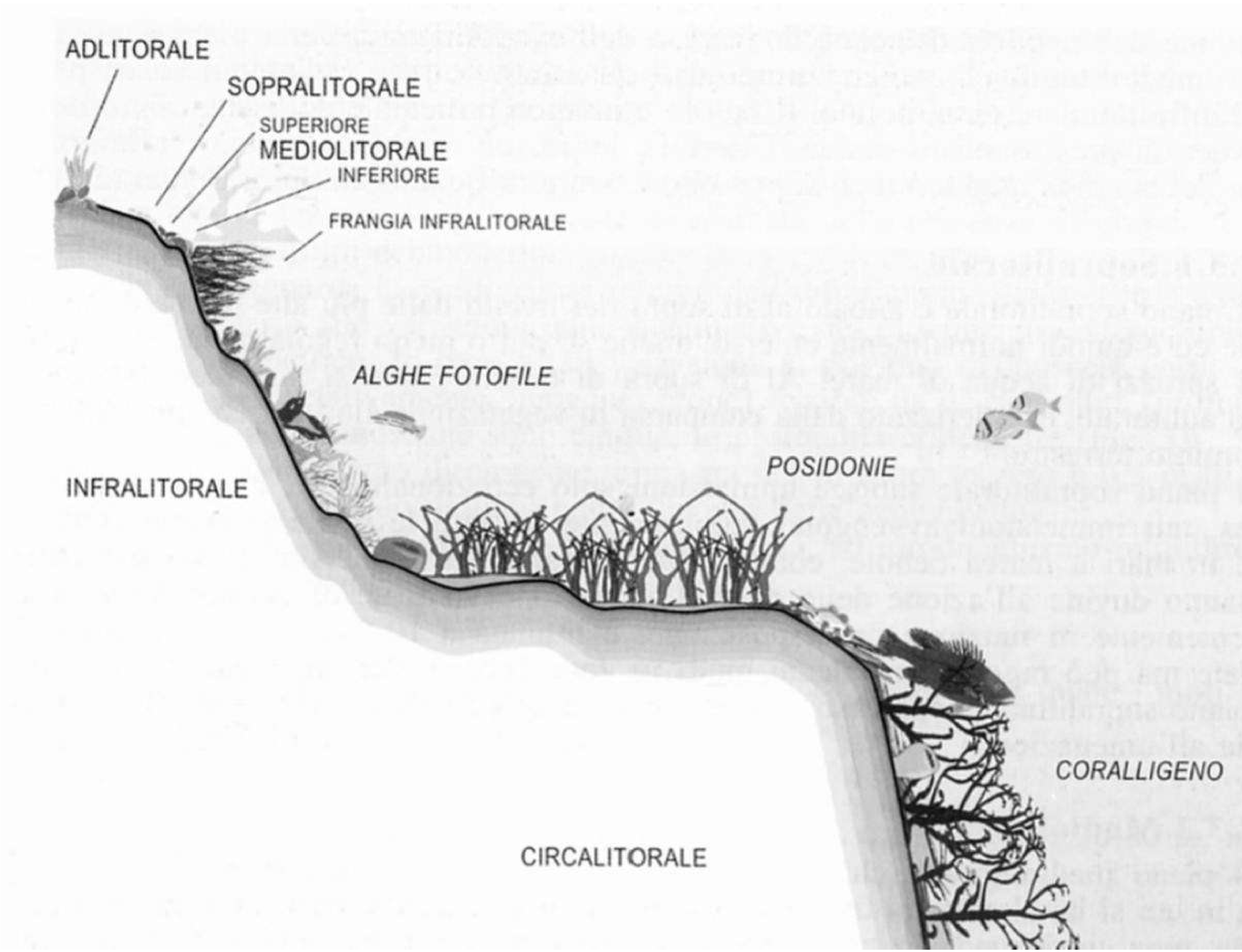
LE MACROALGHE

Piano Nazionale
Lauree Scientifiche
Progetto:
Scienze Naturali e Ambientali

Prof.ssa Giulia Ceccherelli

Una pianta

Un’alga

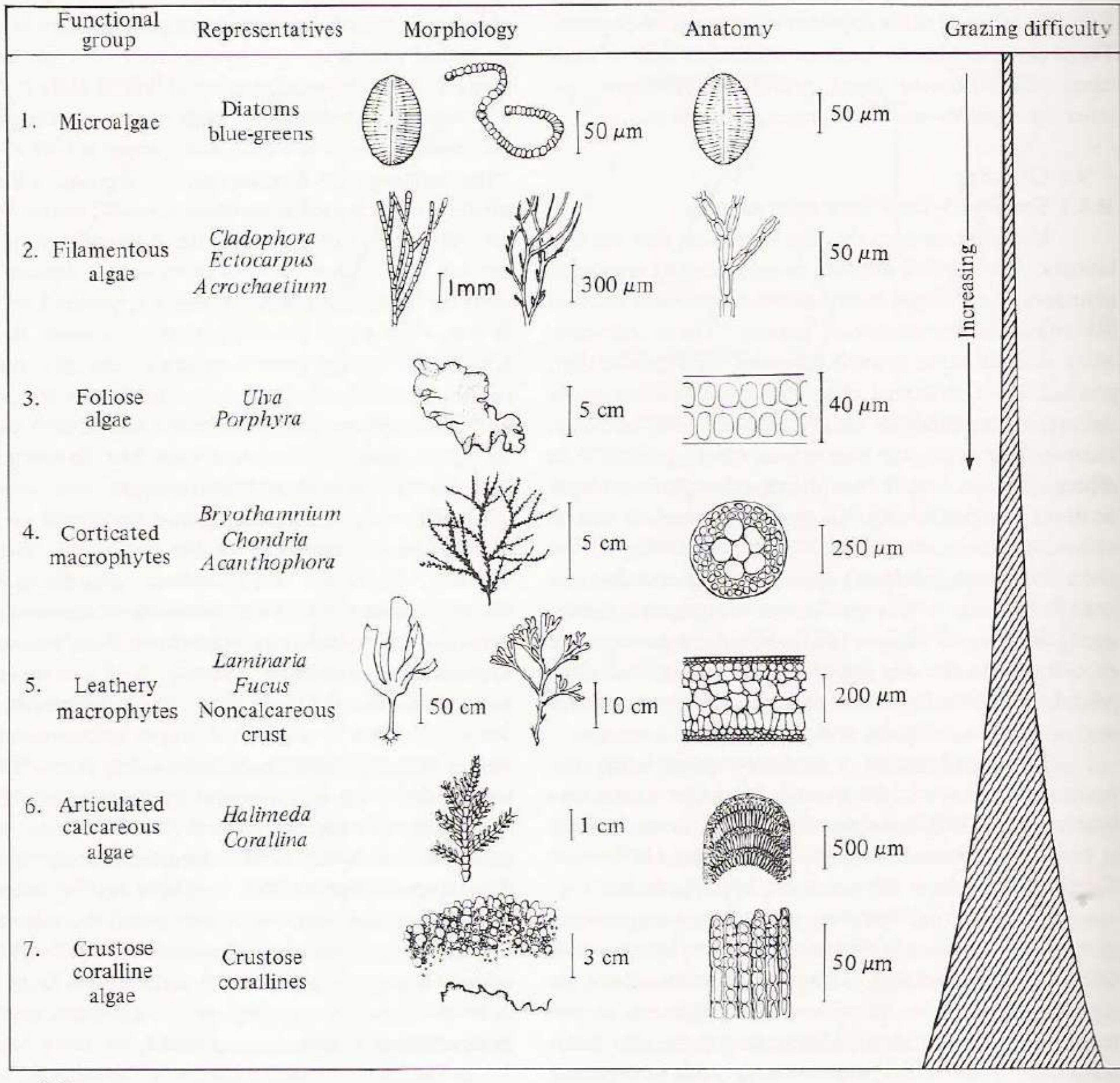

ADLITORALE
SOPRALITORALE
SUPERIORE
MEDIOLITORALE
INFERIORE
FRANGIA INFRALITORALE
ALGHE FOTOFILE
INFRALITORALE
POSIDONIE
CORALLIGENO
CIRCALITORALE

Caratteristiche

-morfologiche
-tassonomiche
-adattamenti
-utilizzo
-ruolo ecologico
-alghe minacciose
-minacce per le alghe

Gruppi morfo-funzionali	Morfologia esterna	Anatomia interna	'Texture'	Appeti bilità	Durezza	Generi rappresentativi
Appiattite	Tubulari sottili o come un foglio	Non corticate, spessore di una cellula o più	Soffice	Alta	Bassa	*Ulva*, *Enteromorpha*, *Porphyra*
Filamentose	Delicatamente ramificate (filament.)	Uniseriate, multiseriateleggermente corticate	Soffice	Alta	Bassa	*Caetomorpha*, *Cladophora*, *Ceramium*
Ramificate	Fortemente ramificate, erette	Parenchimatose o pseudoparenchimatose	'Fleshy'	Moderata	Bassa	*Gigartina*, *Chondrus*, *Agardhiella*
'a pelle spessa'	Fronde spesse e ramificate	Parenchimatose o pseudoparenchimatose	Simile a pelle fino a gommosa	Bassa	Alta	*Fucus*, *Laminaria*, *Sargassum*, *Padina*
Calcaree	Articolate, calcarizzate, erette	Segmenti calcificati, giunture flessibili	Simile a pietra	Bassa	Molto alta	*Halimeda*, *Corallina*
Crostose	Prostrate, incrostanti	Calcificate o non, file di cellule compatte	Simile a pietra ma dura	Molto Bassa	Molto alta	*Hildenbrandia*, *Ralfsia*

Figure 9.16. Algal functional groups as related to molluscan grazer activity. (a) The functional groups; grazing difficulty refers only to structural toughness of the algae and does not take into account the additional difficulty of grazing algal groups 3, 4, and 6 due to their size refuge. (b) Relative importance of each algal group in the diets of 106 species of herbivorous mollusk. (From Steneck & Watling 1982, with permission of Springer-Verlag)



(a)

Appiattite

Ulva sp.

Chaetomorpha sp.

Filamentose

Cladophora sp.

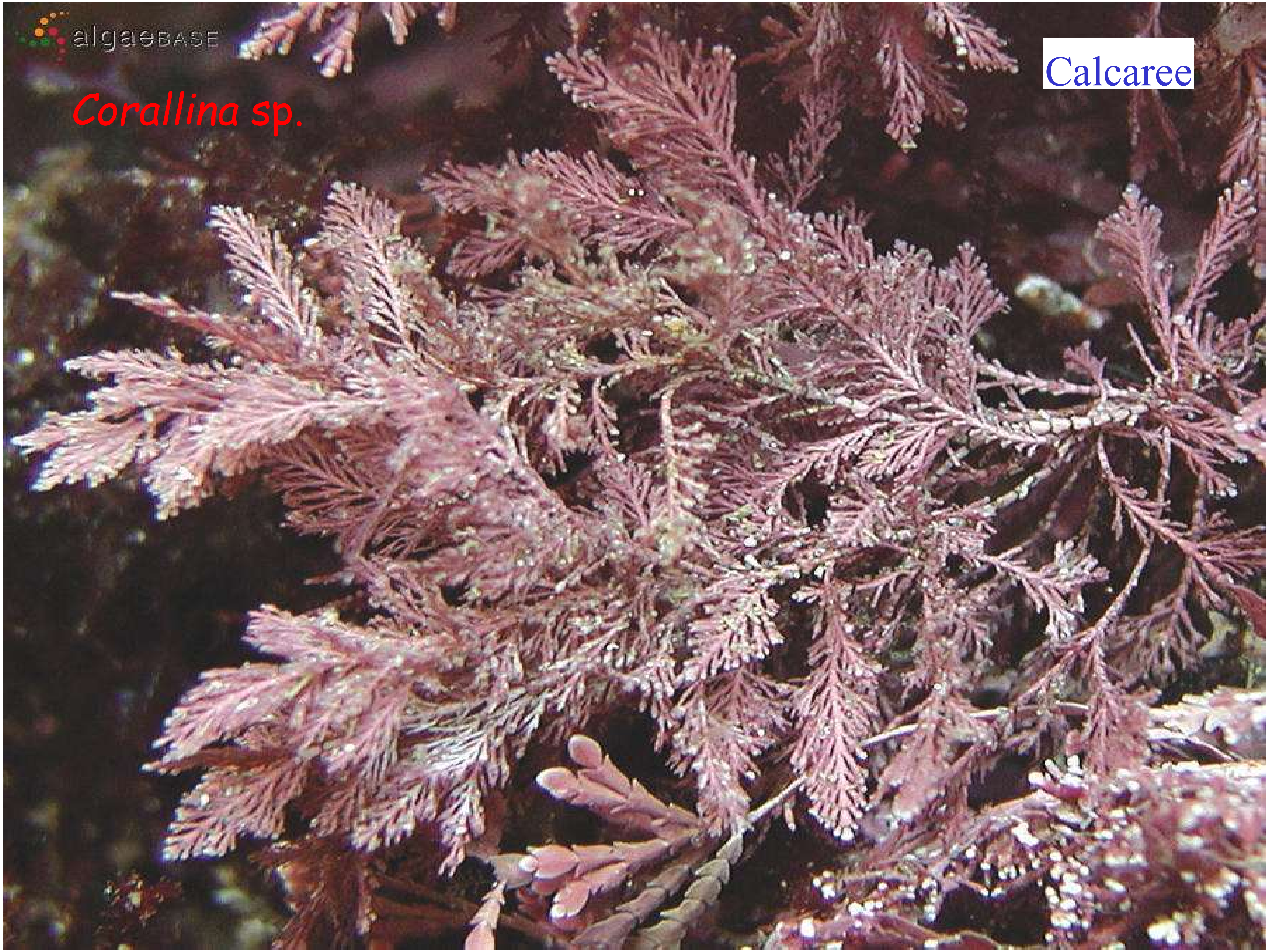
Filamentose

Chondrus crispus

Ramificate


www.algaebase.org
Fucus vesciculosus
A pelle spessa


Macrocystis pyrifera


algaeBASE
Corallina sp.
Calcaree

Hildenbrandia sp.

