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Economic Analysis of Köyceğiz-Dalyan Special Environmental Protection Area

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Strengthening the System of Marine and Coastal Protected Areas of Turkey Project

2013

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Foreword

Turkey is a country surrounded by the sea on three sides. Turkey's nature and climatic conditions adorn it with a significant biodiversity in its coastal areas. However, there are also problems that touch these regions and that become more imminent everyday. Urbanization, industrialization, tourism, other residential areas and activities alike that leads to irregular and unplanned development that have severe impacts on coastal and marine areas.

Developments, especially in the economy also increase marine transportation and dependency on the use of marine and coastal areas for development, housing, commerce, recreational activities and basic needs. Furthermore, the pressure of fast urbanization and settlement activities on coastal areas leads to many problems including loss of dunes, salt beds and marshes; marine and coastal pollution, deterioration and loss of coastal ecosystems. Biodiversity and fertility of coastal and marine areas are faced with this increasing pressure, leading to damages that cannot be undone.

These coastal and marine areas are one of the most precious assets we have and we must protect them. In order to alleviate these pressures and overcome these challenges, relevant structures and infrastructures for effective implementation and surveillance to ensure that these areas are sustainably managed, preserved and protected without being deteriorated and with a balanced approach between use and protection. In this regard, all related agencies and institutions have to go under a capacity building process to meet the demands of the required structures and infrastructures; cooperation and coordination between all parties have to be improved and an effective and efficiently operating work program and a model for financial resources have to be developed.

In its responsibility area covering a coastline that extends over some 8,592 km, General Directorate for Protection of Natural Assets carries out research activities for the protection and study of threatened and endangered species and habitats that are duly specified in the national legislation as well as in international conventions that Turkey is a party; carries out research activities on the biodiversity of marine and coastal environments; determines the marine surface vessel capacity of important bays

and harbors; establishes procedures and principles for use of protection and use of such areas; carries out other integral coastal management activities and strives to minimize risks that threaten such assets.

Protection of marine and coastal resources being a global priority, Marine Protected Areas are fast developing and expanding as a concept. Turkey is no exception to this rule where considerable awareness raising efforts are being carried out.

Through the large scale GEF Project entitled 'Strengthening Turkey's Marine and Coastal Protected Areas' covering the term between 2009-2013 and with the UNDP as the implementing partner, the General Directorate has taken a very first step for devising a long term solution for the protection of marine biodiversity in Turkish coastal waters; for the restructuring of marine and coastal protected areas database and to guarantee effectiveness and sustainability of ecological service functions.

A series of technical reports that are prepared as a part of the project on economic analysis, socio-economy of fisheries in coastal areas, together with other efforts on the identification of marine sensitive areas, integration of economic principles to planning processes, ensuring financial sustainability, mitigation of pollutants from marine vessels and determination of alternative livelihood resources are expected to yield the following project outcomes:

- Responsible institutions have the capacities and internal structure needed for prioritizing the establishment of new MCPAs and for more effectively managing existing MCPAs.
- MCPA financial planning and management systems are facilitating effective business planning, adequate levels of revenue generation and cost-effective management.
- Inter-agency coordination mechanisms in place to regulate and manage economic activities within multiple use areas of the MCPAs.

Documents covering the three main outcomes of the Project so far mentioned are submitted to your perusal.

Osman İYİMAYA
General Director

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Exchange rates

1 TL = US\$ 0.528

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1€ = US\$1.30

Acronyms

ESA	Ecosystem Service Approach
EU	The European Union
IUCN	International Union for Conservation of Nature
GEF	Global Environment Facility
GDPNA	General Directorate for Protection of Natural Assets
GDNCNP	General Directorate for Nature Conservation and National Parks
GDP	Gross Domestic Product
MoFAH	Ministry of Food, Agriculture and Husbandry
MoEU	Ministry of Environment and Urbanisation
MoFWA	Ministry of Forestry and Water Affairs
MCPA	Marine and Coastal Protected Area
REDD	Reduced Emissions from Deforestation and Degradation
SEPA	Special Environmental Protection Area
UNDP	United Nations Development Programme

Yönetici Özeti

Köyceğiz-Dalyan Özel Çevre Koruma Bölgesi 1988 yılında koruma alanı ilan edilmiştir. Bölgeye farklılık kazandıran; büyük bir sulak alan sistemi içinde bulunan Köyceğiz Gölü'nün Dalyan Kanalları ile Akdeniz'e bağlanmasıdır. Alan tatlı su gölleri, dalyanlar, bataklık araziler, kanallar ve kıyılarla eşsiz bir ekosisteme sahiptir. Yüzölçümü 461,5 km² olan bölgenin 32,8 km²'si denizel alandır (SAD, 2010). Kıyı şeridi uzunluğu 24,38 km olup deniz derinliği en fazla 100 m dir (ibid). Alanın karasal yönetim planı 2007 yılında hazırlanmıştır, ancak henüz bütünüyle uygulamaya konulmamıştır (Çınar Mühendislik, 2007). Bu yönetim planına paralel olarak hazırlanan gelişim planları, Tabiat Varlıklarını Koruma Genel Müdürlüğü tarafından onaylanmış ve uygulanmaktadır.

Çalışmanın Amacı ve Yaklaşım

Bu çalışmanın amacı Köyceğiz-Dalyan ÖÇKB'sinin ekonomik analizini gerçekleştirerek:

- Alanın temin ettiği denizel hizmet ve ürünler yelpazesi hakkında farkındalık yaratmak,
- Kilit ekosistem hizmetlerinin devamını tehdit eden baskılara ve bunların ekonomik sonuçlarına işaret ederek, alanın sürdürülebilir yönetimine katkıda bulunmak,
- Denizel hizmetlerin ekonomik değerini ortaya koyarak ve potansiyel gelir getirici faaliyet ve mekanizmaların altını çizerek, alan için hazırlanacak olan "İş Planına" bilgi tabanı sağlamaktır.

Bu çalışmanın da bir parçasını oluşturduğu TVKGM-GEF-UNDP projesi kapsamında, Köyceğiz-Dalyan ÖÇKB'si için alternatif gelir kaynakları seçeneklerinin tespit edilmesi ve bir iş planının geliştirilmesi öngörülmüştür. Raporda alandaki ekosistem hizmetlerinin ve değerlerinin tespit edilmesine odaklanılmış, potansiyel finansal mekanizmalar hakkında sadece genel bir çerçeve çizilmiştir.

Köyceğiz-Dalyan ÖÇKB'sinin ekonomik analizi; alan hakkında mevcut veri ve literatür taramasına ve Mart 2012'de kilit paydaşlarla yapılan görüşmelerden elde edilen verilere dayanmaktadır. Ayrıca muhtemel yarar transfer değerlerini temin edebilmek, alan için belirlenen değerleri karşılaştırmak ve değerlendirme yaklaşımlarına dair farklı anlayışları görebilmek için, bölgedeki deniz ve kıyı alanlarında

yürütülmüş ekonomik değerlendirme çalışmalarına dair bir literatür taraması yürütülmüştür.

Bu çalışma için, "Ekosistem Hizmetleri Yaklaşımı (Ecosystem Service Approach - ESA)" ve "Milyenyum Ekosistem Değerlendirmesi"nin temin, düzenleme, kültürel ve destek hizmetleri sınıflandırmasına (2005) dayanarak, deniz ve kıyı ekosistemleri hizmetlerine yönelik bir tipoloji geliştirilmiştir. Ekosistem Hizmetleri Yaklaşımı, denizel ortamlardaki ekosistemlerin ve bunların barındırdığı biyolojik çeşitliliğin bireysel ve sosyal refaha katkıda bulunduğunu açıkça onaylamaktadır. Bu yaklaşım, yapılan katkının balık gibi doğrudan tüketilen ürünlerin elde edilmesinin çok daha ötesine gittiğini, denizel ekosistemlerin karbon tutma gibi kritik düzenleme fonksiyonları olduğunu da açıklamaktadır. Dolayısıyla, "Ekosistem Hizmetleri Yaklaşımı" karar alma süreçlerinde ekosistemlerin bir bütün olarak ele alınmasını sağlamış ve ekosistemin verdiği hizmetlere değer biçilmesinin önünü açmıştır.

Temel Bulgular

Köyceğiz-Dalyan bölgesinin biyolojik çeşitliliği, geniş çapta ekosistem hizmetlerine taban oluşturmakta ve bunlar da çok sayıda faydalananın ekonomik refahını desteklemekte ve Türkiye'nin gayrisafi milli hasılasına katkıda bulunmaktadır. Çalışmada Köyceğiz-Dalyan ÖÇKB'sinin bir yıllık ekonomik değeri yaklaşık 51 milyon ABD doları olarak hesaplanmıştır. Bu, alanın başlangıç aşamasındaki değerini yansıtmaktadır ve daha detaylı çalışmalarla geliştirilmelidir.

Alan için ortaya çıkarılan toplam değer olarak, tedarik hizmetlerini balık; düzenleme hizmetlerini karbon tutma, erozyon kontrolü ve su arıtımı; kültür hizmetlerini turizm ve rekreasyon kapsamaktadır. Bunlar brüt değerlerdir (yani masraflar düşülmemiştir) ve karbon tutmayla ilişkilendirilmiş faydalar gibi bazı potansiyel değerler henüz elde edilememiştir ("yakalanmamaktadır"). Buna rağmen, bu değerler olması gerekenin altında değerler olarak düşünülebilir. Mesela turizm için tahmini değerler kullanılmıştır ve bazı potansiyel önemli hizmetler hesaplara dahil edilememiştir. Alanda potansiyel olarak var olduğu düşünülen fakat bilimsel bilgi ve veri noksanlığından incelenemeyen ekosistem hizmetleri bulunmaktadır. Doğal ilaçlar

gibi hammaddeler, genetik kaynaklar ve dekoratif ürünler, denizel ortamın mikro-iklim düzenlemesinde, sel, fırtınadan korumadaki rolü, alanın eğitim, peyzaj ve miras değerleri gibi henüz üzerinde çalışılmamış hizmetleri sayabiliriz.

Alana dair toplam değer yaklaşık %95'ini turizm ve rekreasyon teşkil etmektedir ki, bu da, bu ÖÇKB'nin oluşturduğu değer için denizel ve kıyusal doğal kaynağın sürdürülebilir yönetiminin önemini vurgulamaktadır. Bu ekosistem hizmetine dair değer tespitinde yarar transferi yöntemi kullanıldığı göz önüne alındığında, alandaki yıllık 48.5 milyon ABD doları turizm değeri düzeltilebilir. Alana özel turizm harcamaları ve ziyaretçi sayılarına (hem geceleleyen hem de günü birlik) ihtiyaç duyulmaktadır. Denizel ekosistem hizmetleri, istihdam ve yerel geçim kaynağı olarak da önemlidir.

Öneriler

Çalışma sonucuna göre aşağıdaki öneriler geliştirilmiştir.

- Köyceğiz-Dalyan ÖÇKB yönetim planının etkin uygulanabilmesi, bölgede doğal kaynakların planlı kullanımı açısından önemlidir. Kuruluşlar arası koordinasyonun ve finansal imkanların artırılması yararlı olacaktır.

- ÖÇKB'deki balık stokları ekonomik, ekolojik ve biyolojik olarak izlenmelidir. Balıkçılık ekonomisini anlamak, sürdürülebilir balıkçılık yönetim planlarının geliştirilmesi açısından kilit konumdur. Ticari ve rekreasyonel balıkçılık için yapılan değerlendirme; sürdürülebilir av oranının (miktar) net faydaya (gelirler eksi masraflar) çarpılmasına dayandırılmalıdır. Sürdürülebilir av oranlarının tespit edilebilmesi için alandaki balık stoklarının düzenli bilimsel araştırmalarla incelenmesi gerekmektedir. DALKO tarafından yürütülen dalyan balıkçılığı faaliyetlerinin sürdürülebilirliği, özellikle senede iki defa gerçekleşen kefal türlerinin göç dönemi sırasında daha sıkı bir şekilde denetlenmelidir.
- Turizm, bölgenin deniz koruma alanı statüsünü bütünleyici bir şekilde gelişmeli ve yönetilmelidir. Köyceğiz-Dalyan ÖÇKB'sinde turizm deneyimini geliştirmek ve böylece alanda turizm ve rekreasyon kaynaklı gelirleri uzun vadede olarak üst seviyeye çıkarmak için birçok fırsat bulunmaktadır. Bu konuda öneriler şu şekilde sıralanabilir:
 - * Alandaki turizm gelişiminin sınırlarının belirlenmesi için alanın denizel ve karasal turizm taşıma kapasitesi, özellikle Dalyan Kanalları ve İztuzu plajı için araştırılmalıdır

Tablo . Köyceğiz-Dalyan ÖÇKB'si değerlendirme sonuçları özeti

Hizmet	Değer/ yıl ABD\$	Değerleme yöntemi	Not
Balık	1.399.167	Piyasa değerleri	Bu değer sürdürülebilir av oranına göre hesaplanmamıştır (alan için bilinmiyor). Brüt değerlerdir, masraflar düşülmüştür.
Karbon Tutma	54.226	Piyasa değerleri (kaçınılan harcama yaklaşımı)	Orman karbon piyasasına benzer şekilde Mavi Karbon Kredi piyasasının gelişeceği varsayılmıştır. Dolayısıyla bu değer henüz ölçülmemektedir ("yakalanmamaktadır"). Karbon piyasa değeri 11.2 \$/ t CO2 eşdeğeri olarak alınmıştır.
Erozyon kontrolü	171.080	Yarar transferi	Mangos ve arkadaşları (2010). Her kıyı metresi için 160,000 avro, ÖÇKB'sindeki 8.75 km'lik Posidonia çayırlarına ve alanın % 9.4'nün risk altında olduğuna dayanarak.
Atıksu arıtımı	900.000	Yarar transferi	Mangos ve arkadaşları'na (2010) dayanarak, Türkiye kıyıları için hesaplanan 229 milyon avro'luk arıtım hizmeti Köyceğiz-Dalyan kıyı şeridi uzunluğuna göre taksim edilmiştir (24.38 km)
Turizm / Rekreasyon	48.691.598	Piyasa değerleri	Bölgeye gelen ziyaretçi sayılarına dair tahmini yılda 300,000 geceleleyen ziyaretçi ve ortalama turizm harcamalarına (Bann ve Başak 2011a ve 2011b'ye göre diğer ÖÇKB'lerde yürütülen çalışmalar) dayanarak, günübirlik ziyaretçiler ve marina gelirleri dahil edilmemiştir. Günübirlik tekne turları (2,851,200 ABD \$), dalış merkezlerinden biri (97,500 ABD \$) ve günübirlik kira gelirleri (397,688 ABD \$) dahil edilmiştir.
TOTAL	51.216.071		

- * Alanın taşıma kapasitesini dikkate alan bir turizm master planı/stratejisi oluşturulmalıdır. Ekoturizm sektörünün gelişimi için turistlerin ilgisini çeken faaliyetlerin stratejik planlanması ve pazarlanması yararlı olacaktır.
- * Planlama çalışmalarını desteklemek için ziyaretçiler hakkında daha kapsamlı veri toplanmalıdır (ziyaretçi sayıları, profili, ziyaret nedenleri, vb). Mevcut durumda ziyaretçi sayılarına dair güvenilir veriler bulunmamaktadır. Bölgedeki tüm ÖÇKB'ler için bu bilgilerin toplanabilmesi amacıyla, havayolu şirketleri ve otellerden faydalanılabilir.
- * Alanın ekolojik ve arkeolojik önemi, koruma statüsü hakkında ziyaretçiler ve ikâmet edenlere yönelik daha iyi bilgilendirme ve işaretlendirme yapılmalıdır. Alana gelen yerli ve yabancı tüm turistler , bölgenin bir koruma alanı olduğunun farkına varmalı bilgi edinmelidir. Bölgenin görünür yerlerinde bilgilendirme panoları ayrıca türkçe seyir haritaları ve GPS, alanın koruma statüsünü, göstermeli; alanın özellikleri, alan kullanım kuralları aktarılmalı, en az iki dilde(Türkçe ve İngilizce) gerekli bilgilendirme ve işaretlendirme yapılmalıdır.
- * Bölgedeki turist harcamalarını tespit etmek amacıyla alanda özel bir anket yapılması yararlı olacaktır. Alan için turizmin önemi göz önünde bulundurulduğunda, detaylı bir ekonomik etki analizi yapılması da öngörülebilir. Dalyan'da butik oteller ve sürdürülebilir turizm teşvik edilmeli ve düzenlemeler buna göre yapılarak pazarlama desteği sağlanmalıdır.
- * Ekonomik değerlendirme ve özellikle düzenleme hizmetleri bilimsel temele dayanmalıdır. Bu hizmetleri daha iyi anlamak ve değerlendirmeye ışık tutmak açısından, alana özel düzenleme hizmetlerine odaklı bilimsel çalışmaların (karbon tutma, erozyon kontrolü, sel ve fırtınadan korunma, atıksu arıtımı, vb.) yapılması desteklenmelidir.
- * Ekosistem kaynaklı faydaların değerindeki değişimi ve bunlar arasındaki dengeleri gözlemek amacıyla Köyceğiz-Dalyan ÖÇKB'sinde değerlendirme çalışmaları düzenli aralıklarla yürütülmelidir. Gelecekteki değerlendirme çalışmaları, senaryo analizleri içermeli ve böylece farklı yönetim seçeneklerine ve alanın sürdürülebilirliğine ışık tutmalıdır.

Executive summary

Objectives of study & approach

Köyceğiz-Dalyan Special Environmental Protection Area (SEPA), one of the biggest coastal wetlands in Turkey, gained its protection status in 1988. It is located in the transition zone between the Aegean and the Mediterranean Seas and consists of diverse geographic features such as freshwater lakes, lagoons, marshlands, canals and coastlines (Çınar Mühendislik, 2007). It covers about 461.5 km² of which 32.8 km² is marine surface (SAD, 2010). The coastal length in the SEPA is 24.38 km and sea depth remains less than 100m (ibid). The terrestrial management plan for the site was prepared in 2007 but is yet to be fully implemented. Parallel to this terrestrial management plan, town development plans for the SEPA have been approved by the General Directorate for Protection of Natural Assets (GDPNA) and are being implemented.

