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Graduate Research Symposium 2017

Title

The Natural History of Red Sea Giant Clams

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The Natural History of Red Sea Giant Clams

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Earth and Planetary Sciences

Reefs are Under Threat



Research objective and rationale

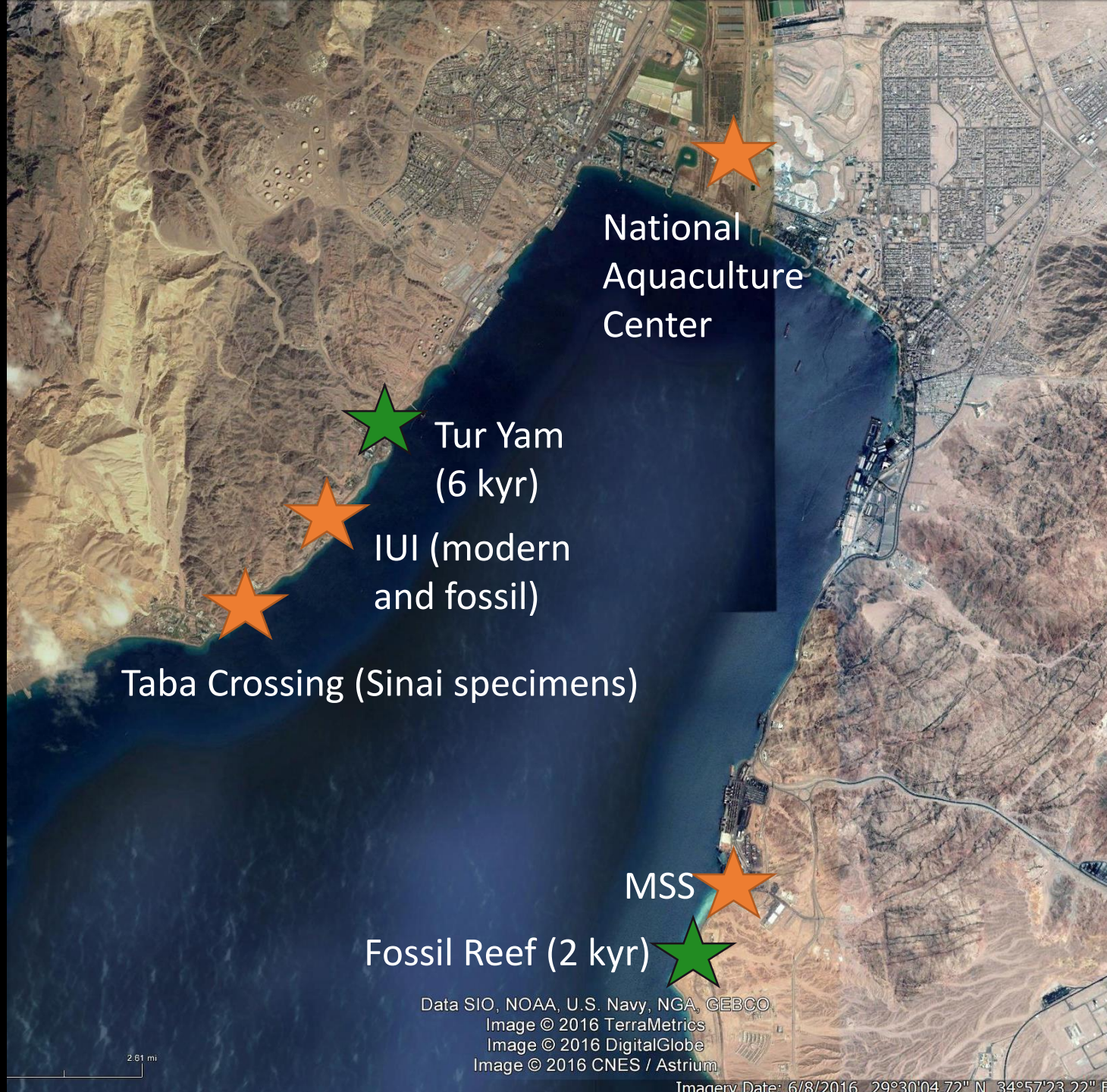
- Overharvesting known to reduce giant clam populations
- What impact has pollution had on their biology?
- Proposal: Giant clam growth has been stunted through time due to their high reliance on photosymbiosis



Giant clams are at risk

- Important component of reefs
- Harness symbiotic algae to accelerate their growth
- Particularly vulnerable to pollution





National
Aquaculture
Center

Tur Yam
(6 kyr)

IUI (modern
and fossil)

Taba Crossing (Sinai specimens)

MSS

Fossil Reef (2 kyr)

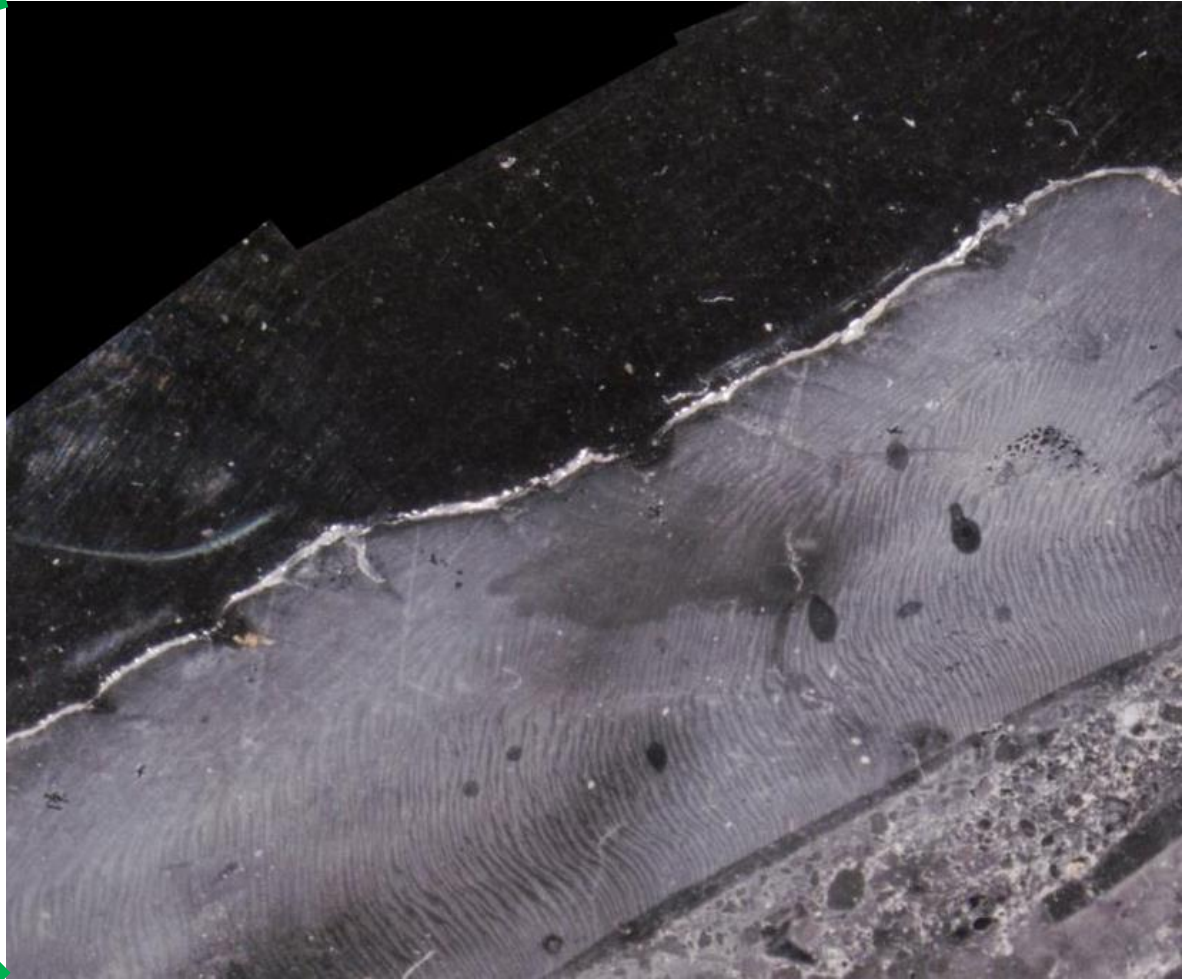
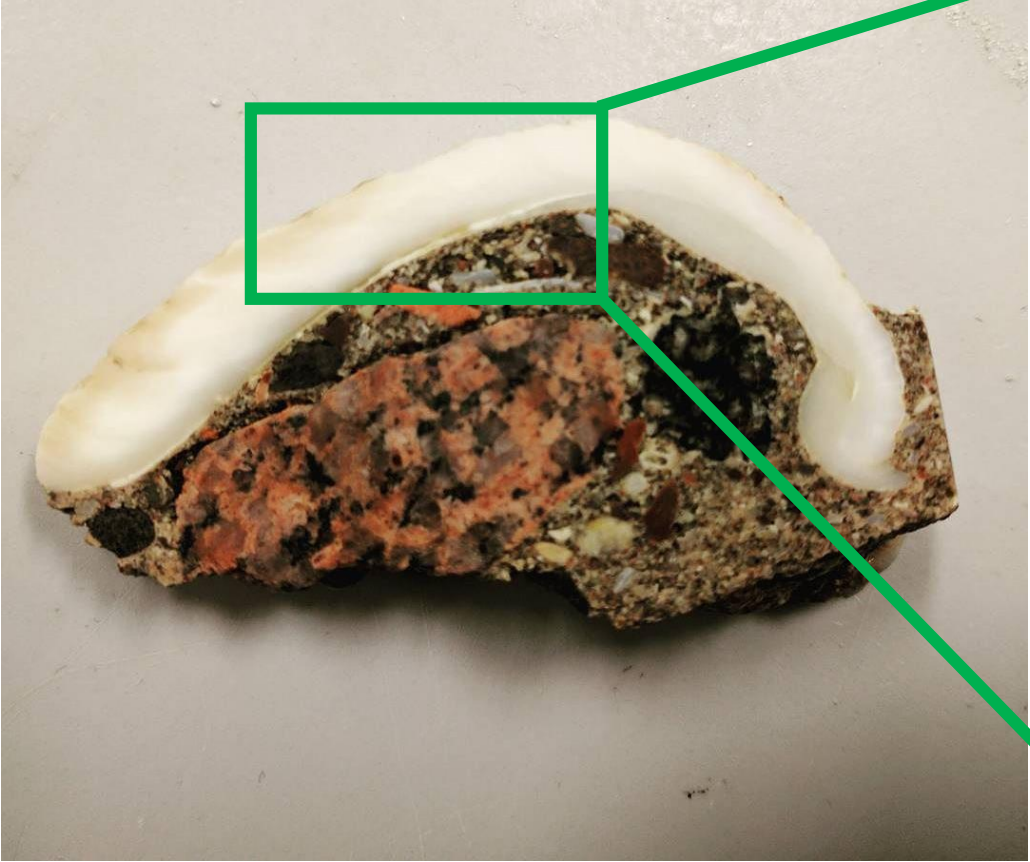
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2016 TerraMetrics
Image © 2016 DigitalGlobe
Image © 2016 CNES / Astrium

