Porites distribution modelling

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The **thermal threshold** required to protect at least half of the **coral reefs** worldwide is estimated to lie at or below a **1.5°C** mean increase in global average temperature.
What happened?

- Symbiosis between corals and zooxanthellae
- Vulnerable to thermal stress
- Coral bleaching
- Fast growing coral is susceptible to bleaching
- Porites is more resistant to bleaching
- Its presence is crucial for reefs to survive global warming

But ..... 

- Unlike coral cover, coral genera presence data are difficult to find.
- This is making coral conservation and management difficult and therefore the zonation process become ignorant to coral diversity.
- Species Distribution Model can provide predictive maps of species distribution in various scenarios.
Partial information on the species’ presence

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Environmental variables

Probabilities of presence in the whole area of interest
Objective

- to create *Porites* distribution map to support coral reefs conservation and management in Indonesia
Methodology

- Environmental variables
  - Substrate type
  - Chlorophyll A
  - Bathymetry
  - Sea surface temperatures
  - Particulate organic carbon

- Porites occurrence
  - Specimens from GBIF
  - Field observations
Maximum Entropy: The basic idea

- Goal: estimate $p$
- Choose $p$ with maximum entropy ($H$) subject to the constraints ($z$) where a species can be present ($y=1$) or absent ($y=0$).

$$H(p) = - \sum_{x \in A \times B} p(x) \log p(x)$$

$$p(y=1|z) = \frac{f_1(z)p(y=1)}{f(z)}$$
Research Location

- Field observations
  1. Belitung Island
  2. Karimun Jawa Islands

Inset
Focus Area: Seribu Islands
Results

Porites distribution in Indonesia with 217,185.323 km² of total habitable area
Performance

- the model performs quite well with test AUC value of 0.9747 and AUC standard deviation of 0.003.

- If compared to the 99 null distributions, the test AUC is considered statistically significant compared to the top 5% of null distribution’s AUC, which is 0.7348.
Results

- Porites is present on all focus area, such as Seribu Islands, Belitung Island, and Karimun Jawa Island. Porites also distributed evenly in Derawan Island, Bunaken Island, North Minahasa, Lembeh Island, and Raja Ampat.
Porites absence in Jakarta Bay

- 13 polluted rivers dumping their sediment, heavy metal, liquid and solid waste altogether, this area has high sedimentation that made life hard for corals and they are unable to photosynthesize.
- Sediment accumulation rate is up to 0.852 cm/year.
- Jakarta will experience coastal reclamation, that will increase the benthic sediment thickness to 2.49 m compared to 0.84 m today.
Variable’s contribution

- Substrate type, bathymetry and curvature gave the highest contribution towards gain.
Substrate type

- **Porites** preferred coral-dominated reefs (1) than sand-dominated reefs (2)
Bathymetry and Curvature

- Most habitable is shallow water
- Most preferred is reefs with curvature from 0 - 1°
Porites shows mixed response toward SST.

With mean temperature 25 -26°C it response increase, suddenly falls to 28 °

It then steadily increase from 28 to 32°

It is less sensitive to maximum SST with contribution only 0.1%

The tolerance before the response falls is 32° but the response increases on 34° and permanently decline on 36°
Conclusion

- Reefs with Porites have a chance to survive temperature-induced bleaching.
- Environmental variables that contributed most to Porites distribution are substrate type, bathymetry, and curvature.
- The model performs very well and can be used for marine spatial planning or conservation planning.
- SDM can be used to complement field observations where data is scarce.
Thank you very much

- Questions
- Critics
- Suggestions