SPICOSA

SIXTH FRAMEWORK PROGRAMME

European Commission

Coastal Systems Approach Framework. Case studies

Mette, A. (dir.), Tett, P., McFadden, L., Priest, S., Fernandes T., Konstantinou, Z., Raux, P., Balle-Béganton, J., Lowe, C., D'Hernoncourt, J.

AMURE CENTRE DE DROIT ET D'ÉCONOMIE DE LA MER

UBO Université de Bretagne Occidentale

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About

The SAF is a product of the SPICOSA research project, funded by the European Commission from 2007-2011. SPICOSA stands for 'Science and Policy Integration for COastal System Assessment'. Its research was aimed at developing and testing a toolbox of methods for providing multidisciplinary and trans-disciplinary advice to environmental managers and policy-makers concerning environmental problems in the coastal zone, in order to improve the zone's ecological sustainability, economic efficiency, and social equity. Sustainability relates to the capability of an ecosystem to go on supplying humans with 'goods and services'. Efficiency is about making the best use of those resources for the satisfaction of human needs. Equity is about the fair distribution of such satisfaction.

It was in response to the need for such a methodology, that the SPICOSA project developed and tested the Systems Approach Framework or SAF.

Editors

Anne Mette and consisting of Paul Tett, Loraine McFadden, Sally Priest, Teresa Fernandes, Zoi Konstantinou, Pascal Raux, Johanna Balle-Béganton, Chris Lowe and Johanna D'Hernoncourt.

Contributors

Denis Bailly, Tom Hopkins, Audun Sandberg, Gillian Glegg, Josianne Stottrup, Guy Engelen, Alice Newton, Jean-Paul Vanderlinden, David Hadley, Cedric Bacher, Marta Estrada, Joachim Maes, Jean-Luc de Kok, Hans-Joachim Wallrabe, Laura Giordano, Maria Ferreira, Jeanette Reis, Jeremy Gault, Rémi Mongruel, Harold Levrel, Vicki Hendrick, Jan Vermaat, John Icely, Maurizio Ribera d'Alcala, Jesko Hirschfeld, Jean-Marc Douguet, Miguel Canedo Arguelles, Jeremy Hills, Martin Le Tissier.

Cited as

Coastal Systems Approach Framework. Case studies, Mette, A. (dir.), Tett, P., McFadden, L., Priest, S., Fernandes T., Konstantinou, Z., Raux, P., Balle-Béganton, J., Lowe, C., D'Hernoncourt, J. 292 p.

Layout

Johanna Ballé, Dominique Buraud

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Content

SPICOSA. Study Site Applications

The project

SPICOSA local applications aim to bridge the gap between coastal stakeholders across various aspects of local economy, policies, uses, conflicts and impacts to enable the dialogue that may lead to sustainability.

The project tests, improves and demonstrates its tools and the System Assessment Framework (SAF) throughout Europe over a diverse set of eighteen study sites. A wide variety of coasts that differ in geomorphology, environmental conditions, cultures, and human activities provide this basis. Each local application of SPICOSA provides more and better insight to the human activities that generate the greatest impacts and those types of coastal zone systems that are most vulnerable to human activity.

Gulf of Riga

Date

01/02/2007 - 31/01/2011

Coordinated by

Evald Ojaveer, Estonian Marine Institute of the University of Tartu

Summary

The Gulf of Riga is situated between the Estonian and Latvian mainland and Saaremaa Island.

The Gulf is an estuarine, land-dominated area. A separate ecological subsystem exists in the gulf. The gulf is a very productive area of the Baltic Sea. On the southern (Riga and its satellite towns) and eastern (Pärnu) coasts of the gulf important holiday resorts have existed long time. Nowadays the importance of tourism has enormously increased both on the mainland and especially on the islands.

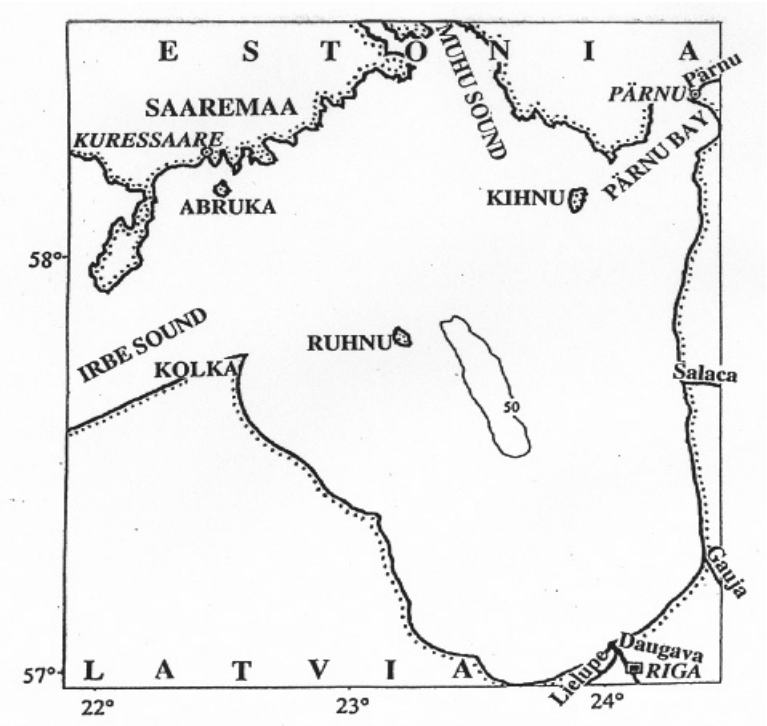
The catchment area is rather flat and constitutes 134 000 km². Five relatively large rivers (Daugava, Lielupe, Gauja, Pärnu, Salaca) and a number of smaller rivers discharge into the gulf. The gulf is surrounded by densely populated areas as well as intensely used agricultural areas situated on the southern and eastern coasts.

Human activities impact to this area are industry, agriculture, fishing and other sources.

Eutrophication, harmful algal blooms and toxic pollution of the gulf; protection of the coasts, beaches and coastal waters including the areas of intense tourism; need for the ratification of the IMO ballast water regulations; recognition of the socio-economic and ethic value of marine resources (bottom vegetation, invertebrates, fish, birds, seals) and marine environment.

During the period covered by the time series indicated below, policy changes have been in the following:

1) enforcement of fishing rules;
2) protection of marine environment and ecosystems;
3) protection of resort areas.



The Gulf of Riga

Characteristics

Marine System

The surface area of the Gulf of Riga is 16 300 km^2, the volume is 424 km^3. The salinity varies from 4 to 7 ppt (in near-coastal areas 0-2 ppt). It is connected with the open part of the Baltic Sea through the Irbe Strait and the Estonian Archipelago (Väinameri). The Gulf is an estuarine, land-dominated area. A separate ecological subsystem exists in the gulf. As there is no halocline in the gulf, the water in the bottom layers is rather cold and well aerated during the year. Therefore, a number of Ice Age relict species have found acceptable habitats there. Strong seasonal thermocline is an important factor for summer dynamics of the ecosystem. The gulf is a very productive area of the Baltic Sea. The dynamics of local populations of the gulf closely depends on periodic climate changes (mainly salinity, winter temperature and river runoff are important factors) and various anthropogenic impacts, and differ from other areas of the Baltic Sea. On the southern (Riga and its satellite towns) and eastern (Pärnu) coasts of the gulf important holiday resorts have existed long time. Nowadays the importance of tourism has enormously increased both on the mainland and especially on the islands. One of the most recent concerns is substantially increased maritime transportation (both cargo ships and leisure boats) that is an important vector for the introduction of non-indigenous species. The invasion of alien species has resulted in fundamental alterations in the structure and functioning of both the benthic and pelagic systems.

Watershed

The catchment area is rather flat and constitutes 134 000 km². Five relatively large rivers (Daugava, Lielupe, Gauja, Pärnu, Salaca) and a number of smaller rivers discharge into the gulf. The average annual freshwater inflow equals to 31 km³ (7.3 % of the volume of the gulf), 86 % of it falls into the southern part of the gulf. A number of dams have constructed on the rivers (incl. Daugava), some water reservoirs exist. The gulf is surrounded by densely populated areas as well as intensely used agricultural areas situated on the southern and eastern coasts.

Human Activities

- **Industrial wastes.** The main industrial pollution sources are from Riga and other towns. Intense agriculture. Intensely used agricultural areas are situated on the southern and eastern coasts.
- **Other**. Overfishing of valuable species. Harmful algal blooms. Invasion of alien species.

Impact Responses

- **Pollution and eutrophication**. The pollution with its side-effects has considerably affected the gulf ecosystem (impoverishment of species diversity, changes in the food web, increase in the frequency of harmful algae blooms, etc) and exerts additional impact to the natural stress factors of biota (limited salinity, low temperature in winter, etc).
- **Overfishing**. Fishing, fish processing and related professions are very important for coastal population. Mainly herring, perch, smelt, pike-perch etc are fished. The exploitation rates are high, some valuable species are overexploited.
- **Other.** Habitat destruction; deterioration of the quality of coastal waters.

Policy

Policy issues

Eutrophication, harmful algal blooms and toxic pollution of the gulf; protection of the coasts, beaches and coastal waters including the areas of intense tourism; need for the ratification of the IMO ballast water regulations; recognition of the socio-economic and ethic value of marine resources (bottom vegetation, invertebrates, fish, birds, seals) and marine environment. The key questions: 1) What is the optimum exploitation regime to grant sustainable management of local fish stocks? 2) What is the acceptable management of coastal environment to support tourism and health resorts? 3) Can we foresee the changes in the unique ecosystem under heavy invasion of alien species? 4) What is the role of maritime transportation in degradation of ecosystems?

Policy changes

During the period covered by the time series indicated below, policy changes have been in the following:

1) enforcement of fishing rules;
2) protection of marine environment and ecosystems;

3) protection of resort areas.

Stakeholders and Institutional Governance

Major organisations

- Ministry of the Environment
- Ministry of Health, County and municipal administrations
- Fishermen's organisations, large ports – both in Estonia and Latvia
- Baltic Marine
- Environment Protection Commission
- International Council for the Exploration of the Sea.

Other leading organisations

- Tourism organisations
- Nature conservation organisations
- Holiday resorts.

Partner Collaboration

Institute of Aquatic Ecology, University of Latvia (Dr. Maija Balode).

Systems Studies

Long time series

- Hydro-meteorological data (temperature, winds, river discharge, cloudiness etc.) - since the 1940-50s;
- Hydrochemical data – inorganic and total N, P, Si – since 70-80s.
- Mesozooplankton: May-July – since 1957; April-November – since 1972.
- Phytoplankton – since the 60ies.
- Macrozoobenthos – since 70-80s.
- Mysids – since 1974.

- Spring spawning herring (year-class abundance, population numbers, population biomass, mean weight at age) – since 1957:
- Smelt (year-class abundance, population numbers, population biomass, mean weight-at- age) - since 1960
- Annual fish catches – since 1956.
- Qualitative and quantitative data on feeding of herring, sprat, smelt, stickleback – since 1994.
- Trace metals and organochlorine compounds in herring – since 1994.
- Dioxins in herring – since 2002.

Research Projects

Continuous state projects:

- Investigations on dynamics and regularities of development of ecological subsystems in the North-eastern Baltic, Gulf of Finland and Gulf of Riga (2003-07).
- The impact of spatial and temporal variation of coastal processes on the biological and functional diversity (2003-07).
- State programmes on the monitoring of eutrophication (since 1994), on dangerous compounds (since 1994), of dioxin content in fish (since 2002), at the Estonian coasts.

Socio-economic study

In 2002 an investigation on the catch effort of Estonian trawl fleet was carried out (MSc thesis).

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/gulf-of-riga/

Gulf of Gdansk

Date

01/02/2007 – 31/01/2011

Coordinated by

Juliusz Gajewski, Maritime Institute in Gdańsk

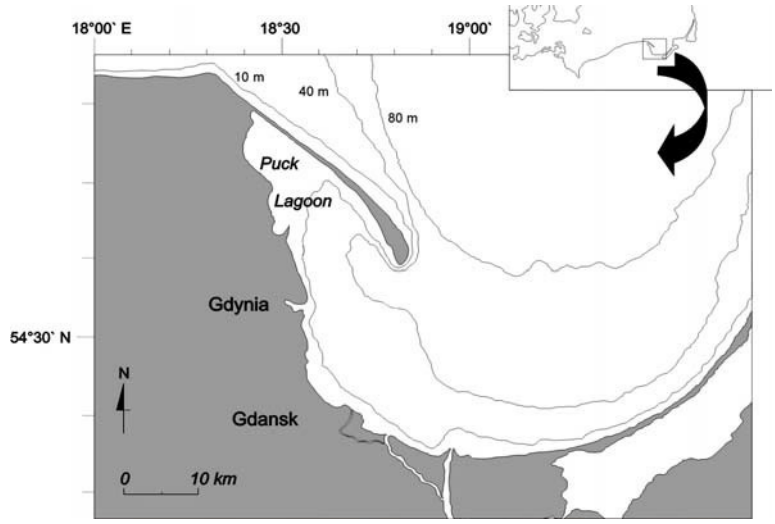
Summary

The Gulf of Gdansk is a south-east part of the Baltic Sea enclosed by a large curve of the shores of Gdansk Pomerania in Poland (Rozewie Cape, Hel Peninsula), and Kaliningrad Oblast of Russia (Sambian Peninsula). Gulf of Gdańsk has different hydro-geomorphological regimes and consists of different units: lagoons, river mouths, sheltered and open coastal areas. This area is under strong anthropogenic pressure.

The Pomorskie region covers almost half of the Polish coastline (Eastern part), with two different types of settlements – westerly and easterly. Westerly part was dominated before 90-ties by intensive collective farming and industrial fishing. On the other hand the easterly part was mainly consisting of small private farms and small boat fisheries. The coastal zone of the study site is mostly low sand beaches – an excellent place for tourism development. Additionally Hel Peninsula being itself attractive creates a very good place for windsurfing in the Puck Bay.

Human activities are Tourism, Agriculture, Fishing and Shipping. And impact reponses are: Eutrophication, Trophic web changes, Diversity loss, Coastal erosion

Policy issue is impact of changes in land use and agriculture in the coastal area and Vistula river catchment area on coastal water quality, consequences for coastal water management, Possibilities of environmentally-friendly reduction of unemployment and/or conversion from fishery/shipbuilding including reduction of "social exclusion" Harmonization of the management approaches of Natura 2000, EU-ICZM recommendations and the Water framework directive.



Characteristics

Marine System

The Gulf of Gdansk is a south-east part of the Baltic Sea enclosed by a large curve of the shores of Gdansk Pomerania in Poland (Rozewie Cape, Hel Peninsula), and Kaliningrad Ob- last of Russia (Sambian Peninsula). Western part of the Gulf of Gdansk is the shallow waters of the Puck Bay and the south-east part is the Vistula Lagoon separated by the Vistula Spit and connected by the Strait of Baltiysk. Gulf of Gdańsk has different hydro-geomorpholo- gical regimes and consists of different units: lagoons, river mouths, sheltered and open coas- tal areas. This area is under strong anthropogenic pressure. Maximal depth is 120 meters, sa- linity: 7 PSU. Total surface area of the Gulf of Gdansk is 5134 km^2 and volume is 840,2 km^3. Major ports: Gdańsk, Gdynia, Kaliningrad, Hel, Puck (ca. 2 millions inhabitants).Sandy bot- tom biotopes are dominated by macrophyte vegetation only occur in the sheltered Puck Bay. Some small areas of stony bottom covered with macrophytes occur in the Gulf of Gdansk as well. The degree of naturalness and degradation of biotopes varies, with the greatest changes being observed below the halocline in the Gdansk Deep. Long-lasting periods of oxygen deficiency have caused the disappearance of almost all macroscopic life on the bottom and the impoverished plankton has limited fish reproduction.

Watershed

The Pomorskie region covers almost half of the Polish coastline (Eastern part), with two different types of settlements - westerly one being populated after II World War by immig- rants from the Polish territories passed to Soviet Union and easterly one being populated by Kaszubian's – people living there already for hundreds years. Westerly part was dominated before 90-ties by intensive collective farming and industrial fishing. On the other hand the easterly part was mainly consisting of small private farms and small boat fisheries. The coastal zone of the study site is mostly low sand beaches – an excellent place for tourism development. Additionally Hel Peninsula being itself attractive creates a very good place for windsurfing in the Puck Bay.

Human Activities

Tourism, Agriculture, Fishing and Shipping

Impact Responses

Eutrophication, Trophic web changes, Diversity loss, Coastal erosion

Policy

Policy issues

- Impact of changes in land use and agriculture in the coastal area and Vistula river catchment area on coastal water quality, consequences for coastal water management,

- Possibilities of environmentally-friendly reduction of unemployment and/or conversion from fishery/shipbuilding including reduction of "social exclusion"
- Harmonization of the management approaches of Natura 2000, EU-ICZM recommendations and the Water framework directive.

Policy changes

- Changes in the settlement type after the II World War in Gdańsk area and west part of the region – immigration and nationalization of agriculture
- Evolution from environmentally negative (70's & 80's) to environmentally-friendly policies (concerning overexploitation of natural resources, including biological ones)
- Changes in urban and waste polices
- Changes in agriculture – bankruptcy of nationalized farms, economical and industrial crisis Changes in industry – bankruptcy of national industry and rebuilding under new regulations Changes in property ownership – privatization
- Demilitarization (e.g. free access to the beaches from 1989)

Stakeholders and Institutional Governance

Major organisations

- Pomorskie Region Authorities Maritime Office in Gdynia
- Local Authorities around Gulf of Gdansk

Other leading organisations

- Union of Coastal Cities
- Fishermen Association

Partner Collaboration

Institute of Oceanography of University of Gdańsk

Systems Studies

Long time series

Long-term (more than 20 years) data on: salinity, temperature, radiance, H_2S, oxygen, chlorophyll a, statistical data on economical, social and industrial issues (statistical information for 50 to 100 years), aerial photos of the coastal zone, various and large amounts of additional data e.g. meteorological, hydrodynamic, water quality, heavy metal, biological data.

