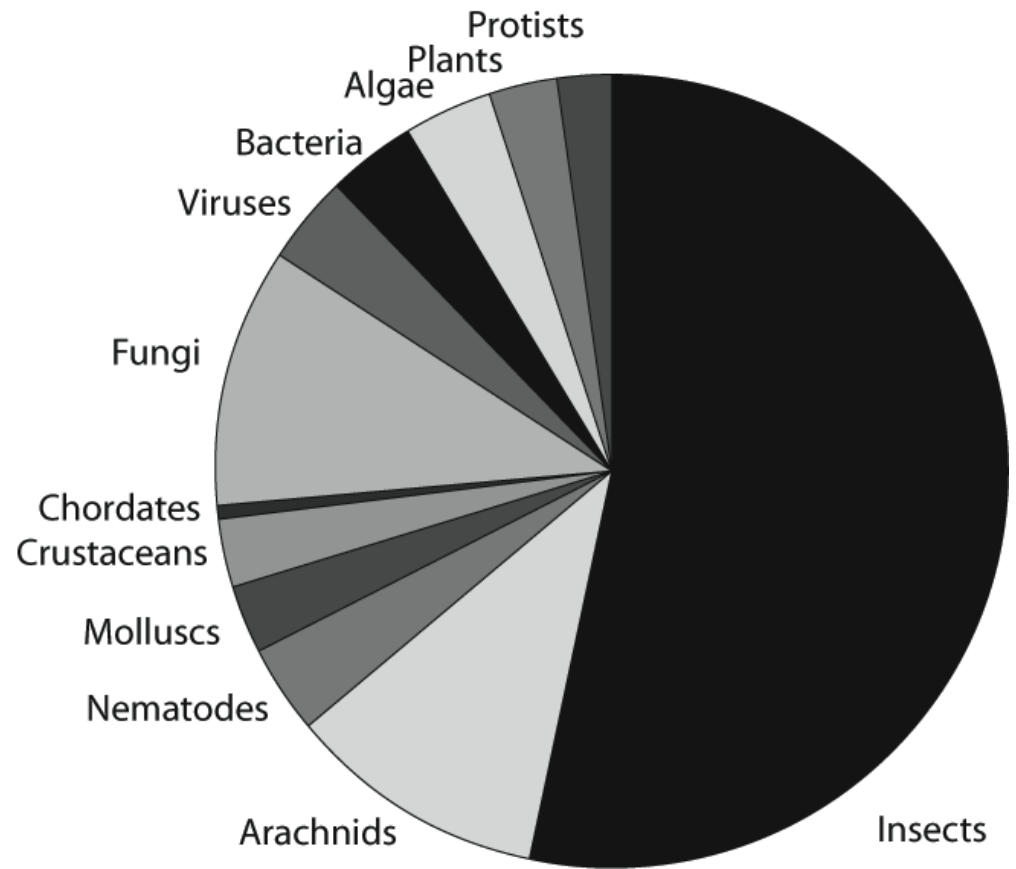


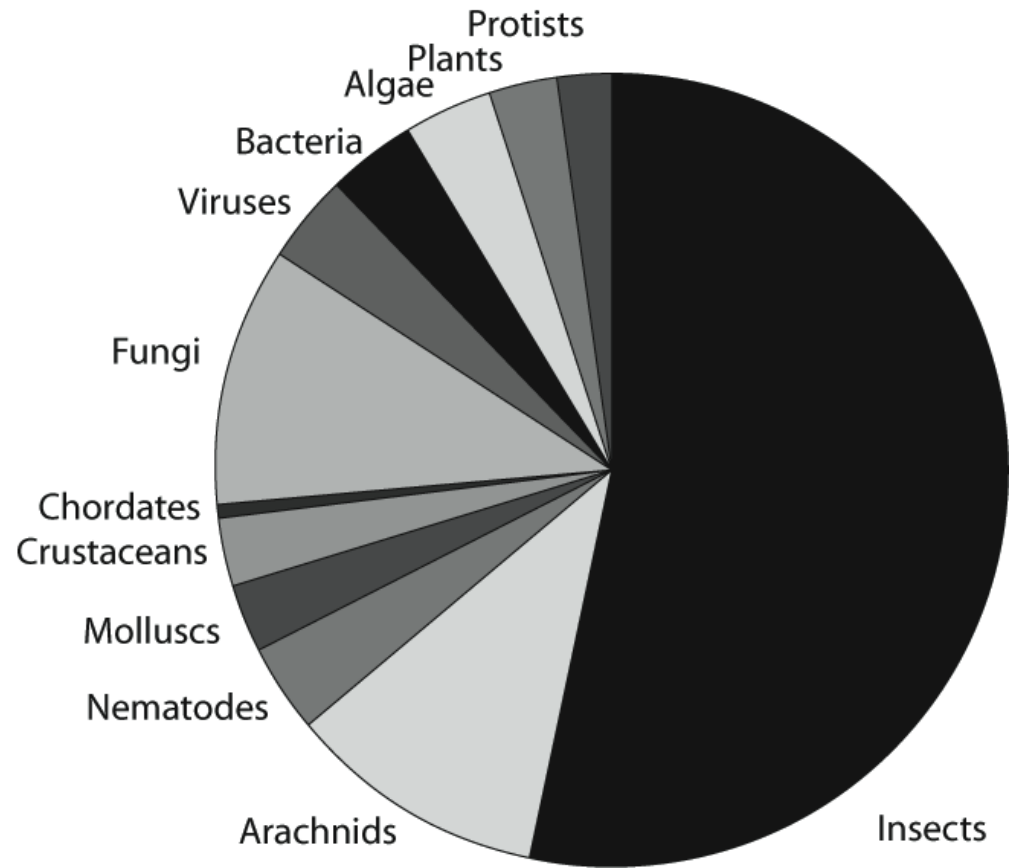
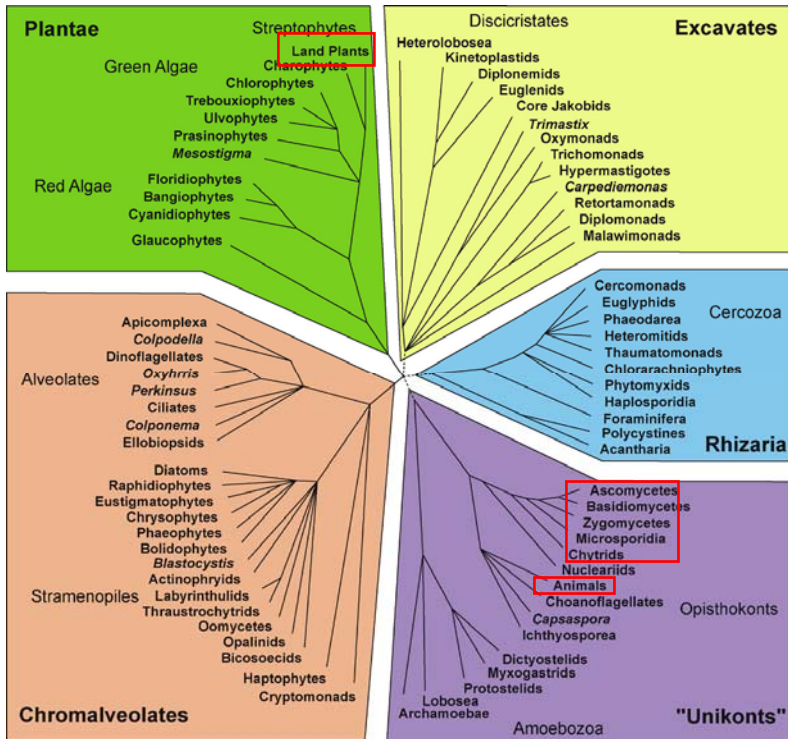
An aerial photograph of a coastal area showing a large, vibrant red tide bloom in the water. The bloom is a thick, orange-red layer that has spread across a significant portion of the bay or inlet. The surrounding water is a deep blue-green, and the coastline is visible with some rocky outcrops and white surf from waves breaking against the shore. The overall scene is dramatic and highlights the impact of the algal bloom on the local marine environment.

