THE ECONOMIC VALUE OF SUSTAINABLE BENEFITS FROM THE MEDITERRANEAN MARINE ECOSYSTEMS

Study report

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AFD : French Agency for the Development
AECID : Spanish Agency of international Cooperation for the Development
BP RAC: Blue Plan Regional Activity Centre
CICES : Common International Classification of Ecosystem Services
CIESM : Mediterranean Science Commission
CIHEAM : International Centre for Advanced Mediterranean Agronomic Studies
DEFI : Développement Economique et Finance Internationale (University of Aix Marseille II, France)
DEPI : Division of Environmental Policy Implementation (division of UNEP)
DTIE : Division of Technology, Industry and Economics (division of UNEP)
EC: European Commission
ECOMERS : Ecosystèmes Côtiers Marins et Réponses aux Stress (University of Nice Sophia Antipolis, France)

Whilst the Mediterranean sea represents a mere 0.3% of the volume and 0.8% of the total surface area of the World Ocean, its position at the interface between three continents, the fact that it is a semi-

This document is the final report for the exploratory study undertaken by the Blue Plan, the aim of which is to provide an economic evaluation of the sustainable benefits[1] provided by Mediterranean marine ecosystems. It was supported by the Mediterranean Action Plan (MAP), the French Global Environment Fund (FFEM), the French Development Agency (AFD) and the Spanish Agency for Cooperation and Development (AECID) and also drew on the experience of the Blue Plan and other of MAP's Regional Activity Centres as well as the support of experts.

The report reproduces the scoping of the study, the evaluation techniques applied and the results obtained. It was jointly drawn up by Anaï Mangos (Marine Ecosystems Programme Officer at the Blue Plan), who was in charge of coordination, Didier Sauzade (Blue Plan Programme Officer "Sea", seconded by Ifremer) and Jean Pascal Bassino (Associate Professor at the University of Montpellier III and researcher at the DEFI, University of Aix Marseille II, Blue Plan consultant). Patrice Francour (Director of the ECOMERS laboratory, University of Nice Sophia Antipolis) and Odile Chancollon (ECOMERS laboratory,) contributed to the section on marine ecosystems under a specific agreement with the Blue Plan.

The study received the wise advices of the members of the Steering Committee for the Blue Plan's "Sea" programme, experts in marine ecology and economics, the list of which can be found in Annex 1.

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Moreover, UNEP's Regional Seas programme has developed a methodology for assessing what share of the economic activities of the countries bordering on the world's Large Marine Ecosystems comes from the goods and services provided by marine ecosystems. The Mediterranean is one of the regional seas studied.

In this context, the Almeria declaration (2008) made by the Contracting Parties to the Barcelona Convention decided to conduct studies aimed at . The Blue Plan thus committed itself to assessing the economic value of the sustainable benefits provided by the ecosystems which comprise the large Mediterranean marine ecosystem. This remit and the development programme for the eco-systemic approach which links MAP and some of the activity centres (SPA RAC and the Blue Plan) to the European Commission (EC) provided the framework within which the Blue Plan drew up this study, which draws in particular on several previous studies conducted under the aegis of the United Nations Environment Programme (UNEP).

Usefulness of the economic evaluation of the benefits rendered by ecosystems and general approach

The environmental economy tends to pool ecological and economic knowledge in order to blend the notions of the environment as both a provider of natural resources and as a plank for socio-economic development. The economic assessment of the benefits provided by ecosystems provides public decision takers with a common and quantitative language, which can be understood by a wide audience and which allows these figures to be included in the calculations relating to public policy (satellite accounts for national accounting, public policy evaluation...). Evaluating the contribution made by ecosystems also opens the way to shaping and testing the effectiveness of new regulatory policies for mitigating the environmental externalities linked to activities (the introduction of compensation systems, for example). The economic value of the benefits from ecosystems thus increases the visibility of the strategic role played by ecosystems- as well as the ecological processes which characterise them- in societal development and in particular highlights the risks to be avoided, which are commonly lumped together under the notion of the (Hardin, 1968).

in order to highlight their importance for the sustainable development of the Mediterranean riparian countries. The emphasis has been placed in particular on the benefits noted in the coastal zones.

The study was conducted in four stages, as set out in appendix 2. The first stage, which focused on the theoretical and methodological scoping, specified the aims of the study and selected a macro-economic approach. The second stage consisted in an assessment of the feasibility of the study, which allowed to experiment a tentative approach based on the transfer of benefits- the results of which are shown in appendix 3-, the nature of the ecosystem services rendered by Mediterranean marine ecosystems to be specified (see appendix 4) and an analytical framework to be drawn up for addressing the field of study (see appendix 5). During this stage, available data was collected. The third stage involved processing the available information and analysing the results, the reproduction of which comprises the bulk of the report. Finally, the fourth stage provided the opportunity to sum up what has been achieved and to identify further prospects for this work.

This report presents the theoretical and methodological framework adopted, explains the evaluation procedure followed for each type of benefit and sums up the main results.

I. Conceptual and operational framework

Evaluating the benefits from ecosystems in economic terms is a complex procedure in two respects:

It looks at the services which may be affected by human action and for which there are few (if any) man-made substitutes;

It must take account of ecosystemic processes, which are still poorly understood.

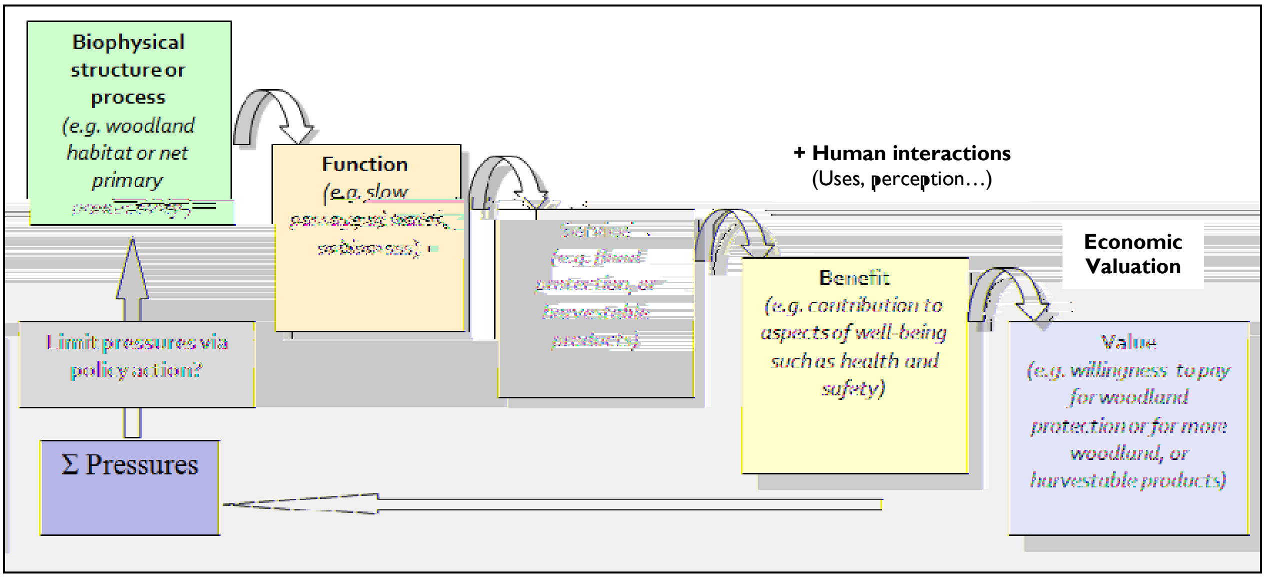
This section aims to clarify the concepts which underlie the economic evaluation of the benefits provided ecosyste70a d(be)-2(ne)ne 70whic70f70(rs)udy. 70olua) mits

The DEPI is responsible for the implementation of environmental policy with a view to promoting sustainable development at global, regional and national levels. This division is

The various types of ecosystem services are subject of numerous classifications[3] (appendix 4). These classifications usually refer to four major categories of services rendered by ecosystems (production of resources, regulation, cultural and support) of which only the first three provide a direct input into the human sphere.

Bouvron (2009) defines ecological functions as being whilst ecosystem services are . These profits comprise the benefits rendered by ecosystems (Boyd et Banzhaf 2007; Boyd 2007). The benefits provided by ecosystems, in other words the finished products provided by nature and about which users make choices, can be subjected to an economic evaluation (figure 1).

Figure 1 : Relations between functions, services, benefits and values.



Source: adapted from Haines-Young and Potschin (2010).

Here, ecosystems are addressed from an economic point of view, which equates their existence to that of environmental assets. Taken overall, these assets constitute natural capital used by man either in conjunction with the other factors of production or not.

In environmental economics, the term "natural capital" refers to the entire set of environmental assets. The various theoretical and empirical studies which have looked at the services rendered by natural capital and enjoyed by man constitute one of the sources of inspiration for this study towards identifying the methods of evaluation potentially applicable to the various ecosystem services rendered by marine ecosystems and in line with the SEEA.

Socio-economic activities, which generate revenue and well-being, generally combine different types of capital[4] : physical capital, human capital (or labour) and very often natural capital. The

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3 The issue of the classification of ecological services has been addressed by numerous studies, some of them still underway, in particular: Costanza et al. (1997) ; De Groot et al. (2002) ; MEA (2005) ; Wallace (2007) ; Beaumont et al. (2007), the TEEB (in preparation) and CICES (in preparation) (see AAppendix 4).

4 These factors are labour, man-made capital (resulting from investment in amenities, buildings or infrastructure) and human capital (resulting from investment in health, education or research and development). The study is exclusively anchored in the sphere of reality, thus an examination of the conditions for financing new production functions and

benefits derived from activities can therefore be attributed to different types of capital depending on their respective contribution to the production of benefit6.9 367122(be)-26.9isiu22(be)-26.9-19(a)0(to)tak(ty

Various methods of economic assessment are applied to the study of ecosystems, which differ according to the elements evaluated and the objectives pursued. Generally speaking, two types of approach can be identified, one based on cost and the other on value, both of them compatible with the SEEA framework.

The cost-based approach tends to assess the loss of benefit or well-being caused by the consumption of natural capital, in other words the destruction or deterioration of ecosystems. In this case, the assessment focuses on the cost of the depreciation, degradation or restoration[7] of the ecosystems when the aim is to maintain a certain level of provision of ecological services[8].

In parallel, the value-based approach strives to assess in economic terms the benefits and enhanced well-being which derive from ecosystems, as perceived by the individual. This assessment is based on the usefulness attached by the individual to the benefits they derive from the ecosystem services delivered by ecosystems.

In striving to measure the value of the sustainable benefits deriving from ecosystems, this study thus embraces the value-based approach and aspires to make a contribution applied to the SEEA by drawing on the framework proposed in the current version (UN 2003). This contribution addresses part of the ecosystem accounts, which are currently under discussion within the framework of the SEEA revision, proposing the evaluation of the sustainable benefits from Mediterranean marine ecosystems.

The benefits are measured as resulting from the use by the economies in the riparian countries (and possibly the rest of the world) of the annual flows generated by Mediterranean's marine environmental assets. The study is primarily based on the data collected or drawn up by the 22 countries which participate in MAP, taking 2005 as the year of reference. This year was chosen as being the most recent for which the large set of data produced by national statistics required for the study was available. Certain evaluations used the most recent data available, which may date back to before 2005.

The economic value of the benefits is estimated exclusively at macro-economic level. Consequently, the dependence of players on these benefits and their vulnerability in the face of potential change in the provision of ecosystem services and benefits are not addressed within the framework of this study

[7] The cost of depreciation refers to the decrease in stocks of natural assets. The cost of degradation refers to deterioration in the ecological processes which determine the level of provision of ecological services. Depreciation or degradation reduces the level of benefit. These phenomena can also produce negative effects (as opposed to the positive ones, which are the benefits), which are shown in negative externalities, particularly for health. The cost of restoration refers to the finances which would need to be committed in order to restore the level of production of the ecological services or reduce the negative externalities.

[8] In order to quantify the scale of natural capital consumption,

the ecosystem's

(J-L. Weber, pers. com, 2010).

The following two sections address in greater detail the notions of natural capital and sustainability on the one hand, and the methods for assessing the benefits deriving from

The value of the stock can be assessed by constructing a natural capital account within the framework of the environmental satellite accounts. This account allows trends in stock value to be measured as proposed by Hamilton and Clemens (1999). Based on studies conducted by the World Bank, they propose genuine saving estimates for various countries. The authors calculate changes over time in the value of physical assets produced, natural capital, and human capital. Amongst the resources comprising natural capital they include commercially exploited forests, oil and mineral deposits, and the atmosphere as a sink for CO_2.

The scale of variation in the stock of natural capital corresponds to the consumption of natural capital, thus to the destruction/degradation of certain assets. Taking this indicator into account allows the national revenue to be assessed, adjusted for the consumption of physical as well as natural[9] capital. This indicator is relatively useful in the economic assessment of the benefits resulting from natural capital. Indeed, the information can be directly used within this framework when the benefits received are the exact equivalent of the natural capital consumed, in other words when the total monetary benefits have resulted from the exploitation of non-renewable resources or the destruction of habitat, for example.

