Du zooplancton pour lutter contre l'eutrophisation

M. Tackx

Présentation basée sur le projet 'BIOFOZI'

et la thèse de Maiwen le Coz (2017) :

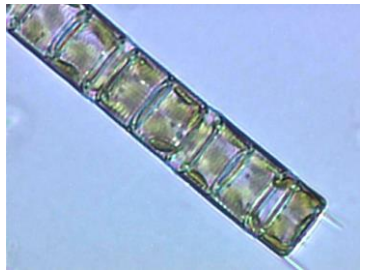
'Distribution et rôle trophique du zooplancton dans le bassin versant de l'Escaut'

EcoLab
Laboratoire écologie fonctionnelle
et environnement

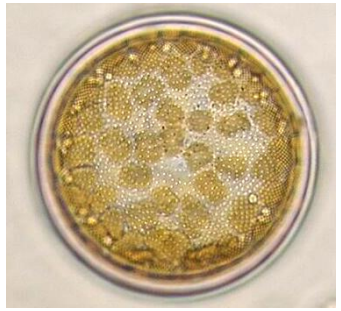
Le plancton

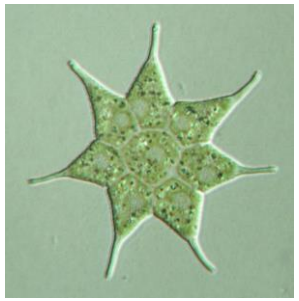
Organismes qui ne résistent pas au courant;
donc qui sont transportés avec les masses d'eau

Le phytoplancton: algues unicellulaires



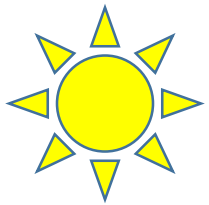
10 µm



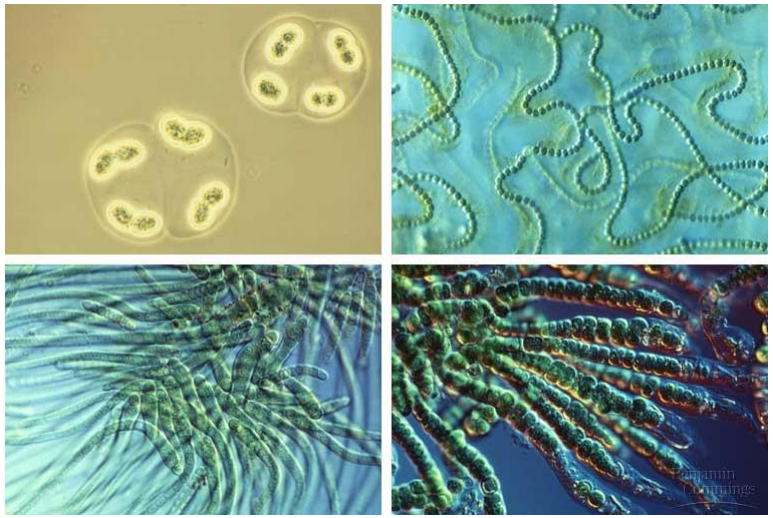


5 µm

Production primaire



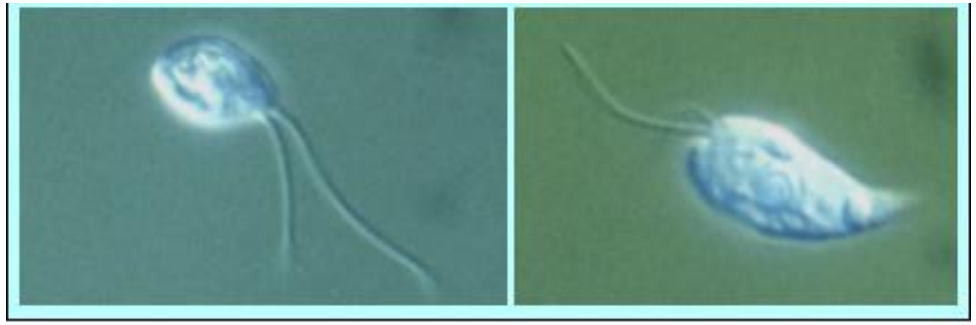
$$N, P, Si + 6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$



