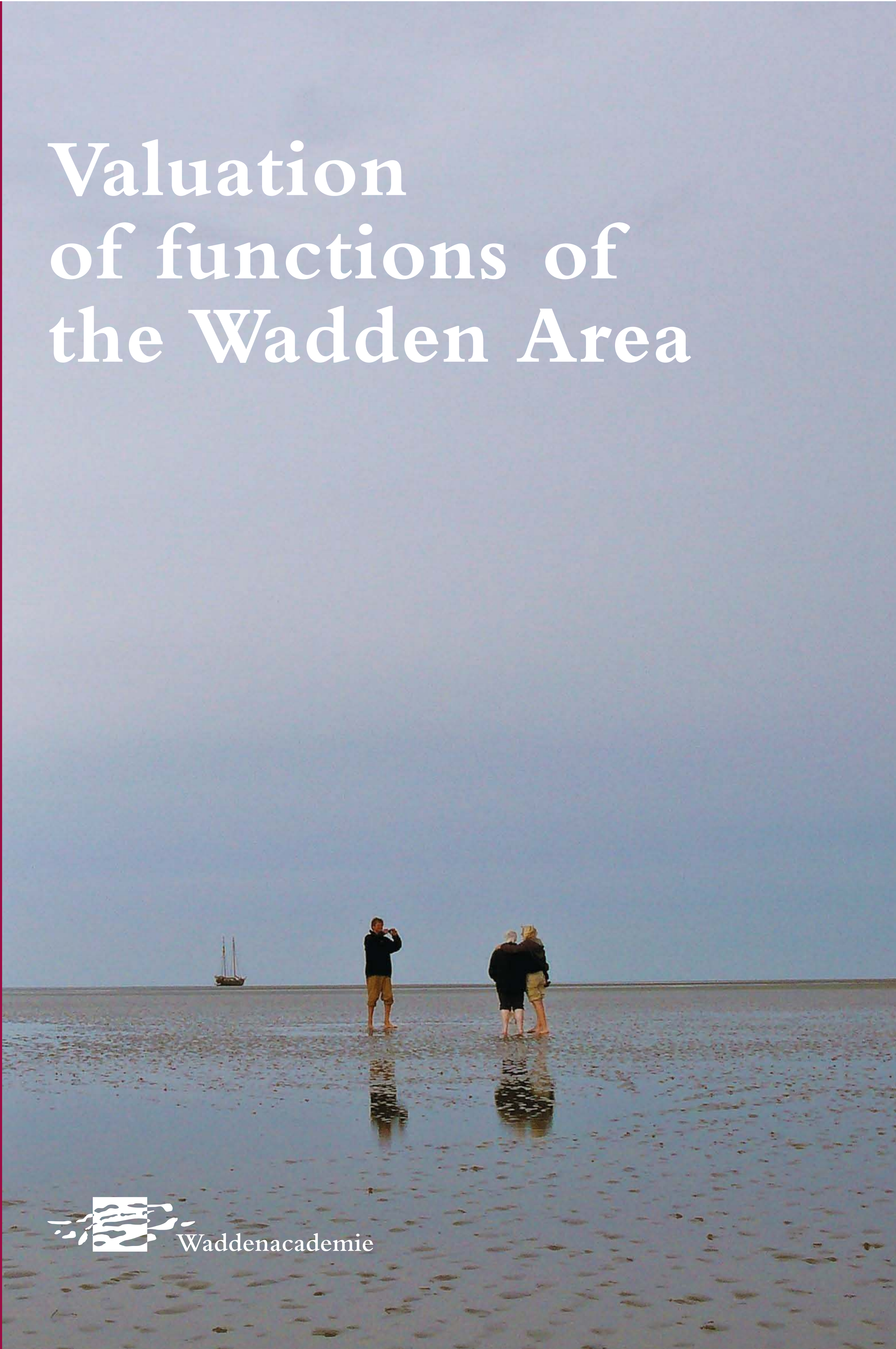
Valuation of functions of the Wadden Area



Waddenacademie

Valuation of functions of the Wadden Area

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Content

1. Introduction

The rationale of this position paper is to explore ways to employ valuation methods to assess the impacts of alternative policy decisions on the functions of the Wadden Area. Based on this rationale, this paper aims to bring an ecological-economic perspective on the benefits of the Wadden Area. It highlights key issues involved in the notion and application of monetary valuation methods for valuing the (ecological) functions of the area. It also pays attention to the development of policy handles on the basis of the outcome of the valuation of ecological functions. Particularly, the paper discuss Payment for Environmental Services (PES), which aims at preservation and protection by purchasing conservation. The use of a valuation instrument within a Payment for Environmental Services Scheme is new. Valuation is of course an established technique within a Cost-Benefit framework. However, Payment for Environmental Services is an innovative way of designing policy instruments in the collaboration between ecologists and economists.

For a long time Western societies heavily relied on *command and control* as the one and only way to prevent „wrong' behaviour of individuals and groups in society. This command and control strategy was implemented in legal instruments that prohibited environmental damaging uses, in instruments to expropriate owners, instruments to create strictly protected areas, and instruments to support interventions targeted directly at resource protection (Wunder 2006). Moreover, *land acquisition* was seen as a powerful instrument directly aiming at environmental problematic situations. Thirdly, environmental *taxes and subsidies* were directed at influencing patterns of resource production and resource use. Finally, trading environmental rights recently was put forward in the European institutional context.

As stated above, a quite recent approach is the use of Payment for Environmental Services. This economic instrument aims at *purchasing* conservation. Consequently, Payment for Environmental Services are defined by the following criteria (Wunder 2006; Engel et al. 2008):

PES is a voluntary transaction in which:

- A well-defined environmental service, or land use likely to secure that service
- Is being „bought' by at least one buyer
- From at least one provider
- If, and only if, the provider secures provision, i.e. conditionality

A PES-scheme presupposes a relation between an environmental service and a value that is to be delivered into the socio-economic system. In the relevant literature a wealth of papers is devoted to the general role the environment plays (functions of nature) and the values that can be attached to this role.

In our research we will pay attention to the services the Wadden Area delivers to society and the way these services can be valued. Our treatment is guided by the following research questions:

- What is the difference between functions and values?
- What are the most relevant functions of the Wadden Area?
- How can values related to the Wadden Area be classified?
- Which approaches and methods of monetary valuation are applied, and what is their potential use for valuing the functions of the Wadden Area?
- How can the outcomes of valuation studies be used in a policy context?
- What is the potential usefulness of the concept of PES and how can it be used in the context of the Wadden Area?

These questions will be addressed in the following five sections. A final section draws conclusions and suggests further research.

2. The Wadden Area: the general context

According to the "Convention on Wetlands of International Importance", better known as the Ramsar Convention (Iran, 1971), wetlands can be defined as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres." As such, all wetlands have two characteristics in common: water and earth. Because of their crucial position between water and land, wetlands provide humankind with important biological resources. Wetlands International – a global organisation that works to sustain and restore wetlands and their resources for people and biodiversity – even asserts that no other type of ecosystem is as important to millions of migratory birds, fish, amphibians, insects, plants and trees as wetlands.

Wetlands also perform many functions that are (potentially) very valuable, not only in ecological but also in economic terms. Following Whitten and Bennett (2005) we distinguish the following functions for the Wadden Area:

- flood control;
- flora and fauna production;
- sediment accretion and deposition;
- ground water recharge;
- ground water discharge;
- water purification;
- storage of organic matter;
- food-chain support / cycling;
- water transport;
- tourism and recreation; and
- contribution to climatic stability.

3. Functions, services and values of nature: a general overview of concepts and definitions

Humans are part of nature, and utilise the goods and services it provides in order to improve welfare. Ecosystem goods (such as seafood, forage, timber, and many pharmaceutical and industrial products) and ecosystem services (which are the conditions and processes of natural ecosystems that support human activity and sustain human life) represent the benefits human populations derive, directly or indirectly, from the functions of nature (Daily 1997; Costanza et al. 1997). But what does the term „functions' actually mean? Since the availability of these goods and services is largely controlled and sustained by ecological processes operating in natural and semi-natural ecosystems, the functions of nature refer primarily to ecosystem functions.

Today, a large number of functions and ecosystem services can be identified. De Groot (1992) provides a detailed treatise on describing and valuing the functions of nature. More recently, Daily (2000) gives a good and detailed summary of what humanity is given by nature. Other publications on the benefits of ecosystems to human society are, for example, Costanza et al. (1997), Daily et al. (2000) Heal (2000), de Groot et al. (2002), Kremen (2005) and Millennium Ecosystem Assessment (2005).

