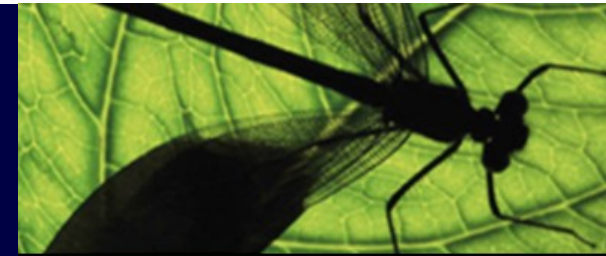


UNIVERSITÀ
DEGLI STUDI DI TRIESTE



BIOLOGIA AMBIENTALE

Laurea magistrale in
Ecologia e Sostenibilità
dei Cambiamenti Globali
- ESCG -

**Biomonitoring for environmental change
detection (6 CFU)**

Fabio Candotto Carniel, Mauro Tretiach
Dipartimento di Scienze della Vita

fcandotto@units.it

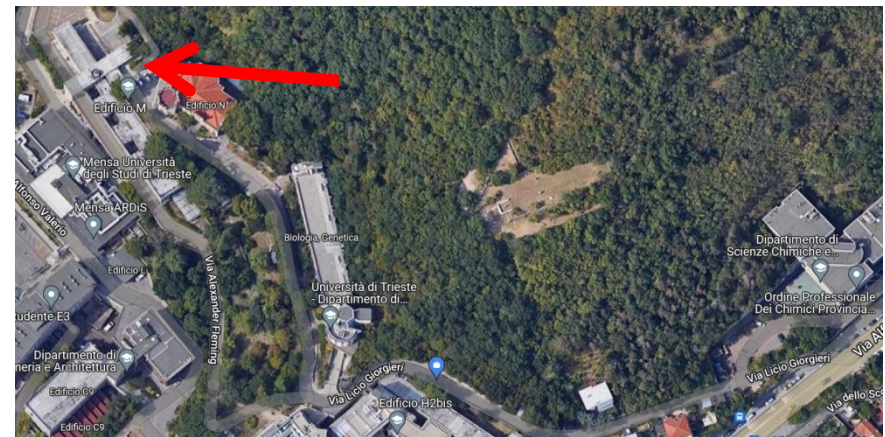
tretiach@units.it

Dr. Fabio Candotto Carniel



**Ricercatore
a tempo determinato B**

**Università di Trieste,
Dipartimento di Scienze della Vita,
via Licio Giorgieri 10,
34127 Trieste, Italia**



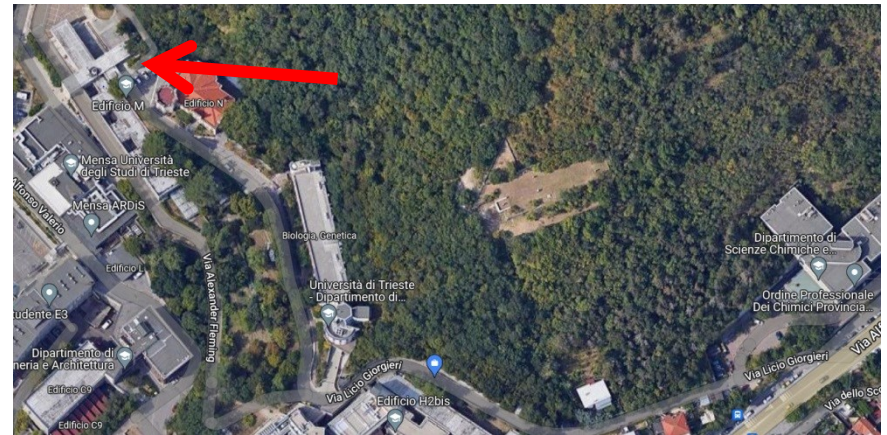
**Bld. M, first floor down,
room B/03
e-mail: fcandotto@units.it**

Prof. Mauro Tretiach

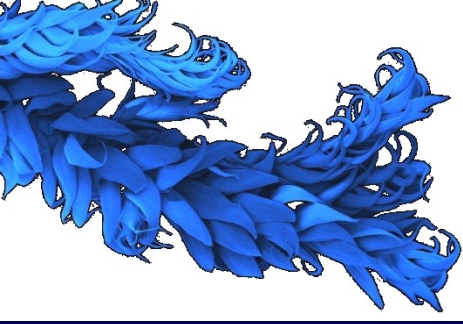


**Full Professor in General Botany
Director
of the Department of Life Sciences**

**Università di Trieste,
Dipartimento di Scienze della Vita,
via Licio Giorgieri 10,
34127 Trieste, Italia**



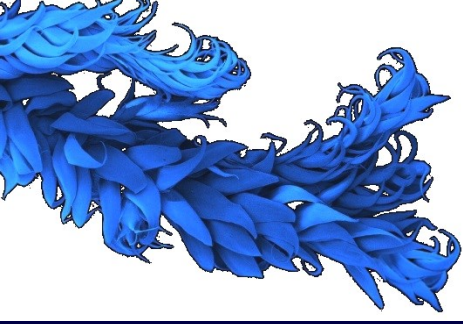
**Bld. M, first floor down,
room B/09
e-mail: tretiach@units.it**



Structure of this cycle of lessons:

Introduction (7 hours):

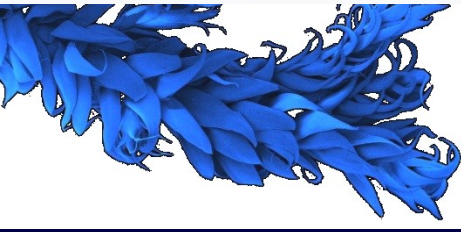
- Presentation
- Environmental change, how do we define it?
- Definition of Biomonitoring, with a short introduction to its history;
- Biomonitoring of environmental change: Why?
- Definitions of community, species populations, ecological niche, habitat, ecological indices;
- Factors that can alter the conditions of the species' habitats: climate (T° , water availability, precipitation, extreme events, etc.), pollution (xenobiotic substances), change in land use (urbanisation, habitat fragmentation, (de-)forestation, etc.);



Structure of this cycle of lessons:

Biomonitoring of past environmental changes (10 hours):

- Methodologies for describing past climate changes;
- Examples of past environmental/climatic changes (e.g. oxygenation of the planet; glaciations, interglacial periods);
- Paleobotany: environmental "treasures" of paleoclimatic information (peat bogs, freshwater sediments, glaciers);
- Palynology (time range – basic assumptions – methods and dating – pros and cons (?) - examples);
- Dendrochronology (time range – basic assumptions – methods and – examples);
- O and C isotopes.



Structure of this cycle of lessons:

Biomonitoring of current phenomena (5 hours):

Monitoring of biorhythm alterations (5 hours)

- Phenological changes in plant species: causes, monitoring and possible consequences for the environment and humans;
- Ornithologist (1 hour) biorhythm alteration and range modifications; (Mortelliti 1 hour) on wildlife biomonitoring

Altitudinal/latitudinal shifts (2 hours)

Modification in climate parameters (4 hours)



Structure of this cycle of lessons:

Evaluation of plant ecosystem functioning (5 hours):

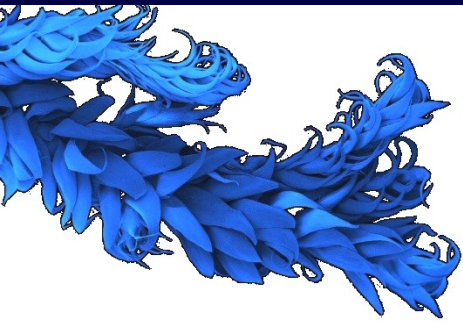
- Analysis of dynamics of carbon in the soil/ecosystem/atmosphere: Monitoring at different scales (3 hours);
- Analysis of dynamics of nutrient and pollutant exchanges in the soil/ecosystem/atmosphere: Monitoring at different scales (2 hours).