Crostose

Hildenbrandia sp.

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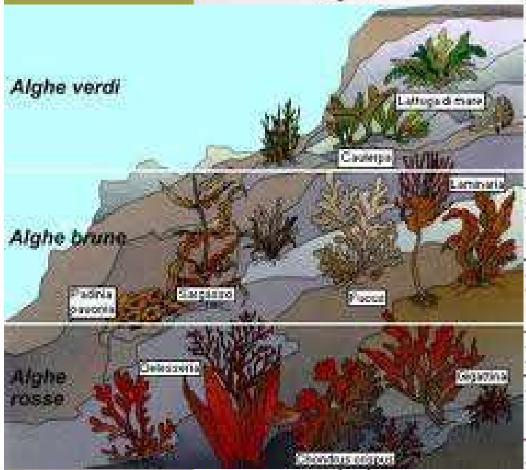
Le macroalghe

Cryptogamae: I–XIII, XIV.1–4, XV–XX; Phanerogamae: XIV.5–9; Thallophyta: II–XII, XV–XX; Algae: II–XII; Fungi:
Gymnospermae: XIV.5–8; Angiospermae: XIV.9.
XI–XXVI; Parazoa (= Porifera): XXVII; and (Eu)metazoa:



Regnum	Divisio (phylum) (Division)		Classis (Class)	Fig. 1.3
	Phyla of Archaebacteria			
	I.	Other phyla of the Eubacteria		
	II.	Cyanophyta (= Cyano-bacteria)	1. Cyanophyceae	
	III.	Prochlorophyta (= Chloroxybacteria)	1. Prochlorophyceae	
	IV.	Glaucophyta	1. Glaucophyceae	
	V.	Rhodophyta	1. Bangiophyceae	10
			2. Florideophyceae	11
c. EUKARYOTA 'Plants' ('Plantae') 'Algae'	VI.	Heterokontophyta	1. Chrysophyceae	5
			2. Parmophyceae	
			3. Sarcinochrysidophyceae	
			4. Xanthophyceae	
			5. Eustigmatophyceae	
			6. Bacillariophyceae	6
			7. Raphidophyceae	
			8. Dictyochophyceae	
			9. Phaeophyceae	7,8
			10. Oömycetes	9
	VII.	Haptophyta	1. Haptophyceae	2
	VIII.	Cryptophyta	1. Cryptophyceae	3
	IX.	Dinophyta	1. Dinophyceae	1
	X.	Euglenophyta	1. Euglenophyceae	4
	XI.	Chlorarachniophyta	1. Chlorarachniophyceae	
	XII.	Chlorophyta	1. Prasinophyceae	
			2. Chlorophyceae	12
			3. Ulvophyceae	14
			4. Cladophorophyceae	
			5. Bryopsidophyceae	16
			6. Zygnematophyceae	13
			7. Trentepohliophyceae	
			8. Klebsormidiophyceae	
			9. Charophyceae	15

Alghe rosse

Alghe brune

Alghe verdi

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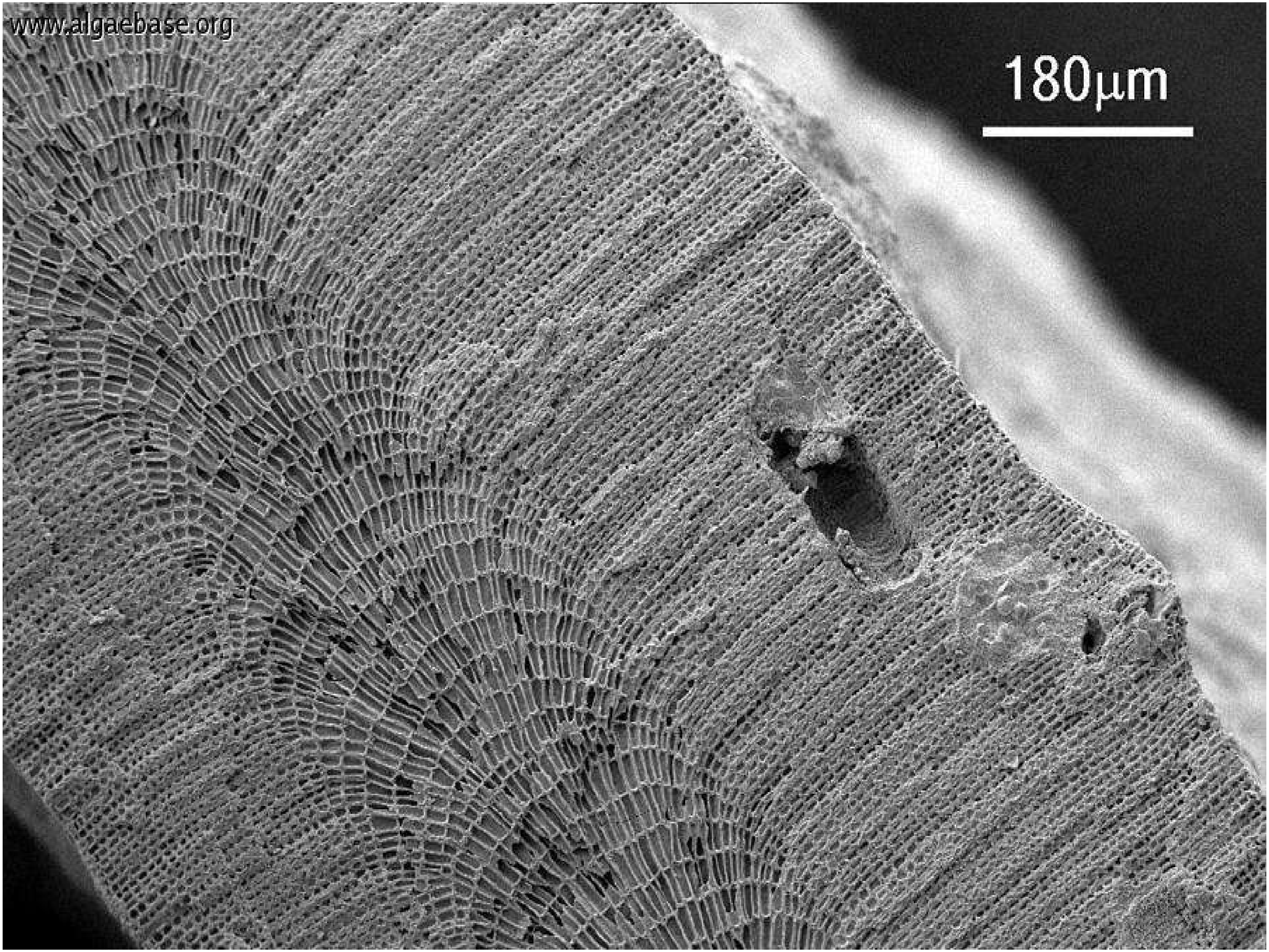
Adattamento morfologico

Lithophyllum dentatum

Lithophyllum frondosum


www.algaebase.org
180μm

Lithophyllum frondosum

Lithophyllum ispidum


In condizioni ottimali forma marciapiedi organogeni (trottoir) su substrati suborizzontali e cornici su substrati subverticali. In condizioni meno favorevoli forma cuscini mammellonati sparsi e croste squamate.

Adattamento fotocromatico

La distribuzione dei pigmenti nei vari gruppi di alghe

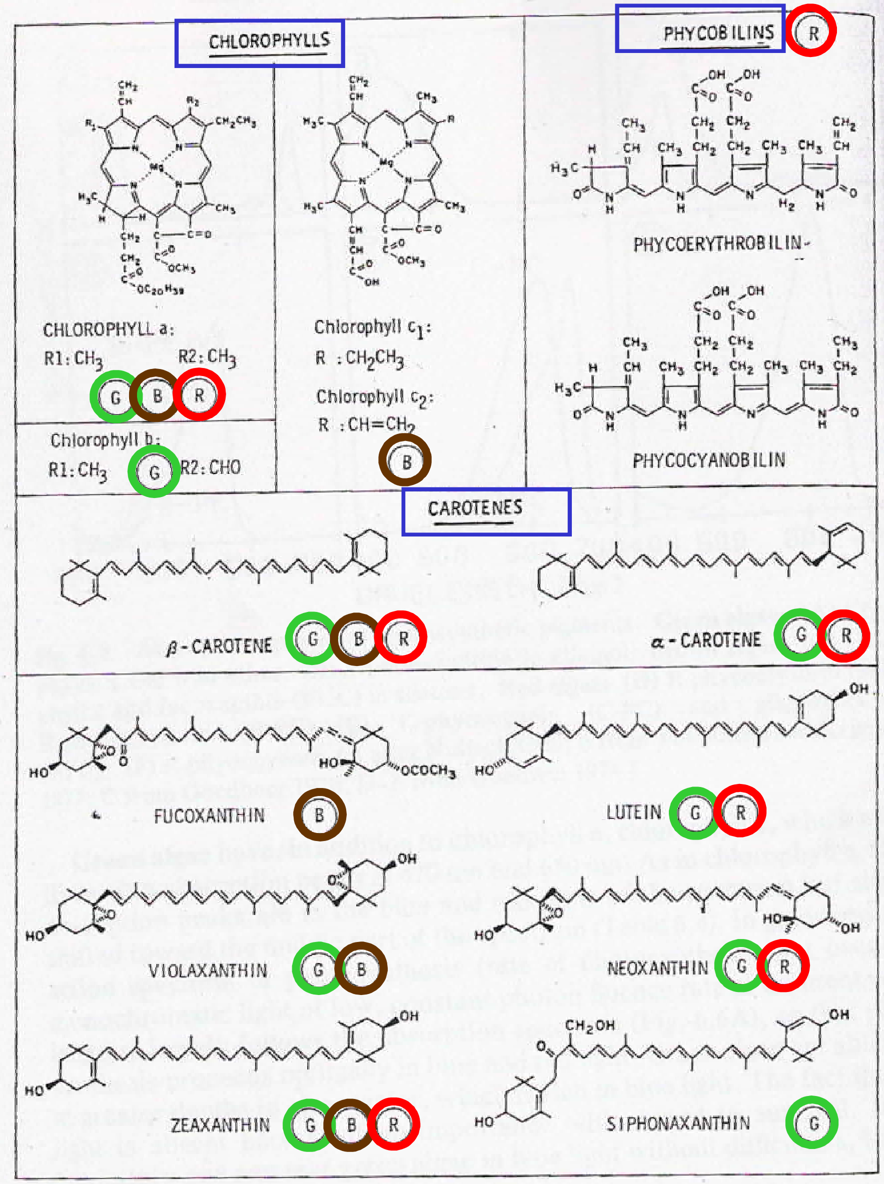


Fig. 6.4 Structural formulae of chlorophylls, chromophores of phycobilins, and carotenoids of seaweeds. G = green algae; B = brown algae; R = red algae. (Structural formulae from Ragan 1981.)

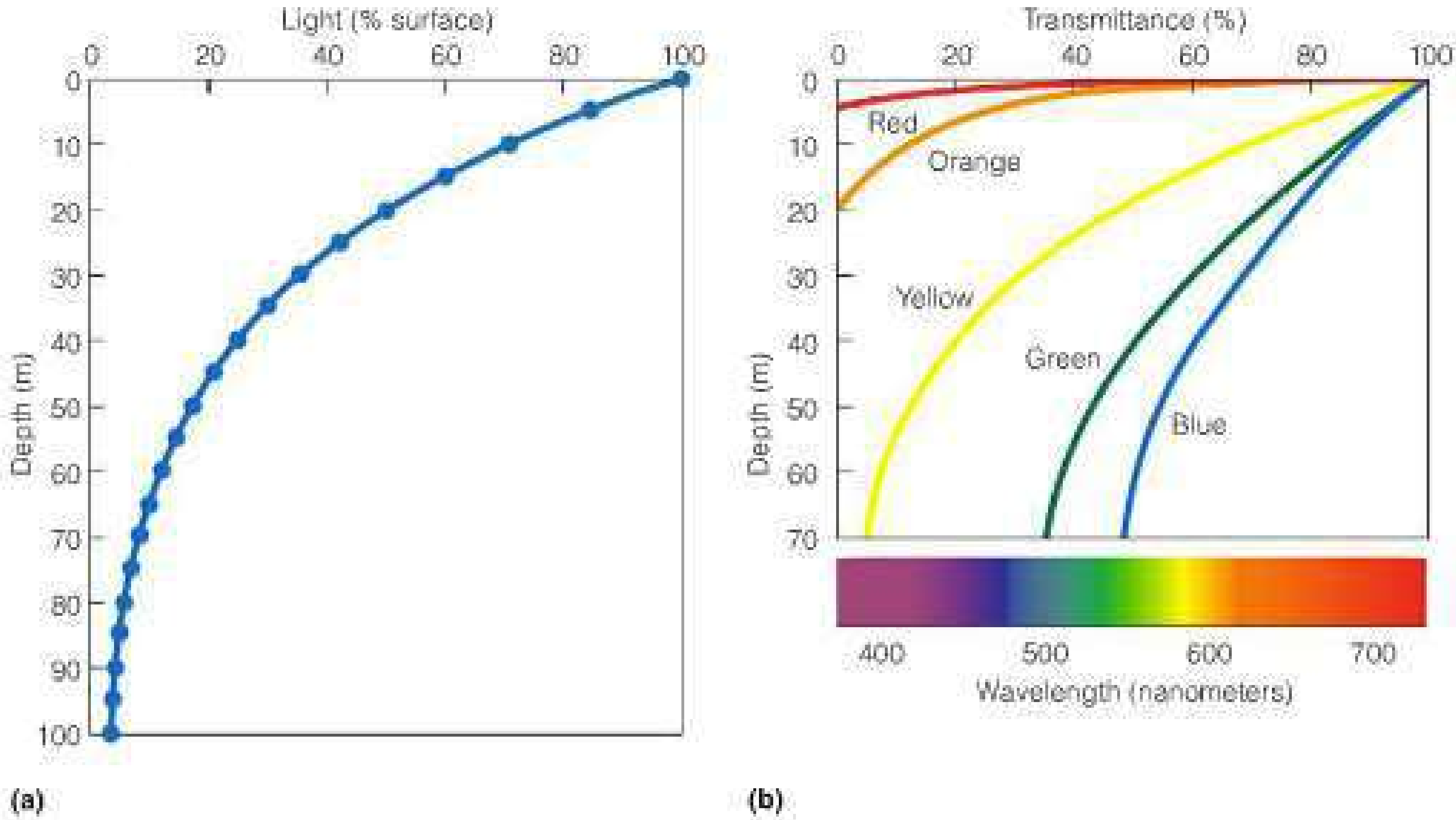


Figure 3.7 (a) Attenuation of incident light with water depth (pure water), expressed as a percentage of light at the water surface. Estimates assume a light extinction coefficient of $k_w = 0.035$ (see Quantifying Ecology 4.1, pp. 56–57). (b) The passage of light through water (transmittance) reduces the quantity of light and modifies its spectral distribution (see Figure 2.4). Red wavelengths are attenuated more rapidly than green and blue wavelengths.

