Curtin University

Remote sensing

Fish, Cameras and Computers **August 19, 2014**

What major changes will ocean sciences be experiencing in the next 3-5 years due to the continued technological innovation in remote sensing?

Fish ecologist with conservation management background

Remote sensing = close range (1-10m) stereo-video

Challenges

1. The need for non destructive (fishery independent) data
2. The need to sample deeper (shelf and slope)
3. The pelagic

Fisheries: What information do we want? Also marine benthos and plankton!

- Species identification
- Counts of abundance
- Length (biomass)
- Sex? ♀ ♂

Coris auricularis

Non destructive data

Trawls, poisons, long-lines, hook and line, traps, nets

+ Catch Fish -> Age, growth, sex, reproductive capacity

- Can't sample in some habitats, effects on habitat?
- The effect of repeated sampling (Serial depletion)
- Selectivity - > species biases (behavior)
- Marine Protected Areas
- Fine scale sampling within habitats
- Need for fishery independent data particularly for EBFM and ESD

Fishery Independent sampling

Can convert XYZ into:

Distance

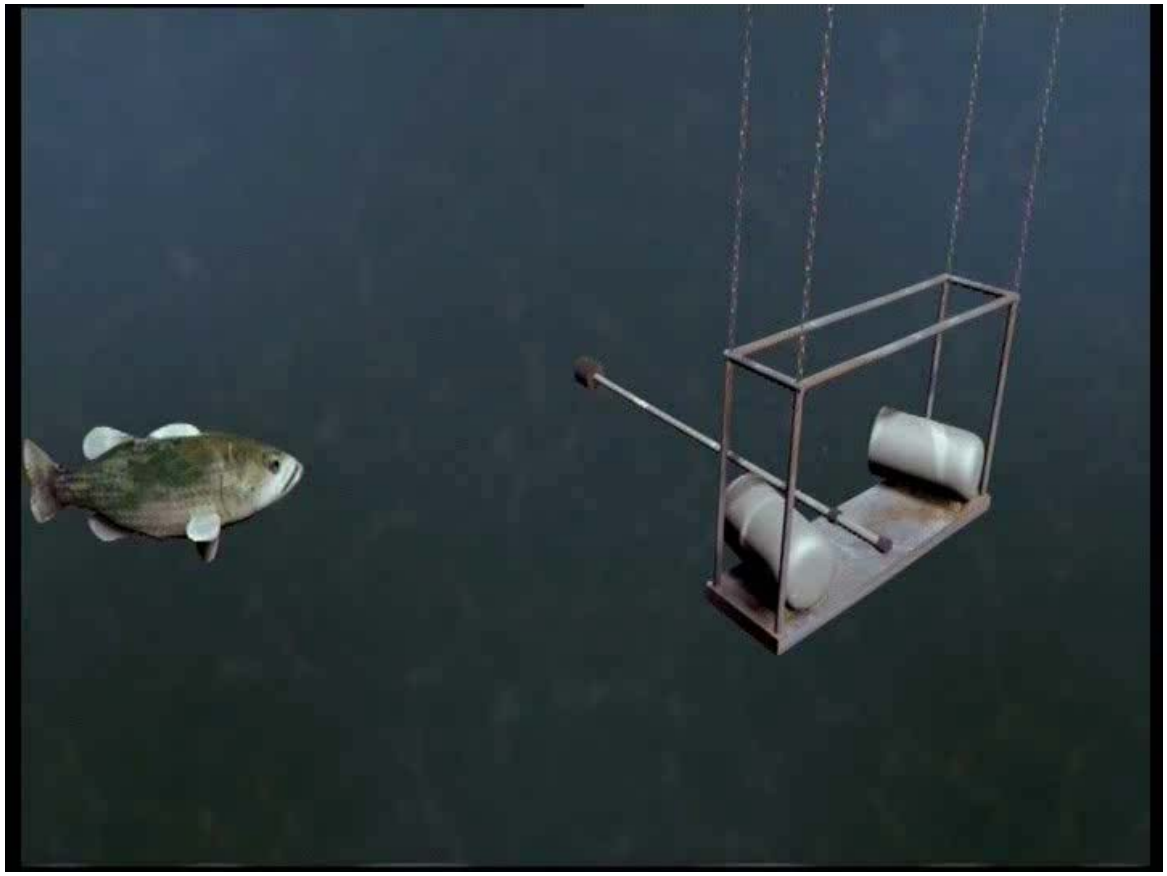
Angle (define sample unit)

