

## Scientific rationale for the proposed CIESM South Adriatic Sea Marine Peace Park

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### SUMMARY

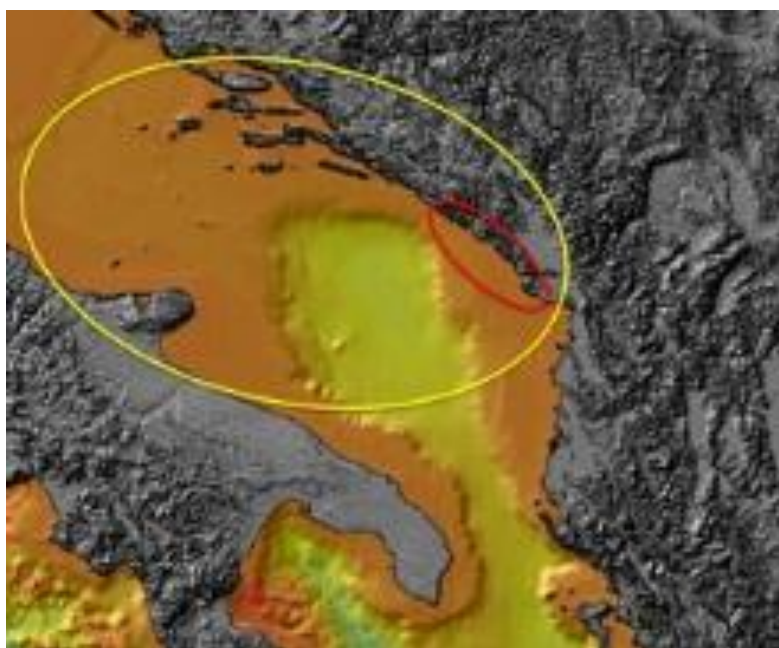


Figure 1. Shaded bathymetry of the CIESM South Adriatic Sea Marine Peace Park (within yellow circle) based on swath bathymetry (DTM at 500m grid). Adapted from L. Brosolo and J. Mascle (2007).

The proposed area, South Adriatic, covers a domain including parts of the central Croatian and Montenegro coasts, and northern Albanian shore on the Eastern Adriatic (Figure1). On the Western side of the Adriatic it extends from Manfredonia to Brindisi in Italy. The onshore area is geologically quite homogeneous, dominated by limestone outcrops that belong to the Mesozoic Apulian platform. The central Adriatic region displays several specific morphological features such as the Jabuka Pit and the Palagrusa sill and deeper areas to the north with a

maximum depth of 270m. The South Adriatic Pit is the dominant morphological feature of the Southern Adriatic. Dense water formed on the Northern Adriatic shelf accumulates in the Jabuka Pit. Along the eastern border of this Pit during summer, wind driven upwelling makes the area potentially rich biologically. The South Adriatic Pit is an area of open ocean convection and dense water formation, whose intensity depends on the air-sea heat flux and buoyancy content. In

the centre of the South Adriatic Gyre the spring phytoplankton bloom is associated with vertical mixing and nutrient input into the euphotic zone. The northern part of the proposed area has been included (together with the northern Adriatic) in lists of important areas for biodiversity in the Mediterranean, such as in potential SPAMI candidates, in the Ecologically or Biologically Significant Areas (EBSAs), in the priority conservation areas for sea birds, and in the priority conservation areas considering the impacts of fisheries in the open seas, including the deep sea. A considerable number of key and endangered species are found in this area. The seagrass *Posidonia oceanica*, several cetacean species, many waterfowl, the monk seal, the loggerhead turtle, and the otter are among the most important globally threatened species of this area. This area is characterized by several unique and sensitive habitats, especially in the south-eastern part. Neretva and Buna/Bojana river deltas, besides their role as sheltering habitats, are also important as migration corridors, especially for fish and bird species. Several MPAs have been instituted in Italy and Croatia, and regionally important Coastal Protection Areas (CPAs) in the Montenegro and Albania. Increasing human occupation of the coastal zone, with localised pollution, increasing fishing effort, maritime traffic, recreational use of the sea, habitat degradation, sewage discharge and agricultural wastes are among the main threats to this area. In recent years, there has been increasing interest in research and environmental work in the southern part of the proposed area, where studies and knowledge are more limited. This work is enlarging the database on marine biodiversity of the southern Adriatic, and improving biodiversity conservation and management in this region. Countries in the eastern Adriatic (Croatia, Montenegro, Albania) are making important steps towards fulfilling the environmental criteria and standards for their accession to EU structures: from this point of view, their involvement in the CIESM initiative for establishing coast-to-coast Marine Parks is another progressive step.

