Hypoxia Induced Metabolic Suppression in Migratory Zooplankton Living in Oxygen Minimum Zones

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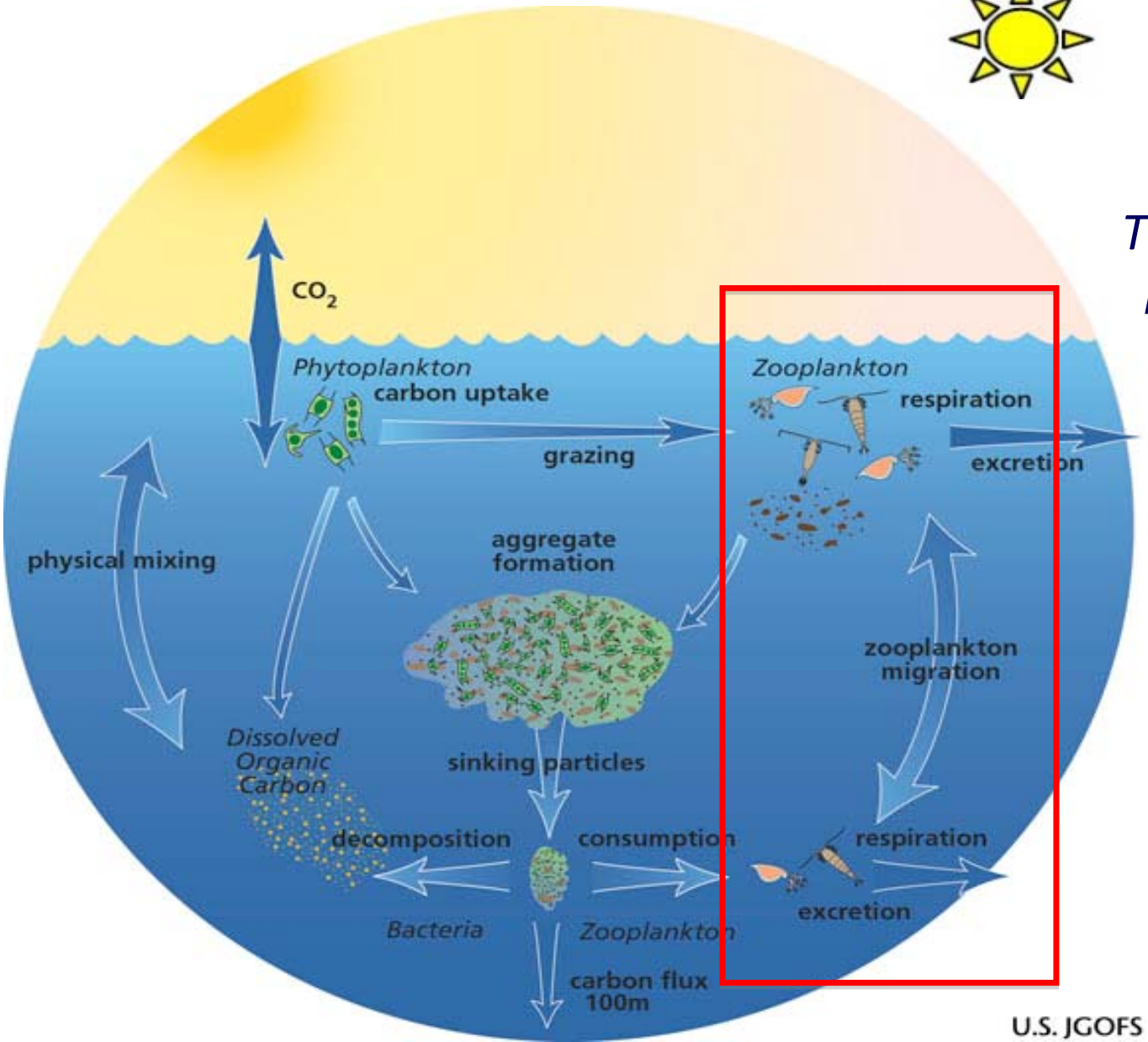
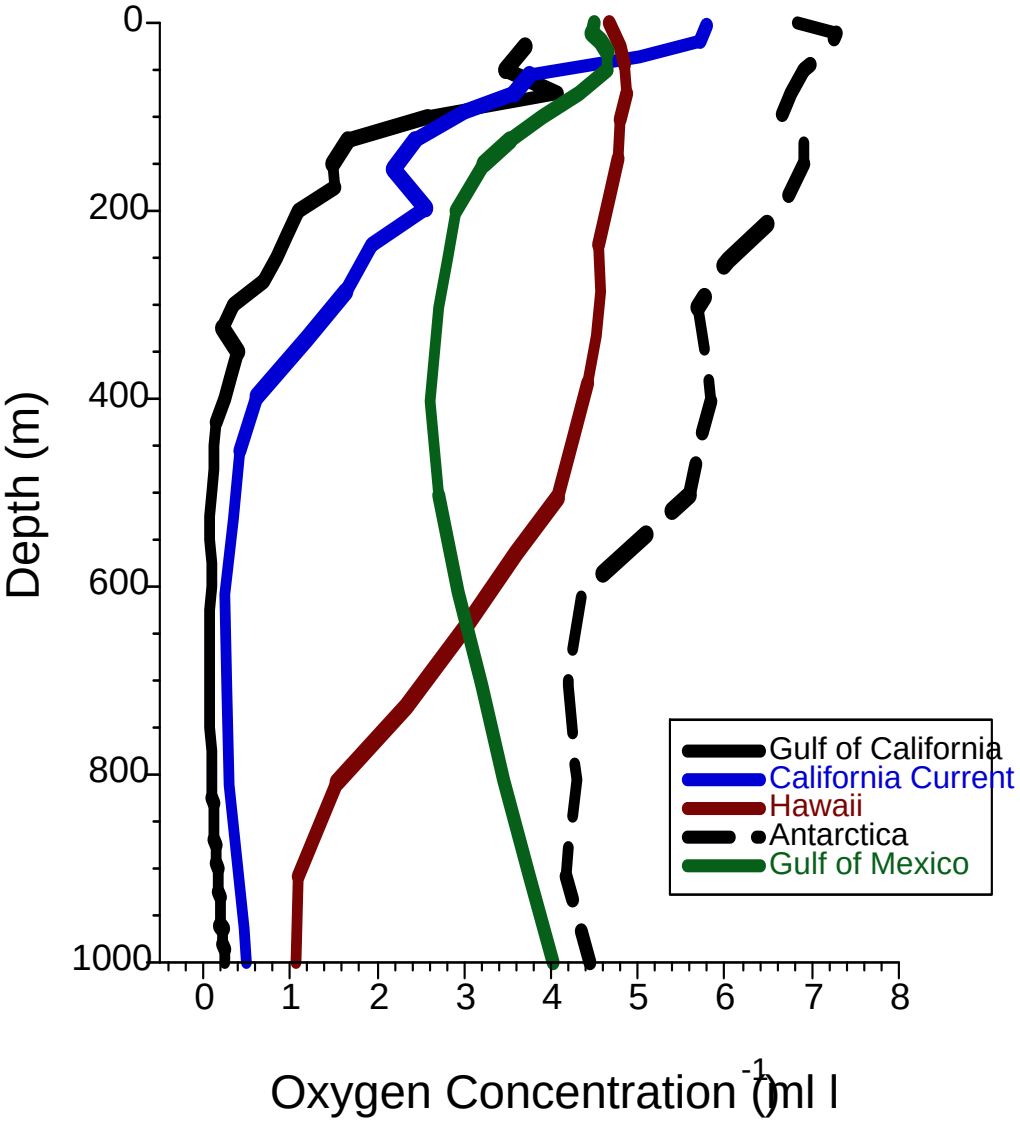
The “Biological Pump”