Length

Biomass or volume

Swimming speed

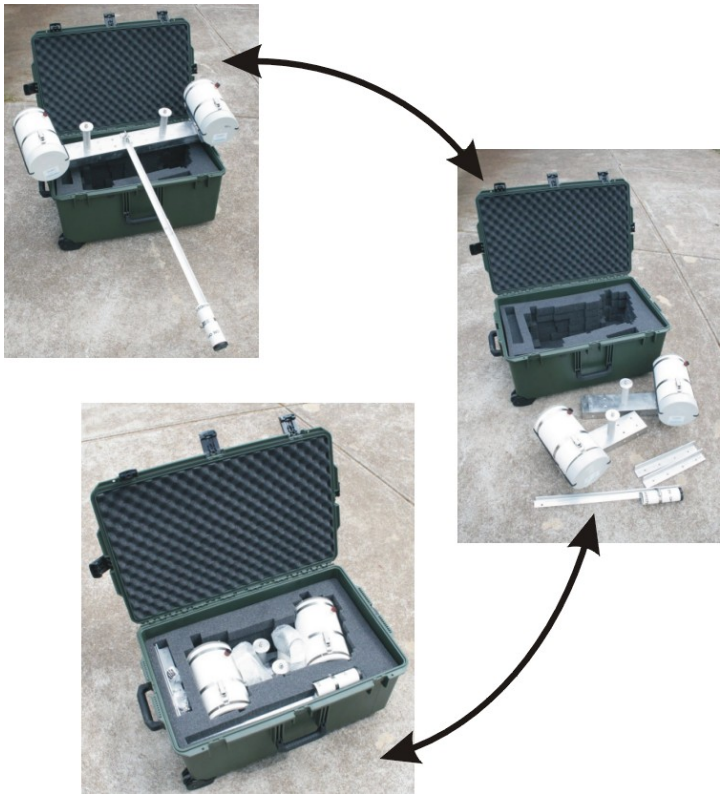
Full high definition accuracy less 0.7% object length



Stereo-video

Harvey et al. 2010. Marine Technology Society Journal. 44(1): 75 – 85.

Diver operated Stereo-video for UVC



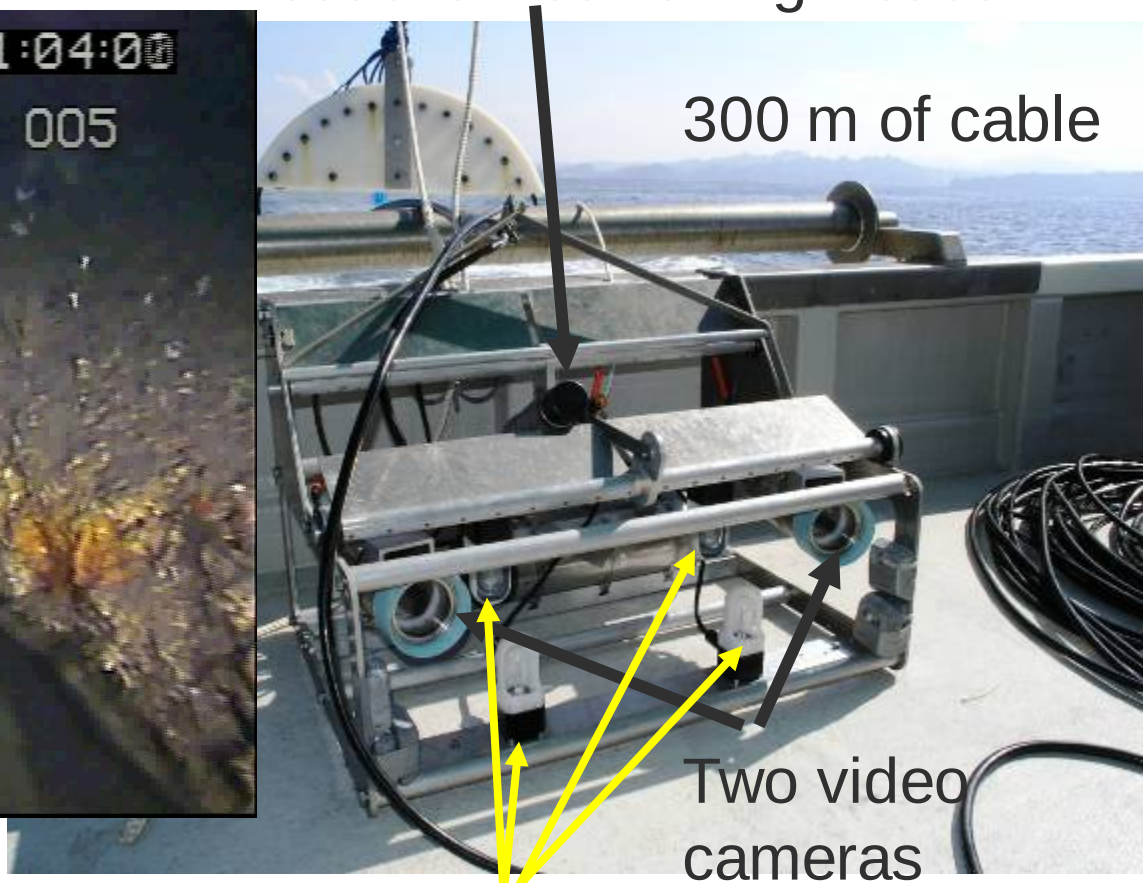
- Neutrally buoyant, manoeuvrable
- Deployable from small boats
- Simple to use
- Removes inter-observer variability

