Deliverable number: D4.5

Report and supporting materials to economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins

Version V2

Dissemination Level*	✔ PU	PP	RE	CO
Project Acronym / number	PEGASO	244170		
Project title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast.			

***PU:** Public; **PP:** Restricted to other programme participants (including the Commission Services);
RE: Restricted to a group specified by the Consortium (including the Commission Services);
CO: Confidential, only for members of the Consortium (including the Commission Services).

Authorisation	
Prepared by	Pascal Raux (UBO - UMR AMURE)
Approved by	Quality assessor
Approved for released by	The project manager
Date	October 31st 2013

Pegaso Project
People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast

Funded by the European Union
under FP7 – ENV.2009.2.2.1.4
Integrated Coastal Zone Management

Specific Programme FP7
Collaborative Projects
Large scale integrating Project

Grant agreement nº: 244170

Project coordination
Universitat Autònoma de Barcelona
UAB / Spain

www.pegasoproject.eu

pegasoproject.eu

Document Information

Project

Project Acronym	PEGASO	Grant agreement nº	244170
Project full title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast		
Funding scheme	Collaborative large-scale integrating project		
Project start date	February 1, 2010	Project duration	48 months
Call topic	ENV.2009.2.2.1.4 Integrated Coastal Zone Management		
Web site	www.pegasoproject.eu		

Document

Deliverable number		Due date	M45	Submission date	M45
Deliverable title	Report and supporting materials to economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins				
Authors	Pascal Raux, Rémi Mongruel, Denis Bailly (UMR AMURE – IFREMER / UBO)				
Reviewers	Roula Al Daia, Antonio Tulla				
Work Package	WPnº4 Multi-scale tools, methods and models for integrated assessment				
Work Package Leader	Denis Bailly (UMR AMURE UBO)				
Lead beneficiary					
Dissemination level	PU				
Nature	R				
Nº of pages (incl. cover)					

pegasoproject.eu

PEGASO

People for Ecosystem based Governance in Assessing
Sustainable development of Ocean and coast

Work Package 4

Multi-scale tools, methods and models for integrated assessment

PEGASO Deliverable D4.5

Report and supporting materials to economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins

Pascal Raux, Rémi Mongruel, Denis Bailly
(UMR AMURE / UBO - Ifremer)

"Economics compares, it doesn't measure well"

"Forty two?!" yelled Loonquawl.
"Is that all you've got to show for seven and a half million years' work?"
"I checked it very thoroughly," said the computer, "and that quite definitely is the answer. I think the problem, to be quite honest with you, is that you've never actually known what the question is."

Douglas Adams, The Hitchhiker's Guide to the Galaxy (1979)

UBO université de bretagne occidentale

Ifremer

AMURE UMR
CENTRE DE DROIT ET D'ECONOMIE DE LA MER
www.umr-amure.fr

Contents

Introduction

The issue for the economic assessment is to assess how socioeconomic information, can contribute to a local/regional assessment in support to the implementation of the protocol on ICZM in the Mediterranean and needs for the Black Sea. The purpose of the present guidelines is then to propose an analytical framework to perform an economic assessment in support to the implementation of the ICZM Protocol for the Mediterranean and development for the Black Sea. Application and illustrations are provided along with the approach at two scales:

- at sub-regional scale (CASES level)
- and at basin/sub-basin scale.

The proposed framework was then initially thought to run at both scales, but availability of public and free access data at the basin scale did not allow implementing the designed framework in a routine process. An additional framework was then developed to target the regional and basin scale.

The framework developed for the economic assessment at local/CASES scale is designed in a complementary way with other tools developed within PEGASO to perform an integrated assessment in support to the ICZM protocol (indicators, LEAC, participation and scenarios). Objective is to think integration in the very early stage of the assessment instead of compiling outputs from different tools in the final stage in an attempt of integrating everything ex-post usually leading to failure. A review or stock take of the different approaches for economic valuation is then first implemented and analyzed in the context of ICZM, relevance and suitability to perform the economic assessment under constraints (data access, local ability in implementing assessment, etc.). Amongst all approaches, the cost based approach in the form of the cost of ecosystem degradation seems the one that best suit to PEGASO constraints and objectives. Costs calculations are based on observed practices and not on individual preferences, e.g. real expenditures that human societies dedicate to maintain the ecosystem services they benefit from, or to limit their decrease. The approach is based on the identification of drivers of ecosystem degradation for which all sectors are relevant to the analysis.

At basin and sub-basin scale, the objective is to assess how socioeconomic information, based on existing and easily accessible, monitored and updated data can contribute to a regional assessment in support to the implementation of the protocol on ICZM in the Mediterranean. Two main constraints are attached to the information to mobilize in the field of socioeconomics. The first one is related to the economic activities to be taken into account. This is partly entitled "the coastal and maritime economy" in the Protocol. The second constraint is related to the scale of the assessment requiring working at ecosystem level. Relevant socio-economic information regarding marine and coastal issues is a scare resource at regional level. Activities are usually considered in terms of land use that is of little interest for a socio-economic analysis if it can't be confronted to socioeconomic dimensions. A first approach is to build over the approach developed for local assessment, by aggregating information and data from local scale (NUTS 3 to 4 and LAU2) to ecosystem scale or to the scale where the issue takes place. On this basis an exhaustive review of existing datasets and databases of interest in the field of marine economic activities at Regional Seas and Institutional level had been conducted by crossing activities and existing initiatives. A series of lessons and constraints for the regional assessment can be drawn from this review, especially by exploring what should be a suitable database to implement the framework designed at local scale.

Limits related to availability of data through international and regularly monitored databases didn't allow implementing, through an aggregative process, the same framework than the one designed for local scale. An index based approach was then elaborated to operate at regional scale. Indexes cover socio-economic development, marine industry activity, environmental threats and were designed and built following the approach for Accounting for Economic Activities in Large Marine Ecosystems and Regional Seas (Hoagland et al. 2006).

Some materials were produced in order to support the present report. They are factsheets of methods and videos, plus a review of socio-economic information available at regional scale:

- Videos:
    - Economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins, Part A Degradation costs: http://polimedia.uab.cat/#v_481
    - Economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins, Part B – The Regional dimension: http://polimedia.uab.cat/#v_482

- Factsheets:
    - PEGASO 2013. Final publishable summary factsheet, Task 4.5 "Economic assessment" WP4 Multi-scale tools, Methods and Models for Integrated Assessment, 4p.
    - PEGASO 2011. Tool: Costs of Ecosystem Degradation (Costs Based Approach), Tool Fact Sheet N°XX, 3p.
    - PEGASO 2011. Tool: Application of Multi-criteria Analysis (MCA) – Illustration, Tool Fact Sheet N°XX, 2p.

- Raux P., 2013. A review of Socio-economic information/Indicators in support to coastal zone management at the scale of the Mediterranean and Black Sea. PEGASO Project, FP7 ENV.2009.2.2.1.4 Integrated Coastal Zone Management, 39p.

1. Stock-take of Economic Assessment methods and approaches

The preliminary overview of the issues faced by the proposed PEGASO's assessment tools in support to ICZM underlined a wide range of methods and approaches regarding the economic assessment in the field of coastal and marine environment, with a trend to balance the initial enthusiast for monetary valuation (Le Gentil et al., 2011). This led to enlighten limits and constraints of methods and to consider them according to the issue to be addressed and to the local context of implementation. This stock-take will try to follow a similar way by going beyond of the opposition between approaches and methods, trying to overpass the confusion between frameworks and assessment methods, proposing an articulation between methods rather than selecting one and then propose a coherent and integrated framework for an integrated assessment in the context of the Mediterranean and Black Sea basin and to review these economic approaches in support to decision-making for marine and coastal management.

The purpose of an economic assessment, as well as other assessment tools, is to inform. In the field of environmental economics and natural resources it aims at determining the optimum use of scarce resources (renewable or not), involving comparison of alternatives in achieving a specific objective under the given assumptions and constraints. It takes into account the opportunity costs of resources employed and attempts to measure in monetary terms the private and social costs and benefits of a project to the community or economy. These are the roots of the so called Cost Benefit Analysis (Box 1). More or less it is a matter of changes in preferences, assessed through changes in welfare or well-being expressed in monetary terms. It assumes that everything is caught through welfare and that distribution issue is a matter of deliberation, political choice and less a matter of economic assessment. Others express that changes in welfare cannot catch all preferences and especially those attached to the redistribution issue (who gains who loses?) especially when dealing with environmental goods. This will lead to different and concurrent approaches in terms of tools, hiding a more important issue about the uses of these tools (context and way of implementation, limits and so on).

This concurrence between schools of thought or different thinking is exacerbated by more and more important statutory and obligations requiring such economic assessment (requirement of impact analysis or environmental impact assessment, etc.). Decision makers also increasingly request economic information prior to making important regulatory decisions. Beyond of these "usual" obligations driving much of the demand for economic analysis, there is also the demand of improving the environment and then assessing the improvement costs of different measures and options to avoid imposing unreasonable cost burdens on society. In the field of marine and coastal environment, it had to deal for a while with the efficiency improvement of environmental regulations that were not required by law (cost-effectiveness approach of proposed regulations). But with new regulations and enforcement measures, especially at EC level, it moves to improve the efficiency of environmental regulations that are required by law. The Marine Strategy Framework Directive is of course the most visible and specific one.

Box 1 Cost Benefit Analysis (CBA) in a nutshell

CBA is a process of quantifying costs and benefits of a decision, program, or project (over a certain period), and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. Unlike the present value (PV) method of investment appraisal, CBA estimates the net present value (NPV) of the decision by discounting the investment and returns. Though employed mainly in financial analysis, a CBA is not limited to monetary considerations only. It often includes those environmental and social costs and benefits that can be reasonably quantified (BusinessDictionary 2011).

The essential theoretical foundations of CBA rely on benefits defined as increases in human wellbeing (utility) and costs defined as reductions in human wellbeing. For a project or policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs (Pearce 2006).

In governmental planning and budgeting, CBA is the attempt to measure the social benefits of a proposed project in monetary terms and compare them with its costs. A cost-benefit ratio is determined by dividing the projected benefits of a program by the projected costs. A wide range of variables, including non quantitative ones such as quality of life, are often considered because the value of the benefits may be indirect or projected far into the future. The fact that policies could be evaluated in terms of their costs and benefits defined in terms of human preferences and willingness to pay, was first established by Arsène-Jules-Étienne-Juvénal Dupuit who proposed the procedure in 1844. It was not seriously applied until the 1936 U.S. Flood Control Act, which required that the benefits of flood-control projects exceed their costs. (The Free Dictionary and Encyclopædia Britannica 2011). After World War II, there was pressure for "efficiency in government" and the search was on for ways to ensure that public funds were efficiently utilised in major public investments. This resulted in the beginnings of the fusion of the new welfare economics, which was essentially cost-benefit analysis, and practical decision-making. Since the 1960s CBA has enjoyed fluctuating fortunes, but is now recognised as the major appraisal technique for public investments and public policy (Pearce 2006).

CBA's insistence on all gains and losses of "utility" or "well-being" being counted means that it forces the wider view on decision-makers. In this respect, CBA belongs to a group of approaches to policy analysis which do the same thing. For example, cost-effectiveness analysis (CEA) and multi-criteria analysis (MCA) impose a discipline in terms of defining goals (working out what it is that the policy should achieve) and differentiating costs from indicators of achievement of the goals (Pearce 2006).

Another goal claiming for economic analysis is to be proactive rather than reactive to expand the scope of regulation or to modify the way it currently regulates an activity. Dynamic approaches are rather more suitable here especially through integrated assessment (systems dynamics modeling or individual based modeling).

Under that demand context, the monetary valuation approach was rather pushed on the front of the stage, initially from US courts in the field of environmental damages compensation (especially regarding oil spill pollution), where the needs for such monetary value assessments were expressed. Cost Benefit Analysis (CBA) was also adopted by Member States as the reference approach for the implementation of the Water Framework Directive (WFD) in Europe. Regarding difficulties in exploiting results for decision making process, the approach wasn't automatically adopted for the

Marine Strategy Framework Directive. Method for assessing the cost of degradation of the marine environment wasn't defined in the MSFD. Member States were asked to provide the initial socio-economic assessment of their marine and coastal water uses according to their own approach. Approach, methods and results were later discussed within the European Working Group on the economic and social assessment.

This explains number of reviews and stock-takes regarding economic assessment approaches and methods for marine and coastal water. A number of EC funded projects initiated these reviews. These projects came in support to the definition and implementation of EC environmental directives related to the marine and coastal water and the measure of the related Good Environmental Status (GEnS). In addition, projects working about integrated assessment frameworks in support to ICZM also implemented similar reviews. The most significant, recent and useful projects in these fields are the followings:

- SPICOSA: Science Policy Integration for Coastal Systems Assessment (FP6)
  http://www.spicosa.eu/ http://www.coastal-saf.eu/
- KnowSeas: Knowledge-based Sustainable Management for Europe's Seas
  http://www.knowseas.com/ www.msfd.eu
- PISCES: Partnerships Involving Stakeholders in the Celtic Sea Ecosystem (LIFE+)
  http://www.projectpisces.eu/
- ODEMM: Options for Delivering Ecosystem-Based Marine Management (FP7)
  http://www.liv.ac.uk/odemm/
- VALMER: Valuing the Sea (INTERREG IVA)
  http://www.valmer.eu/

Objective is not to rewrite again a descriptive list of methods and approaches. There are already a number of well written and documented guidelines in that field. But as WP4 leader (UMR AMURE) was involved in part of these projects (SPICOSA, KnowSeas, VALMER) and we'll take advantage from and make references to guidelines and publication they issued. Most of methods listed hereafter are based on the work performed by the economist team within the SPICOSA project (Hadley and al. 2011) and still maintained and updated by AMURE. But beyond of the stock-take in itself, the repetition of such reviews help to make us think about the quest for an illusive method suitable to all issues instead of focusing on advantages, limits, complementarities and mainly articulation of methods into an assessment framework. The present "stock-take" is an attempt to focus more on that point.

A first approach to differentiate assessment methods relies on the value to be assessed. This leads to first make the difference between price and value.

Price vs. value and Valuation vs. pricing

The price of a good or service and its economic value are distinct and can differ greatly. For example, water used for irrigation could have a very high value, but a very low price or no price at all. Another example is the air we breathe, having a high value but no price at all. The price of a given good thus only informs us of the cost of purchasing that good and not its value. This is linked to some properties and characteristics of certain goods such as public goods that are not exchanged on a

market. The issue is then to value non-market impacts in monetary terms so that it can make possible to compare these particular costs and benefits to market impacts, financial revenues or costs. This can be done in a CBA frame for instance.

This difference between price and value is a characteristic of environmental assets which also belong to public goods and services. For classic or standard goods, the market price is the indicator of their value. But environmental assets are public goods that can't be exchanged on markets; they have no price but a value. Assess these assets' value in monetary terms requires to use specific methods. The basic idea is to use similar market rules that apply to classic goods by creating surrogate markets or simulated value survey based. To help assessing these values, the concept of Total Economic Value was developed, allowing better defining values attached to environmental assets and introducing a difference between use and non use values.

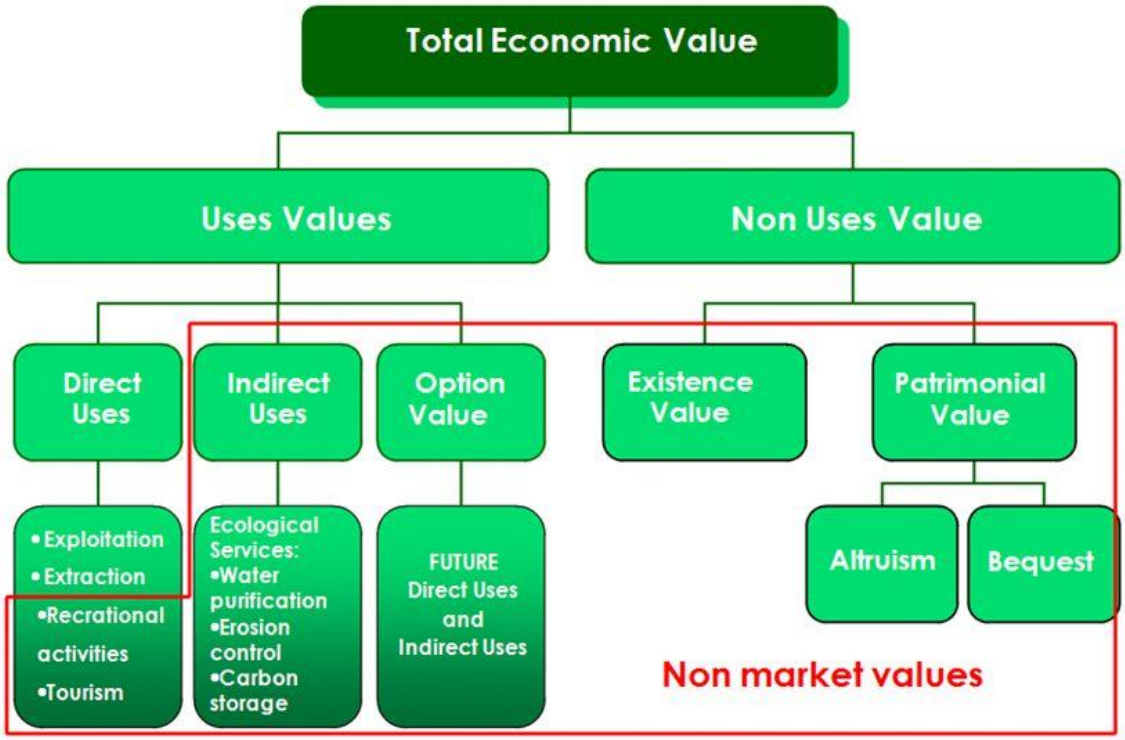
Total Economic Value (TEV)

Economics is often perceived as not being able to encompass all values due to the immeasurable character of some of them. The Total Economic Value frame aims at extending the classical field of economics by integrating the whole environmental values.

Total Economic Value is derived from the preferences of individuals. When goods and services are exchanged in actual markets, individuals express their preferences via their purchasing behavior. The price they pay in the market reflects how much they are willing to pay for. For environmental resources which are not traded in markets, such behavioral and market price data are missing. Hence these resources generate non-market or external benefits. In addition to interpreting the market data, the methods of economic valuation provide several tools that may be employed to value benefits that are derived from non-market goods and services.

The notion of total economic value provides an all-encompassing measure of the economic value of any environmental asset related to human preferences (Pearce et al. 2006). The use of the total economic value classification enables the values to be usefully broken down into categories (Figure 1). It decomposes into use and non-use values. The classification presented here remains voluntary simple and avoids entering into too numerous subcategories. Other classifications exist, especially regarding sub-categories, but the idea remains the same.

Figure 1 Total Economic Value and its components



Adapted from Fleuret A. 2008 (MEEDDAT)

Use value involves some interaction with the resource, either directly or indirectly leading to the subcategory of direct and indirect use value. It can derive from market-related activities or non-market activities. These may be extractive (irrigation, fisheries or timber) or non-extractive (recreational and educational activities).

- Direct use value involves direct interaction with the ecosystem itself rather than via the services it provides.
- Indirect use value: derives from services provided by the ecosystem. This might include the removal of nutrients, thereby improving water quality, or the carbon sequestration services provided by some coastal ecosystems.

An additional subcategory can be defined through the option value, underlining future direct uses and indirect uses of resources. Option value is related to potential, but uncertain, future resource use. This option value is often defined in-between use and non use value through the benefit an individual derives from ensuring that a resource will be available for use in the future (a form of use value, but for possible future and not current use).

Non-use value is associated with benefits derived simply from the knowledge that a particular ecosystem is maintained. It is not associated with any use of the resource. Non-use value is closely linked to ethical concerns, often being linked to altruistic preferences. It can be split into three basic components:

- Existence value: derived simply from the satisfaction of knowing that an ecosystem continues to exist, whether or not this might also benefit others.

- Bequest value: associated with the knowledge that a resource will be passed on to descendants to maintain the opportunity for them to enjoy it in the future.
- Altruistic value: associated with the satisfaction from ensuring resources are available to contemporaries of the current generation.

Differentiation of methods

We will then distinguish methods that estimate economic values (valuation approaches) and methods that produce estimates equivalent to prices (pricing approaches). Similarly the difference between assessment methods can also be made according to use and non use values. In that case, pricing methods will only target a part of the use values: the direct use value, when valuation approaches would target both values and especially non market values (Figure 1). Another alternative could be to also consider a "private CBA" vs. a "social CBA". The first one would deal with market value and private economic activities and would mainly consist in a profitability or financial analysis of extractive and harvesting economic processes (for instance extraction and harvesting for fisheries and aquaculture) as a pricing approach. The second one would also take into account social costs and benefits when environmental issues occur (for instance pollution abatement or environmental improvement) and would have to take into account non market values through the valuation approaches.

But whatever the differentiation made, various methods exist in each of these categories. They are listed and summarized below according to pricing and valuation approaches. Each of the method is positioned according to TEV or part of its value components.

1.1 Valuation approaches

As explained above, such approaches will deal with the monetary valuation of environmental benefits and costs, focusing on non market value (see Figure 1). The aim will be to estimate the total economic value (TEV) of ecosystem change by assessing its components. As value of a good is linked to the welfare derived from that good, valuation methods will then focus on measuring welfare and changes in welfare. They are based on individuals' preferences. Valuation approaches fall in two main categories, depending on how preferences are inferred: stated or revealed.

Revealed preferences methods

Revealed preference methods infer individual preferences by observing their behavior in markets in which a given environmental good is indirectly purchased (making the assumption that non-market use values are indirectly reflected in consumer expenditure).It will then measure the expenditures of individuals related to the acquisition of an environmental good. Most widely used revealed preference methods are: the travel cost method (TCM), hedonic pricing (HP), averting behavior and defensive expenditure and the cost of illness and lost output method. Solely TCM and HP are detailed hereafter, others being rather similar in terms of approach.

- **Travel Cost Method**: TCM allows assessing recreational uses value (an element of direct use value). This is the oldest valuation method (Hotelling 1947). The idea: the value of a site is revealed by expenditures that visitors willing to get there. It's an indirect assessment method

that assesses the frequentation demand function for a natural site (implementation of a survey over visitors...) and consumer benefit for visiting the site.

- **Hedonic Prices**: Hedonic Pricing may be applied to the valuation of ecosystem services such as landscape amenity, air quality, and noise. The technique involves isolating the effect of these services on the demand for a marketed good. In most cases price data from the housing market are used. Estate value depends on housing, area and environmental characteristics. All other things remaining equal, change in price housing is an estimate of the implicit price of an improvement or degradation of the environmental quality. It can be understood as the implicit price which individuals are willing to pay for the relevant environmental characteristics. It is applied to risk reduction (noise, water quality, air quality…).

Revealed preferences methods can also be used in a way to assess values as proxy for consumers' attachment to different level of environmental quality. In that way such assessment based on observed behavior can be more reliable than the ones based on stated preferences.

Stated preferences Methods

Stated preference methods directly elicit individuals' preferences for non-market goods through the use of surveys based on simulated markets. The contingent valuation method and choice modeling experiments are the main forms of stated preference techniques. In contrast with other methods they allow for measuring non uses values. Through survey implementation it assesses the willingness to pay for an environmental improvement or the willingness to receive for a damage expressed in monetary terms.

- **Contingent Valuation Method** (CVM): Contingent valuation method implements a survey over a representative sample of the population and employs a questionnaire format where respondents are asked how much they would be willing to pay (WTP) or willing to accept (WTA) for a specified gain or loss of a given good or service. Economic value estimates yielded by contingent valuation surveys are "contingent" upon the hypothetical market situation that is presented to respondents (a surrogate and fictive market with baseline reference and scenarios of changes) and allows them to trade off gains and losses against money.

- **Choice Modeling** (CM): Compared to CVM, CM enables attributes of an environmental gain scenario to be valued rather than just the overall scenario. Derived from but more complex than the CVM, CM is also heavier as the environmental good is broken into several attributes. Choice modeling is in fact a family of survey-based methodologies. Approaches involve respondents making choices between goods which are described in terms of their various attributes, offered in different amounts, or levels. There are two main choice formats: contingent ranking and choice experiments. In a contingent ranking exercise, respondents rank a set of alternative scenarios of good or service provision in order of preference. In a choice experiment exercise, respondents are presented with a series of scenarios (baseline and changes) along with their associated costs or prices and asked to choose their most preferred option. Similarly to CVM, survey results are then analyzed statistically to derive the values of WTP that correspond to each scenario.

1.2 Pricing approaches or Market based values

Various methods exist as well to infer the price of an ecosystem service: market prices and cost based approaches (opportunity cost, replacement cost approaches…).

Market prices and private CBA

- Market prices data from ecosystem goods and services that are traded offer the most visible indication of value (fisheries, timber and crops are obvious examples). However, it may be necessary to adjust prices to account for government subsidies or taxes in order to obtain real or so called shadow prices.

- **Financial analysis** is based on microeconomic theory. As such, it does not concentrate on the social level but on the private one and thus on firms or groups of firms. The production process is at the core of the economic activity. In this approach, one considers profit as an indicator of economic efficiency. Profit of the firm is calculated using a cost benefit approach; it is equal to total revenue minus total cost. The revenue is the amount of money that flows into the firm, which is composed of product sales mostly but also of subsidies for instance. Costs can be related to the level of activity (variable costs) or independent such as investment and depreciation (fixed costs). To derive the revenue part of the analysis, one uses the level of goods and services produced (outputs) at market price levels. The production system itself is seen as the production of outputs, obtained by combination of factors of productions called inputs. One usually considers that the aim of the firm is to maximize profit. But depending on the economic activity, some firms might have other aims: the stability of production, of employment levels or environmental sustainability for instance.

Cost based approaches

A first estimate of environmental assets can be gained from the assessment of costs that would allow maintaining the provision of ecosystem services. This can be replacement costs, restoration costs, relocalisation costs, etc. Such approaches were used for the assessment of ecosystems services on large scales. Costs based approaches are relatively simple, but are limited to direct use values.

The simplest approach facing an environmental degradation (being real or potential) is to monetary value physical damage to the market price. But if it seems simple, in practice it doesn't necessary give a relevant estimate of losses. It happens that goods and services have no price such as recreational use and it can be very difficult to simulate a market for goods that cannot be appropriated. In practice a price can then be fixed according to existing price lists or assess restoration costs if possible. Other costs based methods are the followings:

- **Replacement or substitution** costs: assess the required expenditures to replace a service provided by an environmental good. It is particularly useful in situations when market data is scarce, but in some cases property value can significantly exceeds its replacement cost.

- **Restoration** costs or **reparation** costs: assess the expenditures required to restore a service provided by an environmental asset.

- **Productivity change** method (or production function method): assess the impact of an environmental asset over the production.

- **Opportunity** costs: assess the costs attached to the loss of potential income or benefits due to a non degradation of environmental assets.

- **Damage** costs method or avoided costs: assess the expenditures avoided due to the non degradation of environmental assets, i.e. the cost of artificial means to provide the same service than the natural asset if this one was destroyed (for instance it could be the cost of a WWTP that would be necessary to substitute to the water purification service of wetlands). **Cost of illness** is similar as it assesses the expenditures treatment of avoided diseases due to the non degradation of environmental assets.

- **Efficient** costs method: what are the minimum expenditures necessary to get a given results.

These approaches propose a set of indirect methods providing an estimate from "engaged" costs to produce substitutes or to avoid losses. But if the substitute is not perfect, then the valuation is incomplete or partial and the result can be far from and lower to the real value. At last, in case of replacement, agents taking the replacement decision could only consider advantages they benefited from and that other advantages could be lost.

1.3 Value Transfer

A number of listed methods are time and resources consuming, especially survey based methods calling for some quite important sample in terms of population. In order to avoid costly valuation studies, a value transfer technique was developed. It is a technique for valuing ecosystem services and environmental assets that employs results from previously existing studies and transfers them into a similar ecological and policy context. Such values are set as reference values.

Value transfer deals both with costs and benefits but reference values are more developed for WTP/WTA than for costs. Benefits transfer is often used when talking about value transfer.

Environmental benefits transfer is a technique in which the results of previous environmental valuation studies are applied to new policy or decision making contexts. Benefits transfer is commonly defined as the transposition of monetary environmental values estimated at one site (study site) to another site (policy site) where information is needed about the monetary value of similar benefits. It provides some estimates in a first approximation.

The benefits transfer tries to answer on how value non market benefits. To value such benefits, it is proposed to follow three steps including the benefit transfer:

1- A qualitative assessment: description and characterization of impacts, based on technical indicators (but non monetary)
2- If appropriate, a first quantitative valuation based on reference values (to further analyze as alert systems rather than intangible values)
3- If appropriate, implementation of a local study.

Several benefits transfer methods coexist: using unadjusted mean WTP value used from another study or from more than one study (average), using mean WTP values adjusted, using the entire WTP function from an original study to predict mean WTP… A detailed guideline for implementing Environmental Benefit Transfer has been issued by the SPICOSA project (Hadley et al., 2011) and can be found at the output website project: www.coastal-saf.eu.

A number of criteria have been identified for benefits transfer to result in reliable estimates, summarized in Brouwer (2000):

- sufficient good quality data
- similar populations of beneficiaries
- similar ecosystem services
- similar sites where these services are found
- similar market constructs
- similar market size (number of beneficiaries)
- similar number and quality of substitute sites where the ecosystem services are found.

Constraints are then numerous and in some cases it can sometimes be as costly as implementing local study. To help implementing benefits transfer, a number of tools have been developed. The first ones are international databases of values for different ecosystem services and environmental assets. These databases help in identifying environmental valuation studies being potentially suitable for benefit transfer. The most important one, but restricted to associated member States, is the Environmental Valuation Reference Inventory (EVRI) database that can be found at www.evri.ca. EVRI was developed in the early 90s by Environment Canada together with the US EPA. In 2007, 2000 studies were available and about 200 over coastal areas and estuaries. There are other available databases at national level and Table 1 attempts summarizing the most important ones.

Table 1 Databases of environmental valuation studies potentially suitable for benefit transfer

	Database	Web Address
International	Environmental Valuation	www.evri.ca
National	Nordic Environmental Valuation Database	www.norden.org/pub/sk/showpub.asp?pubnr=2007:518
	Swedish ValueBase SWE	www.beijer.kva.se/valuebase.htm
	Australian ENVALUE	www.epa.nsw.gov.au/envalue
	French Water Information System	www.economie.eaufrance.fr
Transversal	Case Study Database from the Nature Valuation and Financing Network	www.fsd.nl/naturevaluation/
	Ecosystem Commons	www.ecosystemcommons.org

The French database on economic data about Water Information System is restricted to water studies: www.economie.eaufrance.fr. Ecosystem Commons is a more recent website (2011) which resources provide description and links to a limited number of existing ecosystem services tools, databases, and reference documents that could complete above databases: www.ecosystemcommons.org.

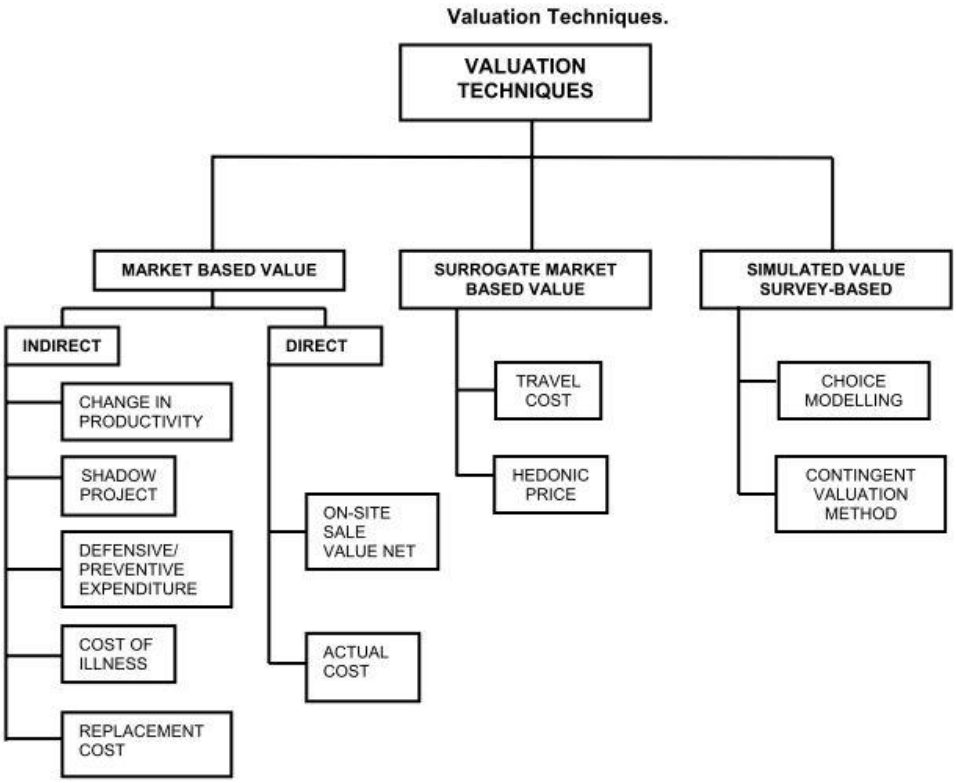
Another supporting tool was developed in order to avoid BT becoming as costly as primary studies. It consists in guideline and protocol to follow in order to select and apply relevant and suitable reference values. Studies must be screened to identify those which are of a sufficient good quality to be used in benefit transfer. Entitled "a tool for quality assessment of economic valuation studies" and published by the Swedish Environmental Protection Agency (Söderqvist et al., 2006), it can be found in a more synthetic and operational format under the SPICOSA project outputs website: www.coastal-saf.eu.

1.4 Comparison between approaches and methods

Each valuation technique has different properties when it comes to valuing parts or whole of the total economic value of environmental assets -where one mainly distinguishes use and non-use (or passive use) values.

Figure 2 presents in a synthetic way the different valuation techniques and the values they aim to assess illustrating the position and role of the different techniques according to each other.

Figure 2 Economic Valuation Techniques

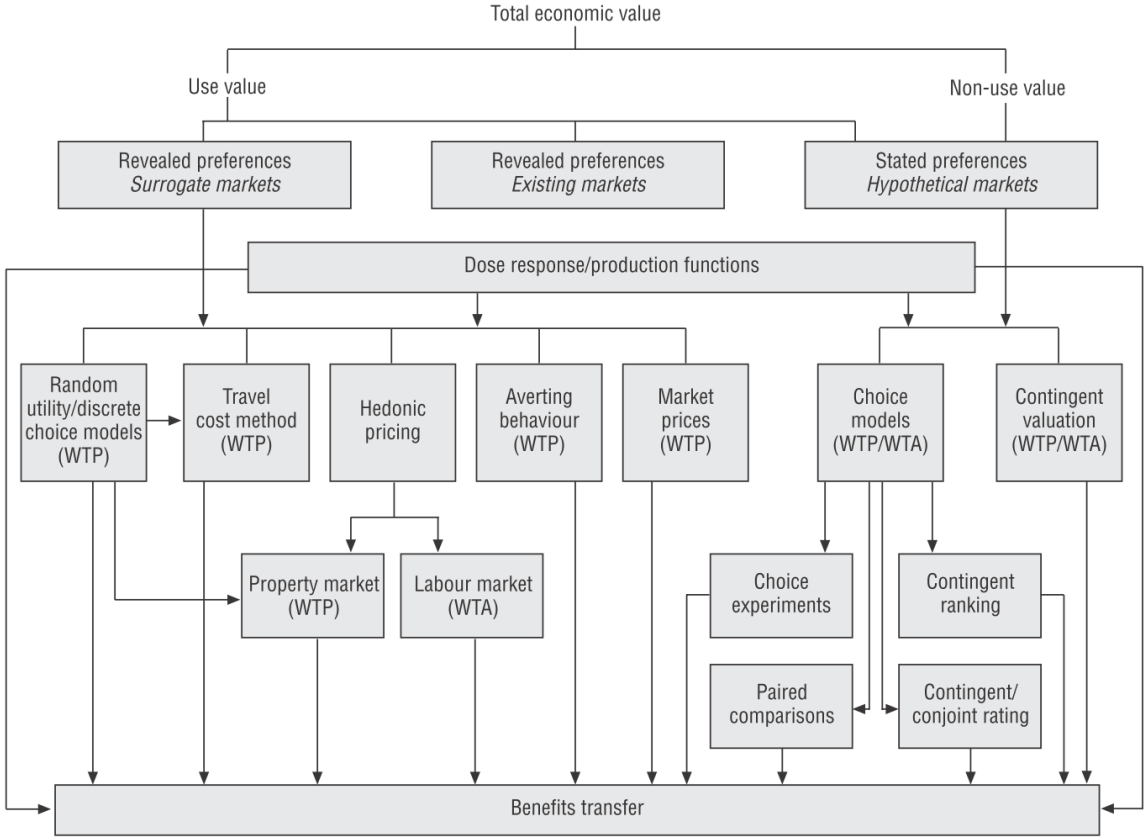


Source XX

Crossing much more in detail methods and value components, Figure 3 from Pearce et al. (2006) shows the various techniques and the TEV components they are best suited to measuring. It illustrates the non-use values can only be estimated using stated preference techniques, i.e. techniques that are based on questionnaires given to respondents and which elicit the respondent's

WTP (or WTA) directly or indirectly from respondent answers. Non use values are likely to be especially important in contexts where the good being valued has few or no substitutes. Stated preference techniques can also be used to elicit use values. But non use value tends not to leave a behavioral trail, i.e. some behavioral change which affects a price or quantity which can be observed. Accordingly, revealed preference is unlikely to elicit non-use values.

Figure 3 Total Economic Value and Valuation Methods



From Pearce et al. 2006

Another comparison can be made according to an additional level of differentiation through the direct or indirect characteristic of methods (Table 2). Methods can be read either according to values estimates or to the way of implementation (direct or indirect).

