Economic assessment of OA: A look into the impacts on shellfish production

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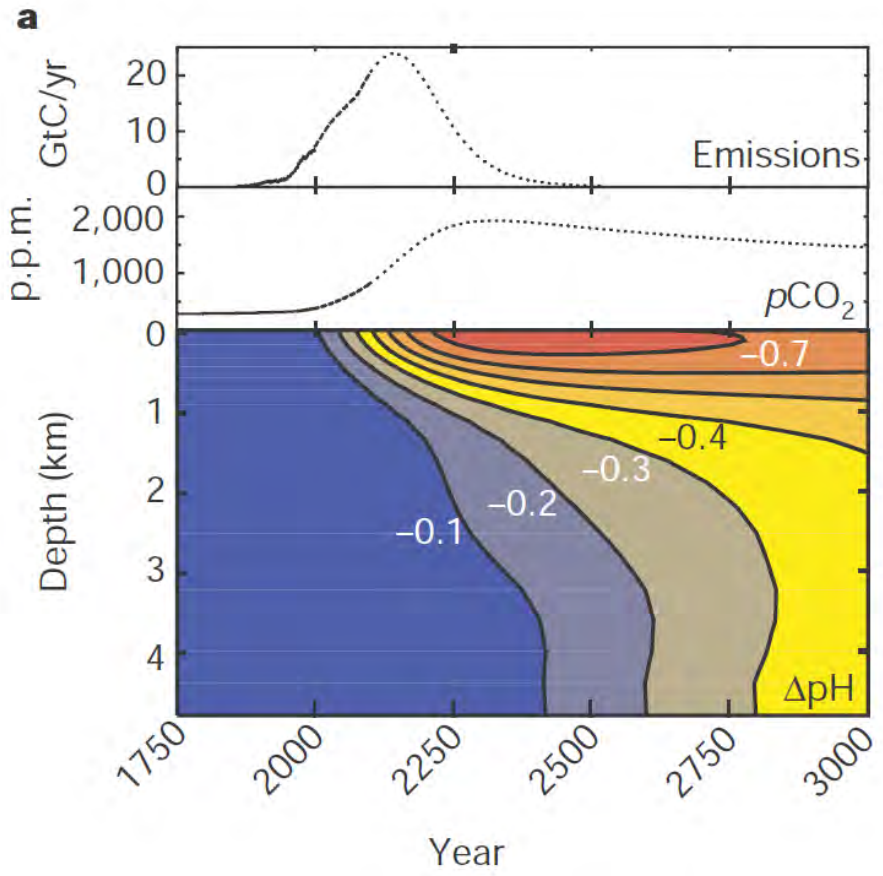
Introduction

- Unlike the extent of climate change caused by human activities, the chemistry of ocean acidification is uncontroversial
- Ocean acidification is likely to have a range of impacts on biological and ecological systems including economically important marine resources like fish stocks, shellfish and coral reefs

➢ ***The impact on human societies depend on …***

… the vulnerability, resilience and adaptation capacity of specific communities but little is currently known

What is the economic impact?