The objective of this study was to undertake an economic analysis of Köyceğiz-Dalyan SEPA in order to:

- Raise awareness of the range of marine goods and services provided by the site;
- Contribute to the sustainable management of the site by highlighting pressures threatening the viability of key ecosystem services and the economic implications of this;
- Inform the business plan to be developed for the site by demonstrating the economic value of marine services and highlighting potential revenue generating activities and mechanisms.

It should be noted that other components of the GDPNA-GEF-UNDP project under which this study sits are focused on the identification of feasible income generating options, and the development of a business plan for Köyceğiz-Dalyan. Therefore this report is focused on the identification and valuation of ecosystem services and only provides a high level discussion of potential financing mechanisms

The economic assessment of Köyceğiz-Dalyan SEPA is based on a review of the available data and literature on the site, interviews with key stakeholders and data gathered through a site visit in March 2012. A literature review of economic valuation studies of marine and coastal areas from the region was also undertaken to provide potential

transfer values, benchmarks against which to assess values derived for the site and insights on valuation approaches.

A typology of marine and coastal ecosystem services has been developed for this study following the ecosystem service approach (ESA), which is based on the Millennium Ecosystem Assessment (2005) classification of ecosystem services into provisioning, regulating, cultural and supporting services. The ESA explicitly recognizes that ecosystems such as marine environments and the biological diversity contained within them contribute to individual and social wellbeing. Importantly it recognizes that this contribution extends beyond the provision of goods such as fish to the natural regulating functions of marine ecosystems such as carbon sequestration. The ESA therefore provides a framework for considering whole ecosystems in decision making and for valuing the services they provide.

Key Findings

Köyceğiz-Dalyan's biodiversity supports a range of ecosystem services that contribute to the economic welfare of a range of beneficiaries and support local communities and Turkey's GDP. The total annual value of Köyceğiz-Dalyan SEPA is estimated to be around US\$51 million per year. This is considered a conservative estimate and represents an initial attempt to value some of the key ecosystem services provided by the site and needs to be refined through further study.

This value incorporates provisioning services - fish, regulating services - carbon sequestration, erosion control, and waste treatment, and cultural services - tourism and recreation. The values are gross estimates (that is cost have not been deducted) and some values are not yet 'captured', such as the benefits associated with carbon sequestration, and are therefore potential values. However, the estimate may be considered an underestimate in that conservative estimates have been used for example for tourism and a number of potentially important services are excluded. Ecosystems services thought to be present (or potentially present) at the site which cannot be estimated due to a lack of scientific information and/or data are - raw materials such

as natural medicines, genetic resources and ornamental resources, which have yet to be studied at the site; the role the marine environment plays in micro-climate regulation, the role of the marine environment in flood and storm protection, the site's heritage value and educational value and the site's landscape and amenity value.

Around 95% of the total value of the SEPA is attributed to tourism and recreation, highlighting the importance of sustainably managing the SEPA's marine and coastal natural resource base, upon which this value is dependent. Given that expenditure estimates and the value-transfer method has been used for determining the tourism value at the site, the estimate for tourism of US\$48.5 million per year clearly could be refined. Site specific evidence of tourist expenditures and willingness to pay is required, along with a better understanding of the number of visitors (both overnight and day visitors). The marine environment is also important in terms of employment and local livelihoods.

The site faces a range of pressures including marine pollution, infrastructure and housing development and illegal fishing activities, which if left unchecked could undermine the SEPA's important ecological assets.

Recommendations

The key recommendations of this study are provided below.

- The management plan for Köyceğiz-Dalyan SEPA needs to overcome bureaucratic and financial impediments to be effectively implemented.
- Fisheries in the SEPA need to be monitored economically, ecologically and biologically. Understanding the economics of fishing is key to the development of sustainable fisheries management plans. The valuation of fisheries should be based on a sustainable harvest rate (quantity) multiplied by revenues minus costs. Scientific studies of fish stocks are therefore required to determine sustainable harvesting rates. Sustainability of DALKO's fishing practices should be monitored more tightly, especially during the twice yearly migration of the targeted Mugil species.
- Tourism needs to be developed and managed in a way that complements that area's status as a marine protected area. A number of opportunities exist for developing the tourism experience in Köyceğiz-Dalyan SEPA, and hence contributing to the maximization of the long term revenues from tourism and recreation at the site. Recommendations include:

Table . Summary of valuation results for Köyceğiz-Dalyan SEPA

Service	Value/ year US\$	Valuation approach	Comment
Fish	1,399,167	Market prices	Value relates to traditional estuarine fishing in Köyceğiz. This is not based on a sustainable harvest rate, which is unknown. This is a gross value – costs have not been deducted. Marine fisheries and recreational fishing not included.
Carbon sequestration	54,226	Market prices (avoided cost approach)	Assumes development of market in blue carbon credits analogous to the forest carbon market. This value is therefore not currently 'captured'. Based on market price of carbon of US\$11.2 / tCO ₂ eq and 89 ha of Posidonia meadows.
Erosion protection	171,080	Value transfer	Mangos et al. (2010). Based on 160,000 Euro per meter of coastline, 8.75km of Posidonia beds and 9.4% of the area at risk.
Waste treatment	900,000	Value transfer	Based on Mangos et al. (2010) estimate for Turkey of 229 million Euros apportioned to the study site based on length of its coastline (24.38 km).
Tourism / Recreation	48,691,598	Market prices	Based on an estimate of 746,792 overnight visits per year and average tourism expenditure per person per night on food and accommodation (based on other Turkish MCPAs in Bann & Başak 2011a & 2011b). Day visitors and marina revenues not included. Includes daily boat tours (US\$2,851,200), one of the dive centers (US\$97,500) and rental fees (US\$397,688).
TOTAL	51,216,071		

- * A study of the site's marine and terrestrial tourism carrying capacity to understand the limits to tourism development in the area. This is particularly required for Dalyan straight, the lagoons and İztuzu beach.
- * Development of a tourism master plan / strategy for the SEPA taking the carrying capacity of the area into account. Development of the ecotourism sector will require a strategy and marketing of the SEPA's range of attractions and activities.
- * Better data collection on visitors is needed to assist planning efforts (visitor numbers, profile, motivation for visit). It is difficult to plan successfully without reliable estimates of visitor numbers, and these currently do not exist. Airlines and hotels could perhaps be utilized to collect this information for all the SEPAs in the Province.
- * Better signage and information for visitors and residents on the ecological and archeological importance of the area and its protection status. Everyone visiting the site should be aware that it is a protected area. This would help strengthen the area's image / brand and improve the quality of the tourism offering. Signage and information about the site should be available in two languages - Turkish and English.
- * A site specific survey is needed to generate information on tourist expenditure in the area. Given the importance of tourism to the site, a detailed economic impact study could also be considered.
- * Mass tourism threatens the sustainability of the natural resource base. Therefore boutique hotels / high quality tourism should be promoted in Dalyan; this will require better facilities and marketing.
- Economic valuation is underpinned by good scientific evidence. This is often particularly important for regulating services. Site specific scientific studies of the provision of regulating services (i.e. carbon sequestration, erosion control, flood and storm protection and waste assimilation) are required to better understand these services and inform the valuation.
- Valuation studies should be carried out in Köyceğiz-Dalyan's SEPA at regular intervals in order to observe changes in the value of benefits derived from the range of ecosystem services and the trade-offs that occur between these. Ideally valuation studies should look at different scenarios and thereby help choose between different management options for the area and cast light on the site's sustainability.

Introduction



2

This study is an activity under the General Directorate for Protection of Natural Assets (GDP-NA)-Global Environment Facility - United Nations Development Programme (GEF-UNDP) project 'Strengthening the Protected Area Network of Turkey: Catalyzing Sustainability of Marine and Coastal Protected Areas'.

The proposed long-term solution for marine biodiversity conservation in Turkey's territorial sea is a reconfigured Marine and Coastal Protected Area (MCPA) network designed to protect biodiversity while optimizing its ecological service functions. The success of this long-term solution is seen to rest on three main pillars: (i) the existence of key agencies capable of identifying and managing sensitive and biologically significant MCPAs; (ii) the application of economic analysis to inform the planning and management of MCPAs and the integration of sustainable financing mechanisms; and (iii) inter-sectoral co-operation that builds on the relevant strengths of various management agencies and branches of Government and civil society to solve marine biodiversity conservation challenges. This study relates to the development of the second pillar.

1.1. Objective

The objective of this study was to undertake an economic analysis of Köyceğiz-Dalyan Special Environmental Protection Area (SEPA) in order to:

- Raise awareness of the range of marine goods and services provided by the site;
- Contribute to the sustainable management of the site by highlighting pressures threatening the viability of key ecosystem services and the economic implications of this;
- Inform the business plan to be developed for the site by demonstrating the economic value of marine services and highlighting potential revenue generating activities and mechanisms.

It should be noted that other components of the GD-PNA-GEF-UNDP project under which this study sits are focused on the identification of feasible income generating options and the development of a business plan for Köyceğiz-Dalyan SEPA. Therefore this report is focused on the identification and evaluation of ecosystem services and only provides a high level discussion of potential financing mechanisms.

1.2. Approach

The economic assessment of Köyceğiz-Dalyan SEPA is based on a review of the available data and literature on the site, interviews with key stakeholders and data gathered through a site visit 16-21 March 2012. A list of people consulted is provided in Annex 1. A literature review of economic valuation studies of marine and coastal areas from the region was also undertaken to provide potential transfer values, benchmarks against which to assess values derived for the site and insights on valuation approaches. The study should be viewed as a high level initial economic analysis of the area, which identifies key ecosystem services provided by the site and prioritizes areas for future research and refinement of the economic estimates presented.

The available literature includes extensive research on the site's marine and coastal biodiversity, conducted by SAD¹ between September-October 2010 on behalf of General Directorate for Protection of Natural Assets (GDPNA). This SAD study focuses on bio-ecological research at depths of 0-50m, physical assessments of the marine environment and surveys with the local fishermen. Another important study of Köyceğiz-Dalyan SEPA is the terrestrial biodiversity assessment conducted by Çınar Mühendislik (2007) between 2005 and 2007. This study developed a terrestrial management plan for the site (completed in 2007). It focused on the terrestrial conservation and management priorities of the site including key ecosystems, flora and fauna, the socio-economic aspects of local communities interacting with the natural systems and the historical/cultural heritage of the MCPA.

Other research initiatives led by GDPNA have concentrated on specific species such as sea turtles, sweet gum trees, otters, salamanders and on water monitoring and have been taken into account in the analysis. However, the economic analysis relies to a greater extent on the relatively recent data generated in the marine and coastal biodiversity assessment for the site (SAD, 2010) as well as the background research related to the terrestrial management plan (Çınar Mühendislik, 2007).

An Ecosystem Service Valuation Framework was developed for the economic assessment, which provides a comprehensive list of marine and coastal services provided at the site (see Section 3). This framework provides the basis for understanding the range of benefits provided by the marine ecosystem and the pressures that they face.

1.3. Layout of report

The rest of this report is set out as follows: Section 2 provides an overview of the site and the pressures that it faces plus available information on the socio-economic characteristics of the area; Section 3 presents the marine ecosystem services typology and a qualitative assessment of the services provided by the site; Section 4 presents the valuation of individual ecosystem services where the required bio-physical and monetary data is available; Section 5 discusses potential financing mechanisms; and, section 6 concludes. Annex 1 lists the people interviewed during field visits in March 2012.

¹ SAD is a Turkish NGO, which specialises in the research and protection of marine and coastal habitats.

Background on site



Köyceğiz-Dalyan SEPA, one of the biggest coastal wetlands in Turkey (Çınar Mühendislik, 2007), gained its protection status in 1988 by the Decree of Cabinet of Ministers number 88/13019 (ibid). A terrestrial management plan for the site was prepared in 2007, however appropriate finances need to be secured before it can be implemented. Parallel to this terrestrial management plan, town development plans for the SEPA have been approved by the GDPNA and are being implemented.

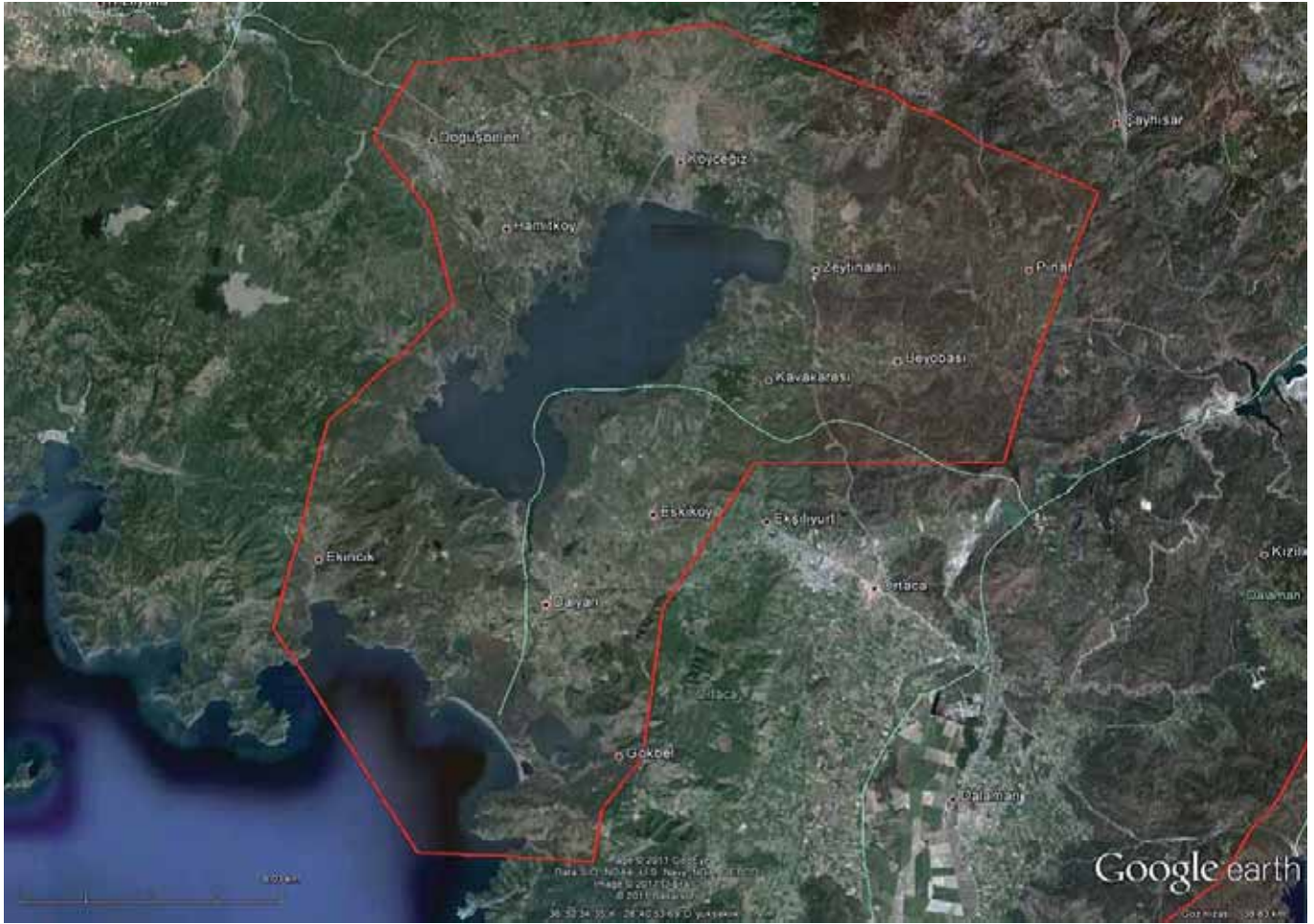
The SEPA covers about 461.5 km² of which 32.8 km² is marine surface (SAD, 2010). Köyceğiz Lake expands to some 55.8 km². The length of the SEPA's coastline is 24.38 km and sea depth remains less than 100m (SAD, 2010). The majority of the coast (74.4%) is rocky, the rest is sandy. In total the SEPA has 7 km of sandy beaches (most notably İztuzu Beach) (ibid).

Köyceğiz-Dalyan Special Environmental Protection Area (SEPA) is located in the transition zone between the Aegean and the Mediterranean Seas and consists of a wide mixture of geographic features such as freshwater lakes, lagoons, marshlands, canals and coastlines (Çınar Mühendislik, 2007). The SEPA is situated within Köyceğiz and Ortaca districts' boundaries in the Muğla Province, about 75 km away from Muğla town center and consists of Köyceğiz town, 4 sub-districts and 13 villages annexed to it (Keskin et al., 2011).

Figure 1 illustrates the boundaries of Köyceğiz-Dalyan SEPA and the settlements that are within the MCPA.

The area is composed of various geographic structures around Köyceğiz Lake, namely Dalyan wetlands and delta, Sülüngür, Ala, and İztuzu Lakes as well as the sandy İztuzu Beach (Çınar Mühendislik, 2007). Köyceğiz Lake, geologically a bay tied to the sea, was disconnected from the sea with the sedimentation of Dalaman river and is fed by several freshwater sources (ibid). It covers around 5,400ha and is surrounded with plains in the northeast and southeast and hilly areas in other parts. The delta waters expand to about 150ha and are semi-saline with an alternating current between the delta to the sea twice a day. In the south of Köyceğiz Lake there is a fault line stretching along a northwest - southeast direction, along which various thermal water springs are found - Sultaniye, Çavuş and Gel Girme (Keskin et al., 2011).

Figure 1. Köyceğiz-Dalyan SEPA boundaries (Source: GDPNA)



Ecological Overview

The dominant vegetation in Köyceğiz-Dalyan SEPA (about 45% of the site) is red pine and sweet gum forests, bushes and brush woods belonging to shrubs and “frigana” family. The areas around the Köyceğiz Lake are covered with grassy plants growing in wet and barren areas. Sand dune vegetation is dominant on the coast (Çınar Mühendislik, 2007).

Köyceğiz Lake is an important wetland both in terms of fish and birds and a candidate Ramsar site (Çınar Mühendislik, 2007). The surroundings of the lake, canals and forests provide reproduction and sheltering places for a range of animals. Various bird species such as Coot, Stark, White-breasted Kingfisher, Sparrow, Reed Warbler, Gull-billed tern, Short-toed Eagle, Bee Eater, Sea Gull, Glossy Ibis, and Little Egret use the area for wintering and incubation.