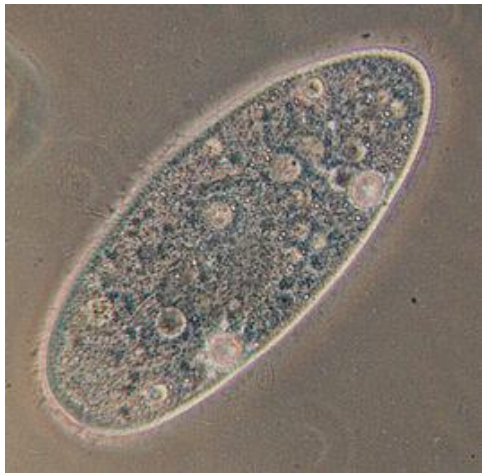
cyanobactéries

Le zooplancton: microzooplancton

flagellées hétérotrophes



ciliées

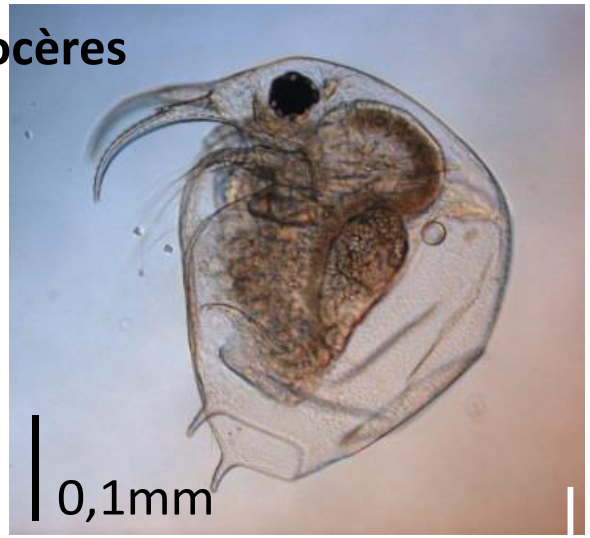


20 µm

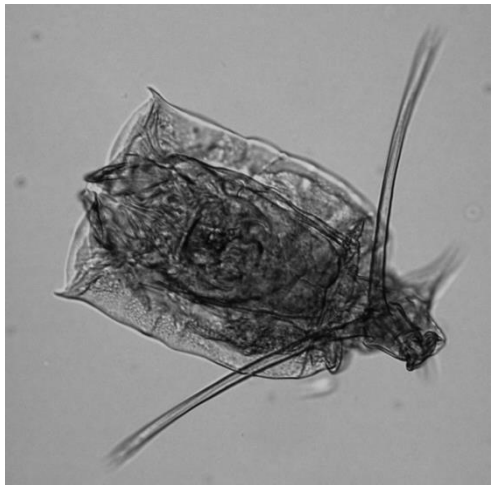
amibes

Le zooplancton: mésozooplancton

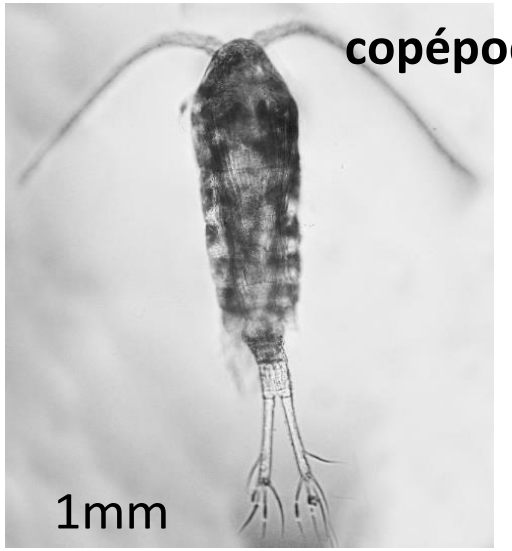
cladocères

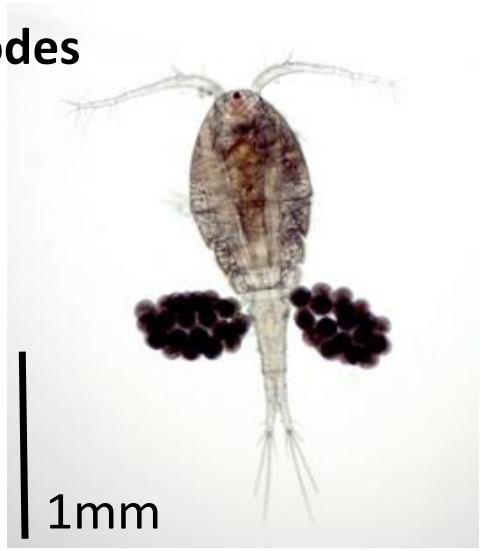


Rotifères: micro- et méso

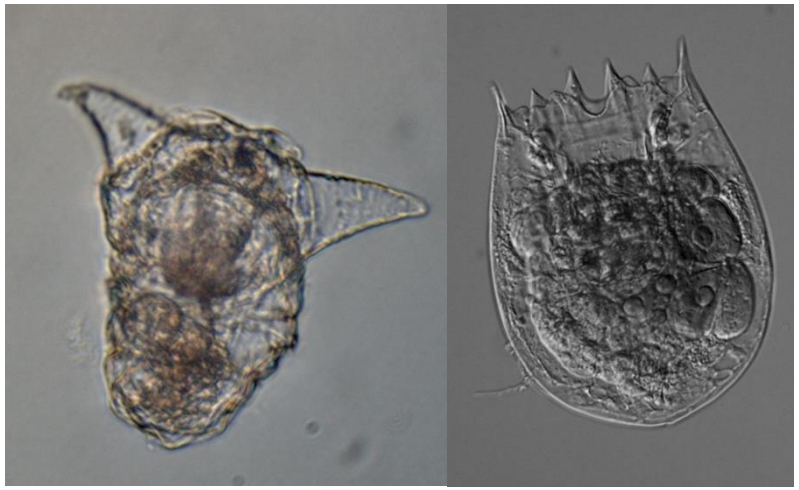


copépodes



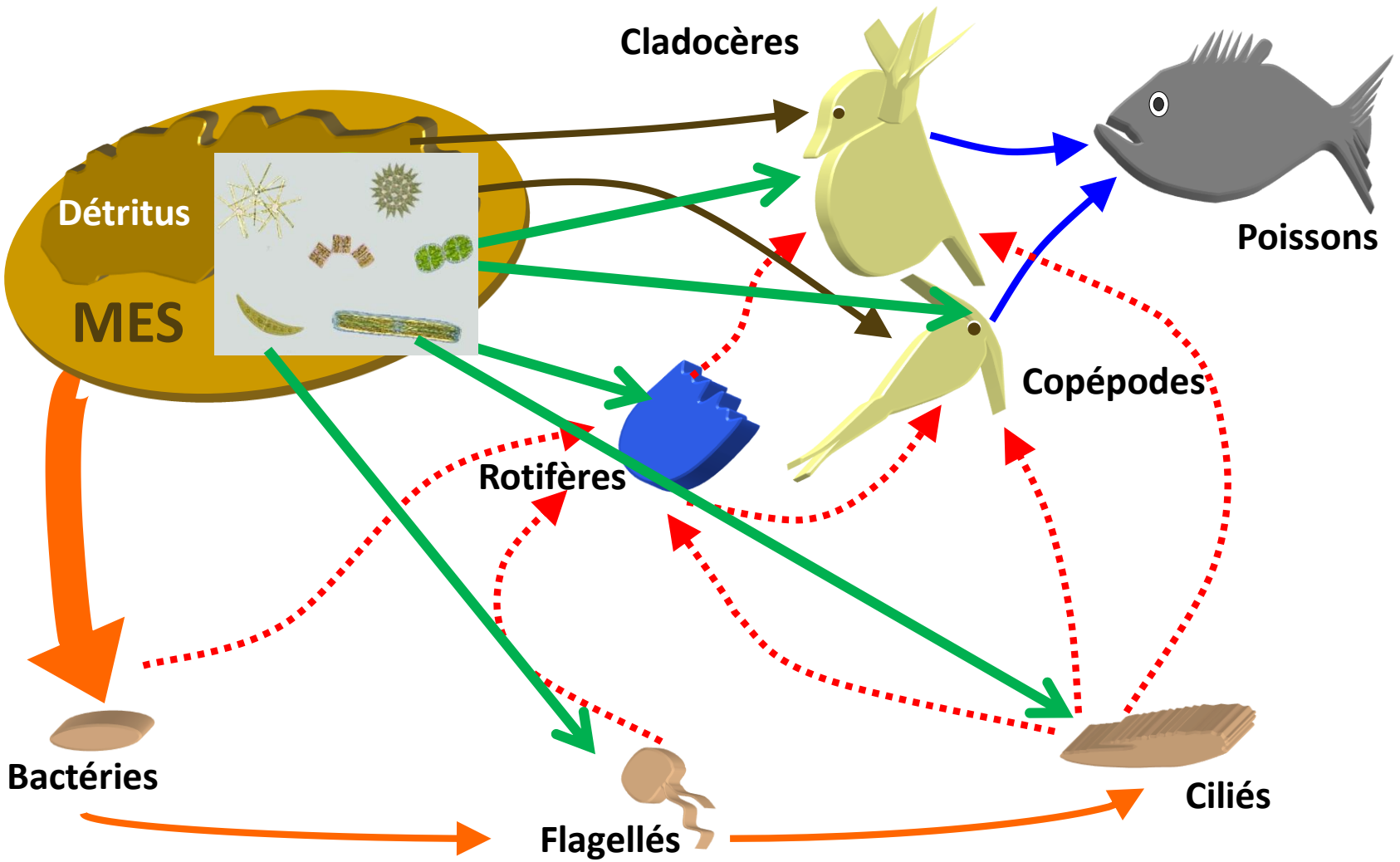


calanoides cyclopoides

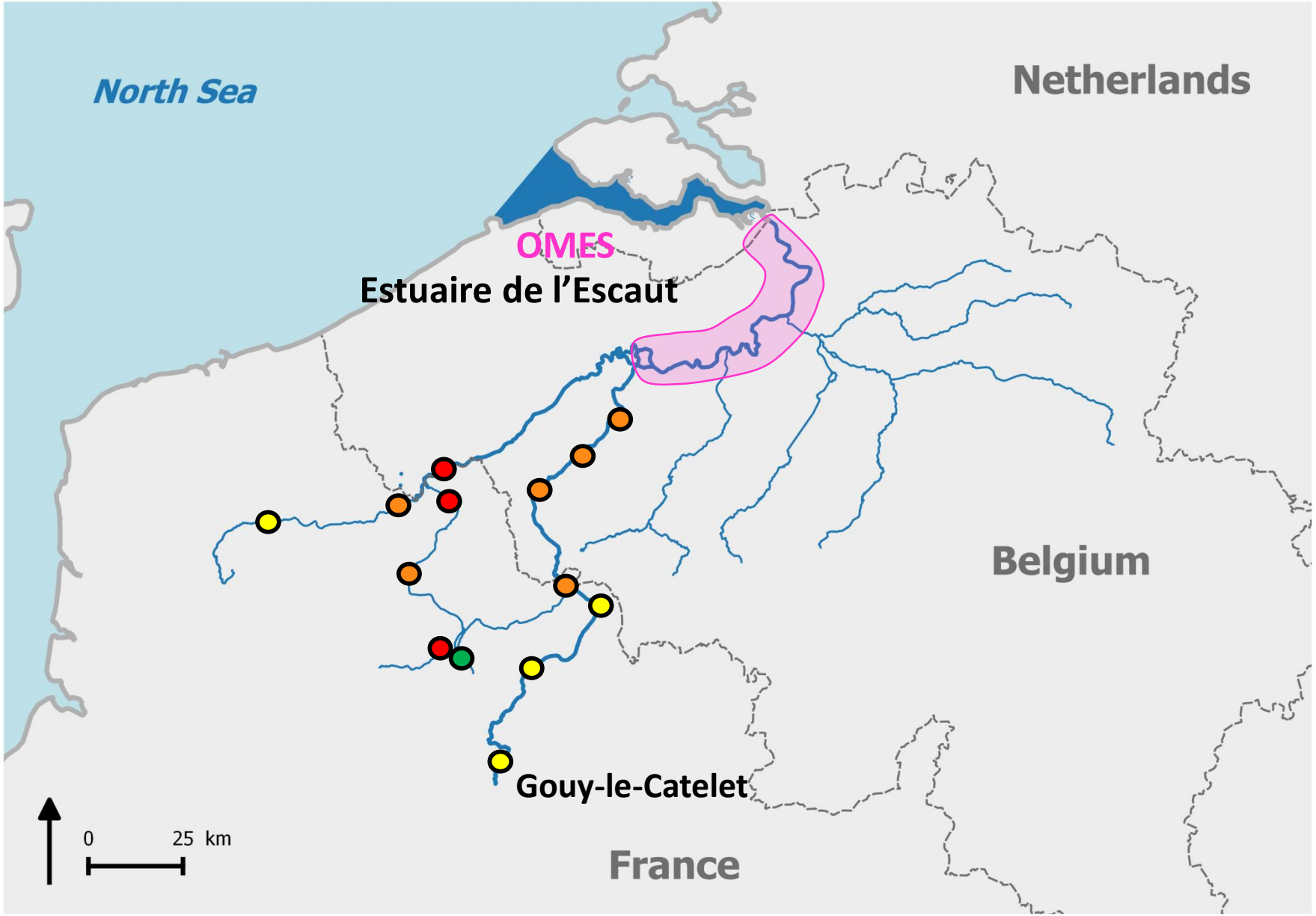


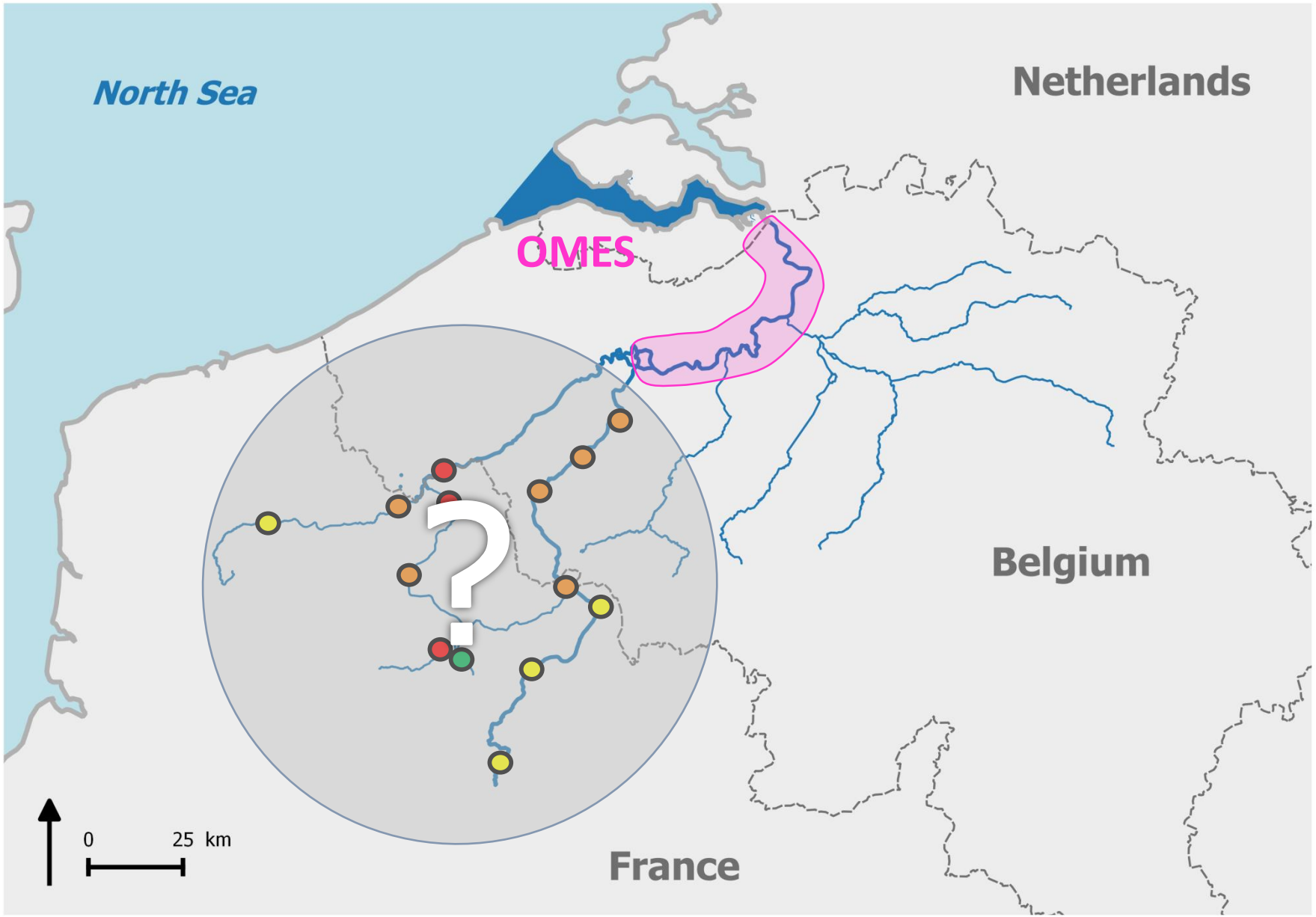
100 µm

Activité trophique du zooplancton

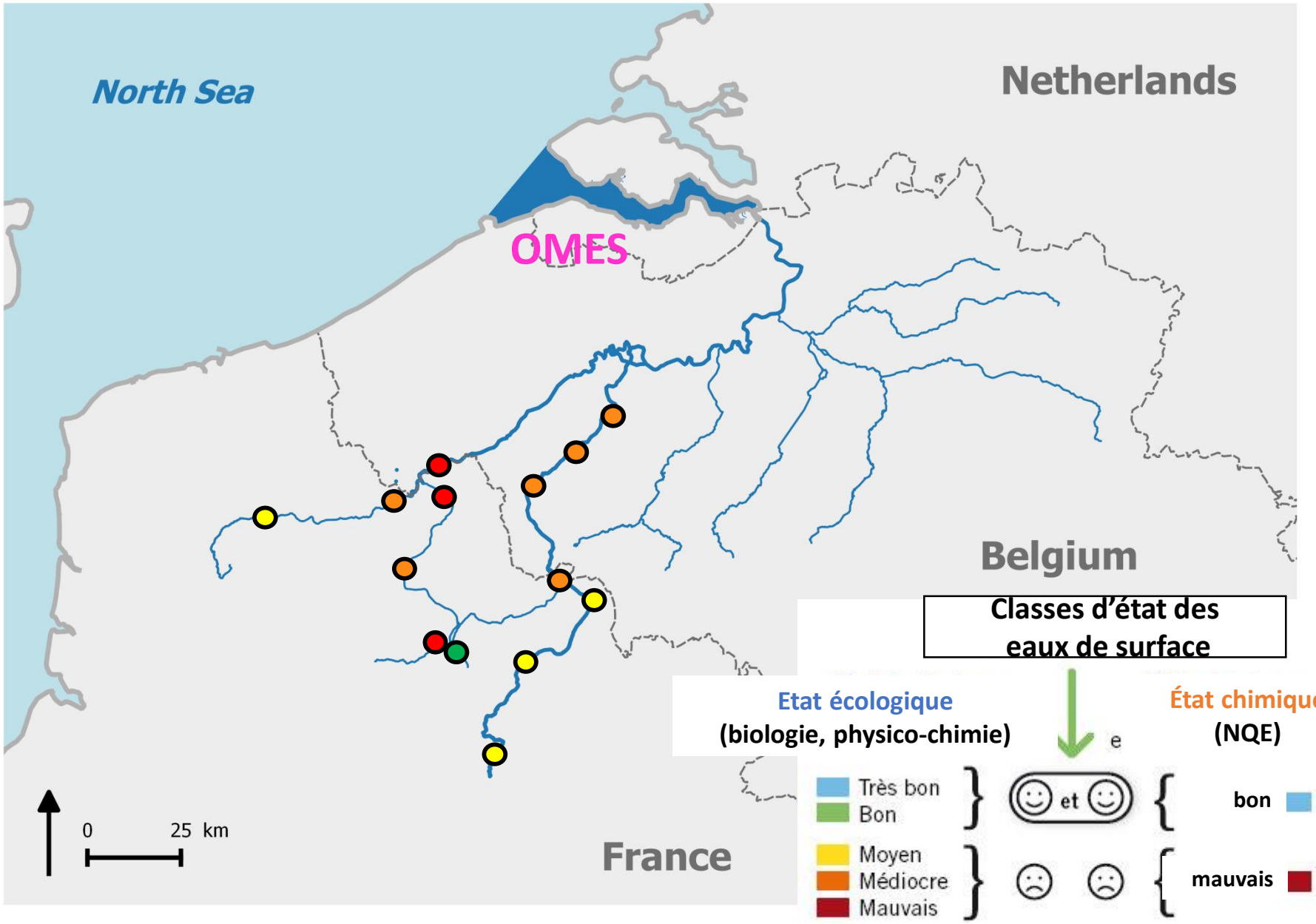


Historique

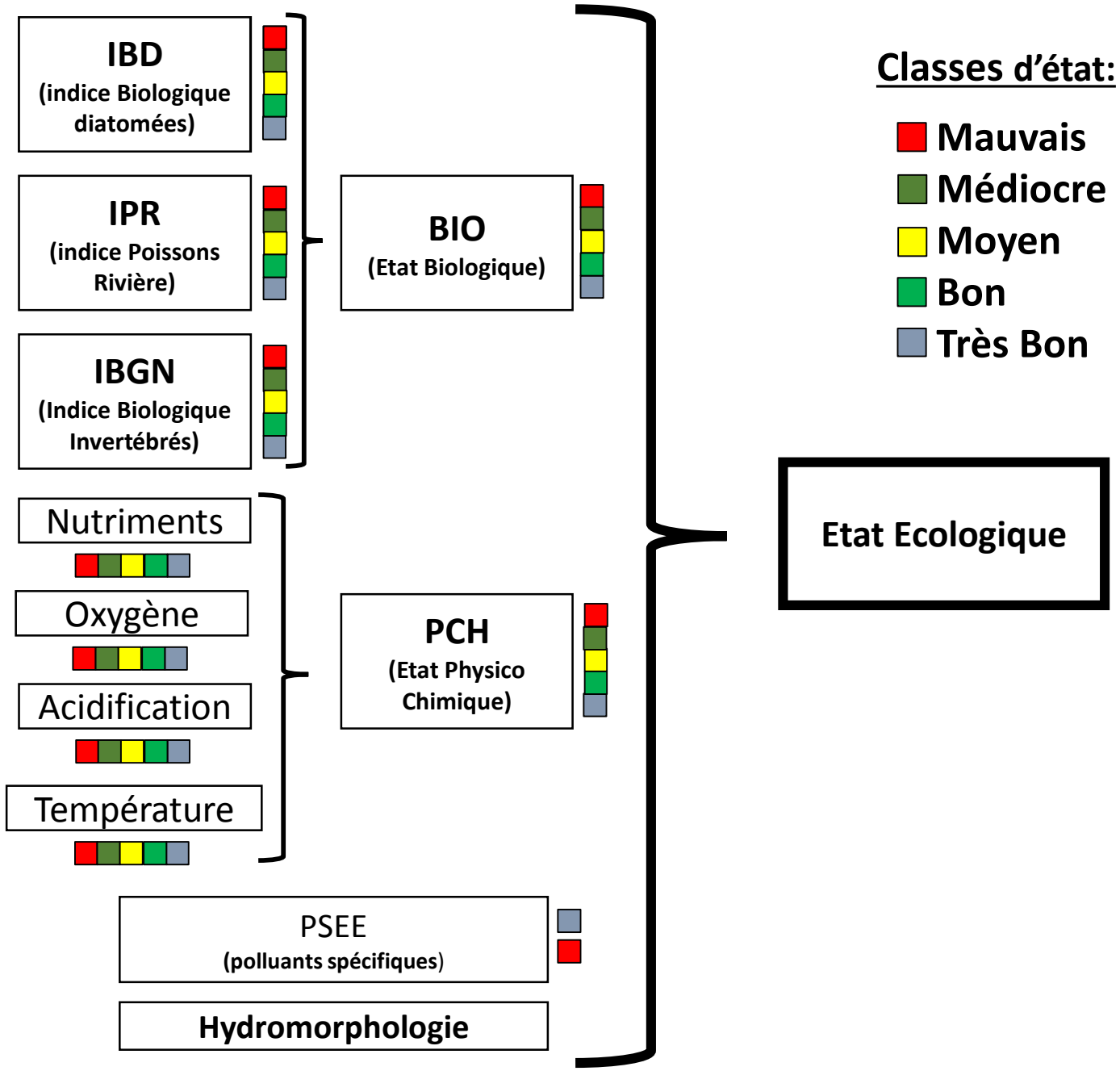

North Sea
Netherlands
OMES
Estuaire de l'Escaut
Belgium
Gouy-le-Catelet
0
25 km
France

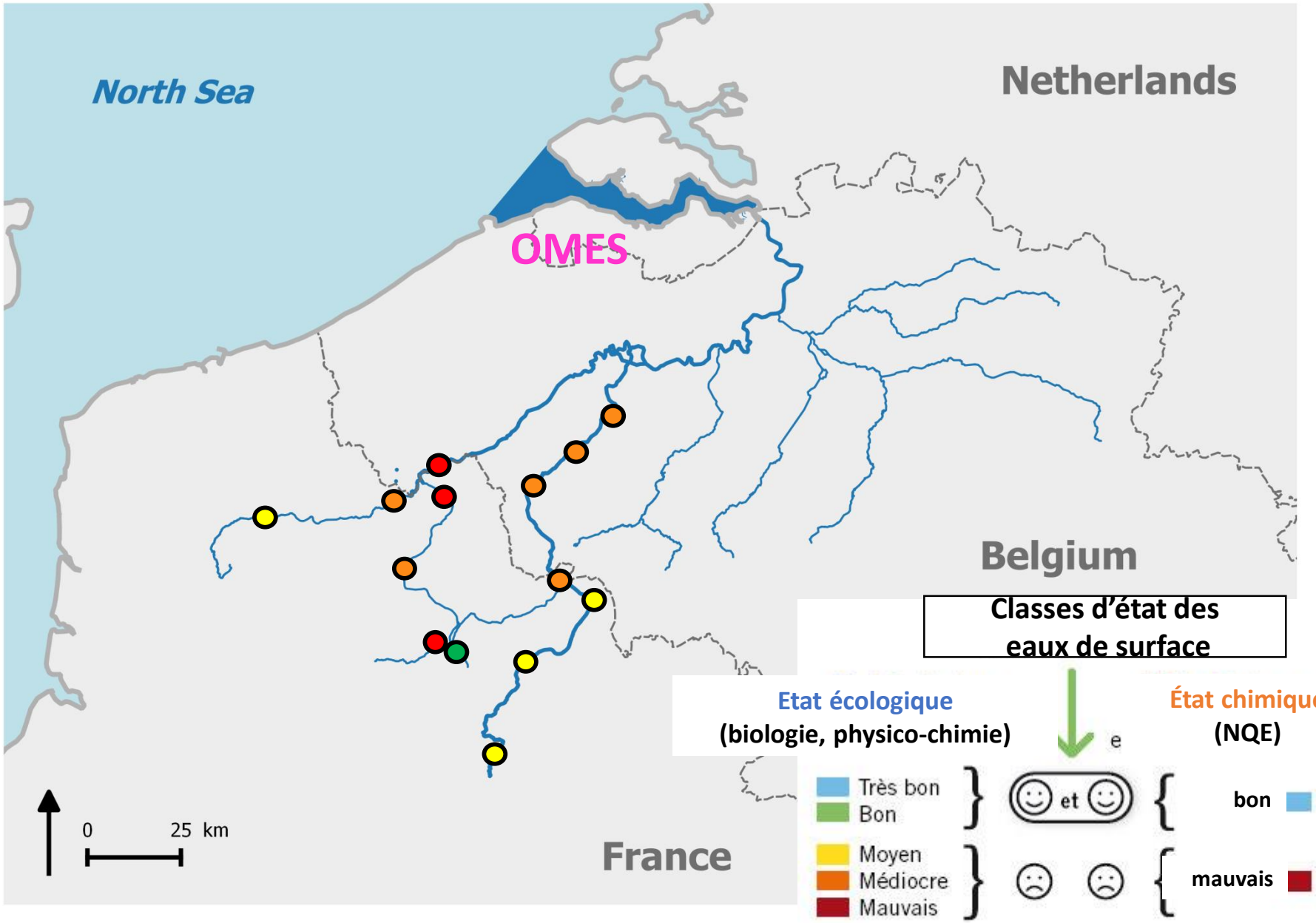

North Sea
Netherlands
OMES
Belgium
France
?
0
25 km

Suivi DCE par l'AEAP



Etat écologique (DCE)