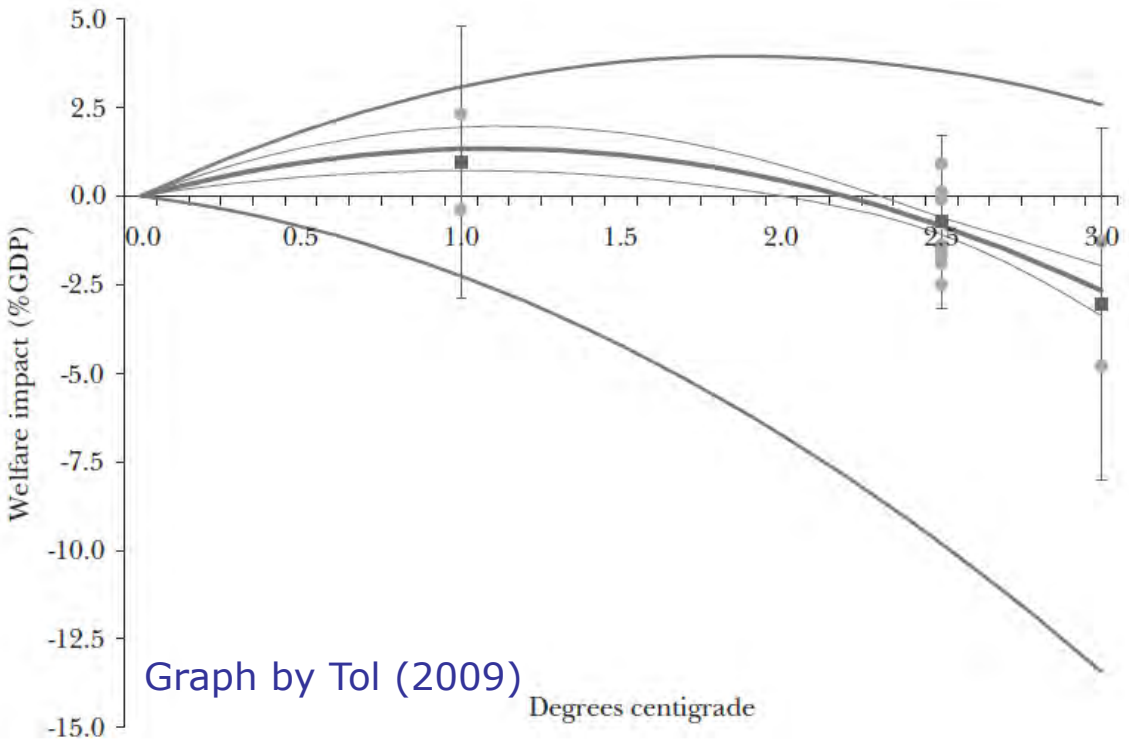
Graph by Caldeira and Wickett (2005)

Significant economic impacts of OA possible

- But few attempts of economic assessment yet

Motivation: Economic damage of climate change

- Agriculture and forestry
- Water resources,
- Sea level rise
- Energy use
- Ecosystems
- Human health (tropical diseases, etc.),
- Extreme weathers (tropical cyclones, etc.)



Graph by Tol (2009)

➢ ***OA should be considered along with those damage components***

Economic assessments so far

- Major integrated assessment models based on the cost-benefit framework (FUND, DICE, etc.) haven't taken OA into account yet
- They also tend to justify weak climate policy (emission reduction), at least in the near term

