

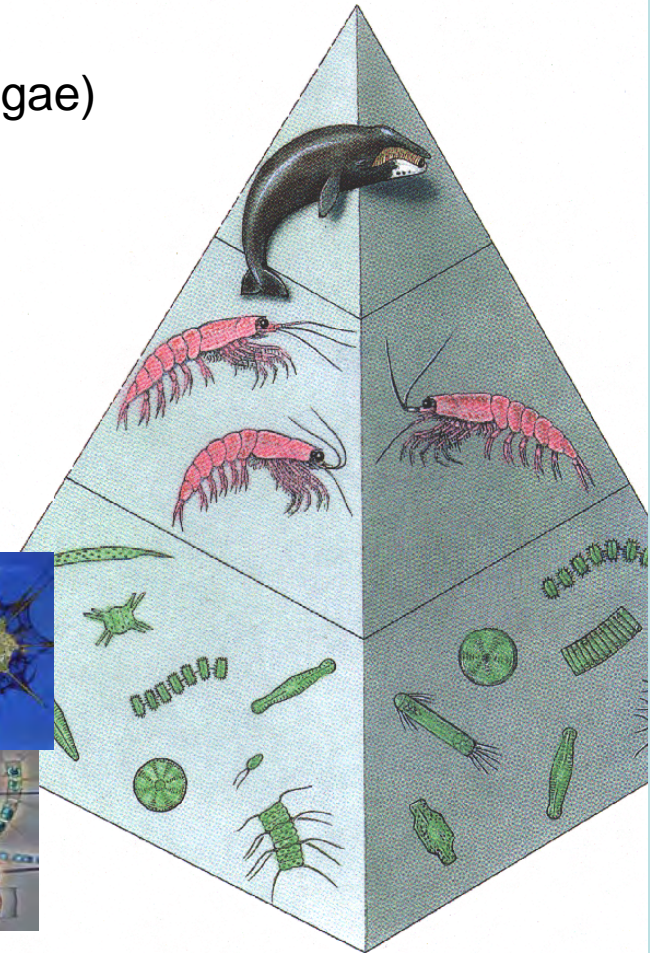
Potential for microalgae R&D in New Caledonia

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Microalgae in the marine food chain

- Primary productivity (Phytoplankton or microalgae) constitute the base of the marine food chain.
- Microalgae account for more than 90% of the primary productivity in the ocean.
- The two major factors controlling primary productivity are the availability of : Light and Nutrients



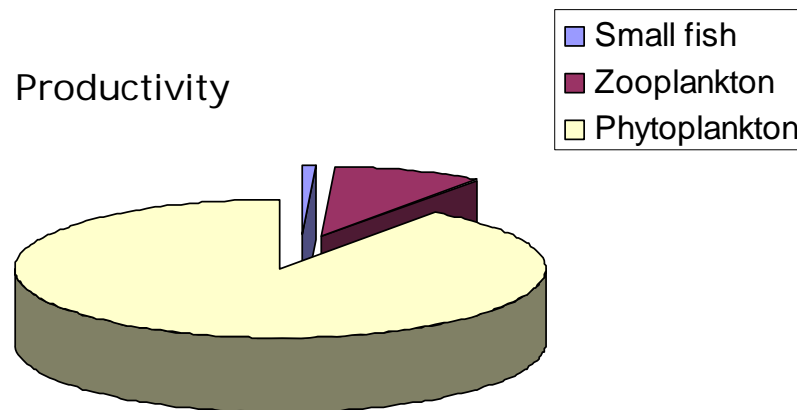
http://www.geocities.ws/oceanking_uk_2003/Foodwebs.htm

