



Consiglio Nazionale delle Ricerche



Istituto di Chimica Biomolecolare

# Microalghe marine per la produzione di biomasse, prodotti e commodities

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**Energia Luminosa**

**Energia Chimica**  
(materia organica)

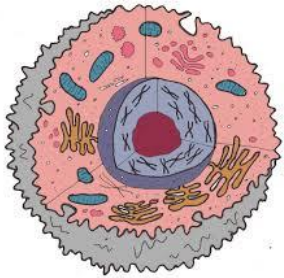
da **30'000** a **1'000'000**

**specie di microalghe**

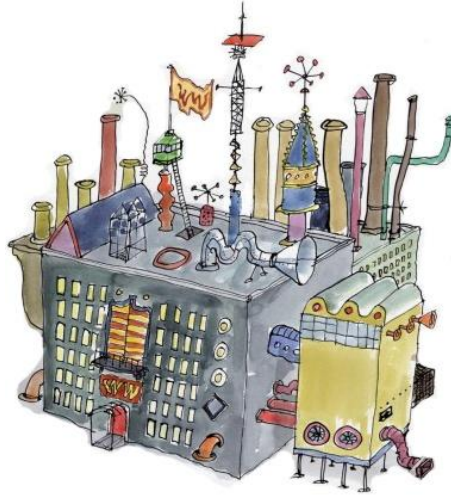
**72'500 specie di alghe**

44'000 classificate

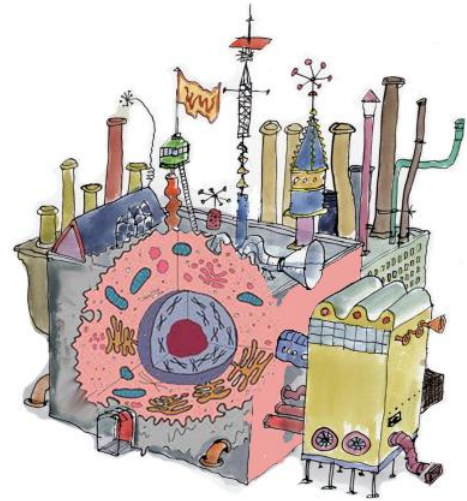
33'248 mai studiate

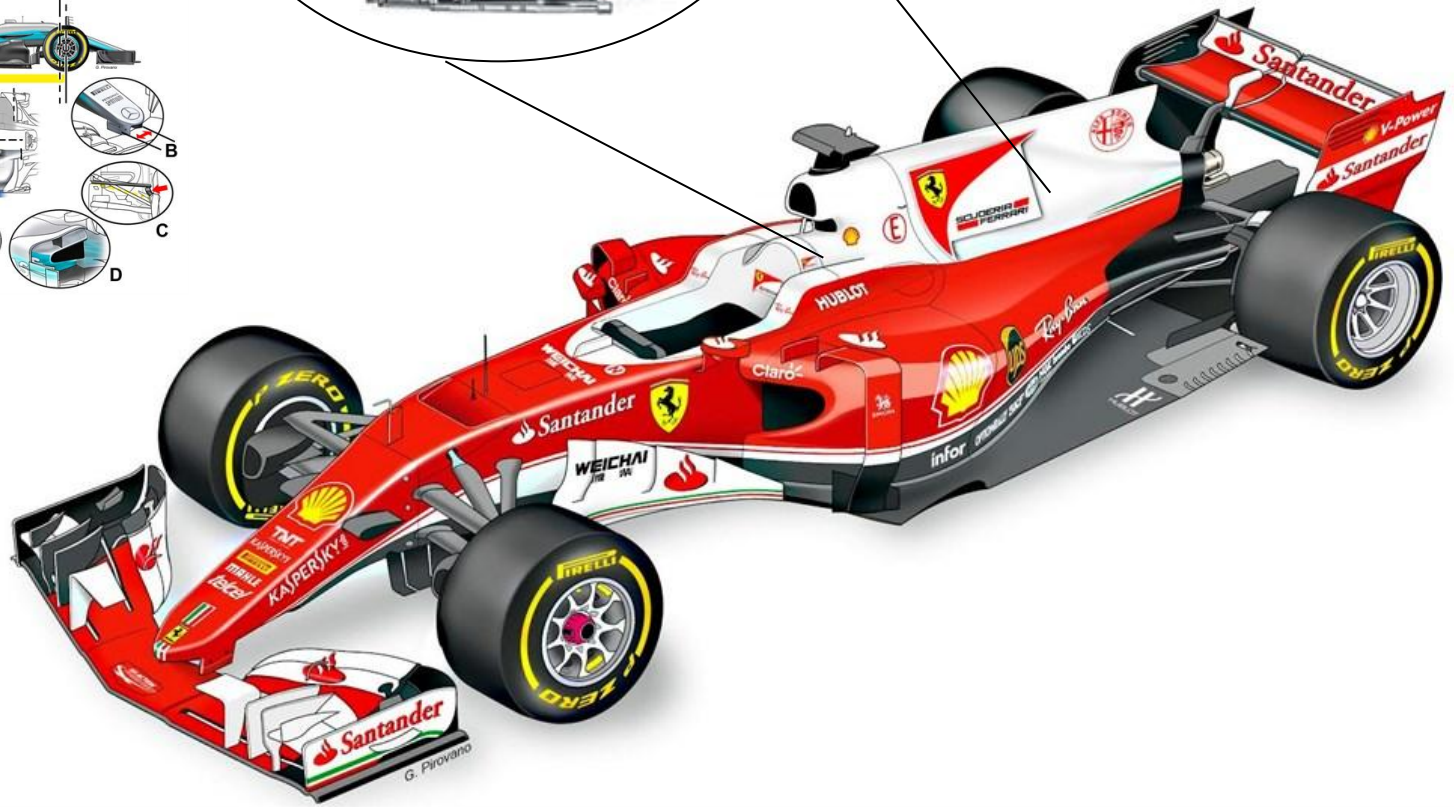
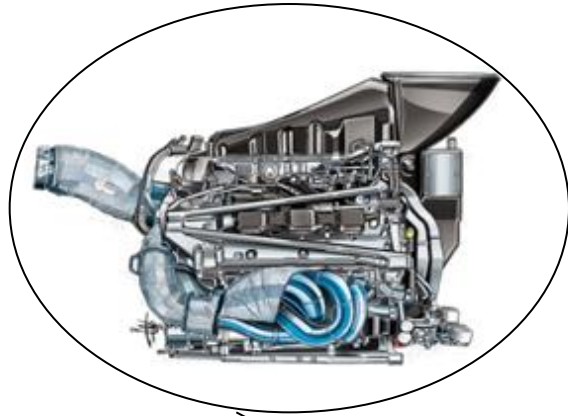
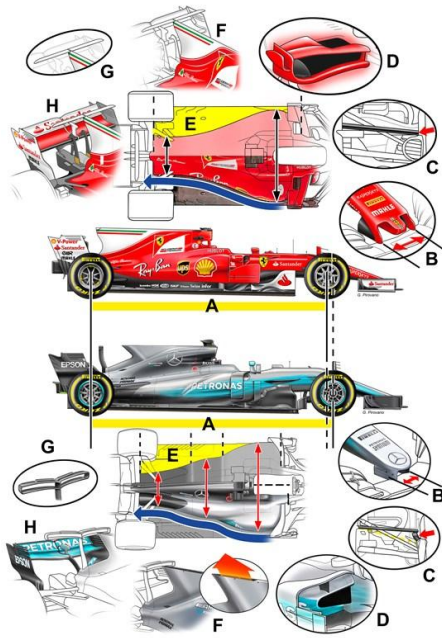


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OLIO di PESCE

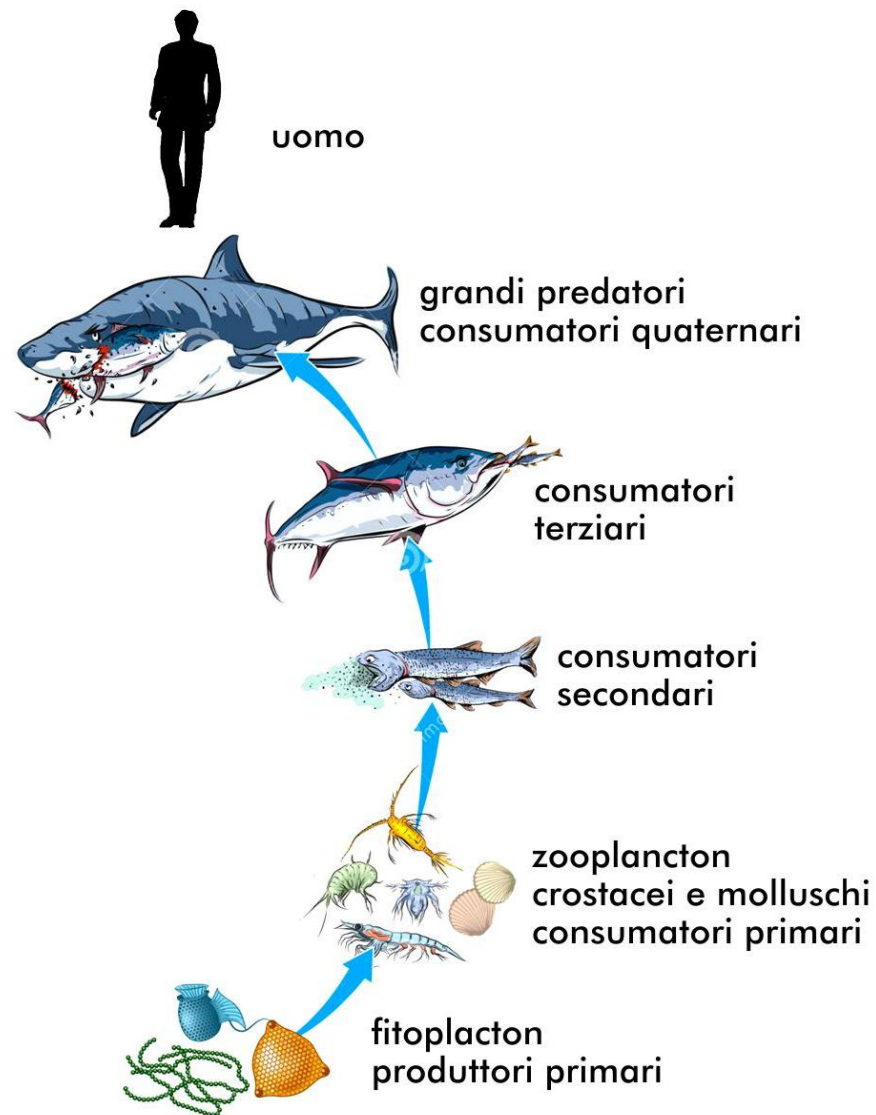
integratore alimentare

A BASE DI ACIDI GRASSI  
OMEGA3 (EPA-DHA)