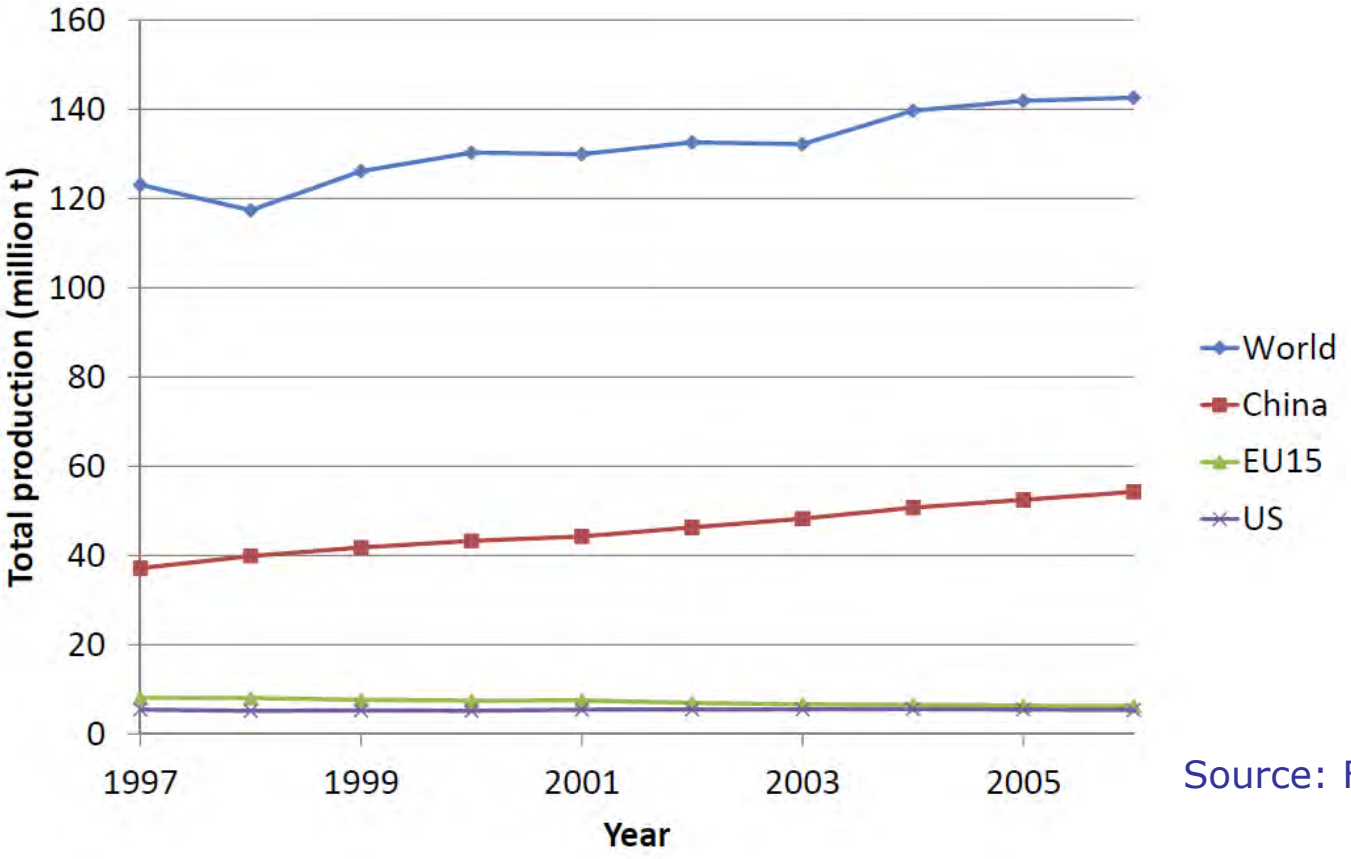
- ***Does OA significantly raises the existing damage estimates of climate change?***
- ***In other words, does inclusion of OA justify stricter climate policy?***

Challenges for economic assessment of OA

- Evidence of biological impact of OA on fish in general is not conclusive yet
- Also, growth and survival of fish are determined by complex predator-prey relationships
- Impacts on shellfish (mollusks) growth are relatively well identified already (calcification impacts)
- Mollusks normally sit in low positions in the food chain

- **We focus on mollusks**
- **We perform a global analysis**

Global importance of mollusk fisheries



Source: FAO

Commercial value (global, 2006):
~US$15 billion, or ~9% of world total fishery production

"Mollusks" in our analysis include –

Abalones, winkles and conchs

Oysters

Mussels

Scallops and pectinids

Clams, cockles, and arkshells

Source: Wikimedia commons (Mussels -- © 2004 David Monniaux)

