UNIVERSITY of TASMANIA

IMAS

Institute for Marine and Antarctic Studies

Detecting a rare and cryptic coastal fish using eDNA and 3D-printed models

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Background

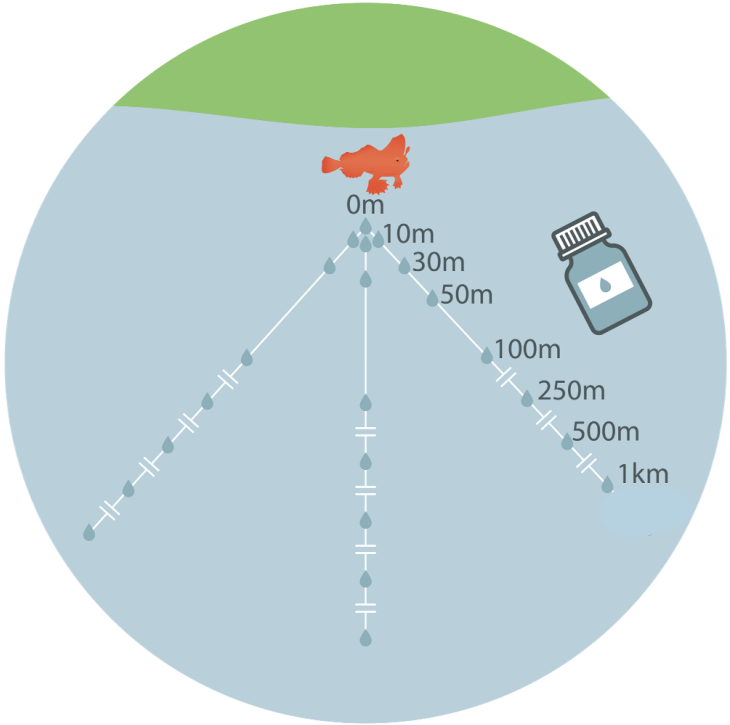
- Successful conservation requires fundamental population data
- Population data are particularly difficult to collect for rare, small and cryptic marine species (*eg* Durso et al 2011)
- Monitoring small cryptic species via UVC and eDNA

Structured underwater visual census (UVC) surveys
Image credit: Antony Cave

Durso et al (2011) *Needles in haystacks: estimating detection probability and occupancy of rare and cryptic snakes*. Biological Conservation 144, 1508-1515.

The red handfish, *Thymichthys politus*

Environmental DNA



Field sampling

Figure credit: Ella Clausius

- Water samples collected along transects at a low density red handfish site
- Site is ~5 m deep, comprising of vegetated rocky reef
- Samples individually pumped through a filter
- DNA extracted from filters
- Designed two primers to amplify *COI* region

Sterivex filter

Image credit: MilliporeSigma

Results: eDNA detection

		Distance away from red handfish population (m)							
		0	**10**	**30**	**50**	**100**	**250**	**500**	**1,000**
Primer pair 1	*Winter*	1/9	0/9	0/9	0/9	1/9	0/9	0/9	0/9
	Summer	1/6	0/6	0/9	0/9	0/4	0/6	0/6	0/6
Primer pair 2	*Winter*	1/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
	Summer	1/6	0/6	0/6	0/6	0/4	0/6	0/6	0/6