#### **KEY GEOLOGICAL FEATURES**

Generally, in the South Adriatic, the onshore area is geologically quite homogeneous dominated by limestone outcrops which belong to the Mesozoic Apulian platform, a former shallow region of a passive continental margin. On the Italian side, these rocks have only been fractured during their deposition, while on the Eastern side they are incorporated into tectonic units, the 'Apulian nappes' emplaced along the frontal domain of the Dinarides and Hellenides during the Alpines orogenies. These thick piles of limestone are characterized by intense karstic processes, resulting in their dissolution, and the creation of numerous caves and frequent underground freshwater drainage systems.

Specific morphological features of the central Adriatic include the Jabuka Pit and the Palagrusa sill and deeper areas to the north with a maximum depth of 270m. The South Adriatic Pit is the dominant morphological feature of the Southern Adriatic. A number of islands, made mainly of massive limestone, are present in the area, which due to their isolation and abundant caves host numerous endemic species.

#### **KEY OCEANOGRAPHIC FEATURES**

Jabuka Pit is a sink for some of the dense water formed on the Northern Adriatic shelf that flows along the Italian coast. This water partly sinks into the pit and partly continues southward over the Palagrusa sill. The renewal of bottom water in Jabuka Pit does not occur every year, but depends on the density of the newly formed water; thus ventilation of the bottom layer is not necessarily an annual occurrence.

Along the eastern border of Jabuka Pit, during summer, the wind drives upwelling making the area potentially biologically rich. Along the Italian shelf, fresher water of terrestrial origin flows southward in the form of the coastal boundary current, separated from the open sea by the coastal front. To the south of the Gargano peninsula (Gulf of Manfredonia) there is a semi permanent anti-cyclonic gyre.

The South Adriatic Pit is an area of open ocean convection and dense water formation, whose intensity depends on the air-sea heat flux and buoyancy content. The buoyancy content depends on the salinity of the inflowing water from the Ionian Sea. The bottom layer is renewed by dense

water from the northern Adriatic shelf that sinks in the Bari canyon and occupies the deepest part of the South Adriatic Pit.

In the centre of the South Adriatic Gyre, the spring phytoplankton bloom is associated with vertical mixing and nutrient input into the euphotic zone. The bloom is occasional, taking place over several days up to one week, depending on the frequency of cold air outbreaks and subsequent re-stratification. Inter-annual variability of the vertical convection, and consequently of the bloom, is rather prominent, and depends on both the buoyancy content of the water column and the winter air-sea heat fluxes.

Ionian waters enter the Adriatic close to the Albanian side (East Adriatic Current) and flow out along the Apulian side (West Adriatic Current), forcing a basin-wide cyclonic circulation. This circulation is subdivided into three cyclonic sub-circulations, occupying the northern, central and southern portions of the Adriatic, trapped by bathymetry (the central one being centred on the Jabuka Pit, the southern one on the Southern Adriatic Pit). Focusing on the southern gyre, surface and subsurface cyclonic circulations may provide an important link between the Marine Protected Areas located on the Eastern and Western coasts of the central and southern Adriatic Sea. This ensures possible exchange of hydrological and biogeochemical characteristics as well as organisms from the eastern to the western side.

At an intermediate and deep level, communication is ensured throughout the whole water column by intense convection occurring in relation to the South Adriatic Pit, originating in the South Adriatic Deep Water. Whilst on the western side of the basin coastal/deep-sea mixing is further enhanced by the overflow and deepening process of the North Adriatic Deep Water. This water is funnelled by gravity and submarine canyons from the shelf break to the continental slope before exiting, along with the surface waters, through the Otranto Channel into the Ionian Sea and the Gulf of Taranto.

## BIOLOGICAL FEATURES

### General information about biodiversity

There is a significant difference in knowledge of marine biodiversity between the north-central and southern parts of the Adriatic Sea. The Northern Adriatic has been studied for many decades, while in the southern basin, especially in the south-eastern part, data about marine biodiversity are more limited.

The northern part of the proposed area has been included (together with the northern Adriatic) in lists of important areas for biodiversity in the Mediterranean, such as the potential SPAMI candidates (UNEP/DEPI/MED WG.348/5), in the Ecologically or Biologically Significant Areas (EBSAs), in the priority conservation areas of sea birds (UNEP/DEPI/MED WG.348/inf.5) and in the priority conservation areas considering the impacts of fisheries in the open seas, including the deep sea (UNEP/DEPI/MED WG.348/inf.4).

