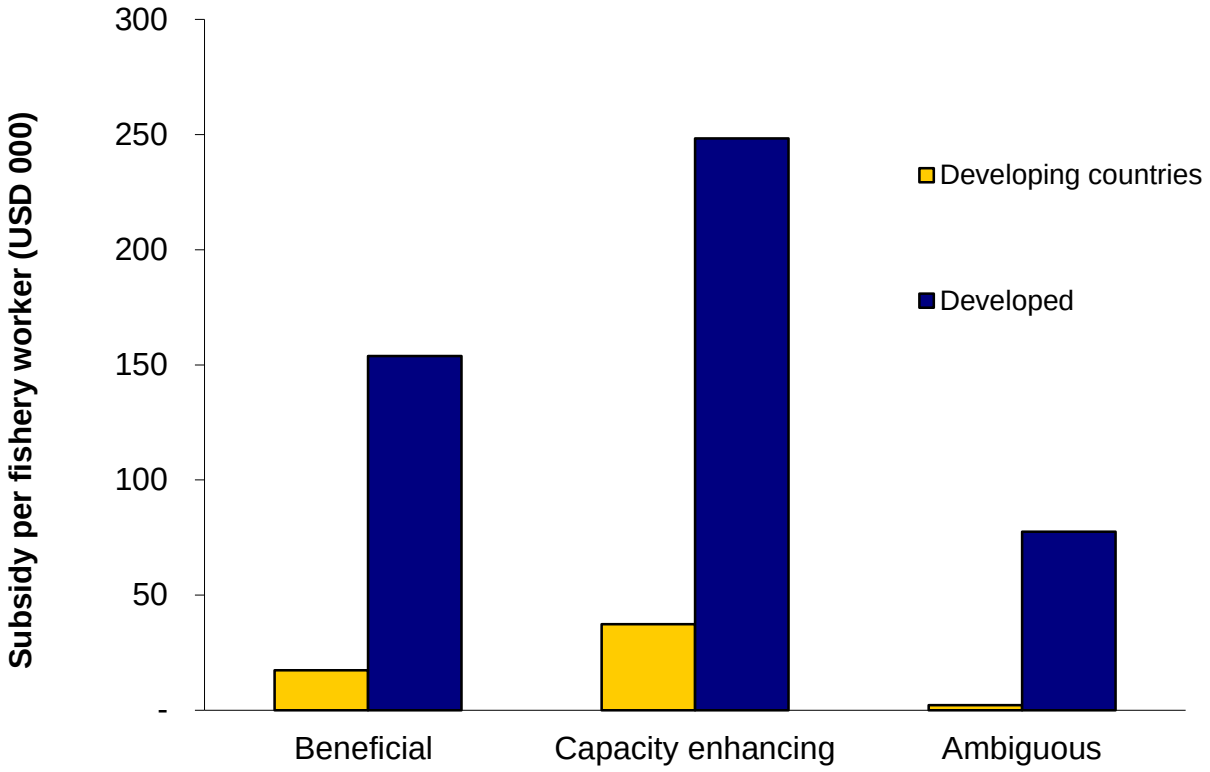
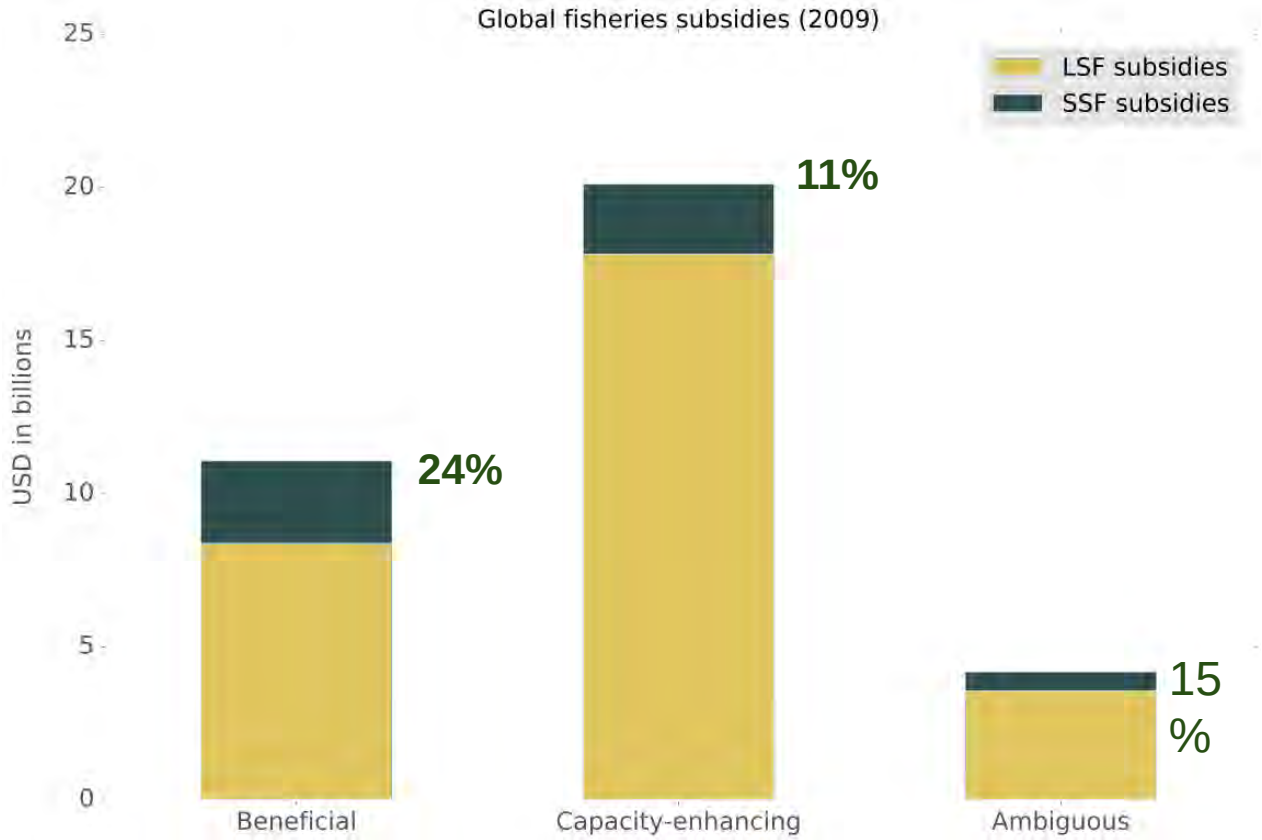
Subsidies are made for inequality