It has also been noted that the estimation of capital stock following the approach by Hamilton and Clemens (1999) takes no account of water resources, the role of the forests in carbon sequestration, fisheries, water, air and soil pollution and loss of biodiversity, etc. This therefore translates into an under-estimation of the total value of the stock of natural capital, possibly on a large scale (Dasgupta, 2003). Measuring benefits as payment for this stock of natural capital would therefore also result in the actual value of the benefits being largely under-estimated, particularly in the case of marine ecosystems, for which only deposits at sea and the carbon sequestrating function of the oceans would be taken into account.

The implications of the scarcity of environmental assets and uncertainties concerning their renewal may be examined from the viewpoint of economic well-being. Economic agents have objectives in terms of intra but also inter-generational equity (Solow, 1991). They are therefore deemed to be altruistic and thus attach importance to the environmental assets which provide them with well-being, but also to those which they do not use themselves but which they know are used by others; they also care about the state in which future generations will find these assets. It is for this reason that this estimate has been conducted in exclusion of anything which corresponds to the consumption of natural capital, retaining only the benefits emerging from sustainable uses.

As far as substitutability is concerned, two approaches can be envisaged: one examines the

[9] The use of this indicator represents progress over measuring the gross domestic product (GDP) or even the net domestic product (NDP), which is adjusted for consumption of man-made capital. Bartelmus (2009) presents some recent results in international comparisons of NDP adjusted for the consumption of natural capital. Amongst the precursors, mention can be made in particular of the ISEW (Index of Sustainable Economic Welfare) developed by Daly and Cobb (1989) on the basis of Nordhaus and Tobin's proposals (1972), with applications for different countries (Diefenbacher, 1994; Castaneda, 1999; Hamilton, 1999) as well as for regions, for example Tuscany (Pulselli et al., 2006). The value of the ISEW is obtained by adjusting the GDP (expenditure-based approach), deducting military spending, adding the non-market services of households and subtracting the cost relating to the degradation of the environment and the depreciation of natural capital. This indicator therefore combines certain aspects of well-being, of which GDP takes no account, as in the Index of Economic Well Being (Osberg & Sharpe, 2005) and the loss of well-being resulting from unsustainable growth. The Genuine Progress Indicator has similar characteristics.

conditions for so-called weak sustainability, which corresponds to a situation where natural capital and man-made capital are substitutable; the other considers the implications of so-called strong sustainability, which corresponds to a situation where there are critical stocks of natural capital. In order to evaluate the benefits from ecosystems, criteria need to be identified on the basis of which a benefit flow could be deemed to be sustainable. It was decided to take a strong sustainability criterion for this study and to consider natural and physical capital as being non-substitutable[10]. This choice is justified in particular by the features of marine environmental assets and the fact that they are relatively little developed by human activity[11] as compared with terrestrial assets.

It therefore proved necessary to identify among the benefits from marine ecosystems the portion which can be regarded as sustainable and to measure it on the basis of sustainability coefficients according to experts judgements, based on ecological rather than economic criteria.

Ecological processes tend to be non linear and complex. The biophysical impact resulting from the degradation of an ecosystem can be weak up until a certain threshold of degradation. Nevertheless, once that threshold is crossed, even a slight increase in degradation can trigger a major biophysical change. This type of phenomenon, known in ecology terms as loss of resilience, indicates that the ecosystem has lost its capacity to absorb disturbances without its functional characteristics undergoing fundamental change. If an ecosystem has reached its resilience threshold, a relatively minor disturbance can push it into a new, irreversible state (Walker 1995; Levin 1999; Dasgupta, Levin, Lubchenko, 2000).

The thresholds and points of non-linearity in the ecological systems need to be taken into account in order to evaluate the consequences of a choice which would affect the structure or functioning of ecosystems, leading to the possible degradation or destruction of natural assets (Brock and Xepapadeas, 2003) thus equatable to the consumption of natural capital. Greater account could be taken of the evaluation of resilience thresholds and the non-linear dynamics of ecosystems within the framework of a diachronic approach which would further extend this study.

In this study, the sustainability conditions of the benefits relating to the services provided by ecosystems are thus examined for each service provided by the ecosystems before means for estimating the annual monetary value of the flows are proposed.

3.2. Diversity of approaches to the economic evaluation of the benefits and principles chosen for this study

The economic value of the benefits from environmental assets can be evaluated in various ways, with the possibility existing in particular of establishing estimates on the basis of surveys which

10 The framework of the 2003 version of the SEEA can be used for an analysis taking account of sustainability but, in its current version, the United Nations manual does not propose any choice between strong or weak sustainability (Dietz and Neumayer, 2006) and takes no account of the risk of loss of resilience (Walker and Pearson, 2007). With the conceptual framework of the SEEA undergoing revision, it can be supposed that these considerations will lead to change.

11 In the sense that land ecosystems can be, since farming or forest activity can lead to a relatively stable balance with a reduction in biodiversity but a degree of increase in productivity, from the point of view of the benefits that can be used by the economy..

use revealed or stated preference and possibly the transfer of values or benefits[12]. The choice of methods

- Aggregation is possible whatever the approach used for estimating the benefits (based on revenue, expendit

Whilst it is true that this method of evaluation allows the scale of economic flows permitted by this ecological service to be measured, it leads to an over-evaluation of the value of the benefits derived from ecosystems[19]. Indeed, it would seem that:

The value measured in this way corresponds to a potential loss in turnover for each producer, which is usually not equal to his income. In order to reflect the loss of revenue for the producer, intermediate consumption should be deducted from turnover in agriculture. Rather than the value of production, it is the value added which should be used[20].

Production requires other assets which are involved in production by providing services, payment for which is not included in intermediate consumption, but which is nonetheless involved in the share-out of value added (payment for labour and physical produced capital). Hence only part of the value added corresponds to the benefits relating to the services provided by ecosystems[21].

This study tends to measure the value of benefits related to services rendered by marine ecosystems, leaving intermediate consumption out of the equation and therefore taking value added as the basis[22]. The same approach is also followed by Lange and Jiddawi (2009), although these authors do not distinguish within value added the contribution made by environmental assets and that of other factors. Once again, the result is an over-estimation of the benefits.

Implementing the economic evaluation of the benefits from ecosystems may be a complex task; from the conceptual point of view, however, the value of benefits is relatively easy to formulate. There are two options:

Either a situation in which the production of benefit needs natural capital to be combined with other factors;

Or a situation in which the benefit provided by services rendered by ecosystems is obtained by only using services provided by natural capital.

In the first case, payment for the services provided by natural capital can be called a resource rent[23]. The more abundant the resources (there is a high volume of exploitation) and the easier to

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review of the available literature. Dependency is nil if the coefficient is equal to 0; the impact on production is then negligible. Dependence is total if the coefficient is equal to 1, the harvest in this case being nil in the absence of pollinating insects. In the studies mentioned, the values of this coefficient are strictly below 1.

19 Assessment procedures of the same type lead Bruke et al. (2008) to over-estimate the value of the benefits.

20 The value of production, including intermediate consumption, therefore, as an approximation of the value of benefits is frequently used in studies proposing an economic evaluation; this is particularly the case for Costanza et al. (1997, 1999) and Merlo and Croitoru (2005).

21 Moreover, in a situation where the service provided by an ecosystem disappears, part of the factors rendered inactive could be reallocated for use in other activities. The revenue produced by these factors would therefore not totally disappear. The inter-sectoral reallocation of production factors may be costly and take time, but that does not fundamentally challenge our objection.

22 Since it was not possible to calculate capital depreciation for every activity and Mediterranean riparian countries, it is the gross value added which is considered in the study.

23 The OECD glossary of statistical terms defines “ ” as follows: *“The economic rent of a natural resource equals*

”. This appears to be the most complete and most relevant definition. It should be noted that the term is translated into French as resources rent (in the plural) but the glossary does not propose any translation of the definition in French.
Source : http://stats.oecd.org/glossary/detail.asp?ID=2332

exploit they are (the contributions from other factors are minimal), the higher the resource rent. It is paid to the natural asset holders when the assets can be appropriated (property rights). If that is not the case, a virtual resource rent can be deemed to exist in the sense that agents (public or private alike) acting as the representatives of natural capital could demand payment by the users. When no payment is made, it means that the holders of the other factors of production (labour, physical produced capital and possibly human capital) capture the resource rent.

There are two possible methods for evaluating the resource rent:

If the natural capital is deemed to be a factor of production in the same way as physical (man-made) capital and labour, all the factors of production are paid for at their marginal productivity, with optimal quantities of factors, in other words for which the ratio marginal productivity to price is the same for all factors; labour and physical produced capital are paid for at their marginal productivity level, which correspond respectively to the wage level and the sum of the interest rate and the capital depreciation rate. Payment for natural capital can be identified by a right of access where such a right exists and if its price is fixed by a market mechanism. Where no right of access exists, the value of the benefit is implicitly nil.

If the natural capital is deemed to be a factor with specific features because of its scarcity (since it cannot be produced by man or substituted), it is paid for by a scarcity rent, which can be identified as a Ricardian differential rent. This rent corresponds to what remains of the added value (difference between the value of the product and the value of intermediate consumption) after the services of labour and the physical produced capital have been paid for. Such is the case for agriculture, with the rent being determined by natural fertility, all things, in particular technology and the productivity of labour and the physical produced capital otherwise being equal[24].

As will be seen later, the SEEA takes an approach in terms of differential rent. But this results in practical difficulties, since for most economic activities the calculation can yield a nil or even negative rent. This calculation method does not seem satisfactory, but in the meantime it appears practically impossible to assess the value of natural capital and its productivity.

The study is therefore anchored in a revenue-to the value of the product[25]. Thus in this case, the value of the benefit is equal to the physical flow produced multiplied by its unit value[26].

Disregarding the problems relating to the measurement of physical flows (mentioned in the following section and subsequently in more detail in part II), the unit value can be seen as the market price for this benefit when the ecosystems produce a benefit deemed to be comparable to the one provided by companies[27], i.e. to a finished product. When no unit market price exists, it is possible to adopt a variant, which consists of using reference prices (set by the authorities representing the company) as unit values. A further possibility consists of using social opportunity costs, known as (Tinbergen, 1954) or even shadow prices (Dasgupta ., 1972)[28]. Finally, when there is no measurement of the opportunity costs nor any other measurement of the unit values estimated by direct evaluation methods, the substitution (or replacement) costs method can be used whilst observing the markets for goods or services which can be substituted for the benefits provided by ecosystems considered in relation to their main utility[29].

25 Still under a production –based approach, it can also be taken that the economic value of the benefit corresponds to the value of the capital stock multiplied by its marginal productivity. However, since stock value and marginal productivity tend more often than not to be unknown, this method cannot be applied in practice.

26 The added value can also be deemed to be equal to the expenditure (effected or avoided) of economic agents using this service. In the report by Chevassus et al. (2009), this principle is applied to hunting, where the value of the benefits picked up by the hunters is equal to the value of the total expenditure incurred in order to hunt.

27 For example, carbon sequestration, with the unit value (per tonne) in the case of emissions reduction being seen as equivalent to the unit value of the carbon sequestered.

28 The shadow price of a resource is the theoretical price which the user is prepared to pay for an additional unit in an optimisation situation (equalisation of the marginal utility/price ratios for all goods and services in the case of the consumer and marginal productivity/price of the various factors in the case of producers). Shadow prices depend on 4 factors: the concept of social well-being, the size and composition of stocks of assets, possibilities for production and substitution between goods and services, and the provisions for allocating resources in the economy (Dasgupta, 2001: 123).

29 See in particular the section on the benefits relating to protection against erosion in part II.

4. Application to the Mediterranean marine ecosystems

This section presents the ecosystems, ecosystem services waters (from 0 to 50 m) although they account for a mere 5% of Mediterranean waters. The coastal zones (between 0 and 100 m) support some major ecosystems, the main ones of which are the magnoliophyte beds and the coral concretions.

Magnoliophytes are land-based flowering plants, which returned to the marine environment some 120 to 100 million years ago. There are about sixty species around the world, of which five are to be found in the Mediterranean (, , , and), which form vast underwater meadows (also known as beds) at a depth of between 0 and 50 metres in the open seas and in the brackish and saltwater coastal lagoons.
Amongst these species, Posidonia ( ), a species endemic to the Mediterranean, plays a key role, often compared to that of the forests. The Posidonia beds comprise the leading Mediterranean ecosystem in terms of biodiversity, since they support a quarter of its recorded marine species over an area estimated to cover almost 1.5% of the seabed. A spawning ground and nursery for many commercial species and the source of major primary production, the beds constitute one of the Mediterranean's sensitive habitats for preserving sustainable non-industrial fishing. Playing an important role in oxygenating the water, they trap and fix sediment (like beach-grasses on the dunes). By protecting the beaches against erosion (by reducing hydro-dynamism and by trapping sediment in the matte) and by encouraging water transparency, they are the guarantors of seaside tourism and provide an effective tool for monitoring the quality of coastal waters. Finally their roots, which grow in the substrate, together with rhizomes form the duff, which traps carbon at length, thus being instrumental in the sea's absorption of man-made CO_2.
The corallogenic reefs are the Mediterranean equivalent of the inter-tropical coral formations, albeit not as spectacular and without the same structure. Corallogenic concretions are built up through the accumulation of calcareous algae (mainly corallinales of the and type), which grow in poor light conditions. Such concretions, which are common throughout the basin with the exception of the Israeli and Lebanese coasts, are mainly to be found at a depth of between 40 and 120 m, but also closer to the surface in caves, on the vertical walls and in poorly lit spots. They provide a home for a vast range of sessile invertebrates (bryozoans, gorgonians, sponges) and comprise the second Mediterranean ecosystem in terms of biodiversity, with over 1,700 species, a high percentage of which are endemic. The species associated with the corallogenic reefs comprise 75% invertebrates, 19% macrophyte algae and one hundred or so fish species[31]. A large number of the species present are of commercial interest and their traditional exploitation dates way back in history (e.g. sponges, red coral). The concretions also host many small sharks.
The Mediterranean deep-sea ecosystems have only recently started to be studied on a systematic basis (WWF/IUCN, 2004). Albeit relatively poor when compared with ecosystems in the Atlantic ocean, given the particular paleoecology and the marked oligotrophic nature of the Mediterranean sea, the Mediterranean deep-sea biological communities present a markedly endemic nature and some remarkable points of biodiversity, such as canyons, deep-water corals, seamounts or deep saltwater lakes, which house a unique fauna of which little is yet known. These particular ecosystems are exceedingly fragile, sensitive to macro-waste and chemical pollutants and are undergoing procedures to protect them, from certain types of fishing in particular.