Although a wide range of functions and ecosystem services have been referred to in the literature, most of the publications suggest that, in general terms, the multitude of different functions of nature can be grouped into four main categories.

The first category – the „production functions' – is obvious: humanity depends on plants and animals for foods, fuel, pharmaceuticals, and industrial products. Nature thus includes goods which are an important and familiar part of the economy, and the sustained production of these goods is a service provided to society at low or no cost by natural ecosystems (Levin 1999; Tilman et al. 1999; Daily 2000). A second category consists of „carrier functions'. Ecosystems provide the available space for many human activities, such as settlements, agriculture, recreation and tourism, and nature protection (de Groot 1992). The third category consists of the „inspirational functions' by providing opportunities for cultural, intellectual and spiritual activities. In addition, the popularity of ecotourism, bird-watching, wildlife films and gardening reveals that human beings are interested in (wild) animals and plants. Those biotic entities make it a pleasure for mankind to exist on earth – perhaps not only from an aesthetic and spiritual viewpoint, but also because they generate substantial economic activity (Ehrlich and Wilson 1991). Less obvious than the direct ecological functions that sustain, facilitate and protect human activities and human well-being are the „life-support and regulation functions' of nature, which comprise the fourth category. This group of functions relates to the capacity of ecosystems to supply an uncountable list of essential ecological processes and services that contribute to the maintenance of a healthy environment by providing clean air, water and soil, by providing flood control via flood-plains and wetlands, and by providing carbon storage and waste absorption (Ehrlich and Ehrlich 1992; de Groot 1992; Costanza et al. 1997; Daily 1997; 2000; Mainwaring 2001). Life-support functions are immense and extraordinarily complex, and most of them are not easily to be identified (Nunes et al. 2001). As a result, they are perhaps the most poorly evaluated to date.

An alternative classification of functions, that more explicitly emphasizes the services provided, is made by the Millennium Ecosystem Assessment (2005). The Assessment, which explicitly links nature, ecosystem services and human well-being, defines ecosystem services as the benefits people obtain from nature. And it is especially this concept of ecosystem services that has received significant attention since the appearance of the Assessment.[1] These ecosystem services are divided into four types, which closely resembles the four abovementioned categories of nature's functions: (i) provisioning services, such as the production of food, timber, fibre, and water; (ii) regulating services, such as the regulation of climate, floods, and disease; (iii) cultural services, such as spiritual and recreational benefits; and (iv) supporting services, such as nutrient cycles, soil formation and crop pollination. See Figure 1 for an illustration.

[1] In order to avoid lengthy texts the involved scientists of the Millennium Ecosystem Assessment dicided to use the term „services' for both goods and services, as well as the underlying functional process and components of the ecosystems providing the (de Groot and Hein 2007).

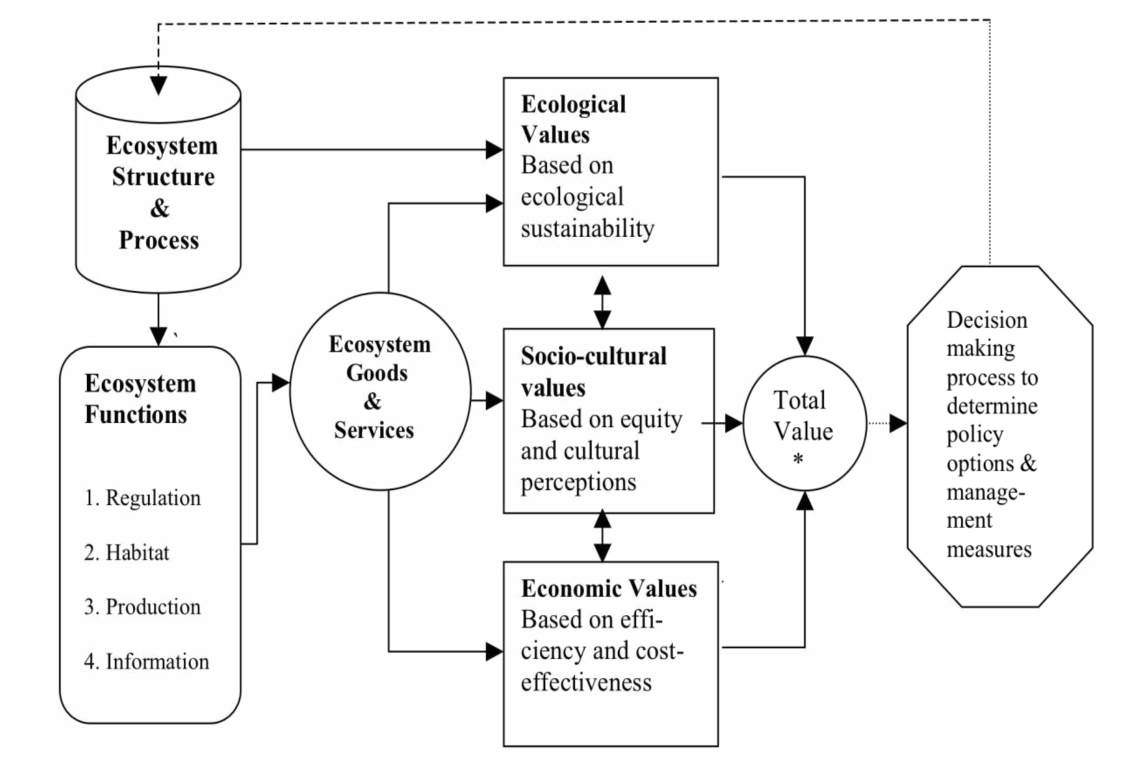

Figure 1 Function analysis and valuation
***Source*: de Groot et al. (2002).**

Note that Figure 1 differentiates between three types of values: Ecological, Socio-cultural and Economic values. Note also that Ecological values depend on Ecosystem services, but that there is also a relation between Ecosystem structure and process on the one hand and Ecological values on the other. Otherwise stated, there are eco-technical criteria as well that place a value on an ecological good. As such, the term ecosystem service implies that the benefits people obtain from ecosystems are of value. That is, ecosystem services have value to society (while the functions of ecosystems are value-neutral). They are the end products of functions and ecological processes (for a detailed discussion of this, see de Groot and Hein 2007; Wallace 2007; 2008; Fisher and Turner 2008; Fisher et al. 2009). These functions and processes are not something people intrinsically value as an end in themselves. On the contrary, their value can only be established by valuing their contribution to different ecosystem services (Balmford et al. 2008). It is thus incorrect to assume that nature protection based on ecosystem-services reasoning is merely based on economic terms and ignores basic ecology (see McCauley, 2006). In fact, quite the opposite is the case: the term ecosystem services embraces ecology as it encompasses all the processes and conditions that sustain humans and other species.

4. Categories of values and the concept of total economic value

As already mentioned in the introduction of this paper, most ecological functions are characterised by the fact that they have no price tag because they are not fully captured in markets. There are, however, some exceptions to this rule, which are especially related to the production function of nature (see section 2). Foodstuffs, for example, are generally traded in markets. Nevertheless, the fact that for many ecological functions no market-based price tags exist does not imply that these functions are of no value. In order to take these values properly into account, a framework is required to for distinguishing and grouping the various values of an ecosystem. The concept of total economic value is such a framework that has been widely used by economists to quantify the full value of different ecosystem goods and services (in an area). This concept consists of two main elements (see Figure 1). One element contains the services provided in the course of the actual use of the Wadden Area in consumption and production activities. This is referred to as use value. In addition, non-use values involve no tangible interaction between the Wadden Area and the people who use it for production or consumption. Because non-use values are closely linked to ethical concerns and altruistic motives, they are more amenable to debate than use values.

For use values, a separation is made between direct and indirect use values. Direct use values are concerned with the enjoyment or satisfaction received directly by consumers of the Wadden Area, which involves both commercial and non-commercial activities. Direct uses include both consumptive uses (for example, agriculture, water use, hunting, fishing, and the gas mining industry) and non-consumptive uses (for example, recreation, tourism, and *in situ* research and education) (Barbier, 1994). Consumptive use values are conceptually clear and offer the best chance of being measurable. After all, they can be marketed, resulting in market prices that signal the (true) scarcity of the asset. Non-consumptive use values, however, relate to assets that provide value without being traded in the market place and are therefore much more difficult to measure. Indirect use values indicate the indirect support to economic activity by natural assets and services, and they relate, as such to life-support benefits. Examples of indirect use values in the Wadden Area include stormwater containment and treatment, water purification, watershed protection, soil formation, and the decomposition and assimilation of wastes.