Citizen Science

Harvey E, Shortis M (1995) Marine Technology Society Journal 29:10-22

Curtin University

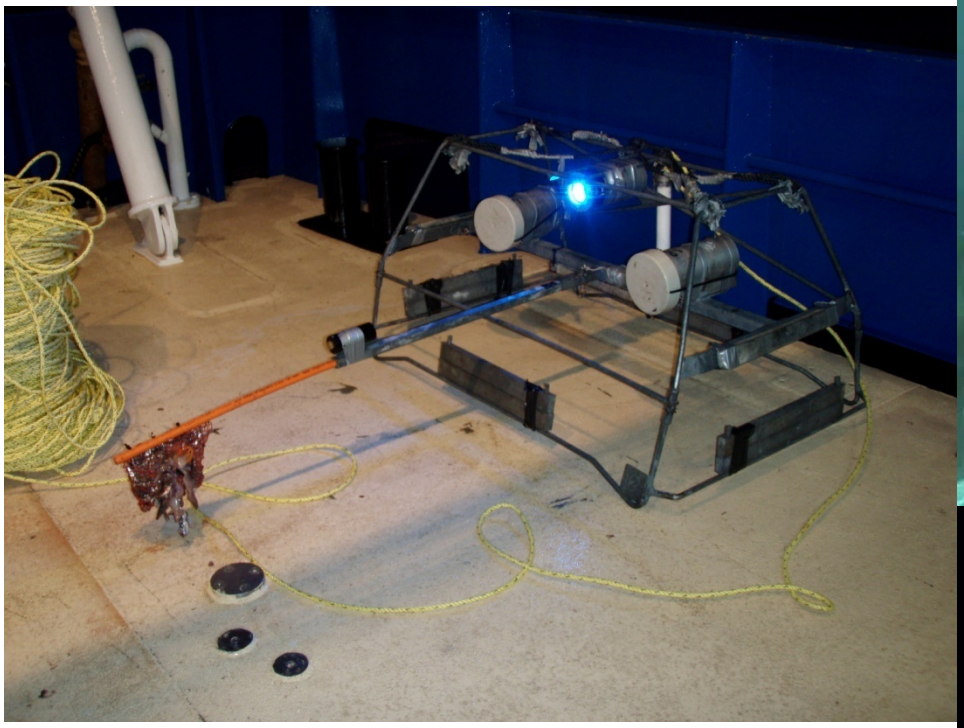
Drift /Towed/ drop stereo-video



McIlwain JL et al. Fisheries Oceanography (2011) 20:497-516
Williams K, Rooper CN, Towler R (2010) Fishery Bulletin 108:352-362
Rooper CN, Martin MH, Butler JL, Jones DT, Zimmermann M (2012) Fishery Bulletin 110:317-3
Jones DT, et al (2012) Fishery Bulletin 110:332-343