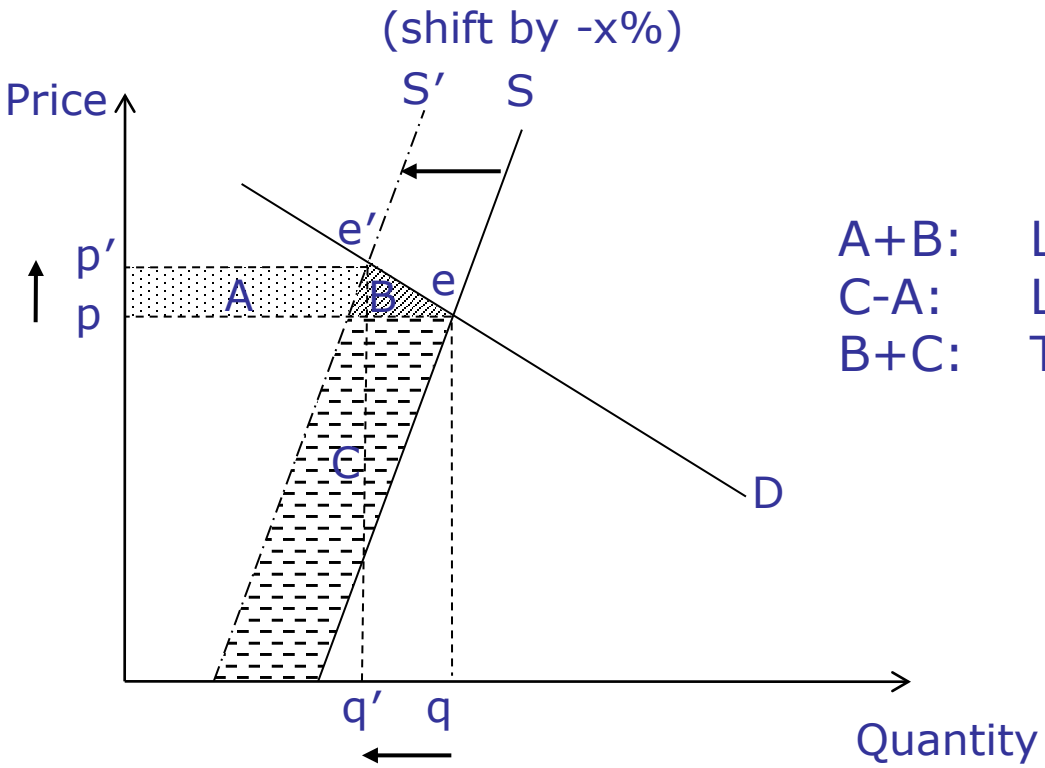
How about aquaculture?

- About 30% of global mollusk production comes from aquaculture
- Aquaculture might in principle be able to isolate itself from the effects of OA
- In practice, mollusk aquaculture normally utilizes the marine environment
- Individual estimation for capture and aquaculture useful

Photo from Wikimedia Commons (by Mike Peel)

Methodology

- Partial-equilibrium analysis approach
- What are net social losses when producers can raise the prices?