Lo spettro di assorbimento della clorofilla a e b e di altri pigmenti

La finestra verde

La maggior parte degli organismi fotosintetici usa le lunghezze d'onda nella banda blu-verde (450-500 nm) che è quella preferenzialmente trasmessa dall'acqua limpida. Molte alghe assorbono energia luminosa a lunghezze d'onda più lunghe

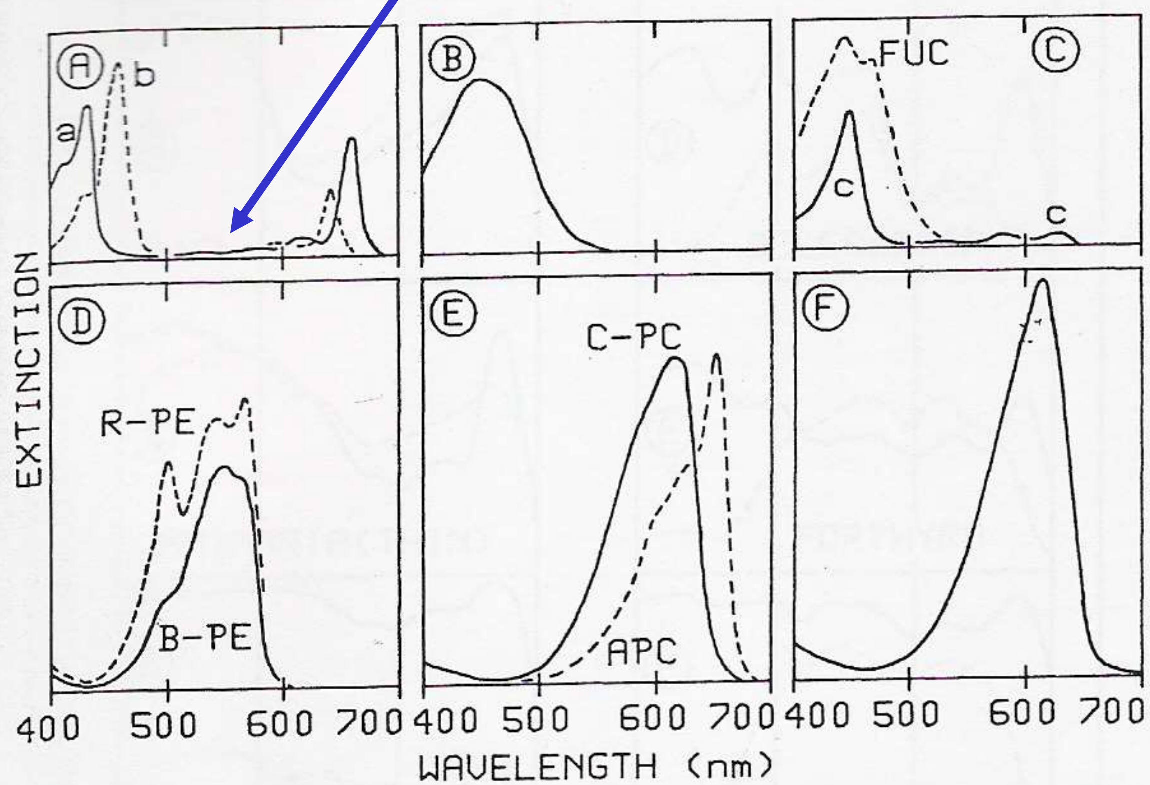


Fig. 6.5 Absorption spectra of photosynthetic pigments. **Green algae: (A)** Chlorophylls a and b in ether. **(B)** Siphonaxanthin in ethanol. **Brown algae: (C)** Chlorophyll c and fucoxanthin (FUC) in acetone. **Red algae: (D)** R-phycoerythrin (R-PE), B-phycoerythrin (B-PE). **(E)** C-phycocyanin (C-PC) and allophycocyanin (APC). **(F)** R-phycocyanin. (A after Nultsch 1986; B from Yokohama and Kageyama 1977; C from Goedheer 1970; D–F from Goodwin 1974.)

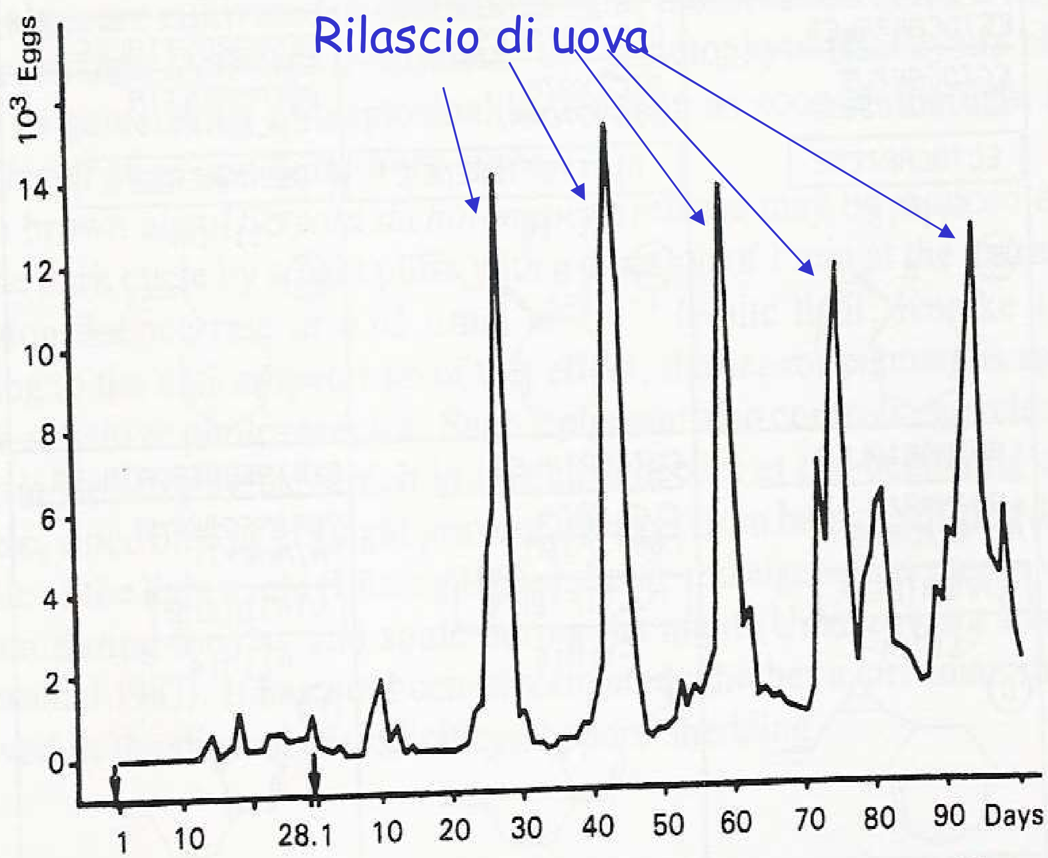


Fig. 6.16 Lunar periodism in the brown alga *Dictyota dichotoma*. Experimental female gametophytes were cultivated at 14 h of light per day. Number of eggs released was counted daily for more than three months. Continuous light was given on days 1 and 28 (arrows). Thereafter a semilunar rhythm of egg release was apparent. (From Müller 1962.)

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L'utilizzo

- Alimenti
- Estrazione di ficocolloidi (medicinali, saponi, cosmesi)
  - Alginati
  - Agari
  - Carragenina

- Fertilizzanti per l'agricoltura
- Purificazione dell'acqua (Maerl)

Alimenti

Dried Kelps
特撰
出し昆布
Dashi Konbu
NET WT. 2 OZ (57g)
© W.P. Armstrong 2000

© W.P. Armstrong 2001

Porphyra
Tekka Maki
(Tuna Roll)

Alimenti

KOMBU (Giappone)	*Laminaria japonica, Laminaria angustata*
HAIDAI (Cina)	*Laminaria japonica*
WAKAME (Giappone)	*Undaria pinnatifida* e altre
NORI (Giappone)	*Porphyra tenera* e altre
Zicai (Cina)	*Porphyra haitanensis* e altre

Estrazione di ficocolloidi (medicinali, saponi, cosmesi)

Alginati

Agari

Carragenina

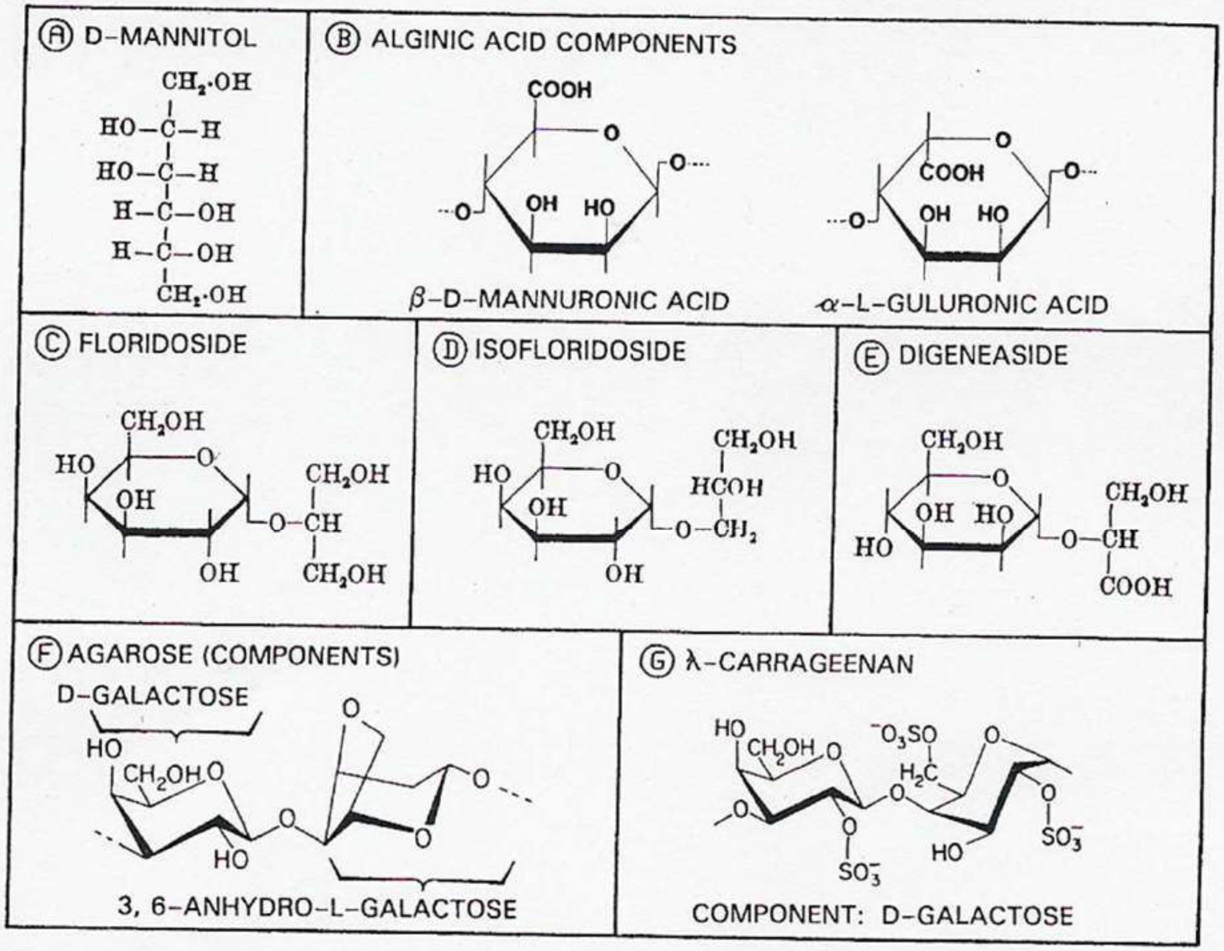


Fig. 8.7 Structural formulae of important seaweed carbohydrates. (Compiled after Percival 1979; Percival and McDowell 1967; McCandless 1981.)