With the exception of the habitats mentioned, the information available is extremely patchy and varies widely from one sector of the Mediterranean basin to the next. Looking at the Posidonia beds alone, which for two decades have benefited from numerous specific study programmes, it has to be said that, in spite of the fact that their theoretical distribution is known and they cover

31 S. Grimes (Pers. com. 2010).

an area estimated at 35,000 km², in some Mediterranean riparian countries only a tiny stretch of coastline has been inventoried.

4.1.2. Classification of the ecosystems used for the study

In order to gain clearer understanding and to better protect them, the Mediterranean marine ecosystems were classified. The Regional Activity Centre for Specially Protected Areas (SPA/RAC) thus drew up a reference list, which identifies 27 major types of benthic habitats in order to assist the Mediterranean countries with their inventories of natural sites of conservation interest.

This list draws to some extent on the one drawn up by EUNIS, the European Nature Information System. This system with its 4-level hierarchy ranks marine (A) and coastal (B) ecosystems at the very top. On the next level down, the marine ecosystems comprise 8 sub-classes, 7 of which apply to the Mediterranean, and with the categories depending on depth (coastal, infra, circalittoral, deep sea and the water column) and the nature of the substrate (loose or rocky). Some specifically Mediterranean marine ecosystems are on levels 3 and 4, which would give a total of twenty or so classes.

It was considered that the gaps in knowledge did not permit this level of detail to be established. Following a bibliographic study and scientific opinion, a compromise was reached between the available knowledge on the one hand and, on the other, those categories of ecosystem which are most characteristic of Mediterranean biodiversity and most subject to relations with human activity. This gave rise to the following classification, with an initial assessment of the area involved throughout the Mediterranean:

From the coastline to the 100 m isobath:

Posidonia beds: 35 000 km²

Corallogenic formations : 108 500 km²

Rocky seabed with photophilic algae: 108 500 km²

Seabed with a soft substrate: 217 000 km²

Beyond the 100 m isobath:

Open seas, including both pelagic and benthic ecosystems, for the rest of the basin, i.e. around 2 066 000 km².

The area of Posedonia beds chosen has been the subject of assessments reported in scientific literature (Pasqualini , 1998). For want of anything better, the area distribution between the following three circalittoral ecosystems was established within the framework of this study following scientific opinion. It is based on a proportion of the area measured on the bathymetric map (GEBCO) between the 0 and 100 m isobaths, inferred area of beds: corallogenic (25%), rocky seabed with photophilic algae (25%) and seabed with a loose substrate (50%).

Estuary and lagoon ecosystems were not specifically identified in this exploratory study and are therefore included amongst the sea-beds with a loose substrate.

Coastal ecosystems are defined as terrestrial ecosystems under the direct influence of the sea, including sea spray, featuring halophilic vegetation in particular. In EUNIS, they are broken down into three sub-classes. In this study, coastal ecosystems are deemed to be adjacent to marine ecosystems for the services generated by the so-called cultural function of benefit to activities in the coastal zone. Their features were not described in detail.

4.2. The benefits considered

The benefits taken into consideration in the study refer to two main situations:

in the coastal zone of the Mediterranean riparian countries. Man-made CO_2 sequestration is the only exception, since th on the markets; only some products harvested within the framework of human productive activity have a market value. For most of the services identified, there is no cost of access to resources (in the sense of paying rights); and where this cost does actually exist, it cannot be directly observed[34]. In this respect, the distinction between non-market and market natural capital, established in particular in work on analysing sustainability conditions (appendix 7)[35] is of limited interest for this study.

Since the appropriation of natural capital is either impossible or unimaginable within the current institutional framework, the implicit value of the stock of natural capital revealed by collective choices is nil. There is no need to estimate marginal productivity to deduce that the benefits therefore have a nil theoretical value.

It is, however, useful to distinguish between those services for which appropriation is materially impossible and other services, which in practice are not subject to rights of access, but for which it would be technically possible to introduce such rights. This is notably the case for fisheries where, within territorial waters or Exclusive Economic Zones (EEZs), market mechanisms for accessing the resource are a possibility, through auctioning, for example[36].

The distinction between appropriable and non-appropriable assets largely overlaps with the distinction drawn in section 2-2 between:

Assets that, in order to be effectively used, should be involved in a production function along with labour, human capital, and man-made physical capital (such is the case in fisheries, for example);

Assets useful for mankind in the absence of any non-ecological intervention (carbon sequestration by the oceans, for example)[37].

As was seen in section I.2.2, this distinction overlaps with the distinction between benefits whose value can be identified as a resource rent paying for the natural capital and those benefits whose value needs to be estimated by a production-based approach. Economic valuation of these two types of benefit will be examined in the case of marine ecosystems, and the sustainability of these benefits will be assessed.

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34 One of the rare exceptions is shellfish farming, where the resale price of usage rights to the areas in which the farms are located can be compared to rights of access to the resource (Montgruel et al., 2008).

35 The term non-market natural capital is used here to refer to that share of renewable resources which corresponds to the environmental services of providing amenities, regulating and supporting the biosphere. The term market natural capital is used to refer to the other renewable resources as well as the non renewable resources used.

36 The implications of under-evaluating environmental resources in terms of guiding technical progress have been studied by Dasgupta (1996). The cost of substituting natural resources by physical capital may be high and affordable substitutes may prove prohibitive when shadow prices are used instead of the market price. The depletion of certain types of natural capital and the substitution by man-made capital can therefore prove socially costly. Thus the introduction of market mechanisms allows these social costs to be reduced.

37 However, it can be noted that in certain cases the amenities in the marine area, which depend on services provided by natural assets which cannot be appropriated, only generate benefits for man, which could give rise to an economic evaluation, when the natural capital is combined with human factors of production or ones produced by man. Such is the case when amenities linked to the aesthetic and climatic qualities of the coastal area are combined with terrestrial natural assets, with produced capital corresponding to residential constructions and labour factors and with human capital to produce services in the real estate sector.

The concept of resource rent, referring here to the payment which should be made in exchange for the services rendered by natural capital in a situation where several factors of production are involved, would appear to lend itself to evaluating the benefit provided by marine ecosystems in the fisheries sector (fisheries rent). This concept is also applicable to benefits received by other activities using natural capital, such as the hotels, real estate, and tourism.

The resource rent can be specifically measured under two conditions:

Identifying the threshold of use for resources beyond which the rent can be deemed to be sustainable;

Identifying the share of value added corresponding to the resource rent. In practice the latter can be captured by agents who do not represent environmental assets, meaning that the rent is actually used to pay for labour and the physical produced capital (in the real world, as opposed to the theoretical realm, factors are not necessarily paid for according to their marginal productivity).

The evaluation of sustainable benefits, taking account of the depreciation of environmental assets with prospects of strong sustainability, excludes that share of benefits corresponding to the consumption of natural capital. This approach can clearly be applied to the case of fisheries, where over-fishing corresponds to a non-sustainable activity leading to the consumption of natural capital. For certain abiotic assets, the rate of depreciation can be regarded as nil. This is the case, for example, with aesthetic and climatic type amenities, which are instrumental in increasing the value added in the hotel business in the coastal areas, compared with otherwise comparable establishments situated inland[38].

As noted in section I.2.2, identification of that part of value added corresponding to the resource rent may depend on measuring the differential rent. This is the approach adopted in the SEEA, which specifies that the fisheries rent may happen to be nil when nothing is left of the value added once the other factors have been paid for. It may even be negative if subsidies come into the 9(I)1atioion J ET BT 1 0 0 1 278.8113 [(Tm [(the 9(ET EMC /P <</MCID 5/Lang6(en-GB) BDC BT 1 0 0 1

assets are concerned, this type of benefit corresponds to climate regulation and other services relating to regulatory functions. The benefit is then assessed as the product of physical flows by unit values. There is no intermediate consumption since only one factor of production is involved. Thus, as was seen in section I.2.2, this could also be taken as a expenditure approach.

Thus the monetary assessment of the flow of benefits must be based on information on physical flows and data or estimates of unit-prices. One initial method, which could be regarded as acceptable for certain services, involves assessing prices on the basis of substitution costs (replacement, avoidance, protection); this is the method mentioned in the SEEA for ecological services give rise to non-market or collective uses. In certain cases there is no substitution cost.

This study does not use prices assessed in surveys aimed at establishing stated preference and avoid as far as possible prices revealed by indirect methods. Consequently, in most cases the unit reference value corresponds to prices obtained by direct methods: market prices and, when unavailable substitution (or replacement) costs. For certain services, estimations of the social opportunity cost, otherwise known as shadow prices, are used.

Another method should be envisaged for other ecological services rendered by natural capital, for which substitution costs exist, when at first sight there are no physical flows for these services. The lack of information about quantities is either related to the lack of knowledge about flows in volume terms[39] or to the fact that assessment of these services depends on social standards, in other words on levels in volume terms determined by collective choices.

In the latter case, these services can thus be compared to merit goods, for which the socially desirable level does not necessarily correspond to the level of individual optimisation[40]. The benefits need to be assessed according to generalised practices or by public bodies or authorities. The physical flows of services are determined by the characteristics of ecosystems, but the acceptable level of use of these services is set according to collective choices at local, national or supranational level.

For certain benefits, particularly waste treatment, both price and quantity are set by the responsible authorities, since the cost of replacement depends on the volume and is not known with any precision. These are then reference values. This corresponds to the approach inspired by Ciriacy-Wantrup (1952) and also used by Baumol and Oates (1971) and Bishop (1978), who recommend that environmental safeguard standards[41] should be determined independent of any economic optimisation. These correspond to critical usage thresholds for natural capital, which agents strive not to exceed at the least economic cost and using available technology[42].

The second part of this report presents the assessment method used for each benefit assessed.

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[39] In which case, estimates must be used, as was notably the case when the benefits relating to protecting the coasts against erosion were calculated.

[40] A comparable situation can be seen in other areas, for example when household education expenditure may well turn out lower than what might be seen as socially desirable, thus justifying public funding in certain cases.

41 This approach was also adopted by the authors of the biodiversity assessment handbook (OECD 2002).

42 The green national accounting techniques developed by certain countries, the Netherlands in particular, are based on the combination of rents and standards, with a ratio between the net domestic product (NDP) expressed as Y and the NDP adjusted for the consumption of natural capital (expressed as Y*) corresponding to the following equation (Hueting, 1991) :

$Y^* = Y - Rr - Cnr - Cna$ (where Rr is the aggregated scarcity rent for non renewable resources; Cnr is the cost of compliance with environmental norms for renewable resources, which corresponds to their rate of renewal; Cna is the cost for achieving waste emission standards, which corresponds to the environment's assimilation capacity).

II. Evaluation of the various types of benefits generated by the Mediterranean marine ecosystems

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exploitation of these resources[44] and the structure of the market for fisheries products should first and foremost be taken into account. The analysis proposed by Mongruel (2000), based on Clark and Munro (1980) takes account both the risks of the non-sustainability of the activity as a result of over-fishing, and the existence, downstream from fishing, of processing activities capturing part of the resource rent. Since most fishing zones are accessible without restriction to a large number of users, whose main aim is to maximise their net individual income, the lack of cooperation leads to overfishing. One of the first analyses of this phenomenon was conducted by Gordon (1954) and foreshadows Hardin's (1968)[45].

The fisheries industry typically comprises a highly competitive primary production sector facing a commercial (and manufacturing) sector, which usually enjoys oligopsonic powers over the fishermen, and an oligopoly over the market for finished goods[46]. The outcome of this is a composite fishing rent consisting into three types of components[47] :

- : it is, however, difficult to distinguish the share which can be attributed to the productivity of the resource from the share attributable to the productivity of factors of production other than the resource;
- : all the factors of production, including natural resources, generate a revenue equal to the surplus of the marginal producer;
- : this emerges from the concentration of demand for fisheries products and the supply of finished goods.

A tragedy of the commons mechanism is played out between the various categories of players in the same industry, the trigger being the unfair distribution of the composite rent. This results in a temporary advantage for a group of agents (or some of them), who prefers to adopt a short-term strategy for maximising the temporary advantage rather than a long-term strategy to maximise the rent. It is actually impossible to predict how the share of the rent captured by the fishermen, on the one hand, and in downstream activities, on the other hand; this is particularly due to uncertainties surrounding the volume of catches, even in a situation of sustainable resource management.

