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Nutrient fluxes on a catchment scale – how can the net nutrient load from aquaculture be minimised?

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AQUA-best project

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Scope of the talk

- **Nutrient (P) fluxes** in relation to **aquaculture in open systems** in marine and freshwater systems
- Management strategies for **sustainable aquaculture nutrient use**
- Spatial scale: the **Baltic Sea catchment area**, from mountain tops to deep sea sediments

The Swedish national strategy for aquaculture

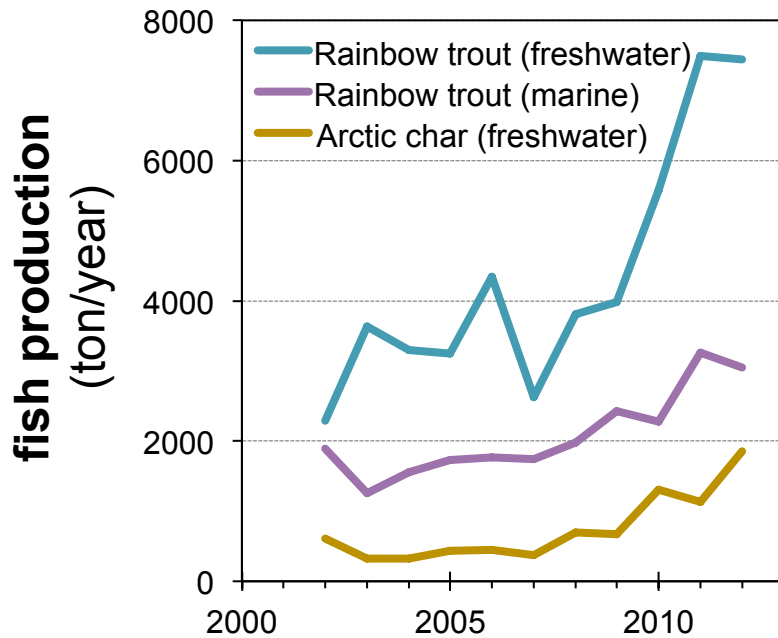
Vision

- Swedish aquaculture is a growing, viable and sustainable industry with ethical production.

Some of the goals

- Swedish aquaculture is characterised by a small environmental impact
- Swedish aquaculture contribute to an ecologically, economically and socially sustainable food production