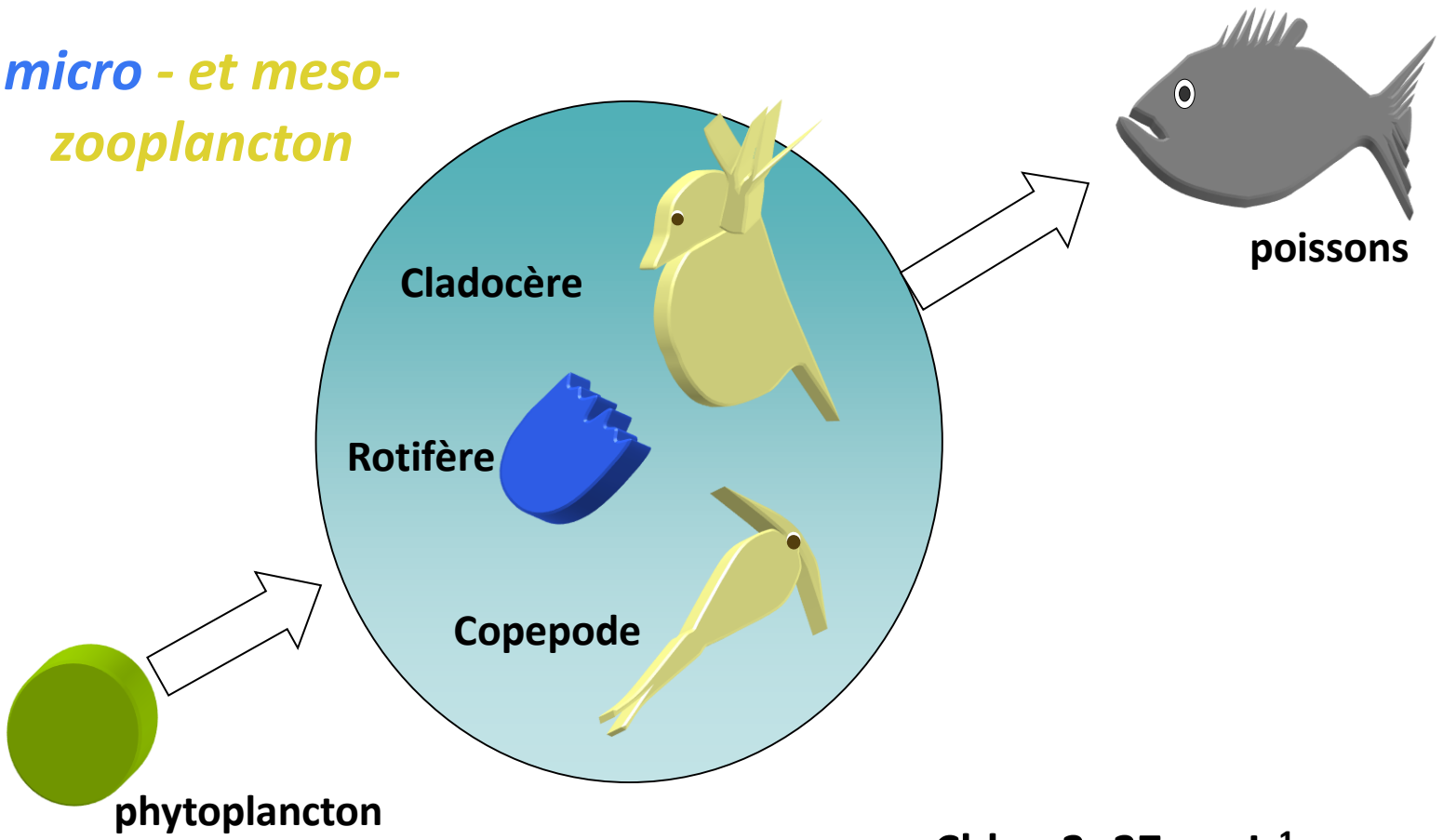



North Sea
Netherlands
OMES
Belgium
France
0
25 km
Classes d'état des eaux de surface
Etat écologique
(biologie, physico-chimie)
e
État chimique
(NQE)
Très bon
Bon
et
bon
Moyen
Médiocre
Mauvais
mauvais

Raisons de déclassement

LE CANAL D'AIRE À LA BASSÉE À AIRE SUR LA LYS (62)	P et N
L'ESCAUT RIVIÈRE À CRÉVECOEUR SUR ESCAUT (59)	NH_4
LA SENSÉE CANALISÉE À FÉRIN (59)	
L'ESCAUT CANALISÉ À NEUVILLE SUR ESCAUT (59)	N
L'ESCAUT CANALISÉ À FRESNES SUR ESCAUT (59)	N et P
LA LYS CANALISÉE À ERQUINGHEM/LYS (59)	N et P, O_2
LA LYS CANALISÉE À WERVICQ (59)	N et P
LA DEULE CANAL À DON (59)	N
LA DEULE CANAL À WAMBRECHIES (59)	PO_4 NH_4
LA SCARPE CANALISÉE À BREBIÈRES (62)	NO_2
LA SCARPE CANALISÉE À NIVELLE (59)	NO_2
LA SAMBRE CANALISÉE À JEUMONT (59)	P et NH_4

eutrophisation



Chl*a* : 3- 37 µg L^{-1}

BIOFOZI

Biodiversité et Fonctionnalité du zooplancton : test de potentiel indicateur de la qualité de l'eau

EcoLab - Université Paul Sabatier, (Toulouse III)/CNRS/INPT

M. Tackx, M. Le Coz, S. Chambord, R. Fernandez, C. Sossou, F. Azémar, E. Buffan-Dubau

Geosystèmes/ LASIR - Université Lille 1

B. Ouddane, S. Net, D. Dumoulin, T. Popescu, S. Rabodonirina.

LOG - Université Lille 1

S. Souissi, J. Ovaert

ECOBE – University of Antwerp

P. Meire, T. Maris, D. Van Pelt

bourse de thèse ESR

Questions

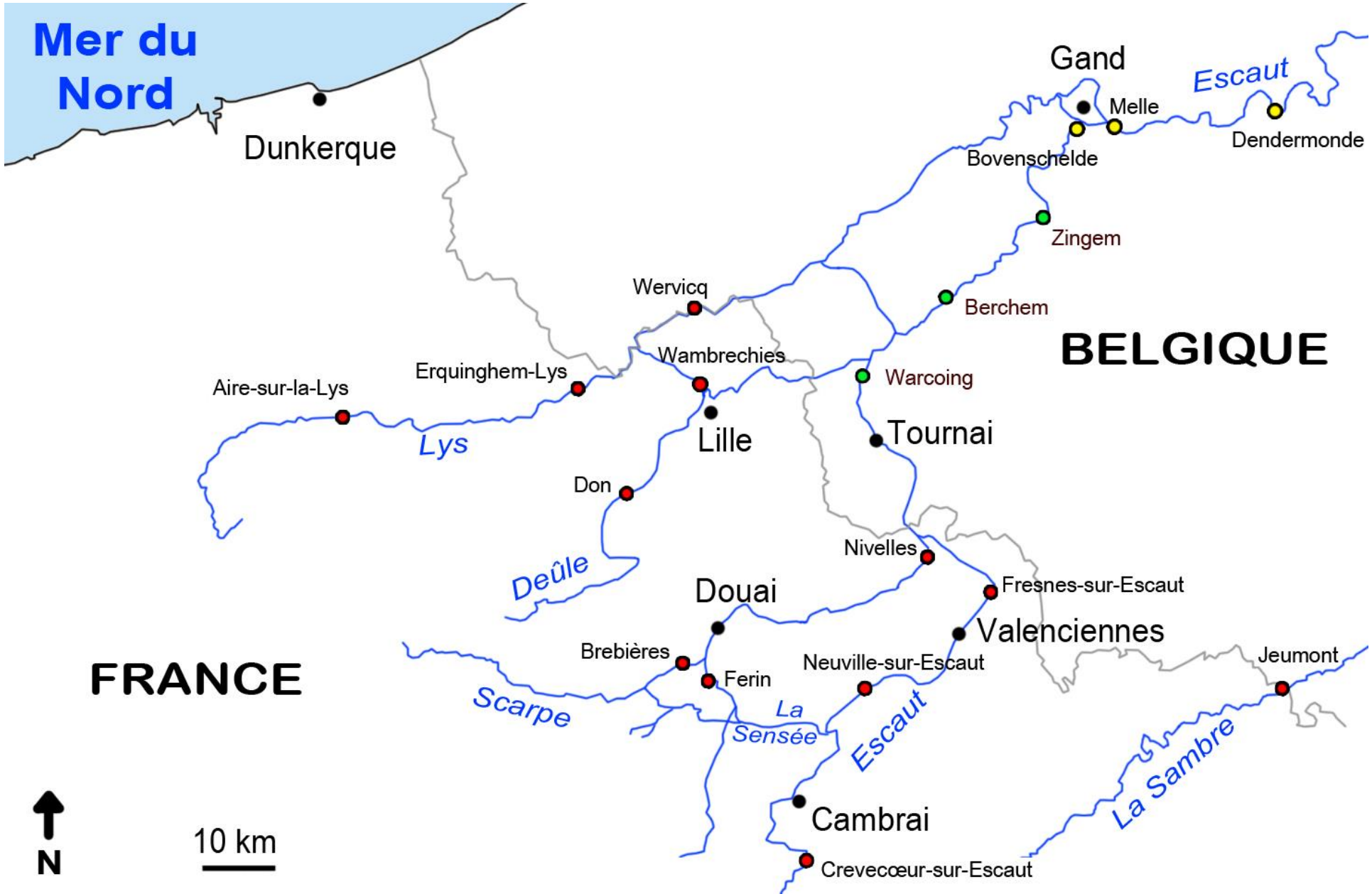
Y a-t-il du zooplancton ?

Communautés importantes ?
Diversifiées ?

En accord avec la classification DCE ?

Rôle trophique du zooplancton ?

BIOFOZI: stations d'échantillonnage : 5 campagnes 2013-2015



Echantillonnage: **50 L sub-surface / 50µm maille + Formol 4%**

Comptage

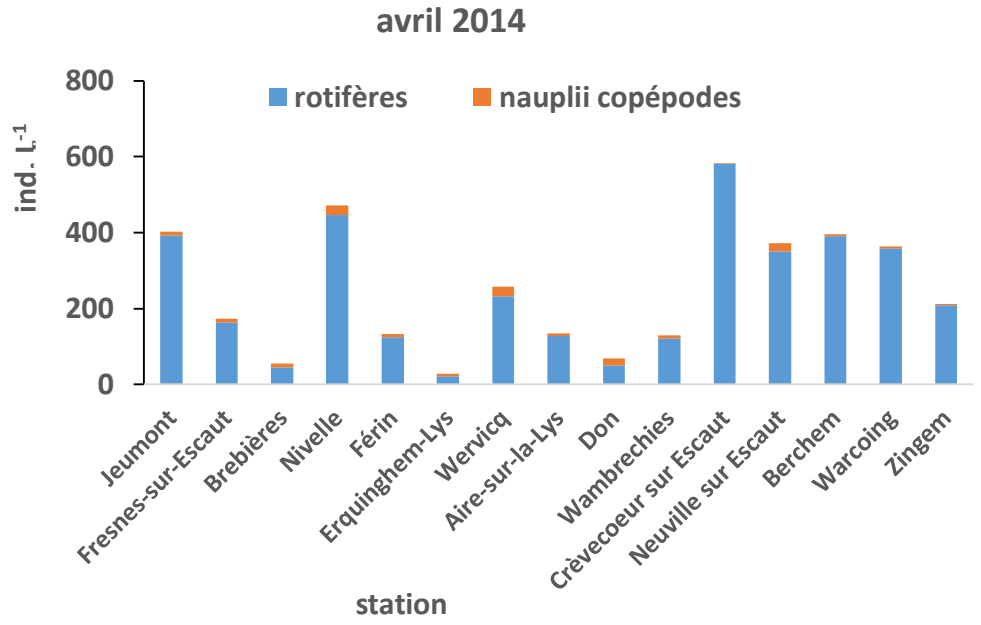
+ paramètres environnementaux

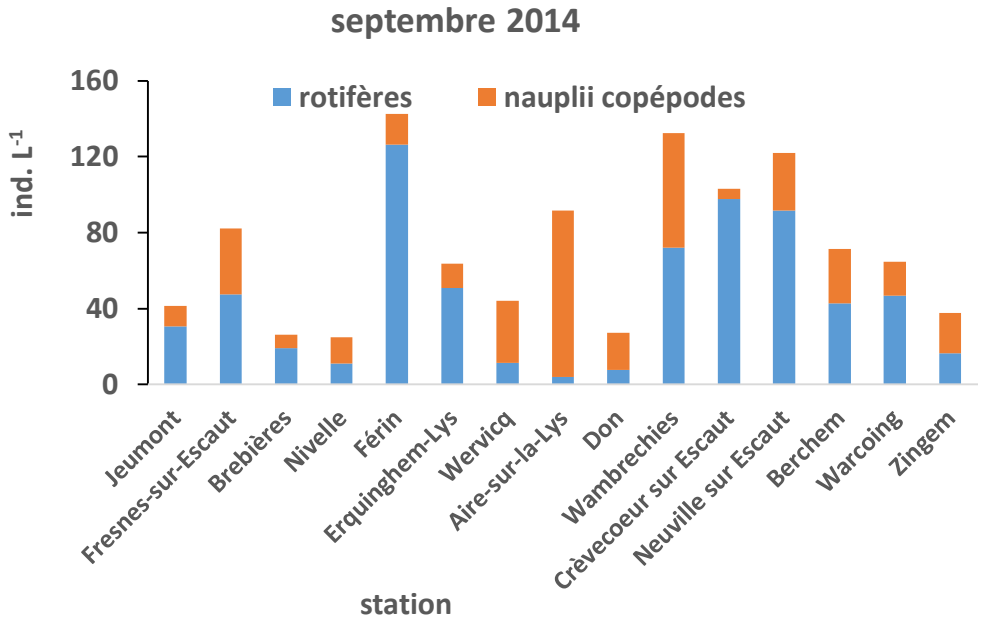
- **Température, O_2, in situ**
- **Chl*a* et pigments marqueurs (HPLC)**
- **MES et MO, nutriments**