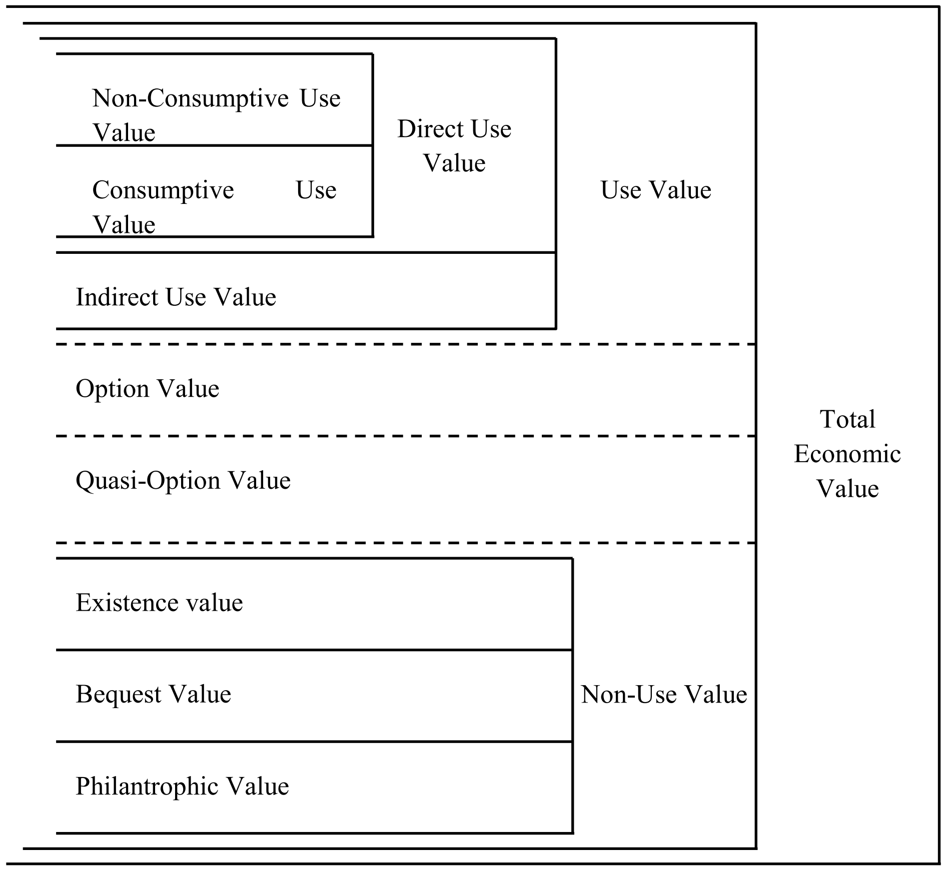

Figure 2 The total economic value of an ecosystem
Source: Turner et al. (1998, p. 13, Figure 2).

While use values arise from the use of the Wadden Area, non-use values are independent of current or potential use. Non-use values exist where the preferences of individuals who do not intend to make use of the Wadden Area would nevertheless feel a „loss' if the area was to disappear (Perrings 1995; Moran and Pearce 1997). Depending on exact definitions, non-use values may include all of the following: option values, quasi-option values, bequest values, philanthropic, and existence values.

Option value, a complex and ambiguous concept originally introduced by Weisbrod (1964) as relevant for assets that might be difficult to reproduce, has been the subject of considerable debate (Smith 1983). It relates to the amount that individuals would be willing to pay today to safeguard the Wadden Area for future direct and indirect use. In the economic literature it has been suggested that option value represents a difference between *ex ante* and *ex post* valuation, where the terms *„ex ante'* and *„ex post'* refer to the amount of information that is available. *Ex ante* relates to the situation where the state of the world is still unknown, while *ex post* refers tot the situation after the state has been revealed (Bishop 1982; Smith 1983; Freeman 1984; Ready 1995). If there is uncertainty about the future value of an ecological function, and awaits improved information before giving up the option to protect the asset, then there may be quasi-option value derived from delaying economic activities. Quasi-option value, a concept forwarded by Arrow and Fisher (1974), is thus simply the expected benefit of awaiting improved information derived from delaying exploitation and conversion of the Wadden Sea today. It suggests a value attached to protection given the expectation of the growth of knowledge (Henry 1974; see also Graham-Tomasi 1995). (Note that in Figure 2, both option value and quasi-option value are indicated with a dotted line, since when adding these values possible double counting needs to be taken into account.)

Bequest value is a willingness to pay to keep the Wadden Area intact for the benefit of one's descendants, or more generally, future generations. Philanthropic value results from individuals placing a value on the conservation of the Wadden Area for contemporaries of the current generation to use (Turner et al. 1998). Existence value involves a subjective valuation as it is based on the satisfaction that individuals experience from knowing that the Wadden Area exist, for themselves and for others, without being used now or in the future (Barbier 1995; Wills 1997). Empirical estimates, obtained through questionnaires, suggest that existence value can constitute a substantial component of total economic value (Moran and Pearce 1997; Alexander 2000).

5. Methods for valuing the functions of the Wadden Area

Looking at the number of papers and monographs published on monetary valuation of biological assets, it could probably be said that it is now a well-established practice. It might also be felt that valuation of nature is still controversial because of the combination of theoretical and empirical problems, and the potential importance the resulting values may have in influencing public opinion and policy decisions (Loomis et al. 2000). For example, biologists such as Ehrlich and Ehrlich (1992), argue that ecosystems are complex, indivisible entities that operate on time scales outside the range of human perception, and that they have values that are difficult or impossible to measure (see also Gowdy 1997). Not only biologists, but also scholars from other disciplines (and even economists) may find monetary valuation a „hopeless' exercise. Philosophers, such as Sagoff (2000) and economists, such as Bromley (Vatn and Bromley 1994), dismiss monetary valuation as ethically insupportable and impracticable. Nunes and van den Bergh (2001), on the other hand, claim that monetary valuation of biodiversity can make sense. However, they point out that the various valuation methods should not be considered as universally applicable to all levels of biological diversity or to all types of biodiversity values. In our view monetary valuation methods should be viewed as methods to express the importance adhered to the good valued (e.g. the protection of migratory birds) relative to other goods (e.g. consumption of shellfish).

Research on the monetary value of biodiversity can be motivated by the desire to better understand the importance of biodiversity (for a much more elaborate treatment of the need for valuation, see, for example, Simpson 2007). Intuitively, the importance of biodiversity to society is best represented by monetary values. However, reality is more complicated than the common intuition suggests. Economics is more concerned with prices than with values or importance. An important difference between prices and values, which is particular relevant for this study, is that prices that arise from market transactions offer, in some sense, objective information, whereas many concepts of value are subjective (Heal 2000). As a result, valuation cannot be dissociated from choice. Economic analysis provides several very ingenious measurement techniques to assign a (subjective) value to the benefits of, or avoided damage due to, changes in ecological functions and services, and next we review some of these. For useful overviews of applying monetary valuation techniques to wetlands, see for example Wilson and Carpenter (1999) and Birol et al. (2006a). Table 1 presents some unit values (WTP) of ecosystem services provided by wetlands.

Table 1 *Unit values (WTP) of ecosystem services provided by wetlands*

Ecosystem service	US$/hectare per year (US$ 2000)*
Flood control	464
Recreational fishing	374
Amenities/recreation	492
Water quality	288
Biodiversity	214
Habitat/nursery	201
Recreational hunting	123
Water supply	45
Materials	45
Fuel wood	14

Source: Brander et al. (2006).

5.1 Non-demand approaches

Following Bateman and Turner (1993), two basic approaches are distinguished: those which value an asset via a demand curve (see the following subsection), and those which do not. In general, non-demand approaches are based on the principle assumption that if people incur costs to avoid damages caused by lost ecological services (such as the pollination of agricultural crops by bee species) or to replace ecological services, then the value of those services are worth at least the amount of money that people have paid to replace them. There are a number of non-demand approaches, such as the opportunity cost approach, the dose response approach, the preventative expenditure approach, the averting behaviour approach, and the replacement cost approach (see, for example, Turner et al. 1994, and Garrod and Willis 1999). Some examples related to measures of wetland functions where non-demand approaches might be applied include the following:

- valuing the sponge and flood-buffering functions of a wetland by estimating the costs of providing these functions artificially;
- valuing the benefits of an activity that causes environmental degradation – say, drainage of a wetland to allow intensive agriculture – in order to set a benchmark for what the environmental benefits would have to be for the development (agriculture) not to be worthwhile;
- valuing the amount of lost wetland by estimating the difference in value of marketed output (e.g. fish caught) that results from a change in the wetland size.
- valuing water quality by measuring the cost of filtering or the chemical treatment of water;
- valuing wetland degradation by estimating the restoration cost.