In recent years the central eastern Adriatic has started to become a focal point for marine research. Recent projects, including the UNDP/Croatian Ministry of Environment/GEF project "Conservation and Sustainable Use of Biodiversity in the Dalmatian Coast through Greening Coastal Development (COAST)" and the WWF Mediterranean Gap Analysis, have identified the islands of Vis, Lastovo, Mljet and their surrounding waters as a priority for Mediterranean conservation. The UNDP Coast project has integrated information from many of the national institutes, non government organisations and universities in Croatia. This list includes the University of Zagreb, the Croatian Natural History Museum, the Institute for Oceanography and Fisheries, the University of Split, and the Blue World Institute.

The Croatian Adriatic is fringed with over 1000 islands, islets and semi-submerged reefs. Within these dense archipelagos are numerous varied environmental niches including mud bottoms, substantial *Posidonia* meadows, limestone reefs and sandy bottoms, many of which have not been fully investigated and mapped. There are offshore island areas thought to have high levels of biological diversity, partly due to their isolation. These are the Vis archipelago, Jabuka, and Palagruza (United Nations Development Programme (UNDP), 2005). In addition the underwater

regions around the islands of Lastovo and Mljet are considered as highly important and listed in protected area networks.

The eastern coast of the proposed park is known for high diversity of birds, especially waterfowl. On the continental shoreline there are other areas of importance for birds. The Neretva Delta contains the largest complex of wetlands in the Croatian littoral, with well developed coastal vegetation, as well as floating and submerged flora. The area is important for central and northeast European bird populations (Muzinic, 2007).

Much of the Croatian Adriatic has been identified as important for the Croatian National Ecological Network (CroNEN) as part of the Bern convention. Some of the same sites, and others, have been listed as potential Natura 2000 sites for when Croatia joins the EU.

Biodiversity in the southern Adriatic is less known. Data about zooplankton, benthic invertebrates, fish and large marine vertebrates are limited. Although the region is generally considered to be of low productivity, in the open waters of the southern Adriatic, micro-phytoplankton including diatoms is quantitatively important (Fonda Umani, 1996). A recent aerial survey for large marine vertebrates has also suggested that there may be rare species, previously unrecorded, inhabiting the region (Fortuna *et al.*, 2010).

The coastal terrigenous mud biocenosis is well developed along almost the entire south-eastern Adriatic, and particularly well developed in areas with relatively weak bottom currents. Sessile form facies are formed through a prolonged process of sedimentation; these are widely distributed and economically important for the coastal demersal fishery. Many economically important commercial species are found in this area, such as picarel, red mullet, hake, squid, cuttlefish, octopus, as well as many selachian species. In the infralittoral, *Posidonia oceanica* meadows are in relatively good conservation pristine status. Deeper bottoms are characterized by high gradients that host pristine sciaphilous assemblages. Coastal and open water detritic bottom biocoenoses, as well as bathyal mud biocoenoses are also present in this area.

The south eastern corner of the proposed area (including north Albania and south Montenegro) is an important area for the coastal biodiversity and includes sensitive coastal habitats. The Buna/Bojana delta shelters a high proportion of coastal biodiversity of the southwestern Balkans. The role of this area is particularly important for certain vertebrates such as birds, fish, mammals, reptiles and amphibians. One of the most important ecological features of the area is migration, especially for globally threatened species fish and bird species. This area is a part of one of the three migration routes of European birds in the north – south direction. It plays a very important role for maintaining bird diversity at regional level, also sheltering species of global conservation concern and species of European conservation concern (see information in the paragraph below).

In recent years, there has been increasing interest in research and environmental work in the southern part of the proposed area, mainly through the implementation of projects at national, bilateral and regional scale, with the participation of universities and research institutions, such as University of Salento, University of Bari, CNR Lesina, University of Split, University of Zagreb, Ruder Boskovic Institute, University of Podgorica, Institute of Marine Biology in Kotor, University of Tirana, University of Shkodra, among others. An important contribution is also provided by non-governmental organisations, especially studies of cetaceans, marine turtles, fish, birds and macrobenthos. These NGOs, include the Tethys Research Institute (Italy), the Blue World Institute of Marine Research and Conservation (Croatia), and the Association for Protection of Aquatic Wildlife of Albania. This work is enlarging the data on marine biodiversity of the southern Adriatic and contributing to the improvement of biodiversity conservation and management in this region.

#### **Presence of endangered/key species**

Meadows of *Posidonia oceanica* are widely distributed and in relatively good condition along parts of the eastern coast of the proposed area.

