Nutrient loads as a driver for Earth System changes in the Baltic Sea region

Michelle McCrackin

26 November 2018

Östersjöcentrum
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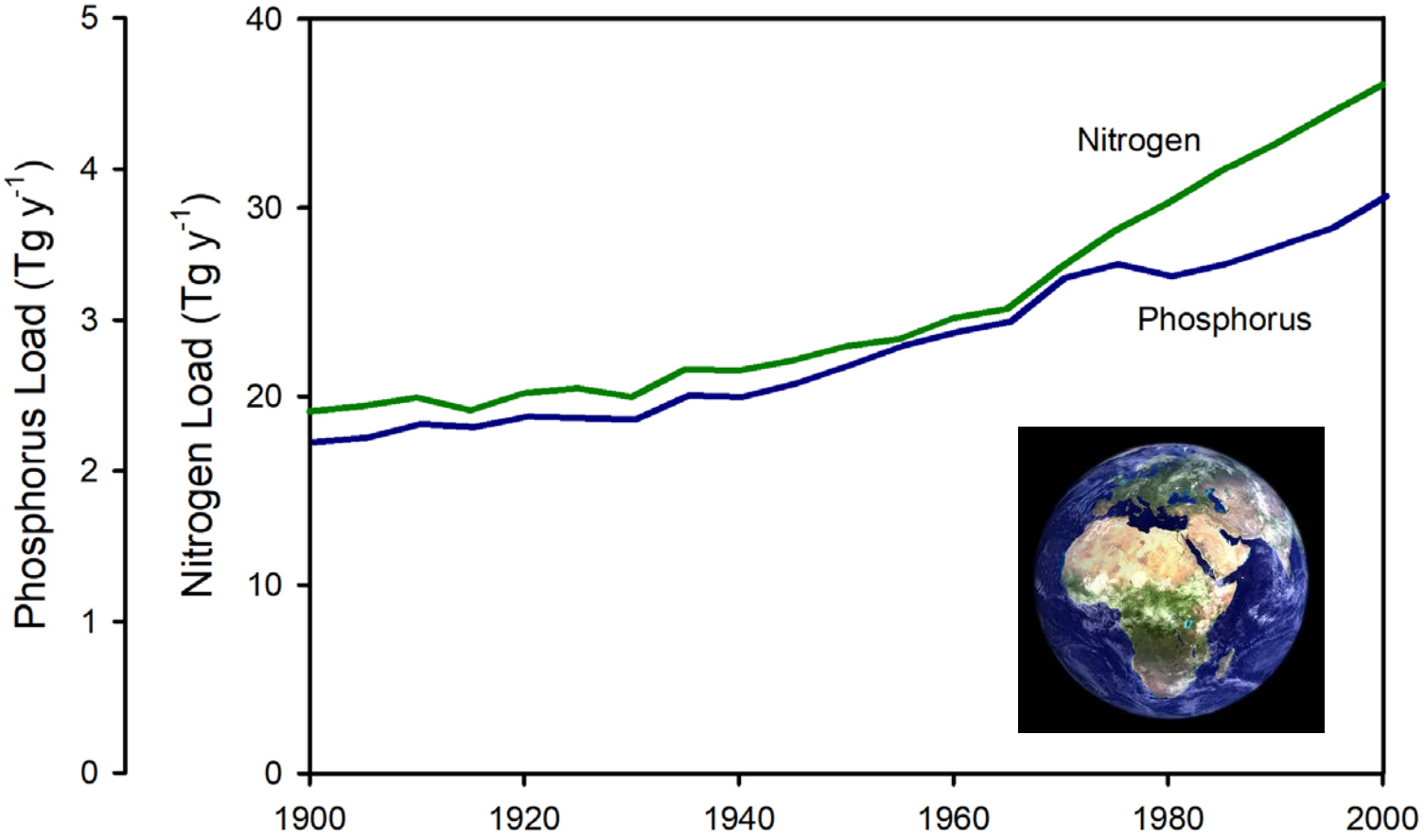
Nutrient loading to coastal areas is a global challenge