Table 2 Valuation Techniques according to Values and Methods

	Revealed preferences	**Stated preferences**
Direct methods	- Market prices observed	- Stated prices: Contingent valuation
Indirect methods	- Revealed prices: Travel Cost, Hedonic Prices - Avoided expenditures	- Contingent ranking - Choice modeling
	Use values	Non use values

Adapted from Chevassus-au-Louis (2011)

Synthesis of advantages and limits of valuation methods

Following comparison between methods, a first assessment of their relative advantages and disadvantages can be drawn. Table 3 is an attempt in that way, built over the preliminary statement of valuation methods.

Table 3 Relative Advantages and Disadvantages of Valuation Methods

Methods	Advantages	Disadvantages	
Contingent Valuation Method	• can estimate use and non-use values • widely used • applicable to a wide range of ecosystem services	• can suffer from a wide range of biases (questionnaires based) • very resource intensive • can be statistically complex to analyse	Non use values
Choice Modeling	Id. CVM • enables attributes of an environmental gain scenario to be valued rather than just the overall scenario	Id. CVM but can be even more complicated	
Averting behavior	• sound theoretical basis • uses data on actual expenditures and data requirements can be modest	• not widely used • can only estimate use values • limited to cases where money spent to offset environmental hazards • appropriate data difficult to obtain	Use values
Cost of illness and lost output	• theoretically sound • useful where there is a clearly established exposure-response relationship • relatively simple if data on exposure and response is available	• can only estimate use values • uncertainty regarding exposure-response • market failures may lead to price distortion • complex and resource intensive if exposure-response relationships not established.	
Travel Cost Method	• a well established technique • based on actual observed behavior	• can only estimate use values • mainly applicable to recreational sites) • difficult to account for the possible benefits derived from travel, multipurpose trips and competing sites • very resource intensive (large sample sizes) • statistically complex	
Hedonic Prices	• well established • based on actual observed behavior and existing data	• can only estimate use values • only applicable to environmental attributes likely to be capitalised into the price of housing or land • market failures may lead to price distortion • data intensive • statistically complex	
Market prices (and all market based)	• relatively simple	• can only estimate direct use values; • market failures may lead to price distortion • only a partial measure of value	
Opportunity cost	• relatively simple • very useful where a policy precludes access to an area (establishment of a protected area)	• can only estimate direct use values • may require detailed surveys to establish economic and leisure activities • only a partial measure of value	
Replacement cost	• relatively simple	• can only estimate direct use values • only a partial measure of value	

What we can learn from that table and from valuation methods in general? First there's no master or universal method. Methods are tools and tools are designed for some purpose with their own limits and advantages. Each of these methods has to be considered according to the issue to address (scale) and the implementation context (technical skill required, data accessibility and so on). Using a screw driver for driving screws is nice, but less suitable for pointing nails even if it can be successful. In that last case a hammer would suit, but won't be successful at all in driving screws… Using methods in a non adequacy way can lead to inefficient outputs. It is then less a problem of tools and methods, but rather how they are used for.

As already underlined, each valuation technique has different properties when it comes to valuing parts or whole of the total economic value of environmental assets. Selecting a method or another is then not trivial as it will impact and drive the result by focusing on a specific part of an environmental asset value, by underlining either the benefits or the costs side, etc. In certain context the choice of method itself can deeply impact the decision making process and is not as neutral as it should be.

But before going ahead with methods and their suitability with PEGASO issues, requirement and local capability, there're other methods and approaches that don't deal directly with value.

1.5 Other economic approaches and methods of interest

Cost effectiveness analysis framework (CEA)

Cost Effectiveness Analysis is an alternative framework to CBA. CEA compares the relative costs and outcomes (effects) of two or more courses of action. Cost-effectiveness analysis is distinct from CBA which assigns a monetary value to the measure of effect. The purpose of a cost effectiveness analysis (CEA) is to find out how predetermined targets, e.g. threshold values for pollutant loads in a catchment, can be achieved at least cost. Theoretically, the least cost allocation of pollution abatement strategies is found if the marginal costs of the proposed measures are equal. In other words it is based on an estimate of the value to be set to encourage concerned people to adapt and reach the objective sought. CEA is often used in the field of health services, where it may be inappropriate to monetize health effect. Typically the CEA is expressed in terms of a ratio where the denominator is a gain in health from a measure (years of life for instance) and the numerator is the cost associated with the health gain.

Accounting and green accounting

Assessing the economic impact of environmental measures or environmental degradations may be done through cost benefit analysis (CBA) or cost-effectiveness analysis (CEA). However, indirect impacts on other sectors (sectors not directly targeted by the measure or directly impacted by the degradation) are often excluded from the analysis. When such indirect impacts are important enough to affect the economy of a region, regional accounting methods may be suitable and complementary to CBA. The resulting regional income/employment effects may be quantified via the use of input-output matrices (I-O).

Input-Output Matrix

An Input-output matrix is a representation of national or regional economic accounting that records the ways industries both trade with one another and produce for consumption and investments. Many countries currently compile national input-output tables in line with the recommendations and obligations of the System of National Accounts (SNA93 in 1993 and its update in 2008).

Input-output matrix is constructed on the simple idea that goods and services produced by economic sectors should be registered in a table simultaneously by origin and by destination (OECD, 2006). Commodities are produced by economic sectors (e.g. cotton produced by agriculture) and they serve as inputs in other sectors in order to produce their final products also called outputs (e.g. manufacturing industry such as textile industry using cotton from agriculture as input to produce its own output, i.e. clothes in cotton).

In addition to I/O Matrix, there're also other approaches in the field of regional accounting methodologies such as Supply Chain Analysis and Computable General Equilibrium models. Being of less interest regarding PEGASO's issues, they won't be developed here.

Green Accounting (e.g., integrated national economic environmental accounting or SEEA).

The 1968 version of the worldwide System of National Accounts (SNA) for calculating Gross Domestic Product (GDP), economic growth over time and related aggregate measures has been considered to be limited in reflecting natural resource depletion and environmental degradation (O'Connor et al., 2001). This can result in quite misleading economic signals about economic growth and development (Lange, 2007) and hide that a rapid economic growth achieved through depletion of natural capital is a temporary strategy that creates no basis for sustained development. Since the 80s, this concern has led to the development of approaches aiming at revising SNA and its most common macroeconomic indicators, GDP and NDP. In that context, environmental accounting also known as green accounting has been developed (Lange, 2007). As stated above, it is complementary to SNA but it can also complement Input/Output analysis since it can be useful for greening I/O tables with the aim of economic assessment of environmental policy options.

For environmental studies, I/O tables need to be "greened" by adding a line on pollutant production by each sector and a column on the production of goods and services resulting from the implementation of the environmental measures for pollutant elimination (either reduction of pollutant from agriculture, industry or households). Green I/O tables allow taking into account the impact of environmental policy options on the total production of each sector and on employment.

Green accounting refers to environmental and economic accounting and links economic and environmental information using national accounting or I/O frameworks. Green accounting handles mixes of physical and monetary units to produce multidimensional sets of indicators. The objective is to explore interdependencies between economics and the environment rather than strict monetary accounting purposes.

Environmental accounting methods can be grouped under three main approaches, even though these methods are often very closely interlinked and built upon each other (O'Connor et al., 2001):

- National Accounts directly expanded with monetary and physical information on the environment; the purpose is to directly expand national accounts with environmental information; the most well known example is the National Accounts Matrix including Environmental Accounts **(NAMEA)**.
- Satellite Accounts: the main difference between Expanded National Accounts and Satellite Accounts is that the latter are kept separate from the conventional National Accounts. An example of satellite accounts to the SNA is the **SEEA-2003** (System of Environmental-Economic Accounting) and its revision (2012) initiated by the United Nations Statistical Commission. It includes some subsystems elaborated on specific resources or sectors including: Energy, Water, Fisheries, Land and Ecosystems, and Agriculture. That makes them more complete than NAMEA.
- Adjusted National Accounts Aggregates: this approach directly integrates monetized environmental components into the National Account System so as to provide aggregate monetary indicators. This is the approach that gives birth to the Green GDP.

Beyond of strict accounting, the approach gave birth to several initiatives such as:

- the 'Beyond GDP' initiative: www.beyond-gdp.eu The Beyond GDP initiative is about developing indicators that are as clear and appealing as GDP, but more inclusive of environmental and social aspects of progress (initiative from European Commission, European Parliament, Club of Rome, OECD and WWF).
- Green Economy Initiative (GEI UNEP).

Limits of environmental accounting methods

All these environmental accounting methods are relevant, as for the I-O tables, when the scale of the issue is great enough to be captured by national accounting. The input-output analysis is not able to capture environmental measures with a small economic impact (on GDP, on production, on employment… at national or regional level) because data are too aggregated. This leads to very few application at local scale, where I/O tables are often non available or too costly to rebuild from a higher regional scale. They are also non dynamic tools and a lot of research focus on this issue trying to make them dynamics. In absolute they can be considered of medium difficulty in using them.

Alternatives to economic valuation and monetary valuation

Valuation is implicitly or explicitly done by all humans (and many other animal species.....) to assess situations and decide on action in view of desirable ends (Braat 2012). In some cases it could be not relevant to perform some economic valuation or monetary valuation. Either due to limited resources, technical and practical considerations, but also regarding legitimacy of the valuation (values not socially accepted):

"Most community-based planners assess values without using quantitative cost benefit analysis (CBA) for the following reasons: they recognise that many of the benefits they are seeking are intrinsically difficult to value; it is an information-intensive (and therefore costly) tool for small-scale projects; and it doesn't lend itself easily to social weighting. Moreover, some development NGOs take the view that the local people should usually decide themselves what they want to invest in, using their own criteria. This does not mean that communities neglect to assess the costs and benefits of different intervention options, but rather that value is assigned locally and not through a formal accounting process."

IIED Brief June 2010.
International Institute for Environment and Development

Under such constraints, other alternatives are possible, each of them having their own interest and limits.

Standards, viability and precautionary

When natural areas or ecosystems are destroyed, leading to losses of ecosystem services, consequences are not always well-known whereas it could threat fundamental processes. This should lead to adopt some precautionary approach that can be expressed according to safe minimum standards (as debated for the implementation of the Endangered Species Act in the US). This could also take the form of viability and precautionary approaches. Remaining under debate, these approaches could also be combined with CBA, CBA being applied beyond of a certain a minima level or limit in terms of conservation or protection.

Multi Criteria Analysis

MCA may be seen as very appropriate for the purpose of integrated assessments including together ecological, economic and social concerns. MCA is a framework which allows decision-makers to evaluate and rank a range of different management options according to a set of well-defined evaluation criteria.

"Multi-criteria analysis (MCA) or multi-objective decision making is particularly useful in situations when a single criterion approach like CBA falls short – especially where significant environmental and social impacts cannot be assigned monetary values. In MCA, desirable objectives are specified and corresponding attributes or indicators are identified. Unlike in CBA, the actual measurement of indicators does not have to be in monetary terms – i.e., different environmental and social measures may be developed, side by side with economic costs and benefits. Thus, more explicit recognition is given to the fact that a variety of both monetary and non-monetary objectives and indicators may influence policy decisions. MCA provides techniques for comparing and ranking different outcomes, even though a variety of indicators are used." (Munasinghe 2007).

A factsheets about MCA has been produced for the PEGASO project based on an application from the Spicosa project. The application is quite simple as it ends with the estimation of a set of indicators in relation to the effects of various decision options. For further reference, a detailed manual has been produced by the UK Department for Communities and Local Government (Department for Communities and Local Government 2009).

2. Considering approaches and methods in the context of PEGASO

Following the stock-take of economic valuation approaches and methods, their interest is discussed in front of their intrinsic properties (limits and advantages), their support to decision making processes and in the context of the PEGASO project's objectives and constraints.

The issue is about the usefulness of different economic approaches in support of decision-making for the management of marine and coastal areas. Integrated assessment of social-ecological system should account for the variety of uses and their interactions on a given territory. It consists in evaluating the existing Human activities, the ecosystem services as they are defined by the Millenium Ecosystem Assessment (MEA) and the impacts which may occur from new settlements and uses of the marine and coastal areas. The economic analysis is expected to contribute to the assessment of the most effective and less costly measures for avoiding or compensating the negative effects of environmental degradations, considering that those impacts may affect ecosystems or local stakeholders, and may be due to ecosystem services losses or to the rules adopted to protect or restore them.

Many experiences trying to improve environmental quality of different fields have failed in Europe, particularly in coastal zones. According to the European Commission (CE 2001), the main reason of these inefficiencies result from the analytical approaches that have generally been favored. Tools and methodologies for economic evaluation of environment are helpful for decision makers in preserving or restoring environment quality at least economic cost, as required by European directives. However, during the last decencies, management of environmental issues and conflicting anthropogenic uses have been framed by sector-related policies (Cordier et al. 2009).

Approaches and methods have then to be considered according to their potential in terms of support to integrated assessment and holistic properties, especially in the context of the PEGASO project that wants itself integrated…

2.1 Green Accounting and Non market values

The economic assessment to be performed within PEGASO has to be thought at two scales: the regional and local ones, with a contribution from CASES to the Regional Assessment (through aggregates and illustrations). According to PEGASO's objectives and articulation with other tools and especially LEAC (Land and Ecosystem Accounting), the green accounting could be the ideal approach. But the scale of the issues addressed at CASES level makes it difficult to apply both due to lack of existing I/O matrixes at these levels and lack of local resources for rebuilding such matrixes. At regional level this should also require to rebuild I/O at the scale of maritime regions. In addition there's often a lack of available or existing data in Southern Mediterranean countries allowing for such approach. A local application of green accounting was introduced to PEGASO CASES on the Alexandria workshop on October 2010, focusing on an issue dealing with fish nurseries degradations and harbor development. In spite of CASES' interest in the approach, it was assessed as too far away from CASES capabilities and resources.

Before assessing the usefulness of the approach, it was also planned to review potential for integration of monetary valuation of non market good and services in green accounting. Despite the

difficulty for implementing green accounting in its primary definition, this potential was anyway assessed and is mainly based on a research paper published by some economists previously involved in the SPICOSA project and developing I/O approach for the sustainability of coastal zones (Cordier et al. 2013).

The paper proposes an alternative approach for reconciling monetary valuation techniques with methods addressing ecosystem-economy interactions. To achieve this goal, authors developed a guiding framework that limits the use of monetary valuation to real market simulations and to the understanding of the impact of economic activities on changes in ecosystems services and feedback effects on economic activities. Simulations of environmental measures scenarios are carried out designing and applying a hybrid ecological-economic input-output model.

The reason for integrating monetary values to the hybrid I/O model is to assess the economic impact of a variation in the supply of an ecosystem service on production sectors and final demand. This differs from other I/O approaches who assess the impact of a variation in the supply of an ecosystem service on satisfaction feelings expressed by individuals (through a measure of individual preferences) as it is usually the case in conventional cost-benefit analysis. There are two stages at which monetary units can be inserted into a hybrid I/O model to represent ecosystem services: i) when using market prices and prices from constructed and surrogate markets and ii) when simulating various scenarios of destruction or restoration of intermediate services of first order.

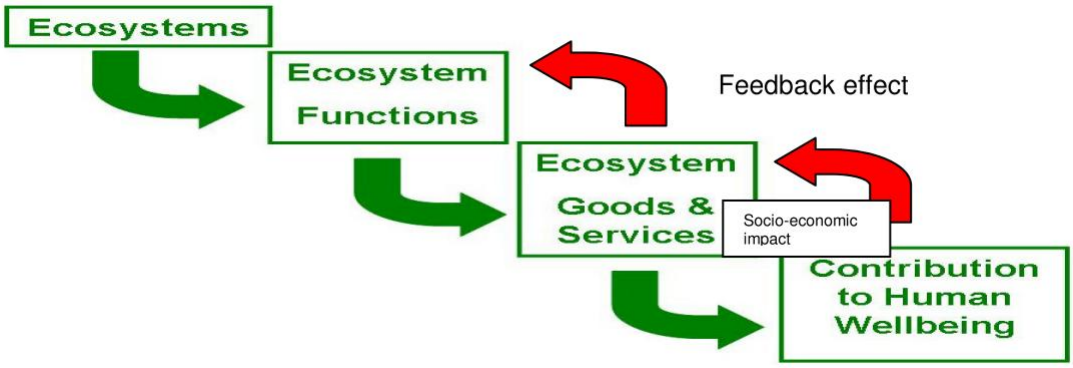
Results from direct approaches may be inserted (in the form of a hypothetical tax) into the I-O model to simulate the impact of environmental measures on disposable income and, therefore, on final household consumption. Results coming from indirect approaches, or monetization techniques based on formal and surrogate markets, are integrated into the hybrid I-O model to simulate the impact of a change in the provision of ecosystem services on the production of economic goods and services by economic sectors.

The approach designed and built by the authors is quite innovative and open the way to new developments. It's also illustrative of the fact that valuations methods shouldn't be considered as concurrent but rather as complementary in a suitable framework. But as already observed for CASES, it's far away of their local capabilities and the scale of the impacts and relationships between uses and resources addressed in such tools is far beyond of the local one (regional economy for instance). This again illustrates the difficulty for PEGASO to develop an assessment tool able to act at two very different and extreme scales.

2.2 Valuation approaches through TEV and monetary valuation methods

PEGASO economic assessment was initially thought and designed aside any economist involvement. It was based on a logical suite of processes in identifying ecosystem services (ES), valuing them in terms of physical units and ending in a rather logical monetary unit valuation as illustrated by Figure 4 at the socio-economic impact step. Methods and approaches retained were CBA and valuation methods especially to capture the non use values attached to ecosystems services (ES).

Figure 4 Linking ecosystems to human welfare



Economics is often seen as non able to take into account some key values attached to the environment and the biodiversity, due to the incommensurable characteristic of some values with the economic benefit (Maitre d'Hôtel et al. 2012), but also due to the incompletion of knowledge about ecosystems functioning. The Total Economic Value framework is an attempt to integrate the whole environmental values, especially by defining an existence value having an altruistic dimension. It's seductive because the method appears as a robust and established tool delivering a result: values are becoming more visible and recognizing ecosystem services values contributes to better decisions.

But there're still methodological debates on the way to integrate these values into the economic valuation. Dealing with non use values may also call for non economic methods. In the way where assessing these values cannot solely and simply rely on stated or revealed preferences, methods aiming at solely valuing these preferences should be carefully used, especially regarding declared preferences. This is particularly true for CVM's estimates that beyond of their low precision, only inform about what people are willing to pay and not what they would effectively pay or what should be paid to avoid or compensate an environmental damage. But these two measures should/could be compared in order to assess the social acceptability of reference values (Chevassus-au-Louis et al. 2009).

On the same way, a review of studies generally concludes that real expenditures to be engaged are lower than CVM's WTP estimates. As a consequence, the choice of conventional CBA methodologies as suggested in European legislations and their underlying concepts of aggregated monetary value may influence decision makers in lowering or postponing the environmental objective. This is for instance allowed in the Water Framework Directive (WFD) if justified by CBA results (disproportioned costs). This can be explained by the difficulties of conventional CBA and environmental economics to take into account sustainability (Pearce et al., 2006).

There're other debates over more technical issues, mainly related to questionnaire based methods techniques. As such methods it is source of certain biases and an important research focus on improvements leading to additional and refined methods, adding diversity to methods and maybe a part of confusion for non experts. Issues mainly bear on the relevance of aggregation and reference population. For instance, one important issue which is not solved by conventional CBA is the definition of the legitimacy population having rights for to use a natural asset (Cordier et al. 2009, Chevassus-au-Louis et al. 2009). People excluded will not be considered by the valuation methods.

Another important difficulty relates to human cognitive limitations occurring in monetary valuation such as stated preferences approaches. Most individuals would face difficulty in weighing up complex or non familiar environmental issues with global effects occurring over a long period of time or large geographical scale (Cordier et al. 2013).

Another issue relies in the method in itself and the relevance for monetary valuation. Option value can be an important motivation to protect Nature, but we have to know that their value can be imprecise, contingent to restrictive hypothesis and often underestimated. Non use values don't call for a consensus among economists and as a consequence their legitimate and necessary assessment could call for non exclusive economic methods. But this should not underestimate the importance of non use values.

The redistribution issue is also central in critics over CBA and valuation approaches. Equity and efficiency issues are not only hard to separate, but that equity concerns have often dominated discourse about social decisions.

There's an abundant literature about limits of monetary valuation techniques for a complete assessment of ecosystem services and environmental assets. A number of other technical issues and biases are tentatively listed in O'Connor 2007. But the purpose here is not to list all limits and advantages of such techniques, but rather to explore their potential for the specific context of PEGASO and analyze whether they can be integrated or used in a complementary way instead of opposed as usual. Beyond of academic debates and controversies, the present stock-take of economic valuation methods and approaches is closely linked to the way of effective use of the results in decision making. And through the conventional CBA and implementation of monetary valuation techniques there are obstacles in that way. Again it is less a question of tools or methods rather than what they are used for.

Economists are focusing on changes and then value of changes. **Economics compares, it doesn't measure well.** That should lead to further consider analyses of values as well as focusing on the interface of values and decision making. Delivering a single aggregate monetary value doesn't bring any relevant input to the decision making process. This is quite well illustrated by the economic valuation of sustainable benefits rendered by the Mediterranean marine ecosystems (Mangos et al. 2010). The result was about 26 billion Euros in 2005. Beyond of awareness about the importance of ES, how this single aggregated value can contribute to the decision making, even broken out into smaller components? Does the switch from Carbon and Biomass units to monetary units bring additional value and information to the management of Mediterranean ecosystems services or to know or prove that ES are important?

Use of single aggregates for comparison with market values also raises important issues fir decision making process as they are not comparable. This is more related to the use of results, knowingly and a potential higher risk of instrumentalization of results. A greater awareness and education about these approaches for their beneficiaries should go along with their implementation.

This questions the place of CBA (the place of the benefits). Instead of using CBA as a decision-making tool it can be used in a much more heuristic manner, where sensitivity analysis is employed in order to explore elements of the analysis which may be uncertain or controversial. It should be also kept in

mind that the **Total Economic Value will be always lower than the Total Ecosystem Value**. Economists compare, they do not measure well. They are working on changes and value of changes. Thus, the purpose is not to assess the TEV of an ecosystem but the TEV of ecosystem change. Conditions and context evolve; successful implementation of policies does not solely depend on costs and benefits alone (institutional and social context). Thus the Total Economic Value can sometimes appear as confusing or bear an unsuitable "appellation".

Another important issue in the context of PEGASO is that CBA suffers some difficulties to integrate social and environmental targets to economic targets. This is first due to the lack of holistic properties. CBA is micro-specific and analytic rather than holistic (Ackerman 2004, Venkatachalam 2007).

Finally the **Benefit Transfer (BT)** approach calling for a more simple economic assessment of ecosystem services of the Mediterranean and Black Sea basins is not the panacea. Benefit transfer remains difficult and not always reliable for foreign value, especially from the US where environmental and ecological supply and demand conditions are not similar to the European ones. The issue is the same between Northern and Southern Europe. In addition if there are tools (database of reference values for non market benefits) the number of transfer values is low: no reference for littoral patrimonial value, 2000 studies but 200 over littoral and estuaries. The uncertainty of BT also questions its accessibility for non economists.

The issue is more to think about methods and approaches in terms of complementarity rather than in terms of opposition, especially methods' complementarity according to the value we want to assess and to other potential uses according to each other (social acceptability of measures to be undertaken, proxy to environmental sensitivity for reveal preferences methods…). Individually, none of them is really satisfying in itself and the assessment context is of first importance in order to select, adjust and coordinate valuation methods.

The fundamental question is not about methods but about what do we want to measure? The question is maybe obvious but essential. The concurrency and mismanagement between methods and approaches often led to forget this question. The following quotation used in introduction to the report on "the biodiversity values, a stock-take of French research (Maître d'Hôtel 2011)" is a quite good illustration and synthesis of the real issue in economic valuation approaches and methods for environmental issues:

"Forty two?!" yelled Loonquawl.
"Is that all you've got to show for seven and a half million years' work?"
"I checked it very thoroughly," said the computer, "and that quite definitely is the answer. I think the problem, to be quite honest with you, is that you've never actually known what the question is."

Douglas Adams, The Hitchhiker's Guide to the Galaxy (1979)
Answer given by Deep Thought, a computer built by a race of hyper-intelligent pan-dimensional beings to calculate the Answer to the Ultimate Question of Life, the Universe, and Everything.

This again should underline that whatever the discipline, the implementation of a tool is just not a matter of technical skill and can't be disconnected from the relevant and related discipline. This will

also drive the choice of approach for PEGASO, according to local capabilities for CASES and regional capabilities for other partners.

2.3 PEGASO: Which approach?

Another way to analyze strengths and weaknesses of methods and approaches in the context of PEGASO is to consider them in a rather different way, through the prism of the integration and according to disciplines. What has to be considered is the usefulness of the different economic approaches in support of decision-making for the management of marine and coastal areas.

There is a wide range of integrated decision-support tools for the management of natural resources and the environment: combining ecology or economy, they originate from one or the other discipline and may propose descriptive approaches as well as more analytical ones (Figure 5). Moving from simple to more complex approaches, it is first necessary to build observation system of Human activities (ecosystem services approach, sectoral economic accounts); then, models can be built for representing the interactions between social dynamics and environmental dynamics (system dynamics modeling) and also for evaluating scenarios which envisage the possible evolutions of uses (input-output matrix). At last, an integrated social-economic analysis should also consider the governance system of the territory as well as the regulation mechanisms which are contemplated or already implemented, be those mechanisms based on rules, market incentives or community arrangements.

Figure 5 Integrated decision-support tools for the management of natural resources and the environment according to disciplines and approaches

	Descriptive approaches	*Analytical approaches*
Ecological approaches integrating economy and society	**Stocktaking and Observation devices of Ecosystem Services :** **- MEA approach** **- Nature Observatories**	**Analysis of resources and uses dynamics:** **- Systems Modelling** **- Individual-Based Modelling or Agent-Based Modelling**
Economic approaches integrating resources and ecosystems	**Indicators about environment and resources uses:** **- Economic Table** **- Green Accounting**	**Assessment of interactions between activities, and between activities and the environment:** **- Input/Output matrixes** **- Cost effectiveness analysis**

In this wider and more integrated framework, two other approaches are emerging: Individual Based Modeling and Systems Modeling approaches. These two approaches are briefly addressed in Box 2 that illustrates main differences between them. Both are based on the analysis of resources and uses

dynamics. They proceed from a very different approach than the one developed in PEGASO, but are of considerable interest for the sustainability of coastal areas.

Box 2 IBM and System approach

Individual-based Modeling (IBM) is a shift in focus from populations to individuals. IBMs are discrete events simulators. Instead of representing processes as occurring at continuous rates, processes are modelled as discrete event with events happening independently at specific times. IBM seems to be quite suitable to natural system dynamics compared with analytical approaches which focus on the study of fixed points reached once the evolution achieved. Its limits are linked to intrinsic characteristics of individual (also called agent) himself: an individual may appear as relevant for one discipline but as non relevant for another one, knowledge about individual is partial or incomplete, it is almost impossible to describe completely, precisely and analytically an individual's behaviour. Finally the final appropriation in classic social sciences approaches is not obvious and requires a more participative approach for modeling with and for stakeholders, applying more particularly the participative modeling concept or companion modeling approach.

System approach proposes a new way to comprehend the World that doesn't take into account separate elements but systems. Compared to the analytical approach that reduces the considered system to simple constitutive elements in order to study them separately and analyse their interaction with the system (suitable to homogenous systems), the system approach is a more global approach, focusing on interconnections between sub-systems and going from the general to the particular. It puts forward the hypothesis that the system structure is much more interesting to forecast its behaviour rather than having a detailed knowledge about its initial conditions, and to issue some general rules devoted to a better understanding of those systems and to drive them. System approach can be split into three steps: systems analysis and therefore system concept definition (boundaries, frontiers, internal and external relationships, structures, rules or properties), modeling and simulation. System model organisation is seen as an embedding of more and more complex systems.

(Raux, 2008)

But a common approach to all these methods in the wider frame of integration is to consider the interdependencies between resources and uses, underlining a web of relationships between economics (uses) and the environment, and illustrating the place and role of activities to each other leading to a better understanding of their impact. Building a web of relationships should be the initial step whatever the valuation approach and method chosen. Allowing to better understanding the issue to be addressed and setting the values to be assessed, it could also serve as a useful communication tool toward stakeholders. It's both a causal or influence diagram and a conceptual model allowing actors to represent themselves and their role within the coastal system. It is already an assessment tool.

Amongst all these approaches, the cost based approach in the form of the cost of ecosystem degradation seems the one that best suit to PEGASO constraints and objectives. As well as for the accounts, costs calculations are based on observed practices and not on individual preferences (Weber 2011). The cost-based approach proposal will consist in estimating real expenditures that human societies dedicate to maintain the ecosystem services they benefit from, or to limit their decrease. Logic of the approach, reasons and roots are addressed in the next section.

Cost based approach in the PEGASO context can appear as a compromise in between the unachievable objective of green accounting and the illusion/difficulty of monetary valuation techniques at larger scale. This is not false, but it also roots in a wider assessment framework, by going beyond of economic valuation techniques. It aims at building a more coherent and integrated assessment framework where the cost of ecosystems degradation could be implemented together with other tools developed within PEGASO (Indicators including LEAC, Scenarios and participatory approaches). Ideally this cost of ecosystem degradations should go along with a cost efficiency analysis to feed the deliberation process within the ICZM approach.

3. A framework to assess the cost of coastal and marine ecosystems degradation

Supporting video: http://polimedia.uab.cat/#v_481

Under a DPSIR framework, already adopted for the indicators construction task, the approach planned to assess the cost of marine ecosystem degradation is based on the identification of drivers of ecosystem degradation (Pressures exerted from human activities) for which all sectors are relevant to the analysis (fewer for the Impacts), even if costs assessment is only concerned with ecological functions rather than physical ones. The first constraint is to keep this sectoral approach in order to try to support comparability and sectoral accountability.

Under that framework, values representing interaction of human activities with marine ecosystems have to be sought. But as underlined for the benefit assessment: paucity of data in many areas is expected to limit what can be achieved at an aggregate level and the underlying issue here is that Impacts are not generally observable in markets either through lack of a relevant market or difficulties in attributing ecosystem State changes to market effects. As a consequence it questions the reliability of targeting an aggregate level assessment for costs, especially based on value transfer.

3.1 A framework for social and economic valuation of uses of the marine and coastal ecosystems

To reach the objective of assessing the cost of marine ecosystems degradation, a simplified Pressures Impacts framework can be considered through a Pressures-Dependencies and Pressures-Impacts framework. Under this framework the first step is to define the economic and social importance of different sectors related to coastal and marine environment, by describing the main activities relying on natural resources uses (fisheries, etc.), depending from (tourism, etc.) or having a significant impact on the marine environment (agriculture, industry, etc.). This information can also be gained from indicators developed within PEGASO. This allows for characterizing the economic and social weight of public, merchant and recreational activities, as well as outlining interactions and interdependencies between activities/uses and the environment (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks). Here we find back the web of relationships between economics (uses) and the environment already underlined in the stock-take of approaches and methods. This should also go along with the description of the political and environmental regulations applicable.

Cost of ecosystems degradation

There are degradation costs associated to above uses, degradation costs due to overuse, misuse or mismanagement of marine ecosystems and resources. From an economic point of view, environmental degradation corresponds to ecosystem capital depreciation and consequently there's a need to prevent, avoid or compensate this degradation in order to sustain common ecosystem services supporting economic welfare and social well-being. There are non-paid costs still needed to remediate ecosystem degradation. In the lack of remediation, ecosystem capital is depreciated.

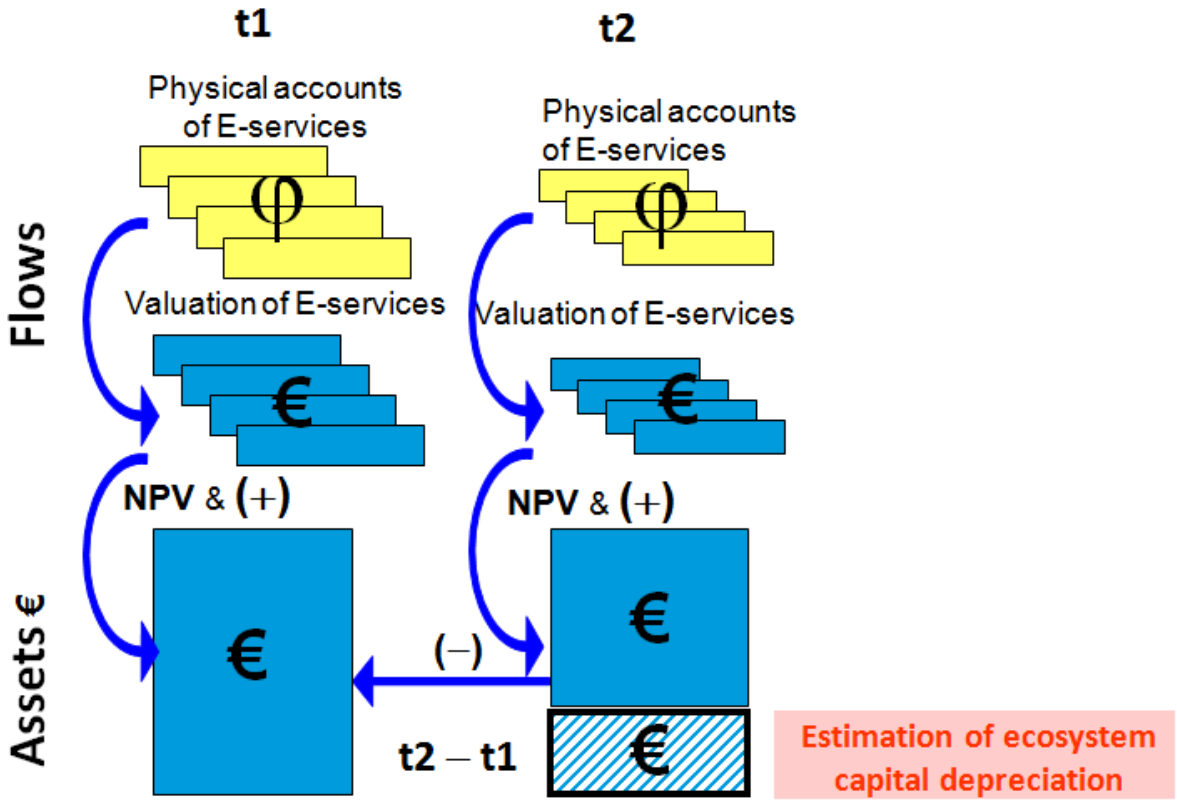
Because ecosystem capital depreciation is not recorded, the commodities based on ecosystem services are often underpriced, leading to ecological debts in physical units (see also Weber 2012).

Different approaches can be implemented in order to assess this degradation of ecosystem capital. With the aim of integrating environmental and economic accounting and producing a Land/Sea and Ecosystem Account (LEAC/SEAC, EC policy objective)[1], the European Environmental Agency (Weber 2011, 2010 EEA) proposed two approaches based on assets values and physical assets to assess the costs of ecosystems degradation.

Ecosystem capital depreciation based on assets values

The approach to assess the degradation of ecosystem capital is based on assets values (Figure 6). The flows of physical account of Ecosystem Services (ES) are valued for each time step and Net Present Value derived from monetary valuation. Difference in Net Present Value of ecosystems services between the two times steps gives an estimate of ecosystem capital depreciation in terms of assets values through monetary valuation of ES losses.

Figure 6 Estimation of ecosystem capital depreciation based on assets values (Weber 2010)

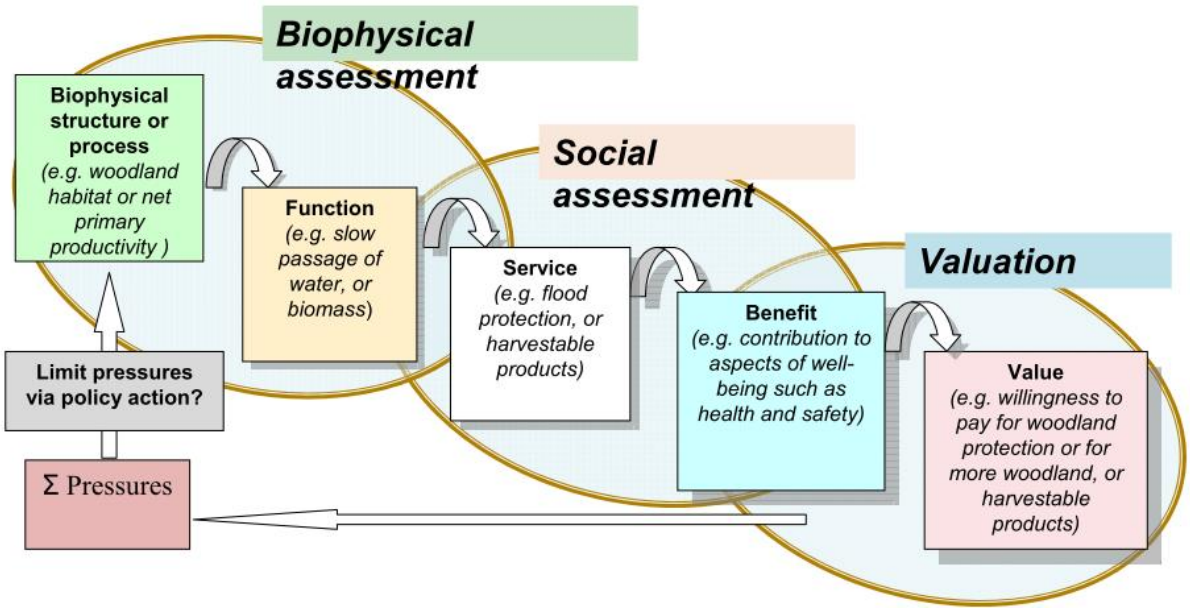


(Weber 2012)

[1] The purpose of the LEAC is to take into account the ecosystem capital through the revision of the SEEA planned for 2012/13, combining the SNA (System of National Accounts) satellite accounts for the environment and the ecosystem approach to accounting. The SNA satellite accounts give the impacts over ecosystem capacity to deliver services/benefits through expenditures, taxes, physical flows and the ecosystem approach to accounting delivering the negative feedbacks from ecosystem degradation on production and wellbeing (Weber 2012).