The central Adriatic is an important region for cetacean species. Since 2007, cetacean research has been undertaken around the Vis archipelago; bottlenose dolphins (*Tursiops truncatus*) are regularly seen, and the presence of mother and calf groups indicates that this area may be important for this species. In addition to bottlenose dolphins, surveys also encountered other animals like

giant devil rays (*Mobula mobular*), blue-fin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), as well as birds like Eleonora's falcon (*Falco eleonora*), Manx shearwater (*Puffinus puffinus*), Cory's shearwater (*Calonectris diomedea*) and European shag (*Phalacrocorax aristotelis*) among others (Holcer *et al.*, 2010). A recent aerial survey for large marine vertebrates indicates that this region hosts fin whales (*Balaenoptera physalus*), particularly around the Palagrusa archipelago where they are sighted on a regular basis. Striped dolphins (*Stenella coeruleoalba*) can be found in the middle of the Adriatic, and Cuvier's beaked whales (*Ziphius cavirostris*) (Figure 2) and Risso's dolphins (*Grampus griseus*) are found on the edges of the Southern Adriatic Pit (Fortuna *et al.*, 2010) (Figure 3).



Figure 2. Cuvier's beaked whales on the edge of the south Adriatic Pit.

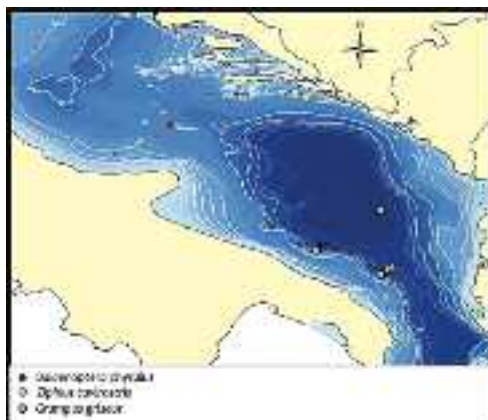


Figure 3. Rare cetacean species of the southern and central Adriatic.

Other globally threatened species may also be encountered in the proposed area. The Mediterranean monk seal (*Monachus monachus*) is believed to be a transient in the region. The loggerhead turtle (*Caretta caretta*) can also be found in large numbers and is believed to be resident year round (Lazar, 2010; Fortuna *et al.*, 2010). Finally, the otter (*Lutra lutra*) is found around river mouths and deltas, particularly in the southeastern region of the area (MacDonald and Mason, 1994).

The Neretva delta and river feeds a large number of protected species, provides breeding grounds for certain fish and crabs, and is important for fish and bird migrations. There are 310 bird species in the Neretva Delta and 115 of them are nesting. Some endangered European species, like the great bittern (*Botaurus stellaris*), the ferruginous duck (*Aythya nyroca*), the snowy plover (*Charadrius alexandrinus*), the common snipe (*Gallinago gallinago* L.) and other species, like the baillon's crake (*Porzana pusilla*) and the moustached warbler (*Acrocephalus melanopogon*) (Mrakovcic, 2001).

In the south-eastern part of the proposed area, around Buna/Bojana river delta in Albania and Montenegro, at least 36 globally threatened animal species (referring to the IUCN Red List of Threatened Species, 2008) have been recorded. Among them there are sturgeons *Acipenser sturio*, *Acipenser naccarii*, *Acipenser stellatus*, lampreys *Lampetra fluviatilis* and *Lampetra planeri*, 16 shark species, and birds like the Levant sparrow hawk (*Accipiter brevipes*), the European nightjar (*Caprimulgus europaeus*), the European roller (*Coracias garrulous*), the black headed bunting (*Emberiza melanocephala*), the lesser gray shrike (*Lanius minor*), the woodchat shrike (*Lanius senator*), the black-eared wheatear (*Oenanthe hispanica*), the Eurasian scops owl (*Otus scops*), the Eurasian spoonbill (*Platalea leucorodia*) and the common redshank (*Tringa tetanus*).

### Critical habitats and unique communities/ecosystems

Within the central Adriatic are a number of islands some of which, including Jabuka and Brusnik, are formed from volcanic rock (Pelleri, 1942; Tučan, 1953). Many of the islands, due to their isolation, host endemic species, including reptiles and mammals (UNDP, 2005). Jabuka island has particularly high biodiversity. Zavodnik *et al.* (2000) review surveys around and on the island of Jabuka and identify 300 taxa, more than 150 of them noted for the first time for the area. In addition, 159 taxa were identified during a dive survey of the near shore. Jabuka Pit, adjacent to the island of Jabuka, is also the most important spawning and nursery ground in the Adriatic Sea for European hake (*Merluccius merluccius*) and Norway lobster (*Nephrops norvegicus*) (Vrgoč *et al.*, 2004). The cold, nutrient-rich waters generated in winter in the northern Adriatic accumulate in this depression, making the area a site of strong nutrient re-cycling processes (Zavatarelli *et al.*, 1998; Artegiani *et al.*, 1997).