Microalgae

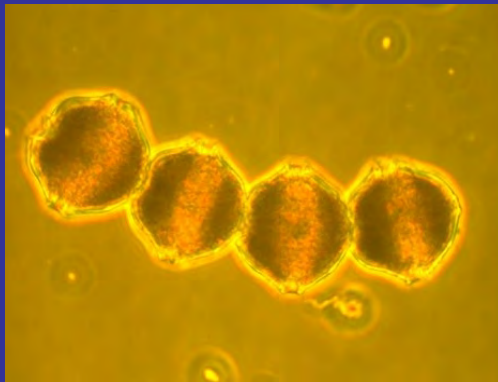
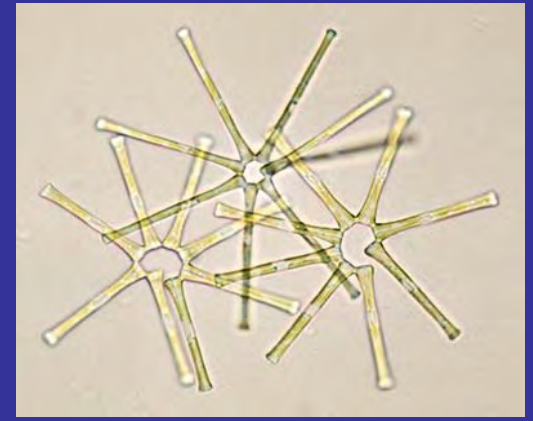
Organism	Relative Size	Relative Number	Productivity
Small Fish	10 cm	0.0005	1
Zooplankton	0.01 - 1 cm	5	10
Phytoplankton	0.001 - 0.01 cm	100	100

http://www.geocities.ws/oceanking_uk_2003/Foodwebs.htm

Productivity or rate of production of biomass of microalgae is 10 to 100 times higher than zooplankton and small fish respectively