Pollution monitoring (15 hours)

- Why monitor air pollution? National and European (?) regulatory framework on pollution: legal and operational definitions; automated gauges of pollution recording (4 hours);
- Why monitor pollution with organisms? Identification of groups of sentinel organisms in the environment;
- Biomonitoring methods of air pollution using plant organisms (bioindication with lichens, tobacco etc...);
- Bioaccumulation through plant organisms (lichens, mosses etc.)
- Standardised protocols in the field of Lichen Bioindication and Bioaccumulation
- Bees as bioaccumulators/bioindicators of xenobiotics (Simone Tosi Seminar).

AT THE END.... Seminars by the students

Students will give a speech of 30 min. on topics they will have selected among the main arguments treated in the course, with special emphasis on the specific interest of the student. Each student will select three scientific papers, that will be discussed with the teachers in advance, and eventually integrated on the basis of the suggestions of the teachers. Then, the student will elaborate a presentation of c. ten to fifteen slides that will be commented upon in front of the class; questions by the colleagues and the teachers will follow.

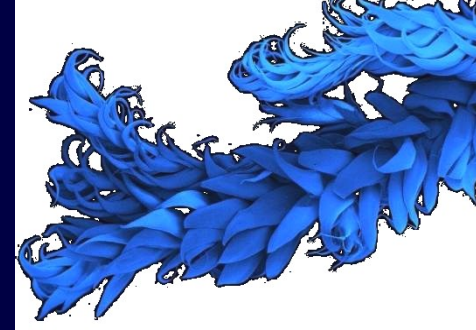


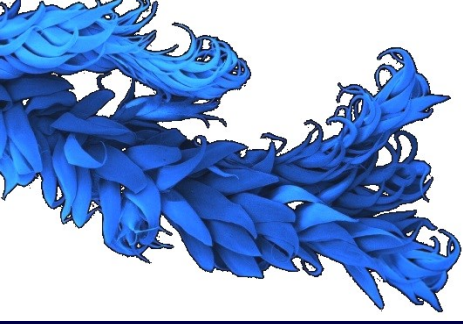
These were our (Fabio's & my) original ideas.

But....

When we started the discussion of a more detailed programme, we discovered «the pleasure of discussion» on lots of arguments, which are new for us. Therefore, we elaborated a new proposal: to try a new approach to teaching, more «participatory». This do not exclude notions given «*ex cathedra*», but we would like to increase your active participation. When possible, both teachers will be present at each lesson, to increase the exchange of ideas, derived from different point of views.

For this, also the location is important, and it is why we would like to sit around a table (although not a round table!). Unfortunately, there are also shortcomings, as follows...

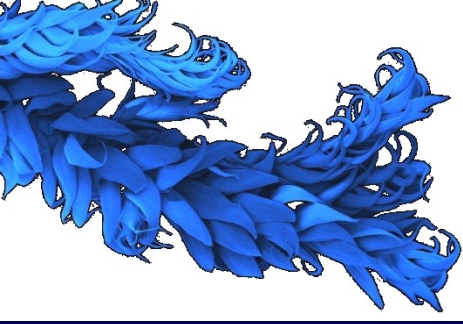




Materials for discussion & study is made available on Moodle.

Password needed.... **MONCC3TH**

Attention! Just a few minutes before each lesson we load the slides of the lesson given that day.



Lessons are recorded by
GOOGLE TEAMS.

The accession password is:

Biomon23*24!

Recording on TEAMS

We must face immediately a critical point....

According to the internal rules of UniTS, all the lessons must be recorded by Teams, and are available for at least 14 days to a maximum of one year.

BUT.... The recommendation is to stop the recording when there is a discussion, in which the students are requested to give their opinions.

NOW, our proposal is to maximise internal discussions, on whatever arguments. Lessons should be interactive, and we shall work for the success of such an approach. This is feasible if we do not need to interrupt recording every five (or less...) minutes.

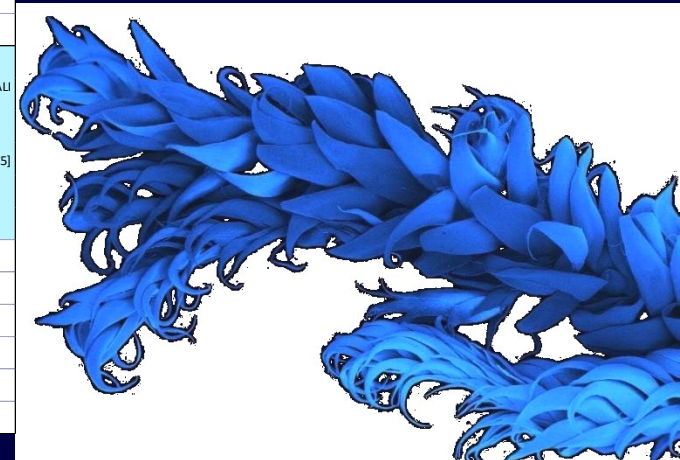
A possible solution is to declare that, aware of the sensitivity of the matter, you accept to be recorded when expressing your personal opinion, knowing that the recorded matter will be seen by people who are not physically present in the room, and that the recorded material could be circulated – albeit illegally.

If you agree on this, I ask to each of you to give a spontaneous declaration of *consensus* just now on.

[...]

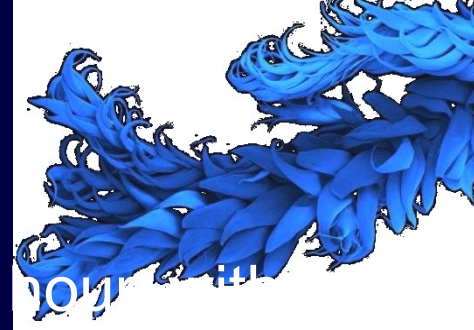
We would like to offer you also some practical activities, also thanks to some of our postdocs and PhD students. These activities are «NOT REQUIRED» for the admission to the final exam, but are an opportunity to make some practice and ... see the world.

	lunedì 02/10	martedì 03/10	mercoledì 04/10	giovedì 05/10	venerdì 06/10
08:00					
08:30					
09:00					
09:30	ENVIRONMENTAL STATISTICS AND MODELLING BACARO Giovanni Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 09:00 - 12:00	DIRITTO AMBIENTALE E DIRITTO DELL'IMPRESA BIANCA MASSIMO Aula A [Edificio M] 09:00 - 11:00			REMOTE SENSING OF ENVIRONMENTAL CHANGES - Laboratorio PETRUZZELLIS FRANCESCO Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 09:00 - 12:00
10:00		GEOGRAFIA DEI CAMBIAMENTI GLOBALI E CITTA' SOSTENIBILI BORRUSO GIUSEPPE Aula A [Edificio M] 11:00 - 13:00		ENVIRONMENTAL STATISTICS AND MODELLING BACARO Giovanni Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 11:00 - 13:00	
10:30					
11:00					
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12:00					
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13:00					
13:30					
14:00	ECONOMICS OF ECOSYSTEM SERVICES CARZEDDA MATTEO Aula 1 Meccanica Applicata [Edificio C5] 13:00 - 16:00	ECONOMICS OF ECOSYSTEM SERVICES CARZEDDA MATTEO Aula A [Edificio M] 14:00 - 16:00			GEOGRAFIA DEI CAMBIAMENTI GLOBALI E CITTA' SOSTENIBILI BORRUSO GIUSEPPE Aula 3 Meccanica Applicata [Edificio C5] 13:00 - 16:00
14:30				REMOTE SENSING OF ENVIRONMENTAL CHANGES - Lezioni PETRUZZELLIS FRANCESCO Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 14:00 - 16:00	
15:00					
15:30					
16:00		BIOMONITORING FOR ENVIRONMENTAL CHANGE DETECTION CANDOTTO CARNIEL, TRETIACH Mauro Aula A [Edificio M] 15:00 - 18:00			
16:30				DIRITTO AMBIENTALE E DIRITTO DELL'IMPRESA BIANCA MASSIMO Aula A [Edificio M] 16:00 - 19:00	
17:00					
17:30					
18:00					
18:30					
19:00					



