


Hemoglobin content in bathyal, abyssal, and hadal fishes in relation to ambient oxygen levels

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IMPORTANCE OF THIS STUDY

Rising sea surface temperatures result in less dissolved oxygen (O₂), increasing the presence of O₂ minimum zones and therefore decreasing the amount of O₂ that ventilates through the deep sea via thermohaline circulation¹.



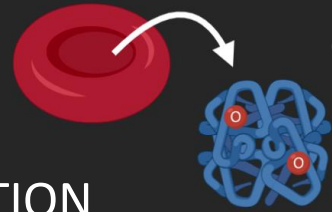
⁴Our study included 6 species from the Mariana and Kermadec trenches (n=18) spanning a capture depth range of 1,554–7,626 meters



RESEARCH QUESTION

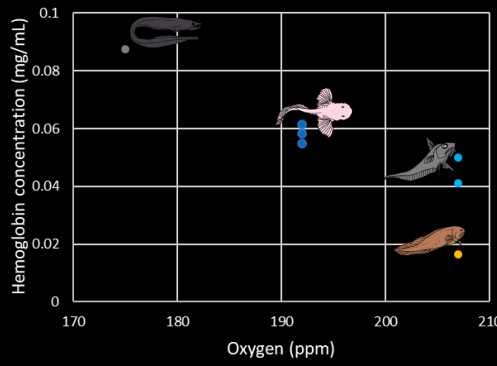
How does ambient oxygen influence hemoglobin (Hb) in deep-sea fishes?

Hemoglobin serves as a metabolic and environmental bioindicator^{2,3}



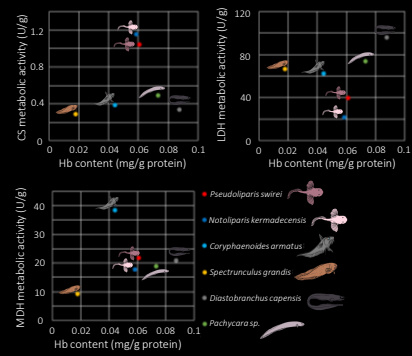
WHAT WE FOUND

In areas of lower oxygen, species had higher amounts of hemoglobin in their blood



Oxygen levels (ppm) versus hemoglobin concentration (mg/mL). Sensors measured oxygen during collection².

- *Diastobranchius capensis*
- *Notoliparis kermadecensis*
- *Coryphaenoides armatus*
- *Spectrunculus grandis*

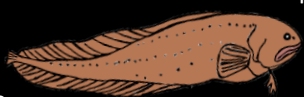


Hemoglobin content versus enzymatic activity. Data on enzymatic activity from Gerringer, Drazen, and Yancey 2017². A) Citrate synthase (CS) represents aerobic respiration. B) MDH is malate-dehydrogenase in aerobic respiration. C) LDH is lactate-dehydrogenase in anaerobic respiration. Enzymatic activity is measured in units (U) per gram (g) protein.

Animals that had lower hemoglobin levels had higher anaerobic activity

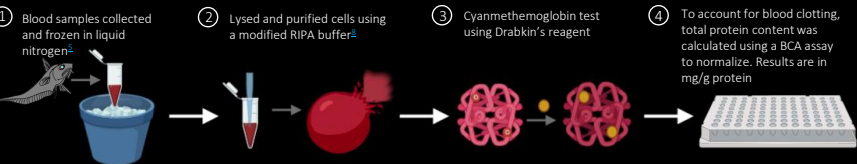
DISCUSSION

If more hemoglobin allows for more efficient oxygen uptake from low-oxygen surroundings, is hemoglobin upregulated?



S. grandis showed lower aerobic activity (MDH) and low hemoglobin, indicating oxygen metabolism of this species is very low at all organismal levels. This also corresponds to the animal's sluggish behavior seen in lander videos².

METHODS



REFERENCES

¹Breitburg et al. 2018; ²Sherwood, L., Klandorf, H., Yancey, P.H. *From Genes to Organisms*. 2nd ed., Brooks/Cole 2013; ³Berg, J. M., Tymoczko, J.L., Stryer, L. *Biochemistry*. 5th ed., W.H. Freeman, 2015; ⁴Gallo and Levin 2016; ⁵Gerringer, Drazen, Yancey 2017; ⁶HADES project, NSF 2011-2015; ⁷Jamieson, Newcastle University 2018; ⁸Falk et al. 1998; Hb and methods figures created with [BioRender.com](#); fish illustrations by Abbey Dias

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