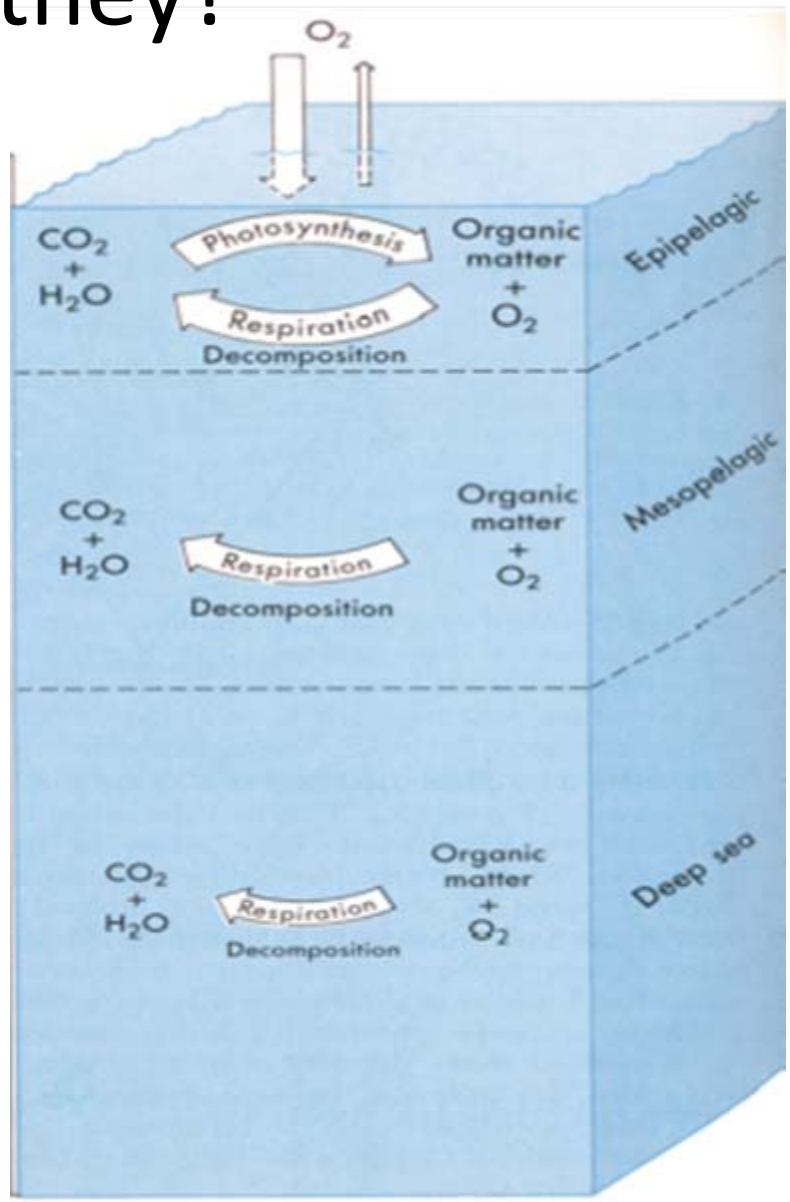
Fixation and transport of carbon from surface to depth



The efficiency of the biological pump is influenced by organismal physiology.

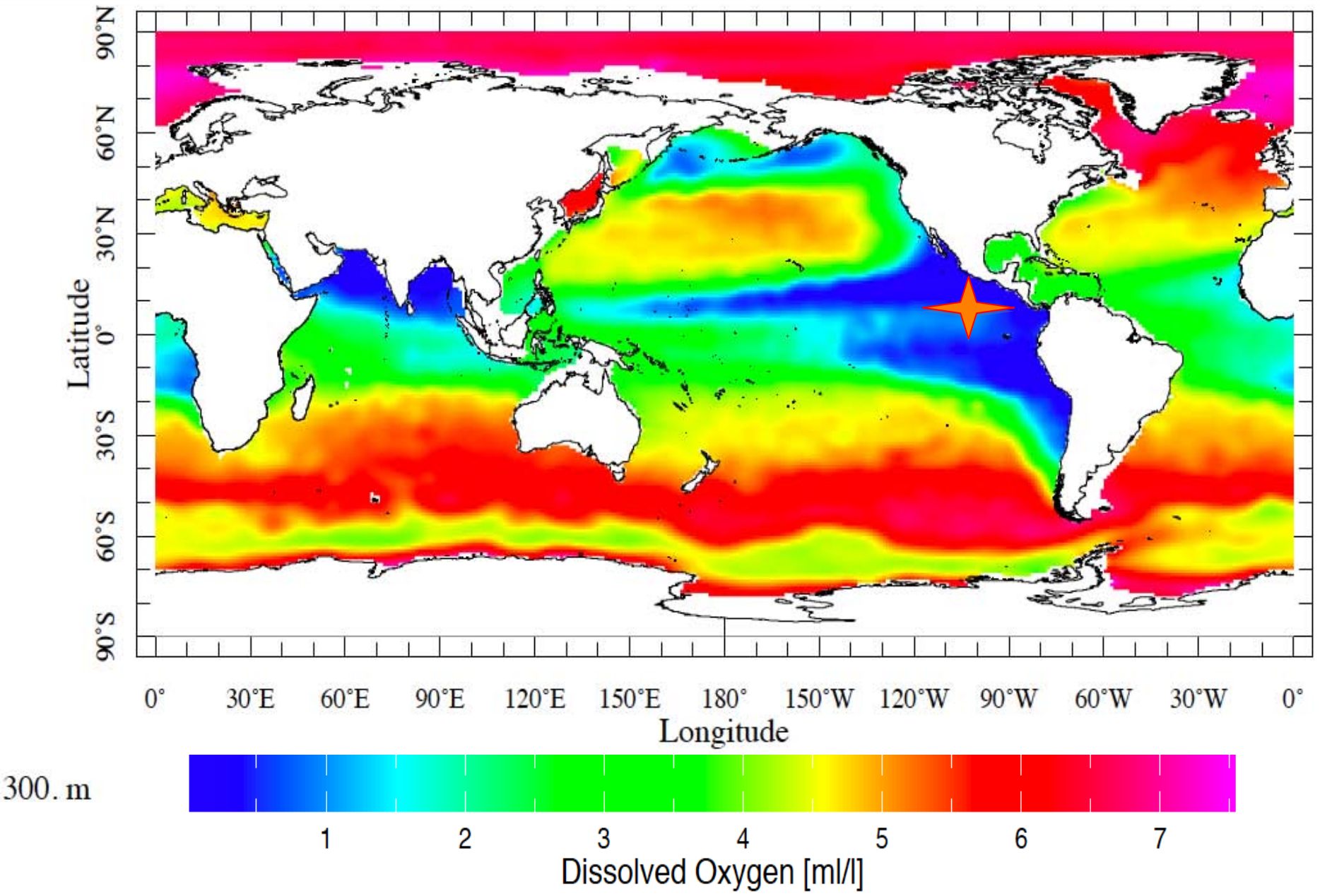
Oxygen Minimum Zones (OMZ's)
What are they?