Final Exam

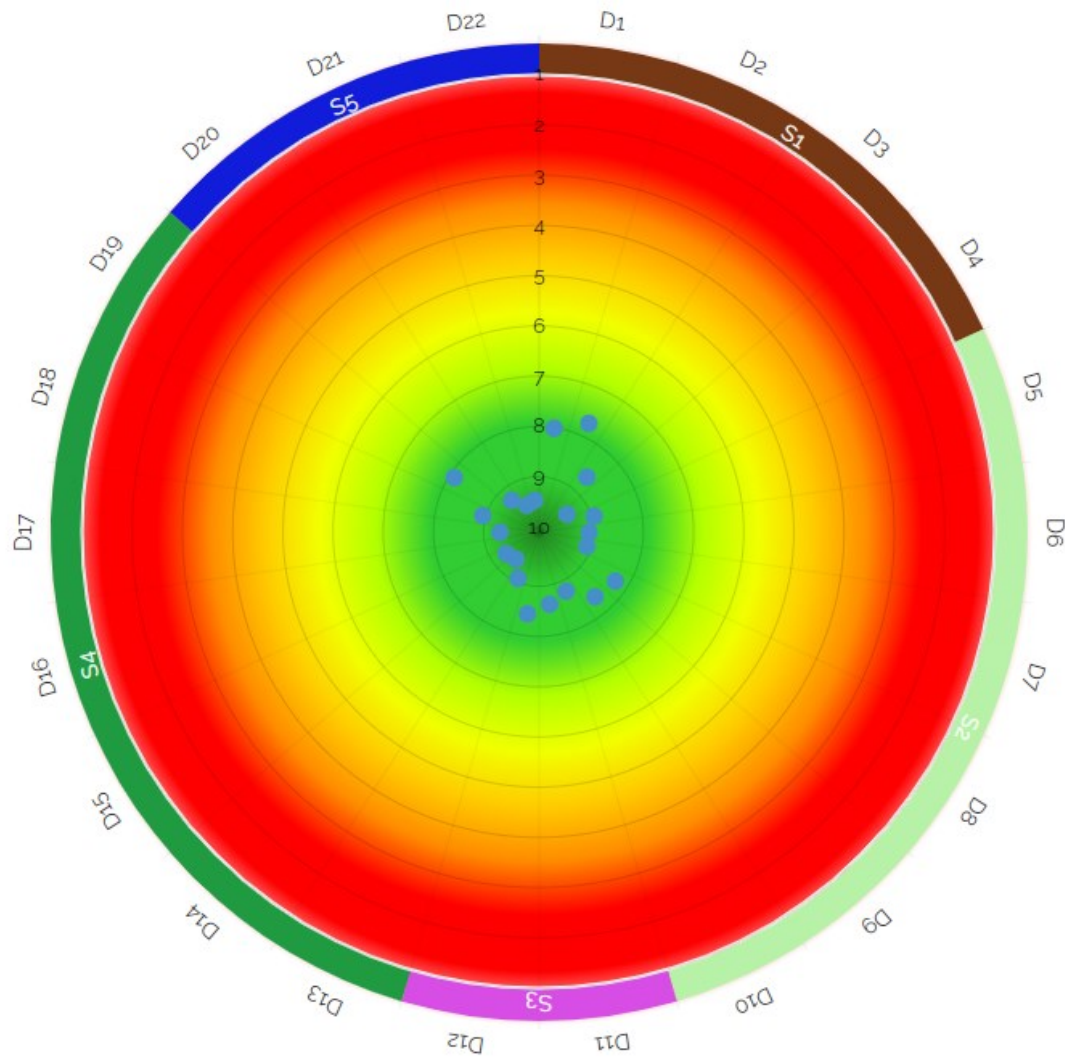
Oral exam on the entire program of about one the first question by drawing lots for one of the 48 lessons of the course, followed by others at fixed intervals (+6, 12 or 18) decided by the student h**self at the beginning of the exam.



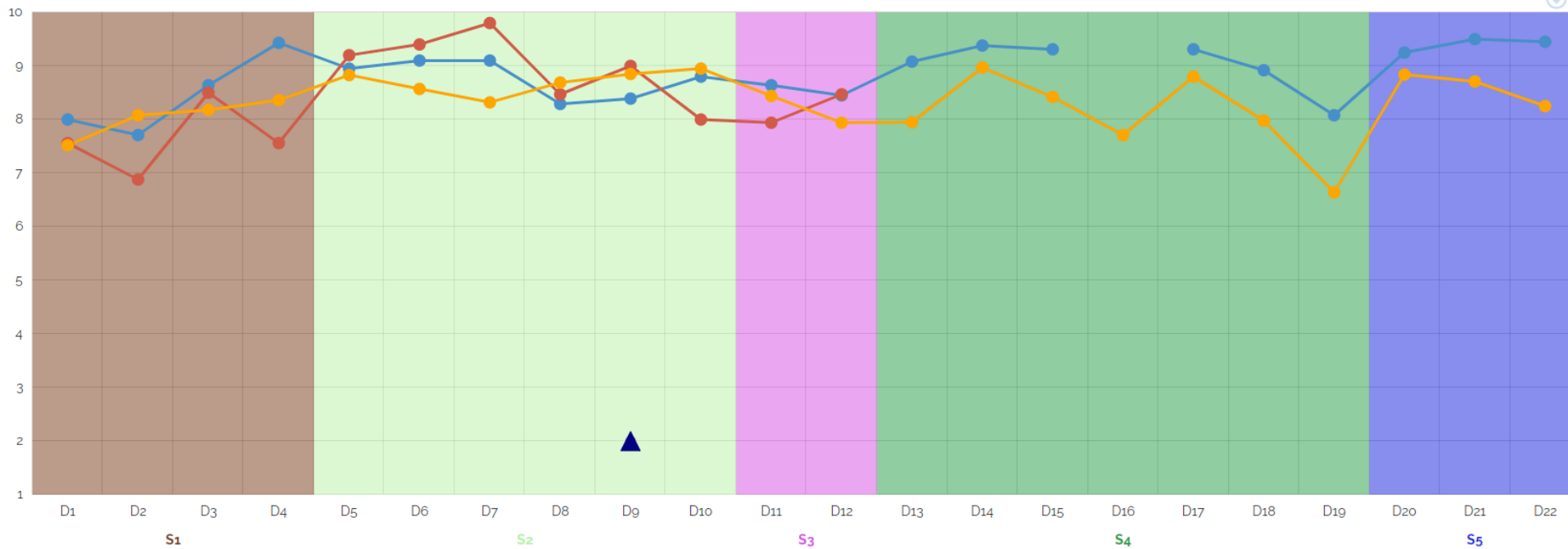
Biomonitors & friends...



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Biomonitors & friends...



■ integrare con attività su campo o in laboratorio, ovviamente covid permettendo.