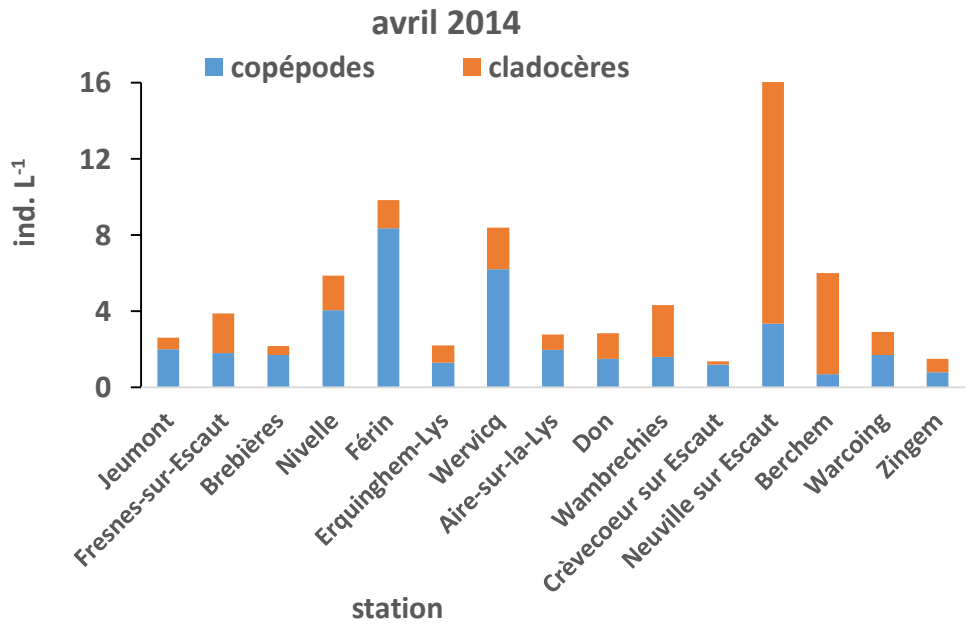
- **<u>Contaminants:</u> HAPs, Mtrs**

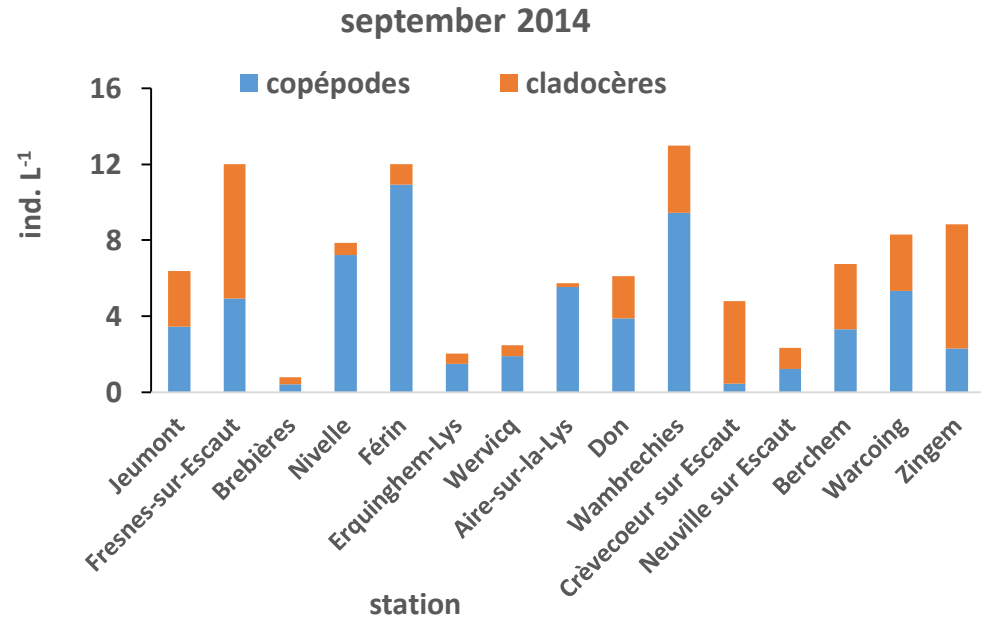
LASIR

Abondance du zooplancton

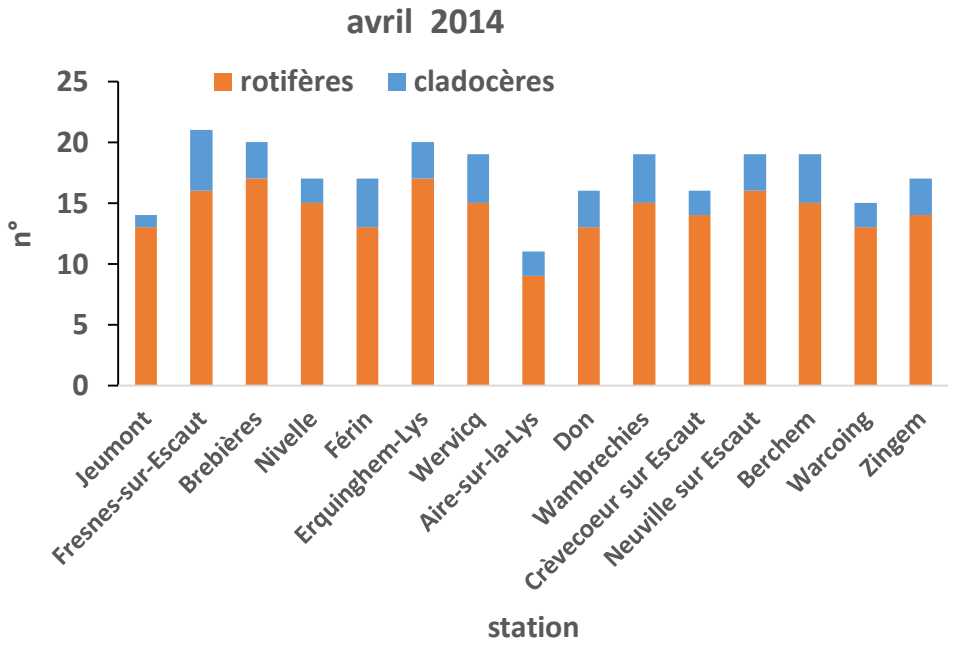


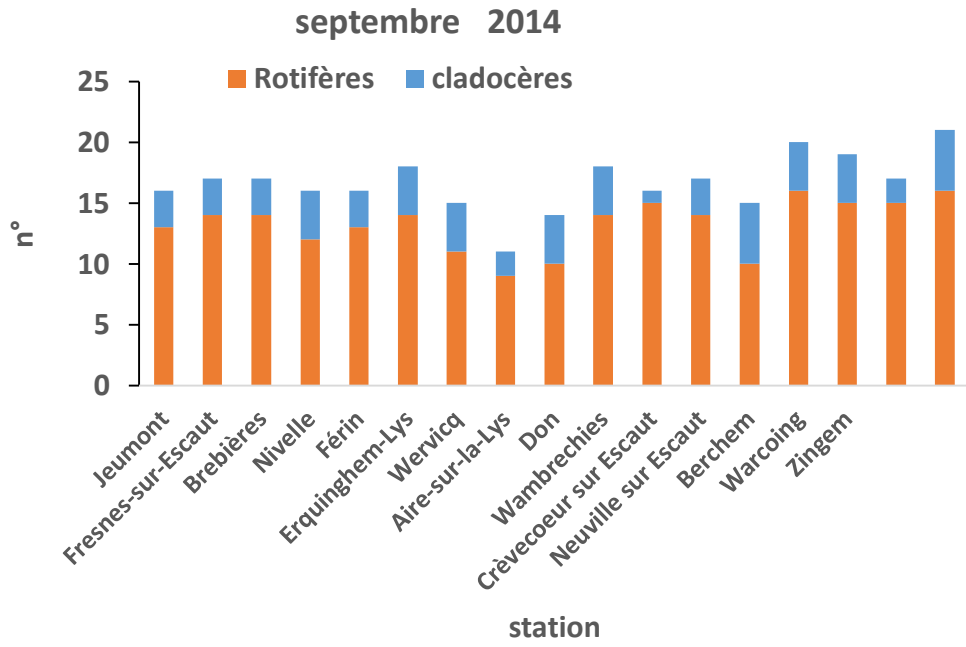






Diversité du zooplancton.

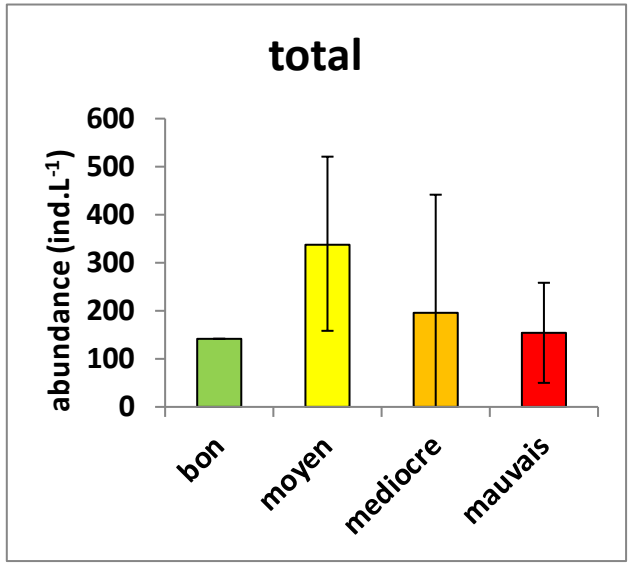


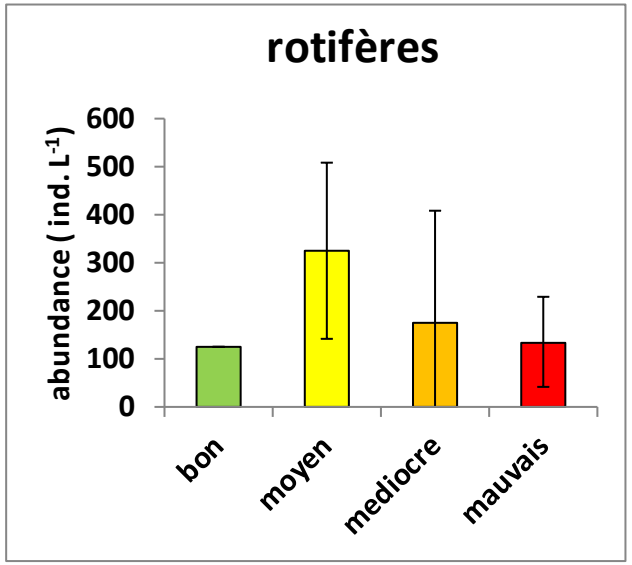


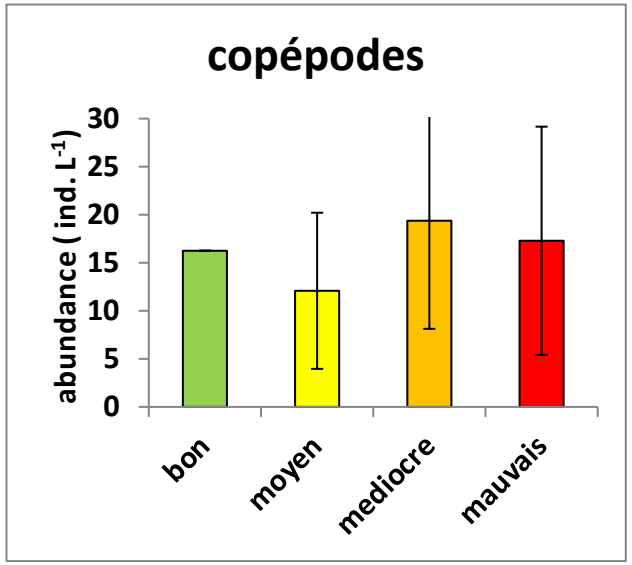
Communautés de zooplancton abondantes et diversifiées

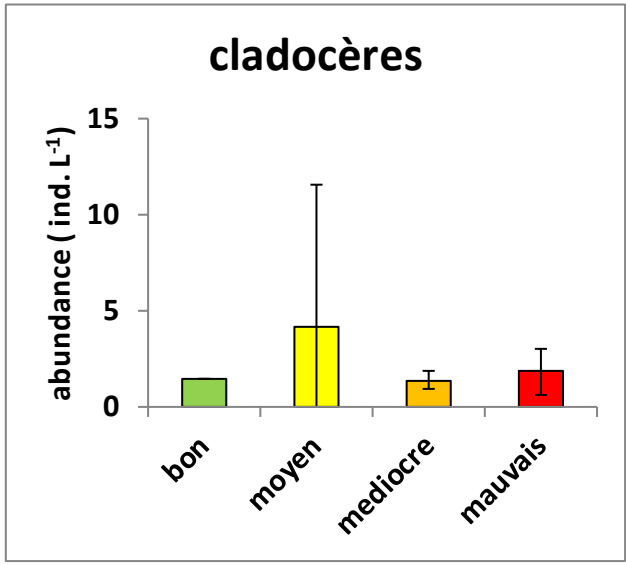
Accord avec classification DCE? Abondances