Diversity of the microalgae





Microalgae are adapted to a wide panel of environments



Small but prolific

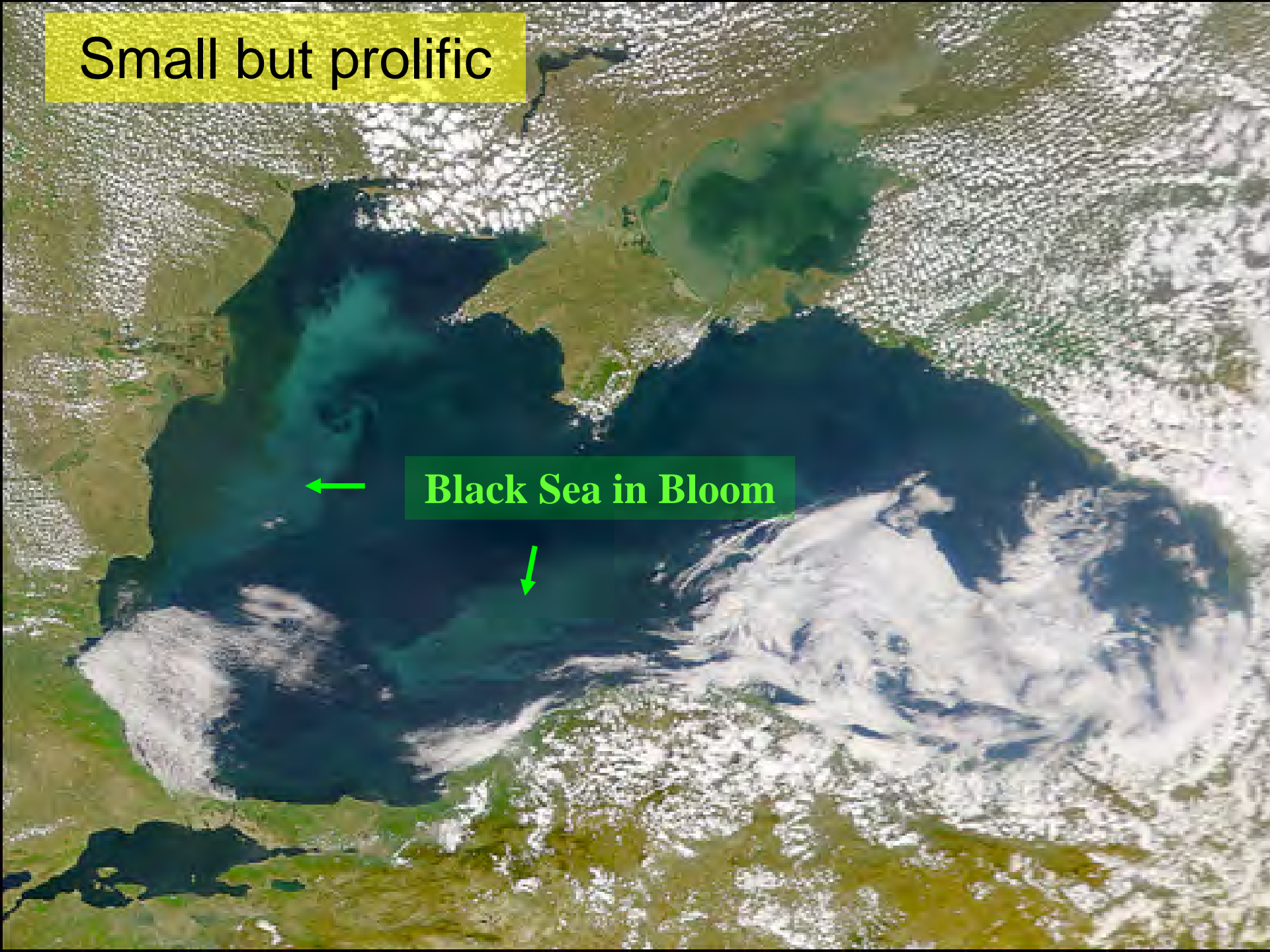


Red tide of *Noctiluca scintillans*



Small but prolific

Black Sea in Bloom

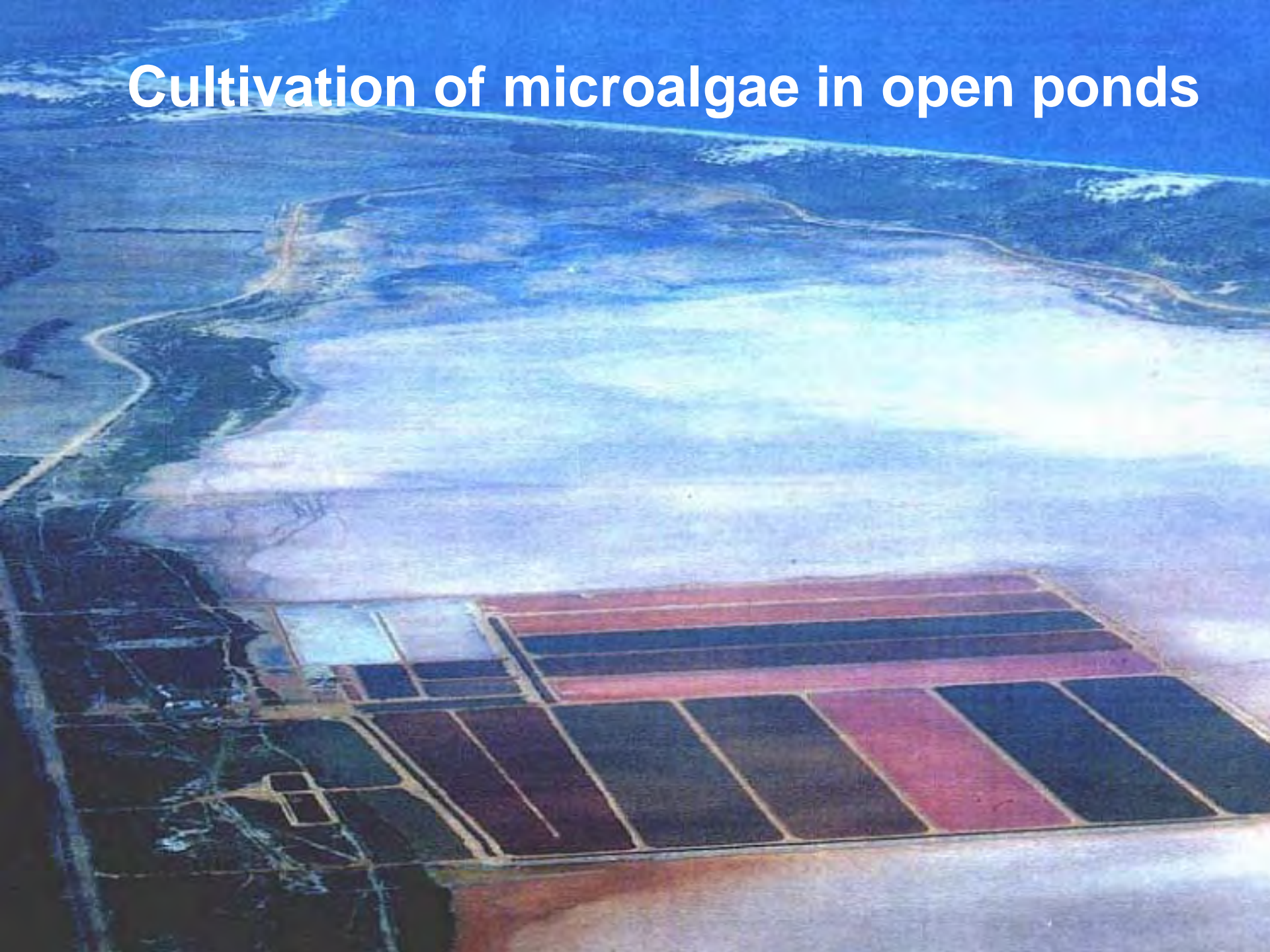


Small but prolific

Phytoplankton of the west coast of Africa

A satellite image of the west coast of Africa, showing the continent's coastline on the right side. The ocean is depicted with various shades of blue and green, indicating different concentrations of phytoplankton. A prominent, bright green and yellowish band runs along the coast, representing a phytoplankton bloom. The text 'Small but prolific' is in the top left, and 'Phytoplankton of the west coast of Africa' is in a blue box at the bottom.

