Vegetación marina alrededor del mundo: Patrones, importancia y evolución

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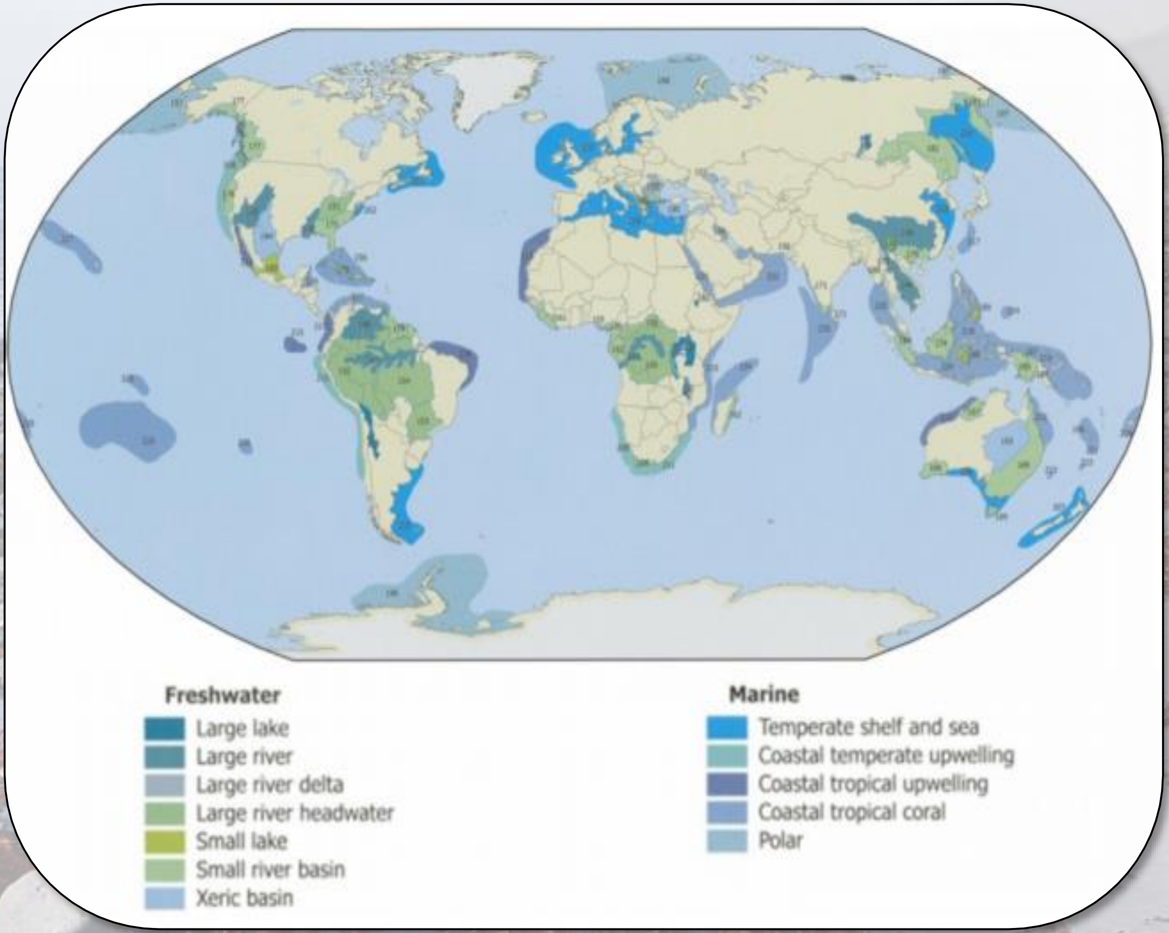
Macroalgae / Seaweeds

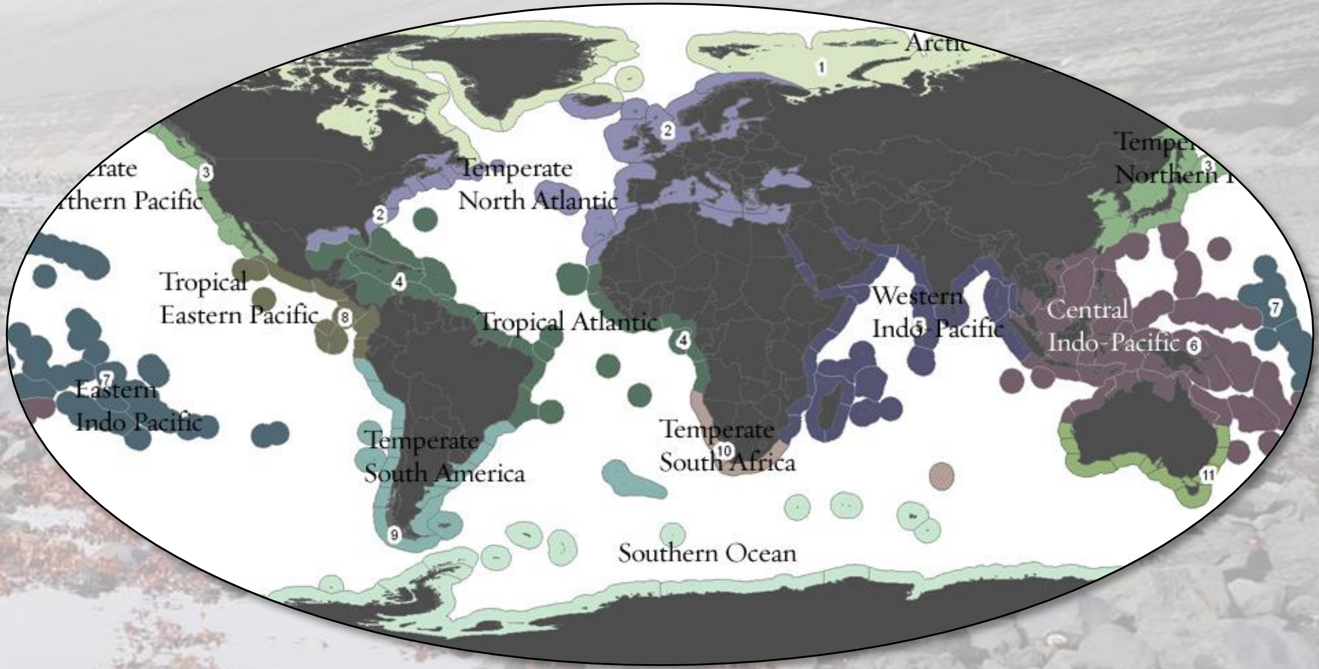


Patrones

Patrones



Freshwater and marine biomes as classified by Olson and Dinerstein (2002). In: The Global 200: Priority ecoregions for global conservation. Annals of the Missouri Botanical Garden, 89(2): 199-224



Marine realms as classified by Spalding et al. (2007). In: Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience, 57(7): 573-583.