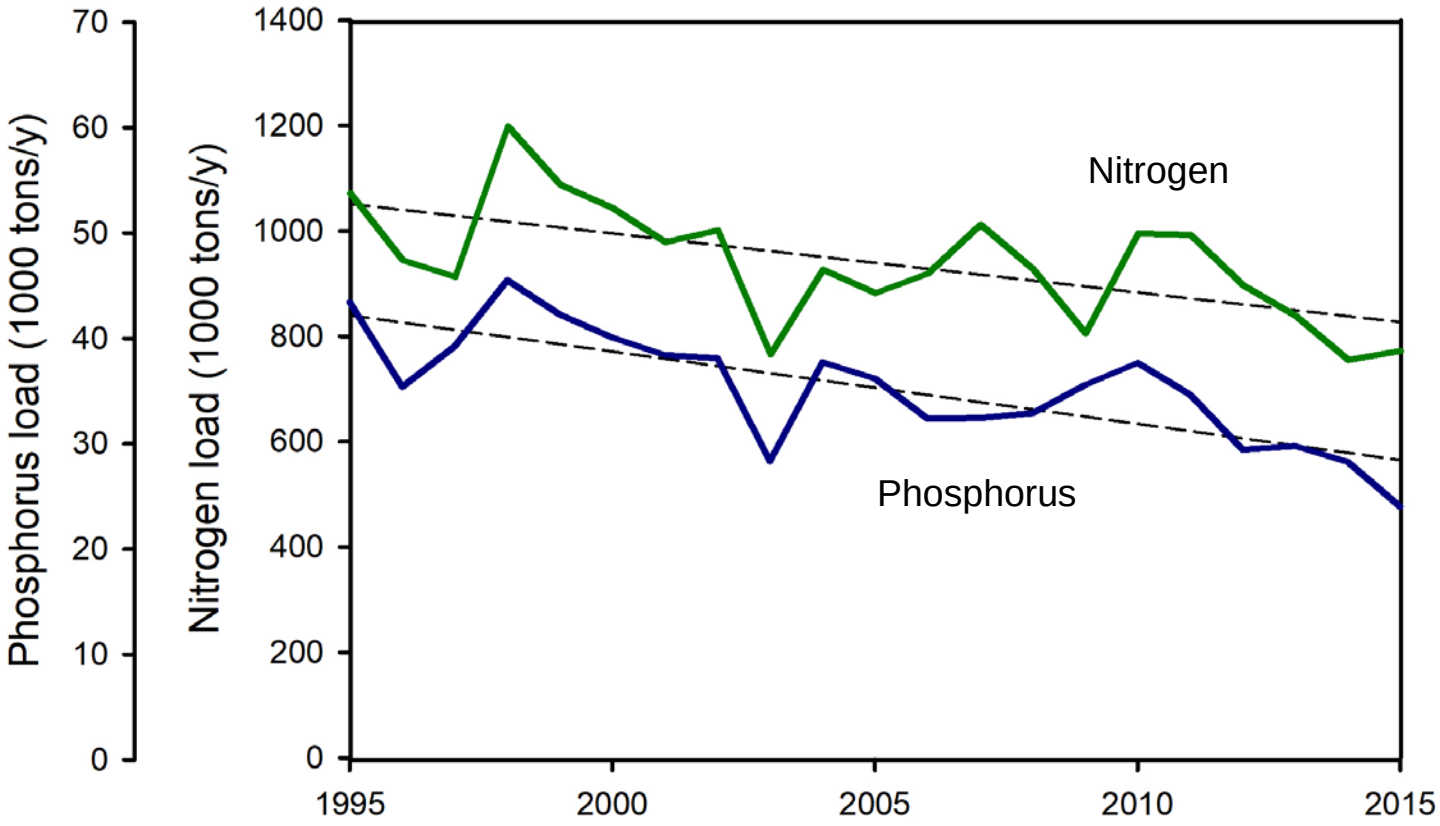


Beusen et al. 2016

Nutrient loads to the sea are decreasing

HELCOM

Nutrient loads to the sea are decreasing



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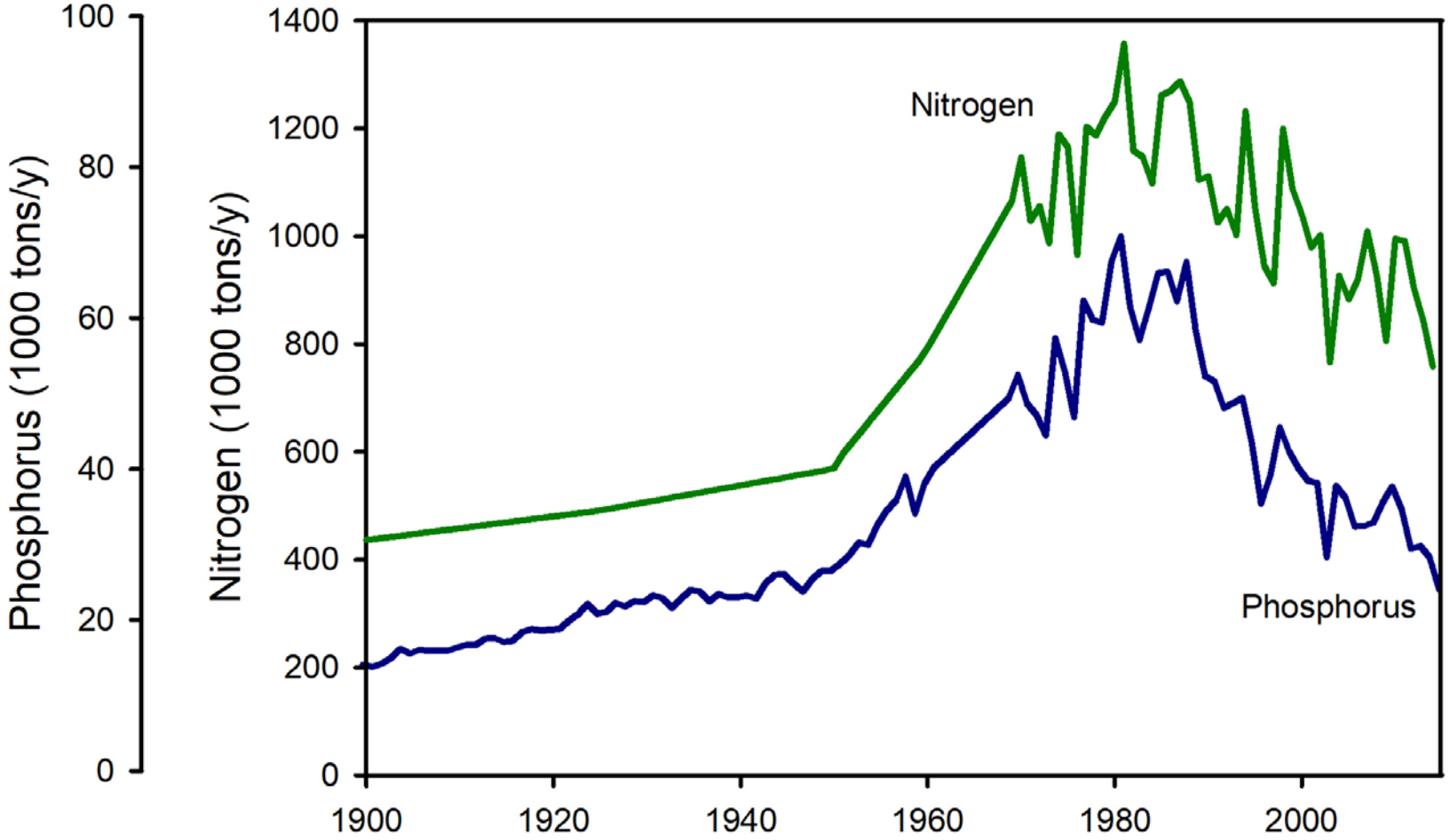
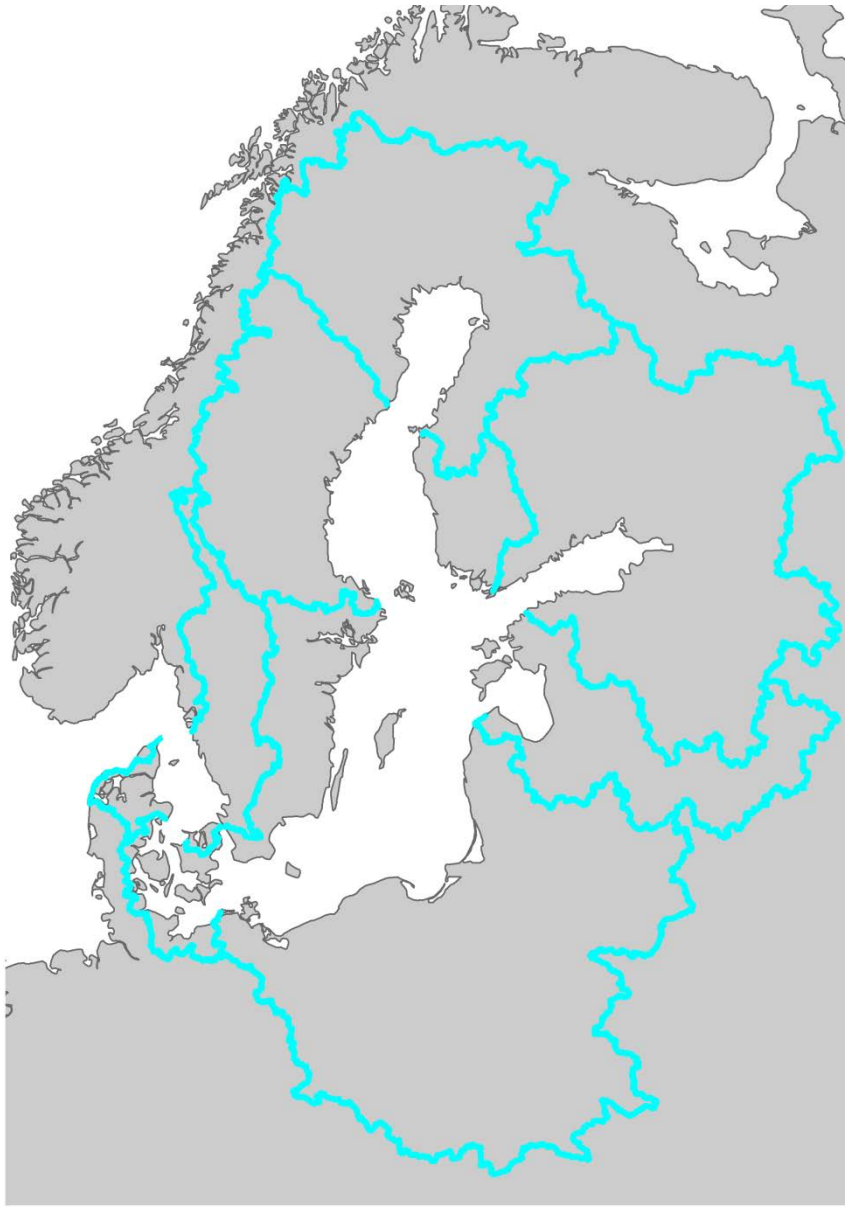
Nutrient loads to the sea are decreasing