The area around the Palagruža archipelago is also an important fishing area with productivity related to the mixing of waters from the northern Adriatic with the southern Adriatic (Vilibić and Supić, 2005). The Palagruža archipelago is also considered an important habitat for fin whales (*Balaenoptera physalus*) that are sighted on a regular basis in this area. The Vis archipelago is a habitat for a resident population of bottlenose dolphins (*Tursiops truncatus*) (Holcer *et al.*, 2010).

The Neretva river region is unique in Croatia as a marsh delta. It provides numerous habitats important for nesting bird species. Nesting is important in the cane fields, on the sand beaches and the trees. The mouth of Neretva provides a nursery habitat for fish and crustacean species. The river also functions as a gateway for fish migrations (Muzinic, 2007).

The karst limestone coastline found along the eastern border of the Adriatic Sea provides a diversity of unique threatened habitats (Bakran-Petrcić and Petrcić, 2008). Within the karst system, a number of unique habitats can be found such as anchialine caves, sea caves, cold saltwater caverns with bathyal elements, submarine springs, karstic estuaries, saltwater lakes and submarine bare karst stone. These are all considered as endangered in Croatia (Ministry of Culture of the Republic of Croatia, 2009).

On the Italian coast (Gulf of Manfredonia) of the proposed area, the Varano and Lesina lagoons are important habitats for bird sheltering and nesting, especially waterfowl, as well as spawning and nursery sites for fish. In this area, several studies have been carried out on benthic assemblages (Marzano *et al.*, 2003; Munari *et al.*, 2009). Attempts have been made to analyse the affinity between the zoobenthic assemblage recorded in the hyperhaline lagoon of Karavasta and the assemblages from two Italian lagoons, the brackish Lake of Lesina and the euhaline Lake of Fogliano, according to the different hydrological conditions and the geographical location (Marzano *et al.*, 2010). In the Gulf of Manfredonia, previously considered an area essentially dominated by muddy assemblages, extensive coralligenous banks have been found (Terlizzi, unpub. data); this represents important information in terms of spatial planning, since this area was recently selected for development as a wind farm area.

In the South Adriatic Pit, a significant *Nephrops norvegicus* – *Thenea muricata* biocoenosis is present. Recent data suggests that this area could also be important for endangered cetacean species such as Cuvier's beaked whale (Fortuna *et al.*, 2010).

The south-eastern corner of the proposed area represents a large transboundary ecosystem between Albania and Montenegro, the delta of Buna/Bojana River (Figure 4). This ecosystem is important



Figure 4. Aerial view of Buna/Bojana delta (Albania & Montenegro).

on a regional scale in terms of biodiversity and hydrology. The Buna/Bojana delta, with Ada Island in Montenegro, the Velipoja coastal forest in Albania, the whole river bed and the Shkodra/Skadar Lake from whence the river flows, has been proclaimed a Ramsar site and an international IBA (Important Bird Area). The mouth of the Buna/Bojana facilitates fish migration from Shkodra Lake and its watershed into the Adriatic Sea. It also links the lakes of Ohrid and Prespa through their connection with Drin River, which joins Buna upstream. This effectively covers a large hydrographic network of the southwestern Balkans, including Albania, Montenegro, Kosovo, Former Yugoslav Republic of Macedonia and Greece. At least 13 fish species and subspecies migrate through Buna/Bojana mouth, of which 6 are globally threatened. The Buna/Bojana delta offers important food sources for fish, spawning grounds, nursery and migration paths on which fish stocks depend (either within the wetland or other habitats connected to them). This area is also very important hydrographically, and is well-known for its high ecological sensitivity. The so called “hydrologic junction” Shkodra Lake - River Buna - River Drin determines the hydrological regime of Shkodra Lake, River Buna itself, and their tributaries, and has an important impact on the morphology and water regime in Buna delta in the south-eastern Adriatic.

In its northern part, in Montenegro, the saltpan (salina) of Ulcinj, is an important site for bird sheltering and nesting, and Ada Island, an interesting habitat as a wetland and alluvial forest, with many globally threatened species of plants and nesting birds (Schneider-Jacoby *et al.*, 2003).