Research Projects

- A model of matter exchange and flow of energy in the Gulf of Gdańsk ecosystem, State Committee for Scientific Research, No 6PO4E 036 09
- EUROCAT: European Catchments Changes and their Impact on the Coast Case Study VISCAT: The Vistula River Catchment and the Baltic Sea Coastal Zone**,** No. EVK1-CT- 2000-00044
- HIPOCAS, 40 Years Hindcast of the sea level, waves and circulation in the Baltic Sea, EU Project Nº.: EVK2-CT-1999-00038, 1-90

Socio-economic study

- Maritime Institute in Gdańsk is preparing yearly assessment – "Maritime Economy – statistic review".
- DEDUCE: The Interreg III C project aiming on production of indicators of implementation of ICZM management.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

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Oder Estuary

Duration:

01/02/2007 - 31/01/2011

Coordinated by

Gerald Schernewski, Baltic Sea Research Institute Warnemünde, Germany / Leibniz-Institut für Ostseeforschung

Summary

The Oder estuary is the mouth of the Oder (Polish: Odra) river, one of the largest rivers in the Baltic region. It is located at the southern Baltic Sea (border between Germany and Poland).

Oder Lagoon. The coastal zone is dominated by the discharge of the river Oder (Odra) into the Szczecin (Oder) Lagoon. The large (687 km²) and shallow (average depth 3.8 m) Szczecin (Oder) Lagoon, is the key element of the Oder estuary region. The lagoon is subdivided into the "Kleines Haff", located mainly on the German territory, and the "Wielki Zalew" on the Polish territory. The Wielki Zalew covers about 60 % of the lagoon area and volume.

Pomeranian Bay. The lagoon is connected to the Pomeranian Bay via three outlets. The bay is part of the Baltic Sea. The bay is influenced by the Oder River water, but intensive windinduced mixing and large-scale currents in the Baltic Sea dominate this system.

Oder River. is one of the most important transboundary rivers in the Baltic region. Many larger cities and industries are located in the river basin. The basin is under intensive agricultural use. Other major river basin – coastal area issues are flooding, shipping and technical measures as well as species migration.

Human ativities are tourism, agriculture, fishing and shipping. Impact responses are eutrophication, nutrient loading, bio-chemical pollution, habitat destruction, biodiversity loss.

Policy

Policy issues

- Impact of changes in land use and agriculture in the river basin on coastal water quality, consequences for coastal water management;
- Development of future land use scenarios, suggestion of concrete measures to reduce pollution and socioeconomic evaluation;
- Impact of climate changes on water discharge and nutrient load in the river basin, effect on coastal eutrophication, consequences for coastal water management and socioeconomic evaluation;
- Harmonization of the management approaches of Natura 2000, EU-ICZM recommendations and the Water Framework Directive.

Policy changes

- Drastic changes in agricultural intensity and practice in the Oder river basin after German reunification and political changes in Poland (from 1989 ongoing). Heavy impacts on nutrient loads and eutrophication were observed.
- Drastic changes in tourism and industry intensity after German reunification (1989) and political changes in Poland (from 1989 ongoing) as well as Poland's membership in EU (2004).
- Changing social, economical and environmental gradients between Germany and Poland and increasing economic problems.
- Changes in agriculture intensity and nutrient loads due to the Polish EU memerbership.

Partner Collaboration

- IOW: Baltic Sea Research Institute Warnemünde (www.io-warnemuende.de)
- EUCC: The Coastal Union (www.eucc.net)
- IOEW: Institute for Ecological Ecomomic Research (www.ioew.de)
- KMG: College for Management and Formation of Sustainable Development (www.kmgne.de)

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume. Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

Publications of Oder Estuary

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Himmerfjärden

Date:

01/02/2007 - 31/01/2011

Coordinated by

Ragnar Elmgren
Stockholm University
SWEDEN
E-Mail: ragnar.elmgren@ecology.su.se
Technical University of Denmark - Danish Institute for Fisheries Research.
Contact: Josianne Støttrup jgs@dfu.min.dk

Summary

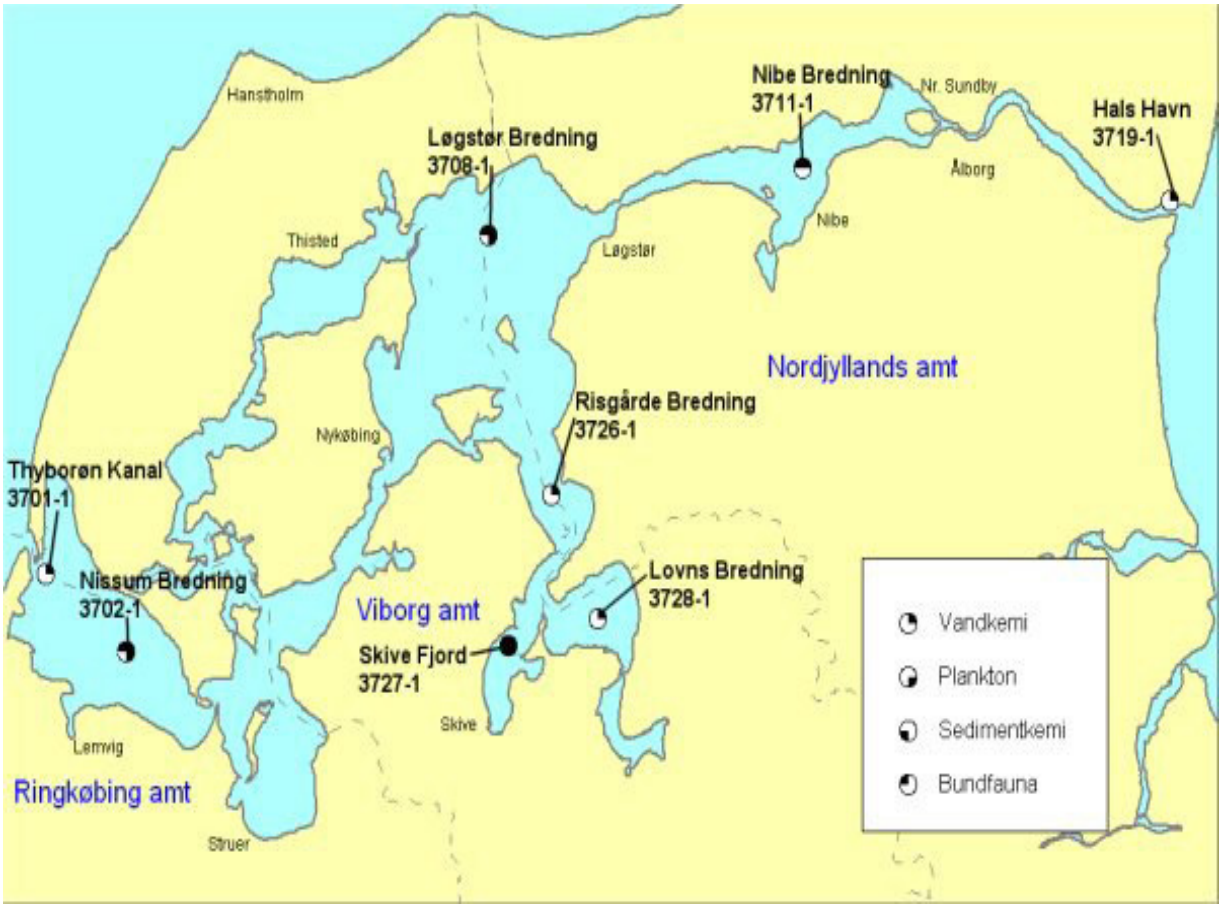
Himmerfjärden is a coastal bay system of 232 km2, located 60 km S of Stockholm, Sweden. Area is 1286 km^2, with 8% lakes, 20% agricultural land, 65% forest, 3% built area. Mean water input 8 m3s-1 from 9 brooks and streams, 7 m3s-1 from Lake Mälaren through Södertälje, 2 m3s-1 diffuse runoff, 1.5 m3s-1 treated sewage ,4 m3s-1 rain.

Human activities are Sewage from Urban area, industrial, Shipping, Fisheries, Agriculture, Forestry.

Policy issues are:

1) Difference in interpretation of Urban Waste Water Directive between Sweden and EU
2) Need for legislation that allows an Adaptive Management approach to minimize coastal eutrophication
3) Implementation of advance nutrient reduction to minimize coastal and open sea eutrophication,
4) Implementation of the Water Framework Directive in the Swedish Coastal Zone.

Policy changes: 1974 Greatly increased discharge of treated sewage, 1984 experimentally increased phosphorus load during one year, 1997 introduction of enhanced nitrogen removal (c.85%) in Sewage treatment plant, 1997-2005 temporary use of an Adaptive Management approach for running the sewage treatment plant, from 2004 implementation of the Water Framework Directive. Permanent permission for adaptive sewage management will be sought in 2008, when a long-term discharge permit for the Himmerfjärden sewage treatment plant will be decided.



The Limfjord is situated in North Jutland, with western inlet to the North Sea and a narrow channel leading to the Kattegat.

Characteristics

Marine System

With a surface area of 1500 km3 and about 1000 km of coastline, the Limfjord is the largest fjord in Denmark. The fjord receives saltwater (32-34 ppt) from the North Sea in the west, and from Kattegat (19-25 ppt) in the east. Wind generated currents and tidal currents generate an average flow of 6.8 km3 from west to east through the fjord. The fjord consists of a system of shallow broads (5-8 m) linked by deeper sounds (18-22 m).

The estuary is strongly impacted by an intensive blue mussel commercial fishery causing habitat changes and heavy eutrophication resulting in frequent oxygen depletion events. The fjord is used for ship transport from the North Sea to the Kattegat and viceversa and water-related recreational activity.

Watershed

The catchment area is relatively flat, expands over 51 counties covering an area of 7528 km2 and provides on average 2.7 km3 of freshwater runoff annually. The freshwater input is equivalent to about 1/3 of the total volume of the Limfjord. Nutrient loading is primarily from non-point sources. The primary land-use

is agriculture covering about 62% of the area. About 15% is covered with forest and the remaining 22% is semi-urban and open nature. Suspended matter has a great influence on light penetration in this relatively shallow fjord and consists of phytoplankton and re-suspended matter, especially in the wind-exposed western part of the fjord.

Human Activities

- **Agriculture.** Large catchment with intensive agriculture results in high annual nutrient input.
- **Commercial fishing for shellfish.** A large mussel fishing industry based on bottom dredging. Stones and shells removed are not returned to the estuary resulting in habitat degradation.

Impact Responses

- **Eutrophication** has caused enhanced oxygen depletion occurrences and durations and changes in benthic-pelagic coupling
- **Impact of mussel dredging** from the commercial fishery has caused changes in musselstocks, in- and epifauna, sediment complexity and coupled effects on species interactions, sediment resuspension, seagrass and macroalgae and led to conservation measures as MPA
- **Other**. Over-fishing, Bio-chemical pollution - Trophic Web Change - Use Depreciation

Policy

Policy issues

Fisheries policy. Much effort has been put into devising a fisheries policy for the whole system, with participation from all the counties (management), research institutions and user groups. A fishery plan was published in 2000 and as a consequence of this several policy measures have been taken, such as; closing trawl fishery for eel and closing areas for all fishery with mobile gear. In 2004 a committee established by the Danish minister of fishery recommended on new regulation and initiatives towards a sustainable shellfish fishery and improved production of mussels by aquaculture. Danish authorities have to implement a number of these recommendations in the next years. A new tool is recently developed using GIS for the management mussel and oyster fishery and aquaculture and taking into consideration biological, political and user issues for the definition of potential sites/areas for fisheries or aquaculture within the whole Limfjord.

Policy changes

Fisheries Policy in particular a policy for mussel and oyster fishery within the Limfjord has been established. A policy for increased production by mussel farming (aquaculture) has been established. A new **land-use policy** is currently being proposed to redistribute land use relative to watershed characteristics and potential run-off/nutrient leakage.

Stakeholders and Institutional Governance

Major organisations

- County and Municipal administrations surrounding the fjord,
- Ministry of Fisheries,
- Ministry of Environment,
- Fishermen organisations,
- Agriculture Organisation,
- Aquaculture Organisation.

Other leading organisations

- National Agency for the Environment,
- Coastal Authority Directorate,
- Tourist industry,
- Nature Conservation organisations such as Danish Nature.

Partner Collaboration

- **NERI-AU** Aarhus University - National Environmental Research Institute (Professor Stiig Markager); Systems Modelling;
- SDU: University of Southern Denmark (Dr. Marianne Holmer). Marine Ecology

Systems Studies

Long time series

Hydrochemical, physical and phytoplankton data, river discharge and nutrient loads of 30 years. Benthos, fish, birds and seals data over 10-20 years. Various and large amounts of additional data e.g. meteorological, hydrodynamic, sediment, heavy metal, biological data. A 3-page listing detailing all available time-series data has been collated.

Research Projects

- A project "GIS-Limfjord" was initiated in 2004 introducing GIS data both on land and sea data as a tool in fisheries management within the Limfjord. It would be possible to access these data to integrate them.
- In 2002 a 3-year EU project EUROGEL was initiated with the aim to describe the distribution and temporal occurrence of jellyfish in the Limfjord and evaluating their grazing impact within the

ecosystem. (2002-2004). Two EU projects (Essence and Mabene – 1999- 2005) deal with the interactions between the benthic communities and the pelagic environment with particular emphasis on grazing aspects of mussel communities and on ecosystem modelling with focus on mussels.

- A national project SUSTAINEX focus on impact of mussel dredging, recruitment processes of blue mussels, bentho-pelagic coupling all integrated in an ecosystem model. Several project deals with sustainable aquaculture of blue mussels and flat oyster coordinated by the Danish Shellfish Centre. One project deals with ecosystem models as tools for management. Funding is for 2007-2008.

A close cooperation exists between research institutes, universities, and managers from the 3 counties bordering the fjord and stakeholders such as commercial and recreational fishermen's organisations.

Social study

In 1996 a social study on "The fight for the Limfjord – Lifestyles, environmental values and policies" was completed analysing the fishing community their use of the fjord, which is directly impacted by the declining fish stocks and future fishery policies. The report analyses the different usages in the fjord, the conflicts and possible consequences of different policies for the local communities.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/himmerfjarden/

Publications

Kratzer, S., Tett, P.: Using bio-optics to investigate the extent of coastal waters a Swedish case study. Hydrobiologia, 629(1): 169–186, 2009.

Kratzer, S., Brockmann, C., Moore G.: Using MERIS full resolution data (300 m spatial resolution) to monitor coastal waters– a case study from Himmerfjärden, a fjord-like bay in the north-western Baltic Sea.

To download the PDF: https://participatory-assessment.eu/himmerfjarden/

Limfjord

Date:

01/02/2007 - 31/01/2011

Coordinated by

Josianne Støttrup
Danish Institute for Fisheries Research
DENMARK
E-Mail: jgs@dfu.min.dk

Summary

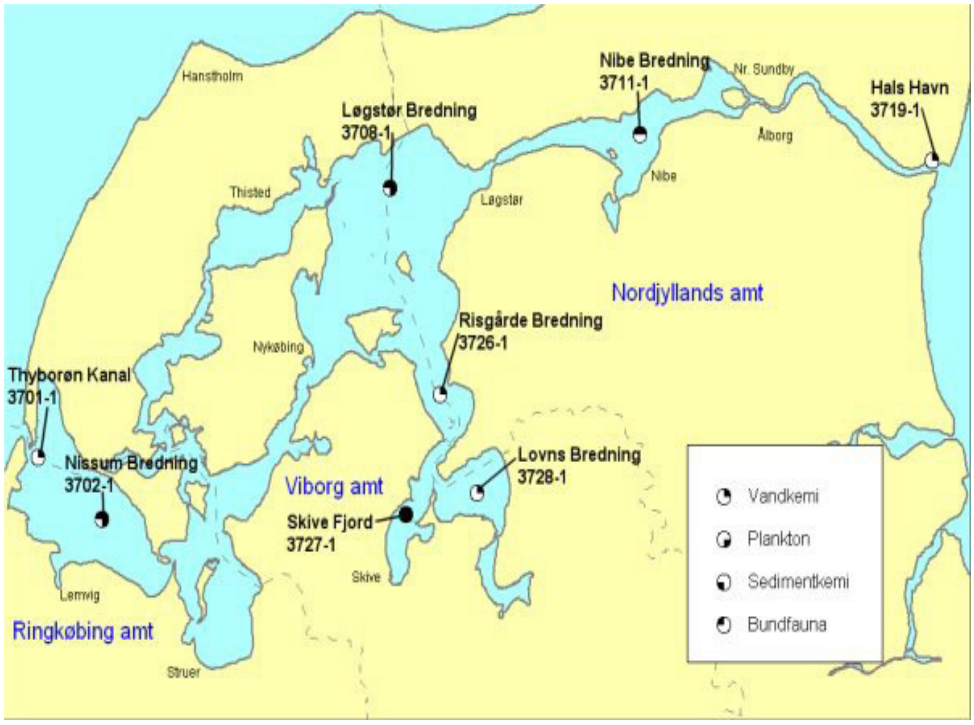
The Limfjord is situated in North Jutland, with western inlet to the North Sea and a narrow channel leading to the Kattegat.

With a surface area of 1500 km3 and about 1000 km of coastline, the Limfjord is the largest fjord in Denmark. The estuary is strongly impacted by an intensive blue mussel commercial fishery causing habitat changes and heavy eutrophication resulting in frequent oxygen depletion events. The fjord is used for ship transport from the North Sea to the Kattegat and viceversa and water-related recreational activity.

The catchment area is relatively flat, expands over 51 counties. The primary land-use is agriculture covering about 62% of the area. About 15% is covered with forest and the remaining 22% is semi-urban and open nature. Suspended matter has a great influence on light penetration in this relatively shallow fjord and consists of phytoplankton and re-suspended matter, especially in the wind-exposed western part of the fjord.

Agriculture, Large catchment with intensive agriculture results in high annual nutrient input. Commercial fishing for shellfish. A large mussel fishing industry based on bottom dredging. Stones and shells removed are not returned to the estuary resulting in habitat degradation.

Fisheries Policy in particular a policy for mussel and oyster fishery within the Limfjord has been established. A policy for increased production by mussel farming (aquaculture) has been established. A new land-use policy is currently being proposed to redistribute land use relative to watershed characteristics and potential run-off/nutrient leakage.