The terrestrial biodiversity study of the site assessed 1,700 different plant species belonging to 110 Families, 470 Genus, 924 species and sub-species (Çınar Mühendislik, 2007). Of these, 81 endemic and 20 rare plants have been identified based on IUCN criteria (rate of endemism 8.65%). Some of the important endemics in the region are Oriental sweetgum tree (*Liquidambar orientalis*), a cyclamen species (*Cyclamen trochopteranthum*), Forbes' Fritillary (*Fritillaria forbesii*) and sea daffodil (*Pancreatium maritimum*).

In Köyceğiz-Dalyan SEPA, a 286 hectare zone has been set aside as a nature reserve and arboretum for the preservation of the sweetgum (*Liquidambar*) which is a relict endemic taxon from the Tertiary geological period (Wikipedia, 2012). Köyceğiz-Dalyan SEPA is considered to be the area providing the greatest expansion of this rare endemic species (Çınar Mühendislik, 2007). Special

management measures and conservation initiatives have been put in place for the Liquidambar forests. GDPNA prepared an action plan for the species in 2008 by assessing the ecological situation of the species as well as the land ownership in the existing forests. In collaboration with MoF-WA, a national NGO - Doğa Koruma Merkezi, has been leading a conservation project since 2009 that aims to ensure forest sustainability by replanting corridors between dispersed segments in order to increase the total forest area to 1,000 hectares in the region. The project also aims to promote eco-tourism in the region by highlighting the ecological and cultural aspects of the sweetgum forests (Doğa Koruma Merkezi, 2012).²

Ornithological research at the site revealed 96 bird species belonging to 25 Families. Three species, namely Ferruginous duck (*Aythya nyroca*), Roller (*Coracias garrulus*), and Krüper's Nuthatch (*Sitta krüperi*) are under the Near Threatened category (ibid). Other avifauna species of importance recorded historically at the site are Black Francolin (*Francolinus francolinus*), Smyrna Kingfisher (*Halcyon smyrnensis*), and Pygmy Cormorant (*Phalacrocorax pygmeus*).

The freshwater ecosystems within the SEPA also host a very rich variety of biodiversity: 50 freshwater fish species were identified during the Çınar Mühendislik research (2007), a figure much higher than other coastal lagoons in Turkey such as Güllük (8 species) and Homa (24 species).

Various coastal ecosystems are juxtaposed in Köyceğiz-Dalyan SEPA; namely rocky shores, sanddunes, rocky reefs, cave/cavity formations, and coastal marshlands that form a wide range of habitat types (SAD, 2010).

The coastal sandunes of the SEPA are one of the most important reproduction areas for Loggerhead sea turtles (*Caretta caretta*) in Turkey. These turtles are a highly threatened (see Box 1). An extensive project has been developed to protect the sea turtles and their reproduction area at the mouth of Dalyan and İztuzu beach. The coastal area is used intensively and the site's management allows use by people during the day time, but not at night (especially during the turtles' spawning season).

Box 1. Conservation of Dalyan's Loggerhead sea turtles: a Milestone in Turkey's conservation history

The Loggerhead sea turtles (*Caretta caretta*) are hard-shelled marine turtles whose persistent population decline globally have rendered them a conservation flagship species. Loggerheads have been listed as Endangered in the IUCN Red List of Threatened Species since 1996. In Turkey, 450-900 *Caretta caretta* individuals are estimated to exist and Dalyan İztuzu beach is considered to be one of the most important nesting sites in the country.

The attractiveness of the unspoilt, sandy İztuzu beach was subject to a state supported mass tourism development plan at the end of 1970's. Through the mobilisation of individual and institutional activists starting in the mid 1980's, this development project received national and international opposition especially due to the potential negative impacts on the turtles' nesting grounds. As a result, Dalyan became the first nature conservation success in Turkey, leading eventually to the formation of the Environment Protection Agency for Special Areas under the Turkish Prime Ministry (the current GDPNA). In 1988 the Turkish Government declared Dalyan Beach and its sea turtles protected.

The conservation of the loggerhead sea turtles has since been a well-monitored scientific activity by different NGOs and academic institutions. It has also increased the popularity of the region, leading to a tourism boom in Dalyan in early 1990's. The Sea Turtle Research, Rescue and Rehabilitation Centre, located on İztuzu beach is run by Pamukkale University. The centre is supported by the Municipality which provides electricity, water and waste collection. The June Haimoff Sea Turtle Foundation was established in 2010 and is focused on the conservation of the Loggerhead sea turtles.

While there is no quota on tourist numbers on İztuzu beach, Professor Erdal Özhan of Med Coast Foundation believes it is one of the best managed turtle beaches in the Mediterranean. Unfortunately, in recent years feeding the sea turtles has become a popular tourist attraction offered by day boat excursions.

Sources: IUCN 2012, DEKAMER 2012, Özhan 1990 & personal communication with June Haimoff & Prof. Dr. Erdal Özhan

The SAD study identified a total of 106 marine species during its biological assessment dives for the MCPA. Of these species, 20 are marine plants; 3 of which are Phanerogamae (with flower) and 17 Cryptogamae (Algae, no flower). The remaining 86

² The NGO has been engaged in awareness raising and fundraising activities for realizing community stewardship and replanting of the sweetgum trees. See for instance: <http://www.globalgiving.org/pfil/9461/projdoc.pdf>

species belong to 14 Porifera (sponges), 3 Cnidaria, 1 Ctenophora, 3 Annelidae, 3 Crustacea (shell fish), 15 Mollusca, 7 Echinodermata, 38 Pisces (fish) and 1 Reptilia group (SAD, 2010).

Furthermore, a total of 160 macro benthic and nektonic animal species and 122 planctonic and macro benthic plant species have been identified in the MCPA characterizing a typical Mediterranean coastal ecosystem which is tied to a lagoon system.

2.1. Pressures

Historically, the terrestrial landuse and city planning works prepared for Köyceğiz-Dalyan SEPA by GDPNA resulted in a relatively slow paced development of tourism and housing in both Köyceğiz and Dalyan (Çınar Mühendislik, 2007). However, private housing developments are on the rise in Dalyan town, leading to the conversion of productive farmlands. A town plan was developed for Dalyan in 1986, and was slightly revised when the area was declared a SEPA. The town is surrounded by top quality agricultural land. Pomegranates and citrus fruits are now being promoted. To protect this valuable agricultural land, by law only 5% of an individual's land area can be built up, to a maximum of 250m². That is 95% of the land is intended to remain available for agriculture. However, land is being purchased by foreigners, who build big villas in the middle of the site and convert the rest of the area to lawn / swimming pool (personal communication Professor Erdal Özhan of Med Coast Foundation³). Köyceğiz town's expansion has somehow been limited by the surrounding Liquidambar forests as well citrus plantations on its West (Çınar Mühendislik, 2007). On the other hand, Ortaca settlement, which became a district of Muğla in 1987, has seen a relatively high increase in population, housing, light industry and commerce development.

Some of the most pressing pressures at the site concern the water regime of the wetlands, which is also connected to the marine and coastal environment.

Agricultural practices in the larger water basin, which are dominated by citrus plantations, are polluting the receiving ecosystems. Köyceğiz Lake, as an extremely enclosed water body, is very vulnerable to pollution. The reduction of the sweetgum forests' original coverage (due to overuse, animal husbandry and conversion of the forests for agricultural purposes), tree felling in the upstream and interventions to the water courses feeding the Köyceğiz Lake (i.e. dredging for sand extraction) have led to substantial flood damages in the SEPA especially in the winter of 2012. Similarly, habitat fragmentation occurs in the reed beds of the SEPA, which are being burnt on purpose or converted to agricultural land (Çınar Mühendislik, 2007).

An important pressure facing the protected area is the amount of boat traffic that the lagoon systems are subject to especially during the high season. According to the GDPNA Köyceğiz headquarters' data, there are 491 boats that are registered both in Dalyan and Köyceğiz and an additional 40 to 50 illegal boats are estimated to operate in these two settlements (TVKGM 2012b). Since the lagoon system is very inter-connected, the ever-increasing number of boats can cause a lot of damage to both the estuarine and lake ecosystems.

Table 1 provides an overview of the pressures facing the site.

2.2. Socio-economic characteristics of site

This section is based on the socio-economic information of Köyceğiz-Dalyan SEPA provided in Keskin et al. (2011) and Çınar Mühendislik (2007). Based on the 2009 census of the relevant districts and villages that fall within the Köyceğiz-Dalyan, the SEPA has a total population of 31,465 people which is equally distributed between women and men (TUIK, 2010). The unemployment rate is 4.3% in the region and the literacy rate is 98% for the town and villages. Socio-economic indicators are provided in Table 2 for Köyceğiz and Ortaca Towns.

³ MEDCOAST (Mediterranean Coastal Network) was founded in the early 1990s by Professor Erdal Özhan of the Middle East Technical University, Ankara. In 2007 it became a recognised institution in coastal management for the Mediterranean and Black Sea.

Table 1. Overview of Pressures in Köyceğiz-Dalyan SEPA (Source: SAD (2010), Çınar Mühendislik (2007), Keskin et al. (2011), and field interviews)

Pressure	Description	Policy Driver / Context	Sector Responsible
Unsustainable and / illegal fishing	Studies on the fishing practices taking place in the lagoons of the SEPA raise concern about the sustainability of mullet harvesting. They suggest that 70% of the grey mullets trapped in the fish barriers have not reached sexual maturity (Çınar Mühendislik, 2007). It has been reported that DALKO falls short of complying with the minimum 30cm catch size determined for the species. Illegal fishing is reported in the marine environment and in Köyceğiz Lake as well. It is prohibited to use fish lines in the lake but this type of fishing does occur. Illegal trawlers have been spotted within the confines of the SEPA, especially in Ekinçik Bay and during the winter months by boats coming from the Black Sea, Çanakakale and Izmir.	- Distance of the relevant Coastal Guards (nearest ones are in Göcek and Marmaris) to the SEPA prevents timely interventions. - Lack of self control mechanisms or external monitoring of DALKO fishing practices	Fishery
Intensive use of the lagoons by the daily excursion boats	There are around 600 boats of different types that make use of the lagoon and delta systems in Dalyan during the high season. 491 of these are legally registered according to GDPNA. This creates an immense pressure on the lagoon system. The boats play loud music causing the fish stress.	The inspection commission (consisting of relevant public authorities and private stakeholders) for the Regulation of Boats working in Köyceğiz Lake & Dalyan Canals, does not adequately monitor and intervene to prevent / minimise pressures.	Tourism
Anchorage	Posidonia beds in some parts of the SEPA are affected by boat anchors. In Ekinçik Bay and around Delikada where boating activities are intense the Posidonia meadows have become patchy and are unable to form mats.	Ineffective control of boat anchoring and monitoring	Fishing, Tourism
Seasonal intense use of marine and coastal areas by yachts and tourists	Even though coastal use in Ekinçik Bay remains relatively low, there is a high overnight yatching use in the bay especially during the high season. Similarly, the daily use of the Iztuzu Beach and the delta by the boat tours as well as daily visitors become excessive in the summer and has negative effects on both the wetland and sand dune ecosystems.	The wetlands and marine zones' usage in the SEPA have not been defined under any management plan or protocol. Iztuzu Beach's capacity has been increased by GDPNA.	Tourism
Waste water sewage	Köyceğiz Lake, rivers, Dalyan Canal, Dalyan mouth and the sea are vulnerable to pollution. About 2/3rds of Köyceğiz district's sewage system has been finalised (54km of waste canals). Since 2002, the waste water treatment plant which is operated by the Köyceğiz-Dalyan Environmental Protection Union, only functions at 50% capacity with a daily average of 1,500-2,000 m ³ treated. Wastewater networks of Beyobası and Toparlar villages have not been completed and the reuse of organic wastes is failing to decrease domestic pollution. Çandır village also lacks treatment infrastructure. Köyceğiz catchment is an extremely closed body with only one discharge point at the Dalyan canal increasing the risk of eutrophication due to agriculture.	- Inefficient municipality infrastructures/lack of finances. - Lack of consistent surface water, ground water and marine pollution monitoring.	Tourism Households
Use of agro-chemicals	Use of agricultural chemicals (especially by the citrus plantations) and aquaculture inputs from trout farms in Yuvarıakçay and Narnam rivers affect the water quality of the Köyceğiz Lake.	- In the 1990's, subsidies were in place for citrus production - Natural forests of the SEPA are not organized as apiculture zones; pine trees are cut before new production areas are formed and quarries are not being kept away from the forests. - Integrated pest management systems are not in place.	Agriculture, Aquaculture & industry
Increasing developments	Property investments are popular in Dalyan putting pressure on the coast and other natural and semi-natural/agro-ecosystems. Increasing numbers of private villas are being constructed in the sub-district. Some illegal constructions in the state treasury lands of Zeytinalan are also evident.	The town plan of Dalyan was prepared in 1988 when the population was 3,000 people with a target of 20,000 people. Currently the same plan is in implementation and contradicts the conservation objectives for the site.	Tourism Households

Table 1. Overview of Pressures in Köyceğiz-Dalyan SEPA (Source: SAD (2010), Çınar Mühendislik (2007), Keskin et al. (2011), and field interviews)

Pressure	Description	Policy Driver / Context	Sector Responsible
Illegal hunting	Illegal hunting activities are an important problem in Köyceğiz Lake as well as the terrestrial zones of the SEPA such as Hamit, Sultaniye and old Köyceğiz villages. The Köyceğiz Wildlife Conservation and Development site, managed by Muğla GDNCNP and targeting the conservation of wild goats, is subject to illegal poaching activities. Illegal hunting of the birds also takes place in the reed beds around the lake.	Insufficient control mechanisms to prevent illegal poaching (i.e. wild boars) and hunting	Households
Invasive species	An alien marine species to the Mediterranean, <i>Halophila stipulacea</i> dominates 0.08 km ² of marine zone (in other words 2.1% of the total marine area of the SEPA). The species is particularly present in the Southern section of the SEPA in Kargıcak Bay where it replaces the native <i>Posidonia oceanica</i> communities. Two alien fish species, <i>Fistularia commersonii</i> and <i>Lagocephalus scleratus</i> are carnivorous predators feeding on young fish posing a serious pressure on native species. The introduction of <i>Tilapia zilli</i> in Köyceğiz Lake is reported to have virtually annihilated the native carp (<i>Cyprinus carpio</i>).		Commercial boating/ navigation
Disruption of natural water-flow regime in the Dalyan wetlands and Yuvarlakçay	Threats such as drainage tunnels, construction of dams and withdrawal of excess water from the system are prominent in the coastal wetlands and groundwater resources of the protected area. These jeopardize the future of the Köyceğiz Lake as a Ramsar site candidate as well as the integrity of the endemic sweetgum forests. A dam is planned on Yuvarlakçay, one of the most important rivers whose source is within the SEPA.	<ul style="list-style-type: none"> - Differing management regimes of the public authorities in a single zone leading to contradictory and even conflicting use of the natural resources. - Ineffective water use in agriculture such as surface irrigation - Lack of economic incentives for farmers to adopt drip irrigation 	Agriculture, construction
Increased fragmentation of the sweetgum forests and reed beds locally	The endemic Anatolian sweetgum forests (<i>Liquidambar orientalis</i>) are near the settlement areas in the SEPA. They are disrupted by leisure areas, converted to agricultural fields, utilized excessively and overgrazed. If exploitation of these forests continues, the species will lose its most important population in the country. Furthermore, habitat fragmentation is also observed in reed areas which are set on fire intentionally to be converted to agricultural fields.	Lack of awareness on the species' rarity (i.e. lack of information boards or visitor center). Ineffective implementation of the sweetgum action plan including its monitoring.	Agriculture, Households, Tourism
Increasing siltation of the lake	Erosion resulting from felling activities in the upstream surface water bodies is reported to increase the lake's water level year by year. This may be further increased by the dredging of these streams for sand extraction.	<ul style="list-style-type: none"> - Lack of integrated watershed management practices that would include the downstream Köyceğiz Lake and Dalyan lagoons - Lack of collaboration between the relevant public authorities (such as MoEU & MoFWA) 	Forestry, agriculture, mining
Feeding of marine and freshwater turtles as a tourist attraction	Some of the boat operators in the SEPA (especially in Dalyan) offer tours that provide the opportunity to hand feed the turtles. This activity disrupts the natural feeding habits of the species. In some cases blue crab is being fed to the turtles, but they are also being fed chicken skin, which is causing a skin disease.	- Lack of implementation of proper conservation measures	Tourism

Table 2. Socio-economic profile of Köyceğiz and Ortaca Towns (source: Çınar Mühendislik, 2007)

	KÖYCEĞİZ	ORTACA
Population	29,196	35,670
Urbanization rate (%)	25.77	47.44
Population Growth Rate (%o)	12.22	19.71
Population Density	18	121
Population Density Ratio (%)	52.82	43.15
Average Household Size	3.81	3.51
Agriculture Sector Employees Ratio (%)	71.80	54.21
Industry Sector Employees Ratio (%)	3.16	5.04
Services Sector Employees Ratio (%)	25.04	40.75
Unemployment rate (%)	3.05	7.37
Ratio of literates (%)	89.65	92.01
Infant Mortality Rate (%)	39.58	36.12
Per Capita Income (TL)	92,997	109,628
Share of Tax Revenues(%)	0.01414	0.02410
Share of Agricultural Production (%)	0.11266	0.15998

Köyceğiz is a farming town producing citrus fruits, olives, honey and cotton. Unlike other areas, this region is also famous for its sweetgum (Liquidambar) trees which have economic value through the extraction of storax oil used in cosmetics. Other economic activities include greenhouse farming and cattle-grazing. The region around Dalyan is a highly fertile and productive agricultural zone. Cotton is grown intensively along with many varieties of fruits and vegetables. In recent years, cotton is being replaced by pomegranates (especially in Dalyan) due to the fact that it is less labor intensive and has a higher economic value than other products. Table 3 summarises the distribution of the agricultural products in the area.

In terms of land use, 64% of land in Muğla consists of forest and brush, 19% is agricultural land, the rest is non-farm area, pastures and meadows (Keskin et al. 2011). Most of the villages in Muğla region are located within forests and the villagers gather forest products either for trading or household use. The most important non timber forest products collected to augment cash incomes are honey and herbal products such as oregano and laurel leaves. There is one cooperative that collects oregano and laurel in Toparlar Village, Köyceğiz.