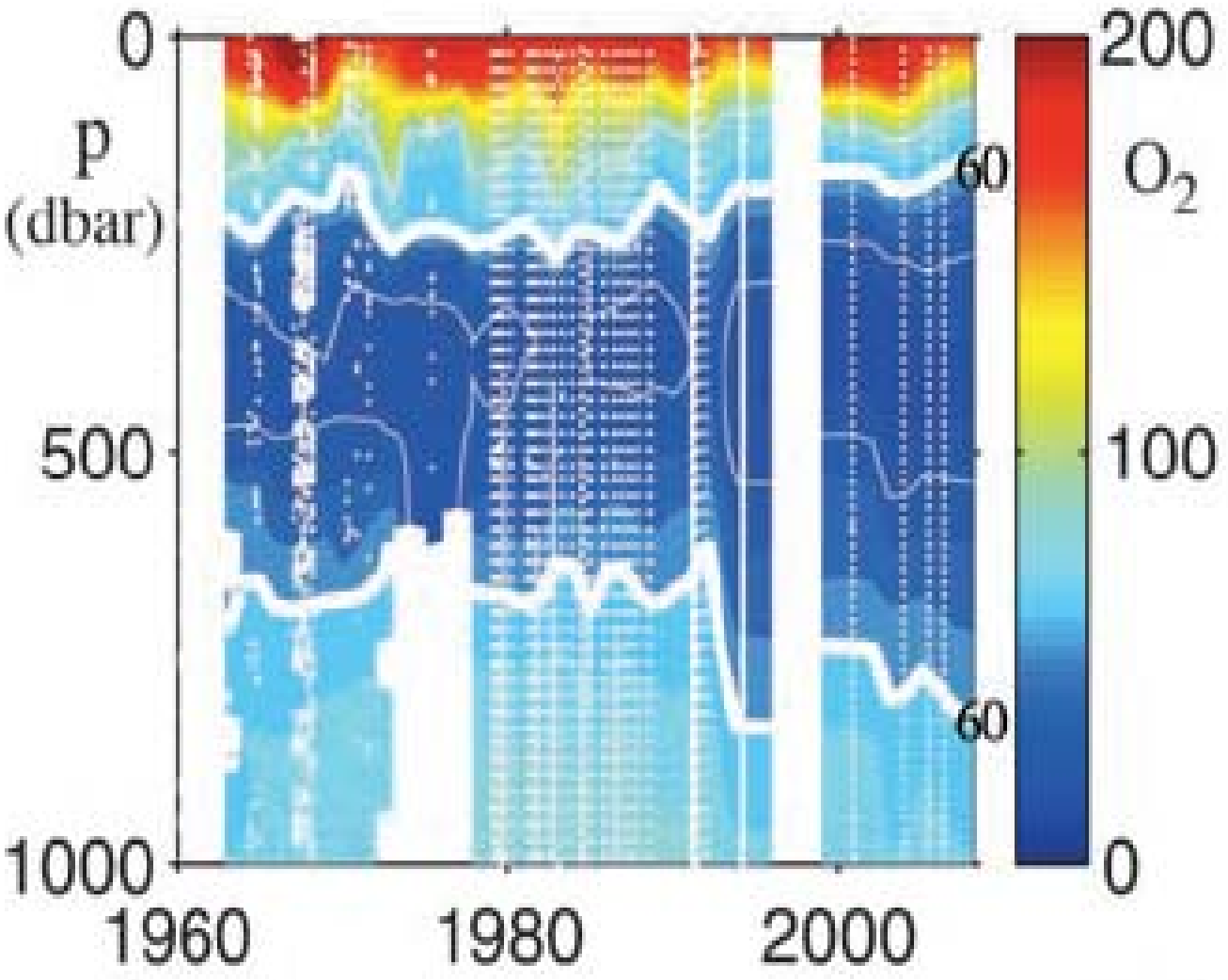


Castro & Huber

Oxygen Minimum Zones of the World



Expanding Oxygen Minimum Zones?

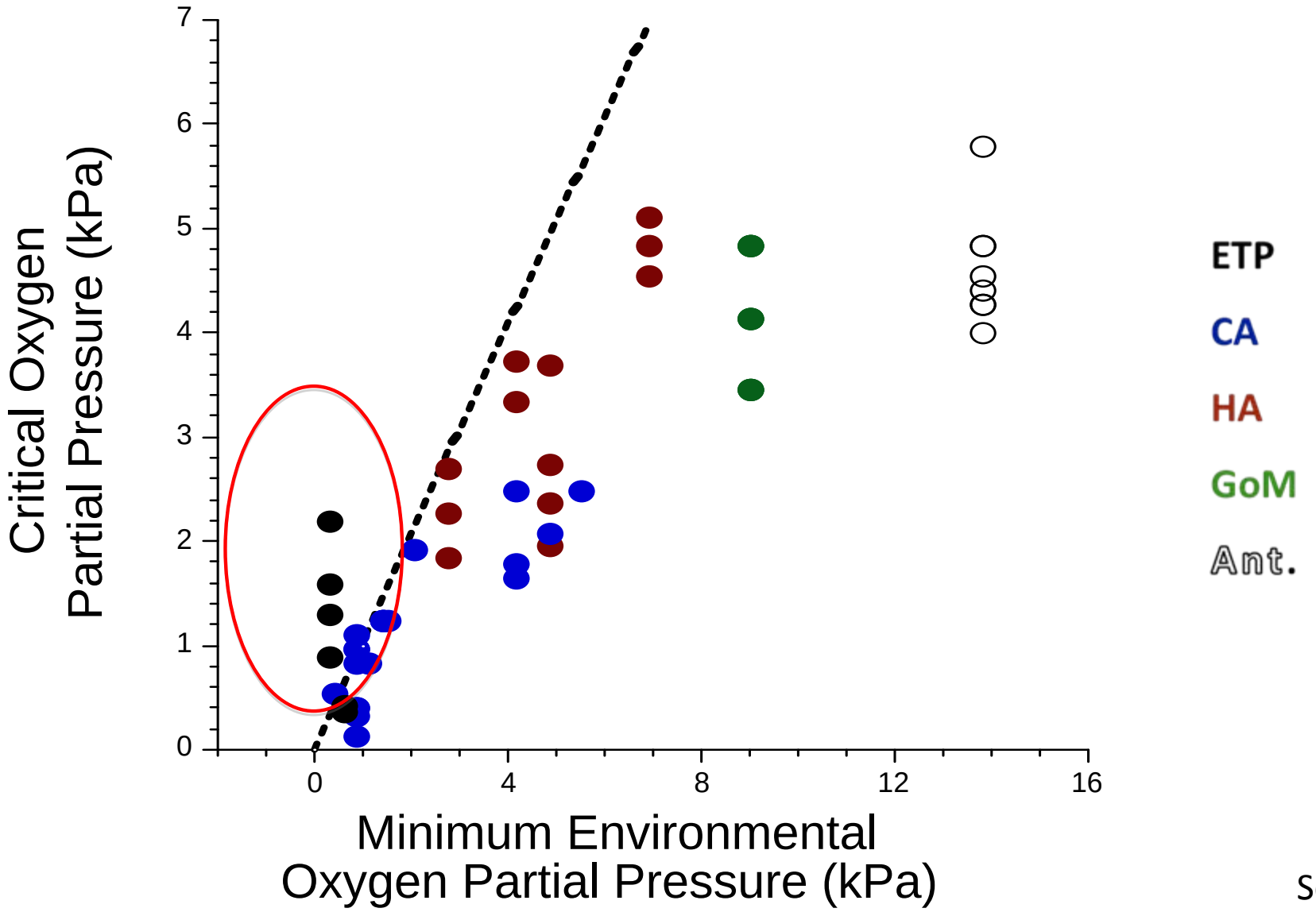


Year

Expanding Oxygen- Minimum Zones in the Tropical Oceans

Lothar Stramma,1* Gregory C. Johnson,2 Janet Sprintall,3 Volker Mohrholz4

A lower limit where organisms can no longer sufficiently extract oxygen from their environment



Seibel, 2011

Method for Estimating Total Metabolism

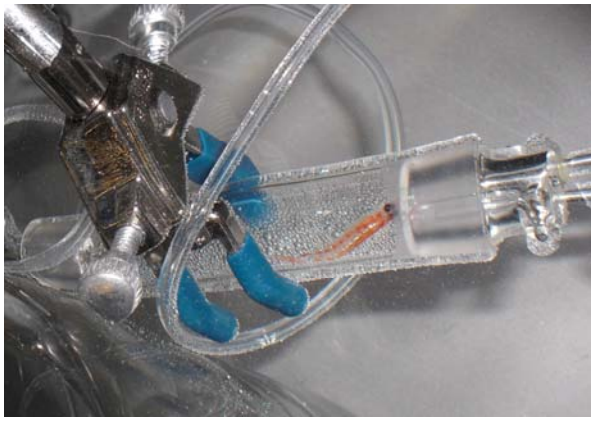
Total ATP energy equivalents **= Aerobic + Anaerobic**

