The beauty and utility of coral reef archives

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Historical and modern photographs of Stone Island GBR. From Clark et al. (2016)
A global problem

25% of marine species live on reefs even though reefs occupy less than 1% of the ocean.

Millions of people rely on coral reefs around the world.
• What is a pristine reef?
• How did they function?
• What was their natural variability over time and space?
• When did reefs start to deteriorate and why?
• And why some reefs are resilient?
7000 year old coral reef in Dominican Republic
>500 μm fraction

Brigida de Gracia
>500 μm fraction
>63 μm fraction

Sponge spicules

Magdalena Lukowiak
Bulk bags

Trench in a 7000 years old coral reef in Panama
Six-metre long core barrels

U-Th Dating
“Stop refining the obituary of nature!”
How different are modern coral communities to pristine, prehuman coral reefs?

Completely…

O'Dea et al. 2020
How different are modern coral communities to pristine, prehuman coral reefs?

Completely…

But sometimes,
Reef fish ecology in prehuman and modern Caribbean reefs: Taxonomically different and yet functionally similar?
acid digestion

oxea
tylostyles
triaene
short triaene
calthrop
amphitriaene
trioid
aspidaster
selenaster
spheraster
anthaster

Magdalena Lukowiak & Mike Hynes
Hawksbill turtle (Eretmochelys imbricata) eating Geodia

Lukowiak et al 2018
Strombus pugilis

Andrew J. Martinez
Strombus pugilis: The largest individuals were exploited for thousands of years causing evolutionary declines in size at reproduction.

O'Dea et al. 2014
60% less protein per conch today

Removing the selection pressure through protection can reverse the trend

Co-manage the natural resource
Coral reefs are important for biodiversity and human welfare, but they are a pale shadow of their past. Historical and fossil records can:

- Define what was pristine
- Quantify variation and place modern events in critical context
- Pinpoint the timing and disentangle the causes of change
- Understand reef function (with and without humans)
- Uncover elements of resilience
- Provide context
- Define variation
- Reveal resilience
- Quantify function
- And co-manage resources
Tropical American Reference collections in the lab:

- Skeletons of >50 species of coral
- Spicules from 130 species of sponges
- Jaws, teeth and otoliths from >250 species of ray finned fishes
- Denticles and teeth from 37 species of sharks.
- Valves from >300 species of bivalves
- Shells from >500 species of gastropod
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Temporal scales, natural variation and novel states

Monitoring