The Limfjord is situated in North Jutland, with western inlet to the North Sea and a narrow channel leading to the Kattegat.

Characteristics

Marine System

With a surface area of 1500 km3 and about 1000 km of coastline, the Limfjord is the largest fjord in Denmark. The fjord receives saltwater (32-34 ppt) from the North Sea in the west, and from Kattegat (19-25 ppt) in the east. Wind generated currents and tidal currents generate an average flow of 6.8 km3 from west to east through the fjord. The fjord consists of a system of shallow broads (5-8 m) linked by deeper sounds (18-22 m).

The estuary is strongly impacted by an intensive blue mussel commercial fishery causing habitat changes and heavy eutrophication resulting in frequent oxygen depletion events. The fjord is used for ship transport from the North Sea to the Kattegat and viceversa and water-related recreational activity.

Watershed

The catchment area is relatively flat, expands over 51 counties covering an area of 7528 km^2 and provides on average 2.7 km^3 of freshwater runoff annually. The freshwater input is equivalent to about 1/3 of the total volume of the Limfjord. Nutrient loading is primarily from non-point sources. The primary land-use is agriculture covering about 62% of the area. About 15% is covered with forest and the remaining 22% is semi-urban and open nature. Suspended matter has a great influence on light penetration in this relatively shallow fjord and consists of phytoplankton and re-suspended matter, especially in the wind-exposed western part of the fjord.

Human Activities

- **Agriculture.** Large catchment with intensive agriculture results in high annual nutrient input.
- **Commercial fishing for shellfish.** A large mussel fishing industry based on bottom dredging. Stones and shells removed are not returned to the estuary resulting in habitat degradation.

Impact Responses

- **Eutrophication** has caused enhanced oxygen depletion occurrences and durations and changes in benthic-pelagic coupling
- **Impact of mussel dredging** from the commercial fishery has caused changes in musselstocks, in- and epifauna, sediment complexity and coupled effects on species interactions, sediment resuspension, seagrass and macroalgae and led to conservation measures as MPA
- **Other**. Over-fishing, Bio-chemical pollution - Trophic Web Change - Use Depreciation

Policy

Policy issues

Fisheries policy. Much effort has been put into devising a fisheries policy for the whole system, with participation from all the counties (management), research institutions and user groups. A fishery plan was published in 2000 and as a consequence of this several policy measures have been taken, such as; closing trawl fishery for eel and closing areas for all fishery with mobile gear. In 2004 a committee established by the Danish minister of fishery recommended on new regulation and initiatives towards a sustainable shellfish fishery and improved production of mussels by aquaculture. Danish authorities have to implement a number of these recommendations in the next years. A new tool is recently developed using GIS for the management mussel and oyster fishery and aquaculture and taking into consideration biological, political and user issues for the definition of potential sites/areas for fisheries or aquaculture within the whole Limfjord.

Policy changes

Fisheries Policy in particular a policy for mussel and oyster fishery within the Limfjord has been established. A policy for increased production by mussel farming (aquaculture) has been established. A new **land-use policy** is currently being proposed to redistribute land use relative to watershed characteristics and potential run-off/nutrient leakage.

Stakeholders and Institutional Governance

Major organisations

- County and Municipal administrations surrounding the fjord,
- Ministry of Fisheries,

- Ministry of Environment,
- Fishermen organisations,
- Agriculture Organisation,
- Aquaculture Organisation.

Other leading organisations

- National Agency for the Environment,
- Coastal Authority Directorate,
- Tourist industry,
- Nature Conservation organisations such as Danish Nature.

Partner Collaboration

- **NERI-AU** Aarhus University - National Environmental Research Institute (Professor Stiig Markager); Systems Modelling;
- **SDU**: University of Southern Denmark (Dr. Marianne Holmer). Marine Ecology

Systems Studies

Long time series

Hydrochemical, physical and phytoplankton data, river discharge and nutrient loads of 30 years. Benthos, fish, birds and seals data over 10-20 years. Various and large amounts of additional data e.g. meteorological, hydrodynamic, sediment, heavy metal, biological data. A 3-page listing detailing all available time-series data has been collated.

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A close cooperation exists between research institutes, universities, and managers from the 3 counties bordering the fjord and stakeholders such as commercial and recreational fishermen's organisations.

Social study

In 1996 a social study on "The fight for the Limfjord – Lifestyles, environmental values and policies" was completed analysing the **fishing community** their use of the fjord, which is directly impacted by the declining fish stocks and future fishery policies. The report analyses the different usages in the fjord, the conflicts and possible consequences of different policies for the local communities.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/limfjord/

Sondeled

Date:

01/02/2007 - 31/01/2011

Coordinated by

Erlend Moksness
Institute of Marine Research / Havforskningsinstituttet (IMR)
Flødevigen Marine Research Station
Nye Flødevigveien 20
4817 His
NORWAY
Website: https://www.hi.no/hi

Summary

The Søndeled fjord-system (Østerfjorden, Nordfjorden, Sørfjorden and Kranfjorden) is situated at the southern coast of Norway. It is separated from the open Skagerrak by islands and sounds. There are fisheries of cod in the fjord and shallow areas with eel-grass are important nursery grounds. Some mussel plants are located in the fjord-system. The fjord is considered moderately eutrophicated due to input of nitrogen from local sources as well as long-distance transport with currents from the European continent. The watershed constitutes both urban and rural settings and is about 516 km2. A river with a mean flow of about 8 m3/s enters the innermost basin. In addition about 2 m3/s of freshwater enter the fjord-system via brooks and as diffuse run-off. The nutrient loading is primarily from diffuse sources. Only 3-4% of the watershed is agriculture fields, while about 70% is forest. The outer part is most urbanized with about 6000 inhabitants, and there is also somewhat industrialized. In the Kranfjorden there is chemical pollution of the sediments from earlier wood-processing industry. Shoreline development with constructions as houses, cottages, landing stages, piers/quays, cables and pipes frequently has lead to conflicting interests in the area.The area is important for recreation and tourism. There are commercial fisheries and mussels plants in the fjord-system.

Policy issues: Increase local economic benefits from tourism, while minimizing negative impacts on local coastal cod stock, and conflicts with local users of the fjord system.

Fish and lobster stock assessment. Marine protected areas for European lobster. Establishing of artificial reefs for European lobster. Causes to, and effects of oxygen deficiency. Habitat mapping and development of GIStools for ICZM. Improvement of the coastal zone plans. Conflicts related to shoreline development. Benefits and drawbacks of mussel production.

Policy changes: Increasing effort to include marine resource and user area in the coastal zone planning. Stricter enforcement and control regarding building activity in the coastal zone. Establishing of MPA.

Future Policy changes: Assessment (EIA), incorporating the EU directive on Strategic Environmental Assessment (SEA). EU directives (e.g. water framework, Habitat, Nature 2000)

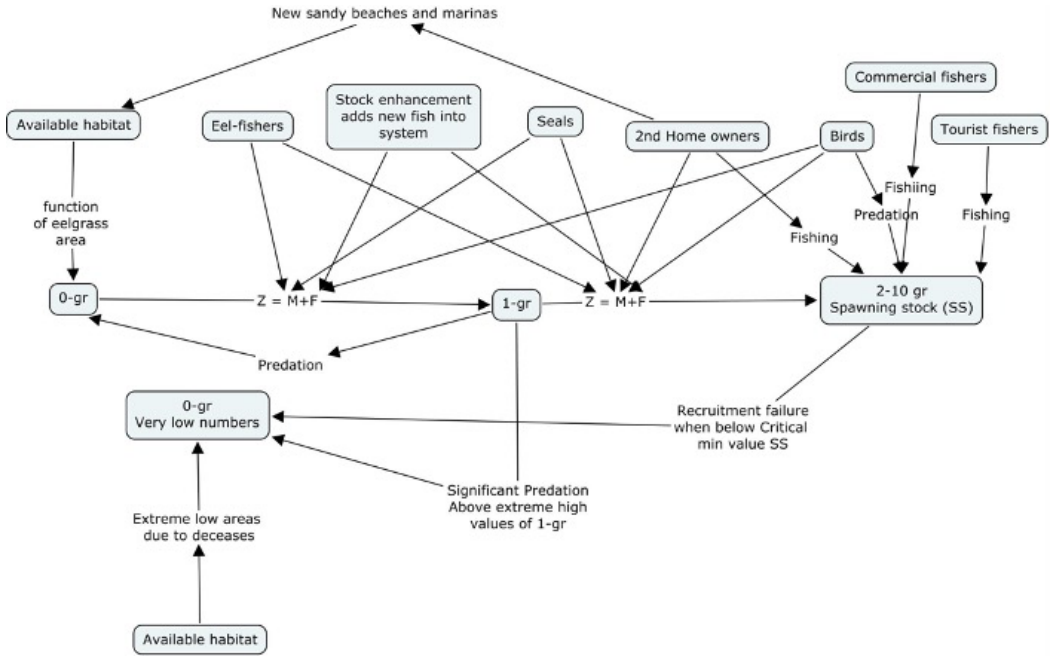
Policy Issue

Increase local economic benefits from tourism, while minimizing negative impacts on local coastal cod stock, and conflicts with local users of the fjord system

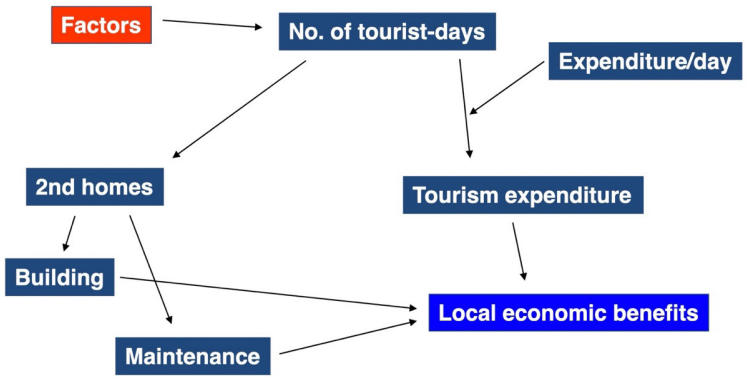
The aim of the modeling is to make a tool that can help policy-makers and regulators by revealing connections between factors and trade-offs between objectives.

The total SSA 7.6 ExtendSim model will interconnect three separate components:

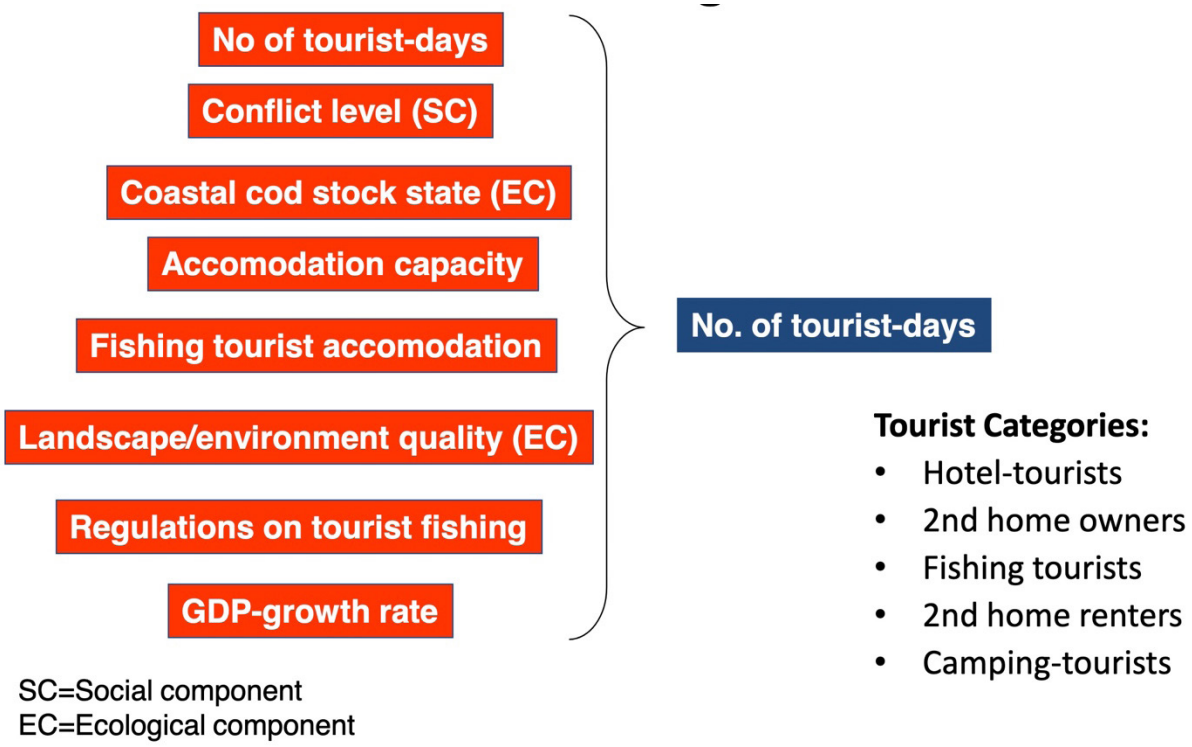
- Ecosystem model (represented by the local stock of coastal cod) (Environmental component; NC)
- Social model (Social component; SC)
- Economy model (Economy Component; EC)



Schematic of local economic benefits from tourism



Factors affecting number of tourist-days for tourist categories

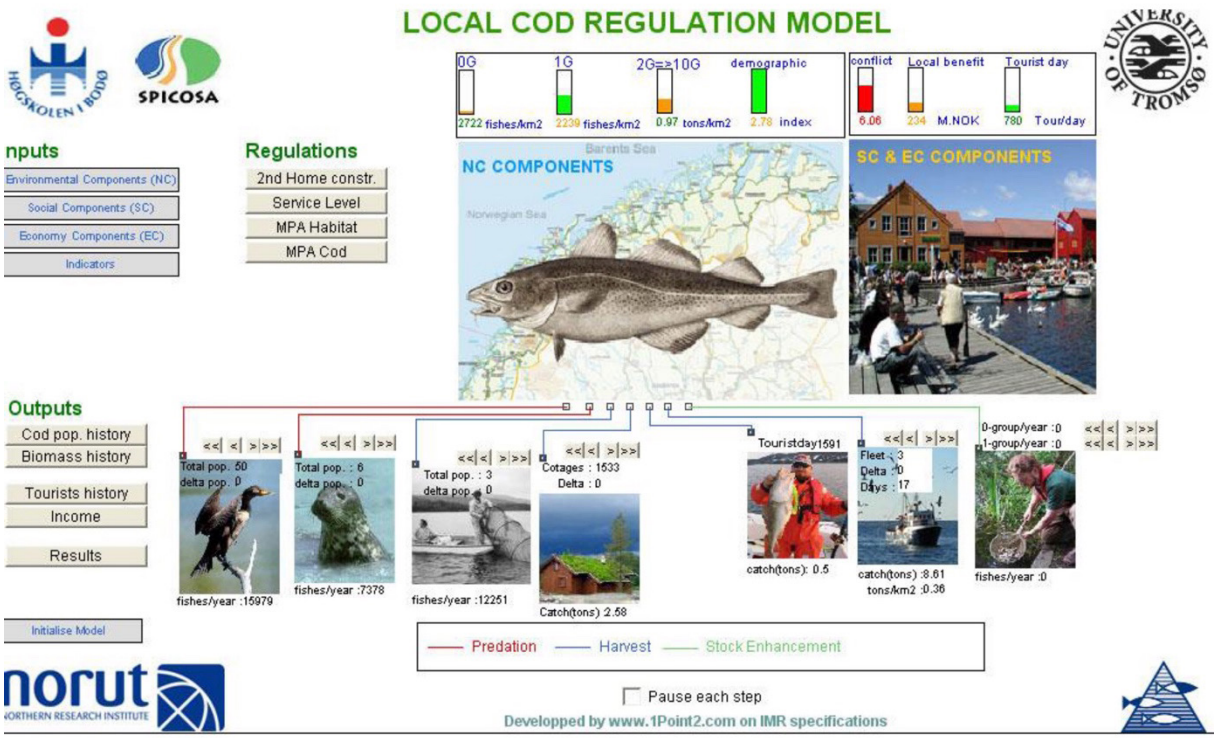


Other economic effects

- Commercial fishery affected by cod stock state
- Potentially: cost of rearing cod
- Potentially: Aquaculture-production and effects on wild fish

Factors affecting conflict level

Local COD Regulation model



Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/sondeled/

Publications

Moksness, E., Gjøsæter J., Wigdahl Kaspersen, I. , Mikkelsen, E., Sandersen, H.T., Vølstad, J.H. *System Formulation. Part 2: Running the model* . IMR, Arendal, 2009 - Manual.

Moksness, E., Gjøsæter J., Wigdahl Kaspersen, I., Mikkelsen, E., Sandersen, H.T., Vølstad, J.H. *System Formulation. Part 1: ExtendSim Model description.* IMR, Arendal, 2009 - Model desciption.

Gjøsæter J., Mikkelsen, E., Moksness, E., Sandersen, H.T., Vølstad, J.H. *Scientific Report for Formulation Step. SSA 7.6, Søndeledfjorden, Norway.* IMR, Arendal, 2008 - Report SPICOSA.

To download the PDF: https://participatory-assessment.eu/sondeled/

Clyde Sea

Date:

01/02/2007 - 31/01/2011

Coordinated by

Scottish Association for Marine Science

Contact: Kenny Black,

Kenny.Black@sams.ac.uk

Summary

The Clyde Sea located on the Scottish westcoast.

The Clyde Sea located on the Scottish westcoast. The Clyde Sea is Scotland's largest and deepest (190 m) fjordic system. It is marinedominated but separated from the Northern part of the Irish Sea by a shallow (50 m) sill.It receives inputs from several smaller sea loch systems each with its own restrictive sill, and the Clyde River system, which passes directly through Scotland's major conurbation, Glasgow. The Clyde

river extends into the Southern Uplands with a catchment of 3900 km2 above Greenock. The Clyde Lochs include Fyne, Gairloch, Goil, Holy Loch, Long and Stiven which penetrate the Highlands to the north, together having a catchment of 693 km2 and runoff of 1.3x 109 m3 yr-1. The rural catchment is dominated livestock production. Higher ground is a mixture of moorland, intensive forestry and sheep farming. Until the 1990s, sewage sludge from the Glasgow area was dumped in the central Clyde Sea but is now processed through several large treatment works with long-sea outfalls. The Ayrshire coast has several industrial chemical manufacturing facilities discharging into the Clyde.