In the southern part of the delta, in Albania, the small Island of Franz Joseph (Figure 5) is well-known for the rare flora and fauna, and as a nesting site for globally threatened birds. It is a very sensitive area that, due to coastal erosion, often changes shape and size, shifting from an island to a promontory and *vice-versa*.

The Velipoja forest reserve, an alluvial coastal forest and a wetland complex created by Buna delta and the Adriatic Sea, is well-known for the high diversity of flora and fauna, including rare and threatened species at national and regional scales.

The Viluni lagoon, situated about 7 km south of Buna mouth, is known for its high diversity of fish, invertebrates and especially waterfowl of global concern.



Figure 5. Franz Joseph Island (Albania).

Baks Rrjollli coastal zone – Rana e hedhun (Blown sand) (Figure 6) - represents an interesting combination of habitats with karstic caves, mountain slopes, sandy dunes, alluvial forest, tamarisk marshes, and interstitial pools combined with an excellent beach. The Blown Sand is an active dune 50 m high, 600 m long and 100 m wide, accumulated on a rocky coast by wind, a unique habitat in the Adriatic. This area gives shelter to nesting bird species of regional and global concern.



Figure 6. The sand dune “Blown sand” (Rana e hedhun) (Albania).

### MAIN THREATS

The proposed zone faces similar threats to those found in all marine environments, increasing human occupation of the coastal zone, with related localised pollution, increasing fishing effort, increasing maritime traffic and increasing recreational use of the sea, besides the global threats of climate change, ocean acidification and invasive species. Being the most northern arm of the semi

enclosed Mediterranean, the Adriatic as a whole is strongly influenced by the adjacent terrestrial area. Yet it remains relatively well preserved on its eastern side due to political isolation during the cold war period. However, Croatia, Montenegro and Albania have undergone significant change over the last 20 years. Associated with this has been an increase in human population density in the coastal zone, and accompanying urban development. In some areas these developments have been uncontrolled, causing considerable impacts to marine biodiversity and environment.

Habitat degradation is also related to increased human activity, urban development, and sewage and agricultural discharges in the coastal area. Chemical water pollution in the area is mainly due to industrial activity, especially on the Italian coast. Also of concern for the Gargano area and Tremiti Islands are chemical residuals from the 2nd World War. Perhaps the most polluted region of the eastern Adriatic is located in the northern part of this area. Kaštela Bay north of Split, Croatia's second city, hosted a chlor-alkali cement works between 1950 and 1990 as well as other heavy industry, and the bay remains contaminated with inorganic mercury and other heavy metals (Kljakovic-Gaspic *et al.*, 2006). Other major towns and cities along the Croatian coast have inappropriate waste water treatment with high levels of faecal coliforms in adjacent waters (World Bank, 2008).

Excessive tourism can be found in some localised areas, such as Velipoja beach in Albania, and Velika Plaza in Ulcinj, Montenegro. In Croatia, where tourism is the largest contributor to GDP, there are numerous islands, including Mljet, Lastovo, Vis, Korcula, Hvar, Brač and Solta, subject to high levels of seasonal migration related to tourism, as well as hosting fishing communities and agriculture (Mackelworth and Caric, 2010). Additionally, sites along the coast host major tourist populations in the summer season, including in and around the major cities of Split and Dubrovnik.

The sensitive areas around the Buna/Bojana and Neretva rivers are threatened by untreated waters from large watersheds. Neretva is also threatened by increasing agricultural development. The extensive karst ecosystems face similar threats from polluted water sources. These sensitive karst systems also face disturbance from diving tourism, similar to those seen on coralligenous facies.

Increasing maritime transport, with merchant, ferry and cruising tourism, is another important factor affecting marine biodiversity. Maritime transport is one of the main reasons for increased pollution, noise and disturbance in marine waters. The impact of noise is of major concern, especially for cetaceans, since the central Adriatic is an important area for these animals. The area around Dubrovnik faces threats from increasing pollution from visits by cruise liners, associated with this waste water pollution, solid pollution (including plastics), and air pollution (Caric, 2010).

Marine traffic also increases the transport and introduction of invasive species. Perhaps the greatest threat is from *Caulerpa taxifolia* and *C. racemosa*, both of which are overwhelming habitats in the region. Since 2001, *C. taxifolia* has been present in Stari Grad Bay, Hvar Island (Zuljevic and Antolic, 2002). Although data on alien and invasive species for this area are limited, a recent assessment in the shallow coastal waters of Albania and Montenegro, together with existing data, has recorded about 23 alien species for both countries, including macroalgae, macrophytes, annelids, crustaceans, molluscs and fish (Beqiraj *et al.*, in press).