Table 3. Distribution of agricultural products in Köyceğiz and Ortaca districts (source: Çınar Mühendislik, 2007)

Product	Ortaca District (da)	Köyceğiz District (da)	TOTAL (da)
Cotton	28,763.2	940.2	29,703.4
Lemon	20,890.5	220.3	21,110.8
Orange	10,920	15,102.3	26,022.3
Wheat	5,490.2	2,370.3	7,860.5
Corn (silage)	5,328.8	1,027.5	6,356.3
Olive	3,915.9	1,989	5,904.9
Corn (Grain)	1,992.9	1,017.2	3,010.1
Pomegranate	2,609.4	0	2,609.4
Tomato	1,532.3	55	1,587.3
Watermelon	735.3	0	735.3
Sesame	608.9	1,420	2,028.9
Melon	370.8	0	370.8
Barley	316.6	151.4	468
Grapefruit	275.7	0	275.7
Lupine	183.3	0	183.3
Millet	155.7	0	155.7
Vetch	129	109.7	238.7
Eggplant	73.9	0	73.9
Clover	62.7	0	62.7
Beans	0	74.9	74.9
Mandarin	0	1,307.1	1307.1
TOTAL	84,355.1	25,784.9	110,140

However, due to mismanagement, the cooperative went bankrupt and is now trying to recover. There are 4 Agricultural Development Cooperatives, 2 Irrigation Cooperatives and 1 Fisheries Cooperative in Köyceğiz. There are 4 olive oil production facilities; 3 in Ekincik, 1 Zeytinalanı. Corn is to most prominent production crop in the region. Sesame is also produced.

The agricultural production areas are in Beyobası village and in Toparlar and Zeytinalanı (Çınar Mühendislik, 2007). According to data obtained from the briefing reports of the District Directorates of Agriculture of 2006, 58% of land in Köyceğiz is dedicated to the production of oranges. Köyceğiz is the largest producer of citrus fruits in the Aegean region (reportedly accounting for 70% of regional

production), which are mainly exported (personal communication with Salih Erbay). Lemons, oranges, grapefruit and tangerines are the main agricultural exports, followed by pomegranate and tomato. Most exports are made to Russia, France, Germany and Romania. The region's Mediterranean climate is suitable for tomato production, and 41,630 tons of tomatoes are produced per year.

Historically sweetgum trees have been important economically in the region through the production of storax (sweetgum oil). Sweetgum forests currently cover 209 ha of private and 383 ha of state land in the SEPA (19 ha in Ortaca, 200 ha in Köyceğiz, 16.5 ha in Sultaniye and 167.5 ha in Beyobası). An estimated 19 tons of oil was produced in the 1980s; falling to between 1-2 tons in the 1990s, 4,198 kg in 1999 and 3,286 kg in 2000 and 5,284 kg in 2001. This decrease in production can be explained both by the replacement of storax with a synthetic equivalent since early 2000's and the ban on the trees' felling as well as oil extraction put in place⁴ due to the fragmentation of the Liquidambar forests on account of pressures from agricultural land conversion and the related drainage of their root systems (Ürker & Yalçın, 2011). In 2002 and 2003 the annual production in the region was around 2,000 kg (ibid).

In addition to farm and resource-based production activities, several households are also involved in other income generating activities such as trading within the village, hiring out services (skilled labour) and work in the tourism sector.

During the preparation of the terrestrial management plan, household interviews were conducted in the following settlements of the SEPA: Köyceğiz district center, Dalyan, Beyobası and Toparlar

municipalities and selected villages. A total of 365 socio-economic surveys were conducted in the SEPA (Çınar Mühendislik, 2007). This research determined that the average household consists of 3.7 people with an average income level of 1,200 TL (in 2007 figures); higher than the median household income in Turkey of 800 TL/month (OECD, 2011). More than 35% of the interviewees are employed in the agricultural sector, 11% in temporary jobs, 10% in commerce, 5% in fixed jobs, 5% live off rental income, and 1% are involved in fisheries. It is noted that households have more than one income source in Köyceğiz-Dalyan SEPA (ibid) with people changing their main occupation in accordance with the season.

About 40% of the interviewees had attained a primary education, 30% highschool/technical school and 18% were university graduates. Overall 87% of the interviewees were literate, which is lower than the regional rate. The majority of the interviewees were in the 35-59 age group followed by the 25-34 ages cluster, with the least populated age category being the 25-59 age group.

The findings of the socio-economic study suggests that Köyceğiz-Dalyan region receives migration from bigger cities such as Ankara, İstanbul and İzmir, smaller provinces such as Amasya, Afyon, Muş as well as other nearby towns such as Marmaris, Dalaman and Dalyan. Foreigners also come to settle to the region. Often new-comers are retired and attracted to the natural features of the region. The main groups benefiting from the site's SEPA status are people engaged in tourism, fishing and boat operators (who are typically from Köyceğiz district center and the other municipalities, rather than rural villages) (ibid).

⁴ In 2008, MoFWA launched the Liquidambar Action Plan with the collaboration of GDPNA and relevant NGOs.

Qualitative Assessment of Ecosystem Services



3.1. Marine Ecosystem Services Typology

A typology of marine and coastal ecosystem services has been developed for this study following the ecosystem service approach (ESA), which is based on the Millennium Ecosystem Assessment (2005) classification of ecosystem services into the following four categories:

- Provisioning services relate to the tangible products, such as fish and pharmaceuticals, provided by marine ecosystems;
- Regulating services refer to the marine environment's natural processes such as waste assimilation and carbon sequestration that contribute to social wellbeing;
- Cultural services may be associated with both use and non-use values and relate to the non-material benefits obtained from ecosystems, for example, through tourism and educational use of the marine environments; and,
- Supporting services are necessary for the production of all other ecosystem services (e.g. soil formation or nutrient cycling). They differ from the other services in that their impacts on people are either indirect (via provisioning, regulating or cultural services) or occur over a very long time.

The ESA explicitly recognizes that ecosystems such as marine environments and the biological diversity contained within them contribute to individual and social wellbeing. Importantly it recognizes that this contribution extends beyond the provision of goods such as fish to the natural regulating functions of marine ecosystems such as carbon sequestration. The ESA therefore provides a framework for considering whole ecosystems in decision making and for valuing the services they provide.

It is important to note that economic valuation is focussed on the 'final benefits' or 'outcomes' realised by society from the services marine ecosystems provide, not the services and functions that contribute to those outcomes. This is to avoid double counting. The benefits generated by supporting services, while fundamental to the provision of final benefits, are not valued independently as they are intermediate benefits which contribute to the provision of a range of final benefits. Their value is captured in the valuation of the final outcomes associated with the services they support. Supporting

services include soil formation and retention, primary production and habitat provision⁵.

Health is also not explicitly listed as an ecosystem service as health benefits are considered to be provided by a range of services such as fish, flood protection benefits and a clean environment for recreation. The health cost associated with a deterioration in these services may be used to measure the benefits provided by the marine ecosystem. Biodiversity is also considered to be cross cutting, the final benefits of which could be associated with a range of services. An exception is biodiversity non-use which is listed as a separate service.

Table 4 provides a typology of marine ecosystem services and a qualitative assessment of the marine ecosystem services provided at Köyceğiz-Dalyan SEPA. Each ecosystem services has been rated as follows: ‘**’ means that the service is important, ‘*’ means that the service is provided, ‘-’ means the service is not relevant at the site, and ‘?’ means that there isn’t enough information to determine whether the services is present or not, so its provision is uncertain. Table 4 also identifies the sectors that are supported by (or benefits from) the provision of each ecosystem service and the sectors that can influence the quality and quantity of that service.

The typology presented in Table 4 does not include marine sub-habitat types, which can include hard beds, rocks, muds, sands, gravels, seagrass meadows and caves. The extent of services provided will depend on the specific sub-habitat type. The available data at Köyceğiz-Dalyan SEPA did not warrant this level of detail, with the exception of the *Posidonia* meadows (seagrasses) which form an important input into the economic valuation. In support of this approach Austen et al., 2010 states that in the case of the marine environment the spatial data are less essential, as most marine environments deliver most marine ecosystem services, albeit to differing amounts.

⁵ Many marine organisms provide living habitat through their normal growth, for example, reef forming invertebrates and meadow forming sea grass beds. ‘These ‘natural’ marine habitats can provide an essential breeding and nursery space for plants and animals, which can be particularly important for the continued recruitment of commercial and/or subsistence species. Such habitat can provide a refuge for plants and animals including surfaces for feeding and hiding places from predators. Living habitat plays a critical role in species interactions and regulation of population dynamics, and is a pre-requisite for the provision of many goods and services’ (Beaumont et al., 2007).

3.2. Provisioning services

3.2.1. Food

The main food product provided by Köyceğiz-Dalyan SEPA is fish. Due to the dynamic geographic composition of the Köyceğiz-Dalyan SEPA lagoons, both marine and freshwater fish species are harvested in the region.

3.2.2. Raw materials

These products relate to the extraction of marine organisms for all purposes other than human consumption. Marine raw materials include seaweed for industry and fertilizer, fishmeal for aquaculture and farming, pharmaceuticals and ornamental goods such as shells. The provision of genetic resources, natural medicines and ornamental products at the site is unknown.

3.3. Regulating services

3.3.1. Regulation of GHGs

A key service provided by marine ecosystems is their capacity to sequester carbon dioxide. The ocean is estimated to hold about one third of all anthropogenic CO₂ emissions and has two interconnected CO₂ absorption circuits: the biological pump and its physico-chemical counterpart. At the global level, the latter has been responsible for most of the capture of CO₂ of human origin, while the biological pump is consider still be working as it did before the dawn of the industrial age (Nellemann et al., 2009). The sequestration of CO₂ emitted by human activities by the physico-chemical pump (through a process of solubility), shows little dependence on ecosystem quality. However, it 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 initiatives currently underway (Orr, 2009) and a European research programme including the socio-economic consequences is set to be launched in the near future.

At the local level, the flow of carbon from the surface towards the sediment depends on biological processes, which in turn depend on ecosystem quality (and does not lead to the acidification of the environment).

Table 4. Qualitative assessment of marine ecosystem services and benefits at K yceđiz-Dalyan SEPA

ES Type	Service	Benefit / outcome	Significance	Sectors supported by ecosystem service	Sectors impacting / influencing the provision of ecosystem service
Provisioning Services	Food	Commercial and subsistence fish and wildlife	**	Households, Fishery, Tourism	Households, Fishery, Agriculture, Industry
	Fibre/materials	Fibre and construction products, e.g., reeds, and aggregates	*	Households, Industry (construction materials)	Households, Industry
	Water	Public water supply, water for industrial and agricultural usage	**	Agriculture, Industry, Tourism	Agriculture, Industry, Tourism
	Natural medicines	Natural medicines (sweetgum oil)	*	Household	Households, Fishery, Agriculture, Industry
	Biochemicals	Biochemicals and genetics	?	Agriculture	
	Ornamental resources	Ornamental resources	?	Industry	
	Source of energy (fuel etc)	Energy provision e.g., hydropower	-	Energy	
	Transport	Commercial use of waterways	*	Industry	
Regulating Services	Regulation of GHGs	Carbon sequestration	*	Potentially all	Potentially all
	Micro-climate stabilization	Air quality	*	Potentially all	
	Water regulation (storage and retention)	Flood and storm protection	**	Tourism, Industry, Households/ Urban Settlement, agriculture	
	Waste processing	Detoxification of water and sediment / waste	**		
	Nutrient retention	Improved water quality	*	Fisheries, Agriculture	
Cultural Services	Spiritual, religious, cultural heritage	Archaeological ruins (historical not recreational value). Use of marine environment in books, film, painting, folklore, national symbols, architecture, advertising	**	Tourism, Households	
	Educational	A 'natural field laboratory' for understanding marine and coastal processes	**	Households	Potentially all
	Recreation and ecotourism	Recreational fishing, birdwatching, hiking, canoeing, Holiday destination (aesthetic views, hot springs), archaeological ruins (historical not recreational value)	**	Tourism	Potentially all
	Landscape and amenity	Property price premiums due to views	**	Tourism	Potentially all
	Biodiversity non-use	Enhanced wellbeing associated for example with bequest or altruistic motivations	*	Potentially all	Potentially all

Code: ** service important, * service provided, - service not relevant, ? uncertain of provision

About 35-50% of the carbon production of the coastal ocean is estimated to be a result of the photosynthesis by marine macrophytes including seagrasses (Duarte & Cebrian, 1996). These marine plants have a global average biomass of about 180 g C m⁻² and an average net production of about 400 g C m⁻² yr⁻¹, ranking amongst the most productive ecosystems in the biosphere (The Encyclopaedia of Earth, 2011).

In the Mediterranean the matte (sheaths and rhizomes) produced by the *Posidonia* meadows store a carbon flow, which has been estimated at 1.2 million tonnes of carbon per year (Pergent, 1997). Thus the preservation or restoration of these coastal ecosystems contributes to the sustainability of this ecosystem service. The Mediterranean *Posidonia* accumulates in its subsurface large quantities of organic material derived from its roots, rhizomes and leaf sheaths embedded in often sandy sediments (Lo Iacono et al., 2008). These organic deposits can reach up to several meters as they accumulate over thousands of years forming what is known as matte, whose high content in organic carbon plays a crucial role in the global carbon cycle (ibid). *Posidonia oceanica* is considered to be one of the most extensive coastal reservoirs of CO₂ because of the preservation of this matte along the Mediterranean coasts over time (Duarte et al., 2005). This in-situ accumulation of large quantities of biogenic materials over millennia is an important ecological phenomenon and occurs only in few ecosystems such as peats, coral reefs and mangroves besides seagrass meadows (Mateo et al., 1997).

Despite their global importance, there is growing evidence that seagrasses are experiencing an unprecedented level of damage and deterioration (Orth et al., 2006). It is estimated that seagrass meadows are being lost due to anthropogenic ecosystem impacts at a rate of up to two football fields per hour, roughly similar to tropical rainforest conversion (Unsworth & Unsworth, 2010).

Seagrass communities (*Posidonia oceanica*) at the Köyceğiz-Dalyan SEPA are concentrated at Ekincik Bay's relatively less inclined sea bottom, especially on the inner bay and on its northeastern coast (SAD, 2010). During the SAD study, 14km² of the MCPA's sea bottom was assessed through dives between the 0-50 m range in order to determine the benthic flora. Accordingly, nine different sea bottom structures were identified in the marine section of

the protected area. The total area where *Posidonia* communities expand is about 1.23 km² however, 0.34 km² of this is patchy seagrass communities while thicker meadows that form mats is reported to cover 0.89 km² (6.4% of the total).

Posidonia can provide a range of regulating services, in addition to carbon sequestration, as discussed in Box 2.

Box 2. Seagrass meadows (*Posidonia oceanica*)

Posidonia oceanica are a type of land-based flowering plant, which returned to the marine environment some 120 to 100 million years ago. They 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. *Posidonia oceanica* is endemic to the Mediterranean and a highly productive system supporting high levels of biomass (Lo Iacono et al., 2008). Despite being endemic its distribution is restricted due to anthropogenic disturbances; their total surface area within the Mediterranean is about 38,000 km² (Mangos et al., 2010).

Posidonia seagrass communities provide a wide range of Ecosystem Services:

- The *Posidonia* meadows are the leading Mediterranean ecosystem in terms of biodiversity provision, supporting a quarter of its recorded marine species over an area estimated to cover almost 1.5% of the seabed.
- They serve as spawning grounds and nurseries for many commercial species and the source of major primary production, thereby supporting the fishing industry.
- They protect beaches against erosion (by reducing hydrodynamism and by trapping sediment in the matte). The dead leaves of *Posidonia oceanica* found on shores act as a natural barrier reducing the energy of the waves and minimizing erosion. They also play an important role in beach and dune systems.
- They encourage water transparency, thereby supporting tourism and providing an effective tool for monitoring the quality of coastal waters.
- They trap and absorb man-made CO₂. According to a recent report seagrasses are the most effective species in terms of long-term carbon storage (Laffoley and Grimsditch, 2009).
- They produce oxygen and are known as the "lungs of the sea" with +/- 14 lt O₂/m²/day capacity on average
- The cycle nutrients through their plant growth.
- They operate as coastal water filters. Subsurface rhizomes and roots stabilize the plant while erect rhizomes and leaves reduce silt accumulation.

Source: Based on Mangos et al. 2010

3.3.2. Micro-climate stabilization

Oceans play a role in regulating the atmosphere and modulating weather. While it is thought that this ecosystem service is provided by both the marine and wetland ecosystems of Köyceğiz-Dalyan SEPA, there are no scientific studies defining this service.

3.3.3. Disturbance Regulation

Flood and storm protection. Marine flora and fauna can help defend coastal regions by dampening and preventing the impact of tidal surges, storms and floods. This disturbance alleviation service is provided by a diverse range of species, such as salt marshes, mangrove forests and sea grass beds, which bind and stabilize sediments and create natural sea defences (Huxley, 1992; Davison & Hughes, 1998 as reported in Beaumont et al., 2007). These natural sea defence systems protect infrastructure and investments in vulnerable coastal areas, and would need to be replaced by man-made alternatives if damaged or lost. This service is important in Turkey given the concentration of socio-economic activities on Turkey's coasts; 27 of Turkey's provinces border the sea and 30 million people live by the coast (UNDP, 2010). It is also considered important in Köyceğiz-Dalyan SEPA, given the communities that live along the coastline and the importance of tourism infrastructure.

Coastal erosion is a natural phenomenon widely observed in the Mediterranean, particularly in coastal zones with soft substrate. According to the European Environment Agency (EEA, 2006) 20% of European coasts are threatened by erosion (i.e. around 20,000 km).

The Mediterranean's *Posidonia* meadows provide protection against erosion through three main functions. Firstly, its foliage, which limits hydrodynamics by 10 to 75% under the leaf cover (Gacia et al., 1999). Secondly, the banquettes formed by its dead leaves and rhizomes on beaches - that can reach a height of between 1 and 2 metres - builds a structure that protects the coastline against erosion (Guala et al., 2006; Boudouresque et al., 2006). Thirdly, the *Posidonia* mat traps sediment (Dauby et al., 1995; Gacia & Duarte, 2001), thus contributing to their stability. Jeudy de Grissac (1984) estimated that the degradation of a one meters thickness of *Posidonia* duff could lead to the coastline retreating by twenty meters.