Curtin University

Baited remote underwater stereo-video (Stereo BRUVs)



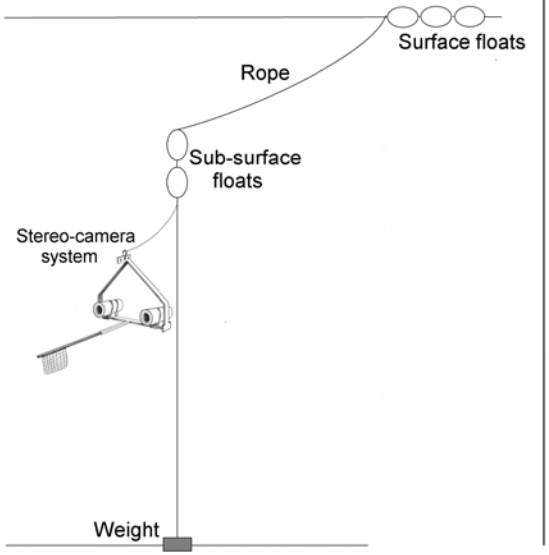
Cost effective

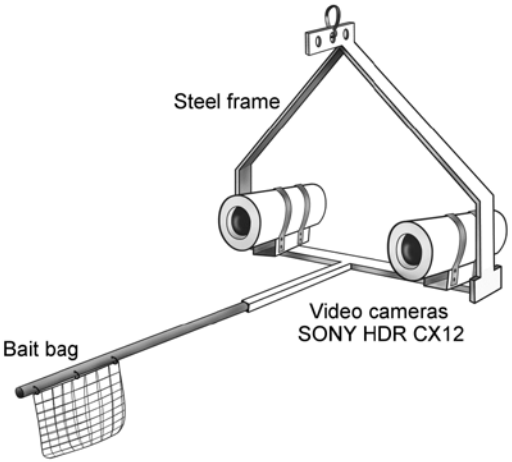
Good statistical power

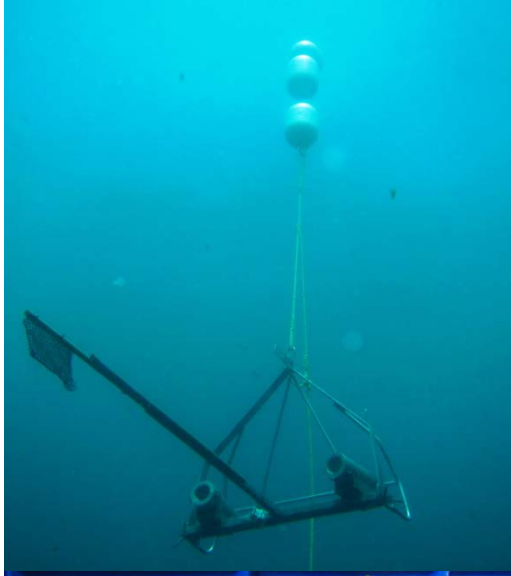
Watson et al. 2010. Marine Biology. 157(6): 1237-1250

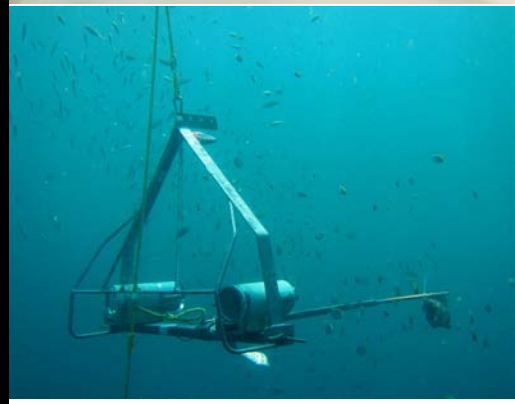
Langlois et al 2010. Aquatic Biology. 9: 155 – 168