261 mi

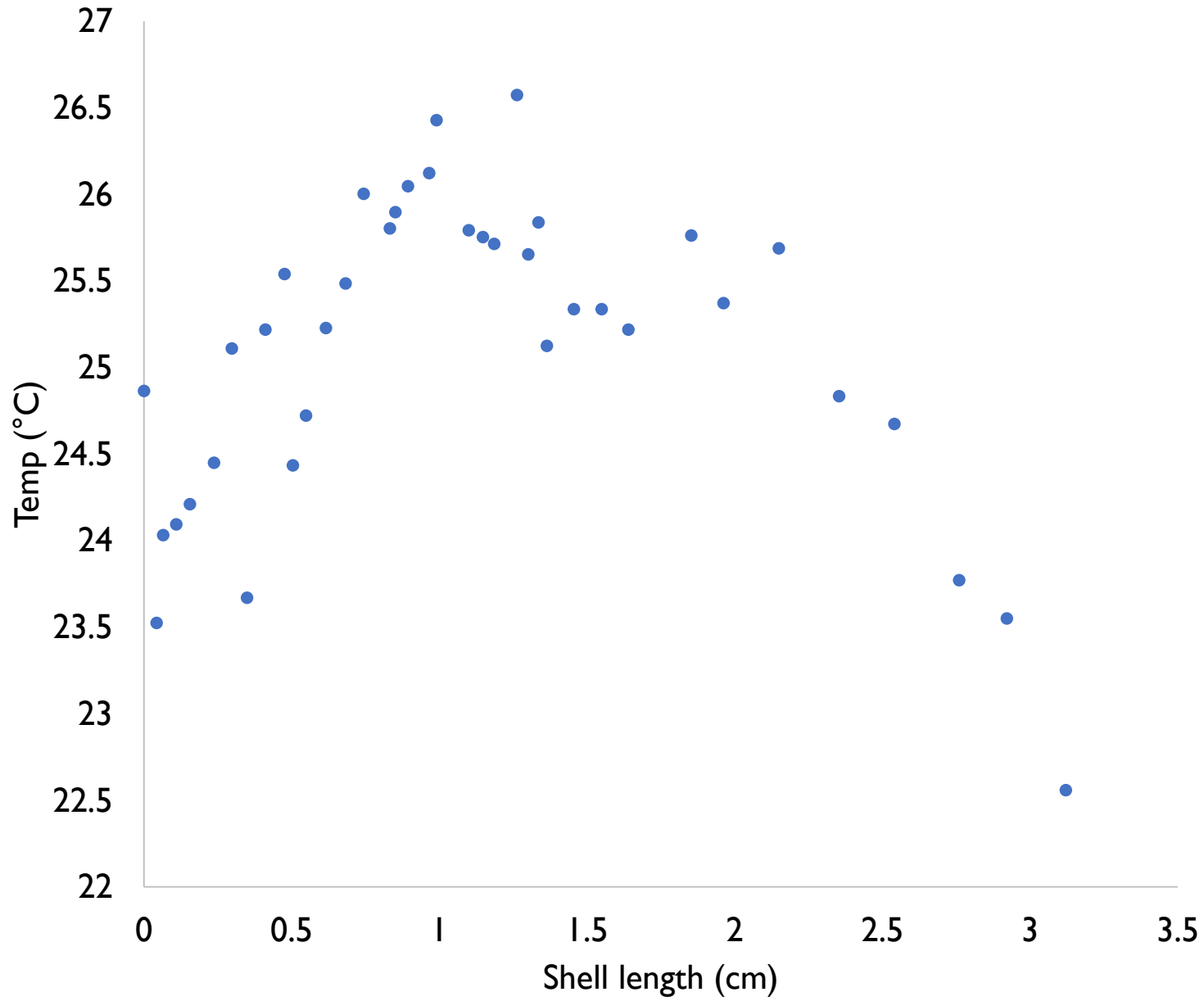
Imagery Date: 6/8/2016 29°30'04.72" N 34°57'23.22" E



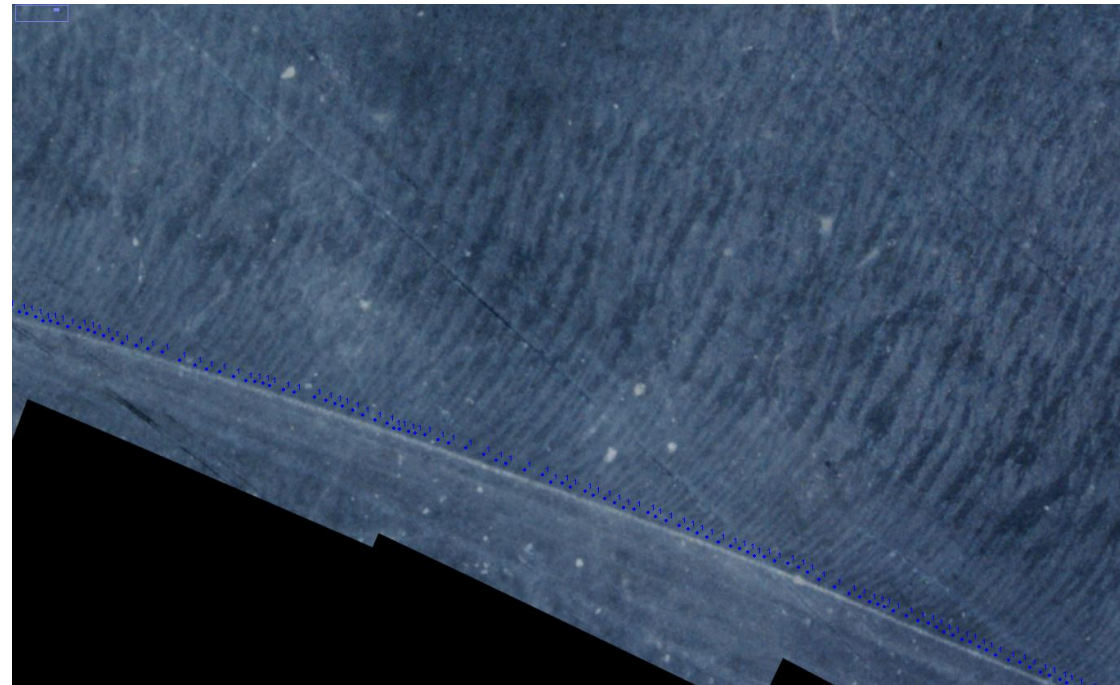
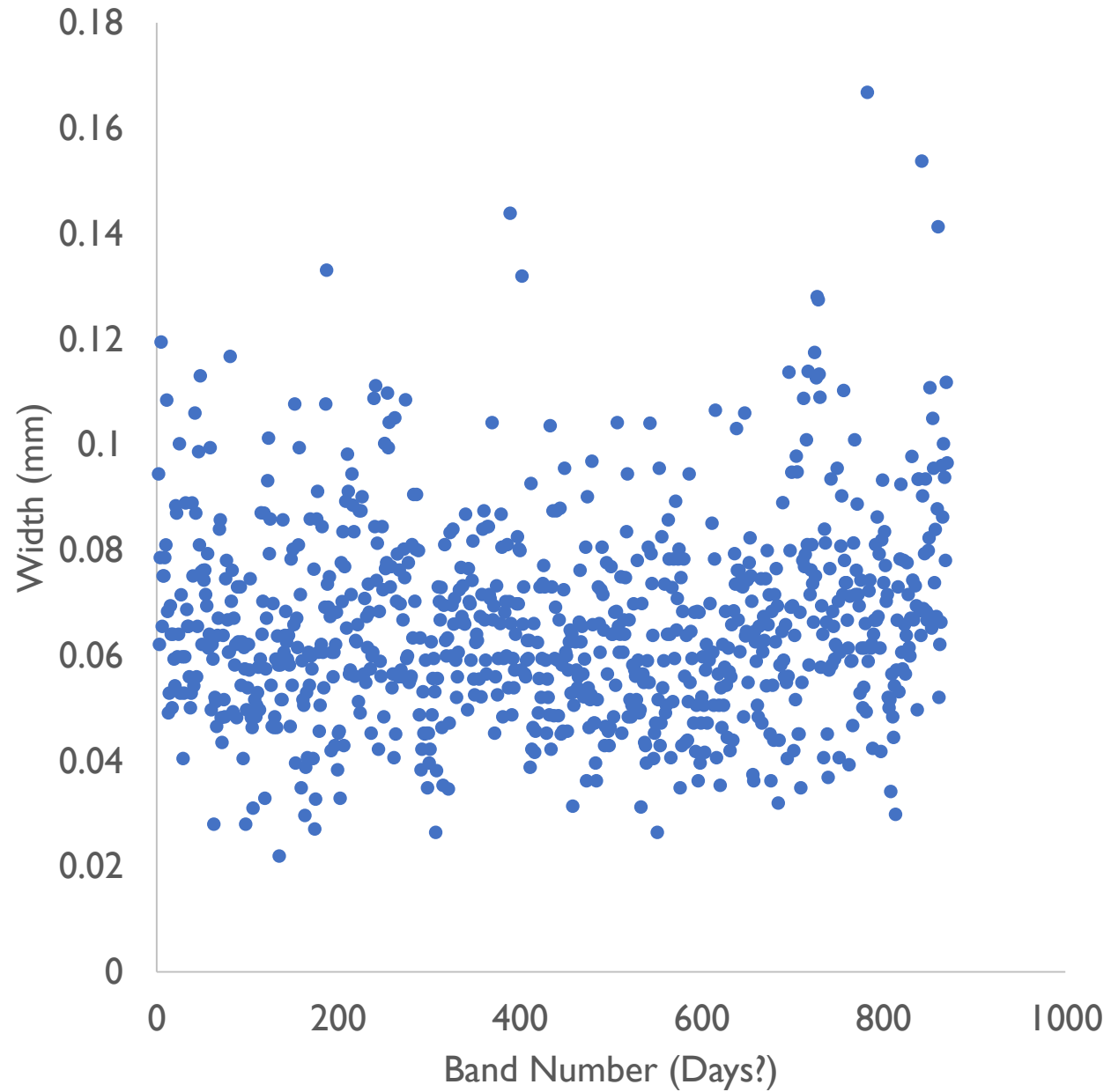
Conservation Paleobiology