avril 2014

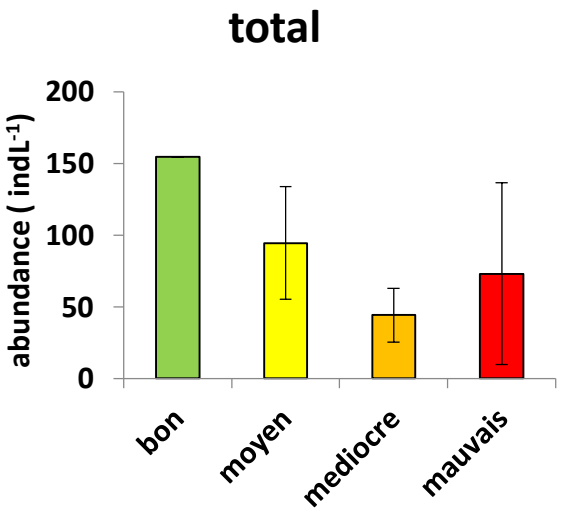


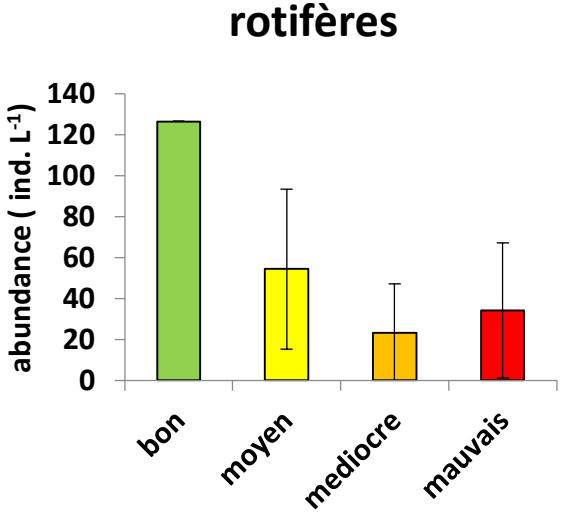


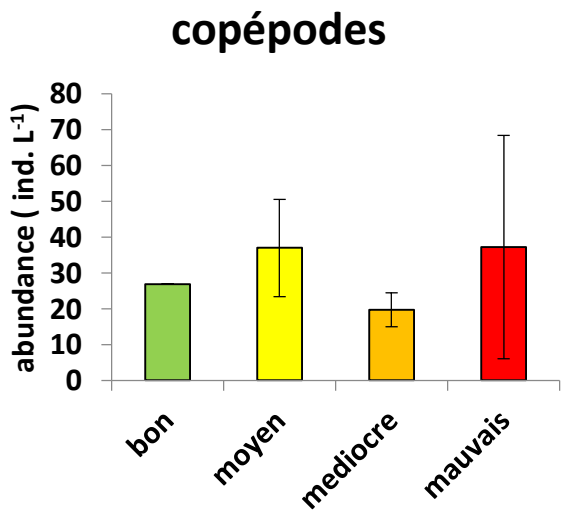


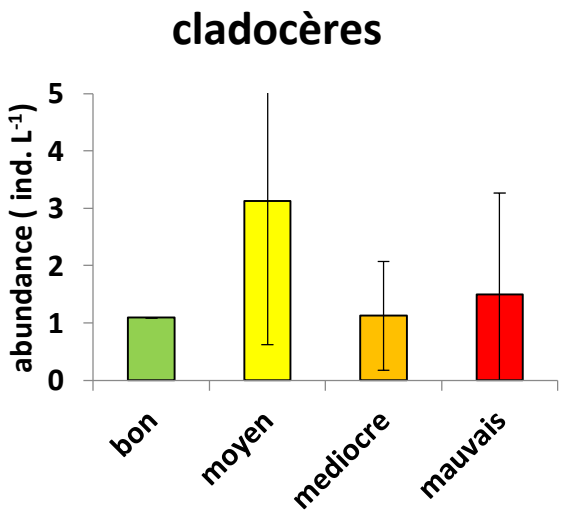


septembre 2014



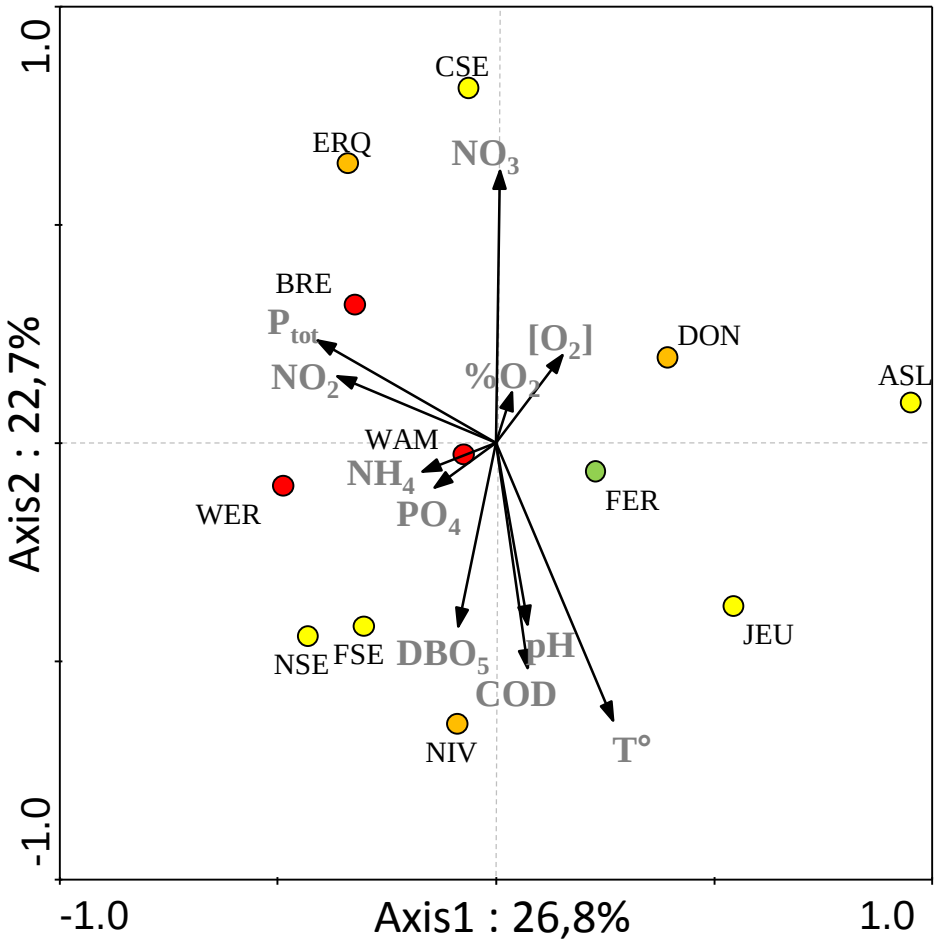


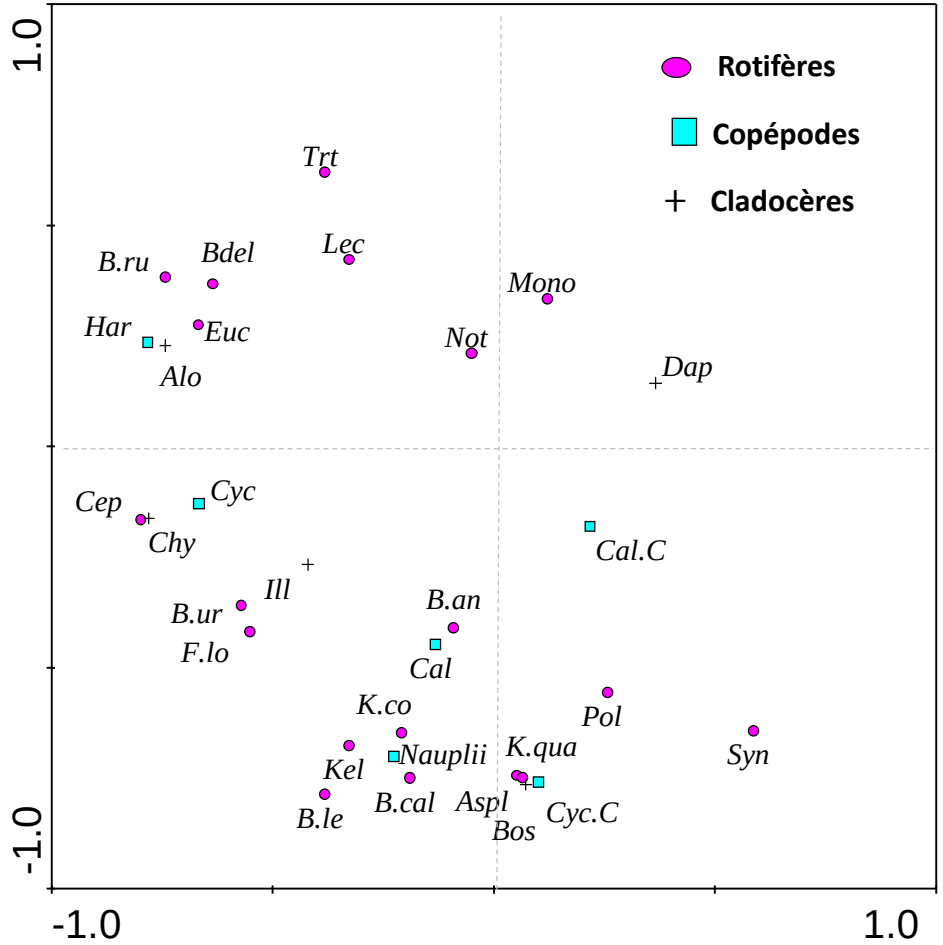




Composition des communautés

Analyses multivariées



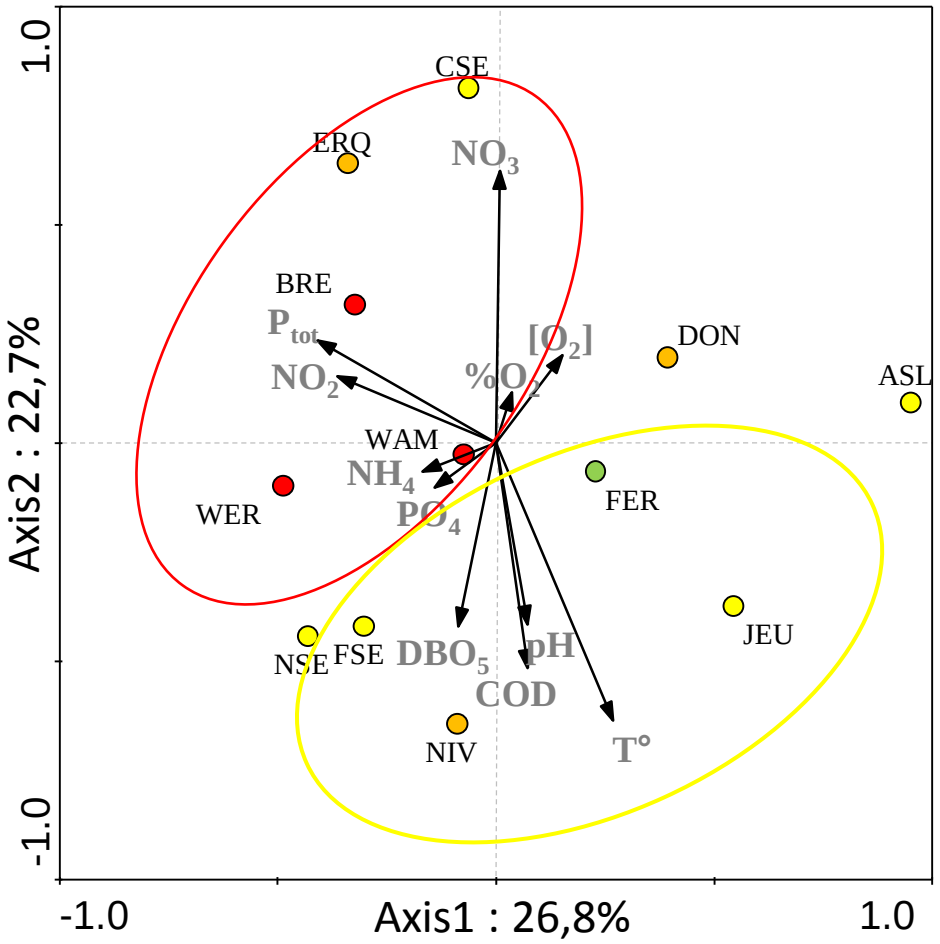


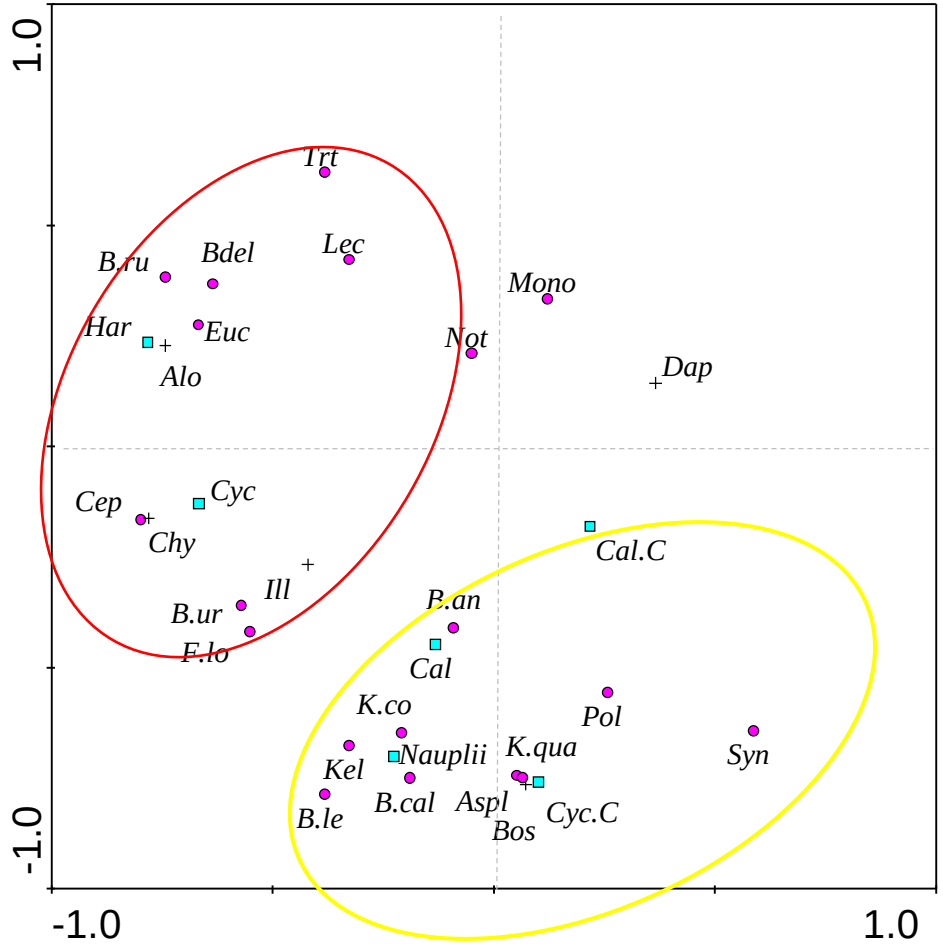
Classes d'état DCE:

- Mauvais
- Médiocre
- Moyen
- Bon
- Très Bon

taxons

Analyses multivariées





Classes d'état DCE:

- Mauvais
- Médiocre
- Moyen
- Bon
- Très Bon

taxons

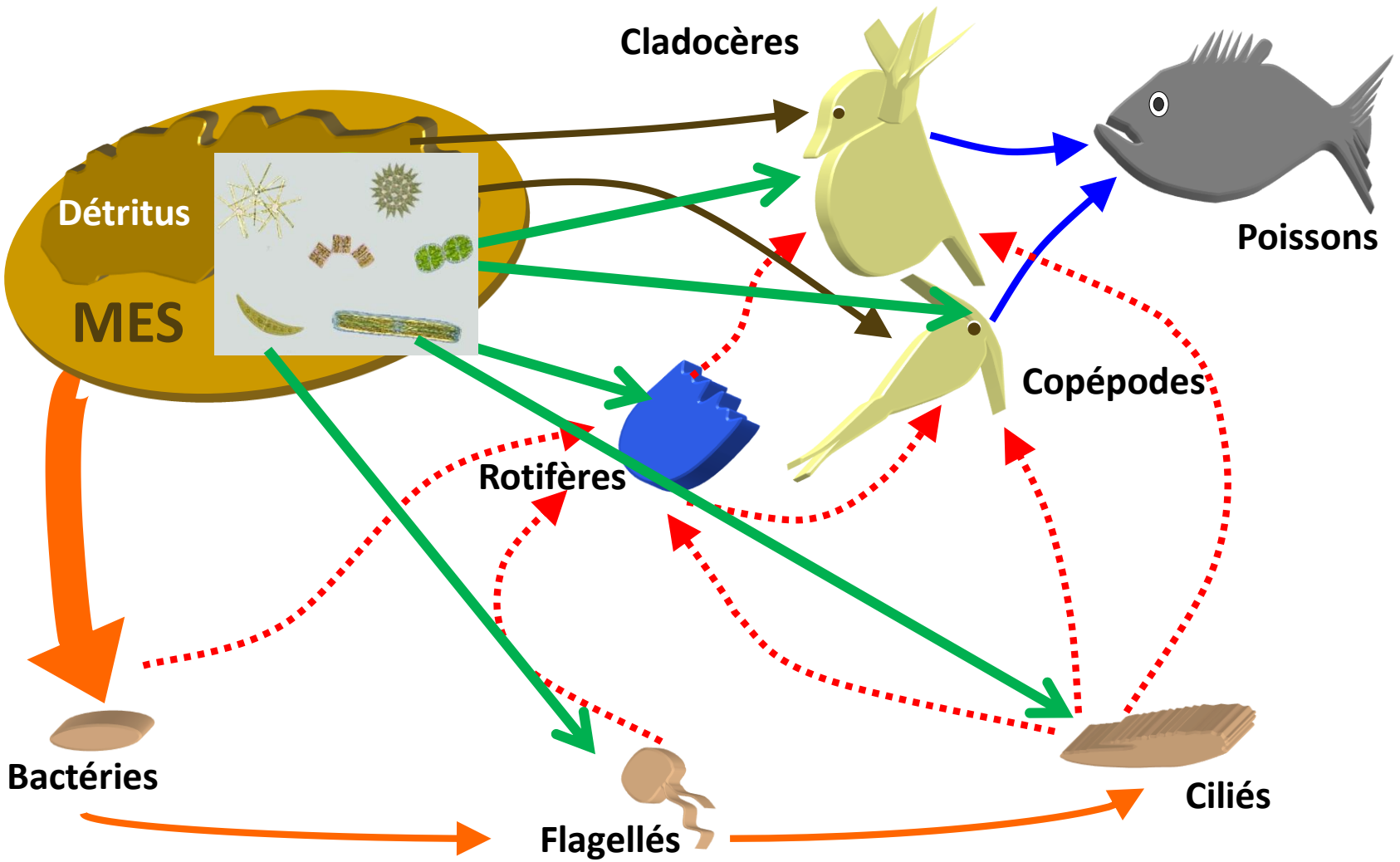
- Rotifères
- Copepodes
- Cladocères

Abondance du zooplancton : pas en accord avec le classement DCE

Zoo partout

Différentes communautés adaptées à différentes conditions de qualité de l'eau

Activité trophique du zooplancton



Expériences d'incubation:

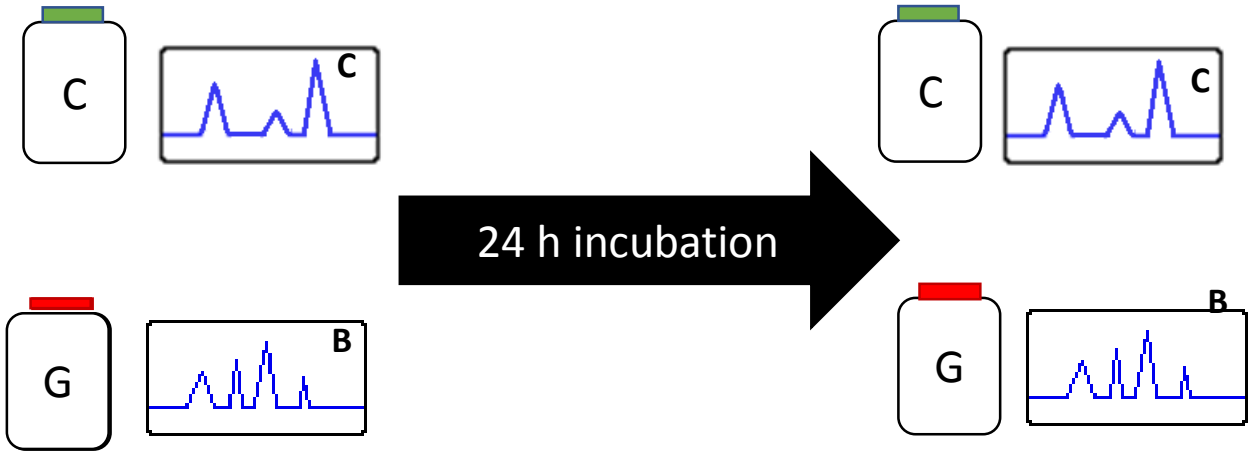
HPLC : quantification de pigments du phyto

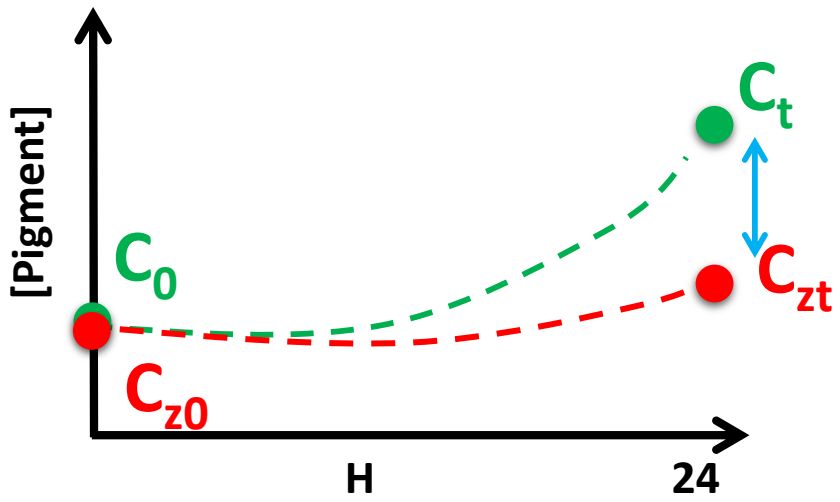
contrôle

Eau naturelle < 50 µm
(MES avec phytoplancton)

broutage

Eau naturelle < 250 µm
(MES avec phytoplancton
+ zooplancton)





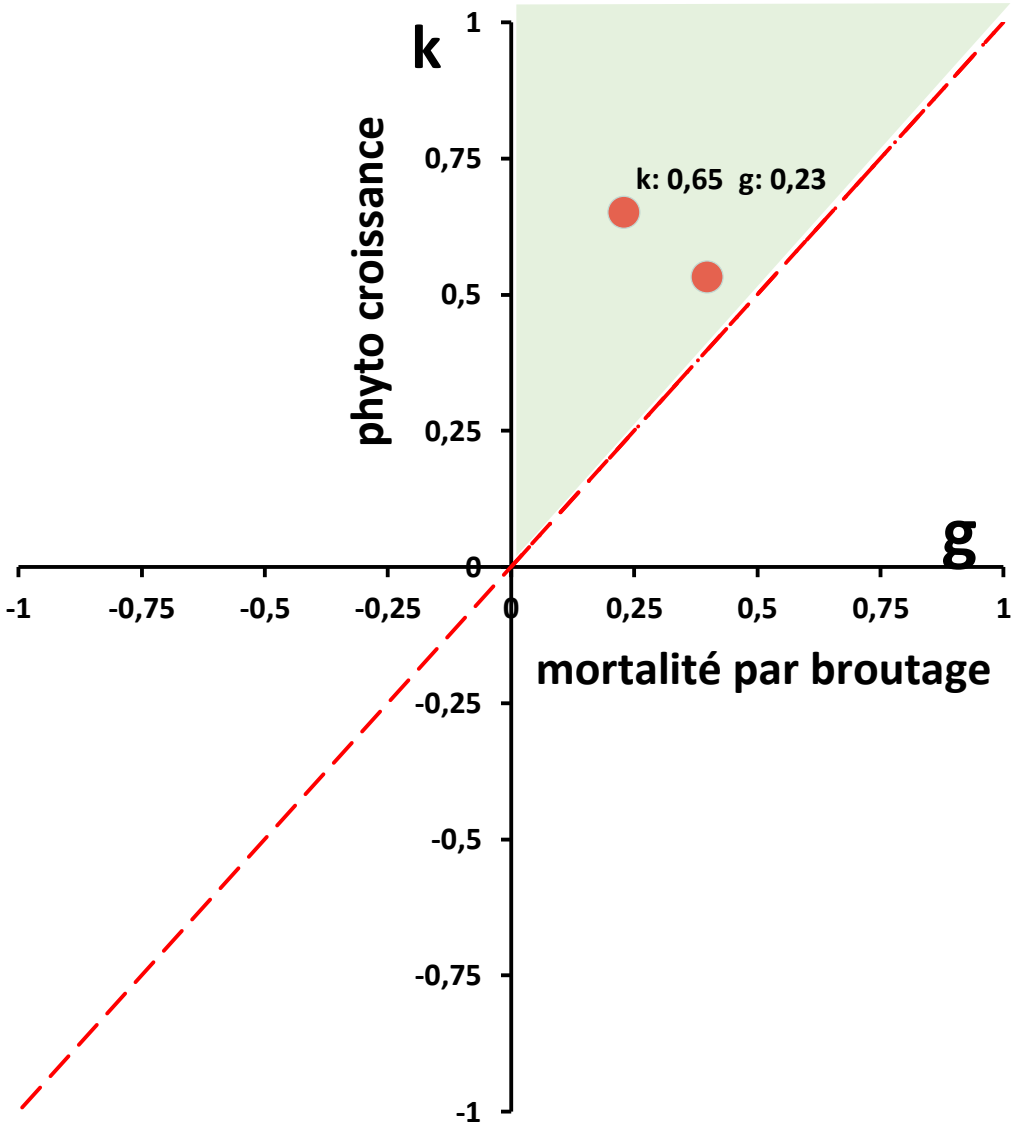
$$k = \frac{1}{t} \ln \frac{\overline{C_t}}{C_o}$$

