AUTOMATIC ANNOTATION METHODS FOR CORAL REEF SURVEYS

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# Evolution of coral reef surveys

Time / information quantum



field time

In situ counting







## Typical reef surveys

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**Porites** 

Rock / CCA

Macro Algae



Sand

**Porites** 

- Collect images
- □ Annotate image
  - Scatter random points
  - Assign labels
  - Calculate coverage
    - 50% Porites
    - 16.7% Sand

Calculate reef coverage

### Automated annotation

- Automated annotation method<sup>1</sup>
  - Color and texture descriptors.
  - Multiple scale around location of interest
  - Learns from previously annotated data
  - Runtimes: 30 second per image at test time.
- ~80% accuracy compared to a single expert.
- How good is good enough?
  - What level of accuracy can be expected?
  - How well does the method generalize?

[1] "Automated Annotation of Coral Reef Survey Images", Beijbom et. al., CVPR, 2012

2008, 2009 ⇒ 2010 (83.1%)											
CCA	.89	.04	.01	.04					.02	95701	
Turf	.40	.46	.01	.03		.03			.06	4759	
Macro	.69	.05	.19	.02		.01	.02		.02	3285	
Sand	.15	.01		.83					.01	11491	
Acrop	.13	.14	.01		.62				.10	182	
Pavon	.25	.06	.01	.03		.60	.01		.04	1586	
Monti	.41	.03	.01	.07			.42		.05	2118	
Pocill	.34	.03				.01		.60	.02	838	
Porit	.20	.02		.01					.76	9967	
CCA TURE Macropavoponii Ocili Orit											
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	OTHER										

## The Inter Operator Study





## Machine operation modes

### ALLEVIATE

- Machine abstain on difficult decisions.
- These decisions are deferred to human expert.

### **A**BUNDANCE

- Machine errors can be characterized on the training data
- Use this to achieve unbiased estimates of abundances<sup>1</sup>.

[1] "Estimating the taxonomic composition of a sample when individuals are classified with error". Andrew Solow, Cabell Davis and Qiao Hu. MEPS 2001



Yellow dot indicates that  $H_0$  "means are equal" can not be rejected at 99% level.

### What is next?



Moorea Coral Reef NSF Long Term Ecological Research

### What is next?



What is next?



Descriptors and learning method are generic. Sampling method and abundance correction generic. The <del>sky</del> ocean floor is the limit!







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Automated annotation in the web browser. Publicly available. Check it out!

# <sup>16</sup> Bonus Material



### Automated annotation



## Moorea Coral Reef LTER



Coral coverage estimation.



Accurate prediction within, and across, years: (80%) Accurate estimation of coverage: Slope = .94, Corr. coeff. = .96

## How good is good (enough)?

- □ 80% accuracy compared to a single expert.
- On one pacific reef location.
- What level of accuracy can be expected?
- How well does the method generalize?

## Accuracy overview