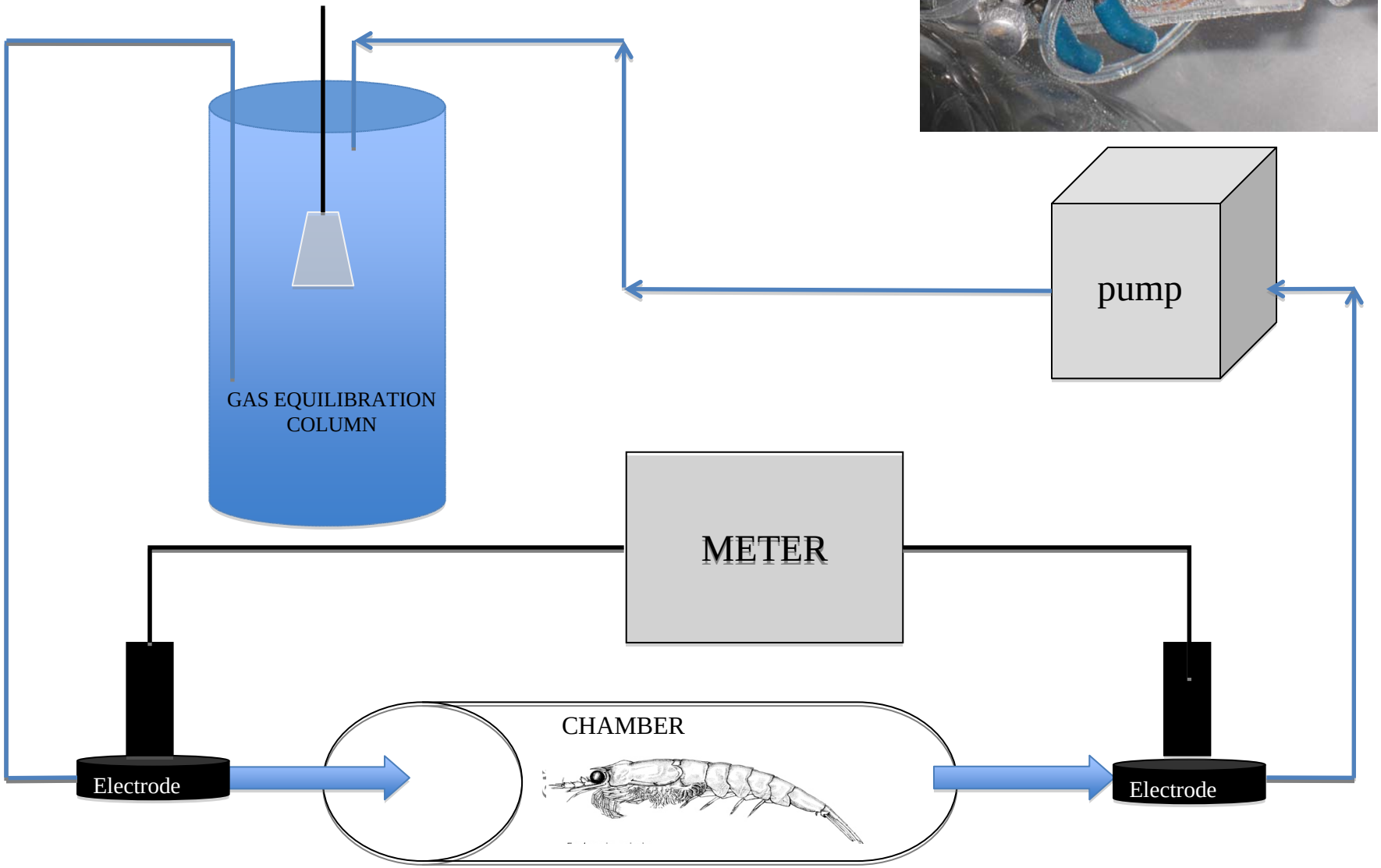
Aerobic ~ O_2 consumed

Anaerobic ~ Δ[Lactate]

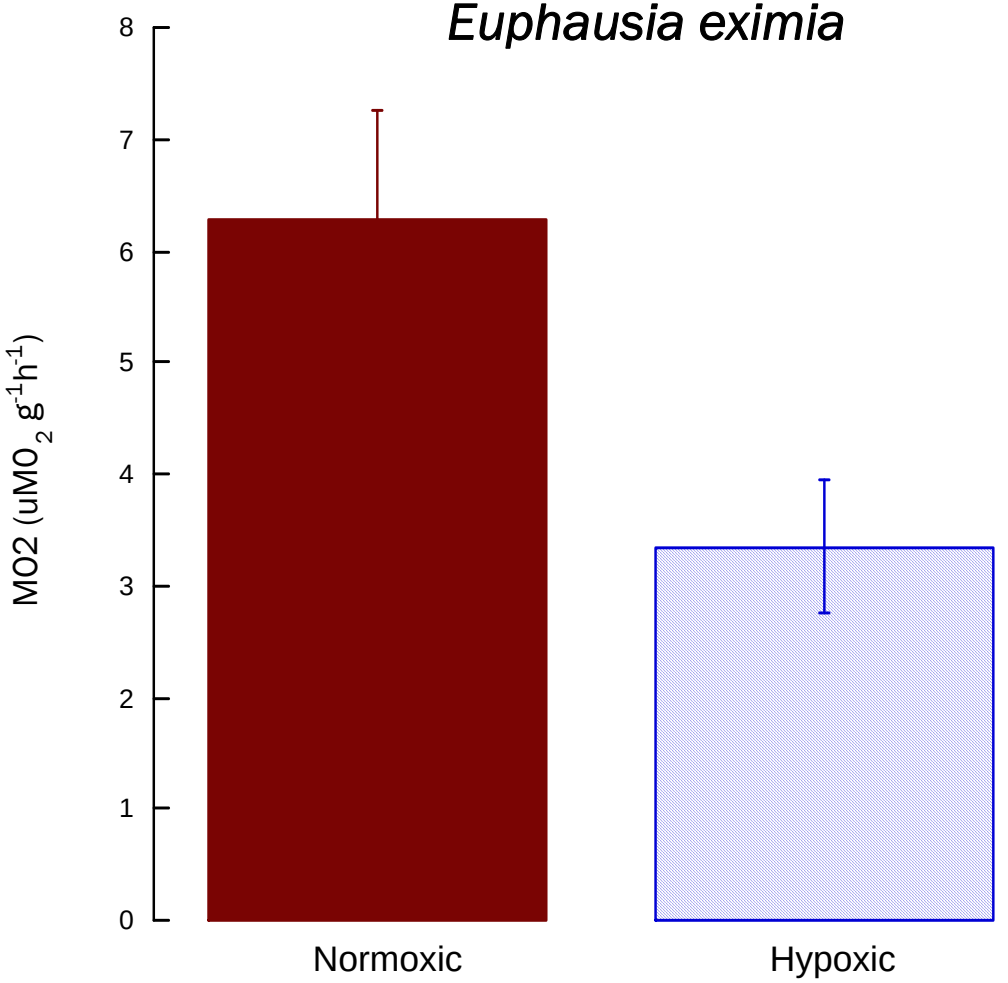
or ~ Δ[Octopine]

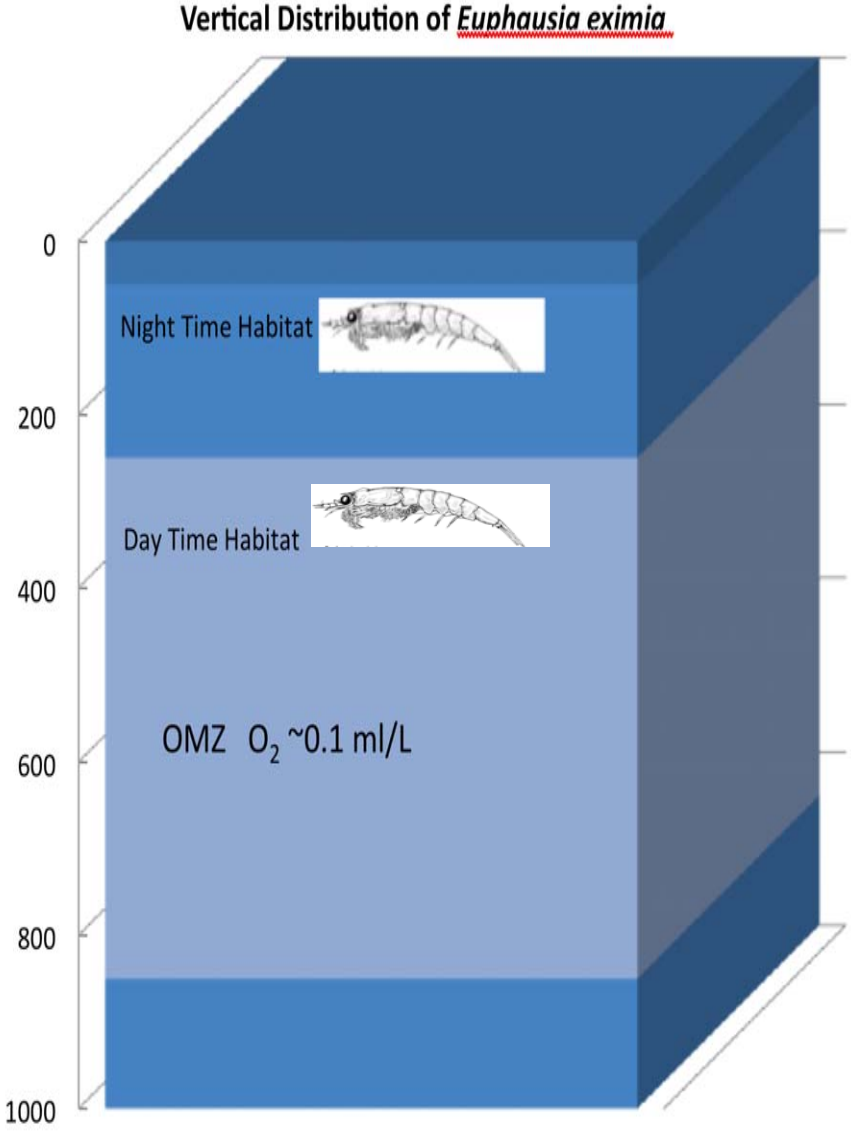
Measuring Zooplankton Respiration via Flow-Thru Setup