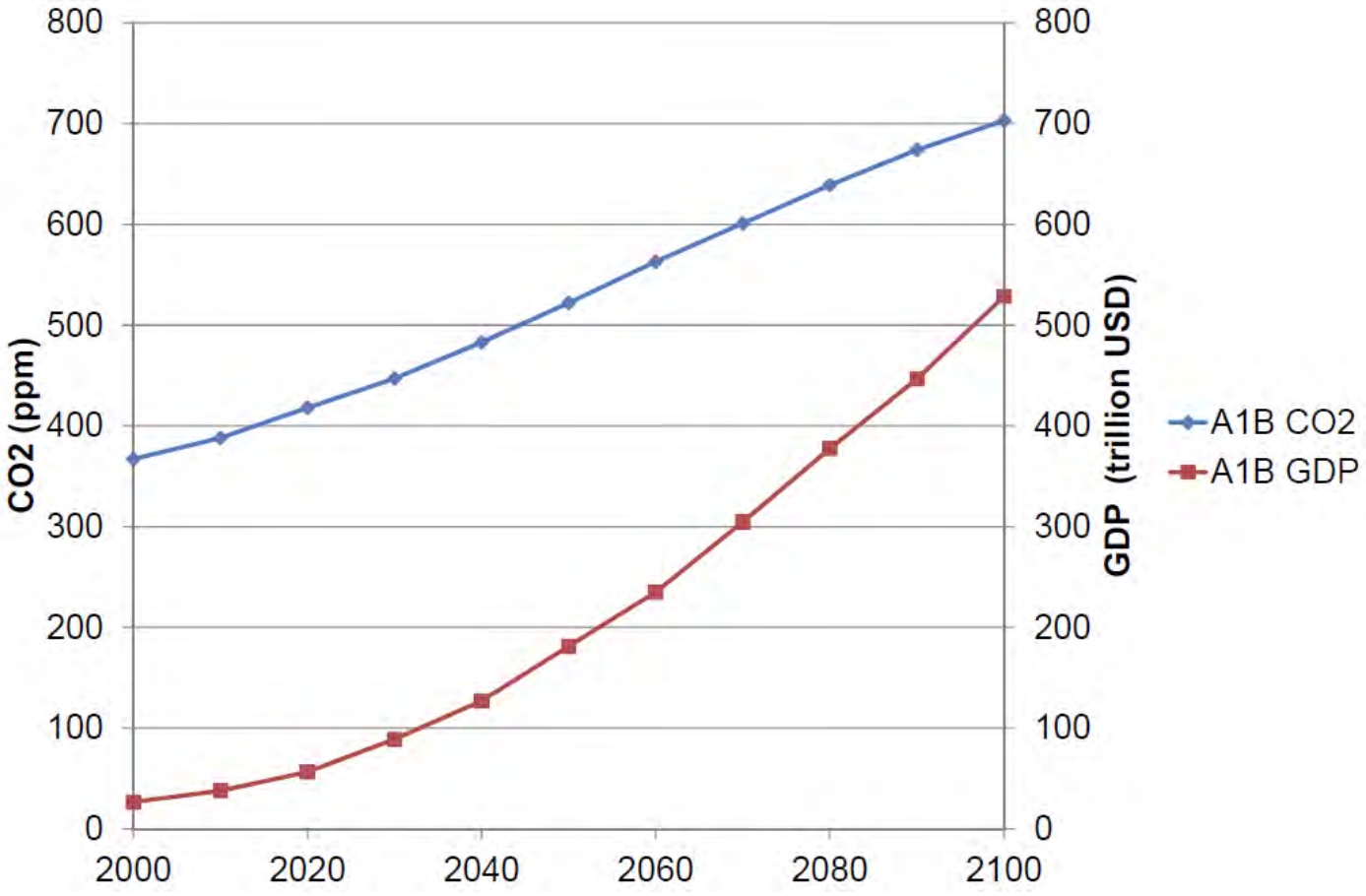


A+B: Loss of consumer surplus
C-A: Loss of producer surplus
B+C: Total net loss

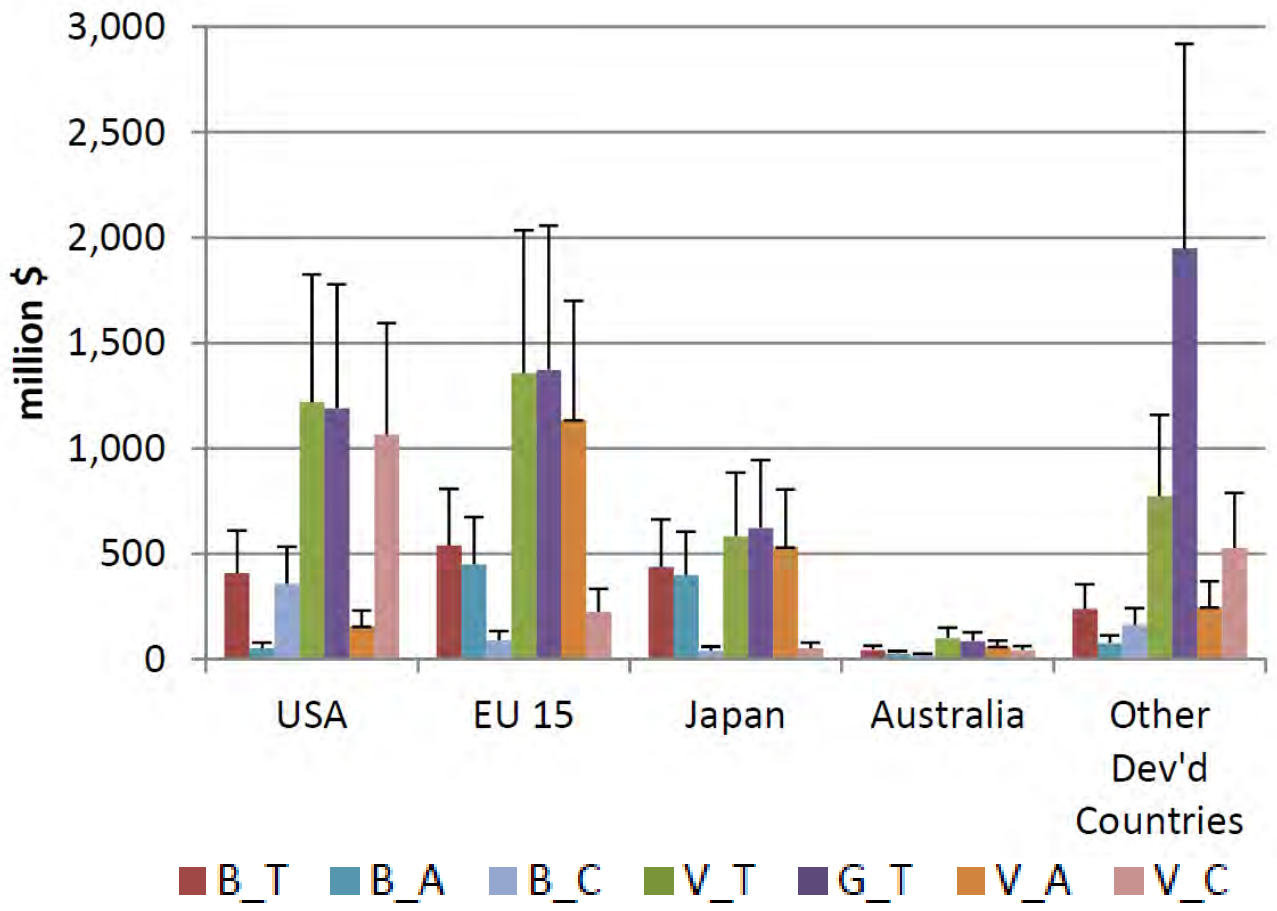
Data

- Relationship between OA and mollusk growth:
  - Kroeker et al.'s (2010) meta-analysis (calcification loss, survival loss)
- Baseline mollusk production by country:
  - FAO (aquaculture), Sea Around Us database (capture)
- Future demand of mullusks:
  - GDP projections: Van Vuuren et al. (2007) and Gaffin et al. (2004)
  - assumed income elasticities of mollusks: parameters used in IMPACT model