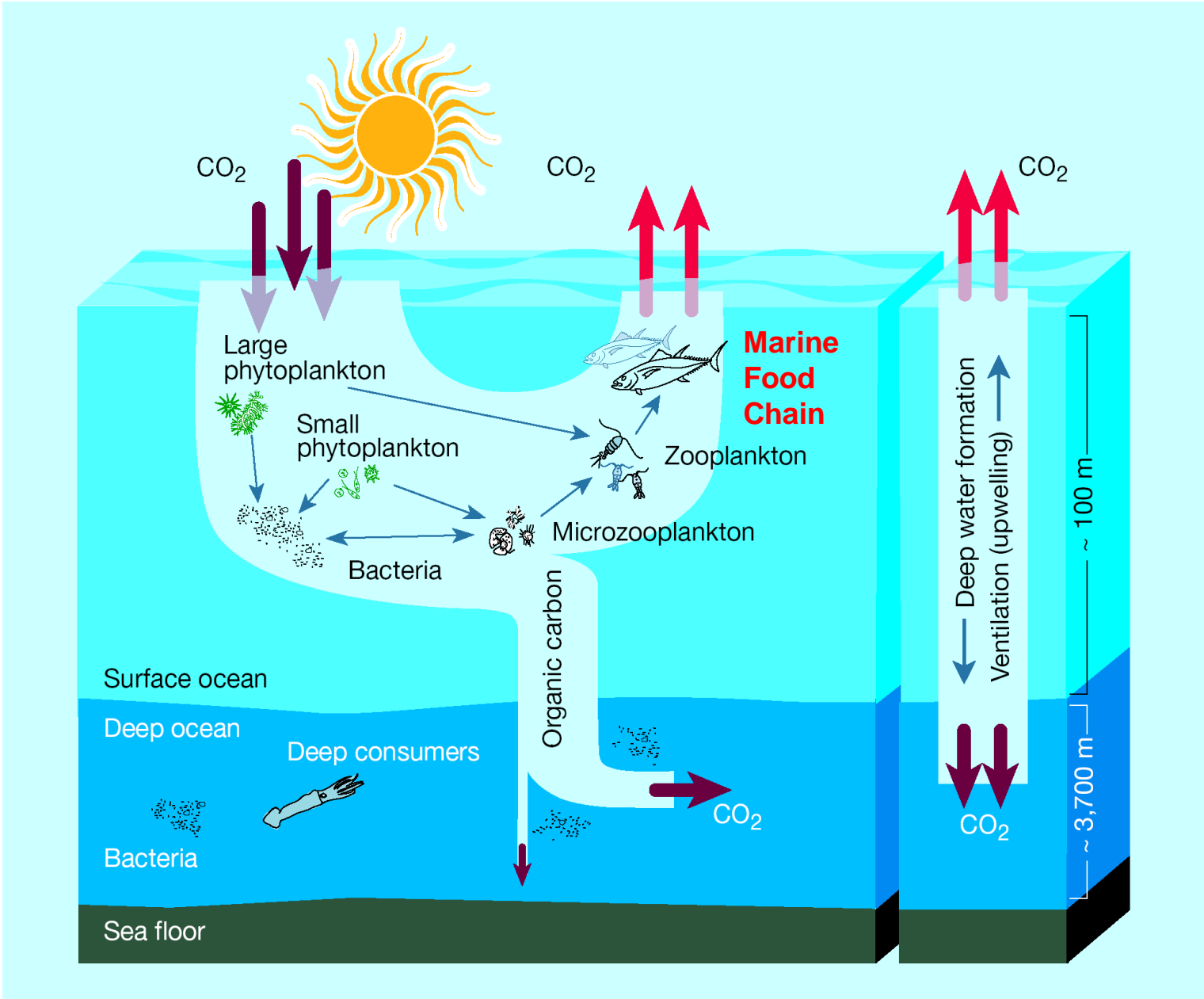
NATURA

IN FESTA

30 PERLE GEL DA 680 mg

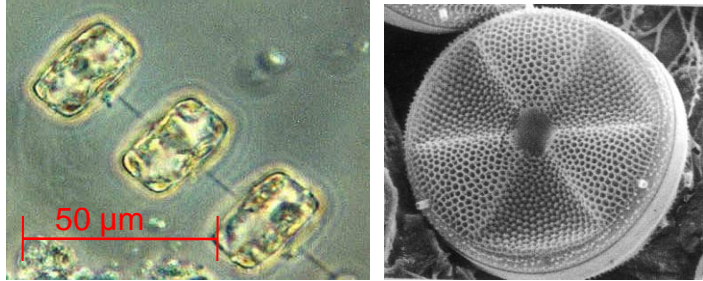






# Diatom as Solar Device

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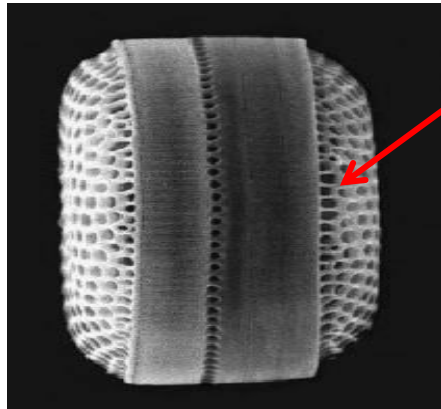


Diatoms play a vital part in the world's ecosystem. They alone account for 45% of the marine primary production, 20-25% of the world's total primary production and 20% of the total oxygen production.

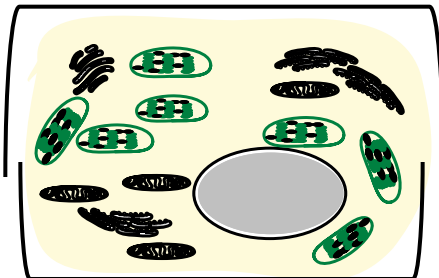
With its ability to fixate carbon, produce carbohydrates and lipids, and utilize the silicic acid present in relatively large concentrations in waters all over the world to form beautifully patterned, nanostructured shells called frustules of biogenic silica, the diatom may provide a solution to more than one problem.