Antarctic Marine Flora

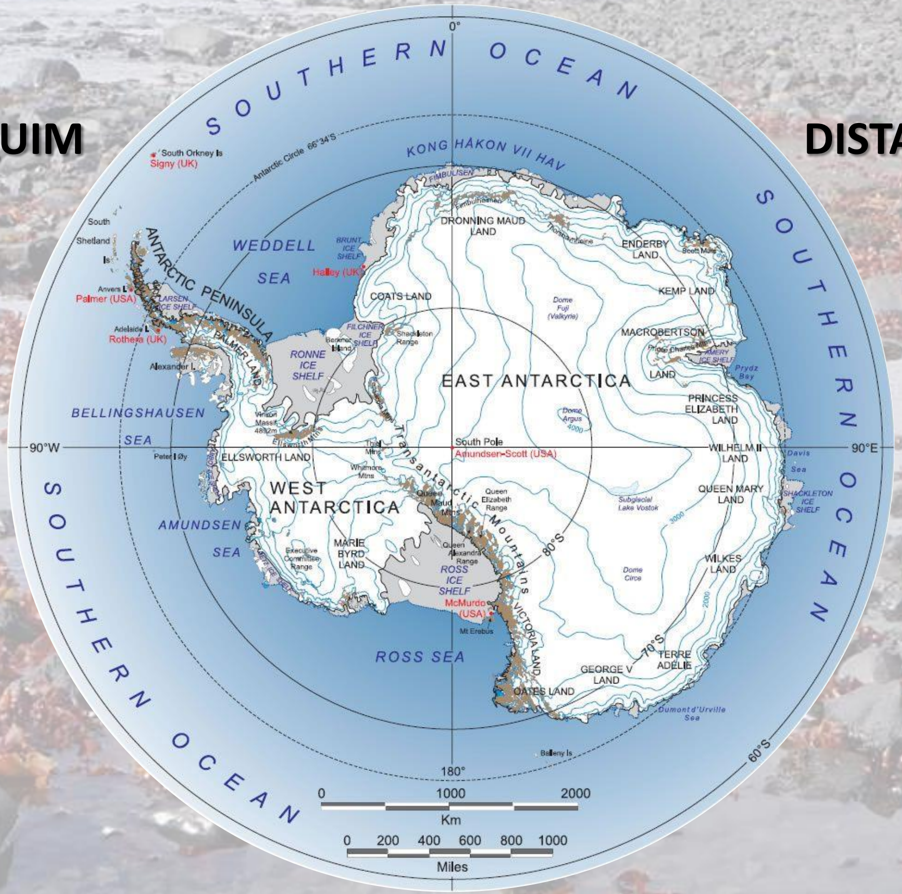
Small forms of *Fucus* from the European coasts

Antarctic Marine Flora

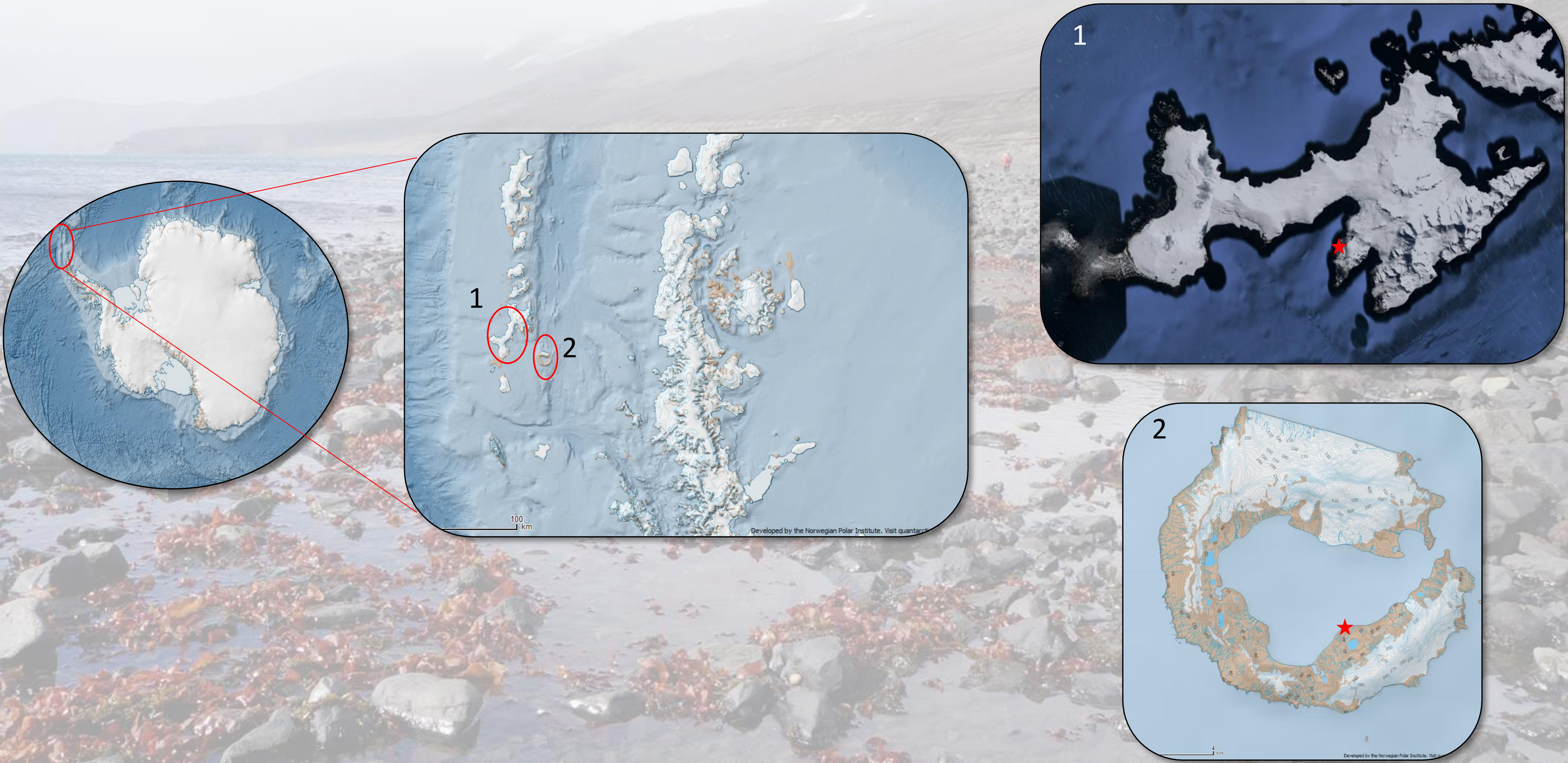
<u>BLUEBIO</u>

ACTIQUIM

DISTANTCOM

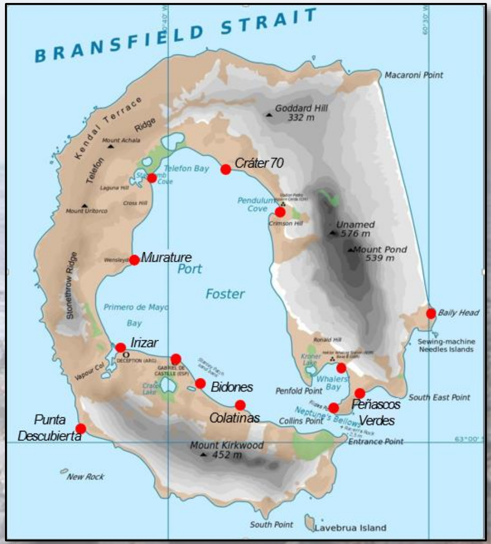


Sampling area



Sampling

Updated checklist of Deception Island



76 species

- 39 *Rhodophyta*
- 19 *Phaeophyceae*
- 18 *Chlorophyta*

63'3% of the known Antarctic flora

	NR	LAV	PDE	PVE	CBA	PFI	BALL	COL	BID	BAEI	IRI	MUR	TEL	C70	PEN	DC
CHLOROPHYTA																
Acrosiphonia arcta **(Dillwyn) Gain**							12			+		15				1
Blidingia minima **(Nägeli & Kützing) Kylin**									+			15				
Chaetomorpha dubyana Kützing							10									
Chaetomorpha mawsonii A.H.S. Lucas												15				
Cladophora coelothrix Kützing												15				
Endophyton atroviride O'Kelly												15				
Monostroma grevillei (Thuret) Wittrock												15				
Monostroma hariotii **Gain**		5					10+			+		15	+		10	1, 4
Prasiola crispa (Lightfoot) Kützing							10					15				
Rhizoclonium ambiguum (J.D. Hooker & Harvey) Kützing												15				
Rhizoclonium riparium (Roth) Harvey												15				
Spongomorpha pacifica (Montagne) Kützing												15				
Ulothrix australis Gain												15				1
Ulothrix flacca **(Dillwyn) Thuret**			+						+			15	+			1