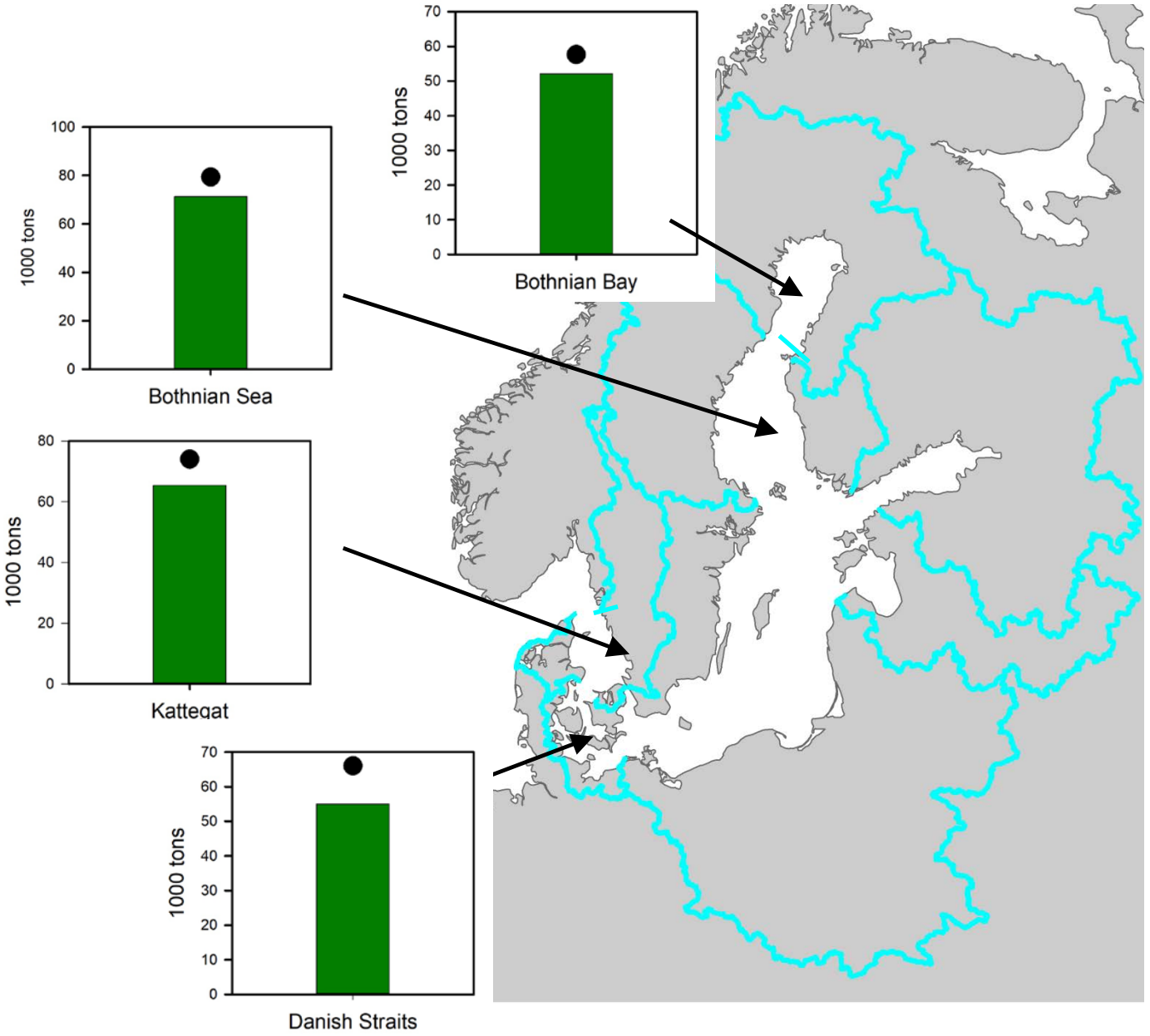


Savchuk et. al 2012, HELCOM

Progress towards nutrient targets



Progress towards nitrogen targets



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