PELAGIC STEREO-BRUVS

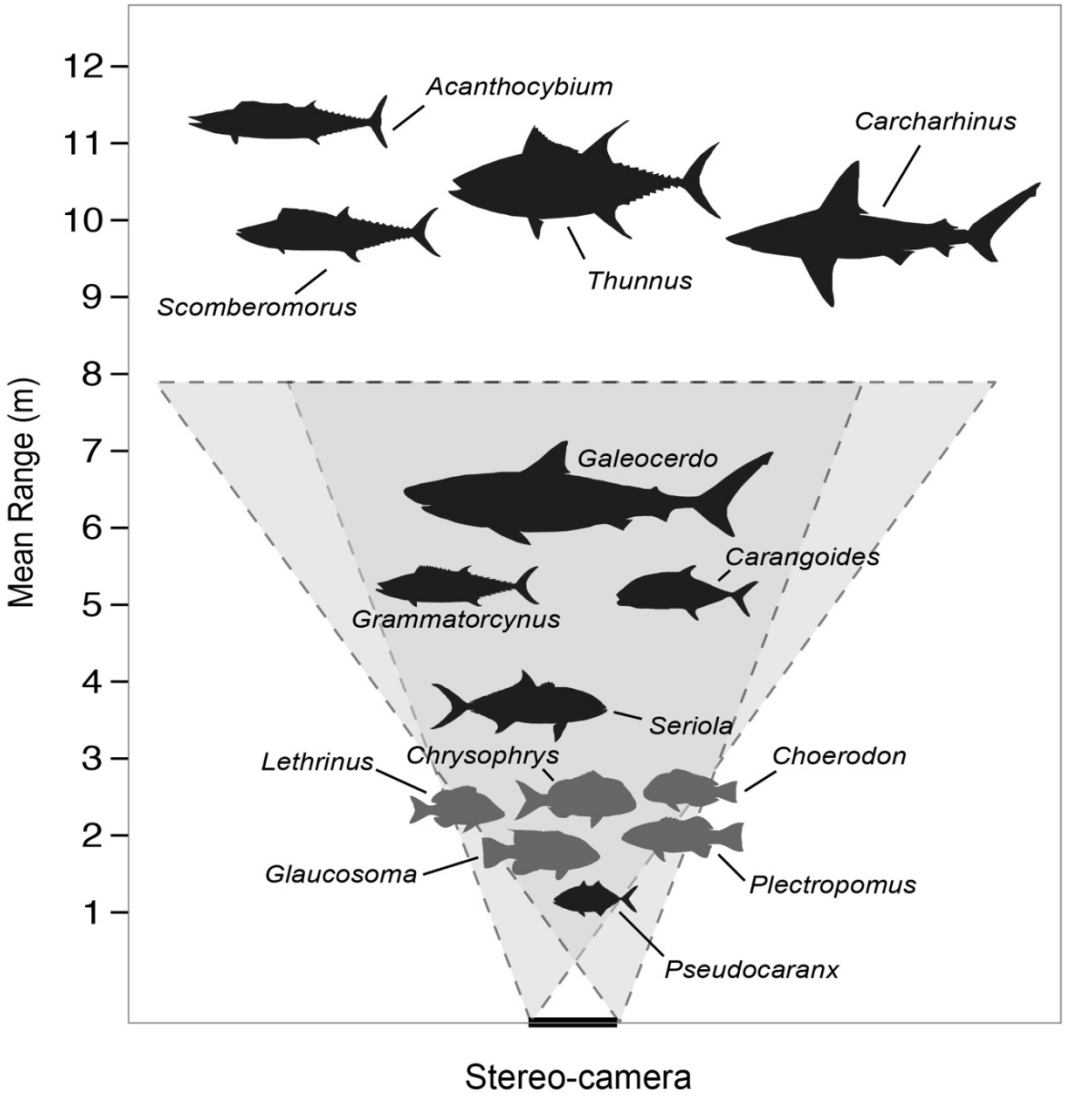








Santana-Garcon J, Leis JM, Newman SJ, Harvey ES (2013) Presettlement schooling behaviour of a priacanthid, the Purplespotted Bigeye Priacanthus tayenus (Priacanthidae: Teleostei). Environmental Biology of Fishes:1-7



Surface deployed, anchored or controlled

Need to investigate alternate methods of attraction.
Flashing lights, spinning lures, FADs