The results of these non-demand approaches can thus be used to demonstrate the importance of these inputs to production and consumption, but also to appraise pollution control or protection against flooding (see Table 1)

5.2 Demand approaches: revealed preference and stated preference methods

Demand curve approaches are broadly divided into revealed preference and stated preference methods. The first type of approach seeks to elicit preferences (for biological assets) by examining the purchases of related goods in the private market place. In other words, revealed preference methods use market information (such as travel costs or the price of housing) as a proxy to estimate the benefits from the Wadden Area.

Stated preference methods consider a change in environmental quality or in ecological functions and, by using survey techniques, they seek to directly measure the value of these changes (Perrings 1995; Garrod and Willis 1999; van der Heide et al. 2003). As such, these methods derive a value by simulating, or constructing a hypothetical market for the biological asset or function in question. Although economists are generally much more comfortable with valuations based on actual transactions and observed behaviour in markets than those given in response to survey questionnaires (Heal 2000), for some public goods there are simply no accurate means of inferring preferences from observations. In such circumstances, there are no viable alternatives to asking individuals how much they would be willing to pay for a biological asset or accept in compensation for its loss in a hypothetical situation of payment.

5.2.1 Travel cost method

The travel cost method (TCM), a revealed preference method, is one of the oldest valuation methods employed by environmental economists (Clawson and Knetsch 1966). It is especially useful for assessing the value of outdoor recreation in natural parks, and to this end, it has been widely used in the USA and to a lesser extent the UK (Perrings 1995). The underlying assumption of the TCM is that the incurred costs of visiting a national park, nature reserve, open space or any other recreational site (thus also the Wadden Area) are directly related to the benefits individuals derive from the amenities within the area, such as hiking, camping, fishing, bird watching and, swimming. The method involves using the value of time spent in travelling, the cost of travel (e.g., petrol costs) and entrance and other site fees as a proxy for computing the demand price of the environmental resource. TCM is primarily concerned with recreation and tourism values and application for valuing anything other than recreational values is rather limited. That is, the method is well suited to assessing values related to leisure and recreation in the Wadden Area, but it is incapable of assessing other ecological functions, such as flood control or the contribution to climatic stability. Although TCM is uncontroversial and widely used by government agencies in the United States, it has its own limitations, which have been addressed extensively in the literature (for example Bateman 1993; Hanley and Spash 1993; Turner et al. 1994; Smith 1997; OECD 2002). For example, the method is only capable of estimating use values, not non-use values, as these are – by definition – not associated with any measurable activity. It should be observed that the TCM results in a perverse outcome if travelling to and entering area becomes so expensive that no one decides to go there. The method would reveal that the value of the area, or the price the public would be willing to pay to secure this form of land use, is zero (Perrings 1995, Shechter 2000). For an extensive discussion of the TCM, particularly its history and scope, the underlying demand and benefits theory, design principles and administration of surveys, measurement of variables, data management and analysis and various applications we refer to Ward and Beal (2000).

To our best knowledge, the TCM has not been applied to the Wadden Area. Nevertheless, there are some studies that use the method for valuing the recreational function of wetlands Farber (1988) and Whitehead et al. (2009), for instance, find that recreation site selection is negatively related to travel costs and positively to wetland acreage. That is, tourists are attracted to large wetlands but discouraged by high travel costs due to long or expensive traveling to the area.

5.2.2 Hedonic pricing method

The hedonic pricing method (HPM) derives the value of environmental amenities, such as pollution and noise level, from actual market prices of some private goods. Just like the travel cost method, the HPM is based on observed behaviour. By far the most common application of HPM is to the real estate market. House prices are affected by many factors, not only by house characteristics like the number of rooms and the size of the garden, but also by the environmental quality of the surroundings, including proximity to natural areas and the quality and uniqueness of such areas. If the non-environmental factors can be controlled for, then the remaining differences in real estate prices are expected to be the result of environmental differences (Turner et al. 1994). In principal, HPM is suitable for the estimation of changes in water (and thus in wetland) quality, but is especially appropriate for assessing noise and air pollution (Spash and Carter 2002). A number of problems (including statistical problems such as multicollinearity) are associated with hedonic pricing. These are discussed in detail in Bateman (1993), Hanley and Spash (1993), and Garrod and Willis (1999). We observe that applicability to valuation in the Wadden Area is limited, although there are some HPM studies applied to wetlands (Bin and Polasky 2002; Kruk 2005). The latter finds an upward effect of Dutch restrictive wetland use policies in housing markets; the effect is not limited to residential properties in the wetland surrounding areas. That is, wetland regulations drive up housing prices, both in the vicinity of the wetland but also further away

5.2.3 Contingent valuation method

TCM and HPM are both revealed preference methods. A common problem with these methods is that in the absence of appropriate data or interdependent market goods, assessing the value the functions of the Wadden Area is either not possible or will lead to spurious results. Stated preference methods bypass the need to refer to market prices by asking people directly what their willingness to pay (WTP) for a change in environmental quality or biodiversity is. This requires the presentation of a change scenario, for example the degradation of natural wetland habitats, a decline in populations of wetland-dependent bird species, or the conversion of wetland into agricultural land.

The contingent valuation method (CVM) is the most used stated preference method: there are now thousands of papers and studies dealing with the topic (Carson 2000; for an overview of fifty years of CVM, see Smith 2004). CVM has been used extensively in the valuation of biological resources, including rare and endangered species, habitats and landscapes, although it should be recognised that this method may fail for those value categories that the general public has no experience with (Nunes and van den Bergh 2001). It invokes a framework of a contingent (or hypothetical) market, used to indicate what individuals are willing to pay for a beneficial change or what they are willing to accept by way of compensation to tolerate an undesirable change (Garrod and Willis 1999; Carson 2000; Carson and Hanemann 2005; Boardman et al. 2006).

The main advantage of CVM is that, in theory and to varying degrees, it is capable of capturing most of the value categories related to the functions of the Wadden Area. The hypothetical nature of CVM offers flexibility in application, and as a result, the method is quite versatile. Nevertheless, results from CVM studies are heavily dependent on the choice of the particular format used to elicit information about the respondent's preferences. The success CVM has experienced relates directly to the energy, time and money spend on the design state of the contingent valuation survey as well as to the question wording, the question sequencing and the individual interviewers (Diamond and Hausman 1993). Respondents are assumed to be rational and knowledgeable and the best judge of their own interests. Moreover, CVM has many acknowledged problems. The hypothetical character induces the occurrences of an impressive list of potential biases that result from using CVM. They include strategic bias, embedding bias, part-whole bias, starting point bias, and payment vehicle bias (see, for example, OECD 2002; de Blaeij 2003; Boardman et al. 2006).

So although CVM has become one of the most widely used non-market valuation technique, debate persists over the reliability of CVM. That is, opinion among scientists is divided. Many economists have expressed „discomfort' with using the estimates from contingent valuation to measure consumers' WTP for changes in non-market goods, such as biodiversity, landscape scenery and environmental quality. More than ten years ago, Diamond and Hausman offered the most dogmatic rejection of the method. They (1994, p. 62) tell us that when using a CVM „… one does not estimate what its proponents claim to be estimating.' In other words, according to these two CVM sceptics, people simply do not have preferences over non-use values (see also Vatn 2004). Also other well-known scholars, such as Kahneman et al. (1990) and Sagoff (2000) express their doubts with respect to the suitability of CVM for various reasons. Nonetheless, the opinions of these (resolute) detractors have not slowed research in this area – on the contrary.

