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## **Management plan for the conservation and sustainable use of the natural values of the privately owned Nature Park «Solana Ulcinj», Montenegro<sup>1</sup>**

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**Abstract:** Salinas are important wetland habitats, whose significance for nesting and migrating waterbirds is based on the process of salt production, i. e. the annual flooding and drying-out of evaporation basins. With a whole area of 14,9 km<sup>2</sup> the salina of Ulcinj (Solana Ulcinj) belongs to the group of the largest, operative salinas in the Mediterranean region. The salina is situated in the delta of the Bojana-Buna River at the eastern coast of the Adriatic Sea in southern Montenegro. Based on regular countings of resting and wintering waterbirds and breeding bird surveys since April 2003, the present management plan (MP) was developed by Euronatur Foundation in cooperation with the Solana Ulcinj.

Because the regular flooding of the salt-pans with seawater and saline waters is essential for preserving the unique wetland habitats of the area, the maintenance of the Solana Ulcinj is a common aim of both parties involved in the MP. EuroNatur and the Solana Ulcinj aim to develop and to preserve the natural values of the salina as a managed protection area based on best practice and international standards of nature conservation.

The sheer extent of the salina's wetland habitats and the high species diversity of its fauna and flora are unique for the eastern Adriatic region. The Solana Ulcinj is the most important resting, wintering and breeding site for many species of waterbirds along the Adriatic Flyway, and according to the presence of 15 species which reach the 1 % threshold of the Ramsar Convention (1971) a wetland of international importance. Therefore, the joined MP aims to preserve the wetland habitats of the salina, which is currently frequented by 12.000–32.000 waterbirds during spring and autumn migration, under the Ramsar Convention, by its formal protection under the laws of the Republic of Montenegro, and by the development of nature tourism and environmental education.

According to the main objectives outlined in the MP, indicators for a successful implementation of activities, joined by both parties, are:

- the population numbers of breeding, resting and over-wintering waterbirds, and the breeding success of colonially nesting shorebirds and other bird species, nesting in the salina
- the permanent (re)establishment of new breeding species in the Solana Ulcinj, with the main focus on Dalmatian Pelican (*Pelecanus crispus*) and Greater Flamingo (*Phoenicopterus ruber roseus*)
- the numbers of tourists and other visitors which visit the salt-work and use the salina's educational facilities
- the acceptance of the project by local people, national authorities and by the international conservation community

Beside a short description of techniques used for industrial salt production in the Solana, a characterization of habitat types, and of the fauna and flora of the area, the present action plan for the proposed Nature Park "Solana Ulcinj" outlines the main objectives of the project and includes detailed management planning for different parts,

i. e. for dikes, canals and all evaporation basins of the salina. In addition, recommendations for the establishment of an information centre, the construction of visitor trails and other facilities for environmental education, are given.

**Sažetak:** Solane su važna močvarna staništa čiji se značaj za gniježđenje i vodene ptice na seobi bazira na procesu proizvodnje soli. Sa površinom koja zahvata 14,9 km<sup>2</sup>, Ulcinjska Solana je jedna od najvećih aktivnih solana u regionu Mediterana. Solana se nalazi u delti rijeke Bojane/Bune, na istočnoj obali Jadrana i krajnjem jugoistoku Crne Gore. Na osnovu redovnih prebrojavanja ptica koje solanu koriste kao odmaralište, gnjezdilište i ptica selica, a koje se provodi od aprila 2003. godine, napravljen je Plan upravljanja (MP = Management plan) zajedničkim snagama Euronatur Foundation i Ulcinjske solane.

Prelivanje solanskih bazena morskom i solanskom vodom je od temeljne važnosti za zaštitu jedinstvenih staništa ove močvare. Upravljanje Ulcinjskom solanom je jedinstveni interes obje strane uključene u MP. Euronatur i Solana Ulcinj teže da razvijaju i zaštite prirodne vrijednosti solane kao zaštićenog područja čije se upravljanje bazira na najboljoj praksi i međunarodnim standardima zaštite prirode.