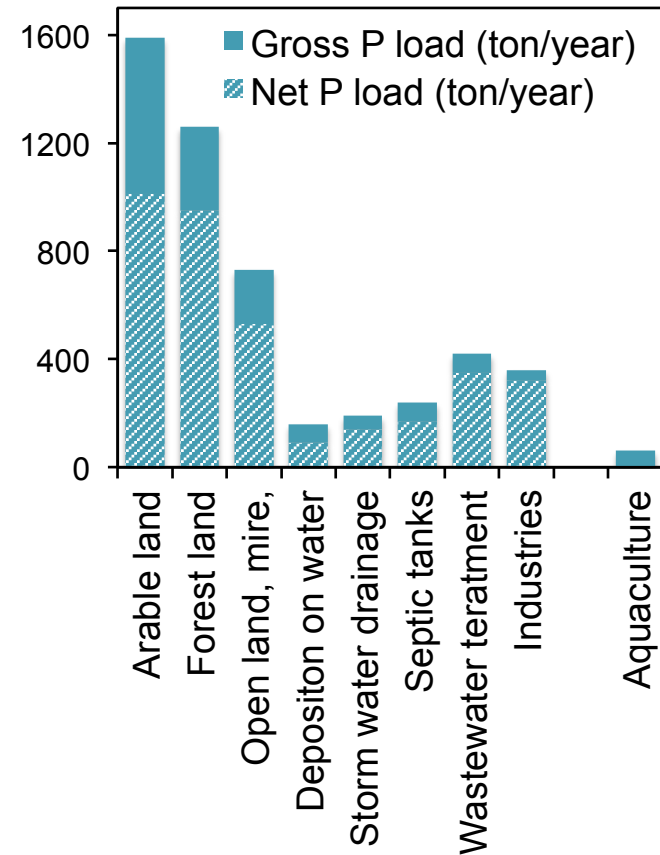
Aquaculture in Sweden



Global production \approx 60 million tons year⁻¹

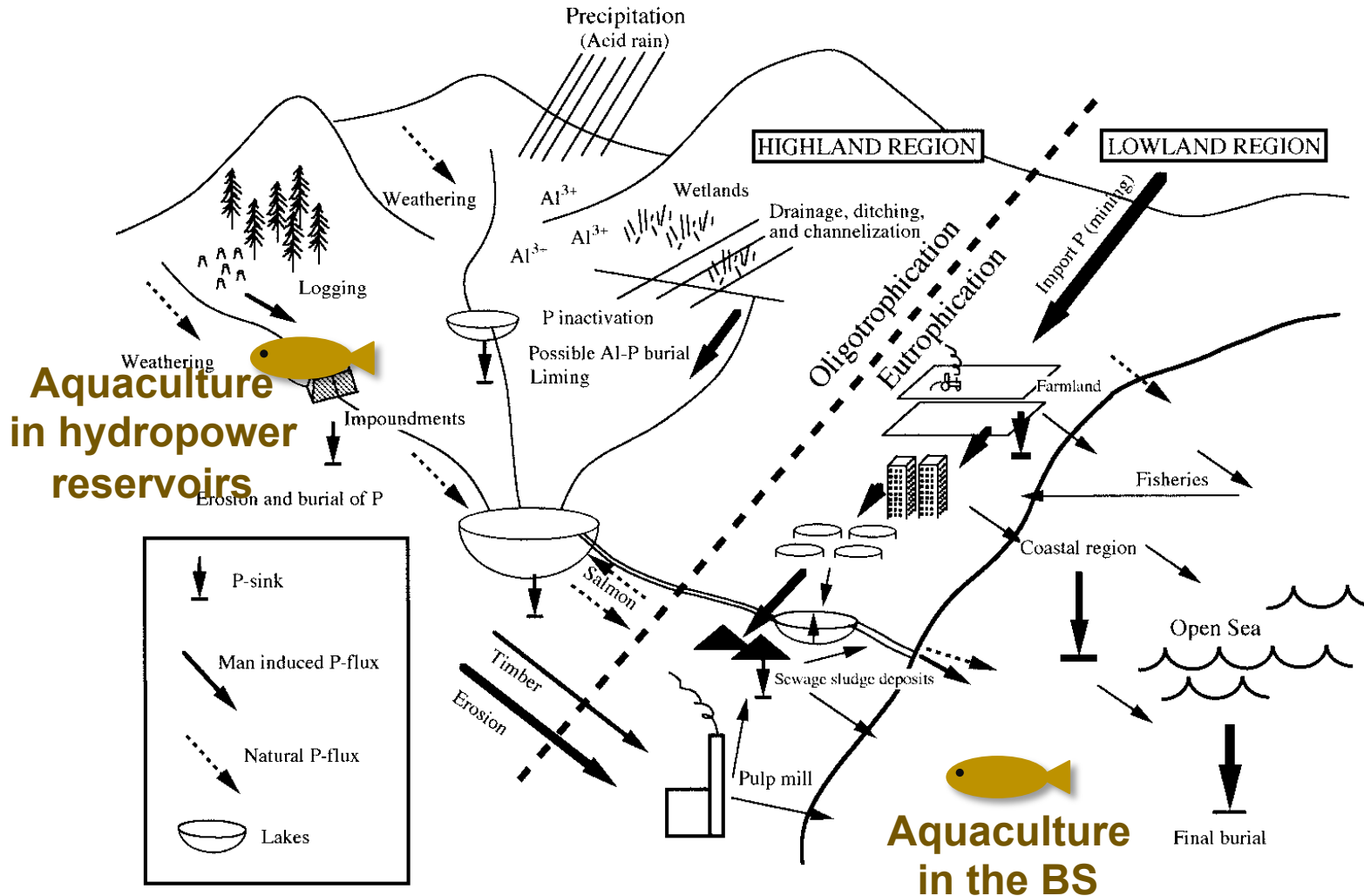
SCB (2013) *Aquaculture in Sweden in 2012*