Although proponents of CVM acknowledge that CV studies range from very good to very bad and that the technique suffers from various design problems that require effort and skill to resolve (Smith 1992; Hanemann 1994; Carson 2000), they believe that extensive methodological research and quality improvements have already increased the reliability and feasibility of the contingent valuation approach. An important stimulus to the use of CVM was the recommendations of the National Oceanic and Atmospheric Administration's, or NOAA, panel on contingent valuation (see NOAA 1993). This panel of eminent social scientists, co-chaired by two Nobel Prize-winning economists, Kenneth Arrow and Robert Solow, specified an extensive set of guidelines for CVM survey development, administration, and analysis. It also found that CVM, if appropriately conducted, could convey useful information. The NOAA panel's recommendations are now being considered as possible standards for employing CVM. As a result, the CV technique is continuing to play a role in monetary valuation, including non-use values, of natural assets (for an application to wetlands, see for example Farber 1988; Brouwer et al. 1999; Brander et al (2006), Whitehead et al. 2009). Geurts and Van der Veen

(2001) researched an environmental problem related to Rottummeroog in a panel study. All studies in general find positive estimates for wetland values which strongly vary by type of wetland, location and socio-economic charactersitics. To get a certain feeling for numbers it is interesting to summarise the latter example on Rottummeroog. The study was done in 1995 after Rijkswaterstaat decided to let the Dutch Waddenisland „go', to let her to be unprotected in a dynamic environment. The question that was proposed to Dutch respondents was what amount of money they were prepared to pay if Rijkswaterstaat was aiming at changing her attitude and implement a new policy to protect the island by means of civil engineering works. Which would imply additional costs to Dutch Government. The answer (median) was 4.32 Dutch guilders per month.

5.2.4 Choice modelling

Choice modelling (CM) is, like CVM, a stated preference method that is capable of measuring the total economic value of a good, and not just the „use part' of this value. In the field of monetary valuation, CM is being increasingly applied as an alternative to CVM (Adamowicz et al. 1994;, 1998). Hanley et al. (2001, p. 436) define CM as "… a family of survey-based methodologies for modelling preferences for goods, where goods are described in terms of their attributes and of the levels that these take." As such, the term choice modelling is somewhat broader in coverage than the method of choice experiments; or, to put it more precisely, choice experiments are a derivative of CM.[2]

CM is capable of measuring consumer acceptance of multi-attribute commodities. Unlike CVM, which tends to provide a single value for an expected (spatial or environmental) quality change, a CM enables estimation of the value of the change as a whole as well as the implicit values of its (spatial) attributes. Generally, in a CM, respondents are confronted with a number of commodity descriptions, or situations, that differ according to the attributes described. Respondents are then asked to rank or rate the bundles of attributes, or select the most-preferred one from the set. The basic premise underlying this method is that commodities, such as wetlands, have a value because of their attributes. In order to decide which commodity they want, people make trade-offs between the attributes (de Blaeij 2003).

The theory underlying the method of CM is Lancaster's model of consumer choice, which hypothesizes that consumers derive satisfaction not from goods themselves, but from the attributes they provide (Lancaster 1966). In addition, CM are consistent with random utility theory which "… is based on probabilistic choice, where individuals are assumed to choose a single alternative which maximizes their utility (welfare) from a set of available alternatives." (Horne et al. 2005, p. 191). A third key element in the method of CM – besides Lancaster's theory of consumer choice and random utility theory – is the experimental design; i.e. the construct used to develop and implement an empirical data framework within which choices can be studied and contextualized (see Garrod and Willis 1999; for thorough and critical descriptions of CM, see Roe et al. 1996; Farber and Griner 2000; Louviere et al. 2000).

CM is designed to determine the structure of preferences that underlie the judgement of multi-attribute commodities and to that end, it measures the rates at which people are willing to make such trade-offs (Shechter 2000). The inclusion of at least one monetary attribute, such as the

[2] The term choice modelling is often used interchageably with the term conjoint analysis (e.g. Hanley et al. 2001). Of these two terms, chois modelling seems to be the most commonly used nowadays.

cost of provision or the WTP for conserving the Wadden Sea, allows for the derivation of implicit prices for each of the other attributes. Of course, it is possible to conduct a CM without the inclusion of a monetary attribute. However, if we want to calculate the welfare measures of a change in the landscape of the Wadden Sea, it is necessary to include a monetary attribute such as price or a cost. Speaking broadly and generally, if one of the attributes is measured in monetary terms, CM can be used to estimate the welfare implications of a specific spatial policy. By deriving empirical values of the willingness to pay (for some benefit) or the willingness to accept (compensation for some harm or damage), changes in consumer surplus can be identified as an indicator of changes in welfare resulting from a spatial (Wadden Sea) policy action.

Unlike CVM, CM does not directly ask for a „willingness-to-pay', but offers the opportunity to rank all of the alternatives from highest (best) to lowest (worst). Defenders of CM therefore argue that the technique outperforms CVM on the point of strategic behaviour. The indirect way of questioning in the CM allows respondents to explicitly determine trade-offs between different attributes of the commodity under valuation. Because CM is designed to rank multi-attribute alternatives, it seems better suitable to value ecosystems, such as the Wadden Sea, which provide a multitude of joint goods and services, than the typical one-dimensional CVM (Farber and Griner 2000). It allows obtaining values for specific characteristics of (wetland) scenarios rather than one specific scenario. Polomé et al. (2006) investigated a restoration project near the island of Texel in an attempt to value new nesting sites for birds. For more general application of CM to wetlands see, for example, Mallawaarachchi et al. (2001) and Milon and Scrogin (2006).

As an example, we present a choice modeling study on the Wadden Sea itself (van den Bergh et al. 2006, de Blaeij et al. 2007, Nunes et al. 2009) to illustrate the theoretical concepts and formulations of the CM-approach. The goal of this study was to assess and identity differences between preferences of five stakeholder groups, namely Dutch citizens, local residents, tourists, policy makers and scientists, for management of cockles fishery in the area.

The questionnaire that the researchers used to operationalise the CM consisted of four parts. The first part contained questions about the behaviour of respondents with respect to, amongst others, visiting the Wadden Sea and food habitats in relation to the consumption of (shell)fish. In the second part, the CM-questions were posed (an example of such a question is given in Table 2). Each respondent faced nine CM-questions, proposing all different trade-offs among the attributes (such as the number of birds in the Wadden Sea, or the surface area where fishing on cockles is allowed) under consideration. In each question, the respondent is asked to make a choice between the current fishing management practice and an alternative policy option. The third part of the questionnaire dealt with questions about alternative marine management policies in the Wadden Sea. And the fourth part assessed the socio-economic characteristics of the respondents.

Table 2 Illustration of a CM question as formulated in a case study for the Wadden

Assuming that the following two fishing management practices (A and B) were the only alternatives available, which one would you consider more attractive, if any?		
	Current situation	Policy proposal
Policy measures		
- Surface area where fishing on cockles is allowed	Current area	Half of the current level
- Allowed harvest of cockles	Current level	Lower level
- Rotation	No rotation	No rotation
Ecosystem effect		
- Number of birds	Current level	More than the current level
Costs		
- Costs per household	0 Euro	50 Euro
	□ A	□ B
		□ No preference

Source: van den Bergh et al. (2006, p. 212, Table 11.1).

From Table 2, it can be seen that in the CM-questionnaire three different measures for the regulation of cockles' fishery are presented to the respondent. In addition to these three different measures or attributes, two other attributes were included in the questionnaire, namely the changes in the number of birds – which were interpreted as a proxy for ecosystem quality – and a monetary variable that refers to a one-time lump-sum amount for an associated policy option. This monetary attribute is required to estimate welfare changes. The five attributes and their levels as used in the CM-study are summarized in Table 3.

Table 3 Attributes and their levels as used in a case study for the Wadden Sea

Attribute	Levels
Policy measures	
- Surface area where fishing on cockles is allowed	• The whole Wadden Sea • Current level • Half of the current level • No fishing (ban)
- Allowed number of cockles harvest	• Current level • Lower level
- Rotation or fixed areas	• Rotation • No Rotation
Ecosystem effect	
- Number of birds	• Lower level • Current level • More than in current situation • Much more than in current situation
Costs	
- Financial costs per household	• Nine different bid amounts between 0 and 250 Euro

Source: van den Bergh et al. (2006, p. 213, Table 11.2).

The results of the CM-study show that the five stakeholders group have different preferences for the policy measures. All groups prefer the policy measure that fishing is allowed in half the area, Dutch citizens and local residents do not want to ban cockle fishery. Rather, they prefer the rotation policy measure, whereas the policy makers and the natural scientists dislike this measure. The latter group of stakeholders believes that this specific fishery policy will destroy the ecosystem in the Wadden Sea.

Table 4 gives an overview of the ranking of the policy measures by the different stakeholder groups.

Table 4 Ranking of Wadden Sea management policies

Stakeholder group	Ranking
Dutch citizen	Many more birds ≈ More birds > Current situation
Tourists	Many more birds > More birds > Current situation
Local residents	More birds > Many more birds > Current situation
Policy makers	Many more birds > More birds ≈ Current situation
Natural scientists	Many more birds > More birds ≈ Current situation

Note: '>' stands for preferred to; and '≈' stands for indifferent to.