AGAR	*Gelidium, Pterocladia, Gracilaria*
ALGINATI	*Laminaria, Macrocystis, Ascophyllum nodosum*
CARRAGENINA	*Chondrus, Mastocarpus*

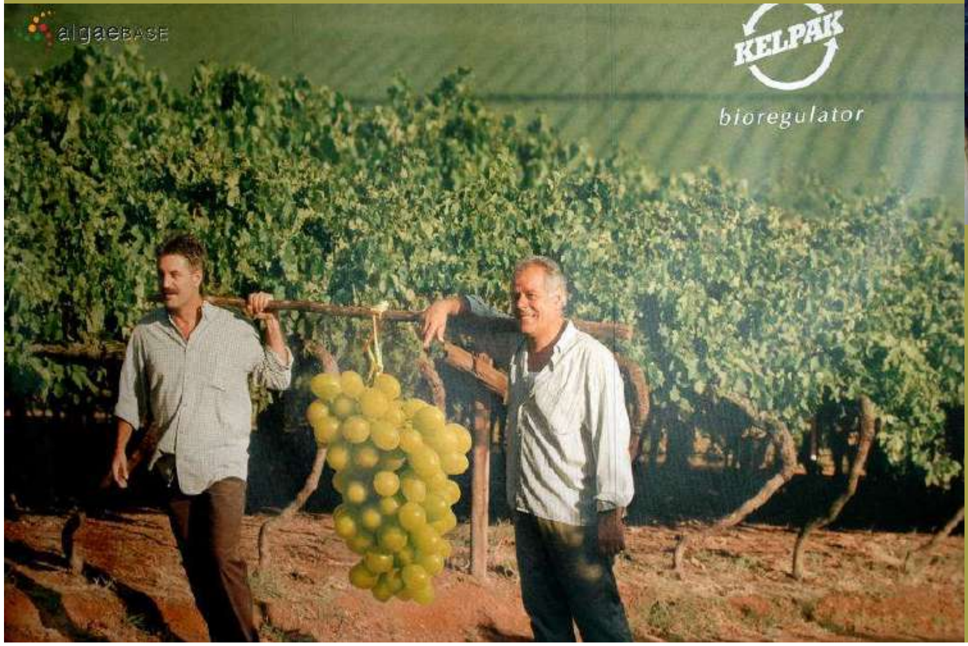
Cosmesi


BODY CREAM
BODY CREAM


Seavite
SEAWEED BODY LOTION
FIRMING AND TONING COMPLEX
LIFE BEGAN IN THE SEA AND NATURE WAS BORN · SEAVITE


ATLANTIC SEAWEED BATH
Seavite
2kg
2kg
ASCO ORGANIC
Seavite
KELP TABLETS

Fertilizzanti liquidi



Fertilizzanti liquidi

Liquid extracts of marine brown algae are marketed for use in agriculture and horticulture. Most of these extracts are prepared from dried *Ascophyllum nodosum* meal (e.g. "Maxicrop", manufactured in the United Kingdom), or from dried total drift, often referred to as "blackweed", but some utilise other species, such as *Fucus serratus* and *Laminaria species* (e.g. "SM3"; United Kingdom). One product currently being marketed is prepared from the stipes of *Ecklonia maxima* from South Africa (Kelpak, right). Other products prepared from seaweed include "Algifert" from Algea, a Norwegian company, "Seagro", manufactured in New Zealand; and "Seasol", an extract manufactured by a company in Tasmania. These are prepared from hot-water extracts of either the dried or wet seaweed, sometimes with the addition of sodium carbonate to aid extraction. Liquid seaweed extracts are used at very high dilution rates which results in only very small quantities of material being applied to a given area. The active substances in the seaweed extracts must therefore be capable of having an effect at a low concentration.


algaeBASE
Eklonia

algaeBASE

Sud Africa


algaeBASE

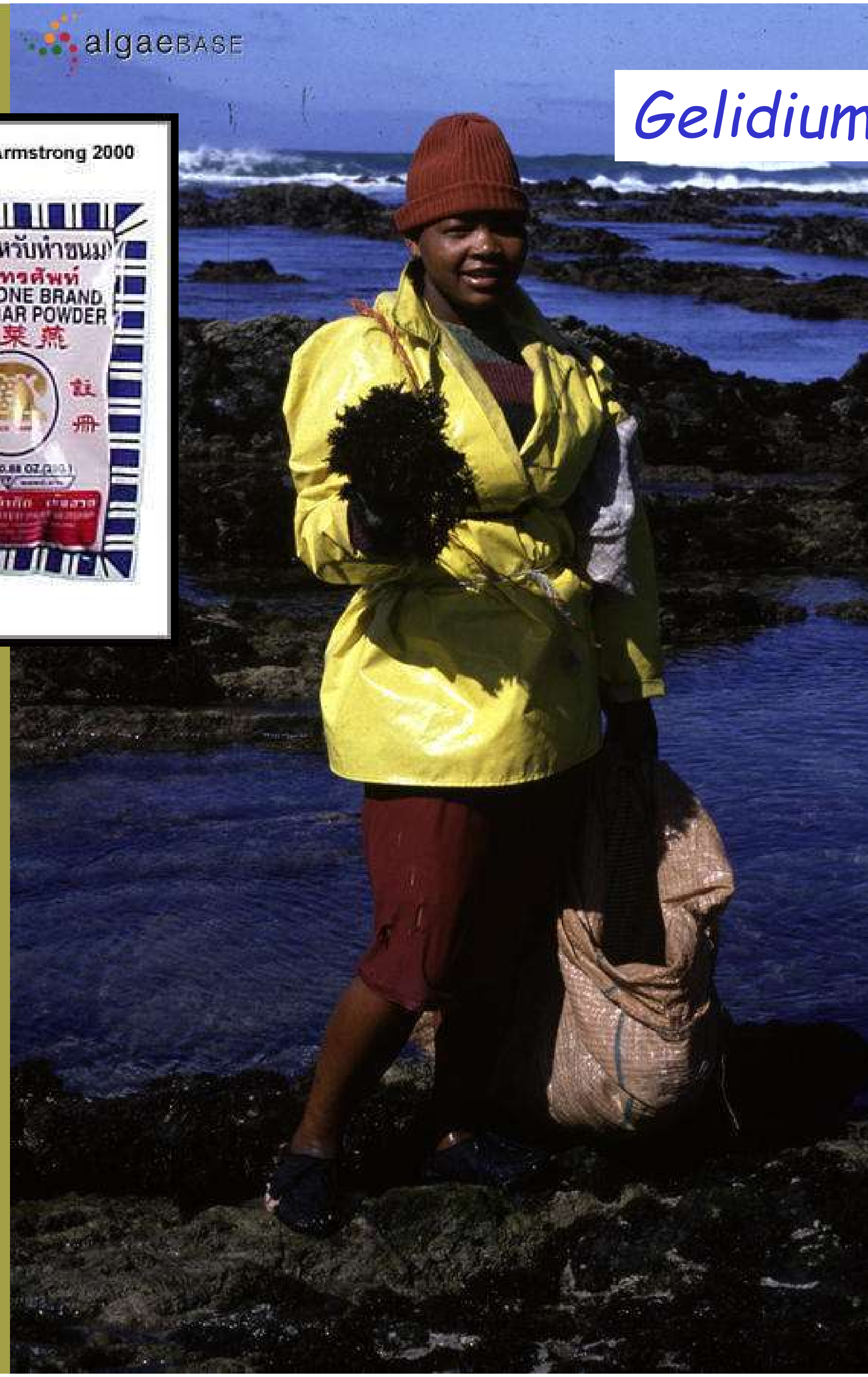
algaeBASE

Ascophyllum nodosum, Irlanda

JCB
Loadall Farm Special Plus
525-67
Turbo

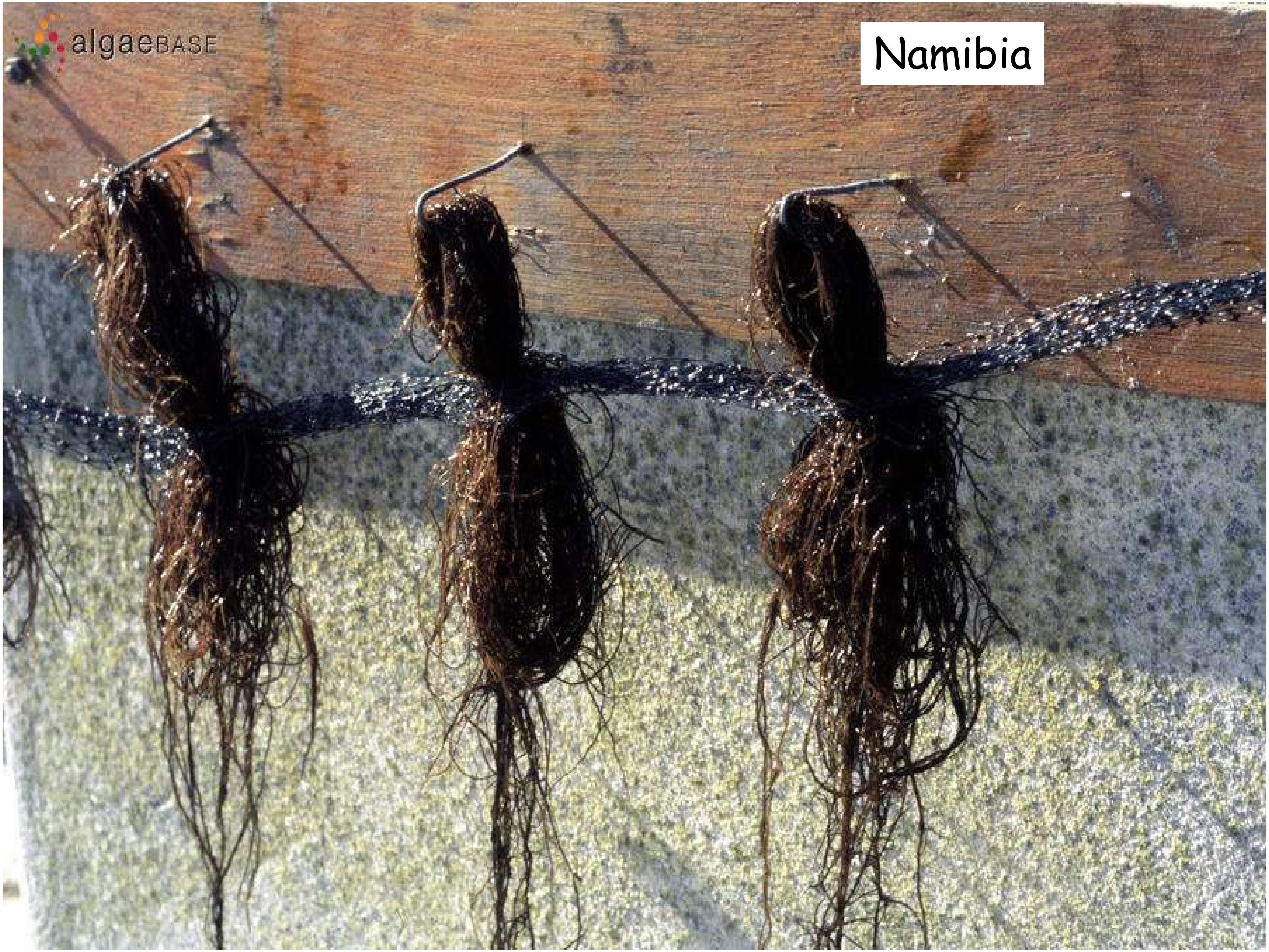

A. nodosum come cibo
Polvere di alginati

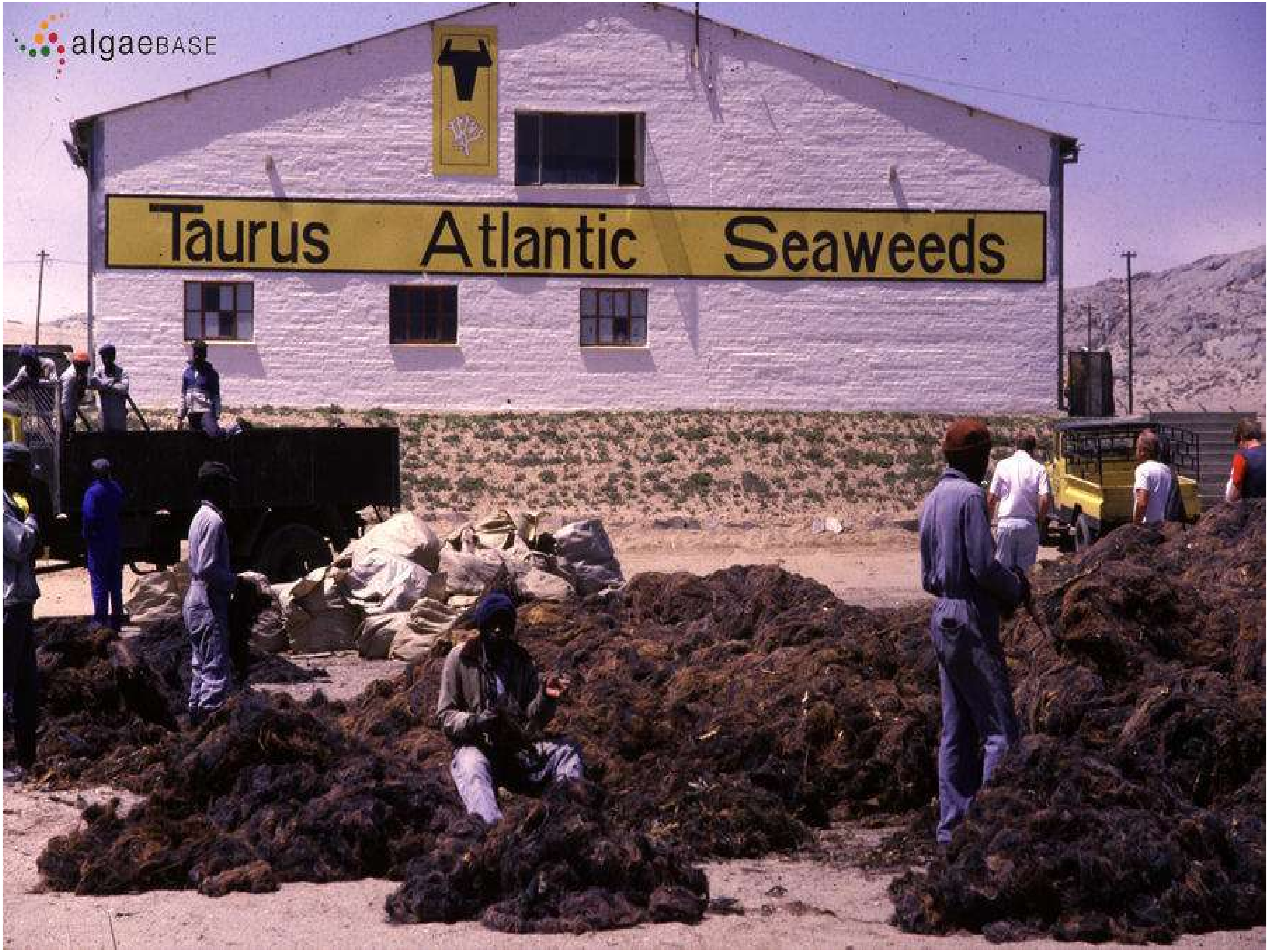
Agar agar



Gelidium, Sud Africa


algaeBASE
Gracilaria sp.