Close to the Millennium Ecosystem Assessment (MEA) approach and as underlined by Haines-Young and Potschin (2010) in defining ecosystem functions, services and benefits, this approach relies on the successive i) Ecosystem biophysical assessment to derive Ecosystem function from biophysical structure or process, ii) then social assessment to derive ES and socio-economic benefits (private and collective well being) and iii) valuation to derive value (Figure 7). These steps are overlapping each other and at the scale of regional seas, valuation claims for the value transfer approach in order to capitalize and reuse the acquired knowledge. As underlined and explained in section 2, it allows adapting value from a site to another site and provides elements in first approximate.

Figure 7 The cascade model. Defining ecosystem functions, services and benefits (Haines-Young and Potschin, 2010; modified de Groot et al. 2009).



But as already underlined, paucity of data is expected to limit what can be achieved at an aggregate level. Initiated in 2003 in France, a review of monetary valuations of non market benefits/damages in the field of water resources leads to the establishment of a reference values database. Its application to coastal areas in 2007 underlines some limits due to the low number of reference values for these areas. Only 3 values were available for present recreational uses and 2 in the case of increasing visits to some sites (recreational fisheries or informal recreational uses). No reference was available for patrimonial value attached to coastal areas. Considering the wider database EVRI[2], over more than 2000 available studies, 200 are related to littoral and estuaries. Difficulties remain regarding the aggregation issue and the value transfer, especially through the adaptation of foreign values such as the US ones being unsuited to European context: necessity of similar conditions regarding supply (environment, species, entropic pressure…) and demand (socio-economic characteristics, uses practices…).

[2] Environmental Valuation Reference Inventory: www.evri.ca

An additional issue deals with the value itself that couldn't be considered as an absolute value that will not bring useful information to the decision making process as underlined by the study about the economic value of sustainable benefits rendered by the Mediterranean marine ecosystems (Mangos et al. 2010). One of the main issues of the study is about the important under estimation of ES value and their contribution to human well-being. One can question the use of such valuation of ES. Comparing the estimated value (26 billion EUR 2005) to 13% of the Greek GDP or to the Carrefour turnover on the 4th quarter seems to be of very little interest and less useful for decision making and public policy evaluation. Following this assessment, the first conclusion could be that Mediterranean natural capital is quite low in terms of benefits provided to the society compared to benefits issued from human and physical capital of neighboring countries, (i.e. the sum of their GDP). The conclusion could be about the non economical interest of preserving natural areas. It is again more obvious when the study reports to surface unit the value assessed: 104 € per ha/year. A massive urbanization of the coastal area would provide much more benefits per ha. Or it could be argued that benefits derived from ES are 7 times lower for the Mediterranean than for a French forestry where it is estimated at 700 €/ha/year by the Centre d'Analyse Stratégique. Detailed results are also subject to questions. But beyond of the results themselves, this is the use of the method that is much more under question and the way results are used for.

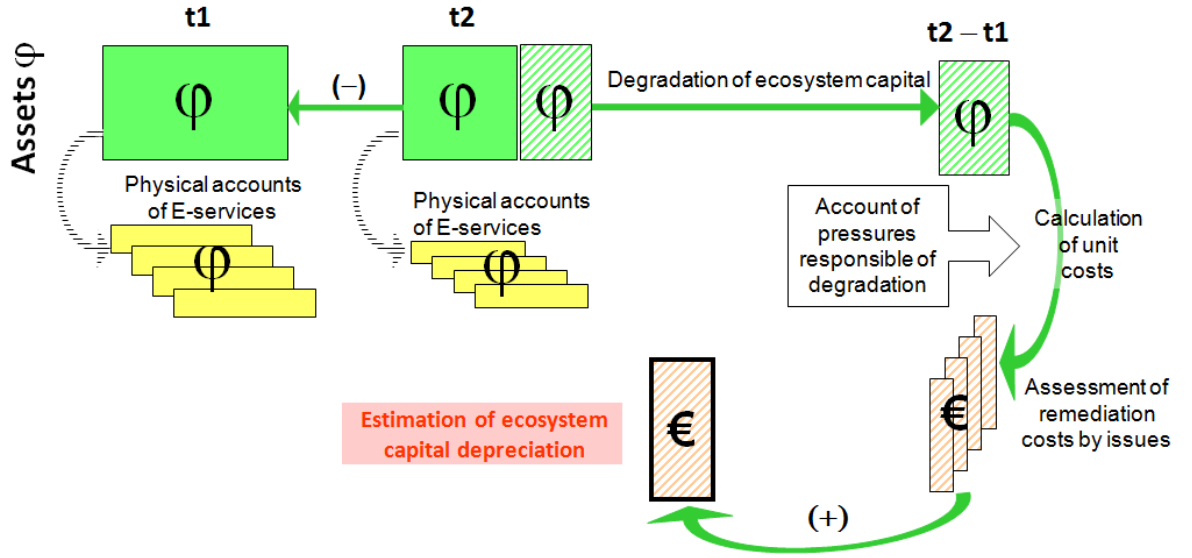
Total Economic Value will be always lower than the Total Ecosystem Value. That doesn't question the tool but rather how tool is applied and used for. Economists are focusing on changes and then value of changes. This would also lead to further consider analyses of values as well as focusing on the interface of values and decision making. Conditions and context evolve and successful implementation of policies does not solely depend on costs and benefits alone (institutional and social context). Instead of using CBA as a decision-making tool it can be used in a much more heuristic manner, where sensitivity analysis is employed in order to explore elements of the analysis which may be uncertain or controversial.

Finally the biophysical, social and valuation assessments call for a multiplicity of experts. Together with the uncertainty attached to the value transfer it calls for an alternative to the monetary valuation of Ecosystem Services in order to assess the cost of ecosystems degradation. This alternative gives up the approach based on assets values for an approach based on physical assets.

Ecosystem capital depreciation based on mitigation costs

The second approach is based on physical assets. In a Pressure Impact framework, difference in terms of physical assets leads to this depreciation of ecosystem capital. Present remediation costs to balance this depreciation are then assessed by accounting pressures responsible for degradation (Figure 8). Their aggregation according to their type gives an overview and an estimation of ecosystem capital depreciation.

Figure 8 Estimation of ecosystem capital depreciation based on physical assets (Weber 2010)



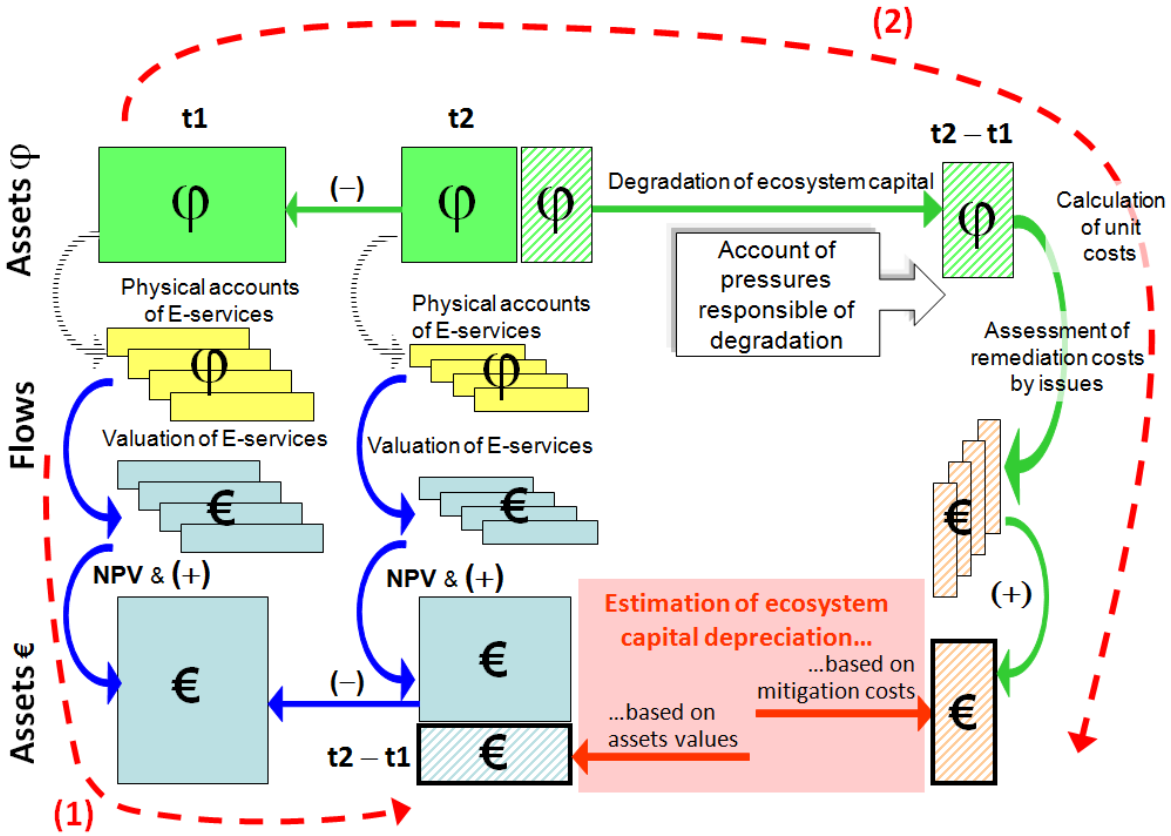
(Weber 2012)

Consumption of Ecosystem Capital is the monetary estimation of ecosystem depreciation resulting from physical degradation alike "fixed capital consumption" (UN System of National Accounts) and alike "capital depreciation" in financial corporate accounts (International Financial Reporting Standard) (Weber 2012). It measures altogether the depletion of the private or common goods (the economic resource, such as timber or managed fish stocks) and the degradation of public goods (such as forest or fisheries).

It also underlines the process to keep biological or ecological stock or fluxes instead of immediately turn them into Euros. Amount of biodiversity biomass or Carbon stock are as reliable and communicating units in terms of absolute value. Switching from these units to monetary units will not bring additional information for the decision making process or public policy choices, if no information in terms of distribution of costs and benefits (who gains who losses) is associated. For instance and beyond debates over aggregation, the Total Economic Value can be lower but effectiveness greater if the redistribution system is not concentrated.

Derived from the ecosystems accounting concepts, Figure 9 summarizes the two ways to assess the ecosystem capital depreciation: either based on assets values derived from physical account of ecosystems services (1), or either based on physical assets or remediation costs (2).

Figure 9 Estimation of ecosystem capital depreciation: 2 ways – Adapted from Weber 2012



Adapted from Weber 2012

Due to operational reasons and especially due to the scales of application (CASES), the cost based approach framework is felt as more suitable and reliable to assess the cost of coastal and marine ecosystems degradations. In addition the cost-based approach fits well with the principles of the MSFD: the main objective of the MSFD is the Good Ecological Status (GES), thus, economic assessment is firstly expected to provide estimates of the cost for reaching GES, through the new program of measures.

Box 3 attempts to sum up the logical process leading to the choice of a cost based approach for PEGASO 's economic assessment.

Box 3 Logic driving to the adoption of the cost based approach for PEGASO economic assessment

Two possible ways for assessing the costs of environment degradation:

- costs associated with **the loss of benefits** resulting from the degradation of natural capital (Barbier et al., 2009; EPA, 2009),

or:

- **maintenance costs** required to compensate for actual or potential degradation of natural capital (Bartelmus, 2009; Pearce 2006; SEEA 2003).

The loss of benefits approach consists in comparing the value of the marine ecosystems in a reference state and in a degraded state. It is supposed to be more robust, but its feasibility for marine ecosystems raises a lot of difficulties:

- Shall the economic valuation be **comprehensive** and encompass all the services of all the marine ecosystems?
- Shall we give a **monetary value** to all marine ecosystem services?
- Shall we **aggregate** values which may have been obtained with different methods (eventually based on different assumptions)?
- Shall we estimate the value of services for a **reference state** which has never been observed or is not yet defined?

Why the cost based approach for the cost of ecosystem degradations?

The cost-based approach consists in estimating maintenance costs i.e. the real expenditures that human societies dedicate to maintain the ecosystem services they benefit from, or to limit their decrease.

The cost-based approach offers various practical solutions:

- the analysis is based on degradation thematics as they appear in current policies or eventually the public debates (reducing the scope);
- it is possible to identify the legal measures or potentially the citizen initiatives which are intended to respond to these degradation thematics (which may be used as a proxy for the "reference state");
- the cost of these measures or initiatives may be estimated based on data which corresponds to observable behaviors (investments, etc.);
- the residual impacts may be described within a multicriteria assessment framework, including non monetary and qualitative indicators;
- the residual impacts reveal the efficiency of the current expenditures as regards the current norms (or social demand) for ecosystem preservation.

The cost-based approach explicitly takes into account the collective choices that have been made about the formulation of the environmental problems, as well as the objectives and norms which exist to tackle these issues, and the effort (measured in terms of changes in use and/or restoration programs) necessary to achieve them.

(Mongruel 2012)

To facilitate and support CASES teams wishing to perform this economic assessment based on costs, it is proposed to encapsulate it into a wider and logical process that will mainly consist in building a multiscale information system. This step by step process acting as guideline is the following:

i) Provide a clear overview of socio-economic pressures and associated environmental degradation.

ii) Analyze the existing links between ecosystem services production and human well-being (web of relationships designed, built and validated with stakeholders).

iii) Identify the degradation thematic based on the causal or influence diagram designed in step ii).

iv) Underline the cost of environmental degradations through Remediation/Mitigation costs and management responses.

Steps i) and ii) are the preliminary steps to build the web of relationships between uses/activities and the environment. It will help identifying the costs to be taken into account. Step iii) allows for structuring the degradation into different topics. A typology of degradation topics is proposed to support this step. Step iv) deals directly with the costs assessment. To support this third step a methodological framework is proposed hereafter. Possible outcomes of this process could be a multi-criteria analysis (MCA) or cost-effectiveness analysis (CEA) to test potential effects of new management scheme implementation. It will aim at providing explanation on the past evolution and assessment of the future one.

3.2 Identifying and structuring degradation costs according to issues for an assessment purpose

Under the remediation costs based approach, it is proposed to structure the degradation costs according to four broad categories.

Environmental degradation corresponds to ecosystem capital depreciation and there's a need to prevent, avoid or compensate this degradation in order to sustain common ecosystem services supporting economic welfare and social well-being. In order to assess the costs associated with environmental degradation, they are structured into four broad categories (Figure 10).

- The first category encompasses the costs of devices devoted to observation and monitoring of marine ecosystems.

- The second and third categories are more common: they are made of costs associated with measures and actions which aim at either preventing or avoiding ecosystem degradation (second category) or restoring environmental assets depleted by the economy (third category).

- The fourth category includes the costs of residual impacts.

Degradation costs are assessed by accounting the different types of pressures which are responsible for degradation in order to get an overview and an estimate of ecosystem capital depreciation.

According to data and knowledge availability, degradation costs analysis may apply to past, present or potential degradations. In practice, the analysis focuses on costs of current individual and collective actions for information, prevention and remediation and on the impacts of present degradation (losses of amenities or benefits as they are perceived at the present time). In opposition to the social and economic valuation of direct uses of the marine and coastal ecosystems, costs are assessed by degradation topics (marine litter, invasive species, eutrophication, etc.) in order to deal with primarily major themes of degradation which are often well described in scientific and grey literature and are easily related to sectoral use(s).

The final and specific process of cost assessment is then carried out:

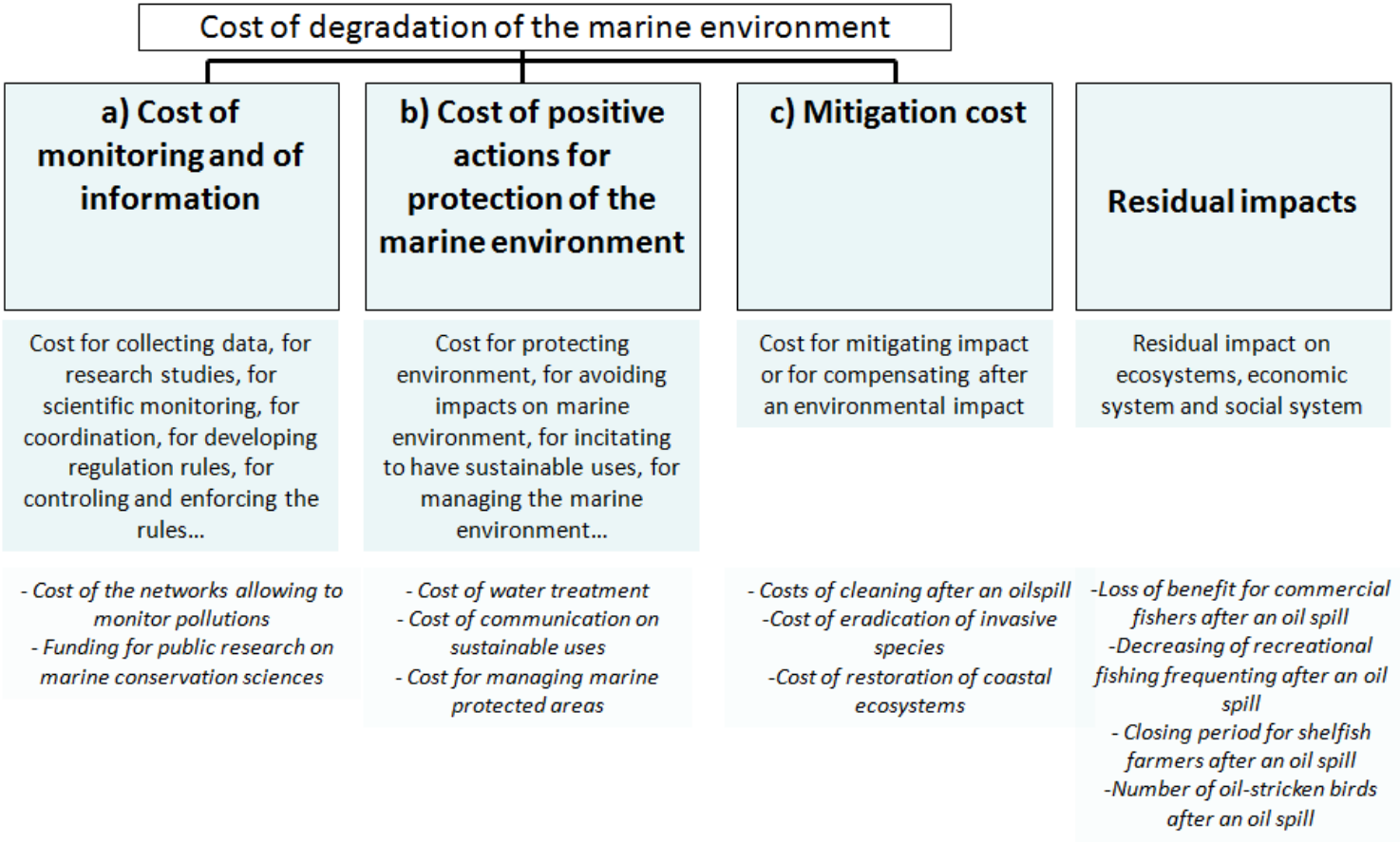
- (i) define or identify a degradation thematic;
- (ii) identify and quantify the costs related to the degradation thematic; and
- (iii) document quantitatively and/or qualitatively residual impacts costs on human wellbeing through multi-criteria analysis or monetary reference value if any available. Residual impact costs are assessed against a baseline where there is no degradation[3].

Degradation topics to proceed with the costs assessment are based on a framework developed for the implementation of the MSFD. They rely on the main pressures (listed at the Annex III of the MSFD) and descriptors of GES (Good Environmental Status):

- Marine litters - Macro Wastes
- Micro pollutants (contaminants)
- Microbial pathogens organisms
- Accidental and operational oil spill
- Eutrophication
- Invasive species
- Degradation of exploited biological resources (fisheries, aquaculture)
- Loss of sea floor integrity, biodiversity and degraded marine food webs
- Degradation related to introduction of energy and alteration of hydrological conditions

[3] Costs of non-additional action; cost of remaining pollution: it's illusive and/or too costly to reach the zero pollution level; pristine state is not the GES; beyond of natural level, a certain level of nutrients can positively impact shellfish aquaculture in terms of growth without damaging the ecosystem in terms of functionality through ES provided…

Figure 10 A cost based typology for assessing the degradation cost of marine ecosystems



(Mongruel 2012)

Table 4 details the proposed typology of degradation topics according to the MSFD descriptors of GES and links with the current legal status framework.

The proposed framework for the assessment of degradation costs of marine ecosystems can work at different scales as it starts from local scales to reach more global ones (coastlines, region, river basins, regional seas…). It also aims at defining relevant methods of cost assessment at these scales, advising on the suitability of data and assisting through the provision of data. Furthermore, by working at this level we will be better able to establish likely future developments, which will be used in the assessment of future costs in the absence of new policy measures (i.e. the costs of non-action).

Box 4 proposes an illustration of the method applied over the 3 main maritime frontlines in France.

Nevertheless an alternative is to work at the level of the administrative unit of the coastal zones, zoom in over the work done in the CASES. Degradation cost was then assessed at local scale over the Bouches-du-Rhône CASE according to water quality issues and addressed at regional scale for the French maritime frontlines (Boxes 5 and 6).

Table 4 Typology of degradation topics according to MSFD descriptors of GES and link with international legal framework

Issues areas	Link with GES descriptors, pressures, and impacts in the MSFD	Current legal framework
Marine litter	descriptor 10 “marine litter”	OSPAR and Barcelona Conventions, Waste water treatment regulation, Water Framework Directive
Chemical compounds	descriptors 8 “contaminants and pollution, ecological effects” and 9 “contaminants in food”	REACH Directive, Waste water treatment regulation, Water Framework Directive, Bathing water regulation
Microbial pathogens	pressure-impact “introduction of microbial pathogens”	Waste water treatment regulation, Water Framework Directive, Bathing water regulation, Regulation on animal products for human consumption (Food law)
Oil spills and illegal discharges	descriptors 8 “contaminants and pollution, ecological effects” and 9 “contaminants in food”	MARPOL, FIPOL, OSPAR and Barcelona Conventions
Eutrophication	descriptor 5 “eutrophication”	Nitrate Directive
Non-native invasive species	descriptor 2 “non-native species”	Ramsar, CITES, Berne, Bonn, Biodiversity, Barcelona, OMI Conventions
Biological degradation of exploited natural resources (split into 2 sub-problems, aquaculture and fisheries)	descriptor 3 “status of species exploited”	European common fisheries policy
Loss of biodiversity, trophic changes, loss of integrity of marine substrates	descriptors 6 and 1 regarding “biodiversity and integrity of the marine substrates” and descriptor 4 “webs”	Convention on biodiversity, European Strategy on Biodiversity, French Strategy on Biodiversity
Introduction of energy into the environment and changes in water regime	descriptors 11 “energy” and 7 “hydrography”	Environmental Impact Assessment Directive

(Mongruel 2012)

Box 4 An application of the cost based approach for costs of ecosystem degradations over the French maritime frontlines (North/Channel, Atlantic/Biscay and Mediterranean)

Implementation

● Data were collected during the first semester 2011, the reference year being 2010 for the initial assessment (time- series when available).

● Depending on the thematic, between 5 (introduction of energy) to 130 (loss of biodiversity) organisations and institutions were contacted; response rate was comprised between 60% (eutrophication) and 100% (degradation of aquaculture resources, microbiological pathogens).

● Data were not significant regarding two thematics: marine litter and introduction of non-native invasive species; they were removed from the analysis.

● In addition to the response rate, some difficulties were encountered regarding the format or the interpretation of some data, in particular as regards the degradation of fishery resources (how to allocate public expenses to specific measures? The issue of "damaging subsidies").

Results of the assessment

i) Maintenance costs for French marine ecosystems in 2010:

- The total amount of the maintenance costs is over **2 billion Euros per year**.
- The most significant proportion of these costs (1.25 billion €) is due to **avoidance measures against microbiological contamination**, mostly in the form of wastewater treatment for reaching sanitary standards (99%).
- As a corollary of this result, the maintenance costs are the highest in the Mediterranean sub-region, where urban density on the coast is the highest.
- Other important degradation thematics are the **chemical pollution** (347 M€), the **loss of biodiversity** (148 M€) and the **degradation of fishery resources** (133 M€).
- Chemical pollution also mostly generates avoidance costs (81%).
- Loss of biodiversity generates mostly monitoring and information costs (52%) which indicates a persistent lack of data in this field, while efficient positive actions (28%) may be difficult to implement.
- Fishery resources generates mostly prevention costs (67%) in the form of management measures (enforcement and control for sustainable fishing), and also monitoring and information costs (27%).

ii) International comparisons with member States applying similar approach:

- At a very large scale, the results obtained by the Netherlands, France and Spain belong to the same range, but there are some inconsistencies:
    - In the Netherlands, total expenditure amounts to 1.58 billion Euros a year, split into land-based costs (1.45 billion) and marine-based costs (0.132 billion) (Walker et al., 2011). Our estimates are fairly close to this, but coastline in France is seven times longer than in the Netherlands.
    - In Spain, total expenditures for the maintenance of marine natural capital was about 1.53 billion Euros in 2010, divided into seven issue areas or thematic (Ministerio de medio ambiente y medio rural y marino, 2011); however the costs of wastewater treatment account for only 38% (73% FR, 90% NL).
- These comparisons highlight the lack of homogenization of costs assessment methods, in contrast to conventional monetary economic valuations which have been discussed for a long time and are more stabilized from a technical point of view. However, the "cost-based approach" could easily be improved if common criteria are adopted to define the expenditures to be taken into account, the standardisation of referentials regarding

measures scope and target, and for the calibration of accounting costs (salaries, investments etc).

Lessons learn

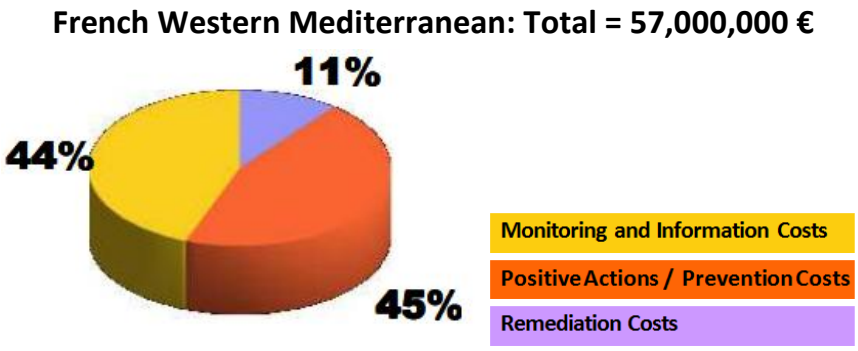
● The maintenance costs due to the risk of eutrophication seem low when compared to the costs of other pollutions associated with river basin runoff: this may be due to inadequate assumptions regarding the impacting perimeter (in the analysis, only river basins where eutrophication occurs were considered as subject to maintenance costs, which is much questionable).

● The residual impacts analysis generated a wide range of data; the interpretation of these data is however difficult at this stage because no methodological discussion occurred as regards the interpretative framework for these impact indicators ; in the absence of such consensus, we did not provide any judgment on the observed residual impacts.

● On the other hand, available data on residual impacts could contribute to an assessment of the efficiency of the current management system; this would suppose to make explicit the link between management objectives and indicators of (good) ecological state or preserved ecosystem services.

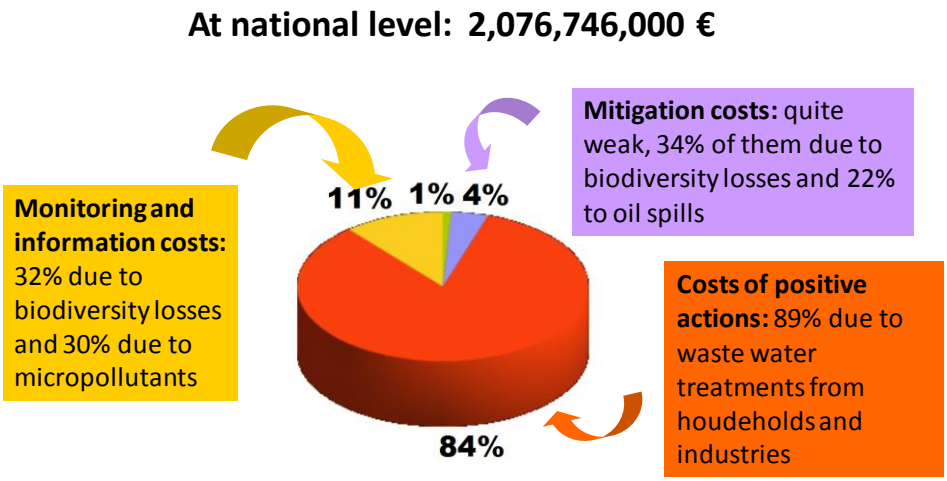
A focus on the French Western Mediterranean: the cost due to biodiversity losses

Losses of marine biodiversity is a transversal issue as it is related to different pressures over biodiversity. A focus on impacts not taken into account in other degradation topics (oil spills, eutrophication…):



Levrel et al., 2012

At national level



Levrel et al., 2012

Box 6 Degradation cost of water quality in the Bouches-du-Rhône CASE (France)

Water quality is a major issue for the Bouches-du-Rhône because of its importance for coastal tourism and nautical activities. Main causes of non-compliance of bathing water are structural deficiencies in sewage system, occasional failures and non-point source discharges. Agricultural and urban areas have a direct impact on the sanitary quality of bathing and shellfish waters. The impacts of microbial pathogens organisms (MPO) on human health result from the practice of leisure activities (swimming, nautical sports) in contaminated water or consumption of contaminated shellfish from aquaculture activities or professional and recreational fishing. Presence of Microbial Pathogens Organisms (MPO) can cause loss of amenities for recreational activities as well as economic losses to tourism, aquaculture and fisheries.

Degradation costs associated to Microbial Pathogens Organisms	
1. Monitoring and information measures	
Monitoring networks of the microbiological quality of shellfish waters	7,608 €
Bathing water monitoring network	159,273 €
Nautical activities monitoring network	17,784 €
Research projects, surveys, sanitary classification	Not available (minor costs)
Total 1	184,665 €
2. Prevention and avoidance measures	
Collective sewage system	154,875,500 €
Non collective sewage system	
Liquid manure control (< 1 km from shoreline)	Not available (minor costs)
Total 2	155,599,555 €
3. Mitigation and remediation measures	
Total costs of shellfish purification in B-areas	70,200 €
DEGRADATION COSTS	155,854,420 €
4. Residual impacts	
Percentage of beaches with insufficient quality (C or D)	1.7%
Percentage of recreational sites with insufficient quality (C or D)	6.9%
Nb. of beach closures per year (days)	92
Nb. of temporary bathing interdiction (days)	19
Percentage of shellfish farming zones in C or D	0%
Nb. of shellfish farming zone closures (days)	0
Nb. of human diseases due to contaminated shellfish products	Not available (very few number)

Degradation Costs count for more than 150 million € (2010) with costs of prevention representing the main part (99.9% of quantifiable costs).

The socio-economic approach applied in support to the integrated assessment of the Bouches-du-Rhône is useful to decision-makers by reason of the market derived information produced. Compared to other approaches (monetary valuation), the cost approach produces minimum but realistic values of degradation. The residual impacts (e.g. cost of remaining pollution) can be documented quantitatively and/or qualitatively through multi-criteria analysis or monetary reference value if any available. Residual impact costs are assessed against a baseline where there is no degradation.

4. Beyond degradation costs of marine and coastal ecosystems, a local indicators system

According to local constraints and low capacity in the field of economics at CASES level, the economic assessment, even through the cost based approach, can be perceived as too difficult to implement. There's then a need to provide minimum but realistic economic information about the issue to be addressed. It can be seen as an initial step in the step by step economic assessment which leads to the degradation cost of marine and coastal ecosystems. Informing about uses, it takes the form of an economic table or an economic dashboard informing and describing main economic activities related to the issue to be addressed (activities relying or exerting a pressure over natural resources through uses).

4.1 Social and economic valuation of uses of the marine and coastal ecosystems

It consists in building a local indicator system, which describes the current situations and could also estimate subsequent changes over time, underline dependencies from well-preserved ecosystems, impacts on coastal zone, but also positive feedbacks. This allows for characterizing the economic and social weight of public, merchant and recreational activities, as well as outlining interactions and interdependencies between activities and the environment.

It first requires defining marine and coastal activities that form the marine and costal economy as illustrated by Table 5a (as provided for the PEGASO set of indicators; see D4.1).

Table 5a Marine and coastal activities contributing to the marine economy

• Submarine cables	• Energy	- Offshore oil and gas-related industry - Electricity power production interacting with marine environment (Marine renewable energy, Nuclear plants…)
• Shipbuilding and repair, scraping…	• Living resources	-Aquaculture -Fisheries -Seafood processing and marketing
• Extraction of marine aggregates	• Transport	-Harbors and supports -Transport (marine traffic)
• Maritime financial services	• Recreational Activities	-Bathing -Yachting and Sport -Recreational fisheries
• Maritime civil engineering (harbors, dams, dikes…)		

Other activities to be considered are the ones impacting marine dependent activities through impacts to the ecosystems and through ecosystem services degradations (Table 5b). These activities can be already part to marine activities (aquaculture, energy, maritime transport, harbor…) or aside these activities (agriculture, urban development…).

Table 5b Activities impacting marine dependent activities

• Other sectors impacting coastal and marine environment (Agro industry, Food Processing, Chemistry…)	-Agriculture -Other industries -Urban sprawl -Coastal tourism
• Aggregated non Marine Economy	-to assess the share of Marine Economy in the Global Economy

This definition and proposal of sectors to be monitored and characterized is not exclusive. For instance, another approach could consist in extractive activities vs. non extractive ones.

Characterization of activities

A series of four indicators can be used to characterize these activities at local scale. They are:

- Demography of enterprises through the variation of the Number of enterprises
- Employment level
- Turnover (volume of activity)
- Added value rate (as an indicators of local richness generated by the activity)

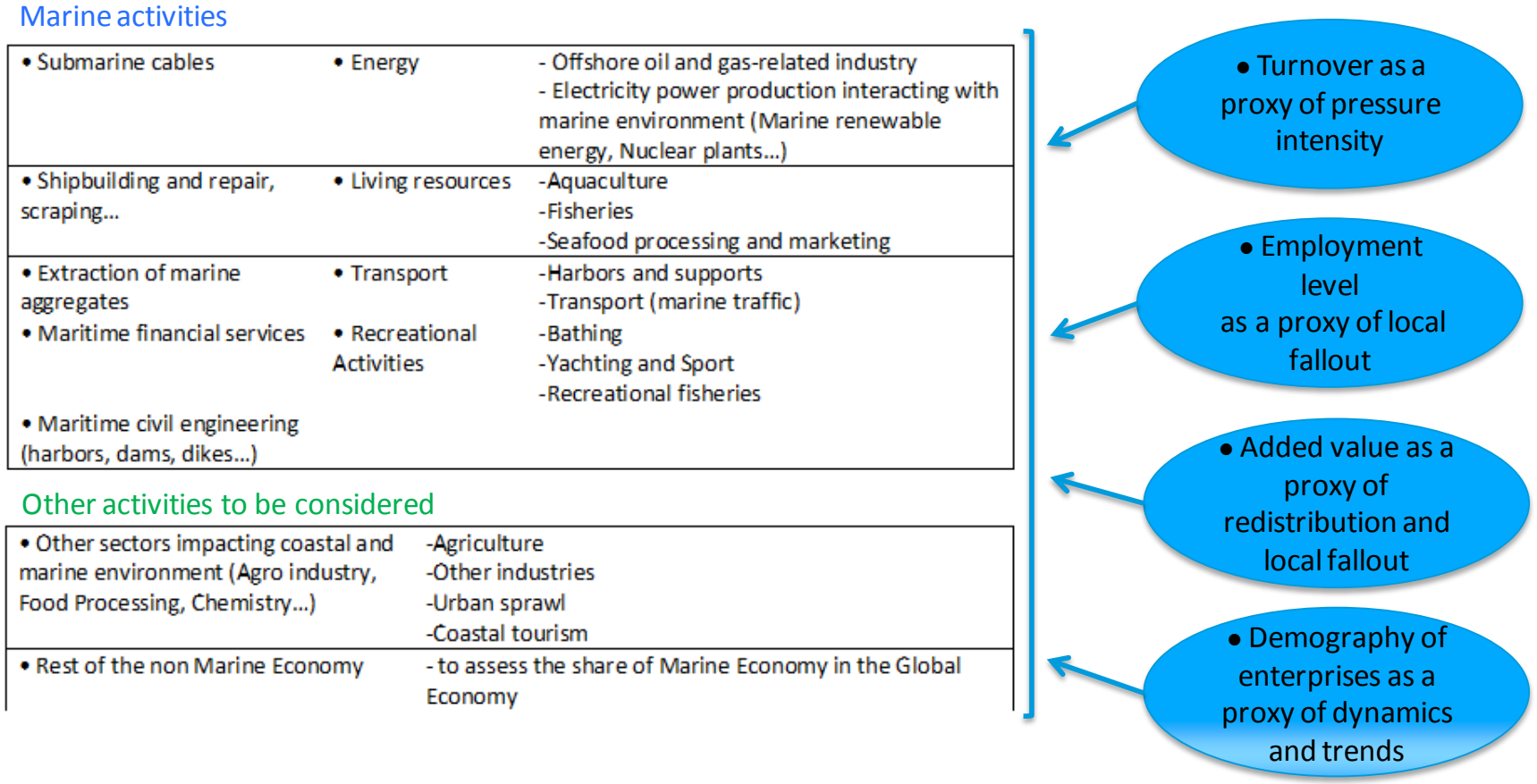
These indicators are used as proxy to assess the economic and social importance of different **sectors** related to coastal and marine environment, by describing the main activities **relying on natural resources uses** (fisheries, etc.), **depending from** (tourism, etc.) or **having a significant impact** on the marine environment (agriculture, industry, urban sprawl, tourism, etc.). Turnover and demography of enterprises are used as proxy of the pressure exerted over the ecosystems, when employment level and added value are used to roughly assess the local fallout of related activities and weight their global activity level. Demography of enterprises also allows for catching the dynamics of the activities and sectors in order to underline trends and future pressures (Figure 11).

