La Simbiosi è l'Evoluzione

NON COPYRIGHT

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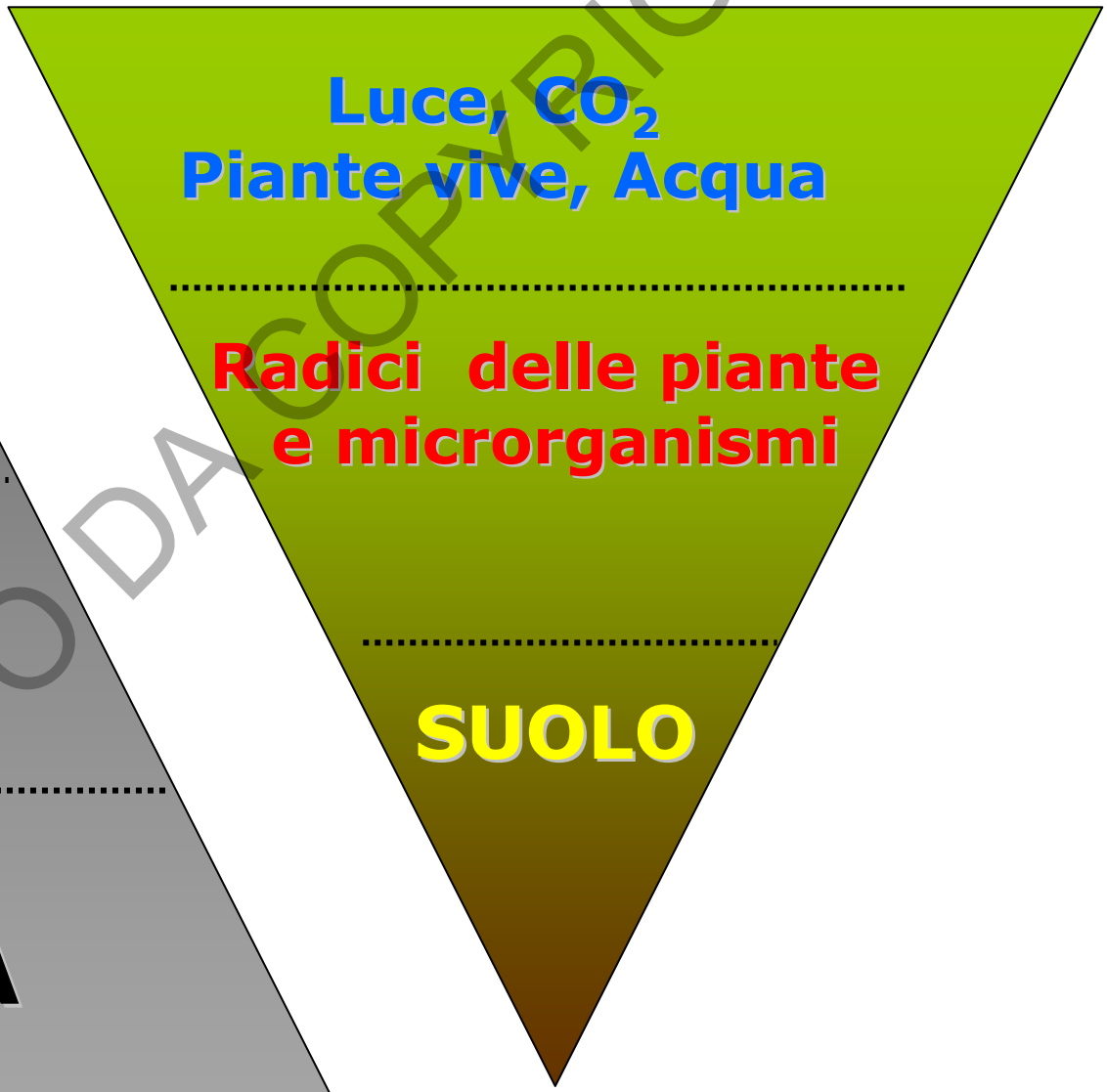
Il SUOLO
è figlio
della
ROCCIA
e padre
delle
PIANTE ?



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Il suolo fa crescere le piante ?

Le PIANTE fanno crescere il SUOLO !

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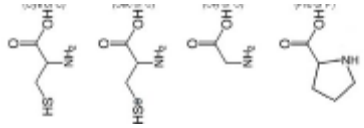
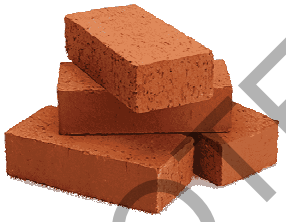
Le PIANTE pagano i microrganismi con composti organici fotosintetizzati (*pompano 'carbonio liquido' dalle radici*)

La moneta



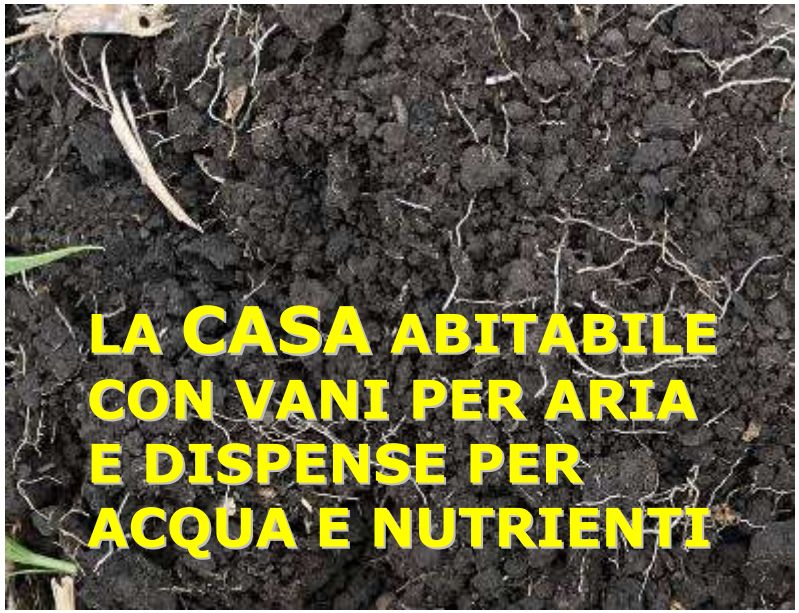
La ROCCIA fornisce i mattoni costruttivi (la 'cava' di origine dei materiali)



Microrganismi e microfauna edificano il suolo e mettono la malta organica che lo struttura

I committenti dell'opera

Gli Architetti e Operai



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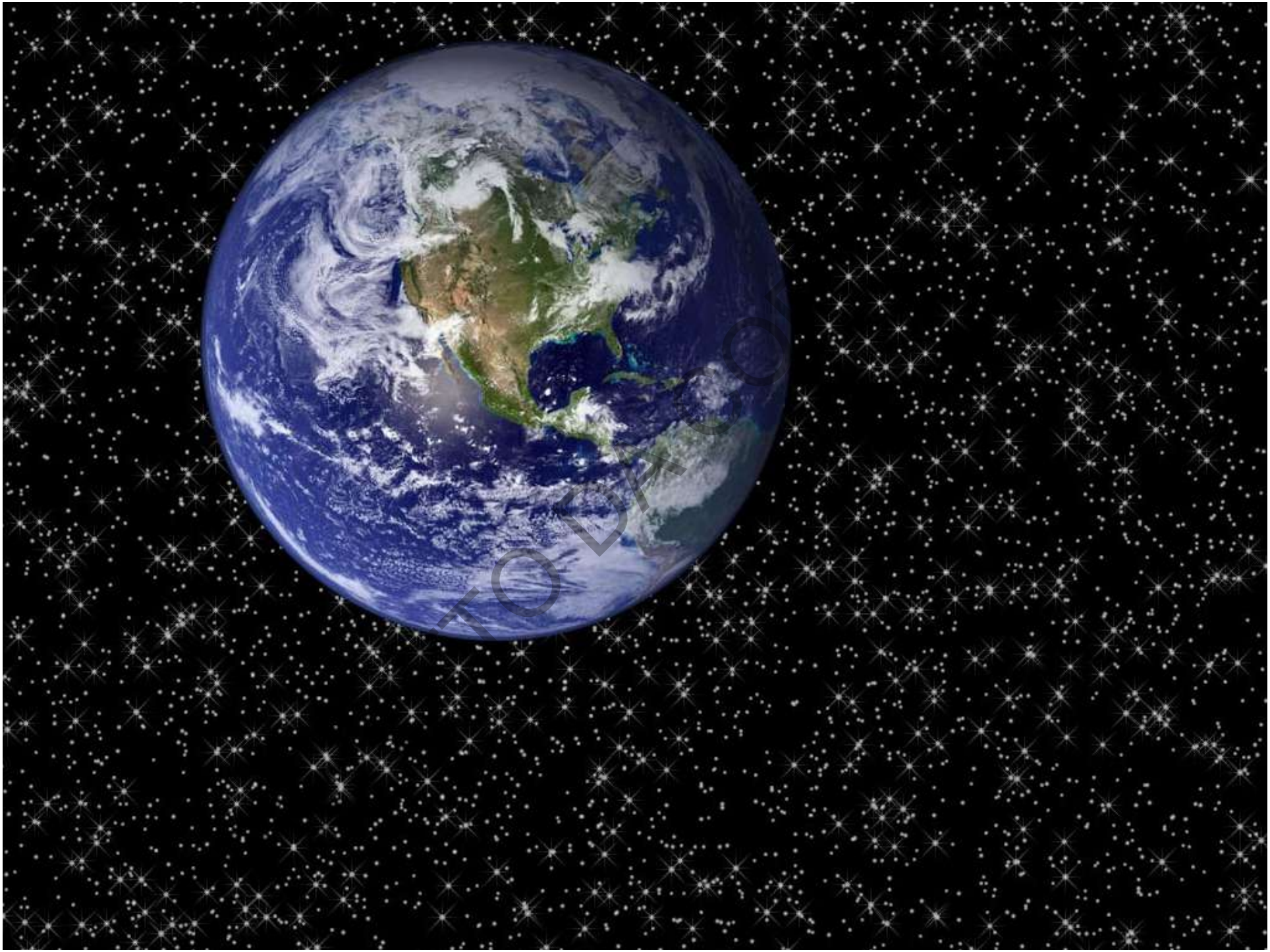
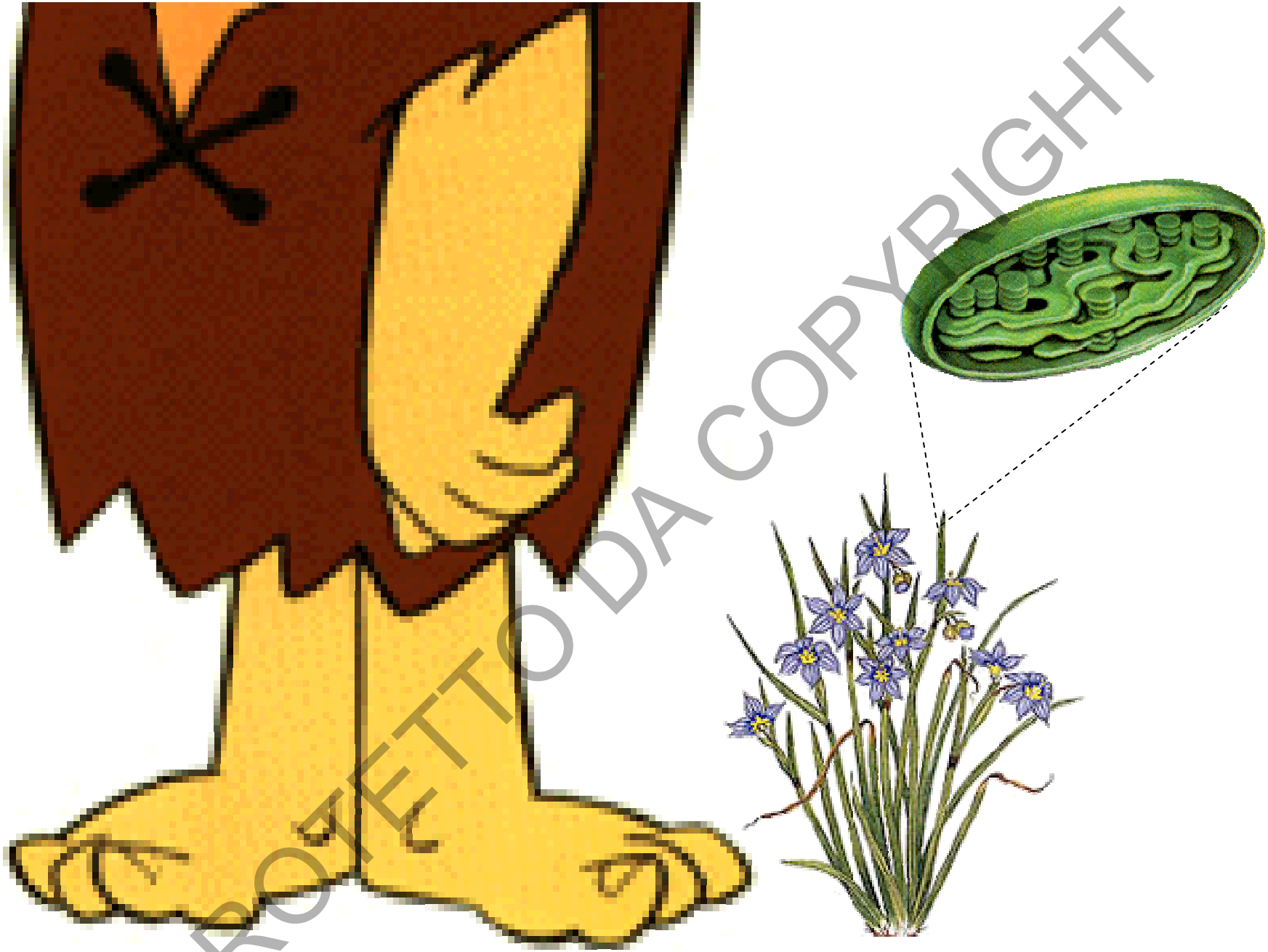