GDP assumptions – IPCC A1B scenario

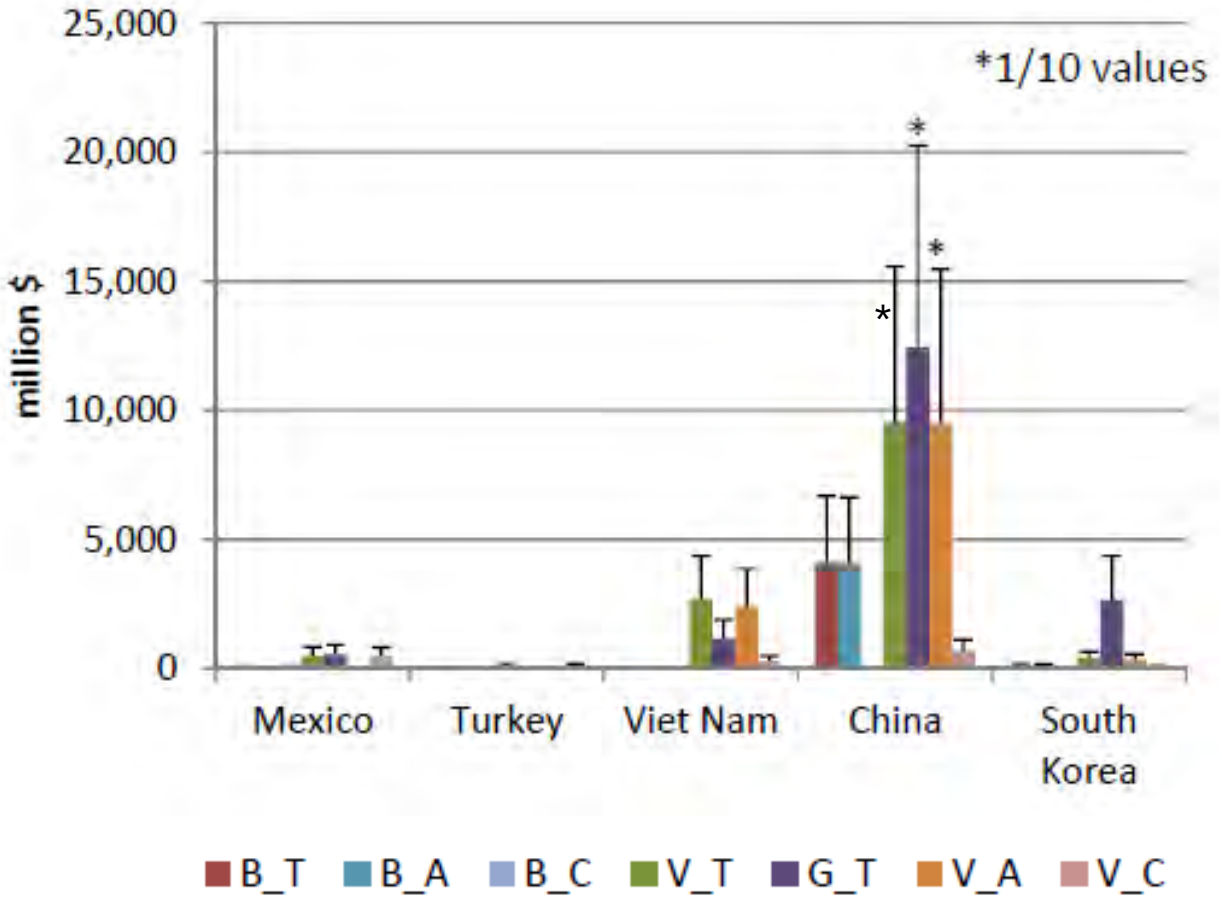


Total (net) economic losses



Narita et al. (2011)

Total (net) economic losses (cont'd)



Narita et al. (2011)

(Relative) importance of the impacts?

- Assuming demand increase along with income increase, losses could be well over US$100 billion in absolute terms
- Key is the demand increase in today's lower-income countries, especially China
- OA impacts on mollusk production correspond to 0.018% (Van Vuuren basis) or 0.027% (Gaffin basis) of the world GDP in 2100
- These levels correspond to an increase in the total economic impacts of climate change by 1.0-1.5%
- But…

Caveats/ future research directions

- More solid scientific basis
- Net economic losses inclusive of (cross-regional) trade – general-equilibrium modeling necessary
- Location specificities of damage, depending on ocean circulations, temperatures, predators/preys, etc.
- More detailed examination of possible adaptation options for fisheries (especially aquaculture)
- Evolution of mollusks to adapt to more acidic environments?

Thank you!