At regional scale some of these indicators are no more relevant due economic contexts and data accessibility. Turnover for instance should be replaced by the GDP, a more suitable macroeconomic indicator.

From traditional administrative scales, data have to be rebuilt at the scale of the issue according to ecosystemic scale where the issue makes sense and underlining new potential management units. The objective is to get a characterization of actors' economic weight for each activity weighing over the resources related to the issue (activities based on direct or indirect uses of site shared resources), at an ecosystemic scale, according to boundaries linked to natural resources uses (river basins, sub-river basins…), to cultural or economic logics, etc. Output can be provided under the form of dashboards. In addition to indicators, the different activities addressed can also be informed by qualitative materials.

Such approach leads to produce another map of the economy at the scale of the issue, moving from traditional administrative or statistical scales to an ecosystemic scale.

Figure 11 Characterization of maritime economy and activities impacting coastal and marine environment



4.1 Social and economic assessment of coastal tourism and nautical activities: an illustration over the Bouches-du-Rhône CASE (France)

In order to illustrate the assessment process, the methodological framework is implemented in a case study dealing with coastal water quality. This is a major issue in the Bouches-du-Rhône county (Nuts 3) because of significant importance of this resource for marine and coastal related recreational activities (tourism and nautical uses) which contributes to the local economy. Main threats are shoreline artificialization and urbanization. Some indicators are produced to inform social and economic weights of beach tourism and other coastal recreational activities. Indicators are produced at the scale of the French Mediterranean coastal zone which suits quite well to the issue scale (same administrative units).

The rate of tourist accommodation is low in comparison with other Mediterranean coastal zones (Colas, 2011) and the accommodation supply is unequally distributed (Table 6). 67% of beds are located in secondary houses. There is a lack of recent data concerning tourist attendance for the coastal zone. Tourist visits attached to the coastal zone are mainly assessed through a survey published in 1997 which showed that 57% of journeys were made in coastal communes (Martin and Deflaux, 1997). A survey carried out by the Bouches-du-Rhône tourism observatory in 2003 valued the average journey duration to 4.7 days and related average expenditures to 41 euros (€) (CDT, 2004). Using these figures and tourist overnights for the year 2009 (43,317,400 overnights: CDT, 2010), estimate of tourist attendance expenditures is assessed at 1 billion € of gross revenue per year for the coastal zone, about 2.4% of the Bouche-du-Rhône gross domestic product.

On the same area, the cost of ecosystem degradation regarding the water quality issue was assessed about 150 million € (2010) (Box 6), e.g. 15% of the gross revenue of coastal tourism related to nautical activities. This calls for more awareness about environmental preservation regarding the importance of the revenues generated by the activity. It doesn't include other economic activities supported by the provision of good water quality (shellfish aquaculture for instance) that would increase needs for environmental preservation to sustain economic activities dependant from water quality. But globally, it can be said that there is a quite low impact over the ecosystem in terms of uses and maintaining good conservation status of habitat and species.

Tourist attendance produces mostly employments in the food and beverage services activities and industries from this sector represent nearly 5% of all industries located in this coastal area (Table 6). According to CDT (2010), the tourism economy has been growing faster than other merchant activities for the last years and tourism is locally an important contributing sector to the economy, especially coastal resorts. Heliotropism and sea proximity are the third and fourth attractiveness mentioned as reasons to visit the Bouches-du-Rhône county by tourists interviewed during the survey carried out in 2003 (44% of responses: CDT, 2004).

There are few coastal resorts in the area, but marina and nautical activities are common places and uses (Table 7). According to Martin and Deflaux (1997), the most important activities are scuba diving and sailing. In 2009, about 15,000 memberships of nautical sports club were registered (Table 7). These data represent minimum value. For example, most of scuba divers in France do not practice their activity within sports club (53%: Chauveau, 2005). Most of them are not tourists but local residents who regularly practice their activity.

It is then difficult to assess estimates of induced effects of marina and nautical activities for the coastal zone. At national scale, a more recent survey showed that one marina generates 7.6 direct employments on average and there is also one indirect employment for ten berths (FFPP, 2011). These figures compared to the importance of leisure boats berth capacity in the Bouches-du-Rhône coastal zone suggest that sailing industry is important for the economy in the area. Nautical activities certainly have important economic and social benefits, but further local information is needed to properly assess this trend.

Table 6 Some characteristics of tourist economy in the coastal zone

Characteristics of tourist accommodation		**Total**	**Standard deviation**	**Data source(s), year(s)**
Tourist accommodation (Nb of beds)		125,066	9,176	INSEE, 2010
Touristic function rate[a]		12.0	191.2	INSEE, 2010
Tourist density (Nb of beds/km²)		71.4	254.4	INSEE, 2010
Enterprises and employments dependant from tourist attendance		**Total**	**As % of all merchant activities[b]**	**Data source(s), year(s)**
Accommodation[c]	Nb of companies	739	0.72	INSEE, 2008
	Nb of employments	3,176	0.75	INSEE, 2008
Food and beverage service activities	Nb of companies	5,123	4.97	INSEE, 2008
	Nb of employments	12,738	3.03	INSEE, 2008

[a]The touristic function rate is the ratio between capacity and population. A rate of 100 indicates that the capacity is equivalent to the resident population.

[b]103,106 organizations and 420,904 employments for the whole Bouches-du-Rhône coastal zone.

[c]Hotels and similar accommodation; holiday and other short-stay accommodation; camping grounds, recreational vehicle parks and trailer parks; other accommodation.

Table 7 Some characteristics of seaside and nautical activities

Coastal resorts		**Total**	**As % of the French Mediterranean coastline**	**Data source(s), year(s)**
"Blue Flag": Nb of municipalities		3	6.8	Pavillon bleu, 2010
Nb of exploited/licensed beaches		7	3.4	CGEDD, 2009
Marina				
Nb of marinas		38	35.5	OPP, 2010
Total amount of berths		17,242	25.7	OPP, 2010
Nautical activities				
Scuba diving	Nb of places	102	27.2	RES, 2010
	Nb of sports club	97	_	FFESSM, 2010
	Nb of memberships[a]	≈ 6,150	26.7	MSS, 2009
Sailing, windsurfing, canoeing, oars	Nb of places	27	18.8	RES, 2010
	Nb of sports club	33	_	FFV, 2010
	Nb of memberships[a]	≈ 9,139	13.9	MSS, 2009

[a]Lacking the municipal data, the number of memberships of sports club located in the Bouches-du-Rhône coastal zone has been assessed on the basis of club sports percentage located in the coastal municipalities.

Environmental impacts of coastal tourism and nautical activities present varying types and degrees. The most important issue is certainly the shoreline artifizialisation and urbanization owing to coastal tourism. Pleasure boats anchorage can also be problematic for local seagrass. Overall, there is generally no conflict between nautical practices and maintaining good conservation status of habitats and species. Single activity does not pose major problems but it is more often the combination of all activities, especially in summer, which can exert strong pressure on ecosystems (Maison, 2009). By contrast, seaside and nautical activities are uses importantly relying on coastal water quality.

4.3 Social and economic assessment according to environmental scale: illustration from the Bay of Mont-Saint-Michel (France)

Economic information for environmental issues

To summarize, the Bay of Mont-Saint-Michel is a place where 4 main natural resources are shared:

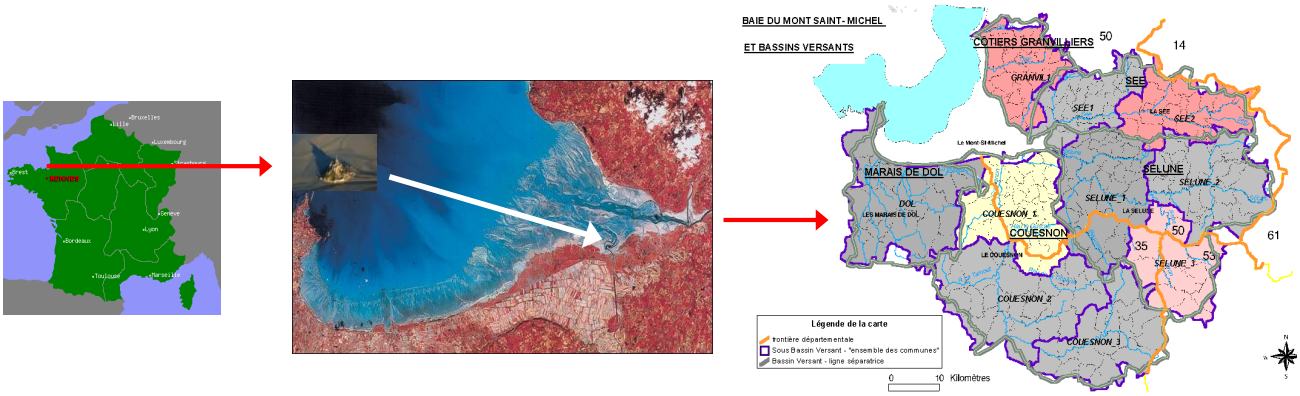
- Primary trophic resources (primary production)
- Water resources
- Biodiversity
- Landscapes

These shared natural resources are support of economic activities:

- Market based (agriculture, shellfish farming, fisheries, tourism)
- Non market activities (hunting, recreational fisheries, sightseeing and cultural heritage)

This leads to conflicts in controlling the main resources (water) either through direct or indirect use (agriculture, tourism, aquaculture, agribusiness). Resources management over the area is also challenged by a trans-territoriality of natural resources (2 regions, 3 departments, 2 water agencies) Figure 12.

Figure 12 The bay of Mont-Saint-Michel (western France)



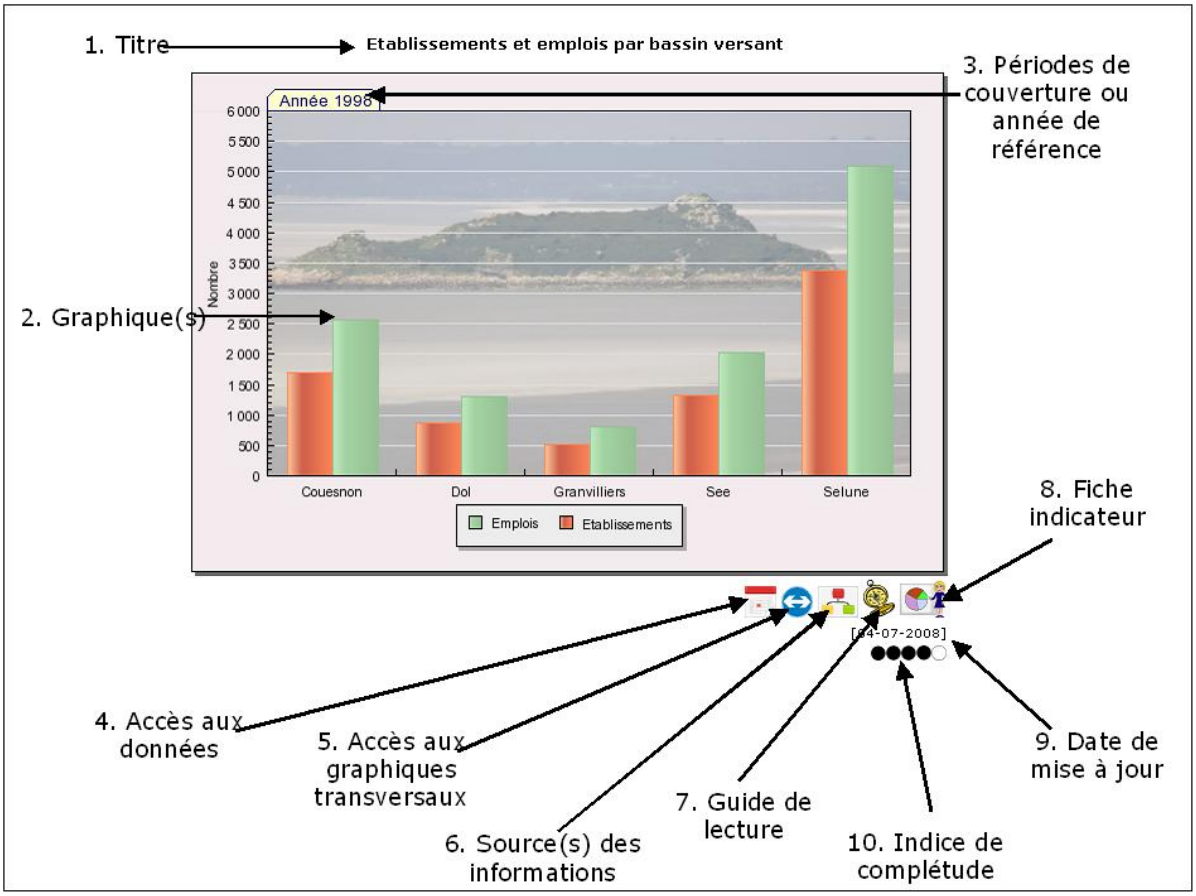
The objective of the economic dashboard is then to provide indicators in order to explain actors' strategy over the share of natural resources by characterizing the economic weight of each activity

relying on natural resources (proxy of environmental pressure). Employment, Turnover, Added Value and its distribution allow for this characterization at the scale of natural resources boundaries (river basins). All existing economic information related to activities and resources is rebuilt to produce another map of the economy, to get an economic assessment according to environmental scale, to the scale of the issue or potential management units, by moving from political and administrative governance unit to environmental governance unit. It also allows assessing differences between the administrative scale and the ecosystemic one, information being able to be delivered at both scales.

The economic table produced is then a table of influences and a simplified model of the system Bay of Mont-Saint-Michel.

There are different ways of restituting and consulting the results beyond of a table. But a useful and interactive way for stakeholders is to build an interactive online atlas: indicators production and restitution of information (Web 2.0 interface) Figure 13. The SDI produced by WP3 is the ideal platform to host such atlas.

Figure 13 An interactive online atlas over the Mont-Saint-Michel Bay



The online atlas is an answer to the restitution issue of the economic table under an accessible and educational way, but also its translation into indicators. It helps to understand how economic variability can be explained by environmental factors.

5. Economic and social assessment at the regional scale (basin and sub-basin scales)

Supporting video: http://polimedia.uab.cat/#v_482

The objective is to assess how socioeconomic information, based on existing and easily accessible, monitored and updated data can contribute to a regional assessment in support to the implementation of the protocol on ICZM in the Mediterranean.

This first calls for an assessment of relevant and available socioeconomic information at the scale of Regional Seas, with the objective of achieving the vision of the protocol which is a "balanced use of the coastal zone"[4] so to have both socio-economic development (being one of the urban sprawl drivers) and conservation of natural capital. These two sides of the "balanced use" can be decomposed in main categories and their linkages through Pressures-Impacts identified. Then going upstream, it can be looked for drivers of coastal development and then checked for the main categories of responses as feedbacks. Impacts can be considered in terms of changes in ecosystem state or in human wellbeing. This can be informed by a causal chain or diagram of influence such as the one designed and built for a Bayesian Belief Network (BBN) or through a web of relationships between economics (uses) and the environment.

Two main constraints are attached to the information to mobilize in the field of socioeconomics. The first one is related to the economic activities to be taken into account. They are marine and coastal activities or activities being impacted or exerted a pressure over the ecosystem. This is partly entitled "the coastal and maritime economy" in the Protocol. The second constraint is related to the scale of the assessment requiring working at ecosystem level[5]. At last, time scale is another dimension attached to socioeconomic information for a Regional Assessment.

Opposite to geophysical and environmental data that are quite abundant in terms of database at regional scale, relevant socio-economic information regarding marine and coastal issues is a scare resource at the same level. Activities are usually considered in terms of land use that is of little interest for a socio-economic analysis if it can't be confronted to socioeconomic dimensions.

There're needs to know more about activities beyond of solely physical accounts. Activities expressed together in volume and value allow for a better assessment of supposed pressures and impacts. For instance, activities expressed in terms of volume can be used as a proxy of the pressure they exerted over the ecosystem either through use of resources or impact to the environment. This can be also weighted according to redistribution issue (richness locally distributed or exported, impact through the local economy or not…) through activities expressed in value.

[4] "…the sustainable development of coastal zones by ensuring that the environment and landscapes are taken into account in harmony with economic, social and cultural development." Art 5 (a) Protocol on Integrated Coastal Zone Management in the Mediterranean, Official Journal L 034 , 04/02/2009 P. 0019 - 0028

[5] "…the biological wealth and the natural dynamics and functioning of the intertidal area and the complementary and interdependent nature of the marine part and the land part forming a single entity shall be taken particularly into account". Art 6 (a) Protocol on ICZM in the Mediterranean.

A first approach is to build over the approach developed for local assessment (CASES scale), by aggregating information and data from local scale (NUTS 3 to 4 and LAU2) to ecosystem scale or the scale where the issue takes place. On this basis an exhaustive review of datasets and databases at Regional Seas and Institutional level had been conducted (Raux, 2013) by crossing activities and existing initiatives. A series of lessons and constraints for the regional assessment can be drawn from this review.

5.1 Lessons learnt from the review: the "Fish and Ships" syndrome

Among the different available databases the followings were reviewed with a specific scope on marine and coastal issues. Sub-databases attached to institutions such as Air Pollutant Emissions Data from the EEA, the State of the Environment: Air and climate (OECD), the International Transport Forum (OECD), UNEP GEO Data Portal, etc. are not listed infra.

- Eurostat
- Organisation for Economic Co-operation and Development (OECD)
- European Environmental Agency (EEA)
- World Bank (World Development Indicators database)
- DG MARE Atlas of the Sea
- Web GIS from the International Centre for Black Sea Studies
- The Mediterranean Information System on Environment and Development (SIMEDD)
- Network of marine protected area managers in the Mediterranean MedPAN and MAPAMED
- United Nations Specialized Agencies Statistics Programmes or specialized agencies:
    - FAO FishStat
    - World Tourism Organization
    - International Maritime Organization (IMO)
- United Nations Statistics Programmes:
    - UNDP Human Development Report database
    - United Nations Conference on Trade and Development (UNCTAT) database
    - United Nations Statistics Division (UNSTATs/UNSD)
    - United Nations Environmental Programme (UNEP)
    - United Nation Data (UNdata)
- International Energy Agency (IEA)
- The Joint Organisations Data Initiative (JodiOil) database
- Sectors based databases (mainly private): oil and gas journal, Baker Hughes rotary rig counts, Lloyds…
- The NASA Socioeconomic Data and Applications Center (SEDAC)
- The National Ocean Economics Program (NOEP) (USA)
- The NOAA's Sate of the Coast (USA)

In addition, several projects dealing with the regional dimension of socio-economic information were also reviewed:

- The Large Marine Ecosystems program (NOAA)
- The Sea Around Us Project
- MEDSTAT
- KnowSeas FP7 project

All these sources have a regional and international dimension. Data can be sometimes available at local or national scale, but the purpose is to avoid digging into every single national and local database (when available) to rebuild the needed information. Such one shot exercise wouldn't be compatible with a routine process being implemented at regular time scale, based on reliable and long term monitoring data and without any specific and particular support from a project or an institution.

Main lessons from the review of available information are linked to three main issues: availability of relevant economic activities information in the field of coastal and marine economy, lack of environmental consideration in producing related socioeconomic information and aggregation scale.

Lack of relevant socioeconomic information in the field of coastal and marine activities

For economic activities and especially marine ones, no database exists able to provide or aggregate data at the scale of Regional Seas (RS). Only part of regional seas is covered by international databases such as Eurostat (EU countries) or the OECD. But even through these bases, data completion at local levels is not enough achieved to proceed with aggregation from coastal NUTS levels to regional scales.

Inherited from land based activities, design and building of databases are not really concerned with marine and coastal dimension for the most detailed databases. Solely natural resources are detailed and carefully monitored due to international regulations and obligations in the fields of natural resources management. But Beyond of physical units it is often difficult to get detailed economic information such as labor and added value.

Specific sectors databases (shipping, oil, fisheries, etc.) from public institutions are also limited and don't provide suitable data (not readable in terms of marine area or out of scope and too wide indicators). In addition, access to private databases is costly and doesn't ensure to be provided with reliable and monitored data that are mainly produced for commercial and strategic purpose.

When available, economic activities are expressed in terms of volume and sometimes value, but there're no other descriptors in transnational databases or databases are too incomplete to proceed with rebuilding of information.

Even at regional level, very few activities are available. Usual activities found are rather: Fisheries and Aquaculture, Shipping, Tourism and Offshore oil. Other activities impacting coastal and marine environment are easier to find when they are land based (agriculture, urban development…).

The review of activities and databases leads to a sort of ***"Fish and Ships"*** syndrome. From an economic point of view, oceans and coasts are too often translated into a fish and ships tank in databases. This is also translated into the lack of environmental dimension associated with coastal and marine activities at all scales.

Socioeconomic information and Regional Seas scale

The identification of marine and coastal related and dependant activities (through uses or impacts), as well as the needs to rebuild information at the regional scale, call for working at sub-national levels and aggregating at the relevant scale of the assessment. When available, coastal and marine activities and related activities exerting or undergoing pressures over ecosystems are limited to local scale and through local databases. But as already underlined above, local scale level are often incomplete to perform the aggregation and databases do not cover the whole Mediterranean area neither the Black Sea.

There's also no ecological dimension in producing socioeconomic information. When environmental dimensions can be found or noticed it is mainly addressed through satellite sectors or in terms of global indicators linked to climate change (CO2 etc.). Activities exerted pressures or being impacted have to be considered at the scale of ecosystems when socioeconomic data are published on scales defined by administrative and political characteristics. There's then an important issue in rebuilding socioeconomic information at the scale of environmental issues or allocating economic information to ecosystems.

Similarly there's no marine/coastal dimension for economic activities or solely reduced to a "fish and ships" issue. Most of bases are about and designed for land based activities.

This illustrates an already existing gap between maritime policies as expressed at national and international levels or in regulatory schemes and information recorded[6]. Policies and declarations are not yet translated into databases, raising an important issue for the implementation of policies and monitoring of actions. Stronger efforts should be made to blue the existing databases and read or being able to rebuild socioeconomic data at the scale of marine and coastal ecosystems. Environmental issues dealing with economic information often face similar difficulties, but it is wider and generalized for coastal and marine issues. This issue is not new and progresses have been made, but at the scale of the Mediterranean and Black sea the issue remains.

Eurostat developed some specific regional databases for maritime or coastal regions, defined at NUTS 3 level. It forms the ideal database for the purpose of regional assessment and to address coastal and marine issue. Nevertheless, for the moment data provided at this scale are too limited (demography, coastal tourism capacity and maritime traffic passengers mainly). To perform an analysis at minima at the scale of Mediterranean and Black Sea, other activities in terms of stressors over the ecosystems would be needed both from Eurostat and non EU countries. But it illustrates what could be a MedStat and a BlackSeaStat at the level of the Mediterranean and Black Sea[7].

The solely illustration of socio-economic information related to geospatial data products found by the review of socio-economic information is a data set of country-level population and Gross Domestic Product (GDP) and corresponding geospatial data products (downscaled grids). This

[6] Marine Strategy, Blue Growth, ICZM Schemes, Integrated Marine Policy, Blue Paper…

[7] Other illustrations, but at the scale of the USA, of what could be a suitable economic information system are the National Ocean Economics Program (NOEP) http://www.oceaneconomics.org and the NOAA's Sate of the Coast: http://stateofthecoast.noaa.gov.

downscaling approach was produced and developed by the Center for International Earth Science Information Network (CIESIN) from the Columbia University as an initial effort to meet the urgent needs of impacts researchers for country-level data. This work was the first exercise of its kind in downscaling socioeconomic drivers.

Consequences for an economic assessment at the regional scale

The aggregation approach of local data (NUTS 2 to 4) to rebuild and analyze socioeconomic information at the scale of Regional Seas seems to be far away from capabilities offered by existing databases. This leads to give up not only aggregation approach, but also indicators rather expressed at these scales (Added Value, Turnover…) and being able to go beyond of the solely pressure or weight exerted by an economic activity over the environment.

Accounting for marine economic activities can be made according to different single metrics. The first one is to express the level of each activity in **monetary measures through the Total Economic Value** (TEV see section 2) measuring the net benefits that derive from marine activities in a country. But the complexity of the techniques and the amount of calculation needed to arrive at the estimated values documented in the KnowSeas FP7 project for instance, demonstrate the relative inaccessibility of economic values relevant to the assessment of benefits derived from the marine environment and the costs arising from the degradation of ecosystems. Even where market data are available, their translation into values compatible with those representing individual preferences for ecosystem integrity is challenging (Cooper 2011). These challenges do not simply arise from the aggregation procedure but rather from the paucity of data or of appropriate classification of collected data relevant to environmental decision-making. For example, there is a paucity of standardized data on individual preferences for the marine environment not represented by market while in other cases data are collected and reported at the level of member States but without reference to their relevance to the marine environment, such as in the cases of the tourism and energy sectors (Cooper 2011). As a consequence it doesn't exist any available compilation of TEV for marine activities.

Another metric could consist in the use of the **Direct Output Impact (DOI)** metric. But it only measure gross revenues derived from activities. It represents the benefits to producers and the costs of production. Because it includes cost and excludes benefits to consumer, DOI is judged as a non accurate measure of the economic value (Hoagland et al. 2006).

To overpass difficulties with the two previous metrics, an index approach aiming at providing a single metric for marine activities and for a purpose of comparison between Large Marine Ecosystems (LMEs) and between Regional Seas had been developed by Hoagland and Jin (2006)[8]. A framework had been developed for incorporating socioeconomic considerations into an adaptive management approach for LMEs. It takes the form of a method for indexing the relationships between marine industry and socioeconomic development. A **Marine Activity Index (MAI)** is designed that doesn't rely upon monetary value but on physical value. Each physical value is converted into an index that

[8] Hoagland, P., D. Jin, 2006. Accounting for economic activities in Large Marine Ecosystems and Regional Seas, UNEP Regional Seas Reports and Studies N°181, 151p.

ranges from 0 to 1 (no dimensions). The MAI is later compared to a socioeconomic index through the HDI index.

To build such index, public available worldwide data on marine activities occurring in coastal nations are compiled. Data on marine activities include fish landings, aquaculture production, shipbuilding, cargo traffic, merchant fleet, oil production, oil rig counts and tourism arrivals. These data are expressed in physical units and not prices.

Constraints over databases lead to deal with macroeconomic indicators and data on marine activities at national level and then establish some rules to build indexes and allocate them from national scale to regional seas. It has then to proceed with national information and raise issue of data allocation according to ecosystems. It is a method for indexing the relationships between marine industry and socioeconomic development (Hoagland et al. 2008).

5.2 An indexes based approach for the PEGASO economic assessment at regional scale

Although working within regional seas and not between regional seas, PEGASO can take advantage from the LME approach. Indexes can also be calculated at country level, but there remains the issue of allocation for multi Regional Seas neighboring countries.

Using similar methodology it is feasible to provide indexes at countries level and according to their contribution to Regional Seas, instead of constructing weighted average indexes for the whole Regional Sea. The allocation in Hoagland et al. (2006, 2008) is made in the final step through weighting process over national indexes and according to countries' percentage of coast in the total regional sea. This allows comparing countries within regional seas, sum of weight being equal to one. For PEGASO we proposed to proceed to two allocations: one over indicators and one over indexes so that they can be comparable within regional seas. Steps are as followed:

- i) compile national activity data (indicators);
- ii) weight these data according to % of Regional Sea's coastline length in the total national coastline length. To avoid attribution of an inexistent activity in a regional sea, building a dichotomous table of activity's existence over regional seas;
- iii) construct **marine activity indexes per country** by ranking Mediterranean, respectively Black Sea, nations according to each activity and standardize values;
- iv) construct combined **marine industry** and **sector index** for each country:
    - calculation of a weighted average index per sector and country: marine activity indexes are weighted according the same weight assigned by Hoagland et al., but these weights have to be discussed and adjusted by stakeholders based on different ecological and economic criteria;
    - calculation of a total marine activity index per country by weighting previous marine sector index per country; similarly, weights should be adjusted by stakeholders;
- v) allocation of national marine industry and sectors indexes to regional sea, based on contribution to country's coastline length to total regional sea coastline length.

It is to note that this process will not solve the allocation process of activity indicators and indexes, but it is maybe the less bad option. This allocation process should be the field for future researches in order to refine the accuracy of allocations.

Objective of the approach is an attempt in identifying and providing socioeconomic information at the scale of regional seas in a routine way as far as possible. Availability of data at national level but rarely at local scale raises difficulties in providing such information and requires some calculation processes that could go beyond of the routine objectives. Going further would require to deeply analyze the following issues:

- Standardization of activity indicators could be better adjusted through scoring methods.
- Weights for activities and sectors have to be adjusted by stakeholders.
- Allocation of indexes to Regional Seas needs to be further investigated.

Other limits attached to the approach are the followings:

- Work on large aggregates that don't allow for detailed analysis and identification of detailed causal factors of the Regional Seas dynamics.
- Rely on wide assumptions.

5.3 Application to the Mediterranean and Black Sea

Among marine and coastal activities that form the marine economy, very few are available at regional level and usual ones are rather: Fisheries and Aquaculture, Shipping, Tourism and Offshore oil. Other activities impacting coastal and marine environment are easier to find when they are land based (agriculture, urban development…).

Building indexes

Table 8 lists indicators and indexes of activities, economic development and environmental preservation that have been identified and selected.

The composite HDI is completed with its Income, Health and Education components in order to differentiate countries having similar or close HDI. In addition to the Marine Activity Index, an environmental index is also built based on available indicators found for all countries: endangered marine species and MPA proportion in territorial waters. Additional non marine indicators are selected to serve as illustrative variables in the analysis: natural resources depletion, population growth and density, coastal population (vintage data), New business density (Table 8).

Data are standardized at the scale of the Mediterranean and Black Sea respectively. Indexes of activity are rebuilt and weighted to get a Marine Industry Index and some Sectors Indexes (Table 9). Indexes are then reallocated at the scale of the Mediterranean and Black Sea accordingly to countries' contribution to the Mediterranean and Black Sea coastline length.

Table 8 Indicators and indexes identified and selected for the Regional Assessment of the Mediterranean and Black Sea.

Indicator/Index	Unit	Year	Data Source
Human Development Index	Dimensionless	2012	UNDP HDR
Education index	Dimensionless	2012	UNDP HDR
Health index	Dimensionless	2012	UNDP HDR
Income index	Dimensionless	2012	UNDP HDR
Fishery Landing	Metric tons	2010	FAO
Aquaculture Production	Metric tons	2010	FAO
International tourism number of arrivals	Number of visitors	2011	World Bank WDI and UNWTO
Offshore oil production	*Barrel/day (reliability questionable)*	*2011*	*Baker & Hughes*
Offshore rig count	*Number (reliability questionable)*	*2011*	*Baker & Hughes*
Container port throughput	Twenty foot Equivalent Unit	2010	UNCTAT
Ship Building order book	000GT	2011	SAJ (The Shipbuilders' Association of Japan)
Merchant Fleet	Dead weight tons in thousands	2011	UNCTAT
Fish species threatened	Number	2012	UNDP HDR
Mammal species threatened	Number	2012	UNDP HDR
Marine protected areas	% of territorial waters	2010	UNSD
Natural resource depletion	% of GNI	2010	UNDP HDR
Population growth	Annual %	2012	UNDP HDR
Population density	People per sq. km of land area	2011	UNDP HDR
Coastal population density	Out of date	2000	UNSD
New business density	New registrations per 1,000 people ages 15-64	2011	UNDP HDR
Environmental Performance Index (EPI) and its components	Dimensionless	2012	NASA SEDAC / Yale University

Table 9 Selected indexes and their components

Indexes and components				
All Med and BS Nations	**HDI**	Education		LMEs (RS)
		Health		
		Income		
	Fisheries Aquaculture	Fisheries		
		Aquaculture		
	Tourism			
	Ship and Oil	Shipbuilding		
		Shipping	Shipping	
			Merchant Fleet	
		Offshore Oil	Offshore Oil	
			Offshore Rig	
	Environmental Threats	Species Threatened	Fish species threatened	Add. Envt
			Mammal species threatened	
		1/MPA		
	EPI (Environmental Protection Index)			
	Natural resource depletion			
	Population			Add. SoEco
	Coastal population			
	New business			

Data have been processed accordingly to steps defined previously and results are the followings:

- Indicators of marine activities at country level in physical units
- Indexes of marine activities at country level
- Indexes of marine sectors and marine industry (total activity) at country level
- Indexes of marine sectors and marine industry at country level attributed to regional seas

Indexes are confronted to HDI indexes as socioeconomic development indexes and to marine and coastal environmental indexes built from related indicators.

Indexes cover socio-economic development (Education, Health, Income, New business, Population), marine industry activity (Fisheries, Aquaculture, Tourism, Ship building, Shipping and Oil) and environmental threats (Species threatened, Natural resources depletion, Environmental protection index) (Tables 9 and 10). Limits related to availability of data through international and regularly monitored databases didn't allow including coastal urbanization for instance.

Table 10 PEGASO Socio-economic and Environmental Composite Indexes, normalized over Mediterranean and Black Sea coastal nations

Nations	HDI 2012	Marine Industry Index	Fisheries Aquaculture	Tourism	Ship building	Shipping	Offshore Oil	Species Threat	Envt. Threats	MPA	Envt. Protection	Natural resource depletion	Population	Coastal Population	New business
Albania	74.9	1.5	0.5	6.4	0	0.6	0	24.8	13.9	3.0	65.9	13.7	5.1	13.9	3.7
Algeria	71.3	4.0	12.6	5.2	0	2.3	0	41.5	29.4	17.4	48.6	100	63.1	5.4	0.6
Bosnia and Herzegovina	73.5	0.2	0.02	0.8	0	0	0	20.4	13.7	7.0	36.8		6.2	0	2.7
Croatia	80.5	12.2	7.5	21.5	30.2	1.9	0	47.9	24.6	1.4	64.2	5.1	6.9	4.1	9.5
Cyprus	84.8	5.9	0.5	5.2	0	17.3	6.6	12.9	10.9	8.9	57.2	0.0	1.8	11.2	100
Egypt	66.2	24.0	60.4	8.0	0	18.1	33.3	51.4	26.0	0.5	55.2	42.3	51.6	52.5	0.2
France	89.3	15.4	3.8	51.1	10.3	11.9	0	36.5	18.3	0.2	69.0	0.1	31.2	6.5	12.5
Greece	86.0	24.2	19.3	35.6	0.2	41.3	24.7	63.8	32.8	1.9	60.0	1.8	18.5	11.9	2.6
Israel	90.0	7.1	0.4	6.1	0	15.7	13.2	43.2	27.2	11.2	54.6	1.1	12.9	7.4	14.3
Italy	88.1	77.3	37.9	100	100	75.2	73.2	37.1	18.7	0.2	68.9	0.6	100	12.7	6.4
Lebanon	74.5	2.1	0.5	3.6	0	6.5	0	23.8	35.5	47.1	47.4		7.2	18.9	
Libya	76.9	3.1	6.8	0	0	1.9	6.6	28.8	64.4	100	37.7		10.0	21.4	
Malta	84.7	9.6	0.4	3.1	0	44.4	0	7.9	10.2	12.5	48.5		0.6	17.8	32.2
Monaco		0.1	0	0.6	0	0	0	1.5	0.8	0			0	100	
Montenegro	79.1	0.5	0.1	2.6	0	0	0	19.2	12.5	5.8			1.0	0.09	42.1
Morocco	59.1	2.8	4.6	5.7	0	3.9	0	53.6	28.6	3.7	45.8	9.3	14.8	11.0	4.0
Palestinian Territories	67.0	0.2	0.2	1.0	0	0	0						6.6	6.7	
Slovenia	89.2	1.6	0.1	4.4	0	3.2	0	18.8	13.1	7.3	62.3	1.5	3.3	2.0	16.2
Spain	88.5	40.2	15.3	79.2	11.2	56.2	39.2	71.1	36.2	1.4	60.3	0.2	48.9	10.6	10.3
Syria	64.8	1.0	0.4	0	0	4.5	0	43.4	25.7	8.0	42.8	76.3	36.7	0.8	0
Tunisia	71.2	6.8	13.5	10.4	0	3.4	6.6	39.0	21.6	4.2	46.7	28.1	17.6	20.3	2.4
Turkey Med	72.2	27.1	13.9	51.7	36.0	29.5	4.6	72.8	37.4	2.0	44.8	2.2	85.0	5.0	2.9
Bulgaria	78.2	3.3	1.3	13.7	0	1.4	0	16.3	8.9	1.5	56.3	10.5	11.9	2.1	26.6
Georgia	74.5	2.3	3.4	6.1	0	1.9	0	13.8	12.4	11.1	56.8	2.5	7.3	8.6	18.0
Romania	78.6	23.7	0.03	16.5	98.3	3.9	0	16.3	8.2	0.1	48.3	8.7	35.0	4.7	17.7
Russian Federation	78.8	1.0	4.1	0.7	0.0	0.3	0	70.8	35.6	0.4	45.4	79.2	2.9	3.3	3.2
Turkey BS	72.2	20.8	51.6	22.1	15.4	12.6	2.0	72.8	37.4	2.0	44.8	2.2	36.4	5.0	2.91
Ukraine	74.0	12.1	9.4	46.4	0.0	4.8	0	24.7	12.9	1.0	46.3	20.6	74.8	3.6	2.90

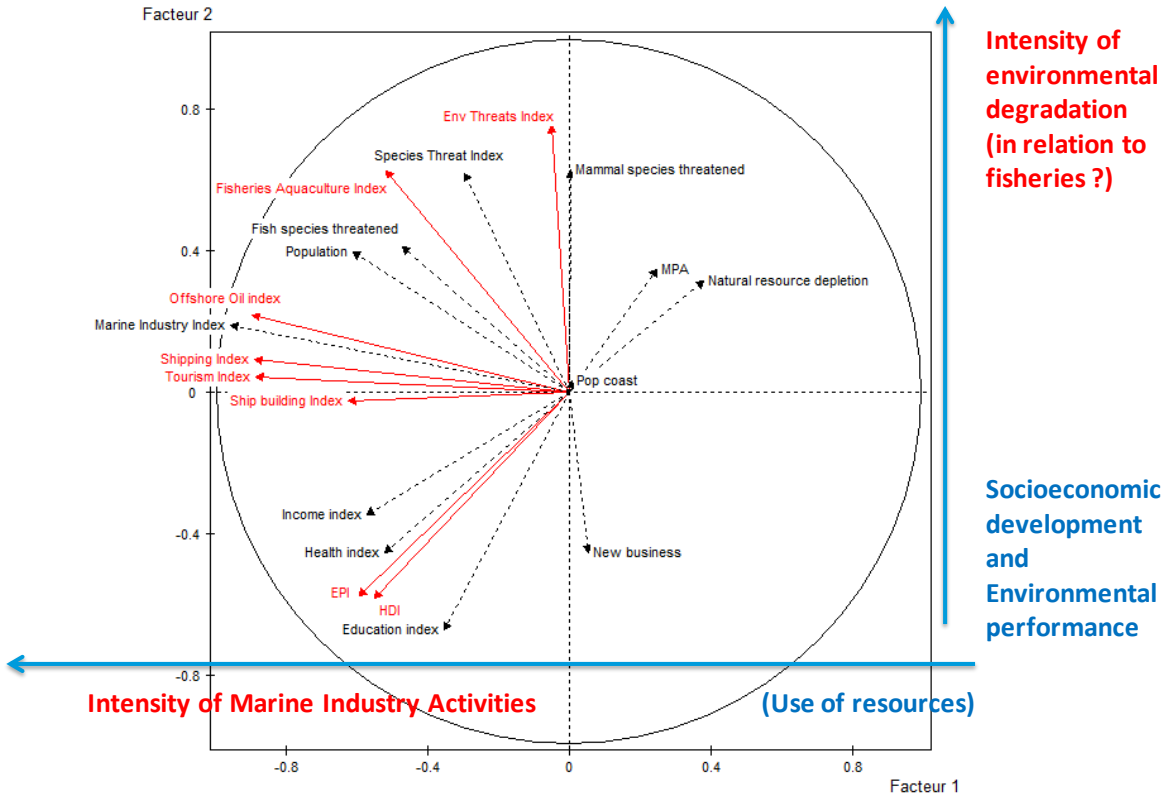
Indexes are built from indicators related to years 2011 to 2012

HDI: composite index of Income, Health and Education indexes
Fisheries Aquaculture: composite index of Fisheries (catches) and Aquaculture (production) indexes
Shipping: composite index of Cargo Traffic and Merchant Fleet indexes
Offshore Oil: composite index of Offshore Rig Count and Offshore Oil Production indexes
Species Threat: composite index of Fish Species Threatened and Mammal Species Threatened indexes
Environmental Threats: composite index of Marine Protected Areas, Natural Resources Depletion and Environmental Protection Indexes
Marine Industry: composite index of Fisheries and Aquaculture, Shipping and Ship Building, Offshore Oil and Tourism

5.4 Analysis and results

A multivariate analysis (Principal Component Analysis) was implemented over the indexes to differentiate countries within regional seas (Figure 14).