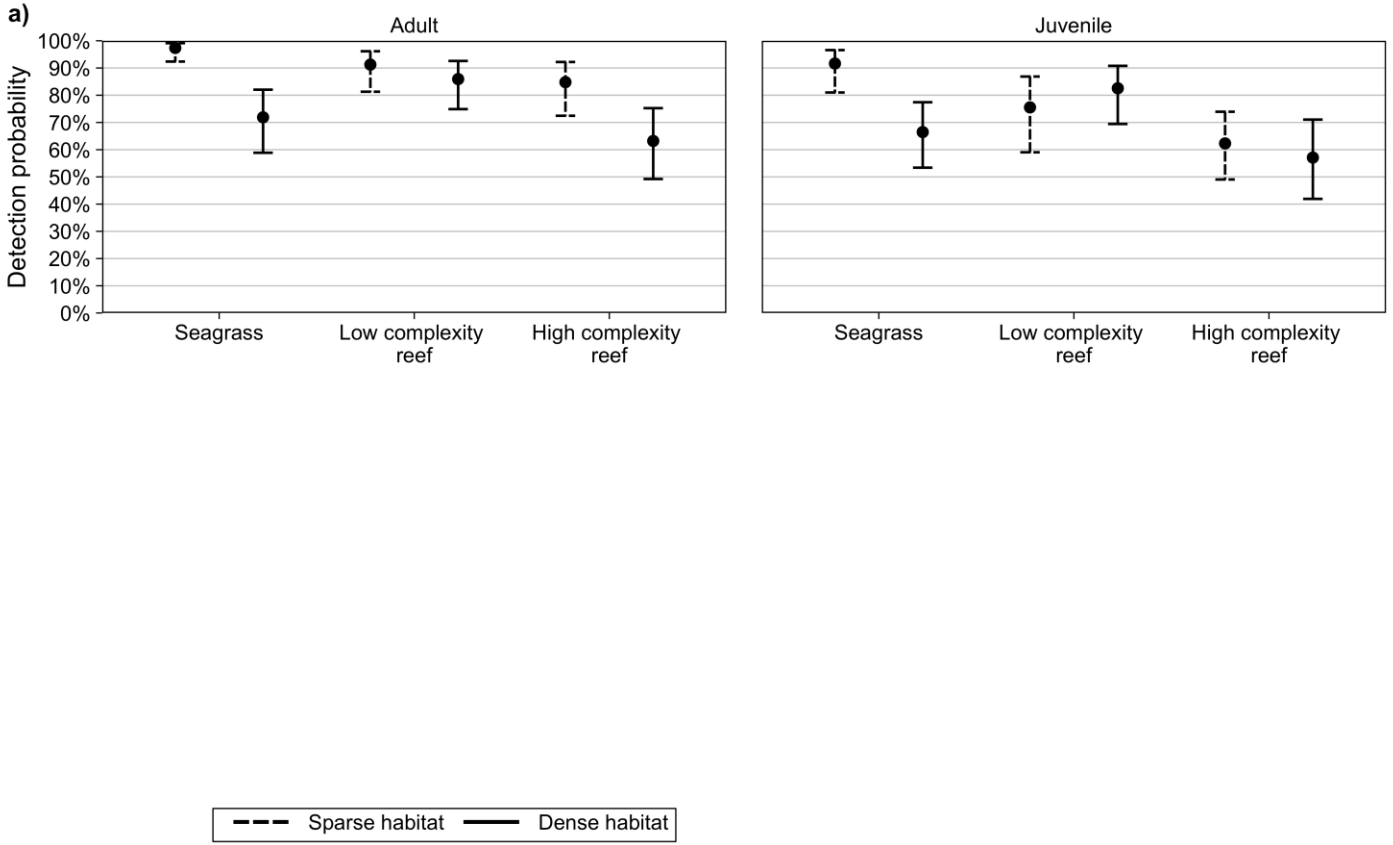
Key findings

- Assays underperformed for this species
- Both only detected presence in ~13% (2/15) of samples collected at 0 m

UVC detection

- 3D-printed adult and juvenile red handfish replicas
- Different conditions:
  - Habitat type: '*seagrass*', '*low-profile reef*', '*high profile reef*'
  - Algal thickness: '*dense*', '*sparse*'
- Hidden on both sides of a 50 m transect line, out to 3 m away from the line
- Different divers then commenced surveys searching for red handfish