# Forma e dimensione delle diatomee

*Thalassiosira sp*

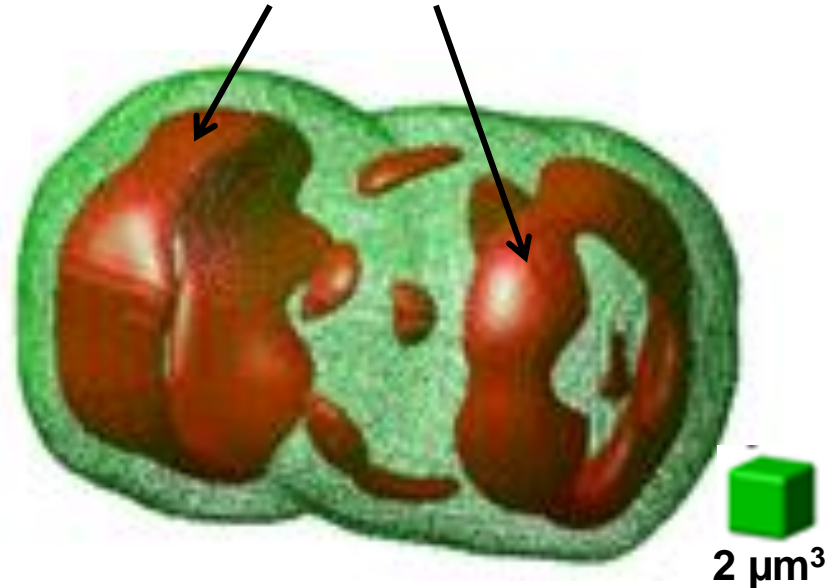


10  $\mu\text{m}$



**silice**

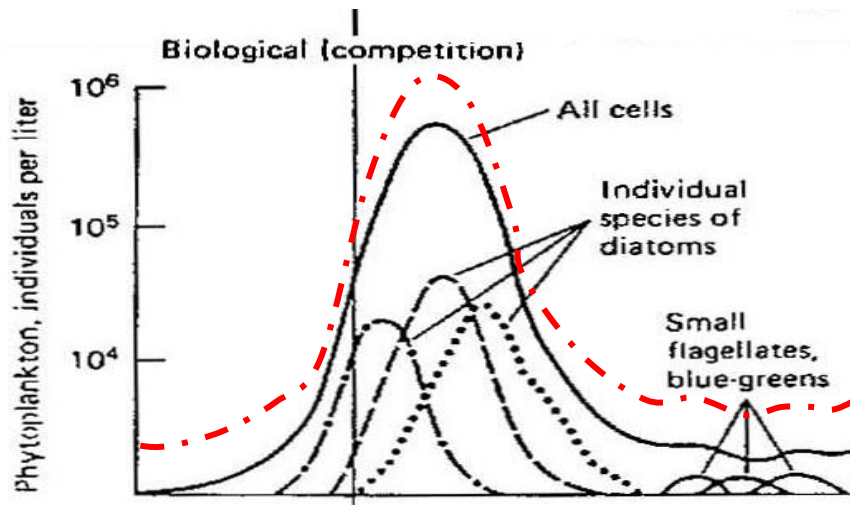
**Cloroplasti**



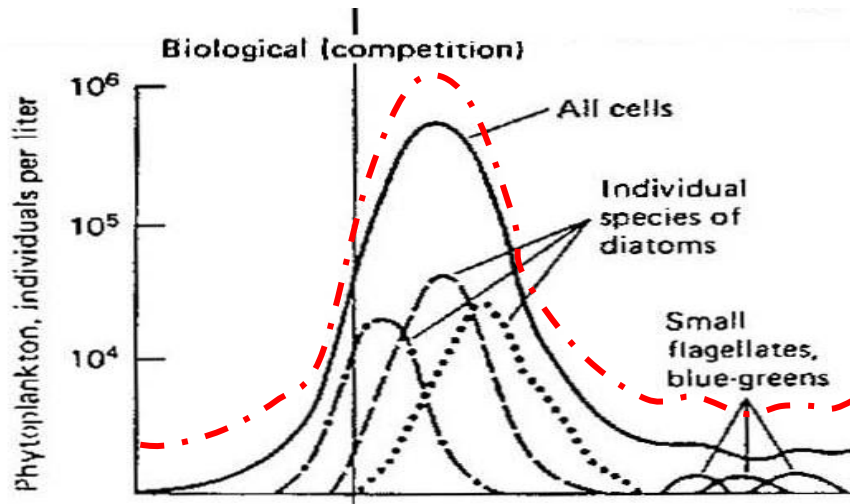
Cell volume = 1305  $\mu\text{m}^3$

Chls volume = 136.9  $\mu\text{m}^3$

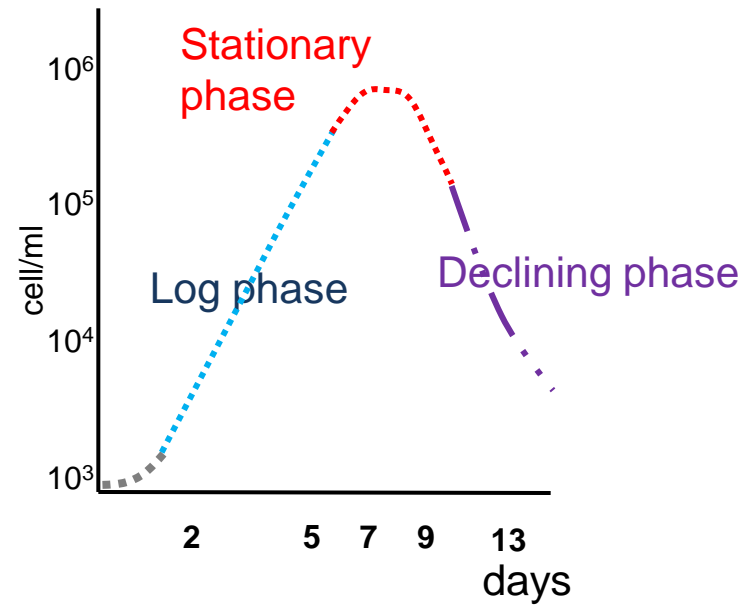
# Crescite naturali



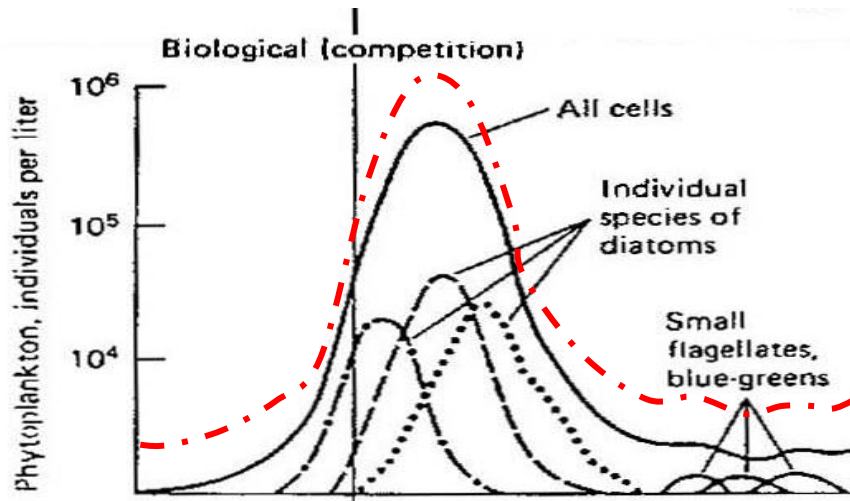
## Crescite naturali



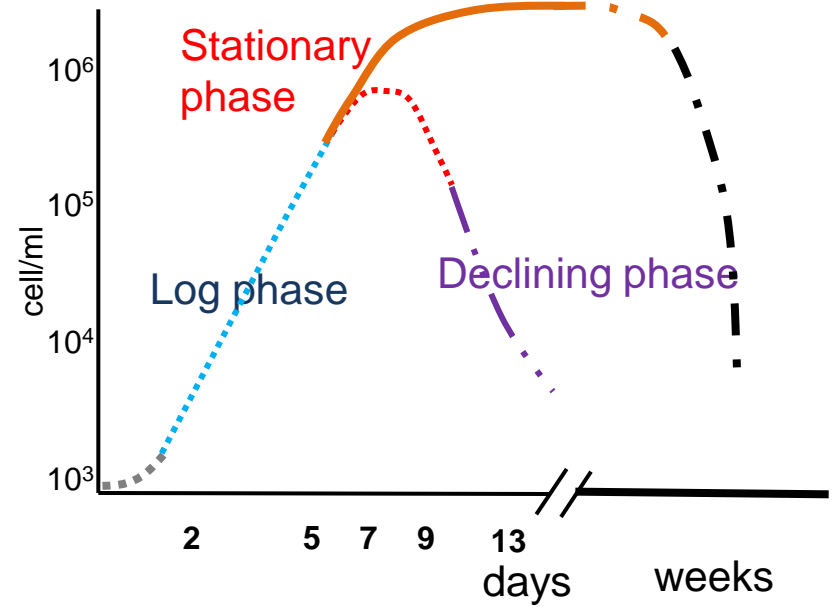
## Produzioni



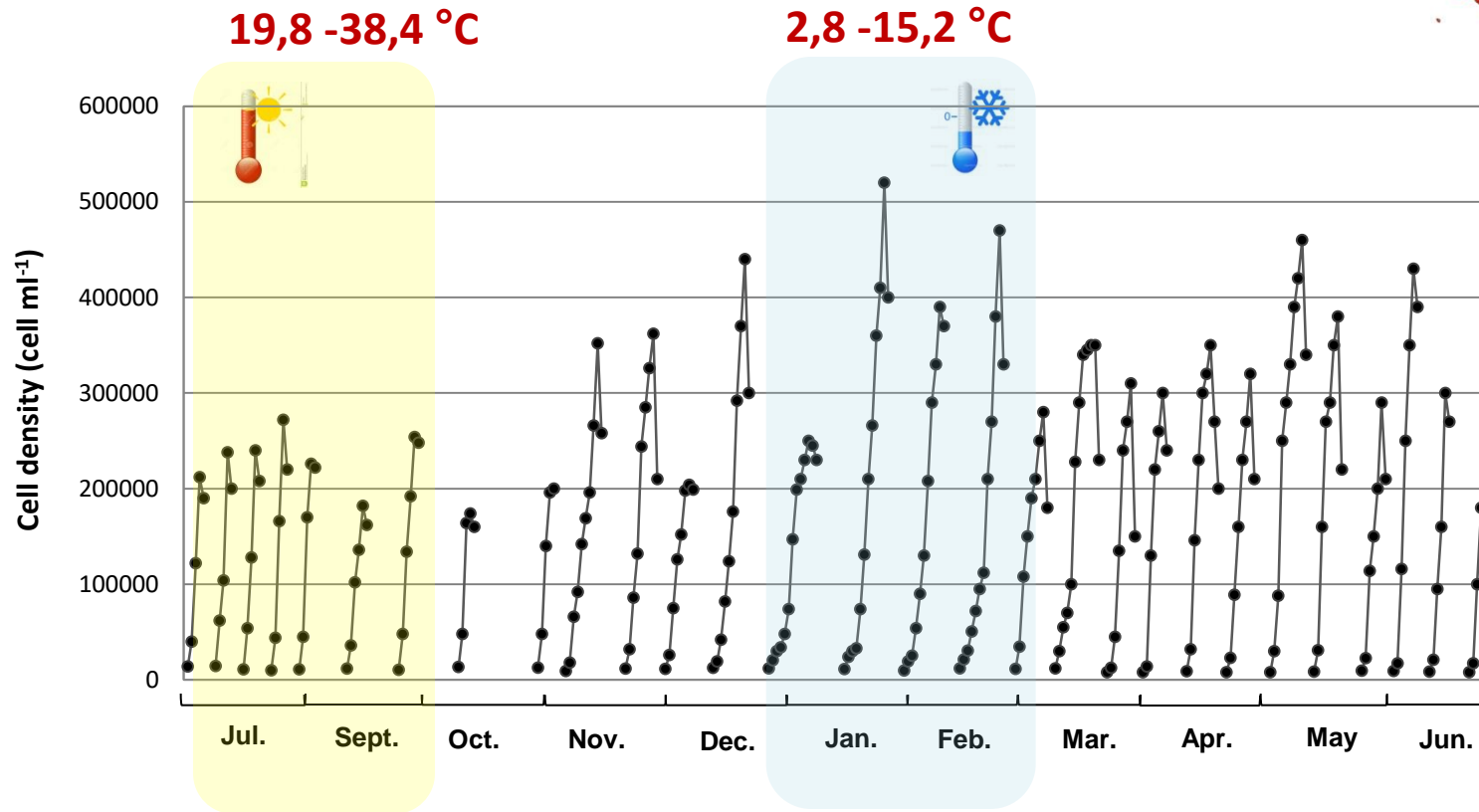
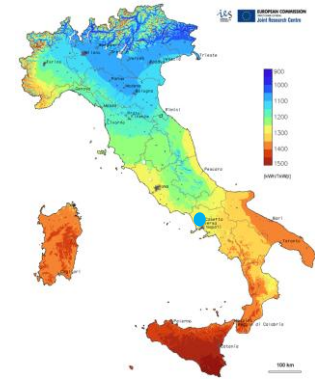
## Crescite naturali