Human activities. Shellfish and Finfish Fisheries and Aquaculture, Agriculture, Industrial and Urban Effluents, Forestry, Tourism, Shipping, Sailing. Impact reponses are: Nutrient enhancement, Habitat Destruction, Biodiversity changes, Trophic Web Change, Pathogens/toxins.

Policy issues. The carrying capacity for shellfish culture and the assimilative capacity for finfish culture. Consequences for fishing and aquaculture of increased recreational sailing activity in terms of space competition both at sea and in harbours. What is the sustainable harvest of wild shellfish and finfish. The role of Marine Protected Areas for enhancing fisheries and for conservation. The consequences for the ecosystem of reduced sewage inputs.

Policy changes. Aquaculture planning processes transferring from National to Local Authority; Implementation of the WFD and Catchment Management Planning; Marine Spatial Planning proposals; Proposed UK Marine Act.

Characteristics

Marine System

The Clyde Sea is Scotland's largest and deepest (190 m) fjordic system. It is marine dominated but separated from the Northern part of the Irish Sea by a shallow (50 m) sill. Deep water remains isolated from the surface during the summer months because of a strong seasonal density gradient. Vertical mixing is dominated by internal waves generated at the sill.

Watershed

It receives inputs from several smaller sea loch systems each with its own restrictive sill, and the Clyde River system, which passes directly through Scotland's major conurbation, Glasgow (pop. ~1 million). The Clyde river extends into the Southern Uplands with a catchment of 3900 km^2 above Greenock. The Clyde Lochs include Fyne, Gairloch, Goil, Holy Loch, Long and Stiven which penetrate the Highlands to the north, together having a catchment of 693 km^2 and runoff of 1.3x 10^9 m^3 yr^{-1}. The rural catchment is dominated livestock production. Higher ground is a mixture of moorland, intensive forestry and sheep farming. Until the 1990s, sewage sludge from the Glasgow area was dumped in the central Clyde Sea but is now processed through several large treatment works with long-sea outfalls. The Ayrshire coast has several industrial chemical manufacturing facilities discharging into the Clyde.

Human Activities

Shellfish and Finfish Fisheries and Aquaculture, Agriculture, Industrial and Urban Effluents, Forestry, Tourism, Shipping, Sailing

Impact Responses

Nutrient enhancement, Habitat Destruction, Biodiversity changes, Trophic Web Change, Pathogens/ toxins

Policy

Policy issues

- The carrying capacity for shellfish culture and the assimilative capacity for finfish culture. Consequences for fishing and aquaculture of increased recreational sailing activity in terms of space competition both at sea and in harbours.
- What is the sustainable harvest of wild shellfish and finfish.
- The role of Marine Protected Areas for enhancing fisheries and for conservation. The consequences for the ecosystem of reduced sewage inputs.

Policy changes

- Aquaculture planning processes transferring from National to Local Authority. Implementation of the WFD and Catchment Management Planning
- Marine Spatial Planning proposals. Proposed UK Marine Act.

Stakeholders and Institutional Governance

Major organisations

- Scottish Environmental Protection Agency Scottish Natural Heritage
- Scottish Executive DEFRA
- Fisheries Research Services

Other leading

- Scottish Coastal Forum

organisations

- Firth of Clyde Forum
- Argyll Fisheries Trust
- Scottish Quality Salmon
- Association of Scottish Shellfish Growers
- Clyde Fishermans Association

Partner Collaboration

- **UoP** Plymouth Marine Laboratory;
- **UC** University of Cardiff, Department of Earth Sciences;
- **NUE** University of Napier, School of Life Sciences.

Systems Studies

Long time series

Few long-time series for any parameter exist on the marine west-coast of Scotland but many research projects have made multiple year measurements of a wide range of parameters. Water quality measurements have been made in the Clyde River system for many years. There is a long time series (~40 years) of surface Temperature and Salinity at the Isle of Cumbrae withi8n the Clyde Sea and a much longer series from the Isle of Man to the South of the Clyde Sea. Several major European Projects such as PROVESS and OARRE have studied the Clyde as have many institutions from around the UK. SAMS has short time series (1-3 years) for a wide range of physical and chemical data taken over the past 100 years.

Input data on weather can be obtained from several sources, river-borne nutrient data from can be obtained from SEPA together with some physical and nutrient data and details of all industrial discharges to the area; data from the former Clyde Sewage Sludge Dumping Ground is readily

available.

Research Projects

PROFILE: Processes in regions of freshwater influence

PROFILE, an EU MAST2 project, generating understanding of processes relating to hydrodynamics, sediments dynamics and microbiology, incorporated in a tested fully coupled model for regions of freshwater influence (ROFIs) was completed successfully in 1996.

Studies of the discharge into an idealised Clyde Sea using the POL 3D-B model showed that the area of freshwater stratification near the river mouth, forming a bulge of a typical river plume in a low friction, low entrainment case, could readily form a persistent region of anticyclonic circulation. This can then affect the direction of subsequent discharges as the outflow varies in time.

OAERRE: Oceanographic Applications to Eutrophication in Regions of Restricted Exchange EU FP5 OAERRE's objectives were:

1. Observations of the physics of vertical and open boundary exchange in Restricted Exchange Environments (REEs), leading to improved parameterisation of these processes in research and simplified models.
2. Study of the phytoplankton and pelagic micro-heterotrophs responsible for production and decomposition of organic material, and of sedimentation, benthic processes and benthic-pelagic coupling, in REEs, with the results expressed as basin-scale parameters.

3. Construction of closed budgets and coupled physical-biological research models for nutrient (especially nitrogen) and organic carbon cycling in REEs, allowing tests of hypotheses about biogeochemistry, water quality and the balance of organisms.

4. Construction of simplified 'screening' models for the definition, assessment and prediction of eutrophication, involving collaboration with 'end-users', and the use of these models to analyse the costs and benefits of amelioration scenarios.

OAERRE is a collaboration amongst physical, chemical and biological oceanographers, and coastal resource managers, with intensive studies relating to eutrophication at sites that exemplify a range of hydrographic and enrichment conditions.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/clyde-sea/

Cork Harbour

Date:

1/02/2007 - 31/01/2011

Coordinated by

National University of Ireland Cork. Contact: Valerie Cummins v.cummins@ucc.ie

Summary

Cork Harbour, a large natural harbour of strategic importance, is situated on the south coast of Ireland. Cork Harbour, with a surface water body of 100km2, extends from the tidal influence of the River Lee to the narrow Harbour mouth. Cork Harbour is a large, sheltered, naturally deepwater harbour. Strong estuarine influences dominate the upper reaches of the Harbour in particular. The coastline is mixed, consisting of built infrastructure, shallow cliffs, intertidal mudflats, reedbeds, shingle and rocky foreshores, which are exposed by the tide (tidal range 3-4m). The bathymetry of the Harbour reflects the morphology of the coastline, with gentle slopes dropping to a depth of 28m near the mouth of the Harbour (11m in the channel which is maintained at that depth for navigation).

Riverine inputs originate from the Lee, the Owenacurra, the Glashboy and the Owenabue. Freshwater inputs from the Lee are controlled by the dam upstream at Iniscarra. Nutrient loading is primarily from non-point agricultural sources distributed throughout the catchment, but primarily in the upper reaches of the Lee estuary. Point source discharges have been reduced by the recent Cork main drainage scheme.

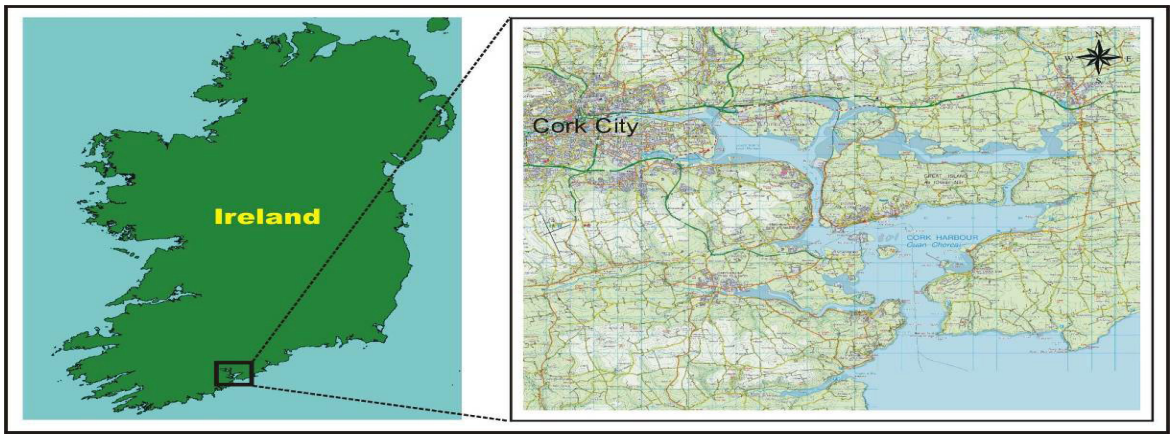
While contemporary use of large tracts of the Harbour is marked by concentrations of **urban** populations (most significantly, Cork City – population ~123,000) and widespread chemical and pharmaceutical **industries**, much of the coast remains unspoilt and characterised by rural **agricultural** land use or **protected habitats**. It's sheltered environment and deep-water channels make Cork Harbour an ideal location for **shipping** and **recreational boating** activities. The physical geography of the Harbour on the south coast of Ireland provides a strategic location for the Port of Cork situated in close proximity to the main shipping line to Northern Europe. **Tourism, marine heritage, fishing, and waste management** are other key human activities associated with the harbour

Policy issues: Dealing with remediation and redevelopment of contaminated **coastal brownfield sites**. Dealing with contamination from **heavy metals leaching** into the Harbour from the disused Irish Steel Plant and from the Irish Fertilisers Industry plant.Potential impacts of the Cork Main Drainage scheme on wading bird populations due to **changing nutrient levels**, recreational activities, and overall development of the Harbour. Issues of **coastal flooding and erosion** (especially flood impacts on Cork City). Identifying the **recreational carrying capacity** of the Harbour.

The potential impact of the **Port of Cork** Strategic Development Plan which, aims to rationalise existing port activities and make provision for additional port activities that need land reservations.

Policy changes: The implementation of the Cork Main Drainage Scheme in response to the Urban Wastewater Treatment Directive.Cork County Development Plans – zonation of landuse for housing, industry, recreation, waste disposal (including incineration) and transport.

IDA (Industrial Development Authority) development policy.



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- **Tourism, marine heritage, fishing, and waste management** are other key human activities associated with the harbour.

Impact Responses

Eutrophication, water pollution, contaminated land, flooding and use conflict.

Policy

Policy issues

- Dealing with remediation and redevelopment of contaminated **coastal brownfield sites**. Dealing with contamination from **heavy metals leaching** into the Harbour from the disused Irish Steel Plant and from the Irish Fertilisers Industry plant.
- Potential impacts of the Cork Main Drainage scheme on wading bird populations due to **changing nutrient levels**, recreational activities, and overall development of the Harbour. Issues of **coastal flooding and erosion** (especially flood impacts on Cork City).
- Identifying the **recreational carrying capacity** of the Harbour.
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Policy changes

- The implementation of the Cork Main Drainage Scheme in response to the Urban Wastewater Treatment Directive.
- Cork County Development Plans – zonation of landuse for housing, industry, recreation, waste disposal (including incineration) and transport.
- IDA (Industrial Development Authority) development policy.

Stakeholders and Institutional Governance

Major organisations

Local to National Authorities

- Cork County Council,
- Cork City Council,
- Cobh Urban Council,
- Department of Communications,
- Marine and Natural Resources,

- National Parks and Wildlife Service,
- Irish Naval Service,
- Irish Coastguard, Department of Environment,
- The Marine Institute,
- Bord Iascaigh Mhara, Department of Community,
- Rural and Gaeltacht Affairs,
- Environmental Protection Agency.

Industrial/Economic users

- Port of Cork Company,
- multi national pharmaceutical companies (e.g. Pfizers, ADM, Novartis),
- Whitegate oil refinery,
- Electricity Supply Board power generating station,
- cruise ship sector,
- fisheries sector (especially angling).

Partner Collaboration

- **CU** Cardiff University,
- Marine and Coastal Environment Group (Dr. Hance Smith)
- **ENVISION**, UK (Dr. Jeremy Hills)

Systems Studies

Long time series

- Bathymetric data – initial admiralty charts go back over 100 years, with regular bathymetric survey data available over the past 30 years.
- Tidal records – over 25 years.
- Marine biotoxins and phytoplankton data- >20 years Geophysical data (sediment samples) - >30 years Water quality data >10 years

Research Projects

The COREPOINT (Coastal Research and Policy Integration), INTERREG IIIB, initiated in 2004, uses Cork Harbour as a strategic study site. Local policy issues are investigated through enhanced scientific

understanding of natural processes within the harbour. These include reserach into physical coastal processes influencing vulnerability to flooding.

Cork Harbour has also been mapped as part of the Irish National Seabed Suvey. The resulting data is used in a national project to advance the development of integrated coastal zone maps. The Blue City Project - use of Information Technology to study Cork City's water resources, (Higher Educational Authority funded), is also nearing completion.

Socio-economic study

Several socio-economic studies have been undertaken including: studies relating to Port of Cork Strategic Development, the Economic Impact of the Port of Cork's Cruise Traffic, the Economic Contribution of the Port of Cork to the Irish Economy and a case study on the Economic Significance of Ford Cork Week 1996 Sailing Regatta.

Systems Approach Framework (SAF)

To download the PDF: https://participatory-assessment.eu/cork-harbour/

Publications

In: O'Mahony, C., Ferreira, M., Fernandez-Palacios, Y., Cummins, V., Haroun, R.. Data availability and accessibility for sustainable tourism: An assessment involving different European coastal tourism destinations. ICS2009 (Proceedings) (SI 56), pp. 1135-1139. Journal of Coastal Research, 2009. https://www.researchgate.net/publication/285788470_Data_availability_and_accessibility_for_sustainable_tourism_An_assessment_involving_different_European_coastal_tourism_destinations

O'Mahony, C., Gault, J., Cummins, V., Köpke, K. and O'Suilleabhain, D.: *Assessment of recreation activity and its application to integrated management and spatial planning for Cork Harbour, Ireland.* Marine Policy, 33(6): 930-937, 2009.

Cummins, V., Gault, J., O'Mahony, C., Köpke, K., Griffin, P., Walsh, E., O'Suilleabhain, D.. Establishing Information Needs for Planning and Assessment of Recreation Activity in the Coastal Environment: A Case Study from Cork Harbour, Ireland. 2008 - Proceedings of the International Pluridisciplinary Conference - The Littoral: Challenge, Dialogue, Action. 16th-18th January, Lille, France.

Cummins, V., Griffin, P., Gault, J., O'Mahony, C., O'Suilleabhain, D.. *Cork Harbour Integrated Management Strategy.*. Coastal and Marine Resources Centre, University College Cork., Coastal and Marine Resources Centre, Environmental Research Institute, University College Cork, Haulbowline Naval Base, Cobh, Co. Cork, Ireland., 2008 - Project report, INTERREG IIIB Coastal Research and Policy Integration (COREPOINT) Project.

Köpke, K., O'Mahony, C., Cummins, V. and Gault, J.. *Assessment of Coastal Recreational Activity and Capacity for Increased Boating in Cork Harbour.* Coastal and Marine Resources Centre, University College Cork., Coastal and Marine Resources Centre, Environmental Research Institute, University College Cork, Haulbowline Naval Base, Cobh, Co. Cork, Ireland., 2008 - Project report, INTERREG IIIB Coastal Research and Policy Integration (COREPOINT) Project.

Scheldt Delta

Date:

01/02/2007 - 31/01/2011

Coordinated by

Bert Van Eck

DELTARES

NETHERLANDS

E-Mail: Bert.vanEck@deltares.nl

Summary

The study area is located at the south-western part of the Netherlands and the north-western part of Belgium. It is formed by three major rivers: the Scheldt, the Rhine and Meuse.

The delta coast has an overall length of about 100 km and consists of straight regular sandy beaches in the northern part between Hoek van Holland (NL) and The Hague (NL) and an irregular sandy delta coast in the southern part from Hoek van Holland (NL) to Oostende (B). The Delta has various closed tidal inlets and two open tidal inlets (Eastern and Western Scheldt). Formerly all water bodies were in open connection. The Western Scheldt is still functioning as estuary of the transboundary river Scheldt (Zeeschelde). At many locations the coast is backed by relatively strong and wide dunes. At some locations only one single relatively weak dune row exists and at other locations dune rows are absent and replaced by dikes. The large-scale mouth of the Scheldt estuary has relatively strong in- and outgoing tidal currents. The Delta area covers a wider area since it is connected through the transboundary catchments of Rhine, Meuse and Scheldt with major economic areas in Europe.

Two major European centres of naval transport and industry – Rotterdam and Antwerp – fringe a coastal countryside where recreation, agriculture and aquaculture are dominant economic activities. Main human activities in the delta area include coastal engineering/shore line protection against flooding in all water bodies, agriculture freshwater runoff and outlets, shipping at the harbour facilities, tourism, shellfish cultures and land reclamation for port development.

The overall policy issue in this densely populated Delta is how to achieve a truly sustainable development of the area. The aim is to achieve a balance between regional economic development, social well-being and restoration of ecological values. Important issues are how to **sustain regional economic growth**, to h**armonize port accessibility**, to match sustainable coastal and riverine tidal **defence systems**, with port accessibility, recreation demands and urban development, to c**ope with regional pressures**, to i**mprove the ecological integrity** and to e**nsure the freshwater supply** on the Delta islands.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/scheldt-delta/

Publications

de Kok, J.-L.. *EUTROPHICATION IN THE SCHELDT BASIN - EXTEND MODEL - Status Report*. 2009 - SPICOSA Project.