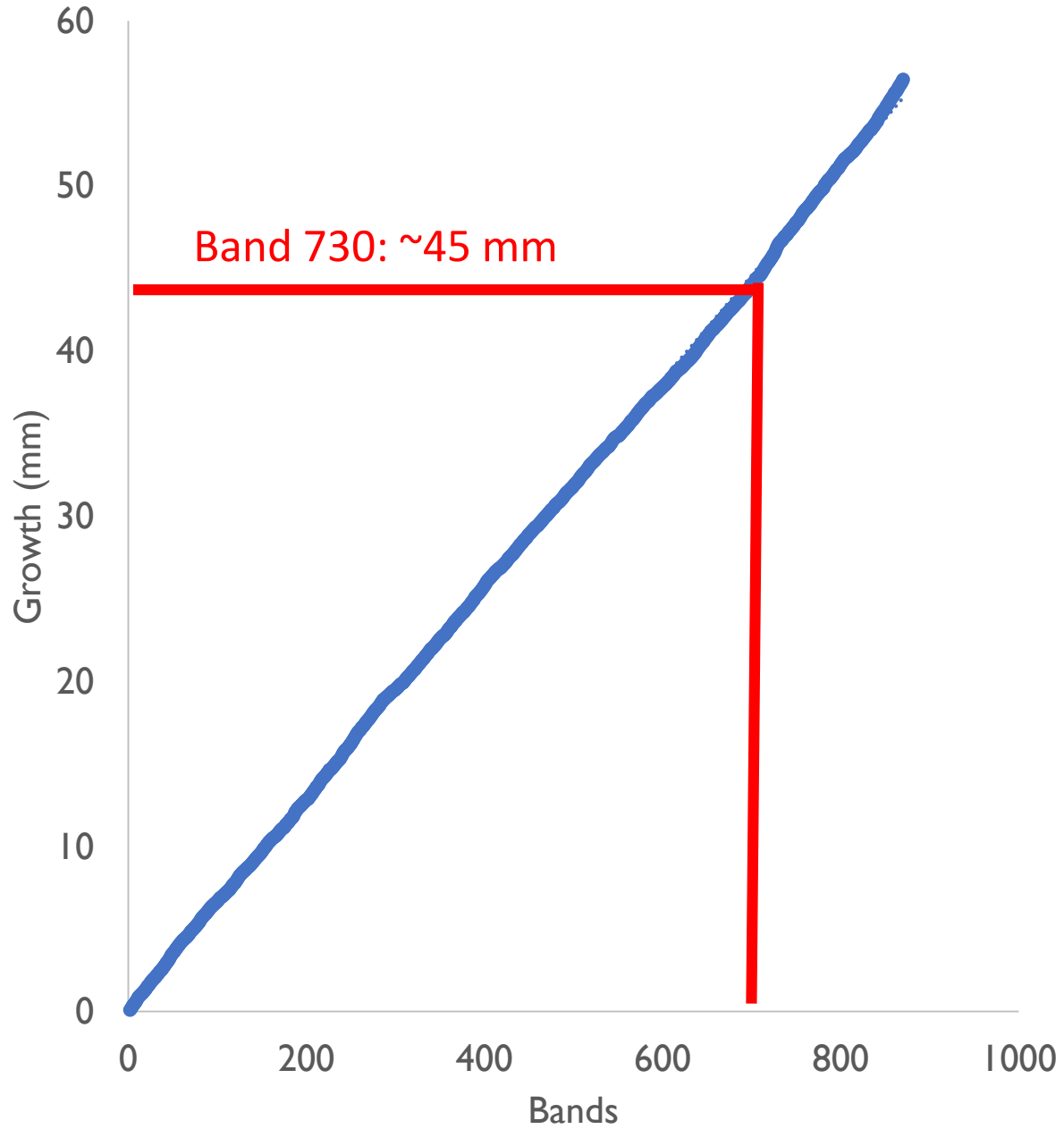
Temps recorded in Sinai *T. maxima*



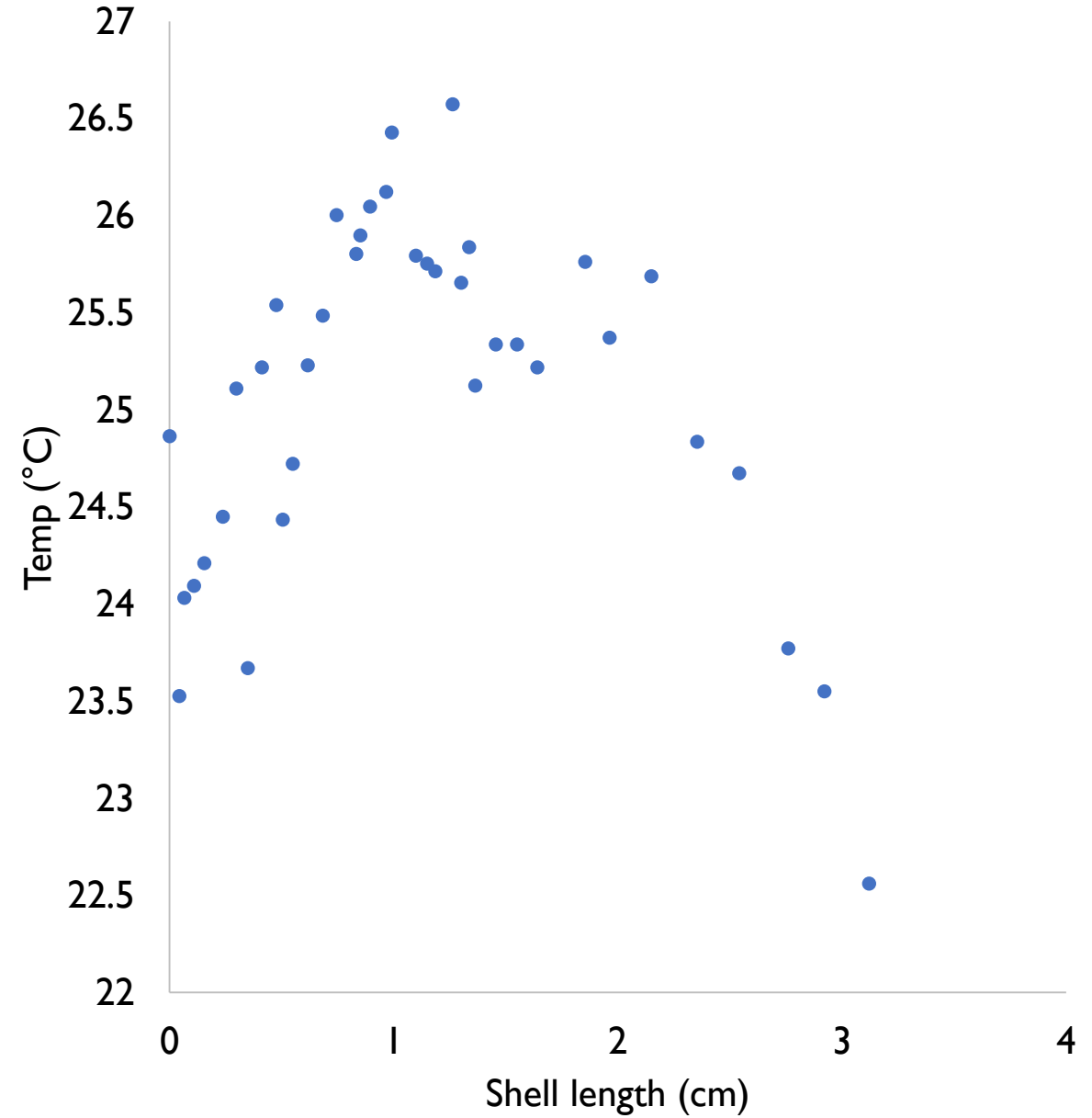