TO DARK



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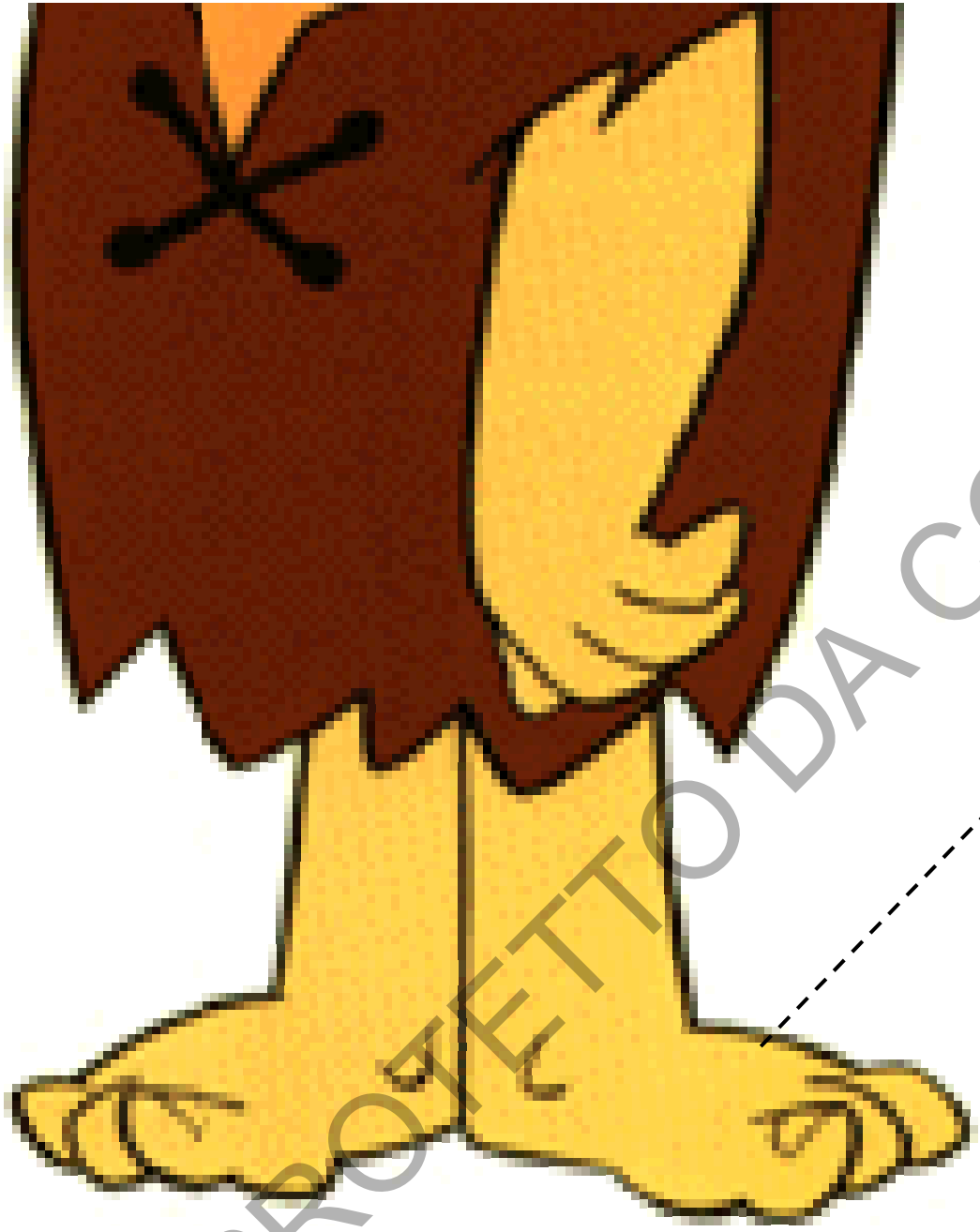

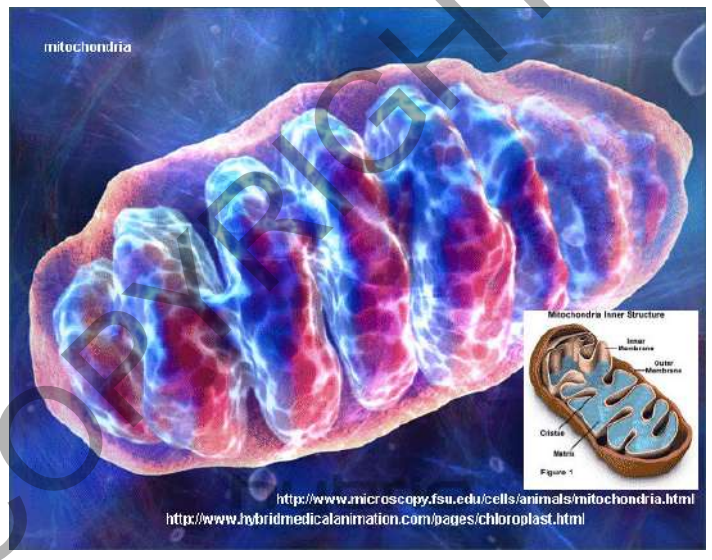

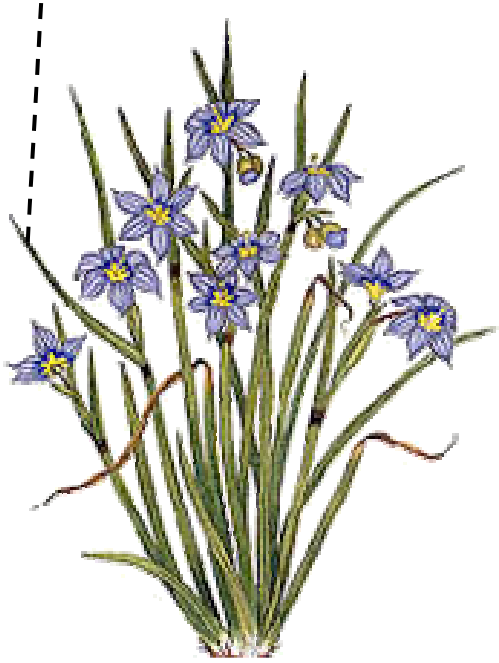

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Table 2.1
Comparison of atmospheric and temperature conditions

Condition	Mars	Venus	Earth without life	Earth with life
Atmosphere				
Carbon dioxide (CO_2)	95%	98%	98%	0.03%
Nitrogen (N_2)	2.7%	1.9%	1.9%	79%
Oxygen (O_2)	0.13%	trace	trace	21%
Surface temperature (°C)	–53	477	290 ± 50	13

Source: Lovelock 1979.

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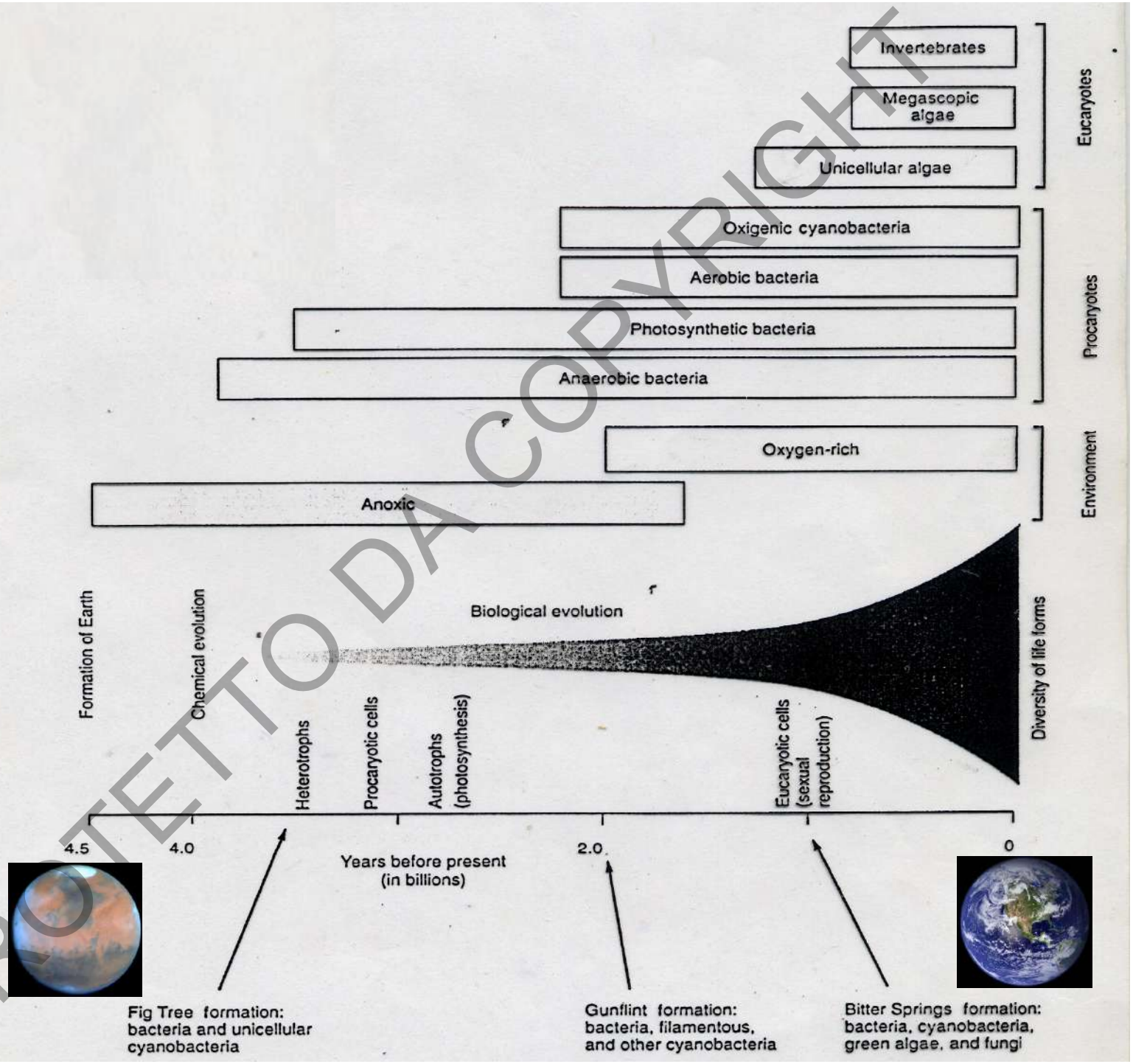