To download the PDF: https://participatory-assessment.eu/scheldt-delta/

Pertuis Charentais

Date:

01/02/2007 - 31/01/2011

Coordinated by

Jean PROU
IFREMER LER/PC
Mus de Loup
17390 LA TREMBLADE
FRANCE
E-Mail: jean.prou@ifremer.fr

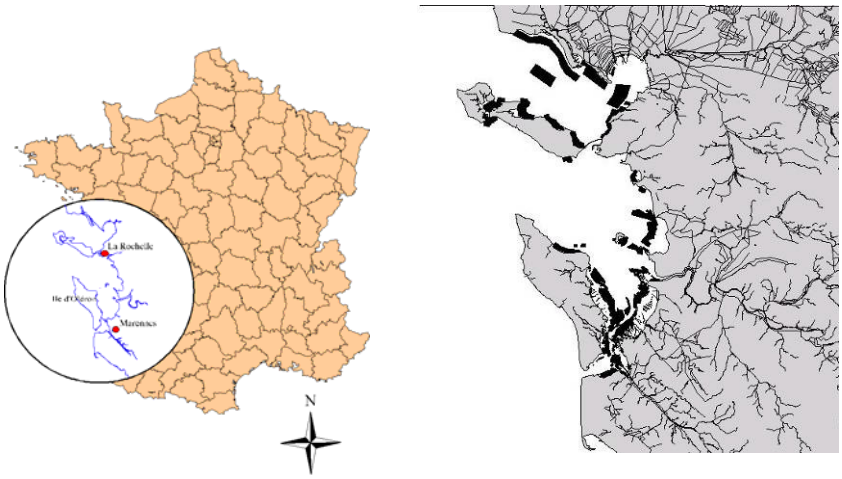
Summary

The Pertuis Charentais (40x80 km) located on the Atlantic coast. This area protected by two islands and is characterized by shallow waters (0-15 meters), intertidal mudflats, strong currents, extended wetlands and three main river discharges. Bird migration site, wetlands protection, sole nursery and benthic habitat are the main environment protection features. Integrated development schemes collapsed due to conflicts concerning environmental protection, space uses and freshwater sharing.

Some activity work along the coastal area, extensive aquaculture production (mussels and oysters), the Pertuis are also characterized by important summer tourism activity involving urban and harbour coastal development. In Hinterland, agriculture activity over-exploited freshwater resources for maize culture. So, main problem in this area were :

- Over-exploitation of freshwater resource (both surface and groundwater).
- Bio-chemical pollution (bacterial contamination, agriculture wastes), Ground and surface water deterioration.

The project proposed to Setting up of a “coastal waters management plan” (SMVM) equivalent to the “terrestrial” one and procedures of negotiation for freshwater management.



The Marennes-Oleron and Charente system is located on the Atlantic French coast

Characteristics

Marine System

The Pertuis Charentais (40x80 km), located on the Atlantic coast is protected by two islands and is characterized by shallow waters (0-15 meters), intertidal mudflats, strong currents, extended wetlands and three main river discharges. Bird migration site, wetlands protection, sole nursery and benthic habitat are the main environment protection features. Integrated development schemes collapsed due to conflicts concerning environmental protection, space uses and freshwater sharing.

Watershed

The river Charente extends on a 10000 km2 watershed.

Human Activities

EU leader for extensive aquaculture production (mussels and oysters), the Pertuis are also characterized by important summer tourism activity involving urban and harbour coastal development. Hinterland, agriculture over-exploited freshwater resources for maize culture

Impact Responses

- **Over-exploitation** of freshwater resource (both surface and groundwater).
- **Bio-chemical pollution** (bacterial contamination, agriculture wastes), Ground and surface water deterioration.

Policy

Policy issues

- socio-economic benefits to shellfish farming: trophic resources for oyster (phytoplankton production, organic matter, etc) depends on freshwater inputs (volumes, nutrients)
- mutual socio-economic benefits to both tourism and shellfish farming : management of freshwater quality (bacteria, viruses) on recreational and shellfish growing areas
- sustainability of marine and upstream activities especially for this site chosen as an EU intercalibration site in the frame of the Water Framework Directive.

Policy changes

- Failure of a coastal zone integrated management plan (SMVM) because of use conflicts (principally between environmental protection and socio-economic sectors).
- Agreement between actors (environmental protection, agriculture, shellfish culture, drinking water distribution) freshwater use on Charente river. Driven by politicians

Proposed: Setting up of a "coastal waters management plan" (SMVM) equivalent to the "terrestrial" one and procedures of negotiation for freshwater management

Stakeholders and Institutional Governance

Majororganisations

- EPTB Charente - Institution Interdépartementale du Fleuve Charente
- Agence de l'eau Adour-Garonne
- Other leading organisations
- GRAP Poitou Charentes - FREDON et Service régional de la protection des végétaux

Partner Collaboration

- CEMAGREF
- SOGREAH
- UBO University of Western Brittany

Systems Studies

Long time series

Marine:

- temperature, salinity, nutrients, particulate matter, chlorophyll (since 1976 on 5 sampling sites)
- chemical contaminants (since 1975)
- microbiological contamination (since 1989)
- harmful algal blooms (since 1986)
- oyster stocks (century)
- oyster growth and condition index (since 1978)
- oyster mortality (since 1994)
- oyster larvae abundance (since 1956)
- mussel growth mortality (since 2000)

Land:

- pesticides and nutrients on Charente river since 1992
- water fluxes at the outlet of Charente river since 2001, salinity since 1976
- land use, agriculture systems and practices, policies

Research Projects

- TROPHEE « Trophic capacity of European Ecosystems » (1990-1994, FAR): assessment of carrying capacity of cultivated shelffish areas – Coordinator: Ifremer
- INTRMUD " Morphological development of Intertidal Mudflats " (1996-1999 – MAST3) : dynamics of intertidal mudflats – coordination : Plymouth
- ESSENSE « Effects of Shellfish culture and options for Sustainable Exploitation » (1999-2001) : to improve knowledge for sustainable development of shellfish culture and exploitation – coordinator Netherlands Institute of Fisheries Research (Netherlands)
- OPCOM « Operational Modelling for Coastal Zone Management » (MAST3, 1997- 2000) : implementation of operational models in the coastal zone – coordinator : HYDROMOD (Allemagne), other partners : IFREMER-CREMA (France), IST (Portugal), Hidromod (Portugal), ERIV et EIA (Finland).
- Monitoring networks : REMI, REPHY, RNO, REMORA
- REPER is a observatory for research on environment in Pertuis Charentais : organization of monitoring networks, implementation of databases, permitting studies of interrelations in complex ecosystem impacted by anthropogenic activities

- Programme Interface (historical project) From the watershed to the maritime area: water resource as object of an integrated and applied research. A case study : Charente watershed and Mer des Pertuis
- Research on the Charente catchment area and the Marenne-Oléron's bay : continental part: 1994-1998 The aim of this work was to study the impact of the Charente's catchment area on the trophic system of the Marenne-Oléron bay and the consequences on its selfish farming.
- On the large watershed scale, a scientific collaboration between WQRU and IFREMER is presently running (D. MUNARON thesis in relationship with CREMA L'Houmeau and La Tremblade Station) using MARS 2 D advection-dispersion model to simulate Charente pesticide runoff behaviour in sensitive littoral environment of Mer des Pertuis lagoon (French 1st oyster production site).
- Programme Transpest 16 - MEDD pesticides (2005) – indicators (transfer of pesticides from agricultural areas to rivers) at the watershed level – sampling and monitoring of water quality at the same scale.
- Programme MEDD 2006 – test of pesticides indicators at the plot and watershed scale.
- Effects of Water Framework Directive on agriculture at the French national scale (CEMAGREF, French Ministry of Agriculture, DGFAR 2004-2005).-

Social study

Analyse du jeu des acteurs et des normes légales de la gestion des pêches et de la conchyliculture dans les pertuis charentais. Darbon D., Deglise C. Institut d'études politiques. Sciences Politiques Bordeaux.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/pertuis-charentais/

Publications

Mongruel, R., Bacher, C., Ballé-Béganton, J., Bordenave, P., Lample, M., Levrel, H., Mensencal, Y., Prou, J., Pérez Agúndez, J.A., Réthoret, H., Vernier F.: *Using ecosystem services modeling to explore conflict mitigation in the coastal zone*. David A. Swayne, Wanhong Yang, A. A. Voinov, A. Rizzoli, T. Filatova (Eds.).

Guadiana Estuary

Date:

01/02/2007 - 31/01/2011

Coordinated by

omasz Boski
CIMA - Universidade do Algarve
Campus de Gambelas
8000-139 Faro
PORTUGAL
E-Mail: tboski@ualg.pt
Website: http://www.ualg.pt/cima/ omasz Boski
CIMA - Universidade do Algarve
PORTUGAL
tboski@ualg.pt
Website: https://www.ualg.pt/cima/

Summary

Guadiana River Estuary is located in the southeast of Portugal and makes a border between Portugal and Spain. The geographical coordinates of the south most point on the Portuguese margin are 37°10' N and 7°24'E

Guadiana River Estuary is located in the southeast of Portugal and makes a border between Portugal and Spain. The geographical coordinates of the south most point on the Portuguese margin are 37°10' N and 7°24'E.

Guadiana is the one of most important rivers on Iberian Peninsula whose total length is 730 km, of which the last 200 make a natural border between Portugal and Spain. Geologically the drainage basin of 67 000km2 is much diversified. The Guadiana Estury is a mesotidal, narrow funnel-shaped body, well mixed

for low, summer (XX m3/sec) discharges, but vertically stratified in winter. The mixing zone is within the first 10 kms from mouth but brackish conditions may extend 40 km inland. Winter discharges delivers vital nutrients to shelf sea. More than 40 dams store water mostly for irrigation purposes (mostly in Spain) and decrease severely the water flow. The closing of the Alqueva dam—the largest artificial lake in Europe, with an area of 250 km²—in the Guadiana drainage basin, in Southern Portugal, will affect the river hydrology, by reducing the freshwater input and its inherent characteristics, and will influence the ecology of the estuary and nearby coastal waters. causing eutrophication and sediment starvation along the coast. Forestry and agriculture are the principal activities in the Portuguese part of drainage basin. Industrial pollution is not important in the estuarine area. Domestic sewage discharge at present is important due to the legal halt of water treatment plant constructed in the ecologically sensitive salt-marsh area.

The Human activities on the two margins (East – Spanish, West – Portuguese) of the estuary are at present distributed in an asymmetric way. The real estate development which is much more intense on the Spanish side, added recently, 14 km from the river mouth, a new leisure mega-village named Esuri. Actually Esuri is a small town foreseen mostly for secondary residences, constructed mostly on salt marsh terrains.

The remaining most important activities are paired together with their impacts or with other activities with potential for conflict. I. Agriculture - eutrofication II. Aquaculture - effluents, III. Tourism and recreation – habitat destruction, IV. fisheries – border conflicts, Sewage discharge - water and sediment pollution.

Most recent changes in policies with impacts on the zone:

- Shift from cereal agriculture to the wildlife (birds) sanctuary on Portuguese side of the estuary with subsequent application of NATURA 2000 status
- Construction of major bridge over the estuary which replace the ferryboat transport
- Construction of a jetty which retains most of the drifting sediment on Portuguese side of the estuary

Characteristics

Marine System

The Guadiana Estuary is a mesotidal, narrow funnel-shaped body, well mixed for low, summer (XX m3/sec) discharges, but vertically stratified in winter. The mixing zone is within the first 10 km from the mouth but brackish conditions may extend 40 km inland. Winter discharges delivers vital nutrients to the shelf sea. Since 2002, damming of the river reduced drastically this flux. Aquaculture and fisheries are important activities in this area. The wave regime is predominantly SW, associated mainly with swell from Atlantic Ocean. The strong long-shore current is west-to-east and transports ca 200 000m3/year of sand partially retained by groin. Domestic sewage discharge at present is important due to the legal halt of water treatment plant.

Watershed

Guadiana is the one of most important rivers on Iberian Peninsula whose total length is 730 km, of which the last 200 make a natural border between Portugal and Spain. Geologically the drainage basin of

67 000km2 is much diversified. More than 40 dams store water mostly for irrigation purposes (mostly in Spain) and decrease severely the water flow, causing eutrophication and sediment starvation along the coast. Forestry and agriculture are the principal activities in the Portuguese part of drainage basin. Industrial pollution is not nimportant.

Human Activities

The Human activities on the two margins (East – Spanish, West – Portuguese) of the estuary are at present distributed in an asymmetric way. The most important activities are indicated together with impacts: Agriculture - eutrophication, Aquaculture - effluents, Tourism and recreation – habitat destruction, fisheries – border conflicts, salt production.

Impact Responses

- **River discharge reduction** (recently-2002 closed Portuguese Alqueva dam) caused nutrient enhancement and contributes to the toxic algae blooms. Coastal erosion will become more severe.
- **Tourism development and urbanization** have invaded natural habitats and added untreated sewage discharge.

Policy

Policy issues

The damming of Guadiana River eliminated from coastal waters the turbid plumes, which support the plankton blooms and the planktivorous fish stocks. It aggravated the eutrophication impacts. The so called « minimal ecological discharge » is negotiated with water managing authorities in order to keep these issues controllable.

Policy changes

On the Portuguese side of the estuary, the Natura 2000 zone was declared and effectively stopped the urban/tourism development. However the adjacent zone is under strong pressure from tourism on coastal fringe and golf fields inland. The latter are menacing the Natural sanctuary area (Castro Marim salt marsh natural reserve of 2400ha, RAMSAR site).

On the Spanish side, the construction of a tourist-urban development for ca 30,000 people under completion changed dramatically the land use policy, invaded the agriculture dominated land and salt marshes which were covered by imported earth and transformed into the golf fields.

Stakeholders and Institutional Governance

Major organisations

- Ria Formoza Natural Park - Castro Marim Natural Reserve,

- Municipality of Castro Marim (Portugal),
- Municipality of Vila Real de Santo António, (Portugal)
- Municipality of Ayamonte (Spain),
- Regional Port Authority

Other leading organisations

- The association of solar pond salt producers,
- Confederação Portuguesa das Associações de Defesa do Ambiente.

Systems Studies

Long time series

- Sediment infilling of the estuary/postglacial sea level rise – last 10000 years.
- Tides – 5 years. Fish discharged (tone) in local port – 30 years.
- Fluvial discharge of Guadiana – 50 years. Rainfall data -120 years

Research Projects

- Monitoring and environmental management of Guadiana Estuary – development of a tool - MEGASIG (2004 -2006), EU-INTERREG IIIA program. Objective: create a versatile management and educational tools for the stakeholders.
- Multidisciplinary study of Guadiana River Estuary: Estuarine Dynamics – Present Situation, Anthropogenic Influences and the Perspective for the future – EMERGE. (1999 -2002). EU- INTERREG II program. Objective: define the principal environmental forcing factors acting upon estuarine system.

Socio-economic study

To be undertaken within the framework of recently approved Asia Link "Coastal-Profs" project.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/guadiana-estuary/

For additional information

- Website in Portuguese https://www.cima.ualg.pt/en/spicosa/local/caso.html

Barcelona Coast

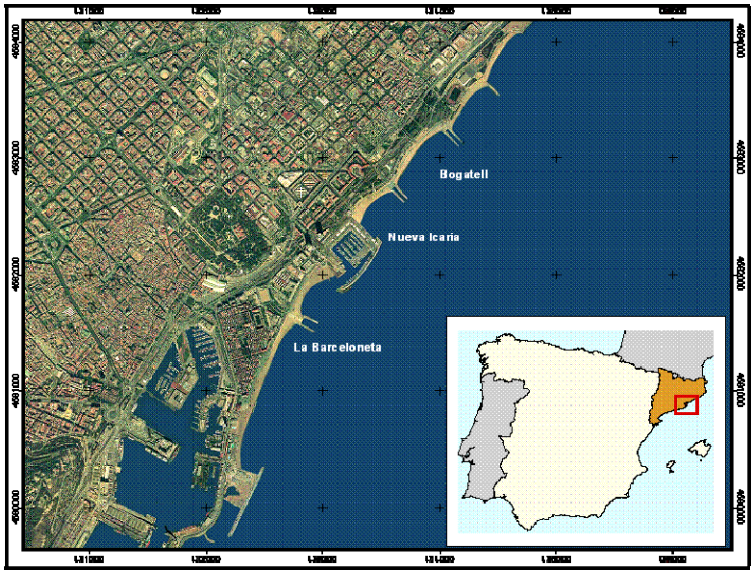
Date:

01/02/2007 - 31/01/2011

Coordinated by

Dolors Blasco
Institut Ciències del Mar , CSIC
SPAIN

Summary



Barcelona Waterfront, Northwestern Mediterranean, Catalunya, Spain

Barcelona and surrounding cities reach about 4 million habitants. Along the coast there are tourism activities, recreational and commercial harbours, some fisheries, waste effluents and two waste water treatment plants. Near the coast human activities are mainly urban activities with some industries. In the rivers watersheds there are heavy industries and agriculture.

The main source of anthropogenic contamination in the Barcelona continental shelf was till recently the Besós River. A wastewater treatment plant was installed near the river mouth in order to decrease this impact. The plant has been discharging a mixture of solids and liquids produced in its digestion tanks (sewage sludge) through a pipeline since 1979. The coast receives discharges from the Besòs River, and the Llobregat River with a mean water discharge of 5 and 20 m3/s respectively. However the water discharge of both rivers is extremely variable (maximum values of more than 2000 m3/s in strong flood events). Both rivers traverse urban, industrial and rural settings and the watershed size is 5000 km2 for Llobregat and 1000 km2 for Besòs. The watershed near the coast is all urban. During rain events, the coast receives the impact of urban drainage storm collectors, besides that from the rivers.

It necessary some project to reduce or avoid the problem:

- Construction of a new Wastedisposal Plant: primary treatment, and new waste water emissary: 3 Km from the coast and at 50 meter depth, before was 600 m off and at 20 m depth
- Implementation to a secondary treatment.
- Construction of a new harbor, remodelation and amplification of the old harbor, construction of several protection dikes and underwater barriers.