Površina pod slanom močvarom i visoka raznolikost vrsta flore i faune su jedinstveni na istočnoj obali Jadrana. Solana Ulcinj je najznačajnije odmaralište, zimovališta i gnjezdilišta mnogih vrsta vodenih ptica i šljukarica na Jadranskom seobnom putu (Adriatic Flyway). U vezi vezi sa tim, na solani je prisutno 15 vrsta ptica čija brojnost prelazi 1 % svjetske populacije na osnovu standarda Ramsarske konvencije (1971) koja tretira močvare od međunarodnog značaja. Zajednički plan upravljanja ima za cilj da zaštiti močvarna staništa solane koja gosti između 12–32.000 vodenih ptica tokom prolječne i jesenje seobe, a na osnovu standarda Ramsarske konvencije i formalne zaštite kao parka prirode na osnovu Zakona o zaštiti prirode Crne Gore kao područja za razvoj eko edukativnog turizma.

Na osnovu glavnih ciljeva koji proističu iz plana upravljanja, indikatori uspješnosti njegove implementacije obje zainteresovane strane su:

- brojnost populacija gnjezdarica, zimovalica i ptica na odmoru (vodenih i ptica šljukarica), uspješnost gniježđenja kolonijalnih gnjezdarica na solani
- stalno održavanje postojećih i pravljenje uslova za gniježđenje novih gnjezdarica, u prvom redu kudravog pelikana (*Pelecanus crispus*) i flamingosa/plamenca (*Phoenicopterus ruber roseus*)
- broj turista koji će posjećivati solanu i koristiti edukativne potencijale koje ona ima
- prihvatanje projekta od strane lokalne zajednice, državnih institucija i međunarodne zajednice koja se bavi zaštitom prirode

Pored kratkog opisa načina proizvodnje soli na solani, karakteristika staništa, registrovanih pripadnika flore i faune na predmetnom području, ovaj prijedlog mjera za ustanovljavanje Parka prirode Ulcinjska Solana daje smjernice projekta i uključuje de-

taljno planiranje upravljanja različitim oblastima, kao što su, na primjer, nasipi, kanali i svi bazeni posebno na cijelom području solane. Dodatno, plan daje preporuke za ustanovljavanje informativnog centra, izrade staza za posjetioce i drugih dodatnih mogućnosti, kao što su ekološka edukacija za lokalnu zajednicu, škole i turiste.

**Abstrakt:** Kriporet janë habitate të rëndësishme si zona të lagështa, rëndësia e të cilave për folezimin dhe migrimin e shpendëve të ujit është e bazuar në procesin e prodhimit të kripës. Me një sipërfaqe totale prej 14,9 km<sup>2</sup> Kriporja e Ulqinit – është një nga kriporet më të mëdha vepruese në rajonin e Masdheut. Kriporja gjendet në Deltën e lumit Buna/Bojana, në bregun lindor të detit Adriatik, në jug të Malit të Zi. Bazuar në numërimet e rregullta të shpendëve ujorë dimëruës dhe vëzhgimet e shumimit të shpendëve që në Prill 2003, u krijua plani aktual i menaxhimit (PM) nga Euronatur Foundation në bashkëpunim me Kriporen e Ulqinit.

Për arsye se përmbytja e rregullt në kripore me ujërat e detit dhe ato të kripores është esenciale për ruajtjen e habitateve unike të zonës, mirëmbajtja e Kripores së Ulqinit është një qëllim i përbashkët i të dy palëve të përfshirë në këtë PM. Euronatur-a dhe Kriporja e Ulqinit kanë për qëllim të zhvillojnë dhe të ruajnë vlerat natyrore të kripores si një zonë e mbrojtur e menaxhuar bazuar në praktikën më të mirë dhe standartet ndërkombëtare të ruajtjes së natyrës.

Përmasat e habitateve të kripores dhe diversiteti i lartë i specieve të faunës dhe florës së saj janë unike për rajonin e Adriatikut lindor. Kriporja e Ulqinit është vendi më i rëndësishëm për qëndrimin, dimërimin dhe shumimin e shumë specieve të shpendëve ujorë dhe të brigjeve ujore përgjatë Adriatikut, dhe persa i përket prezencës së 15 specieve që arrijnë pragun 1 % të Konventës së Ramsarit (1971) – një zonë e lagësht me rëndësi ndërkombëtare. Prandaj, PM i përbashkët ka për qëllim të ruajë habitatet e kripores, e cila aktualisht frekuentohet nga 12–32.000 shpendë ujorë gjatë migrimit të pranverës dhe vjeshtës nën Konventën e Ramsarit, nga mbrojtja e saj formale si një park natyror nën ligjet e Republikës së Malit të Zi, si dhe nga zhvillimi i turizmit natyror dhe edukimit mjedisor në zonë.