# **BARCODING DINOFALGELLATE ALGAE**

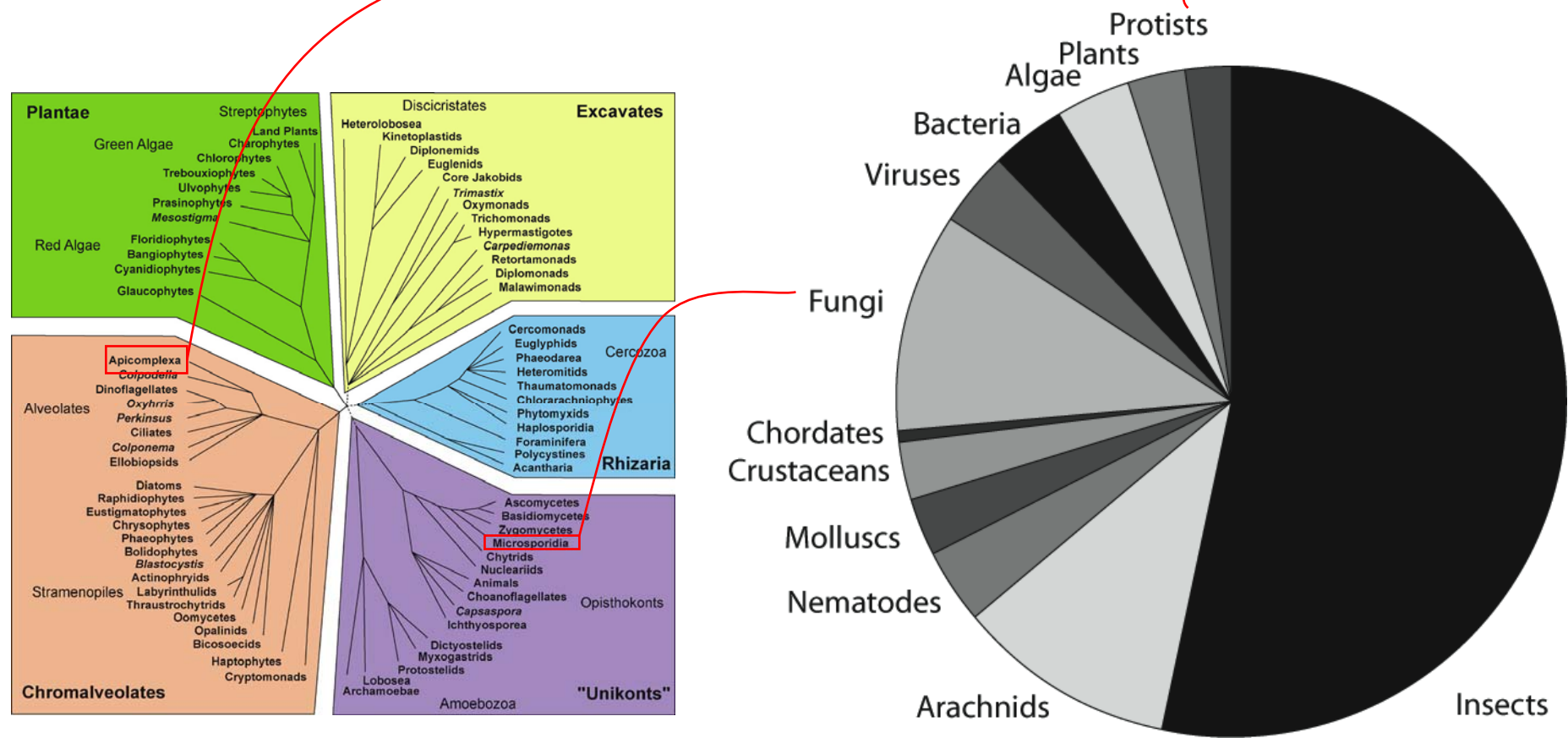
**PATRICK KEELING  
ROWENA STERN**



Adapted from the United Nations Environment Program-World Conservation Monitoring Centre (UNEP-WCMC): *Global Biodiversity Assessment Tables 3.1-1 and 3.1-2* ([www.unep-wcmc.org](http://www.unep-wcmc.org)).