“Band Width” throughout the shell



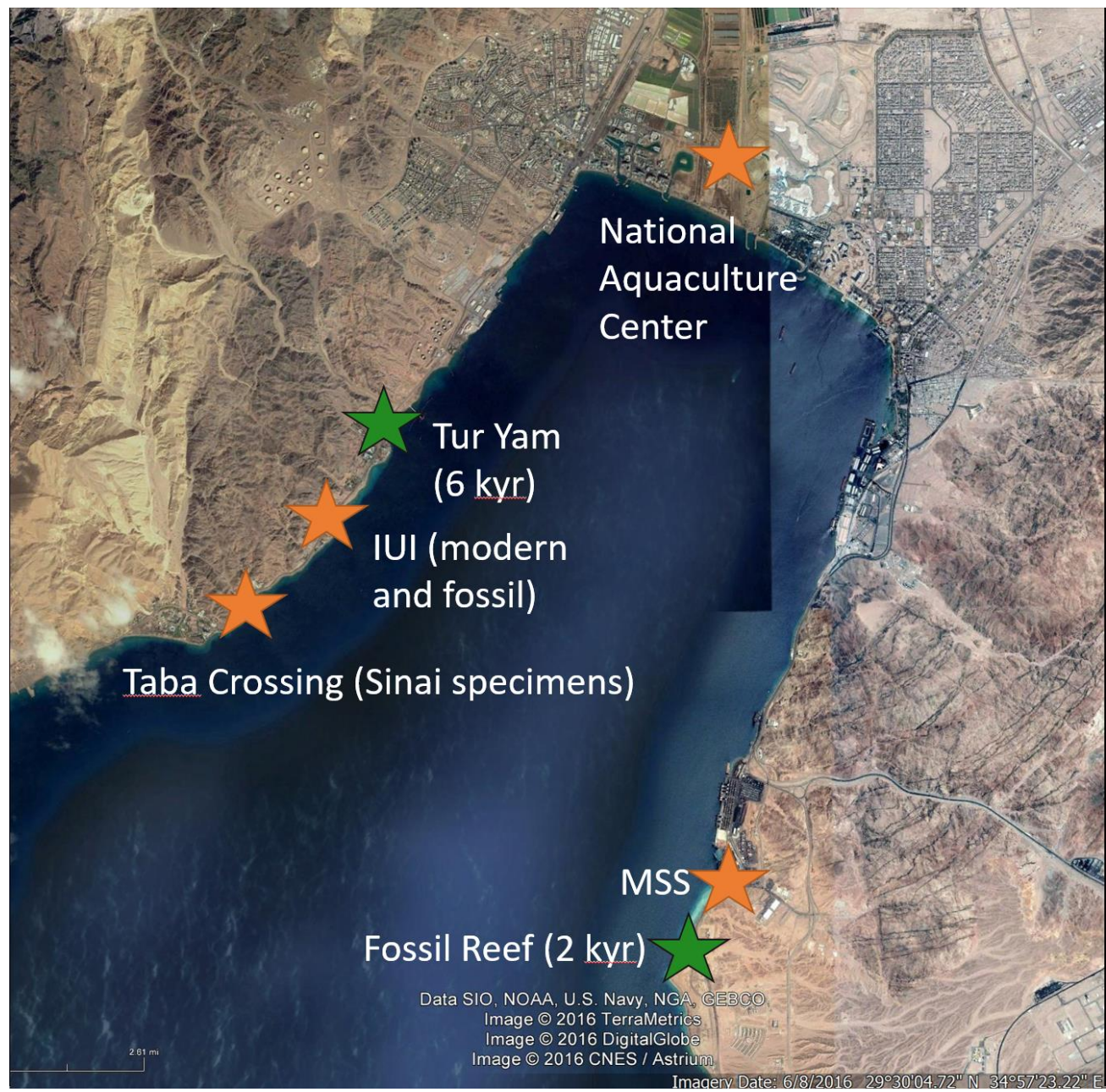
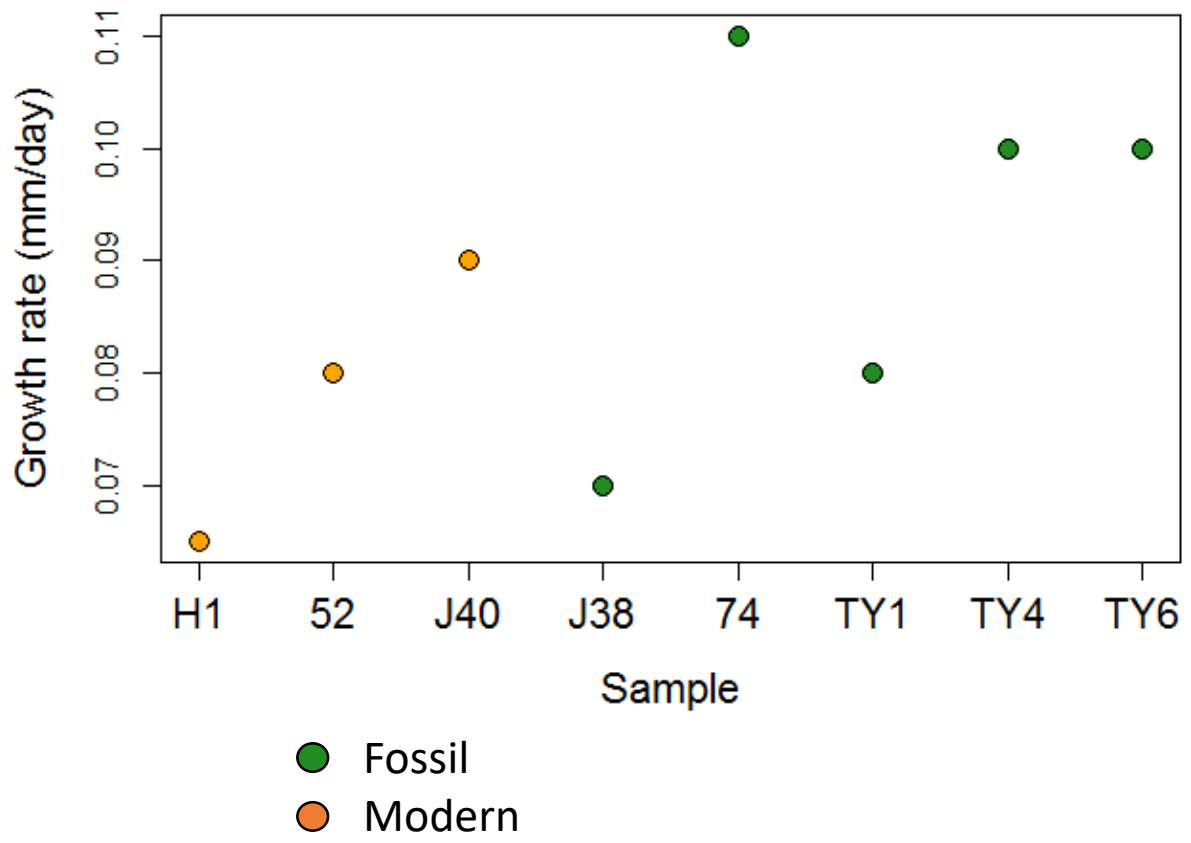
Shell HI cumulative growth