Bazuar në objektivat kryesore të nënvizuara në PM, indikatorët për një implementim të suksesshëm të aktiviteteve të përbashkëta janë:

- numri i popullatave të shpendëve ujorë dhe këmbëgjatëve që qëndrojnë, folezojnë dhe dimërojnë, dhe sukcesi i shtimit të kolonisë së shpendëve ujorë dhe bregujorë në kripore
- (ri)stabilizimi i specieve të reja në Kriporen e Ulqinit, me fokus kryesor Pelikanin Kaçurrel (*Pelecanus crispus*) dhe Flamingot (*Phoenicopterus ruber roseus*)
- numri i turistëve të cilët vizitojnë kriporen dhe përdorin lehtësirat edukative të saja
- pranimi i projektit nga banorët lokal, autoritetet kombëtare dhe nga komuniteti ndërkombëtar për ruajtjen

Përveç një përshkrimi të shkurtër të teknikave të përdorura për prodhimin tregtar të kripës në Kripore, dhe një përshkrim i tipeve të habitateve, dhe të faunës dhe florës të gjetur në zonë, drafti aktual i planit të veprimit për “Parkun Natyror të Kripores së Ulqinit” të propozuar nënvizon objektivat kryesore të projektit dhe përfshin planifikimin e detajuar të menaxhimit për pjesë të ndryshme, p.sh. për digat, kanalet dhe kriporet e vogla. Gjithashtu janë dhënë rekomandime për ngritjen e një qendre informacioni, ndërtimin e rrugëve për vizitorët dhe lehtësira të tjera për edukimin mjedisor për banorët lokal, shkollat dhe turistët.

**Zusammenfassung:** Trotz deren wirtschaftlicher Nutzung beherbergen Küsten- oder Meeressalinen viele, ökologisch wertvolle Lebensräume. Besonders die jährliche Überflutung und das anschließende, langsame Trockenfallen der Verdunstungsbecken schafft günstige Brut-, Rast- und Überwinterungsbedingungen für eine Reihe von Wasser- und Watvögeln. Mit 14,9 km<sup>2</sup> gehört die Saline von Ulcinj (Solana Ulcinj) im Süden Montenegros zu den größten Salinen des Mittelmeerraumes. Im Gegensatz zu vielen Küstensalinen im ehemaligen Jugoslawien ist die Saline Ulcinj weiterhin in Betrieb und bildet, neben dem Tourismus, die wichtigste wirtschaftliche Grundlage der Region um die Bezirkshauptstadt Ulcinj/Ulqini (Opština Ulcinj). Die Saline wurde in den 1930er Jahren im Schwemmland des Bojana-Buna Deltas, wenige Hundert Meter von der Küste der Adria, in einer großen Inlandlagune (Zogajnsko Jezero), die durch einen schmalen, natürlichen Kanal (Porta Milena) mit dem Meer verbunden ist, errichtet. In der ehemaligen Lagune bestand bis in die erste Hälfte des 20. Jahrhunderts eine Brutkolonie des Krauskopfpelikans (*Pelecanus crispus*).

Der vorliegende Managementplan (MP) hat den dauerhaften Schutz der Saline als wichtigstes Brut- und Rastgebiet für viele Wasser- und Watvögel an der östlichen Adria durch eine nachhaltige, wirtschaftliche Nutzung und touristische Erschließung zum Ziel. Er wurde in Zusammenarbeit mit der Saline Ulcinj von der Stiftung Europäisches Naturerbe (EuroNatur) an Hand der Ergebnisse von Wasservogelzählungen (IWC) und von Erhebungen der Brutbestände in der Saline brütender Wasser- und Watvögel erstellt.

Voraussetzung für die langfristige Erhaltung der Salzwiesen und anderer Feuchtlebensräume in der Saline ist die regelmäßige Flutung der Verdunstungsbecken. Daher ist die dauerhafte Sicherung und Wirtschaftlichkeit der Salzproduktion in der Saline ein erklärtes Ziel beider an diesem MP beteiligten Organisationen. Dies, sowie der Schutz der Feuchtlebensräume in der Saline mit ihrer Fauna und Flora soll durch den formellen Schutz des Gebietes, durch ein entsprechendes Habitatmanagement und begleitende Schutzmaßnahmen nach internationalen Naturschutzstandards durch die Zusammenarbeit von EuroNatur mit der Solana Ulcinj erreicht werden.