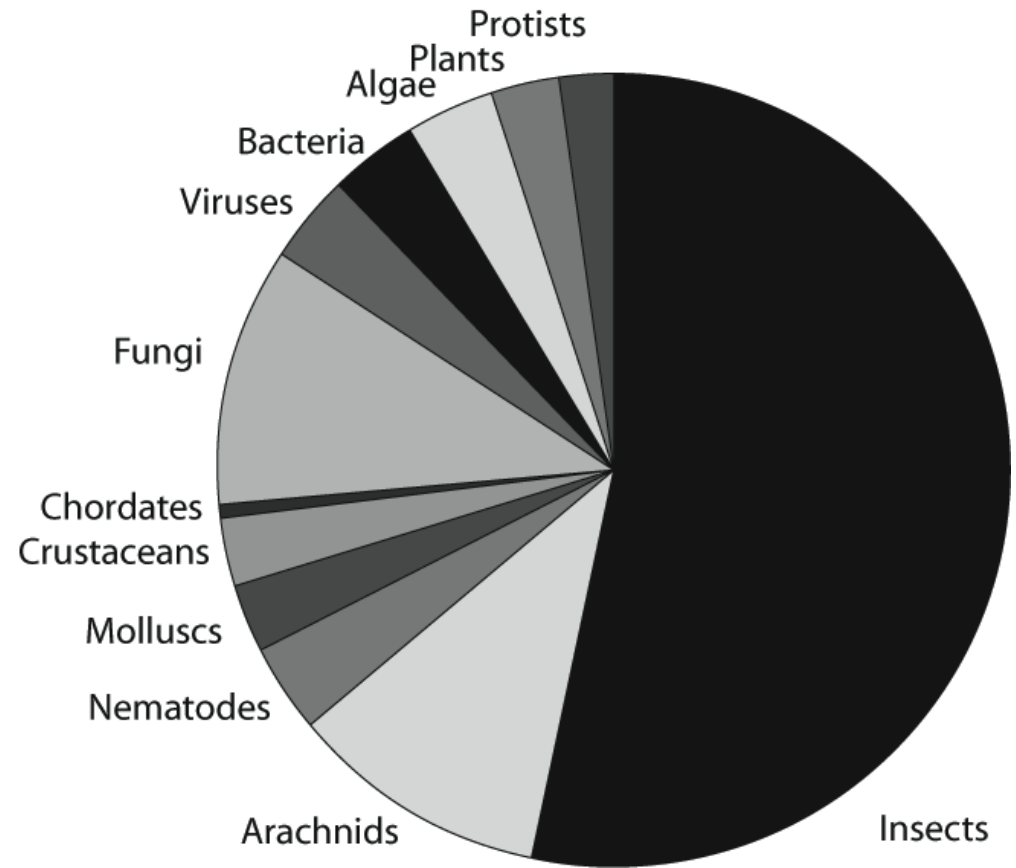


Adapted from the United Nations Environment Program-World Conservation Monitoring Centre (UNEP-WCMC): *Global Biodiversity Assessment Tables 3.1-1 and 3.1-2* ([www.unep-wcmc.org](http://www.unep-wcmc.org)).



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**taxa  
or  
taxonomists?**



Adapted from the United Nations Environment Program-World Conservation Monitoring Centre (UNEP-WCMC): *Global Biodiversity Assessment Tables 3.1-1 and 3.1-2* ([www.unep-wcmc.org](http://www.unep-wcmc.org)).