Source: Nunes et al. (2009, p. 498, Table 11).

In Nunes et al. (2009), the researchers give for some stakeholder groups the estimated willingness-to-pay amounts for realising (many) more birds in the Wadden Sea. Tourists for example, are willing to pay € 80.- for more birds and € 97.- for many more birds. For Dutch citizens, these willingness-to-pay amounts are € 50.- (more birds) and € 51.- (many more birds), and for local residents € 71.- and € 51.-.

The case study described here is, of course, not the only example of the application of a CM to wetlands. Other examples are, amongst others, Carlsson et al. (2003), Hoehn et al. (2003), Birol et al. (2006b) and Milon and Scrogin (2006). The various case studies show that various and diverging wetland management policies can be properly valued by a CM-approach. As such, CM seems to be a useful and practical ex ante valuation tool that can assist policy makers in assessing welfare effects of Wadden Sea management policies.

One final remark is in order. For the valuation of changes in the landscape of the Wadden Sea, it is worthwhile pointing out that visual representation of the alternative spatial situations is essential. As valuation of landscape components is subjective, and the respondents on the basis of individual experience, visual aids, such as figures, can interpret verbal description differently maps and drawings, are important parts of a successful presentation.

5.2.5 Benefit transfer

While the debate over the existing techniques for monetary valuation continues, the search for new approaches remains. The method of benefit transfer is fairly new and still a developing subject (see, for example, the special issue of *Ecological Economics* on the state-of-the-art and science of benefit transfer, edited by Wilson and Hoehn 2006). Benefit or value transfer involves „borrowing' monetary environmental values estimated at one site (the study site) and applying them to another (the policy site). The attraction of benefit transfer is that it avoids the cost of conducting „primary' studies whereby the benefits of natural or environmental assets or the damages associated with degradation are measured with one or more of the techniques described above (OECD 2002).

Navrud (2001; see also Rosenberger and Stanley 2006; and Spash and Vatn 2006) distinguishes two main approaches to benefit transfer: namely, unit value transfer, and function transfer. Unit value transfer is the easiest approach and refers to simply transferring the results of an environmental valuation study to the policy site. The valuation estimates may be left unadjusted, or may be adjusted in some way. Although transferring unadjusted estimates is undesirable, since the values experienced in the study site may not be the same as in the policy site, it is widely practised (OECD 2002).

A more sophisticated approach is to transfer the entire benefit function. Thus, instead of transferring only the benefit estimates, a researcher transfers a benefit function, substituting data on independent variables at the new site. Both unit values and value functions can be based on multiple studies. Meta-analysis can be used to take the results from a number of studies, synthesise research findings, and analyse them in such a way that the variations in unit values or value functions found in those studies can be explained (van den Bergh et al. 1997; Navrud 2001; Dalhuisen 2002).

The advantage of benefit transfer is that it is both pragmatic and cost-effective and therefore, the method is a very attractive alternative to expensive and time consuming original research to quickly inform decision making (Garrod and Willis 1999). To date, however, benefit transfer is a controversial issue in various policies contexts. The major reason for this is that the accuracy of transferred estimates is debated because validity tests show that the uncertainty in transfers could be quite large, both spatially and intertemporally. This is especially the case for complex goods, such as life-support functions and landscape values. The benefit transfer approach is recognised as a valid technique for valuation of ecological functions in the Wadden Area only if the circumstances at the study site are very close to those of the policy site, which is highly unlikely. This does not necessarily imply that the application of benefit transfer should be restricted to transfers within one and the same region. Ready and Navrud (2006) explore the issues that must be addressed when conducting benefit transfers between different regions (namely between countries). They also provide information about the benefit transfer of landscape values (Navrud and Ready 2007). Brouwer et al. (1999) and Brander et al. (2006) apply the benefit transfer approach to wetlands.

6. The role of values in designing new policies for the Wadden Area

A basic policy question with respect to wetlands is to balance the exploitation of the various functions, especially between ecological and conventional economic functions. Turner et al. (2000) point out that compared to conventional economic values, the ecological functions are often under-valued in the policy-making process such that wetland losses and degradation results. On the other hand, ecological functions may also be over-valued, as, for instance, in the case of gas exploration in the Wadden Sea. Whitten and Bennett (2005) answer the balancing question by referring to conflicting interests and imperfections in the decision making framework selected by society, which must perform two key functions in allocating scarce resources amongst competing uses:

- accurately signal information about individuals'(producers and consumers) desires and the availability of these resources to meet these desires, and
- generate incentives for producers and consumers to act on the desires of others in society.

Regarding the competing uses, the Wadden Area has witnessed a variety of conflicting interest between conventional economic activities, such as fishery, port and industrial activities on the one hand, and nature preservationon the other. But potential conflicts also exist between the various conventional economic activities. An example of this conflict is reflected in the tourism versus fisheries debate. To be more specific, the Wadden Area is a popular birdwatching area, because it is *inter alia* an internationally important wetland for birds migrating from their breeding grounds in the north (e.g. Scandinavia, Greenland) to their wintering grounds in Europe and Africa (and vice versa). These birds use the Wadden Area for a short stay, as a major and sometimes even irreplaceable stop-over site for refueling or as a wintering area (Baptist et al. 2007). As such, the ecological function of the Wadden Sea is vital for birdwatching in the area and its tourism and recreation industry. However, this ecological function is (negatively) influenced by the shellfish fishery (Nunes et al. 2009). After all, shellfish – and especially cockles – constitute an important element of the diet of the bird population in the Wadden Sea, so that harvesting of cockles and mussels reduces the food available to those birds.[3] As a consequence, shellfish harvesting activities conflict with food availability for birds and indirectly with bird watching tourism and recreation. In policymaking

[3] Shellfish fishey does not only have an impact on the stocks of shellfish, and therefore on the population of shellfish eating birds, but it affects the Wadden Sea also in other ways. For example, environmental organizations claim that the process of mechanicl Shell fishing alters the sediment stucture of seabeds in an irreversible way (seede Blaeij et al. 2007).

terms this conflict comes down to the decision whether or not to restrict shelfish harvesting activities which in its turn requires information on the net benefits of both activities and their comparison. Thus, within the Dutch Wadden Sea, there are conflicting interests of various stakeholder groups, such as between the fishery sector and the Waddenvereniging, the Dutch society for protection of the Wadden Sea. Regarding the decision making framework, and given the different and often conflicting preferences, the key question arises: What restrictions should be imposed on the use of the Wadden Sea in order to improve welfare at different spatial levels (regional, national, international)? In order to answer this question, it is essential to have a good insight into all the values of the Wadden Sea. It follows that some of the functions (particularly the ecological functions like foraging grounds for migrating birds) are considered by many to be of little or no value, or even at times to be of negative value. Particularly, Turner et al. (2000, p. 8) observe: "This lack of awareness of some of the value of conserved wetlands and their subsequent low priority in the decision-making process has resulted in the destruction or substantial modification of wetlands, causing an unrecognized social cost." Jackson et al. (2001) provide an overview of overfishing and the collapse of coastal ecosystems.

One of the reason for the fact that functions of ecosystems like the Wadden Sea are inadequately valued is that these functions are not fully captured in markets. However, the fact that there is no organized market for these functions – and, as a result, no market prices exist to adequately reflect the relative scarcity of these functions – does not mean that they are of no value.

Economic analysis departing from a broad welfare perspective can shed light on the value of biodiversity in general and on the Wadden Sea in particular by providing insights into the potentially high benefits of the Wadden Sea. Thus it can reveal the economic and social pressures that threaten it. Through monetary valuation, economists can support debates on how to pursue nature policy goals amid competing claims. Therefore, economic analysis can make a worthwhile contribution to nature policy discussions and decisions as it helps decision makers to make informed decisions about Wadden Sea management policies where there are alternative ways of allocating scarce financial and other resources. That is, in order to arrive at an optimal trade off between ecological and conventional economic interests, all the benefits that flow from Wadden Sea policy should be assessed and clearly expressed in monetary terms.

Quantifying the values of changes in the functions and services of the Wadden Area would help improve nature management decisions from an economic and ecological point of view. To that end, clarification of the relationship between ecological and economic processes is essential. This means that, in order to establish practical policy measures for managing the Wadden Sea in a manner that is both sustainable and efficient, a combination of sound ecology and good economics is required. That is, Wadden Sea policy has to be consistent not only with ecological viewpoints but also with economic concepts and realities. In line with the conviction that the design and implementation of effective Wadden Sea policy prescriptions requires a balanced input of insights from ecology and economics, the methods that can be used to assess the value of the functions of the Wadden Sea should be based on integrative or interdisciplinary approaches. That is, the economic analysis of these functions should not be taken from a strictly economic angle, but rather from a broad welfare perspective including ecological-economic interaction.