Nutrient load from Sweden

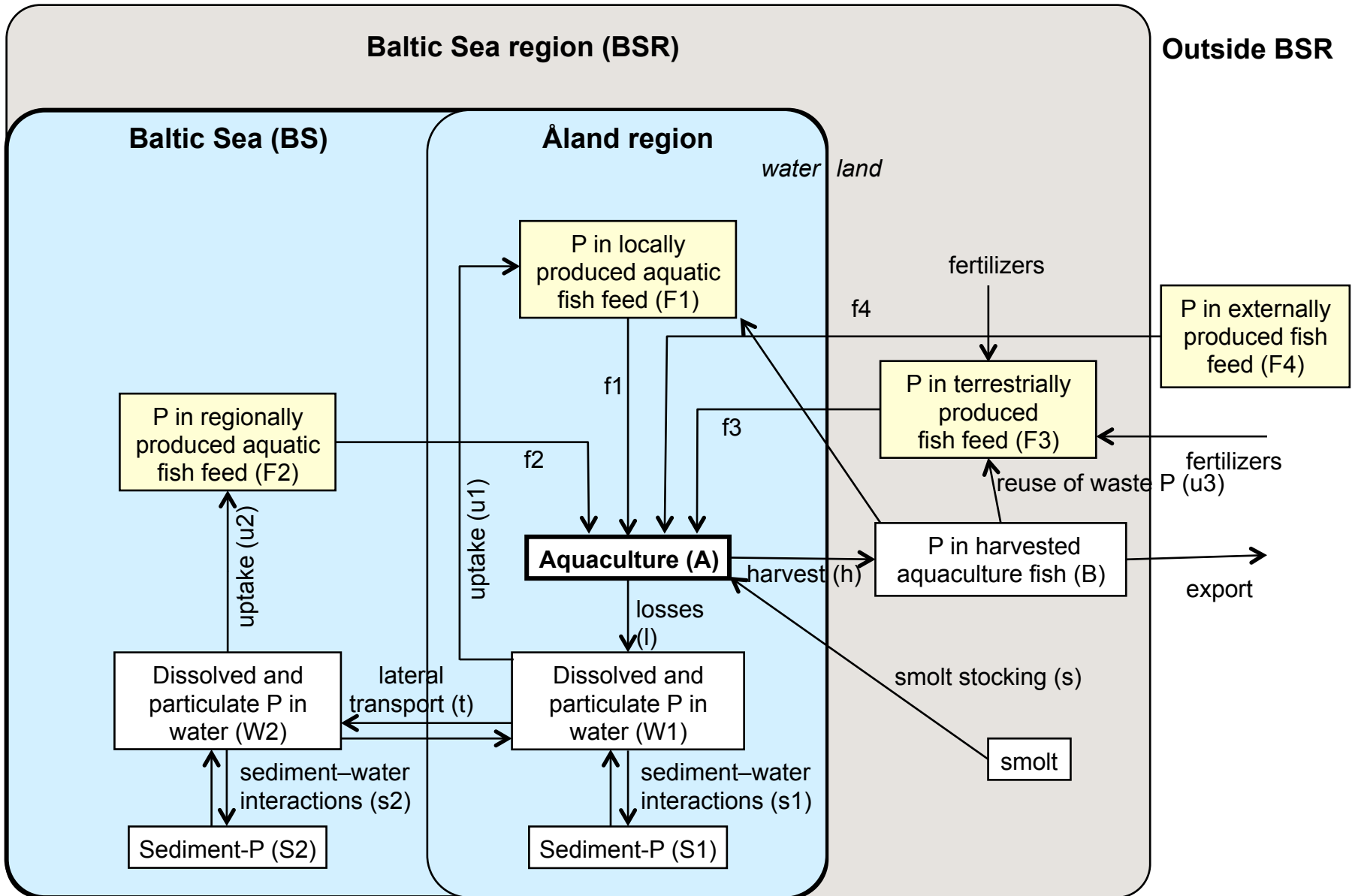


Naturvårdsverket (2008) *Näringsbelastningen på Östersjön och Västerhavet 2006*. Rapport 5815.
Mietala (2012) *Data om svenska fiskodlingar*. SMED rapport Nr 110.