Aufgrund der Größe der vorhandenen Feuchtlebensräume und der hohen Artenvielfalt von Pflanzen und Tieren zählt die Saline in Ulcinj zu den bedeutendsten Feuchtgebieten an der östlichen Adria zwischen Norditalien und Albanien. Die Saline Ulcinj ist

das wichtigste Rast-, Überwinterungs- und Brutgebiet für viele Wasser- und Watvögel an der östlichen Adriaküste. Weiterhin liegt sie, nahe der Straße von Otranto, für viele Wasservögel an einem strategisch wichtigen Punkt entlang der Zentraleuropäischen Zugstrasse (Central European Flyway). Die Bestände von 15 Wasser- und Watvogelarten, die wir seit 2003 festgestellt haben, überschreiten die in der Ramsar Konvention (1971) festgelegte 1 %-Grenze ihrer globalen Populationen. Die Saline ist somit ein Feuchtgebiet von internationaler Bedeutung. Der vorliegende MP hat den Schutz der Saline, die z. Z. am Herbst- und Frühjahrszug von 12.000–32.000 Wasser- und Watvögeln genutzt wird, als Feuchtgebiet internationaler Bedeutung nach der Ramsar Konvention, durch die Erklärung zu einem Schutzgebiet seitens der Republik Montenegro und durch eine nachhaltige, touristische Erschließung zum Ziel.

Die Umsetzung und der Erfolg der im MP im Detail dargestellten Schutzziele und vorgeschlagenen Maßnahmen sollen im Rahmen eines integrierten Vogel- und Habitatmonitorings überprüft werden. Indikatoren für eine erfolgreiche Umsetzung des MP sind:

- die Populationsgrößen der in der Saline brütenden, rastenden und überwinternden Wasservögel und Limikolen, sowie der Bruterfolg von insbesondere, koloniebrütenden Wasser- und Watvögeln
- die dauerhafte Etablierung neuer Brutkolonien ehemaliger oder neuer Brutvogelarten, insbesondere von Krauskopfpelikan und Rosaflamingo (*Phoenicopterus ruber roseus*)
- die Zahl der Besucher, die die Beobachtungs- und Informationseinrichtungen in der Saline nutzen
- die Akzeptanz des Projektes durch die lokale Bevölkerung, die montenegrinischen Behörden und durch internationale Naturschutzexperten

Neben einer Beschreibung der industriellen Salzgewinnung in der Saline, einer Kurzcharakteristik der Habitattypen, sowie der Fauna und Flora des Gebietes, enthält der vorliegende MP eine umfassende Darstellung der Maßnahmen, die in verschiedenen Teilen der Saline umzusetzen sind (Aktionsplan). Weiterhin werden Vorschläge für die Errichtung eines Informations- und Besucherzentrums, eines Besucherleitsystems, von Beobachtungsständen und anderen Erziehungs- und Informationseinrichtungen für Schulklassen, Vogelbeobachter und Touristen vorgestellt.

**Key words:** management plan, waterbirds, waders, colonial waterbirds, International Waterbird Count, IWC, salina, Solana Ulcinj, Montenegro, Ramsar site, Dalmatian Pelican, *Pelecanus crispus*, Important Bird Area, IBA Ulcinj salt pans, Nature Park, action plan.