Characteristics

Marine System

30 Km of almost linear open Mediterranean coast broken by different coastal infrastructures such as harbours, protective barriers, etc. Tide generated currents are negligible and wave periods exceeding 7-8 s rare. The most persistent current direction is towards the SW, following the general circulation pattern of the peninsular shelf current of the North-western Mediterranean with an average velocity of 5 and 10 cm s^{-1}. The land is mostly beaches and urban construction. The bottom is mud or sand of various grain sizes up to gravel. The water is oligotrophic marine waters, naturally enriched in nutrients by the deep Mediterranean waters through winter mixing, and sporadically by the freshwater land runoff.

Watershed

The coast receives discharges from the Besòs River, and the Llobregat River with a mean water discharge of 5 and 20 m^3/s respectively. However the water discharge of both rivers is extremely variable (maximum values of more than 2000 m^3/s in strong flood events). Both rivers traverse urban, industrial and rural settings and the watershed size is 5000 km^2 for Llobregat and 1000 km^2 for Besòs. The watershed near the coast is all urban. During rain events, the coast receives the impact of urban drainage storm collectors, besides that from the rivers.

Human Activities

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Impact Responses

- **Urbanisation**. Changes on the dynamics and diversity of the marine ecosystem: Toxic algal bloom, jellyfish blooms, disappearance of key commercial species (e.g. anchovy, sole, hake, shrimp shellfish)

- **Coast line and morphodynamic modification** resulting in beach erosion, changes in sediments dispersion and sediment accumulation sites and in modifying the benthic community. Changes in bottom sediment and bathymetry by Harbour dredging and dumping activities, harbour expansion, and new structures (submerged barriers, and so on). Artificial plumes from urban collectors during rain events.
- **Toxic pollution** by waste discharged from rivers, and urban collectors. Accumulation of contaminated bottom sediment for decades. Organism, water and sediment contamination by urban and industrial waste.

Policy

Policy issues

- Evaluation, monitoring and managing the effect of water and sediment runoff produced by sporadic rain and storms in seas like the Mediterranean, where those represent a major contribution of the land /ocean interaction: eutrophication, sediment transport and re- suspension, beach erosion, bacterial contamination, unexpected contaminants, beach water quality, etc.
- Urban development/eutrophication/ biodiversity: Waste water treatment plant and emissary:
- Exploring Possibilities (social, economical and ecological) of improving the highly degraded Barcelona littoral front for fisheries, and water sport activities.
- How to comply with the new EU Water Quality Regulation Policies

Policy changes

- 2002 Construction of two new Waste Disposal Plants: primary treatment, and new waste water emissary: 3 Km from the coast and at 50 meter depth, before was 600 m off and at 20 m depth 2006 Implementation to a secondary treatment.
- Construction of a new recreational harbour, modernisation and amplification of the commercial harbour, construction of several protection dikes and underwater barriers.
- 4. Opening new beach sites, developing new beaches.

Stakeholders and Institutional Governance

Major organisations

- Spanish Ministry of Environment. Conselleria de Medi Ambient of the Autonomous Catalan Government.
- Conselleria de Obras Publicas of the Autonomous Catalan Government.
- Barcelona City Hall

Other leading organisations

- Agencia Catalana del Aigua. Autoritat Portuaria of Barcelona Harbour
- Fishermen organisations and recreational organisations. CLAPSA: Organization managing rain water discharge of Barcelona, through collectors.

Systems Studies

Long time series

Data of many variables (hydrographic, plankton and fish biomass, sediment and contaminants, bacteria counts etc) have been taken several times since 1965.

Long time data:

- Meteorological data from a station right on the site, and sociological data. Since 1995 monitoring data on temperature and chlorophyll satellite information, Bacterial counts, nutrients, river outflow, phytoplankton biomass and species, Water colour, Beach erosion, meteorological data,
- Since 2003 real time data on temperature, currents, beach erosion and water turbidity and colour.

Research Projects

- Morfodinámica de playas urbanizadas: integración de datos experimentales y modelos teóricos. Parte experimental 01/01/2004 - 01/12/2007, (PUDEM), Spanish Government.
- Aproximación multiescala a la variabilidad de la turbulencia y su efecto sobre la estructura y la dinámica del ecosistema costero en el Mediterráneo noroccidental (VARITEC) 01/01/2003 - 01/12/2004. Spanish Government.
- Pla de vigilància de fitoplàncton nociu i tòxic a la costa catalana. 2004-2007.Funding agency: Agència Catalana del Aigua (ACA), Catalan Government.
- Programa de vigilància i control de la qualitat ambiental de les aigües litorals a Catalunya durant els anys 2003 a 2007. 2003-2007. Catalan Government

Socio-economic studies

- Integrated program to study the effect of the mud submarine deposit of the area of the Besós prodelta on the Barcelona Coastal area. (SPIO): Corporación Metropolitana de Barcelona y Ministerio de Obras Públicas. 1987-1989
- PORT (2002 -2004): Estimación de las obras del plan director sobre los recursos pesqueros que explota la flota pesquera de la cofradía de Barcelona. Autoritat Portuaria de Barcelona (APB).

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/barcelona-coast/

For additional information

- http://www.icm.csic.es/ca

Publications

Blasco, D. *SPICOSA*. ICM, Barcelona, 2009 - Presentation for the Press Briefing in «Oceans of Tomorrow: the TARA Ocean Expedition and Star Projects in the EU Marine Research.

Thau Lagoon

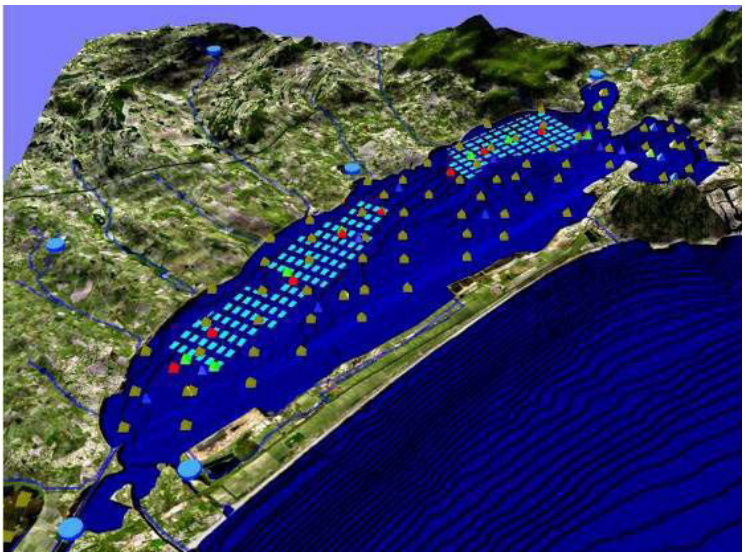
Date:

01/02/2007 - 31/01/2011

Coordinated by

Thierry Laugier
IFREMER
Boulevard Jean Monnet
34203 SETE Cedex
FRANCE
E-Mail: Thierry.laugier@ifremer.fr

Summary



The Thau lagoon is situated in the Languedoc Roussillon region (South East of France), along The Mediterranean border

The Thau lagoon is situated in the Languedoc Roussillon region (South East of France), along The Mediterranean border. The Thau lagoon and its surroundings are recognized as sites of Communautary Interest, as an important conservation areas (ZNIEFF, ZICO, NATURA 2000), and the Canal du Midi which is connected to the Thau lagoon is part of world human patrimony (UNESCO).

The Thau lagoon has a surface of 75 km2 and an average depth of 4,5m (max : 10m.). It is under strong marine influence. The lagoon is connected north to the sea by the canal of Sète (90% of exchanges) and South by the Grau de Pisse Saumes. The volume of the lagoon is 280.000.000 m3. During a year a third of this volume is exported to the sea.

Main hydrological regime of rivers is intermittent, only one, the Vene has a permanent output. Precipitation show large interannual variation (from 200 to 1.000 mm per year). The population on the watershed

reaches 107.000 inhabitants (density of 380 inhab.km2) with a very strong growing rate (75% on the last ten years), so urbanism are the problem in region.

Some of activities which doing in this area are Shelfish farming (more than 10% of the whole french production), fisheries (clams and fishes), Tourism and recreational activities (bathing, nautism), agriculture (wineyards), and marine industry (Sète harbour).

Most of activities are potentially as a cause of the environmental pressure. Some case are happened ie: Harmfull Algae bloom (PSP : Alexandrium and DSP: Dinophysis); bacteriological contaminations, anoxias, biodiversity changes, alien species (macroalgae), nutriment fluxes, trophic balance changes.

Much effort has been put into the setting up of a first integrated management programm (SMVM for Schema de Mise en Valeur de la Mer) which defines priorities of action about shelfish farming and offer a spatialised plan for the developpment of concurrential activities in the lagoon and on a part of the watershed. The main drawback of this SMVM (the first to be adopted in France) is its fixed frame which is difficult to make evoluting as decision for evolution/modification has to be taken at the summit of the French state (Conseil d'Etat). Other efforts have been put in works on the watershed (Two Contrats d'Etang) as to optimise waste water processing in relation with the occurrence of bacteriological contamination of lagoon waters and shellfish.

The Project will be setting up of a first integrated management plan (SMVM) with priority to shellfishculture activities in the lagoon.

Characteristics

Marine System

The Thau lagoon has a surface of 75 km2 and an average depth of 4,5m (max: 10m.). It is under strong marine influence. The lagoon is connected north to the sea by the canal of Sète (90% of exchanges) and South by the Grau de Pisse Saumes. The volume of the lagoon is 280.000.000 m3. During a year a third of this volume is exported to the sea. As tide is very weak (10cm.), the wind is the main factor of water masses transport. Wind is often strong, particularly when blowing from the NW with a mean of 118.5 days per year above Beaufort

force 5. The climate imposes a wide range of water temperatures and salinities with minima of 5° in january and salinity near 27 and maxima of 29° in august and salinity reaching 40.

Watershed

Watershed has a surface of 280 km2. Main hydrological regime of rivers is intermittent, only one, the Vene has a permanent output. Precipitation show large interannual variation (from 200 to 1.000 mm per year). The population on the watershed reaches 107.000 inhabitants (density of 380 inhab.km2) with a very strong growing rate (75% on the last ten years).

Human Activities

Shelfish farming (more than 10% of the whole french production), fisheries (clams and fishes), urbanism, recreational activities (bathing, nautism), health activities (thermalism, thalassotherapy; 2nd french site), agriculture (wineyards), marine industry (Sète harbour)

Impact Responses

Harmfull Algae bloom (PSP: Alexandrium and DSP: Dinophysis); bacteriological contaminations, anoxias, biodiversity changes, alien species (macroalgae), nutriment fluxes, trophic balance changes.

Policy

Policy issues

Much effort has been put into the setting up of a first integrated management programm (SMVM for Schema de Mise en Valeur de la Mer) which defines priorities of action about shelfish farming and offer a spatialised plan for the developpment of concurrential activities in the lagoon and on a part of the watershed. The main drawback of this SMVM (the first to be adopted in France) is its fixed frame which is difficult to make evoluting as decision for evolution/modification has to be taken at the summit of the French state (Conseil d'Etat)

Other efforts have been put in works on the watershed (Two Contrats d'Etang) as to optimise waste water processing in relation with the occurrence of bacteriological contamination of lagoon waters and shellfish.

Policy changes

On the basis of the implementation of the WFD (particularly considering bathing waters and shellfish waters quality) policy changes have been implemented as to take the place of the SMVM policy issue. Those changes apply to:

- a third Contrat d'Etang (Contrat Qualité) directly dedicated to the water quality of the lagoon and environmental management procedures (ISO 14001),
- a SCOT (Schema de COherence Territorial) and iii/ a SAGE (Schema d'Amenagement et de Gestion des Eaux) including an integrated territorial approach between the lagoon and the watershed.

Stakeholders and Institutional Governance

Major organisations

Syndicat Mixte du Bassin de Thau. (SMBT) This organisation has been set up recently (2005) and results from the fusion of two territorial communities corresponding to the southern and northern part of the lagoon and its watershed. The SMBT is nowadays the unique organisation in charge of the implementation of integrated management of the lagoon and its watershed and in charge of the implementation of the three management tools which are the Contrat Qualité, the SCOT and the SAGE.

Other leading organisations

- Cepralmar: an organisation depending from the Languedoc Roussillon regional council in charge of the relationships with the sea professionnals

- Conseil Général de l'Herault who has responsabilities on the infrastructures development on the territory

Partner Collaboration

- GEYSER (Mediation)

Systems Studies

Long time series

Hydrological, hydrochemical, microbiological, phytoplancton, macroflora and macrofauna, river discharges, nutriments loads, meteorology, hydrodynamism, sediments, heavy metals, organic contaminants but also land use dynamics, economical statistics, administrative limits and rules evolution. Some of the data series start from the end of the second War (1947).

Research Projects and Socio-economic study

- PNEC (Programme National en Ecologie Côtière) chantier lagunes méditerranéennes started in the year 80 (understanding of the ecological mecanisms, management tools development and integration of socio economic studies)
- Institutional monitoring networks : RNO (1975), REMI (1984), REPHY(1992) and regional RSL (Réseau de Suivi Lagunaire started 2000;
- Syscolag programme (see http://www.syscolag.org/) dedicated to the setting up of a shared knowledgee data base including metadata service, and GIS implementation
- Dynamic atlas of Thau lagoon developped in the framework of Githau/Syscolag (ICZM of Thau lagoon) and RSL projects
- DITTY european project (development of a Decision Support System for the management of southern mediterranean lagoons)
- Implementation of Sustainable and ICZM indicators programme (launched with the socio- economist team of Montpellier University).

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

Taranto Mare Piccolo

Date:

01/02/2007 - 31/01/2011

Coordinated by

Carmela Caroppo
Institute for Coastal Marine Environment (IAMC) (IAMC-CNR)
Via Roma, 3
74100 Taranto TA Puglia
ITALY
E-Mail: carmela.caroppo@iamc.cnr.it

Summary

The Mar Piccolo of Taranto is located North of the town of Taranto-Apulia-IT. The Mar Piccolo is connected with the Mar Grande basin through two channels, only one of which is important for water exchange.

The Mar Piccolo of Taranto is located North of the town of Taranto and has a surface area of 20.72 km^2. It is an inner, semi-enclosed sea with estuarine features divided by two promontories of land into two smaller inlets, called First and Second Inlet which have a maximum depth of 13 and 10 m, respectively. The Mar Piccolo is connected with the Mar Grande basin through two channels, of which only one is important for the water exchange in the basin. Tidal range does not exceed 30-40 cm. The presence of both 34 submarine freshwater springs (locally called "Citri") and the outfalls of small tributary rivers influence the salinity. The scarce hydrodinamism and the reduced water exchange with the nearby Mar Grande determine, mainly in summer, a high water stratification.

There are many activity which can causes unsustainable Forcings in this site, ie:

- Urbanization - Industrial Waste
- Intensive Aquaculture
- Intensive Agriculture
- Unresolved Use Conflict

The heavy industry and navy docks are two of the main employers in the area. The steel ndustry, not only through the emissions but also through the water-scooping machines, trongly influences the biodiversity and environmental quality of water and sediments. The resence of such industrial activities is also in conflict with other productive instalments suchs the mussel farms and related activities. The drainage of agricultural soils and the sewagenputs are also important factors that influence the water and sediment quality. The Mar.

Piccolo is one of the Sites of National Interest for the high level of pollution and a special Programme has just been started in order to plan an intervention for cleaning sediments and reducing pollution. Regional Programmes also include interventions for the characterization and recovery of surrounding sites that may indirectly influence the quality of the basin.

Characteristics

Marine System

The Mar Piccolo of Taranto is located North of the town of Taranto and has a surface area of 20.72 km2. It is an inner, semi-enclosed sea with estuarine features divided by two promontories of land into two smaller inlets, called First and Second Inlet which have a maximum depth of 13 and 10 m, respectively. Tidal range does not exceed 30-40 cm The volume of water exchanged per hour through the connecting channels is:

- Inlet: 500000 $m^3 h^{-1}$; 24 cm s^{-1}.
- Outlet: 380000 $m^3 h^{-1}$; 18 cm s^{-1}.

Watershed

Besides Taranto (300 000 inhabitants), some small inland cities sum-up the residential population to over 500 000 inhabitants, with a rise of 20-30% during summer. A navy base (the most important in Italy), a commercial port, mussel-culture and a fishing fleet directly or indirectly influence the water quality. The presence of 34 submarine freshwater springs (locally called "Citri") and the outfalls of small tributary rivers influence the salinity and carry agricultural chemicals (the latter). The scarce hydro-dynamism and the reduced water exchange with Mar Grande determine, mainly in summer, a high water-stratification.

Human Activities

Urbanization, Heavy industry, Aquaculture, Tourism, Transports and Agriculture are driving forces. Mussel-culture, Navy docks and the fishing fleet are internal pressures.

Unsustainable Forcings

Unresolved use conflicts; Urbanization and emissions; Heavy industry (stainless steel, cement, oil refinery) and relevant emission; Intensive Aquaculture; Intensive Agriculture and Drainage; Navy docks; Shipping.

Impact Responses

- Bio-chemical Pollution; Diversity loss; Eutrophication (Algal blooms, microbial pollution);

- Habitat Destruction; Sediment and Turbidity (metals, IPA, PCB in marine sediments); City devitalization; Social problems; Economy loss; Geomorphic changes.

Policy

Policy issues

The heavy industry and navy docks are two of the main employers in the area. The steel industry, not only through the emissions but also through the water-scooping machines, strongly influences the biodiversity and environmental quality of water and sediments. The presence of such industrial activities is also in conflict with other productive instalments such as the mussel farms and related activities. The drainage of agricultural soils and the sewage inputs are also important factors that influence the water and sediment quality. The Mar Piccolo is one of the Sites of National Interest for the high level of pollution and a special Programme has just been started in order to plan an intervention for cleaning sediments and reducing pollution. Regional Programmes also include interventions for the characterization and recovery of surrounding sites that may indirectly influence the quality of the basin.

Policy changes

The heavy industry (stainless-steel, oil refinery, cement manufacture) started to be establish in Taranto some fifty years ago (second half of the 1950s) completely changing the economy of the city and Province that were essentially based on agriculture, aquaculture, navy docks and handicrafts. Such change has caused a large increase of the population of Taranto grown to over 280 000 inhabitants from 150 000. Consequently, severe social problems exploded, especially when the steel industry, grown to hire over 22 000 employees, started to reduce the activity and to fire people (now there are less than 8 000 employed staff). These problems have strongly influenced the quality of life and safety in the city.