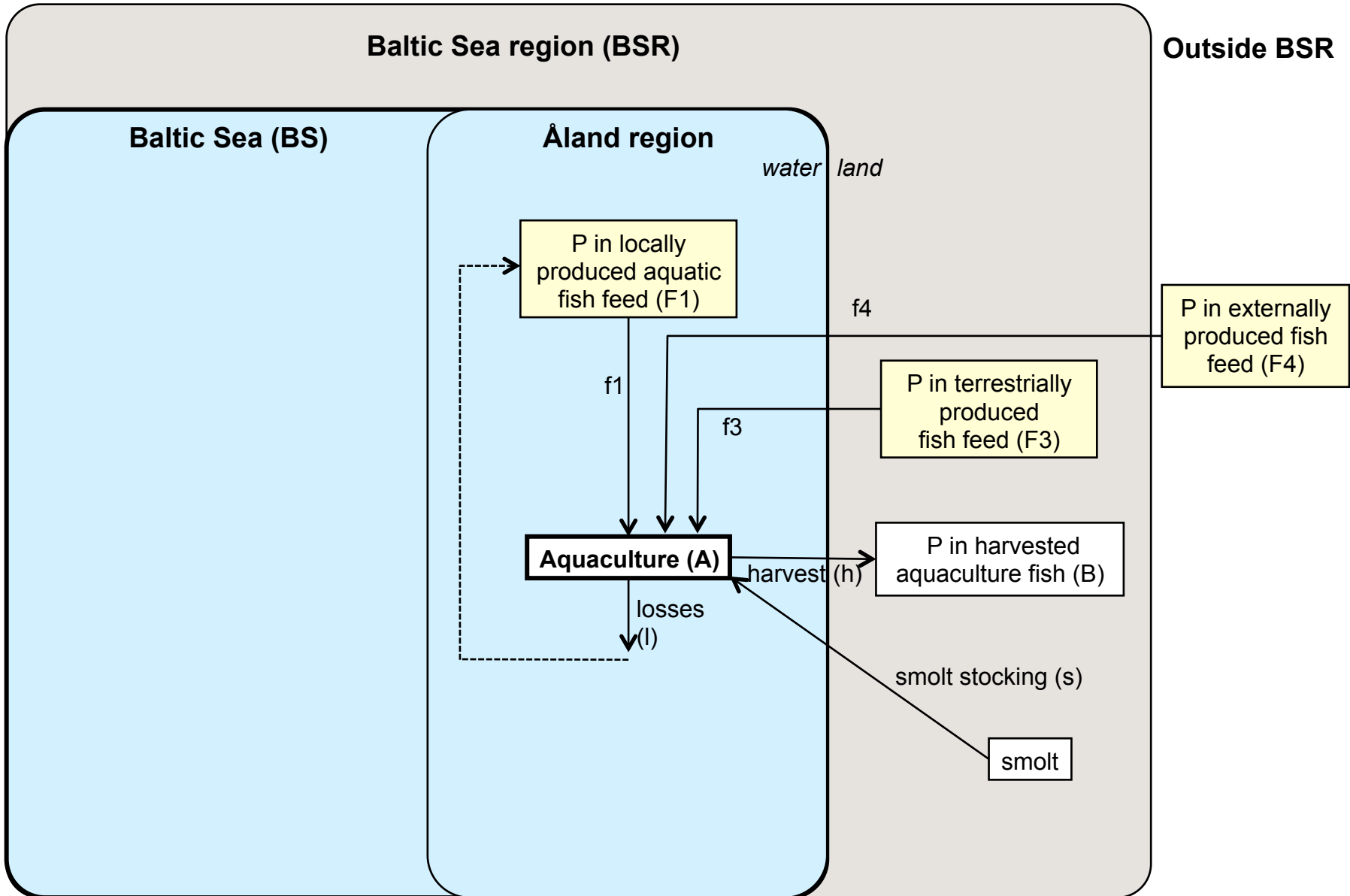
oligotrophication vs. eutrophication



A simple model of P in aquaculture in the Baltic Sea

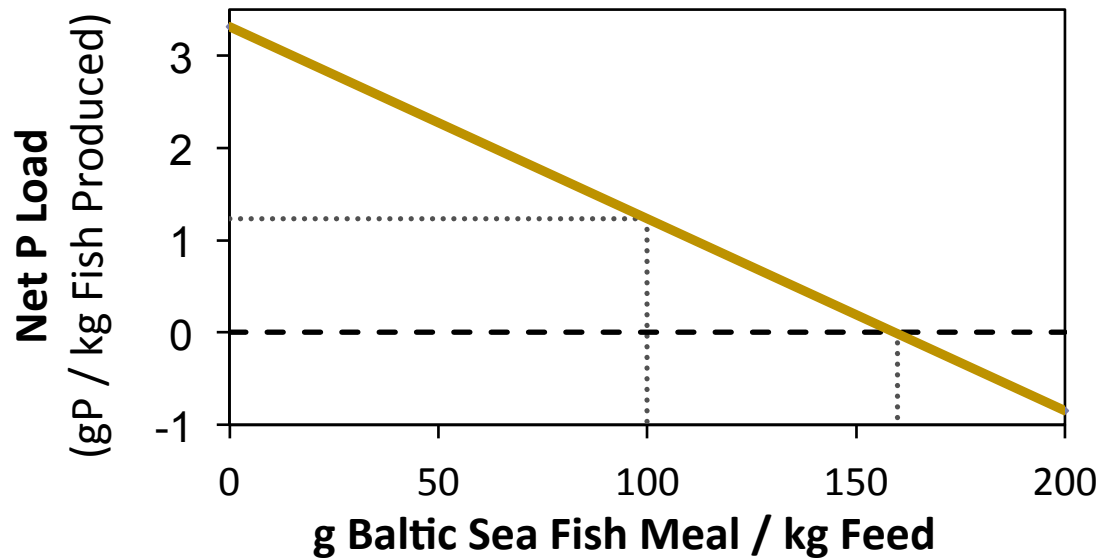


An even simpler model



How much does the net P load decrease when fish from BS is used in the feed?