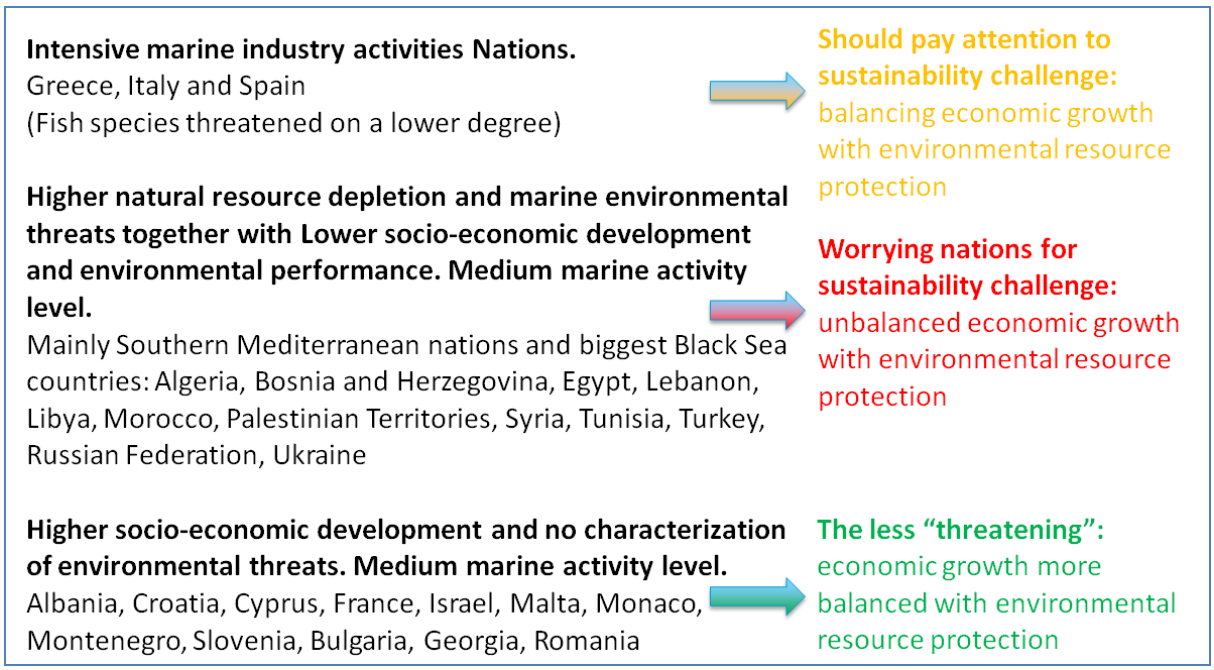
Figure 14 Multivariate Analyse on Indexes (Principal Component Analyse)



Mediterranean and Black Sea countries are differentiated according to indexes values and form three main groups (Figure 15). Greece, Italy and Spain appear as the most intensive nations in terms of marine industry activity, benefiting from their important coastline length. But they are intermediate in terms of environmental threats and resources depletion. To achieve the sustainability of marine economy they should pay more attention to natural capital preservation. Southern Mediterranean countries are the nations presenting the most important signs of unsustainability of their coastal zones. In spite of a lower marine industry activity, an economic growth achieved through depletion of natural capital is a temporary and short term strategy that will not generate a basis for sustainable development of coastal zones. Opposite to the previous countries, Albania, Croatia, Cyprus, France, Israel, Montenegro and Slovenia are the Mediterranean countries presenting a higher socio-economic development while natural capital is the less threatened. But the case of Israel, Malta and Monaco, but also France at a lower degree should be balanced with a high coastal urbanization rate as underlined by the cumulative pressure and impact indexes. It is associated to an economic development constraint by limited spatial development and a significant investment in marine

protected areas, quite representative of islands nations or limited hinterland countries. This coastal urbanization rate is not included in the analysis due to lack of data available in routine.

Figure 15 Typology of Mediterranean and Black Sea countries according to marine industry activity, socio-economic development and environmental threats.



5.5 Lessons learned

The issue for the economic assessment at regional scale was to find and get access to available information at the scale of regional seas. This raises several sub-issues: data allocation when countries are neighbored by more than one regional sea and the existence of international databases. For this last issue and for routine purpose, it is not possible to go through each country national statistic office to rebuild the information: completion of data is often questionable and their availability is very variable. In addition this exercise of rebuilding each time a potential and suitable database is quite long, hazardous in terms of success and doesn't allow an efficient monitoring of marine related information to support ICZM. At the moment, for economic activities and especially marine ones, no such database able to provide data covering regional seas exists. Only part of regional seas is covered by international databases such as Eurostat or the OECD. The review also proposes what could be or what should be such database based on the Eurostat experience and experiments.

Today the only way to collect and extract relevant and reliable economic information at the regional scale is to go down to and dig into specific activity database, when existing and of free access (FAO and other UN agencies for instance).

When available, economic activities are also expressed in terms of volume and sometimes value, but there're no other descriptors in transnational databases or databases are too incomplete to proceed with rebuilding of information.

There are then two ways of rebuilding information at suitable scale:

- either aggregates of available data at infra national scale (NUTS2, 3 and 4);
- either attribution/allocation of national data at regional scale. Incompletion of NUTS2, 3 and 4 database at European and regional seas level rather calls for this approach.

For macroeconomic information the issue is similar with data provided at country level and difficulties to rebuild it at regional seas level (i.e. part depending from regional seas for each country). There's no information or no available information at infra level for all countries (GDP for instance).

In most of databases consulted and reviewed there's no ecological dimension in producing socioeconomic information. When some environmental dimension can be found or noticed it is mainly addressed through satellite sectors or in terms of global indicators linked to climate change (CO2 etc.). Similarly there's no marine/coastal dimension for economic activities or solely reduced to a fish and ships issue. Most of bases are about and designed for land based activities.

As already underlined, the complexity of the techniques and the amount of calculation needed to arrive at the estimated values demonstrate the relative inaccessibility of economic values relevant to the assessment of benefits derived from the marine environment and the costs arising from the degradation of ecosystems (Cooper 2011).

For PEGASO the approach from LMEs, maybe more limited in terms of activities, but more synthetic and being more easily appropriated by stakeholders seems to be the most relevant one.

Conclusion

The review of economic assessment methods in the context of the ICZM protocol implementation rather advocates for a cost based approach. At regional level, at the scale of Regional Seas, access to information is much more complicated without a local or national relay aware about costs issues. In addition, information regarding marine and maritime economy is scarce and not well monitored beyond of shipping and fisheries industries. For the regional sea scale, an index based approach is then proposed. But beyond of these two frameworks, a rather simple and preliminary process should be implemented, whatever valuation frameworks and as an initial step. It takes the form of an economic table or an economic dashboard informing and describing main economic activities related to the issue to be addressed (activities relying or exerting a pressure over natural resources through uses).

An economic assessment is not performed for itself and confusion often arises over values and prices, valuations and their meaning, usefulness of results… The assessment doesn't deliver a solution, but rather enlighten the different choices in an exploratory way. Economics compares but it doesn't measure well. It takes its meaningful property in a complementary way with other tools such as additional indicators (including LEAC and CIM) and mainly scenarios and participatory processes. To that purpose, the economic assessment approach proposed for PEGASO is thought to be implemented according to a logical, coherent and integrated framework combining other tools. Within such scheme and regarding economics, implementation steps are the following:

- identify and select the policy issue within a forum of representative stakeholders;
- describe the political and regulatory framework;
- provide a clear overview of socio-economic pressures and associated environmental degradation, by building a web of relationships between ecosystem services production and human well-being;
- inform and describe the economic and social importance of different sectors related to coastal and marine environment, by describing the main activities relying on natural resources uses (fisheries, etc.), depending from (tourism, etc.) or having a significant impact on the marine environment (agriculture, industry, etc.);
- outline interactions and interdependencies between activities and the environment (dependence from ecosystems, impacts on coastal zone…);
- assess the degradation costs of marine ecosystems and resources associated to interactions and interdependencies.

Information derived from the economic assessment will feed the integrated assessment scheme together with other tools developed within PEGASO to support the implementation of the ICZM protocol for the Mediterranean and extension to the Black Sea (PEGASO Deliverable D4.6, Raux et al. 2014).

Finally the methodology proposed for assessing the degradation cost of marine and coastal ecosystems should take place in a wider integrated framework allowing implementing the series of

tools developed for the economic assessment and other complementary PEGASO tools (indicators, scenarios, and participatory methods). This implementation is proposed in a rather logical and step by step approach, each step being complementary and dependent to the other, in order to get a structured framework for the best implementation and use of assessment methods. This framework is designed under the form of an Environmental Territorial Diagnosis (ETD) and will act as the so-called "Tool Box" developed within Task 4.6 in order to integrate PEGASO's multi-scale tools, methods and models to perform an integrated assessment.

References

Ackerman F., Heinzerling L., Massey R.I., 2007. Wrong in retrospect: cost-benefit analysis of past successes. In: Erickson J. D., Gowdy J. M., 2007. Frontiers in Ecological Economic Theory and Application. Advances in Ecological Economics, pp. 7-35.

Barbier E.B., 2009. Ecosystems as natural assets. Foundations and Trends in Microeconomics Journal, 4(8):611–681.

Barbier E.B., Baumgärtner S., Chopra K., Costello C., Duraiappah A., Hassan R., Kinzig A., Lehmann M., Pascual U., Polasky S., Perrings C., 2009. The valuation of ecosystem services, in Naeem S., Bunker D.E., Hector A., Loreau M., Perrings C. (eds), Biodiversity, Ecosystem Functioning, and Human Well Being. Oxford and New York, Oxford University Press, 248-262.

Bartelmus, P. (2009). The cost of natural capital consumption: Accounting for a sustainable world economy. Ecological Economics 68, 1850-1857.

Braat L., 2012. Introduction to Ecosystem Services, Science Policy and Practice, VALMER workshop, November, 6th- 8th 2012, Brest, France. Accessible on the Internet: http://www.umr-amure.fr/valmer_workshop/doc_valmer_wp1/Leon_braat_introduction_ecosystem_services_science_policy_and_practicex.pdf

Brouwer R., 2000. Environmental value transfer: state of the art and future prospects, Ecological Economics 32 (1): 137–152.

CDT., 2004. La clientèle touristique dans les Bouches-du-Rhône, Comité Départemental du Tourisme, 12 p.

CDT., 2010. La fréquentation touristique dans les Bouches-du-Rhône en 2009, Comité Départemental du Tourisme, 9 p.

CE (Commission européenne), 2001. Qualité des zones côtières: une priorité pour l'Union européenne. Un nouveau souffle pour les zones côtières européennes.

Chauveau M., 2005. Étude socio-économique relative à la plongée subaquatique de loisir en 2004-2005, Ministère de la Jeunesse, des Sports et de la Vie associative, 103 p.

Chevassus-au-Louis B., Salles J.-M., Bielsa S., Richard D., Martin G., Pujol J.-L., 2009. Approche économique de la biodiversité et des services liés aux écosystèmes. Contribution à la décision publique. Centre d'analyse stratégique, www.strategie.gouv.fr, 376p.

Chevassus-au-Louis B., 2011. Concepts de services écosystémiques et paiements des services environnementaux appliqués à l'agriculture, Concepts d'agricultures et de gestions du territoire protectrices des ressources, Pollutec Horizons 2011, Paris-Nord Villepinte, 29 Novembre 2011 – 2 Décembre 2011.

Colas S., 2011. Environnement littoral et marin, Ministère de l'Ecologie, du Développement durable, des Transports et du Logement, 165 p.

Cordier M., Pérez Agúndez J., A., O'Connor M., Hecq W., 2009. Limits of conventional cost-benefit analysis for the integrated management paradigm and the concept of ecosystem services, AMURE Working Papers Series, N° D- 26- 2009, 40p. www.umr-amure.fr/electro_doc_amure/D_26_2009.pdf

Cordier M., Pérez Agúndez J., A., Hecq W., Hamaide B., 2013. A guiding framework for ecosystem services monetization in ecological-economic modeling. Ecosystem Services, in Press, 21p.

Department for Communities and Local Government, 2009. Multi-criteria Analysis Manual, London, 165p. http://www.communities.gov.uk/documents/corporate/pdf/1132618.pdf

EPA, 2009. Valuing the Protection of Ecological Systems and Services, a report of the EPA Science Advisory Board, Science Advisory Board, U.S. Environmental Protection Agency, Washington, May 2009, 122p.

Fleuret A., 2008. Que sont les valeurs non monétaires et comment peut-on les appréhender ? Retombées économiques et valeur des espaces naturels protégés, IEP Aix en Provence, 16 octobre 2008. Ministère de l'Ecologie, de l'Energie, du Développement Durable et de l'Aménagement du Territoire, Paris.

Hadley D., D'Hernoncourt J., Franzén F., Kinell G.,Söderqvist T., Soutukorva Å, and Brouwer R., 2011. Monetary and non monetary methods for ecosystem services valuation – Specification sheet and supporting material, Spicosa Project Report. http://www.coastal-saf.eu/formulation-step/pdf/Specification%20sheet%20economic%20valuation_final.pdf

Haines-Young R., Potschin M., Groot de R.S., Keinmast F. and Bolliger J., 2009. Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting. Report to the European Environment Agency, contract no. EEA/BSS/7/07.

Hoagland P. and D. Jin, 2006. Accounting for economic activities in Large Marine Ecosystems and Regional Seas, UNEP Regional Seas Reports and Studies N°181, 151p.

Hoagland P. and D. Jin, 2008. Accounting for marine economic activities in large marine ecosystems. Ocean & Coastal Management 51(3): 246-258.

Hotelling H., 1947. "Letter to the National Park Service," Reprinted in an Economic Study of the Monetary Evaluation of Recreation in the National Parks (1949). U.S. Department of the Interior, National Park Service and Recreational Planning Division, Washington, DC.

Lange G.-M., 2007. Environmental accounting: Introducing the SEEA-2003. Ecological Economics, Special Issue on Environmental Accounting : Introducing the System of Integrated Environmental and Economic Accounting 2003, Vol. 61, N° 4, pp. 589-591.

Le Gentil E., Raux P., Mongruel R. and Bailly D., 2011. Bibliography and preliminary stock take for tools contributing to integrated assessment, Deliverable D4.0, PEGASO FP7 project, People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast, 30p.

Levrel H., Jacob C., Bailly D., Charles M., Guyader O., Mongruel R., Aoubid S., Bas A., Cujus A., Frésard M., Girard S., Hay J., Laurans Y., Paillet J., Pérez J., 2012. The costs of environmental degradation in the Marine Strategy Framework Directive: A case study from France, Amure Publications, Working

Papers Series D-34-2012, 21p. Available on Internet: http://www.umr-amure.fr/electro_doc_amure/D_34_2012.pdf

Maison E., 2009. Sports et loisirs en mer, Agence des Aires Marines Protégées, 229 p.

Maitre d'Hôtel E., Pelegrin F. (2012). Les valeurs de la biodiversité: un état des lieux de la recherche française. Rapport FRB, série expertise et synthèse, 2012, 48 pages

Mangos, A., Bassino, J-P., Sauzade, D. (2010). The economic value of sustainable benefits rendered by the Mediterranean marine ecosystems. Plan Bleu, Valbonne. (Blue Plan Papers 8), 78p.

Martin M.C. and Deflaux J., 1997. Impact économique et touristique des loisirs nautiques en Provence Alpes Côte d'Azur, Chambre Régionale de Commerce et d'Industrie, 298 p.

Mongruel R., Levrel H., Charles M. and Bailly D., 2012. Cost-based approach in the context of the EU Marine Strategy Framework Directive, VALMER workshop, November, 6th- 8th 2012, Brest, France. Available on Internet: http://www.umr-amure.fr/valmer_workshop/doc_valmer_wp1/Remi Mongruel_Cost Based Approach for the MSFD.pdf

Munasinghe M. and Development M., 2007. Tools and methods for integrated analysis and assessment of sustainable development. Retrieved from http://www.eoearth.org/view/article/51cbef157896bb431f69c44b

OECD (Organisation for Economic Co-operation and Development), 2006. Input-output analysis in an increasingly globalised world: applications of OECD's harmonized international tables. STI/Working paper 2006/7. Statistical analysis of Science, Technology and Industry. Available on Internet: http://www.oecd.org/dataoecd/6/34/37349386.pdf

OECD (Organisation for Economic Co-operation and Development), 2006a. The OECD Input-output database : 2006 edition. STI/Working paper 2006/8. Statistical analysis of Science, Technology and Industry. Available on Internet : http://www.oecd.org/sti/working-papers

O'Connor M., Steurer A., Tamborra M., 2001. Greening National Accounts. Environmental Valuation Europe. Policy Research Brief Number 9. Cambridge Research for the Environment, 24 p. Available on Internet : http://kerbabel.c3ed.uvsq.fr/_Documents/CACT-FIC-DICT-C3ED-MOC-20010301-00001.pdf

O'Connor M., 2007. Paradigms for Sustainability Assessment: inventory of Costs & Benefits versus Representative Diversity of Indicators, Background paper in support of the SEEA 2010 reform process, accounting of environmental degradation, London Group, 23p.

Pearce D. W., Atkinson G. and Mourato S., 2006. Cost-benefit analysis and the environment: recent developments. Paris: Organisation for Economic Co-operation and Development. 315p. Available on Internet: http://213.253.134.43/oecd/pdfs/browseit/9706011E.PDF.

Raux P., 2008. SAF (System Approach Framework) formulation guide for economic assessment, SPICOSA (Science and Policy Integration for Coastal Systems Assessment) EC FP6 Integrated Project, Project N°0369927, Deliverable D2.2, 24p.

Raux P., 2013. A review of Socio-economic information/Indicators in support to coastal zone management at the scale of the Mediterranean and Black Sea. PEGASO Project, EC FP7 ENV.2009.2.2.1.4 Integrated Coastal Zone Management, 39p.

Söderqvist T. and Soutukorva Å., 2006. An instrument for assessing the quality of environmental valuation studies, Enveco Environmental Economics Consultancy, Swedish Environmental Protection Agency, 118p.

SEEA 2003, Handbook of National Accounting - Integrated Environmental and Economic Accounting, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, 572p.

SEEA 2012, System of Environmental-Economic Accounting, Central Framework, 2012. White Cover version, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, 306p.

SNA 1993, System of National Accounts, 1993. Inter-Secretariat Working Group on National Accounts, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, Brussels/Luxembourg, New York, Paris, Washington, D.C., 814p.

SNA 2008, System of National Accounts, 2009. Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, 662p. ISBN 978-92-1-161522-7.

Venkatachalam L., 2007. Environmental economics and ecological economics: where they can converge? Ecological Economics 61 (2007) 550-558.

Weber J-L., 2007, Implementation of land and ecosystem accounts at the European Environment Agency, Ecological Economics, Volume 61, Issue 4, 15 March 2007, p. 695–707, http://www.sciencedirect.com/science/article/pii/S0921800906004629

Weber J-L., 2011, An experimental framework for ecosystem capital accounting in Europe, EEA Technical report No 13/2011, ISSN 1725-2237, 43p. http://www.eea.europa.eu/publications/an-experimental-framework-for-ecosystem

Weber J-L., 2012. Recording ecological debts in the national accounts: possibilities open by the development of ecosystem capital accounts, ISEE2012 Conference, Ecological Economics and Rio+20: Challenges and Contributions for a Green Economy, 16-19 June 2012, Rio de Janeiro, Conference Proceedings, Reference Paper N°950, 17p.

Weber J-L., 2012. Mise en place expérimentale de comptes du capital-écosystème en Europe, L'enregistrement des dettes et crédits écologiques dans les comptes nationaux: possibilités ouvertes par le développement des comptes du capital-écosystème. 14ème Colloque de l'Association de comptabilité nationale, Session 5 - Comptabilité de l'environnement : analyses, avancées et piétinements, 6, 7 et 8 juin 2012, Centre de conférence Pierre Mendès-France, Ministère de l'Économie, des Finances et de l'Industrie, Paris, 20p.

Deliverable number: D4.5_Appendix

A review of Socio-economic information/Indicators in support to coastal zone management at the scale of the Mediterranean and Black Sea

Version V1

Dissemination Level*	✔ PU	PP	RE	CO
Project Acronym / number	PEGASO	244170		
Project title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast.			

***PU:** Public; **PP:** Restricted to other programme participants (including the Commission Services);
RE: Restricted to a group specified by the Consortium (including the Commission Services);
CO: Confidential, only for members of the Consortium (including the Commission Services).

Authorisation

Prepared by	Pascal Raux (UBO - UMR AMURE)
Approved by	Quality assessor
Approved for released by	The project manager
Date	Month 00th 20XX

Pegaso Project
People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast

Funded by the European Union
under FP7 – ENV.2009.2.2.1.4
Integrated Coastal Zone Management

Specific Programme FP7
Collaborative Projects
Large scale integrating Project

Grant agreement nº: 244170

pegasoproject.eu

Document Information

Project

Project Acronym	PEGASO	Grant agreement n°	244170
Project full title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast		
Funding scheme	Collaborative large-scale integrating project		
Project start date	February 1, 2010	Project duration	48 months
Call topic	ENV.2009.2.2.1.4 Integrated Coastal Zone Management		
Web site	www.pegasoproject.eu		

Document

Deliverable number		Due date	Unplanned	Submission date	M45
Deliverable title	Report and supporting materials to economic assessment methods to decision making within the coastal zones of the Mediterranean and Black Sea Basins				
Authors	Pascal Raux (UMR AMURE – IFREMER / UBO)				
Reviewers					
Work Package	WPnº4 Multi-scale tools, methods and models for integrated assessment				
Work Package Leader	Denis Bailly (UMR AMURE UBO)				
Lead beneficiary					
Dissemination level	PU				
Nature	R				
Nº of pages (incl. cover)					

PEGASO

People for Ecosystem based Governance in Assessing
Sustainable development of Ocean and coast

Work Package 4

Multi-scale tools, methods and models for integrated assessment

Appendix to PEGASO Deliverable D4.5

A review of Socio-economic information/Indicators in support to coastal zone management at the scale of the Mediterranean and Black Sea

Pascal Raux
(UMR AMURE / UBO - Ifremer)

www.umr-amure.fr

Table of contents

A review of Socio-economic information/Indicators in support to coastal zone management at the scale of the Mediterranean and Black Sea

The assessment at regional scale (i.e. Regional Seas understood as ecosystems, governance units, etc.) in terms of socio-economic information is expressed according three dimensions: time scale, geographic scale and activity or sector. The first issue is to define activities and the way to express them to form a marine economy or a characterization of the marine based activities. In addition to activities, more macroeconomic indicators can also inform about socio-economic development. Then, an additional issue relies upon the regional scale often defined in terms ecological characteristics when socioeconomic data are published on scales defined by administrative and political characteristics.

The purpose of the review of activities indicators and related databases is not to provide new indicators and indexes, but to review existing and relevant ones as well as their access at both time scale and geographic scale. In a second step it could be proposed some improvements through new indicators to be built or extended and the identification of gaps.

The review of data bases and potential integration into the PEGASO SDI will start from the whole Mediterranean and Black Sea and then to EU Med and to neighboring countries. Databases, institutions managing and processing data, or projects can sometime be redundant due crossed use of data.

1. Activities and sectors to be considered

Marine activities were already defined in the indicators task and the proposed set of indicators:

• Submarine cables	• Energy	- Offshore oil and gas-related industry - Electricity power production interacting with marine environment (Marine renewable energy, Nuclear plants…)
• Shipbuilding and repair, scraping…	• Living resources	-Aquaculture -Fisheries -Seafood processing and marketing
• Extraction of marine aggregates	• Transport	-Harbors and supports -Transport (marine traffic)
• Maritime financial services	• Recreational Activities	-Bathing -Yachting and Sport -Recreational fisheries
• Maritime civil engineering (harbors, dams, dikes…)		

Among these activities very few are available at Regional level and usual indicators of activities are rather: Fisheries and Aquaculture, Shipping, Tourism and Offshore oil.

Other activities to be considered are the ones impacting marine dependent activities through impacts to the ecosystems and to ecosystem services degradations. These activities can be already part to marine activities (aquaculture, energy, maritime transport, harbor…) or aside these activities (agriculture, urban development…).

• Other sectors impacting coastal and marine environment (Agro industry, Food Processing, Chemistry…)	-Agriculture -Other industries -Urban sprawl -Coastal tourism
• Rest of the non Marine Economy	- to assess the share of Marine Economy in the Global Economy

Another approach could consist in extractive activities vs. non extractive ones.

2. Characterization of activities

At local scale, indicators used to characterize activities are:

- Number of enterprises (demography of enterprises)
- Employment level
- Turnover (volume of activity
- Added value rate (as an indicators of local richness generated by the activity)

These indicators are used as proxy. The purpose is to define the economic and social importance of different **sectors** related to coastal and marine environment, by describing the main activities **relying on natural resources uses** (fisheries, etc.), **depending from** (tourism, etc.) or **having a significant impact** on the marine environment (agriculture, industry, etc.). This allows for characterizing the economic and social weight of public, merchant and recreational activities, as well as outlining interactions and interdependencies between activities and environment (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks). Turnover and number of enterprises are used as proxy of the pressure exerted over the ecosystems when employment level and added value are used to roughly assess the local fallout of related activities and weight their global activity level. Demography of enterprises also allows for catching the dynamics of the activities and sectors in order to underline trends and future pressures.

At regional scale some of these indicators are no more relevant due economic contexts and data accessibility. Turnover for instance should be replaced by the GDP, a more suitable macroeconomic indicator.

3. Macroeconomic indicators

This is not an exhaustive list of available macroeconomic indicators especially relevant for the Mediterranean and Black Sea basins, but at least it can reflect the type of macroeconomic indicators implemented at regional scale and illustrating the socioeconomic context of an area:

- Demography (population, rate of growth…) and Migration
- GDP – Gross Domestic Product (adjusted and non adjusted) à Economic Growth
- Employment and unemployment rate
- Standard of Living
- HDI – Human Development Index
- Level of Natural resources use
- % of protected areas…

4. Available data and Illustrations at the Regional scale

An important issue about socio-economic information is the non spatialization of information. Most of data are non geo-referenced and can only be viewed from land where enterprises are settled, at the scale of cities and communes (LAU 2) for the most detailed scale. Macroeconomic information is rather available at NUTS 1 and 2 levels.

There's no existing database providing socioeconomic information per country at the scale of Regional Seas (i.e. according to their contribution to Regional Seas). When existing, information needs to be rebuilt from various databases with the issue of neighboring countries over several Regional Seas: France (Atlantic, Channel and North Sea, Mediterranean), Spain (Atlantic and Mediterranean), Morocco (Atlantic and Mediterranean), Egypt (Mediterranean and Red Sea) Turkey (Mediterranean and Black Sea), Russian federation (12 seas washing the Russian coasts).

To identify the available source of data at the regional scales, the review is conducting by crossing activity and existing initiatives. The most complete information at Regional Seas is the one attached to natural resources. International regulations and obligations in the fields of natural resources management lead to a detailed and global monitoring of these resources. But beyond of biomass or stock expressed in volume and value it is often difficult to get detailed economic information such as labor and added value.

4.1. The Large Marine Ecosystems program (NOAA) - www.lme.noaa.gov

Large Marine Ecosystems (LMEs) is program from the NOAA with support from the IOC UNESCO and IUCN. For a large part it is a synthesis of existing data over 66 LMEs, including the Mediterranean (LME 26) and the Black Sea (LME 62), and some of them are reprocessed according to LMEs specific protocol to produce and rebuild suitable economic information to LME.

Five LME modules are developed for integrated ecosystem assessments. They take the form of 5 modules of spatial and temporal indicators of ecosystem (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem health, (iv) socioeconomics and (v) governance. The objective of the socioeconomics module is the integration of social and economic indicators and analyses with all other scientific assessments, to assure that prospective management measures are cost-effective. From the module analyses, a number of socio-economic data can be reported at the scale of the Mediterranean and Black Sea for neighboring countries.

Through the socioeconomics module, a framework has been developed for incorporating socioeconomic considerations into an adaptive management approach for LMEs. A method for indexing the relationships between marine industry and socioeconomic development has been developed by Hoagland and Jin (2006) of the Marine Policy Center of the Woods Hole Oceanographic Institution. Index is called the Marine Activity Index (MAI).

The index approach aims at providing a single metric for marine activities for a purpose of comparison between LMEs and between Regional Seas[1]. It is different from the PEGASO objective

[1] In the case of Mediterranean and Black Seas, Regional Seas are identified to the same LMEs.

working at the scale of the Regional Seas. Nevertheless, to build such index, authors compile public available worldwide data on marine activities occurring in coastal nations. Data on marine activities include fish landings, aquaculture production, shipbuilding, cargo traffic, merchant fleet, oil production, oil rig counts and tourism arrivals. These data are expressed in physical units and not prices.

The question of data allocation to LME or Regional Sea is also discussed in the case of several LME/Regional Seas for a country where only a portion of a country's marine activities has to be attributed due to the lack of sub-national level available (NUTS 3 for instance):

- One approach is to calculate the country's coastline length within the region to be considered and to report it to the total country's coastline length. Then use the same ratio to weight the marine activities.
- Authors prefer to weight marine activities for each country of the region to be assessed. They calculate the share of the region coastline for each country and use that share to weight the country's marine activities. This reduces the risk of attributing some marine activities to region where they might not take place.

Authors give the published sources, unit and vintage of data, so that an update could be made available (but some of databases are not of public access). In addition to marine activities, the HDI index from UNDP is included for comparison purpose with the MAI.

Marine Industry Indicators and Data Sources from Hoagland et al. (2006)

Indicator	Unit	Year	Data Source
Human Development Index (HDI)	Dimensionless	2002	*Human Development Report 2004* (UNDP 2004)
Fishery landings	Metric tons (MT)	2003	Fisheries Global Information System 2003 (FAO 2005)
Aquaculture production	Metric tons	2003	Fisheries Global Information System 2003 (FAO 2005)
International tourism number of arrivals	Number of visitors	2004	World Development Indicators 2004 (World Bank 2004)
Shipbuilding orderbook*	Gross tonnage (GT)	2nd quarter 2004	*Shipping Statistics Yearbook 2004* (ISL 2004)
Shipping cargo traffic	Metric tons**	2002	*Shipping Statistics Yearbook 2004* (ISL 2004)
Merchant fleet***	Deadweight tons (DWT)	Jan. 1, 2004	*Shipping Statistics Yearbook 2004* (ISL 2004)
Offshore oil production****	Average barrel/day	2004	*Oil and Gas Journal Databook 2004 (OGJ 2004)* US Department of the Interior (2005)
Offshore rig count	Number	Dec., 2003	*Oil and Gas Journal Databook 2004* (OGJ 2004)

* Ships of 100 GT and over.
** Units for a small fraction of ports are in freight tons, revenue tons, or harbor tons (see ISL 2004).
*** By nation of domicile; ships of 1000 GT and over.
**** Data for some countries are partial due to (1) missing data for some offshore fields and (2) lack of separate statistics for offshore (vs. onshore) production.

Hoagland et al. 2006

For the purpose of the PEGASO project, data are extracted and rebuilt for Mediterranean and Black Sea neighboring countries based on the marine activity database built and published by the LMEs program. HDI has been also updated for 2012 based of UNDP databases[2]. These data can be used to compare level of each individual marine activity across coastal countries of the Mediterranean and Black Sea. But these marine activities data are for country level and can be shared over 2 LMEs or more:

[2] http://hdrstats.undp.org/en/tables/

Mediterranean Sea		Black Sea	
Exclusive Mediterranean Countries	**Non Exclusive Mediterranean Countries**	**Exclusive Black Sea Countries**	**Non Exclusive Black Sea countries**
Albania, Algeria, Croatia, Cyprus, Greece, Israel, Italy, Lebanon, Libya, Malta, Palestinian Territories, Slovenia, Syria, Tunisia	Egypt, France, Morocco, Spain, Turkey	Bulgaria, Georgia, Romania, Ukraine	Russian Federation, Turkey

Due to data vintage, there could be missing countries such as the Montenegro being independent in 2006. Other should be integrated according to their impacts on the Seas through river basins and some marine activities (Bosnia Herzegovina).

Purpose of the method designed by authors is to provide indexes at the scale of the LMEs with the objective of ranking and comparing LMEs based on these indexes. Indexes are then built at the scale of LMEs and Regional Seas and are not provided at country level. In addition to HDI and Marine Activity Indexes, 3 others more specific indexes were built: Fishery and Aquaculture, Tourism and Ship&Oil indexes.

Results for the Mediterranean and Black Sea are the following and allow for comparing the two Regional Seas:

Regional Seas	Socioeconomic Index (HDI)	Fishery and Aquaculture Index	Tourism Index	Ship & Oil index	Marine Industry Activity Index
Mediterranean	83.262	1.087	27.192	4.595	8.413
Black Sea	77.323	2.859	7.941	1.176	2.865

Ship & Oil index includes shipbuilding, shipping and offshore oil

Hoagland et al. 2006

Crossing Socioeconomic Development Index and Marine Activity Index:

	Low socioeconomic Development (*SEI* < 50)	**Medium socioeconomic Development** (50 ≤ *SEI* < 80)	**High socioeconomic development** (*SEI* ≥ 80)
High marine industry activity (MAI ≥ 30)	None		
Medium marine industry activity (5 ≤ MAI < 30)	None		Mediterranean Sea
Low marine industry activity (MAI < 5)		Black Sea	

Hoagland et al. 2006

Access and Time scale

Data are not directly accessible from the site; solely limits of LMEs are available for download into GIS software. Need to go back to raw data sources. Until now, LME was a one shot exercise in order to deliver framework and methodology and data are not planned to be updated. Data range from 2002 to 2004.

Aside this specific exercise for accounting economic activities, there're also specific reports on the state of LMEs. But they do not go beyond of general statement about a series of ecological criteria and solely fisheries is addressed in terms of activity through landings by species and commercial groups. Data are given for the whole regional seas and are not detailed according to countries.

Hoagland, P., D. Jin, 2006. Accounting for economic activities in Large Marine Ecosystems and Regional Seas, UNEP Regional Seas Reports and Studies N°181, 151p.