1.1.2. Assessing the resource rent in fisheries and aquaculture

Identifying the components of the rent does not, however, provide an answer about how to measure them. The aim is to assess the resource rent in monetary terms, the value of which corresponds to the contribution made by ecosystems to the fisheries sector. The 2003 version of the SEEA manual proposes a calculation method for a Ricardian differential rent for fisheries, based on national accounting data, which usually produces a nil value. In fact the entire value added is used to pay for the services of labour and capital (appendix 8). The SEEA specifies that the rent can even turn out to be negative due to subsidies (UNEP/ETB, 2007). This approach,

44 Unlike the situation prevailing in agriculture or forest exploitation, where it is easier for a producer to adopt strategic choices and techniques aimed at preserving the resource.
45 The efforts undertaken to limit the effects of overfishing have led to the creation of the Maximum Sustainable Yield (MSY). For reasons related to the dynamics of ecosystems, the MSY is not a satisfactory indicator of sustainability (Bell & Morse 2008, 57). It is therefore necessary to use a sustainability criterion other than the MSY.
46 This is a simplification; the wholesale trading sector tends to be separate from the manufacturing and retail trade sectors. Each of these three sectors has oligopsonic and oligopolic powers. This does not bring into question the existence of a composite rent and what ensues. In the case of small-scale fishing, it is often the fisherman himself (or a member of the same household) involved in the direct marketing of the product; in principle, it is possible to distinguish incomes from fishing from income related to the commercialisation of the marine products.
47 Mongruel (2000, 95-96).

which is based on the concept of residual rent, is not a satisfactory one, since it is simply the result of natural capital not being developed.

Ideally, in order to assess the value of the contributions made by marine ecosystems to the fishing sector, information should be available on the characteristics of the production functions in the fisheries sector, in order to assess the quantities of factors used, their unit price (shadow as far as natural capital is concerned), the marginal productivity curve for the factors in representative companies (all supposing that this concept is relevant; in terms of productivity, agents would appear to be highly heterogenic), as well as information concerning market structure.

Gross value added (VA) in fishing activity as such for each country is used as an initial rough estimate. This leads on the one hand to an over-assessment, since that share of the VA corresponding to the payment for labour and capital is not deducted; but on the other hand it also implies an underestimation, since what is probably a not insignificant share of the resource rent is actually captured downstream. Since most catches made by Mediterranean fishermen are intended for consumption rather than for processing by manufacturing industry, trade is the most important downstream sector. Not much is known about it, however, since circuits in the Mediterranean tend to be relatively short and are not channelled through auctions.

The SEEA takes the resource rent in aquaculture (fish and shellfish breeding) as nil. It is well documented, however, that shellfish production is sensitive to water quality. Moreover, fish farming uses the environment as a physical support for farming activity and the feed used comes from fishing. Thus aquaculture, like the fisheries sector, is based on the existence of a resource rent[48]. Since there is fundamentally little difference between the commercialisation of aquaculture products and fisheries products (significance of relatively short circuits, relatively small share of production intended for processing by the manufacturing sector), the method applied to approximate the rent in this study is the same as for fisheries.

1.1.3. Identifying the sustainable component of the rent

The SEEA manual mentions the non-sustainability of part of fishing, but do nd9(us)5(ed)-32(come)-4(s)i influenced by the size of the continental shelf, which is no more than a narrow strip apart from in the northern Adriatic, the Gulf of Gabes, the northern Aegean, the south of Sicily and the Gulf of Lion.

European countries such as Italy, Spain, France and Greece have large albeit shrinking fleets with high fishing capacity; the Maghreb countries (Morocco, Algeria and Tunisia), Libya, Egypt, Croatia and Turkey have considerable fleets but with lower fishing capacity; the other countries have only a limited coastline and small fleets.

It should be pointed out that fishermen from non-riparian countries such as Portugal but also Korea and Japan, the latter being a member of the General Fisheries Commission for the Mediterranean (GFCM), also operate in the Mediterranean. Although the catch volumes recorded- particularly in the case of Japan- look low compared with the overall volume, the species being sought tend to belong to the family of thonids, some species of which, like the bluefin tuna, are deemed to be over-exploited. Concerning Japan more specifically, although it declares a low rate of direct fishing, it plays a significant role as a reference buyer of bluefin tuna and as an investor and supplier of equipment.

Compared with other major global sectors, Mediterranean fishing is relatively stable overall, with landings peaking in 1995 to stabilise at around a million tons and lately following a downward trend.

The main species fished are: sardine ( ) and anchovy ( ) for the small pelagics, hake ( ), striped red mullet ( ), blue whiting ( ), anglerfish ( ), seabream ( ), octopus (.), squid ( ) and the pink shrimp ( ) for demersal fish species and, as far as the large pelagic species are concerned, bluefin tuna ( ) and swordfish ( ) as well as other species of local interest at specific sites.

Although some highly migratory species such as tuna exist in the open seas, most fishing takes place within the coastal zone and therefore features large numbers of small boats engaged in multi-specific fishing, with many landing points. The complex nature of Mediterranean fisheries and the lack of EEZs facilitate neither the assessment of stocks and catches nor controls, and there is deemed to be a high level of illegal, unreported and unregulated fishing[50].

The Mediterranean is currently not affected by an international system of TACs (Total Allowable Catches), with the notable exception of the bluefin tuna. The GFCM makes recommendations concerning the Mediterranean fisheries with the International Commission for the Conservation of Atlantic Tunas (ICCAT).

To the north it is quite clear that fleets are overfishing resources. The populations of demersal fish are being overfished across the board: shallow areas (within 3 miles or at depths of less than 50 m) are often illegally trawled and illegal net sizes (undersized) are used (UNEP/SPA/RAC 2003). Driven by a highly profitable export market, the bluefin tuna is subject to massive overfishing in contradiction with ICCAT recommendations. A large share of catches is used to feed fattening farms, whose capacity now exceeds allocated quotas. Sea Around Us showed that for the year 2005, 55% of identified stocks were over-exploited and 20% had collapsed, the percentage reaching 20% and 2% respectively for catches. FAO in its 2004 annual report and the GFCM in its annual report provided a more detailed overview of the state of stocks and catches, based on one-off studies.

50 Regarding illegal, unreported and unregulated fishing see in particular (OECD 2004; Agnew 2009).

However, data available for the assessment of the rent only permits a global approach for all fisheries in the Mediterranean. Wit

After applying a sustainability coefficient of 0.8 to the VA for the fisheries sector, a total of almost 3 billion Euros emerges for the Mediterranean as a whole. The data per country is presented in appendix 11.

1.2. Discussion of the results and prospects for revising the evaluation

1.2.1. Uncertainty regarding catches and the non-sustainable part of the rent

Various sources of information suggest an under-estimation of the catches measured by FAO. For species for which fishing quotas are set and checked, catches tend to be globally under-estimated[53]. This under-estimation of the amounts extracted from fisheries stocks is backed up by the existence of fishing practices, which are only slightly regulated if at all: recreational and sports fishing and subsistence fishing, which are common practices on all banks.

The difficulties with evaluating the non-sustainable part of the rent mainly stem from the wide range of local conditions:

Sustainability varies by zone and species; knowledge about the interactions between species is limited and uncertainty exists regarding the loss of resilience and the risk of .[54]

There is, moreover, a tendency to underestimate catches for certain zones or species (illegal or unregulated catches)[55].

The share of catches thrown back into the sea varies widely, since it depends on the regulations in force and the techniques used. It can be taken as being relatively low in the non-industrial fishing sector.

Revenue transfers (subsidies) appear to be particularly high in the EU countries, where they can lead to activity being maintained even when the rent is low or even negative.

Non sustainable catches correspond to what the SEEA describes as the consumption of natural capital[56]. It would seem desirable to examine trends in resource rent and the consumption of natural capital in order to estimate a sustainability coefficient for the main species caught, which corresponds to the annual ratio of sustainable catches to total catches for a relatively long period of time covering, for example, the last two decades.

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53 For example, it is estimated that in 2004, 175t of sea urchins were removed from the north western Mediterranean basin as a whole (FishStat), whereas in the late 80s, Direac'h (1987) estimated that 350t of sea urchins were taken each year from the French Mediterranean coast alone. In France, 1 kg of sea urchins (the equivalent of about a dozen) sells for about 6€ ; in other words for 2004 to use FAO's figure, a turnover of about 1 050 000€.

54 The implications of these dynamics for the analysis of the value of services are underscored by Walker & Pearson (2007).

55 Agnew et al. (2009) propose estimates for the ocean areas alone, but their methodology appears to be transposable to the Mediterranean. Some information on the Mediterranean is also available from the OECD (2004).

56 The catches thrown back into the sea should thus be taken into account to estimate natural capital consumption in order to account for the degradation and effective depreciation of fishing stocks, since some of these throw-backs are no longer viable. Since this data is not available, the non viable rejected catches should thus be estimated on the basis of catches landed.

1.2.2. Uncertainties regarding value added (VA) and the share of rent in the VA, and prospects for improvement

For the countries for which there is no information in UN Data, the method applied is based on an extrapolation of the VA from catches. There is a possible alternative method, for active population and wage data are in fact available for the fishing sector for certain Mediterranean countries in the data collected by the International Labour Organisation (ILO-Laborstat). For the other Mediterranean countries, it would therefore be possible to extrapolate the VA from the active population, assuming the same VA/asset ratio as in a country for which all the data is available and which can be deemed comparable in terms of salaries in the sector and therefore in principle also of technology used in the fisheries sector.

The value of production tends to be under-estimated by FAO, particularly as far as non-industrial catches (or small-scale workers) are concerned. Since this type of fishing is widespread in the Mediterranean, this could lead to a general under-estimation of catches in this zone. In non-industrial fishing, the wage is often adjustable according to results.

It would be desirable to assess payments in kind (the fisherman's cut), since catches distributed in this way may well not be reflected in the trade flows measured by national accounting. Since sustainability levels have been determined as a function of an assessment of over-fishing thresholds, an upwards re-estimation of catches would not affect the level of the rent although it should lead to a reduction in its percentage share of VA.

A further source of under-evaluation of the VA would seem to lie in the difficulties with identifying revenue corresponding to the mixed income of skippers, particularly in non-industrial fishing (see for example Tzanatos (2006) for Greece). Revenue is likely to be under-estimated, given the under-estimation of the volume of catches as a result of illegal fishing and undeclared catches, particularly for local fisheries and self-consumption (national accounting rules stipulate that self-consumption should be taken into account in the case of food products, but it is clearly difficult to apply them).

Depending on data availability, it would be possible for certain countries to recalculate the VA and to evaluate how sensitive results are to subsidies being taken into account. Data by Mediterranean state on subsidies can be found in Sumaila (2006). Fixed capital consumption is shown in the national accounts of some Mediterranean countries. The stock of physical produced capital is not directly available, but it can be estimated for certain countries from the number of different types of vessels in the fishing fleets registered in the Mediterranean ports; the consumption of fixed capital can possibly be estimated from the stock. After adjusting production to take account of the probable under-evaluation of volumes, it would then be possible to recalculate the VA and check whether the implicit Ricardian rent is nil.

2. Benefits relating to the provision of amenities and recreational supports

2.1.1. Method of assessment and outcome

The amenities provided by marine and coastal ecosystems contribute to the well-

The definition of coastal zone used here is based on the criterion of presence of halophilic plants. Since it is difficult to provide an accurate measure, this zone is approximated as a 100-metre strip, corresponding, in principle, to a area in a number of Mediterranean countries. This means that, barring exceptions, there are no business premises and residential buildings in the coastal zone in question[63]. Thus the resource rent does not include the urban rent; consequently, the services rendered by marine and coastal ecosystems can be regarded as sustainable if the impact of activities on these ecosystems depends less on density (which only affects terrestrial ecosystems) than on the techniques implemented to limit discharge below the critical threshold and more generally to avoid disturbing coastal and marine ecosystems. If this is assumed to be the case, there is therefore no need to apply a sustainability coefficient to isolate the share of VA which potentially corresponds to the rent.

The coastal effect is assessed by multiple regression in order to identify the share of the coastal resource rent in the VA and to validate the hypothesis of there being a negative relationship between activity in the hotel industry (VA level) and the share of the rent in the VA (which would imply that the urban ground rent is excluded). The dependant variable applied is the number of establishments per NUTS 3 (Eurostat 2005 data) for four Mediterranean EU countries- France, Greece, Italy and Spain- the only ones for which NUTS 3 data is available. It is used as an approximation for value added in the hotel sector (assuming limited regional variation in the value added per establishment). Appendix 9 provides as detailed presentation.

The length of the coastline is used as explanatory variable allowing to assess the sensitivity of the number of establishments to the coastal effect; thus, for the four countries considered, NUTS 3 data for which the length of the coastline is nil (no Mediterranean seafront) is left out of the equation. This leaves 126 observations (126 NUTS 3), 9 in France, 40 in Greece, 61 in Italy and 16 in Spain. The variables available in the Eurostat database at the same NUTS 3 level, and which can be regarded as explaining activity in the hotel business, thus the number of establishments, are the resident population (pop), the NUTS area (km²), average per capita income of the NUTS at purchasing power standard (gdp_pps) and the average wage in hotel and restaurant (wht), also at the NUTS level. The population and area are combined in a measurement of the demographic density (pop_km2); density is expected to exert a positive influence on the number of establishments (the higher the density, the more activities outside tourism requiring hotel services). The same goes for per capita income (wealth effect and indication of the scale of superior services, which draw heavily on hotel services). Average wage, however, is expected to exert a negative influence (the establishments will be located in regions with the same features, but where labour costs are lower).