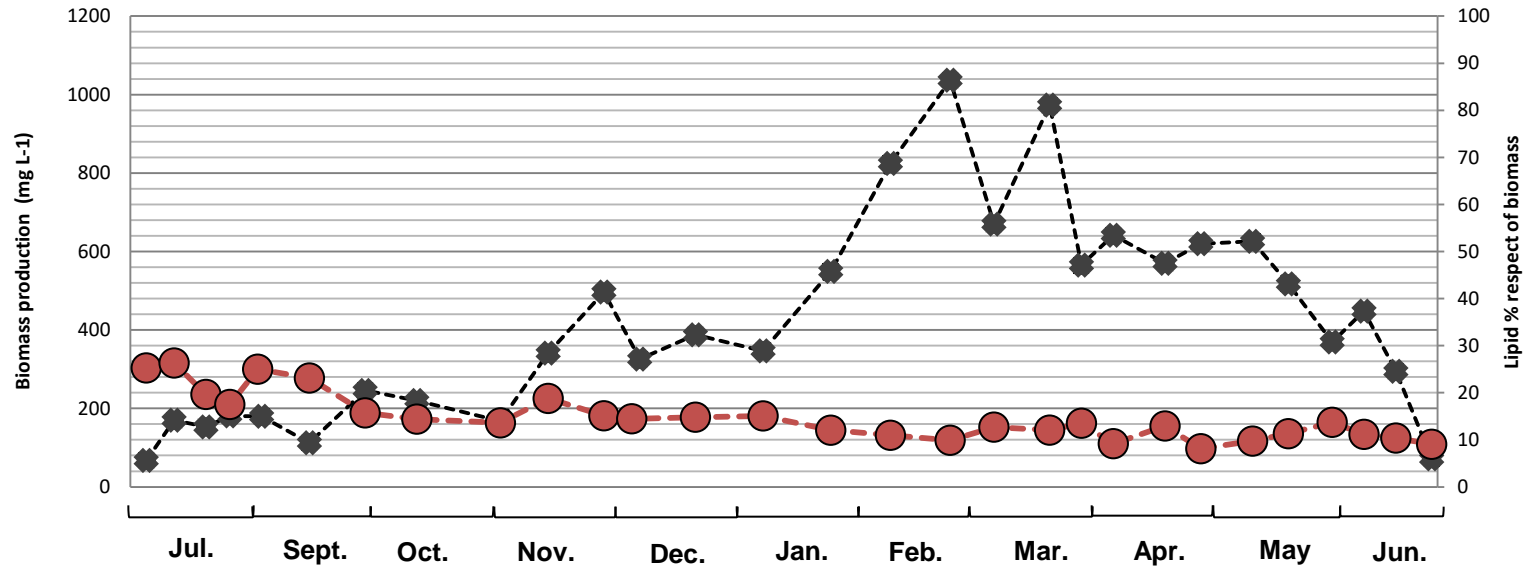
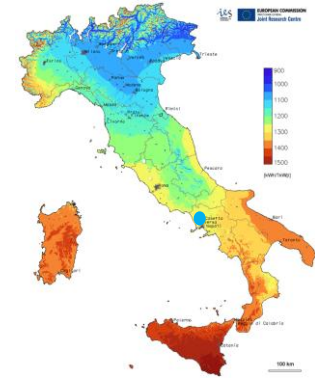
## Produzioni



# Crescite annuali di *Thalassiosira weissflogii*



# Produttività annuali di biomasse di *Thalassiosira weissflogii*

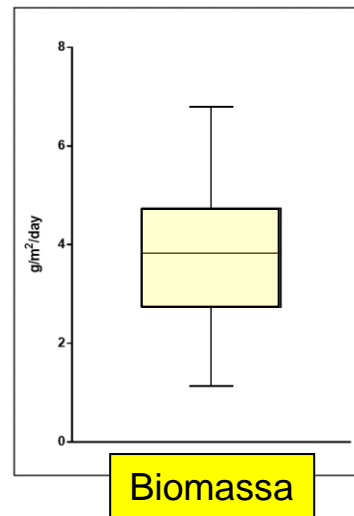


- ★ Produttività in Biomassa
- Percentuale di oli

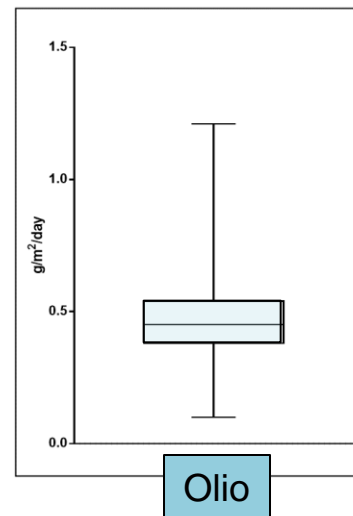


# Produttività giornaliera per unità di superficie (g/m<sup>2</sup> day)

4 g/m<sup>2</sup> d



Biomassa

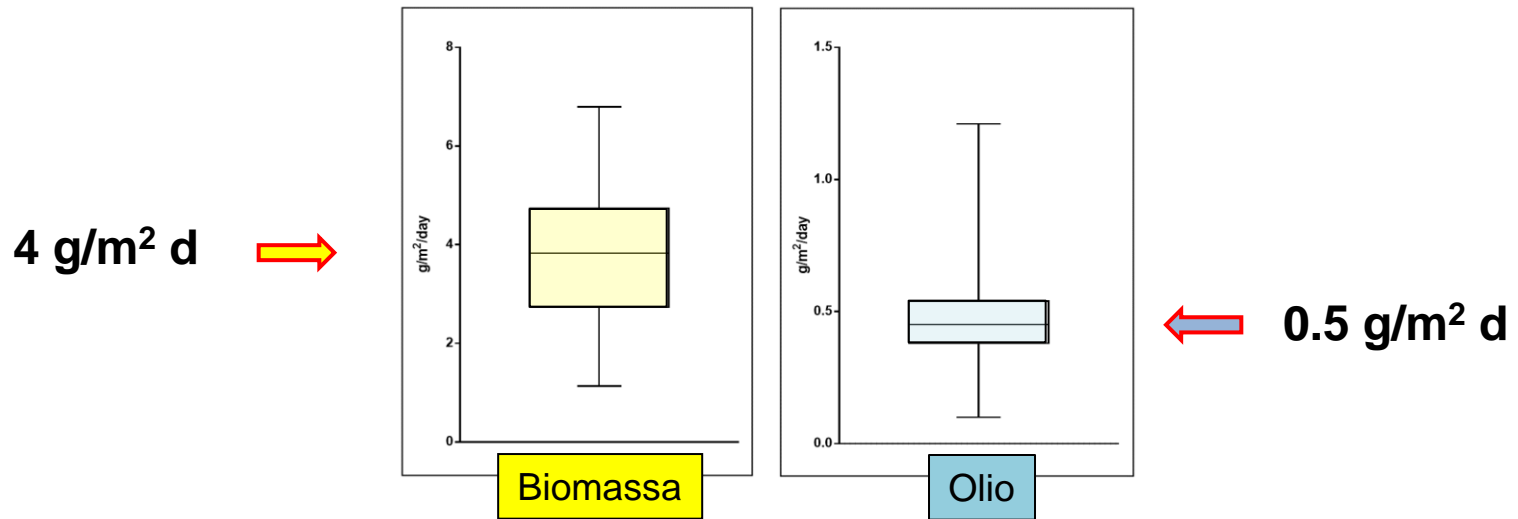
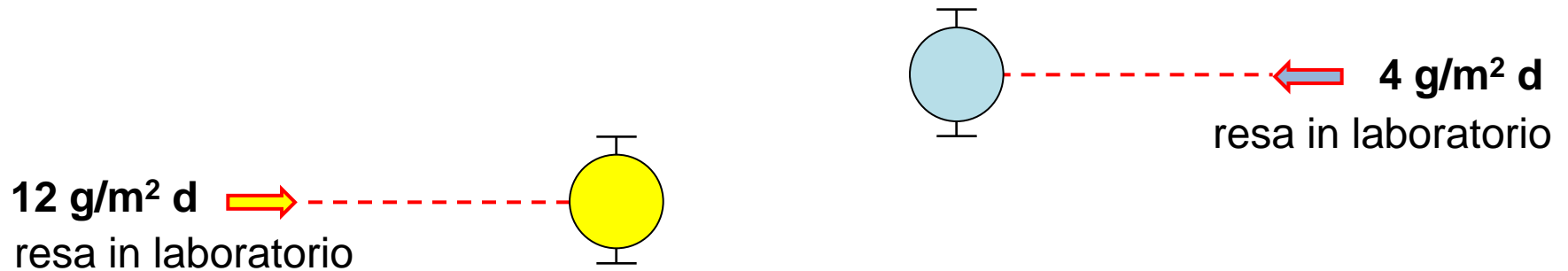