According to Prof. Özhan coastal erosion is not an issue in Köyceğiz-Dalyan SEPA.

3.3.4 Waste remediation

A significant amount of human waste, both organic and inorganic, is deposited in the marine environment. This waste would require additional treatment if it were to be taken up by terrestrial systems, and therefore would entail increase treatment costs. Marine living organisms store, bury and transform many waste materials through assimilation and chemical de and re-composition (Beaumont et al., 2007). The capacity of marine ecosystems to absorb, detoxify, process and sequester waste shows a wide variation. Some toxic pollutants, such as heavy metals, cannot be converted into harmless substances, whereas some organic waste can even encourage ecosystem development through its biomass and benefit ecosystems. Marine ecosystems provide an ecosystem service for the quantity of waste below the threshold at which it becomes harmful to them (Mangos et al., 2010).

While this service is thought to be provided by Köyceğiz-Dalyan SEPA, there are no site specific studies defining or quantifying this service for the area.

3.4. Cultural Services

3.4.1. Spiritual, religious and cultural heritage

The marine environment may be linked to the cultural identity of a community, or associated with religion, folklore, painting, cultural and spiritual traditions. Communities that live by and are dependent on the sea for their livelihood often attach special importance to marine ecosystems that play a significant role in the economic or cultural definition of the community (Beaumont et al., 2007). Communities living in Köyceğiz-Dalyan SEPA are intricately linked to the dynamically related coastal wetlands and the marine environment as well as to the natural forests that surround the SEPA.

In ancient Egyptian civilisation, it is reported that sweetgum oil was used as a "love elixir" and perfume by Cleopatra and it has been used as a medicine since Hippocrates. Today the balsam-free bark of the tree is used as incense known as buhur regionally (Ürker & Yalçın, 2011). Also, the natural sulphur springs of the SEPA are known to have

therapeutic properties both internally (one source is used for stomach and intestinal problems) and externally (i.e. skin problems).

The cultural heritage of the SEPA is also significant. The SEPA hosts the antique city of Kaunos, historically a strategic port between the Eastern Mediterranean and the Aegean, which is now accessible by boats from Dalyan. The rock tombs of the ancient city characterize the Köyceğiz-Dalyan SEPA.

3.4.2. Education and research

Marine living organisms provide stimulus for education and research. Beaumont et al. (2007) cites a number of uses of marine information including: the study of microbes in marine sediments to develop economical electricity in remote places; the inhibition of cancerous tumour cells; the use of *Aprodite* sp. spines in the field of photonic engineering, with potential implications for communication technologies and medical applications; the development of tougher, wear resistant ceramics for biomedical and structural engineering applications by studying the bivalve shell. In addition, marine biodiversity can provide a long term environmental record of environmental resilience and stress.

Köyceğiz-Dalyan ecosystems and related biota has been the subject of at least fifteen academic thesis. According to the Turkish Council of Higher Education database, these studies are mainly in the Environmental Sciences and Engineering and Water Resources fields, and focus on either specific species found in the SEPA such as blue crabs and sea turtles or environmental aspects of the protected area such as water quality assessments, nutrient and hydraulic modeling of the lagoon catchment (YÖK, 2012).

Furthermore, important research and rehabilitation activities are currently being conducted within the SEPA. Since the mid-1980's many academic institutions such as Hacettepe and ODTÜ have carried out research and monitoring activities of the marine sea turtles (Özhan, 1990). Since 2009, DEKAMER, the Sea Turtle Research, Rescue and Rehabilitation Center of Pamukkale University has been operating on the Dalyan İztuzu beach monitoring the loggerhead marine turtles' population especially during the nesting season.

Köyceğiz-Dalyan SEPA is also a pilot site for the Mediterranean and Black Seas under the Integrated Coastal Zone Management Project, PEGASO (personal communication with Prof. Dr. Erdal Özhan).

3.4.3. Recreation and Tourism

Marine ecosystems provide the basis for a wide range of tourism and recreational activities, resulting in significant employment opportunities for coastal communities and contributions to GDP. Tourism is an important activity within Köyceğiz-Dalyan SEPA and closely linked to the marine and coastal environment. A range of marine based recreational activities are currently offered including boat tours both in the bays and in the delta, swimming, and mud baths.

3.4.4 Landscape and amenity

Landscape and amenity services provided by marine ecosystems attract tourists and generally make the area an attractive place to visit and live. This benefit can be captured through property price premiums in the area and the returns to coastal businesses (restaurants and hotels) relative to non-coastal businesses.

3.4.5. Biodiversity non-use

Biodiversity non-use relates to the benefits people derive from marine organisms unrelated to their use. Such benefits can be motivated by bequest values (the value placed on ensuring the availability of marine ecosystems for future generations), and existence value (a benefit derived from simply knowing that the marine ecosystem biodiversity exists).

3.4.6. Option value

Option value relates to currently unknown potential future uses of marine biodiversity and reflects the importance of more uses being discovered in the future. The biodiversity may never actually be exploited, but there is benefit associated with retaining the option of exploitation.

Valuation of Ecosystem Services



In 2008, a World Bank study put the total annual figure for all marine ecosystem services at more than US\$20 trillion. This estimate only accounted for the marine ecosystem goods and services for which a market already exists and is therefore considered to be an underestimate.

This section presents, where possible, monetary estimates for the ecosystem services identified in Table 2 as being present at Köyceğiz-Dalyan SEPA. The monetary estimates have been derived using market pricing or value transfer valuation approaches. Market price approaches include the use of market prices to value traded ecosystem services and also the so called cost based approaches. Market prices for marine ecosystem services that are traded reflect a lower bound estimate of its value, as they do not capture the consumer surplus⁶ element of value. They are therefore only proxies of welfare value. However, such estimates are still very informative and relatively straight forward to derive. Cost based approaches take the cost of replacing a service or averting a damaging impact on a marine resource as a proxy for the value of the benefits provided by the marine environment. They suffer from the same complications as market prices and risk the under-valuation of non-market goods

Value transfer (also called benefits transfer) involves the application of values from an existing study (often called the 'study site') to a new study (often referred to as the 'policy site') where conditions are similar and a similar policy context is being investigated. Value transfer is a practical means of demonstrating the monetary value of marine benefits. It is cheap and quick relative to primary research, but there are a number of factors which influence the reliability of the transfer exercise. The quality of the original study is obviously a key consideration for value transfer applications. In order to minimize errors / uncertainty, the primary research study should be based on adequate data and a theoretically sound approach. The degree of similarity between the study site and the policy site is also a major factor. Value transfer will be more reliable if the policy site is located within the same region / country as the study site, and displays similar site characteristic (e.g. size, services and availability of and distance to substitutes). Other factors affecting the reliability

⁶ Consumer surplus is the amount an individual is willing to pay above the market price. The price reflects the cost of obtaining a good, not the actual benefit derived from its 'consumption', which is equal to the market price plus consumer surplus.

of the value transfer exercise include: the reference condition (i.e., how closely the baseline at the study site matches the baseline at the policy site); the proposed change in the provision of the service (i.e., the magnitude of the change and whether the valuation is of a change in the quantity or the quality of an attribute); and the range/ scale of the commodity being valued (e.g., one site or many sites valued and physical area).

As well as providing welfare measures an attempt has been made to illustrate the importance of these ecosystem services in terms of the jobs they create and their contribution to local livelihoods.

The marine ecosystem services valued in this study are – fish, carbon sequestration, protection against coastal erosion, waste treatment and tourism and recreation. Where relevant, background is provided on these services – i.e., physical (quantitative) data, management structure, pressures and opportunities for development. For the regulating services (carbon sequestration, protection against coastal erosion, waste treatment) a review of relevant valuation evidence for the region is also presented.

4.1. Provisioning Services

4.1.1. Fish

The Turkish Aegean region has nine lagoon systems where traditional estuarine fisheries activities take place (Erdem & Gülşahin, 2006). Köyceğiz's lagoons are among the most important of these as they are fed by nutrient loaded freshwater systems leading to high productivity (ibid). Fish species live, feed and grow in the Köyceğiz lagoons (extending to the delta of about 1,150 ha) and then migrate seasonally to the sea. It is during the migration time that traditional fishing methods are applied (ibid). These coastal fisheries are an important socio-economic activity in the SEPA.

The lagoon system in the SEPA consists of four main sections: Köyceğiz Lake, the channel network linking it to the sea, Sülüngür Lake which is linked to the channel network and İztuzu Lake which has a seasonal link to the sea (ibid).

Two fisheries cooperatives operate within the SEPA: one in Dalyan and another in Ekincik (SAD, 2010). These cooperatives are mainly active in the delta lagoons (Box 3).

Box 3. Dalyan Fishery Cooperative (DALKO)

DALKO, Dalyan Fishery Cooperative, was established in 1971 in Dalyan. The cooperative was set up in order to provide an informal system of conservation for the lake and it engages people all around the lake in its management and conservation. Currently, DALKO has 601 members and 61 staff. A total of 40 boats operate under DALKO which range between 6-12 m with an engine power of 5-85 HP. Not all members fish and few members are completely dependent on fishing; the majority are also involved in the tourism sector, citrus production and bee keeping. DALKO has exclusive fishing rights in the delta and in Köyceğiz Lake through a rental scheme with the national treasury and approved by GDPNA based on 2 year contracts. The estuarine system was rented for the first time to DALKO in 1971.

Köyceğiz Lake is connected to the Mediterranean Sea by Dalyan Delta. Traditional estuarine fishing is practiced by DALKO in Köyceğiz Lagoon system using fish barriers. Grey mullet (*Mugil cephalus*) is the main commercial fish harvested by the cooperative, representing 90% of the catch. The fish migrate from the Lake to the Mediterranean Sea to breed. As they travel to the sea they are trapped in the delta by the barriers. These migrations happen twice a year in the Summer (late June/beginning of July) and Winter (October), with the Winter migration being the most significant in terms of productivity. According to the cooperative 20% of the fish caught are released in order to maintain fish populations and the nets allow smaller fish (less than 40 cm to pass through). Studies nevertheless raise concern about the sustainability of DALKO's mullet catch highlighting that 70% of the grey mullets trapped in the fish barriers have not reached sexual maturity. It has been reported that DALKO falls short on complying with the minimum 30cm catch size determined by MoFAH for the species (Çınar Mühendislik, 2007).

Seabass, Sea bream and blue crab are also harvested in the lagoons. The cooperative also produces caviar and was awarded the International Slow Food Prize in 2000. However, this is not widely known as the award has not been used in product promotion. In the past, common eel was an important economic species but since the EU ban in 2008, eel is no longer harvested. Eel is an endangered species in many European habitats. One potential opportunity could be for the cooperative to sell eels to restock other areas in Europe; this has not been explored.

Two staff members were killed in 2008 for trying to stop illegal fishing of grey mullet. The cooperative employs a private security company to monitor illegal fishing activities

Source: Field interviews, Keskin et al., 2011, Çınar Mühendislik, 2007

Research on the fish species found in the Köyceğiz-Dalyan SEPA was conducted by Çınar Mühendislik (2007). This study identified 50 different species in the SEPA's ecosystems illustrating a significant biological wealth compared to other lagoon systems in Turkey (Çınar Mühendislik, 2007).

Table 5. Fish species inventory in the Köyceğiz-Dalyan SEPA (source: Çınar Mühendislik 2007)

Familia	Species	Common Name (in Turkish)	Common Name (in English) ⁷	Habitat
<i>Dasyatidae</i>	<i>Dasyatis pastinaca</i> (Linnaeus, 1758)	İğneli vatoz	Common stingray	M
<i>Clupeidae</i>	<i>Sardinella aurita</i> Valenciennes, 1847	Büyük sardalya	Round sardinella	M
<i>Engraulidae</i>	<i>Engraulis encrasicolus</i> (Linnaeus, 1758)	Hamsi	European anchovy	M
<i>Synodontidae</i>	<i>Synodus saurus</i> (Linnaeus, 1758)	Zurna balığı	Atlantic lizardfish	M
<i>Anguillidae</i>	<i>Anguilla anguilla</i> (Linnaeus, 1758)	Yılanbalığı	European eel	M
<i>Gadidae</i>	<i>Phycis phycis</i> (Linnaeus, 1766)	Gelincik balığı	Forkbeard	M
<i>Moronidae</i>	<i>Dicentrarchus labrax</i> (Linnaeus, 1758)	Levrek	European seabass	M
<i>Serranidae</i>	<i>Epinephelus aeneus</i> (Geoff.St.Hilarie, 1809)	Lahoz	White grouper	M
<i>Cichlidae</i>	<i>Tilapia zilli</i> (Gervais, 1848)	Dişli balık	Redbelly tilapia	F*
	<i>Oreochromis aureus</i> (Steindachner, 1864)	Dişli balık	Blue tilapia	F*
	<i>Oreochromis mossambicus</i> (Peters, 1852)	Dişli balık	Mozambique tilapia	F*
<i>Poeciliidae</i>	<i>Gambusia affinis</i> (Baird & Girard, 1853)	Sivrisinek balığı	Mosquitofish	F*
<i>Carangidae</i>	<i>Alepes djedaba</i> (Forsskal, 1775)	Çatal balığı	Shrimp scad	M*
	<i>Lichia amia</i> (Linnaeus, 1758)	Akya	Leerfish	M
<i>Mullidae</i>	<i>Mullus barbatus</i> Linnaeus, 1758	Barbun	Red mullet	M
<i>Sparidae</i>	<i>Sparus aurata</i> Linnaeus, 1758	Çipura	Gilthead seabream	M
	<i>Boops boops</i> (Linnaeus, 1758)	Kupez	Bogue	M
	<i>Diplodus annularis</i> (Linnaeus, 1758)	İsparoz	Annular seabream	M
	<i>Diplodus sargus</i> (Linnaeus, 1758)	Sargoz	White seabream	M
	<i>Diplodus vulgaris</i> (Geoff.St.Hilarie, 1817)	Karagöz	Two-banded seabream	M
	<i>Lithognathus mormyrus</i> (Linnaeus, 1758)	Mırmır	Sand steenbras	M
	<i>Pagellus acarne</i> (Risso, 1826)	Yabani mercan	Axillary seabream	M
	<i>Sarpa salpa</i> (Linnaeus, 1758)	Salpa	Salema	M
<i>Centracanthidae</i>	<i>Spicara smaris</i> (Linnaeus, 1758)	İzmarit	Picarel	M
<i>Labridae</i>	<i>Xyrichtys novacula</i> (Linnaeus, 1758)	Ustura balığı	Pearly razorfish	M
<i>Scaridae</i>	<i>Sparisoma cretense</i> (Linnaeus, 1758)	İskaroz	Parrotfish	M
<i>Trachinidae</i>	<i>Trachinus araneus</i> Cuvier, 1829	Trakonya	Spotted weever	M
<i>Uranoscopidae</i>	<i>Uranoscopus scaber</i> Linnaeus, 1758	Tiryaki balığı	Stargazer	M
<i>Gobiidae</i>	<i>Gobius niger</i> Linnaeus, 1758	Kayabalığı	Black goby	M
<i>Siganidae</i>	<i>Siganus rivulatus</i> Forsskal, 1775	Sokar balığı	Marbled spinefoot	M *
<i>Scombridae</i>	<i>Scomber scombrus</i> (Linnaeus, 1758)	Uskumru	Atlantic mackerel	M
<i>Sphyrnidae</i>	<i>Sphyrna sphyraena</i> (Linnaeus, 1758)	İskarmoz	European barracuda	M
<i>Mugilidae</i>	<i>Mugil cephalus</i> Linnaeus, 1758	Topan kefal	Flathead grey mullet	M
	<i>Liza aurata</i> (Risso, 1810)	Altınbaş kefal	Golden grey mullet	M
	<i>Liza ramado</i> (Risso, 1810)	Ceran	Thinlip grey mullet	M
	<i>Liza saliens</i> (Risso, 1810)	Kastros	Leaping mullet	M
	<i>Liza carinata</i> (Valenciennes, 1836)	Bıldırın kefal	Keeled mullet	M *
	<i>Oedalechilus labeo</i> (Cuvier, 1829)	Dudaklı kefal	Boxlip mullet	M
	<i>Chelon labrosus</i> (Risso, 1827)	Mavrakı	Thicklip grey mullet	M
<i>Atherinidae</i>	<i>Atherina boyeri</i> Risso, 1810	Gümüş balığı	Big-scale sand smelt	M
	<i>Atherina hepsetus</i> Linnaeus, 1758	Gümüş balığı	Mediterranean sand smelt	M
	<i>Atherinomorus lacunosus</i> (Forster, 1801)	Gümüş balığı	Hardyhead silverside	M *
<i>Scorpaenidae</i>	<i>Scorpaena scrofa</i> Linnaeus, 1758	İskorpit	Red scorpionfish	M
<i>Triglidae</i>	<i>Trigla lyra</i> Linnaeus, 1758	Öksüz	Piper gurnard	M
<i>Bothidae</i>	<i>Bothus podas</i> (Delaroche, 1809)	Pisi balığı	Wide-eyed flounder	M
<i>Soleidae</i>	<i>Solea solea</i> (Linnaeus, 1758)	Dil balığı	Common sole	M
<i>Echenidae</i>	<i>Remora remora</i> (Linnaeus, 1758)	Vantuz balığı	Shark sucker	M
<i>Cyprinidae</i>	<i>Cyprinus carpio</i> Linnaeus, 1758	Sazan	Common carp	F
	<i>Leuciscus cephalus</i> (Linnaeus, 1758)	Tatlısu kefali	Chub	F
	<i>Capoeta bergamae</i> (Karaman, 1969)	-	-	F

[M = Marine fish species; F = Freshwater fish species; * = Alien species]

⁷ English common names are taken from Fishbase.org website

Table 5 lists the family, species, common names and respective habitat of the fishes in the region.

Mugilidae species are among the most economically important and highly harvested species. Seven out of the nine Mugil species encountered in Turkey are reported to be found in Köyceğiz's lagoons and Mugil cephalus, Chelon labrosus and Liza ramada species are the main species that are marketed (Çınar Mühendislik, 2007).

According to the SAD study (2010), fishing activities in the marine zones of the SEPA are limited to 8-10 people (most fishermen have reportedly switched to tourism), who generally use 7-8m boats with 10 hp. Marine fishermen are reported to be active less than half of the year (about 165 days/year/fisherman). The main targeted species in the marine environment are amberjack, red mullet, sea bream, two-banded bream, shrimp, grouper, saddled seabream, common pandora, bonito, dentex, rabbitfish. Among these, two-banded bream and pandora make up the most caught around 600kg/year/fisherman. One fisherman wants to establish a sea fishing cooperative (8-9 fishermen) to protect sea species which are being affected by trawlers coming from Marmaris and illegally fishing in the area.