## Glossary

<b>Be°</b>	B°, Bé°, Baume or degrees Baumé is a measure for the density of various liquids developed by French pharmacist Antoine BAUMÉ in 1768. Originally Baumé degrees (heavy) represented the percent by mass of sodium chloride in water at 60 degrees Fahrenheit (15,5 °C) and was later calibrated to 0° Bé (light) being the density of 10 % NaCl in water by mass and 10° Bé (light) set to the density of water (WIKIPEDIA).
<b>bp.</b>	breeding pair(s)
<b>brackish water</b>	water which contains 0,5–30 grams/litre of salt (NaCl), but not as much as seawater
<b>brine</b>	concentrated solution of inorganic salts, formed by the partial evaporation of saline waters; brine contains > 50 grams of salt per litre
<b>cyst</b>	dormant stage in the life cycle of some invertebrates which is protected by a thick membrane (e.g. the eggs of brine shrimp, <i>Artemia</i> sp.)
<b>CZIP</b>	Centre for the Protection and Research of Birds, Podgorica (Montenegro)
<b>EuroNatur</b>	short for: Euronatur Foundation, Germany
<b>euryhaline</b>	organisms, e. g. plants or arthropods, which tolerate a wide range of degrees of salinity
<b>fresh water</b>	water containing < 0,5 gram of dissolved salt per litre
<b>halophyte</b>	terrestrial plant that is morphologically and/or physiologically adapted to grow in salt-rich soils and salt-laden air
<b>IBA</b>	Important Bird Area
<b>intertidal (zone)</b>	area between the highest and lowest tide mark
<b>IWC</b>	International Waterbird Count(s), organized by Wetlands International, Wageningen, The Netherlands
<b>IUCN</b>	International Union for Conservation of Nature and Natural Resources, with headquarters in Switzerland
<b>MP</b>	management plan
<b>NGO</b>	non-governmental organisation
<b>Ramsar Convention</b>	intergovernmental convention which regulates the protection of wetlands of international importance; signed in Ramsar, Iran, in 1971
<b>roost</b>	resting or sleeping place of birds, often used in large numbers (communal roost)
<b>salina</b>	a wetland which has been transformed for economic reasons, normally for the production of salt; many synonymously used terms, like man-made salterns, salt ponds, solar salt-works, salt-pans etc. are used in English to describe salinas

- saline water** water that contains a significant concentration of 30–50 grams/litre of dissolved salts
- salinity** proportion of salt (sodium chloride) present in a given amount of water or soil
- salt-pan, pan** a shallow basin which is used for the concentration of dissolved salts of sea water, and the precipitation and crystallisation of salts on its bottom
- Solana** short for: Solana Ulcinj
- wader(s)** wading birds of the order Charadriiformes
- WPE3** short for: Waterbirds Population Estimates. 3<sup>rd</sup> Edition, Wetlands International Global Ser. 12, Wetlands International, Wageningen, The Netherlands, 2002
- WPE4** short for: Waterbirds Population Estimates. 4<sup>th</sup> Edition ([www.wetlands.org/getfilefromdb.aspx?ID=832cc151-2de7-4f2e-9a05-41de0aec8594](http://www.wetlands.org/getfilefromdb.aspx?ID=832cc151-2de7-4f2e-9a05-41de0aec8594))

Water salinity based on dissolved salts in grams per litre				
Fresh water	brackish water	sea water	saline water	brine
< 0.5	0.5–30	ca. 30	30–50	> 50

## 1. Vision and mission

The Solana Ulcinj is situated at the south-eastern coast of the Adriatic Sea and covers large areas of a former inland lagoon, which is locally known as “Zoganjsko Jezero”<sup>2</sup>. The salina represents an integrated element within the network of interconnected alluvial and coastal wetland habitats (beta diversity) of the Bojana-Buna Delta. Following rules of the Bird Directive of the European Union, GRIMMETT & JONES (1989) and Bird-Life International (HEATH & EVANS 2000) have identified the Solana as an Important Bird Area (IBA “Ulcinj salt pans – Ulcinjska solane”, 1.350 ha). The significance and international importance of the area’s ecological values is formally recognised by the Solana’s management and EuroNatur, which forms the basis for their cooperation and joined efforts outlined in the MP.

The significance of the Solana Ulcinj for breeding and migrating birds is based on the process of salt production (SADUL et al. 1998). Therefore the maintenance of the Solana is a common aim of both parties. The aim of the Solana Ulcinj and EuroNatur is to develop and to preserve the unique habitats, and the fauna and flora of the salina as a managed protection area, based on best practice and international standards of nature conservation (PERENNOU et al. 1996).

Because the site fulfills criteria of the Ramsar Convention (1971) it will be nominated as a wetland of international importance, and both parties agree to lobby for the inclusion of the area into the list of Ramsar sites and to take legal steps for its protected preservation by the Republic of Montenegro. EuroNatur has completed the Ramsar Information Sheet (RIS) in 2006, and has forwarded it to the Ministry for Tourism and Environment of the Republic of Montenegro.