Olio

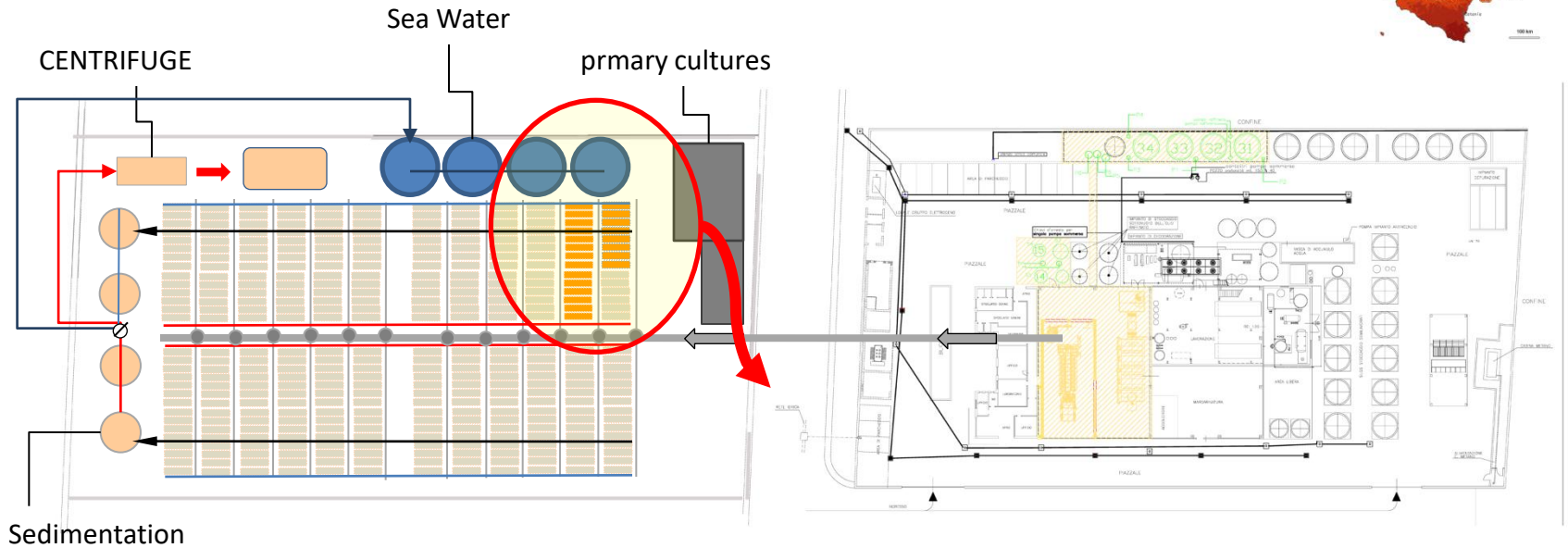
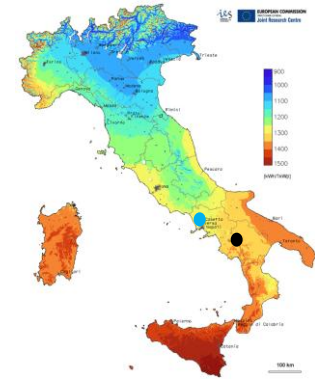


0.5 g/m<sup>2</sup> d

# Produttività giornaliera per unità di superficie (g/m<sup>2</sup> day)



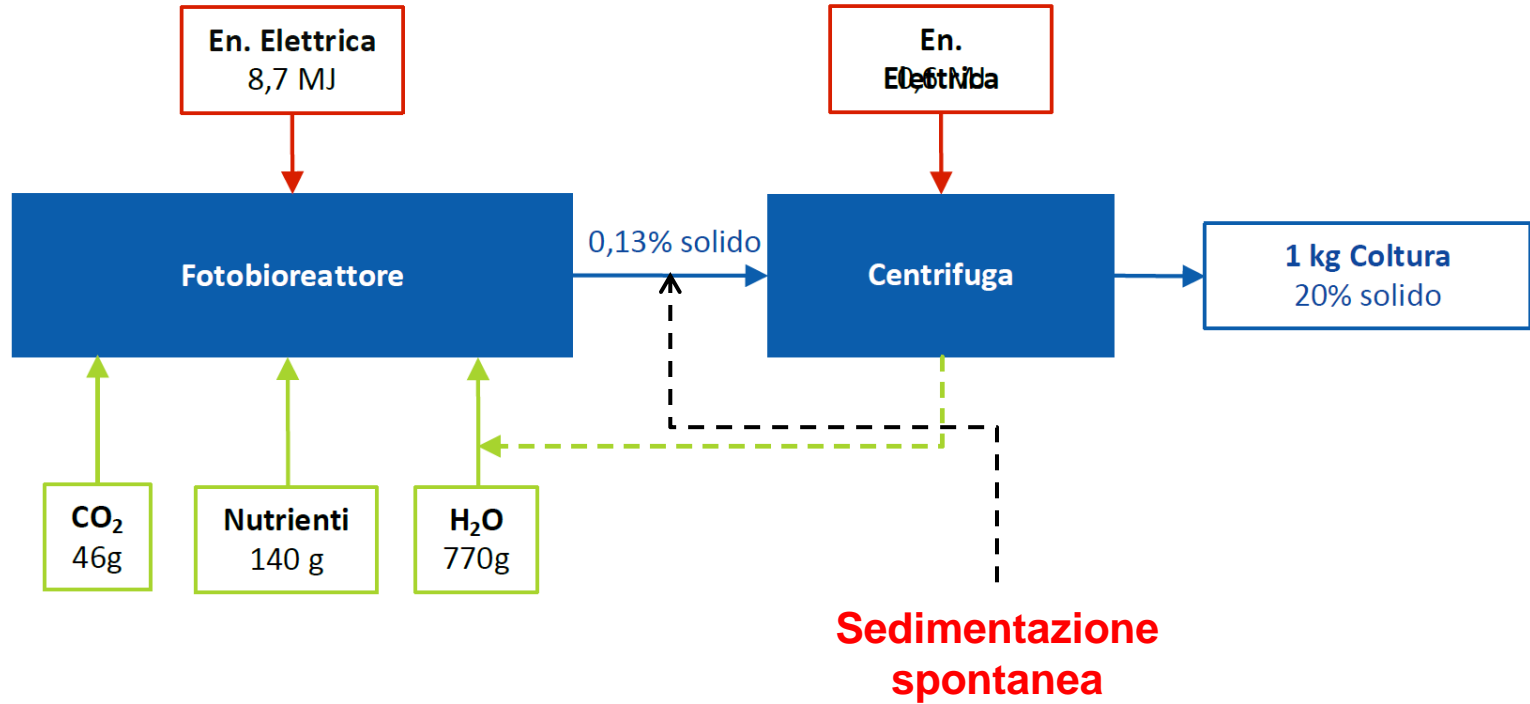
# Pilot Plant



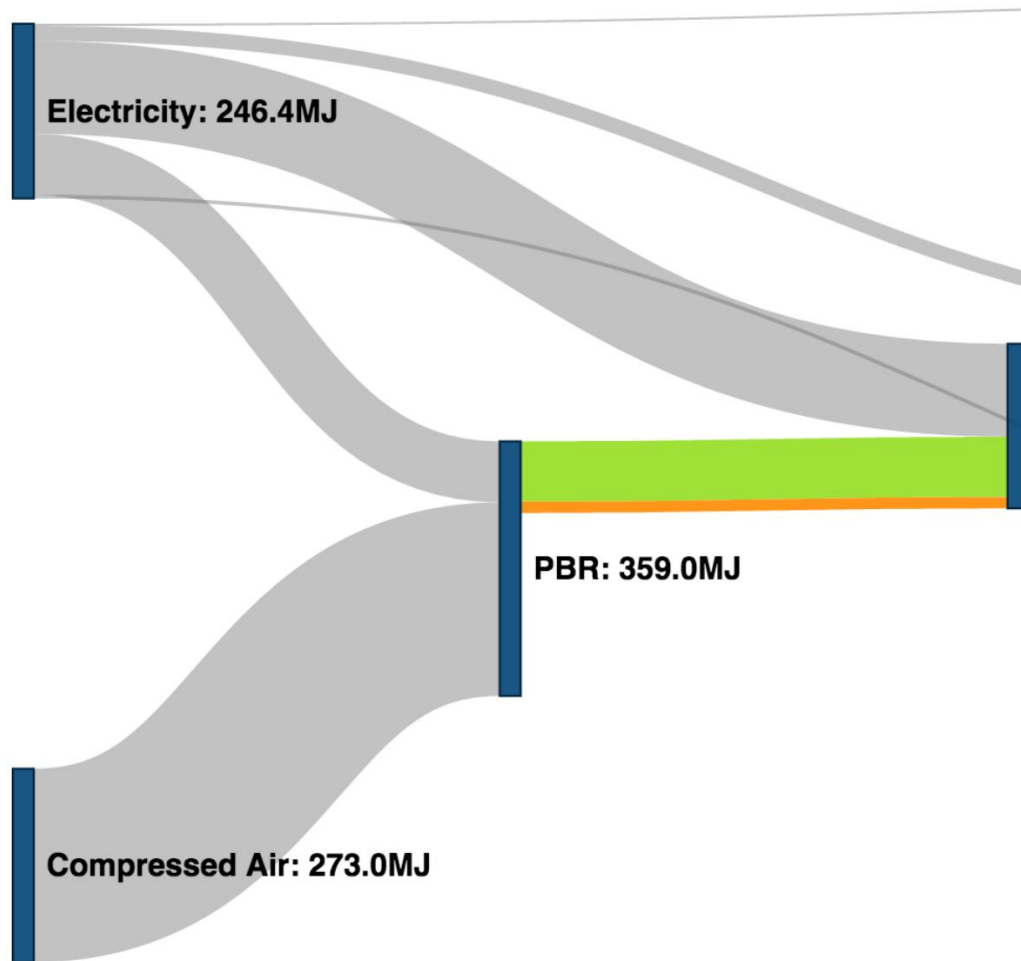
- Production cycle: 8-9 days
- Biomass Production: 7-10 kg per cycle