The results obtained by calculation (ordinary least square estimator method in log-log form) are satisfactory, with a relatively high adjusted correlation coefficient (0.48). The coefficient for the length of the coastline variable is positive and significant. The other results are also significant and have the right sign. A negative relationship between the share of the resource rent and a low level of urbanisation can also be observed. The results of this multiple regression are used to calculate a mean effect (not weighted by population or the number of establishments) at the level of the 126 NUTS 3. This coastal effect turns out to be 5% on average, which implies that the

63 The urban area located within the 100-metre zone excluded since it is legacy from days gone by and that, moreover, the impact on marine ecosystems is relatively low. In principle, economic activities within the 100 metre strip which involve temporary constructions which can be dismantled (« straw huts » and beach attendants' premises) have only a limited impact on the ecosystems.

presence of 5% of hotel establishments can be attributed to the presence of the coast (appendix 9 for a more detailed presentation). This percentage is used as part of the contribution made by the marine and coastal ecosystems to the value added in the hotel sector for the Mediterranean countries as a whole. It should be pointed out that part of the activity in the hotels and restaurants, and in real estate sectors (and even tourism, addressed hereafter) in the coastal regions may also depend on the provision of ecological services by terrestrial ecosystems. It is assumed here that using the length of the coastline allows only capturing the effect related to marine ecosystems, rather than the entire resource rent.

Since the current state of the data does not allow an estimation or restaurants and real estate, it is assumed that the share of amenity-linked services in the value added of these two sectors also amounts to 5%.

Gross value added data for the year 2005 by country in the hotels and restaurants sector (sector I in the ISIC classification) has been obtained from the UN Data database and converted into Euros. This information is not available for Algeria, Montenegro, Monaco, the Palestinian Territories and Syria. For Algeria, the 2003 data has been used as an approximation. For Montenegro and Syria, the values have been extrapolated from the active population (ILO Laborstat data), assuming the same sector 1 VA-active population ratio as in Croatia in the case of Montenegro and as Turkey in the case of Syria. For Monaco and the Palestinian Territories, the VA has been assessed with the assumption that the VA in the sector represented the same percentage of net domestic revenue as in Greece (7.4%) and Egypt (3.1%), respectively.

An adjustment is needed to estimate the VA in the Mediterranean coastal regions. For France, Greece, Italy and Spain, this has been done by using the share of hotel establishments amongst the NUTS 3 located on the Mediterranean coast as a percentage of the total (Eurostat data). For the other countries, adjustment coefficients are used, which(u)10(s d)3dreoand er the shand ofthec[( )] TJETI

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for France, Greece, Italy and Spain; for the other countries, the coefficient accounting for the share of the population in the Mediterranean coastal NUTS 3 as a percentage of the total population (calculated using data reported in Attané ., 2001). The total for the Mediterranean amounted to 11 billion Euros in 2005. The data by country is presented in appendix 11.

2.1.2. Discussion of results and prospects for revising the evaluation

It appears that the concept of resource rent has not been used thus far for the purpose of economic analysis of the contribution made by amenities linking to marine and coastal ecosystems to activity in the hotels and restaurants, and real estate in the coastal zones. Consequently, the figures presented here should be regarded as an initial assessment of the value of the services rendered by ecosystems to these sectors of the economy at either national or regional level, using national accounting data. The study shows that in monetary terms their importance is by no means insignificant.

The amount for each of the two sectors is greater than the estimated value of the resource rent in fisheries, which was nonetheless assessed as being equivalent to 80% of the value added, whilst a mere 5% has been established for the two sectors studied in this section. It can be seen that the services provided by the marine and coastal ecosystems give rise to resource rents, which are mainly paid out to the owners of terrestrial assets, if it is taken that the coastal zone as defined (100 metre strip) cannot be used as a support for establishments located outside the urban areas (ecosystems would appear to make a limited contribution in urban areas in terms of percentage of value added[65]). The relationship with terrestrial ecosystems does not stop there. Hotels and restaurants, and real estate activities may only have a limited impact on the workings of coastal and marine ecosystems, but their development necessarily gives rise to the major consumption of natural terrestrial capital in the zones set back from the areas defined as coastal.

For real estate more specifically, the assessment is based on household accommodation expenditure, which includes the amounts paid by households against the provision of services from electricity, gas and water networks. Thus the estimated value tends to be over-evaluated, although this is balanced out by the fact that rental and imputed rental costs for agents other than households are not taken into account. Yet amenities also have a value in the case of buildings occupied by businesses or administration.

The fact that household accommodation expenses are not reported for quite a large number of countries in the UN Data database implies that extrapolation is the only option available. An alternative assessment was conducted, using gross value added in real estate (sector L in the ISIC classification). As such, it includes the VA from non-financial service activities to companies (rental, leasing and research and development in particular, which have high values, particularly in the developed countries). It should be pointed out that this assessment is based on UN Data, where no information exists for Albania, Israel, Lebanon, Libya, Monaco, Montenegro, the Palestinian Territories, Morocco, Syria and Tunisia. For these countries, VA figures were extrapolated, assuming the same VA in the sector/total population ratio as in a country which is comparable (Bosnia for Albania, Italy for Monaco, Serbia for Montenegro, Algeria for Morocco and Egypt for the Palestinian Territories). The resource rent has a value of 16 391 million Euros for the Mediterranean coastal regions as a whole, which is 46% higher than what was calculated using available information on household rental payments. This discrepancy could

65 In the case of establishments located in urban areas, what has mainly been noticed is an urban rent linked to the positive externalities of the activities located in the nearby urban area.

be attributed to the inclusion in sector K of activities relatively important in the EU countries, accounting for a considerable share of economic activity in the Mediterranean region.

UN Data contains information on VA in rit[(a)-3(cc)-estate (sector L) for three countries -Algeria,3(cc)-Libya and Egypt- for which household spending is not included in the same database. When the VA in

2.2. Benefits in recreational activities

Marine and coastal ecosystems provide amenities and supports for recreational activities. No information is available about the value added generated in each of these activities (diving, sailing...). By way of approximation, information on international tourist spending[66] in the coastal zones has been used. In fact, tourist spending covers transport spending (apart from cross-border travel), accommodation, food, leisure and enjoyment, sectors whose activity is partly related to the attraction of the sea-related amenities and the recreational supports provided.

According to the statistics from the World Tourism Organisation, the Mediterranean basin is one of the main tourist destinations, receiving 30% of international tourist flows and their spending in 2005 (UNWTO, 2009 and 2008) as well as being the leading destination for tourists of European origin[67]. Tourist intensity is unequally distributed between countries, although the attraction of the coast would appear to be a feature common to tourism throughout the Mediterranean. At regional level, over half of all tourists spend their stay in coastal areas (an average of 54% for the region; Blue Plan, 2005). It is thus interesting to investigate how the presence of marine ecosystems affects the dynamics of tourist activities on the Mediterranean coast, in other words to assess the contribution made by ecosystems, which enables the tourist sector to offer attractive services.

2.2.1. Method of assessment and results

To assist consistency in the study, the evaluation of these benefits should be based on the value added generated by tourist activities, as is the case for fisheries or the hotel industry. However, not all Mediterranean countries have as yet developed tourism satellite accounts within their national accounting. For this reason, and given that the tourism sector largely comprises service activities, the hypothesis has been established that for each Mediterranean state the value added represents 50% of the tourist spending recorded by the UNWTO (which corresponds to a mean value for the share of VA in the hotel and restaurants in Mediterranean riparian countries: 40% for Italy, 60% for the countries to the south of the Mediterranean).

On this basis of calculation, the first step in assessing the resource rent originating from marine ecosystems that is captured in tourism related activities requires identification of what share of tourist activities takes place in the coastal zone. To measure this share, the estimated value added from tourism (based on UNWTO data) is crossed with the estimated share of coastal tourism relative to each Mediterranean riparian state at NUTS 3 level (Blue Plan, 2005) (table 2).

The second stage in the evaluation involves measuring the coastal effect[68] on tourist spending. There are two main methods for measuring the effect of the amenity and recreational support

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66 The tourism considered here should be understood according to the World Tourism Organisation's (UNWTO) meaning, according to which tourists are people who arrive in a foreign place to spend at least one night. It should be noted that UNWTO data uses the information provided by the national authorities who in most countries define international tourists as non-residents. Certain countries however, particularly Algeria, Morocco and Tunisia, define international tourists on the basis of nationality rather than usual residence. This therefore results in an under-evaluation, since spending by national tourists who usually live outside the national territory (in the European Union, for example) is not taken into account.

67 In 2001, 82% of tourists in the Mediterranean were of European origin (Benoit and Comeau, 2005).

68 Here, the notion of coastal effect covers the effects relating to the presence of marine ecosystems and therefore to the ecological services provided.

services provided by the marine and coastal ecosystems: using statements from tourists about their reason(s) for choosing their destination/place of stay and observing how their spending is distributed or testing the effect of the presence and importance of certain factors on the level of activity. With the hypothesis that tourist spending reacts to the same structural determinants as the hotels and restaurants, the same coefficient for the influence of marine and coastal ecosystems has been transferred to the tourist sector in the coastal zone, i.e. 5% of the value added created.

The regional economic assessment of the benefits provided by marine ecosystems calculated here is based on an aggregation of national assessments of such benefits, and thus takes account of specific national features. In the end, it is estimated that these benefits reached a value of almost 3 billion Euros in the coastal zone in 2005. The data for each country is presented in appendix 11.

<u>Table 2 : Assessment of the value added generated by the tourist sector in the Mediterranean coastal zone.</u>

	854	50%	427	213
	184	30%	55	28
	512	10%	51	26
	2 318	100%	2 318	1 159
	7 370	72%	5 306	2 653
	6 851	10%	685	345
	43 942	20%	8 788	4 394
	13 334	95%	12 667	6 334
	2 797	70%	1 957	979
	35 319	65%	22 957	11 455

2.2.2. Discussion of results and prospects

Assessing the value of the benefits for recreational activities through tourism leads to the adoption of too broad a perimeter (since transport activities are included in tourist statistics, for example) and gives rise to double counting with the benefits in the hotels, restaurants, and real estate. In fact, accommodation and food spending has already been taken into account (as least partly) in the hotels, restaurants, and real estate sectors. Ideally these latter activities are the only ones which should be dissociated in order to isolate spending linked to recreational activities alone, but the available information does not allow for this. The result is therefore an over-estimation of the value of the benefits provided by marine and coastal ecosystems in recreational activities. However, limiting the scope to international tourists alone leads to an under-evaluation of the economic significance of recreational activities, which goes some way towards balancing out the over-evaluation linked to the double inclusion of transport and accommodation spending in tourism. The consumption of market services in recreational and leisure activities linked to marine and coastal ecosystems is not only a matter for international tourists- it also concerns domestic tourists as well as the permanent residents of the coastal regions. It is therefore likely that in most cases an approximation using the value added from international tourism leads to the value added achieved in the recreational activities being under-evaluated. This claim is strengthened by the fact that the recreational activity sector also includes the activities for producing the equipment used in the course of these recreational activities.

Moreover, in order to assess the value of the benefits for recreational activities through tourism, the applied coastal effect parameter was transferred on the basis of a study of this effect on hotels in certain Mediterranean coastal NUTS 3 (appendix 9). The existence of structural levers common to behaviour on the hotel business and tourism services can be questioned. Whilst it is true that part of these markets overlap (as previously mentioned), it is likely that other tourist markets are subject to different behavioural structures on both the supply and the demand side. The study of the coastal effect of tourism and the value added generated in this sector should be further refined.

In the case of Greece and Tunisia (appendix 11) for example- countries featuring marked coastal tourism- the value of the benefits would appear to be under-estimated. At national level, the study of the value of benefits rendered by the marine ecosystems to the tourism sector should be covered by national sectoral studies which illustrate in more specific terms the geographical distribution of tourist activity, the value added generated and the market's reaction to various structural determinants.

Finally, with the prospect of the assessment of the benefits which emerge from the provision of amenities and recreational supports being revised, it would be desirable to collect the results of sectoral analyses of those activities which are directly linked to ecological services. In parallel, given that these activities are not exclusively based on the contribution made by marine and coastal ecosystems, information should also be collected with the aim of establishing the extent to which these activities depend on the provision of such ecological services.

3. Value of benefits linked to climate regulation

The existence of the large Mediterranean marine ecosystem influences climate fh BT□Tf□10u7s average for the World Ocean (Gruber, 2009). It has been proposed that, in order to quantify this ecological service, the estimate provided by Huertas (2009) should be used, which gives a total sequestered volume of 108 million tonnes of CO_2[69] per year for the Mediterranean as a whole. It should be noted that this quantity represents a mere 5% of the CO_2 emitted by activities in the Mediterranean riparian countries (UN Data).

The definition of the reference economic value for a tonne of CO_2 is the subject of numerous international studies because of its important role in the environmental evaluation of projects, particularly in the transport field: European HEATCO project, DEFRA study (2005) in the United Kingdom or in France the work of the Quinet commission on the shadow value of carbon (CAS, 2008).