algaeBASE
Namibia


algaeBASE
Taurus Atlantic Seaweeds


algaeBASE


algaeBASE


algaeBASE


algaeBASE
YAMAHA

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Kappaphycus alvarezii (Floridophyceae)

K. alvarezii **(purdoy)**

K. avarezii **(tambalang green)**


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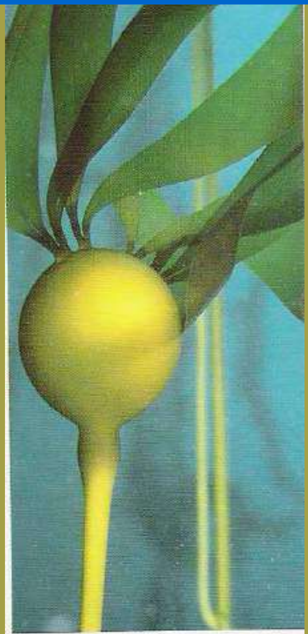
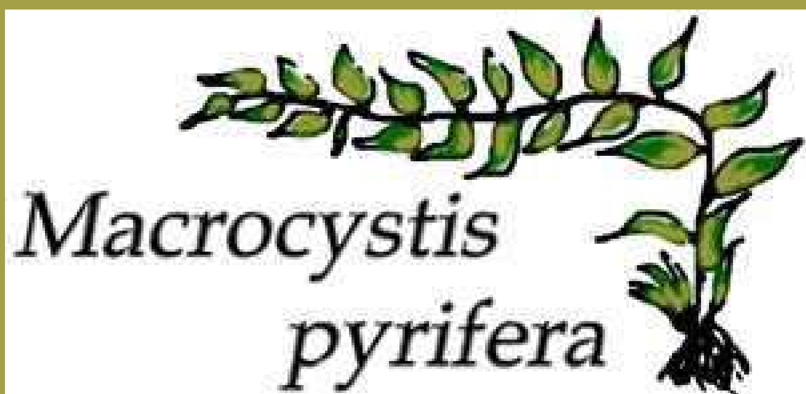
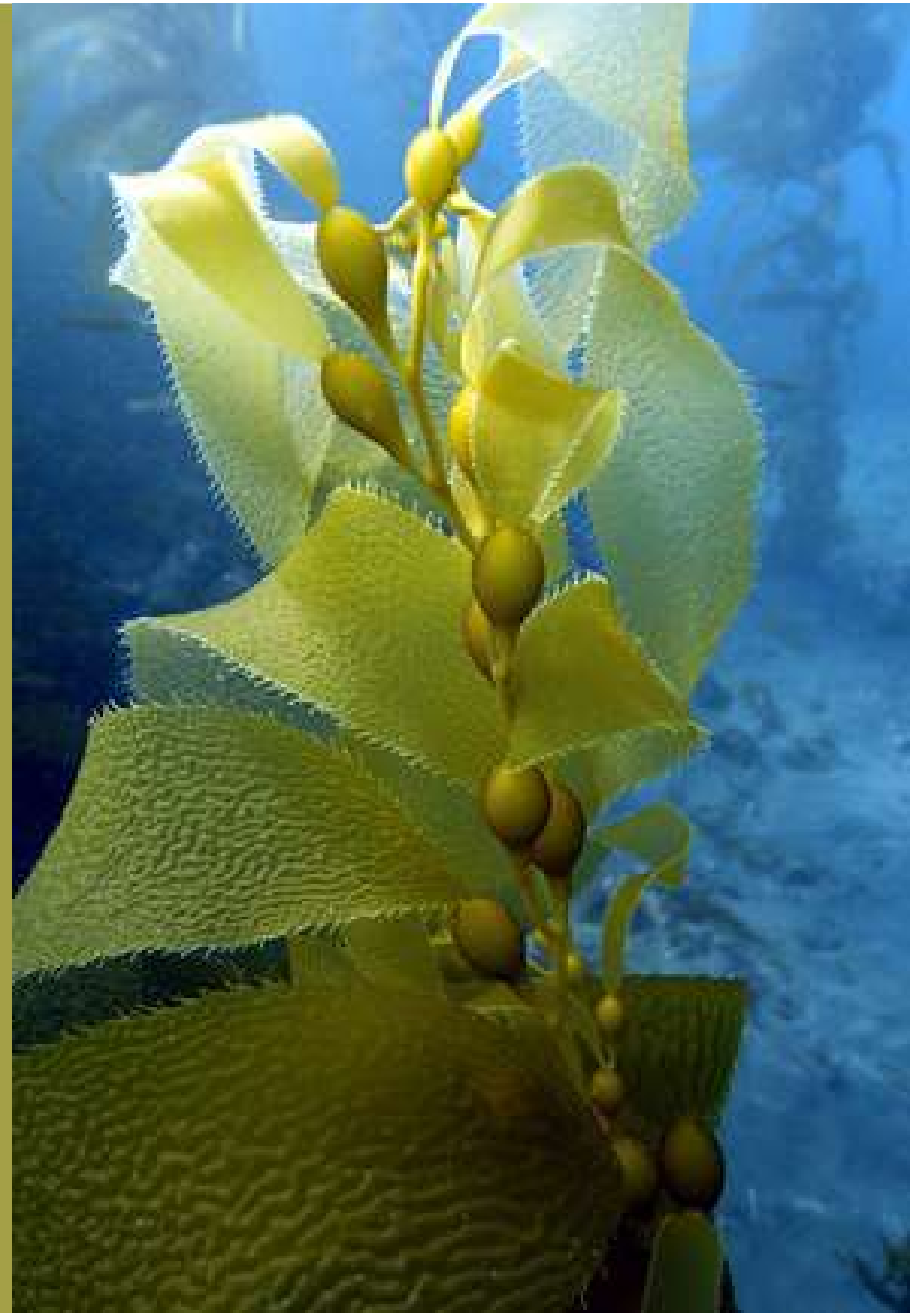
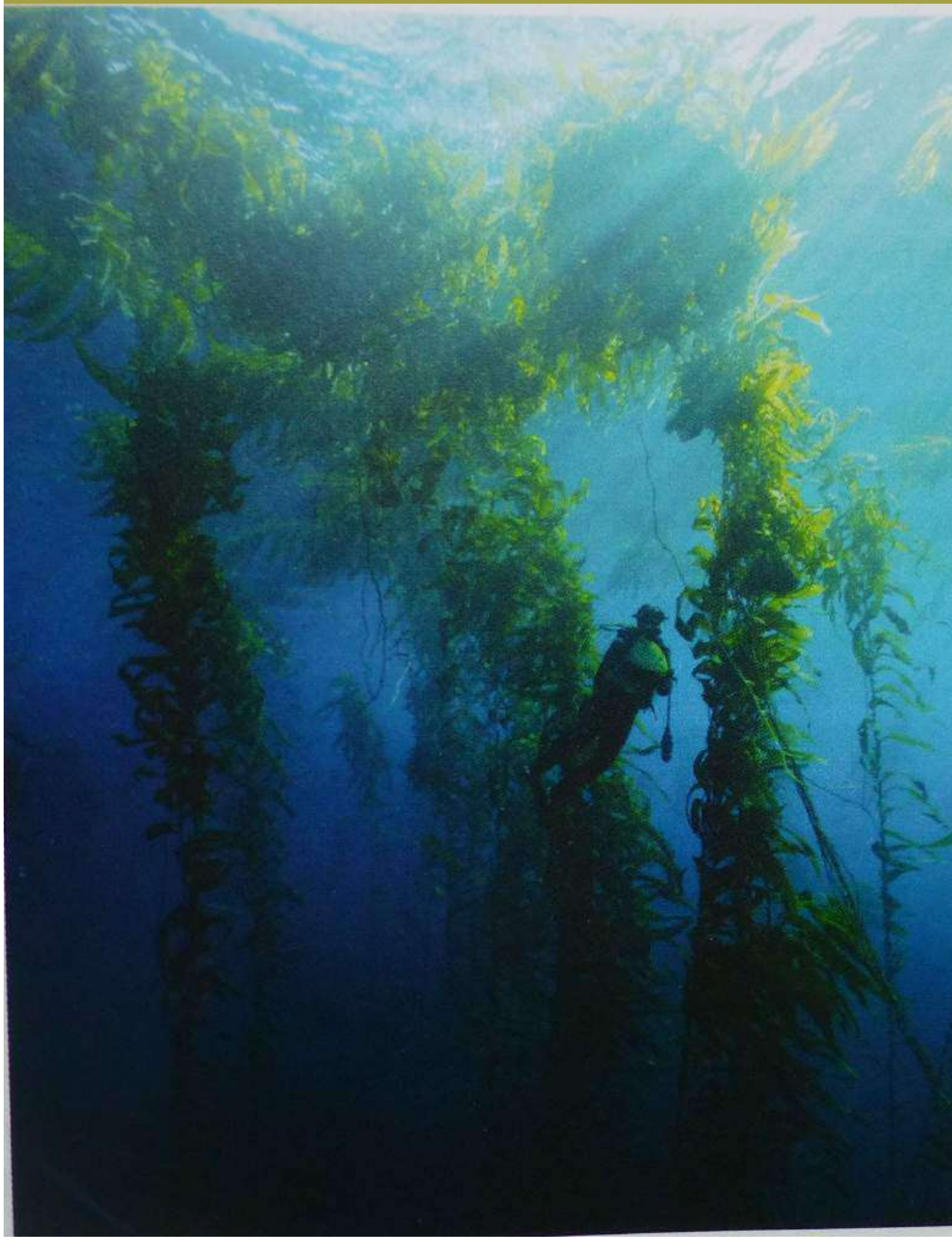
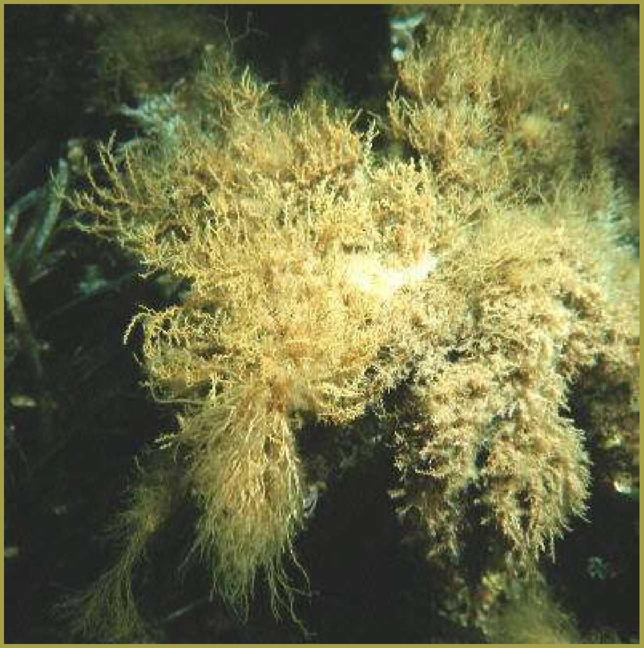


Inflated like a balloon, this swollen bull kelp float holds a curious mixture of gases, including carbon monoxide.


Macrocystis
pyrifera







Cystoseira spp.