On the Albanian coast, erosion has become a major problem in the last 3 decades, mainly related to human activity and especially to hydrological changes and river damming. In the Buna/Bojana delta, the Velipoja coast is one of the areas highly impacted by coastal erosion, and of Franz Joseph Island is rapidly losing its surface.

Finally, uncontrolled and illegal fishing practices are important threats to marine biodiversity in the Adriatic, and have a significant impact on fish stock depletion. High fishing pressure and non-selective fishing gear has already affected the demersal ecosystem and species biodiversity around the regions of Jabuka Pit and the Palagruza Sill (Jukic-Peladic *et al.*, 2001). Depletion of catches in Albanian waters is mainly related to overfishing, water pollution, and habitat destruction. Generally in Croatia, the development of the industrial pelagic fishery threatens to overwhelm fish stocks if unchecked (Mackelworth *et al.*, 2011). Ghost nets are also a threat to sensitive ecosystems, such as coralligenous facies.

### PROPOSED MODIFICATIONS OF ZONE BOUNDARIES AND JUSTIFICATIONS

It has been proposed to exclude most of the Montenegrin coast and territorial waters from the South Adriatic Sea Peace Park, since the inclusion of the whole coastline was deemed to be impractical and politically sensitive.

The area was extended in the central part of the Adriatic, aiming to cover three important geological and oceanographic features, the southern Adriatic Pit, the Palagruza Sill and the Jabuka Pit.

The Albanian part has also been reduced to exclude the most southern segment, due to the high impact of pollution and uncontrolled development in that segment.

The Albanian part is extended from Buna/Bojana river mouth to the Shengjini rocky coast (about 25 km of coastline), while the Montenegrin part is from Buna/Bojana river mouth to Ulcinj saltpan.

### CURRENT MPAS AND REGULATIONS

There are a number of protected areas in the region. Marine Protected Areas (MPAs) have been proclaimed in Croatian and Italian waters, while in Montenegro and Albania the currently existing protected areas within the proposed area have the status of Coastal Protected Areas (CPAs).

There are three protected areas in the Croatian part including a marine component: Mljet National Park, Malostonski Bay Special Reserve and Lastovo Park of Nature (Figure 7). Mljet National Park is managed mainly for ecosystem protection and recreation, with the original designation based on terrestrial aesthetics rather than biodiversity. At the time of designation, there was little available scientific data that would justify protective measures, and, it was only recently that the national park boundaries were extended to include surrounding marine areas (Benović *et al.*, 1999). Mljet National Park is under pressure predominantly from tourism, with additional problems regarding illegal construction on the islands, localised pollution, uncontrolled access, and illegal fishing by visitors and the local community. Malostonski Bay was designated a Special Marine Reserve, officially managed mainly for scientific reasons. However, this site was designated for historical bivalve aquaculture areas that have been protected with the aim of conserving present and future bivalve production (Benović *et al.*, 1999). But recreational use of the bay continues, with increasing risk of pollution that could threaten the integrity of bivalve production. In 2006 the Lastovo archipelago, which represents the second largest protected marine area in the country (UNEP-MAP RAC/SPA, 2007) was established for both terrestrial and marine natural values, archaeological findings, and a rich cultural heritage. It has been designated on biological grounds, but with the concept of multiple-use as part of its rationale. However, despite consultations, initial local support for the designation appears to have declined (Frankic, 2004; WWF, 2006).

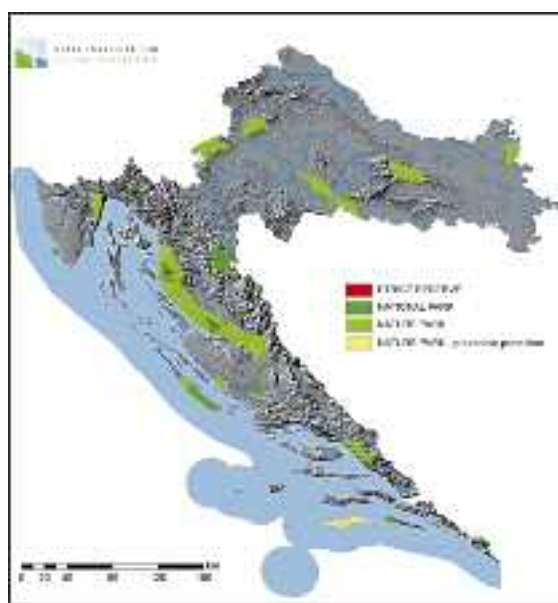


Figure 7. Protected areas in Croatia.