Questo corso AA 2020-21 —

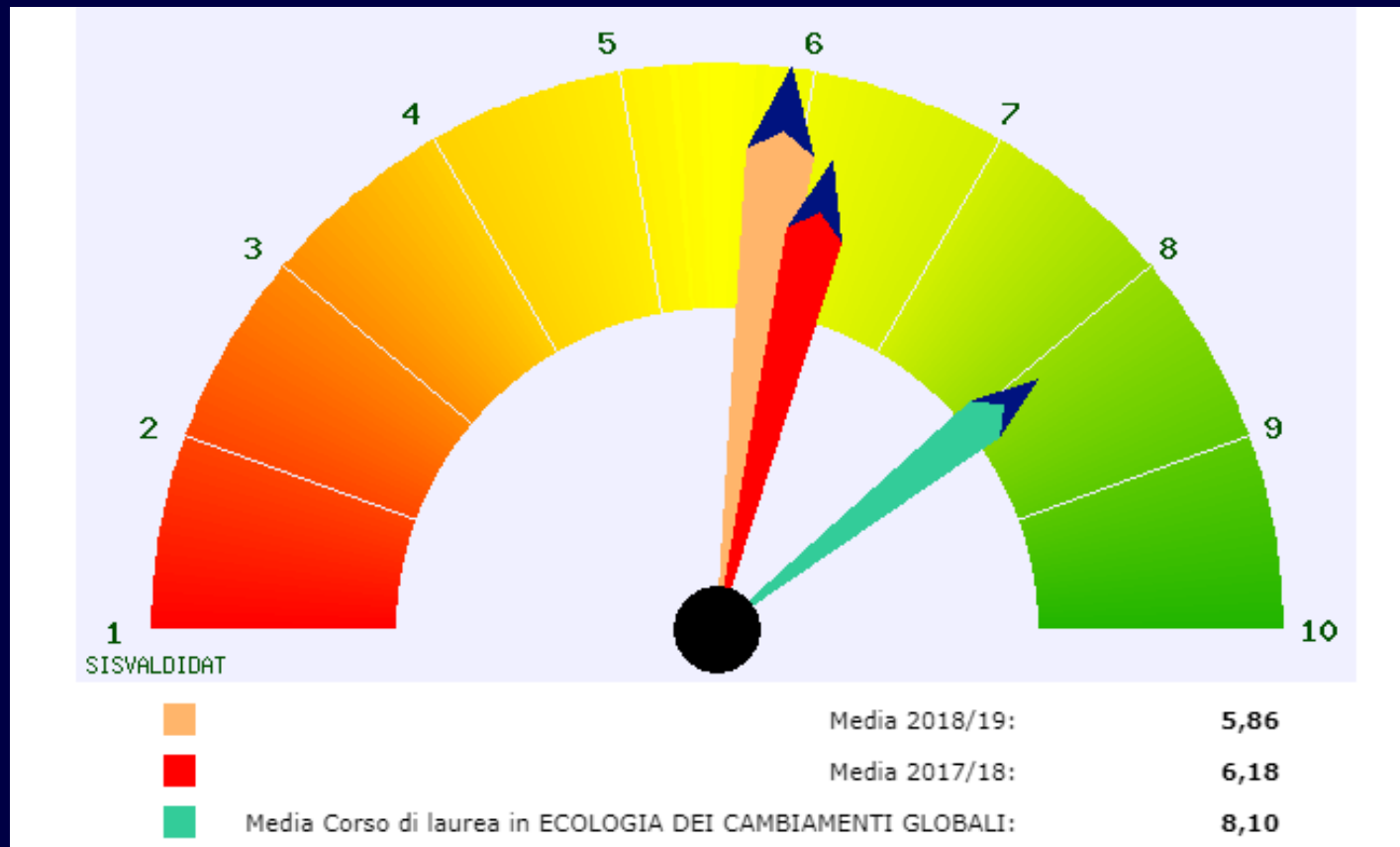
Questo corso AA 2019-20 —

Tutti i corsi di ECG 2020-21 —

Biomonitors & friends...



Study Load



B1-2 presentazione; modalità desame; inquinamento 10 02 (2).ppt [modalità compatibilità] - Microsoft PowerPoint

Corso: 631SM-1 - BIOMONITORAGG x Dipartimento di Scienze della Vita x

Non sicuro | dsv.units.it

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Dipartimento di Scienze della Vita

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Attività editoriale
Attività congressuale


Biomedicina
Biologia Ambientale
Psicologia

Trieste Symposium on Perception and Cognition e il

18
21

Plant and animal ecophysiology

Research Area: Environmental Biology



Agrotur II (2014 - 2020)

○ ○ ○ ○ ● ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

DIPARTIMENTO DI SCIENZE DELLA VITA

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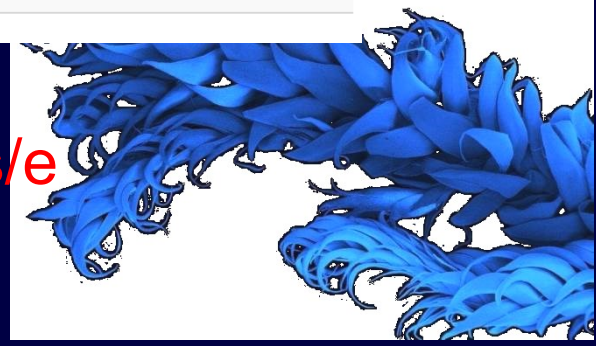
Research Groups

- Plant physiological ecology (Prof. Nardini)
- Animal physiological ecology (Prof. Giulianini)
- Biology of lichen symbiosis (Prof. Tretiach)

dsv.units.it/ricerca/ambiti/biologia-ambientale



<https://dsv.units.it/en/research/researchareas/environmental-biology?q=en/node/18749>



<https://dsv.units.it/en/research/researchareas/environmental-biology?q=en/node/18749>

BIOLOGY of LICHEN SYMBIOSIS



UNIVERSITÀ
DI TRIESTE



Mauro Tretiach,
Prof.



Fabio Candotto Carniel,
PhD, Senior Post-Doc



Humberto
Castillo-Gonzales
MSc, Post-Doc

Giada Caorsi,
MSc, PhD student



Enrico Boccato,
MSc, PhD student



Nida Zaib, PhD
student



Ceseri Sofia, PhD
student



Our studies are focused on the following main themes:

- 1) Revision of critical taxa of the European lichen flora, and floristic research;
- 2) Ecophysiology and biology of lichens;
- 3) Biomonitoring with lichens.
- 4) Ecotoxicology of nanomaterials

Biomonitoring & friends...



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In the years, a good, satisfactory settlement has been reached between basic and applied research, a sort of virtuous loop where discoveries from **Systematics**, **Physiology** and **Ecology** are immediately integrated in the applicatory field of **Environmental Biomonitoring**. The latter sustains a large part of the cost of the former activities, thanks to a number of contracts with private and public companies.

Most of these activities are developed with students, and are treated within teaching courses of the Magistral Degree in Global Change Ecology.

Biomonitors & friends...

Systematics

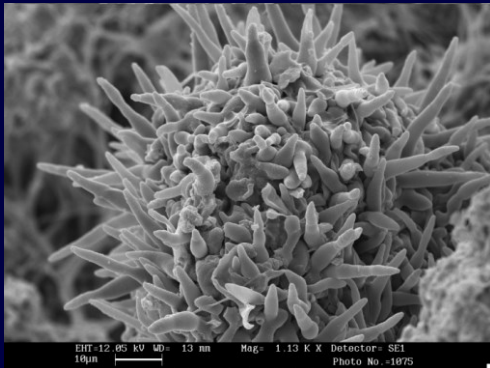
Ecophysiology

Biomonitoring



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Basic researches in the field of **Systematics** mainly concern the critical revision of problematic taxa and the description of new species, based on the field collection of specimens, often in beautiful landscapes.



Biomonitors & friends...

