

Ocean warming and deoxygenation – impacts on North Pacific fish and fisheries

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Our 'oxygen project' team

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Numerous members of the Changing Ocean Research Unit (CORU) at the Institute for the Oceans and Fisheries, UBC and other collaborators.

Climate change effects and its impacts are wide-spread in the world's oceans

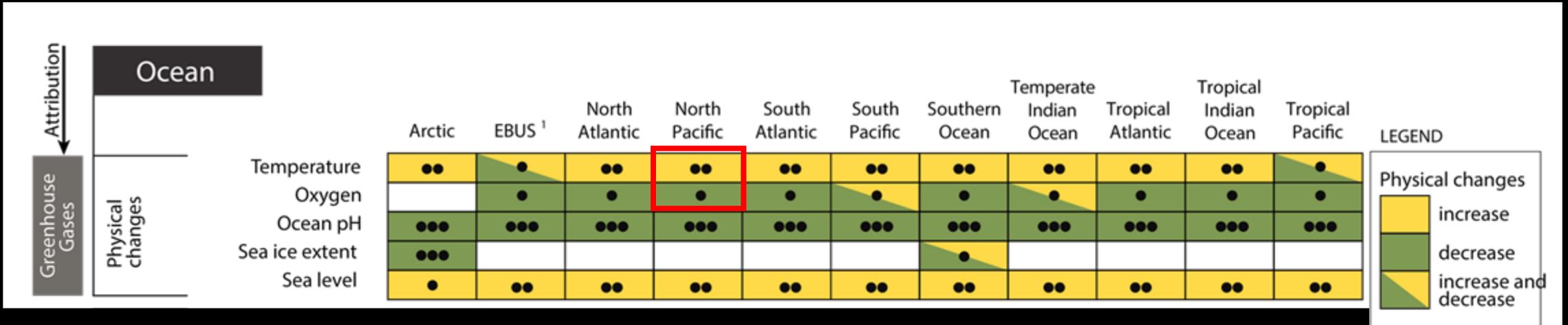
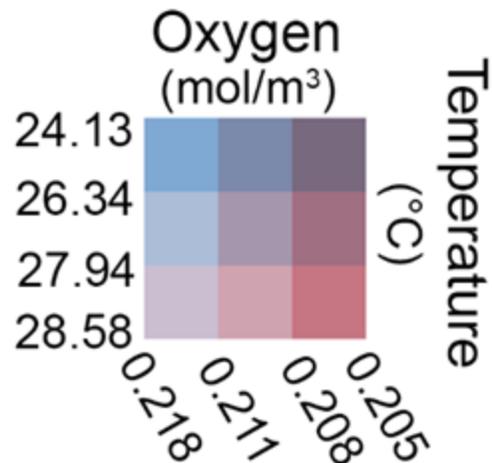


Figure 2 SPM; IPCC SROCC (2019)

Temperature and oxygen in the Eastern Tropical Pacific

Climatology

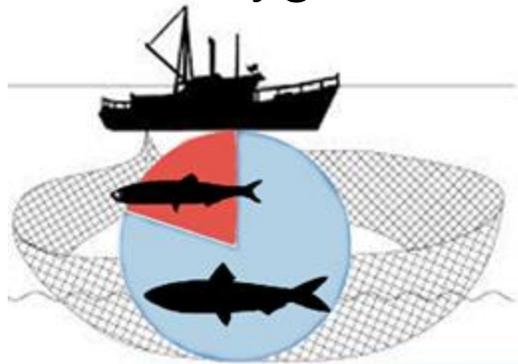


- The northern and southern most EEZ had the lowest temperatures and highest dissolved oxygen concentrations;
- Temperature and oxygen gradients serve as “natural experimental treatment”.

Warming drives changes in catch composition

What is the role of oxygen limitation?

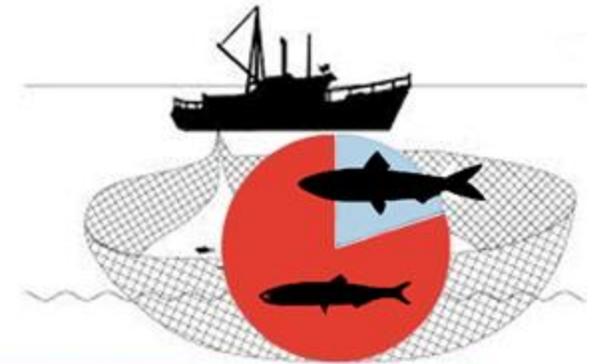
Cold-adapted species with high oxygen demands