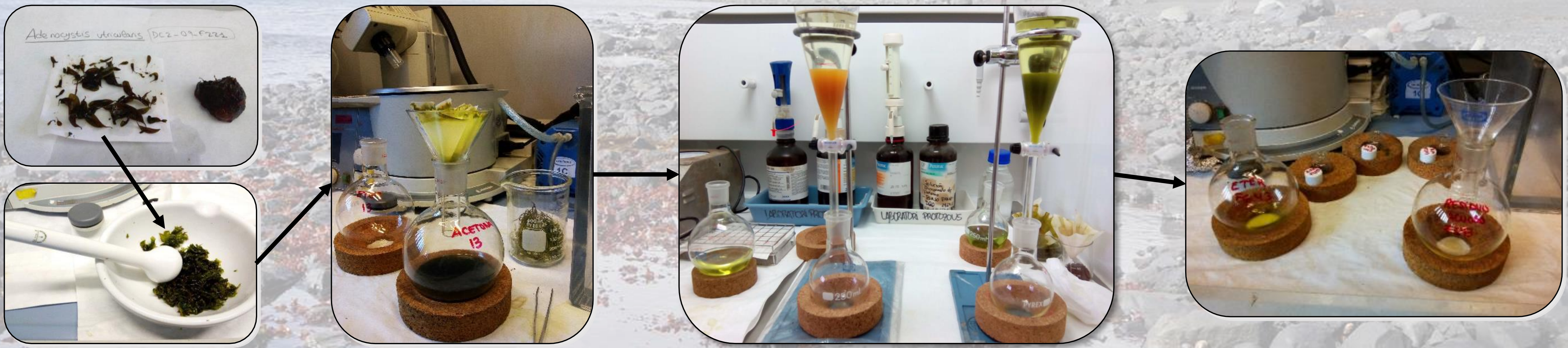
New cites for the Deception marine flora

1. *Austropugetia crassa* R. L. Moe
2. *Delisea pulchra* (Greville) Montagne
3. *Leniea lubrica* R. L. Moe
4. *Pantoneura plocamioides* Kylin
5. *Porphyra plocamiestris* R. W. Ricker
6. *Chordaria linearis* (J. D. Hooker & Harvey) A. D. Cotton

BCN-Phyc Herbarium
(Plant Biodiversity Resource Centre of the University of Barcelona).

Angulo-Preckler, *et al.*, (2018). Macrobenthic patterns at the shallow marine waters in the caldera of the active volcano of Deception Island, Antarctica. *Continental Shelf Research*, *157*, 20-31.

Antibiotic properties of macroalgae from Antarctica
Methodology



Antibiotic properties of macroalgae from Antarctica
Methodology

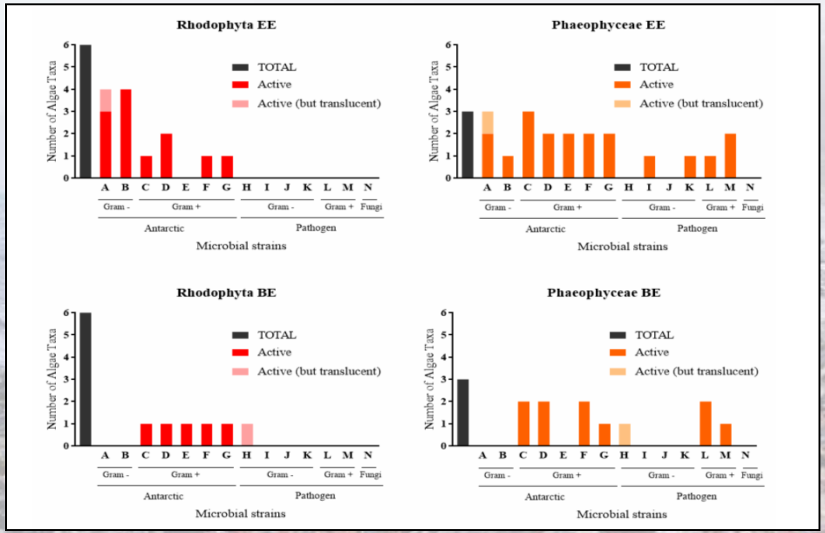
Acar (1980)

Microorganisms used in the antibiotic assay	
Antarctic	**Microorganism Type**
Psychrobacter sp.	Gram -
Paracoccus sp.	Gram -
Arthrobacter sp. (A)	Gram +
Arthrobacter sp. (B)	Gram +
Oceanobacillus sp.	Gram +
Bacillus aquamaris	Gram +
Micrococcus sp.	Gram +
Patogens	
Vibrio cholerae CECT-657	Gram -
Escherichia coli O157H7, ATCC 43888	Gram -
Pseudomonas aeruginosa NCTC 10332T	Gram -
Escherichia coli CECT515	Gram -
Bacillus cereus CECT 4014	Gram +
Staphylococcus aureus CECT 59	Gram +
Candida albicans CECT 1001	Fungus *Saccharomycetes*

Activity depending on Inhibition area radius	
No effect	0 (-)
Weak inhibition	0-1mm (+)
Moderate Inhibition	>1-3mm (++)
Trong Inhibition	>3-7mm (+++)
Very Strong Inhibition	>7-15mm (++++)

Lippert *et al.* (2003)

Antibiotic properties of macroalgae from Antarctica



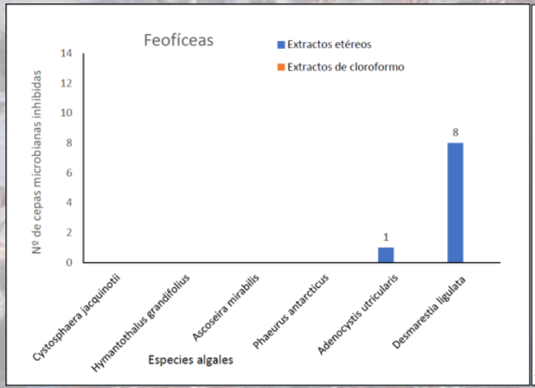
Source: Camacho (2017)

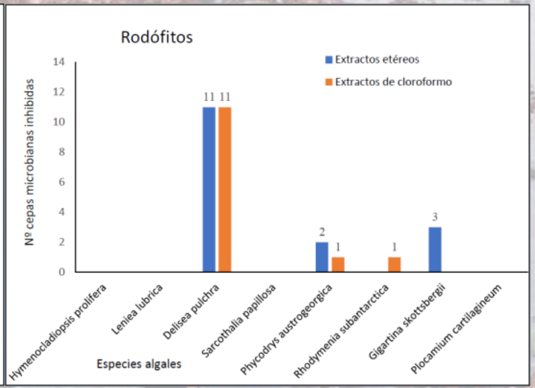
22 Antarctic macroalgae tested

- 14 Rhodophyta (**8** showed activity)
- 8 Phaeophyceae (**4** showed activity)

Delisea pulchra (Greville) Montagne

Desmarestia antarctica R.L.Moe & P.C.Silva





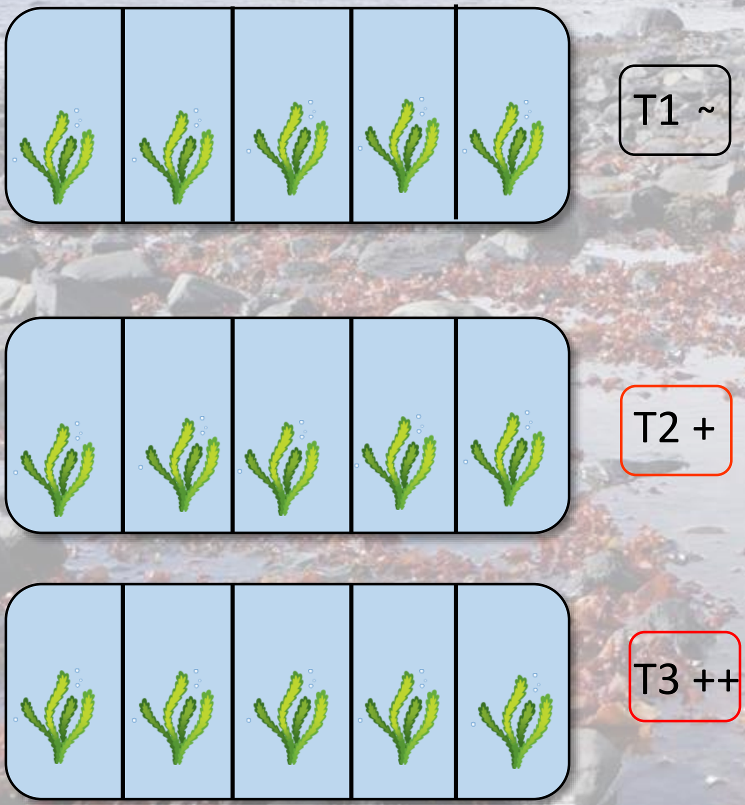
Source: Carcedo (2018)