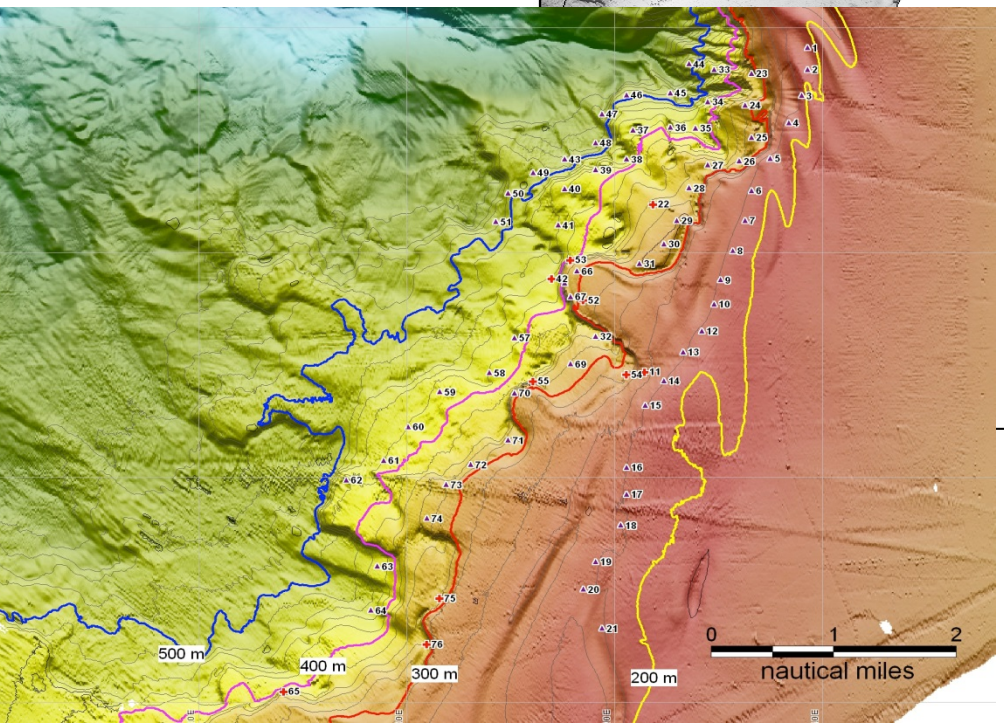
Can depth be controlled by an AUV?

