Arm Regeneration of *Asterias forbesi* in Hypoxic Conditions

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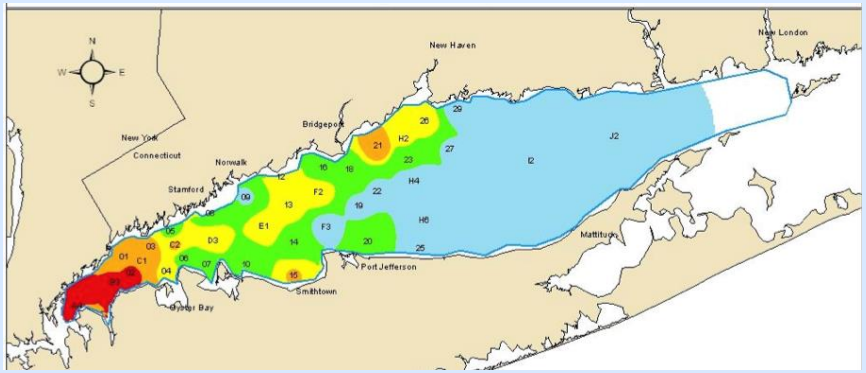
Background

- Autotomy – echinoderms' natural ability to expel entire appendages

- *Amphiura filiformis* demonstrates reduced arm regeneration from hypoxic conditions, 14 - 25% length and 25 - 36% area (Nilsson and Sköld 1991)

- *Asterias forbesi* is native to the Long Island Sound (LIS)

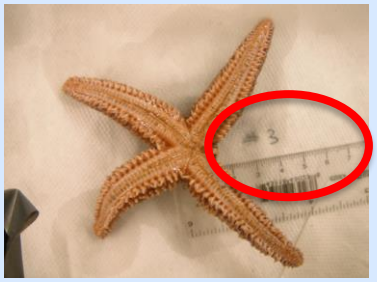
- LIS exhibits annual hypoxic (<3.5 mg 1^{-1} DO) and anoxic (0 mg 1^{-1} DO) conditions – especially in Western LIS



2013 Long Island Sound Hypoxia Season Review, DEEP

Methods

- *A. forbesi* ordered from Woods Hole MBL



- Induce autotomy

Condition	*A. forbesi* count	Days Since Autotomy 31-Jan	20-Feb	12-Mar
Control	5	0	20	40
Partial Hypoxia	5	0	20	40
	3	-	0	20

- Photos for arm measurements (mm) with Image J™

When?

- Before autotomy
- Immediately after autotomy
- After 20-day intervals

How?

- Arm lengths measured from central-most tube feet to the arm tip

Methods

Regeneration Experiment #1 (RE#1)*:* ***Hypoxia vs. Normoxia***

- Five *A. forbesi* in both conditions

- Maintained hypoxia (~3.50 ppm DO) daily

Results: RE#1, Hypoxia

~72 hours: One dead, all stressed

- lack of skeletal rigidity, feeding behavior, mobility
- RE#1 ended, tank oxygenated to normoxia

~144 hours: Two dead

- *A. forbesi* did not recover from initial hypoxia

Shick 1976: No autotomy, lethal exposure to 3.0 ppm DO

140 hours:

- *A. forbesi* reached >50% mortality

48 to 84 hours:

- stressed, but a full recovery when returned to normoxia

Methods

Regeneration Experiment #2: ***Partial Hypoxia vs. Normoxia***

- Three hours of daily hypoxia, 16 days
- Five *A. forbesi* in both conditions (3 to replenish lost in RE#1)
- Fed live blue mussels (*Mytilus edulis*) daily

	Control Tank Normoxia	**Experimental Tank Partial Hypoxia**	
Condition	Normoxic	Normoxic	Hypoxic
ppm DO	7.07 ± 0.04	6.94 ± 0.06	3.48 ± 0.05
°C Temperature	23.27 ± 0.28	23.36 ± 0.22	