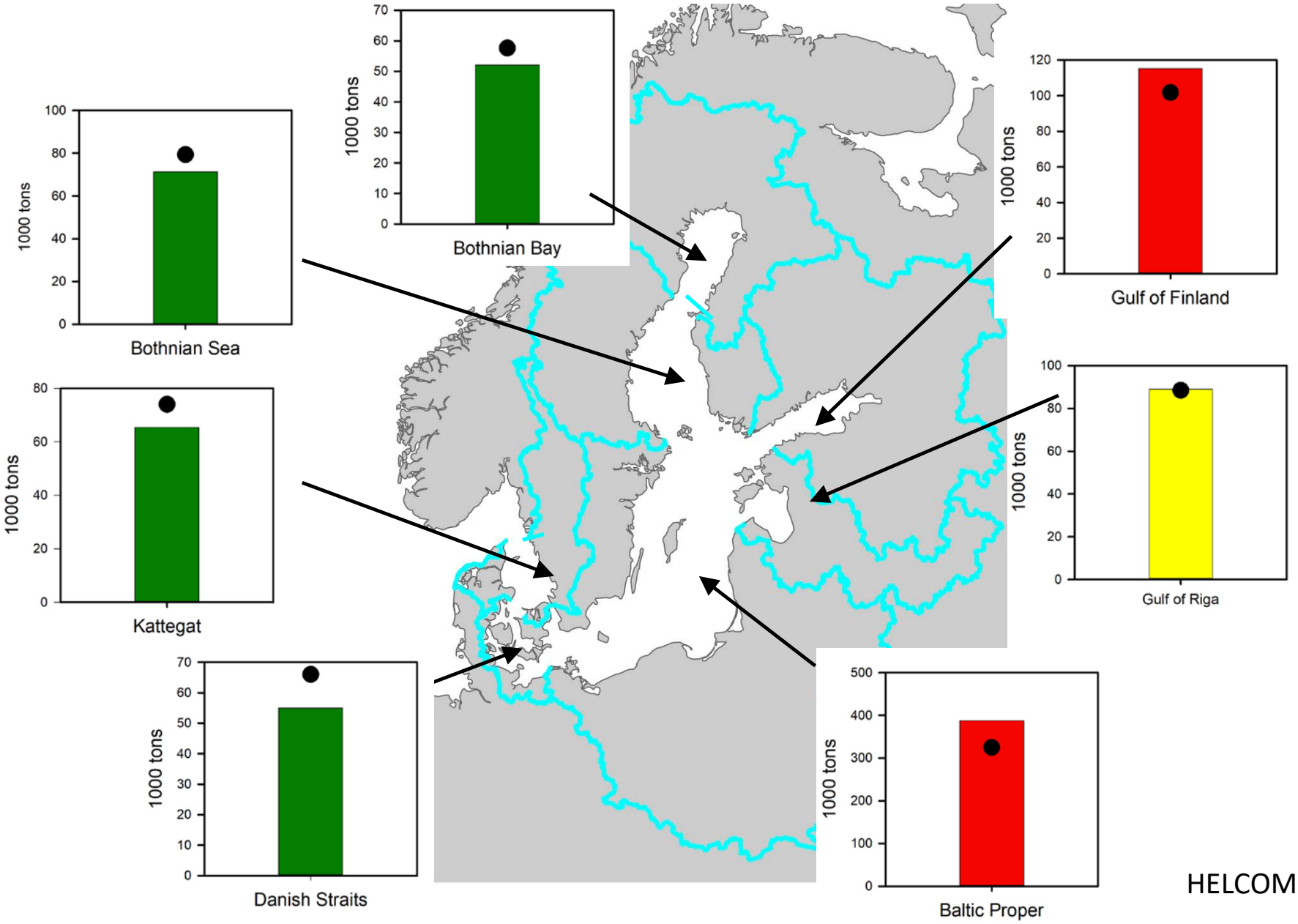
Progress towards nitrogen targets



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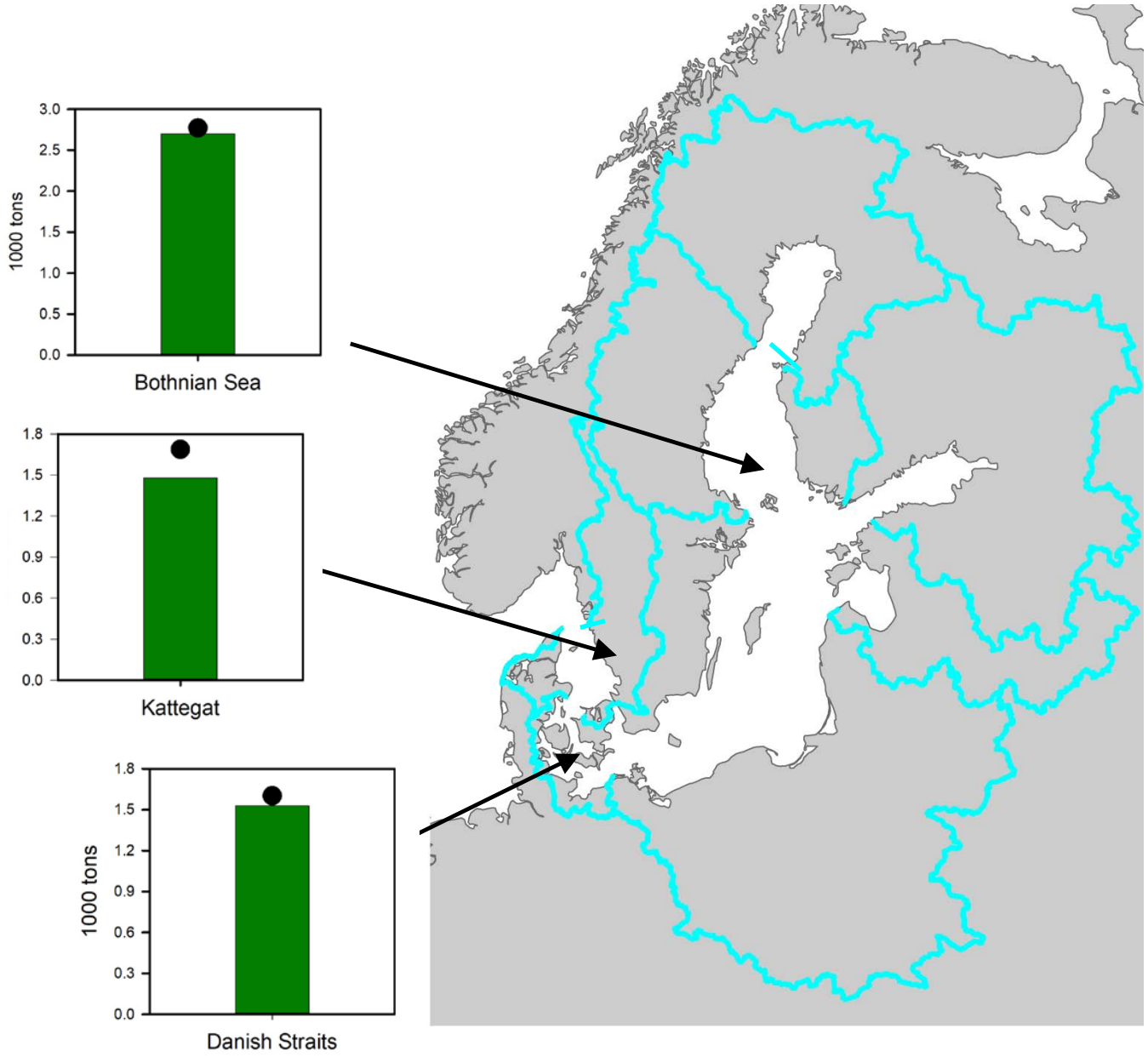
Progress towards phosphorus targets