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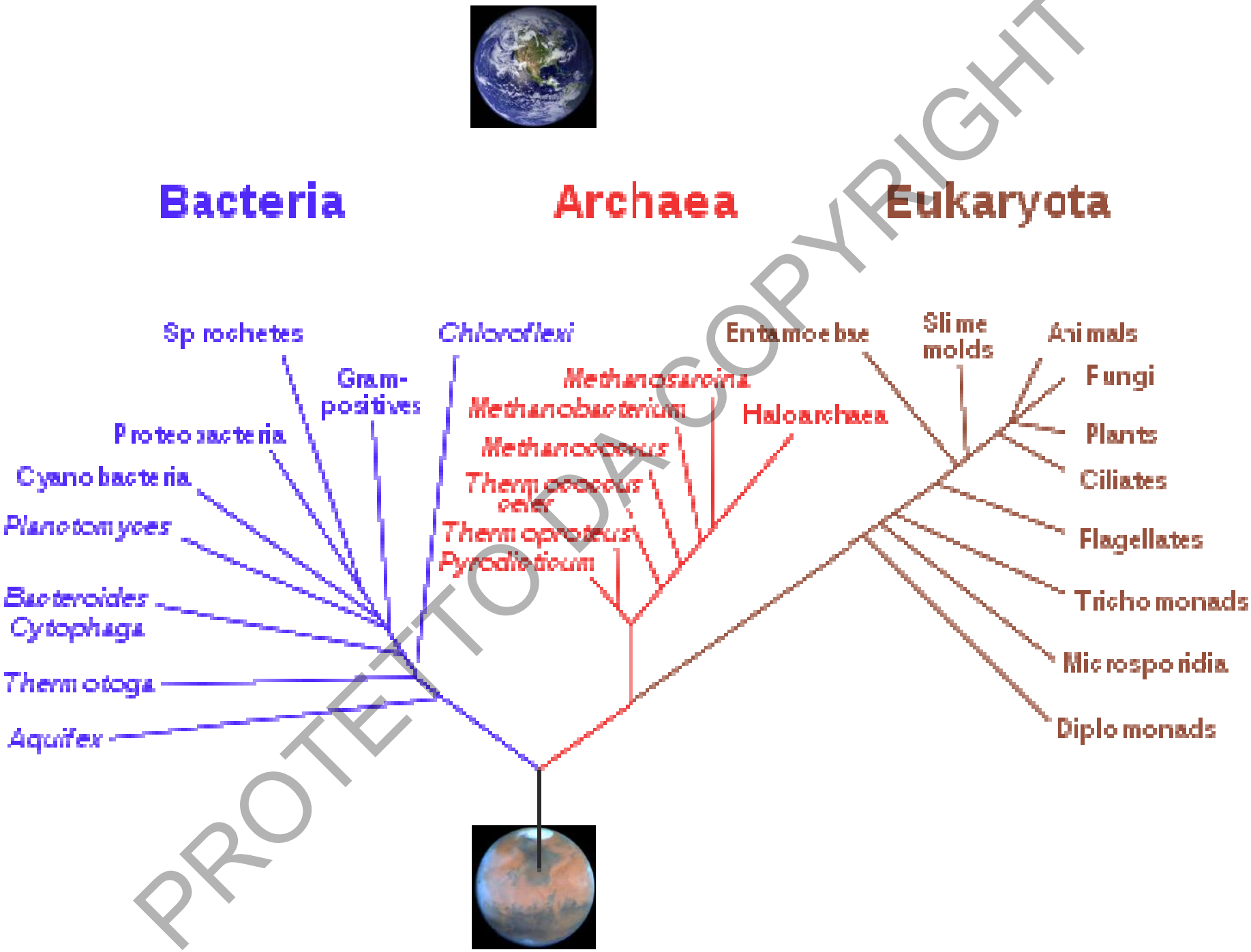

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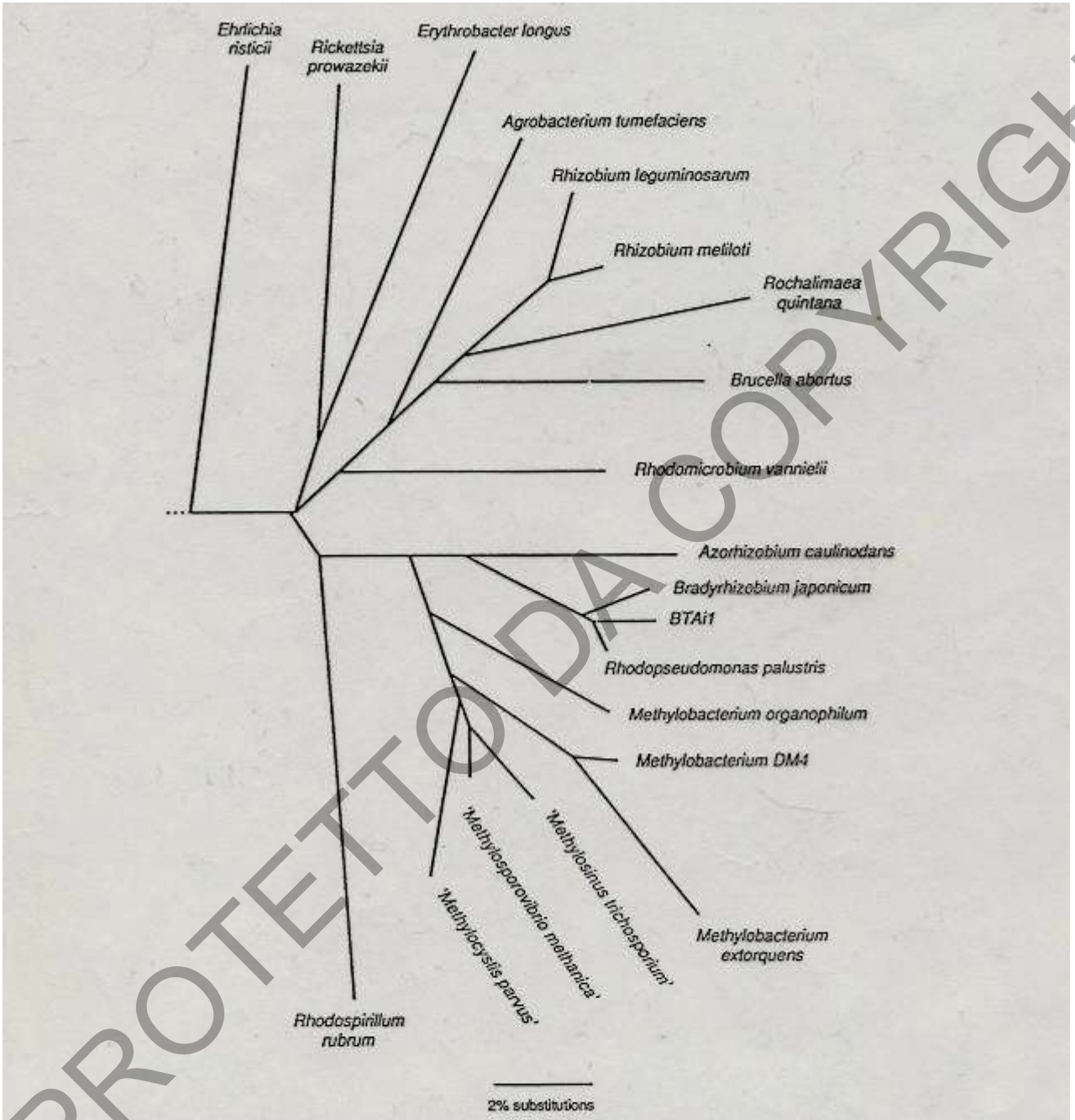

FIG. 3. Phylogenetic tree of bacteria in the alpha subdivision of the class *Proteobacteria*. Tree was constructed by the Neighbor-Joining method (23) from the Jukes-Cantor distances in Table 2. The *B. japonicum* sequence used was that of strain USDA 31. The tree was rooted by comparison with *E. coli* (which is in the gamma subdivision).

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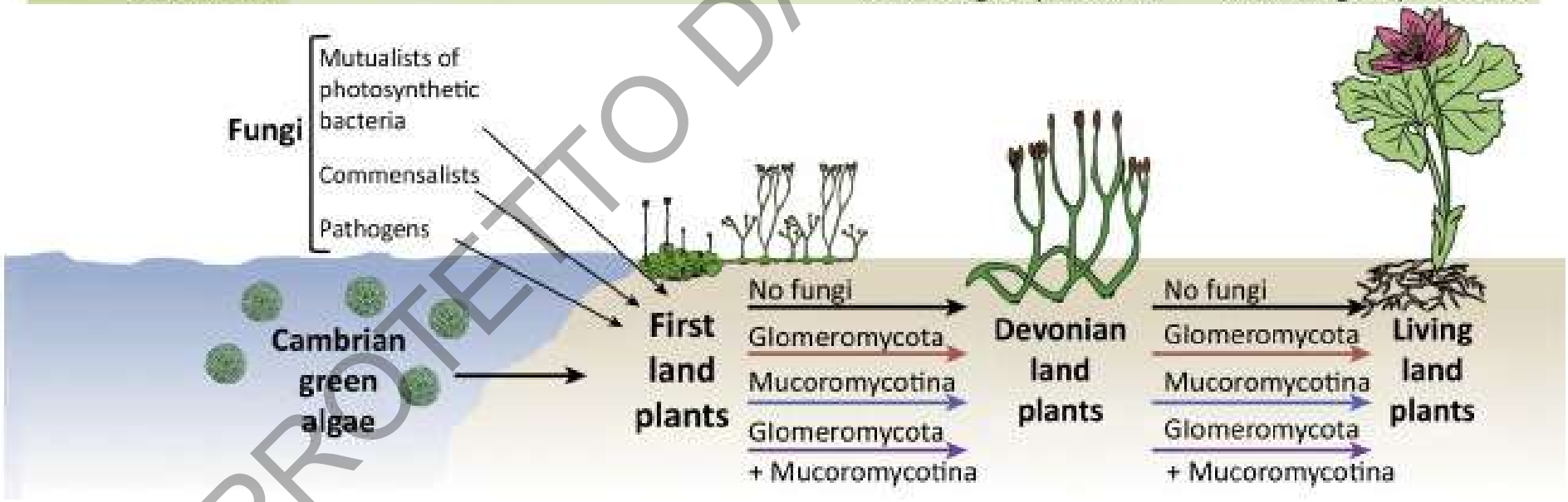
Atmosphere:	4500 ppm CO_2	4500 ppm CO_2	3000 ppm CO_2	350 ppm CO_2
Substrate:	Brackish water	Moist, mineral soil	Mineral and organic soil	Mineral and organic soil
Water and nutrient uptake:	Direct	Direct	Direct and symbiotic	Direct and symbiotic
Specialized structures:	Rhizoids	Rhizoids	Rhizoids, rhizomes and fungal symbionts	Roots, root hairs and fungal symbionts