# Challenges for microbial barcoding

- No concrete idea how many species exist, but it's a lot.
- No concrete species concept for many groups, so what is the unit of diversity?
- Less than 1% cultivatable seems to be the rule of thumb for a given environment.
- Few cultivatable 'species' are formally described.
- Many groups lack *cox1*.
- **One first step: Barcoding culture collections**

Dinoflagellates:  
~3,000 described species

Haptophytes:  
~600 described species

Cryptomonads:  
~200 described species

Chlorarachniophytes:  
9 described species

QuickTime™ and a  
TIFF (LZW) decompressor  
are needed to see this picture.

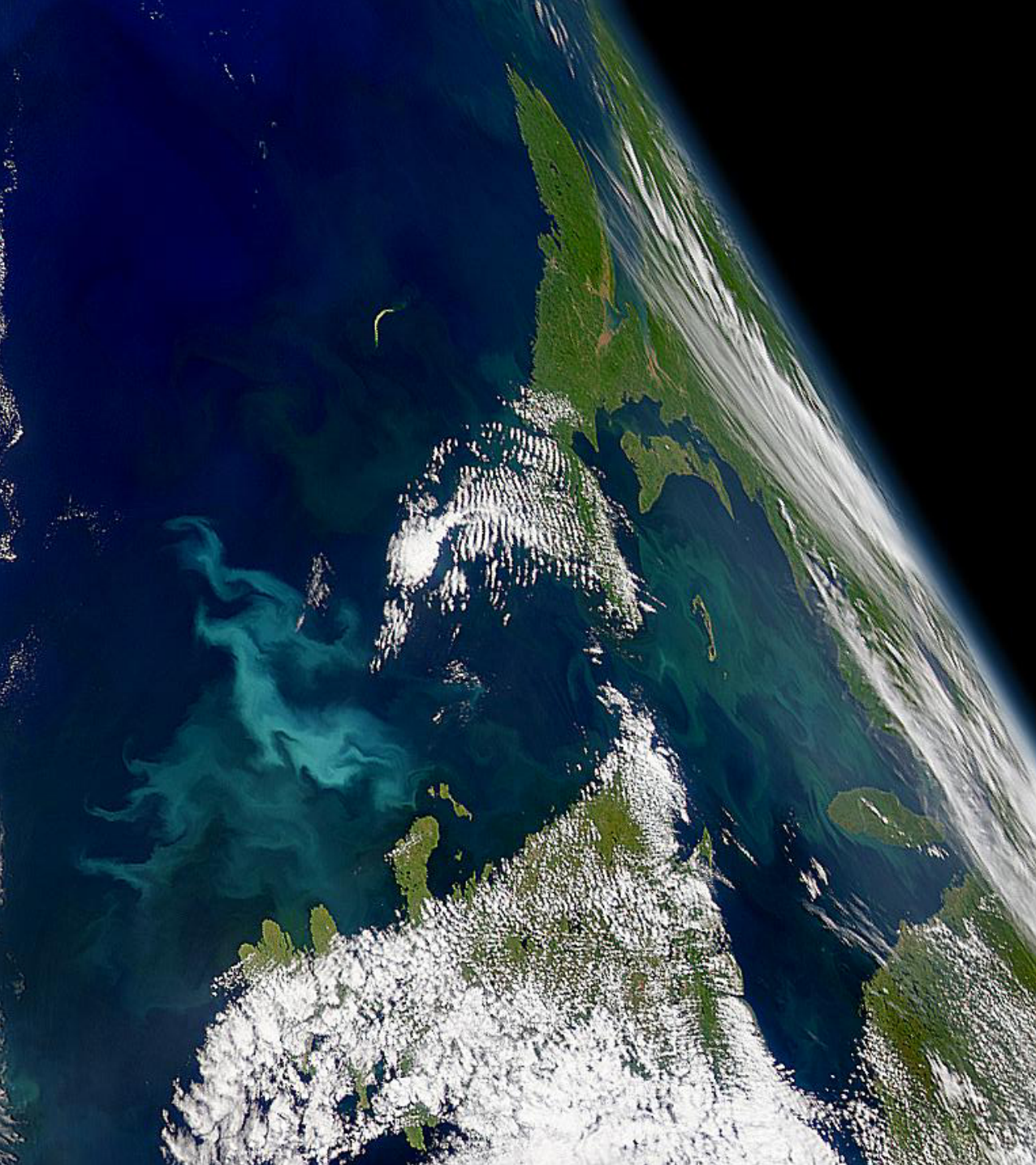


Dinoflagellates:  
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Chlorarachniophytes:  
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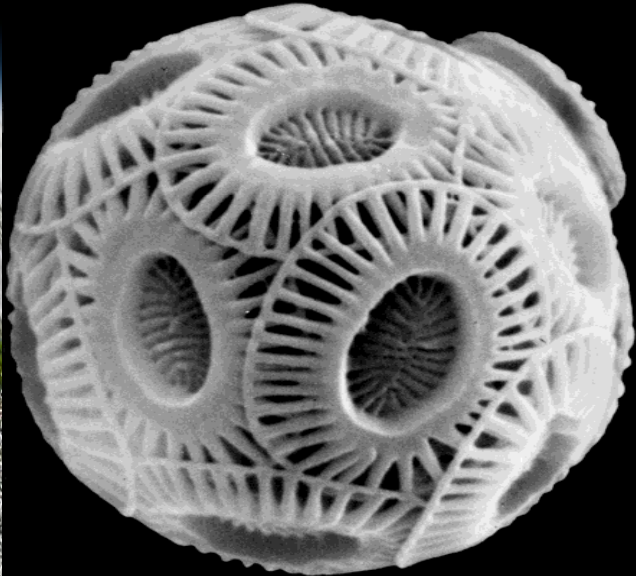


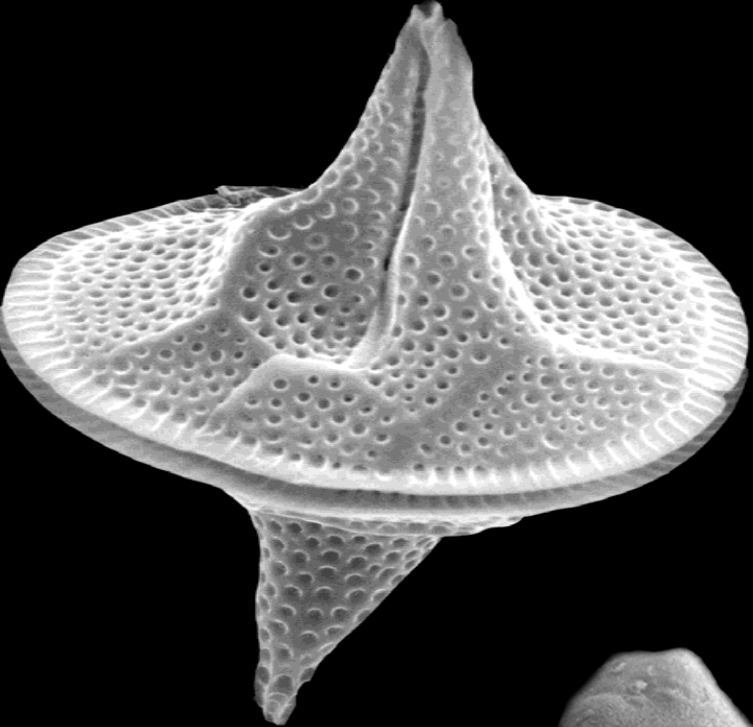
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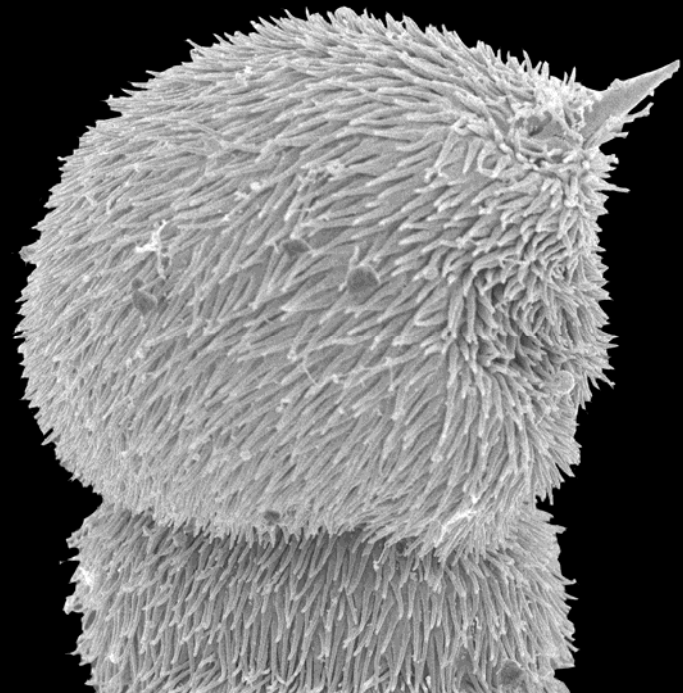