Cultivation of microalgae in open ponds



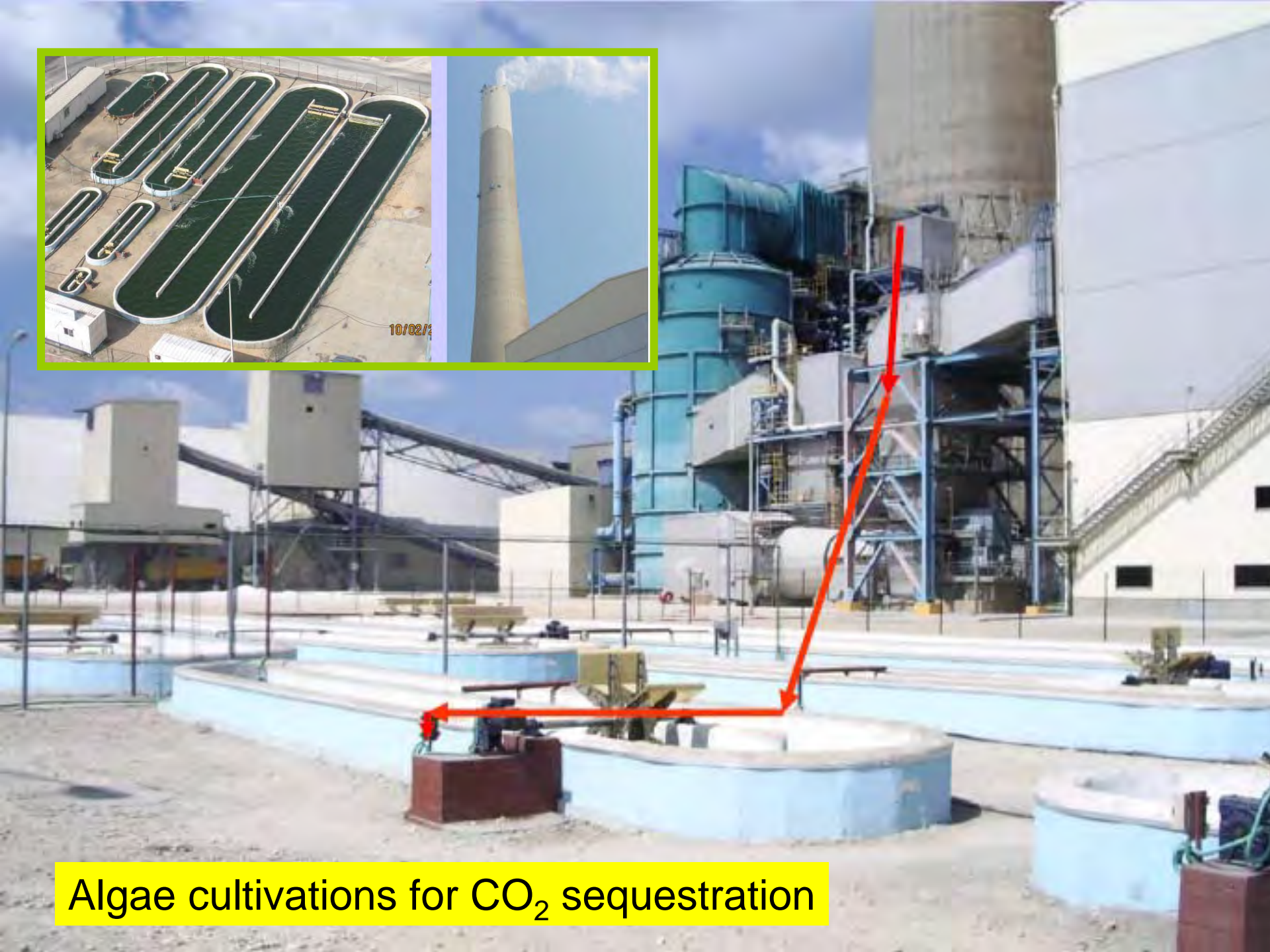
Cultivation of microalgae in open ponds



Cultivation of microalgae in open ponds



Seamiotic algae ponds at Ashkelon, Israel



Algae cultivations for CO₂ sequestration

Cultivation of microalgae in Photobioreactor



Culture of *Haematococcus pluvialis* for astaxanthine

Cultivation of microalgae in Photobioreactor



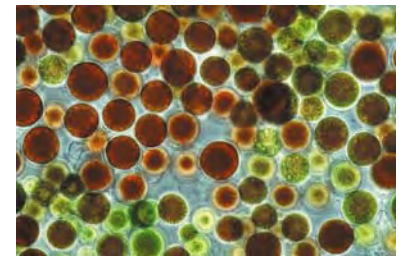
Microalgae

Production and processing



Yield

Species	Dry matter yield (Kg/Ha/day)
Nannochloropsis	200
Spirulina plantesis	103
Dunaliella salina	120
Scenedesmus species	134
Ankistrodesmus	182
Haematococcus pluvialis	38
Rape seed	9
Sunflower	6



Microalgae

**Protein content of few algae species
(% dry matter)**

Strain	Protein
<i>Scenedesmus obliquus</i>	50-56
<i>Scenedesmus quadricauda</i>	47
<i>Scenedesmus dimorphus</i>	8-18
<i>Chlamydomonas reinhardtii</i>	48
<i>Chlorella vulgaris</i>	51-58
<i>Chlorella pyrenoidosa</i>	57
<i>Spirogyra</i> sp.	6-20
<i>Dunaliella bioculata</i>	49
<i>Dunaliella salina</i>	57
<i>Euglena gracilis</i>	39-61
<i>Prymnesium parvum</i>	28-45