Reduced Oxygen Consumption(MO_2) Under Hypoxic Conditions





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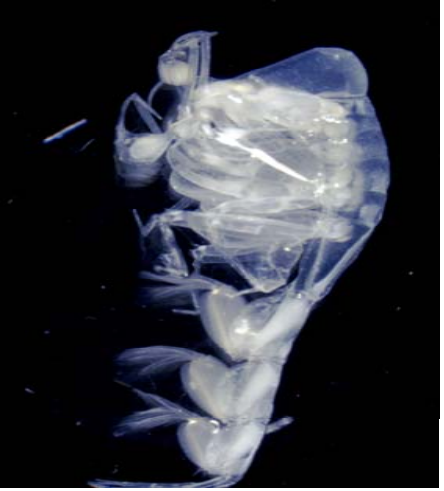
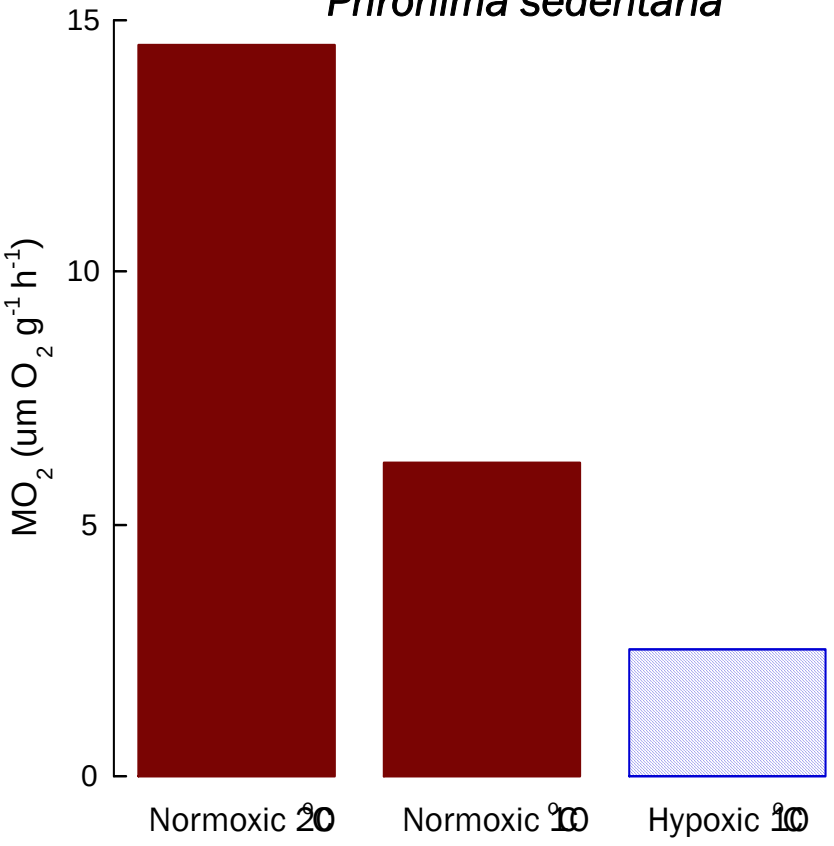
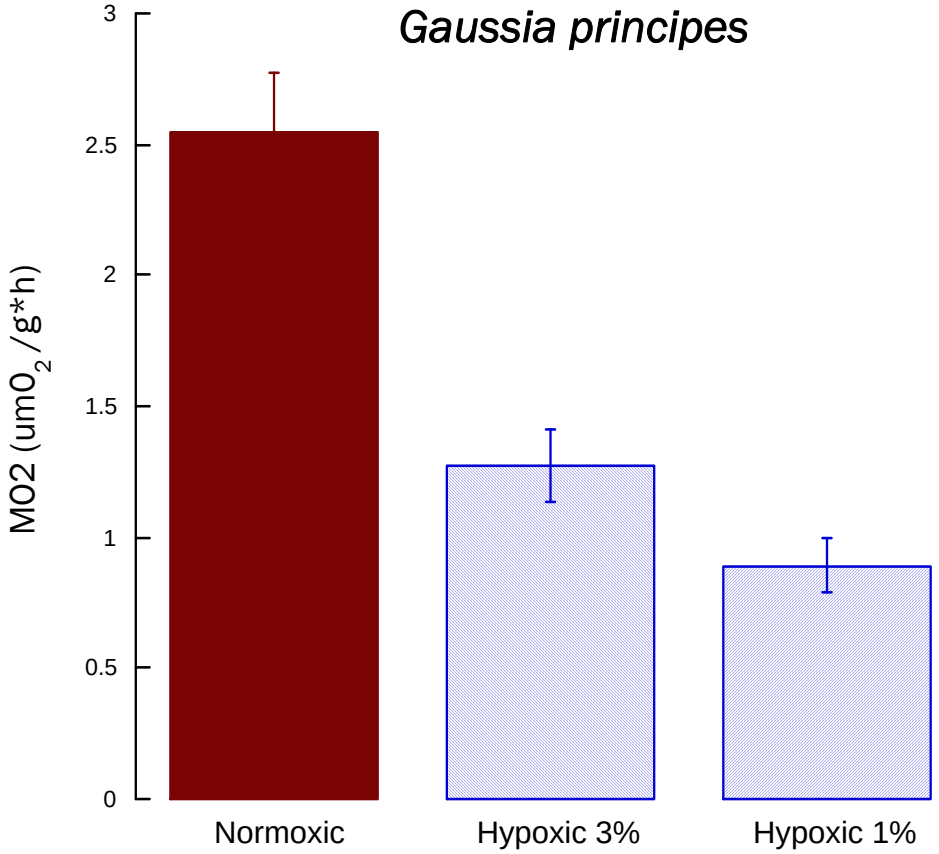