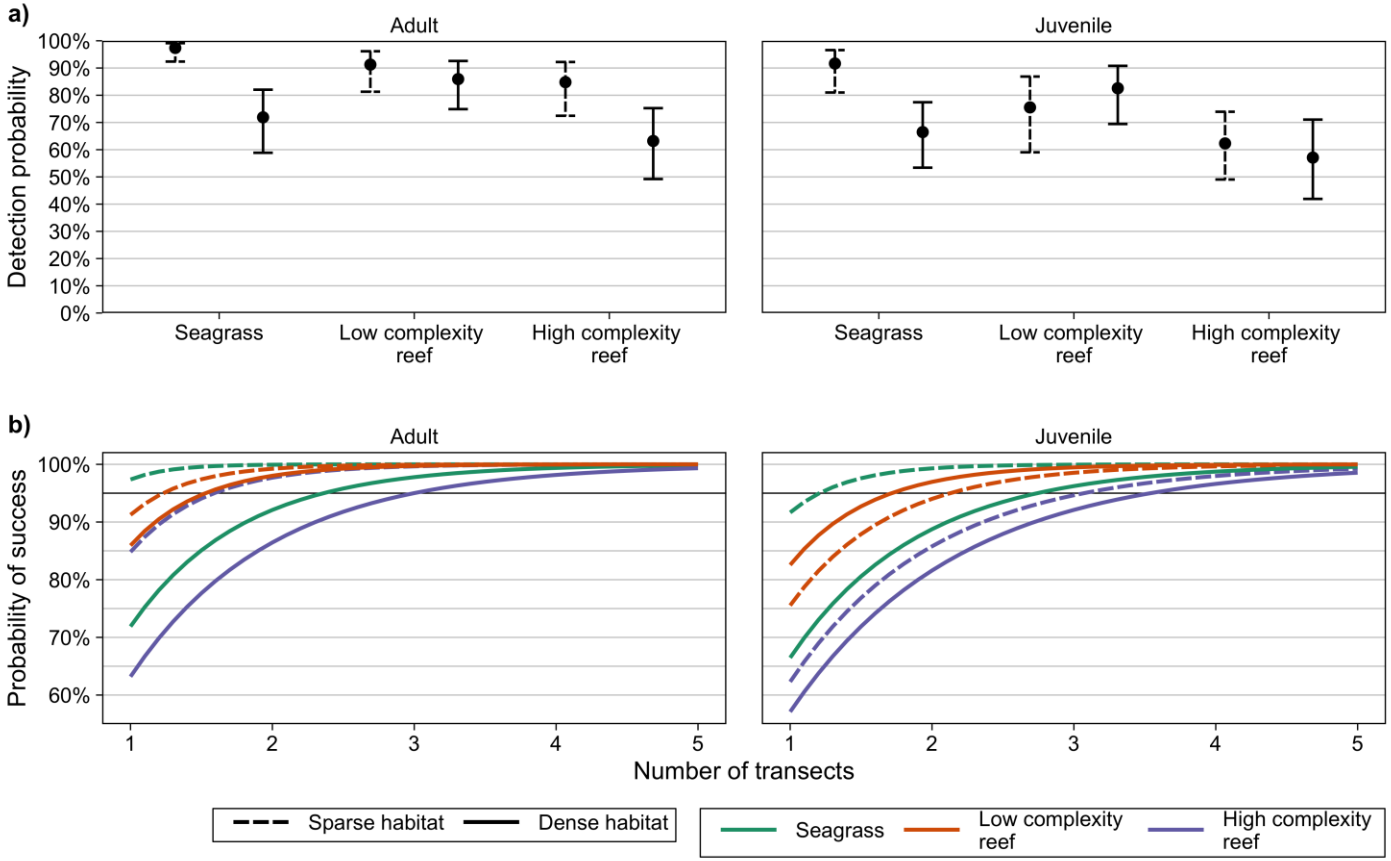
Results: UVC detection



Key findings

- Very good detection via UVC
- Mean detection probabilities ranged from 57 to 97%
- Near certainty (95% probability) detection of an adult was achievable by only one to three surveys (300 m^2 transects) depending on complexity

Results: UVC detection



Key findings

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Binomial distribution equation for calculating probability of multiple events:

$$P_S = 1 - (1 - P_D)^n$$

Solved for number of transects:

$$n = \frac{log(1 - 0.95)}{log(1 - P_D)}$$

Conclusions

- To find new populations, diver-based UVC surveys are more effective at detection and would be the recommended approach if confidence is required
- Yet, eDNA may offer the capacity to cover larger spatial scales given more locations can be sampled per day by a water sampling team in a small vessel than by a dive team
- Habitats covered in this study typical of shallow coastal environments, and thus results could be applicable to other similar species

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