4.2. Databases according to sectors

The issue of data allocation remains for countries belonging to several regional seas. Solely fisheries resources (catches) can be allocated to Mediterranean or Black Sea according to FAO/GFCM fishing areas.

4.2.1. Fisheries Resources FAO / Eurostat / Searoundus project

The FAO FishBase and Mediterranean and Black Sea Fisheries database from the GFCM allow for covering the Mediterranean and Black Sea in value and volume. But for landings and values, there's no difference made between Mediterranean and Black Seas, leading to difficulty again in allocating production and values for multi neighboring countries. Solely catches can be allocated to one or the other Regional Seas (RS) according to fishing areas or sub-fishing area. They can be declined according to species, family, commercial products, etc.

Tables of indicators were built for both Regional Seas for:

- Catches in quantity per country and per species group Med (tonnes).
- Catches in quantity per country and per species group BS (tonnes).

No value is available regarding catches. Solely existing values are related to trade and commodity per country. A table was constructed for Mediterranean and Black Sea countries, but value cannot be attached to RS:

- Value of commodities and trade for Mediterranean and Black Sea countries (1000 USD).

Time series: 1950 to 2011 for both catches and aquaculture

Under Eurostat a value can be attached to catches through the species price. But it requires going down to the species level and per country. Such procedure can be difficultly seen as a routine process and under Eurostat solely EU member States and associated countries are covered.

For aquaculture there's no difference made between Mediterranean and Black Sea, considered as a whole aquaculture area by FAO and GFCM. Tables of indicators were built for the Mediterranean and Black Sea together:

- Production in volume, per country, group of species of Med&BS (tonnes)
- Production in Value, per country, group of species of Med&BS (1000 USD)

On Eurostat, Fisheries resources are mainly based on FAO, but additional statistics can be found about fishing fleet (not available under FAO where solely data about Vessel Record Management Framework are sent to FAO by institutional partners). But again, data are only delivered for the EU member States and EEA.

The Sea Around Us project www.seaaroundus.org

The "Sea Around Us" project was initiated in 1999 to study the impact of fisheries on the marine ecosystems of the world, and to offer mitigating solutions to a range of stakeholders. The project through its website proposes analyses, visualizations, articles in peer-reviewed journals and data access mainly based on the FAO Fishstat. Data are available at the scale of countries' Exclusive Economic Zones, Large Marine Ecosystems, the High Seas and other spatial scales, and as global maps and summaries. Regarding LMEs, the project directly links to the LMEs NOAA's project reports and data.

The project mainly deals with fisheries and ecosystems data. The solely economic data of interest are related to catches and landings in volume and value and are already available through the FAO FishStat. Interest in the site relies mainly in analyzes and visualization at the scale of countries, LMEs or EEZs (Figures 1 to 6).

4.2.2. Other marine economic activities

Regarding economic activities, there's no database covering the whole Mediterranean or Black Sea. Socioeconomic information in general is always distributed or attributed according to geopolitical aggregates, but not yet at ecosystems scales. That leads to go through specific sectors databases (shipping, oil, fisheries, etc.) to try to rebuild information when databases are of free access: World Tourism Organization (WTO http://www2.unwto.org), International Energy Agency (IEA http://www.iea.org) limited to part of OECD countries, International Maritime Organization (IMO http://www.imo.org), the Joint Organisations Data Initiative (JodiOil http://www.jodidata.org) ... But most of these UN specialized agencies and Institutional agencies don't provide suitable data for our regional assessment purpose. Data are often not readable in terms of marine area or are provided in terms of regulations or too wide indicators.

To balance such lack of data, the related industries often organized themselves to produce and maintain economic databases. But access is quite complicated and costly when database are managed by private companies (oil and gas journal for offshore oil and rig number, Lloyds for shipping and maritime traffic, etc.). At last there's still the issue of data allocation to RS, but with the lack of data available at local level there's no other way for the moment than reallocating national data.

Figure 1 Landings by fishing country in LME: Mediterranean Sea (Sea Around Us Project 2011)

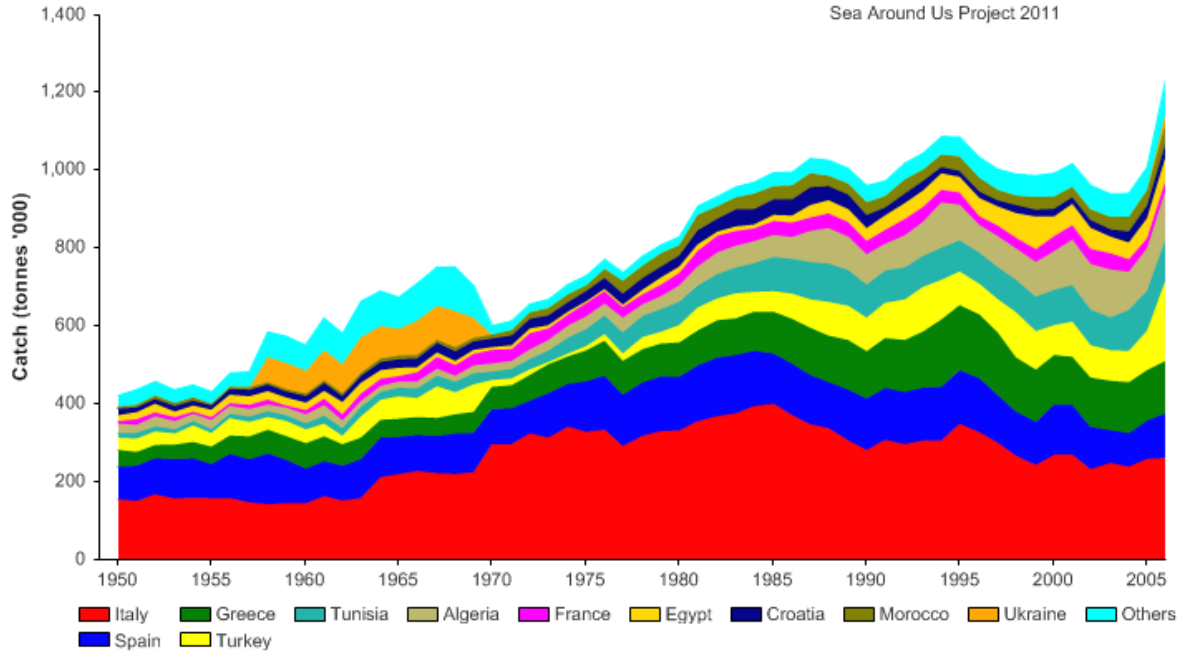
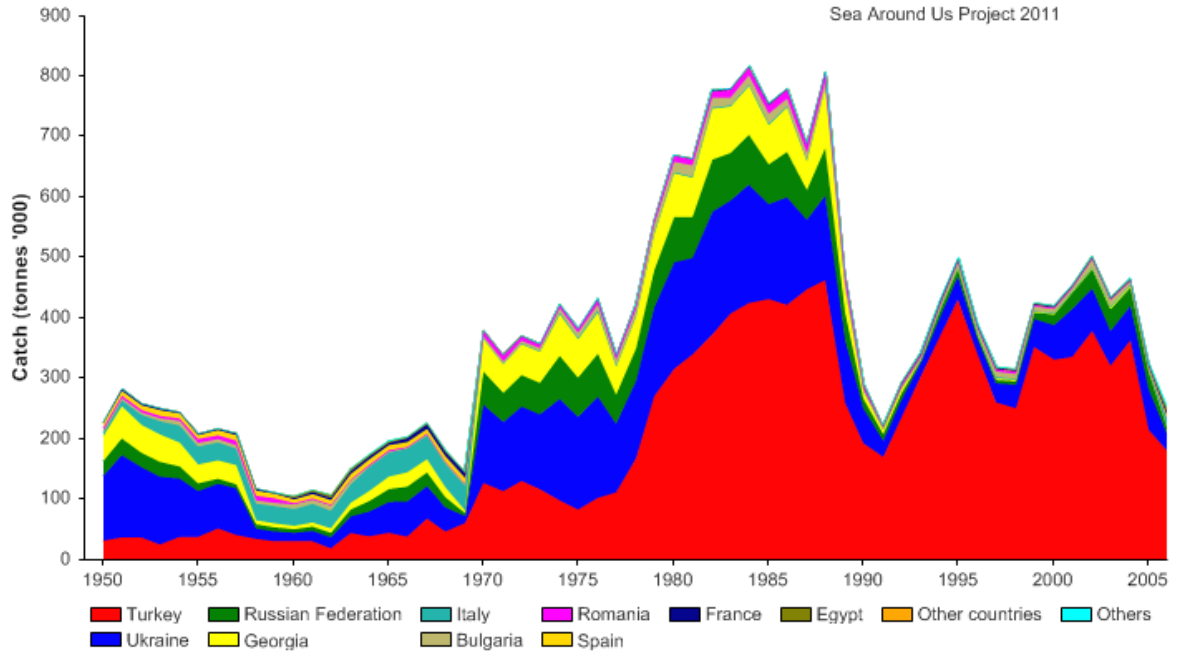


Figure 2 Landings by fishing country in LME: Black Sea (Sea Around Us Project 2011)



Stock status in LME: <u>Mediterranean Sea</u>:

Figure 3 Percentage of catches from stocks of a given status – Mediterranean

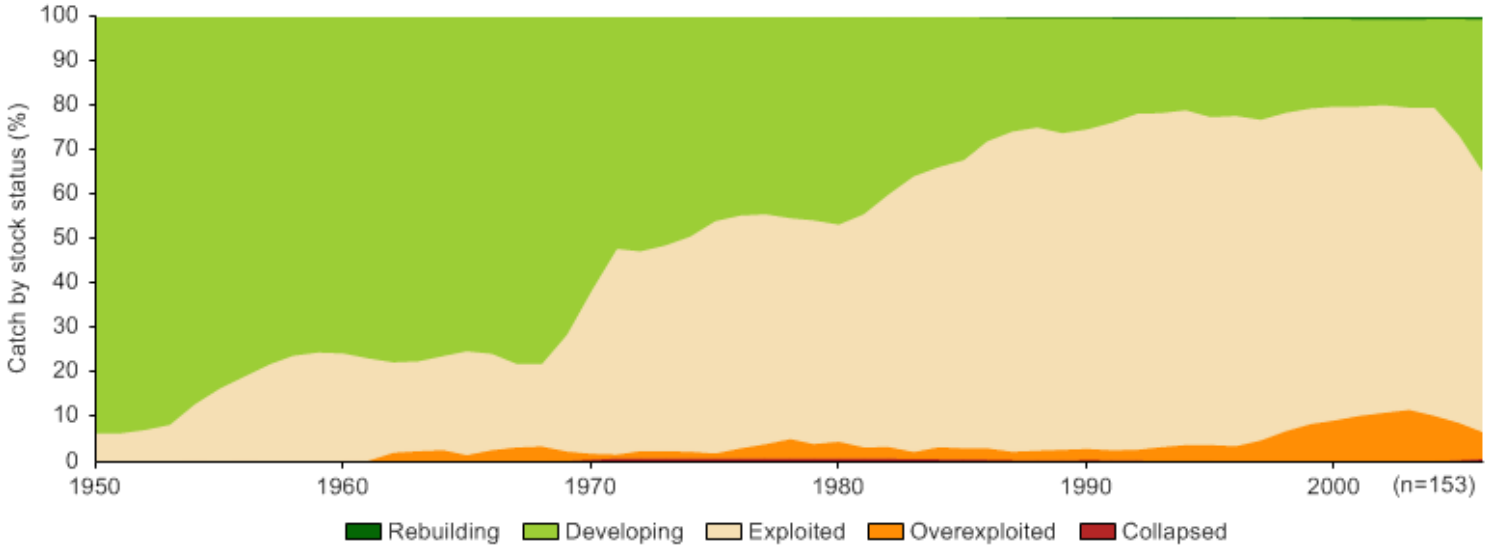
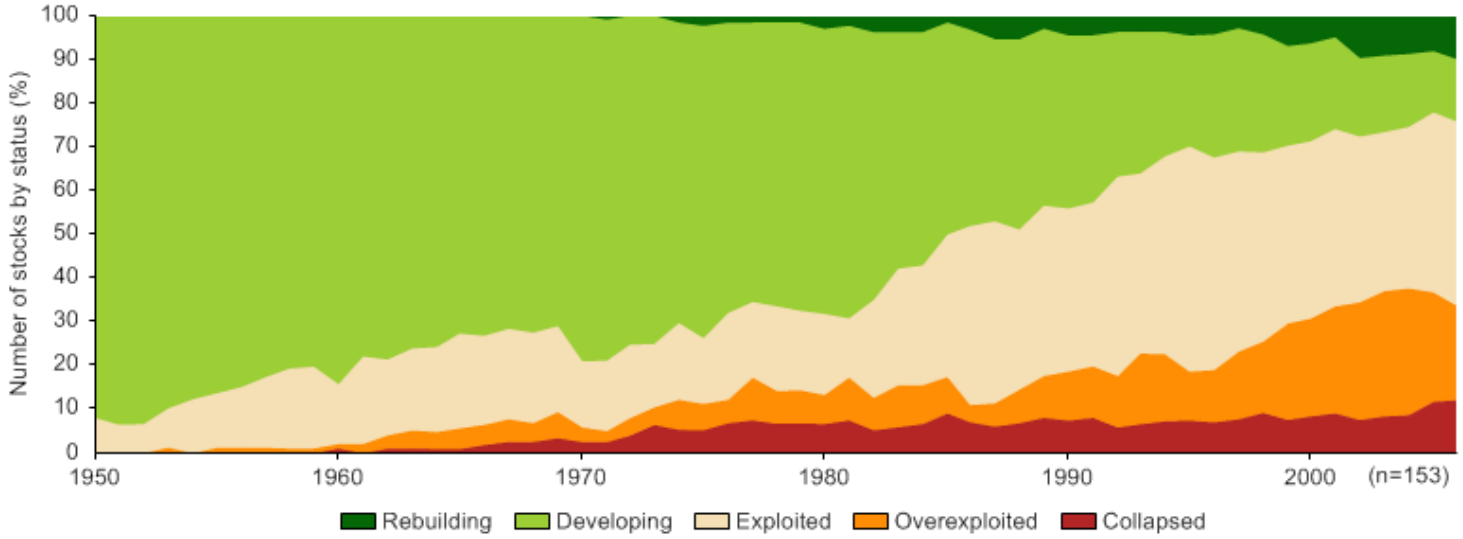


Figure 4 Percentage of stocks of a given status – Mediterranean



x

Stock status in LME: Black Sea:

Figure 5 Percentage of catches from stocks of a given status – Black Sea

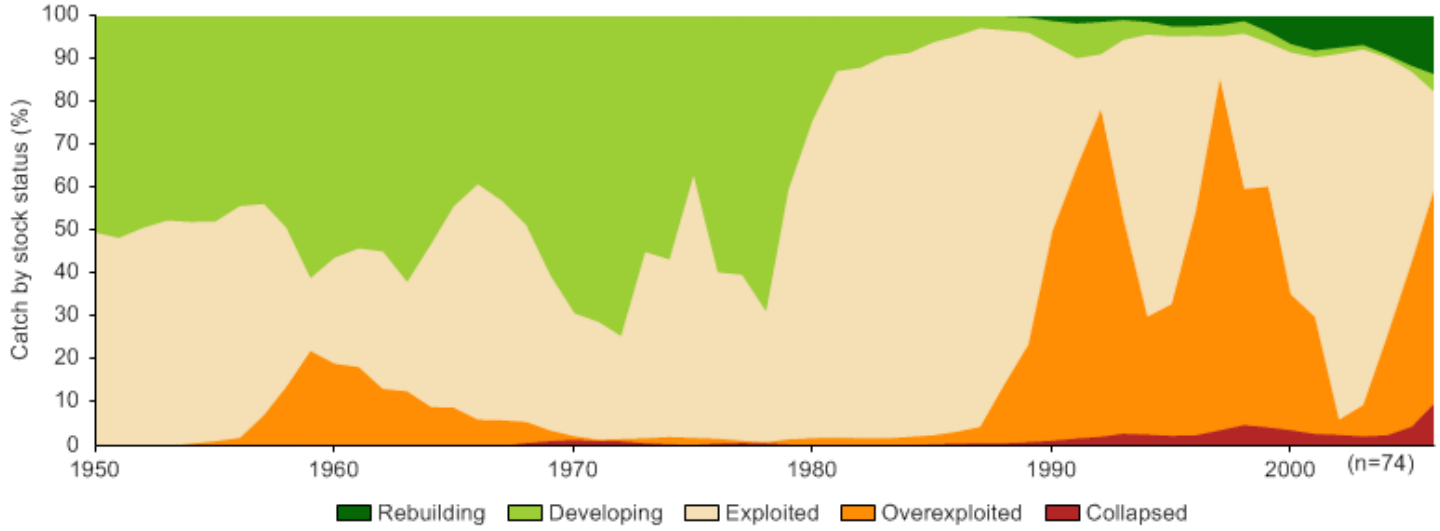
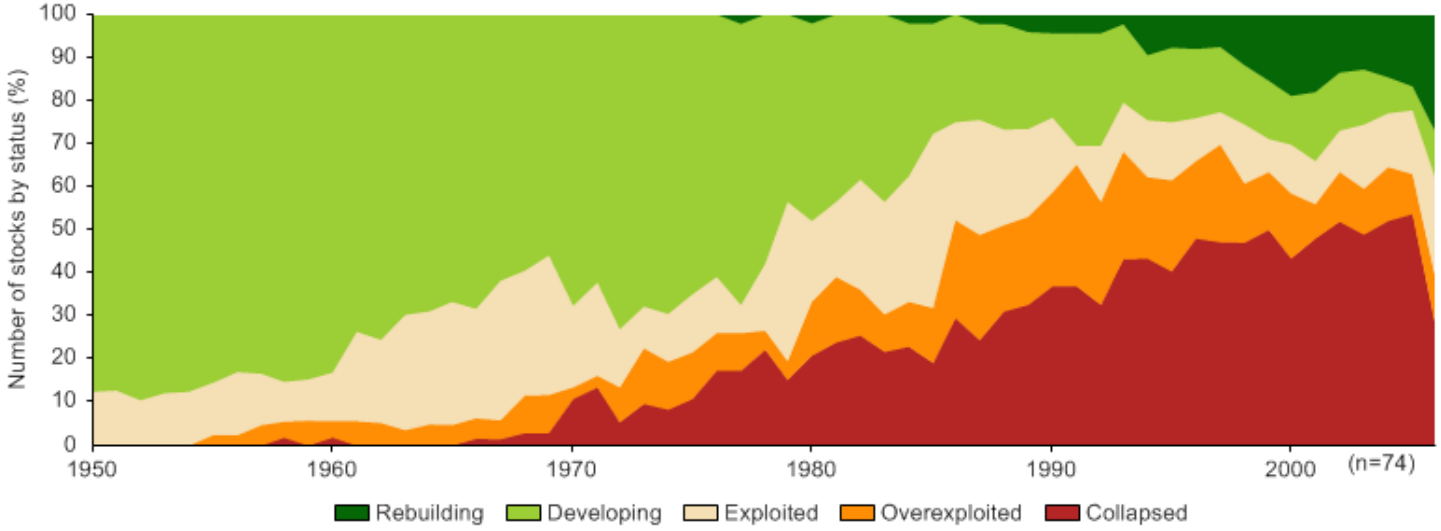


Figure 6 Percentage of stocks of a given status – Black Sea

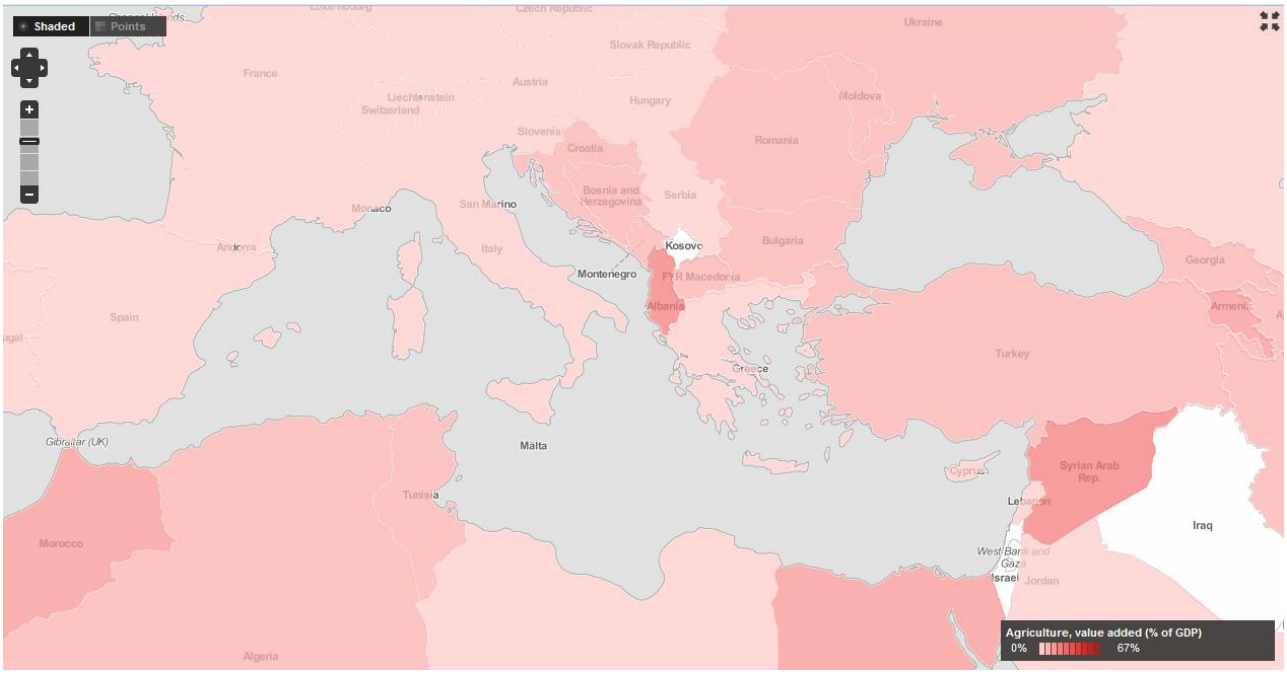


4.2.3. The World Development Indicators (WDI) database from the World Bank

"World Development Indicators (WDI) database is the World Bank collection of development indicators, compiled from officially-recognized international sources. It presents the most current and accurate global development data available, and includes national, regional and global estimates."

The World Bank publishes statistics about economic activities for the whole countries. The WDI and related databases are the most complete ones at international level. But data are not always the ones users are looking for at detailed scales, but rather proxy or aggregates. In addition activities recorded are mainly land based activities or aggregated to land based activities (agriculture is made of: forestry, hunting, and fishing, as well as cultivation of crops and livestock production, Figure 7). Even for the Millennium Development Goals database managed by the World Bank there no interesting information for marine and coastal area.

Figure 7 Example of activity indicator: value added for agriculture (WorldBank WDI)



Following sectors are the one of interest identified and rebuilt for PEGASO:

- International tourism: international arrivals, but nor marine dimension; per country and per year.
- International tourism, expenditures; per country and per year.

Other data are more relevant for macroeconomic dimensions (Export/Import volume and value, Demography, GDP…).

4.2.4. Eurostat (http://epp.eurostat.ec.europa.eu) and EOCD (www.oecd.org/statistics/)

The solely transnational databases for detailed economic activity information are the Eurostat and OECD ones, but limited to EU or EEA countries plus Turkey or OECD countries. For OECD there's no coastal or marine dimension in indicators produced (mainly land based or inland sectors, activities and issues)[3] and data are often accessible under payment fees. Information is provided at country level and sometimes at NUTS2 and 3 levels, but in a very incomplete way that doesn't allow rebuilding information for coastal areas at the scale of the Med or Black Sea. Nevertheless it gives a good idea of what could be feasible if a "Medstat" and "BlackSeastat" was built adopting similar protocol for data collection and monitoring.

Some activities are sometimes covered at the whole Mediterranean and Black Sea scale due to availability of international databases such as FishStat (FAO) or other databases from the UN (IMO, WHO…). But for activities requiring data from nations (number of enterprises, Added Value, Turnover…) there's a gap with non EU member States.

Different sources of data are available under Eurostat and at different geographic and administrative scales. From the whole and generic database, information is not as detailed as wished for a coastal or marine approach. For instance regarding Maritime Transport:

- Maritime Transport (volume based on harbor and type of freight): NUTS 1 (National) level for EU27 + Turkey and Norway. Aggregated at country level but data not available at harbor level (some at harbor level but very incomplete and no allowance for rebuilding information at coastal level).
- Maritime Transport (passengers and fret) at regional level: NUTS 2 level for EU27 + Turkey and Norway; but again incomplete for numerous countries and no aggregation possible at the scale of coastal regions.
- …

For energy, the statement is similar. There's for instance some data about consumption at NUTS2 level but very incomplete (less than 20% of NUTS2 are informed).

An additional source of data, but still fed by Eurostat, is the Coasts and Seas section developed by the European Environment Agency (http://www.eea.europa.eu//themes/coast_sea/). Beyond of fisheries and aquaculture, it only deals with bio-physical data and a number of potential interesting data in terms of pressures are out of date (e.g. accidental oil spill from shipping dating from 2004).

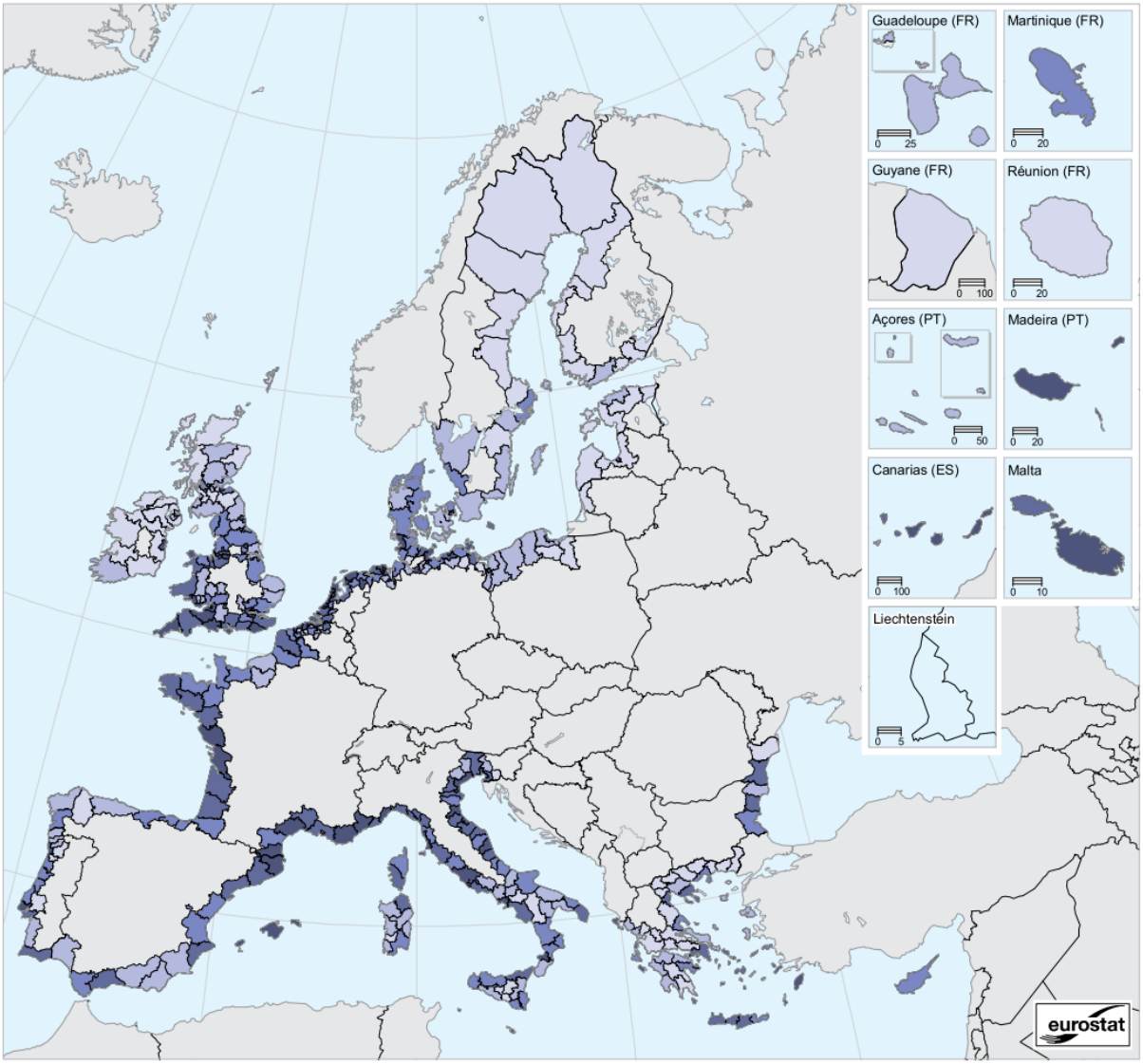
But Eurostat developed some specific regional databases and especially for maritime or coastal regions:
http://epp.eurostat.ec.europa.eu/portal/page/portal/maritime_coastal_regions/introduction

Coastal regions are statistical regions defined at NUTS level 3 with a coastline or with more than half of their population living less than 50 km from the sea. It is the ideal level of data availability so that we can rebuild information at Regional Seas scales. Nevertheless, data provided at this scale are mainly limited to demography. Other data focusing on coastal tourism capacity (Figure 8) and

[3] Solely the apparent consumption of fish was found as useful indicators through the Environment topic and Material resources indicator and Shipping through National sea transport statistics of the International Transport Forum http://stats.oecd.org/index.aspx?DatasetCode=NATIONAL_SEA_TRANSPORT.

maritime transport and ports (maritime traffic passengers mainly) can get obtained but not directly from the online database. These indicators are the support of the "EU Costal Regions portrait" regularly published by Eurostat.

Figure 8 Density of tourist accommodation in hotels, campsites and other tourist accommodation in EU coastal regions, by NUTS 3 regions, 2010 (1) (bed places per km²)



(') Kiel, Kreisfreie Stadt (DEF02), Stormarn (DEF0F), France and Malta, 2009.
Source: Eurostat (online data codes: tour_cap_nuts3 and demo_r_d3area)

Eurostat Focus on Coastal Regions 13, Eurostat regional yearbook 2012

To perform an analysis at minima at the scale of Mediterranean and Black Sea, other activities in terms of stressors over the ecosystems would be needed both from Eurostat and non EU countries. But Eurostat again illustrates what could be a MedStat and a BlackSeaStat at the level of the Mediterranean and Black Sea. Such a project already exists, supporting countries from the Southern Mediterranean in the monitoring and records of statistics with the aim of reaching a homogenous level in terms of data quality and monitoring over the Mediterranean. This multi-country programme called 'MEDSTAT' delivered first notebook on statistics, but still at the level of macroeconomic indicators at the country scale and not yet at the scale of activities and according to regional scales (Pocketbook on Euro-Mediterranean statistics, 2011 Ed.).

Other illustrations, but at the scale of the USA, of what could be a suitable economic information system are the National Ocean Economics Program (NOEP) http://www.oceaneconomics.org and the NOAA's Sate of the Coast: http://stateofthecoast.noaa.gov.

But instead of looking in detail and reviewing Eurostat with a marine and coastal eye, we can benefit from the work performed by the KnowSeas FP7 project.

4.2.5. The KnowSeas project targeting directly the scale of the EU Mediterranean and Black Sea

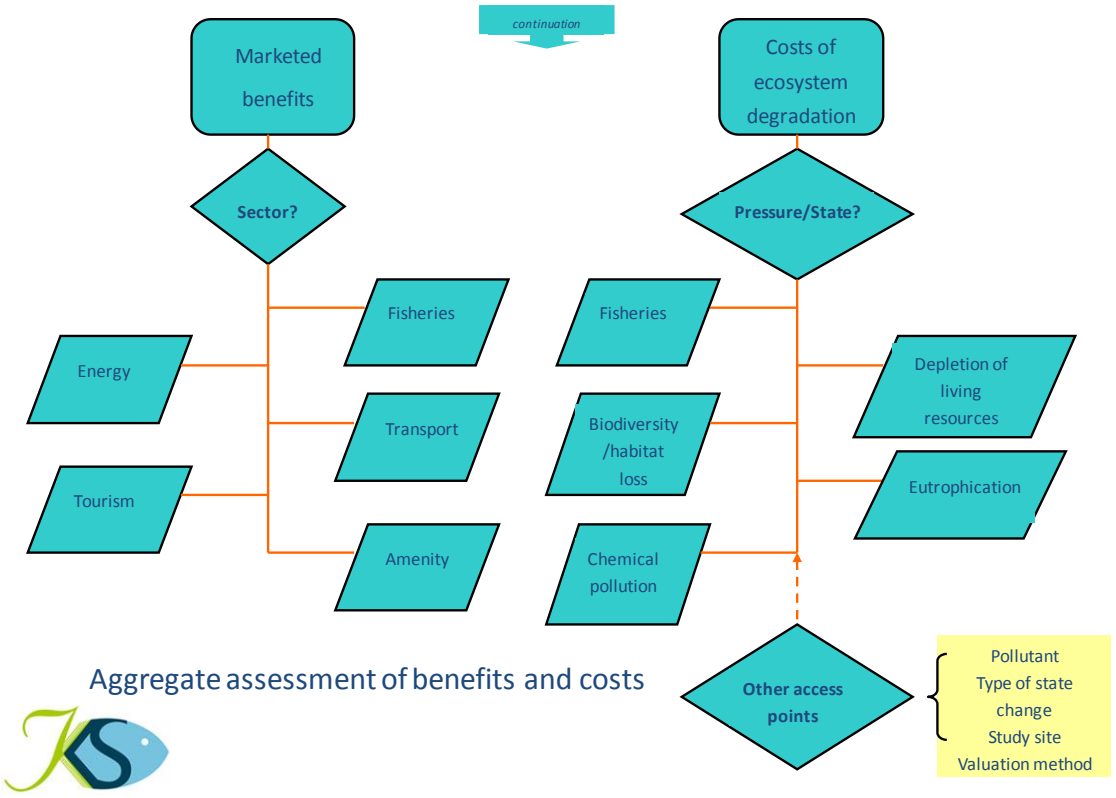
UBO was involved in the FP7 KnowSeas project where it contributed to establish an assessment of cost and benefits at regional seas level, in support to the implementation of the MSFD. A number of data were collected from different database to characterize a set of marine activities and stressors.

The KnowSeas project was just completed by the end of June 2013 and is entering in its evaluation process, but mention of and reference to the project will allow for exploitation and visualization of data collected and reprocessed. A geonode was also developed by KnowSeas for application on study sites and especially on the Gulf of Lion for the Mediterranean.

A set of databases were compiled in order to get an aggregated view of main marine and coastal market based activities.

Scale: EU Regional Seas as defined by the MSFD.

Market based activities covered by KnowSeas:

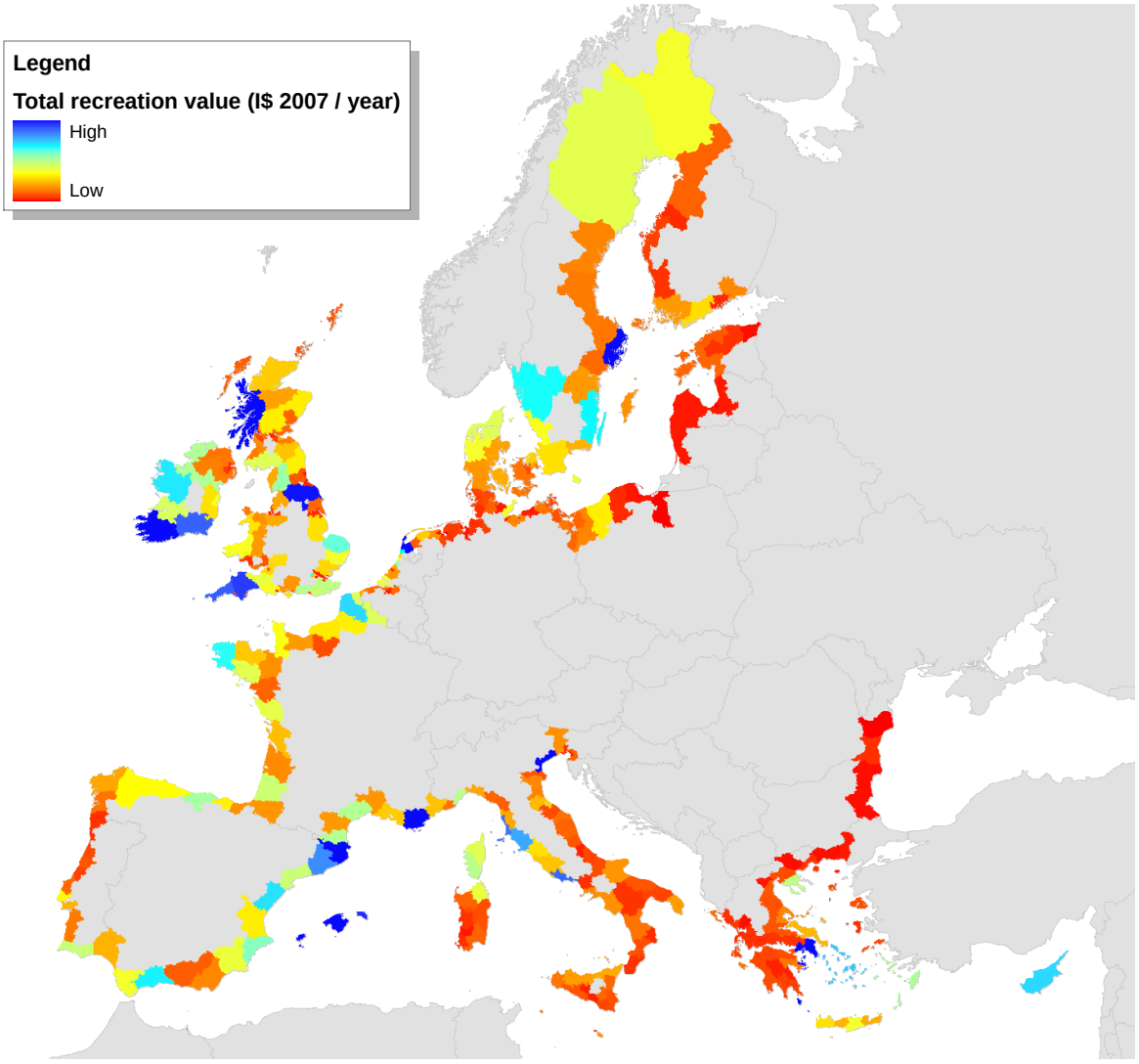


But data from Eurostat and other databases needed to be reprocessed with additional data calculated within KnowSeas and this can difficultly seen as routine process based on available databases. Results are given hereafter and are summarized in Tables 2 and 3.