Recreational fishing also takes place in the sea and the lagoon systems but it is not controlled or monitored in any way. Some of the commercial boats in Dalyan and Çandır offer day long crabbing, angling and sea fishing tours with prices in the range of 35 TL or €17/person. Recreational fishers do not pay for the fish they catch and no data are available on their catch. Strictly speaking a license is required, but no one obtains one. However, according to Prof. Erdal Özhan recreational fishing is not that significant on the Köyceğiz coast.

4.1.1.1 Valuation

For the 34-year period between 1972-2005 the total production of aquatic products in Köyceğiz Lake was 8,768 tons. In 1972 total production was 52 tons. The highest production was in 1994, reaching 444 tons (Çınar Mühendislik, 2007). In general, a fluctuating trend is observed in catch statistics (see Figure 2). Between 1972-1981 average production was 267 t/year, between 1982-1991 it was 271 t/

year and from 1992-2001, 254 t/year. In 2002-2005 an average of 211 t/year production marked the lowest values (ibid). The total production of aquatic products was 172.2 tons in 2006 (covering the period from January 1st to November 30th). The majority was grey mullet (155.7 tons). Other species were - sea bass (6.5 tons), sea bream (4.6 tons), painted eel (2.4 tons), eel (1 ton) and other species (2.9 tons). In addition, a total of 7.7 tons of culture fish were produced in net cages at Lake Sülüngür (2.6 tons of sea bream and 5.1 tons of sea bass). Fish roe or caviar production was 112 kg during this period. Between 1995-2005, annual production has fluctuated between 21.1 kg/ha and 70.8 kg/ha, with an average of 39.8 kg/ha (ibid).

Figure 2: Fisheries Production in Köyceğiz Lagoons – 1972-2005 Source: Çınar Mühendislik, 2007

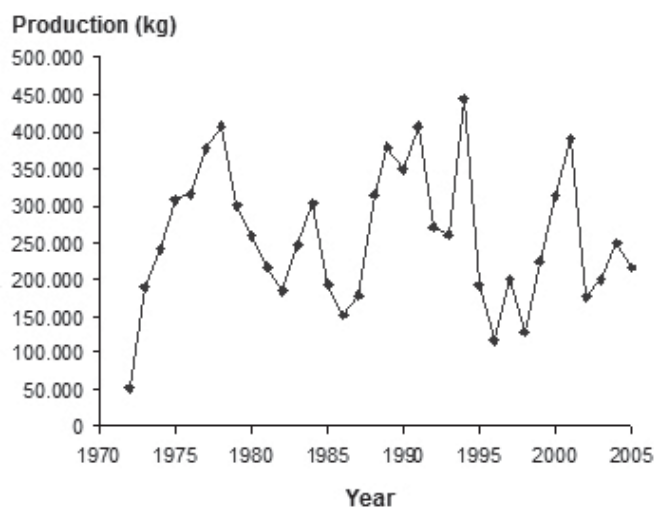


Table 6 presents the most up to date catch and production figures for the area (2003 and 2010) obtained from DALKO. According to DALKO data, during the period 1972-2006, the commercial catch in Köyceğiz Lagoon ranged from 52,125 tons in 1972 to 44,949 tons in 1994. The value of fish in 2010 is estimated at 2,649,938 TL (US\$1,399,167).

The fish is sold locally in Köyceğiz and Dalyan and regionally in Dalaman and Ortaca as well as to buyers from İzmir and Antalya. The cooperative's objective is to provide local and affordable fish to the region.

Table 6. Fish production figures in Köyceğiz-Dalyan lagoons (source: DALKO statistics)

Year	Grey mullet	Thicklip grey mullet	Eel	Small Seabream	Striped seabream	Seabass	Seabream	Fish roe	Other	Total
2003	213,245	2,746	13,889	7,238	526	0	0	226	0	237870,5
2004	121,705	467	6,295	4,665	110	0	0	189	0	133,431
2005	111,732	2,162	20,556	1,987	41	2,301	5,501	88	0	144,368
2006	149,146	816	0	667	1,842	1,774	5,000	112	1,948	161,305
2007	173,966	1,686	11,438	14,809	1,170	10	20	290	1,501	204,890
2008	182,537	1,763	10,699	2,147	124	142	1,817	196	2,869	202,294
2009	530,218	2,612	30	7,367	1,087	471	2,678	458	6,189	551,110
2010	567,132	450	8	2,474	704	287	3,357	112	393	574,918
Total Production (kg)	2,049,681	12,702	62,915	41,354	5,604	4,985	18,373	1,671	12,900	2,210,186
Average price (TL/kg)	4.5	10	10	8	8	15	15	100	5	
Total Economic Value (2010)	2,552,094	4,500	80	19,792	5,632	4,312	50,362	11,200	1,965	2,649,938

Recreational fishing: Recreational fishing takes place in Köyceğiz Lake targeting mainly carp species (*Cyprinus spp.*) that are then released back to the lake. One person in Köyceğiz is a licensed guide for recreational fishing and keen foreigner visitors come every year to the town for this activity (personal communication with Alp Giray). Data on the number of recreational fishermen are not available; however, each fisherman needs to buy a fishing stamp that costs 17TL valid for three days. The guide's license in turn costs 180TL valid for two years.

Traditional estuarine in Köyceğiz-Dalyan ecosystems support the livelihoods of many families. Currently, 61 people are employed by DALKO alone with their annual salaries totalling 1,680,000 TL a year.

4.2. Regulating services

4.2.1. Carbon sequestration

4.2.1.1. Existing estimates

Mangos et al. (2010) estimated the carbon storage function of the Mediterranean Sea as a whole and based on this provided disaggregated values for individual Mediterranean countries. The Mediterranean Sea accounts for only 0.8% of ocean area, therefore it plays a small role in world climate

regulation. However, a recent estimate (Huertas, 2009) proposes the value of 78 kilo moles of carbon $\pm 15\%$ per second for the Mediterranean Sea as a whole. This corresponds to an annual average rate of anthropogenic CO₂ sequestration of 11.8 t km²/yr, which is around twice the average for the World Ocean (Gruber, 2009).

Adopting Huerta's (2009) estimate, Mangos et al. (2010) estimate the total sequestered volume for the Mediterranean at 108 million tonnes of CO₂ per year⁸. As reported by Mangos et al (2010) this quantity represents a mere 5% of the CO₂ emitted by activities in the Mediterranean riparian countries (UN Data).

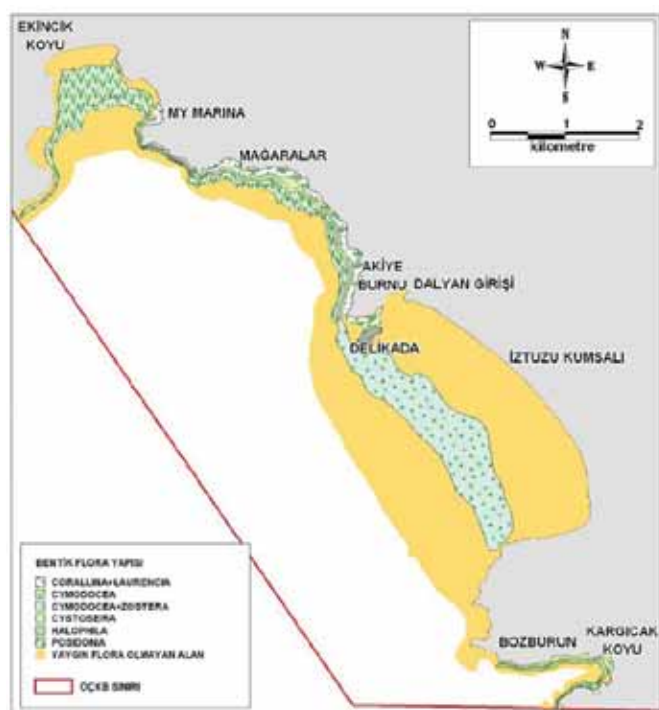
The average price for carbon for the year 2005 was used - 20.5€/t of CO₂ (World Bank, 2006). This results in an annual regional value of 2.2 billion € (108 Mt x 20.5 €/t). This value was distributed amongst the riparian states based on their share of the total volume of CO₂ emitted using statistical data provided by UN Data. The value for Turkey is estimated at 230 million Euros per annum. This provides a ball park estimate of the value of marine carbon sequestration in Turkey generally. Available site specific data and current carbon values were used to estimate this service at Köyceğiz-Dalyan SEPA.

⁸ One tonne of carbon corresponds to 11/3 or 3.67 tonnes of CO₂

4.2.1.2. Value of carbon sequestration at Köyceğiz-Dalyan SEPA

Based on the marine biodiversity assessment conducted by SAD (2010), *Posidonia* communities are mainly prevalent in the non-inclined sections of Ekinçik Bay along with *Cymodocea nodosa* (Figure 3). The total area of *Posidonia* communities in Köyceğiz-Dalyan SEPA has been identified as 1,23 km² of which 0.34 km² is patchy seagrass communities while thicker meadows that form mats of at least 1 m is reported to cover 0.89 km² (6.4% of the total). This latter figure, accounting for the healthy *Posidonia* communities is used in the valuation.

Figure 3: Distribution of the different benthic flora species including *Posidonia* meadows in Köyceğiz-Dalyan SEPA
Source: SAD, 2010



A number of global and regional studies have measured the carbon storage of *Posidonia* species both in its biomass (including aboveground and belowground vegetation) and its soil organic carbon. For instance, the estimates available of soil organic pools under *Posidonia oceanica* beds have been published based on samples of the vertical mat walls of the meadows at seven heavily vegetated Mediterranean sites (Mateo et al., 1997). This estimated a mat/sediment storage capacity of 2.1 t CO₂/ha/yr. Duarte et al. (2010) carried out a meta-analysis for the net community production of different seagrass species globally and estimated the aboveground carbon sequestration rate to be in

the range of 32.5 t CO₂/ha/yr, assuming an average dry weight of 672g/m² (average depth of 5 m).

For the purposes of this study global averages defined both for the living biomass and the soil organic carbon by the Nicholas Institute for Environmental Policy Solutions at the Duke University (Murray et al., 2010) have been adopted (Table 7). This study demonstrates that the biggest carbon pool for *Posidonia oceanica* lies in the soil organic pools, with a global average of 500 t CO₂/ha.

Table 7. Global averages and standard deviations of the carbon sequestration rates and global ranges for the carbon pools by habitat type

Habitat Type	Annual Carbon Sequestration Rate (tCO ₂ eq/ha/yr)	Living biomass (tCO ₂ eq/ha)	Soil organic carbon (tCO ₂ eq/ha)
Seagrass	4.4 +/- 0.95	0.4 –18.3	66–1,467
Tidal Marsh	7.97 +/- 8.52	12–60	330–4,436
Estuarine Mangroves	6.32 +/- 4.8	237–563	1,060
Oceanic Mangroves	6.32 +/- 4.8	237–563	1,690–2,020

Source: Murray et al., 2010

While carbon credit markets do not yet cover projects related to the marine environment it is highly likely that markets for 'Blue' Carbon will emerge in the future. This is discussed in more detail in Section 6. An estimate of creditable carbon can be derived for seagrasses associated with their avoided loss.

Removal of seagrass results in the release of previously stored CO₂ from both biomass and soil and an end to the annual carbon sequestration function. The total creditable carbon is therefore equal to the release of stored carbon over a relevant timeframe plus the annual carbon sequestration rate.

By using the market price of carbon, it is possible to calculate the value of creditable carbon, associated with their avoided loss. A lower bound of US\$11.2/t CO₂ eq was adopted based on the average price of traded carbon on the voluntary markets in Turkey in 2010 (Peters-Stanley et al., 2011) and an upper bound of US\$20/t CO₂ eq (based on EU Emission Trading System (ETS)).

Table 8 presents the results of the analysis. The carbon value Köyceğiz-Dalyan's *Posidonia* meadows is estimated at US\$ 54,226–96,832 a year (US\$609–1,088/ha), with a present value of

Table 8. Potential carbon sequestration value of *Posidonia* meadows at Köyceğiz-Dalyan SEPA

Posidonia surface (ha)	Carbon sequestration† (tCO ₂ eq/ha/yr)	Soil carbon released†** (tCO ₂ eq/ha/yr)	TOTAL Annual carbon loss per site (tCO ₂ eq)	Value (US\$11.2 / t CO ₂ eq)			Value (US\$20 / tCO ₂ eq)		
				Annual value US\$/ha	Annual Value / US\$	PV (10 years, 10%), US\$	Annual value US\$/ha	Annual Value / US\$	PV (10 years, 10%), US\$
89	4.4	50	4,842	609	54,226	20,906	1,088	96,832	37,333

US\$20,906–US\$37,333. This assumes that soil carbon is released at 50 t CO₂eq/ha/yr, over a period of 10 years, and is based on a 10% discount rate. The monetary value of this service will fluctuate depending on the price of carbon, and the discount rate used in the analysis. It should be stressed that these values are based on a market existing for ‘blue’ carbon, the site being able to generate verifiable site specific estimates of current carbon storage and sequestration functions, and ensuring the site’s long term protection and maintenance.

4.2.2 Protection against coastal erosion

4.2.2.1 Existing estimates

Mangos et al. (2010) estimated the benefits of coastal erosion protection provided by marine ecosystems using the expenditure avoided approach. The following three steps were undertaken:

- Determining the length of built-up coastline that could benefit from protection. Since the density of coastal urbanization was not available for all Mediterranean countries, a 20% erosion figure established for the European coasts was used along with an estimate urbanization coefficient of 80%. On this basis it emerges that coastal erosion is affecting 16% of the Mediterranean coasts, i.e. 7,360 km.
- Assessing the presence of effective *Posidonia* meadows along the built-up and eroded coastline identified in step 1. Pasqualini et al. (1998) estimated that the *Posidonia* meadows covered some 35,000 km² in the Mediterranean. Given the size of the 0-50 m bathymetric section in which this plant can thrive, it would thus cover some 40% of the benthic area corresponding to 0-50 m depth. As *Posidonia* tends to be abundant in areas with soft substrate (which represent about 50% of the coast), and given the geographical dispersal of *Posidonia*, it is estimated that 90% of the *Posidonia* meadows are established in coastal zones threatened by erosion. The provision of an effective protection service against erosion

depends on various characteristics such as the size of the meadow, its maturity and the intensity of the erosion affecting the coast. Using the estimate that over 10% of the European coasts demonstrate the existence of protection mechanisms against erosion (EEA, 2006) and assuming that 50% of the *Posidonia* meadows provide an effective protection against erosion at the regional level it is estimated that 3,312 km of *Posidonia* meadows provide an effective protection service against coastal erosion.

- Monetary assessment of the value of the protection provided. It is assumed that the economic value of these benefits is equivalent to the expenditure avoided (investment and maintenance costs)⁹. In 2001, expenditure on coastal erosion defence observed along European coastlines amounted to 3.2 billion Euros. It can thus be estimated that European spending on erosion defence amounts to about 160,000€ per km of coastline.

At the regional level, the valuation shows that the *Posidonia* meadows allow the riparian countries to avoid annual spending of about 530 billion €/yr, covering investment and other costs (i.e. maintenance costs). For Turkey the value is estimated at 60 million euro per annum. This is a crude estimate based on the length of the coastline and a default unit value of 160,000€ per km of coastline. It does not reflect the risk of erosion or the site specific expenditure that would be needed to protect areas at risk.

4.2.2.2. Valuation of erosion control at Köyceğiz-Dalyan SEPA

There are no site specific studies of the risks faced by Köyceğiz-Dalyan SEPA’s coastline or the role *Posidonia* meadows play in defending the coastline against erosion or estimates of expenditure on protection activities or infrastructure.

⁹ 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).

Information on the total length of coastline with *Posidonia* beds is not available. This has therefore been estimated using Google Earth and the maps indicating the distribution of *Posidonia* provided by SAD (2010). In total around 8.75 km of the coastline in the SEPA appears to benefit from the presence of *Posidonia*. Using a transfer value of 160,000 € per km of coastline (Mangos et al., 2010), the value of protection against coastal erosion is 160,000 € per km of coastline * 8.75 km = 1.4 million € per year.

Information on the length of coastline occupied by man-made structures (human settlements, hotels, coastal facilities such as piers, docks and roads) prone to coastal erosion is also not known for the site. Again, this has been estimated via Google Earth. Accordingly, around 9.4% of the coastal areas in Köyceğiz-Dalyan SEPA are estimated to be occupied by man-made structures. A conservative estimate of the erosion protection service offered by *Posidonia* meadows would be 131,600 € per year (US\$ 171,080).

4.2.3. Waste treatment

4.2.3.1. Existing estimates

Mangos et al. (2010) considered the liquid waste produced by human activities, which is the main pollutant of the marine environment. The 'combined approach' is recommended for wastewater treatment by the European Commission (EC) and MEDPOL (MEDPOL, 2004). This is based on the emission threshold for waste and a quality objective for the receiving environment. However, some waste is still inadequately treated such as diffuse waste, for which no viable treatment solution has been found and due to the limits of the treatment techniques applied for example.

Mangos et al. (2010) value this service on the basis of an environmental tax. Such a tax would allow environmental costs to be included in water pricing, and is in line with the EC's Water Framework Directive (EU_WFD, 2000/60/CE) which requires EU members to introduce water pricing policies which reflect both financial and environmental costs. In France, these taxes are levied by the Water Agencies and are based on the specific situation and usage (domestic or non domestic pollution, diffuse pollution or breeding). In 2005 the environmental tax for domestic use at the department of the Bouches du Rhône, stood at 0.18€/m³. This zone is

considered to be representative of the French Mediterranean seafront and features both highly urbanised and industrialised sectors (Marseilles, Fos) and other protected ones (Camargue, Calanques). This is used to value the waste assimilation service provided by marine ecosystems across all the Mediterranean riparian states.