Additionally within the Neretva Delta is a Ramsar site, Mediterranean Specially Protected Area, Ornithological Reserve, Zoological Reserve and Protected Landscape Area. The Delta, its associated salt marshes, saline lagoons, sand banks and wet meadows are of considerable importance for wintering and staging birds and for several species of breeding birds. Large parts of the area have been subject to drainage and agricultural development, increasing road construction, urbanization and hunting.

Marine conservation has lagged behind terrestrial conservation in Croatia, and less than 1% of the territorial sea is protected. Generally protected area management capacity and political will has been lacking (Frankic, 2004). Recently, EU tenders have started to focus on marine conservation, and the Marine Natura 2000 sites should be identified in the coming months.

In Italy, the Gargano National Park includes the MPA of Tremiti Islands and the Varano and Lesina lagoons along the coast. Tremiti Islands was instituted in 1989. Systematic mapping activities have shown that the Archipelago is characterized by critical habitats (coralligenous formations, submarine caves, seagrasses, rhodolite banks) deserving careful monitoring due to increasing threats from tourism (diving, bathing, shipping, anchoring). Protection is generally weak, and poaching is still very active (Guidetti *et al.*, 2008). Long term monitoring, carried out by the University of Salento, shows that the MPA has not been correctly zoned and that the no take no man zone (called Pianosa) is characterized by low biodiversity assemblages even after more than twenty years of protection, (Fraschetti *et al.*, 2011). Pianosa can be considered a de facto marine refuge (e.g., a remote reef that is inaccessible) requiring the input of new recruits from neighbouring unprotected areas. Considering the position of this MPA and the oceanographic features described above, large-scale regulation could be a profitable strategy to facilitate the recovery of this area.

In the middle of the Adriatic, the Jabuka - Pomo Biological Protected Zone (BPZ) jointly declared by Italy and Croatia is located outside national territorial boundaries. Other BPZs (for nurseries as main purpose) are located around Tremiti Islands (Area Tremiti) and off Bari (so named Zone C “al largo della Puglia”).

In Montenegro, Ada Island, in the southern part of the Buna/Bojana delta is a Ramsar site, an international IBA (Important Bird Area) and IPA (Important Plant Area).

In the Albanian sector, there are several units with different protection status within the proposed area. In the southern part of Buna/Bojana mouth, the Velipoja Forest has the status of a Managed Natural Reserve with a core area, the Franz Joseph Island, which is strictly protected as a National Natural Monument. The Velipoja Reserve also has the status of a Ramsar site, IBA and IPA, together with Buna/Bojna River and Shkodra Lake in the Albanian part, as a whole unit. Further south, the Viluni lagoon – Baks Rjolli coast is a Managed Nature Reserve, with a core area, the peculiar sand dune “Blown sand” (Rana e hedhun), strictly protected as a National Natural Monument.

In Albania, despite the presence of protected areas, the implementation of environmental legislation is still weak. Damage to natural habitats, including that within protected areas, is due to uncontrolled human access and illegal activities, such as construction of tourist facilities, deforestation, and fishing and hunting. Some recent efforts through national and international projects on protected areas in Albania aim to strengthen the national network of Coastal Protected Areas and encourage the proclamation of new MPAs. This should have positive impacts on marine ecosystem conservation in the country.

The presence of different approaches and different levels of institutional conservation extended to the middle of Adriatic (i.e. Jabuka) should help a shared process of developing management based on the best practice in the existing situations. Jabuka, for example, not only “covers” (with almost 2000km<sup>2</sup>) one of the most important geo-oceanographic peculiarities, but also protects the nursery areas for many of commercial fishes, thereby supporting the economies of the Croatian/Italian coastal fisheries.

## **FINAL CONSIDERATIONS**

The Bosnia and Herzegovina territorial sea and shared resources of the Neretva region should also be considered as they are included within the border of the proposed South Adriatic Park.

There are potential threats from the adjacent Northern Adriatic Sea. There is increasing hydrocarbon exploration in this shallow region, and proposals for the development of refinery and storage capacity in the region. Associated tanker traffic must transit through this zone. In addition, the planned expansion of Northern Adriatic ports will add to maritime traffic and threats.

On the eastern coast, as the standard of living in Croatia, Bosnia and Herzegovina, Montenegro and Albania rises towards EU levels, we can also expect a rise in the use of the coastal zone for tourism and recreation; this leads to further potential exploitation and disturbance. Some form of integrated planning for the Adriatic is urgently required.