Temps recorded in Sinai *T. maxima*

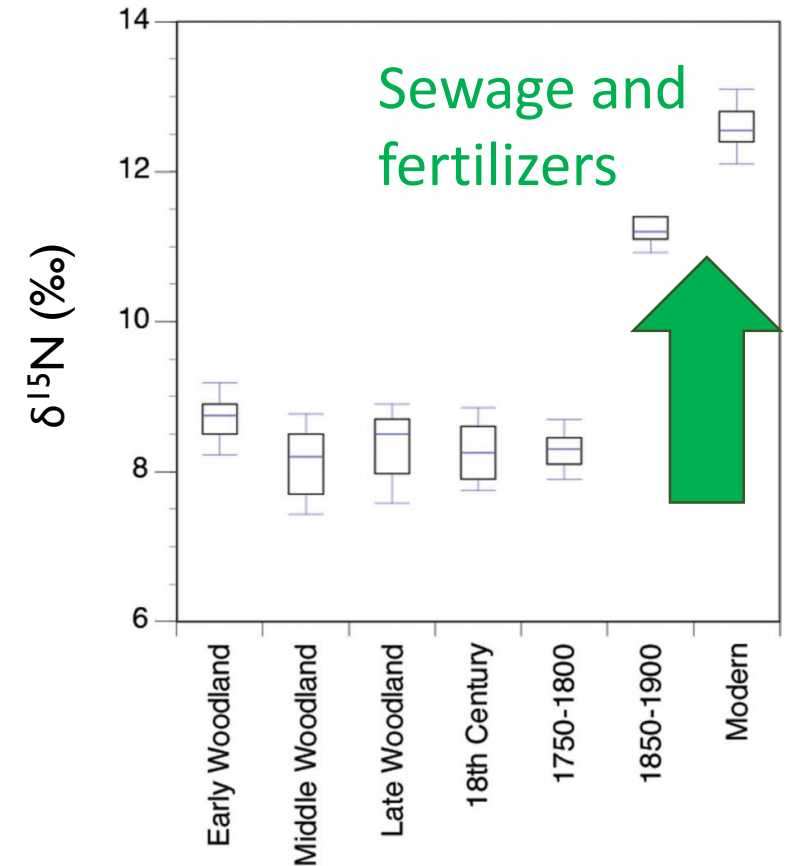


Rates of growth in fossil and modern clams



How will we know if pollution is to blame?

- Hypothesis is that clams' growth is reduced by lower water clarity.
- We can test this by tracing the pollution source: **nitrogen** sourced from sewage and fertilizers.
- Nitrogen from sewage and fertilizers has significantly **higher $\delta^{15}\text{N}$** value than normal ocean values.

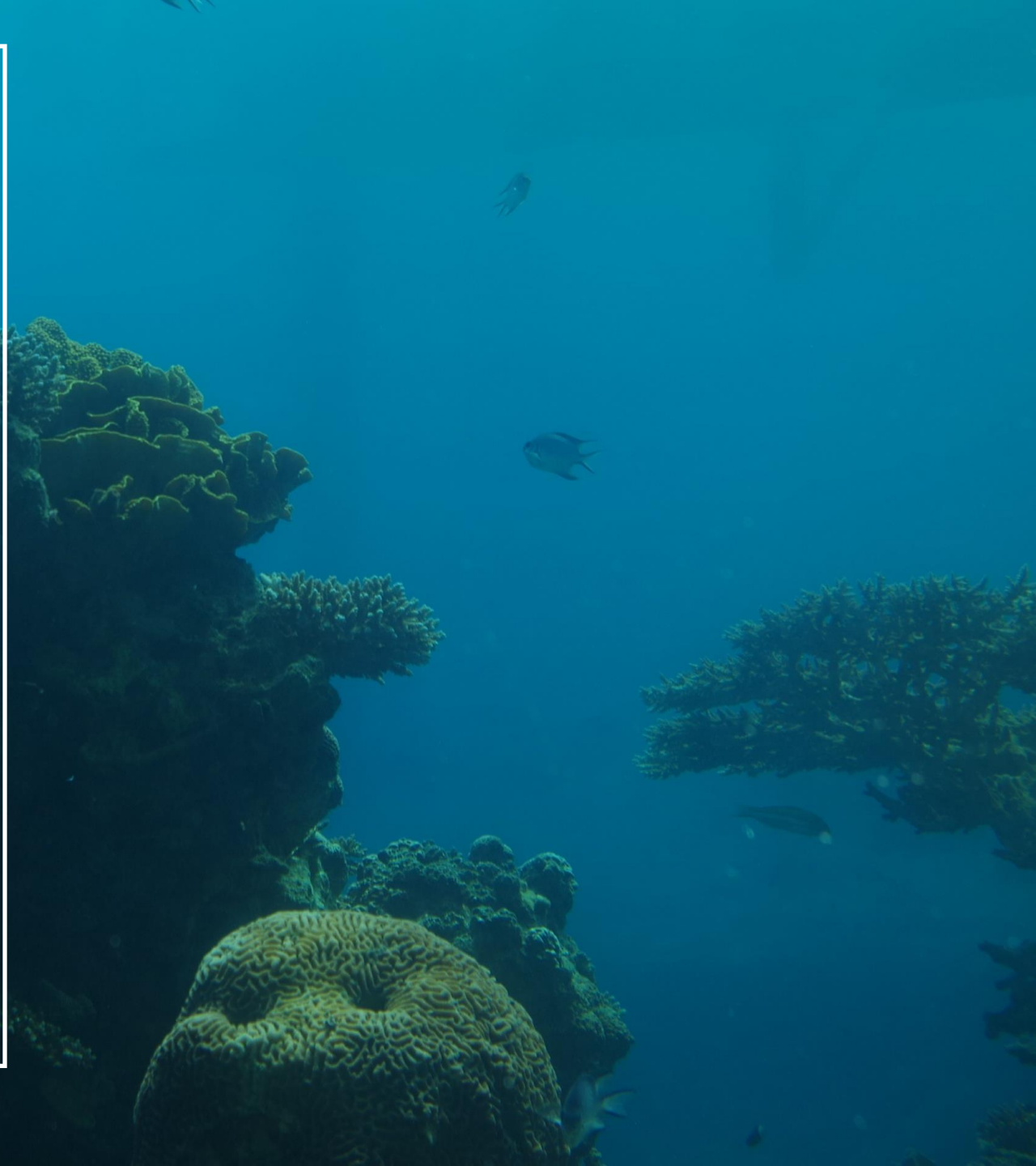


Significance

- Seems that past giant clams are growing more slowly.
- If that decline can be attributed to human pollution, we'd know that efforts to protect the reefs are not sufficient.
- Conservation paleobiology has great potential to place the present health of marine communities in long-term context.

Acknowledgements

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- Tariq Al-Najjar

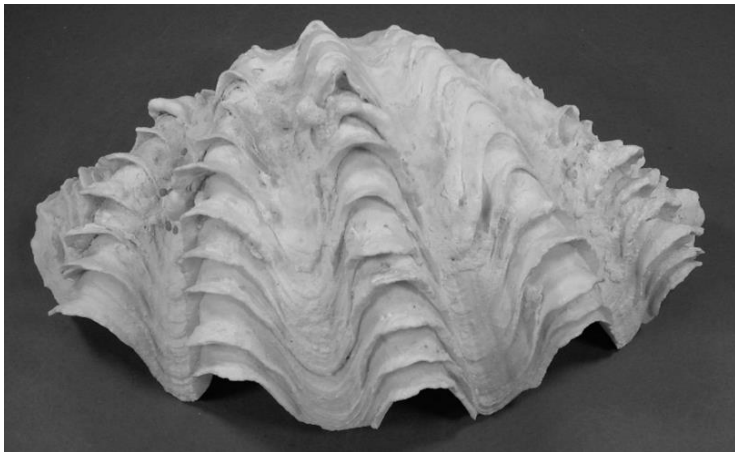




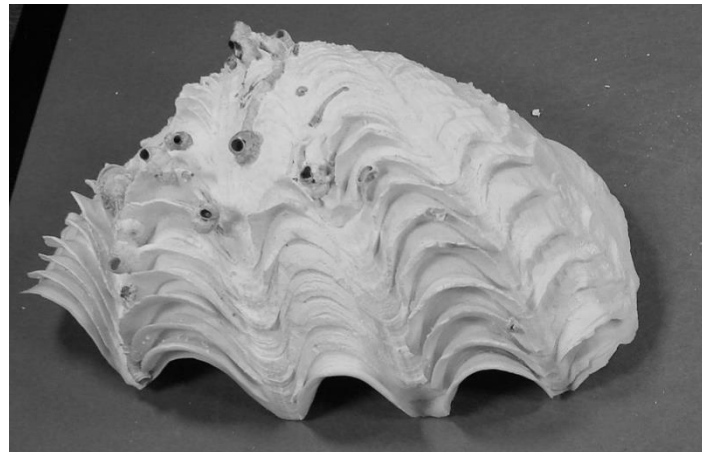
النهاية
הסוף
(the end)

- Red Sea hosts northernmost population of *Tridacna*: three species
- Vary in their degree of symbiosis and habitat
- Most **symbiont-dependent species, *T. squamosina*, is the most threatened**
 - Was up to 80% of pre-human assemblages, now a remnant population
- *T. maxima* and *T. squamosa* have broader range of habitats and utilize filter-feeding more than *T. squamosina*