<i>Tetraselmis maculata</i>	52
<i>Porphyridium cruentum</i>	28-39
<i>Spirulina platensis</i>	46-63
<i>Spirulina maxima</i>	60-71
<i>Synechoccus</i> sp.	63
<i>Anabaena cylindrica</i>	43-56



**Protein content of 3 common products
(% dry matter)**

	% protein
Meat	33
Milk	26
Soy bean	37



Microalgae = high protein source

Source: Becker, (1994)

Microalgae

Microalgae = high lipid source with high value fatty acids (EPA+DHA+AA)

Oil content of few algal species (%dw)

Microalgal species	Oil content(% dw)
Ankistrodesmus TR-87	28-40
Botryococcus braunii	29-75
Chlorella sp.	29
Chlorella protothecoides (autotrophic/heterotrophic)	15-55
Cyclotella DI-35	42
Dunaliella tertiolecta	36-42
Hantzschia DI-160	66
Nannochloris	31(6-63)
Nannochloropsis	46(31-68)
Nitzschia TR-114	28-50
Phaeodactylum tricornutum	31
Scenedesmus TR-84	45
Stichococcus	33(9-59)
Tetraselmis suecica	15-32
Thalassiosira pseudonana	(21-31)
Crptheodinium cohnii	20
Neochloris oleoabundans	35-54
Schiochytrium	50-77

Yields (Liters of oil /Ha /year)

	Litre/ha
Corn	170
Soybeans	454
Safflower	785
Sunflower	965
Rapeseed	1202
Oil Palm	6009
Micro Algae	13519
	23659