Phyto croissance

$$g = \frac{1}{t} \ln \frac{\overline{C_t}}{C_{zt}}$$

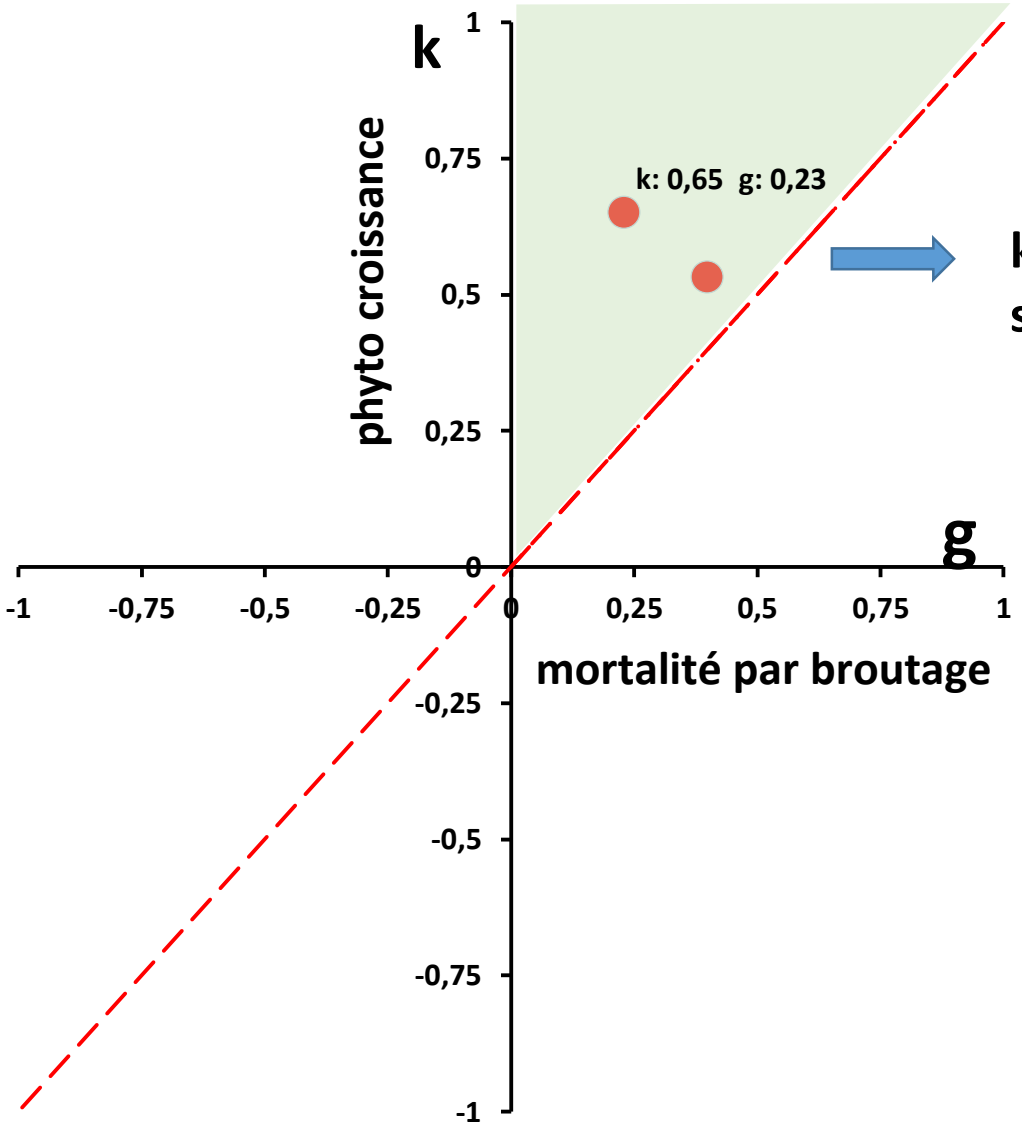
Zoo broutage:
mortalité par broutage

Impact du zooplancton sur le phytoplancton



- Chlorophylle a: biomasse totale phyto

Impact du zooplancton sur le phytoplancton

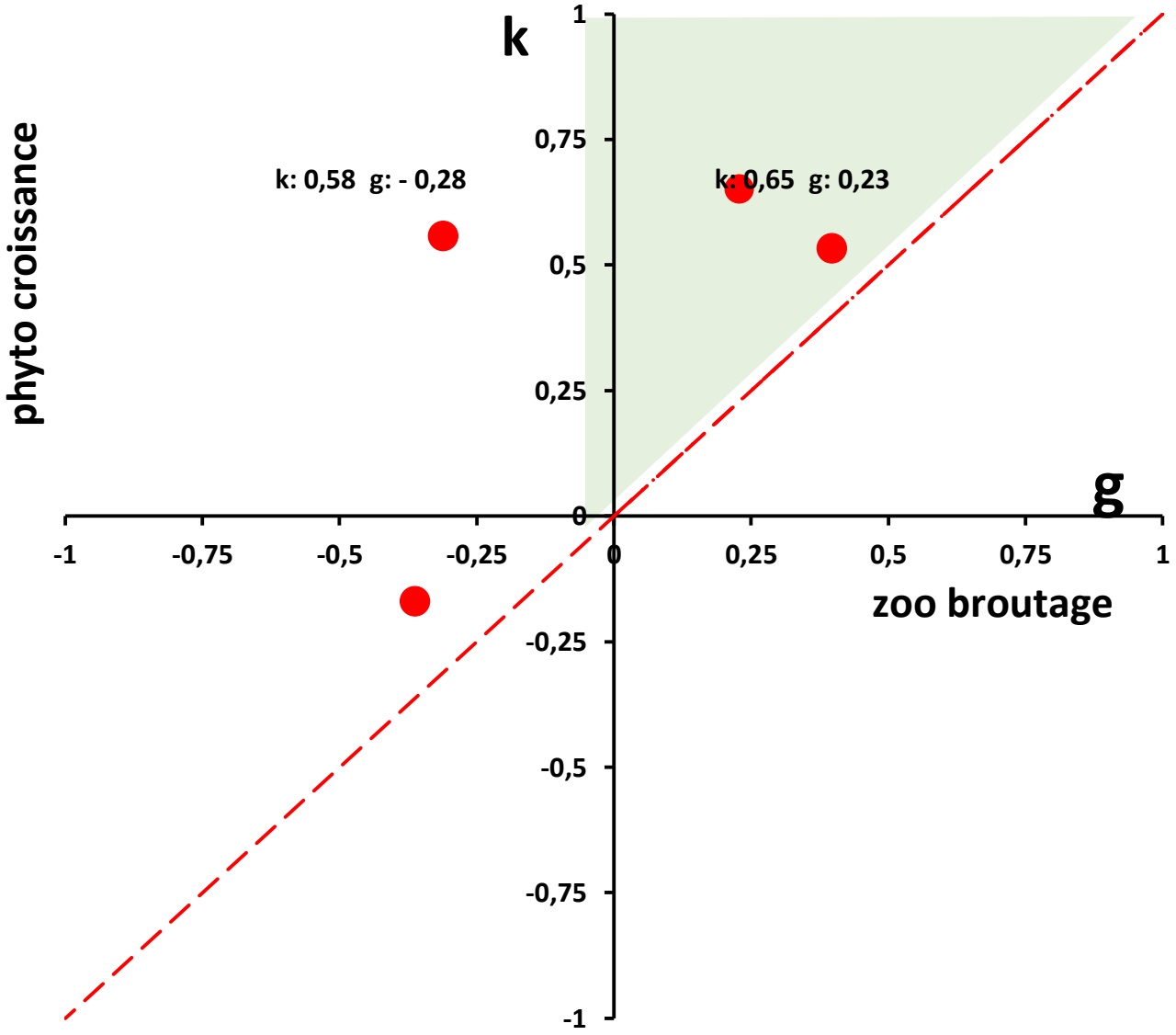


- Chlorophylle a: biomasse totale phyto

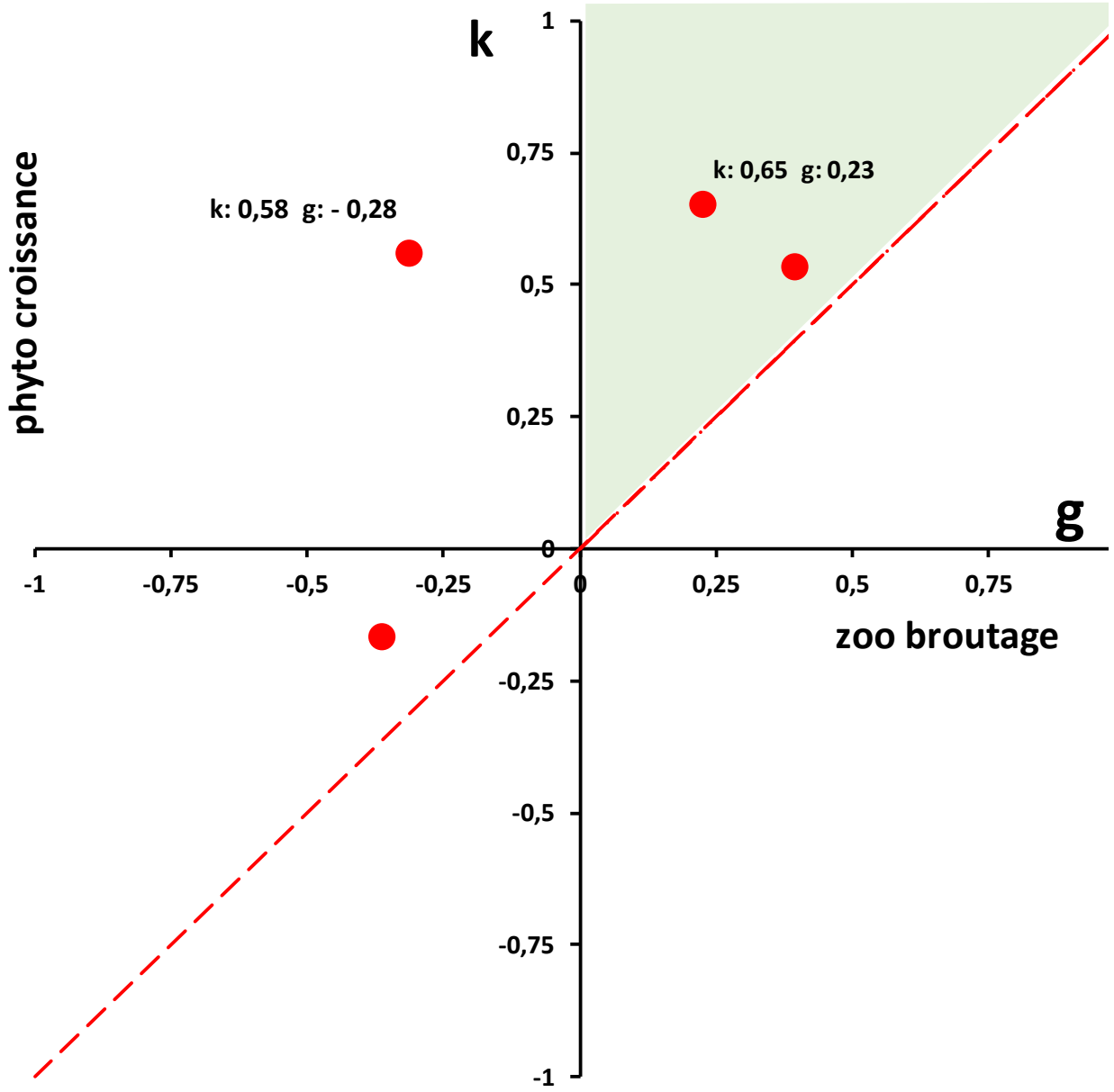
k > g: le phyto n'est pas surexploitée par le zoo

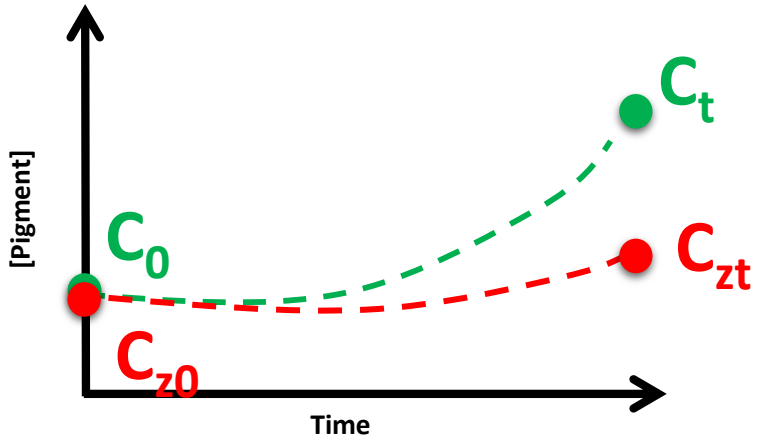
Impact du zooplancton sur le phytoplancton

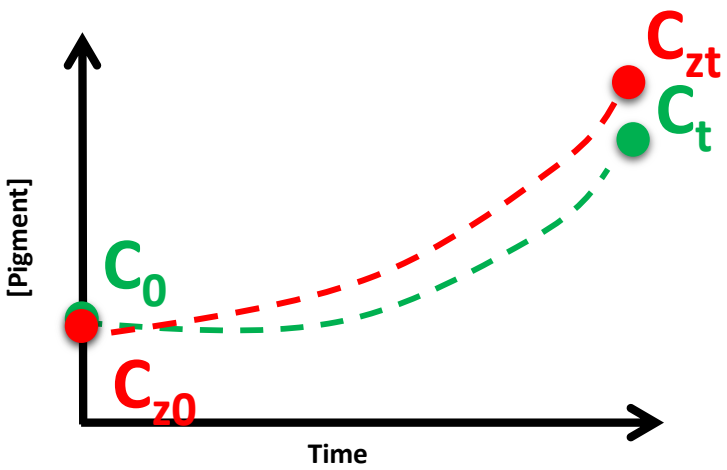
Broutage négatif ?



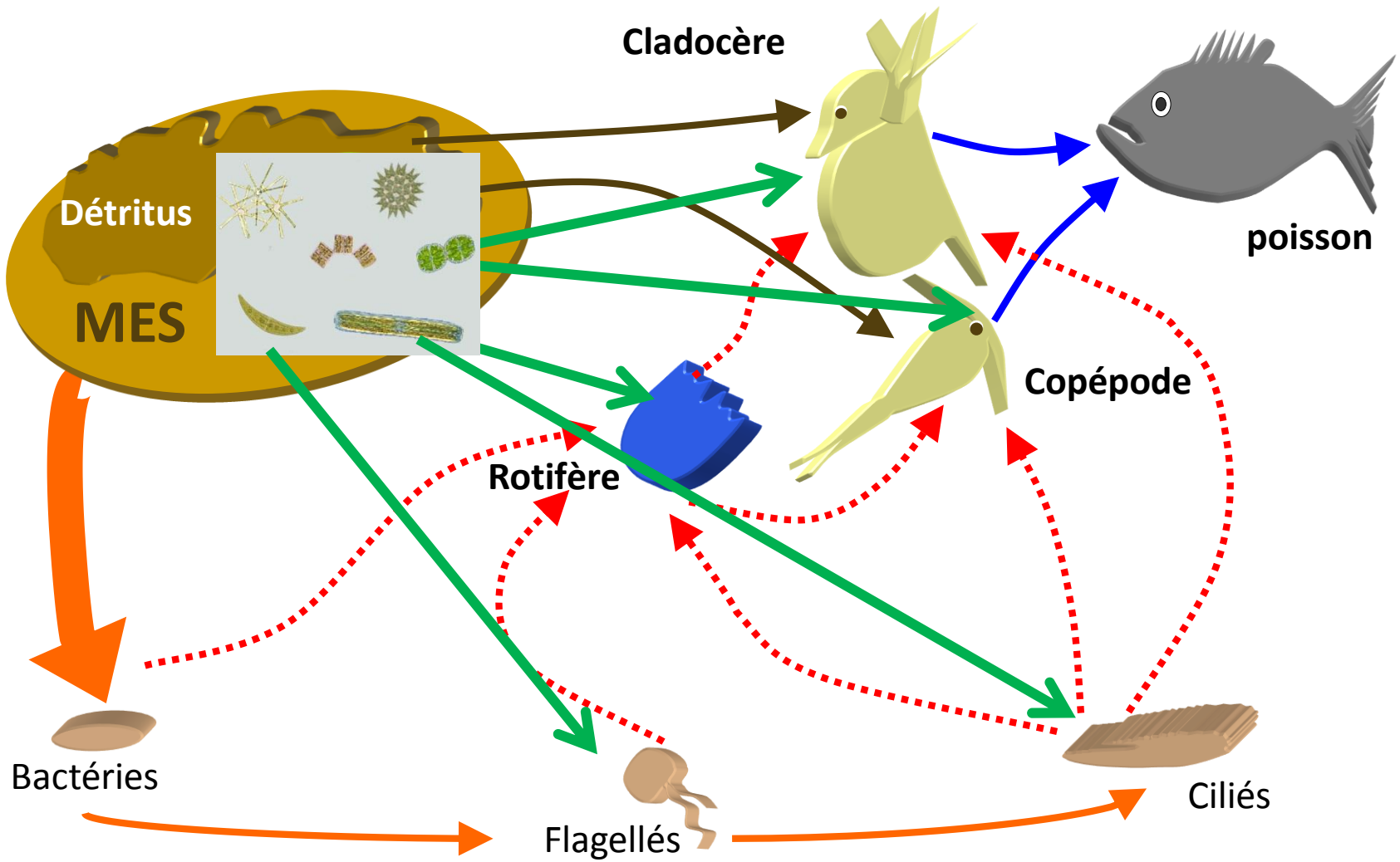
Impact du zooplancton sur le phytoplancton