Tested microorganisms

- Antarctic bacteria were inhibited for most algae
- **Gram-** were **more resistant**
- ***Escherichia coli***, ***Pseudomonas aeruginosa*** & ***Candida albicans*** were the most resistant

Chemical activity in different climate change scenarios

- Does Temperature changes affect to the chemical defences expression on macroalgae?
- Compare 3 different temperature scenarios in 3 different biomes (Antarctica, Mediterranean, Tropic)
- *Cystosphaera jacquinotii, Cystoseira compressa, Sargassum sp.*

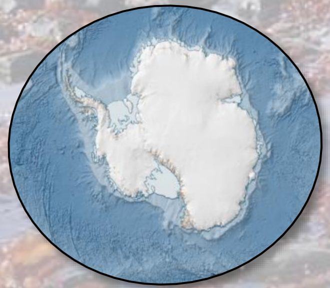


Genus Plocamium J.V.Lamouroux
in Antarctica

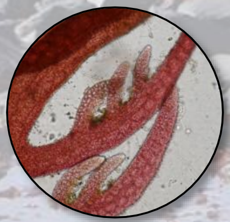
P. cartilagineum (Linnaeus) P.S.Dixon

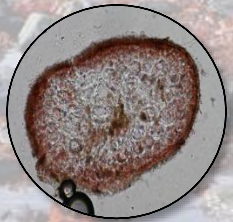
P. hookery Harvey

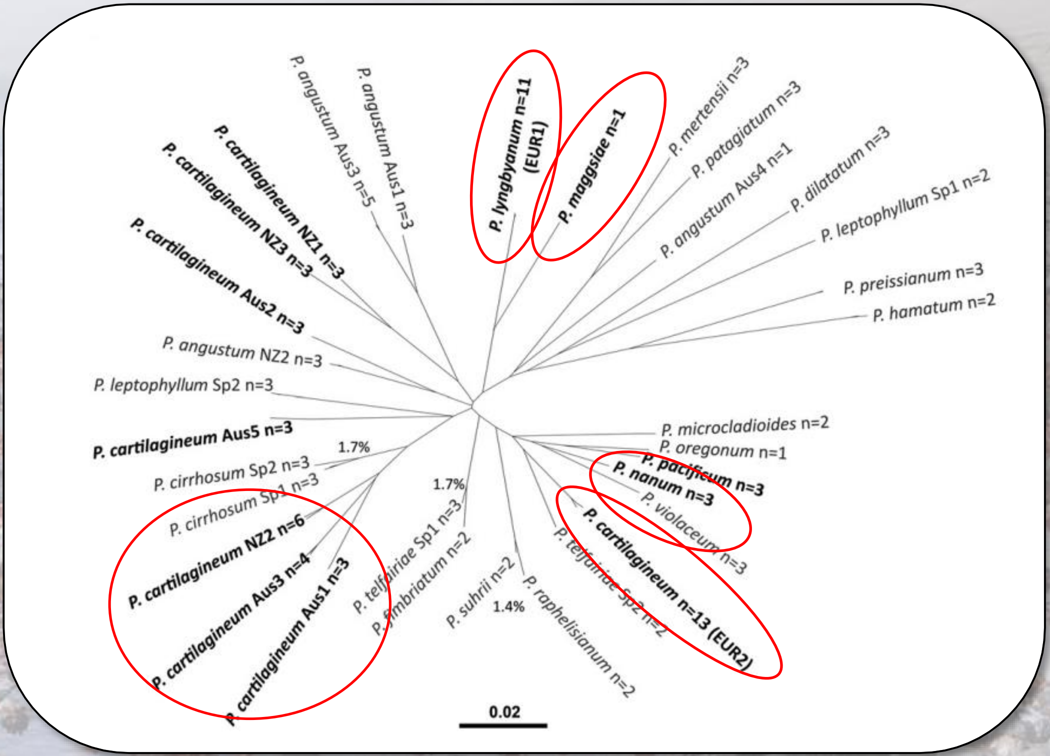
P. secundatum (Kützing) Kützing



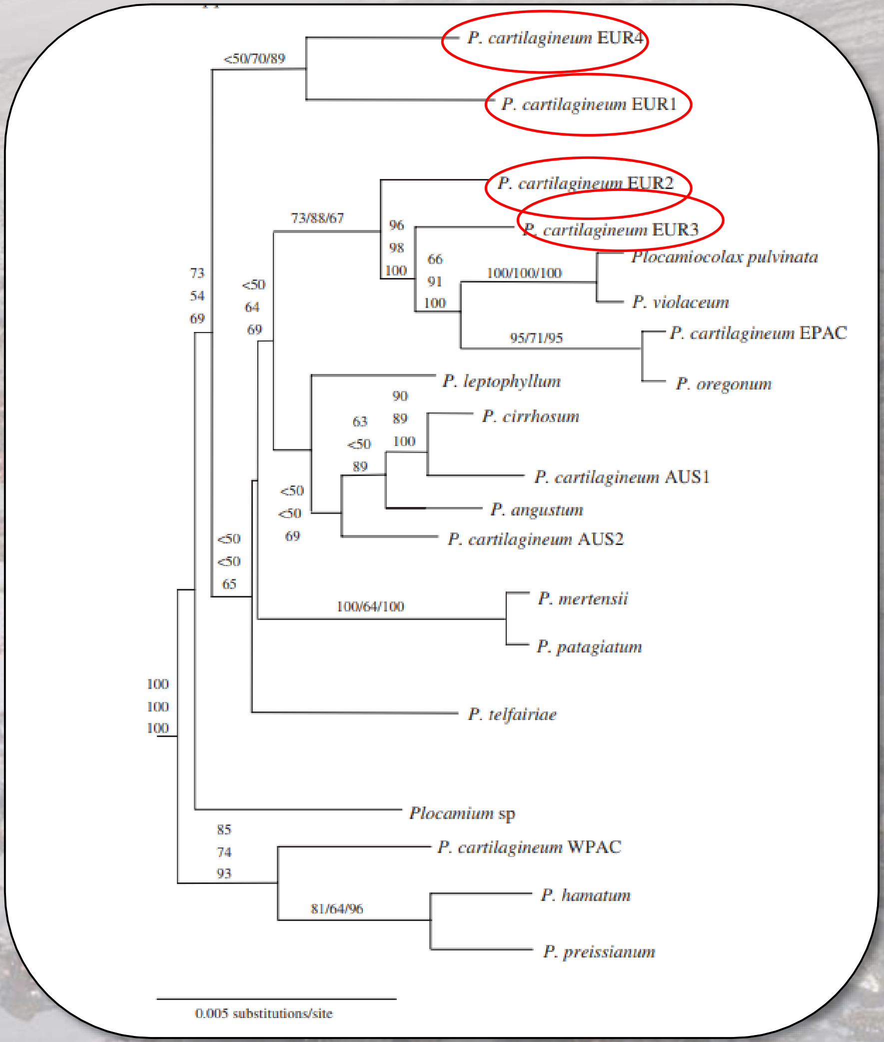
Genus Plocamium J.V.Lamouroux *in Antarctica*







Source: Cremades *et al.* (2011).



Source: Saunders *et al.* (2005).