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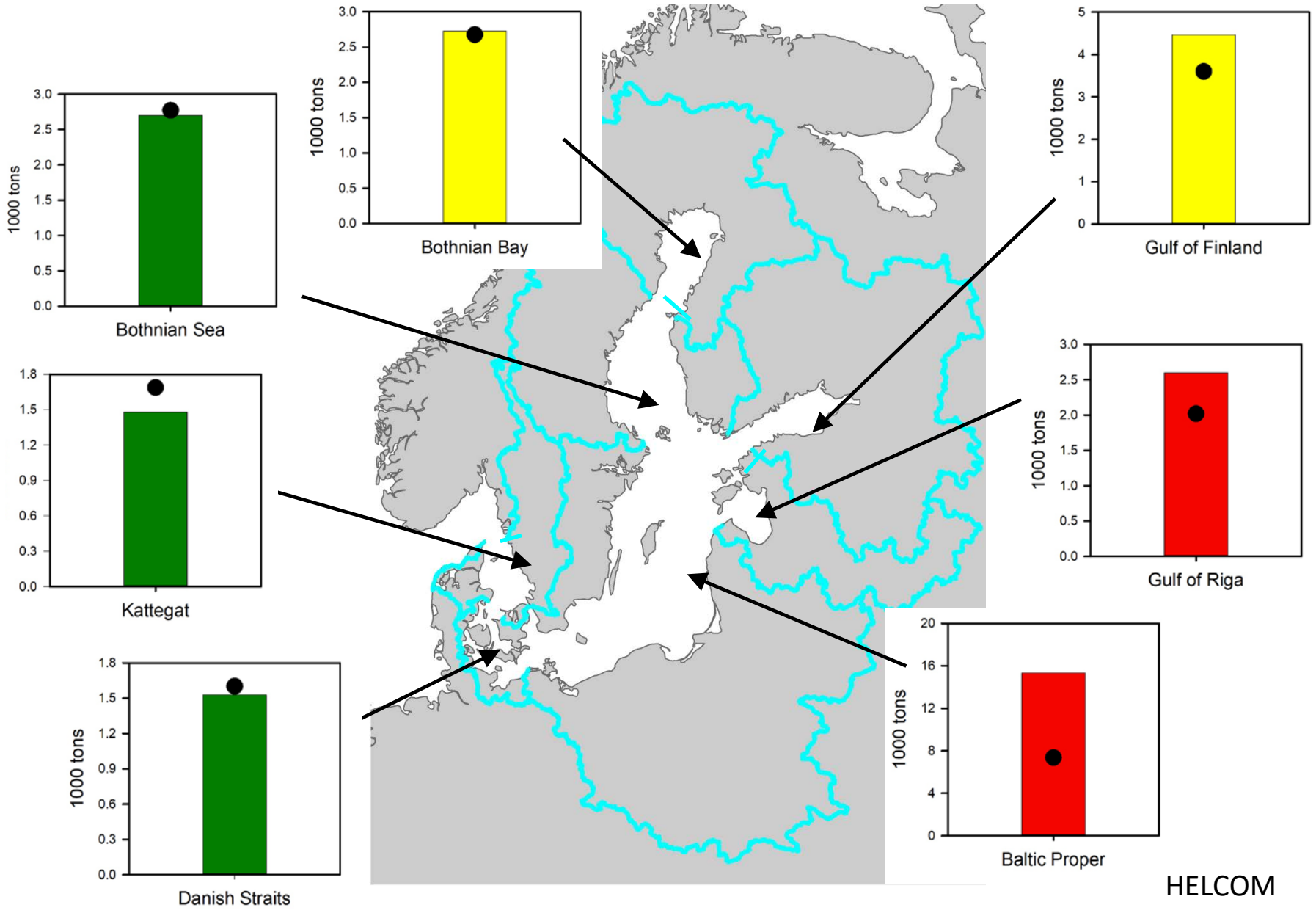
Progress towards phosphorus targets



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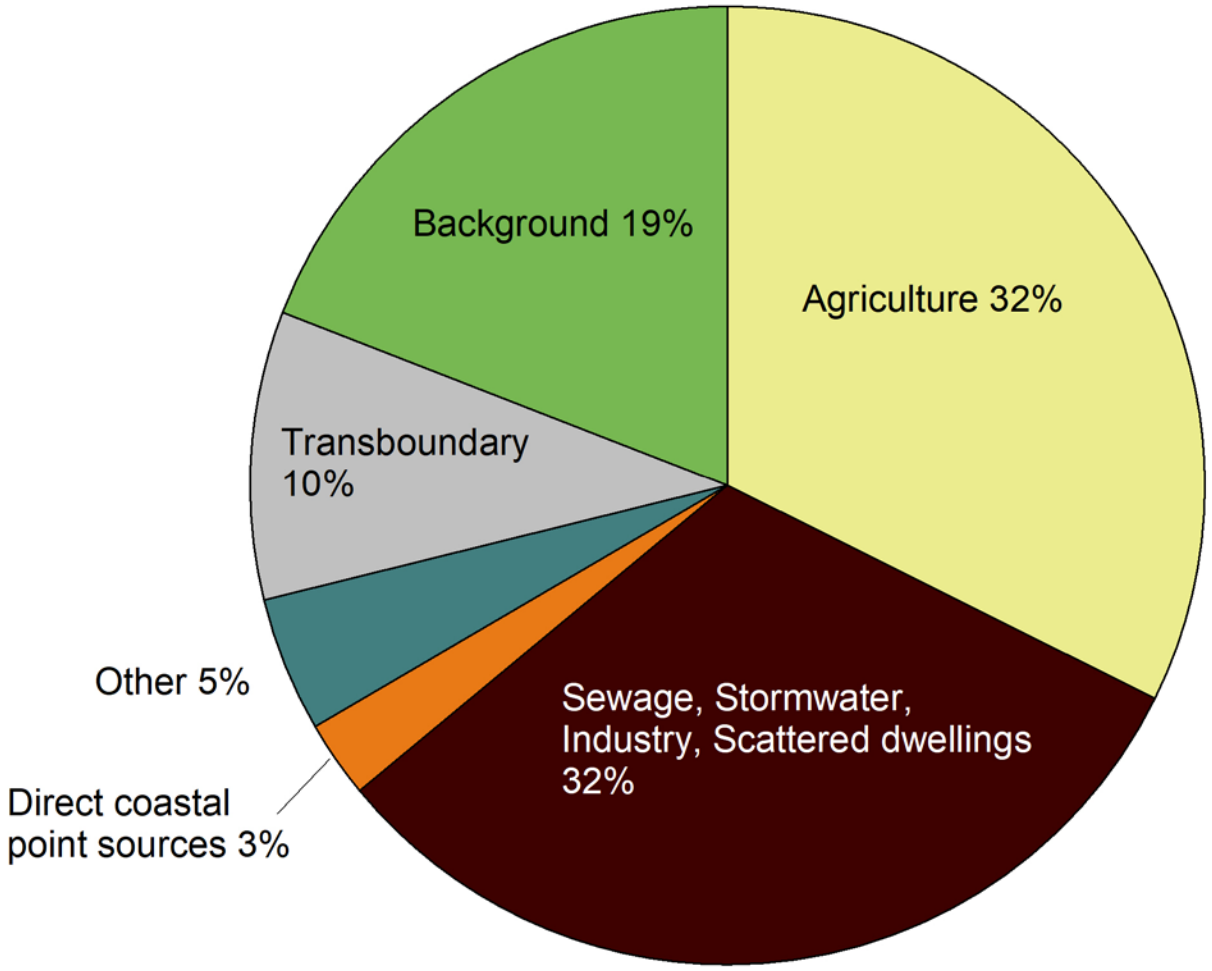
Sources of Phosphorus to Baltic Proper