Teh & Sumaila (2011); Sumaila *et al*. (2013)

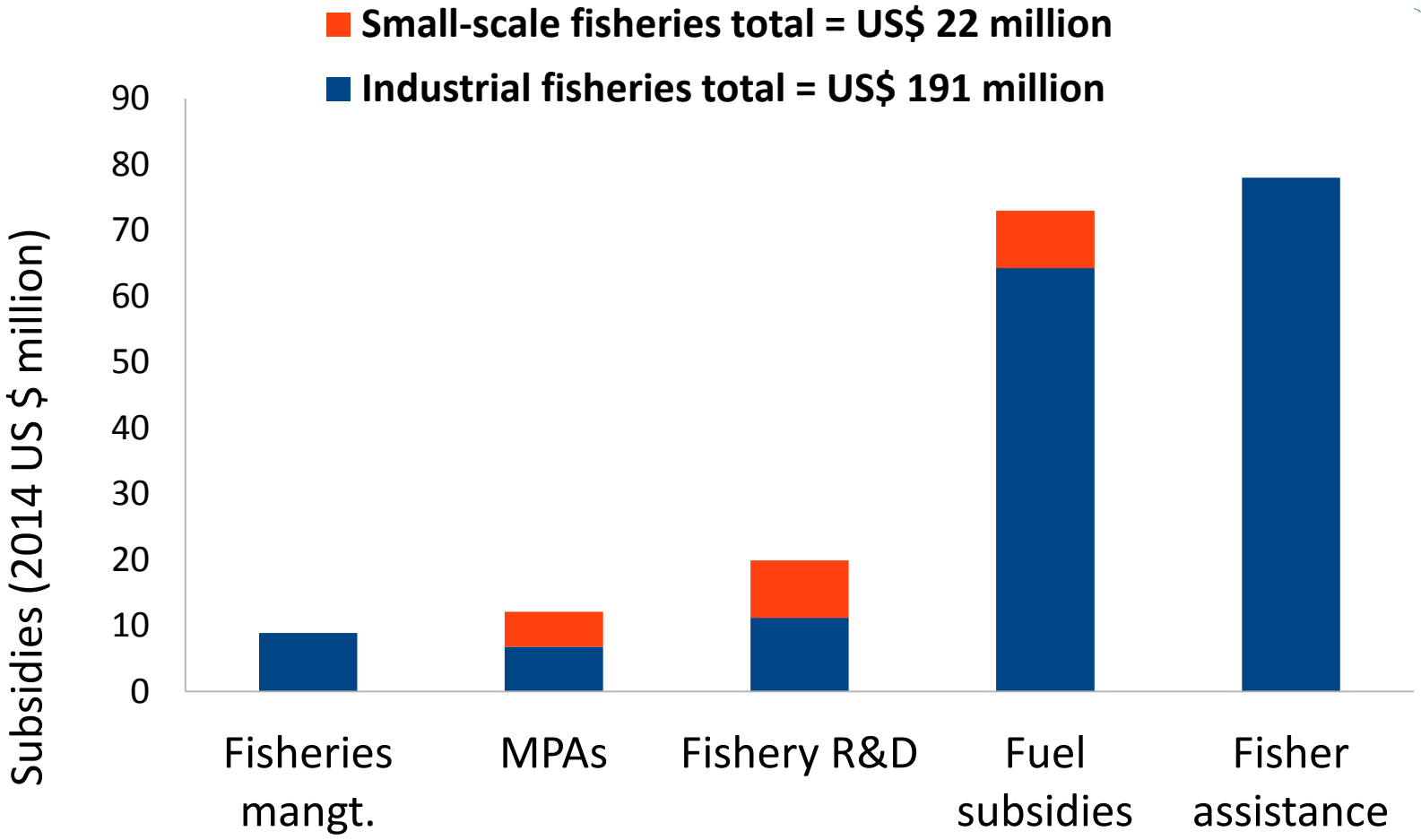
Fisheries subsidies by size by categories