- Plant capacity of 21'000 L
- Production lines: 2
- Flue gas

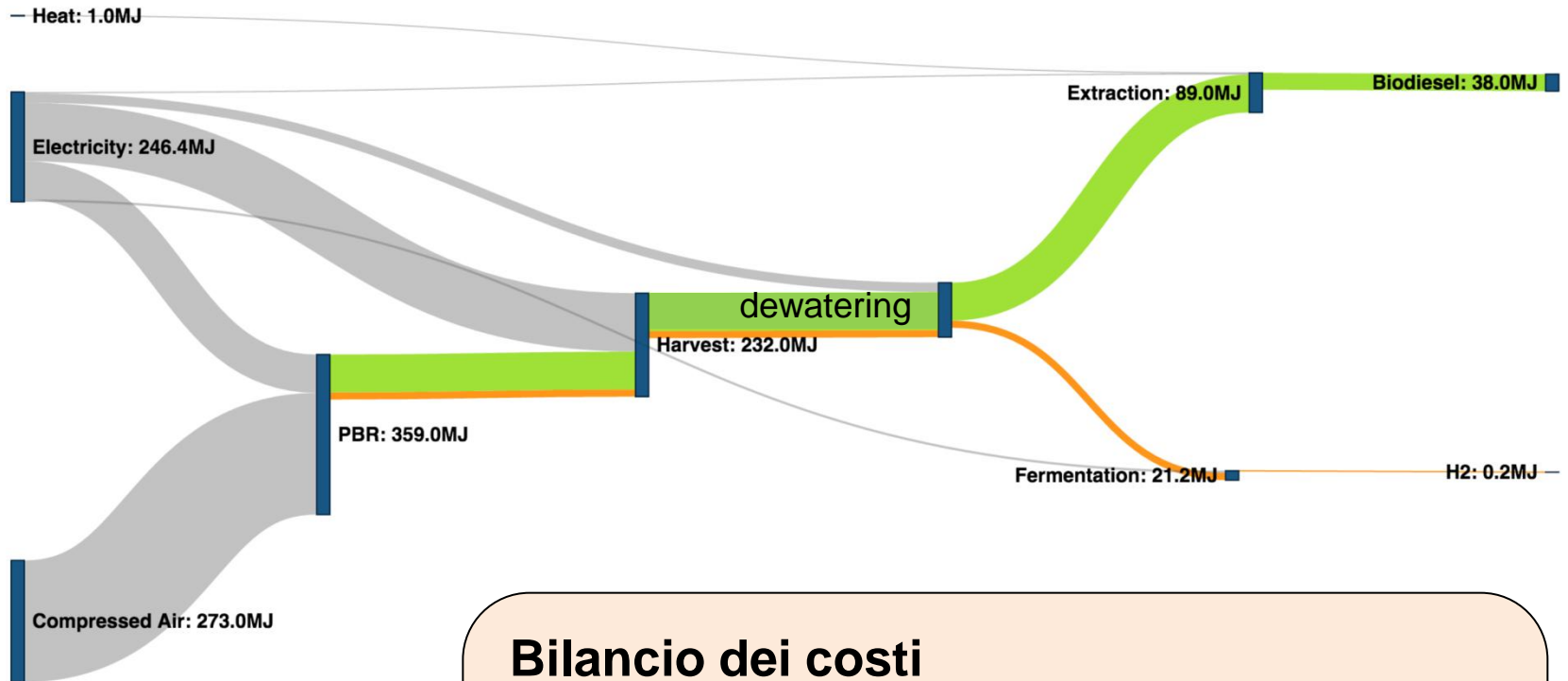
# Life-cycle Assessment (LCA)



# Life-cycle Assessment (LCA)



# Life-cycle Assessment (LCA) Proiezione su biodiesel



## Bilancio dei costi

Biodiesel: **0,80 / 1,25 €/L\***

Biodiesel Seconda generazione: **1,58/3,15 €/L\***

Biodiesel da diatomee nell'impianto pilota: **16 €/L**

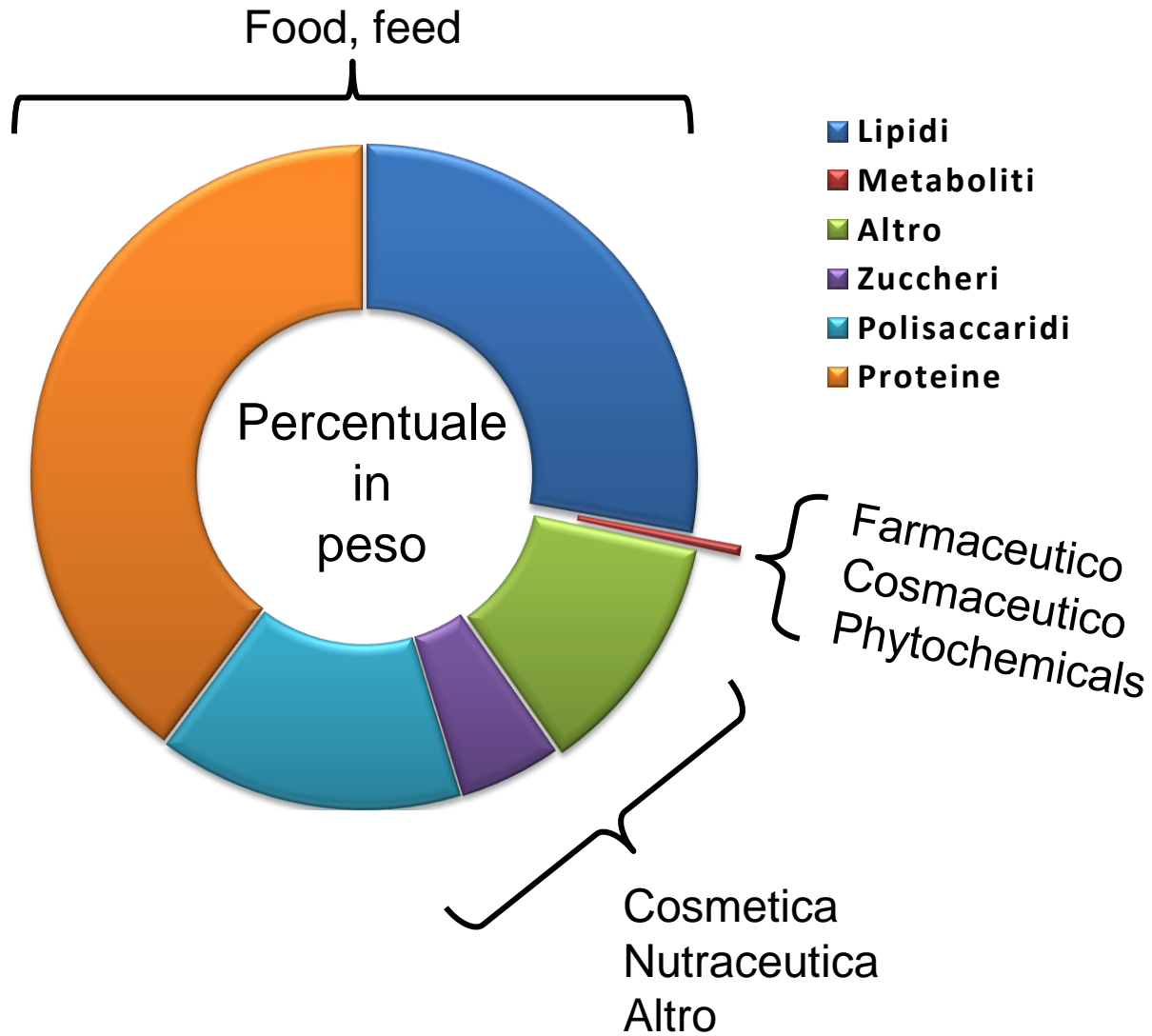
\*2014

## Specie microalgali più usate per acquacoltura (1988)

Class	Genus	Examples of application
Bacillariophyceae	<i>Skeletonema</i>	PL, BL, BP
	<i>Thalassiosira</i>	PL, BL, BP
	<i>Phaeodactylum</i>	PL, BL, BP, ML, BS
	<i>Chaetoceros</i>	PL, BL, BP, BS
	<i>Cylindrotheca</i>	PL
	<i>Bellerochea</i>	BP
	<i>Actinocyclus</i>	BP
	<i>Nitzchia</i>	BS
	<i>Cyclotella</i>	BS
Haptophyceae	<i>Isochrysis</i>	PL, BL, BP, ML, BS
	<i>Pseudoisochrysis</i>	BL, BP, ML
	<i>Dicrateria</i>	BP
Chrysophyceae	<i>Monochrysis (Pavlova)</i>	BL, BP, BS, MR
Prasinophyceae	<i>Tetraselmis (Platymonas)</i>	PL, BL, BP, AL, BS, MR
	<i>Pyramimonas</i>	BL, BP
	<i>Micromonas</i>	BP
Cryptophyceae	<i>Chroomonas</i>	BP
	<i>Cryptomonas</i>	BP
	<i>Rhodomonas</i>	BL, BP
Cryptophyceae	<i>Chlamydomonas Chlorococcum</i>	BL, BP, FZ, MR, BS BP
Xanthophyceae	<i>Olisthodiscus</i>	BP
Chlorophyceae	<i>Carteria</i>	BP
	<i>Dunaliella</i>	BP, BS, MR
Cyanophyceae	<i>Spirulina</i>	PL, BP, BS, MR

PL, penaeid shrimp larvae;  
 BL, bivalve mollusc larvae;  
 ML, freshwater prawn larvae;  
 BP, bivalve mollusc postlarvae;  
 AL, abalone larvae;  
 MR, marine rotifers (*Brachionus*);  
 BS, brine shrimp (*Artemia*);  
 SC, saltwater copepods;  
 FZ, freshwater zooplankton

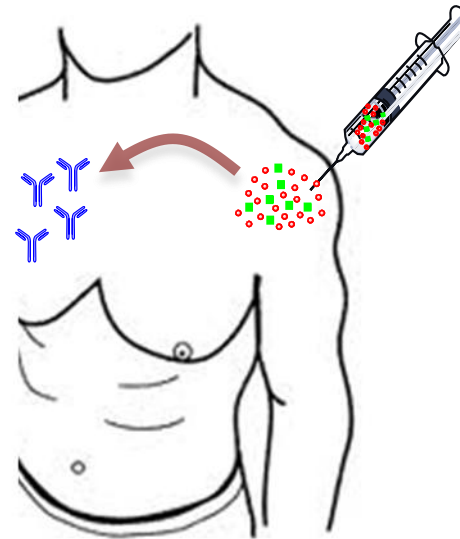
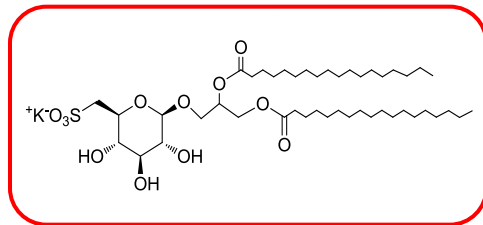
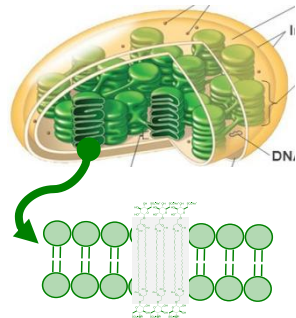
# Valorizzazione della Biomassa