Systematics

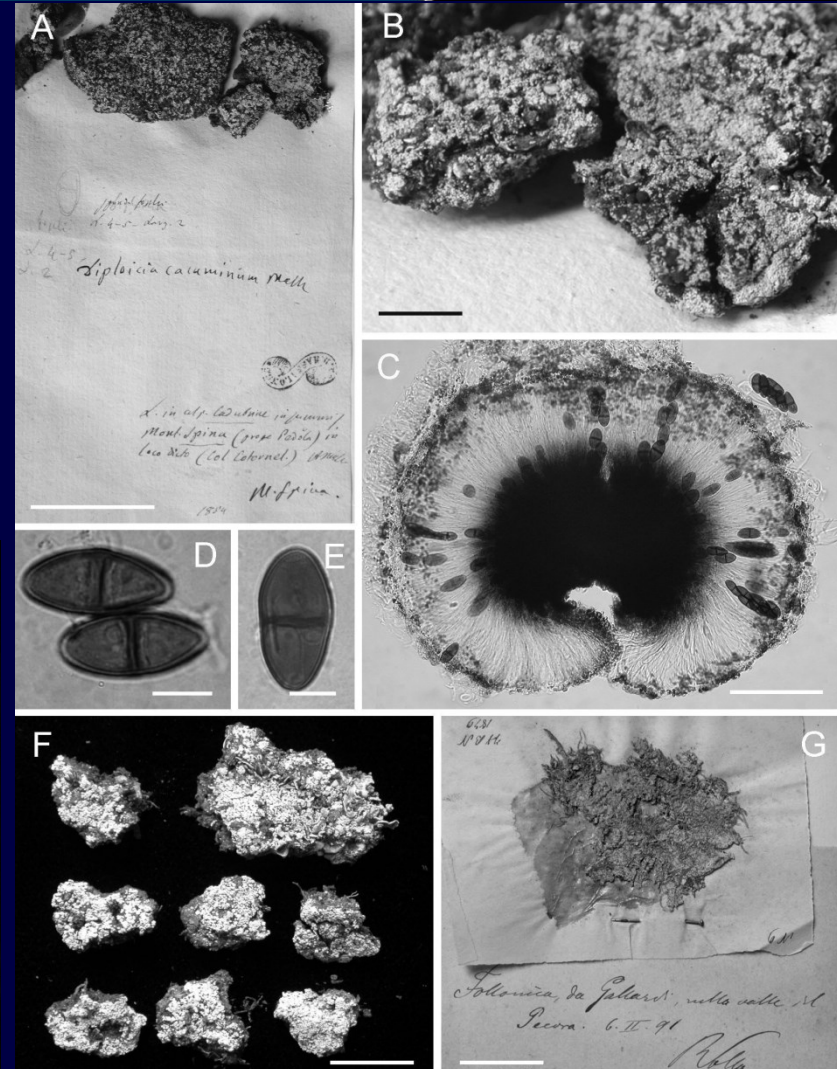
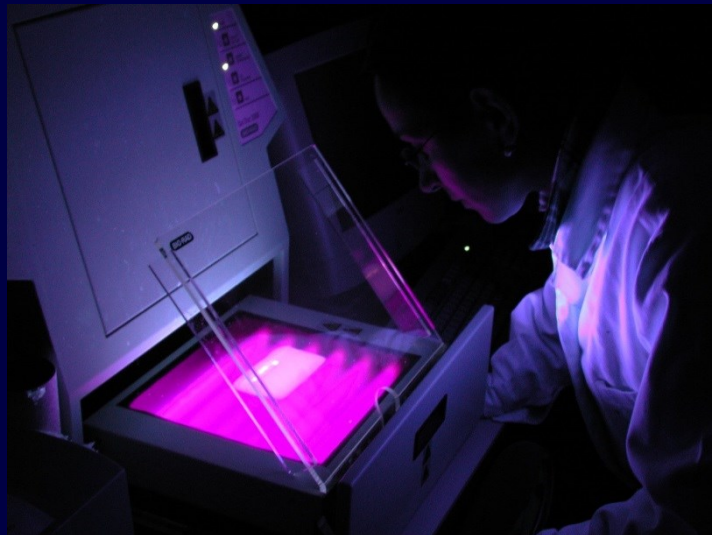
Ecophysiology

Biomonitoring



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Traditional, morpho-anatomical studies, eventually integrated by SEM and TEM observations, are implemented with DNA sequencing of both myco- and photobionts. Phylogenetic trees are built up, and compared with the morphological ones.



Biomonitors & friends...

Systematics

Ecophysiology

Biomonitoring



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New arrangements are proposed, always based on the study of type materials that needs hard work in historical collections.



72

Nova Plantarum

D I S T R I B U T I O X I.

*Planta flore apetalò, astemone, seu apode, apice, aut po
capsulâ singulari constante, sed sterili, cujus embryo ab
in fructum multicapsularem.*

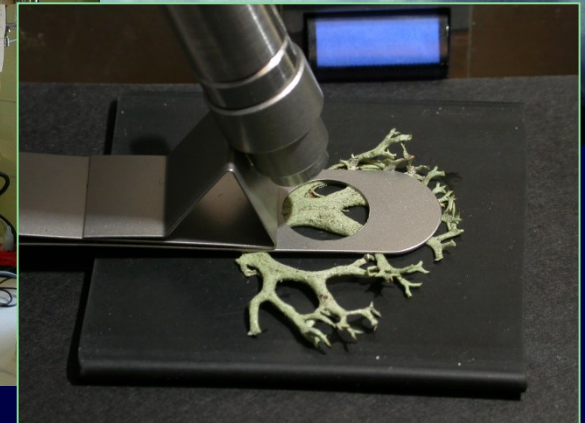


Biomonitors & friends...

Systematics
Ecophysiology
Biomonitoring



Basic researches in the field of **Ecophysiology and Biology** mainly concern photosynthetic activity in dependence to environmental factors (also pollutants) and photobiont characteristics.



Biomonitoring & friends...

Systematics
Ecophysiology
Biomonitoring

The most recent researches were aimed at describing:



1. the factors affecting chlorophyll a fluorescence in species of foliose and crustose lichens, along ecological gradients;
2. the reproductive cycles within the green algal genus *Trebouxia*, the most common photobiont of the lichen symbiosis, and the interplay between germinating ascospores and algal zoospores for the resynthesis of the lichen symbiosis;
3. the discovery of WHAT, a new devitalization technique for the eradication of biodeteriogens of open-air monuments.

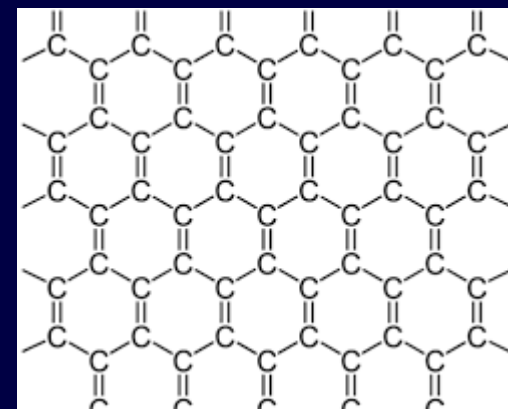
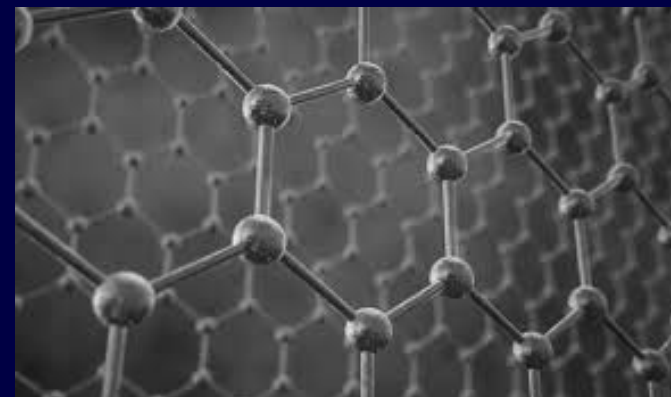
Biomonitors & friends...

Systematics
Ecophysiology
Biomonitoring



Fabio later will introduce our research in the field of ecotoxicology of 2D-nanomaterials, starting from **Graphene Related Materials, GRMs**.

Fabio will describe in many details these activities, better than I can do, because he was the reference person for all the researches of our group on this topic.



Biomonitoring & friends...

Systematics
Ecophysiology
Biomonitoring



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Biomonitoring with lichens and mosses is one of the traditional, main activities of our group.

In co-operation with other national and international research centres, researchers of our Department developed new methodological approaches, experimental protocols, and guidelines approved by national authorities (e.g. ISPRA).