Fish feed component	g / kg fish feed				%P
	today	feasible	zero	min	
Fish meal from Baltic Sea	0	100	160	200	2.0
Fish meal from outside BS	200	100	40	0	2.0
Fish oil	200	200	200	200	0
Rapeseed oil	96	96	96	96	0
Soy protein	285	255	237	225	0.68
Wheat gluten	18	48	67	79	0.14
Wheat meal	180	180	180	180	0.37
Vitamin mix	20	20	20	20	0



What about hydropower reservoirs?



Large (>10 km²) lakes and hydropower reservoirs in the 11 largest river basins in Northern Sweden

Regulation amplitude

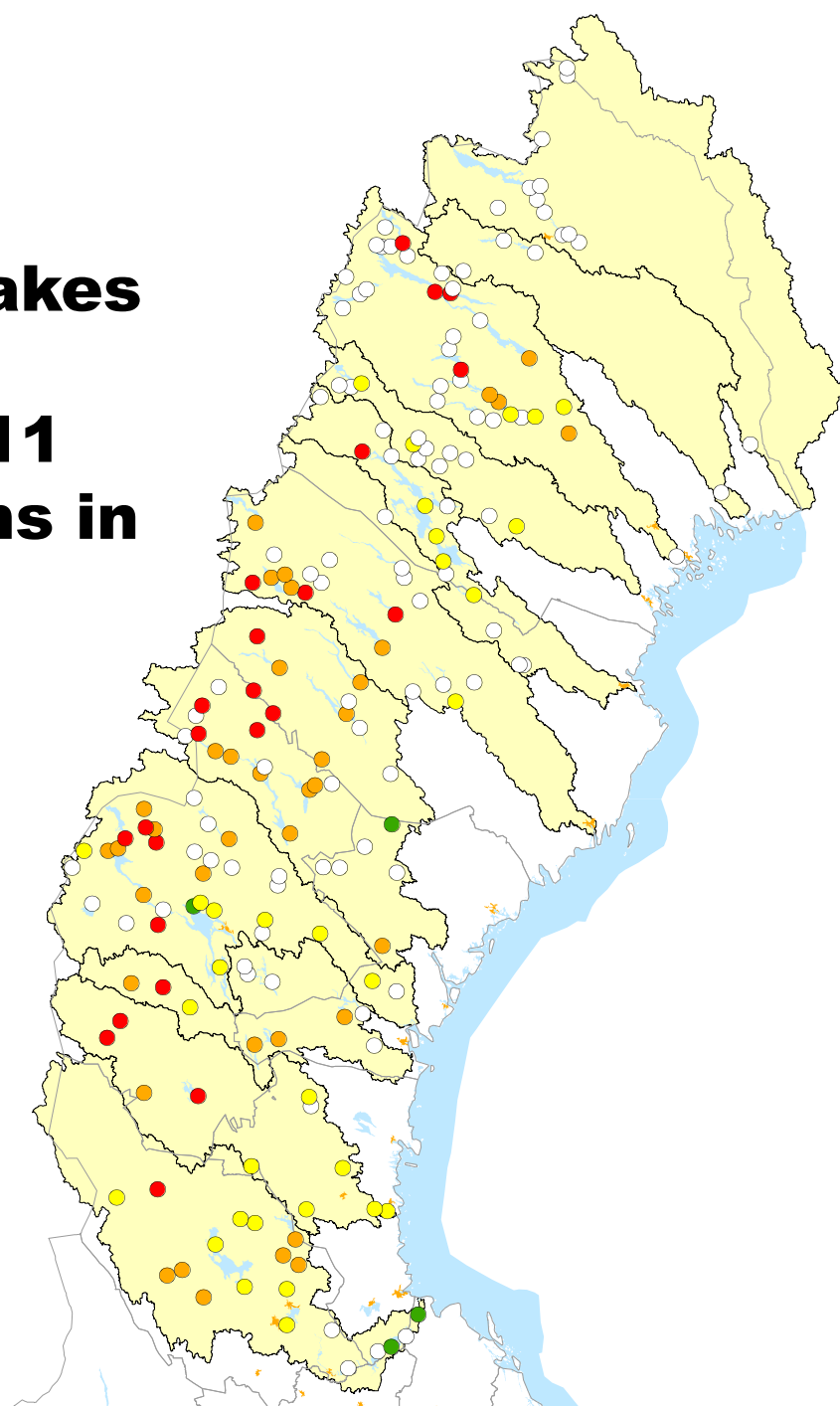
○ unregulated

● < 1 m

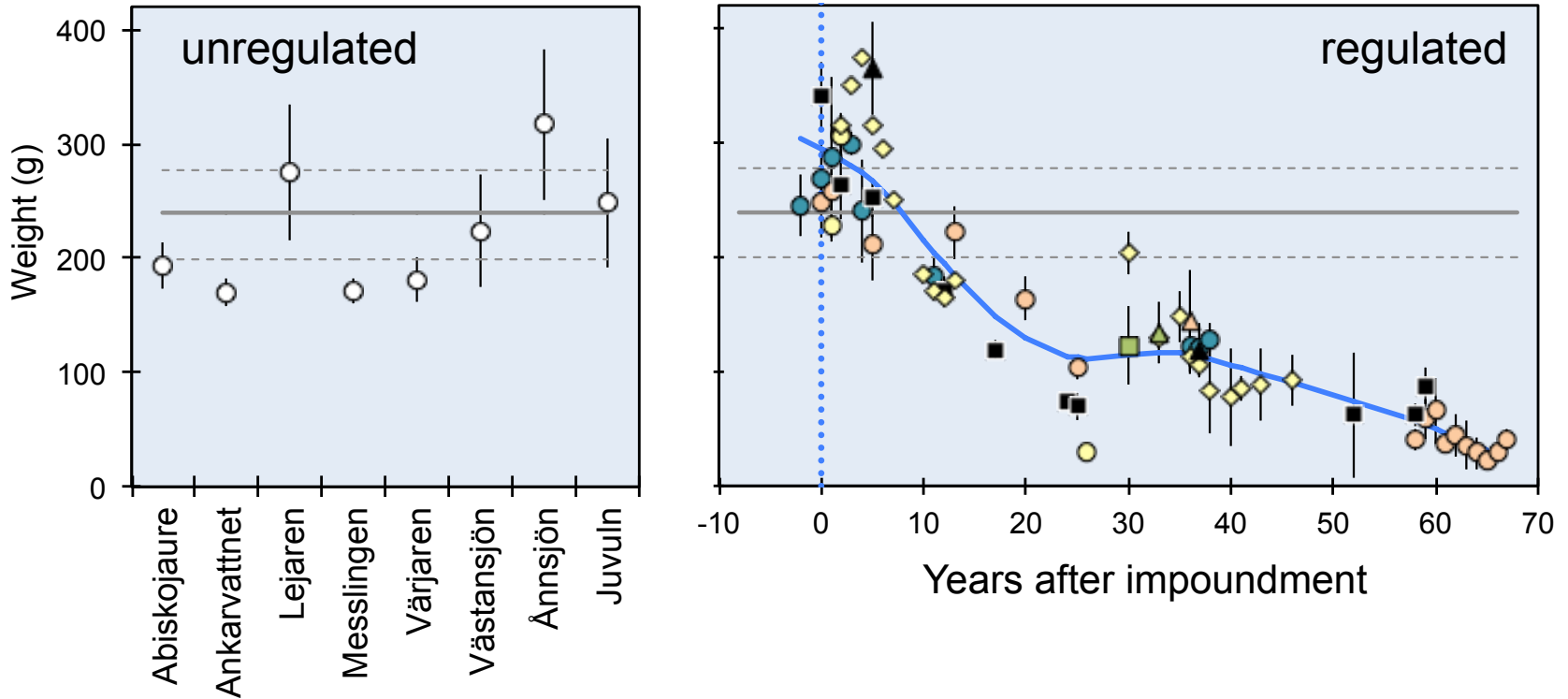
● 1-3 m

● 3-10 m

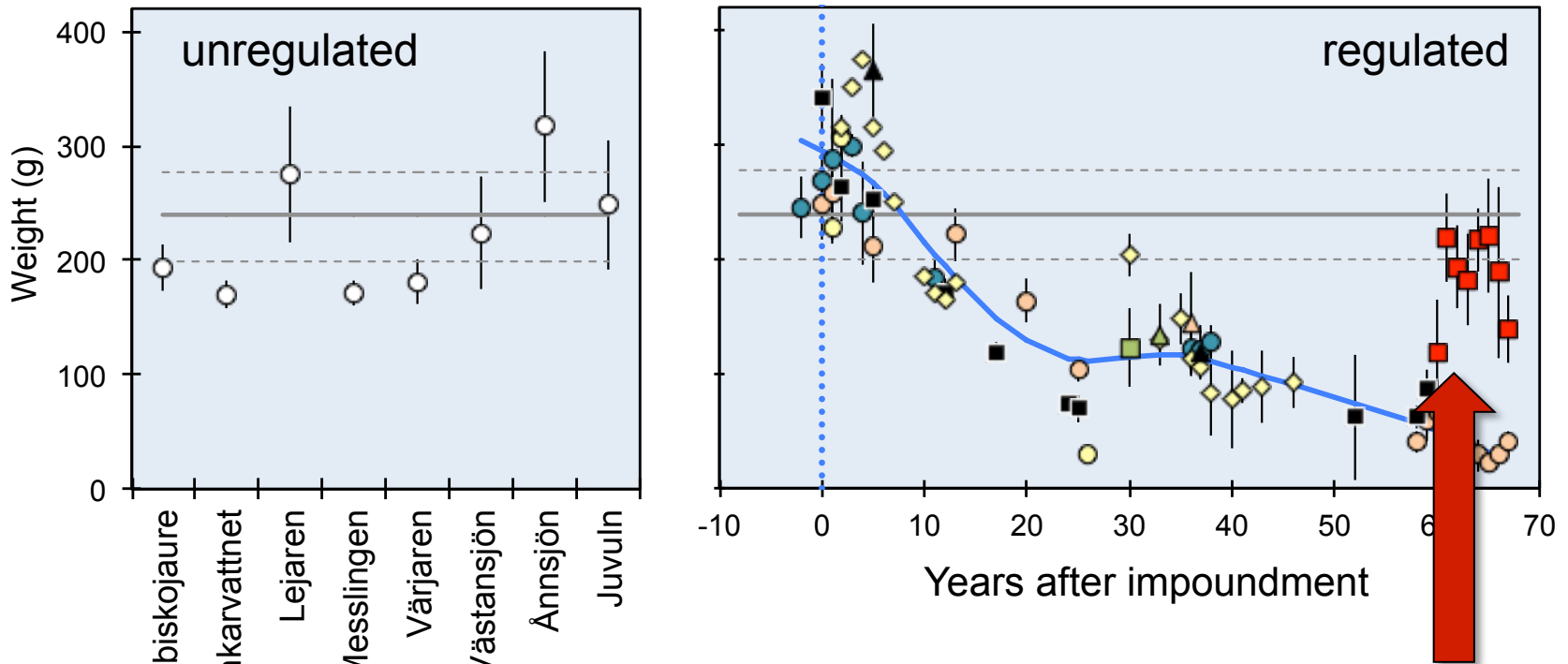
● >10 m



Weight of (wild) Arctic char at age 4+ in unregulated and regulated lakes

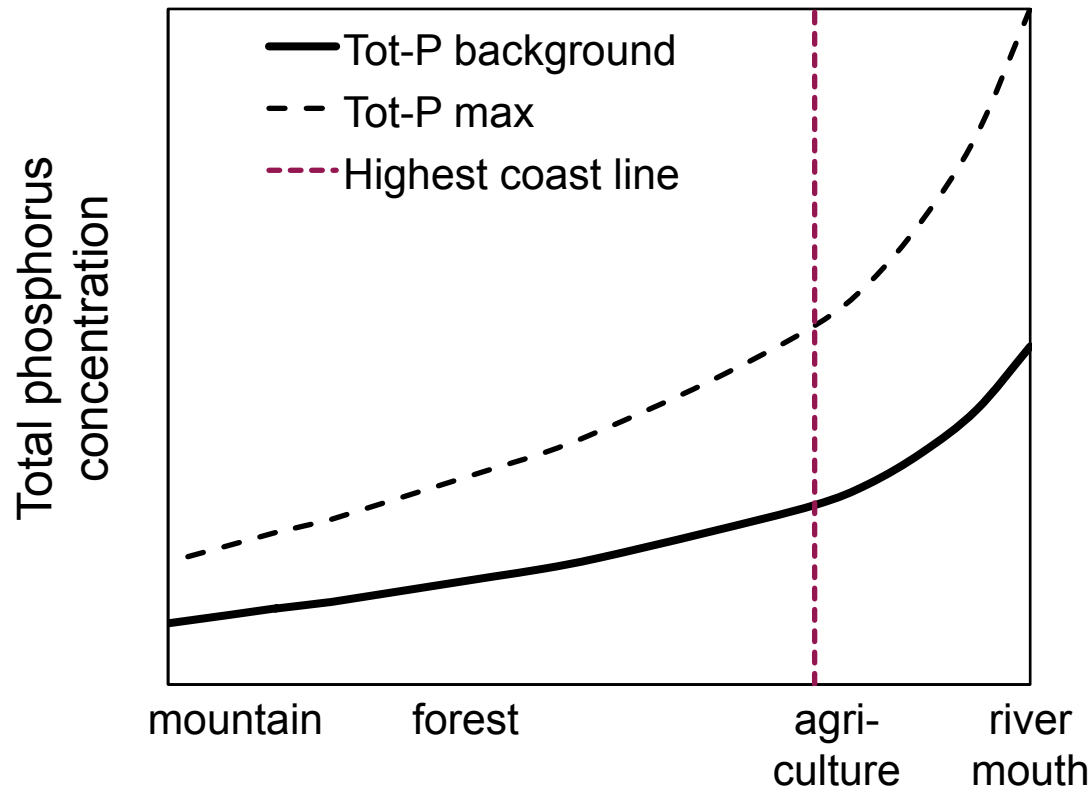