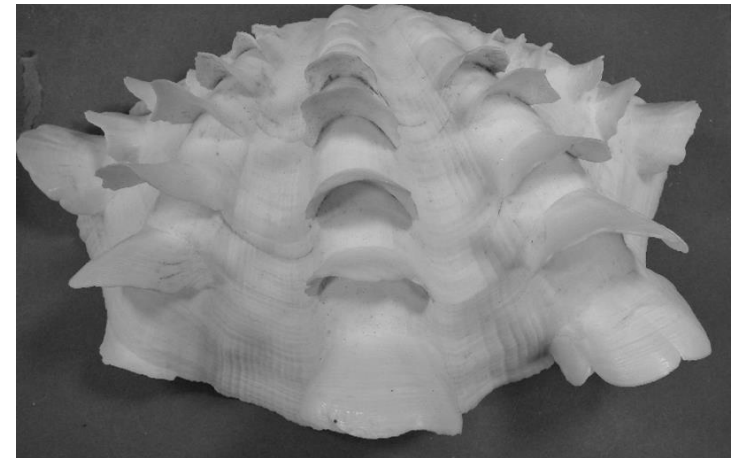
Tridacna squamosina



Tridacna maxima

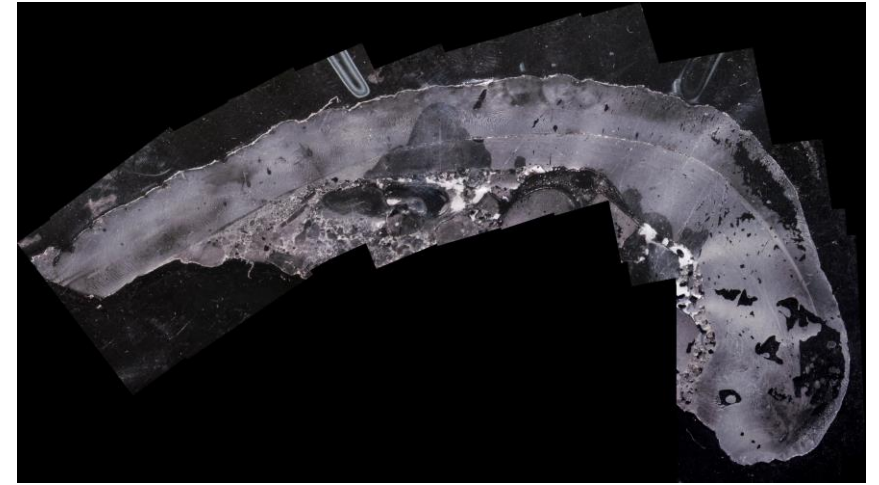


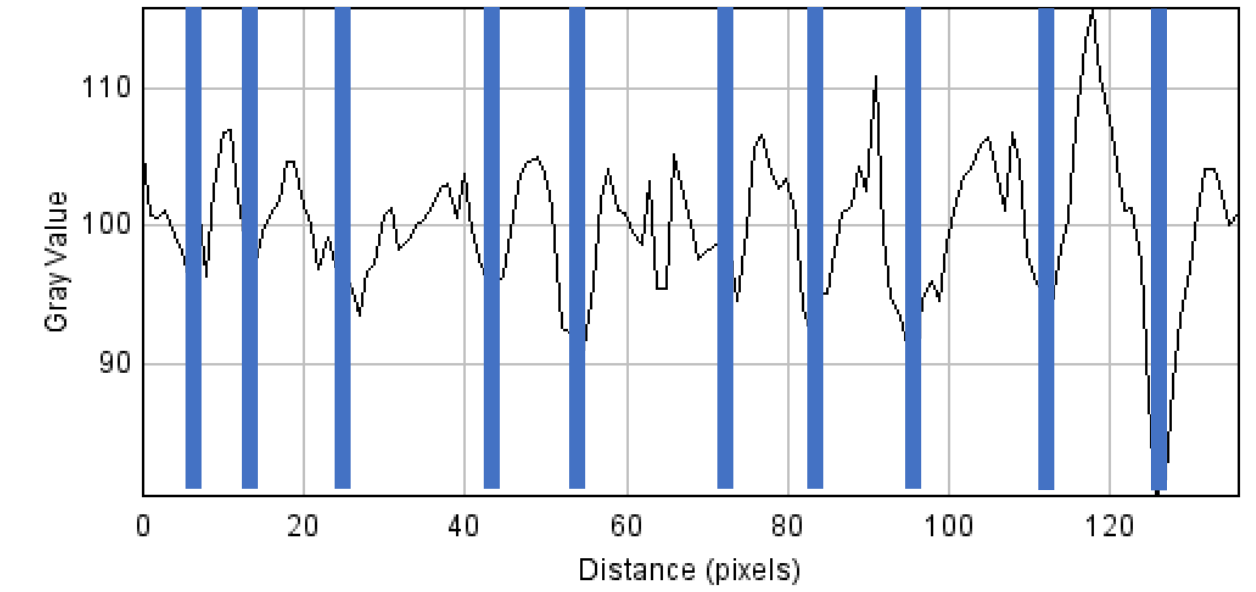
Tridacna squamosa



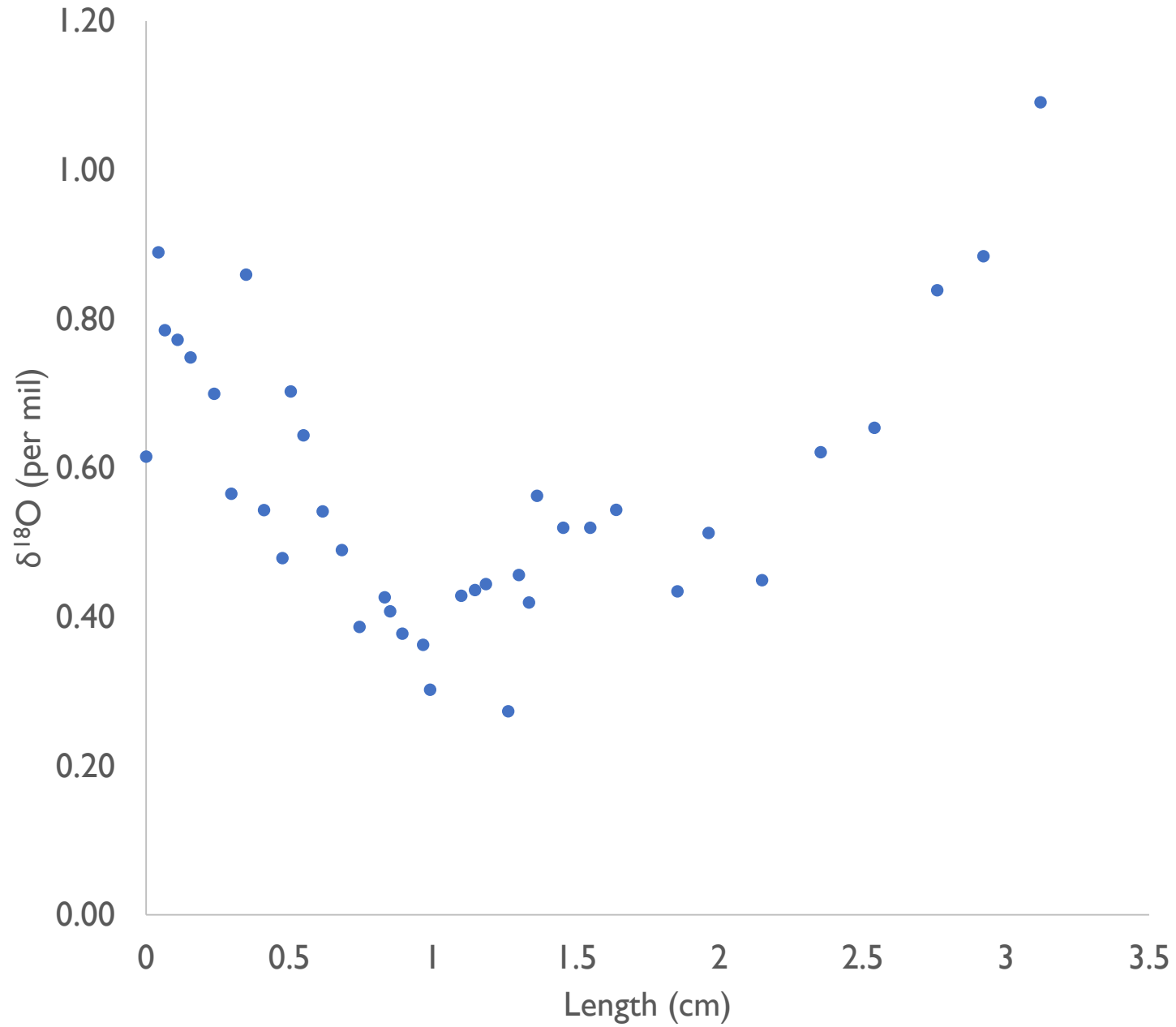
Conservation Paleobiology

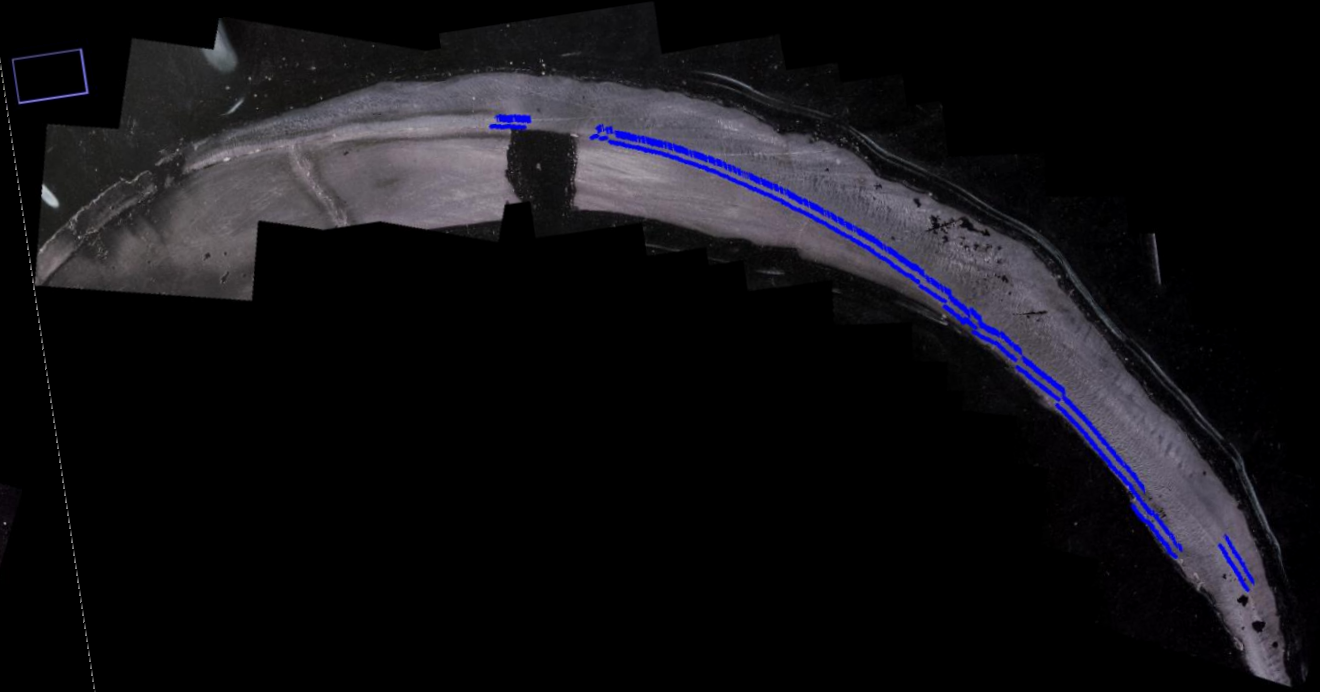
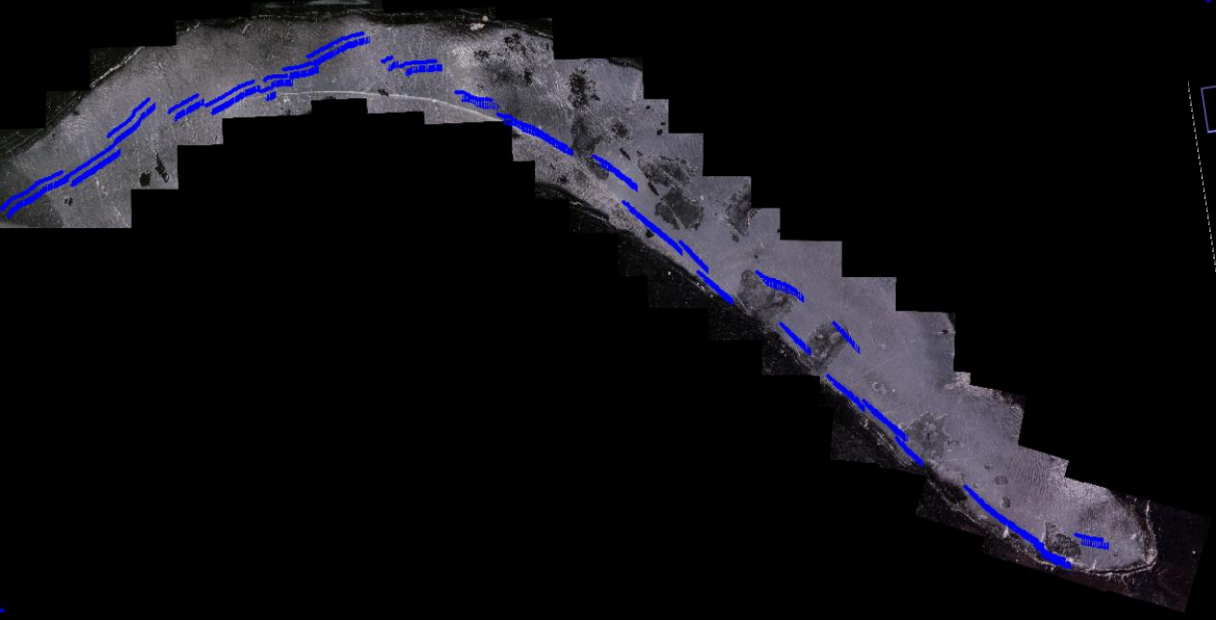
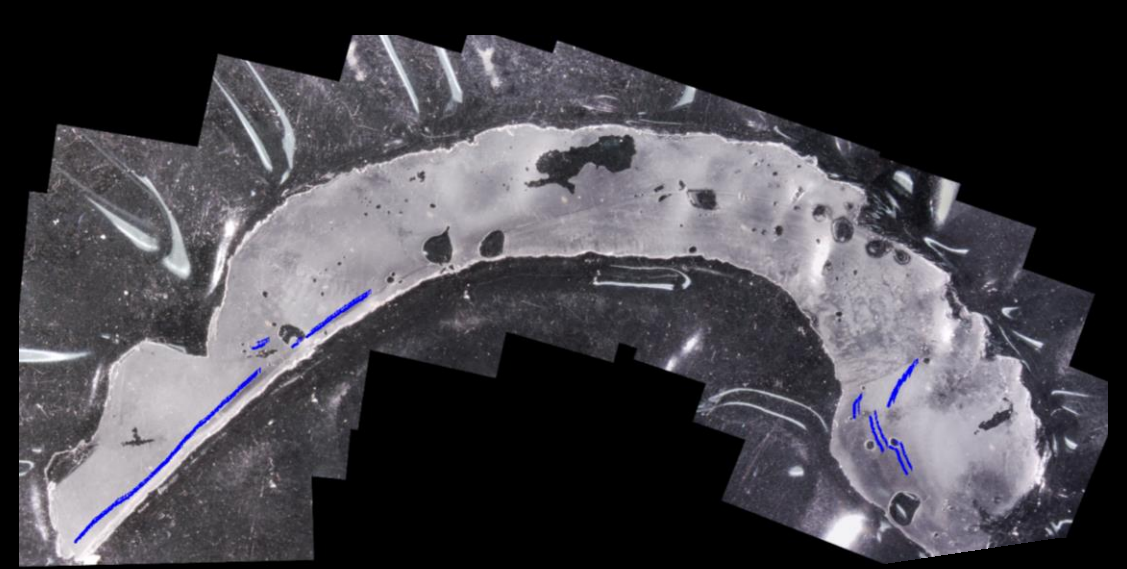
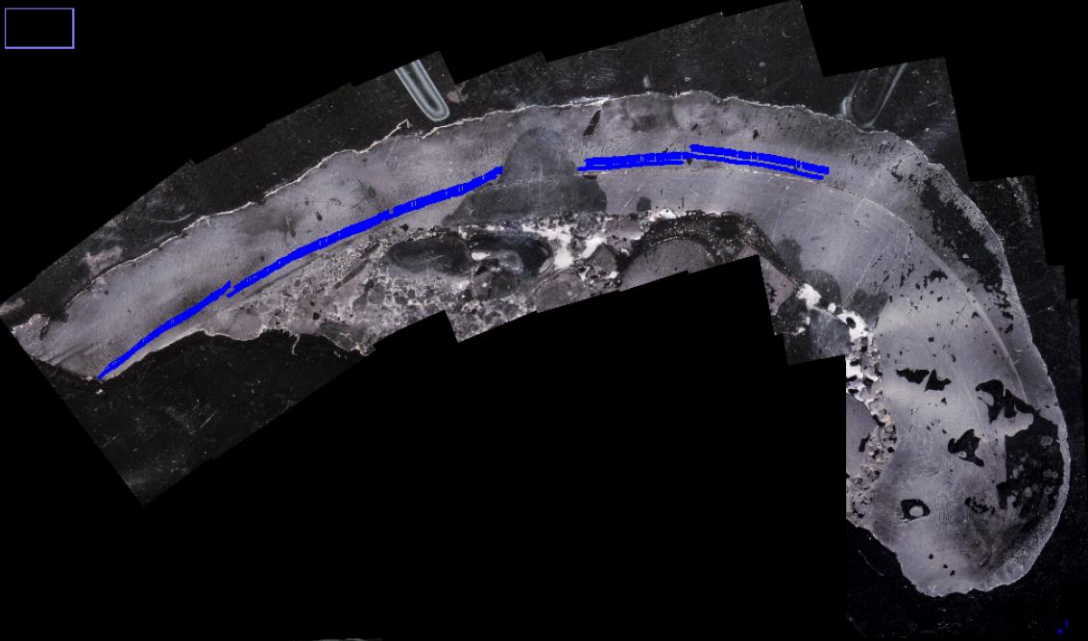
- We can compare width of bands in ancient and modern times to determine whether average growth rate has declined.
- Doing so, we will have a metric comparing health of ancient and modern populations.
- Hypothesis: giant clam **growth rate is slower in the modern** compared to preindustrial specimens.
- This change is likely due to **growth suppression** caused by reduced water clarity due to pollution.