HELCOM PLC6

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Journal of Environmental Quality ENVIRONMENTAL ISSUES

Phosphorus Mitigation to Control River Eutrophication: Murky Waters, Inconvenient Truths, and "Postnormal" Science

AGU PUBLICATIONS

Global Biogeochemical Cycles

RESEARCH ARTICLE
10.1002/2016GB005498

Key Points:
- Legacy nitrogen contributes 85% of annual nitrate-N loads in the Mississippi River Basin and 47% in the Susquehanna River Basin

Two centuries of nitrogen dynamics: Legacy sources and sinks in the Mississippi and Susquehanna River Basins

K. J. Van Meter[1], N. B. Basu[1,2], and P. Van Cappellen[1]

[1]Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, Ontario, Canada, [2]Department of Civil and Environmental Engineering, University of Waterloo, Waterloo, Ontario, Canada

Long-term accumulation and transport of anthropogenic phosphorus in three river basins

Stephen M. Powers[1]*, Thomas W. Bruulsema[2], Tim P. Burt[3], Neng Iong Chan[4], James J. Elser[4], Philip M. Haygarth[5], Nicholas J. K. Howden[6], Helen P. Jarvie[7], Yang Lyu[8], Heidi M. Peterson[9], Andrew N. Sharpley[10], Jianbo Shen[8], Fred Worrall[11] and Fusuo Zhang[8]

AGU100 ADVANCING EARTH AND SPACE SCIENCE

Global Biogeochemical Cycles

RESEARCH ARTICLE
10.1029/2018GB005914

Key Points:

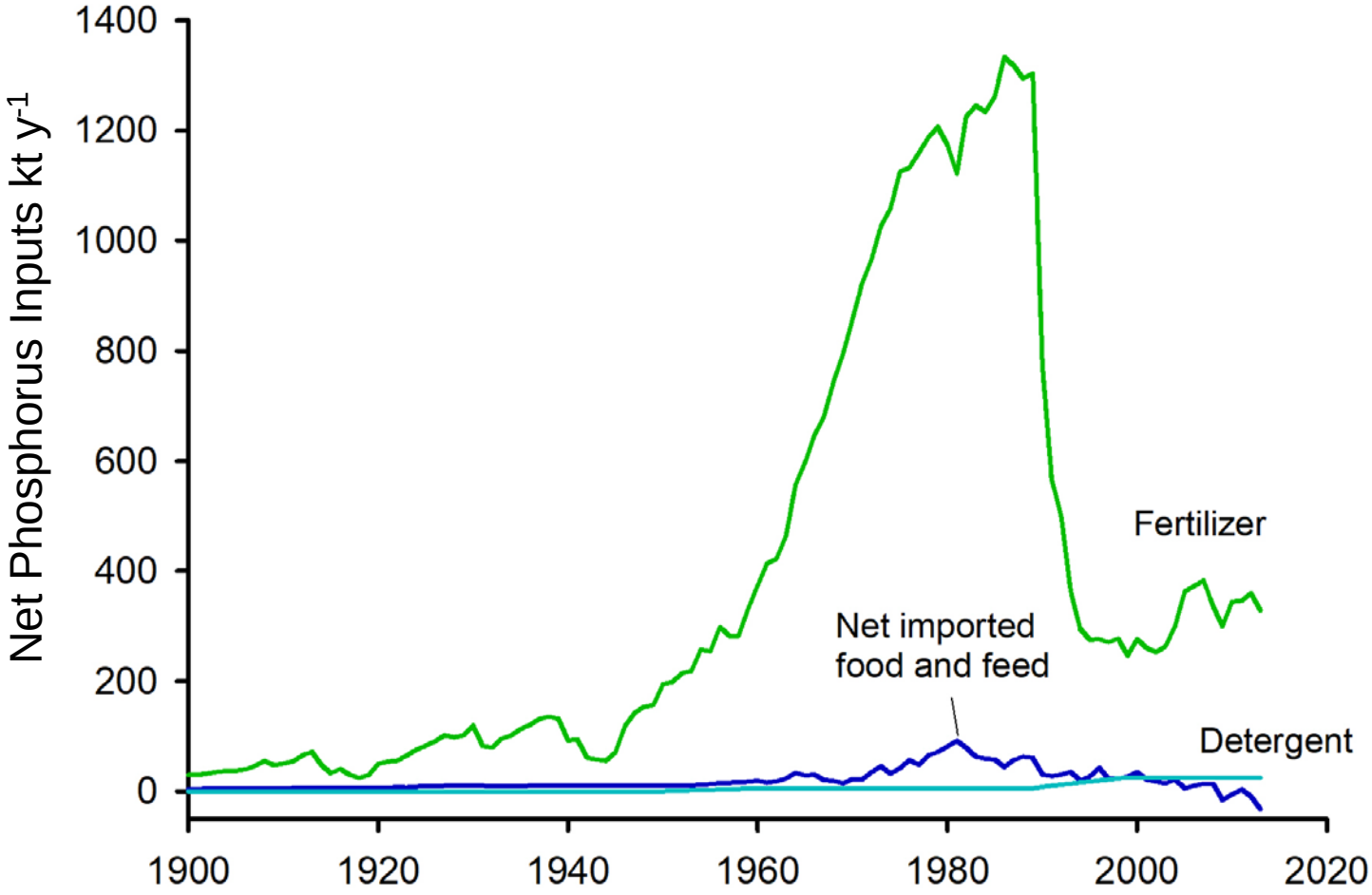
- A three-parameter, two-box model describes phosphorus dynamics in the Baltic Sea drainage basin since 1900
- Transfers from "legacy" phosphorus pools that accumulated in previous years contribute about half of current