These activities are supported by dozens of applicatory studies, carried out by appointment of public and private companies.

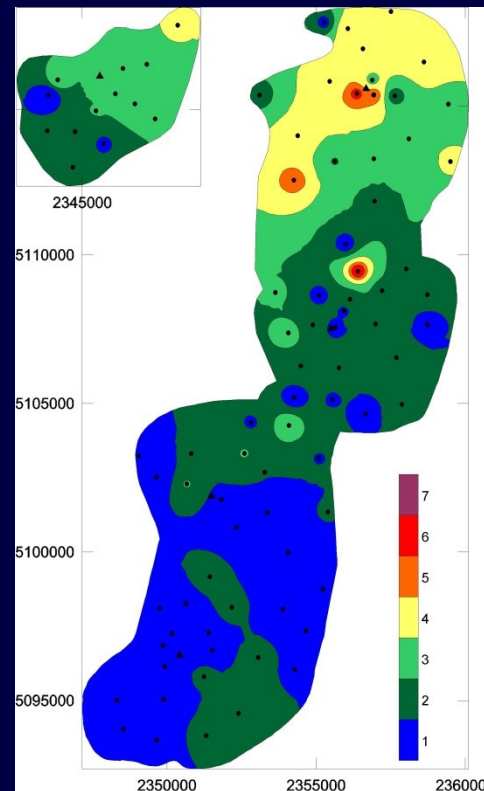
Biomonitors & friends...

Systematics
Ecophysiology
Biomonitoring

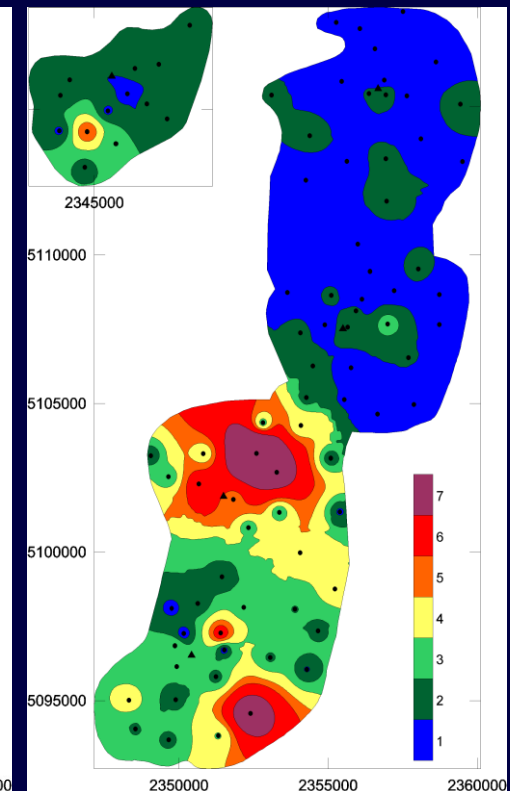


With native and transplanted cryptogams it is possible to get in short times, at low cost, and with a high sampling density, distribution maps of airborne persistent pollutants, e.g. trace elements, such as mercury (left) and copper (right).

Mercury



Copper



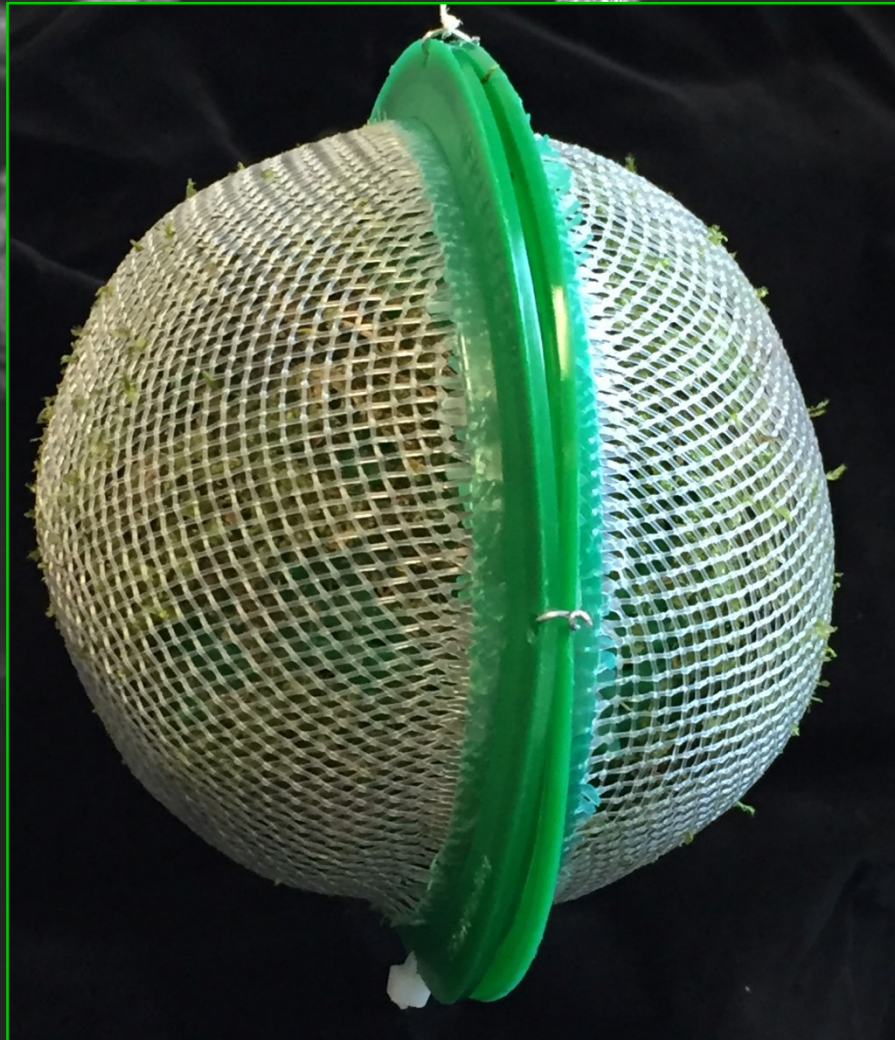
- Due progetti nazionali finanziati dal MIUR (PRIN 2004 e 2008) - sono stati focalizzati sugli effetti del PM₁₀ sulla vitalità di campioni biologici trapiantati e sulla valutazione di fattori biotici e abiotici che influenzano il processo di bioaccumulo;
- un terzo PRIN (2010) finalizzato allo studio dei meccanismi che proteggono i licheni dall'ozono;
- Tra il 2012 e il 2014, il gruppo di ricerca è stato coinvolto nel progetto EU FP7 MOSSCLONE, finalizzato a mettere a punto e testare un metodo nuovo ed economico per monitorare la contaminazione dell'aria, in particolare da metalli pesanti e IPA, mediante un clone devitalizzato di sfagno, che viene utilizzato come sensore di contaminazione passiva quando esposto in un dispositivo di nuova generazione, la «**mossphere** ©»

Biomonitors & friends...

Systematics
Ecophysiology
Biomonitoring



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...this small ball, made of a plastic net, contains a moss or lichen sample. It is used to measure trace metal and PAHs deposition in areas where native mosses and/or lichens are missing.

In the last five years we promoted and carried out:

- A project aimed at defining *background* values at national level for a lichen frequently used in transplants;
- Standardisation of new protocols for the use of lichens as bioaccumulator of potentially toxic elements (PTE).



This year we worked for establishing a new International Association for Biomonitoring of Environmental Pollution – IABEP.

The fundative congress will be held next week here in Trieste, and you are «kindly» invited to participate (!).