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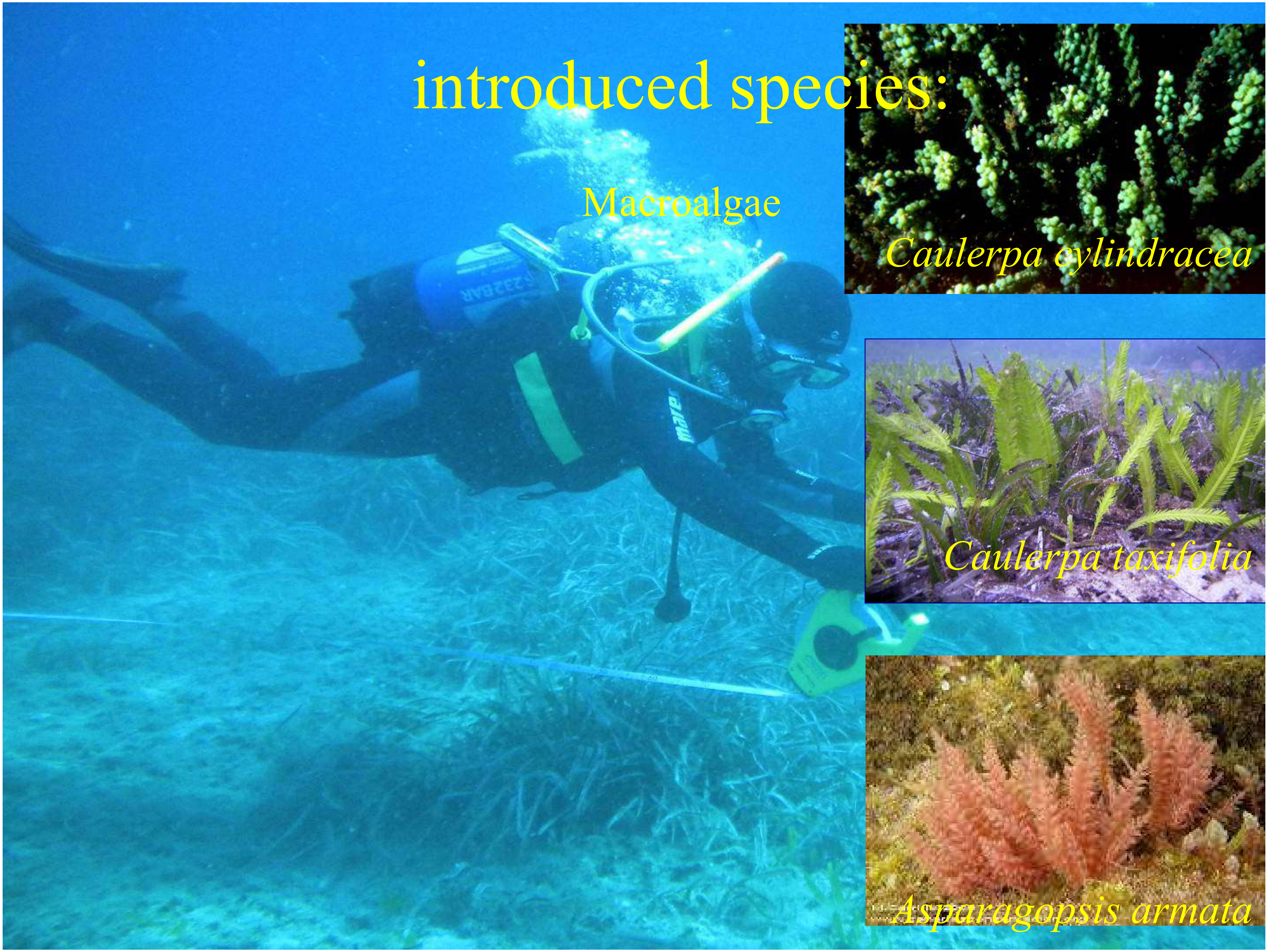
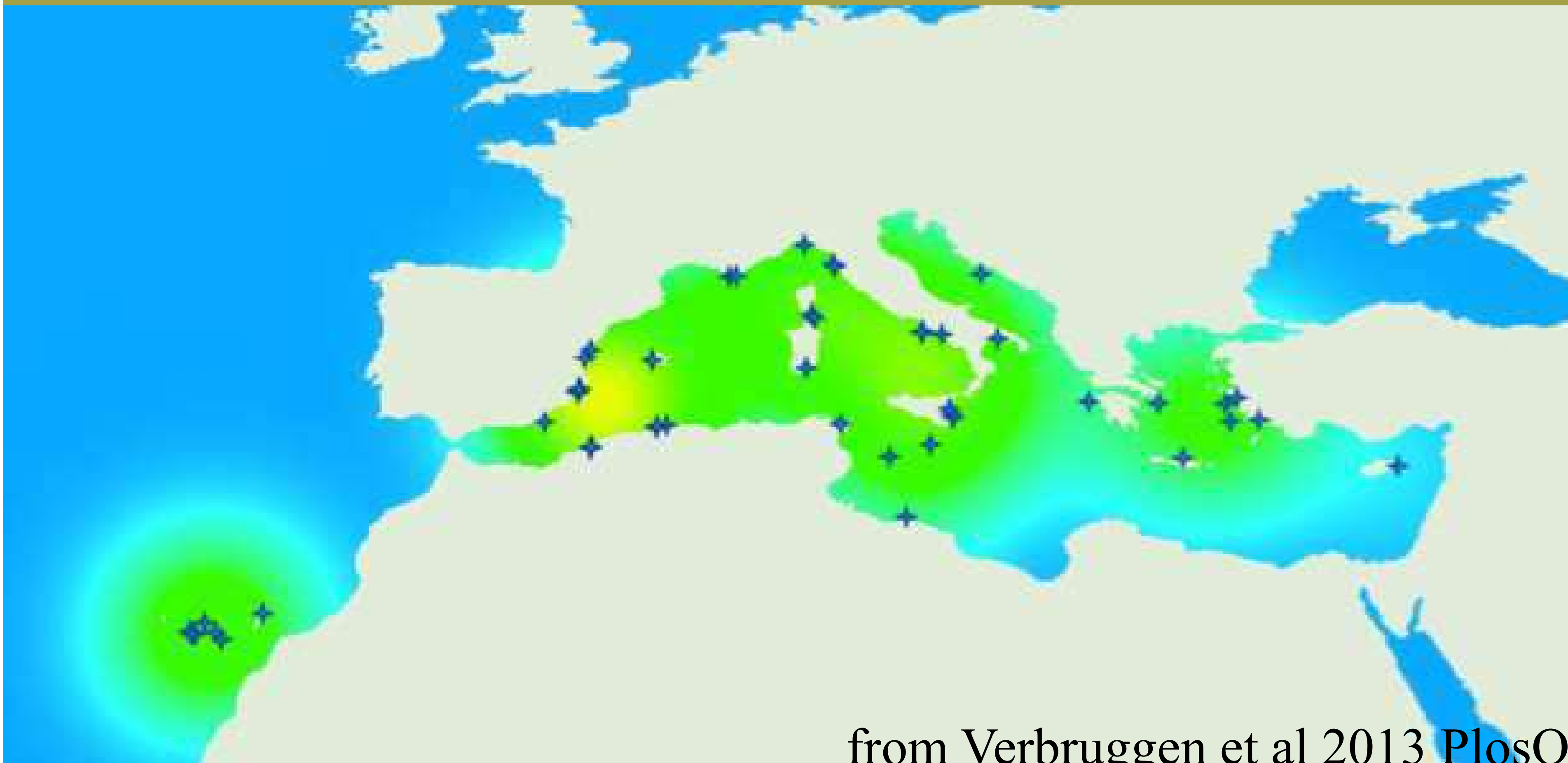

introduced species:
Macroalgae
Caulerpa cylindracea
Caulerpa taxifolia
Asparagopsis armata

Since the early 1990s it invades all kinds of substrata and depths……….



from Verbruggen et al 2013 PlosON

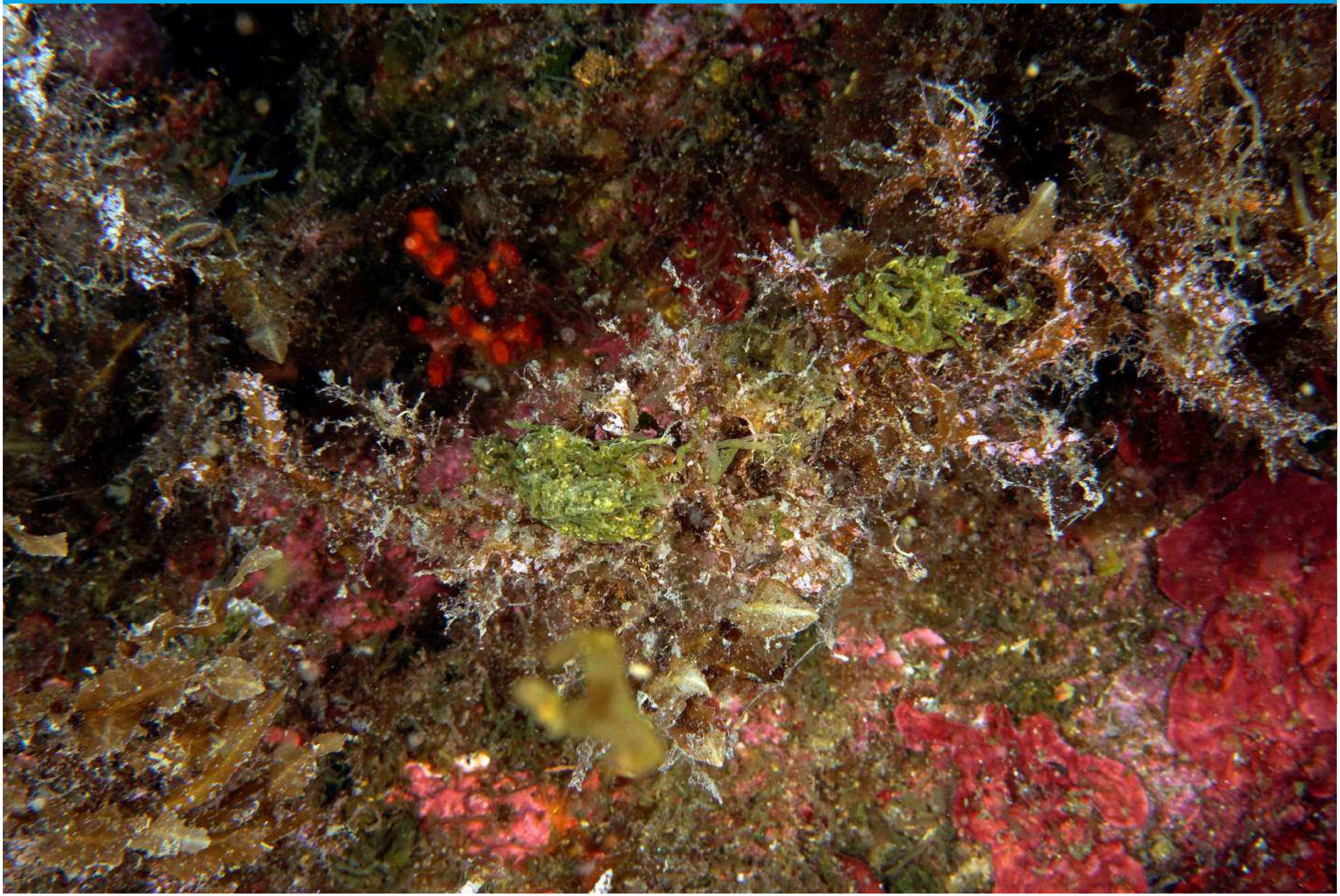
establishes dense monospecific stands, it easily overgrows and outcompetes seaweeds,
all-sized) seagrass and invertebrates leading to an overall decrease in species diversity.

Mechanical destruction

Other invaders

…...although introduced turf species advantage C. cylindracea

Herbivores



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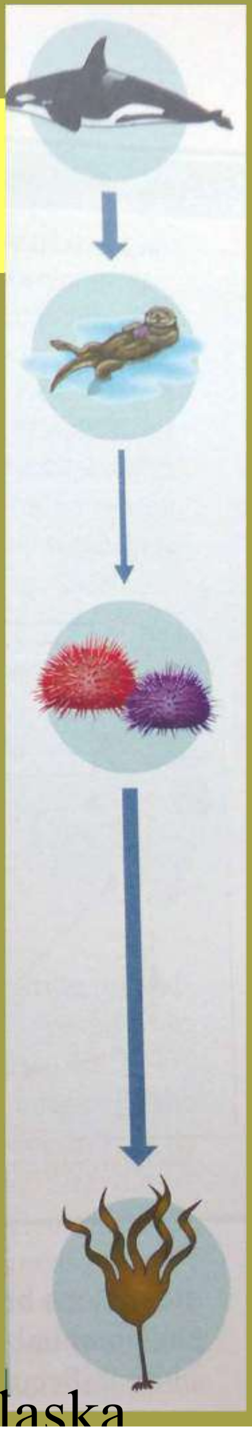
Global fishing of sea urchin predators and expanding sea urchin barrens

How are kelp forests stable?

Stability is due to top-down control effects

Test-crushing predatory fishes

Lobsters (*Panulirus interruptus* and *Jasus edwardsii*)



Ex Alaska

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MARINE ECOLOGY PROGRESS SERIES
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FEATURE ARTICLE: REVIEW

Sea urchin barrens as alternative stable states of collapsed kelp ecosystems

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ABSTRACT: Sea urchin barrens are benthic communities on rocky subtidal reefs that are dominated by urchins and coralline algae; in the absence of intense herbivory by urchins, these barrens support luxuriant seaweed communities such as kelp beds (or forests). Barrens can extend over 1000s of km of coastline or occur in small patches (10s to 100s of m) within a kelp bed. They are characterized by low primary productivity and low food-web complexity relative to kelp communities and are generally considered a collapsed state of the kelp ecosystem. To assess the stability of sea urchin barrens and potential for return to a kelp-dominated state, we document temporal and spatial patterns of occurrence of barrens along temperate and polar coasts. We examine the various drivers of phase (or regime) shifts in these areas, the threshold levels of urchin abundance that trigger abrupt changes in ecosystem state, and

Sea urchins *Strongylocentrotus droebachiensis* graze along the edge of a kelp bed, creating a barren.