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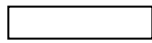
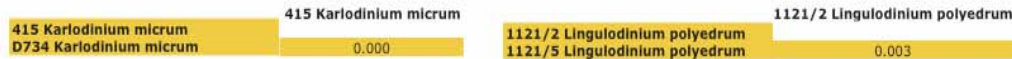
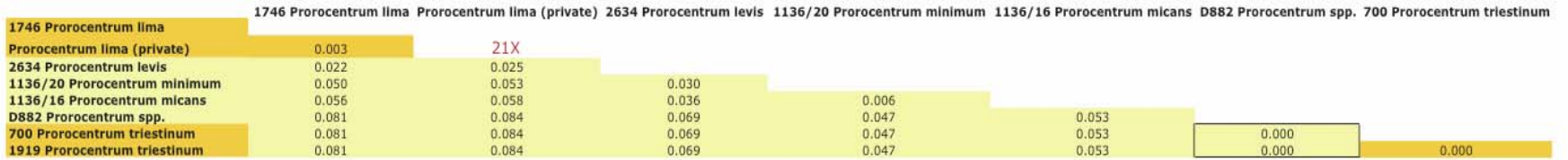
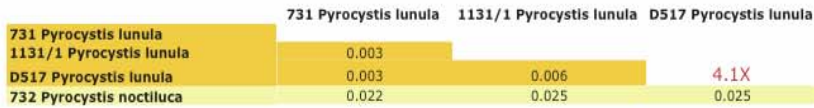


# PROGRESS

Culture collection	Total no dinoflagellates	Groups	Barcodes (COI & ITS)	Percentage Of Culture Collection
CCAP, Oban, Scotland	39	Dinoflagellates: 15 Brown algae: 376	61 165	41%
CCMP Maine, USA	349	Dinoflagellates: 79 Others: 118	95 24	23%
CCCM, Vancouver, Canada	47	Dinoflagellates: 42	44	43%
UTCC, Toronto, Canada	2	Dinoflagellates: 2	0	
SCCAP, Oslo, Norway	Unavail.	Haptophytes: 36	4	
Other private	3	Dinoflagellates	3	
CSIRO	54			
UTEX	26			
CAW	103			
MCC-NIES	68			
ATCC	18			
<b>TOTAL</b>	<b>686</b>		<b>430</b>	