Small forms of *Fucus* from the European coasts

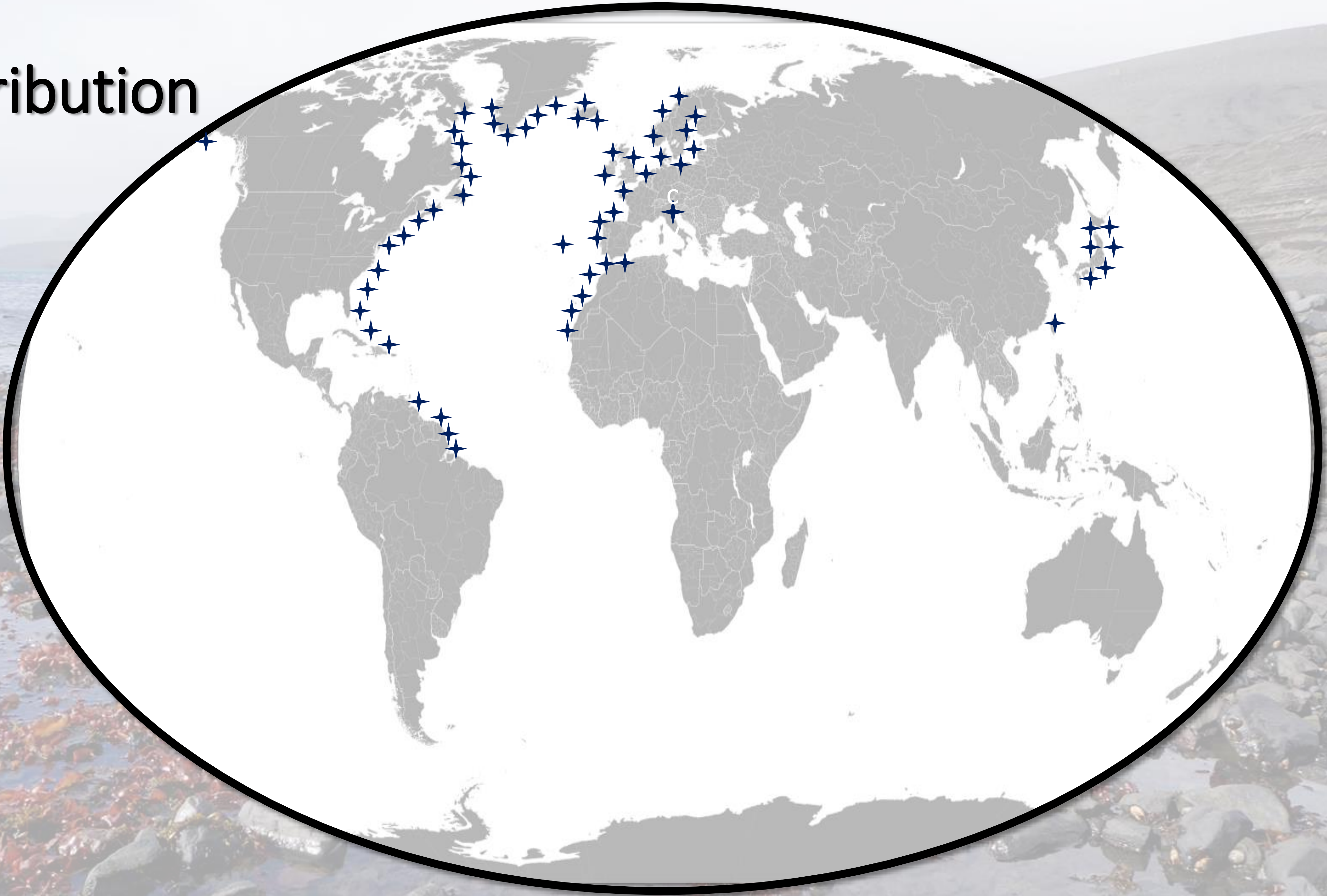
Fucus vesiculosus Linnaeus

Source: aphotomarine

Fucus serratus Linnaeus

Source: wikipedia

Distribution



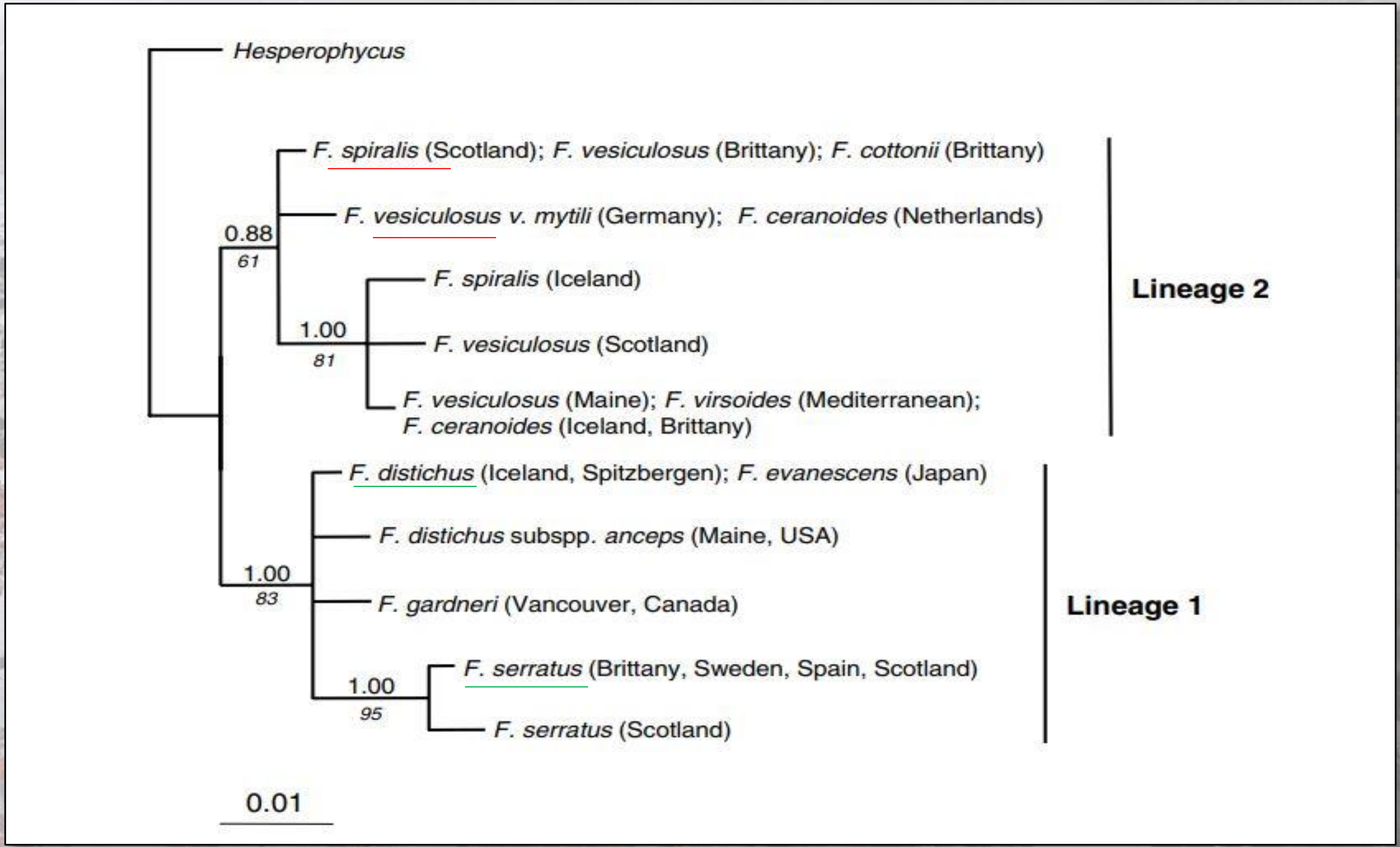
The genus *Fucus*

Fucus Linnaeus, 1753

About **9 accepted species**

- *F.chalonii*
- *F.cottonii*
- *F.vesiculosus*
- *F.spiralis*
- *F.serratus*
- *F.radicans*
- *F.distichus*
- *F.virsoides*
- *F.ceranoides*

Source: *Algaebase* (11-07-2018)



Bayesian phylogenetic tree based on **mtDNA 23S** sequences. Numbers above and below the line are Bayesian posterior probability and MP bootstrap values (1000 replications), respectively. **Source**: Coyer *et al.* (2006)