Photo: Robert Scheibling

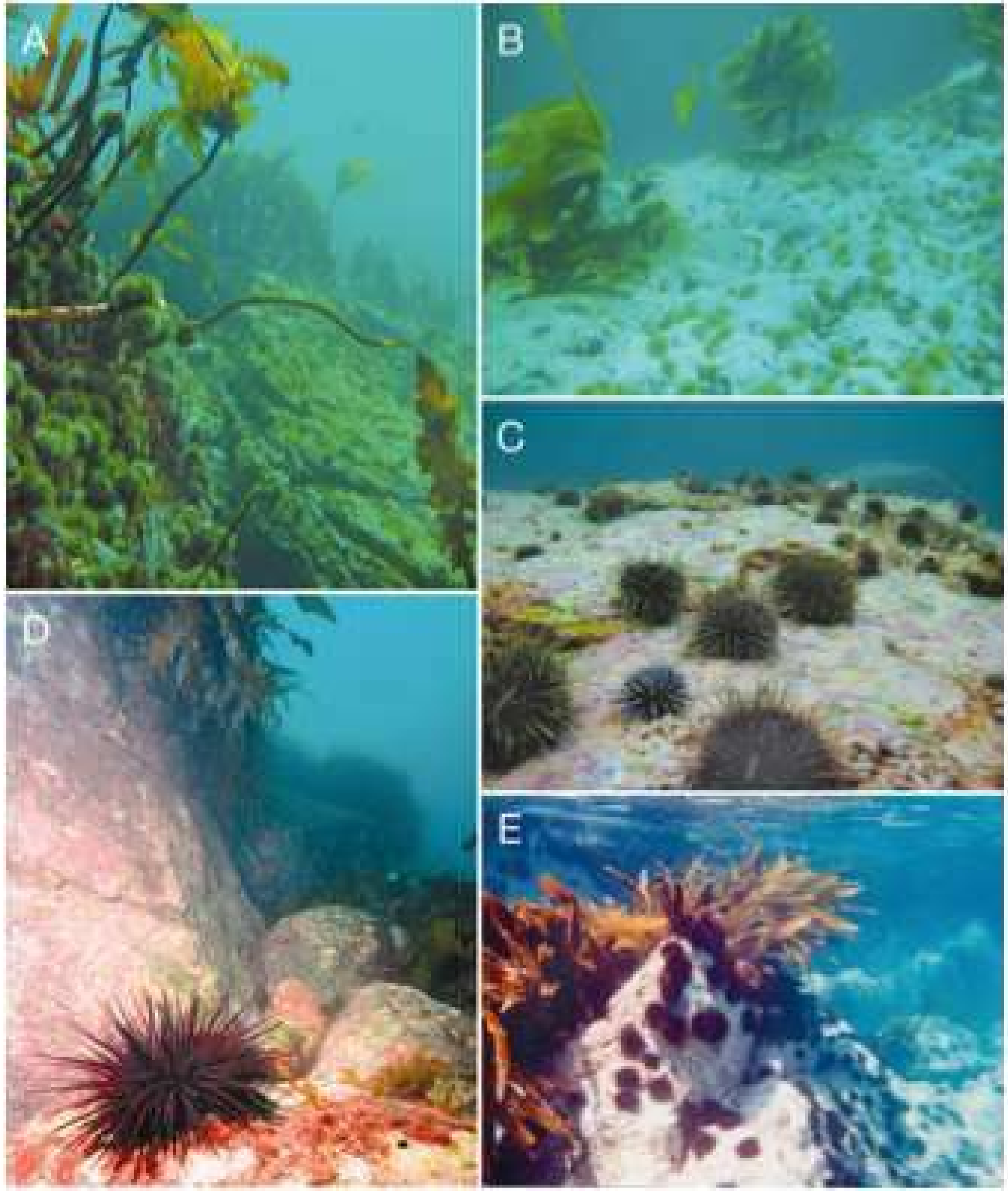
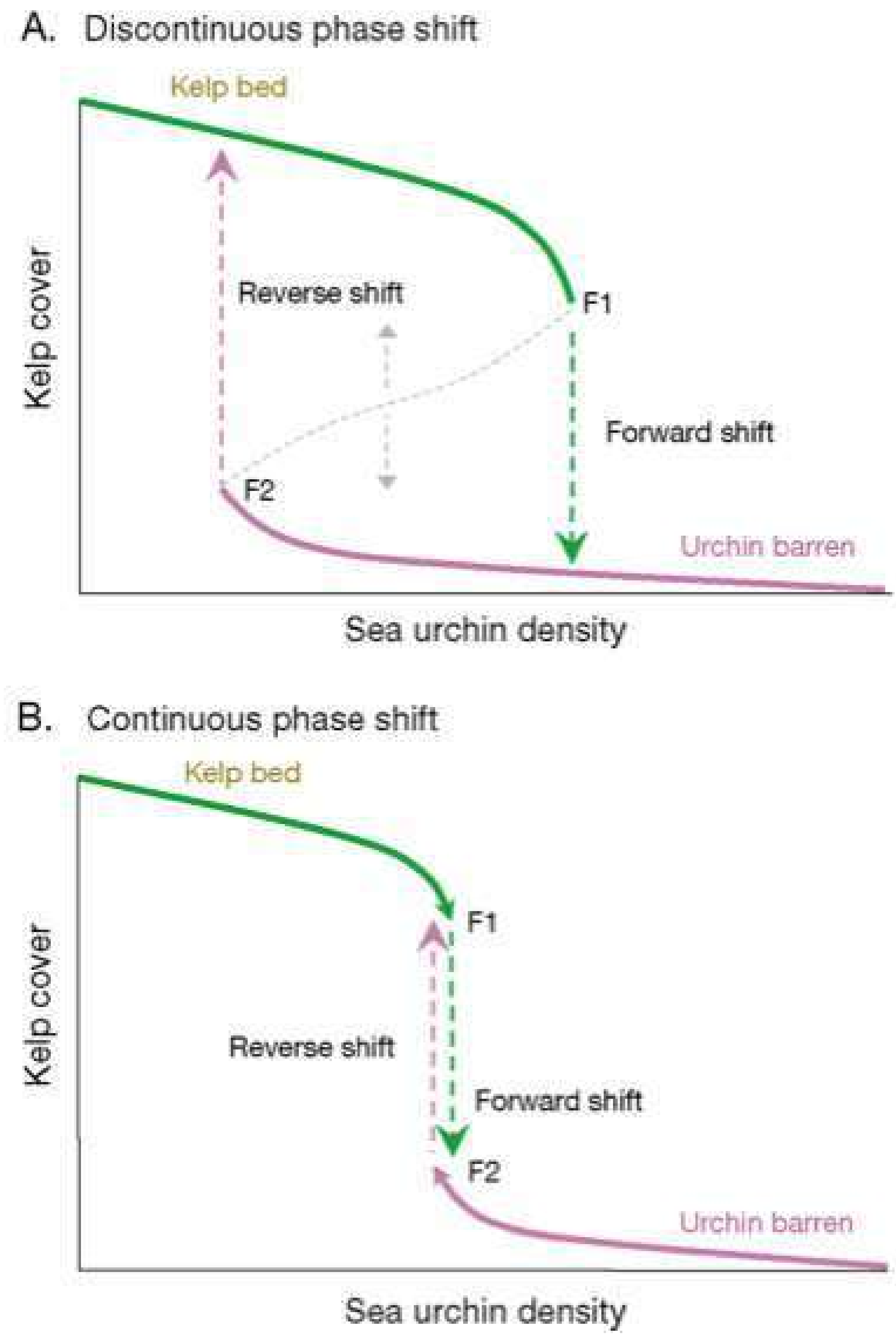


Fig. 1. (A) Destructive grazing front of sea urchins *Strongylocentrotus droebachiensis* advancing into a kelp bed near Halifax, Nova Scotia, Canada. Photo credit: R. E. Scheibling. (B) Extensive urchin (*S. polyacanthus*) barrens in the Aleutian Islands, USA. Photo credit: B. Konar. (C) Urchins *S. droebachiensis* on scoured coralline algae in barrens in Norway. Photo credit: C. W. Fagerli. (D) Range-expanding urchin *Centrostephanus rodgersii* forming patchy barrens in a kelp bed in southeast Tasmania. Photo credit: S. D. Ling. (E) *S. nudus* grazing a kelp bed in Japan. Photo credit: D. Fujita


A. Discontinuous phase shift
Kelp bed
Kelp cover
Reverse shift
F1
Forward shift
F2
Urchin barren
Sea urchin density
B. Continuous phase shift
Kelp bed
Kelp cover
F1
Reverse shift
Forward shift
F2
Urchin barren
Sea urchin density

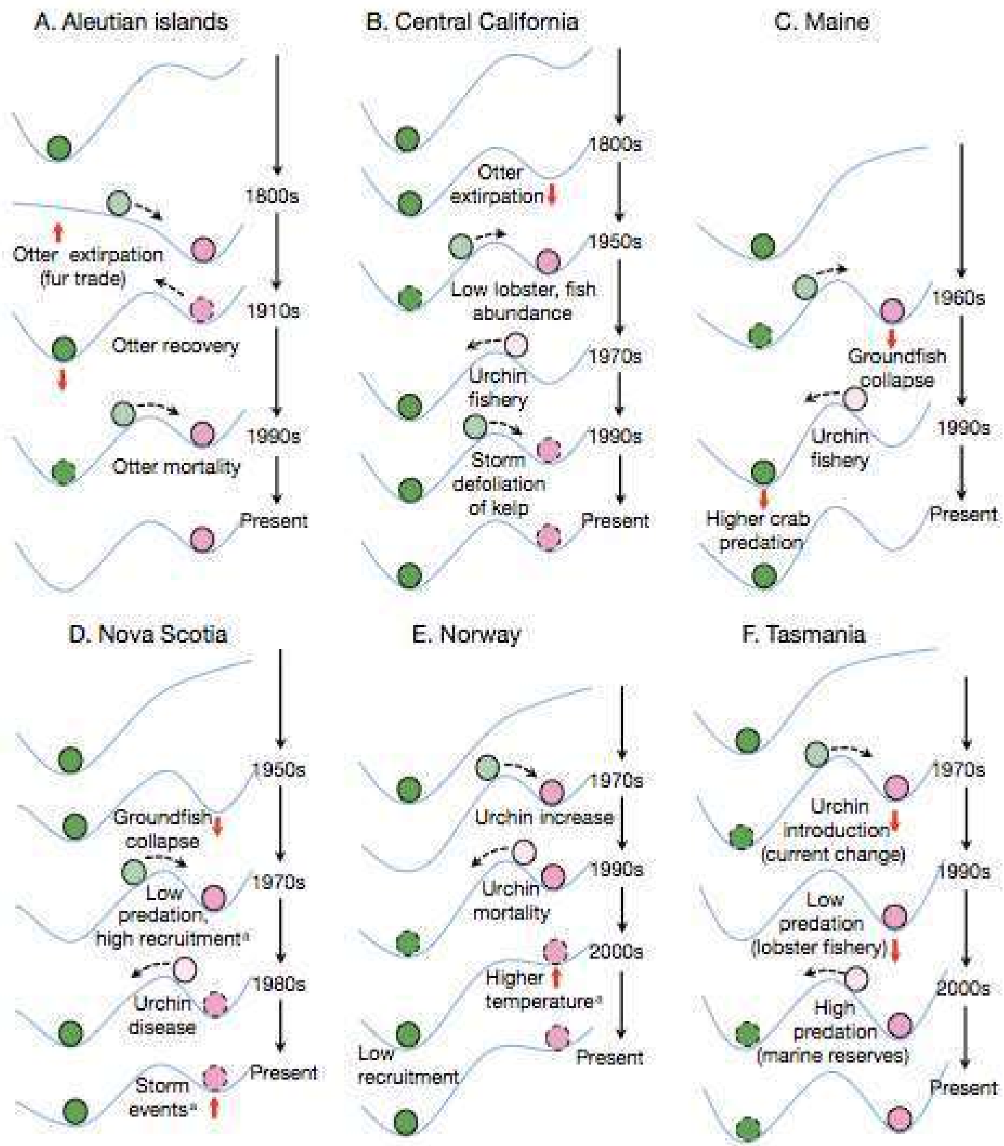
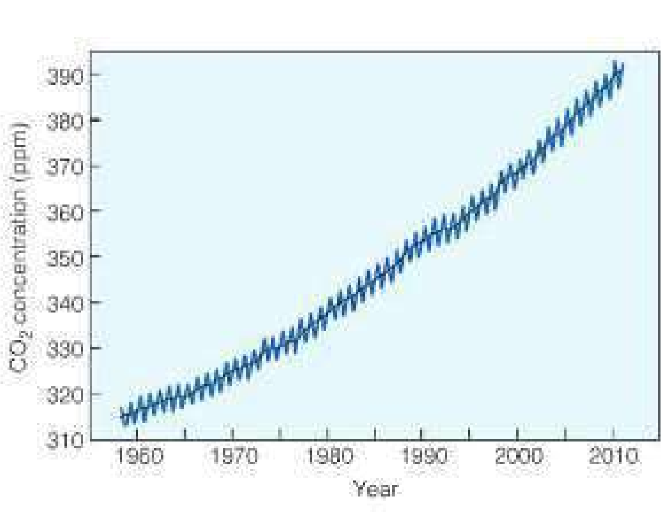
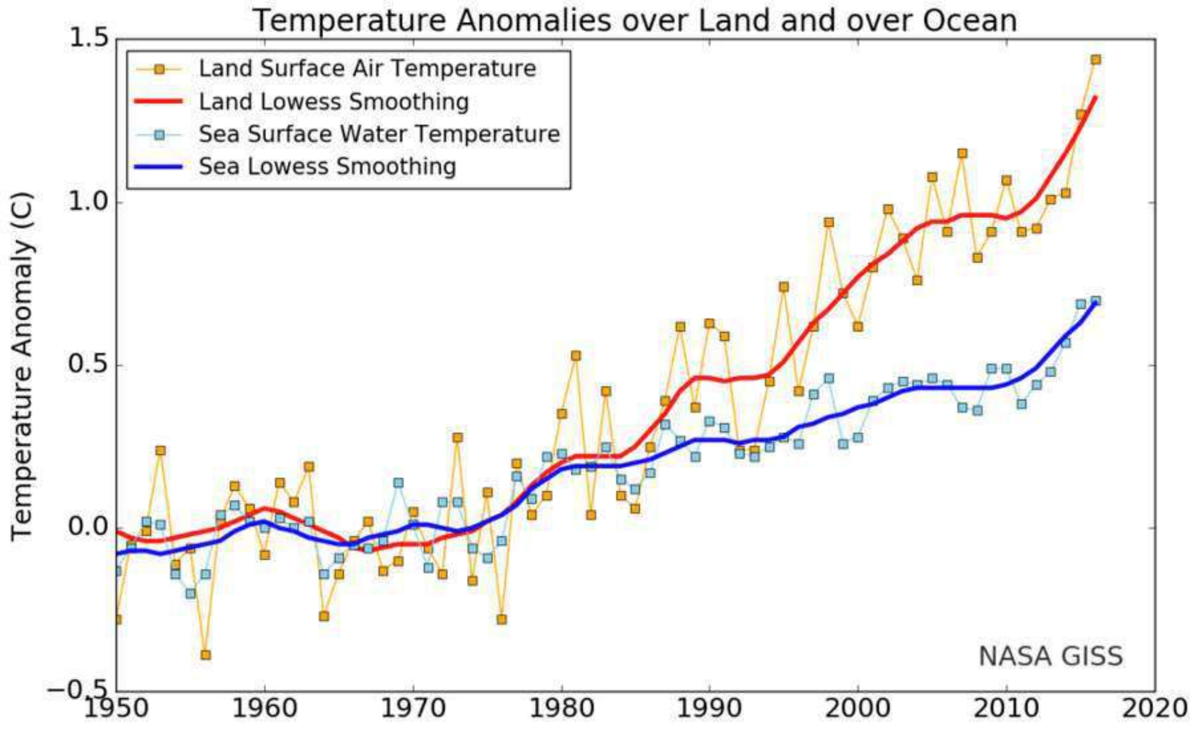