The joined project, outlined by the MP, further aims to establish infrastructure for promoting environmental education in the region, which will enable local people, tourists and bird watchers to observe birds and other wildlife in the salina.

All measures aim to preserve and to support the populations of breeding birds, resting and wintering migrants, and to create international awareness for the area as a prime destination for tourists and nature enthusiasts. In the same way, all measures are based on the long-term goal of the Republic of Montenegro to develop the country as a “Ecological State”. Both parties agree to stop illegal hunting, bird shooting, and other human disturbances in the salina which are incompatible with conservation.

Indicators for a successful implementation of joined activities are:

- the population numbers of breeding, wintering and resting waterbirds during migration, and the breeding success of bird species nesting in the salina
- the permanent (re-)establishment of new breeding birds, like Greater Flamingo and Dalmatian Pelican<sup>3</sup>
- the numbers of tourists which visit the salina and use the Solana’s observation and education facilities
- the image and acceptance of the project by local people, national authorities and by the international conservation community

<sup>2</sup> The first part of the name originates from Albanian language (zog = bird), the second from Montenegrin (jezero = lake). According to REISER & VON FÜHRER (1896) Dalmatian Pelicans have bred in the lagoon till the beginning of the last century.

<sup>3</sup> For German and scientific names of birds mentioned in text see Appendix 1 (p. 76–77)

## 2. Methods and background

This MP is based on numerous visits of the Solana by the authors, a monitoring programme for documenting the population numbers of waterbirds and of other bird species which was launched by Darko SAVELJIĆ in 2000, and which is continued with the help of EuroNatur since 2003. During most visits by a team of conservation experts and ornithologists, coordinated by EuroNatur, the Solana's management was contacted for information, for planning and discussing activities.

Between 31 October and 2 November 2003, EuroNatur organized a first workshop, concerning the ecological value of the Bojana-Buna Delta, during which a number of materials on the biodiversity of the area were collected from a number of experts (SCHNEIDER-JACOBY et al. 2006b).

In 2004, Snezana VUKSANOVIĆ from the Museum of Natural History of Montenegro in Podgorica, and Danka PETROVIĆ of the University of Podgorica have mapped the plant communities in the salina (VUKSANOVIĆ & PETROVIĆ 2004).

A geographical information system (GIS) for the Bojana-Buna Delta was created by Ulrich SCHWARZ (Fluvius). It provided us with an excellent data base, which was used by Borut STUMBERGER to produce the maps, included in the MP, and for calculating surface areas as well as the total length of levees and canals.

In 2005 EuroNatur organized first conservation activities which demonstrated the potential of the Solana for colonially nesting waterbirds, but at the same time indicated that the urgently needed reconstruction of some basins, in particular of Jezero 2, may destroy many currently important nest sites.

Consequently, two workshops were held in the Solana to discuss management planning:

In the first workshop from 14–15 April 2004, Danka PETROVIĆ (University of Podgorica), Vaso RADOVIĆ (Solana Ulcinj), Mio RADULOVIĆ (Solana Ulcinj), Peter SACKL (Landesmuseum Joanneum, Graz), Darko SAVELJIĆ (Institute for Nature Protection, Podgorica), Martin SCHNEIDER-JACOBY (EuroNatur), Borut STUMBERGER (EuroNatur) and Snezana VUKSANOVIĆ (Museum of Natural History of Montenegro, Podgorica) participated.

The second workshop on 11 May 2005, was visited by Jelena ALEKSIĆ (Solana Ulcinj), Vaso RADOVIĆ (Solana Ulcinj), Peter SACKL (Landesmuseum Joanneum, Graz), Darko SAVELJIĆ (Institute for Nature Protection, Podgorica), Martin SCHNEIDER-JACOBY (EuroNatur) and Borut STUMBERGER (EuroNatur). In addition, the workshop was visited by Lazar BAN, who is responsible for the Porta Milena Revitalization Project in Ulcinj.

Methods used for preparing the MP are based on the following documents:

- the Management Planning Toolkit of EUROSITE (1999)
- the training module of MedWet & Station Biologique de la Tour du Valat "A Management Plan for a Mediterranean Wetland" (PERENNOU et al. 1996)
- the "New Guidelines for Management Planning for Ramsar Sites and Other Wetlands" of the RAMSAR CONVENTION OF WETLANDS (2002)

The Solana Ulcinj and the EuroNatur team with their local partner organisation, CZIP, will continue to evaluate actions and the updating of the MP. The basis for this process is the continuous monitoring of activities and population numbers of birds, outlined in chapter 5, and regular meetings of all parties.