Moreover, since January 2005, Europe has had a quota trading system in place (ETS[70]), which covers almost 45% of CO_2 emissions, mainly from the fuel-intensive energy and industry sectors. This market has led to the emergence of a price for CO_2 which, before the financial crisis, was fluctuating between 17 and 25 Euros[71]. Since it is the result of transactions on a global market, the average price for the year 2005, which is the reference year for the study, i.e. 20.5€/t of CO_2 (World Bank, 2006), was taken as the value for this study. It should be pointed out that this value is not very different to those which emerged from the studies mentioned for the same period.

The method proposed for evaluating the economic benefit for this ecological service (SErc), which does not involve any human activities for its implementation, is particularly simple:

$SErc = F_{CO_2} \times Vcref$

where F_{CO_2} is the annual flow of CO_2 of human origin sequestered by the Mediterranean sea and Vcref is the reference value per tonne of CO_2 selected for the study.

Annual regional value: 108 Mt x 20.5 €/t = 2.2 billion Euros.

It is currently not possible to evaluate the quantity of CO_2 of human origin sequestered by the territorial waters of the riparian countries. Moreover, this type of approach would leave out large swathes of the Mediterranean, which do not belong to these territorial waters. The proposal is to distribute the value of the ecological service by riparian state in accordance with their respective share in the total volume of CO_2 emitted by the riparian countries as a whole, based on the statistical data provided by UN Data on CO_2 emissions per country. These results are presented in appendix 11.

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69 One tonne of carbon corresponds to 11/3 or 3.67 tonnes of CO2.

70 Emission Trading Schemes

71 The World Bank publishes an annual report on trends on this market, from which it is possible to extract an average price per tonne of CO_2.

3.2. Discussion and further studies

Climate regulation by the oceans does not boil down to CO_2 sequestration alone. However, the choice taken to focus on this process as an initial approach can be justified as follows:

There is justification for not taking the ocean's thermo-dynamic operations into account, to which the Mediterranean Sea contributes and which play a considerable role in the world climate, since current marine ecosystems do not intervene directly in this function.

Looking at the other greenhouse gases listed in the Kyoto protocol, it can be seen (i) that the ocean is a net producer of methane and nitrogen oxide (Rhee, 2009) and this study only considers the positive benefits from ecosystem services (ii) the other gases listed (CFC, SF_6) barely interact with the ocean.

The ocean also acts as a sink for numerous pollutants present in the atmosphere, but this service was not assessed in this study as it is deemed to be non-sustainable.

The monetary assessment conducted may change enormously over time as a result of fluctuations in price and quantity. The carbon market fell in 2009 but is expected to show a marked rise over the coming decade. The quantity of CO_2 of human origin sequestered by the Mediterranean Sea should be specified at the end of scientific work currently underway.

The capacity for human intervention in the sustainability of this service needs to be addressed at various levels. At global level, the flow of anthropogenic CO_2 sequestered by the ocean is linked to human activities which generate CO_2. Moreover, this sequestration has largely been achieved at global level through a process of solubility (the physico-chemical pump), which shows little dependence on ecosystem quality. However, this process leads to the gradual acidification of the oceans, which will have a considerable effect on marine ecosystems and the living resources produced, particularly in the Mediterranean (CIESM, 2008; Gambaiani et al, 2009). This issue, about which little is yet known, is the subject of many initi

Value of protection against coastal erosion

Marine and coastal ecosystems are generally recognised as providing protection to coastal zones against storms or erosion phenomena, for example. This ecosystem service secure the durability of infrastructures and investments on a threatened coastline by contributing to the stability of the coastline.

Within the framework of this study, valuation focuses on the benefits produced by the erosion defences provided by marine ecosystems. Coastal erosion is a natural phenomenon widely observed in the Mediterranean, particularly in coastal zones with soft substrate. The European Environment Agency (EEA, 2006) states that 20% of European coasts are threatened by erosion (i.e. around 20 000 km). The threat is felt differently from one country to another, with 37.8% of the Cypriot coast being under threat, for example, as compared with 24.9% in France, 28.6% in Greece, 22.8% in Italy and 11.5% in Spain. Various local scientific observations have shown that coastal erosion is also affecting the southern and eastern shores of the Mediterranean basin.

Although coastal erosion is a natural phenomenon, it is nonetheless a cause of public concern in the Mediterranean, given the marked concentration of socio-economic activities on the coasts[72]. Thus the fact that the marine ecosystems provide a service which limits harmful impact of erosion, it produces benefits for all socio-economic activities present on the threatened coastline.

Whithin the marine ecosystems identified in the Mediterranean, only the Posedonia meadows have been scientifically recognised as providing protection against erosion. The provision of this ecosystem service hinges on three properties inherent to Posidonia. Firstly, its foliage, which limits hydrodynamics by 10 to 75% under the leaf cover (Gacia ,1999). Then the banquettes formed by its dead leaves and rhizomes[73] on beaches - that can reach a height of between 1 and 2 metres - which builds a structure both rigid and flexible that protects the coatline against erosion (Guala ., 2006, Boudouresque ., 2006). Finally, the matte of Posidonia [74] traps sediment (Dauby , 1995, Gacia and Duarte, 2001), thus contributing to their stability. According to a study conducted in 1984 (Jeudy de Grissac, 1984), depending on the underwater profile and for a sandy coast, degradation of one metre thickness of Posidonia duff could lead to the coastline retreating by twenty metres or so.

Evaluating the benefits attached to the protection line against coastal erosion afforded by the Posidonia medows requires that the risk of coastal erosion is a matter of concerne, and that the Posidonia meadows present in the area are effective in mitigating erosion phenomena. The value of the benefits provided by this service is considered here as the equivalent of the avoided defence expenditures (investment and maintenance).

72 Moreover, the recurrence of public policies dedicated to combat coastal erosion within the riparian countries shows, that most countries feel affected by this risk.

73 The rhizome is the underground stem of certain perennial plants (different from the root).

74 The matte is the structure made of comprising rhizomes, sheaths and the dead leaves (Boudouresque et al., 2006).

4.1. Method of assessment and results

However, the presence of Posidonia alone does not guarantee the provision of an effective protection service against erosion. In fact, this provision depends on various characteristics such as the size of the meadow, its maturity or the intensity of the erosion affecting the coast. Taking as a basis that over 10% of the European coasts demonstrate the existence of protection mechanisms against erosion (EEA, 2006) – which represents half of the European coasts subject to erosion – and in order to circumvent the lack of available information on the matter, the hypothesis has been established that 50% of the Posidonia meadows provide an effective protection against erosion. It has thus been estimated that at the regional level, 3 312 km of Posidonia meadows provide an effective protection service against coastal erosion.

Finally, the third stage of the valuation aims at establishing the economic value of the benefits received from Posidonia meadows. The assessment technique based on shadow prices (here avoided costs) has been applied and and suppose that the economic value of these benefits is equivalent to the avoided expenditures (investment and maintenance costs). In 2001, expenditures on coastal erosion defence observed along European's coastlines have been rose up to 3.2 billion Euros[78] (EC, 2004; EUROSION programme). It can thus be estimated that European spending on erosion defences amounts to about 160 000€ per coastline km. This unit cost per km was transferred in this study.

At the regional level, the valuation shows that the Posidonia meadows allow the riparian countries to avoid an annual spending of about 530 billion €/yr, covering investment and other costs (i.e. maintenance costs).

The results are presented in annex 11. It can be noted that due to the valuation technique applied, the value of protection against erosion depends mainly on the length of the coastline and thus does not directly reflect the risk of erosion. In the case of Greece, for example, where the coastline is very long but the coastal strip is not particularly built-up, it is likely that the method applied produces an over-estimation. In this case, the erosion coefficient established for the Mediterranean as a whole should be modulated in order to better reflect the real risk encountered along the coasts of this kind of specificities.

4.2. Discussion and further works

The valuation of the benefits flowing from the protection against erosion provided by the Posidonia meadows shows how important it is to have precise information about the sectors in which erosion constitutes a threat (thus where infrastructure does exist) and where the meadows are established. Some data exists on the erosion of specific coasts, on coastal urbanisation and on the amounts spent to defend against or prevent the risk of erosion. However, whilst being useful in order to address the issue, these data could not be used for this study since it did not cover an area enough large or representative to allow an extrapolation to all of the Mediterranean

the extreme north of the Adriatic as well as along the coasts of Languedoc, between the Camargue and Port-la-Nouvelle (Boudouresque et al., 2006).

[78] This expenditure breaks down as 53 % for new investment, 38 % for maintenance and 9 % for the purchase by the public authorities of property threatened by coastal erosion (EC, 2004).

coasts in consideration. The lack of information was circumvented by establishing likely but not checkable hypotheses and by the transfer of coefficients stated by European projects and institutions. To improve the valuation of these benefits, more information would be needed at both regional and local level, dealing with coastal urbanisation, area affected by erosion, settlement of Posidonia meadows, their effectiveness in defending the coastline against erosion and the amounts spent on protection activities or infrastructures.

The evaluation method used here and which is recommended by the SEEA (2003) based on replacement costs does not totally satisfy the methodological approach. Indeed, different substitutable activities to the ecosystem service has to be pointed and valuated (i.e. dykes and other techniques in the case of erosion) but these substitutes rarely do constitute absolute substitutes for environmental assets, in fact they do not provide the other ecosystem services provided by one ecosystem and involve other kind of externalities (change of landscape, shifting the erosion problem elsewhere...) that are not taken into account in the valuation of one specifique benefit but that can harm the overall benefits received (i.e. loss of amenities due to a dyke). Other valuation techniques could be used, such as insurance based approaches observing prices on these markets when erosion is considered as a risk or conducting field surveys. Although these methods introduce other kind of bias, it would be interesting to compare the results from the various approaches.

5. Value of waste treatment

Marine ecosystems provide a service by receiving a large share of the waste from human acti

s thrt-5evhold.( )1090It fMaif dthe thrt-5evhold d(w)-2ere d environments. In Europe, the EC's Water Framework Directive (EU_WFD, 2000/60/CE) based on the application of Costanza *et al's* unit values to the areas of the various large Mediterranean ecosystems estimated by Martinez (2007) values this service, which represents 78% of the total for the Mediterranean.

The choice was made for this study to take the hypothesis of the sustainability of the services provided by ecosystems, which means that the absorption by marine ecosystems of toxic substances (heavy metals, organic pollutants, persistent organic pollutants...) or the treatment of recyclable substances such as nutrients rendered beyond the reprocessing capability of these ecosystems should not be counted as a service.

According to this hypothesis, this service thus boils down to the treatment of recyclable matter, within the limits of these ecosystems' capacities. It was taken that this limit is not exceeded when the upstream treatment of waste is in line with the so-called combined approach recommended by both MEDPOL and the European Commission, considering both the waste emission threshold and the objective regarding the quality of the receiving environment.

Within this context it is proposed that this service (treatment of acceptable waste) should be valued on the basis of a tax paid in order to consolidate and perpetuate a situation which is already acceptable from an environmental point of view.

In France, the domestic pollution tax brought in by the 2006 water and aquatic environments law[79] meets this objective, since it aims at ensuring that treatment plants are correctly run and contributes to the funding of action and works to preserve the aquatic environment. It corresponds to a reference value, the level of which has been capped by decree, and is then modulated according to coherent geographical units by the Water Agencies Board (basin agency), where the users are represented, making this tax similar to a "willingness to pay".

It was decided to choose a geographic zone which is representative of the French Mediterranean front- Bouches du Rhône- which features both highly urbanised and industrialised sectors (Marseilles, Fos) and other protected ones (Camargue, Calanques).

This value was transferred to the whole of domestic water consumption in the riparian countries. It can effectively be taken for initial approximation that the sums involved in investment, plant maintenance, operations and installations for treating water prior to its discharge , depend only to a minor degree on the specific conditions prevailing in each riparian countries. In fact, the variable maintenance costs are low in comparison with the investment costs. Since the cost of raw materials and technology included in the investment were similar across the board, it can be presumed that there is little divergence.

The application of this same tax rate to industrial water uses represents a further extrapolation. It should be pointed out that the figure arrived at is low compared with the figure for domestic pollution.

These issues should be studied in further depth in cooperation with MEDPOL, in order to take better account of the various Mediterranean situations.

In contrast, the physical data on which this evaluation is based (domestic water consumption by the Mediterranean coastal population and, to a lesser extent, the volumes of industrial water discharged directly into the Mediterranean Sea) appear to be relatively robust.

79 Law n° 2006-1772 of 30 December 2006 on water and aquatic environments.

III. Results and discussion

The results of the study are synthesised and commented on here.

1. Results at regional level

The values of the benefits assessed for the various ecological services dealt with in this study have been aggregated in order to build (or constitute) a value significant at the regional level. This aggregated value should be seen as an order of magnitude, rather than a measurement, because of the following constraints:

- Scarcity of relevant data, with restrictive implications both in terms of the applicable methods and the valuation realized;
- Loss of information due to the aggregation of ecosystem services, which essentially differ in their respective contribution to human well-being;
- Aggregation of results coming from the valuation methods that are coherent in their principles but heterogeneous in their implementation;
- Accumulation of non-quantified lack of precision in case by case valuation, as previously discussed;
- Uncertainty about the nature and consistency of all the services provided by the Mediterranean marine ecosystems.

Bearing these cautions in mind, the aggregated economic value of all the benefits considered generated by the Mediterranean marine ecosystems was estimated at over 26 billion Euros in 2005 for all of the riparian states (table 4). This amount equates almost 13% of Greece's Gross National Product (GNP) or 120% of Tunisia's GNP. Considering that the Mediterranean Sea covers 2.5 million km², the large Mediterranean marine ecosystem seems to enable a global benefit estimated over 10 450€/km²/yr.