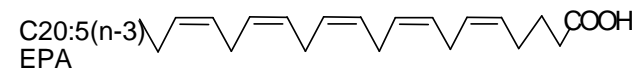
Microalgae

Long-chain Polyunsaturated Fatty Acids

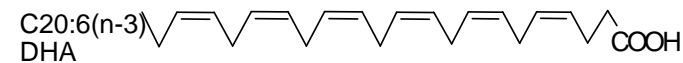
Arachidonic acid



Eicosapentaenoic acid



Docosahexaenoic acid



- Vertebrates and invertebrates require nutritional long-chain polyunsaturated fatty acids : they are not able to synthesize them.
- Human get long-chain polyunsaturated fatty acids from fish.
- Fish get long-chain polyunsaturated fatty acids from algae.



The areas of application of microalgae.

Human food

Spirulina
Diatomea
Chlorella



Animal feed

Oysters
Fish
Crustacean
Poultry
Pigs



Nutraceutical

Polyunsaturated fatty acids
DHA, EPA, AA



Cosmetic

Dermatology
Hair care



Health

Antioxidants
Exopolysaccharides
Antivirus
Cellular plant



Industry

Dyes
Enzymes
Adhesives
Filtration



Energy

Hydrogen
Biofuels
Methane

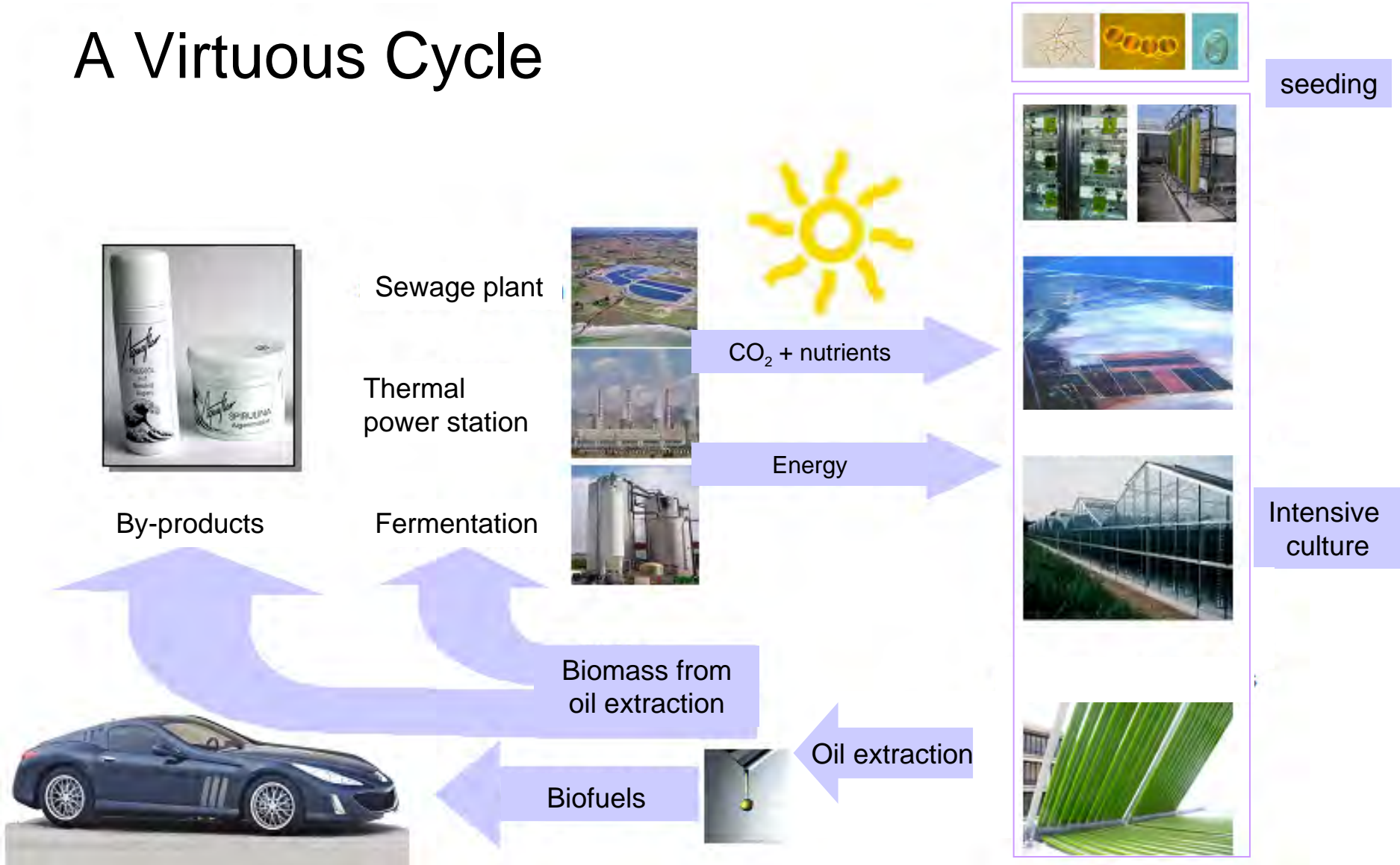


Environment

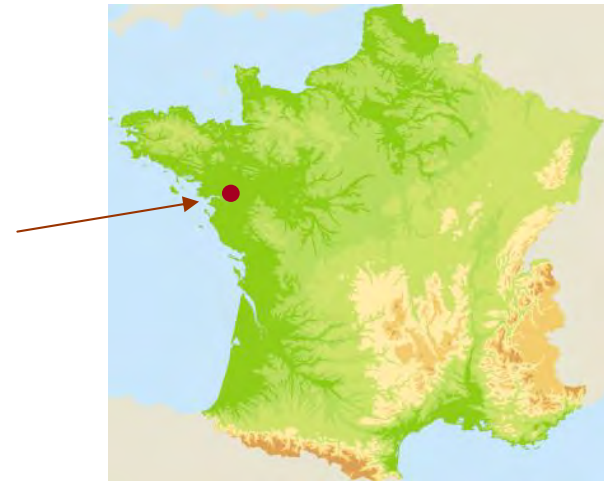
Sequestering of carbon
Decontamination
Remediation



A Virtuous Cycle



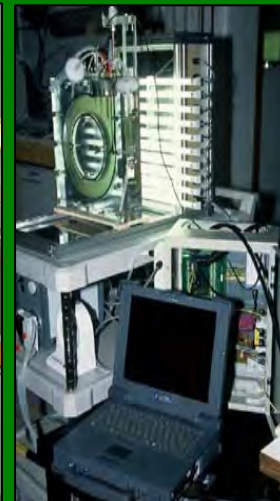
Laboratoire Physiologie et Biotechnologie des Algues (PBA)