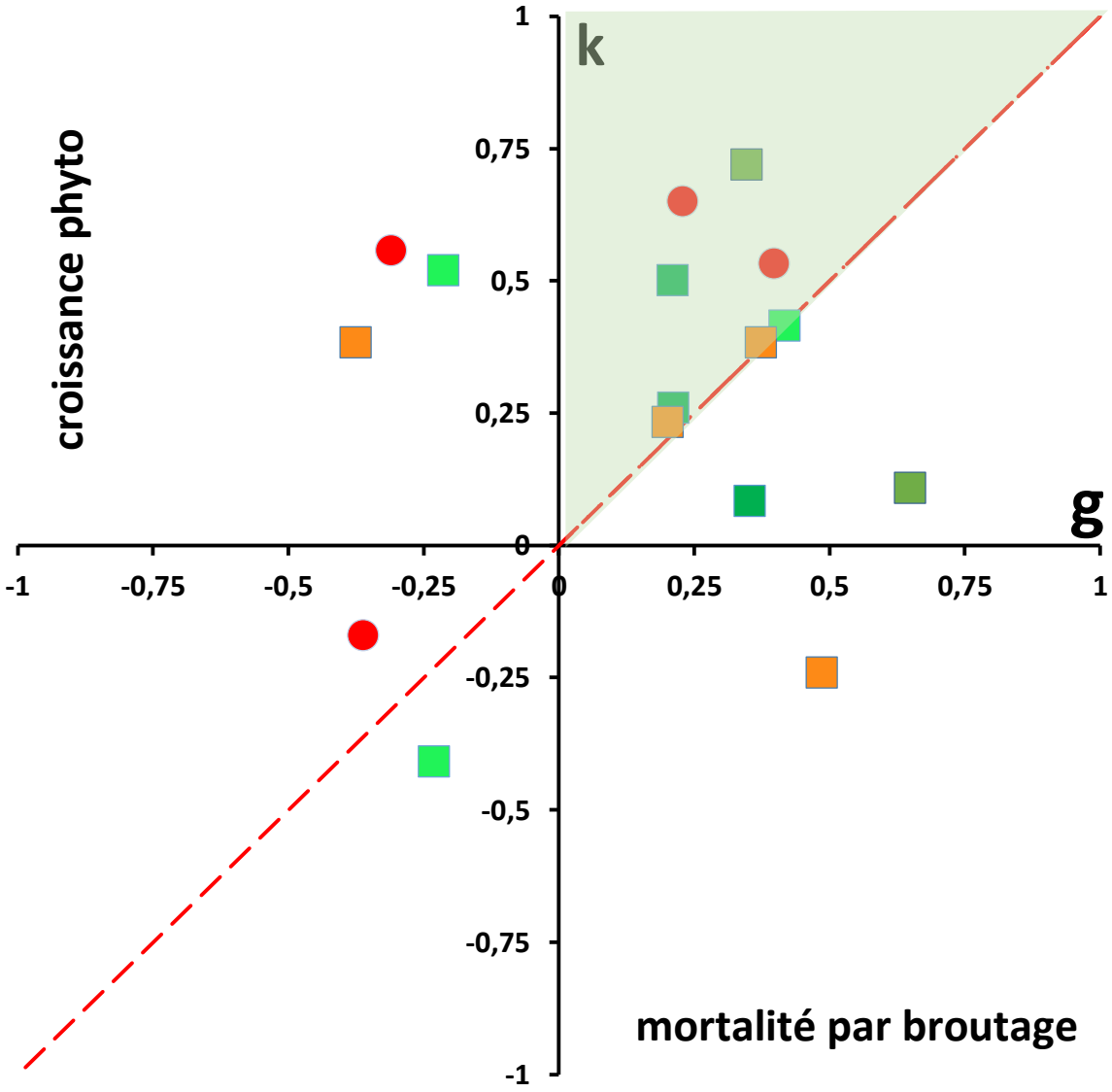






Activité trophique du zooplancton





Chla

Pigments marqueurs

Chlorophycées

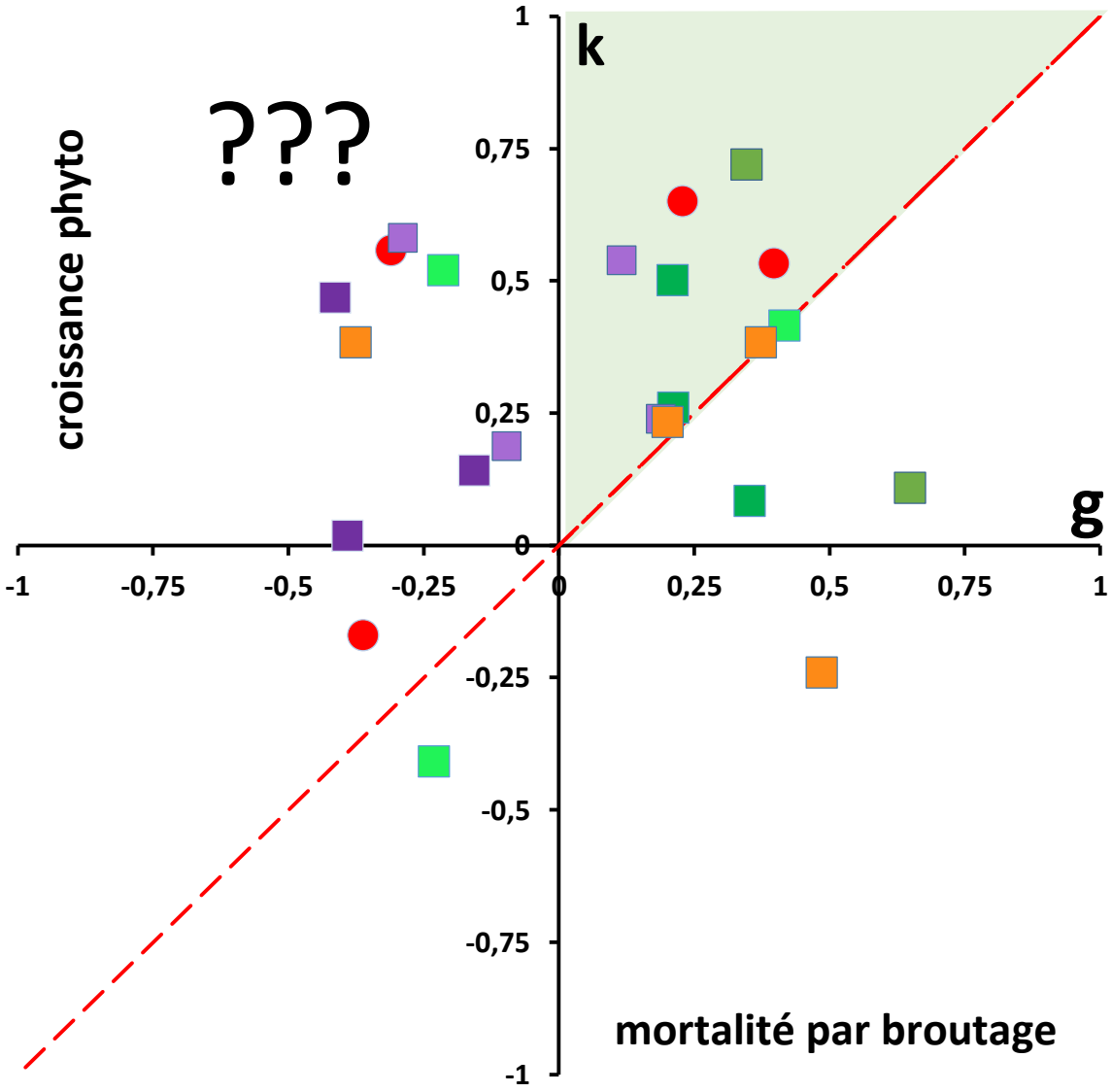
violaxanthin

lutein

chl-c

alloxanthin

Cryptophycées



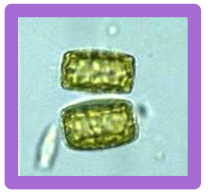
Chla

- violaxanthin
- lutein
- chl-c

Chlorophycées

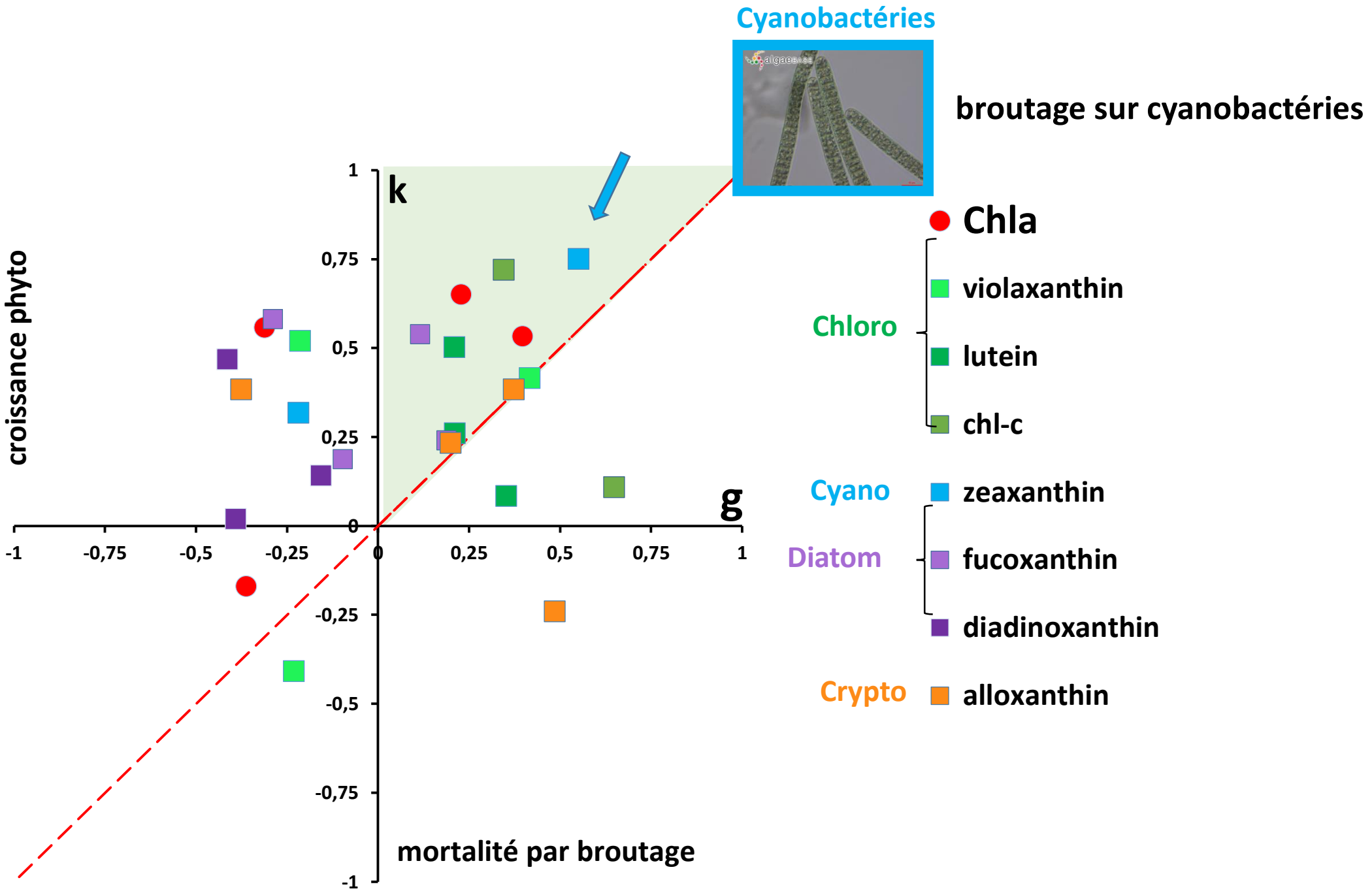
Diatomées

- fucoxanthin
- diadinoxanthin



- alloxanthin

Cryptophycées


Cyanobactéries
broutage sur cyanobactéries
k
g
croissance phyto
mortalité par broutage
1
0,75
0,5
0,25
0
-0,25
-0,5
-0,75
-1
-1
-0,75
-0,5
-0,25
0
0,25
0,5
0,75
1
Chla
Chloro
violaxanthin
lutein
chl-c
Cyano
zeaxanthin
Diatom
fucoxanthin
diadinoxanthin
Crypto
alloxanthin

Le zooplancton impacte tout les taxons du phytoplancton (cyanos)?

Ne surexploite pas le phyto

Cascade trophique responsable d'une 'préservation' de phyto?

Conditions des processus pas encore claires

Conclusions générales et recommandations

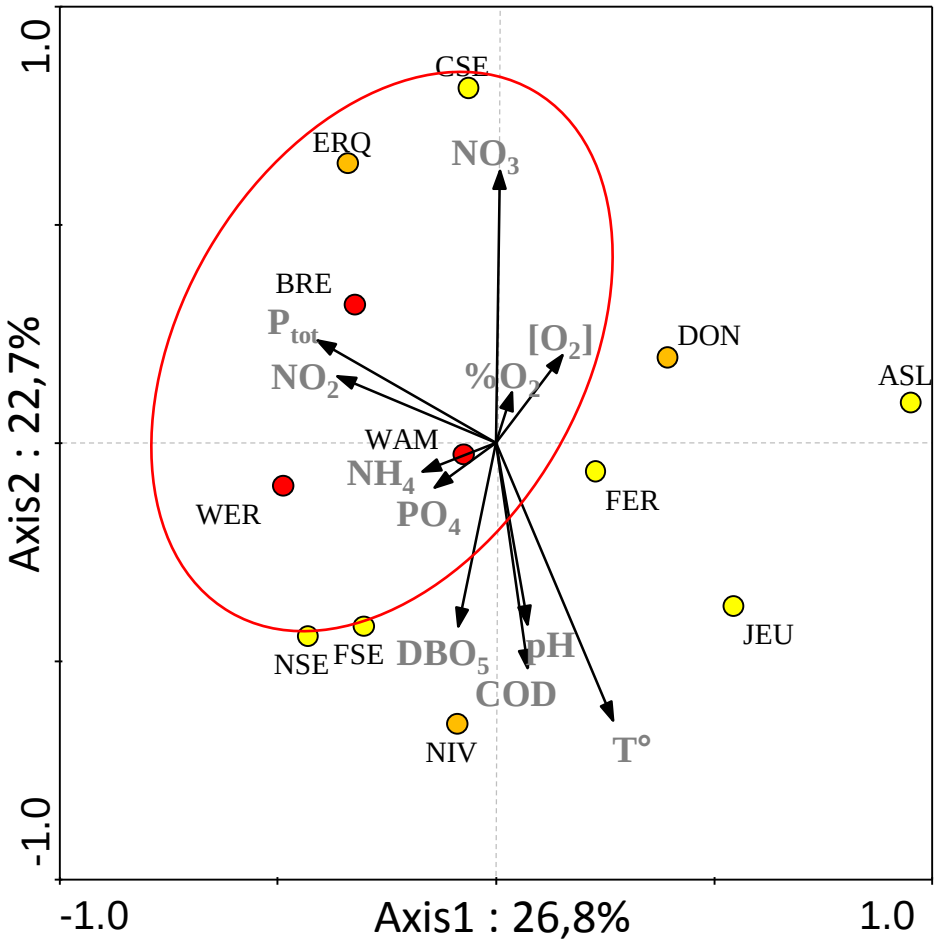
Mise en évidence de l'existence du zooplancton dans le bassin amont de l'Escaut

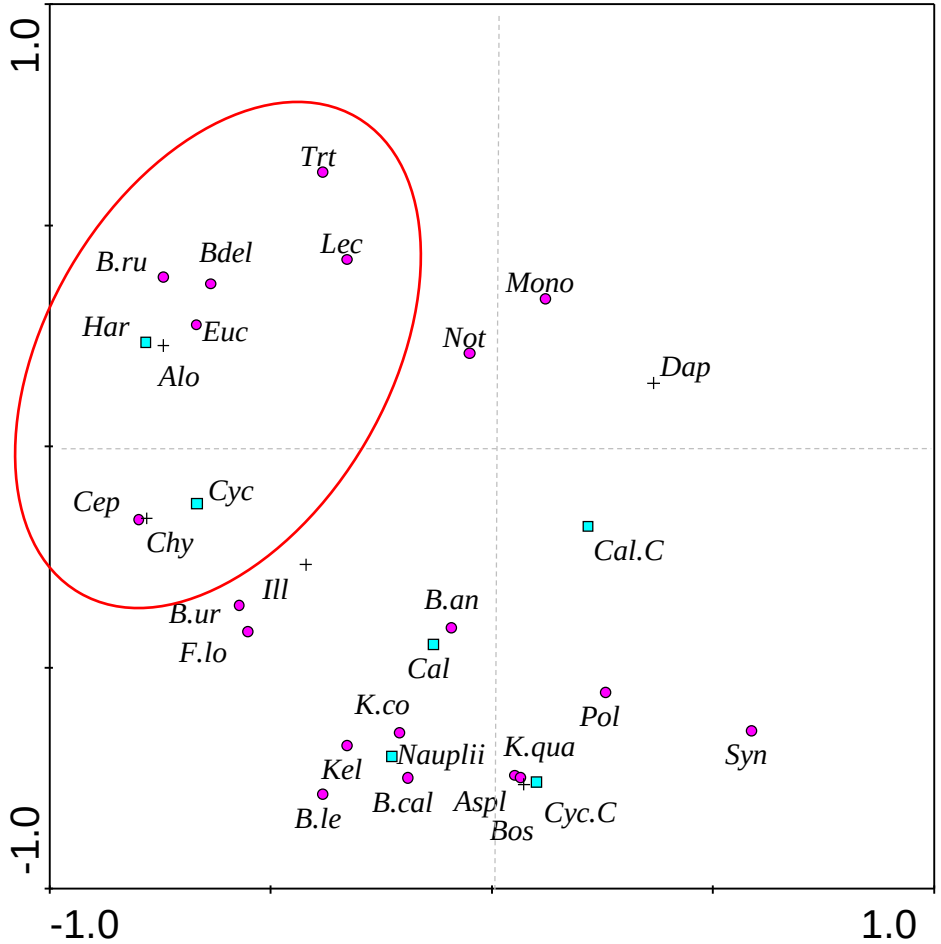
PARTEZ A LA RENCONTRE DE LA BIODIVERSITE

A LA DECOUVERTE DU ZOOPLANCTON

Projet de livret (BIOFOZI- AEAP)

Potentiel d'utilisation du zooplancton pour lutter contre l'eutrophisation





Classes d'état DCE:

- Mauvais
- Médiocre
- Moyen
- Bon
- Très Bon

taxons

- Rotifères
- Copépodes
- \+ Cladocères

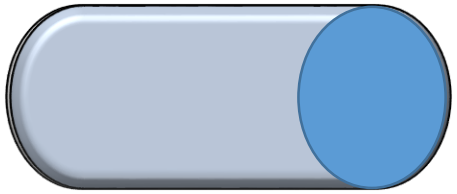
Potentiel de développement du zoo : une question de temps de résidence

Modèles de gestion: hydrologie !