Table 4: Value of the benefits flowing from Mediterranean marine ecosystems

[redacted]

Resource rent related to the production of food resources			

are the people permanently or temporarily located in coastal zones, who benefit from the landscape, the local climate and the access to marine and coastal areas for their leisure and well-being. As for the value of these benefits, it is harnessed by the marketed activities that are based on the ecological services of providing amenities and recreational support, such as the hotel and restaurant service activities, housing expenditures (by household) or tourism. The suppliers of these services constitute the direct beneficiaries of the economic benefits generated by the provision of the associated ecosystem services.

The value of the benefits related to fisheries represents about 11% of the overall value of the benefits considered. Fishermen (employers and workers) are the direct beneficiaries of the economic benefit resulting from the provision of food services by marine ecosystems. All other actors who also benefit from this ecosystem service in a leaded or indirect way can also be included in this category. In contrast, the final beneficiaries of this ecosystem service are those who actually consume the food resources, in other words those who benefit from the nutritional input, the fish or fish product final consumers.

The protection of coastal zones against erosion appears being the lowest economic value of benefits (2% of the total value). The level of this value clearly demonstrates the need to improve data availability for this type of study in order to implement valuation method which would better fit with the specificities of the context. For instance, a risk based-approach or the estimation of local opportunity costs for coastal defence expenditure would better reflect the value of this ecosystem service which is sometime of strategic importance.

2. Results at country and ecosystem levels

As far as possible, the valuation methods and results of the study were broken down to reach a country level of application, which is more meaningful for decision-takers and the public itself and which is more widely used in macro-economics. The results obtained are commented for two countries. The value of the benefits provided by ecosystems can also be allocated to each different ecosystem providing these ecological services.

2.1. Value of the benefits illustrated by country

Two countries were selected, Greece and Tunisia, for which most of the primary data needed was available, and whose seafronts are entirely Mediterranean (table 5 and annex 11 for a breakdown results by country).

Table 5: The value of the benefits flowing from the Mediterranean marine ecosystems for Greece and Tunisia

2.2. Value of the benefits illustrated by ecosystem

According to this distribution, the pelagic ecosystems seems to contribute to 74% of the benefits value related to the provision of food resources harnessed by fishing and aquaculture activities. However, it should be noted that this distribution takes no account of the differences in value added for fishing in each of these different areas since it is only based on the catchments. It considers neither the value of the catches on the market nor the level of the costs involved in these catches. Moreover, the distribution fails to address the eco-systemic links which exist when the individuals of one species frequent various ecosystems during their lifetime.

Conclusion

This exploratory study and the results which issue from it are a first attempt to assess the benefits from the marine ecosystems in the Mediterranean in economic terms. The constraints faced in drawing up the study, be these in terms of applying the sustainability criterion to evaluate the benefits under consideration or the lack of sound data for some potential benefits, which as a result could not be included in the study, have given rise to what is probably a low initial assessment of the value of all the sustainable benefits from marine ecosystems.

As such, this study calls for further work to be conducted on the data availability and for a possible revision of the scoping and the method of evaluation.

Although the evaluation approach applied to the contributions issued from ecosystems shows room for improvement and aggregates the results issued from various evaluation methods, as discussed in part II of this report, the results arrived at nonetheless provide an initial scale of magnitude for the value of the benefits flowing from the marine ecosystems in the Mediterranean. This evaluation focuses on the value of the flows created by the environmental assets comprising the natural marine capital, without making any attempt to estimate the value of the stock of natural capital.

This initial evaluation reveals the need to dig deeper as a result of gaps observed in relevant data for the basin as a whole, but also in terms of backup from additional studies, which would allow the micro-economic processes to be better reflected. For this purpose, particular efforts should be made to further the knowledge base, both at ecological level (data relating to ecosystems, the ecological processes- as in the European MEECE project, Marine Ecosystem Evolution in a Changing Environment –, the quantities of flows used…) and at economic level (value added created in the various maritime activities, non-market uses of marine and coastal ecological services, the jobs created by these activities, the taxes and subsidies relating to these activities, etc.). This additional knowledge could be gleaned from case studies on specific sites in the Mediterranean or by sector of economic activity (fishing, tourism...). Some of these studies are already included in the Blue Plan programme (local studies on Marine Protected Areas and a regional one on the sustainability of Mediterranean maritime activities).

Moreover, the study is scoped to assess the exclusively sustainable portion of the benefits flowing from the marine ecosystems and therefore does not address the income created by the non-sustainable exploitation of natural resources and other ecosystem services of marine origin. However, for knowledge-related and data reasons, it was only possible to apply this principle to fishery-related benefits and to the regulatory service relating to waste treatment. Since the aim of this type of study is to provide public decision-takers with information which will assist them in their task, further work will need to be undertaken in order to better quantify the various levels of consumption of natural capital and to extend the scope of observation in order to cover the interaction between activities on land and at sea. The Blue Plan also intends to conduct works in this sense, focusing its efforts on maritime activities.

These efforts could lead to the development of an economic evaluation of the contributions made by ecosystems at a more significant level for public decision-makers and could lead to a more specific focus on certain remarkable types of ecosystem such as the Posidonia meadows or certain ecosystem services such as waste treatment. Such furtherance could in parallel be instrumental in supporting the implementation of environmental satellite accounts in the national accounting of various Mediterranean countries, in application of what is recommended by the United Nations in the SEEA 2003 and its development. The SEEA would then make it possible to provide significant national aggregates in terms of sustainable benefits from ecosystems, drawing a distinction between the sum of benefits received and the sum of the consumption of natural capital, and allow them to be tracked over time.

Moreover, it would also be useful toefu35nyful the21-20empo[(dr)3(a)eful beaof4 tothe202[]l(, a)3(pt(its)6( )-1

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The programme of work for this experimental regional study was organised in four successive stages:

Stage 1: scoping (January –March 2009)

- Theoretical and methodological inventory. Choice of a macro-economic approach.
- Choice of options for scoping the field of study in accordance with the Blue Plan remit:
    - Regional scope: all Mediterranean marine ecosystems.
    - Sustainable development: taking account of the sustainable benefits.
- Identification of partners and launch of cooperation.

Stage 2: Feasibility study (March-August 2009)

- Preliminary study: roll-out of Costanza (1999) at Mediterranean level, applying it to the marine and coastal areas of the Mediterranean countries proposed by Martinez (2007). Results presented in appendix 3.
- Development of a macro-economic type approach and drawing up of a methodology to assess the value of the benefits provided based on the SEEA (UN 2003).
- Identification of the ecosystem services provided in the Mediterranean (appendix 4) and drawing up of an analytical framework (ecosystems/ecological services/benefits provided) in order to bring together and interpret the results (appendix 5).
- Identification of needs in terms of data and the collection of ecological data (ecosystems, their geographical representation, the ecosystem services provided) and economic data on use (level of activity, manpower...).

Stage 3: Processing and results (September-December 2009)

- Data processing
- Analysis of the results
- Circulation of the results: drafting of a report.

Stage 4: Participant feedback (January-May 2010)

- Circulation of the study (report and oral communications)
- Lessons learned
- Future prospects

The preliminary study, consisting of a calculation based on global unit values reported in Costanza 1997 and in Costanza 1999)[82] and area by Mediterranean riparian state (Martinez 2007), provides an order of magnitude at regional level. These values should not be taken as alternative results to those of this study (the reasons why Costanza .'s (1997) unit values do not appear to be usable are mentioned in part I section 2-2). The preliminary study was conducted purely in order to indicate the implicit state of knowledge; the article by Costanza . (1997) is in fact one of the most often cited (and criticised) regarding benefit evaluation and Martinez .'s (2007) data is available on the internet. When the Blue Plan study on the benefits relating to the services provided by the Mediterranean marine ecosystems was launched, no other easily accessible data base appropriate to this study was available.

- The unit values (in dollars US (USD) per hectare for 1997) per type of service chosen by Costanza (1999) are as follows:
  - N, P and K processing ( ): 118 USD per ha in the high seas, 1 431 on the continental shelf, 19 000 in the sea-grass beds, 21 100 in estuaries.
  - Food production: 15 USD per ha in the high seas, 68 on the shelf, 52 in estuaries.
  - Raw material production: 2 USD on the shelf and in the sea-grass meadows, 20 in estuaries.
- The areas for the various types of ecosystem in km² per state are the ones used by Martinez (2007). An extrapolation based on the coastline per country allows the missing data for Cyprus, Malta, Monaco, Montenegro and the Palestinian Territories to be generated. An

seas, compared with the oceans. Climate regulation represents 5% of the total, food products 4%[84]

[redacted] this study: in green when [redacted] included in a broader category, in red when not evaluated.

[redacted]		[redacted]				[redacted]
[redacted]		[redacted]				[redacted]
[redacted]	Production of food resources	[redacted]	Food resources	Production of food resources	Production of food resources	[redacted]
[redacted]	[redacted] raw materials	[redacted]	-	Production of raw materials	Production of raw materials	[redacted]
[redacted]		[redacted]	-			[redacted]
[redacted]		[redacted]	Drinking water		Freshwater	[redacted]
[redacted]		[redacted]	Energy		-	[redacted]
[redacted]	[redacted] resources	[redacted]	-	-	Production of genetic resources	[redacted]
[redacted]	-	[redacted]	-	-	-	[redacted]
[redacted]	Production of medicinal resources	[redacted]	-	-	Production of medicinal resources (biochemical products, test organisms …)	[redacted]

	Air quality regulation			Oxygen	Air and climate regulation	Air quality regulation	Air quality regulation
	World climate regulation			Chemical environment		Climate regulation	World climate regulation
	Regulation of the local climate and natural hazards			Temperature	Disturbance prevention (flood and storm protection)	Mitigation of extreme events	Local climate included in amenities
				Light			Mitigation of natural hazards (including erosion)
	Water cycle regulation		Water cycle regulation	Humidity	-	Water cycle regulation	Water cycle regulation included in amenities
	Water provision			-	-		Not applicable
	Mitigation of erosion			-	-	Prevention of erosion	Erosion included in Mitigation of natural hazards
	Soil formation		-	-	-	Soil formation	Not applicable
	Nutrient recycling		-	-	Classed under support function	-	Considered as a support function
	Waste treatment		Water purification and waste treatment	-	Waste treatment	Waste treatment (water purification)	Waste treatment
	Pollination		Pollination	-	-	Pollination	Not applicable
	Biological control (maintaining the structure and workings of the food chain)		-	-	-	Biological control (maintaining the structure and workings of the food chain)	Considered as a support function
	-	-	Disease regulation	-	-		Regulation of disease and parasites destined for humans: included in Waste treatment
	-	-	Parasite regulation	Protection against predation	-	-	
	Refuge/habitat	Refuge	-	-	Habitat	Nursery	Function not assessed as deemed to be intermediate ecological processes towards the final ecological services
	-	Spawning ground/Nursery	-	-	-	Protection of genetic diversity	
	-	-	-	-	Resilience and resistance (life support)	-	
	-	-	-	-	Nutrient recycling	-	

The ocean plays a major role in th

The rainfall received does not contribute in even fashion to people's well-being[87]. A distinction can mainly be drawn between (i) water evaporating from forests and uncultivated land, (ii) water benefiting rain-fed crops and (iii) the so-called « blue » water for other uses, irrigation, industry and domestic uses, the annual volumes of which are available in the annual water balances drawn up for each riparian state by the Blue Plan and Margat (Blue Plan, 2007, 2008).

Assessing the value of water is a particularly complex issue, set out in the SEEAW manual, which applies the SEEA conceptual framework to water (United Nations, 2007). In the absence of a free market for water, as is the case for the Mediterranean riparian countries just as for most countries around the world, the SEEAW proposes various assessment methods including the so-called shadow price one. Establishing the shadow price for water, however, requires a large amount of empirical physical and economic data in order to establish a matrix (input/output) for water uses then a generalised programming model. Consequently, very few country-level studies have been conducted. The SEEAW happens to present a study on Morocco (Bouhia, 2001), which amongst other things provides shadow prices for water for different sectors and different abundance conditions. It is proposed that the results of this study should be used for want of anything better, extrapolating them to the Mediterranean countries as a whole.

A particularly cautious approach has been chosen:

- Evaluation limited to the benefits provided for the agricultural sector, which is the main water user in the Mediterranean (the available data on volumes for other uses being subject to caution for this evaluation).
- Shadow price for water chosen in Bouhia (2001) corresponding to an average year with no particular water constraints based on observations from the 90s. Bouhia (2001) shows that this price presents a flexibility which decreases sharply with resource availability (decreases only slightly when there is more availability than in an average year, but rises sharply when availability is below average). Some World Bank forecasts quoted in Bouhia (2001) point to a 50% drop in availability for Morocco in 2020 compared with the reference year of 1997, characterised by a situation of chronic water stress. It can therefore be assumed that the current shadow price for agricultural water is already much higher than what was assumed for the calculation.
- Basic scenario drawn up in 1997. Back then, non sustainable uses of water were already coming in for sharp criticism (use of groundwater resources, with no other constraints apart from the cost of pumping), although these uses were already very widespread and often in the majority, which tends to drive the shadow price for water down.