Results: RE#2, Partial Hypoxia

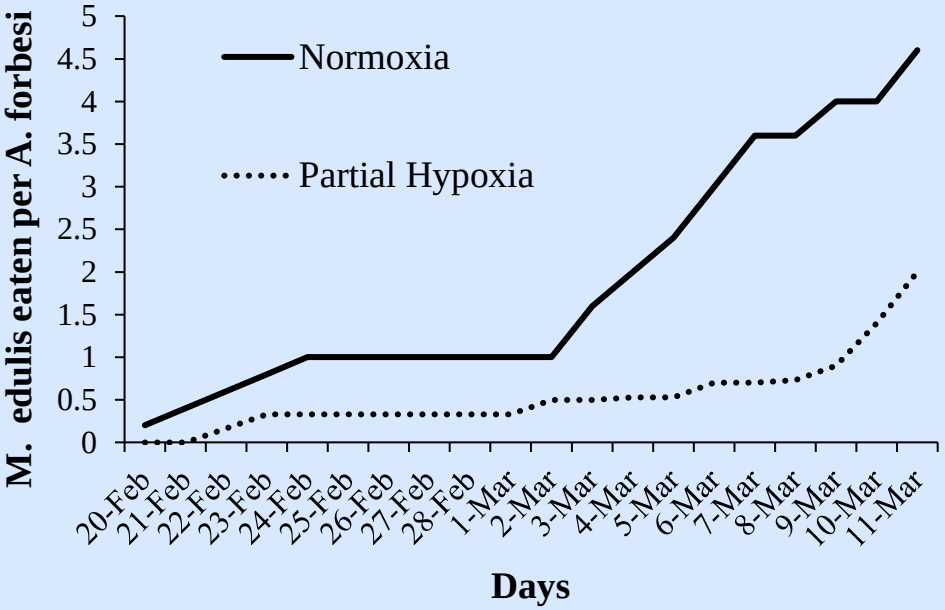
0-20 days post-autotomy:

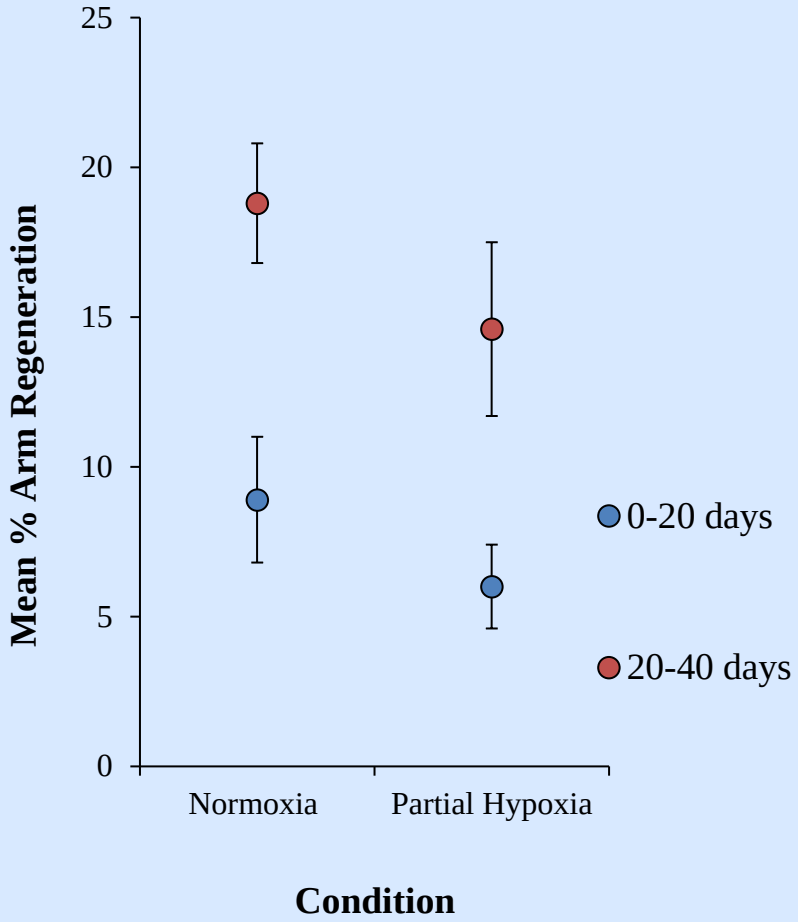
- 2.9% less arm regeneration in partial hypoxia

20-40 days post-autotomy:

- unchanged by the variables addressed

- twice the feeding rate in normoxia





Conclusions

I. After autotomy, hypoxia impacts:

a.) **initial** regeneration rate of *A. forbesi*
b.) survival
c.) feeding behavior

II. Asteroids have decreased regeneration rates in hypoxia as do ophiuroids

To support the results of this study, future research should address:

a.) Distributions of *A. forbesi* in hypoxic waters

b.) Regenerative ability of other *Asterias* species in hypoxia

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Questions

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