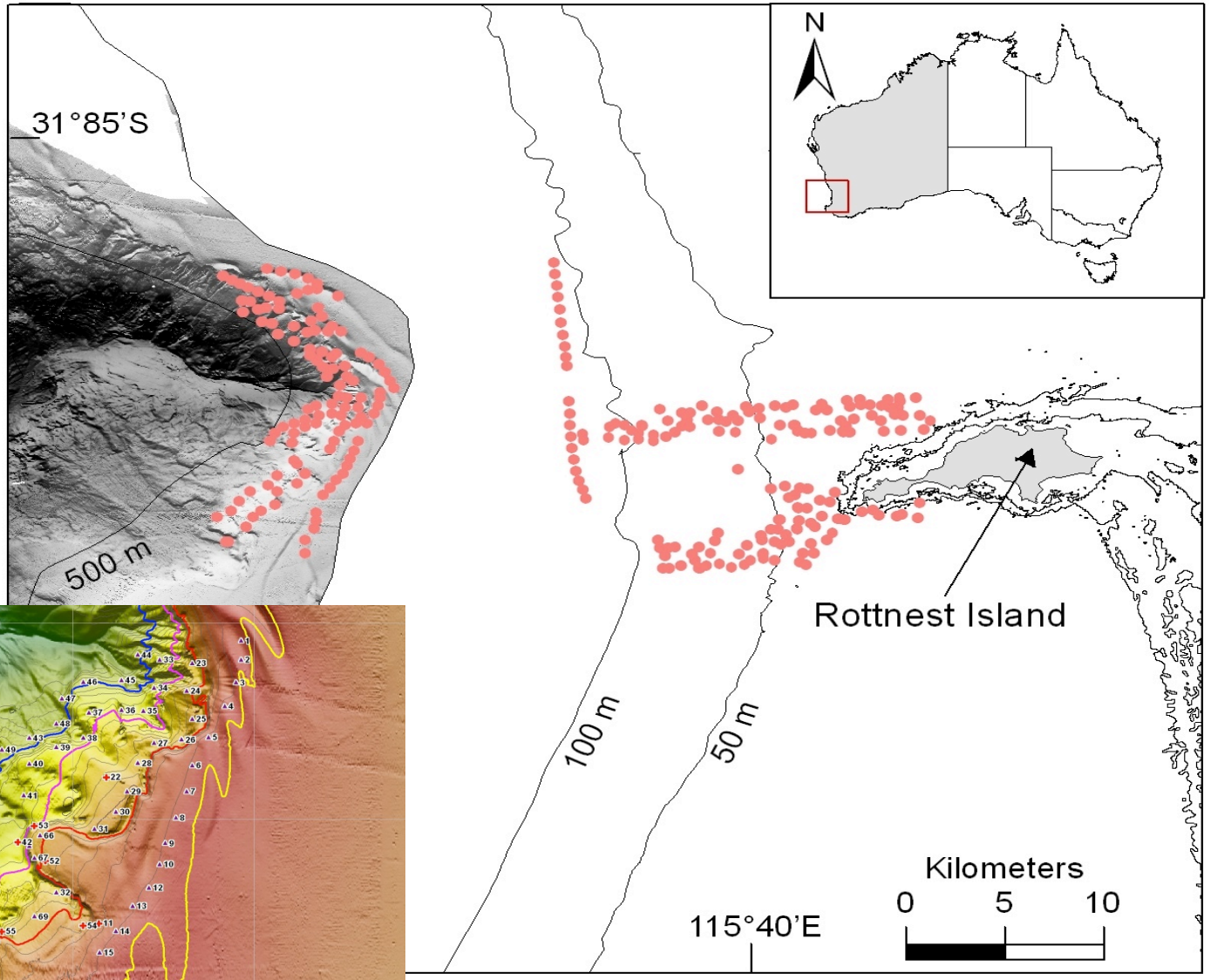
Increasing field of view

Acoustic cameras?
Laser line scanning systems?
Other technologies?