Tourism

Tourism Data are available at NUTS1 and 3 levels from Eurostat allowing for characterizing the whole EU coast. Value attached to tourism or recreational visits is based on domestic and international arrivals from Eurostat at NUTS3 level and valued and aggregated from an estimate of recreational value made on a meta-regression of individual, per trip recreation values (Figure 9).

Figure 9 Distribution of total recreation values in coastal NUTS-3 regions of Europe



From Ghermandi A. and Nunes P. (2011) – KnowSeas project.

Fisheries

Value is based on catches expressed in volume at both species level and per EU member States country. Catches are valued according to species values and then aggregated from fishing areas to EU RS (2,262 million Euros in 2010 for the Mediterranean and 3.41 million Euro for the Black Sea in 2010 excluded non EU countries). Figures 4 and 5 illustrate data available at Eurostat level using Eurostat viewer, but solely in volume. From KnowSeas, data are available both in volume and value, but solely for EU member States.

Aquaculture

Value is extracted from FAO and GFCM databases but limited to EEA countries (see above for FAO FishStat database). Eurostat allows for viewing these data on a map (Figures 10 and 11).

Energy

Hydrocarbon production data for the latest available year, 2009, are obtained from IEA (International Energy Agency World Energy Statistics). How much of this production was offshore was investigated using country-level sources, where available. Offshore electricity production data are obtained from country-level sources. Production is valued for each country (oil and gas at import costs, electricity at price per unit charged to industry). Assessment was limited to the North East Atlantic where most of activities take place (North Sea) (Table 3). No assessment made for other Seas due to no significant energy production by EU member States.

Freight Transport

Assessment is first based on the gross weight of goods handled in all ports for EU27 and Norway. For each country, traffic volume (in terms of weight of goods transported) is attributed to the seas over which the goods would need to be transported giving a volume-distance measured in tonne-nautical miles. After eliminating double counting (as volumes includes both inward and outward flows), traffic is evaluated using rated based on unit cost data in $ per kg for maritime freight provided by the OECD (2010). A lot of assumptions are made all along the valuation process due to paucity of data (type of goods freighted, unit costs provided for solely 3 routes…) and the valuation is not judged as really reliable.

Figure 10 Aquaculture production in volume for Med and BS EU countries

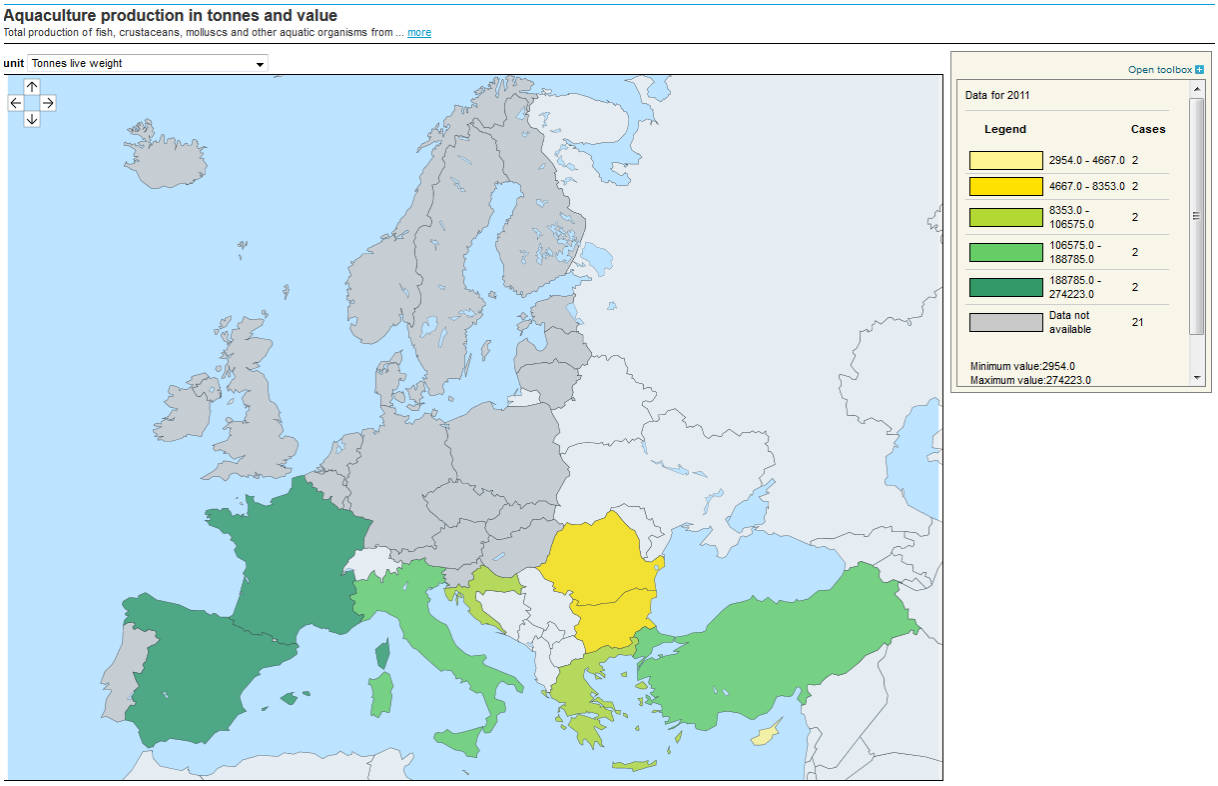


Figure 11 Aquaculture production in value (Euros) for Med and BS EU countries

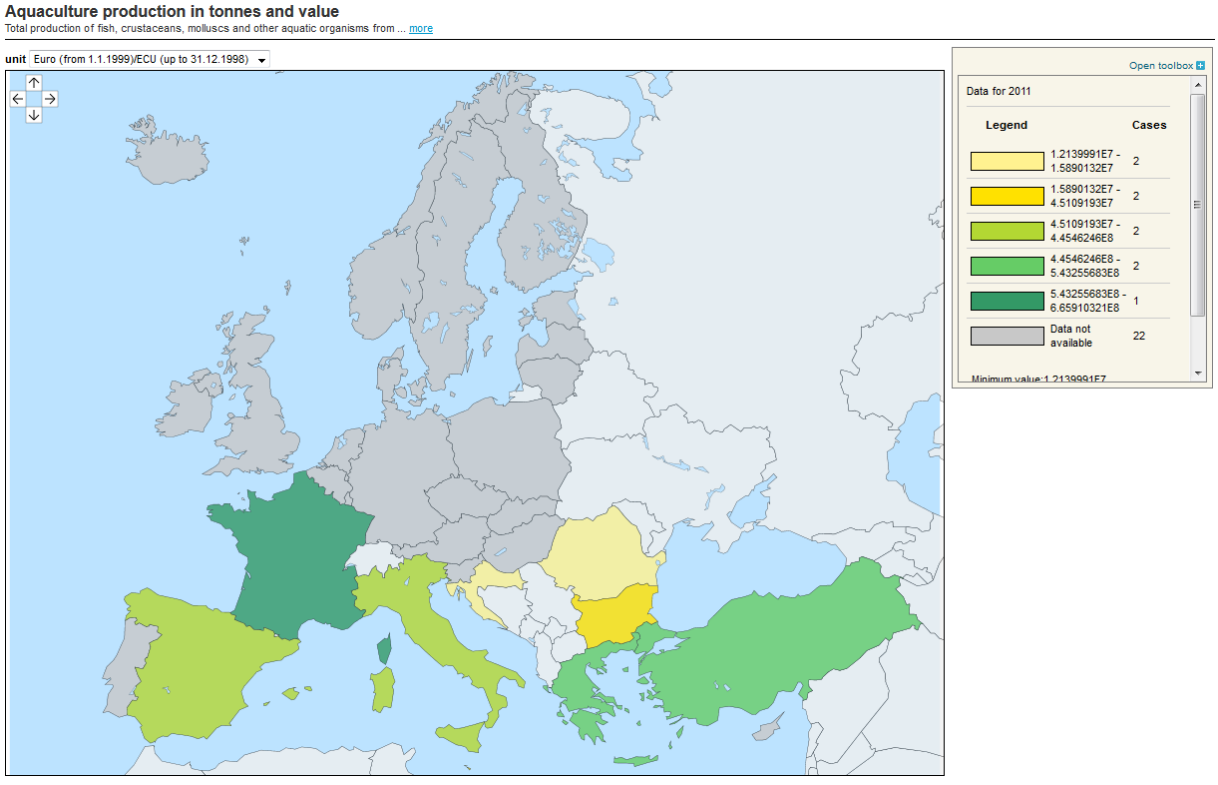


Figure 12 Fisheries catches in the Mediterranean in Volume (tonnes live weight)

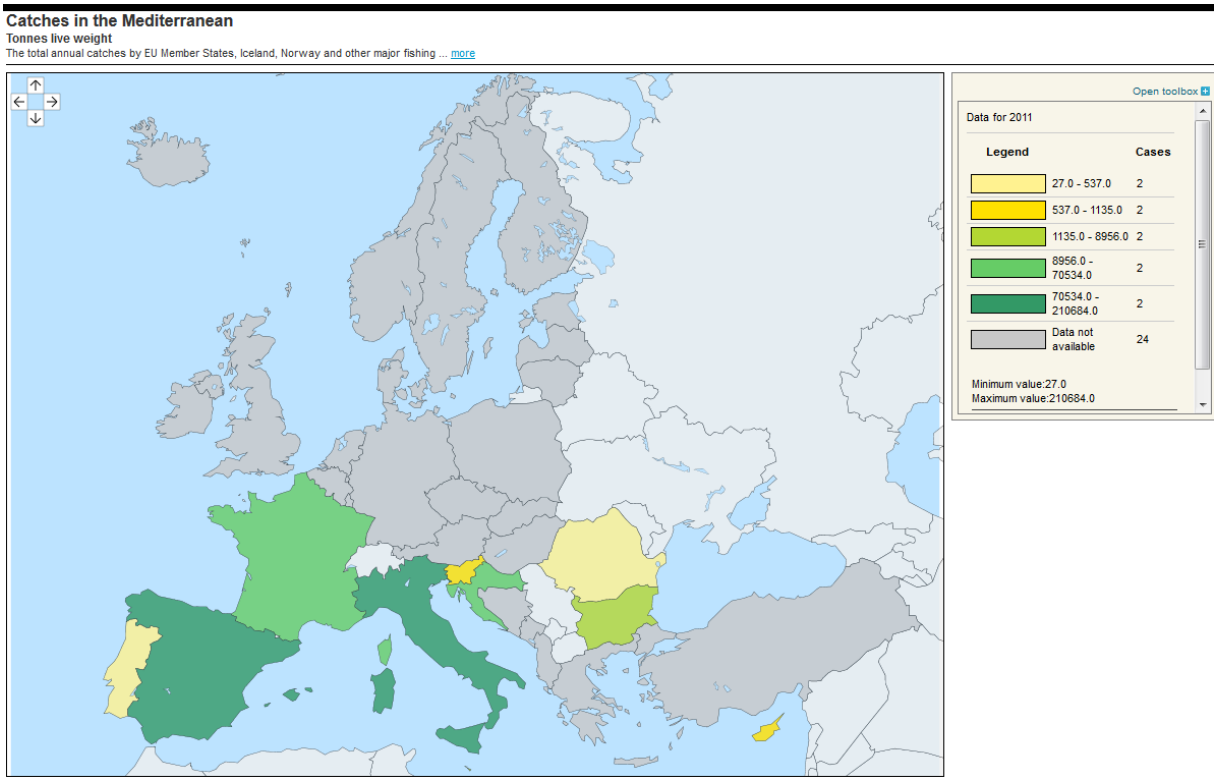
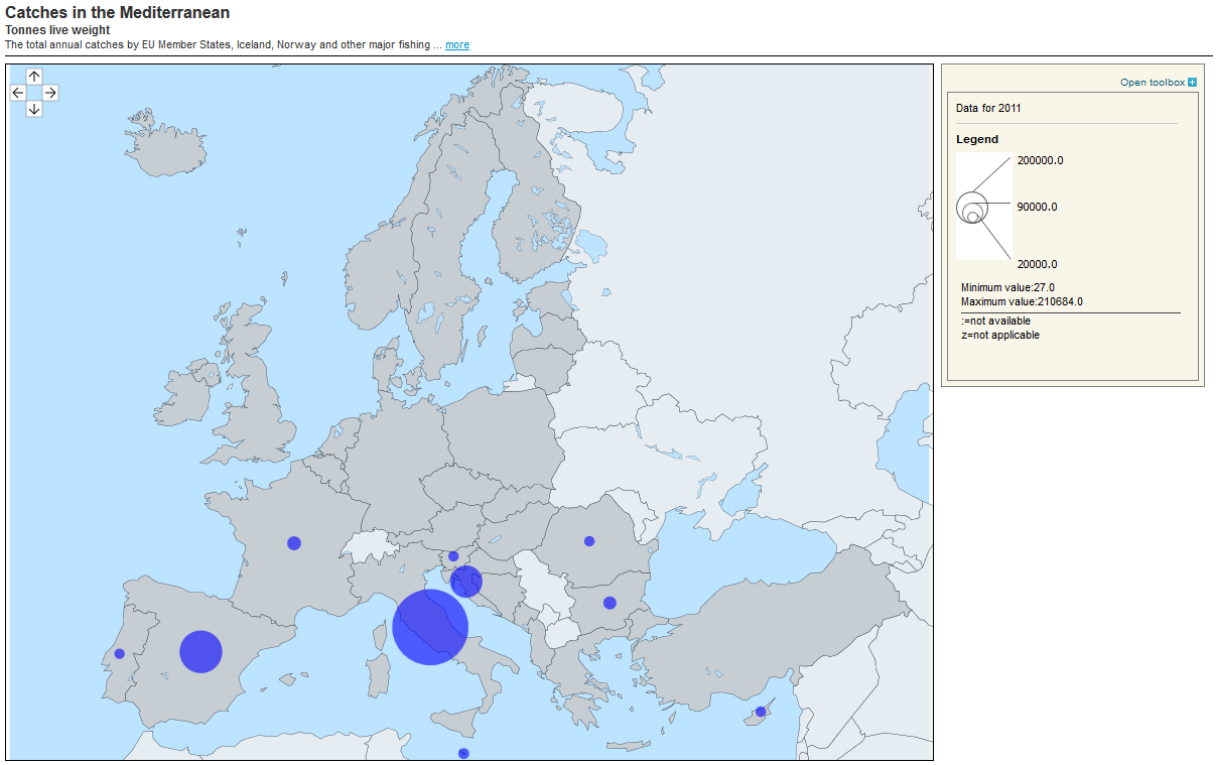


Figure 13 Fisheries catches in the Mediterranean Volume (tones live weight)



Carbon storage

Carbon and CO2 storage valuation was valued from two storage sources: saltmarshes (using Corine land cover maps 2000 and 2006) and seagrass (*Posidonia oceanica* seagrass beds in the Mediterranean). The assessment was performed applying the damage cost avoided method and according to different sedimentation rates. Estimates from SCC, EUA and CER prices, and DECC forward prices were used to value carbon storage. Values were aggregated from saltmarshes level to RS level. The aggregation could be provided at country level too.

For seagrass value was assessed based on C and CO2 sequestration estimates (sequestration rate per hectare per year x *Posidonia oceanica* area (hectares) in the Mediterranean Sea) and according different rates.

Limits to the estimates: lack of data for net C or net CO 2 sequestration in the saltmarshes of each European country and especially in Mediterranean coastal areas. Needs of data related to carbon stored in the water column.

Water quality

A benefit transfer was implemented to value health effects and eutrophication at regional sea level for EU member States. But value derived for each RS doesn't pay attention to neighboring countries of several RS and can lead to double counting if several RS are considered at the same time.

Table 1 Aggregated WTP per European Regional Sea for water quality related to recreation for health risk reduction and eutrophication reduction respectively.

Countries	Population at 2011	WTP chosen		WTP aggregated per regional sea and related countries (€, millions)	
		Health Risk reduction	Eutrophication reduction	Health Risk reduction	Eutrophication reduction
Mediterranean Sea				**7,723**	**4,656**
Spain	4,6152,926	60.05	24.97	2,771	1,152
France	65,075,310	33.54	24.97	2,183	1,625
Italy	60,626,508	33.54	24.97	2,033	1,513
Slovenia	2,050,189	33.54	24.97	69	51
Greece	11,329,618	53.14	24.97	602	283
Cyprus	804,435	53.14	24.97	43	20
Malta	417,608	53.14	24.97	22	10
Black Sea				**1,537**	**326**
Romania	21,413,815	53.14	11.29	1,138	242
Bulgaria	7,504,868	53.14	11.29	399	85

From Luisetti et al. (2011) in KnowSeas D4.2

Table 2 Summary of valuation methods and results by source – KnowSeas FP7 project (Cooper et al. 2011)

◆ Good scope coverage and reliable valuation base ◆ Poor scope coverage **or** unreliable valuation base ◆ Poor scope coverage **and** unreliable valuation base

Type of value	Sector/Activity	Evaluation method: Scope	Evaluation method: Valuation base	Value/€2010'm p.a.: Ecosystem services	Value/€2010'm p.a.: Marine space	
Direct use	Energy	Principal hydrocarbon producers in NEA (>90% of EEA production)[1]	Production quantities in 2009 at market values		114,362.4	◆
	Fisheries – capture	EEA countries	Average catch 2007-2009 at market values	8,675.0		◆
	Fisheries – mariculture	EEA countries	Average production 2006-2009 at market values	5,515.2		◆
	Freight transport	Principal countries and main routes involving major ports (~55% of EEA traffic)[2]	Maritime freight movement in 2009 evaluated at median cost per ton nautical mile[3]		13,745.5 - 62,359.6	◆
	Recreation (visits)	EU27 countries with coastline	Estimation of aggregate expenditure by visitors based on meta-analysis[4]	31,393.5		◆
	Recreation (water quality) – health risk	EU27 countries	Representative WTP for avoidance/remediation grossed up by population	15,327.0		◆
	Recreation (water quality) – eutrophication	EU27 countries	Representative WTP for avoidance/remediation grossed up by population	40,342.0		◆
Indirect use	Carbon storage – salt marshes	Total saltmarsh area in EU27	Marginal damage cost avoided[5]	0.6 - 297.5		◆
	Carbon storage – seagrass	Mediterranean *Posidonia oceanica*	Marginal damage cost avoided[6]	31.4 - 1,095.3		◆

[1] Principal hydrocarbon producers in NEA: DE, DK, NL, NO, UK. Principal marine electricity producers: DE, DK, FR, UK.
[2] Principal countries and main routes involving major ports (BE, DE, ES, FR, IT, NL, NO, UK) accounting for ~55% of EEA traffic.
[3] Range based on lowest and highest cost estimates.
[4] Total PPP$36,434.7m per Table 4 (D4.2 Recreation visits.doc) translated at €0.8226/$ (OECD PPP rates) and inflated by 4.7455% for the period 2007-2010.
[5] Range based on estimate ranges for sedimentation rate and cost avoided. Low end: €527,730 (per Table 2 in D4.2 Carbon Storage.doc) adjusted for inflation at 14.9633% for the period 2003-2010 (per "Inflation" sheet in D4.2 Energy.xls). High end: €275,567,304 (per Table 4 in D4.2 Carbon Storage.doc) adjusted for inflation at 7.9478% (per "Inflation" sheet in D4.2 Energy.xls) for the period 2006-2010.
[6] Range based on estimate range for cost avoided. Low end: €27,300,000 (per Table 6 in D4.2 Carbon Storage.doc) adjusted for inflation at 14.9633% for the period 2003-2010 (per "Inflation" sheet in D4.2 Energy.xls). High end: €1,014,650,000 (ibid) adjusted for inflation at 7.9478% (per "Inflation" sheet in D4.2 Energy.xls) for the period 2006-2010

Table 3 Summary of valuations by sea– KnowSeas FP7 project (Cooper et al. 2011)

Type of value	Sector/Activity	Value/€2010'm p.a. NEA	Baltic	Mediterranean	Black	Total
Direct use	Energy	114,362.4				114,362.4
	Fisheries – capture	6,062.0	347.2	2,262.4	3.4	8,675.0
	Fisheries – mariculture[1]	4,305.1		1,210.1		5,515.2
	Freight transport					
	low median estimate	6,728.9	6,344.7	451.1	220.8	13,745.5
	high median estimate	30,527.3	28,784.2	2,046.5	1,001.6	62,359.6
	Recreation (visits)[2]	12,867.1	3,304.5	15,204.5	17.4	31,393.5
	Recreation (water quality)					
	– health risk	5,855.0	212.0	7,723.0	1,537.0	15,327.0
	– eutrophication	23,226.0	12,134.0	4,656.0	326.0	40,342.0
Indirect use	Carbon storage – salt marshes					
	low end estimate	0.3	0.1	0.2	~0	0.6
	high end estimate	148.0	24.7	119.8	5.0	297.5
	Carbon storage – seagrass					
	low end estimate			31.4		31.4
	high end estimate			1,095.3		1,095.3
Indicative total (for comparison of seas only)	low end total	173,406.8	22,342.5	30,933.7	2,709.6	229,392.6
	proportion	75.6%	9.7%	13.5%	1.2%	100.0%
	high end total	197,352.9	44,806.6	33,712.6	3,495.4	279,367.5
	proportion	70.6%	16.0%	12.1%	1.3%	100.0%
	excluding energy, high end total	82,990.5	44,806.6	33,712.6	3,495.4	165,005.1
	proportion	50.3%	27.2%	20.4%	2.1%	100.0%

[1] The value is not analysed between the Mediterranean and Black seas in the source document. For the purposes of the indicative totals, the aggregate value is equally apportioned.

[2] The source document specifies values at the level of countries rather than seas. In most cases there is a direct correspondence between countries and seas but in others the following apportionments have been utilised for the purposes of this table: Denmark (50:50, NEA:Baltic), France (50:50, NEA:Mediterranean)

4.3. The DG MARE "Atlas of the Sea" (http://ec.europa.eu/maritimeaffairs/atlas)

Finally, data available under Eurostat regarding marine area are found under the DG MARE Atlas of the Sea. As a consequence it doesn't go beyond of Eurostat's indicator and is even far less detailed excepted for fisheries (Figure 14) and aquaculture where data are completed with TAC and Quotas information according to EC regulations. But other coastal and marine activities are just concerned with maritime transport expressed in gross weight per country and energy through TENs. Tourism is informed through the number of beds per square kilometer at NUTS 3 level (Figure 15). Factsheets over the Mediterranean and Black Sea are quite poor with just a table of statistics about transport of goods for the main ports of the areas.

- European fishing fleet
- coastal activities
- maritime transport and ports statistics

Figure 14 European Union fishing fleet at NUTS1 level (Eurostat)

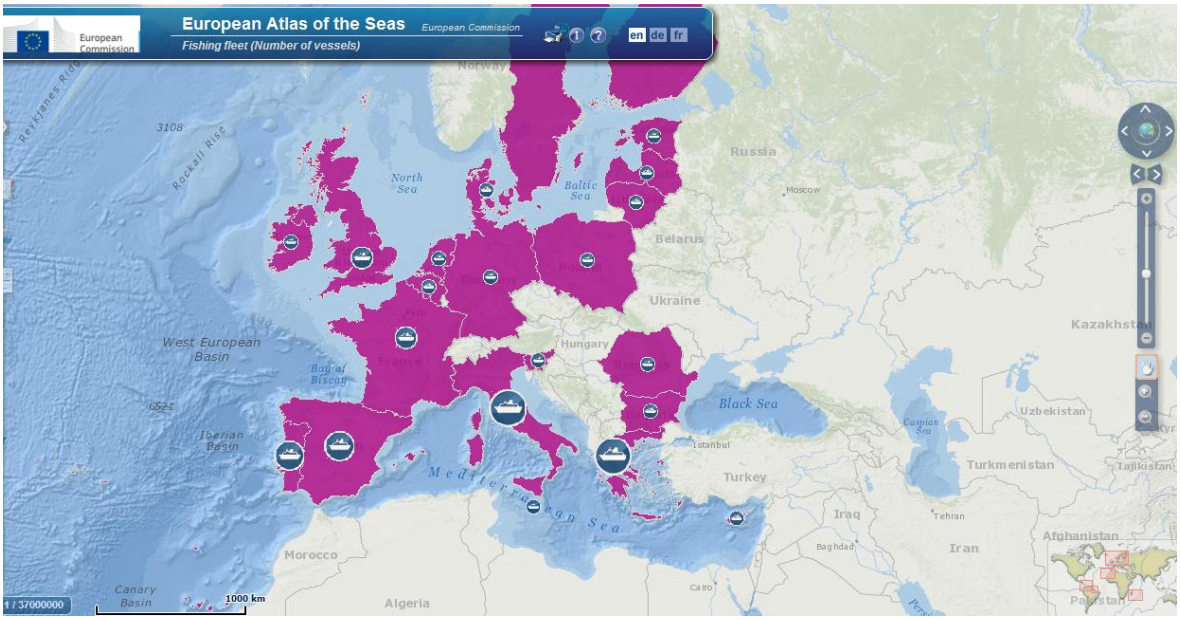
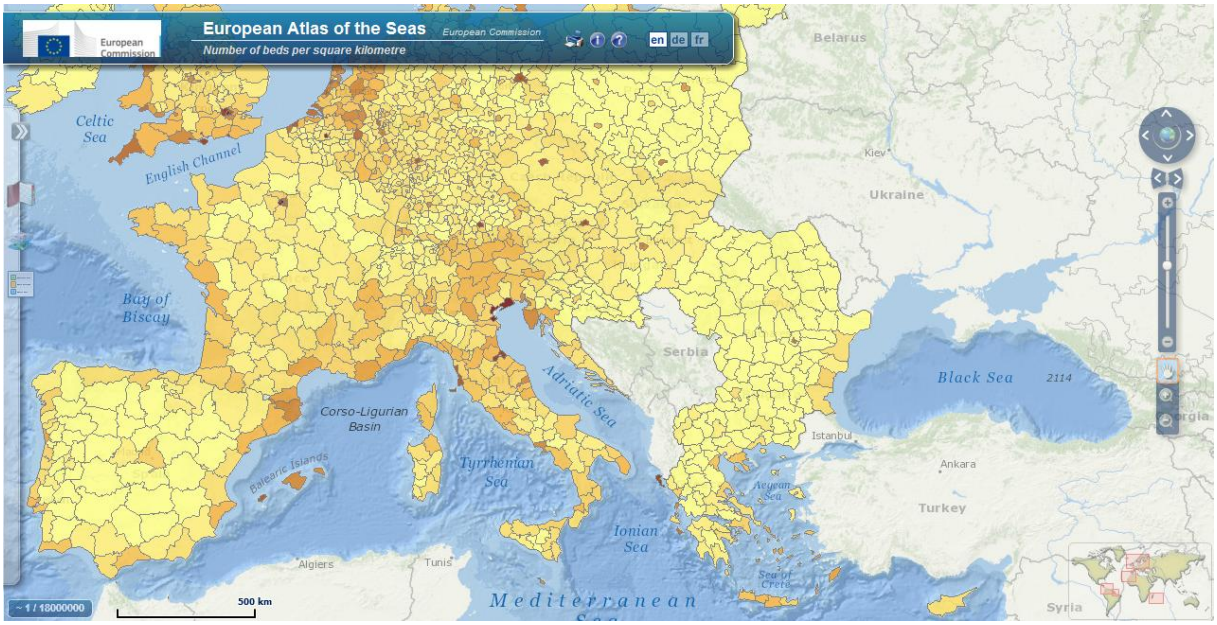


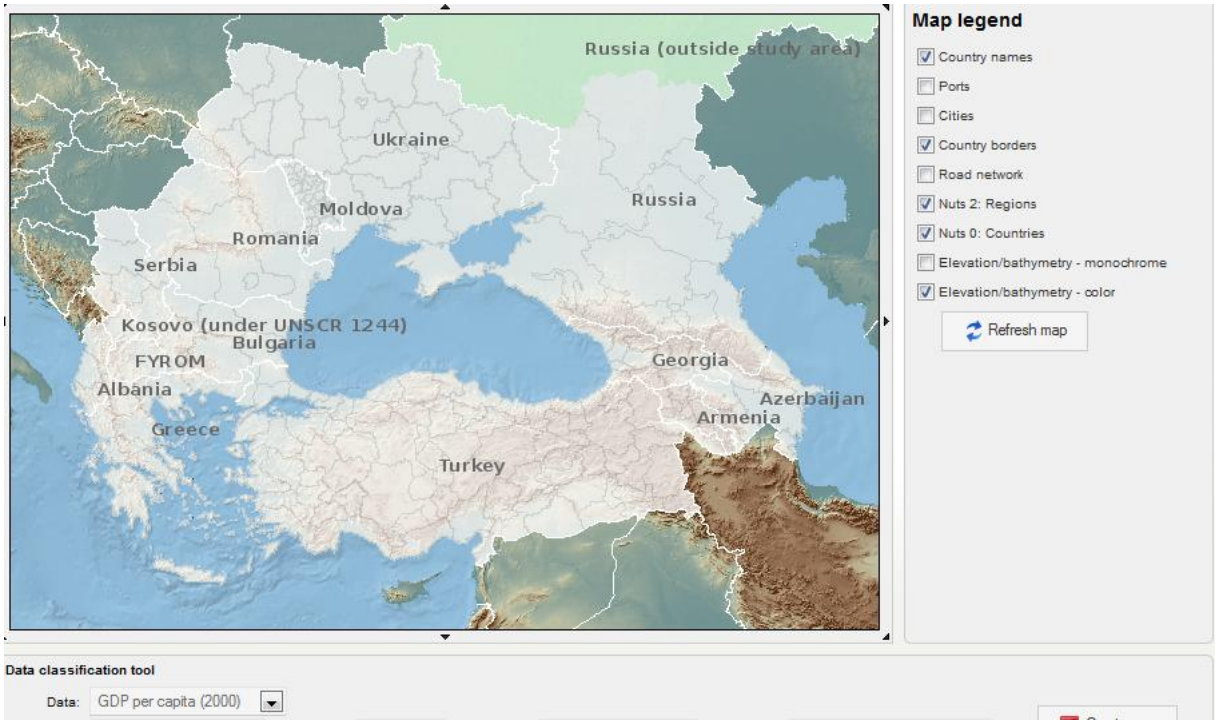
Figure 15 Number of beds per square kilometer at NUTS3 level (Eurostat)



4.4. The Web GIS from the International Centre for Black Sea Studies (www.icbss.org/webgis.php)

This is the most complete atlas regarding Black Sea. Its structure reflects the ambition of the atlas with a classic panel of macro socioeconomic indicators theoretically available at NUTS2 level, but with a number of gaps according to regions (Figure 16). In terms of activities and related stressors, there's no detail beyond of primary, secondary and tertiary sectors.

Figure 16 Viewer of the GDP request from ICBSS (ICBSS)



A good database and observatory of macroeconomic dimensions, but needed to be completed with activities or sectors.

4.5. Macroeconomic indicators for RS

4.5.1. UNDP Human Development Report- http://hdr.undp.org

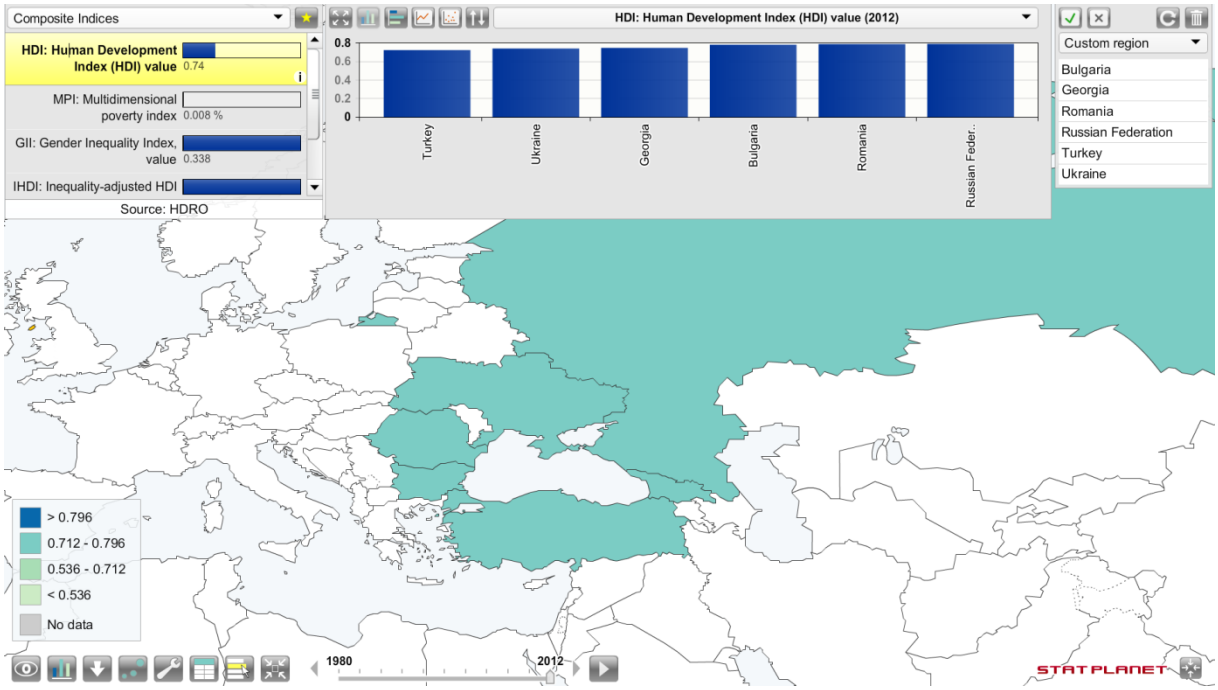
UNDP is THE database covering whole countries and providing data about "Macro Socio" dimensions and especially about the HDI developed and maintained through UNDP services. Information is provided at country level or big politico geographic entities, but not yet according to large ecosystems dimension.

The Human Development Index (HDI) is an index published by the United Nation Development Program (UNDP). It's a way of measuring development by combining indicators of life expectancy, educational attainment and income into a composite human development index (UNDP[4]). The HDI is used to rank countries. From 2010 there's a new method of calculation still combining three dimensions: life expectancy at birth, education index and a decent standard of living component

[4] http://hdr.undp.org/en/statistics/hdi/

measured by GNI per capita (PPP$) instead of GDP. This indicator was already included into the LME approach.

Figure 17 HDI for the Black Sea neighboring countries (UNDP HDR Viewer)



In addition to HDI a series of indicators are of interest for PEGASO:

- Consumer Price Index
- Employment to population ratio, population 25+ (% aged 25 and above)
- International inbound tourism (thousands)
- Multidimensional poverty index (%)
- Natural resource depletion (% of GNI)
- Net migration rate (per 1,000 people)
- Population, total both sexes (thousands)
- Population, urban (%) (% of population)
- Use of Natural resources

Demography (found in a number of databases: UNSTATs (Outlook 042), WorldBank and States, UNDP).

4.5.2. The World Bank

In the same database than activities, the World Bank is also publishing a series of macroeconomic and financial indicators. GDP for instance will rather be collected under World Bank as it is available under different formats (adjusted or not). Data are available at country level and not according to NUTS2 area for instance, that would allow rebuilding them at the scale of RS. The last complete series for all the Mediterranean countries is from 2005. For 2009 Palestinian Territories are missing and for 2012, Israel and Libya are missing too (Figures 18 to 20 WorlBank viewer).

Energy, households final consumption expenditures (Figures 21 and 22), employment and demography data are also recorded, but no detail is provided about marine relevant area.