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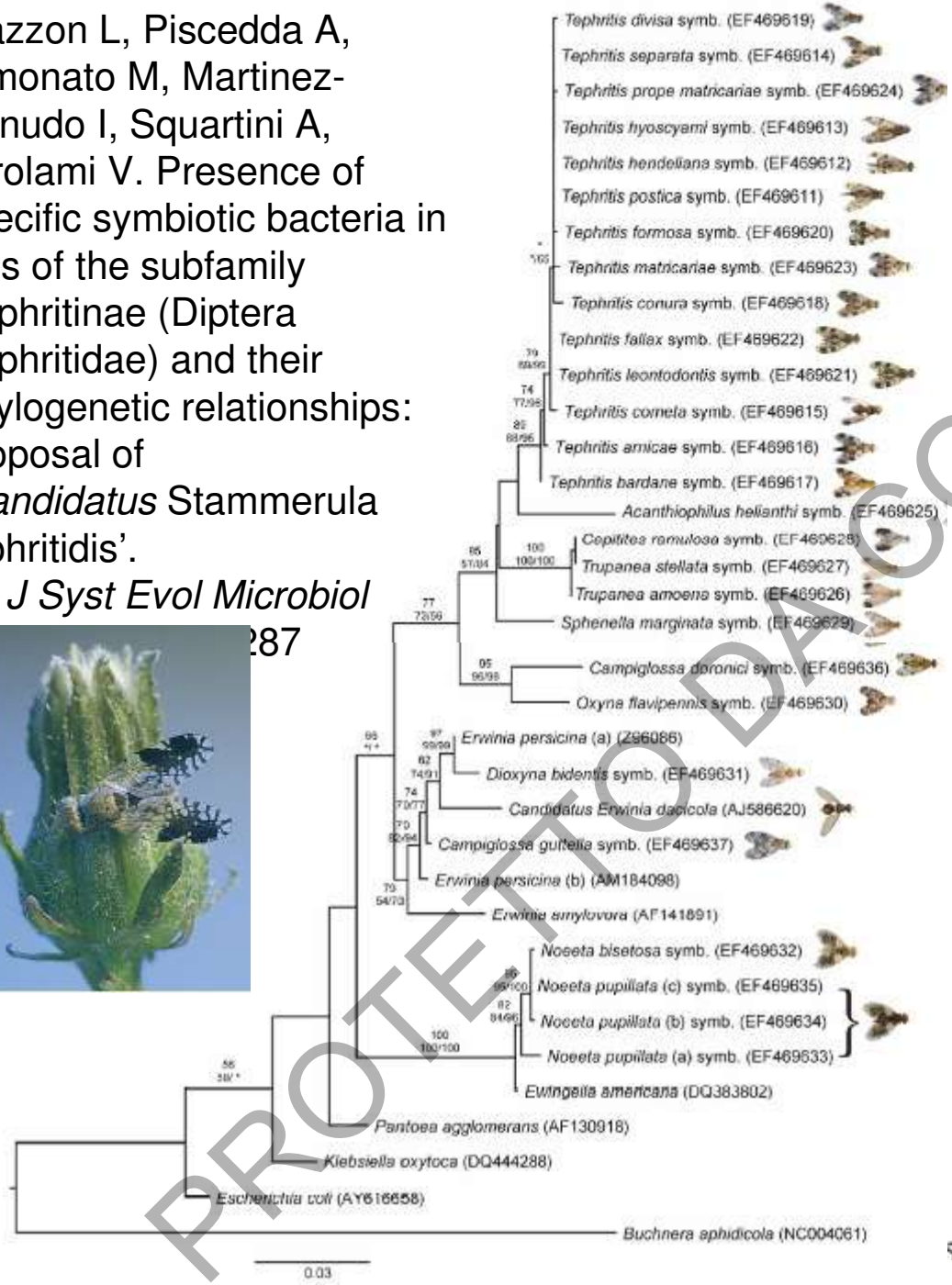
Mazzon L, Piscedda A, Simonato M, Martinez-Sanudo I, Squartini A, Girolami V. Presence of specific symbiotic bacteria in flies of the subfamily Tephritinae (Diptera Tephritidae) and their phylogenetic relationships: proposal of '*Candidatus* Stammerula tephritidis'.
Int J Syst Evol Microbiol 2[illegible]287



insect species and number of sequenced specimens		host plant
Acanthiophilus helianthi†	3	*Centaurea jacea*
		Cirsium arvense
Campiglossa doronici	3	*Doronicum austriacum*
Campiglossa guttella	4	*Hieracium murorum*
		Hieracium glaucum
Capitites ramulosa	6	*Phagnalon saxatile*
Dioxyna bidentis†	4	*Bidens tripartita*
Noeeta bisetosa	1	*Hieracium piloselloides*
Noeeta pupillata	10	*Hieracium porrifolium*
		Hieracium murorum
		Hieracium umbellatum
Oxyna flavipennis	4	*Achillea millefolium*
Sphenella marginata†	5	*Senecio inaequidens*
		Senecio vulgaris
		Senecio alpinus
Tephritis arnicae	2	*Arnica montana*
Tephritis bardanae†	1	*Arctium minus*
Tephritis cometa†	1	*Cirsium arvense*
Tephritis conura†	4	*Cirsium oleraceum*
		Cirsium erisithales
Tephritis divisa	2	*Picris echioides*
Tephritis fallax†	2	*Leontodon hispidus*
Tephritis formosa	8	*Sonchus oleraceus*
		Sonchus sp.
Tephritis hendeliana	3	*Carduus chrysacanthus*
		Carduus nutans
Tephritis hyoscyami	3	*Carduus personata*
Tephritis leontodontis†	2	*Leontodon autumnalis*
		Leontodon hispidus
Tephritis matricariae	5	*Crepis vesicaria*
Tephritis prope matricariae	4	*Crepis chondrilloides*
Tephritis postica	1	*Onopordum acanthium*
Tephritis separata	1	*Picris hieracioides*
Trupanea amoena†	4	*Lactuca serriola*
		Reichardia picroides
Trupanea stellata†	3	*Erigeron annuus*
		Crepis foetida

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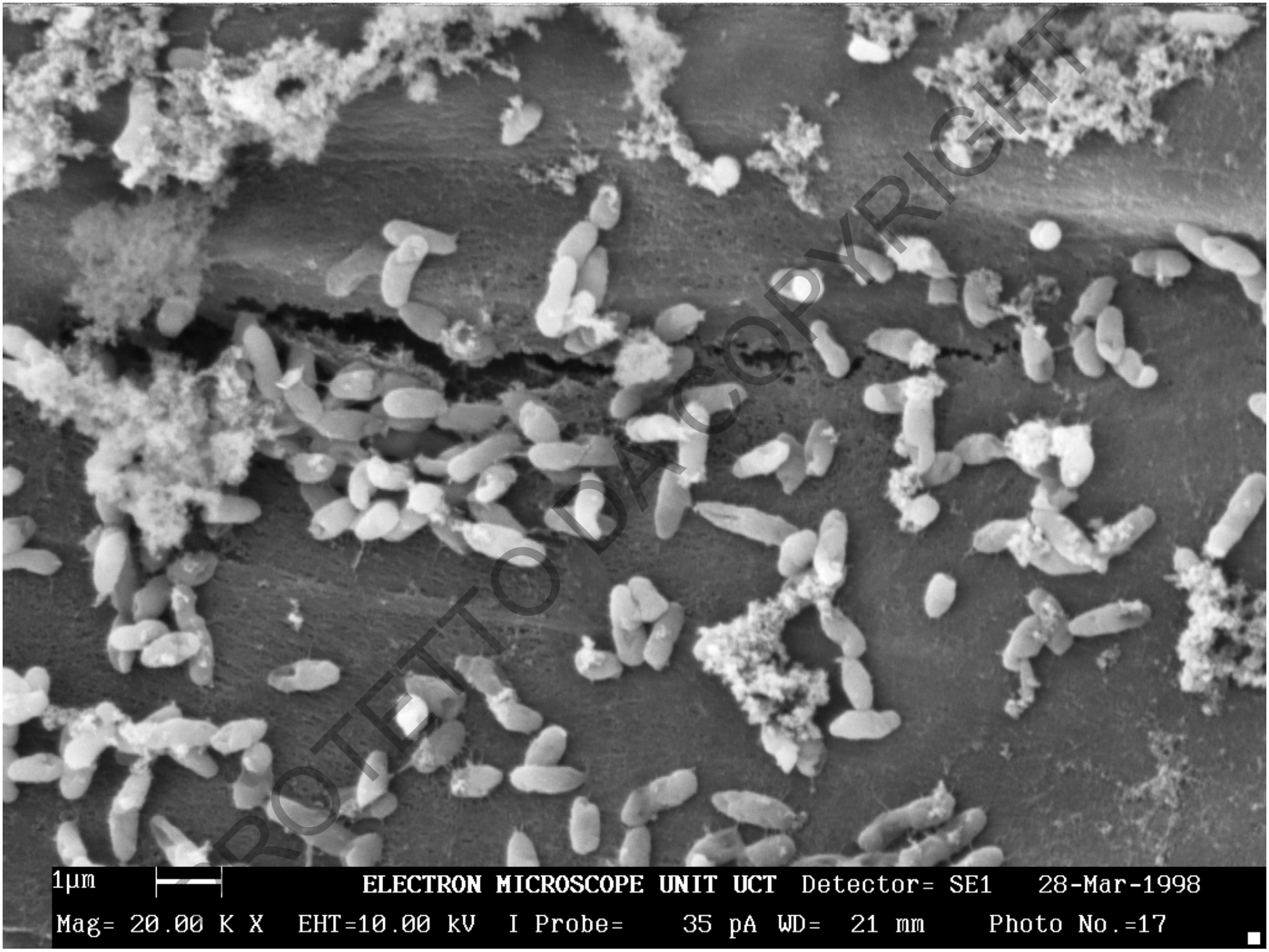