Most capacity-enhancing subsidies go to large scale fisheries (LSF).



Sumaila *et al.* (2013); Schuhbauer, Sumaila *et al.* (*in prep.*)

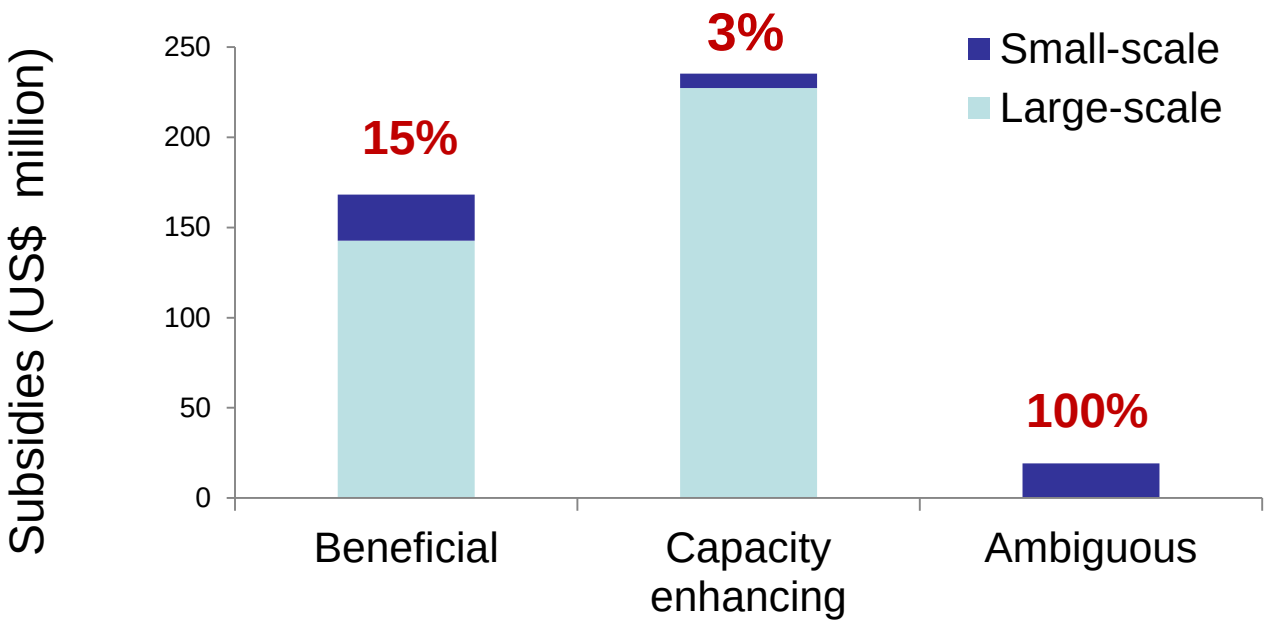
Mexican fisheries subsidies



Approximately **12%** of all fishing subsidies go to the small-scale sector

Schuhbauer, Sumaila *et al.* (*in prep.*)

National effort: Indonesia



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Summary results so far

- Global fisheries subsidies were estimated at about USD 35 billion;
- Bad subsidies were the highest categories provided at about USD 20 billion;
- Fuel subsidies was the highest type of subsidy provided;
- Only a small fraction of fisheries subsidies goes to small scale fishers;
- Large scale fisheries receive a higher proportion of capacity enhancing subsidies.

Thanks for your attention

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