Economic analysis of its values facilitates decision-making on improving regional and national welfare in Wadden Area. The results of economic valuation are input to decision-making methods, such as cost-benefit analysis (CBA). Apart from Cost-Benefit analysis, as one of the major economic tools to use on the evaluation of new projects, there are other frameworks like EIA, Environmental Impact Assessment, and SEA, Strategic Environmental Assessment. These two alternatives have in common that they have been developed as alternatives for CBA, mainly because ecologists were very much in opposition with the economic bias of CBA, especially with respect to discounting, which may lead to accept projects with adverse environmental effects in the medium/long term.

Note that especially in the Netherlands, CBA is presented as an integrated decision framework. Such a CBA integrated framework is designed as a bookkeeping method where, on the one hand, costs and benefits are presented so as to evaluate the net benefits of a project in euro's, and, on the other hand, non-euro pros and cons are offered in order to allow a truly integrated decision. Indeed, it is supposed to be a weighing scheme of ecological values, socio-cultural values and economic values. Non-economists question this kind of integration, as said before because of the role of monetarization and discounting. Consequently, Environmental Impact Assessment (EIA), and later also Strategic Environmental Assessment (SEA), were developed as competitive frameworks and have followed an independent route. Moreover, a combination of Multi-Citeria Analysis (MCA) and CBA has recently be proposed as an alternative route to combine monetary and non-monetary issues (Sijtsma, 2006).

We acknowledge frames like EIA and SEA, but want to stick here to CBA because it is an integrated framework and it has direct links to policy measures. By estimating the value of ecological goods and functions, they can be included in CBA, which describes and compares monetary costs and benefits of alternative policy decisions or „projects'. However, it is important to realise that economic analysis facilitates not only formal methods of decision-making; it goes beyond such a strict evaluative interpretation. Specifically, economic analysis provides a base for studying relevant issues that have arisen in the Wadden Area. For example, the „Knowledge Agenda for the Wadden Area' (*Integrale Kennisagenda van de Waddenacademie*), published by the Waddenacademie (2009, p. 48) raises the question of what the essential qualities or values of the nature in the Wadden Sea are. Moreover, it emphasizes (p. 50) the special attention that should be paid to the integration of ecological values, or the so-called „non-use values', into economic approaches. And somewhat further (p. 59) the Knowledge Agenda addresses the issue of what values can be ascribed to the Wadden Area and whether these values are important (and if so, why and to whom). These and other questions and issues can be usefully tackled by employing economic analysis, whereby social and ecological values are accurately accounted for. It should be observed, however, that basic ecological functions which support the entire system, are beyond standard economic analysis.

7. Payment for Environmental Services

As stated in the Introduction of this report, a quite recent approach in the combination of economic and ecological analyses is the use of Payment for Environmental Services. This instrument aims at purchasing conservation. The voluntary transaction of buying an environmental service is as simple as it looks like and is remarkably effective (Pagiola 2008) .

As an example, Figures 3 and 4 present the scheme for a typical wetland example of cockle fishermen acting unsustainable, but having the opportunity to change to a sustainable situation.

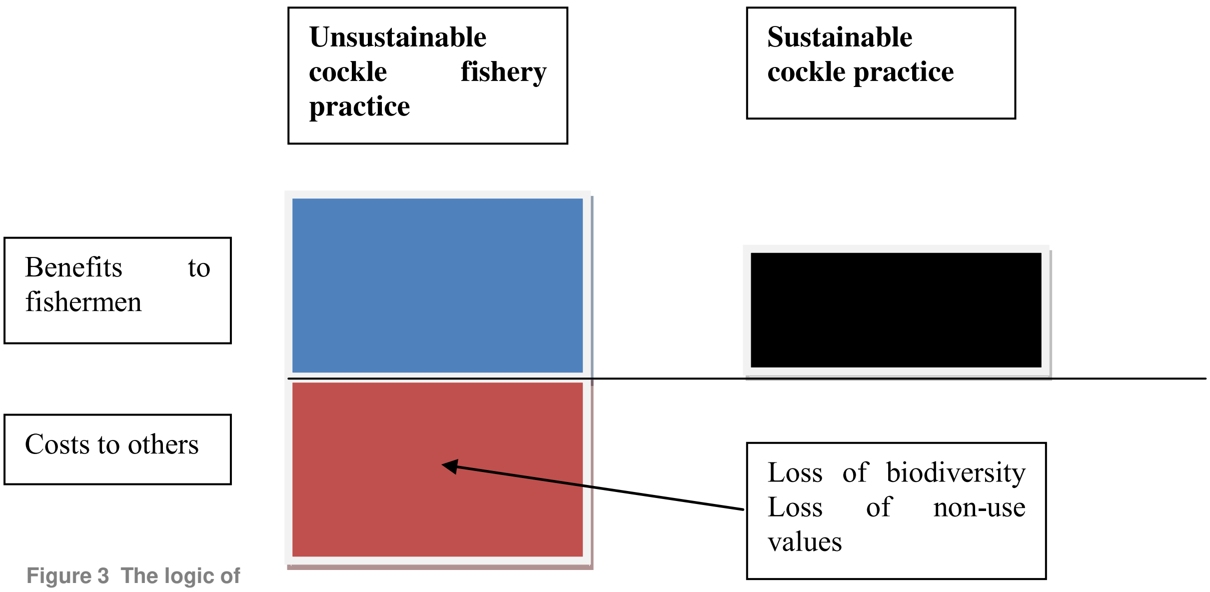

Figure 3 The logic of Payments for Environmental Services (PES): the starting scheme

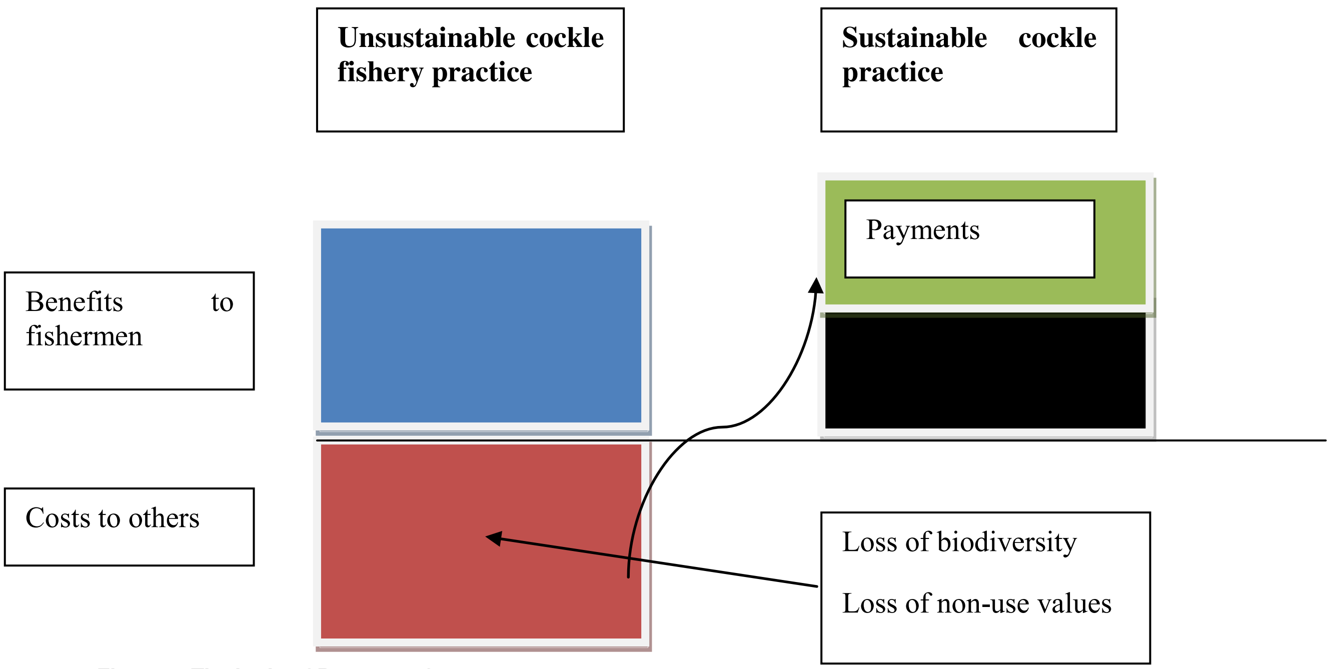

Figure 4 The logic of Payments for Environmental Services (PES): inclusion of payments

In a situation of unsustainable fishery (Figure 3), cockle fishermen will not have any incentive to change to another way of doing business because cost to external parties are not taken up in their profit/loss bookkeeping. Furthermore, a change to sustainable practices would even result in lower benefits, as shown in the top right box.