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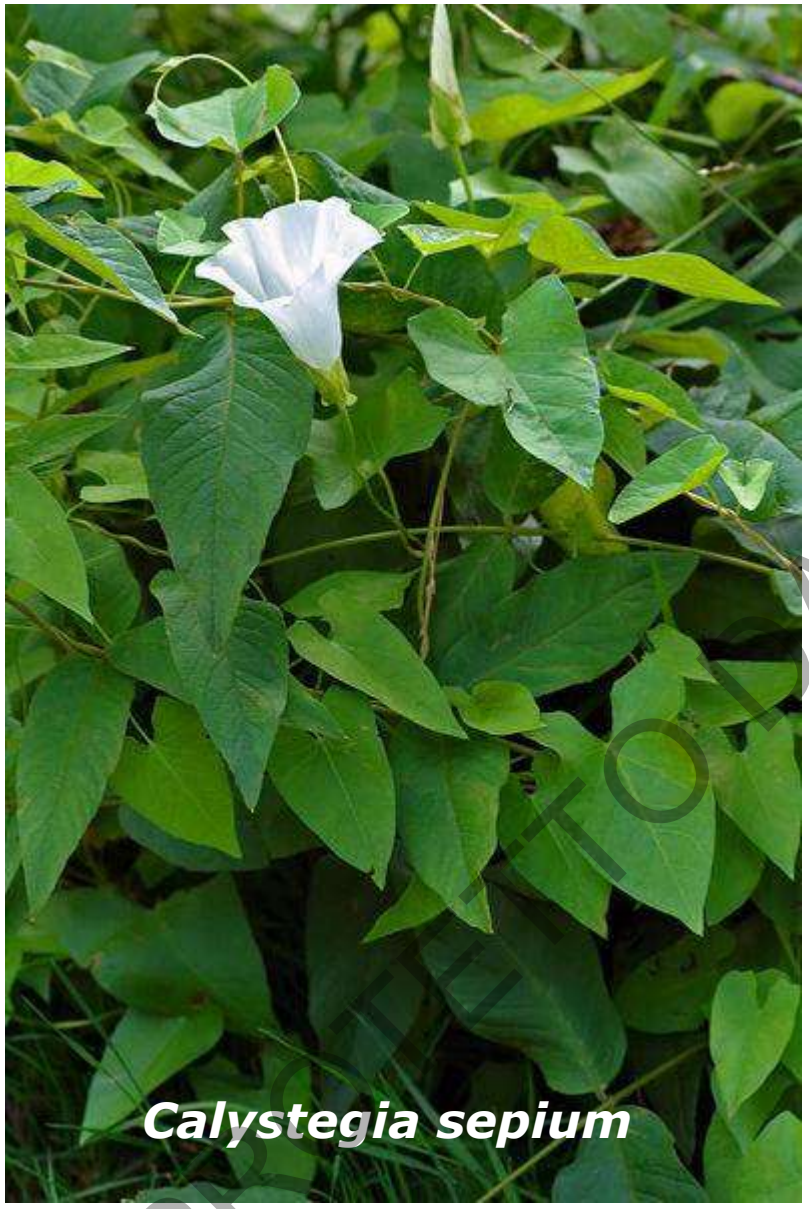

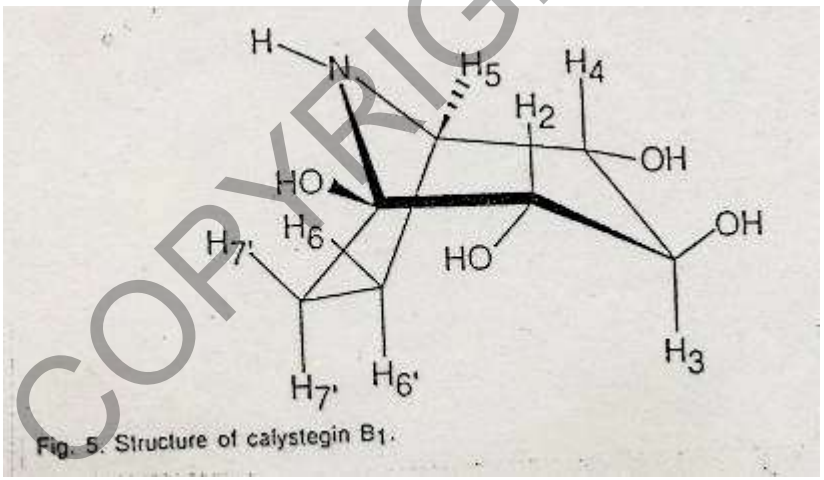

Fig. 5. Structure of calystegin B1.

Rizosfere influenzate

Piante produttrici di Calistegina (geni cas)

Batteri capaci di degradare La calistegina (geni cac)

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Più di 140 Kg di azoto atmosferico fissato per ettaro e per anno,
Grazie alla simbiosi tra batteri e leguminose.

Azotofissatori simbiotici

Eterotrofi (organotrofi) 5-140 Kg N fissato/Ha
fotosintati della pianta come fonte di energia

Azotobacter / Paspalum (Graminaceae)
Azospirillum / Digitaria (Graminaceae)
anche canna da zucchero e sorgo, anche ormoni

Rhizobium / Leguminose
alcuni beta-proteobatteri / Leguminose
Bradyrhizobium /Leguminose

Bradyrhizobium /Parasponia, Trema (Ulmaceae)

Frankia (Attinomiceti) / 137 specie di angiosperme arboree (Alnaceae, Betulaceae, Rosaceae, Coriariaceae, Rhamnaceae, Eleagnaceae, Myricaceae etc.)

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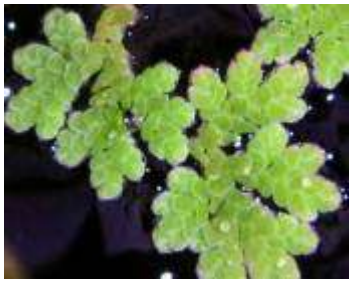
Azotofissatori simbiotici

Autotrofi (Fototrofi) ***5-30 Kg N fissato/Ha***
luce come prevalente fonte di energia

Nostoc / Cycas (Gimnosperme)

Nostoc / Peltigera (Licheni)

Halosiphon /Sphagnum (Muschi)



Anabaena /Azolla (Felci)

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Noduli di leguminose da granella

Glycine max (soja)

Cicer arietinum (cece)

Arachis hypogaea (arachide)

Noduli di leguminose da foraggio

Lotus corniculatus (ginestrino)

Trifolium repens (trifoglio)

Onobrychis viciaefolia (lupinella)

Cyanopsis tetragonoloba (guar)

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Hedysarum coro
(sulla)

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International Journal of Systematic and Evolutionary Microbiology (2002), 52, 1267–1276

DOI: 10.1099/ijs.0.01821-0

Rhizobium sullae sp. nov. (formerly 'Rhizobium hedysari'), the root-nodule microsymbiont of Hedysarum coronarium L.

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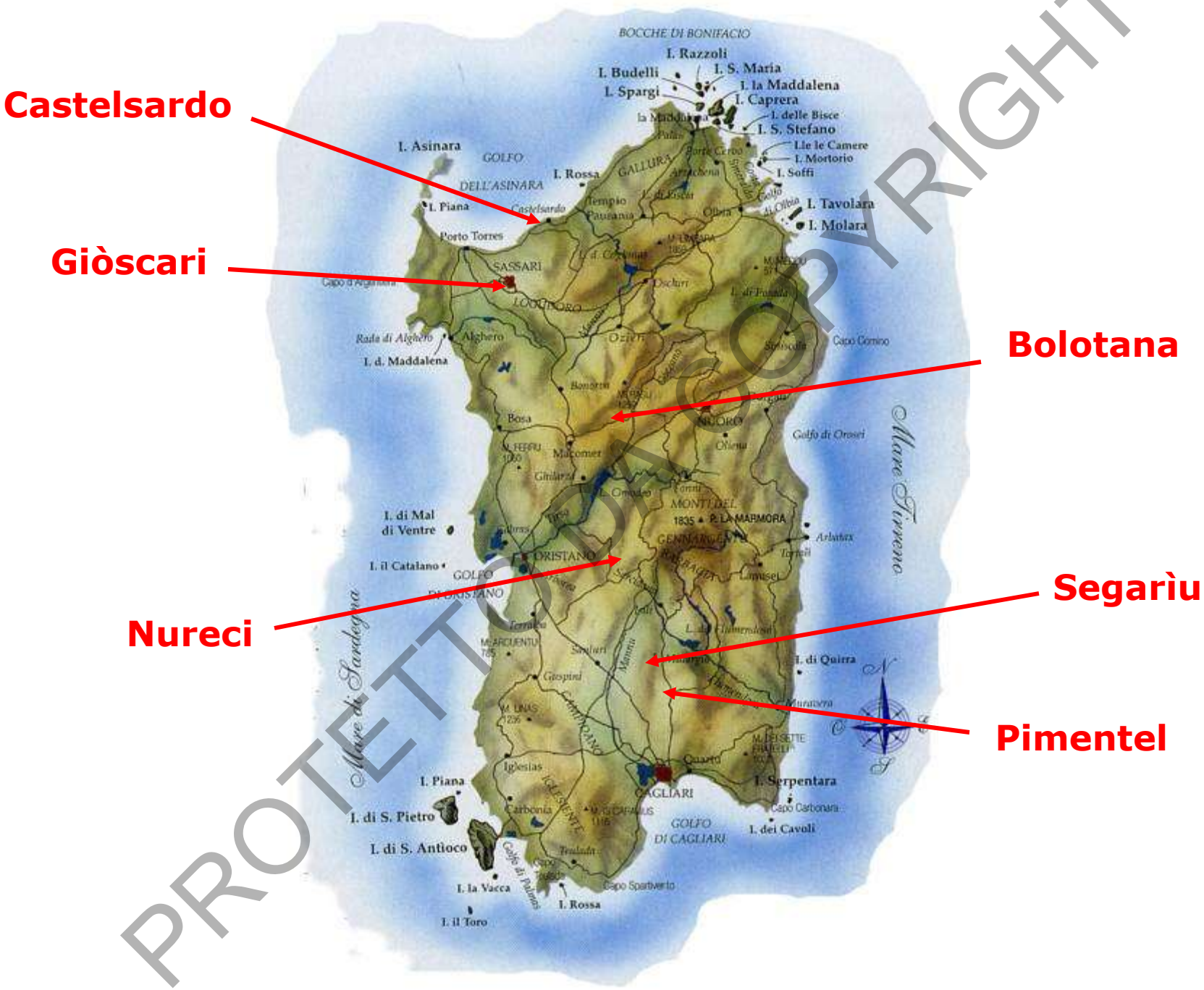
This work is the completion of a series of reports describing the nitro bacterial symbionts of sulla (*Hedysarum coronarium* L., Leguminosa providing the grounds for their proposal as a new taxon. The intro summarizes a large amount of previous evidence gathered on th genetics and ecology of such organisms, which have in the pas visionally as '*Rhizobium hedysari*'. Upon adding 16S RN DNA restriction analysis of the *rrn* operon, DNA– analysis of low-molecular-mass RNA specie that specifically nodulate sulla consi om previously described rhizob f the species boundary. Th IS123[T] (=USDA 49



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-The 191 legume species growing in the island of Sardinia -

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Rizobi nelle graminacee ?