# Composti ad Alto Valore Aggiunto

(DERIVATO MICROALGALE PER FORMULAZIONE DI VACCINI)

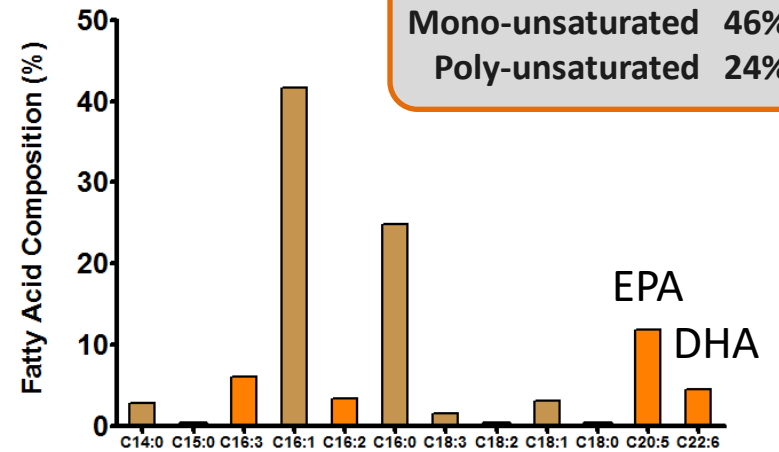
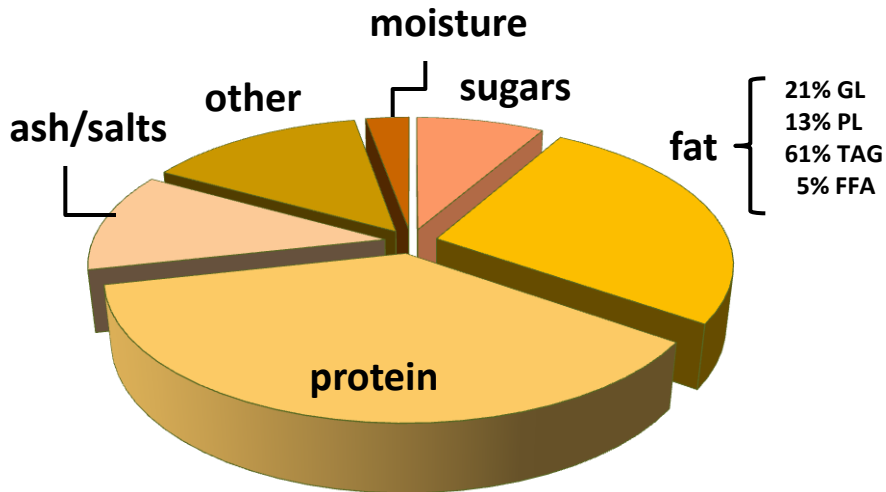


-  = Immunizzazione
-  = Antigene (proteina ricombinante)
-  = Sulfavante (derivato microalgale)

Brevetto n. EP20140741377 Beta-glycolipids for use as adjuvants (MI2013A000949)