Curtin University

Acoustics aid sampling and data analysis





Curtin University

Unmanned Aerial Vehicles

High resolution still and video

LIDAR

Hyperspectral

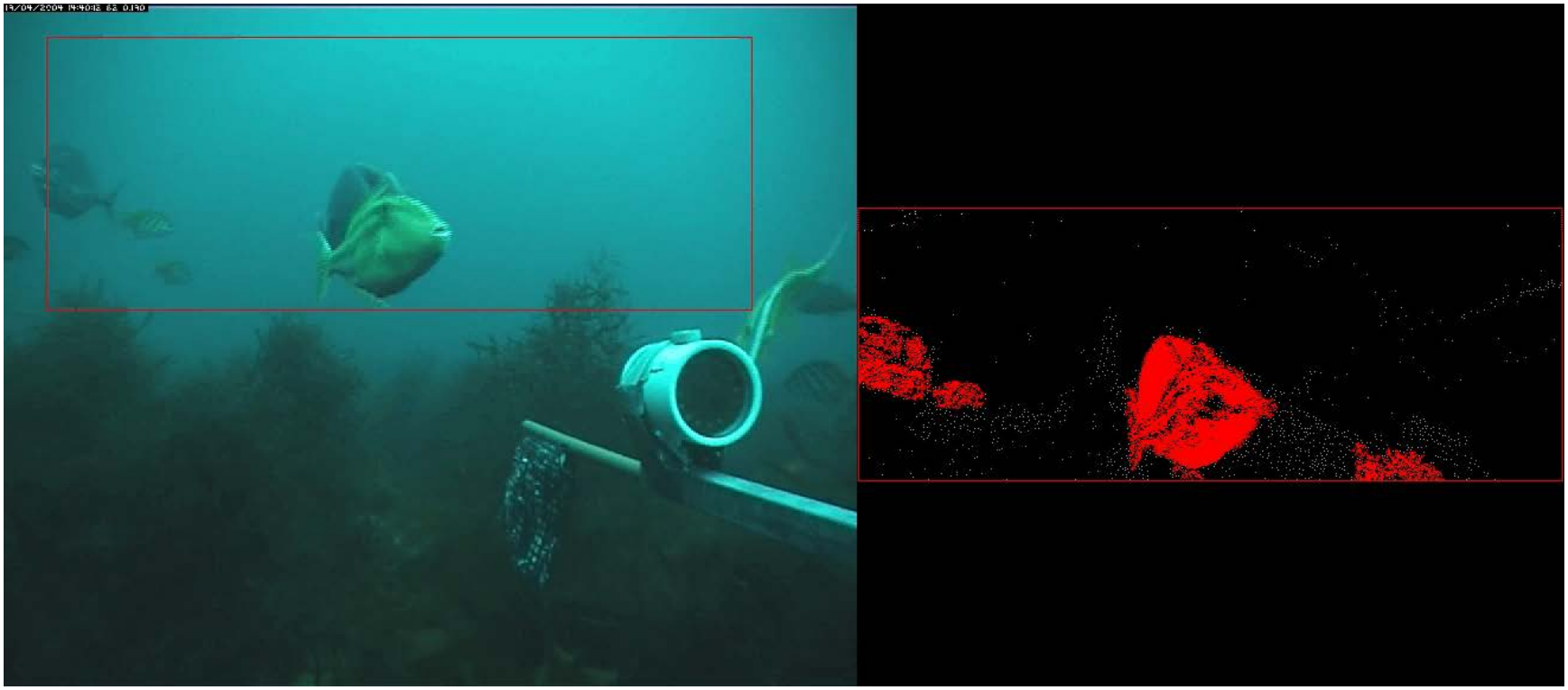
The need for automation

- Time. 1 BRUV 2 ~ 3.5hrs
- Cost = $180-230 salary for analysis
  5000 hrs annually = $1 000 000 +

- User adoption: Inhibits uptake

Curtin University

Is automation realistic?



Motion detection

Tracking

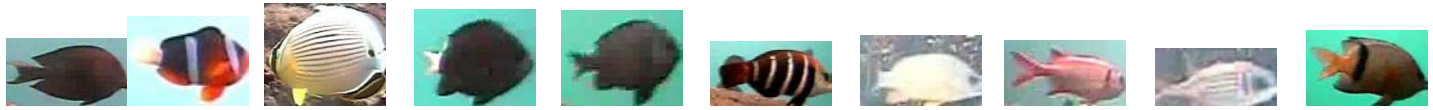
Automated measurement

Species Identification

- Labeled training data sets, Morphometric information and behavior
- ANNs, Support Vector Machines, Classification and decision trees

Is automation realistic?

MacLeod, Benfield and Culverhouse, Nature 467(9): 154-155



	Acanthurus Nigrofuscus	Amphiprion Clarkii	Chaetodon Lunulatus	Chromis Margaritifer	Dascyllus Reticulatus	Hemigymnus Fasciatus	Lutjanus Fulvus	Myripristis Berndti	Neoniphon Sammara	Plectrogly Phidodon Dickii
 Acanthurus Nigrofuscus	**29**			1	2					
 Amphiprion Clarkii		**45**								
 Chaetodon Lunulatus			**29**							
 Chromis Margaritifer				**17**						
 Dascyllus Reticulatus					**14**					
 Hemigymnus Fasciatus	2	1		2	1	**39**				2
 Lutjanus Fulvus							**5**		2	
 Myripristis Berndti					1			**30**		2
 Neoniphon Sammara									**58**	
 Plectrogly Phidodon Dickii										**16**

Automatic Fish Measurement

Challenges

- Data storage and accessibility
  - Numbers (MaxN, Density, length range)
  - Metadata
  - Imagery, annotated files, calibration files
  - 1 hour stereo-video =32 GB data
    - (8000 hours = 256, 000 GB)
- Data with public funding
- Other users need to have ability to access
  - download, reanalyse, verify

Opportunities due to technological innovation?

Need non destructive and fishery independent data.

Fine scale optical sampling

Can we increase scale and resolution?

Deeper sampling with multiple delivery tools (AUVS, ROVS, Baited cameras/Landers)

Deployed equipment need to be collecting multiple types of data

Investment in automated image analysis