Trifolium alexandrinum

Oryza sativa

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Aust. J. Plant Physiol., 2001, **28**, 845–870

The beneficial plant growth-promoting association of *Rhizobium leguminosarum* bv. trifolii with rice roots

Youssef G. Yanni[A], *Rizk Y. Rizk*[A], *Faiza K. Abd El-Fattah*[A], *Andrea Squartini*[B], *Viviana Corich*[B], *Alessio Giacomini*[B], *Frans de Bruijn*[CDE], *Jan Rademaker*[D], *Jaime Maya-Flores*[C], *Peggy Ostrom*[EF], *Maria Vega-Hernandez*[C], *Rawle I. Hollingsworth*[EG], *Eustoquio Martinez-Molina*[CH], *Pedro Mateos*[H], *Encarna Velazquez*[H], *Judith Wopereis*[D], *Eric Triplett*[I], *Mercedes Umali-Garcia*[J], *Juliet A. Anarna*[J], *Barry G. Rolfe*[K], *Jadish K. Ladha*[L], *James Hill*[L], *Rajni Mujoo*[M], *Perry K. Ng*[M] *and Frank B. Dazzo*[CEN]

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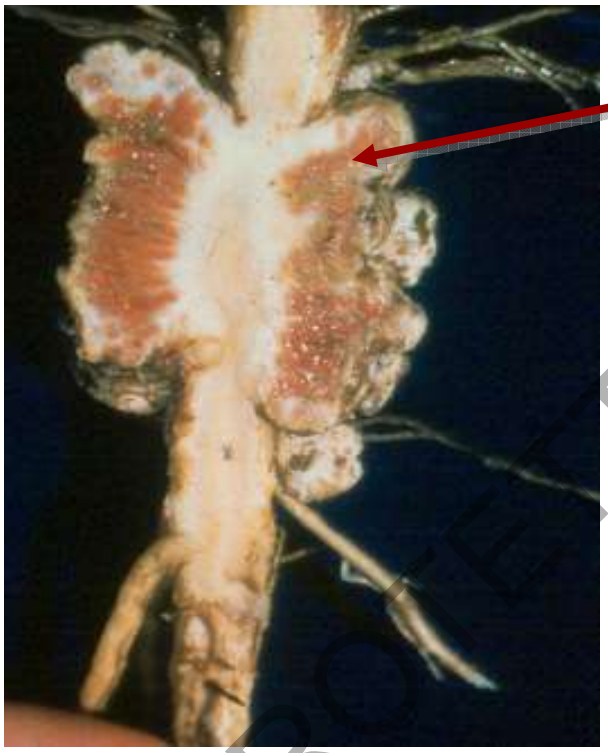
La NITROGENASI

è sensibile all'ossigeno molecolare

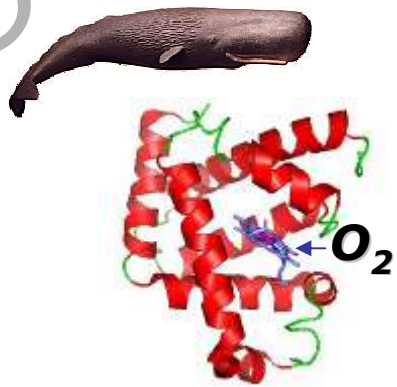
Rizobi → **aerobi, simbionti (*Leguminosae*)**

compartimentalizzazione → **noduli (tubercoli) radicali**

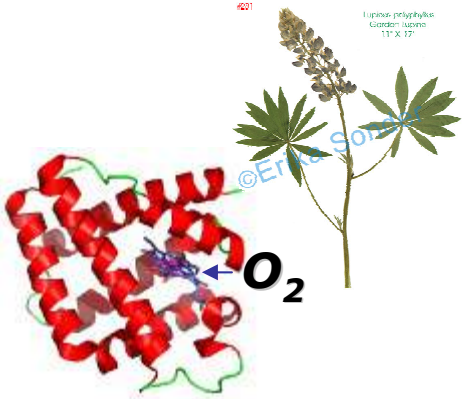


Leg-emoglobina

Proteina con eme e ferro con funzione di legare ossigeno, in analogia con emoglobine e mioglobine animali



Mioglobina di capodoglio



Leg-emoglobina di lupino

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Endofiti

la vita nella vita

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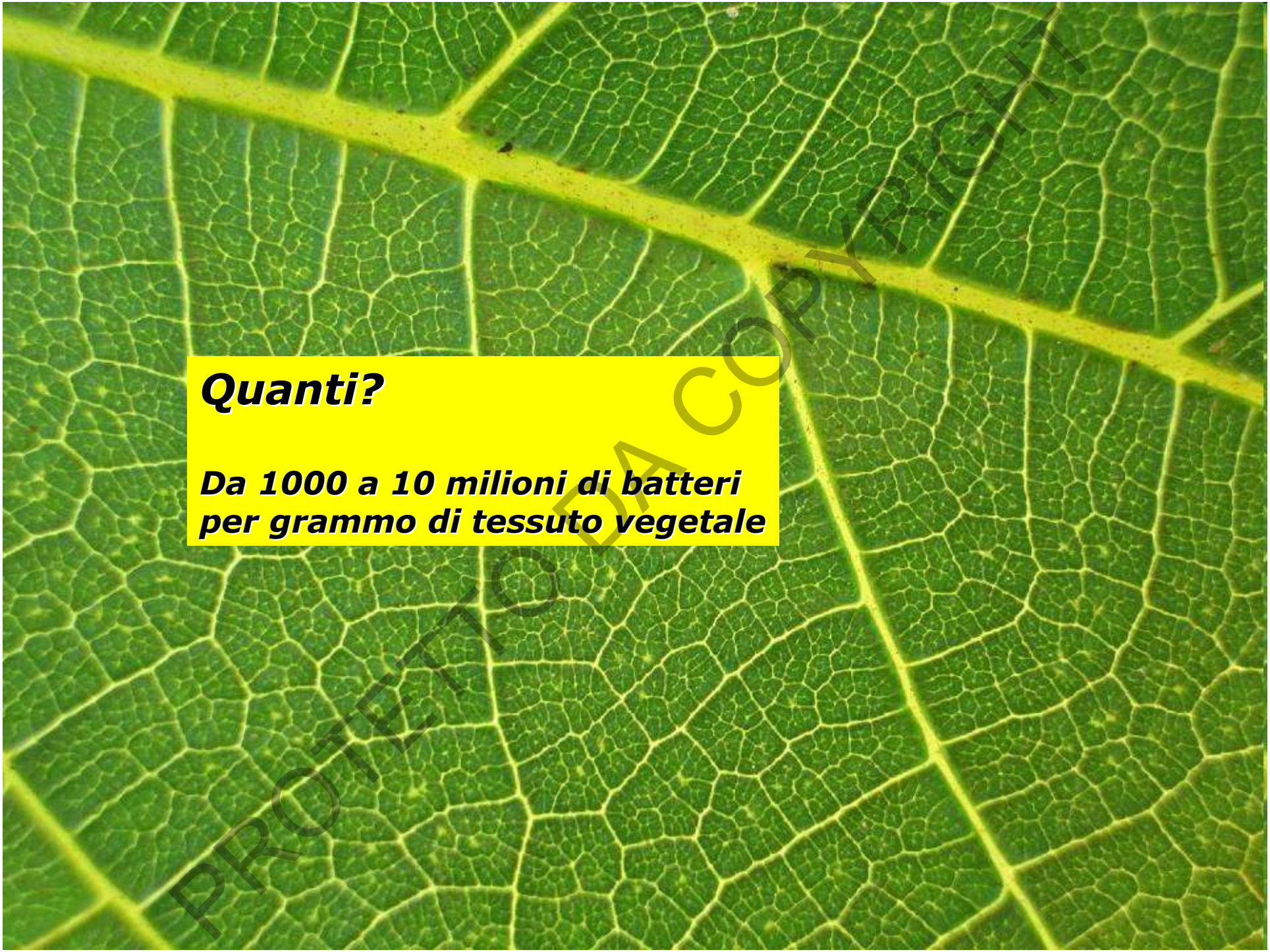

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Table I.1. List of recovered endophytic species. Modified from Rosenblueth and Martínez-Romero (8), Rajkumar *et al.* (7) and Ryan *et al.* (6).

Endophytes	Plant species
α-Proteobacteria	
Azorhizobium caulinodans	Rice
Azospirillum brasilense	Banana
Azospirillum amazonense	Banana, pineapple
Bradyrhizobium japonicum	Rice
Devosia sp.	*Thlaspi caerulescens*
Gluconacetobacter diazotrophicus	Sugarcane, coffee
Methylobacterium mesophilicum	Citrus plants; *Thlaspi goesingense*
Methylobacterium extorquens	Scots pine, citrus plants; *Thlaspi goesingense*
Methylobacterium populi BJ001	*Populus deltoides x nigra* DN34
Methylobacterium oryzae sp. *CBMB20*	*Oryza sativa*
Methylobacterium sp.	*Thlaspi caerulescens*
Phyllobacterium sp.	*Thlaspi caerulescens*
Rhizobium leguminosarum	Rice
Rhizobium (*Agrobacterium*) *radiobacter*	Carrot, rice
Sinorhizobium meliloti	Sweet potato
Sphingomonas paucimobilis	Rice
Sphingomonas sp.	*Thlaspi caerulescens; Thlaspi goesingense*
β-Proteobacteria	
Azoarcus sp.	Kallar grass, rice
Burkholderia pickettii	Maize
Burkholderia cepacia	Yellow lupine, citrus plants
Burkholderia sp.	Banana, pineapple, rice
Burkholderia sp. *Bu61 (pTOM-Bu-61)*	Poplar
Chromobacterium violaceum	Rice
Herbaspirillum seropedicae	Sugarcane, rice, maize, banana
Herbaspirillum rubrisulbalbicans	Sugarcane
Herbaspirillum sp.*K1*	Wheat
γ-Proteobacteria	
Citrobacter sp.	Banana
Enterobacter spp.	Maize; *Nicotiana tabacum*
Enterobacter sakazakii	Soybean
Enterobacter cloacae	Citrus plants, maize
Enterobacter agglomerans	Soybean
Enterobacter asburiae	Sweet potato
Erwinia sp.	Soybean
Escherichia coli	Lettuce
Klebsiella sp.	Wheat, sweet potato, rice
Klebsiella pneumoniae	Soybean
Klebsiella variicola	Banana, rice, maize, sugarcane
Klebsiella terrigena	Carrot
Klebsiella oxytoca	Soybean
Pantoea sp.	Rice, soybean
Pantoea agglomerans	Citrus plants, sweet potato
Pseudomonas chlororaphis	Marigold (*Tagetes* spp.), carrot
Pseudomonas putida	Carrot
Pseudomonas fluorescens	Carrot, *Brassica napus*
Pseudomonas citronellolis	Soybean
Pseudomonas synxantha	Scots pine
Pseudomonas viridiflava	Grass
Pseudomonas aeruginosa strain R75	Wild rye (Elymus dauricus)
Pseudomonas savastanoi strain CB35	Wild rye (Elymus dauricus)
P. putida VM1450	Poplar (Populus) and willow (Salix)
Pseudomonas fulva	*Nicotiana tabacum*
Pseudomonas sp	Populus cv. Hazendans and cv. Hoogvorst. *Alyssum Bertolonii, Nicotiana tabacum*
Salmonella enterica	Alfalfa, carrot, radish, tomato
Serratia sp.	Rice
Serratia marcescens	Rice, Rhyncholacis penicillata
Stenotrophomonas sp.	Dune grasses (*Ammophila arenaria* and *Elymus mollis*); *Nicotiana tabacum*
Firmicutes	
Bacillus spp.	Citrus plants; *Alyssum bertolonii; Thlaspi goesingense*
Bacillus megaterium	Maize, carrot, citrus plants
Clostridium	Grass *Miscanthus sinensis*
Clostridium aminovalericum	*Nicotiana tabaccum*
Desulfitobacterium metallireductans	*Thlaspi goesingense*
Paenibacillus odorifer	Sweet potato
Paenibacillus polymyx	Wheat, Lodeg pine, green beans,*Arabidopsis thaliana, Canola*
Paenibacillus sp.	*Alyssum bertolonii*
Staphylococcus saprophyticus	Carrot
Staphylococcus sp.	*Alyssum bertolonii*
Bacteroidetes	
Flavobacterium sp.	*Thlaspi goesingense*
Sphingobacterium sp.	Rice
Sphingobacterium multivorum	*Thlaspi caerulescens*
Actinobacteria	
Arthrobacter globiformis	Maize
Arthrobacter sp.	*Alyssum bertolonii*
Blastococcus sp.	*Thlaspi goesingense*
Curtobacterium flaccumfaciens	Citrus plants
Curtobacterium sp.	*Alyssum bertolonii; Thlaspi goesingense*
Kocuria varians	Marigold
Leifsonia	*Alyssum bertolonii*
Microbacterium esteraromaticum	Marigold
Microbacterium testaceum	Maize
Microbacterium sp.	*Brassica napus, Alyssum bertolonii*
Mycobacterium sp.	Wheat, Scots pine
Nocardia sp.	Citrus plants
Plantibacter flavus	*Thlaspi goesingense*
Propionibacterium acnes	*Thlaspi goesingense*
Rhodococcus sp.	*Thlaspi caerulescens, Thlaspi goesingense*
Streptomyces	Wheat
Streptomyces griseus	Kandelia candel
Streptomyces NRRL 30562	Kennedia nigriscans
Streptomyces NRRL 30566	Grevillea pteridifolia
Streptomyces sp.	*Monstera* sp.
Sanguibacter sp.,	*Nicotiana tabaccum*