Fucus chalonii Feldmann

F. spiralis var. nanus (Stackhouse) Batters

Fucus cottonii M.J.Wynne & Magne

F. spiralis var. limitaneus (Montagne) I.M.Pérez-Ruzafa

Ecology

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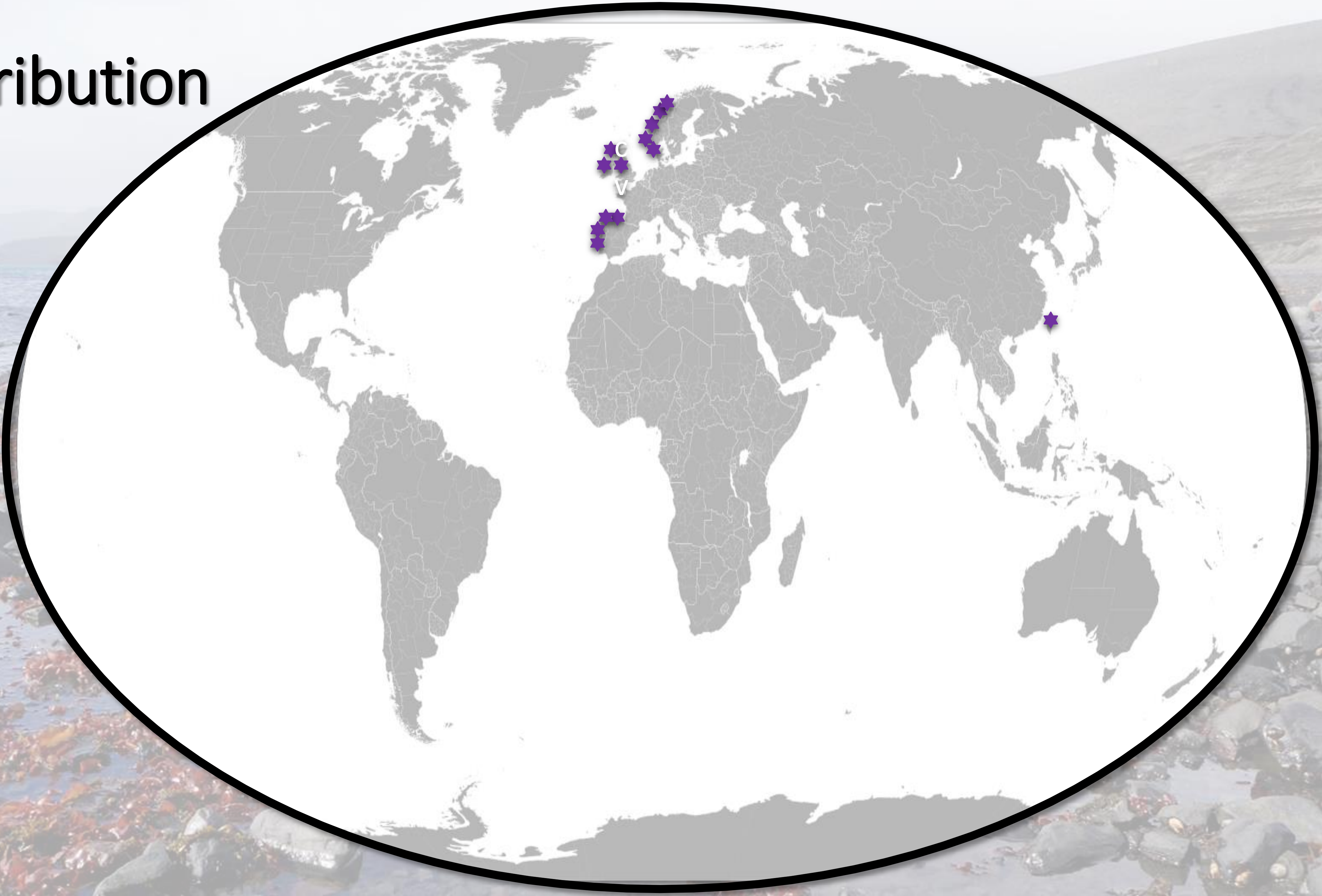


1. What is the position of those small *Fucus* forms in the phylogenetic tree? Are they true species? How was their evolution?

2. How different are populations? Are those differences related to ecology?

3. Is the distribution changing? Is there any pattern?

Methodologies

- **Phycological analysis:** classical study of morphology and anatomy.

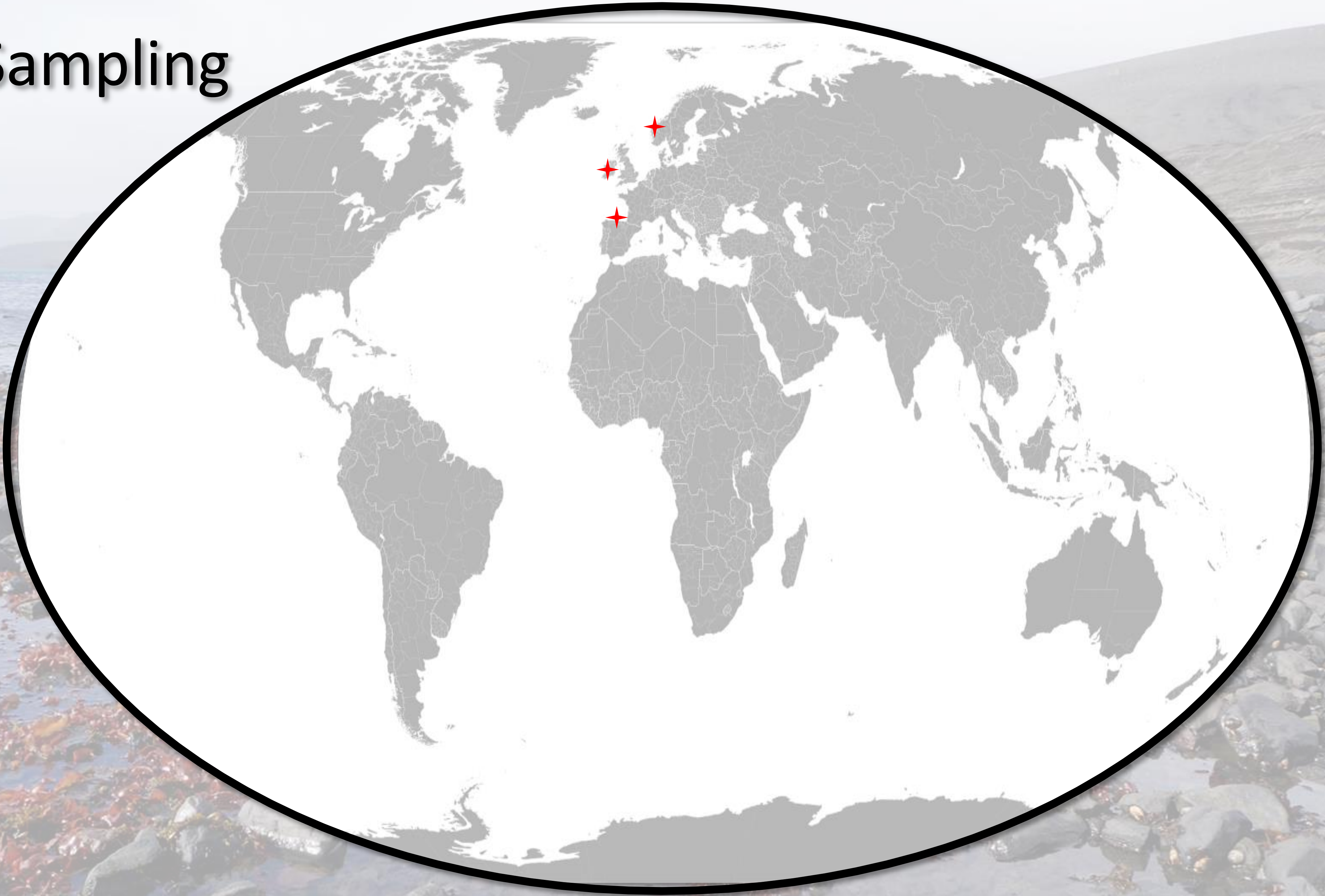
- **Genetic analyses**: DNA-Barcoding & analysis of repetitive elements from the genome (microsatellites)

- **Measures of the DNA nuclear content (C-values):** current methodology by fluorimetry. Application of flux cytometry.

- **Karyotype analyses**: chromosome staining and Image analysis.

- **Species distribution analyses and niche comparison**: by maximum entropy algorithms and niche definition algorithms.

Sampling



Results

Conceptacle structure and germling growth. Fig. 6. Mature oogonium containing egg cells ready to be released; Figs 7-8. Antheridia (Fig. 7) and germlings (Fig. 8) after 6 days in culture from Locality 1 (Illaunnginga) (possible damage to the attachment rhizoids due to transfer to microscope slide). Fig. 9. Immature oogonia from Locality 2 (Clifden). Fig. 10. Immature oogonia. Fig. 11. Antheridia both from Locality 3 (Achill Sound). Scale bar is 50 µm.