Phronima sedentaria



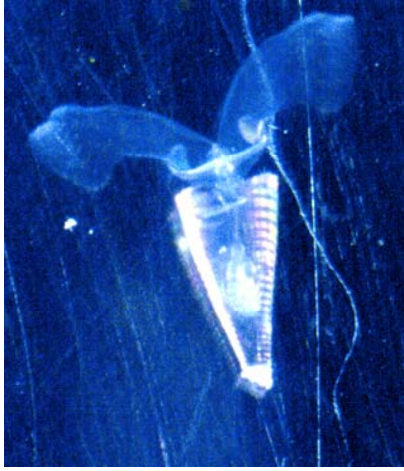
Elder, L., et al., unpublished

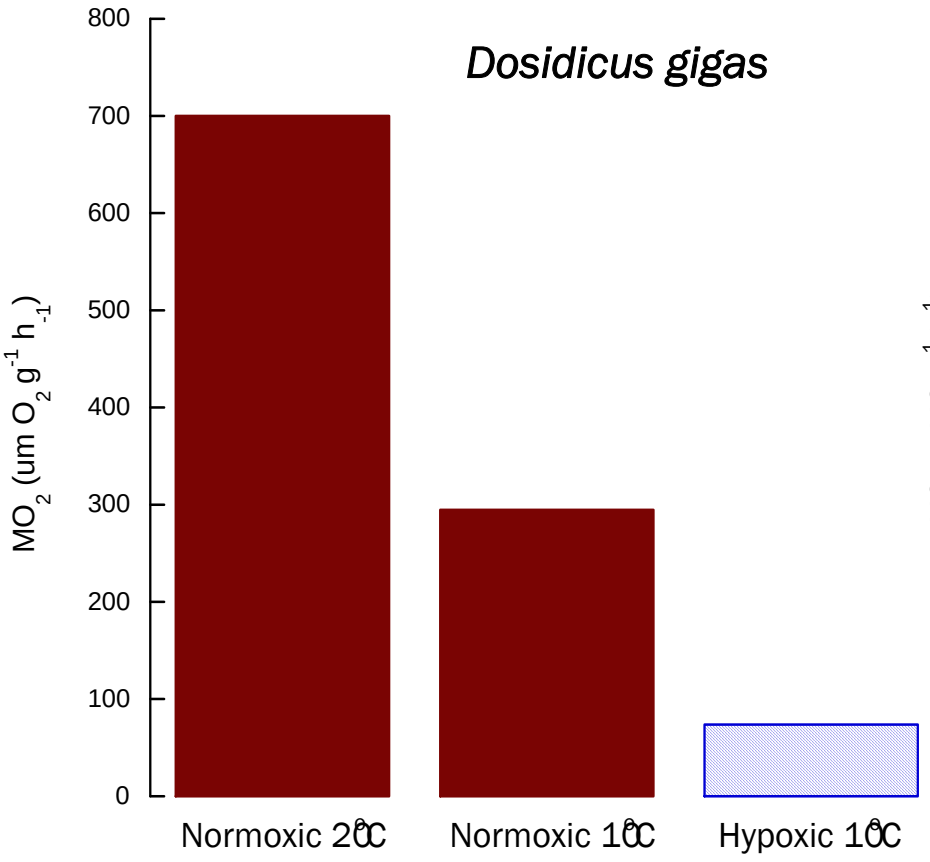
Gaussia principes

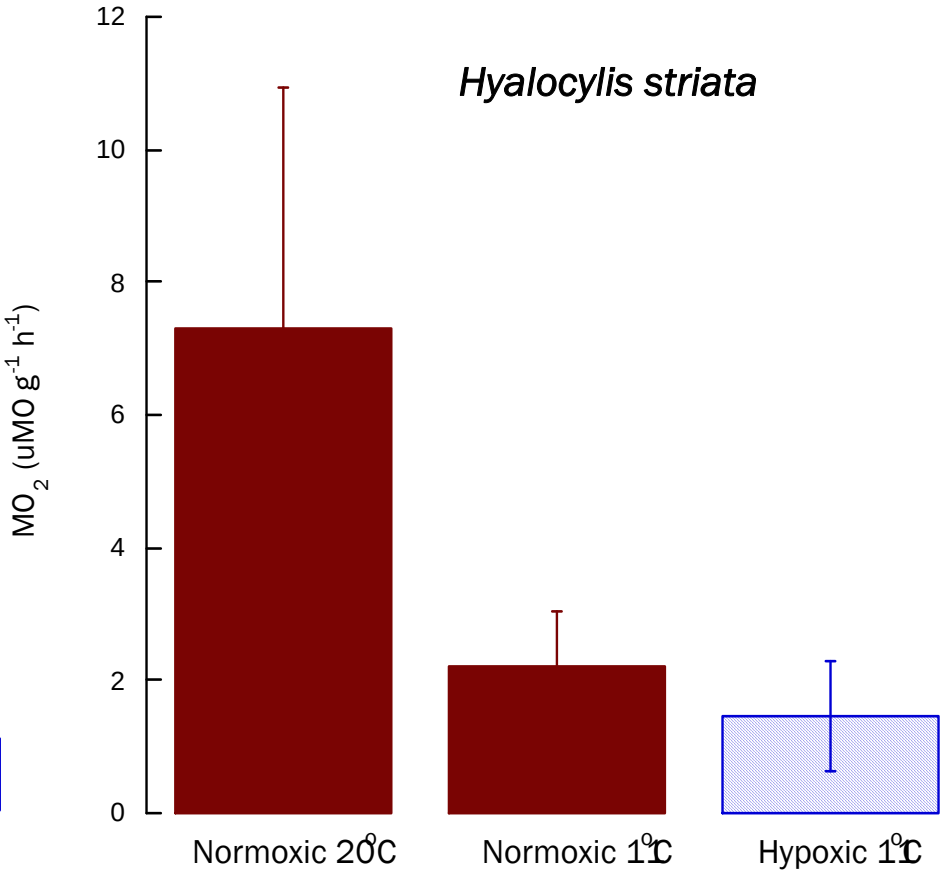


Schneider, J., et al., unpublished

Reduced Oxygen Consumption (MO_2) Under Hypoxic Conditions





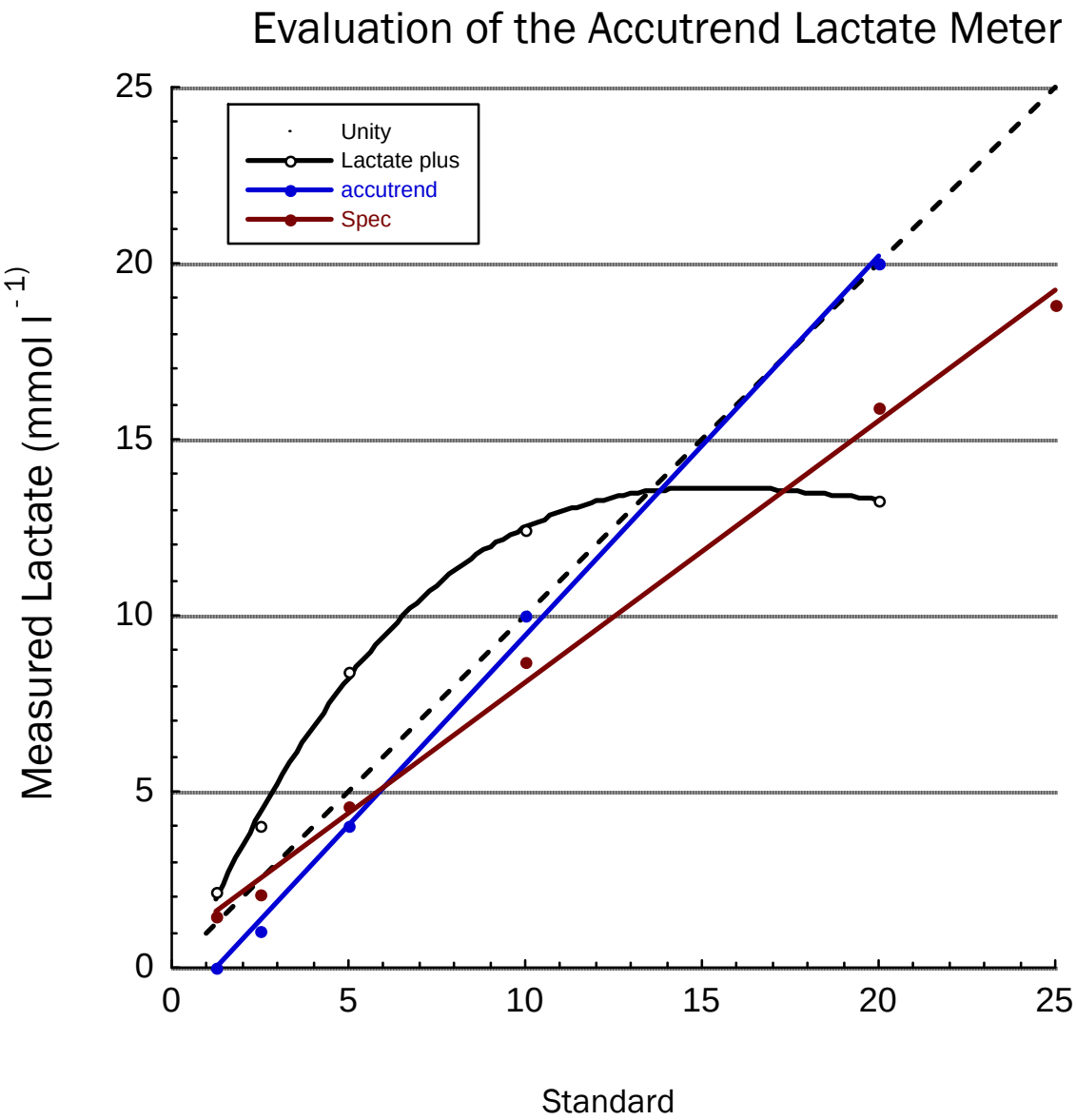


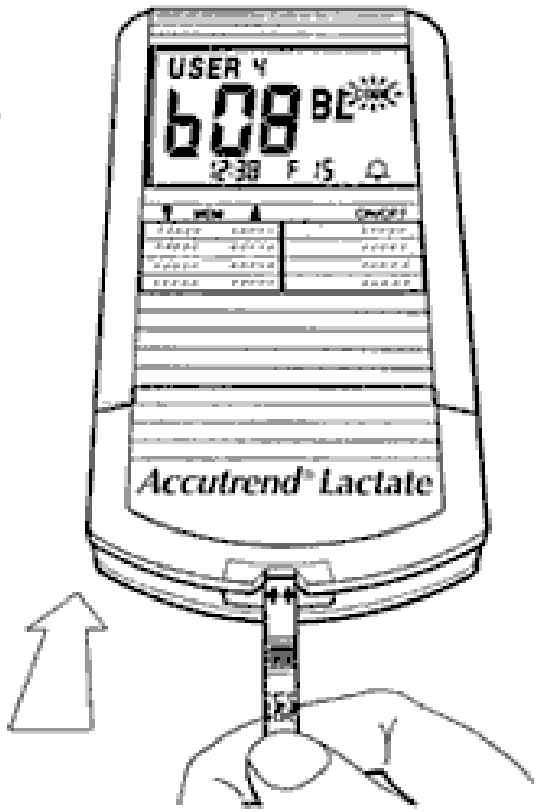
Rosa & Seibel, 2010

Maas, A., et al., unpublished

Measuring Anaerobic End Products

Anaerobic ~ Δ**[L-Lactate]**

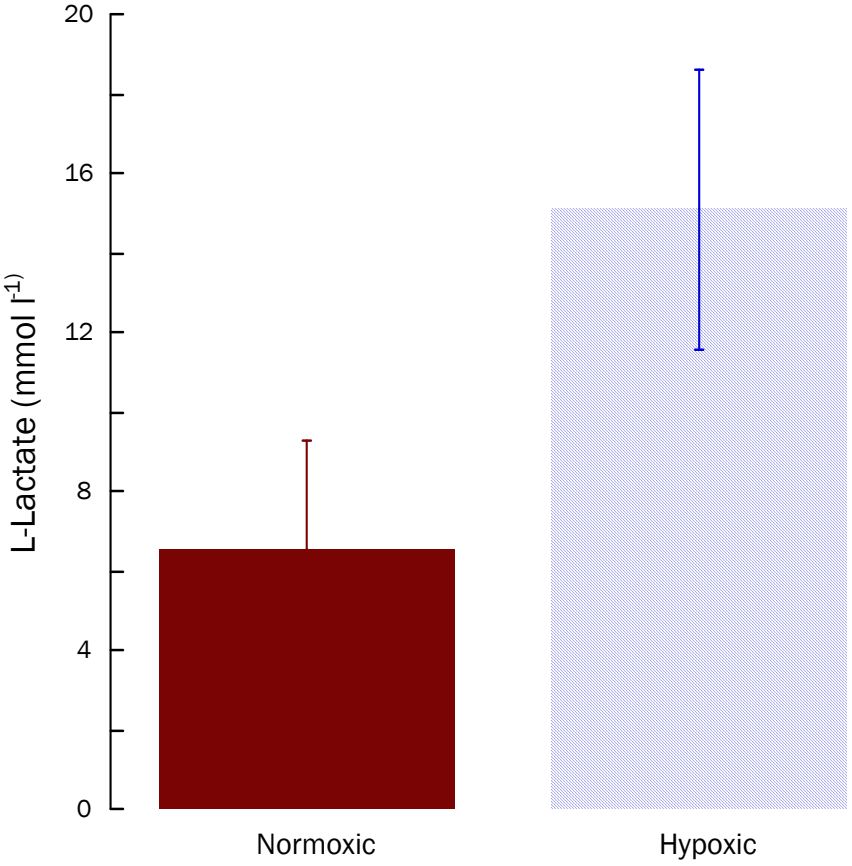