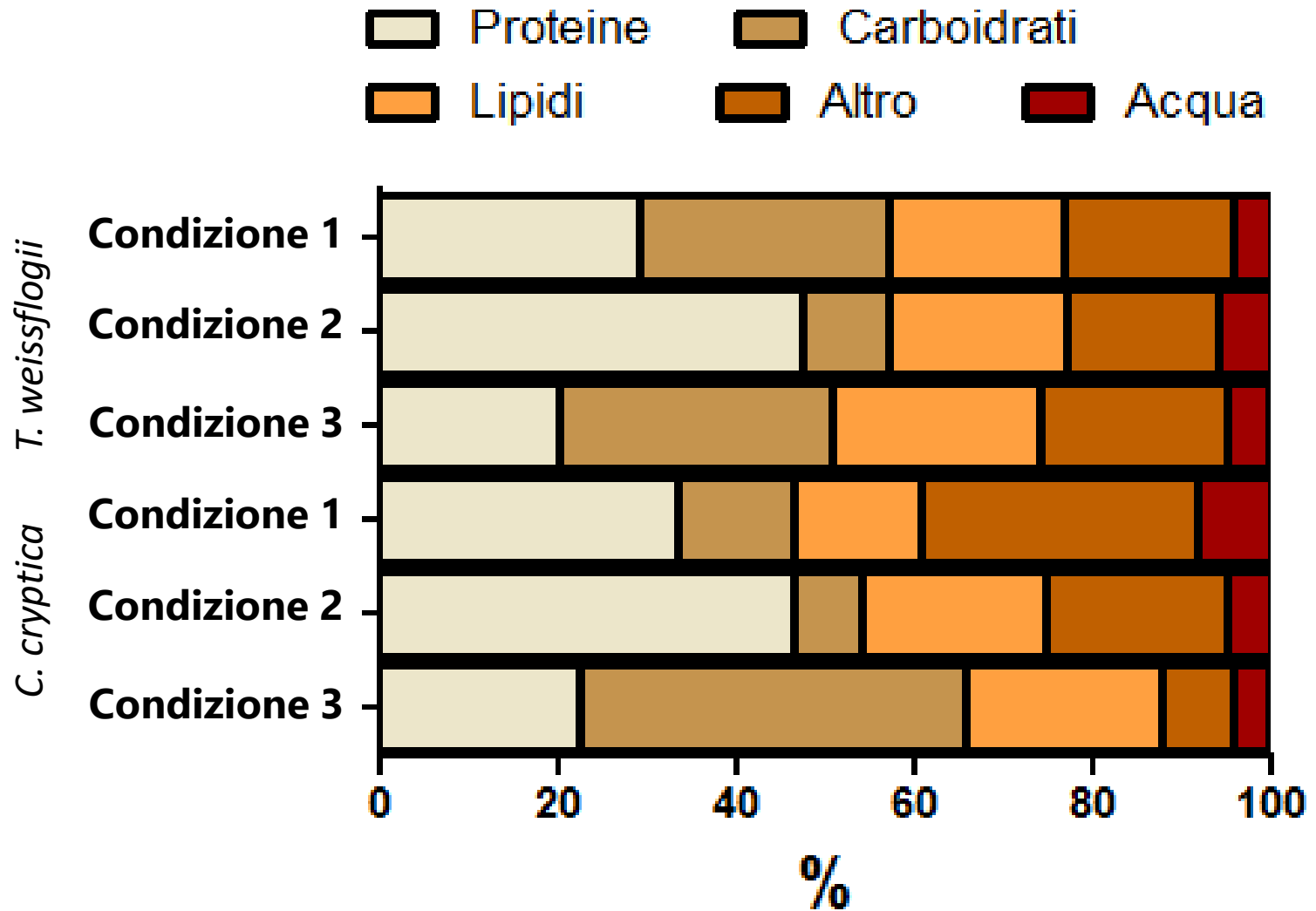
# FARINE ALGALI

*Cyclotella cryptica*

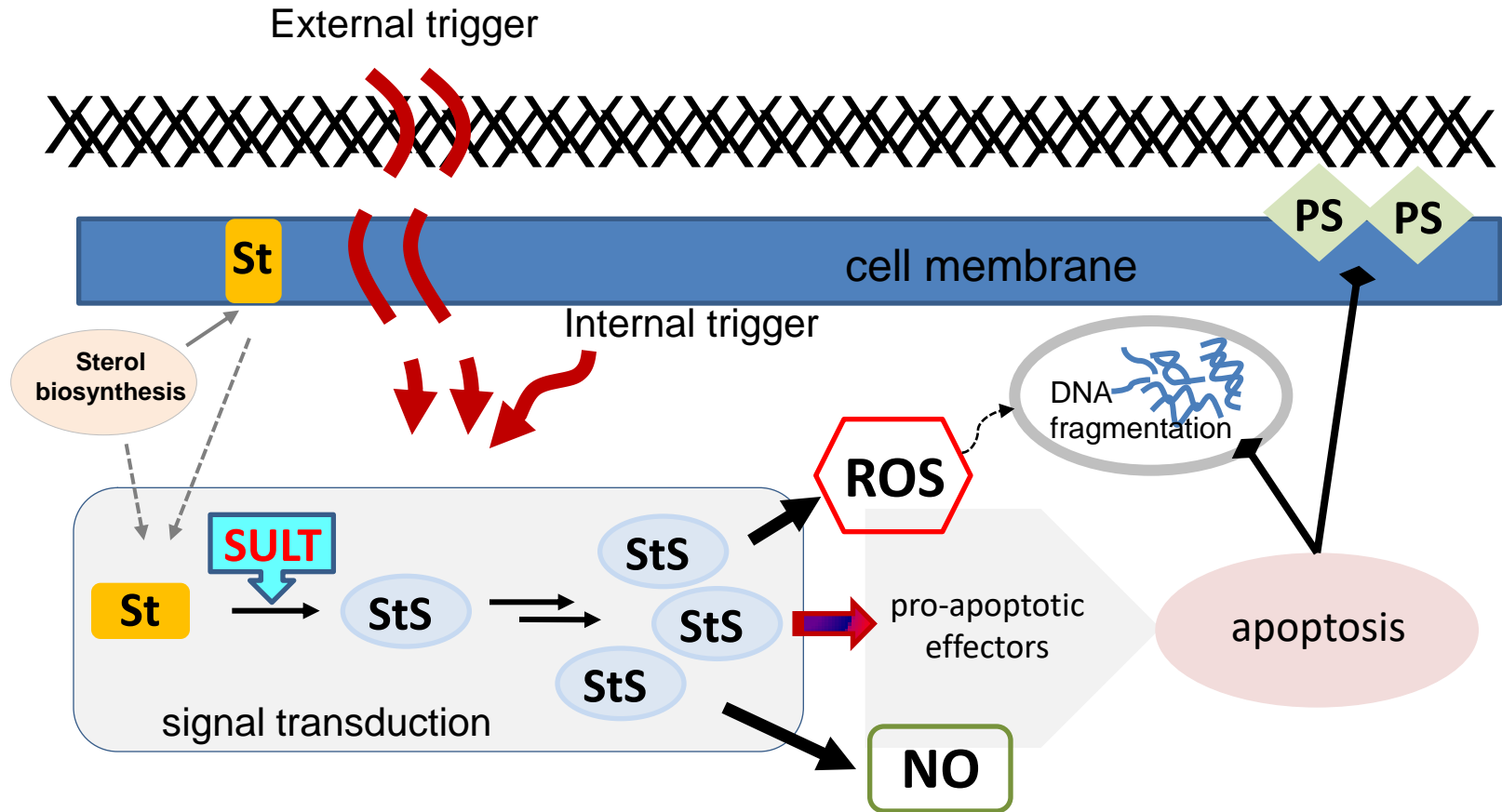


Saturated 30%  
 Mono-unsaturated 46%  
 Poly-unsaturated 24%

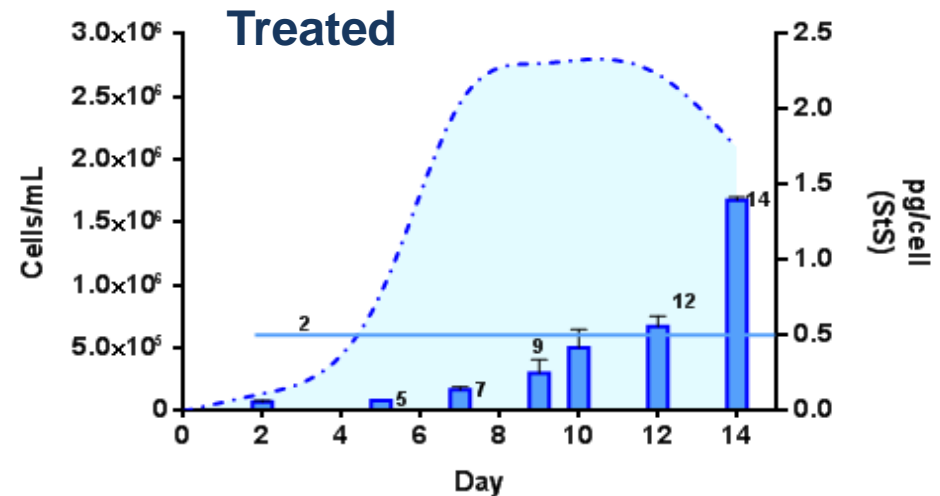
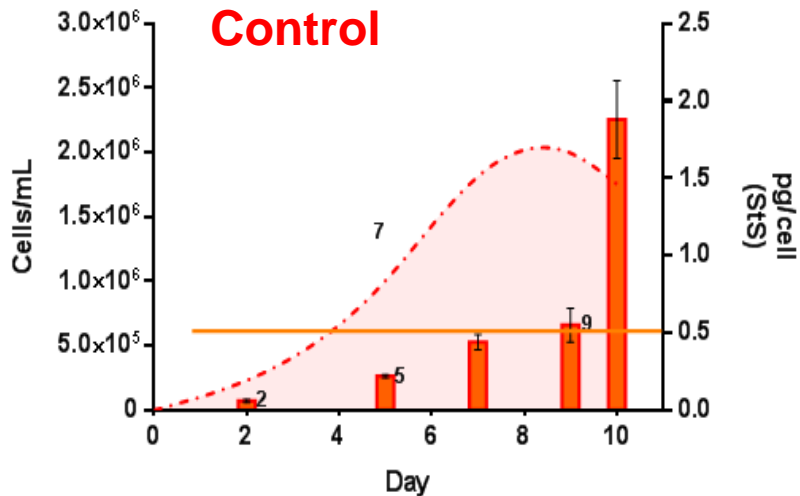
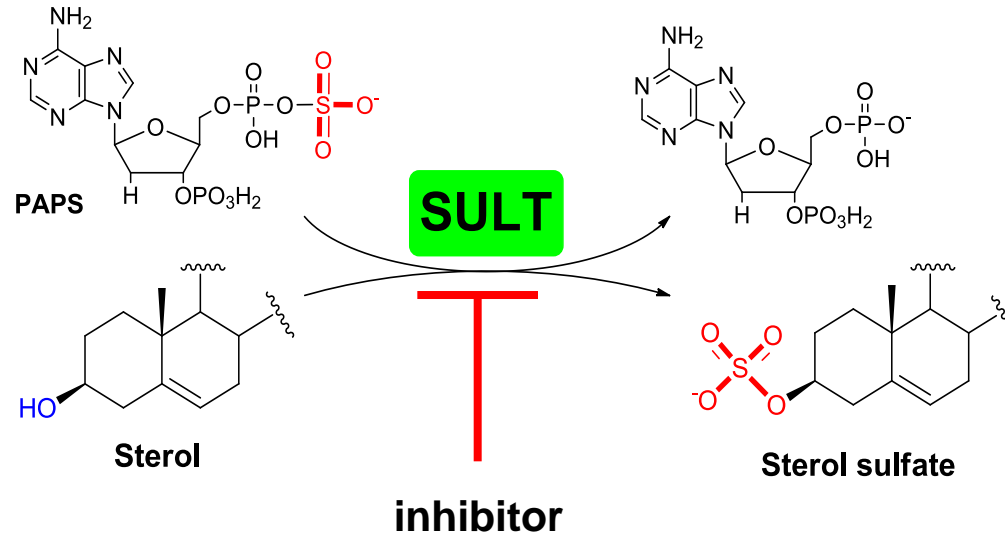
# Composizione Farine & Condizioni di Crescita



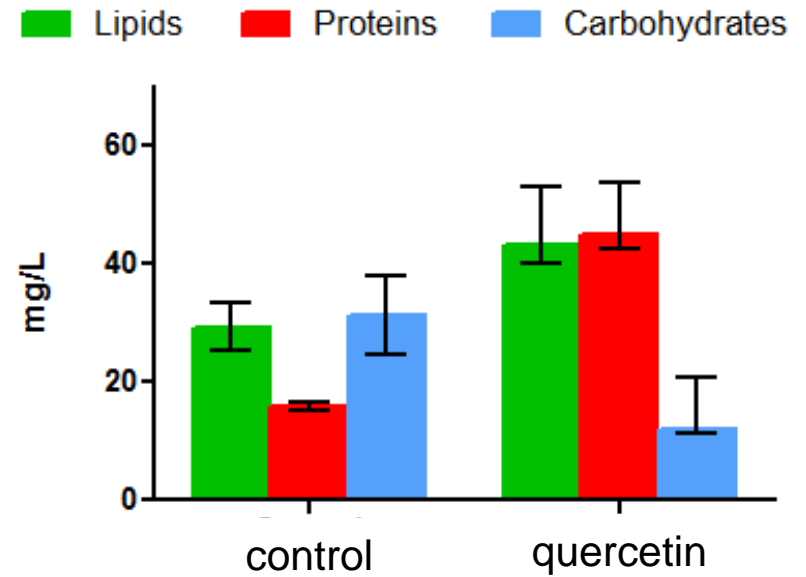
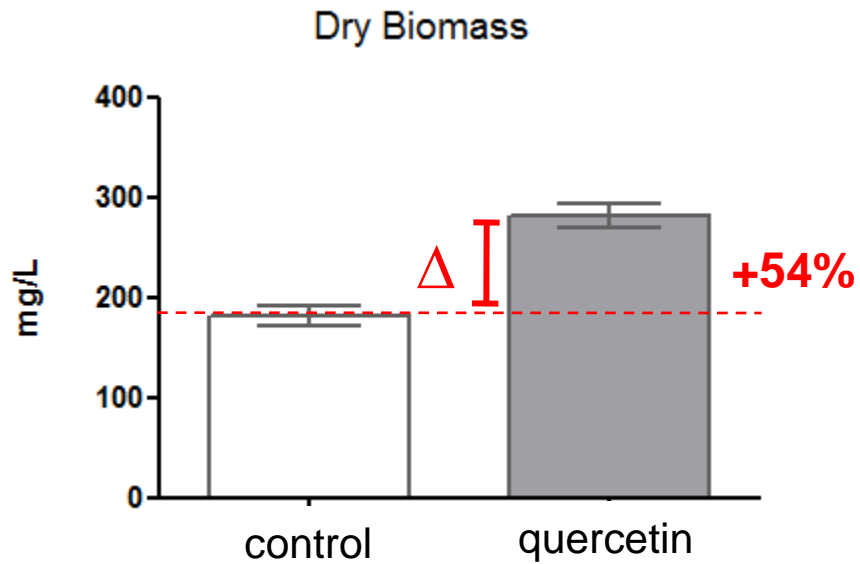
# Signaling transduction by sterol sulfates in *S. marinoi*



# Inibizione della SULT



# Plasticità Metabolica



# Conclusioni

- ✓ Le microalghe possono essere una “materia prima” per applicazioni numerose e diversificate;
- ✓ Nuove possibilità derivano dallo sfruttamento delle potenzialità fisiologiche e dalla diversità (solo molto parzialmente esplorata) delle differenti specie;
- ✓ L'utilizzo per scopi energetici NON sembra essere economicamente sostenibile allo stato attuale della tecnica;
- ✓ I settori industriali “food e feed” sembrano essere quelli più tecnologicamente maturi per l'utilizzo di biomasse/prodotti microalgali;
- ✓ Ampie potenzialità economiche derivano dallo sfruttamento dei composti biologicamente attivi (farmaceutica) e funzionali (nutraceutica e cosmetica);
- ✓ Insieme a miglioramenti tecnologici, la manipolazione genetica e biochimica sembrano essere i prossimi step di sviluppo dell'utilizzo biotecnologico delle microalghe.