A Century of Legacy Phosphorus Dynamics in a Large Drainage Basin

Michelle L. McCrackin[1], Bärbel Muller-Karulis[1], Bo G. Gustafsson[1,2], Robert W. Howarth[3], Christoph Humborg[1,2], Annika Svanbäck[1], and Dennis P. Swaney[3]

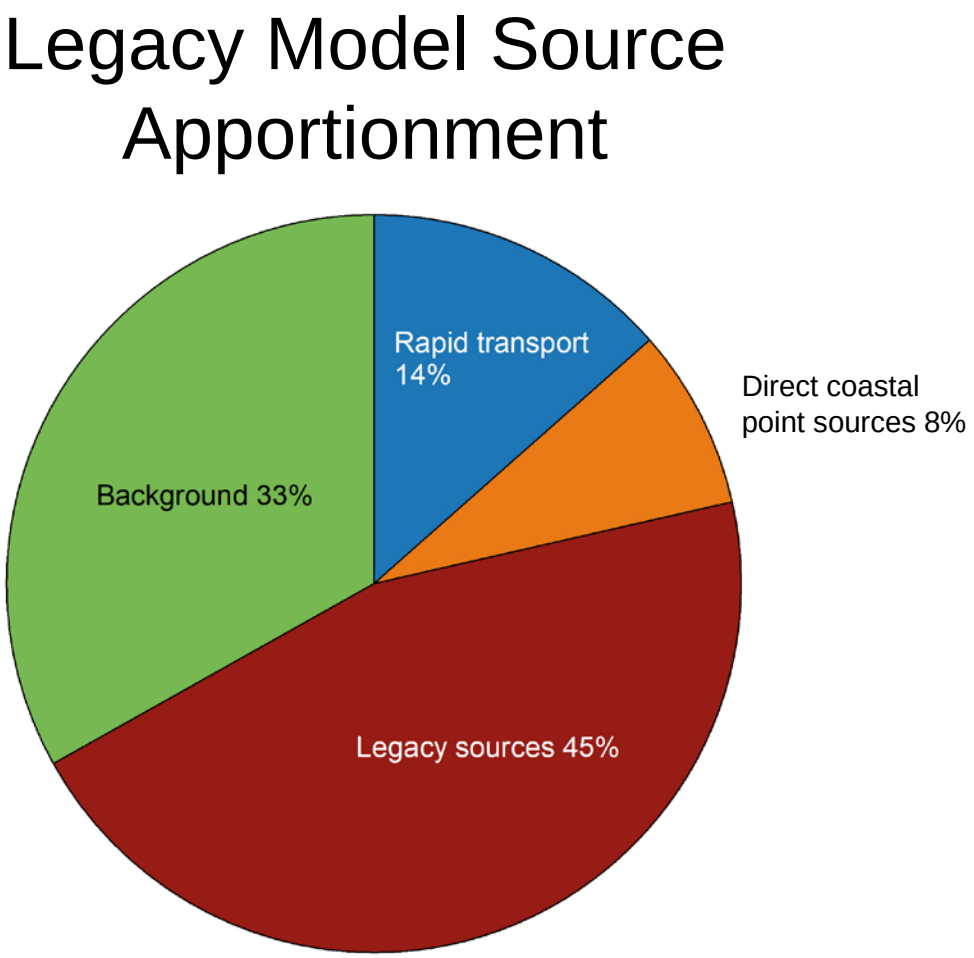
[1]Baltic Sea Centre, Stockholm University, Stockholm, Sweden, [2]Faculty of Biological and Environmental Sciences, Tvärminne Zoological Station, University of Helsinki, Hanko, Finland, [3]Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, USA