Figure 18 2005 GDP per capita (current US$) – All Med and BS countries (WorldBank)

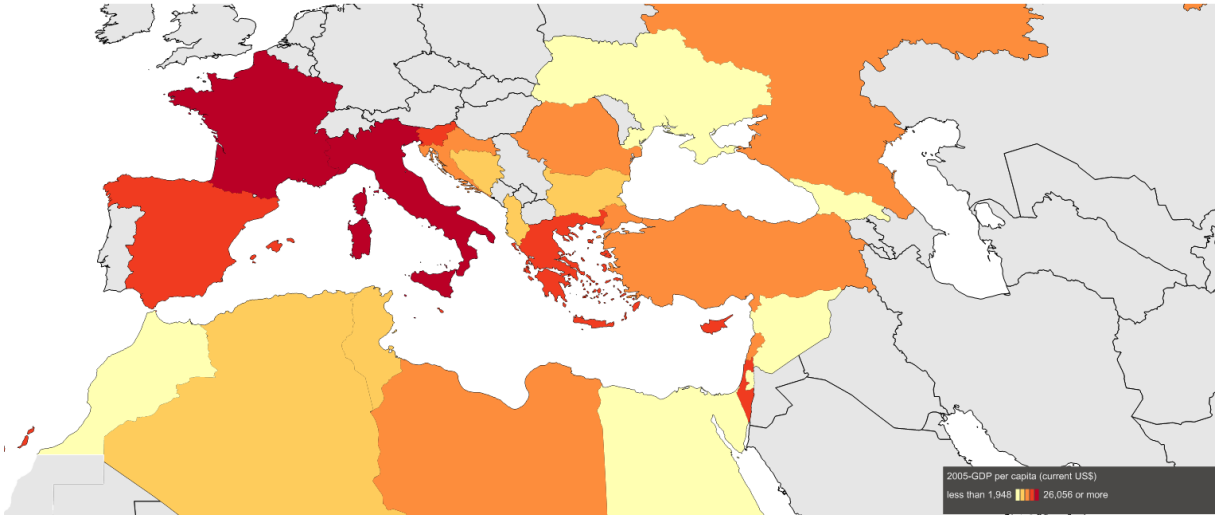


Figure 19 2009 GDP per capita (current US$) – Palestinian Territories missing (WorldBank)

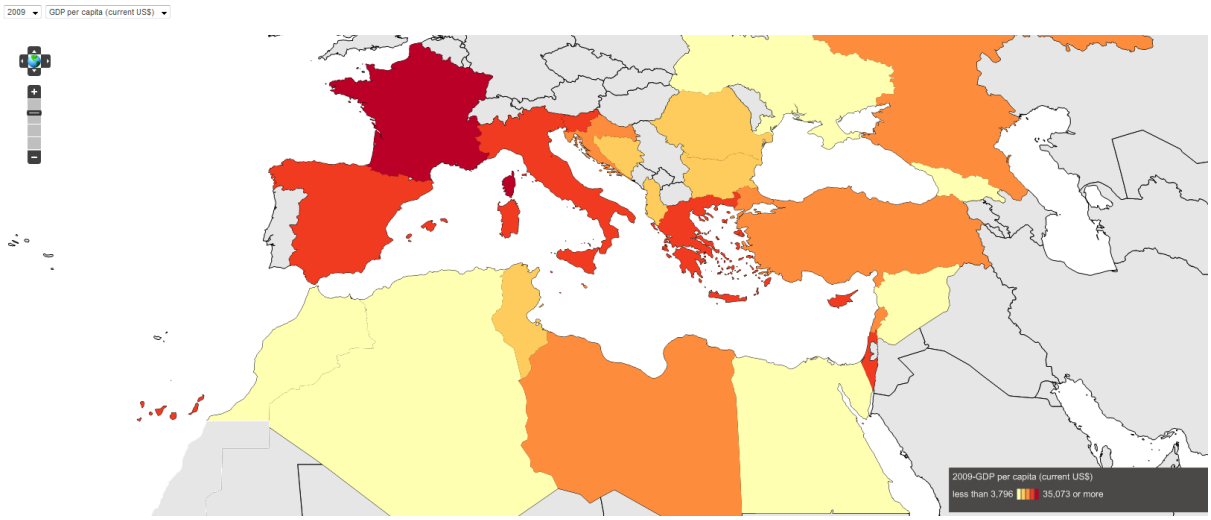


Figure 20 Last update for GDP: 2012 GDP per capita for Med and BS countries (WorldBank) Number of non available data.

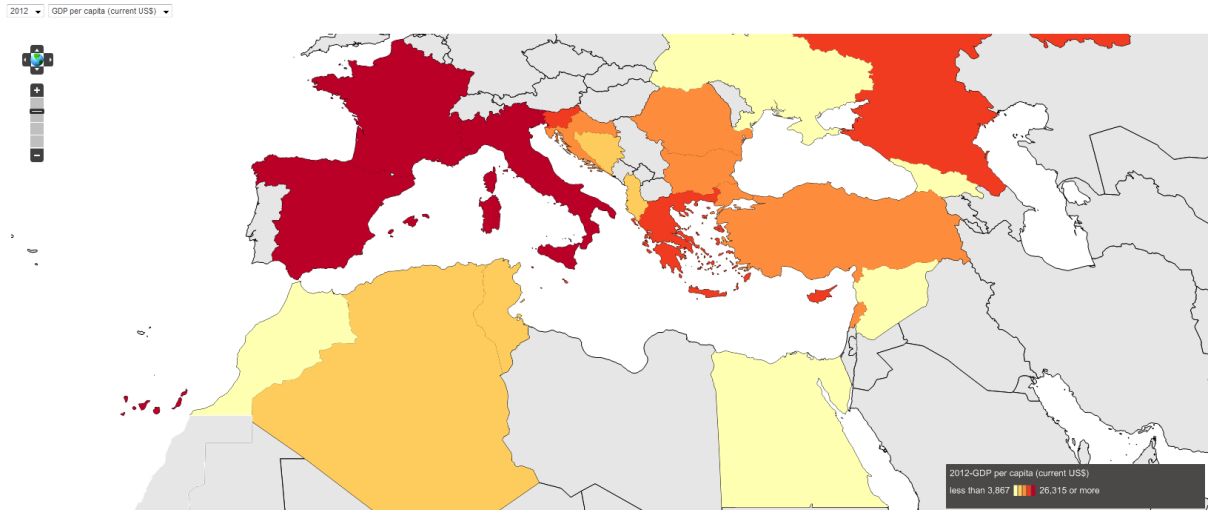


Figure 21 Household final consumption expenditure per capita (constant 2005 US$) 2011 (WorldBank)

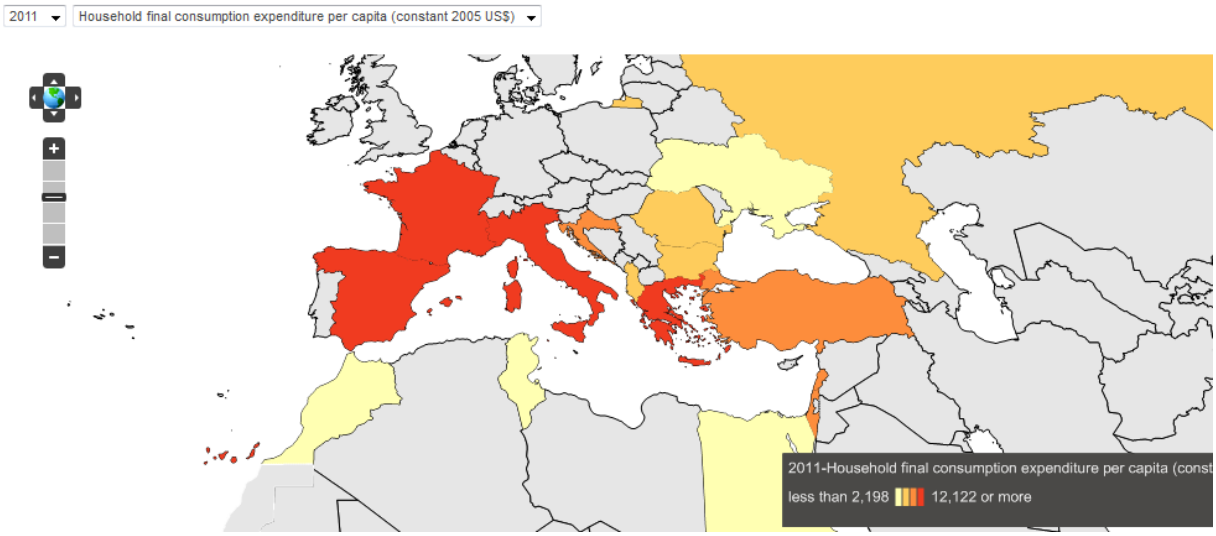
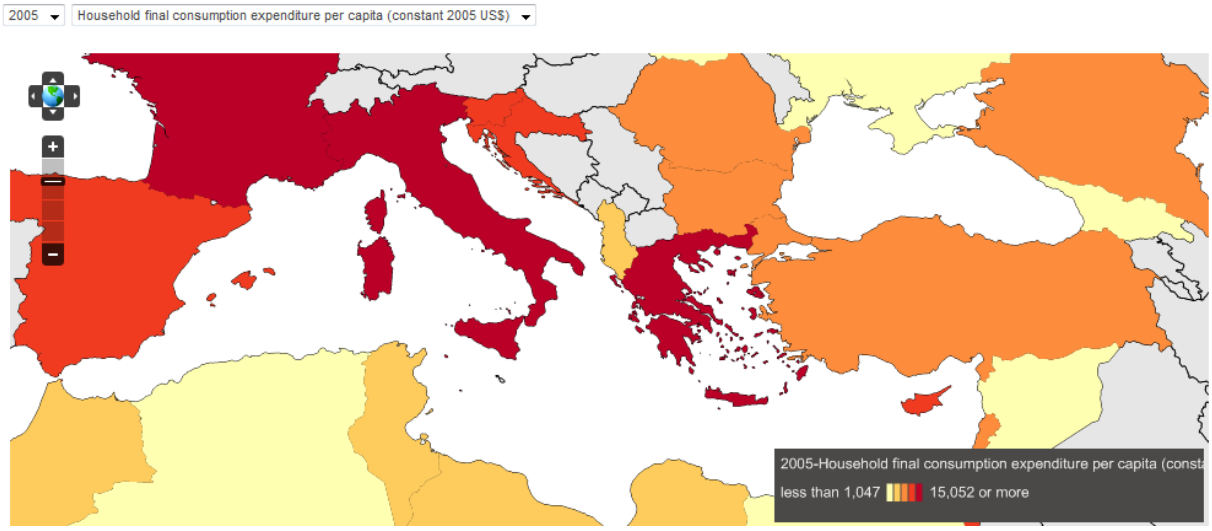


Figure 22 Household final consumption expenditure per capita (constant 2005 US$) 2005 (WorldBank)
Last year of complete data for Med and BS



4.5.3. Other UN based or related databases

UNCTAT (United Nations Conference on Trade and Development) http://unctad.org

UNCTAD produces more than 150 indicators and statistical time series related to International trade, Economic trends, Foreign direct investment, External financial resources, Population and labor force, Commodities, Information economy and Maritime transport. Regarding maritime transport, the following data are available:

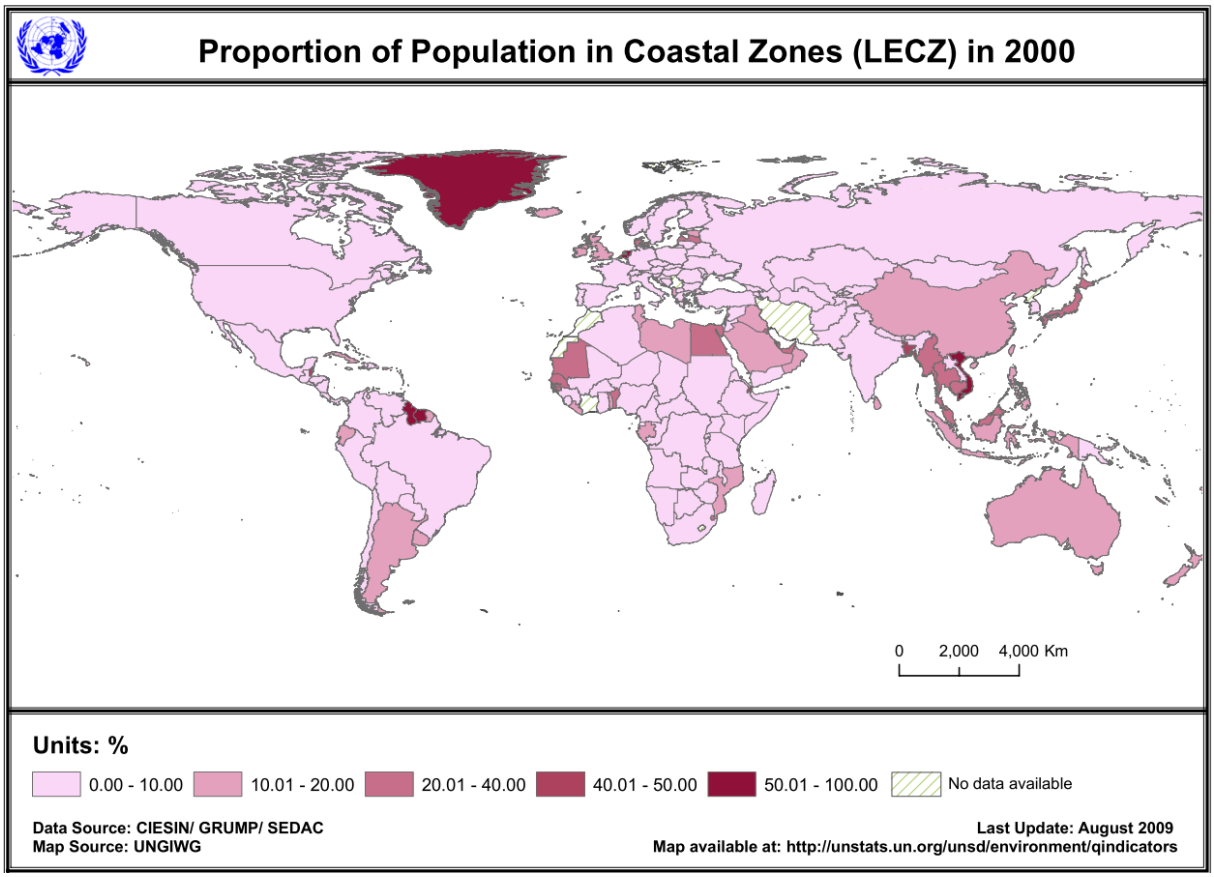
- Total fleet
- Gross Tonnage in thousands
- Dead weight tons in thousands
- TEU (Twenty foot Equivalent Unit)

United Nations Statistics Division (UNSD) http://unstats.un.org

The UNSD has a specific section for Marine and Coastal Areas informed at country level with:

- the Proportion of population in coastal zones (LECZ): last update is given for August 2009, but data available are for the years 1990, 1995 and 2000 (Figure 23);
- the Marine Protected Areas (MPAs).

Figure 23 Proportion of population in coastal zones (LECZ) - UNSD



United Nation Data (UNdata) http://data.un.org/

The UNdata website is an information portal based on databases from UN agencies. As a consequence similar needs and lacks will be underlined regarding marine and coastal activities. For instance, regarding offshore oil production for the Mediterranean and Black Sea and based on UNSD information, solely Spain appears in the database.

The United Nations Atlas of the Oceans http://www.oceansatlas.org

The Mediterranean Information System on Environment and Development (SIMEDD) http://simedd.planbleu.org/simedd

It is the only Information System really working (by mandate) at the scale of the Mediterranean. But for regional assessment purpose, the socioeconomic information is not enough completed. Nevertheless, it underlines the suitable structure to host a potential information system about marine and coastal economic activities.

The World Database on Protected Areas (WDPA) http://www.wdpa.org and http://protectedplanet.net

Incorporating the UN List of Protected Areas, the WDPA is used to report progress towards the UN Millennium Development Goals (MDGs), specifically Goal 7, which aims at ensuring environmental sustainability. For this, UNEP-WCMC carries out an updated analysis of protected area coverage in the beginning of each year, using the latest version of the WDPA available (Figures 24 and 25).

Figure 24 Protected area of the Mediterranean (From http://protectedplanet.net)

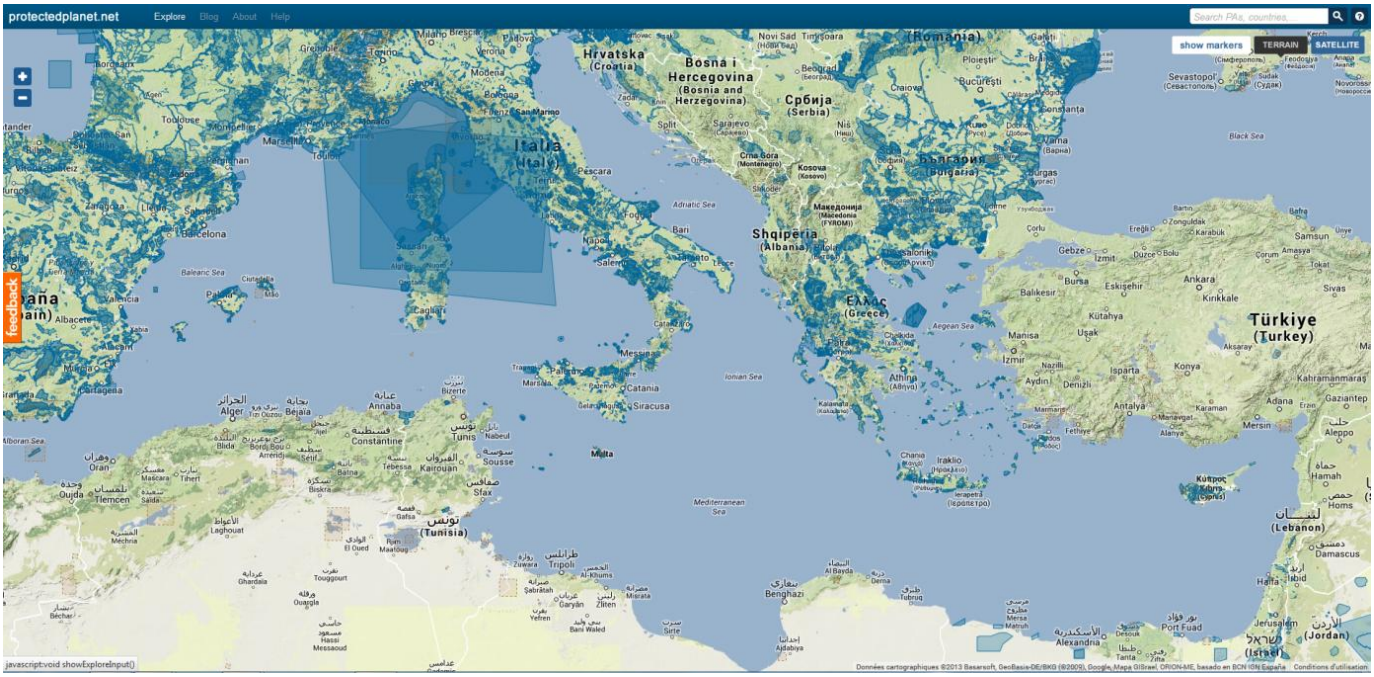


Figure 25 Protected areas of the Black Sea (From http://protectedplanet.net)

Network of marine protected area managers in the Mediterranean MedPAN www.mapamed.org

MAPAMED (Marine Protected Areas in the Mediterranean) is a GIS database that gathers information on marine protected areas of the Mediterranean, and more generally on sites of interest to the conservation of the marine environment.

The Environmental Data Explorer (UNEP) http://geodata.grid.unep.ch

The Environmental Data Explorer is the authoritative source for data sets used by UNEP and its partners in the Global Environment Outlook (GEO) report and other integrated environment assessments. Its database holds different variables, as national, subregional, regional and global statistics or as geospatial data sets (maps), covering themes like Freshwater, Population, Forests, Emissions, Climate, Disasters, Health and GDP.

The NASA Socioeconomic Data and Applications Center (SEDAC) – Hosted by CIESIN at Columbia University http://sedac.ciesin.columbia.edu/

SEDAC is one of the Distributed Active Archive Centers (DAACs) in the Earth Observing System Data and Information System (EOSDIS) of the U.S. National Aeronautics and Space Administration. SEDAC focuses on human interactions in the environment.

Three main environmental indexes can be found on SEDAC: the Environmental Performance Index, the Environmental Sustainability Index and the Environmental Sustainability Index:

Environmental Performance Index (EPI): the EPI utilizes a proximity-to-target methodology focused on a core set of environmental outcomes linked to policy goals. The Pilot Trend Environmental Performance Index (Trend EPI), introduced in 2012, ranks countries on the change in their

environmental performance over the period 2000-2010. It is a composite index of Agriculture, Climate, Conservation, Governance, Health, Marine and Coastal, Sustainability, Water indexes.

Environmental Sustainability Index (ESI): the ESI is a measure of overall progress towards environmental sustainability. The index provides a composite profile of national environmental stewardship based on a compilation of indicators derived from underlying datasets.

Natural Resource Management Index (NRMI): the NRMI is a composite index for 174 countries derived from the average of four proximity-to-target indicators for eco-region protection (weighted average percentage of biomes under protected status), access to improved sanitation, access to improved water and child mortality.

Goddard Space Flight Center (GSFC), and Center for International Earth Science Information Network (CIESIN)/Columbia University. 2009. Indicators of Coastal Water Quality: Ancillary Data. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://sedac.ciesin.columbia.edu/data/set/icwq-ancillary-data

5. Main Results

The issue is to get available information at the scale of RS. This raises several sub-issues: data allocation when countries are neighbored by more than one RS and the existence of international databases. For this last issue and for routine purpose, it is not possible to go through each country national statistic office to rebuild the information: completion of data are often questionable and their availability is very variable. In addition this exercise of rebuilding each time a potential and suitable database is quite long, hazardous in terms of success and doesn't allow an efficient monitoring of marine related information to support ICZM. At the moment, for economic activities and especially marine ones, no such database able to provide data covering RS exists. Only part of RS is covered by international databases such as Eurostat or the OECD. The review also proposes what could be or what should be such database based on the Eurostat experience and experiments.

Today the only way to collect and extract relevant and reliable economic information at the regional scale is to go down to and dig into specific activity database, when existing and of free access (FAO and other UN agencies for instance).

When available, economic activities are also expressed in terms of volume and sometimes value, but there're no other descriptors in transnational databases or databases are too incomplete to proceed with rebuilding of information.

There are then two way of rebuilding information at suitable scale:

- either aggregates of available data at infra national scale (NUTS2, 3 and 4);
- either attribution/allocation of national data at regional scale. Incompletion of NUTS2, 3 and 4 database at European and RS level rather calls for this approach.

For macroeconomic information the issue is similar with data provided at country level and difficulties to rebuild it at RS level (i.e. part depending from RS for each country). There's no information or no available information at infra level for all countries (GDP for instance).

In most of databases consulted and reviewed there's no ecological dimension in producing socioeconomic information. When some environmental dimension can be found or noticed it is mainly addressed through satellite sectors or in terms of global indicators linked to climate change (CO2 etc.). Similarly there's no marine/coastal dimension for economic activities or solely reduced to a fish and ships issue. Most of bases are about and designed for land based activities.

For PEGASO the approach from LMEs, maybe more limited in terms of activities, but more synthetic and being more easily appropriated by stakeholders seems to be the most relevant one.

The complexity of the techniques and the amount of calculation needed to arrive at the estimated values documented in the KnowSeas project demonstrate the relative inaccessibility of economic values relevant to the assessment of benefits derived from the marine environment and the costs arising from the degradation of ecosystems. Even where market data are available, their translation into values compatible with those representing individual preferences for ecosystem integrity is challenging (Cooper 2011). These challenges do not simply arise from the aggregation procedure but rather from the paucity of data or of appropriate classification of collected data relevant to environmental decision-making. For example, there is a paucity of standardized data on individual preferences for the marine environment not represented by market while in other cases data are collected and reported at the level of member States but without reference to their relevance to the marine environment, such as in the cases of the tourism and energy sectors (Cooper 2011).

Appendix

Tables of indicators and indexes for Mediterranean and Black Sea countries according to Hoagland et al. (2006) method.

Data at standardized at the scale of the Mediterranean and Black Sea respectively. Indexes of activity are rebuilt and weighted to get a Marine Industry Index and some Sectors Indexes. Indexes are then reallocated at the scale of the Mediterranean and Black Sea accordingly to countries' contribution to the Mediterranean and Black Sea coastline length.

Activity Indicators for Med and BS countries

Socioeconomic and Marine Industry Indicators by Nation										
Mediterranean Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fishery (MT)	Marine Aquaculture (MT)	International Tourism (visitor)	Shipbuilding Orderbook (1000 GT)	Shipping Cargo Traffic (1000 MT)	Merchant Fleet (1000 DWT)	Offshore Oil Production (bbl/day)	Offshore Rig Count (number)
Albania	0.781	0.749	1537	500	40800	0	0	0	0	0
Algeria	0.704	0.713	141530	65	1145200	0	0	0	0	0
Croatia	0.83	0.805	19938	4365	8576200	2247	2596	0	0	0
Cyprus	0.883	0.848	1741	1731	2752800	0	7731	0	0	0
Egypt	0.653	0.662	117439	43478	5717600	15	0	0	0	9
France	0.932	0.893	750844	197274	81201200	470	322018	4641	0	0
Greece	0.902	0.86	90221	98459	16251000	20	24935	156385	3850	0
Israel	0.908	0.9	2991	3359	777590	0	33389	0	0	0
Italy	0.92	0.881	293331	148962	43510000	1500	268136	11941	10385	1
Lebanon	0.758	0.745	3613	0	1093400	0	0	0	0	0
Libya	0.794	0.769	33671	0	0	0	0	0	0	1
Malta	0.875	0.847	1138	881	1133200	0	0	0	0	0
Monaco										
Montenegro		0.791								
Morocco	0.62	0.591	894612	1078	4929000	0	0	0	0	0
Palestinian Territories	0.726	0.67	1508	0	0	0	0	0	0	0
Slovenia	0.895	0.892	1087	206	1488400	0	9431	0	0	0
Spain	0.922	0.885	887837	279770	55991200	536	245829	4759	6114	0
Syria	0.71	0.648	3060	0	1694600	0	0	0	0	0
Tunisia	0.745	0.712	89518	1271	5510600	0	20027	0	0	1
Turkey	0.751	0.722	463074	39726	14415000	454	28531	8715	0	0
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003
Black Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fishery (MT)	Marine Aquaculture (MT)	International Tourism (visitor)	Shipbuilding Orderbook (1000 GT)	Shipping Cargo Traffic (1000 MT)	Merchant Fleet (1000 DWT)	Offshore Oil Production (bbl/day)	Offshore Rig Count (number)
Bulgaria	0.796	0.782	10211	15	3807000	153	18076	0	0	0
Georgia	0.739	0.745	3267	0	289600	0	0	0	0	0
Romania	0.778	0.786	1612	0	3417400	925	40524	0	0	0
Russian Federation	0.795	0.788	3177230	741	312200	361	105971	15258	0	0
Turkey	0.751	0.722	463074	39726	14415000	454	28531	8715	0	0
Ukraine	0.777	0.74	207438	236	6110600	418	0	0	0	0
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003

Activities Indexes calculated for Med and BS countries adapted from Hoagland et al. method.

Multiplié par 100:	Activities Index									
Mediterranean Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fis	Marine Aq	Internatior	Shipbuildir	Shipping C	Merchant F	Offshore O	Offshore Ri
Albania	78.100	74.900	0.050	0.179	0.050	0.000	0.000	0.000	0.000	0.000
Algeria	70.400	71.300	15.718	0.023	1.410	0.000	0.000	0.000	0.000	0.000
Croatia	83.000	80.500	2.110	1.560	10.562	100.000	0.806	0.000	0.000	0.000
Cyprus	88.300	84.800	0.073	0.619	3.390	0.000	2.401	0.000	0.000	0.000
Egypt	65.300	66.200	13.022	15.541	7.041	0.668	0.000	0.000	0.000	100.000
France	93.200	89.300	83.910	70.513	100.000	20.917	100.000	2.968	0.000	0.000
Greece	90.200	86.000	9.976	35.193	20.013	0.890	7.743	100.000	37.073	0.000
Israel	90.800	90.000	0.213	1.201	0.958	0.000	10.369	0.000	0.000	0.000
Italy	92.000	88.100	32.707	53.244	53.583	66.756	83.267	7.636	100.000	11.111
Lebanon	75.800	74.500	0.283	0.000	1.347	0.000	0.000	0.000	0.000	0.000
Libya	79.400	76.900	3.647	0.000	0.000	0.000	0.000	0.000	0.000	11.111
Malta	87.500	84.700	0.006	0.315	1.396	0.000	0.000	0.000	0.000	0.000
Monaco										
Montenegro		79.100								
Morocco	62.000	59.100	100.000	0.385	6.070	0.000	0.000	0.000	0.000	0.000
Palestinian Territories	72.600	67.000	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slovenia	89.500	89.200	0.000	0.074	1.833	0.000	2.929	0.000	0.000	0.000
Spain	92.200	88.500	99.242	100.000	68.954	23.854	76.340	3.043	58.873	0.000
Syria	71.000	64.800	0.221	0.000	2.087	0.000	0.000	0.000	0.000	0.000
Tunisia	74.500	71.200	9.897	0.454	6.786	0.000	6.219	0.000	0.000	11.111
Turkey	75.100	72.200	51.704	14.200	17.752	20.205	8.860	5.573	0.000	0.000
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003
Black Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fis	Marine Aq	Internatior	Shipbuildir	Shipping C	Merchant F	Offshore O	Offshore Ri
Bulgaria	79.600	78.200	0.271	0.038	24.901	16.541	17.057	0.000		
Georgia	73.900	74.500	0.052	0.000	0.000	0.000	0.000	0.000		
Romania	77.800	78.600	0.000	0.000	22.143	100.000	38.241	0.000		
Russian Federation	79.500	78.800	100.000	1.865	0.160	39.027	100.000	100.000		
Turkey	75.100	72.200	14.531	100.000	100.000	49.081	26.923	57.118		
Ukraine	77.700	74.000	6.481	0.594	41.209	45.189	0.000	0.000		
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003

$$I_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)}$$

Activities Index distributed over Med and BS adapted from Hoagland et al. method.

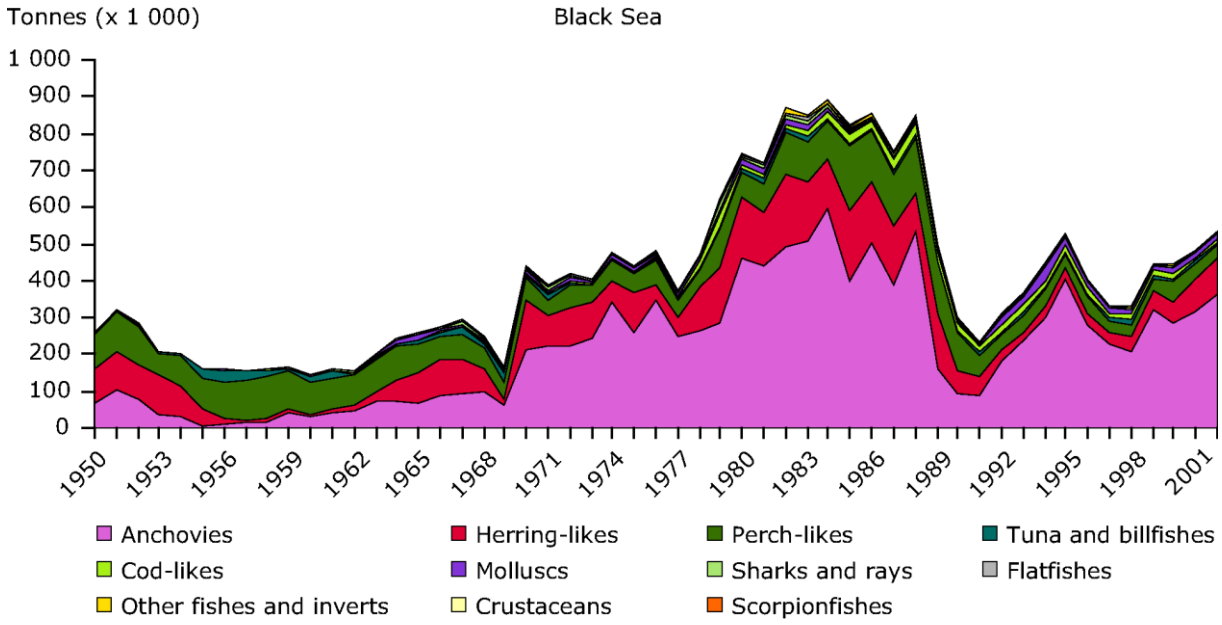
Multiplié par 100										
Mediterranean Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fishery	Marine Aquaculture	International Tourism	Shipbuilding Orderbook	Shipping Cargo Traffic	Merchant Fleet	Offshore Oil Production	Offshore Rig Count
Albania	0.953	0.914	0.001	0.002	0.001	0.000	0.000	0.000	0.000	0.000
Algeria	3.379	3.422	0.754	0.001	0.068	0.000	0.000	0.000	0.000	0.000
Croatia	5.968	5.788	0.152	0.112	0.759	7.190	0.058	0.000	0.000	0.000
Cyprus	1.987	1.908	0.002	0.014	0.076	0.000	0.054	0.000	0.000	0.000
Egypt	3.441	3.489	0.686	0.819	0.371	0.035	0.000	0.000	0.000	5.270
France	3.831	3.670	3.449	2.898	4.110	0.860	4.110	0.122	0.000	0.000
Greece	0.316	0.301	0.035	0.123	0.070	0.003	0.027	0.350	0.130	0.000
Israel	18.614	18.450	0.044	0.246	0.196	0.000	2.126	0.000	0.000	0.000
Italy	0.773	0.740	0.275	0.447	0.450	0.561	0.699	0.064	0.840	0.093
Lebanon	14.531	14.282	0.054	0.000	0.258	0.000	0.000	0.000	0.000	0.000
Libya	0.667	0.646	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.093
Malta	6.160	5.963	0.000	0.022	0.098	0.000	0.000	0.000	0.000	0.000
Monaco										
Montenegro		0.071								
Morocco	0.353	0.337	0.570	0.002	0.035	0.000	0.000	0.000	0.000	0.000
Palestinian Territories	1.191	1.099	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slovenia	0.098	0.098	0.000	0.000	0.002	0.000	0.003	0.000	0.000	0.000
Spain	6.602	6.337	7.106	7.160	4.937	1.708	5.466	0.218	4.215	0.000
Syria	0.398	0.363	0.001	0.000	0.012	0.000	0.000	0.000	0.000	0.000
Tunisia	3.405	3.254	0.452	0.021	0.310	0.000	0.284	0.000	0.000	0.508
Turkey	8.674	8.339	5.972	1.640	2.050	2.334	1.023	0.644	0.000	0.000
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003
Total	**81.339**	**79.470**	**19.584**	**13.508**	**13.804**	**12.690**	**13.851**	**1.398**	**5.185**	**5.964**
Black Sea Nations										
Nation	HDI (2002)	HDI (2012)	Marine Fishery	Marine Aquaculture	International Tourism	Shipbuilding Orderbook	Shipping Cargo Traffic	Merchant Fleet	Offshore Oil Production	Offshore Rig Count
Bulgaria	3.224	3.167	0.011	0.002	1.009	0.670	0.691	0.000		
Georgia	3.525	3.554	0.002	0.000	0.000	0.000	0.000	0.000		
Romania	5.010	5.062	0.000	0.000	1.426	6.440	2.463	0.000		
Russian Federation	15.749	15.610	19.810	0.370	0.032	7.731	19.810	19.810		
Turkey	18.362	17.653	3.553	24.450	24.450	12.000	6.583	13.965		
Ukraine	31.453	29.955	2.624	0.240	16.682	18.293	0.000	0.000		
Year of data	2002	2012	2003	2003	2004	2004	2002	2004	2004	2003
Total	**77.323**	**75.001**	**26.000**	**25.062**	**43.598**	**45.134**	**29.546**	**33.775**	**0.000**	**0.000**

Marine Industry Index and Sectors Index distributed over the Med and BS adapted from Hoagland et al. method.

Multiplié par 100								
Mediterranean Sea Nations								
Nation	**HDI (2002)**	**HDI (2012)**	**Fisheries & Aquaculture Index**	**Tourism Index**	**Ship building Index**	**Shipping Index**	**Offshore Oil index**	**Marine Ind**
Albania	0.953	0.914	0.001	0.001	0.000	0.000	0.000	0.000
Algeria	3.379	3.422	0.378	0.068	0.000	0.000	0.000	0.089
Croatia	5.968	5.788	0.132	0.759	7.190	0.039	0.000	1.624
Cyprus	1.987	1.908	0.008	0.076	0.000	0.036	0.000	0.024
Egypt	3.441	3.489	0.753	0.371	0.035	0.000	1.757	0.583
France	3.831	3.670	3.173	4.110	0.860	2.781	0.000	2.185
Greece	0.316	0.301	0.079	0.070	0.003	0.135	0.087	0.075
Israel	18.614	18.450	0.145	0.196	0.000	1.417	0.000	0.352
Italy	0.773	0.740	0.361	0.450	0.561	0.488	0.591	0.490
Lebanon	14.531	14.282	0.027	0.258	0.000	0.000	0.000	0.057
Libya	0.667	0.646	0.015	0.000	0.000	0.000	0.031	0.009
Malta	6.160	5.963	0.011	0.098	0.000	0.000	0.000	0.022
Monaco								
Montenegro		0.071						
Morocco	0.353	0.337	0.286	0.035	0.000	0.000	0.000	0.064
Palestinian Territories	1.191	1.099	0.000	0.000	0.000	0.000	0.000	0.000
Slovenia	0.098	0.098	0.000	0.002	0.000	0.002	0.000	0.001
Spain	6.602	6.337	7.133	4.937	1.708	3.717	2.810	4.061
Syria	0.398	0.363	0.001	0.012	0.000	0.000	0.000	0.002
Tunisia	3.405	3.254	0.237	0.310	0.000	0.189	0.169	0.181
Turkey	8.674	8.339	3.806	2.050	2.334	0.897	0.000	1.817
Total	**81.339**	**79.470**	**16.546**	**13.804**	**12.690**	**9.700**	**5.445**	**11.637**
Black Sea Nations								
Nation	**HDI (2002)**	**HDI (2012)**	**Fisheries & Aquaculture Index**	**Tourism Index**	**Ship building Index**	**Shipping Index**	**Offshore Oil index**	**Marine Ind**
Bulgaria	3.224	3.167	0.006	1.009	0.670	0.461		
Georgia	3.525	3.554	0.001	0.000	0.000	0.000		
Romania	5.010	5.062	0.000	1.426	6.440	1.642		
Russian Federation	15.749	15.610	10.090	0.032	7.731	19.810		
Turkey	18.362	17.653	14.001	24.450	12.000	9.044		
Ukraine	31.453	29.955	1.432	16.682	18.293	0.000		
Total	**77.323**	**75.001**	**25.531**	**43.598**	**45.134**	**30.956**		
Year of data	2002	2012	2003	2003	2004	Composite (200	Composite (2003)	Composite

$$TAI_i = \sum_{k=1}^{m} v_k (AI_i)$$

Fisheries - Black Sea catches per species



Fisheries - Mediterranean catches according to species