Weight of (wild) Arctic char at age 4+ in unregulated and regulated lakes

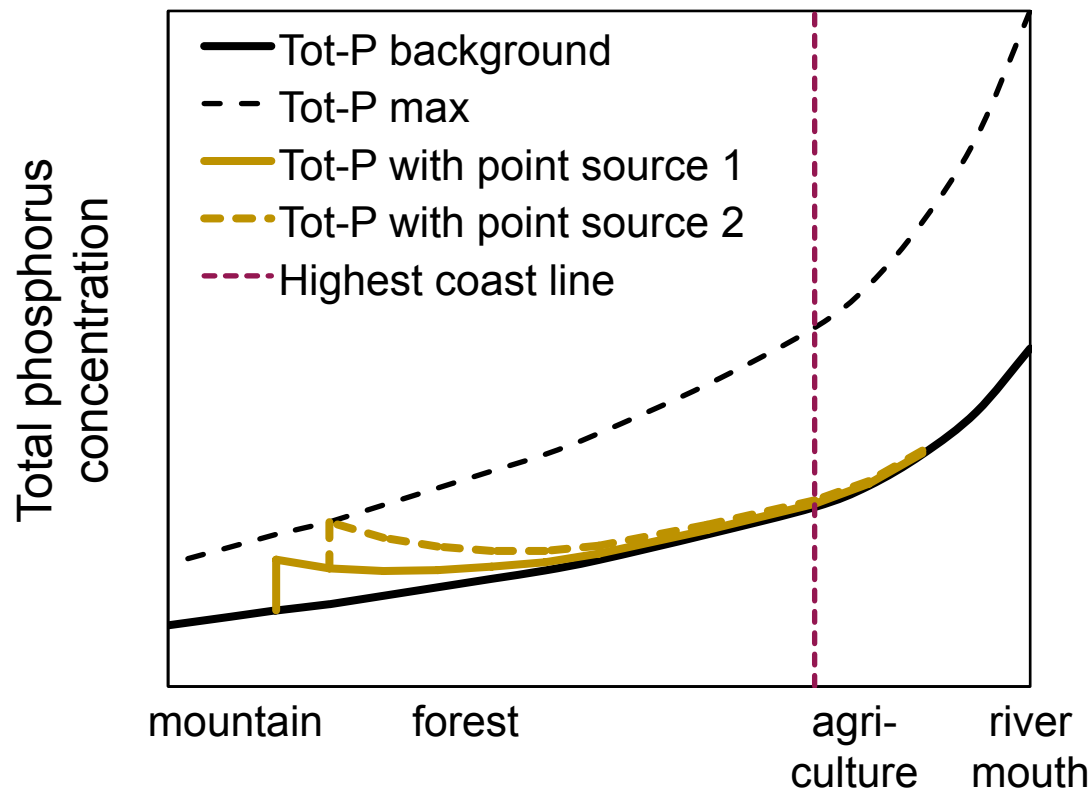


**Compensatory
nutrient
enrichment**

P concentrations in a river catchment perspective



P concentrations in a river catchment perspective



Take home message

- To achieve sustainable aquaculture, nutrient fluxes must be considered at relevant spatial and temporal scales
- Increasing aquaculture in open systems is a challenge for eutrophication
- P load from aquaculture can be substantially decreased by using fish feed made from BS resources
- Aquaculture in hydropower reservoirs may be a viable option, but more knowledge on local and regional effects of nutrient release is needed
- To succeed, we must collaborate across scientific disciplines and with stakeholders