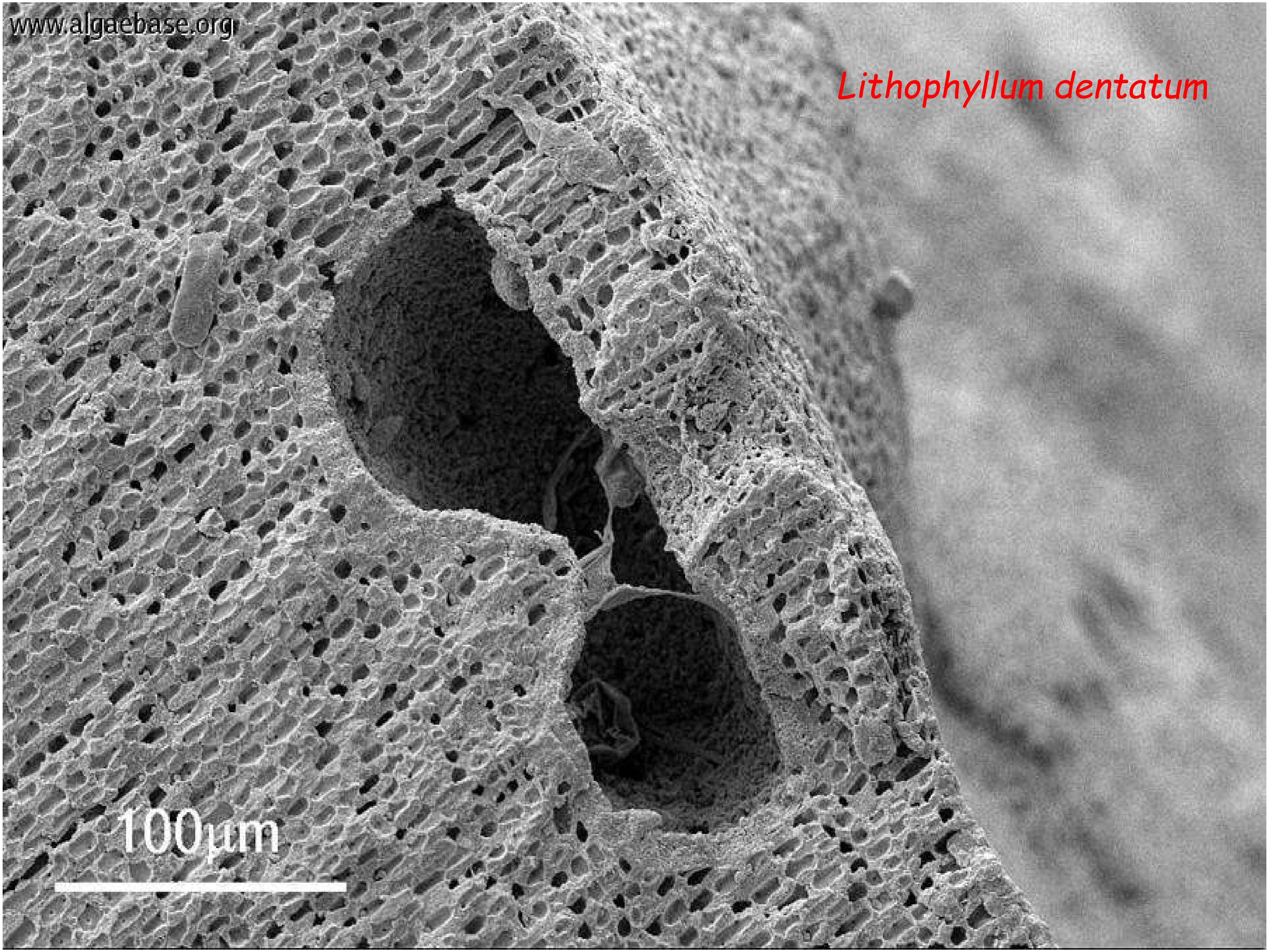
Fig. 5. Ball-in-cup diagrams representing phase shifts between kelp beds and sea urchin barrens in 6 regions: (A) Aleutian Islands, USA, (B) Central California, USA, (C) Maine, USA, (D) Nova Scotia, Canada, (E) Norway and (F) Tasmania, Australia. For each region, the top diagram (in chronological order) represents the earliest known community assemblage (determined by archeological evidence for the Aleutian Islands, California and Maine); this is followed by documented phase shifts and associated drivers leading to the present community state. See 'Barrens in regions with documented multiple phase shifts' for detailed explanation of drivers and dynamics for each region. Green balls represent kelp states, pink balls represent barren states and light green or light pink balls indicate a transitional stage (e.g. kelp bed with active urchin grazing patches or barrens with kelp regrowth). Balls with dashed lines represent patchy kelp or barrens; balls with solid lines represent extensive kelp or barrens. Red vertical arrows represent changes in domains of attraction (resilience); dashed black arrows represent shifts from one domain of attraction to another. [a]A statistical association, not a mechanistic driver

CO₂ in AIR



LAND and SEA temperature




www.algaebase.org
Lithophyllum dentatum
100µm

sea acidification

$$CO_2 + H_2O \longleftrightarrow H_2CO_3$$

Carbonic acid further dissociates into a hydrogen ion and a bicarbonate ion:

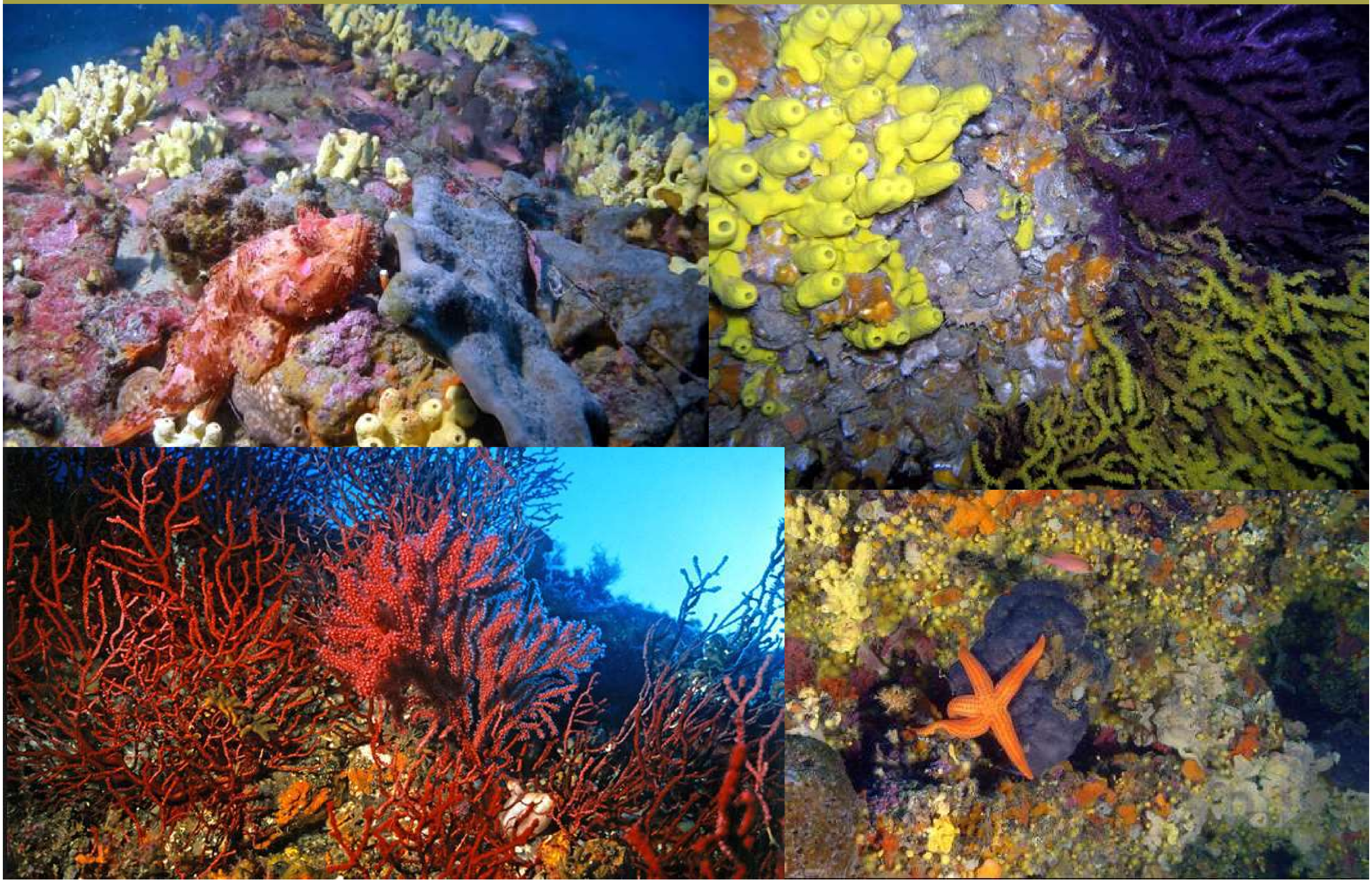
$$H_2CO_3 \longleftrightarrow HCO_3^- + H^+$$

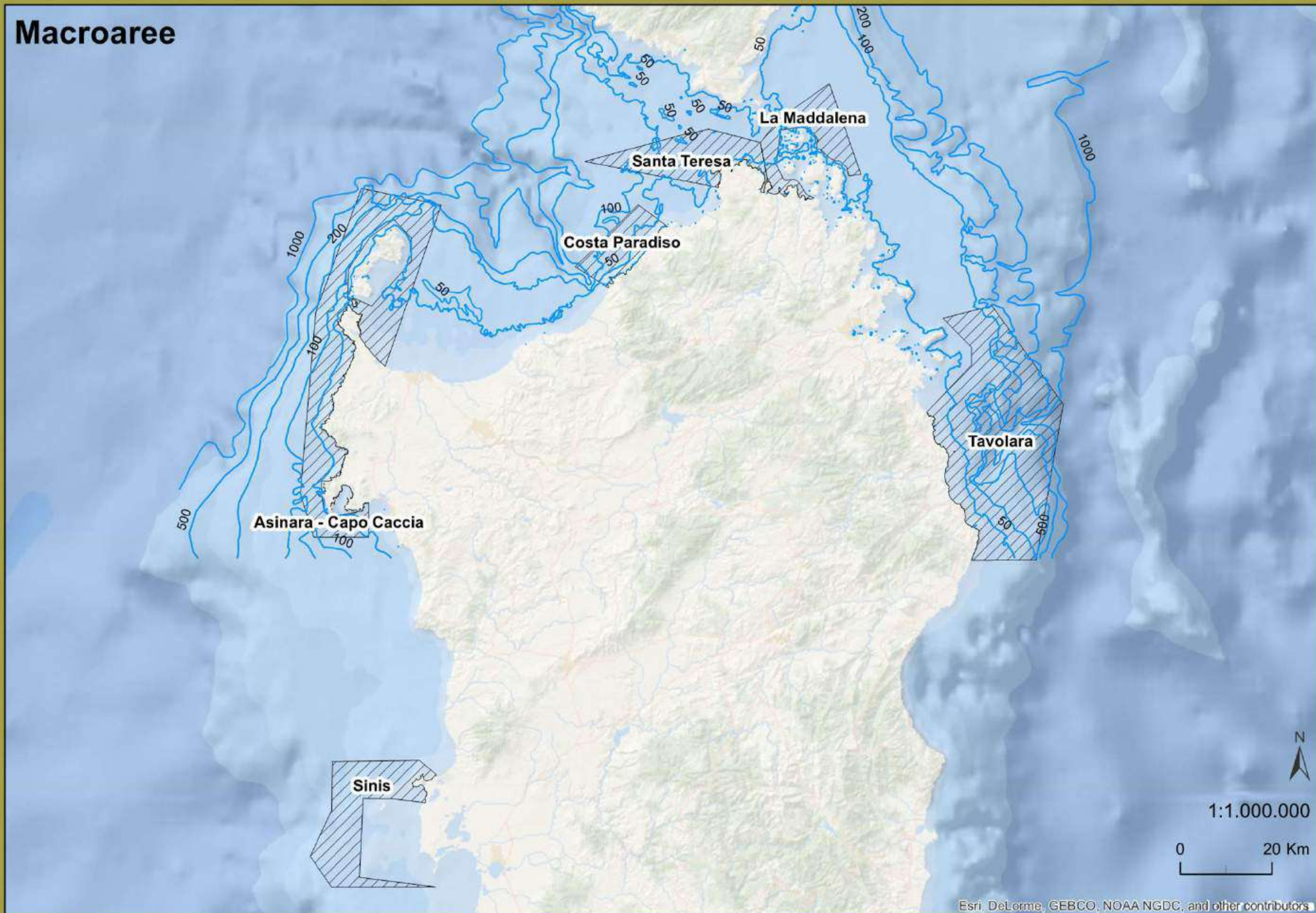
Bicarbonate may further dissociate into another hydrogen ion and a carbonate ion:

$$HCO_3^- \longleftrightarrow H^+ + CO_3^{2-}$$

The carbon dioxide–carbonic acid–bicarbonate system is a complex chemical system that tends to stay in equilibrium.

Mediterranean coralligenous




Macroaree
La Maddalena
Santa Teresa
Costa Paradiso
Asinara - Capo Caccia
Tavolara
Sinis
1:1.000.000
0
20 Km
N
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
50
100
200
500
1000


KLEIN S4900