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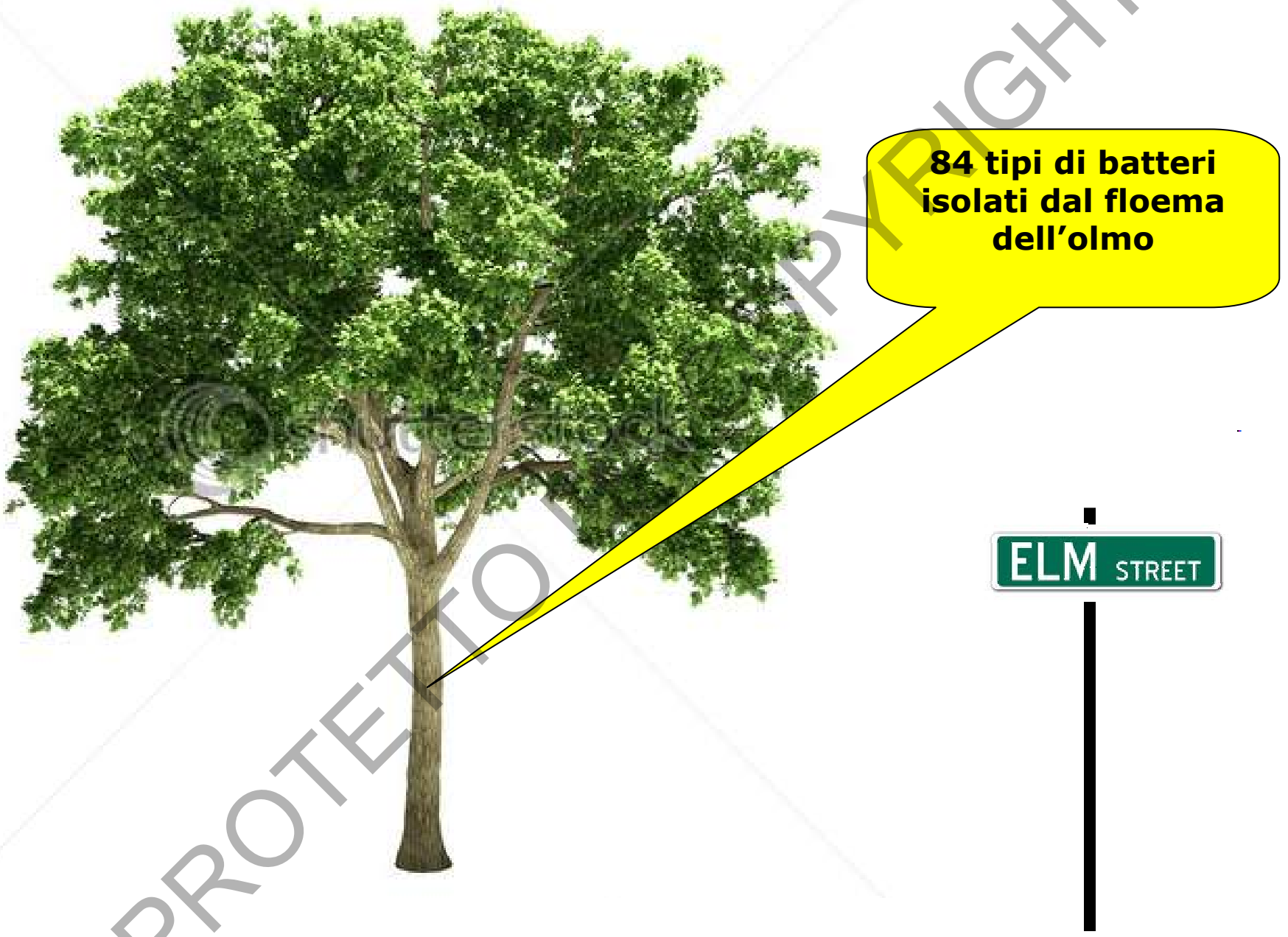

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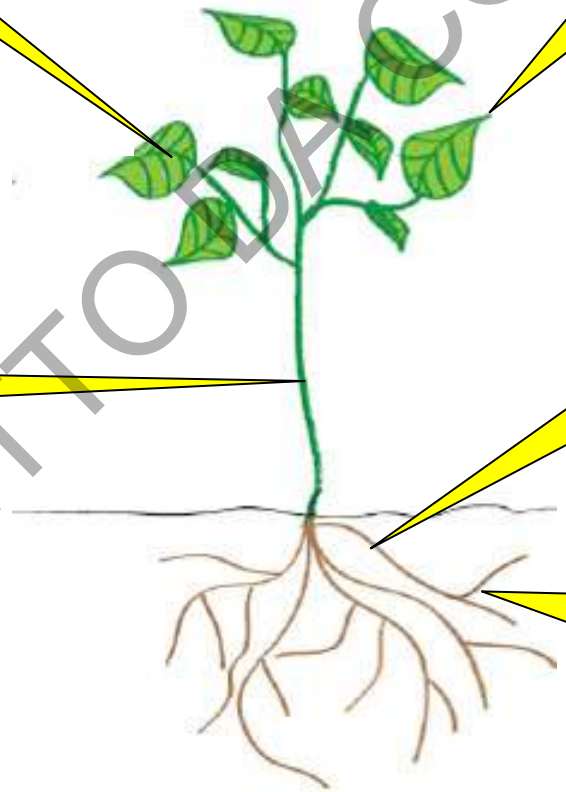
Perché le piante ospitano microorganismi?

Composti anti-erbivori

Disappetenza verso fitofagi

Ormoni vegetali (auxine, citokynine, acc deaminasi→ meno etilene)

+ crescita



Azotofissazione (rizobi e Frankia)

+ crescita

Composti anti fungini

+ protezione da funghi patogeni

Aumento efficacia assimilazione (funghi micorrizici)

+ crescita

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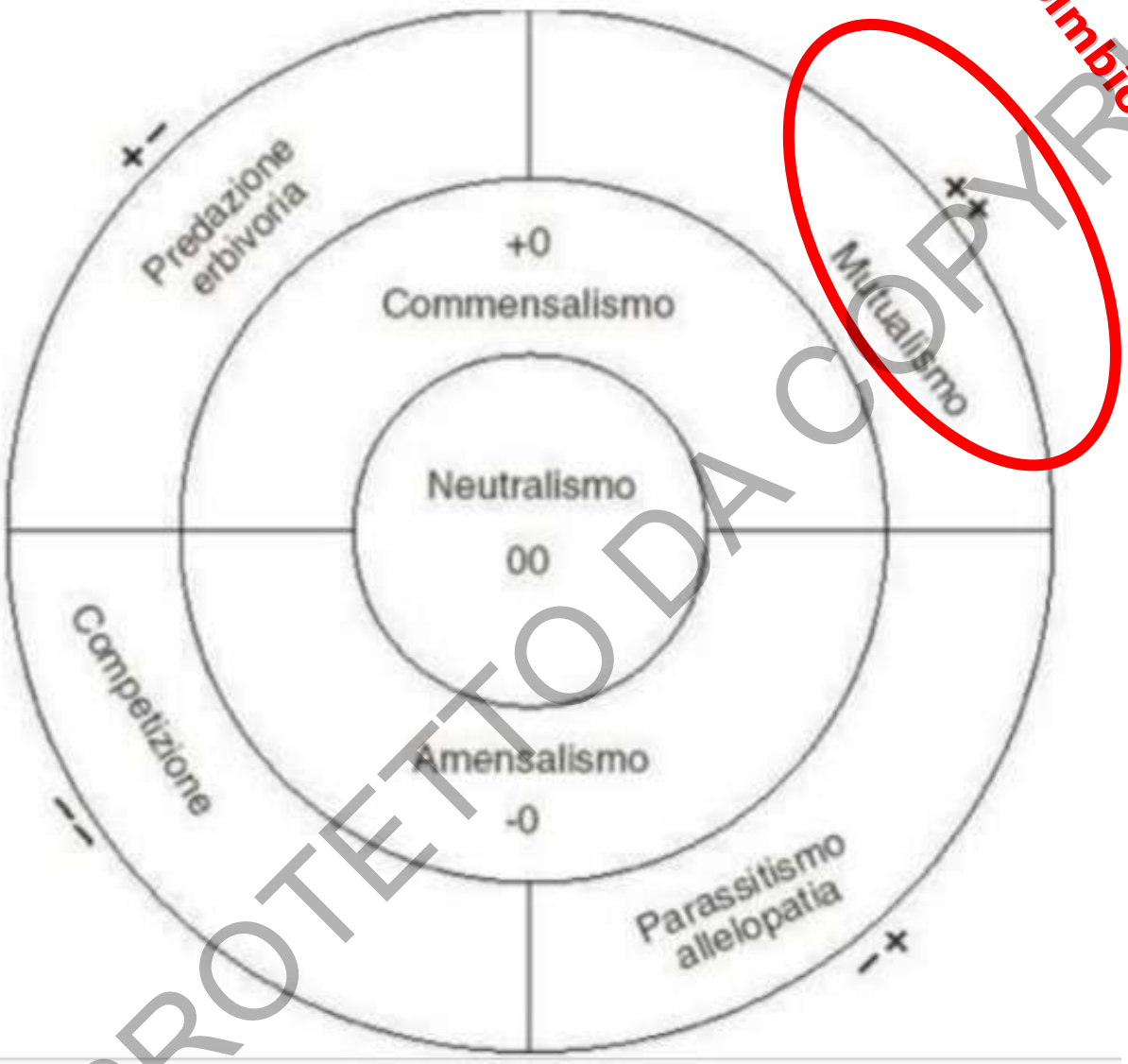
MODELLO COORDINATO DELLE INTERAZIONI TRA DUE POPOLAZIONI



La Simbiosi è solo qui ?