Stakeholders and Institutional Governance

- Major organisations
- All local and regional authorities (Province of Taranto, Municipality of Taranto),
- Ministry of the Environment,
- Ministry of Industry,
- Navy,
- Aquaculture enterprises,
- Recreational bodies
- Tourism organizations.

Participatory organisations SSA

- Aquaculture and fishing enterprises;

- Tourism enterprises.

Partner Collaboration

- **SZN** Stazione Zoologica Anthon Dorn

Systems Studies

Long time series

- Chemico-physical data for seawater and biochemical components of suspended matter: 1970 until today;
- Floristic lists of macroalgal species: 1920-1925; 1987 until today.
- Floristic lists of microalgal species and cystes: 1991-1994; 1996-1997; 2001-2003.
- Metals (Hg, Pb, Cd, Cu, Zn, Ni and V) and HPAs and PCBs: 1986 until today
- Quantitative data of fecal indicators: 1981 until today; Bacterial diversity: 1999 until today
- Cystes in the sediments

Research Projects

- "Study of the ecosystem Mar Piccolo of Taranto: biocenoses with particolar attention to phytocenoses";
- "Individuation and monitoring of non-indigenous species in the Taranto seas";
- "Chemico-physical and biochemical conditions in Mar Piccolo of Taranto";
- "Pilot study for the environment characterisation of marine areas subject to pollution";
- "Study for recovery and exploitation of shoreline in Mar Piccolo";
- "Preliminary study of ILVA water-scooping machine environmental impact the on Mar Piccolo ecosystem and on mussel-culture activities";
- "Monitoring and reclassification of costal zone for mussels production, stabulation, commercialisation and sale (D.L. 192/77 and D.L. 30/12/92, n. 530)";
- "Anthropogenic impact on the biodiversity of marine ecosystems";
- "Risk analysis and evaluation of the environmental quality index of coastal zones at high environmental impact: new classes of persistent pollutants";
- "Anthropic impact on biogeochemical cycles: ecological aspects";
- "Mussel culture: environmental studies at the production sites: bioaccumulation, epibionthic fauna and infauna on the harvesting collectors";

- "Innovative technologies including: Bioremediation, utilization of bacteria, and antibacterial activity of extracted products";
- "Technologies for CO2 storage and reuse, inlcuding enhanced fixation in macroalgae for biofuel production";
- "Technological innovation and Policolture activities for mussel culture";
- "Integrated procedures for the investigation of marine throphic processes and for the management of platforms for the continuos monitoring of the marine environment";
- "Characterization of waste water from the Taranto industrial area";
- "Study on the environmental impact of the water up-take plants from the ILVA factory on the Mar Piccolo ecosystems and mussel farming".

Socio-economic study

Study from an environmental, social and economical point of view of some areas near Taranto not or little subject to integrated policy: "Programma Terra Progetto Posidonia".

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Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/taranto-mare-piccolo/

For additional information

- https://www.cnr.it/

Publications

Petrocelli, A.. *Stakeholder participation to improve local economy in Mar Piccolo of Taranto, Italy.* 2008.

Venice Lagoon

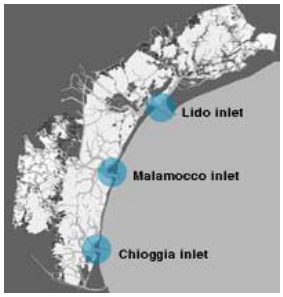
Date:

01/02/2007 - 31/01/2011

Coordinated by

Pierpaolo Campostrini
CORILA - Consortium for the Management of Research on the Venice Lagoon System
Palazzo Franchetti - San Marco 2847
30124 Venice
ITALY
Website: www.corila.it

Summary



The Lagoon of Venice is situated in North Adriatic, and it is connected to the Northern Adriatic Sea through three inlets

The Venice Lagoon is characterized by a high concentration of human activities. Two main cities (Venezia, Chioggia) and a number of towns and villages (400,000 residents) are distributed around its perimeter and on some islands; 14 million tourist presences per year contrast with a resident population of 60,000 in the historical centre. Venice has one of the most important ports in Italy (30 million of tonnes of goods per year and 1 million cruise ship passengers), the third busiest Italian airport and the relics of the core of Italy's petrochemical and chemical industry (Marghera). Urban development, port activities, tourism related pressures and flows, recreational activities, commercial and traditional fishing, industrial and agricultural pollution encounter each other in the Lagoon and influence its natural dynamics and the resilience of the system. Catchment land use is historically a varying mixture of agricultural and industrial.

Lagoon morphology erosion, geomorphic changes, bio-chemical pollution, eutrophication, sediment and turbidity, biodiversity loss and habitat destruction, trophic web change, use depreciation, groundwater systems – in rough order from most studied top least studied.

Maintaining the "lagoon status", between sediment inputs and erosion, and defending from sea storms, implies wide human interventions, which in Venice have continued since the XIV century. The presence of industrial and port activities, together with increased human pressures and intensive agriculture in the

drainage basin, in the last century focused on the problem of eutrophication and pollution of water and sediment. Venice and its lagoon was declared "of national interest" by an Italian law in 1973 and a "World Heritage Site" by

UNESCO in 1987. Huge economic resources have been spent by the Italian state for the safeguarding of the lagoon, the cultural heritage and for re-vitalizing the city. Cost–benefit ratio of these interventions is still an issue. Considering sea level rise, the physical defence of the city necessitates a mobile barrier system between the lagoon and the sea: after a 30 yearlong debate, the political decision has finally been taken. Fishing of clams is a important economic activity (counting 60% of the national production), but its actual sustainability is uncertain: over-fishing, 'fishing down the food-web', sediment resuspension, damage to benthos and habitat destruction are recurrent problems. Granting access to the port, placed on the inner lagoon part, implies excavation of contaminated sediment from silted channels.

Allowing fruition of some lagoon sites, for tourism and fishery, is necessary for the economic life of the residents, but creates easily non-sustainable conditions for the environment. Considering the sea in front of Venice, multi-regional and multi-national approaches are under consideration for an appropriate and effective management, starting with INTERREG initiatives.

Characteristics

Marine System

Tidal lagoon of 550 km2, includes dunes, tidal channels, bare mudflats, seagrass beds and salt marshes, sea walls protection. Unique combination of hydro-geomorphologic features (defined by centuries of human interventions); natural features including endemic plant species and breeding ground and overwintering for bird species and other significantbiodiversity as well as functional dynamics which support human activities in a city endowed with some of the worlds most important cultural heritage.

Watershed

Watershed of 1800 km2/1 million eq. inhabitants. Two main cities (Venezia, Chioggia) and a number of towns and villages (400,000 residents) are distributed around the lagoon perimeter and on some islands; 14 million tourist presences per year contrast with a resident population of 60,000 in the historical centre. Venice has one of the most important ports in Italy (30 million of tonnes of goods per year and 1 million cruise ship passengers), the third busiest Italian airport and the relics of the core of Italy's petrochemical and chemical industry (Marghera).

Human Activities

The Venice Lagoon is characterized by a high concentration of human activities and Catchment land use is historically a varying mixture of agricultural and industrial.

Urban development and cultural heritage, tourism, recreational activities, commercial and traditional fishing, Industry, Agriculture, Aquaculture, Marine Heritage, Shipping

Impact Responses

Lagoon morphology erosion, geomorphic changes, bio-chemical pollution, eutrophication, sediment and turbidity, biodiversity loss and habitat destruction, trophic web change, use depreciation, city de-vitalization and cultural losses, social and economy weakness.

Policy

Policy issues

Maintaining the ”lagoon status”, between sediment inputs and erosion, and defending from sea storms, implies wide human interventions, which in Venice have continued since the XIV century. The presence of industrial and port activities, together with increased human pressures and intensive agriculture in the drainage basin, in the last century focused on the problem of eutrophication and pollution of water and sediment. Venice and its lagoon was declared “of national interest” by an Italian law in 1973 and a “World Heritage Site” by UNESCO in 1987. Huge economic resources have been spent by the Italian state for the safeguarding of the lagoon, the cultural heritage and for re-vitalizing the city. Cost–benefit ratio of these interventions is still an issue. Considering sea level rise, the physical defence of the city necessitates a mobile barrier system between the lagoon and the sea: after a 30 year- long debate, the political decision has finally been taken. Fishing of clams is a important economic activity (counting 60% of the national production), but its actual sustainability is uncertain: over-fishing, ‘fishing down the food-web’, sediment resuspension, damage to benthos and habitat destruction are recurrent problems. Granting access to the port, placed on the inner lagoon part, implies excavation of contaminated sediment from silted channels. Allowing fruition of some lagoon sites, for tourism and fishery, is necessary for the economic life of the residents, but creates easily non-sustainable conditions for the environment. Considering the sea in front of Venice, multi-regional and multi-national approaches are under consideration for an appropriate and effective management, starting with INTERREG initiatives.

Policy changes

Concerning the major policy changes made or proposed within the data life of the proposed Site, they includes:

- The exploitation of a Strategic Plan of the Municipality towards 2014, which include several policy action in the environment and sustainable development,
- The Lagoon Morphology Restoration Plan, which is going to be updated
- Plan for reduction of nutrient load from drainage basin (regional authority plan)
- Changing in the lagoon and sea fishery organisation

The adoption of a new General Intervention Plan, considering the barrier system

Stakeholders and Institutional Governance

Major organisations

- Comune di Venezia (municipality),
- Provincia di Venezia (district administration),
- Port Authority,
- Regione del Veneto (regional level),
- Magistrato alle Acque -local agency of the Ministry of Infrastructure and Transport,
- Ministry of Environment

Other leading organisations

- Port enterprises,
- Tourism-related association of enterprises,
- Fishing-related association of enterprises,
- Chambre of Commerce

Partner Collaboration

- Corila members,
- DSE-UNIVE,
- Università Ca' Foscari,
- Dipartimento di Scienze Economiche e Dipartimento di Scienze Ambientali;
- Istituto Nazionale di Oceanografia e Geofisica Sperimentale, OGS

Systems Studies

Long time series

Meteorological data and Relative Sea Water level data, Water quality monitoring – chemical, biological and ecotoxicological parameters, Biodiversity, Sediment pollution, Remote sensing, Economic and social data

Research Projects

- MELa1 – monitoring water quality parameters and understanding their evolution 5 years long.. PI Pastres; Solidoro; Rismondo; Zirino.
- DRAIN freshwater and nutrient load from drainage basin. PI Marcomini; Zonta

- ORIZZONTE 2023 evaluation ecological status.
- First Research Programme CORILA 2000-2003and Second Research Programme of CORILA 2004-2007, includes researches on: Cost-benefits analysis of land reclamation of brownfields in the Venice lagoon, Characteristics and conditions for a model of post- industrial sustainable development for Venice, Speciation and flow of pollutants, Ecological quality indices, biodiversity and environmental management for lagoon areas, Trophic chain and primary production in the lagoon metabolism, Meteo-oceanographic conditions and coastal zone water quality, Erosion and sedimentation processes in the Venice lagoon.

Socio-economic study

Many social or economic studies have been conducted relating to the coastal zone natural resources, by CORILA and others, e.g. a study concerning the incentives needed for a more "ecological" exploitation of fishing resources. CORILA participates in ENCORA EU concerned action, as Task Leader for Economy issues in ICZM.

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/venice-lagoon/

For additional information

- http://www.corila.it/

Publications

Volpi-Ghirardini, A. Losso, C., Brigolin, D., Canu, D., Pastres, R., Solidoro, C.. *ECOTOXICOLOGICAL EVALUATION OF CLAM HARVESTING AREAS.* SSA 15 Venice Lagoon , voghi@unive.it, closso@unive.it, Environmental Science Deptarment, Universty CÃ Foscari, Venice, Italy, 2009.

Micheletti, C., Lovato, T., Critto, A., Pastres, R., Marcomini, A.: *Spatially Distributed Ecological Risk For Fish of a Coastal Food Web Exposed To Dioxins.* Environmental Toxicology and Chemistry, © SETAC, 27(5): 1217–1225, 2008.

Ecological quality indices, biodiversity and environmental management for lagoon areas. In: Volpi Girardini A., Losso C., Arizzi Novelli A., Ghetti P.F.. *A toxicity index for the Venice Lagoon.* Research Programme 2004-2006, 2006 Results, CORILA (6), pp. 249-255. CORILA, Venice, 2008.

Thermaikos Gulf

Date:

01/02/2007 - 31/01/2011

Coordinated by

Dr. Yannis N. Krestenitis

Professor of Coastal Engineering and Oceanography / Laboratory of Maritime Engineering and Maritime Works

Department of Hydraulics & Environmental Engineering

School of Civil Engineering

Aristotle University of Thessaloniki

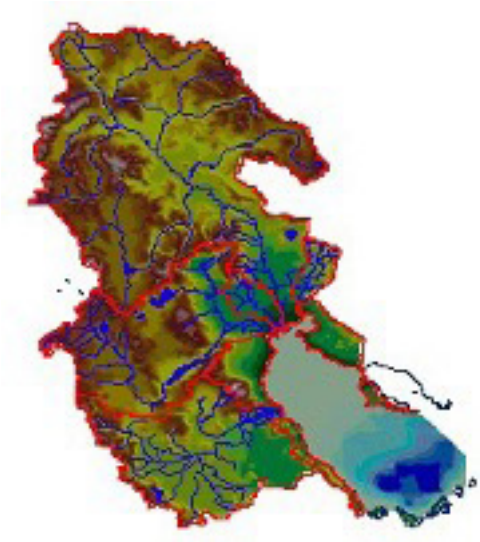
GR 54124 Thessaloniki

GREECE

E-Mail: ynkrest@civil.auth.gr

https://www.civil.auth.gr/en/

Summary



Thermaikos is a U-shaped gulf situated in NW Aegean Sea – Greece

Thermaikos Gulf forms an extended shelf area, which has a significant influence from rivers. Most of the particulate inputs are trapped near the river-mouth. The suspended particulate matter concentrates in nepheloid layers, at the surface and near the bottom and most of them is deposited and berried on the shelf. The fresh/salt water interface zone plays a significant role in the increase of atmospheric N2O and CH4 concentrations coming from the bacteria production in this zone. The gulf shows eutrophication events

caused by the high nutrient supply, derived from the river discharges. Multiple human activities are taking place around and in the gulf as excessive urbanization, industrial activities, agriculture, fishing, mussel farming, tourism.

Policy Issue. Sustainable management of mussel culture at the area of Chalastra, Thermaikos bay.

Thermaikos Gulf is the biggest source of farmed mussels (Mytilus galloprovincialis) in Greece, representing the 88% of the country's cultivated sea area and 80-85% of the total national production. The farms are being located in two major areas, NW of the Gulf of Thessaloniki, Chalastra (inner Thermaikos Gulf-the area under consideration for the Policy Issue) and NW of Thermaikos Gulf (estuary area of Axios-Loudias-Aliakmon rivers). Mussel farming is an activity that takes place at the area for more than 25 years, occupying an important percentage of the local population, with the mussel production of Chalastra area exceeding the 12.000tn/yr. The sea area is part of the protected area of the estuary (under the Ramsar convection) but the mussel farming is an activity compatible to the natural environment, and thus a compatible activity to the protection status. The last years, due to several reasons, as the increase of the population of the greater area of the County of Thessaloniki, the development of other Human Activities (H.A.'s: agricultural & industrial activities) and the intense increase of the mussel farming at the area, there has been an important modification to the natural environment of the Gulf that leaded to a decline of the mussel production with socioeconomic impacts to the local population (decline of mussel farmers income, unemployment, not authorized expansions of mussel cultures, negative advertisement of the products to local and international markets, etc).

Characteristics

Marine System

Thermaikos Gulf forms an extended shelf area, which has a significant influence from rivers. Most of the particulate inputs are trapped near the river-mouth. The suspended particulate matter concentrates in nepheloid layers, at the surface and near the bottom and most of them is deposited and berried on the shelf. The fresh/salt water interface zone plays a significant role in the increase of atmospheric N_2O and CH_4 concentrations coming from the bacteria production in this zone. The gulf shows eutrophication events caused by the high nutrient supply, derived from the river discharges.

Watershed

The total catchments basin of Thermaikos Gulf extends to an area of ~72.000 km^2, drained from four main rivers. The average discharge of the river system reaches values from 300- 350 m^3s^{-1} and the annual discharge is estimated in 6-8 x 10^9 m^3y^{-1}. The solid annual discharge is rapidly reduced from 3-4 x 10^6Ty^{-1}, some decades ago, to 0,6-0,7 x 10^6Ty^{-1} in the recent years.

Human Activities

Urbanization [Thessaloniki a city of 1,5 million citizens], agriculture [Thessaloniki plain, Thessalia plain], industrial [Thessaloniki industry area], tourism [E and W site of the Gulf], fisheries, aquaculture mainly mussel farming.

Impact Responses

Intensive agriculture, intensive aquaculture, overfishing, urban/industrial wastes, water cycle intervention, transboundary pollution, massive tourism, second house settlements along the coasts, public ignorance of the value of the environment,

Policy

Policy issues

- What measures should be undertaken to reduce nutrients?
- How Thessaloniki can have a clear water sea in its sea front?
- How a land planning for the aquaculture can be established?
- How fisheries can be regulated according to the carrying capacity of the system?
- How the summer tourist invasion can be managed?

Policy changes

- Management plan and measures for the treatment of the domestic sewage
- Land planning of the mussel farms
- Measures to avoid over fishing

Stakeholders and Institutional Governance

Major organisations

- Organisation for the Master Plan and Environmental Protection of Thessaloniki
- Thessaloniki Prefecture (Department of Agricultural Development, Department of Fishing, Department of Water Resources and Irrigation Works)

Other leading organisations

Thessaloniki Water Supply and Sewerage Company S.A. Thessaloniki

Partner Collaboration

- **AUTH** University of Thessaloniki, Aegean University,
- **EREOPE** University of the Aegean

Systems Studies

Long time series

Hydrochemical, -physical and phytoplankton data, river discharge and nutrient loads. Benthos, fish data. Various and large amounts of additional data e.g. meteorological, hydrodynamic, sediment, heavy metal, biological data.