Table 2. Calculated F_{IS}, H_{exp} and allelic richness (Å) for n individuals from populations of *Fucus spiralis* (*Fs*), *F. vesiculosus* (*Fv*) and small salt marsh *Fucus* (ssm*F*) from Locality 2 (Clifden) and Locality 3 (Achill Sound).

Locality-taxon	*n*	F_{IS}	H_{exp}	*Å*
2-*Fs*	6	0.590*	0.327	1.400
2-ssm*F*	5	0.271	0.513	2.800
2-*Fv*	6	0.102	0.570	2.726
3-*Fs*	15	0.618*	0.295	1.472
3-ssm*F*	6	0.510*	0.374	2.600
3-*Fv*	14	0.504*	0.813	4.266

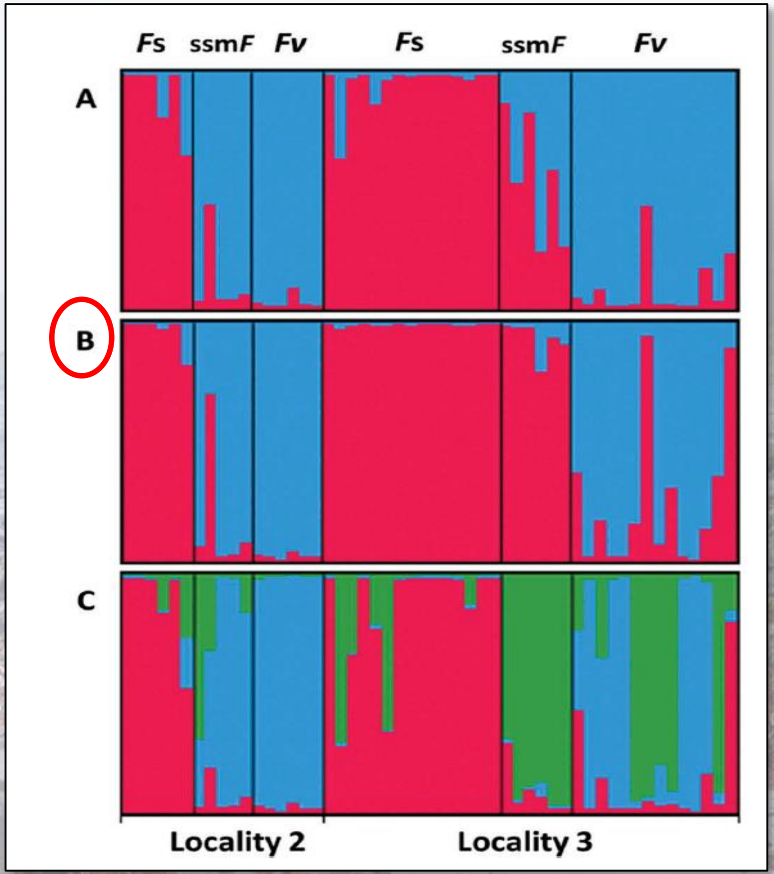
Significant F_{IS} values are marked with an asterisk. Allelic richness (*Å*) is standardized to $n = 5$.

Table 3. Pairwise F_{ST} values comparing populations of *Fucus spiralis* (*Fs*), *F. vesiculosus* (*Fv*) and small salt marsh *Fucus* (ssm*F*) from Locality 2 (Clifden) and Locality 3 (Achill Sound).

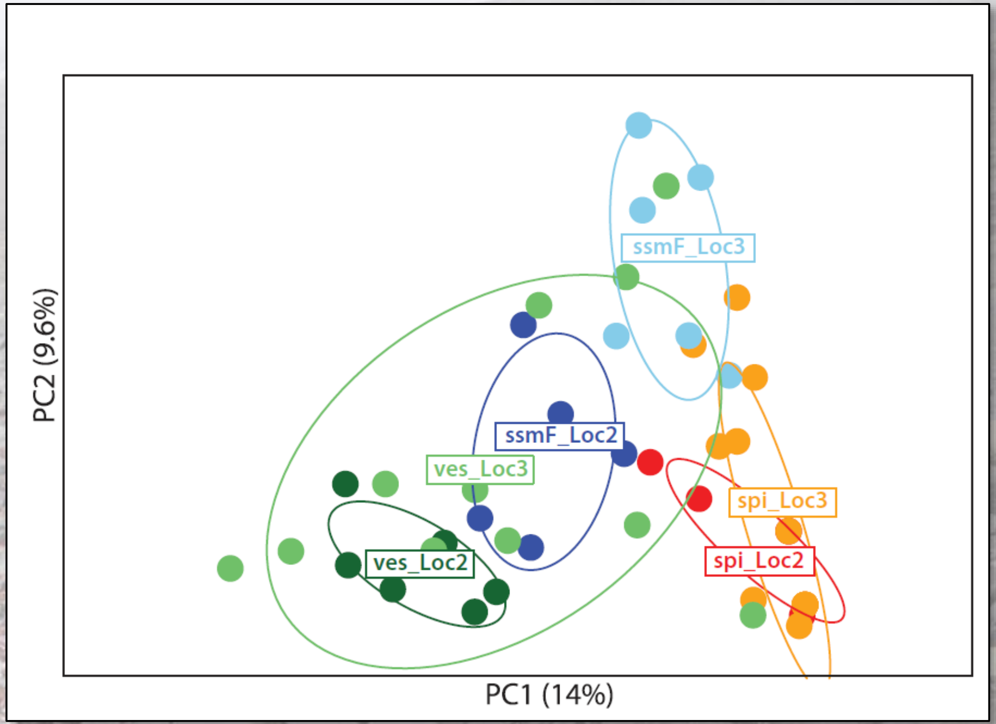
Locality-taxon	2-ssm*F*	2-*Fv*	3-*Fs*	3-ssm*F*	3-*Fv*
2-*Fs*	0.408	0.447	−0.059	0.469	0.238
2-ssm*F*		0.073	0.492	0.349	0.064
2-*Fv*			0.526	0.464	0.078
3-*Fs*				0.497	0.327
3-ssm*F*					0.182

Sjøtun *et al.* (2017). Unravelling the complexity of salt marsh 'Fucus cottonii' forms (Phaeophyceae, Fucales). European Journal of Phycology, 52(3), 360-370.c