Nutrient legacies: 46 Mt P imported into the catchment



McCrackin et al. 2018 Global Biogeochemical Cycles

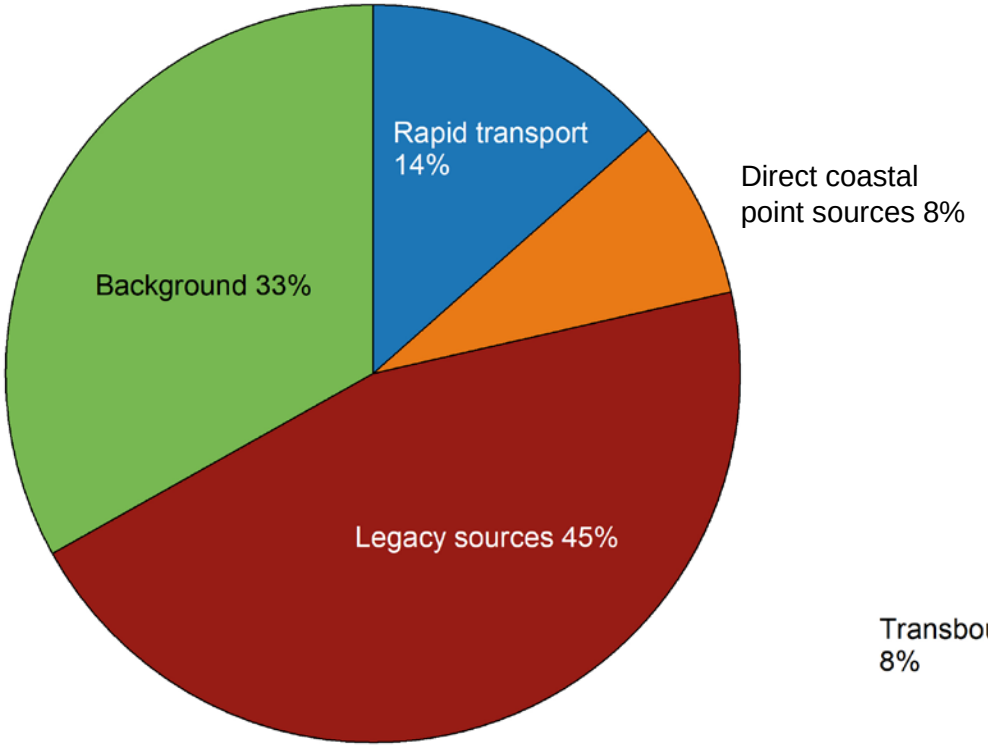
Sources of Phosphorus to Baltic Sea



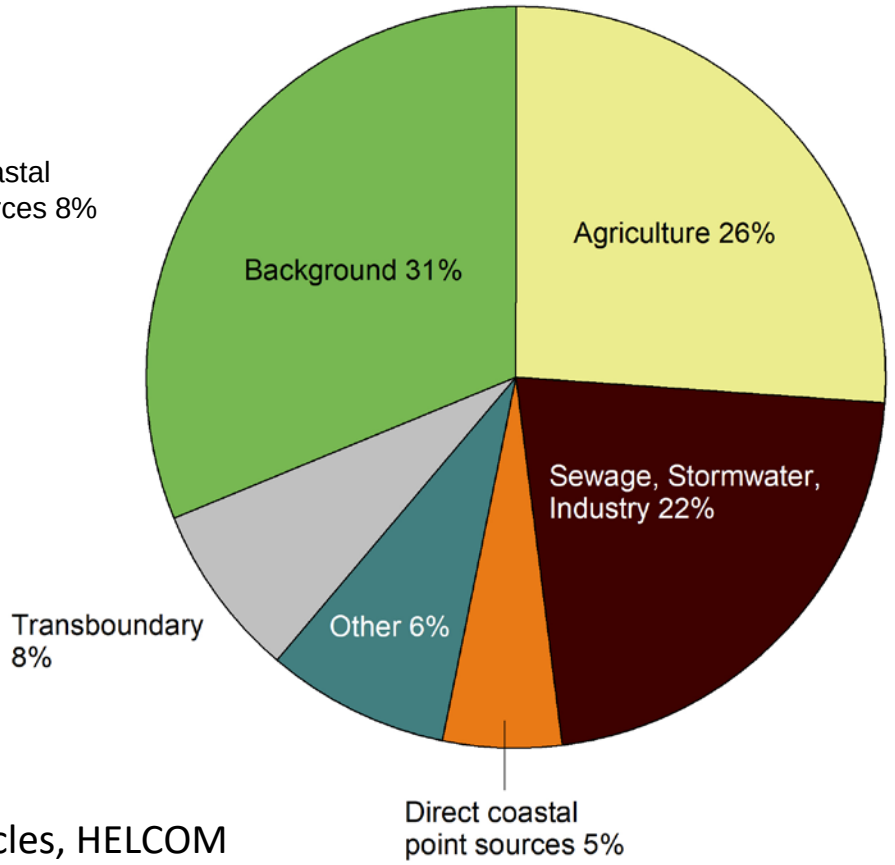
McCrackin et al. 2018 Global Biogeochemical Cycles

Sources of Phosphorus to Baltic Sea

Legacy Model

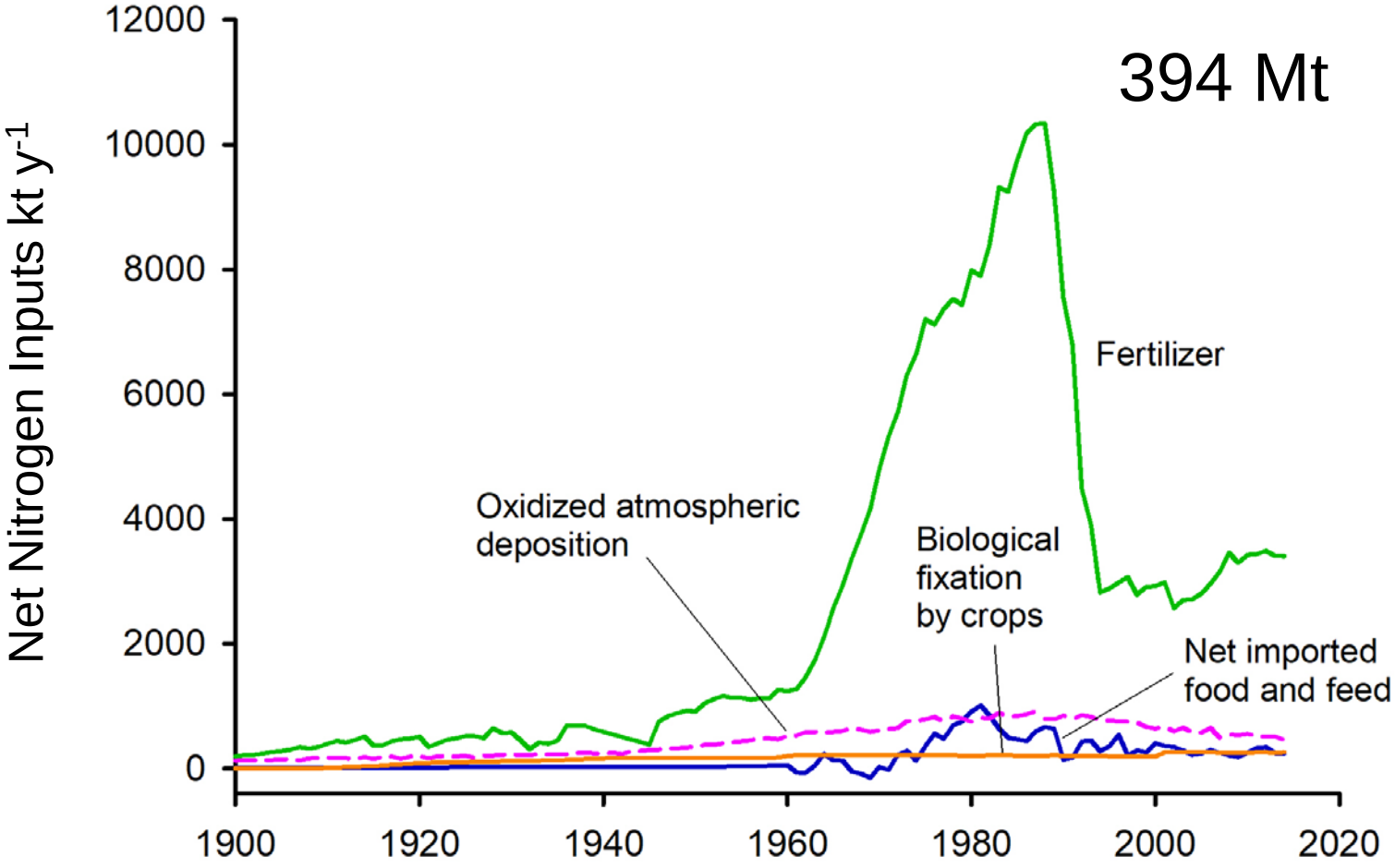


PLC6



McCrackin et al. 2018 Global Biogeochemical Cycles, HELCOM

Potential for Nitrogen Legacy



Summary

- Substantial reductions in nutrient loads

- Knowledge gaps
  - Source apportionment
  - Contribution of nutrient legacies

Compare to regions