In 2005 the Mediterranean coastal population stood at about 148 million (adapted from Attané and Courbage, 2001). Average domestic water consumption for these countries stands at 99 m³/yr per inhabitant (FAO Aquastat, 2000). Given that 35% of the Mediterranean population lives in coastal areas, and assuming an identical per capita consumption, water consumption is estimated in coastal areas at 14.5 km³ per year. At the regional level, the value of the service for domestic consumption is estimated at 2.6 billion Euros. The value of this service for industrial use is based on the volume of industrial water discharged directly into the Mediterranean sea, as assessed by MEDPOL, (in Blue Plan, 2005, statistical appendix), i.e. 557 million m³ per year (or 0.56 km³/yr) and evaluated on the same basis as for domestic consumption at 0.18€/m³, i.e. 100 million Euros. The total value for the service is therefore estimated at 3 billion Euros (excluding agriculture).

The value of waste treatment per country is calculated on the basis of the estimated consumption per country of domestic water by the coastal populations and discharge of industrial water into the Mediterranean Sea, breaking down the overall assessment of the benefit by country according to the method described. The value for Turkey is estimated at 229 million Euro per annum.

The absorption by marine ecosystems of toxic substances (heavy metals, organic pollutants, persistent organic pollutants) or the treatment of recyclable substances such as nutrients beyond the reprocessing capability of these ecosystems should not be counted as a service. Therefore the service is limited to the treatment of recyclable matter, within the limits of these ecosystems' capacities. It was assumed that the limit is not exceeded when waste is treated using the combined approach. This waste treatment service is 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.

4.2.3.2. Valuation at Köyceğiz-Dalyan SEPA

Mangos et al. (2010) estimated the waste treatment service of Turkey's marine environment to be 229 million Euro per annum. The total length of the Turkish coastline including the islands is 8,592 kilometres. The total length of Köyceğiz-Dalyan SEPA is 24.38 km (or 0.3%). This suggests that 0.687 million Euros (US\$ 0.9 million) per annum can be apportioned to Köyceğiz-Dalyan SEPA waste treatment service.

4.3. Cultural Services - Tourism and recreation

4.3.2. Background

Köyceğiz-Dalyan SEPA is easily accessible from Dalaman airport (located about 40 km from the SEPA) and both national and foreign tourists come from Muğla and its districts to visit the Köyceğiz and Dalyan region on tours (Çınar Mühendislik, 2007). Tourism highlights in the area include the ancient city of Kaunos, rock tombs, hot springs and İztuzu beach. However, the area's natural resources including its unusual canal and lagoon system are the main reasons for tourism development in Dalyan region (Çınar Mühendislik, 2007). Tourism in the region started relatively slowly under the supervision of GDPNA and picked up in Dalyan in mid-1980's with the popularity of the town increasing due to the sea turtles (see Box 1). Generally tourism development has been compatible with nature, with the construction of tall buildings largely avoided.

Beaches can be found all along the coast and serve as one of the primary coastal tourism attractions. İztuzu, Dalyan's turtle beach, is well known for the *Caretta caretta* (Loggerhead Sea Turtles). Turtles are a flagship species for the area and have made it very popular. National and international nature conservation organizations monitor and protect the turtles' nesting grounds in Turkey. The beach is in operation between the 1st of March and the end of October. However it is closed to the public during the period that the turtles lay their eggs between 20.00 and 08.00 daily (May to October). It can be reached by boat tours from Dalyan or by road. The beach is considered to be well managed and won the Best Open Space Europe 2008 award by the Times Travel Green Space Awards. The beach is rented from GDPNA and managed by the

Dalyan Municipality. The car park has a capacity for 250 cars and during the high season is full at weekends, and at half capacity on week days. Parking costs 6 TL/car (2012). The umbrellas and deck chairs can be rented on the beach for 7 TL each per day and the beach has a restaurant / kiosk. There is no entrance fee for the beach. Köyceğiz City beach and Ekincik beach are also popular.

The natural sulphur springs and the mud baths are important attractions that are located on the shores of the Köyceğiz Lake. On the Southwestern section of Köyceğiz Lake and on the West of Dalyan canal, there are three hot springs - Sultaniye, Delibey, Rızaçavuş-Gelgirme. Therapeutic centers have been constructed at these sites. Sultaniye hot-spring has been managed by Köyceğiz Municipality for the past 40 years and is open throughout the year. These historical hot-springs contain 12 different minerals and have a constant temperature of 39-40°C. They receive on average 300 people/day during the high season consisting of 100 days. The entrance fee is 3 TL/person for tours and 4 TL/person for individual guests. The Municipality's revenue is reported to be 150-200,000 TL per annum (personal communication with Salih Erbay). It is assumed that the other sites generate a similar income. This value has not been included in the recreational value of the SEPA.

The ancient city of Kaunos, whose settlement dates back approximately to 10th Century BC, can be visited by excursion boats from Dalyan and is accessed by a 1km footpath. Lycian Rock tombs dating to 4th Century BC are situated on carved slopes to the west of Dalyan. According to the Ministry of Culture and Tourism statistics, in 2011, 54,000 people visited the archaeological site generating 385,000 TL (US\$ 203,280). This value is also not included in the estimate of tourism for the SEPA.

4.3.3. Valuation of Key Tourism Activities

In Köyceğiz-Dalyan SEPA, the total bed capacity is reported to be 8,224 (Table 9), nearly 88% of which is found in Dalyan (Çınar Mühendislik, 2007). Between June 15 and September 15, the occupancy rate is 75% and between May-June 15, 30-35%. The main visitors to Dalyan are British (many travelling through British tour operators), Dutch and German. Around 750-800,000 visitors are reported to visit Dalyan annually (including day visitors) (personal communication with Arif Sarı).

Table 9. Bed capacities' distribution to the SEPA's accommodations (source: Çınar Mühendislik, 2007)

Settlement Name	Number of Hotels	Bed Capacities	%
Dalyan	186	7,224	87.8
Köyceğiz	18	679	8.2
Ekincik	6	204	2.5
Toparlar	2	33	0.4
Sultaniye	2	72	0.9
Kavakarası	1	12	0.2
TOTAL	215	8,224	100

Some estimates of the potential number of daily visitors to İztuzu and Ekincik beaches are available (Çınar Mühendislik, 2007). Based on this, 240,000 and 205,000 people may be visiting the respective beaches annually. However the total number of annual visitors to the SEPA has not been estimated by previous studies. According to the Ministry of Culture and Tourism's official statistics (Kültür ve Turizm Bakanlığı, 2012) in 2010 there were a total of 43,538 overnight stays in municipality licensed institutions and 56,124 overnight stays in ministry licensed institutions in Köyceğiz. Dalyan is tied administratively to Ortaca district and it has been assumed that half of the visitor figures stated for Ortaca reflect the visitors coming to Dalyan. Accordingly, 647,130 people would have stayed overnight in Dalyan. In total, 746,792 overnight visitors are estimated for the region.

Site specific data of tourism expenditures is not available for the site. Therefore average daily tourism expenditures estimated in other MCPAs in Turkey has been used based on studies by Bann & Başak (2011a & b) conducted in Foça and Gökova SEPAs as part of this GDPNA-GEF-UNDP project. Accordingly, an average daily expenditure of 115 TL/person is applied. The value of tourism is estimated at $746,792 * 115 \text{ TL} = 85,881,080 \text{ TL}$ (US\$ 45,345,210). This excludes day visitors.

Daily boat tours

Boat tours are a key tourism activity in the SEPA and are operated from the following locations: Köyceğiz, Dalyan, Ekincik and Çandır. The registered boats (491 in the SEPA) are organised under

their respective boat cooperatives¹⁰. Not all boat owners belong to the cooperatives, some choose to remain outside the framework and rules of the organization. For instance, there are around 5-10 individual boats (family run businesses) and 20 individual operators in Dalyan. There is some tension between the cooperative in Dalyan and the individual operators over price cutting.

The Dalyan Boat Cooperative, the biggest of the region, was established in 1983 and was the first cooperative for marine transportation in Turkey. The cooperative has 150 members with licensed boats, all of whom are local residents. It is open all year, but most activity is between the 1st April and 31st October, with a peak season of 2.5 months (July – mid September). The tours are very popular and they accommodate over night visitors as well as visitors brought by bus from the major tourism centers in the area such as Marmaris, Dalaman, Sarıgerme and Fethiye.

A traditional daily tour (10.30-18.00) consists of a visit to the mud pools, a swim on the lake, lunch, İztuzu beach and Kaunos ruins. Boat tours are also offered to the following sites – İztuzu (Turtle) Beach (departs when full); Kaunos Ruins; Mud baths; Köyceğiz Lake, Sultaniye Thermals and Mud baths; River turtle watching (daily boat departs at 06.00); Beach turtle watching; Köyceğiz public bazaar; and, Ekincik caves. The average price of tours are provided in Table 10.

Besides the visitors coming to Dalyan with the charter buses, the cooperative boats cater to the customers of daily gulet type boat tours that are coming from Sarıgerme, Marmaris, Fethiye and Bodrum. It is estimated that 30-40 gulet style boats come daily to the Dalyan straight opening where the customers take two of the smaller lagoon boats (personal communication with Atilla Gültekin). Çınar Mühendislik (2007) suggests that 3,000-3,500 daily visitor arrive via the sea.

During the high season, 40-50 boats partake in the "classic tour" of the lagoons. The tours to Fethiye and Göcek illustrate the close proximity and connectivity of these two SEPAs and the importance of nature tourism across the sites.

In addition to the Dalyan Boat Cooperative, a total of 108 boats are registered in Köyceğiz-Dalyan

¹⁰ Officially, 383 boats are registered in Dalyan and 108 in Çandır, Köyceğiz and Ekincik. Unofficial estimates calculate more than 600 boats in Dalyan – 491 commercial; 104 private; 4 fishing boats.

Table 10. Average boat tour prices in Dalyan

Excursion	Price (TL)
Turtle Beach (public boat)	10
Sea Turtle watching by boat	25
River Turtle watching by boat	25
Lake trip and Sultaniye Thermal and Mud baths	20
Kaunos (Taxi boat services)	25
Dalyan daily boat trip (with lunch)	25
Köyceğiz market (by boat) (with lunch)	30
Köyceğiz Market (Taxi Boat Service)	20
Ekincik Caves (by boat)	35
Fethiye Market (with lunch). Includes a visit to Ölüdeniz beach	45-50
Göcek 12 Island (includes lunch)	40-75
Crabbing, angling and fishing day tour	35
Moonlight cruise of Köyceğiz Lake plus barbeque	35
Feeding Turtles	20
Feeding Nile turtles and bird-watching	30

lagoons from Köyceğiz, Çandır and Ekincik towns according to GDPNA statistics (TVKGM 2012a). Çandır Boat cooperative has 14 members and they carry 10,000 customers in a season (personal communication with Ümit Şahin). There are a total of 18 boats that carry out tours of the SEPA out of Köyceğiz harbour. The majority of these, 80%, visit Sultaniye hot springs, Kaunos and İztuzu beach and cater to customers that come on organized tours.

Kardak Tourism is a private operation based in Dalyan which has been in business for 24 years. They have 22 boats and employ 43 people in the season, most of whom are from Dalyan, and 4-5 people permanently.

According to GDPNA officials, the demand for the boat tours in the SEPA is in the range of 800-1,000 people a day during May-June and September-October and 2,000-2,500 people a day during July and August (personal communication with Lütfü Yıldız).

Using an average tour price of 25 TL per person, the gross value of boat tours is estimated at US\$ 2,851,200¹¹.

¹¹ 2,000 people * 60 days (peak season July and August) = 3,000,000 TL (US\$1,584,000) and 800 people * 120 days (May, June, September and October) = 2,400,000 TL (US\$1,267,200). Total = US\$ 2,851,200.

Diving

Two dive companies operate in Dalyan, which is considered to be adequate as only 1-2% of visitors want to dive. There are 6-7 dive spots, including a shipwreck and coves. Certain areas in the SEPA are closed to diving.

One dive company charges 50-60 euros per person per day (10am-5pm). This includes one tank dive for touristic divers and 2 tank dives for licensed divers. During the season, April to end of September, they take 10-20 people diving a day. The value of diving can therefore be estimated at 75,000 Euros (US\$97,500) for this one dive centre only¹².

Alternative recreational activities within the SEPA

Köyceğiz town established a **canoeing** centre in 2010. This was an initiative of the District Youth Services and Sports Directorate. Currently 20 students over 10 years of age from the community train on the lake. The center is not a commercial venture.

There are 6 hiking trails identified as part of the management plan of the SEPA¹³. Köyceğiz Tourism and Environment Association has 40 members and organizes treks and hikes throughout the year to enjoy the natural terrestrial features of the SEPA and the greater Köyceğiz region. Every Sunday (except during the hot summer months) a hiking trip is organized to a different destination with a contribution of 15 TL/person (personal communication with Ömer Oflaz). The association took an active part in the determination of biking, trekking paths and birdwatching spots suggested in the management plan of the SEPA.

Yachting is not the main focus of marine tourism in the SEPA, however, Ekincik Bay has a small marina, My Marina receiving boats and yachts daily.

An alternative recreational zone of 13 decare is also planned by the local municipality slightly North of Dalyan town center on the shores of the lagoons to promote birdwatching, amateur line fishing, canoeing and sailing. The project has secured financial support from the Southern Aegean Development Agency in 2011 (personal communication with Arif Sari).

¹² 5 months / 150 days at 10 people (to cover lower numbers of visitors off peak) = 1,500 divers * 50 euros = 75,000 Euros (US\$97,500).

¹³ (i) From the eastern end of the settlement in Köyceğiz to Kaşıkçı (ii) From north of Zeytinalan through the mountains and ending at the beginning of river (iii) Köyceğiz to Sandras Mountain (iv) From the edge of Kargıcak Çayı creek, passing through the forest to the waterfall (v) From Sultaniye to Ülemez Hill and (vi) Çandır to Ekincik.

Rental income

Currently four rental sites are in operation in Köyceğiz-Dalyan SEPA, which generate income for the GDPNA and MoEU. Rental income for these sites in 2011 is provided in Table 11, and totals 753,197 TL (US\$397,688).

Table 11. Rental income from Köyceğiz-Dalyan SEPA

District Name	Rental Site/Operation Name	Fee 2011 (TL)
Köyceğiz	Ekincik Kiosk +WC	4,354
Köyceğiz	Ekincik Beach	2,306.52
Ortaca	Dalyan İztuzu Beach	226,109
Ortaca	Dalyan Straight Entrance (%30)	520,427.80
TOTAL		753,197.32

4.4. Summary of Valuation

The total annual value of the ecosystem services in Köyceğiz-Dalyan SEPA is estimated to be around US\$ 51 million per year (see Table 12).

The cultural services of tourism and recreation account for around 95% of the total value. Given that the value-transfer method has been used for determining the tourism value at the site, the estimate for tourism of around US\$48.5 million per year clearly could be refined. Site specific evidence of tourist

expenditures and willingness to pay is required, along with a better understanding of the number of visitors (both overnight and day visitors).

Fish are another important natural resource in the Köyceğiz-Dalyan SEPA with an annual gross contribution of US\$1,399,167 to the local economy. The traditional estuarine fisheries are coordinated exclusively by the DALKO cooperative in the lagoons of the SEPA but their fishing activity requires improved monitoring and training so that the sustainability of the fish stocks can be ensured in the future.

Regulating services are valued at US\$1,125,306 per year. The seagrass communities provide a carbon sequestration benefit worth US\$54,000 per year and an erosion protection service valued at around US\$170,000 a year, while the coasts in Köyceğiz-Dalyan SEPA help assimilate waste, a service valued at US\$900,000 annually. However, valuation of these services is based on value transfer estimates as scientific studies on the provision of these services at the site are unavailable.

Marine ecosystems are important in terms of employment and local livelihoods in the SEPA. The local economy is mainly based on the service sector followed by agriculture. The interconnected nature of the estuarine and marine ecosystems where the main tourism activities are concentrated renders the effective management of both systems crucial.

Table 12. Summary of valuation results for Köyceğiz-Dalyan SEPA

Service	Value/ year US\$	Valuation approach	Comment
Fish	1,399,167	Market prices	Value related to traditional estuarine fishing in Köyceğiz. This is not based on a sustainable harvest rate, which is unknown. This is a gross value – costs have not been deducted. Marine fisheries and recreational fishing not included.
Carbon sequestration	54,226	Market prices (avoided cost approach)	Assumes development of market in blue carbon credits analogous to the forest carbon market. This value is therefore not currently 'captured'. Based on market price of carbon of US\$11.2 / tCO ₂ eq and 89 ha of Posidonia meadows.
Erosion protection	171,080	Benefits transfer	Mangos et al. (2010). Based on 160,000 Euro per meter of coastline, 8.75km of Posidonia beds and 9.4% of the area at risk.
Waste treatment	900,000	Benefits transfer	Based on Mangos et al. (2010) estimate for Turkey of 229 million Euros apportioned to the study site based on length of its coastline (24.38 km).
Tourism / Recreation	48,691,598	Market prices	Based on an estimate of 746,792 overnight visits per year and average tourism expenditure per person per night (based on other Turkish MCPAs in Bann & Başak 2011a & 2011b). Day visitors and marina revenues not included. Includes daily boat tours (US\$2,851,200)1, one of the dive centers (US\$97,500) and rental fees (US\$397,688).
TOTAL	51,216,071		

Note 1/ There may be double counting here with the expenditure of overnight visitors, which including expenditure on non-specialised tours, however daily boat tours are also popular with day visitors to the area.

Opportunities to increase revenue flows from Köyceğiz- Dalyan SEPA



This section draws on the economic analysis undertaken to identify new potential income generating activities that can increase revenue flows to Köyceğiz-Dalyan SEPA.

A key component of the GDPNA-GEF-UNDP project, under which this economic assessment has been undertaken, is to identify new and innovative financing arrangements for the site. Underpinning the identification of appropriate financing mechanism is a clear scientific understanding of the services being provided by the marine ecosystem, a quantification of this service (in biophysical terms), and an understanding of its economic value and of the beneficiaries. Potential services provided at Köyceğiz-Dalyan SEPA include (in addition to fish) carbon sequestration, waste assimilation and tourism and recreation benefits.

It should be noted that other components of the GDPNA-GEF-UNDP project are focused on the identification of feasible income generating options for the site and the possible development of a business plan for Köyceğiz-Dalyan SEPA. Therefore this section only provides an overview of the opportunities for financing falling out of the economic analysis and a high level discussion of potential new and innovative financing mechanisms. Many of these mechanisms such as carbon credits for blue carbon and Payment for Ecosystem Services (PES) type arrangements are only considered to be viable in the long term due to the fact that markets in these services are still developing globally and/or institutional arrangement in Turkey do not yet permit their use.