Research Projects

EUROCAT [An ELOISE EU-Project]

- European catchments. Catchment changes and their impact on the coast
- Long-term assessment of N & P loads and heavy metals of the Axios River and their impact on the coastal system of the Thermaikos Gulf. Formulation of management proposals aiming at the sustainable development of the river catchment and the coastal zone

INTERPOL [An EU Project]

- Impact of natural and trawling events on resuspension, dispersion and fate of pollutants
- Study of the effects of natural and anthropogenic (trawling) sediment resuspension on the biogeochemical cycles and transfer of pollutants, nutrients and key-elements in the continental shelf of the Thermaikos Gulf.

Socio-economic study

Metro-Med [An EU-MAST-III ELOISE-Project]

- Dynamics of Matter Transfer and Biogeochemical Cycles: Their modelling in Coastal Systems of the Mediterranean Sea
- The target of Metro-Med project is to study and simulate the mechanisms of matter transfer and of the biogeochemical cycles in the coastal ecosystems (incl. Thermaikos Gulf).

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

For additional information

- https://www.civil.auth.gr/en/

Publications

Krestenitis Y.N.,Konstantinou Z.I.,Latinopoulos D. *Documentation Report for Appraisal Step implementation in SSA16 Thermaikos gulf* . Aristotle University of Thessaloniki, Thessaloniki, Greece, 2010 - SPICOSA Report.

Krestenitis,Y.N.,Konstantinou,Z.I. *Scientific Report on System Output of SSA16-Thermaikos gulf, regarding the SAF methodology.* Aristotle University of Thessaloniki, Thessaloniki, Greece, 2010 - SPICOSA project Output Step Report.

Konstantinou Z., Latinopoulos D., Krestenitis Y.N. *Problems and perspectives during the development of simulation models in the ICZM effort of Chalastra bay, Thermaikos gulf..* In: Liakopoulos, A., Kanakoudis, B., Anastasiadou-Partheniou, E., Tsihrintzis, B. (eds). *Proceedins of the common conference of EYE and EEDYP for the Integrated Water Management under climate change conditions.* pp. 495-502. University of Thessalia, Greece, Volos, Greece, 2009.

Konstantinou Z., Latinopoulos D., Krestenitis Y.N. Science and Policy Integration for Coastal System Assesment: An ambitious Idea, the implementation in a Greek study site and problems encountered. In: Sakellariou, D.(eds.). Proceedings of the 9th Symposium of Oceanography and Fisheries. pp. 305-310. Hellenic Center of Marine Research, Athens, Greece, 2009.

Izmit Bay

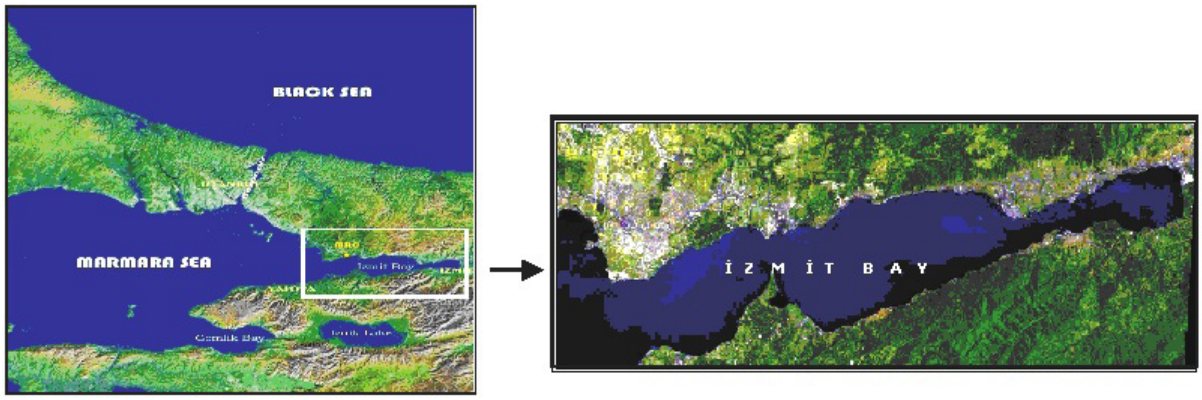
Date:

01/02/2007 - 31/01/2011

Coordinated by

Leyla Tolun
TUBITAK, Marmara Research Center (MRC)
Po Box. 21
41470 Gebze –Kocaeli
TURKEY
E-Mail: Leyla.Tolun@mam.gov.tr
Website: https://mam.tubitak.gov.tr/

Summary



Izmit Bay

Izmit Bay, located in the southeastern part of the Marmara Sea has an area of 279 km^2. The bay consists of three parts, connected to each other by narrow openings. The bay has a two- layer water stratification and flow system with a halocline / thermocline which separates the lower water layer of Mediterranean origin (35-38 ‰) from the upper layer of Black Sea origin (22-28 ‰). The thicknesses of the layers change seasonally depending upon the current systems in the area. The major discharges are from the northern part of the Bay.

Izmit watershed is a part of Marmara watershed. Although Dilderesi river and Eastern hannel are the main freshwater inputs to the Bay, both of them carry polluted waters rom surrounding industries, settlements and agricultural area. Dilderesi is 12 km long and carries 70x106 m3/year.

Characteristics

Marine System

Izmit Bay, located in the southeastern part of the Marmara Sea has an area of 279 km^2. The bay consists of three parts, connected to each other by narrow openings. The bay has a two- layer water stratification and flow system with a halocline / thermocline which separates the lower water layer of Mediterranean origin (35-38 ‰) from the upper layer of Black Sea origin (22-28 ‰). The thicknesses of the layers change seasonally depending upon the current systems in the area. The major discharges are from the northern part of the Bay.

Watershed

Izmit watershed is a part of Marmara watershed. Although Dilderesi river and Eastern Channel are the main freshwater inputs to the Bay, both of them carry polluted waters from surrounding industries, settlements and agricultural area. Dilderesi is 12 km long and carries $70x10^6$ m^3/year.

Human Activities

Urban wastes, industrial wastes (toxic) and, heavy ship traffic, atmospheric pollution, restricted water circulation, natural phenomenon like earthquake, pollution transport from the adjacent seas

Impact Responses

Oxygen deficiency in bottom waters, biochemical pollution, eutrophication, accumulation of pollutants in sediments and biota, sediment toxicity, habitat destruction, toxic algal blooms, bio-diversity loss.

Policy

Policy issues

- **Water quality**. Development of water quality models, identification of limiting nutrient and self-purification capacity, nutrient discharge regulations and control, setting up toxicity threshold levels
- **Integrated waste management**. Legal constraints, development of regional criteria for discharges and water quality, capacity building towards the public health and environmental welfare, risk assessment and minimization for hazardous and toxic wastes (accidents), development of contingency plans. Unification of the SMEs for pollution abatement and conservation of resources
- Promoting **decentralized approach** for the source control, reuse/recycle of the wastes, enhancement of public awareness, involvement of stakeholders in the decision making process.
- Rational integration of institutional bodies, cost control from a central budget allocation body and optimization of the efforts by cost-benefit analysis, improvement of existing NGOs in the region as well as promoting international well known NGOs to focus on the problems
- Land use options, changes, foreseen impacts and prioritization

Policy changes

- **Land use policy** has been drastically changed in favour of industrial establishments. The proximity of Izmit Bay to the metropolitan city of Istanbul enhanced this development.
- **Environmental policies**. The large volumes of wastes from domestic and industrial sources were mostly discharged to the environment without any treatment and until 1980's, it was assumed that this activity was not deleterious. As a direct consequence of pollution the insufficient environmental policies towards resource management and abatement of pollution was affected and needed to be upgraded. Environmental laws and regulations was set up associated with water pollution control, solid waste control air pollution control etc. However, the levels of nutrient and organic matter in the Bay waters have increased despite the regulations and eutrophication problems persist in the bay. In recent years periodic red tide events have been observed and the Secchi depth has decreased. Furthermore, hazardous wastes and toxic substances in the industrial and complex wastewaters are still out of control.

Stakeholders and Institutional Governance

Major organisations

- Ministry of Environment and Forestry,
- Kocaeli Metropolitan Municipality,
- Kocaeli Province
- Directorate of Environment and Forestry

Other leading organisations

- Kocaeli University,
- Gebze High Technology Institute,
- Kocaeli Chamber of Industry, NGOs

Systems Studies

Long time series

- **Physical parameters.** Water column depth, sechi disk depth, temperature, salinity, conductivity, current (before earthquake), light penetration, total suspended solids (for years 1985, 1990, 1995, 2000). Meteorological data (daily since 1985).
- **Chemical parameters**. Dissolved Oxygen, pH, nutrients (total nitrogen, nitrate and nitrite nitrogen, total phosphorus, ortho-phosphate phosphorus, reactive silicate), total and dissolved organic carbon, total polycyclic aromatic hydrocarbons (years between 1999-2003), PCBs (years between 1999- 2000)in different matrices (sediment and biota).

- **Biological parameters**. Chlorophyll-a, phytoplankton, (number and species), primary production, biomarkers.
- **Remote Sensing and Geographical Information Systems (since 1998).** NOAA and Landsat images. Digital data integrated GIS.
- **Point sources**. Domestic and industrial wastewater discharges (from nine main discharges of north-eastern region), pollutant loads (total nitrogen, total phosphorus, silicate, total organic carbon, biological oxygen demand), toxicity measurements on the sources. Atmospheric PAH deposition (four seasons in year 2002).

Research Projects

- Wastewater Treatment and Disposal Studies. 1988-1989. NATO TU-WATERS
- The effects of industrial developments on the coastal waters and semi enclosed areas - Izmit Bay case study (two projects): 1994 –1996, 1999-200. Focus was on eutrophication, water quality, pollution sources and marine biodiversity. In the second project water quality monitoring studies and toxicity of the wastewaters was investigated.
- Determination of the Adverse Effects of the Industrial Wastewaters to the Coastal Water Quality of Yalova. 1997 -1998.
- Determination Of The Pollution Level In Izmit Bay After The Earthquake. 2001-2002.
- Effects of the Natural Phenomenon and Land Based Sources to the Coastal Waters: Case Study of Izmit Bay and Dilderesi River (2001 -2002). The aim was to determine the industrial and domestic pollutants arising from heavily industrialized northern part of Izmit Bay and their effects to the coastal waters of the Bay.
- Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) Entering Izmit Bay: Determination of Sources and Concentration Levels (2002-2003).

Systems Approach Framework (SAF)

Contribution following the SAF sequence, that is the system design volume followed by the system formulation volume, the system appraisal volume and finally the system output volume.

To download the PDF: https://participatory-assessment.eu/izmit-bay/

For additional information

- https://mam.tubitak.gov.tr/

Danube Delta

Date:

01/02/2007 - 31/01/2011

Coordinated by

Lyudmila Kamburska
Global Environment Monitoring Unit (GEM), Institute for Environment and Sustainability (IES), Joint Research Centre (JRC) of the European Commission
E-Mail: lyudmila.kamburska@jrc.it

Summary

Danube Delta-Romanian-Bulgarian Coastal Zone. The Black Sea lies between Southeastern Europe and Asia Minor. The Danube Delta is located around the area where the Danube River flows into the Black Sea in Dobrogea, Romania and a small part in Odes'ka oblast', Ukraine.

The Black Sea has an area of 422,000 km² and a maximum depth of 2210 m. The basin is anked among the most ecologically threatened water bodies of the world, it has unique natural eatures -presence of H2S at a depth below 150m (13 % of the total Black Sea domain supports ife), drainage area exceeding 5 times the surface area of the basin, very low water exchange ate, low salinity and is under great anthropogenic pressure due to the substantial fresh water nput (especially in the North-Western part of the basin), that determine the extremely high sensitivity of the Black Sea ecosystem to external forcing.

The Danube basin, Delta and Black Sea represent a continuum of closely related ecosystems. The Romanian Black Sea coast is the most subjected to freshwater flow area, the Danube river loads (Danube delta) contributing substantially to the coastal ecosystem degradation. Due to its geographic position and the pattern of the main Black Sea currents the Bulgarian Black Sea shelf is under the strong influence of the major freshwater inflow from the North-West.

The Black Sea is the only basin with a drainage area five times larger than the sea. The inflow of freshwater from the surrounding areas, especially central and middle-Eastern Europe mounts to 320 km³ per year. The most important river entering the Black Sea is the Danube, eceiving runoffs from substantial parts of seventeen European countries including major ndustrial and agricultural areas. The watershed of Danube is 817,000 km². The Danube Delta is he largest and best preserved of European deltas, with an area of 3446

km². Romanian irrigated and is 31,020 km2, the arable land- 41 %, permanent pastures-21 %, while the permanent crops are 3 %. In Bulgaria 40.02% of the total land is arable land, whilst permanent crops are 1.92%.

Characteristics

Marine System

The Black Sea has an area of 422,000 km² and a maximum depth of 2210 m. The basin is ranked among the most ecologically threatened water bodies of the world, it has unique natural features -presence of H2S at a depth below 150m (13 % of the total Black Sea domain supports life), drainage area exceeding 5 times the surface area of the basin, very low water exchange rate, low salinity and is under great anthropogenic pressure due to the substantial fresh water input (especially in the North-Western part of the basin), that determine the extremely high sensitivity of the Black Sea ecosystem to external forcing.

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Watershed

The Black Sea is the only basin with a drainage area five times larger than the sea. The inflow of freshwater from the surrounding areas, especially central and middle-Eastern Europe amounts to 320 km³ per year. The most important river entering the Black Sea is the Danube, receiving runoffs from substantial parts of seventeen European countries including major industrial and agricultural areas. The watershed of Danube is 817,000 km². The Danube Delta is the largest and best preserved of European deltas, with an area of 3446 km². Romanian irrigated land is 31,020 km2, the arable land- 41 %, permanent pastures-21 %, while the permanent crops are 3 %. In Bulgaria 40.02% of the total land is arable land, whilst permanent crops are 1.92%.

Human Activities

Agriculture, industrial and urban effluents, fisheries and shipping, tourism

Impact Responses

- Nutrient enrichment, biodiversity changes, invasive species, habitat destruction, food-web shifts
- **Eutrophication** has caused severe ecosystem impacts such as phytoplankton blooms, anoxia, and hypoxia and together with **overfishing**, **invasive species** and trawling have been considered the key ecological issues especially in the North-Western Black Sea coastal waters. Nutrient over-enrichment has lead to dramatic alteration in the structure of marine fauna and flora, resulting in undesirable food web shifts during the last decades and constitutes a continuous threat to biodiversity and

ecosystem functioning. Overfishing and invasive species introductions acting in parallel add further to the cascade of ecosystem alterations.

Policy

Policy issues

- Water Framework Directive (2000/60/EC); NATURA 2000, Council Directive 91/271/EEC concerning urban waste-water treatment; Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources;
- Marine Monitoring and Assessment (eutrophication, biodiversity, hazardous substances) in the context of implementation of the future Marine Strategy;
- Trans-boundary Integrated Coastal Zone Management

Policy changes

Implementation of the European policies by the pre-accession countries.

Stakeholders and Institutional Governance

Major organisations

Black Sea Commission, National and Local Environmental Protection Agencies, Romania, National Company "Romanian Waters", National Institute for Danube Delta –Tulcea, Romania,

Ministry of Environment and Water, Bulgaria, Black Sea Directorate, Bulgaria

Other leading organisations

- Ministry of Development and infrastructure (Bulgaria), Ministry of Transport (shipping camara), Bulgaria; Ministry of Tourism, Bulgaria; National Agency of fishing and aquaculture,
- Bulgaria

Partner Collaboration

Partners : INCDDD National Institute for Danube Delta –Tulcea Romania; IO-BAS Institute of Oceanology, Bulgarian Academy of Sciences, Varna, Bulgaria; MHI Marine Brunch of Ukrainian Hydrometeorological Institute, Sevastopol, Ukraine.

Systems Studies

Long time series

- Black Sea inter-disciplinary (physical, chemical and biological data) multivariable historical database was created in the framework of the NATO TU-Black Sea Project;
- Existing Data base for the Study site belonging to the various institutions in the region

Research Projects

- Danube Delta Project, financed by GEF (1994-1998) aimed at effective protection, enhancement and management of protected areas of the Ukrainian and Romanian part of Danube delta
- European River Ocean System (EROS) 2000 and EROS-21 EU Project (1994-1998) developed an integrated approach to the eutrophication, contaminant problem, particle transfer, sedimentation and biogas production of the north-western Black Sea through the establishment of fine resolution coupled hydrodynamical-biogeochemical models of the river and marine systems in order to describe and predict the response of the coastal ecosystem to natural variability and anthropogenic factors such as changes in land use and hydraulic management;
- Black Sea Ecosystem Process and Forecasting/Operational Database Management System, NATO SfP (1998-2001) developed further the NATO Black Sea Data Base and Management System for management oriented operational marine forecasting and research;
- EUROCAT (European Catchments). Catchment changes and their impact on the coast. EC (2002-2003). An integrated network aiming to determine limiting concentrations of pollutants and nutrients for sustainable development on the basis of ecological and socio-economic indicators;
- Sea-Search: a Pan European Network for Ocean & Marine Data and Information Management, EU (2002-2005), a Pan European Network for Ocean and Marine Data and Information Management (oceanographic and biological data). This activity will continue at more detailed level (data of interdisciplinary parameters) within the 6FP Project SeaDataNet, starting in 2006;

Socio-economic study

- CESUM-BS, 5FP-EU (2000-2003)-the objective of the project was sustainable development of the Black Sea region in the context of environmental, economic and social problems for harmonisation with the EC standards through increased regional and international co-operation and networking. The environment-socio-economic aspects included selection of indicators for ecosystem health assessment and identification of priority socio-economic drivers for sustainable management of the Black Sea ecosystem and balanced economic development at regional level;

- THRESHOLDS, 6FP-EU, (2005-2008) – identification of thresholds for ecosystem performance to provide management options for rehabilitation;
- GEF/UNDP "Black Sea Recovery Project" – collection of new data for assessment of the recent Black Sea state and provide options for management

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