Cool



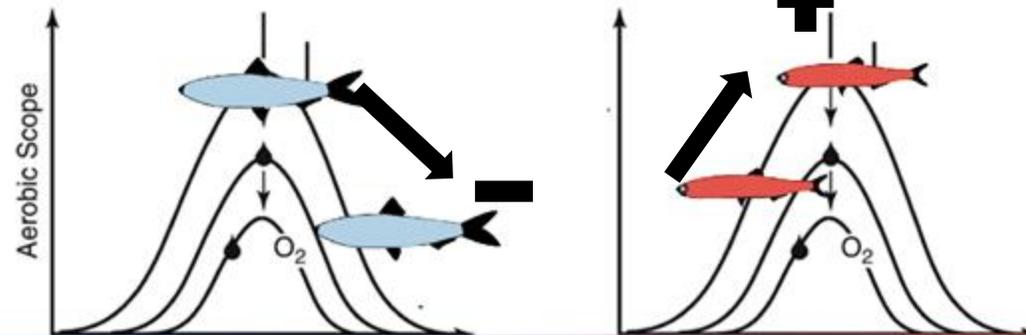
Warm-adapted species with low oxygen demands



Warm

Aerobic Scope

Abundance



Temperature

Aerobic Growth Index - tool to study the effects of warming and deoxygenation on fish communities



Source: <https://www.popsoci.com/do-fish-get-out-breath/>



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Aerobic growth index (AGI): An index to understand the impacts of ocean warming and deoxygenation on global marine fisheries resources

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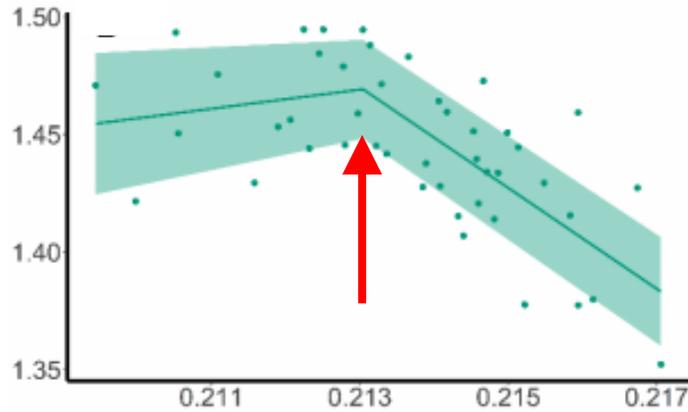
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Effects of temperature and oxygen on **pelagic** fishery resources

Example: Ecuador (1970 – 2016)



AGIC

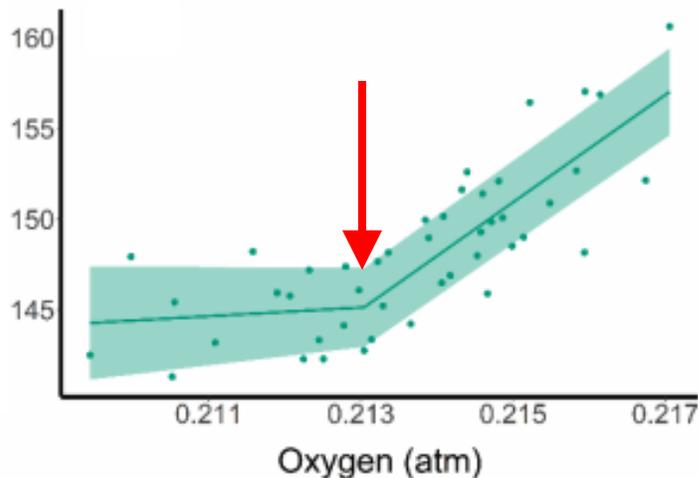


Mean Aerobic Growth Index of the Catch (AGIC):

- Break-points of oxygen level at ~ 0.213 atm;



MODC



Mean Oxygen Demand of the Catch (MODC):

- Lower oxygen levels, especially during stronger equatorial upwelling, relate to biological communities being dominated by species with lower oxygen demands (i.e., lower MODC).

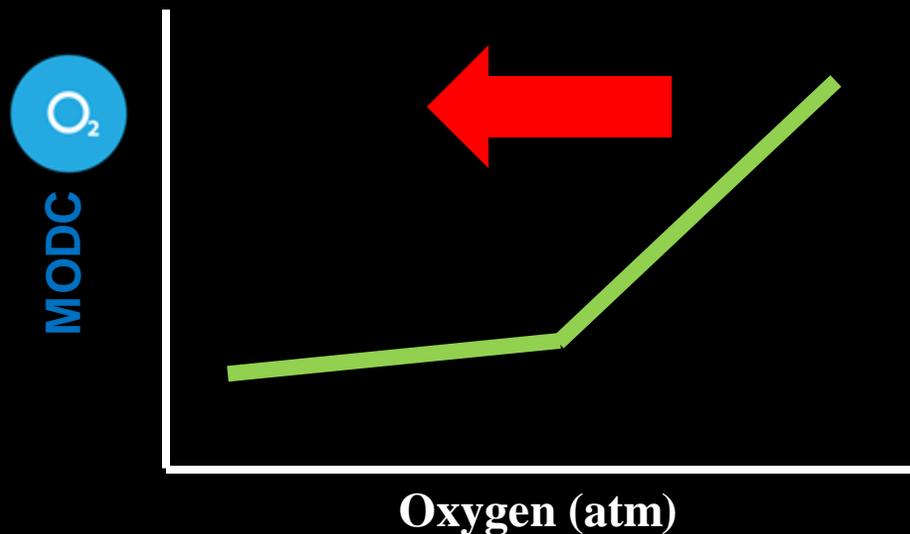
Humboldt squid is appearing in seafood menu in Vancouver in recent years!