Pour comprendre le développement du zooplancton

données hydrologiques: les débits ne suffisent pas

$Q=S\times v$

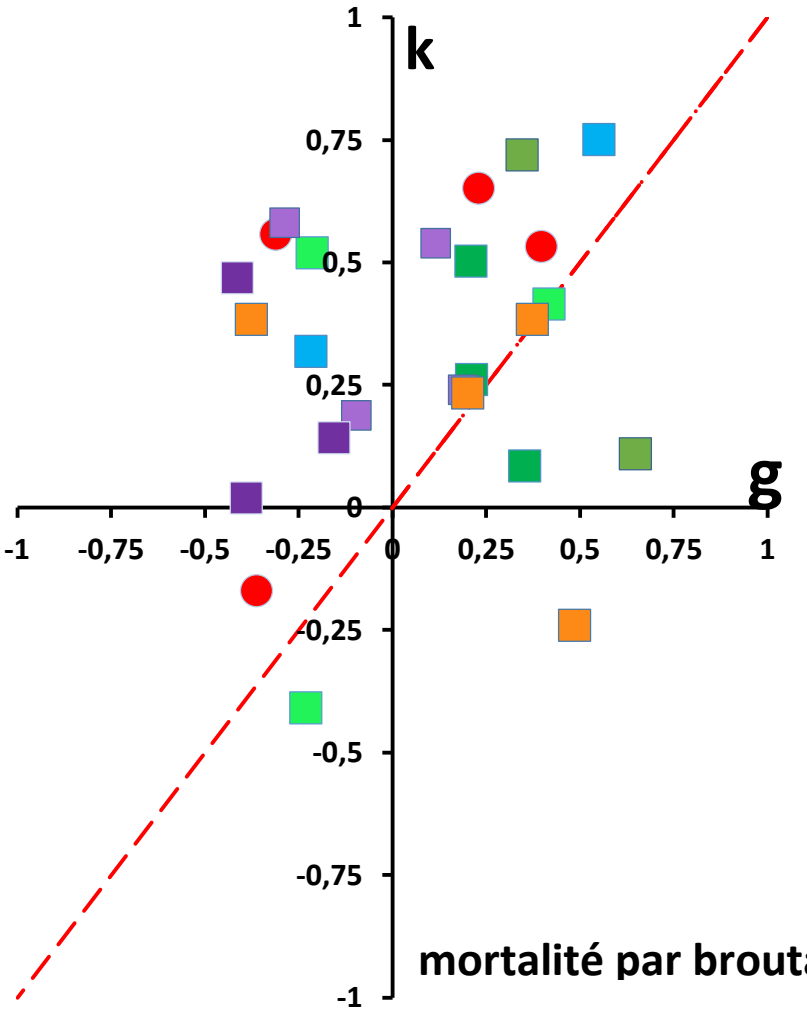


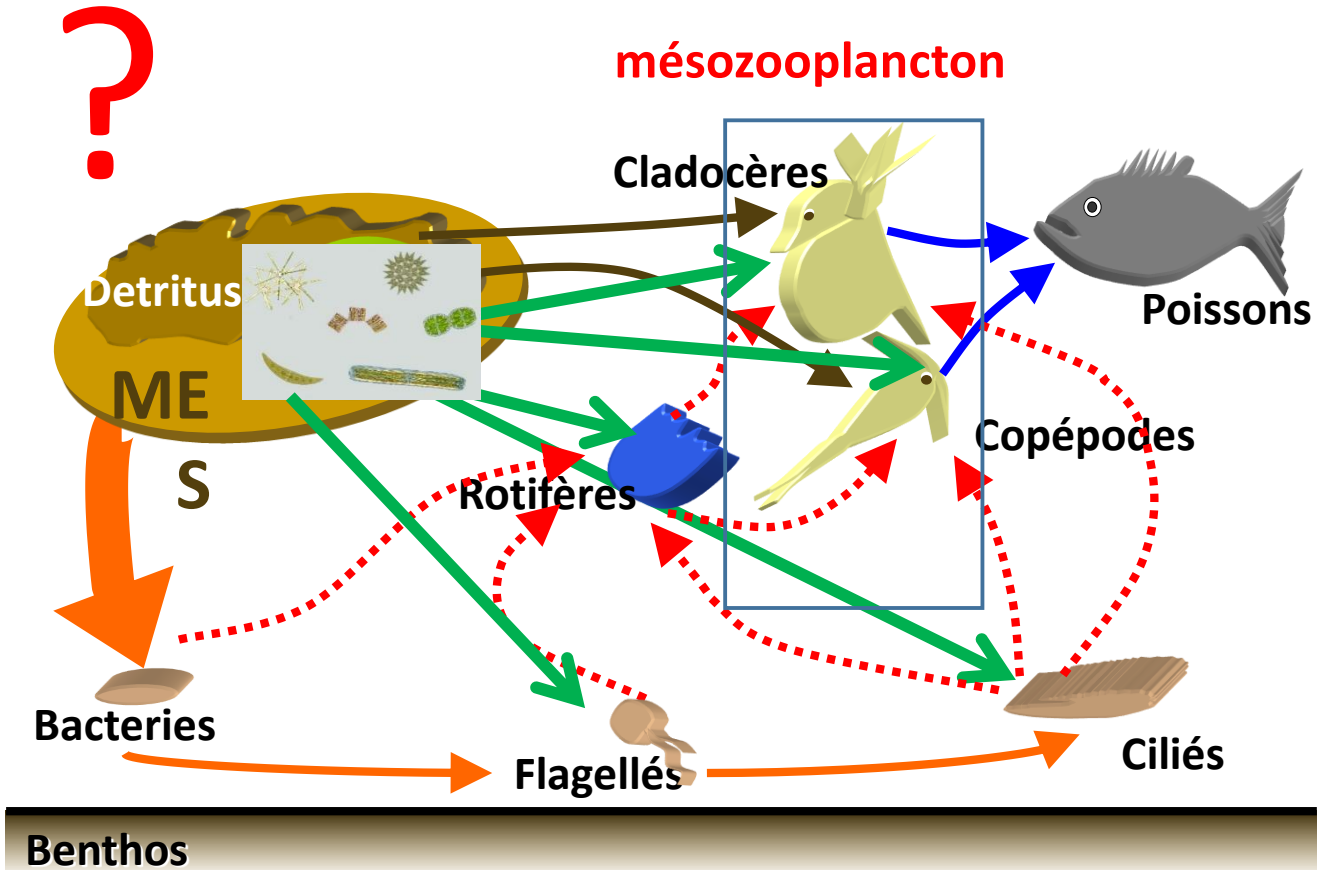
section (S)

temps de résidence ou vitesses de courant (v)

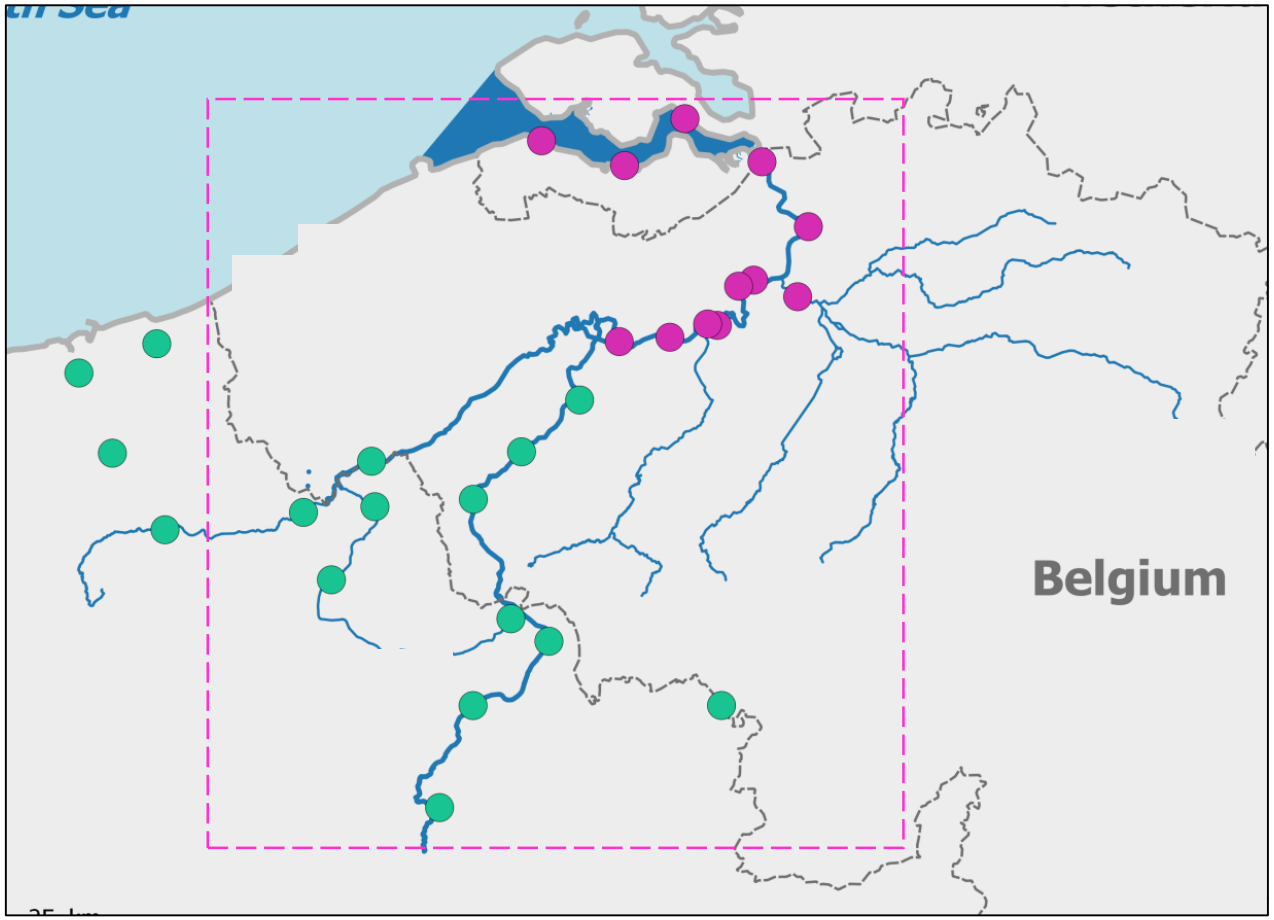
modèles hydrologiques ?

Activité trophique du zooplancton





Caractère transfrontalier….à exploiter



Zooplankton of the Scheldt river continuum

A.C. Sossou [1,2,5], M. Le Coz [1,2,3], S. Chambord [1,2,3], T. Maris [5], F. Azémar [1,2], J. Peene [7], E. Buffan-Dubau [1,2], G. Spronk [6], J. Kromkamp [7], J. Ovaert [1,2,4], P. Meire [5], S. Souissi [3], B. Ouddane [4], S. Net [4], D. Dumoulin [4], M. Tackx [1,2]

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[2] CNRS; EcoLab; 31062 Toulouse, France.
[3] Université Lille 1- Sciences et Technologies, LOG (Laboratoire d'Océanologie et de Géosciences) – UMR 8187, Station Marine, 28 Av Foch, 62930 Wimereux, France.
[4] Université Lille 1- Sciences et Technologies, LASIR (Laboratoire de Spectrochimie Infrarouge et Raman) – UMR 8516 LASIR, Bâtiment C559655 Villeneuve d'Ascq Cedex , France.
[5] University of Antwerp, ECOBE (Ecosystem Management Research Group) Department of Biology, Prinsstraat 13, 2000 Antwerpen, Belgium.
[6] Rijkswaterstaat Zuiderwagenplein 2 I 8224 AD Lelystad, The Netherlands.
[7] Niaz Netherlands Institute for Sea Research, Korringaweg 7, Yerseke, The Netherlands.

Context of study & objectives

The Scheldt river has its source in the north of France, flows through Belgium and into the North Sea at Vlissingen in The Netherlands. Three salinity zones can be distinguished in the estuarine stretch under tidal influence: the saltwater Westerscheldt, the brackish and freshwater zone of the Zeescheldt. Its upstream basin is mainly drained by the rivers Scheldt and Lys. In the frame of MONEOS, OMES and BIOFOZI projects, the ecological status and functioning of the Scheldt river continuum is studied.

Aim of this study: to examine how the zooplankton community structure changes along the continuum and which environmental variables are most significant in explaining the variance in the zooplankton community

Materiels & methods

- 21 stations were sampled (Fig1) in April 2013.
- At each Westerscheldt station, 150-250 L of water are taken at sub-surface with a pump and filtered through a 50 µm net for zooplankton. Only 50 L of water was taken at the other stations.
- A set of environmental variables were measured.
- Mesozooplankton was collected in plastic container and fixed with formaldehyde 4% final concentration.
- Determination and abundance quantification of mesozooplankton groups was done under binocular microscope.
- Multivariate analysis were realized using CANOCO software.

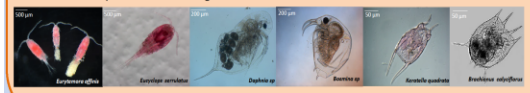

Fig 1: Scheldt continuum. Light violet: Salt water Westerschelde, violet: freshwater estuarine, green: upstream riverine stations.

Results

1) Abundance and spatio-temporal distribution

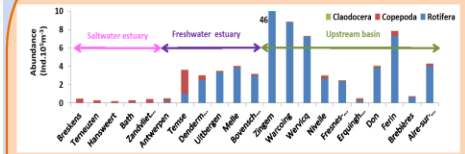

Fig 2a: Brackish-marine water is essentially dominated by copepods whereas freshwater shows mainly rotifer abundance. Cladocera appear in both fresh- and brackish water.

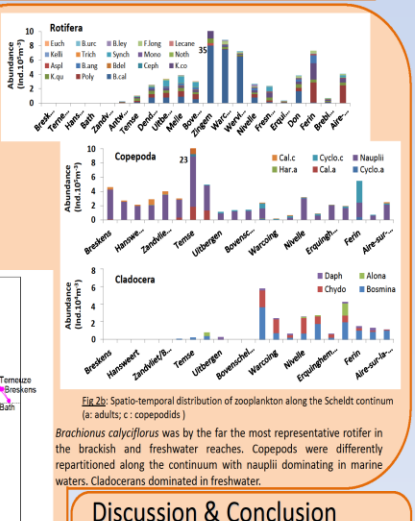

Fig 2b: Spatio-temporal distribution of zooplankton along the Scheldt continum (a: adults; c : copepodids)

Brachionus calyciflorus was by the far the most representative rotifer in the brackish and freshwater reaches. Copepods were differently repartitioned along the continuum with nauplii dominating in marine waters. Cladocerans dominated in freshwater.

2) Relation between taxa, stations and environmental data

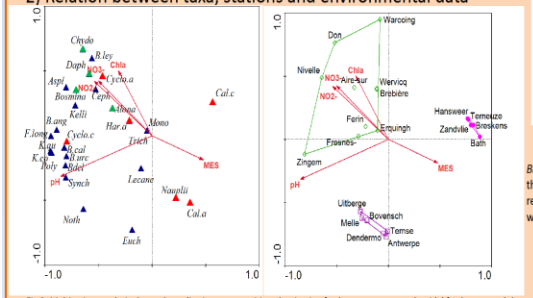

Fig 3: Multivariate analysis shows three disctinct communities: the riverine freshwater upstream, the tidal freshwater and the brackish marine community. (cladocera: green, copepoda: red and rotifers: blue).

- The upstream community, composed of rotifers and cladocerans, was linked to high Chl*a* and nutrient concentrations.
- Calanoids in the brackish-marine community was associated with high SPM concentrations.
- The tidal-freshwater community, composed of calanoids copepods and rotifers occurs in less nutrient rich waters than the upstream riverine community.

Discussion & Conclusion

Species repartition is different along the Scheldt continium. Of the 23 rotifer taxa encountered in the freshwater Scheldt, ¼ is common to both the riverine and the tidal system. This international inventory and ecological analysis of the zooplankton along a 300 km river-estuarine continuum forms a useful basis for understanding specific tolerance of different zooplankton taxa to environmental conditions.

Contact

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118, Route de Narbonne, 31062 Toulouse cedex 9 FRANCE

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merci de votre attention
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West Hinder
Fairy Bank
Sandettié Bank
Zélande
Brabant-Septentrional
Limbourg
Maas
Région Flamande
Bruxelles
Belgique
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