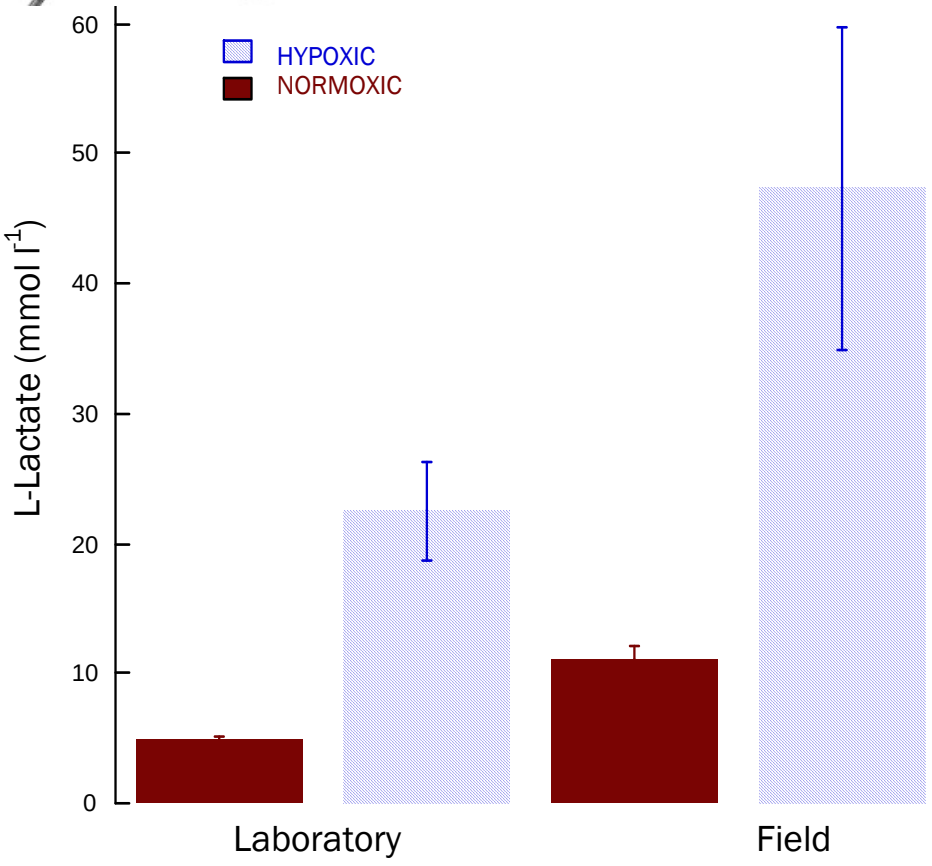


Increased Accumulation of Anaerobic End Products Under Hypoxic Conditions

Euphausia eximia

Nematocelis gracilis

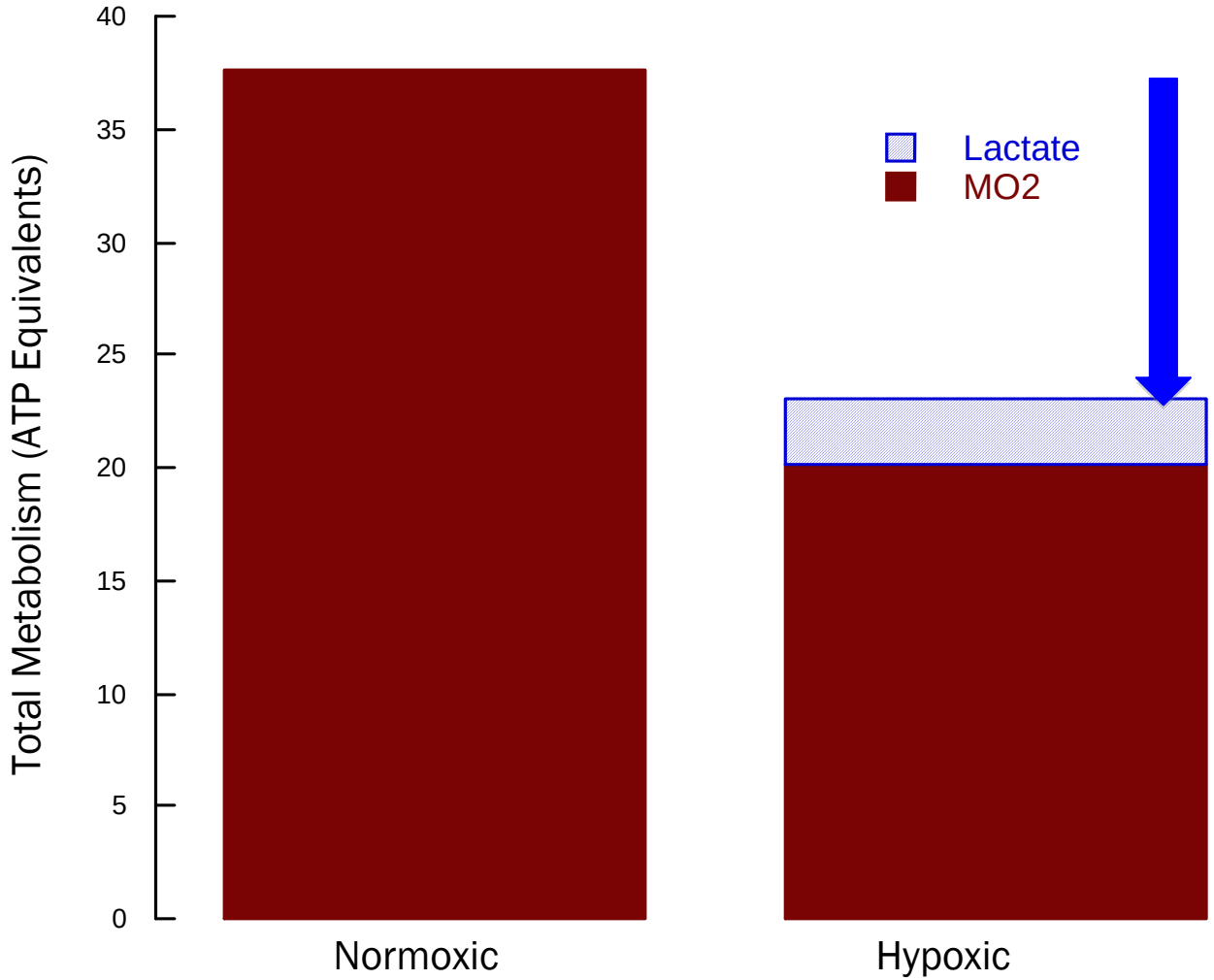




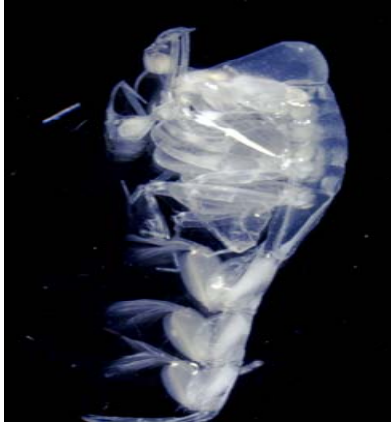
Metabolic Suppression

Total ATP energy equivalents **= Aerobic + Anaerobic**

Euphausia eximia



Metabolic Suppression

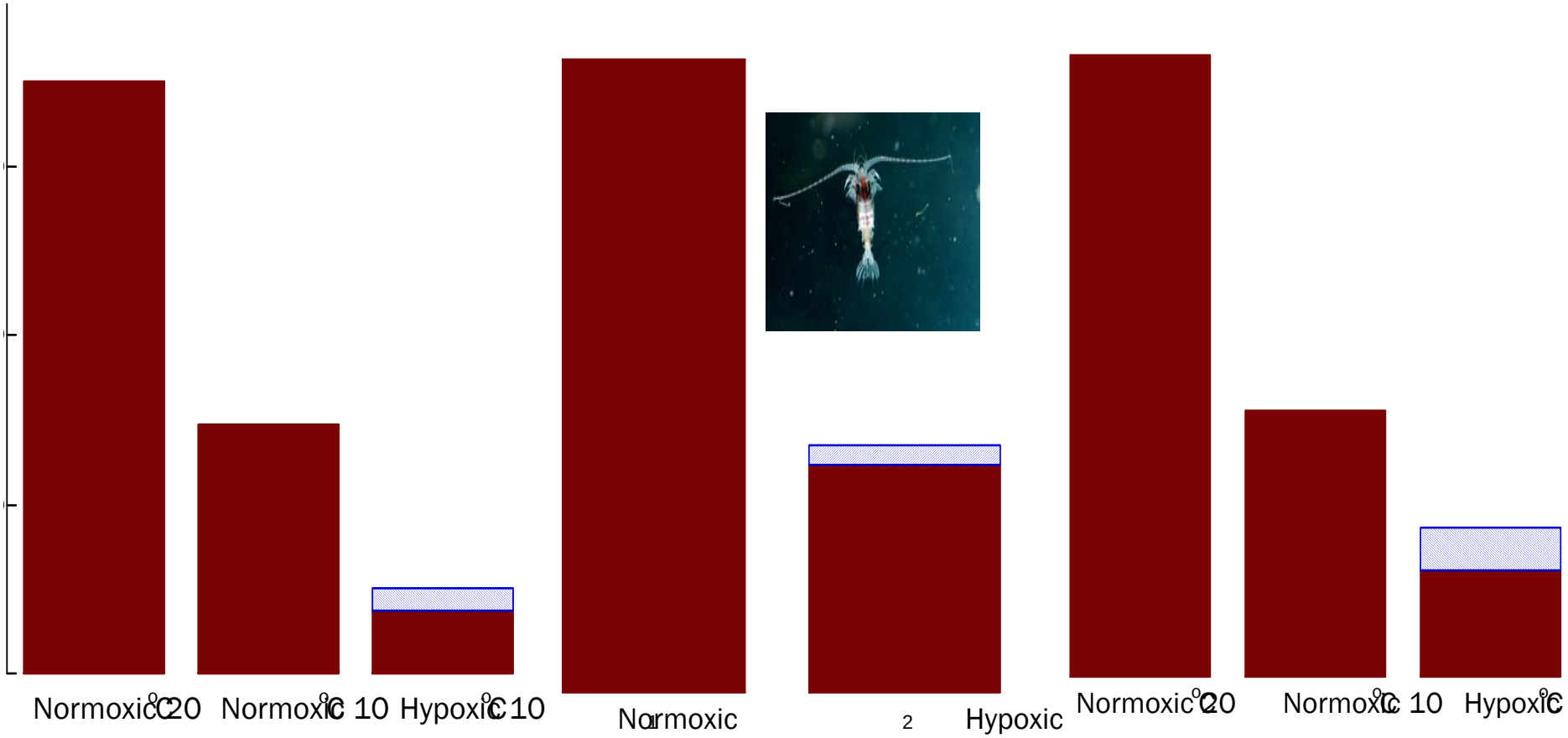


Total ATP energy equivalents = **Aerobic** + **Anaerobic**

Dosidicus gigas

Gaussia Principes

Phronima sedentaria



Rosa and Seibel, 2010

Elder, L., et al., unpublished

Variation between species

Organism	% Suppression
Dosidicus gigas	~80%
Euphausia eximia	~45%
Phronima sedentaria	~50%
Gaussia principes	~65%
Hyalocylis striata	~35% (MO_2)

Conclusions

Metabolism of vertically migrating zooplankton in OMZ's is reduced on average ~60% (45-80%)

Result in an over estimate of respiratory carbon flux in regions with pronounced OMZs

Intensifying OMZ's may result in shift to migrator-dominated mid-water ecosystem

Acknowledgements

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