Costs to external parties, however, are a source of potential funding for fishermen in case these actors can be seduced to pay for sustainable harvesting of cockles. And they might be willing to pay, because any improvement will provide them with higher welfare, and/or with lower costs. As can be seen from Figure 4 in the top right box we add now a payment for environmental services (leading to lower external costs). Because of these payments sustainable forms of fishery become profitable.

In the literature different types of Payment for Environmental Services schemes are available that have proven to be effective conservation strategies. PES has been applied to situations of carbon sequestration, biodiversity protection, watershed protection and landscape beauty.

Despite our optimistic tone there are critics on the application of PES, questioning the effectiveness of a PES proposal. Firstly, some scholars argue that there is a „global deficit of care' with respect to biodiversity loss in the world (Turner and Daily 2008). Any kind of PES schemes will not solve this deficit, and therefore other solutions have to be designed. Secondly, and more fundamental from a methodological point of view, there might be a scale mismatch: biodiversity problems most of the time are local issues that require local political actions; however, policy instruments for biodiversity often act on a national and international scale. In this respect PES schemes might act on the wrong scale. Finally, in answer also to our own remarks in Section 3, economic incentives do not cover issues like fairness or legitimacy (Turner and Daily 2008). Accordingly, in the implementation of a PES-scheme particular attention should be paid to this issue.

8. Conclusions

The main classes of functions of the Wadden Area, one of the most important wetlands in Europe, are:

- Production services, i.e. products obtained form ecosystems
- Regulating services, i.e. benefits obtained from the regulation of ecosystem processes
- Information services, i.e. non-material benefits that people obtain through spiritual enrichment, cognitive development, recreation etc.
- Habitat services, necessary for the production of all other ecosystem services

The fourth category, habitat services, is of an indirect nature: necessary for all ecosystems. Between the classes but also within the classes of functions there often arise conflicts, which require policy intervention. Several types of decision-making techniques have been developed, particularly cost-benefit analysis (CBA), combinations of CBA and multi-citeria analysis (MCA), Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). We acknowledge frames like EIA and SEA, but want to stick here to CBA because it gives us the opportunity to insert monetary values of functions of nature that are derived from a sound framework of interdisciplinary collaboration between ecologists and economists.

A crucial step in CBA is the comparison between costs and benefits of various policy options. Particularly, in order to arrive at an optimal trade off between functions, all the benefits and costs that flow from a given Wadden Sea policy should be assessed and clearly expressed in monetary terms. However, for several costs and benefits no prices are available since the underlying functions do not involve market transactions.

There exist several methods that can be applied to value the functions of the Wadden Area including the travel cost method, hedonic pricing, contingent valuation and choice modeling. Application of these methods requires inputs from other disciplines. For instance, policy measures aimed at the protection of migratory birds require detailed inputs from ecology. Hence, CBA and valuation can be based on multidisciplinarity, interdisciplinarity, integrated assessment and transdisciplinarity (Hinkel, 2008).

Within this type of research economists and ecologists will be able to exchange information and scientific principles. *Functions of nature and the consequent use of Payment for Environmental Services* may act as a bridge between disciplines that up till recently had little common ground, which hampered fruitful interaction. Given the experience of Dutch researchers in valuation studies and in ecological qualities there are ample opportunities to formulate a high quality valuation project in the Dutch wetlands with accompanying payment for environmental services. Examples of research topics are the following:

1 Cockle, shrimp and mussel fishery and a move towards a more sustainable, but less profitable, way of fishing technique. Although this issue seems to be solved for cockle fishery by means of an arrangement between the stakeholders, it still is an interesting example how environmental services are dealt with and can be transferred to issues like mussel seed farm or shrimp fishing.
2 Harbour extension near Harlingen and accompanying economic developments. This issue is a very difficult one. It involves a choice for particular types of industry on industry sites in Harlingen with complicated environmental effects. It extends research on environmental services of a particular economic activity towards an extensive land use change decision.
3 Oil and gas mining and different technical options for digging. Given the experience on Ameland this topic is well understood and can serve as a standard for doing research on Payment for environmental services.
4 Dredging in the Eems and different technical techniques to prevent water turbidity. This topic is complicated not for reason of science, but because of the difficulty in defining the right environmental good/service that has to be paid for;
5 Mining salt in (under) the Waddensea comparing various techniques of digging: new topic, highly relevant.

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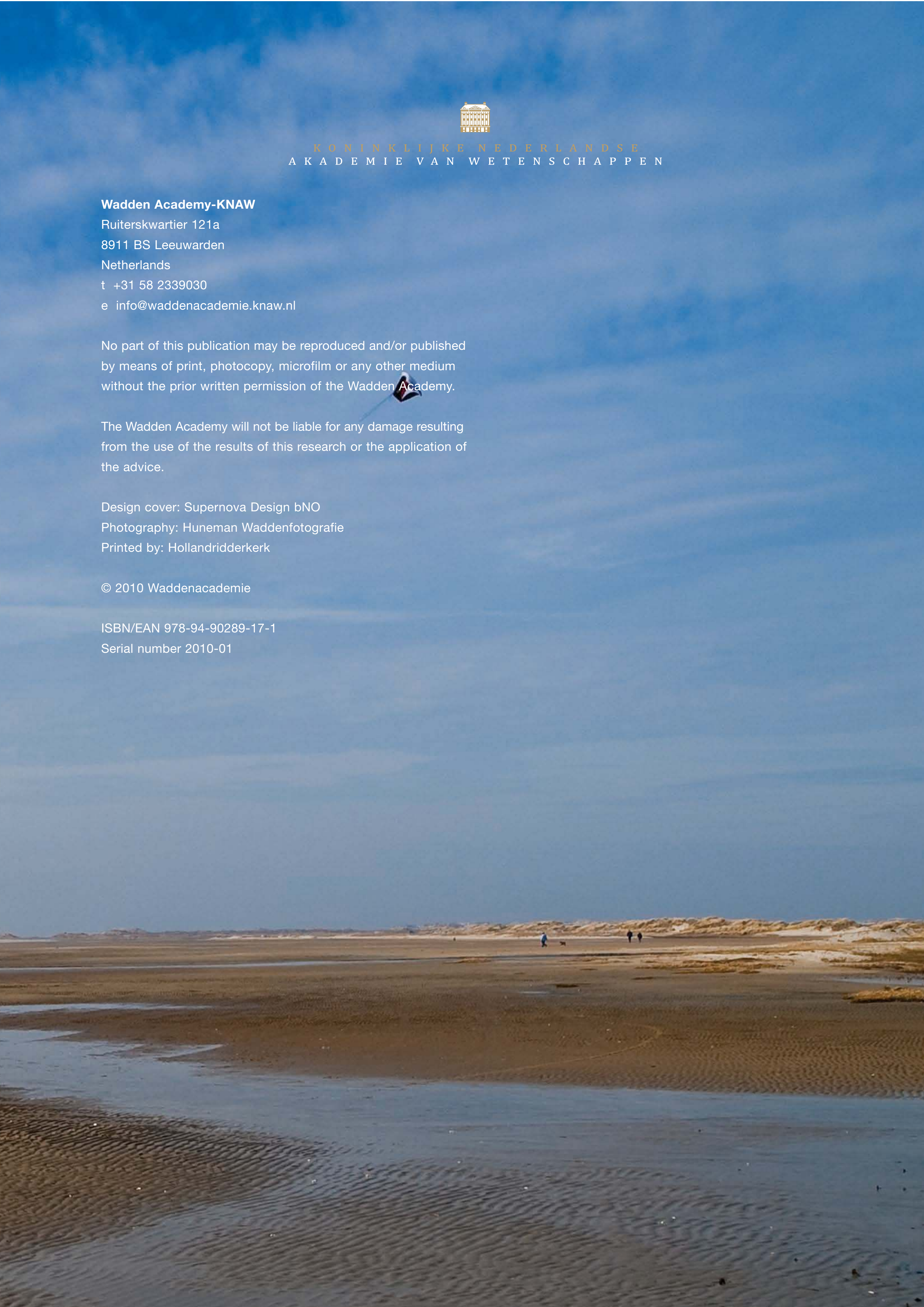

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