A typology of potential financing mechanism is provided in Table 13. This categorizes potential mechanisms into external flows, mechanism for generating funding such as taxes, and market based charges. At present the site is financed through budget allocations from the Turkish government.

Table 13. Typology of potential financing mechanisms

External flows	Generating funding	Market based charges
Domestic government / donor assistance	Licensing and royalty fees	Tourism charges
Private voluntary donations	Fiscal instruments	Resource-use fees
Environmental funds & debt for nature swaps	Benefit & revenue sharing	Payments for Ecosystem services (PES)
	Cost sharing	Mitigation banking and biodiversity offsets
	Investment, credit & enterprise funds	Blue Carbon Markets

Source: Adapted from Emerton et al. 2006

Markets in marine ecosystem services are beginning to emerge around the world. Formal markets now exist to regulate commercial fisheries and potential markets are being proposed for marine biodiversity offsets and carbon sequestration. In addition focused business deals and payments for ecosystem services (PES) are being forged to invest in restoration and conservation of specific marine ecological systems and the services that they provide (Forest Trends and the Katoomba Group, 2010). The sections below discuss some of these potential financing options and their applicability to Köyceğiz-Dalyan SEPA. The focus is on opportunities for capturing blue carbon, Biodiversity offsets and PES, as innovative approaches that may present in time new and innovative financing for the site.

5.1. Tourism related revenues and charges

The tourism and recreational revenues could be increased at the site through a combination of improved management and marketing of tourism and recreational activities (discussed further in Section 6) and the identification of new revenue generating opportunities. Possible revenue generating activities include sailing and windsurfing and a project to introduce these is in development in Dalyan. The necessary infrastructure works also need to be carried out in the SEPA to support terrestrial ecotourism activities envisioned within the site's management plan.

There are 450 villas in Dalyan belonging to foreigners (mainly British). These villas are being illegally rented for £500-£1,000 a week and taxes are being avoided. The villas are full in the summer and are in competition with the hotels. This tax loop hole could be closed to both generate revenue and improve the income of local businesses (hotels and restaurants) who compete with the villas.

5.2. Marine Carbon Markets

Due to the fact that they store large amounts of carbon and are threaten by conversion and pollution, seagrasses could be a viable target for carbon finance. This would require data on carbon sequestration rates, on site storage, emission profiles and the cost of protection. There are currently no markets for credits generated by 'blue' (marine) carbon activity. A logical venue for considering blue carbon payments would be through the United Nations Framework Convention on Climate Change

Box 4. Initiatives to mitigate the impacts of boat tourism

In an effort to minimise the impact of boat propellers on the turtles, propeller cages were developed by Municipality. According to the boat cooperative, 150 propeller cages were constructed without trailing them first and have not been popular with boatmen as they inhibited the maneuvering of the boat, especially when starting up. Debris was also getting stuck between the propeller and the cage. Some boatmen are sceptical that the propellers actually hurt the turtles as in their view, the turtles would dive below the boat when they saw one. However, propeller issues are common as evident by injuries to turtles brought to the turtle hospital on İztuzu beach.

Boats do not use lights during the grey mullet migration.

Özay Akdoğan built the first solar powered boat in Turkey 6 years ago, with support from Germany, which gained its licence to operate last year. The boat is used to visit the turtles and for bird-watching tours. He is now working on the development of a battery powered boat.

The boat cooperative expressed a wish to operate with a fleet of solar powered boats that could sail on Köyceğiz Lake and the Dalyan canals. Solar boats reduce oil pollution and create less waves or ripples and therefore protect the shore and plants from erosion. The boats can sail for eight hours using solar powered batteries. However converting to solar powered or battery operated boats is expensive suggesting a role for Government in devising an incentive system to promote this activity.

(UNFCCC) process. Currently, the only blue carbon activity that could potentially be covered under the UNFCCC would be mangrove protection, possibly falling under the auspices of Reduced Emissions from Deforestation and Degradation (REDD+)¹⁴.

Global markets aimed at reducing GHG emissions offer a potentially large economic incentive to avoid the conversion of coastal ecosystems. This idea is analogous to REDD. Incentives to retain rather than emit blue carbon would preserve biodiversity as well as a variety of other ecosystem services at the local and regional scale (Murray et al., 2010).

Participation in a market for blue carbon will involve some costs associated with measuring, monitoring and verifying seagrass loss and carbon stocks, establishing a baseline against which

¹⁴ Reducing emission from deforestation and forest degradation (REDD) is a payment scheme designed to compensate landowners for the value of carbon stored in their forest that would otherwise be released into the atmosphere. REDD + additionally recognises efforts for reforestation and sustainable forestry.

emission reductions are measured, and enforcing contracts and monitoring transactions. There are no available estimates of these costs and they tend to be 'upfront' and therefore need to be carefully assessed before parties proceed with protection efforts (Murray et al., 2010).

5.3. Payments for Ecosystem Services

Payments for Ecosystem Services (PES) are contractual and voluntary transactions where a 'buyer' agrees to pay a 'seller' conditional on delivery of an ecosystem service, or implementation of a land use or management practice likely to secure that service. Following the successful development of terrestrial PES systems, markets for marine ecosystem services are now being explored and could become an important source of new finance for marine protected areas in the future. For example a PES might create a financial incentive to protect, restore, or sustain a marine ecosystem service such as shoreline protection and the provision of fish nurseries. Establishing PES often takes years, requiring detailed studies to define the service being provided (this is crucial for a credible PES), estimate its value and undertake extensive stakeholder engagement to build trust and commitment.

Payments for Ecosystem Services are not operating at present in Turkey. Currently, no state regulations or incentives for PES have been developed.

5.4. Biodiversity offsets

Biodiversity markets are a potentially powerful tool for internalising traditionally externalized costs and compensating good practices. For example, if a business has to pay to mitigate its residual impact on marine species, it either has to bear the cost of mitigation or develop elsewhere to avoid this cost. Conversely, if businesses can be financially compensated for protecting or enhancing a rare marine species or habitat there will be an economic incentive to protect habitat.

Payment systems for biodiversity compensation include: biodiversity offsets, mitigation banking, conservation banking, habitat credit trading, fish habitat compensation, BioBanking, complementary remediation, conservation certificates. Some are based on compliance with regulation while others are done voluntarily for ethical, competitive, or pre-compliance reasons. They all aim to reduce biodiversity loss and build the cost of biodiversity impacts into economic decisions through markets or market-like instruments and payments (Marsden et al. 2010).

'Species banking' and biodiversity offsets are mechanisms by which development in one location is exchanged for protection of the same species or community at another comparable habitat. While an offset that attempts to achieve no net loss is preferable from an ecological and social standpoint, less comprehensive forms of impact compensation, in which funds are set aside for biodiversity management or valuable biodiversity is protected elsewhere, can be a first step towards better biodiversity footprint management or even eventually a regulated offset system.

Marine biodiversity supports the marine ecosystem services upon which many communities depend. Where regulation for coastal and offshore development is strong, species banking and marine biodiversity offsets could become an important mechanism for marine conservation.

Conclusions and Recommendation



6.1. Conclusions

Köyceğiz-Dalyan's biodiversity supports a variety of ecosystems services that contribute to the economic welfare of a range of beneficiaries and support local communities as well as Turkey's GDP. The total annual value of Köyceğiz-Dalyan SEPA is estimated to be around US\$51 million per year. This is considered to be a conservative estimate and represents an initial attempt to value some of the key ecosystem services provided by the site, and needs to be refined through further study.

This value incorporates provisioning services - fish, regulating services - carbon sequestration, erosion control, and waste treatment, and cultural services - tourism and recreation. The values are gross estimates (that is cost have not be deducted) and some values are not yet 'captured', such as the benefits associated with carbon sequestration, and are therefore potential values. However, the estimate may be considered an underestimate in that conservative estimates have been used for example for tourism and a number of potentially important services are excluded. Ecosystems services thought to be present (or potentially present) at the site which cannot be estimated due to a lack of scientific information and/or data are - raw materials such as natural medicines, genetic resources and ornamental resources, which have yet to be studied at the site; the role the marine environment plays in micro-climate regulation, the role of the marine environment in flood and storm protection, the site's heritage value and educational value and the site's landscape and amenity value.

Around 95% of the total value of the SEPA is attributed to tourism and recreation, highlighting the importance of sustainably managing the area's marine and coastal natural resource base, upon which this value is dependent. According to one hotel owner over the past 7 years the tourism sector has 'lost more than it has gained'. There is an increasing trend to use intermediary agencies (big tour operators bring big tour groups from Fethiye and Marmaris), resulting in lower prices and a loss of quality. A decision needs to be taken on how to manage area as there is a real risk that mass tourism will destroy the area.

Regulating services total US\$1,125,306 a year and are mainly based on the natural waste treatment capacity of the coastlines/lagoons and the ecological functions performed by the Posidonia

meadows found in the SEPA. The continuous flow of these ecosystem services can only be ensured if the inputs both from the agrico chemicals entering Köyceğiz Lake and the impact of tourism activities (i.e. excursion boats' bilge water, wastes of housing and other developments especially in Dalyan) are properly monitored and controlled.

The value of fisheries is estimated at US\$1,325,967 per annum for the lagoons of the SEPA. This assessment does not include the value of the marine fisheries in the SEPA, recreational fisheries or the illegal trawlers making use of the SEPA's waters.

The estimated value may be based on under reporting of the actual catch, however it may better reflect a sustainable fishery resource value. Unfortunately, available scientific studies raise concern about the current situation of the mullet harvesting, the main targeted species in the lagoons. It is suggested that 70% of the grey mullets trapped in the fish traps during the migration period consist of species that have not reach sexual maturity (Çınar Mühendislik, 2007). Therefore, the economic value should be based on a sustainable harvest level, which is not specified for the area. Consistent analysis of fish stocks are therefore needed to assess the sustainability of the fishery.

The marine environment is also important in terms of employment and local livelihoods in particular in the services sector. The income sources of the local populations both in Köyceğiz and in Dalyan are heavily dependent to the tourism activities such as daily marine and lagoon tours, eating and accommodation during the summer months.

The geographic location of Köyceğiz-Dalyan SEPA between Datça-Bozburun and Fethiye-Göcek SE-PAs makes it the ideal stop-over point between sites and highlights the need for integrated and holistic management of all the marine sites along the coast.

As outlined in Table 1, the site faces a range of pressures including marine pollution, infrastructure and housing development and illegal fishing activities, which if left unchecked could undermine the SEPA's important ecological assets.

6.2. Recommendations

The key recommendations of this study are provided below. These recommendations highlight

priorities in terms of the future economic valuation of the site's ecosystem services as well as priority management issues.

General management issues

- The management plan for Köyceğiz-Dalyan SEPA has already been prepared (Çınar Mühendislik, 2007) and in depth studies have been conducted for promoting ecotourism in the region (e.g. developing hiking trails and biking tracks around the lake). However, the management plan is not being implemented effectively due to bureaucratic and financial impediments which need to be overcome.
- The development of Dalyan town should be controlled as population growth and urban sprawl into rural/agro-ecosystems is already putting significant pressure on the SEPA.
- GDPNA's authority for managing and implementing the management decisions for Köyceğiz-Dalyan, one of the first SEPA sites in Turkey, remains ineffective despite their actual presence at the site (Köyceğiz-Dalyan is one of the few sites where GDPNA has a site office). This needs to be addressed.
- In terms of the conservation of Köyceğiz Lake:
 - * New aquaculture initiatives should not be allowed on streams and rivers feeding Köyceğiz Lake and currently existing aquaculture operations should improve their waste management;
 - * Agricultural expansion should be monitored along with the use of agro-chemicals (this is also important for the conservation of fish stocks in the lake and lagoon systems);
 - * Detailed stock and population dynamics studies should be conducted on the invasive *Tilapia* ve *Oreochromis* species in order to assess their role and impact on Köyceğiz Lake and the lagoons' food chain.

Fishery valuation and management

- Fisheries in the SEPA need to be monitored economically, ecologically and biologically. Understanding the economics of fishing is key to the development of sustainable fisheries management plans.
- The valuation of fisheries should be based on a sustainable harvest rate (quantity) multiplied by revenues minus costs. Scientific studies of fish stocks are therefore required to determine sustainable harvesting rates.

- Time series data is needed to understand the change in stock overtime and to monitor whether or not the fishery is on a sustainable path.
- Sustainability of DALKO's fishing practices should be monitored more tightly, especially during the twice yearly migration of the targeted Mugil species.
- The number of fishermen in the Dalyan lagoons (ie. DALKO memberships) should be limited by a quota. This requires better coordination between the relevant public authorities such as MoFAH, GDPNA and others as well as improved inspection.
- Continuous training should be given to DALKO members and other fishermen on the importance of releasing the smallest and largest fish caught in the fish barriers.
- Better data collection on visitors is needed to assist planning efforts (visitor numbers, profile, motivation for visit). It is difficult to plan successfully without reliable estimates of visitor numbers, and these currently do not exist. Airlines could perhaps be utilized to collect this information for all the SEPAs in the Province.
- Better signage and information for visitors and residents on the ecological and archeological importance of the area and its protection status. Everyone visiting the site should be aware that it is a protected area. The tourism sector could play a role in disseminating this information. There is a tourism school in Dalyan where such issues should be clearly presented. This would help strengthen the area's image / brand and improve the quality of the tourism offering.

Developing a sustainable tourism industry

The area's natural resources including its unusual canal and lagoon system are the main reasons for tourism development in Dalyan region (Çınar Mühendislik, 2007). Tourism needs to be developed and managed in a way that complements that area's status as a marine protected area. A number of opportunities exist for developing the tourism experience in Köyceğiz-Dalyan, and hence contributing to the maximization of the long term revenues from tourism and recreation at the site. Recommendations include:

- A study of the site's marine and terrestrial tourism carrying capacity to understand the limits to tourism development in the area. This is particularly required for Dalyan straight, the lagoons and İztuzu beach.
- Development of a tourism master plan / strategy for the SEPA taking the carrying capacity of the area into account. Development of the ecotourism sector will require a strategy and marketing of the SEPA's range of attractions and activities that have already been defined in the site's management plan. This strategy should identify options for alleviating tourism pressure on the coasts and lagoons of Dalyan by redirecting tourism to other sites around Köyceğiz.
- A site specific survey is needed to generate information on tourist expenditure and willingness to pay in the area. Given the importance of tourism to the site, a detailed economic impact study and /or valuation study could be considered.
- High quality tourism will require better facilities and proper marketing. Boutique hotels should be promoted in Dalyan and incentives should be considered for small businesses to maintain the character of the area and resist the move to mass tourism.
- The amount of boat traffic (close to 500 registered boats plus illegal boats) threatens the lagoon's ecological integrity. Uncontrolled speed and noise of the boats disturb the marine/estuarine species. Day boat excursion operators must obey the rules of conduct defined in the Regulation of Boats working in Köyceğiz Lake & Dalyan Canals. This needs to be better enforced through fines and self control mechanisms. Awareness raising / education courses for boat captains on the environmental features of the area and its conservation value are recommended.
- Respective daily tours conducted between Fethiye-Göcek and Köyceğiz-Dalyan SEPAs illustrate the close proximity and connectivity of these two protected areas and the importance of marine tourism across the sites. Therefore, these SEPAs should be considered as a whole and managed accordingly.

Refining the valuation of the site's regulating services

- Economic valuation is underpinned by good scientific evidence. This is often particularly important for regulating services. Site specific scientific studies of the provision of regulating services (i.e. carbon sequestration, erosion control, flood and storm protection and waste assimilation) are required to better understand these services and inform the valuation. Information is needed on how a change in the structure and function of ecosystems leads to changes in the provision of ecosystem services, and how changes in the provision of ecosystem services affect human well-being.
- A priority area of research is site specific studies of the carbon sequestration and storage rates of Köyceğiz-Dalyan's Posidonia meadows. This would position Turkey to potentially benefit from the emerging market in Blue Carbon.

Time series analysis and Socio-economic studies

- In line with GDPNA's intention to carry out regular biodiversity assessments and socio-economic studies at the different SEPAs of Turkey, valuation studies should be carried out in Köyceğiz-Dalyan's SEPA at regular intervals in order to observe changes in the value of benefits derived from the range of ecosystem services and the trade-offs that occur between these. Ideally valuation studies should look at different scenarios and thereby help choose between different management options for the area and cast light on the site's sustainability.
- A socio-economic study specific to Köyceğiz-Dalyan's SEPA could be undertaken to better inform the development of the area and guide the design of possible mechanisms to promote benefit sharing among local communities.

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ANNEX 1 - PEOPLE INTERVIEWED DURING THE FIELD VISITS (16-20 MARCH 2012)

Interviewees	Name	Title
Food, Agriculture, Animal Husbandry Directorate	İsa Özden	Engineer
Köyceğiz Governorship	Yücel Gemici	Governor
Köyceğiz District Tourism and Culture Information Office	Neşet Menteşeoğlu	Director
GDPNA Köyceğiz Office	Lütfü Yıldız	Officer
Köyceğiz District Youth and Sports General Directorate	Mehmet Kaleli	Officer
Flora Otel	Alp Giray	Hotel owner/conservationist
Paşa Boats (Köyceğiz)	Erol Paşa	Owner
Çandır Boat Cooperative	Ümit Şahin	Cooperative head
Kardak Tourism (Dalyan)	Özay Akdoğan	Owner
Köyceğiz Tourism and Environment Association	Ömer Ofıaz	Chair person
Dalyan Municipality	Arif Sarı	Head of municipality
Köyceğiz Municipality	Salih Erbay	Head of municipality
DALKO-Dalyan Fisheries Cooperative	Muhammed Aktaş	Cooperative head
Pegaso Project (Integrated Coastal Zone Management Mediterranean & Black Seas) & MEDCOAST	Prof. Erdal Özhan	Project leader & Founder
Sea Turtle Center /DEKAMER (Research Centre of Pamukkale Univ.)	Prof. Dr. Yakup Kaska	Director
Dalyan Boat Transportation Cooperative	Atilla Gültekin	Cooperative head
Kaptan June Foundation	June Haimoff	Founder
Dalyan Diving Center	Erđinç Dönmez	Co-owner



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