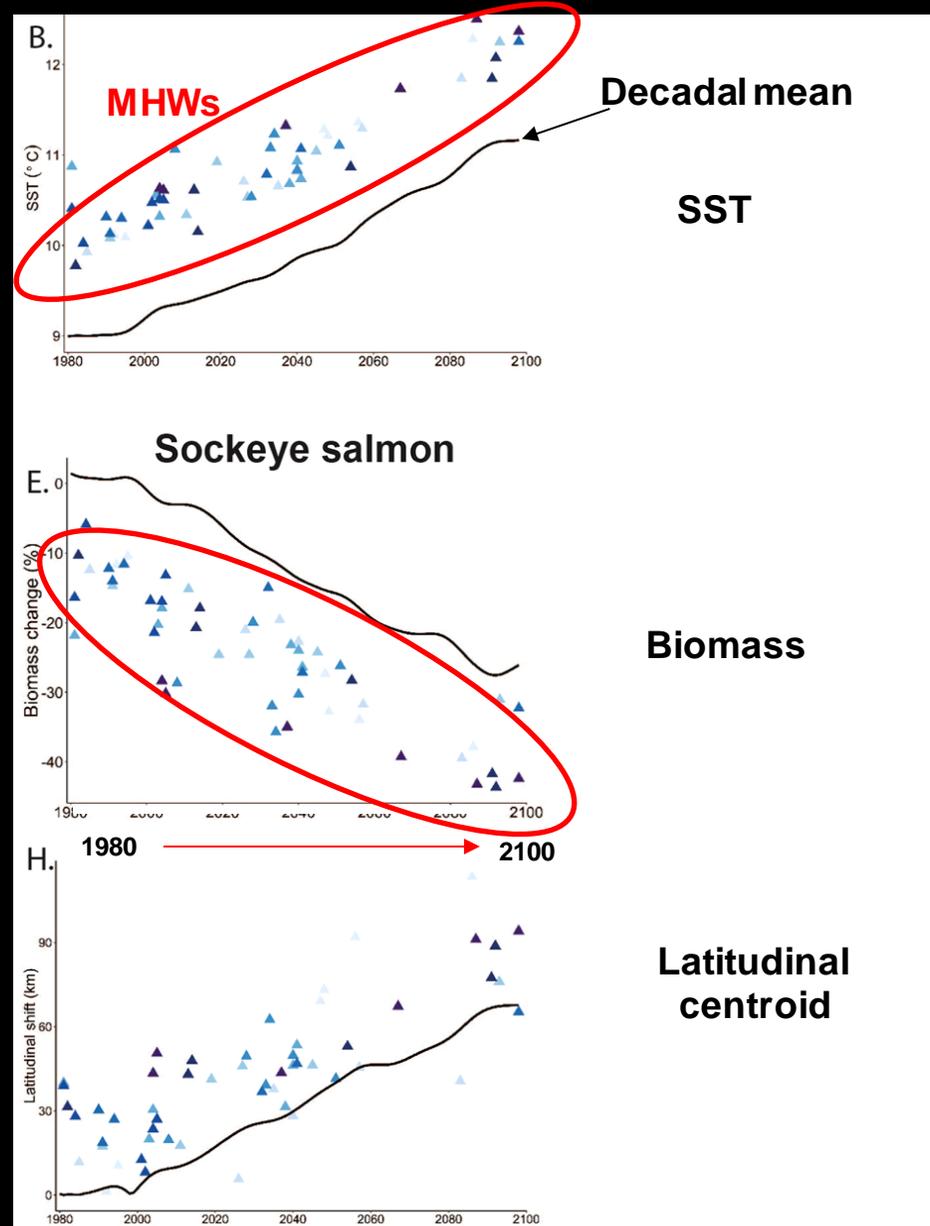
© 2009-2017 Katie (Nature ID)

Squid

- Warming water- and OMZ- adapted;
- Vertical migration and metabolic suppression in hypoxic waters;
- Warmer, less oxygenated waters, especially during the “blob”.



Marine heatwaves exacerbates impacts on “cold-adapted” fish stocks



Cheung & Frölicher (2020) Scientific Reports;
Cheung et al. (2021) Science Advances.

Summary

- Changing ocean temperatures and oxygen levels are playing an important role in **shaping the fish stocks and fisheries**;
- Useful projection of changing fish stocks and fisheries requires incorporating the physical, biogeochemical, ecological and socio-economic linkages;
- Important to understand the implications for **sustainable development** of coastal communities, particularly in terms of **social equity challenges**.

Thank you