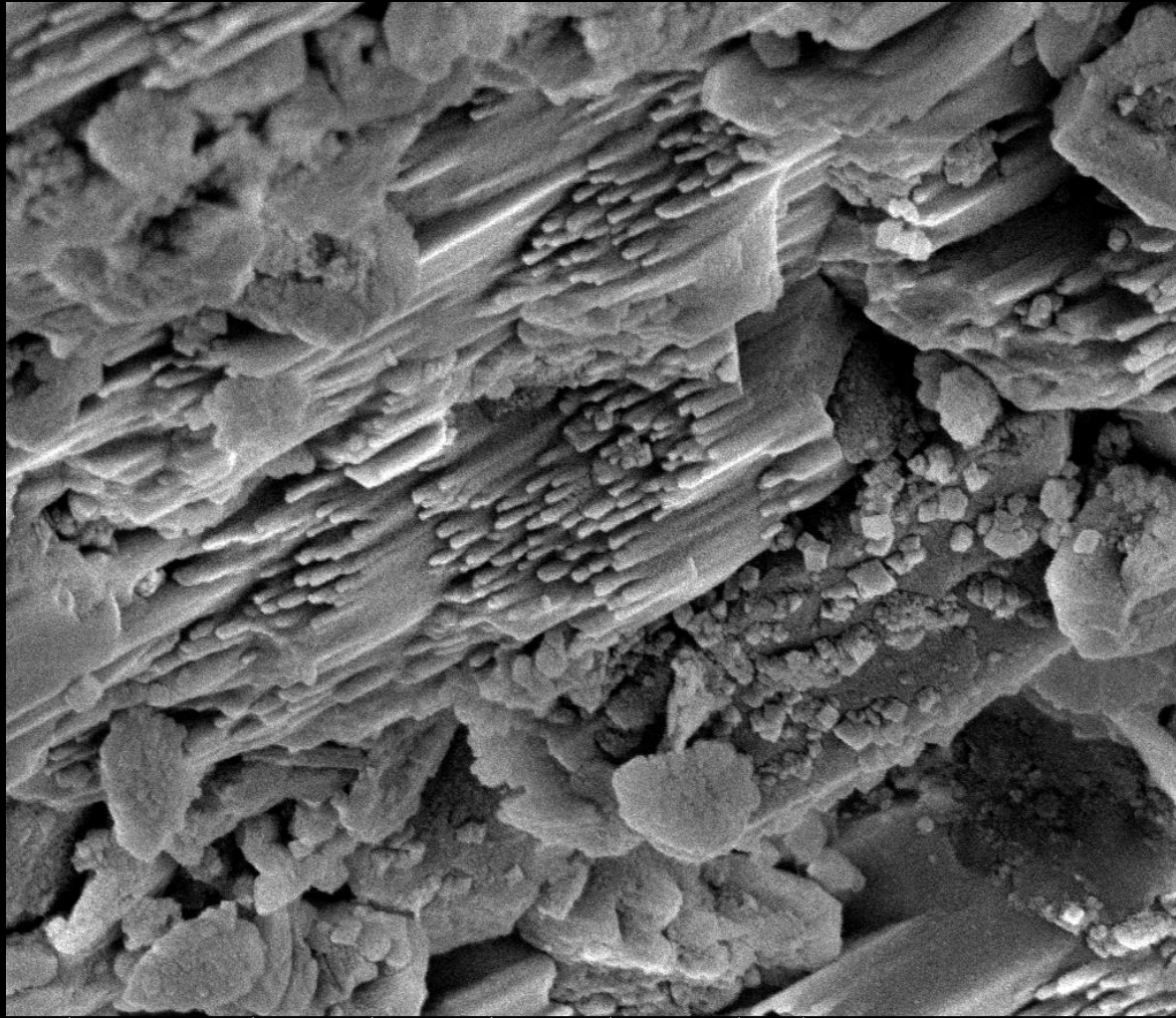
$\delta^{18}\text{O}$ of a modern Sinai *T. maxima*





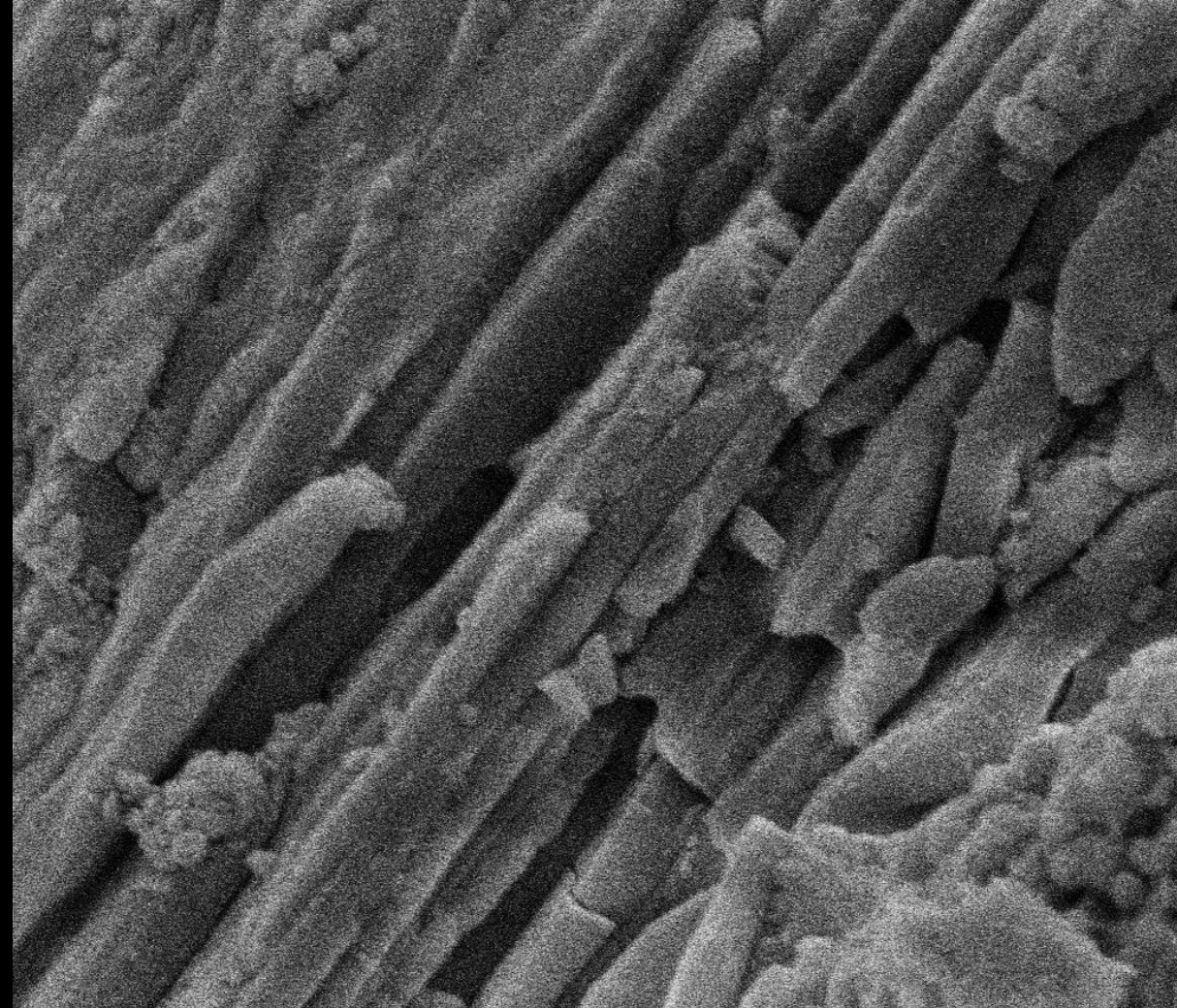
Work to be done!

Count	Continue to count bands.
Corroborate	Corroborate the timing of those bands with $\delta^{18}\text{O}$ -based temperature data.
Compare	Compare rates of species- and site-specific growth in pre-industrial and modern times for Israel and Jordan.



	3/27/2017	HV	curr	WD	mag	tilt	1 μ m
11:07:03 AM	5.00 kV	6.66 pA	7.4 mm	32 500 x	-0 °		

TY1, 6 kyr



	3/27/2017	HV	curr	WD	mag	tilt	1 μ m
10:55:28 AM	5.00 kV	6.66 pA	9.5 mm	32 499 x	-0 °		

78, Fossil, Unkown age