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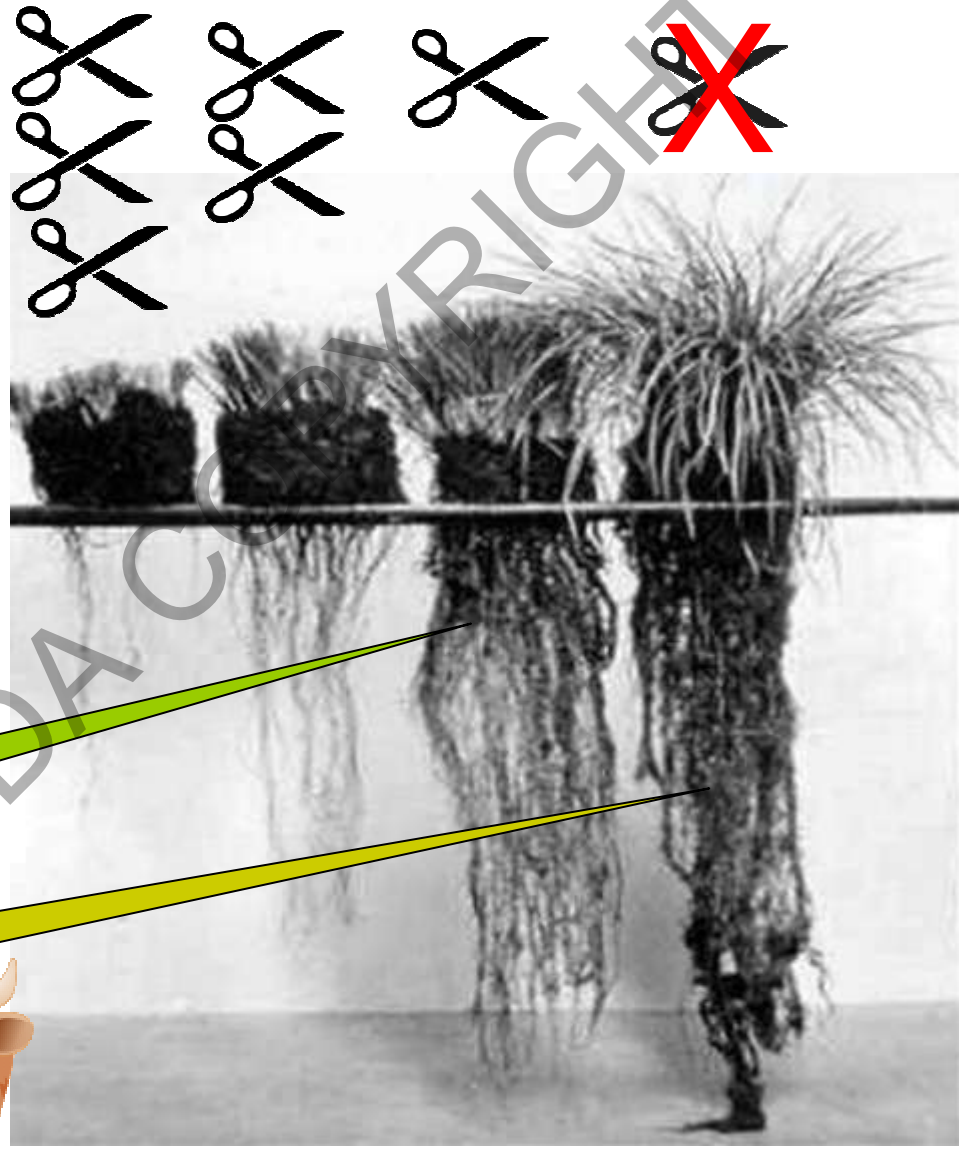
An experiment of selective leaf cutting

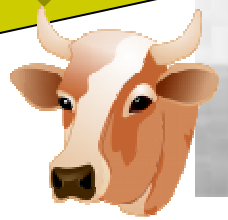
It shows that **root growth is a clear function of leaf growth**



if you cut leaves very short, the photosynthetic area will be limiting and roots will not be growing much.

The third plant is the optimum

The fourth has longer roots but bad signs (dark, dying/senescent roots)



That is why you need to adjust the **grazing frequency** and let plants grow enough to be able to produce exudates (liquid carbon) at the deep.
The good signs for roots are white colour and attached aggregates of soil and a pleasant fresh 'humus' smell

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America before 1492

The native tallgrass prairie features > 140 plant species

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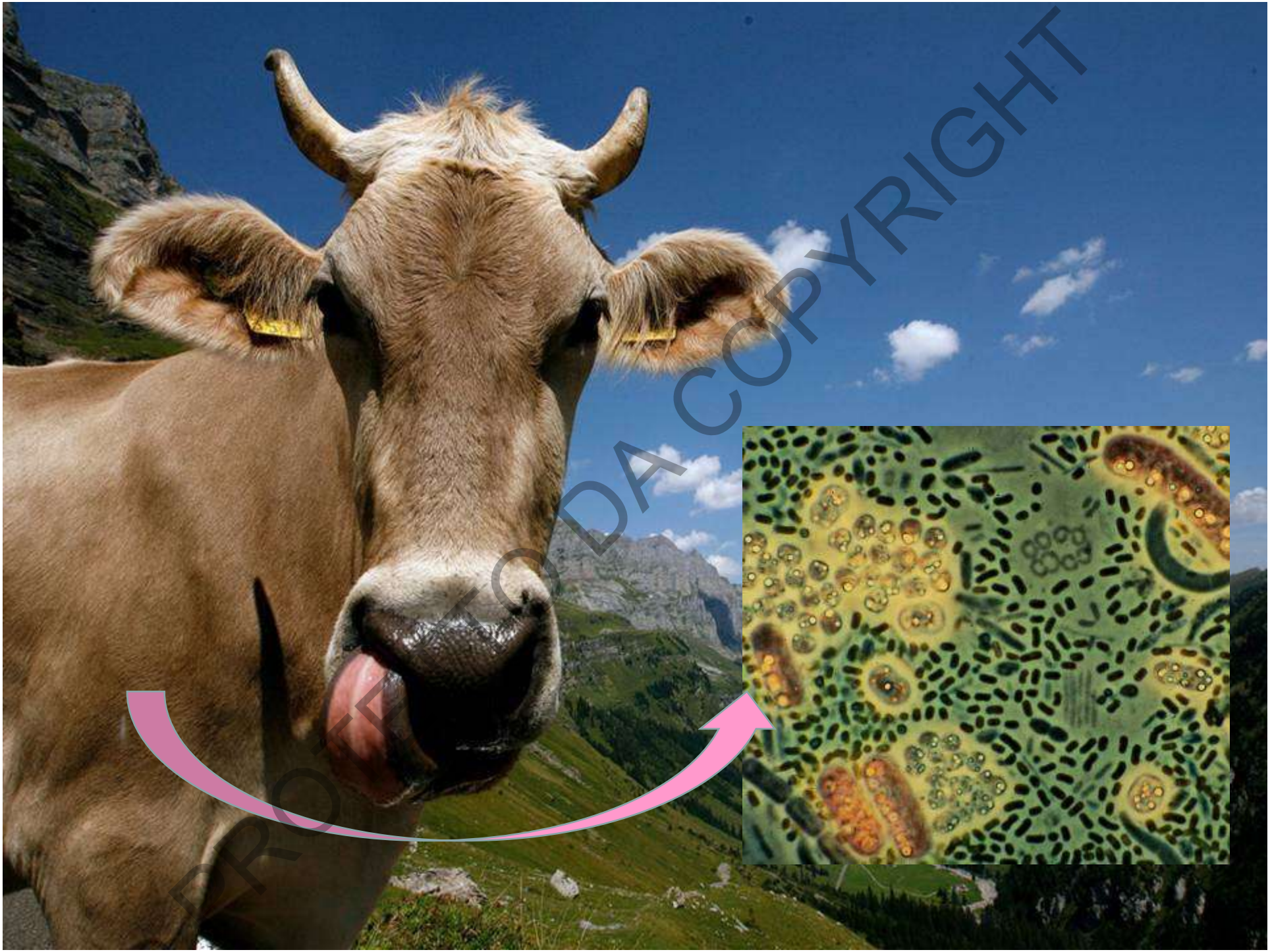

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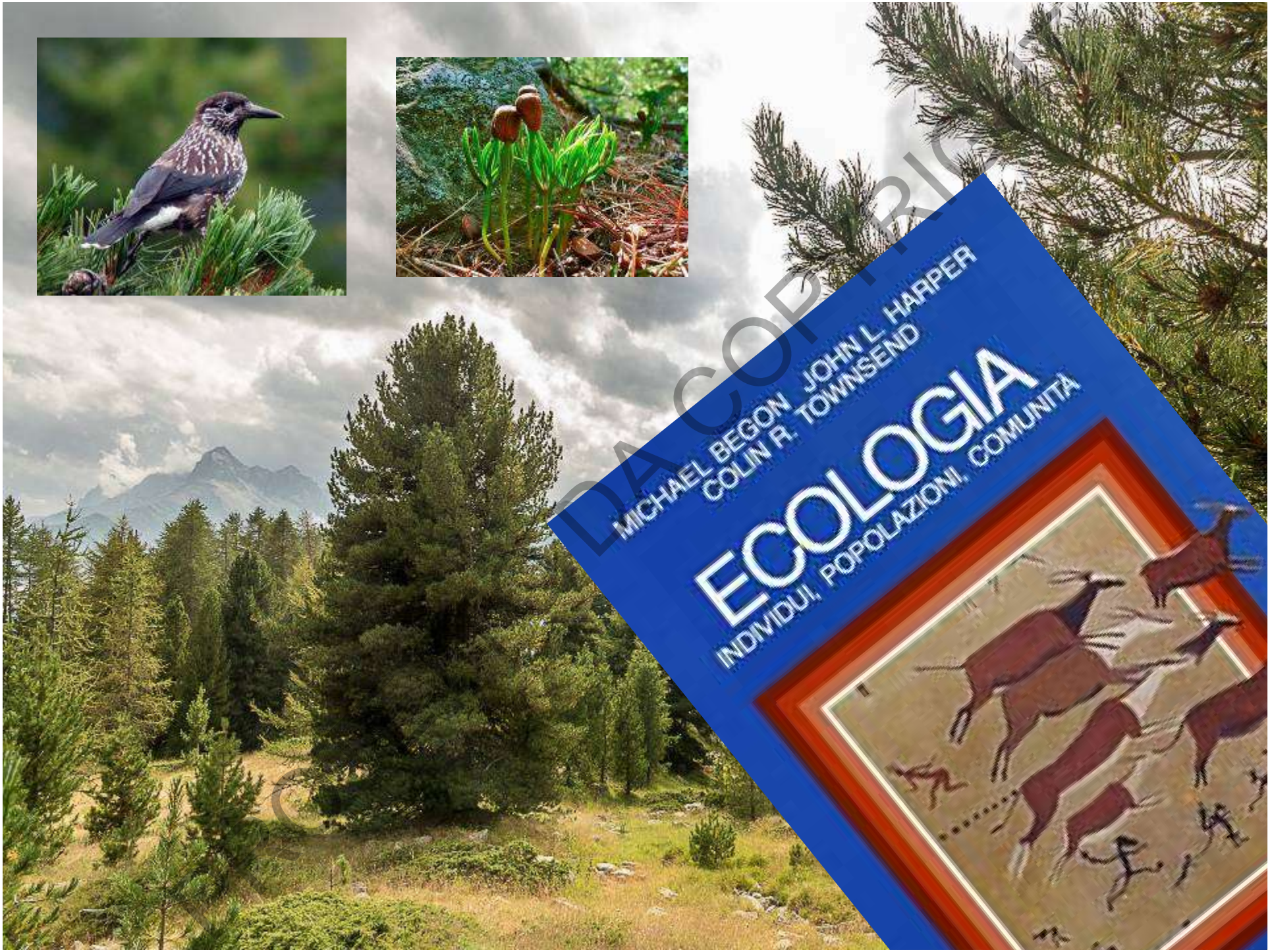
MICHAEL BEGON JOHN L. HARPER
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ECOLOGIA
INDIVIDUI, POPOLAZIONI, COMUNITÀ

Madre Natura ! Fa’ che la nostra **popolazione** sia sempre tutta giovane e sana !

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DIRITTO DA COPYRIGHT

TTO DA COPYRIGHT

Ops, quello era il **problema**, proviamo con la **soluzione…**

TUTTO DA COPYRIGHT

Nooo ! Non ci va ! Questi avranno pur effetto sulla **popolazione** ma LEDONO LE NOSTRE POSSIBILITA' A LIVELLO DI **INDIVIDUI** !!!

OGGETTO DA COPYRIGHT

NO COPYRIGHT