IABEP 2023 (11-13 October 2023)

[Home](#) [Programme](#) [IABEP](#) [Venue](#) [How to arrive](#) [Contacts](#)

<http://dryades.units.it/IABEP2023/index.php>



comune di trieste

Organized with the contribution of



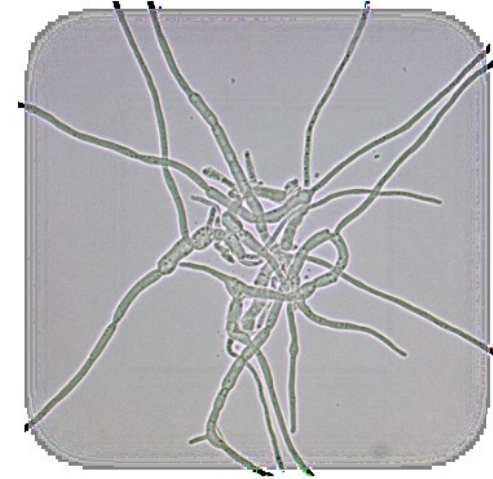
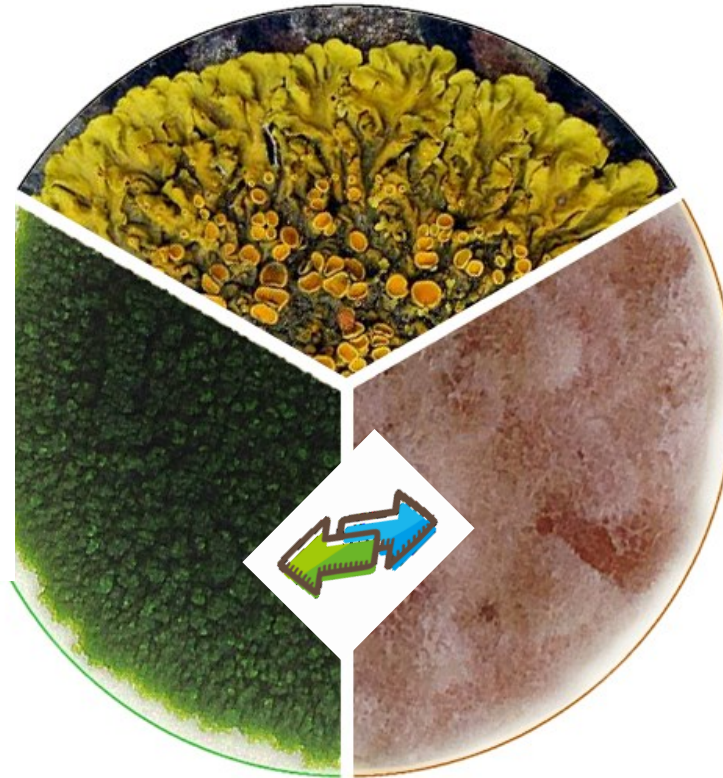
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Dipartimento di
Scienze della Vita



Base research: Lichens = symbiosis between a algae (or cyanobacteria) and a fungus



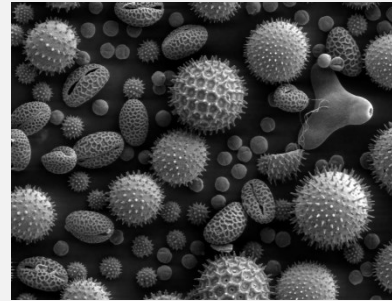
First symbiosis ever described – still little knowledge on the «lichenization» process (transition from a free-living to a symbiotic state) - What chemical interactions trigger and drive this process?

Desiccation tolerance

«Ability to survive **complete desiccation** (< 10% water content) and return to a normal metabolism when water is newly available»



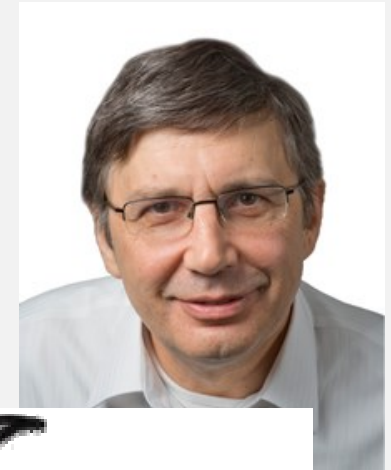
Typical of species, (phylogenetically distant) that thrive in macro- or micro-environments characterized by scarce or unpredictable water availability, or of developmental stages such as pollen, seeds or larvae



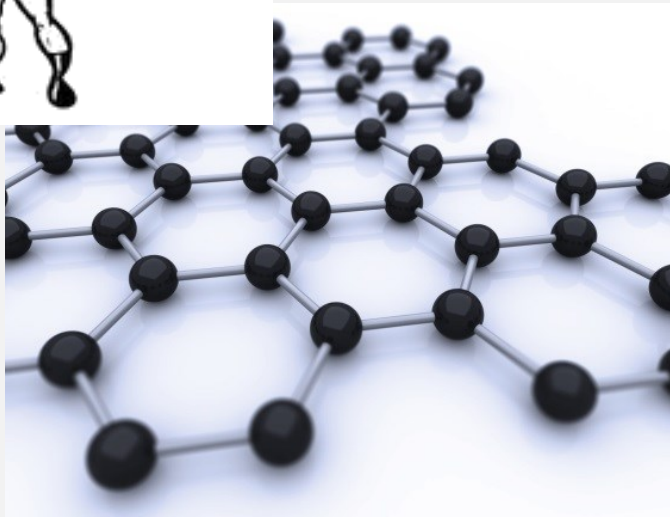
Can live almost everywhere: extremotolerant and extremophilous



Applied research => Environmental impact and fate of Graphene



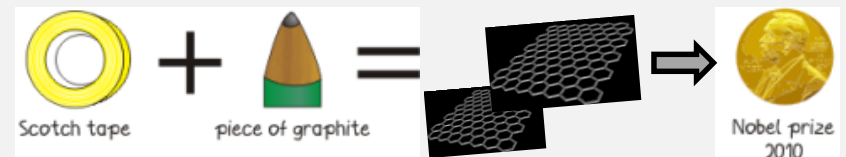
What is graphene?



“A two-dimensional crystal composed of monolayers of carbon atoms arranged in a honeycombed network with six-membered rings.”

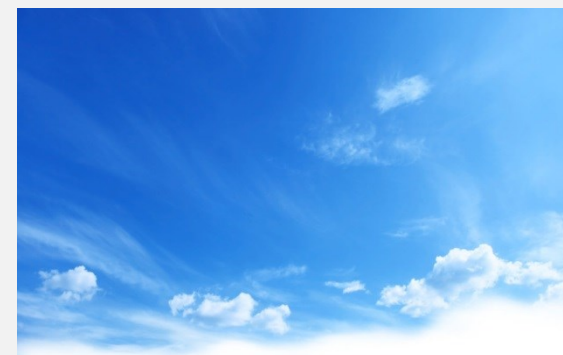
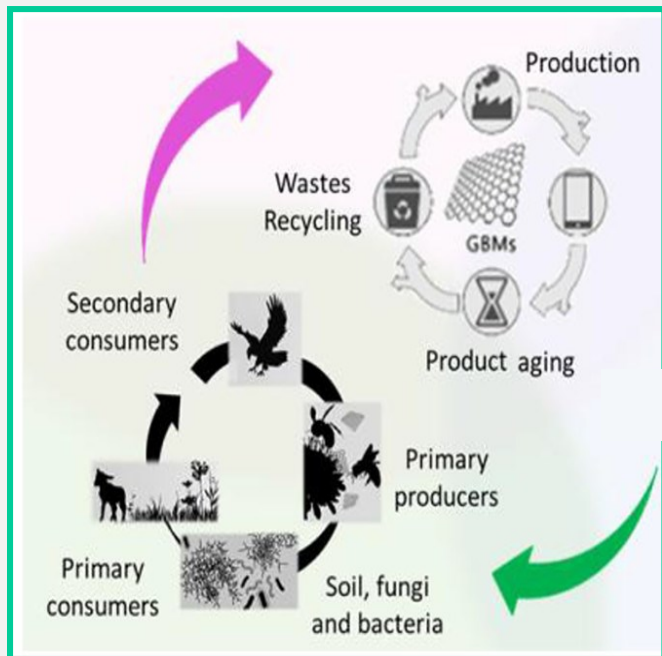
Geim, AK (2009) Science. 324: 1530-1534