In 1997, the marginal value of an additional cubic metre of water for the agricultural sector in Morocco was assessed at 0.36 DH/m^3 (where DH= Moroccan Dirham), i.e. updated and converted into euro-2005: 0.036€/m^3. This price is well below the observed production cost of irrigation water, which was evaluated at 1.14 DH/m^3 for groundwater resources at the same moment in time, and is also below the cost of mobilising water for surface resources.

In determining the quantities of agricultural water used in the Mediterranean catchment basins, the FAO/Aquastat statistics meant that water use in agriculture could be assessed for each Mediterranean country on the basis of the 2000 data for the whole of their national territory. Based on Blue Plan and Margat (2008) data, the portion relating to their Mediterranean catchment basin

87 And even regularly produces damage- if not disasters- not considered here.

was calculated by establishing the share between (i) the renewable water resources which can be mobilised in an average year throughout the national territories of these countries and (ii) these same resources for that portion of their territory which belongs to the Mediterranean catchment basin. The necessary adjustments were made in order to take account of specific cases (e.g. in Egypt, taking account of rainfall alone, leaving aside input from the Nile) and to complete the tables. It was ascertained that the total quantity obtained through the use of connate water (not groundwater) in agriculture is close (+ 12%) to the quantity assessed by the Blue Plan and Margat (2008) for the catchment basins of each Mediterranean state. The annual total amounts to 72.65 km^3, with three countries accounting for 60%: Italy (28%), Turkey (17%) and Spain (15%).

Finally, in 2005, the value of the benefits provided for agriculture at regional level amounted to some 3 billion Euros.

The national value of the benefits is a function of the consumption of agricultural water estimated for the Mediterranean catchment basins of each country, breaking agricultural water consumption down by country according to the method described earlier for the assessment of the benefit as a whole.

The assessment of the contribution made by the Mediterranean to the large water cycle is still the subject of scientific study. The data used for this study is relatively recent and is still being discussed within the scientific community, as is shown by the dispersal of the results presented by Mariotti (2001). Scientific research currently underway on the global climate and its regional roll-out in the Mediterranean should result in the rainfall assessment becoming more finely tuned. It should be pointed out that rainfall varies widely from one year to the next and depends on climate trends. In the absence of specific data for the year of reference for the study (2005), this is more of an evaluation of an average year as established on the basis of physical and economic observations carried out in the 80s and 90s.

The decision to stick to the agricultural sector alone was mainly dictated by the fact that this sector is the leading user of water in the Mediterranean. Moreover, the physical data available for the other sectors was subject to caution or difficult to use for certain countries. Thus the water used in large quantities to cool electricity production plants is frequently reused, which is not the case after certain other highly polluting industrial uses. Consequently, this study does not take account of the benefits provided by water in other sectors of activity such as tourism, energy and domestic use. The evaluation could be completed in this respect in collaboration with water use specialists in the Mediterranean.

The main difficulty with the evaluation stems from determining the value of water in economic terms. The shadow price-based approach looks particularly interesting, but it requires a considerable amount of analytical work upstream, which has been conducted in particular in China (Xiuli, 2008) and Morocco (Bouhia, 2001). The latter country has been the subject of in-depth study, which has the advantage of involving a Mediterranean country and of being quoted as an example by the SEEAW. The results of this work were therefore used for this study and, for lack of anything better, were extrapolated to all of the countries in the Mediterranean basin. The shadow price for agricultural water depends by definition on the function of agricultural production, which differs from country to country and particularly between countries to the north and those to the south. It can, however, be assumed that all the countries in the Mediterranean basin have developed modes of production tailored to their water availability in an average year, based on agronomic water

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the sustainable use of natural capital. In fact, the short term economic optimum may exceed the sustainable use threshold (Hueting 1989).

In this study, natural capital and physical produced capital cannot be substituted and the sustainability approach is said to be strong; this requires the preservation of a critical stock of natural capital (K^*_n), which is described by Pearce and Atkinson (1993) using the following equation:

$\delta \leq 0$

This constraint implies a nil or negative depreciation rate and the possibility of an appreciation of critical natural capital.

It should also be mentioned that certain recent approaches propose going beyond the two-way opposition between strong and weak sustainability.

Thus Hediger (1999, 2000) identifies four types of sustainability:

« very weak sustainability », which corresponds to Hartwick-Solow sustainability: the economy's production capacity must be kept constant;

« weak sustainability » : the value of the total capital, which comprises physical produced capital and natural capital must be preserved;

« strong sustainability » : certain environmental functions must be preserved and the natural capital (or the quality of the environment) must be kept constant; strong sustainability therefore implies growth in the stock of renewable resources through recycling;

« very strong sustainability » ; it requires a switch to a stationary state in the economy with constant population and production and the preservation of all types of natural resources.

Finally, Chevassus-au-Louis . (2009, 176) believe for their part that the issue can be broken down according to three hypothetical situations, which come back to the discussion of the substitutable nature of biodiversity:

The irreversible loss of technically substitutable elements of eco-systemic services;

Loss of irreplaceable elements of biodiversity, the imaginable consequences of which do not, however, threaten the survival of our societies;

Loss of indispensible elements of biodiversity, the unforeseeable consequences of which put the survival of our societies as we know them at risk, if not the very future of mankind.

Since the rent is residual, the method of calculation is as follows:

(1) MI = Q - IC - w.N and thus (1') MI = VA - w.N

MI, is the mixed income In the case of fisheries, MI is the mixed income of fishermen employers, combining payment for non-salaried labour and capital service flows, in other words equipment.

Q the value of production; Q = Σp .q ; p average unit prices at the quayside for species and q catch quantity landed during the period under consideration (preferably one year).

IC intermediate consumption.

VA the value added in the sector, which corresponds to the service flows for the labour and capital factors (including production subsidies but excluding production taxes)

w.N payment for salaried work (w wage level and N the number of employees)

(2) GOS = MI - CL and thus (2') GOS = VA - w.N - CL

GOS the gross operating surplus

CL compensation of labour for fishermen-entrepreneurs

(3) NOS = GOS - CFC and thus (3') NOS = VA - w.N - CL - c.K

NOS net operating surplus.

CFC consumption of fixed capital CFC = c.K, with c being the depreciation rate and K the stock of fixed capital; c = 7.5% in the example referring to fisheries in the SEEA manual.

(4) RR = NOS - r.K and thus (4') RR = VA - w.N - CL - c.K - r.K

RR the rent from natural resources

r.K payment for fixed capital; r net rate of return on fixed capital; r = 4% in the case presented in the SEEA manual. Since VA = Q – IC, this then gives us

(4") RR = Q - IC - w.N - CL - c.K - r.K

An assessment of the coastal effect on activity in the hotel business has been put forward. It is based on the one hand on the use of regional data for the Mediterranean regions equivalent to level 3 in the EU's nomenclature of territorial units for statistics (NUTS 3). Data are available in the Eurostat database for four EU countries: France, Greece, Italy and Spain (provincias in Spain, the equivalent of the départements in France, nomoi in Greece, provincie in Italy). It is also based, on the other hand, on measurements of the length of the coastline (lcote variable) by NUTS 3 conducted by the Blue Plan on the basis of Euromaps and GEBCO[92] (assessment obtained using GIS techniques by Karel Primard de Suremain). It seems appropriate to regard this effect as an indicator of the benefits of the services provided by ecosystems and therefore to use the portion related to the activity linked to the coast as an approximation of the resource rent related to these ecosystems as a percentage of the value added (VA). It should be pointed out that a further part of activity can be linked to the presence of services provided by terrestrial ecosystems. It is taken here that using the length of the coastline means that the effect relating to the marine ecosystems alone can be identified, rather than the resource rent in its entirety.

The hypothesis adopted is that economic activity (explained variable) is positively influenced by the length of the coastline, all other aspects being equal (in other words by introducing control variables). Ideally, the aim would be to assess this relationship using micro-economic variables. The difficulty of accessing this type of data prompts the use of NUTS 3 level regional variables for various EU countries, despite the limited nature of the available data.

The variables concern both the explained variable re1ainr-212re209(db8-160(va)-4(riabl)-2(eh)--2(a)-

Figure 3: Relationship between length of coastline and the number of establishments (log-log)

In order to assess the relative mean level effect, the coefficient is multiplied by the mean value (in log) of the length of the coastline and the exponential of the value obtained is then calculated.

The value for the mean for the lcote log is calculated, giving 4.46959.

This mean (X) is multiplied by the coefficient β and is then expressed exponentially:

$\beta X = .6004553 \times 4.46959 = 2.683789$

$Exp(\beta X) = 14.64$

The mean is calculated for the Ettour log, giving 281.3492.

The Exp(βX)/Ettour ratio is then calculated which is, in percentage terms, the number of additional establishments as a result of the effect relating to the length of the coastline.

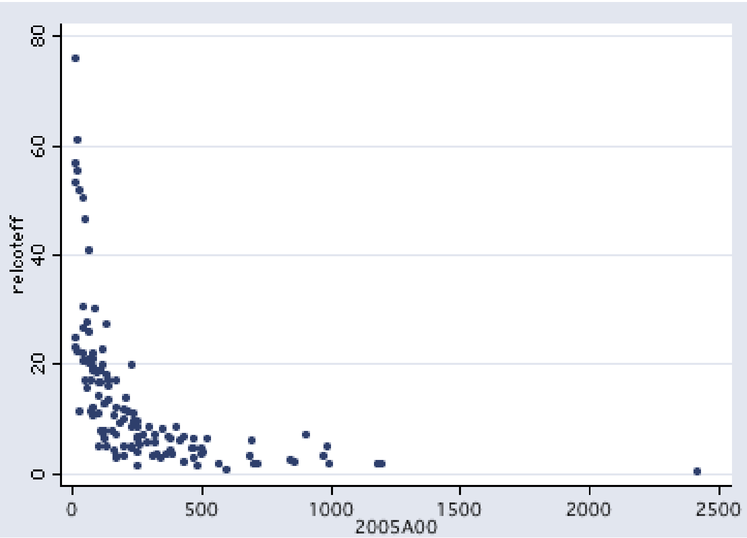
Effect = 14.64/281.3492 = 5.2 %

In other words an assessment of around 5%.

If the hypothesis of a linear relationship between the length of the coastline and the benefits attached to marine and coastal ecosystems is postulated, it can be taken that this percentage gives an indication of the share of the resource rent (natural capital from the marine and coastal areas alone) in the VA for the hotel sector. For want of anything better, this share can be used to assess the resource rent in restaurants, tourist activity and real estate in coastal NUTS 3 regions (a similar assessment not being possible for these activities given the lack of representative variables).

For each NUTS a predicted value (predicted by the equation) of the coastal effect (lcote effect variable) is generated, which is then expressed exponentially and measured in relation to the number of establishments in the NUTS. The results obtained are presented in figure 4.

Figure 4: Relationship between the number of establishments (x axis) and the coastal effect on the number of establishments by NUTS, in percentage terms (y axis)



It can be seen that the lower the number of establishments, the more marked the relative effect, which was the assumption. High values are obtained in the Greek islands, Corsica and Sardinia (particularly the NUTS3 corresponding to Costa Smeralda).

Similar results are obtained by adding a dummy variable for the island NUTS (disland); a positive

Fish catches data distribution are from FAO statistics for year 2005 published in 2007 (table 8),.

Recorded catches correspond to catches in the groups of species which were attached to one or more ecosystems, following the behaviour of adult individuals of these species. The expertise was provided by Pr. Patrice Francour, ECOMERS laboratory, University of Nice Sophia Antipolis. Where the distribution produced figures with decimal points, the data was rounded off.

Table 8 : Catch distribution by ecosystem type

Albacore	3 657	3 658					3657
Angelshark	14	14		14			
Angelsharks, sand devils nei[93]	102	102		102			
Angler(=Monk)	5 762	5 762			2 881	2 881	
Aquatic invertebrates nei	4						
Argentines	109	109					109
Aristeid shrimps nei	3 174	3 174		3 174			
Atlantic bluefin tuna	23 886	23 886					23 886
Atlantic bonito	77 460	77 460					77 460
Atlantic horse mackerel	2 354	2 354					2 354
Atlantic mackerel	14 644	14 644					14 644
Atlantic pomfret	20	20					20
Axillary seabream	125	125	42		42	42	
Barracudas nei	2 668	2 668					2 668
Basking shark	4	4					4
Black goby	3	3		1	1	1	
Black seabream	284	284	95		95	95	
Blackmouth catshark	52	52		52			
Blackspot(=red) seabream	12	12	4		4	4	
Blotched picarel	820	820					820
Blue and red shrimp	2 413						
Blue ling	42	42		21			21
Blue shark	66	66					66
Blue whiting(=Poutassou)	8 805	8 805					8 805
Bluefish	2 783	2 783					2 783
Bogue	30 544	30 544					

Common spiny lobster	339	339	113

Marlins,sailfish,etc. nei[96]	50						
Meagre	1 281	1 281	427		427	427	

Stingrays, butterfly rays nei	2	2

Albania		27	14	11					
Algeria		13	159	1					
Bosnia Herzegovina		1	5	1					
Cyprus		45	66	58					
Croatia		15	64	133					
Egypt		43	139	17					
France		294	1 178	220					
Greece		680	1 078	317					
Israel		170	682	49					
Italy		1 235	4 888	574					
Lebanon		182	80	90					
Libya		4	145	6					
Malta		12	19	19					
Morocco		9	36	17					
Monaco		3	6	0					
Montenegro		3	6	7					
Palestinian Territories		2	8	0					
Slovenia		1	8	11					
Spain		1 183	1 781	836					

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