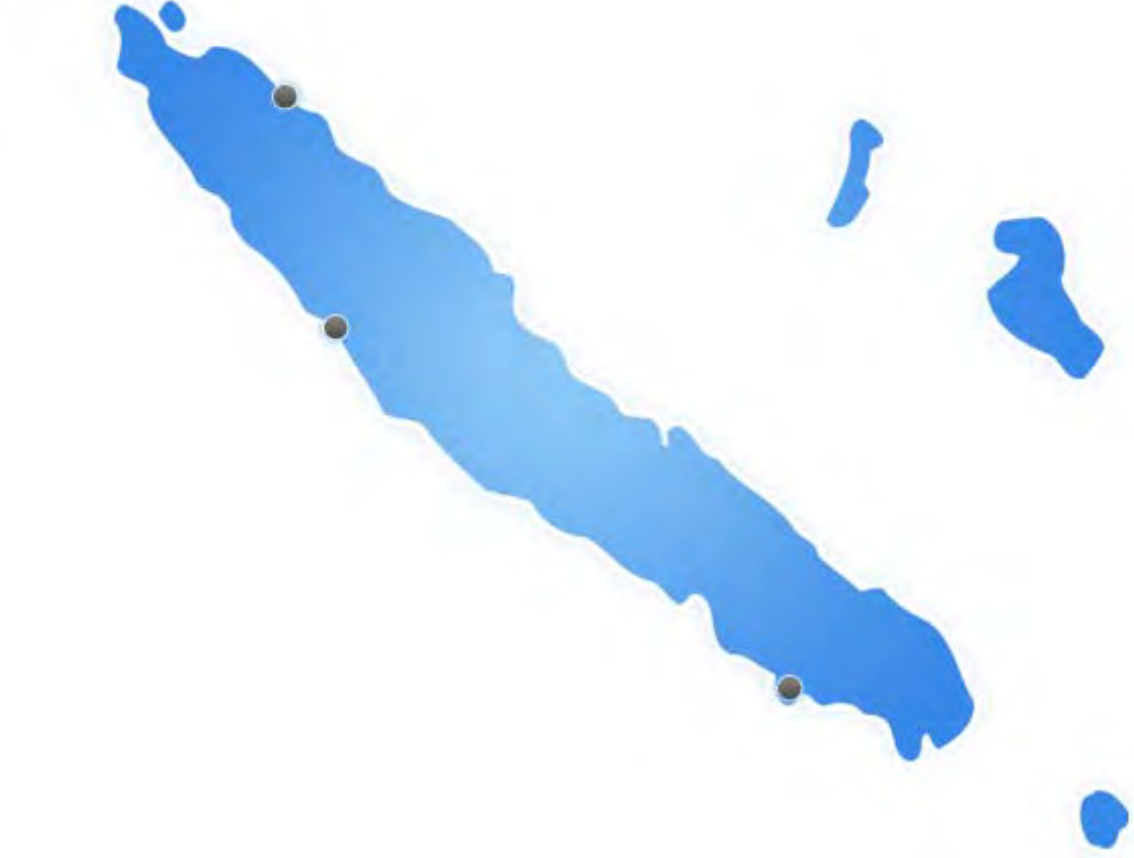


Microalgae

PBA Ifremer Nantes

30 years of skills in culture of Algae, 15 years in biotechnology of Microalgae, 12 permanent positions, high level of equipment.
Key words: Aquaculture, Biotechnology, Ecophysiology, Molecular Biology, Taxonomy, Genomic, Proteomic,
Six patents, One start-up Company





Potential for microalgae R&D in New-Caledonia



Great opportunity to develop mass culture of microalgae

- Ideal climatic conditions
- Large areas of salt marsh
- High biodiversity
- Country with strong tradition in aquaculture
 - Shrimp farming and more recently rabbit fish, sea cucumber...
 - An aquaculture industry structured with well trained professionals
 - Local market for rich protein feedstuff to feed aquaculture and terrestrial animals
- Mining industry with emission of CO₂
- High potential in research with the University of New Caledonia (UNC) and research organizations (IFREMER, IRD,...)



AMICAL

R&D project for production of micro-algae
in New-Caledonia

- 4 years PPP project lead by the New Caledonia Economic development Agency (ADECAL – Technopole) with IFREMER as the key scientific partner. **Total cost : 5 Meuros**
- Strongly supported by local public stakeholders and French Government (green economy development as strategic priority)

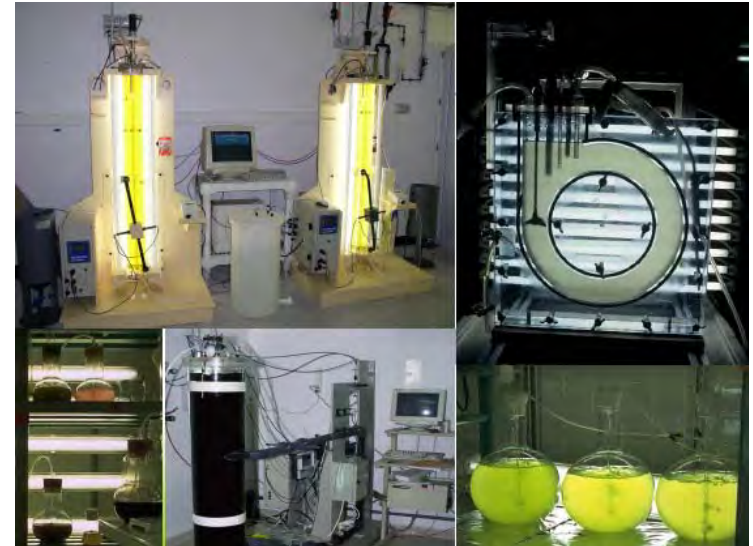


AMICAL

Ifremer

2012 - LEMA

Laboratory for applied research in biology and physiology of microalgae.



2013 - LTMA

Laboratory of technological development and transfer :
pilote scale for mass culture of algae and processing.

ADECAL
TECHNOPOLE



Microalgae

Merci - Thank you

