PHOSPHORUS AND NITROGEN FUTURE IN EUTROPHISED MEDITERRANEAN LAGOONS

5th annual Franco-French seminar
Marseille 2-3 October 2012

Languedoc-Roussillon”, the “Agence de l’Eau Rhône Méditerranée & Corse” and Ifremer developed a
ability to export

Mixed vs. Confined area
nitrogen fluxes

Hydrodynamic model (MARS-3D)
Simulations under meteorological forcing (dec. 2005 – march 2007)

Figure 3 (a) Volume exchange during theoretical total exchange and (b) mixing area in Bages-Sigean lagoon

• Low variation of volume exchange among simulations
• Mixed vs. Confined area
  mixed area restricted to the South of Bages-Sigean lagoon

Lower nutrient availability for primary production in mixed areas (South) than confined area (North)

Restoration Time
North
South

Improve description of physical process in model using results of the 3D hydrodynamics model (description of mixed vs. confined areas)

REMMAI)NG ISSUES

• What are the effects of seagrasses on benthic fluxes?
• What are the effects of nitrogen and phosphorus sediment content on benthic fluxes?
• Which nitrogen and phosphorus forms (Dissolved or Particular) are mainly exported from the lagoon?
• Improve parametrization of nitrogen and phosphorus fluxes at sediment – water interface in budget model (LOICZ)

AIMS OF THE STUDY

• to characterise and quantify the main nutrient flows participating in the reduction of internal nitrogen and phosphorus content in Mediterranean lagoons
• to improve the parametrization of mathematical models
• to define dynamic restoration scenarios of eutrophised Mediterranean lagoons

PRELIMINARY RESULTS

HYDRODYNAMICS

BENTHIC FLUXES

• Spring experiment
• 2 sampling sites (Bages-Sigean and Mejean lagoons)
• Uptake (macrophytes) or Release (sediment)?
• Enhancement remineralisation processes

Figure 4: Experimental design to measure nutrient fluxes. Temperature, light are controlled during all the experiment

Figure 5: Mean (std. dev.) g m-2c-1 Total Dissolved Nitrogen and (b) Total Dissolved Phosphorus fluxes over 20h in Bages-Sigean in Spring

Figure 6: Mean (std. dev.) g m-2c-1 Total Dissolved Nitrogen and (b) Total Dissolved Phosphorus fluxes over 20h in Mejean in Spring

ECOLOGICAL CONTEXT

Increased nitrogen and phosphorus inputs from watersheds, especially since the 1960s with the
increased anthropogenic activities is recognized as a major cause of environmental degradation of coastal ecosystems. On the Mediterranean coast, lagoons are particularly affected by the eutrophication leading to significant changes in ecosystem structure, functioning and services. Since 2000, the “Région Languedoc-Roussillon”, the “Agence de l’Eau Rhône Méditerranée & Corse” and Ifremer developed a

Many actions on watershed led to a significant reduction of nutrient inputs. However, the time
required to restore these degraded environments to achieve good ecological status under the Water Framework Directive (WFD) is unknown. Coastal restoration is characterized by a hysteresis, i.e. a
partial or complete restoration involving different processes and generally longer than the rapid degradation mechanisms. This hysteresis is due to a complex ecosystem functioning involving all
physical, chemical and biological processes that play a role in the matter cycles. In a lagoon, the recovery time will depend on

• the structure and functioning of the communities
• the release of nitrogen and phosphorus implicated as the internal load
• the ability to export the excess nitrogen and phosphorus to the open areas.

Figure 1: Conceptual view of lagoon functioning. Areas indicate fluxes between compartments

Figure 2: Median of nitrogen and phosphorus sediment supply among Languedoc-Roussillon lagoons (data from BALS). Numbers indicate the size of sampling. Spatial distribution of nitrogen (g m-2 c-1) and phosphorus (mg m-2 c-1). Effects in confined in Bages-Sigean and Mejean lagoons.