2004 – extracted the first monoatomic layer



Thanks to the **extraordinary chemical-physical properties** graphene can be applied to a wide range of applications

Graphene life cycle and possible fates



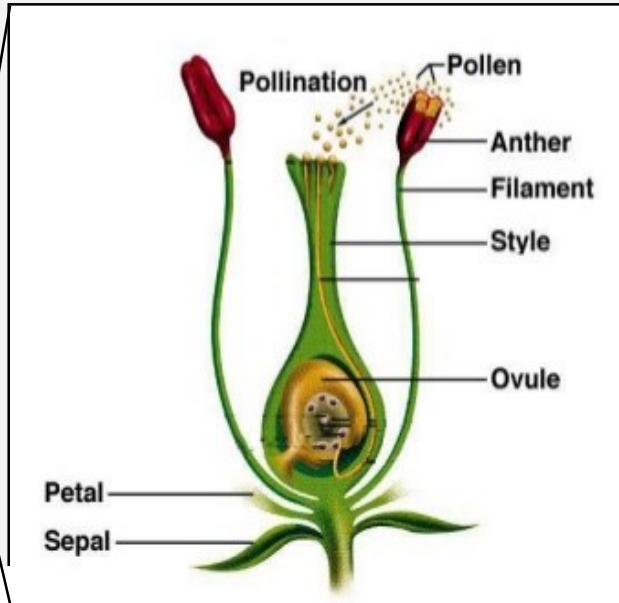
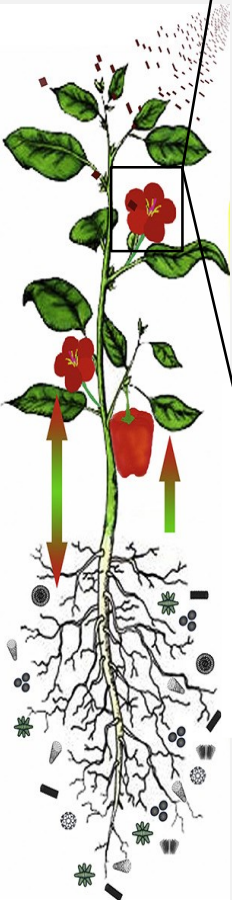
ACS Nano 2018, 12, 10582–10620

POTENTIAL EMERGING POLLUTANT

Environmental impact: Graphene effects on seed plants

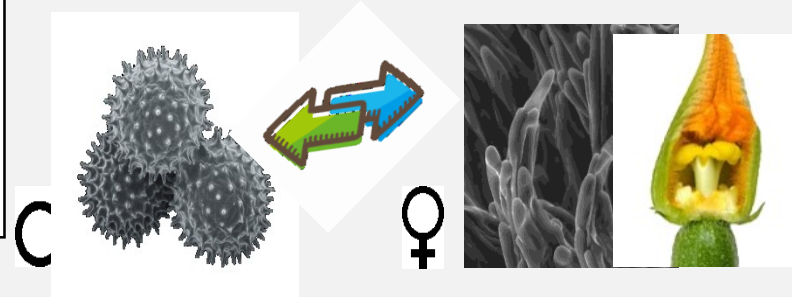
Impacts of carbon nanomaterials (CNMs)

Seed germination, plant growth, development, toxic or no responses



Sexual reproduction of seed plants:

- ❖ It is a delicate process
- ❖ xenobiotic substances can impair it



Aim: verify if GRMs can affect the sexual reproduction of seed plants

Environmental fate:

Biodegradability of GRMs

Do GRMs get degraded in terrestrial environments by primary decomposers?

Basidiomycetes

Ascomycete



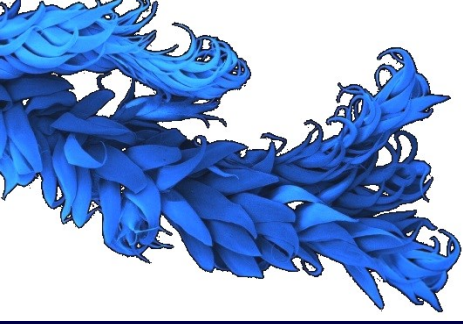
Bjerkandera adusta



Phanerochaete chrysosporium



Morchella esculenta



Now it's your time to tell something on your CV...

Our questions are:

- (a) How many are from UniTS, how many from other Univs.;
- (b) How many biologists, and how many naturalists, how many «others...»;
- (c) Your knowledge on specific matters, such as Environmental chemistry; Environmental law; «Geology and related matters» etc...
- (d) Special interests, with emphasis on (i) phenomena; (ii) groups of organisms (ex. vascular plants, birds, insects, Nematoda...); (iii) readings and social activities.
- (e) Thesis.

Last practical argument:
Your possible participation to the fundative congress of the
International Association for Biomonitoring of
Environmental Pollution – IABEP, that will be held next
week here in Trieste.

IABEP 2023 (11-13 October 2023)

Home

Programme

IABEP

Venue

How to arrive

Contacts

<http://dryades.units.it/IABEP2023/index.php>



comune di trieste

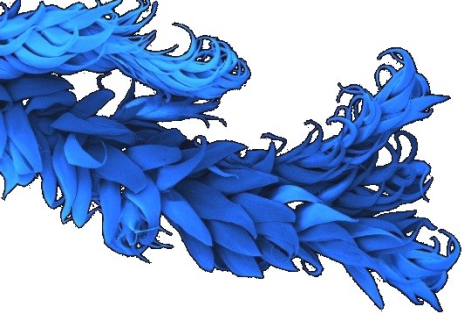
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Dipartimento di
Scienze della Vita



	lunedì 02/10	martedì 03/10	mercoledì 04/10	giovedì 05/10	venerdì 06/10
08:00					
08:30				<h1>IABEP</h1>	
09:00					
09:30	ENVIRONMENTAL STATISTICS AND MODELLING BACARO Giovanni Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 09:00 - 12:00	DIRITTO AMBIENTALE E DIRITTO DELL'IMPRESA BIANCA MASSIMO Aula A [Edificio M] 09:00 - 11:00			
10:00					
10:30		GEOGRAFIA DEI CAMBIAMENTI GLOBALI E CITTA' SOSTENIBILI BORRUSO GIUSEPPE Aula A [Edificio M] 11:00 - 13:00			
11:00					
11:30					
12:00					
12:30					
13:00					
13:30	ECONOMICS OF ECOSYSTEM SERVICES CARZEDDA MATTEO Aula 1 Meccanica Applicata [Edificio C5] 13:00 - 16:00		<h1>IABEP</h1>		GEOGRAFIA DEI CAMBIAMENTI GLOBALI E CITTA' SOSTENIBILI BORRUSO GIUSEPPE Aula 3 Meccanica Applicata [Edificio C5] 13:00 - 16:00
14:00		ECONOMICS OF ECOSYSTEM SERVICES CARZEDDA MATTEO Aula A [Edificio M] 14:00 - 16:00			
14:30				REMOTE SENSING OF ENVIRONMENTAL CHANGES - Lezioni PETRUZZELLIS FRANCESCO Aula Informatica 3A [Edificio H2, H2bis (e colleg. con H3)] 14:00 - 16:00	
15:00					
15:30					
16:00		BIOMONITORING FOR ENVIRONMENTAL CHANGE DETECTION CANDOTTO CARNIEL, TRETIACH Mauro Aula A [Edificio M] 16:00 - 18:00			
16:30					
17:00					
17:30					
18:00				DIRITTO AMBIENTALE E DIRITTO DELL'IMPRESA BIANCA MASSIMO Aula A [Edificio M] 16:00 - 19:00	
18:30					
19:00					

ENVIRONMENTAL CHANGE: HOW DO WE DEFINE IT?