Results



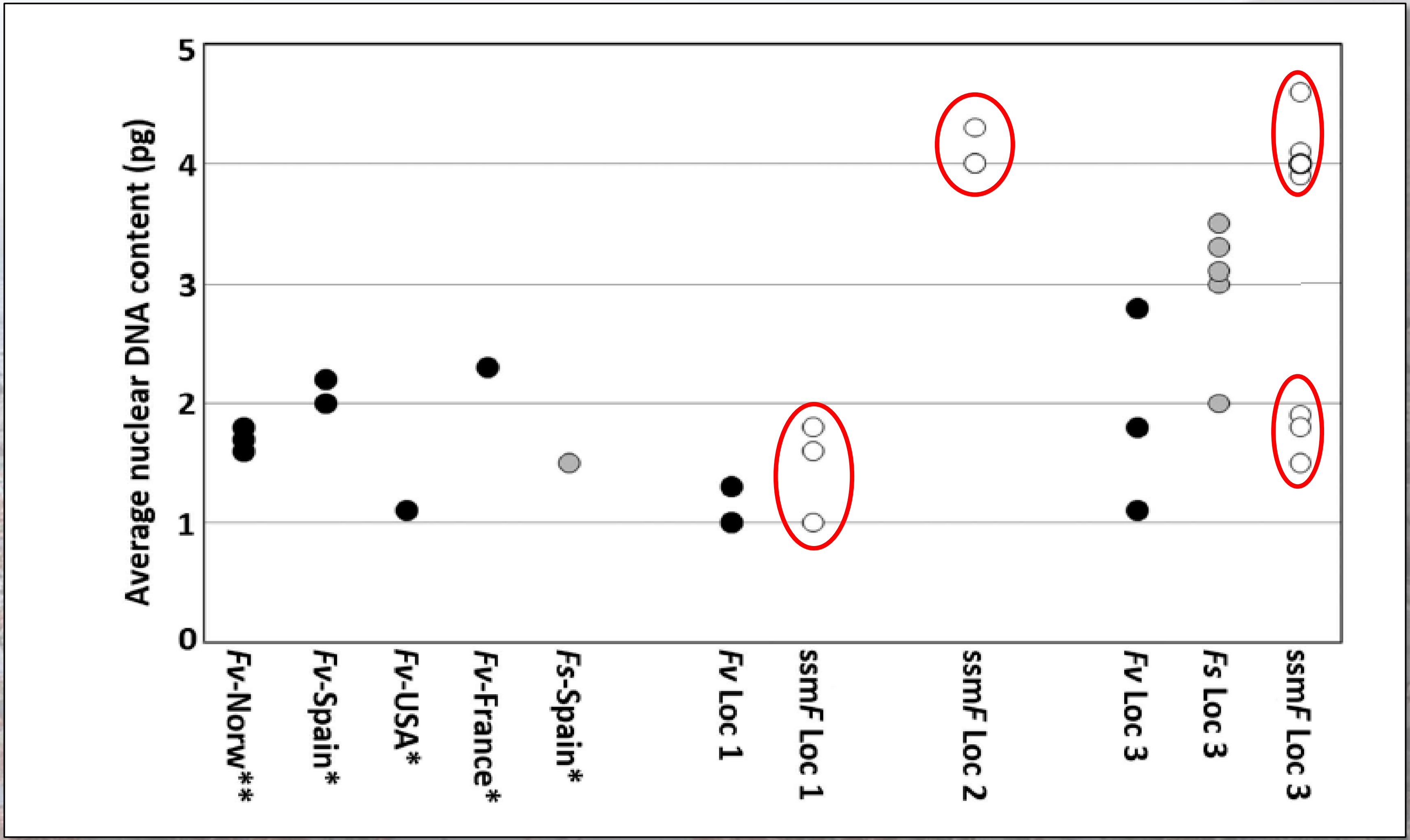
Results from **STRUCTURE** (A) and **INSTRUCT** (B) **analyses** with K = 2; and from INSTRUCT analysis with K = 3 (C). Localities 2 and 3 consist of individuals sampled as *Fucus spiral*is (Fs), *F. vesiculosus* (Fv) and small salt marsh *Fucus* (ssmF). Each individual is represented by a bar and colours represent the proportional assignment to the STRUCTURE/INSTRUCT groups.



The two first principal components (PC) of a **Principal Component Analysis** showing genetic affiliation of haplotype composition of ssmF (blue), *F. vesiculosus* (ves) (green) and *F. spiralis* (spi) (orange-red) from Locality 2 (Loc2) and Locality 3 (Loc3). The circles represent 95% inertia ellipses for the populations, which characterizes the dispersion of each population around its centre of gravity. Percentages along axes indicate the proportion of overall variability explained by the principal components.

Sjøtun *et al.* (2017). Unravelling the complexity of salt marsh 'Fucus cottonii' forms (Phaeophyceae, Fucales). European Journal of Phycology, 52(3), 360-370.c

Results

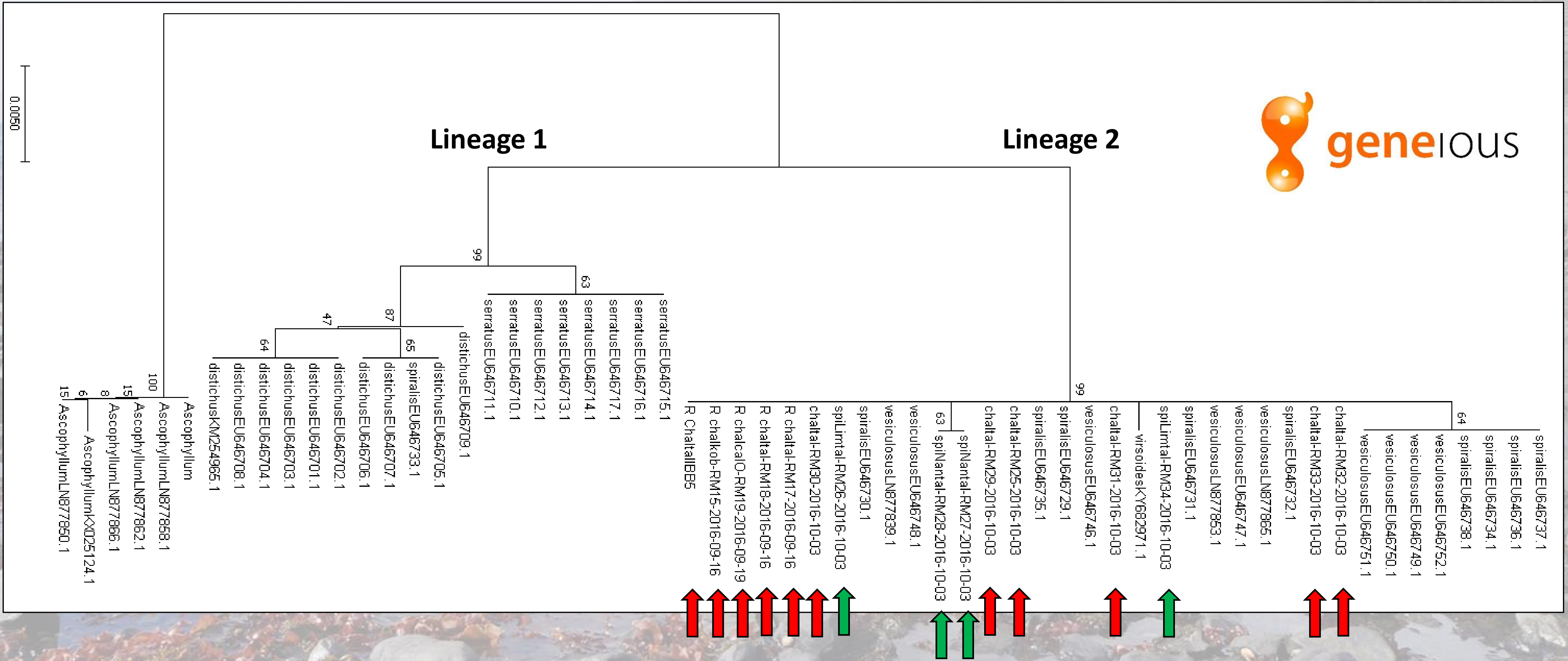


4x or 6x 8x?

Average nuclear DNA content (2C; pg) in ***Fucus vesiculosus*** (Fv, black circles), ***F. spiralis*** (Fs, grey circles) and **small salt marsh *Fucus*** (**ssmF**, white circles). Data from Illaunnginga (Locality 1), Clifden (Locality 2) and Achill Sound (Locality 3) are shown, together with unpublished data from Norway (**) and earlier published data (*) from Spain (Gómez Garreta *et al*., 2010), USA (Kapraun, 2005) and France (Phillips *et al*., 2011, recalculation from Peters *et al*., 2004).

Source: Sjøtun *et al.* (2017)

Results



Bayesian tree of **COI-1** region for the studied species of *Fucus* plus several other species from the genus from GenBank

Discussion

- The **ssmF** showed high **variation** with respect to **reproduction mode**, **genetic affiliation** and **nuclear DNA content**.

- s**smF can originate from different *Fucus* taxa** (Coyer *et al*., 2006; Neiva *et al*., 2012) . **This is supported by our microsatellite study** (in ex.: locality 2 ssmF derived mainly from *F. vesiculosus*, Locality 3 ssmF higher degree of hybridization/introgression)

- Kapraun, 2005; Gómez Garreta *et al*., 2010; Phillips *et al*., 2011 reported **variable genome size** for some brown algae, ¿**autopolyploids**?, ¿**allopolyploids**?

Near Future…

- Keep studying the composition of Antarctic flora quantitatively (Second BLUEBIO expedition)

- Finish the current Antarctic experiments and start new collaborations (role of seaweed in cloud formation & Passengers)

- Apply the methodologies showed to all the small *Fucus* forms and compare the results to understand the underlying processes of their evolution


Thank You!