•79 different spp. collected =~50% of species in most culture collection

# Dinoflagellate COI



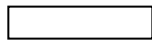
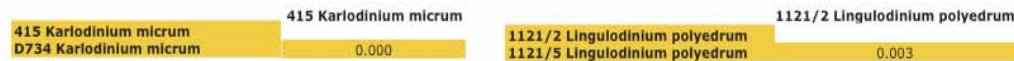
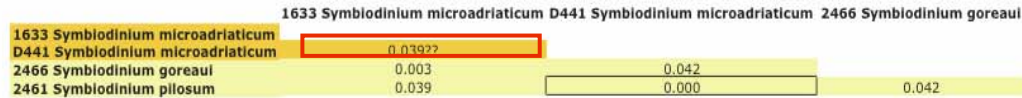
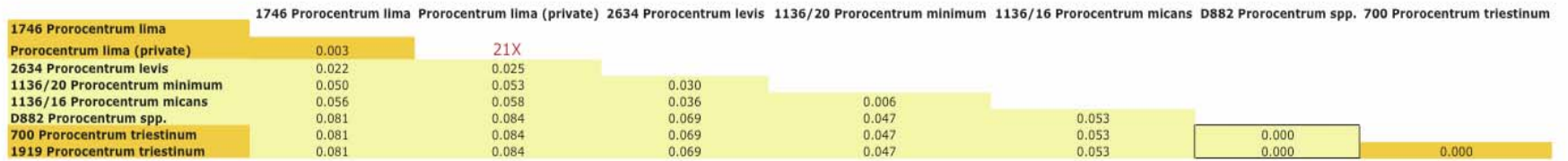
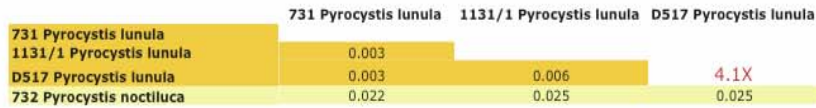
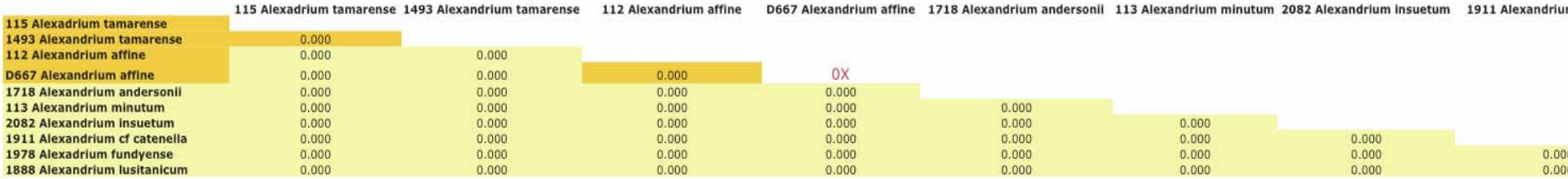
Identical match of unknown spp. to a known one



possible culture sample misidentification

Numbers: within species vs average between species

# Dinoflagellate COI



Identical match of unknown spp. to a known one



possible culture sample misidentification

Numbers: within species vs average between species

# Dinoflagellate ITS

	2431 Symbiodinium spp.	2468 Symbiodinium kawagutii	2466 Symbiodinium goreaul	2461 Symbiodinium spp.	D411 Symbiodinium microadriaticum
2431 Symbiodinium spp.					
2468 Symbiodinium kawagutii	0.055				
2466 Symbiodinium goreaul	0.155	0.173			
2461 Symbiodinium spp.	0.348	0.349		0.371	
D411 Symbiodinium microadriaticum	0.352	0.347		0.365	0.002
2467 Symbiodinium microadriaticum	0.333	0.333		0.360	0.159
					0.160

	D183 Alexandrium tamarense	115 Alexandrium tamarense	D667 Alexandrium affine
D183 Alexandrium tamarense			
115 Alexandrium tamarense	0.022		
D667 Alexandrium affine	0.242	0.216	
1888 Alexandrium lusitanicum	0.332	0.308	0.273

	1383 Polarella glacialis
1383 Polarella glacialis	
2088 Polarella glacialis	0.051

Possible misidentified culture

# What's next

- Complete all major culture collections (CO1 & ITS)
- Environmental PCR sampling
  - to test coverage of culture collection barcode database
  - estimate species diversity
- Developing high-throughput methods for single cell barcoding

# **ACKNOWLEDGMENTS**

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**Canadian Barcode of Life Protist group:**

**Gary Saunders, Margaret Beaton,**

**Dennis Lynn, Irena Kazmarska**

**Mona Hoppenrath**

**Culture collection managers**

**Bob Anderson and CCMP**

**Frithjof Kuepper and CCAP**

**SeaRa Lim and CCCM**