### 3. Site description

#### 3.1. General information

The Solana Ulcinj is situated in the southernmost part of the Republic of Montenegro (13.812 km<sup>2</sup>), close to the border to Albania at the south-eastern coast of the Adriatic Sea (Fig. 1a). Its nearest distance to the city of Ulcinj and to the borderline to Albania is 1 km, to the regional center Bar 23 km, and 62 km to the country's capital of Podgorica. The Community of Ulcinj (Opština Ulcinj/Ulqini) is inhabited by 24.217 people, with some 13.500 of them living within the city limits of Ulcinj (MONSTAT 2005). According to Montenegrin law, below the central government, opština is the highest administrative level.

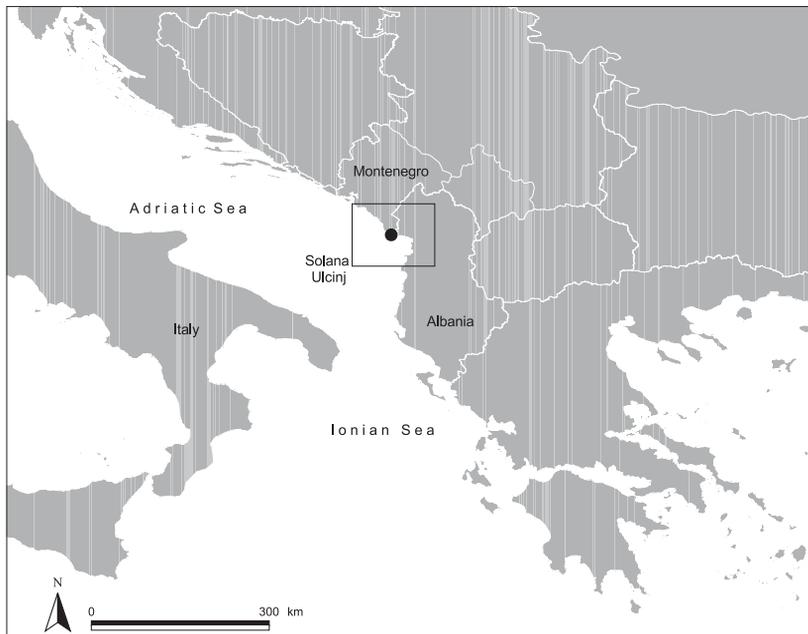


Fig. 1a: Location of the Solana Ulcinj, Montenegro, in the eastern Mediterranean region. The full circle indicates the location of the salina.

##### 3.1.1. Location

The Solana is situated in the inland lagoon and marshlands of the former Zoganjsko Jezero in the 225 km<sup>2</sup> large delta of the Bojana-Buna River (Fig. 1b). The salina is separated from the Adriatic Sea by a barrier island, called Velika Plaža, and from the Bojana-Buna River by a natural levee which was formed by the river. For flood prevention

the latter was partly replaced by an artificial dike. The area's soils consist mainly of fine riverine deposits, like mud (organic) and sand (anorganic). According to the influence of the nearby sea and of recent salt production, the salina is dominated by alkaline soils. Below the mudflats of the salt-pans huge layers of shells of marine mollusks are present. The Solana is a significant and integrated element of the approximately 1.000 km<sup>2</sup> large "Lake Skadar-Bojana/Buna River" ecosystem of interconnected wetlands.



Fig. 1b: Location of the Solana Ulcinj at the east coast of the Adriatic Sea.

**Size:** 1.492 ha; surface area of basins 1.383 ha or 92,2 %; of dams, levees, canals and the salina's surrounding outer drainage canal 109 ha or 7,8 % of the Solana's whole area. Together dams and levees amount to a total length of 130 km.

**Boundaries of the site:** Of the salina's perimeter of 18,7 km, 16,6 km follow the surrounding outer canal and 2,1 km, close to the administration and processing buildings, the northern bank of Porta Milena, i.e. the naturally formed inlet of the former inland lagoon. Thus, the delimitation of the salina follows mainly artificial structures. The site includes the whole area of the Solana, but excludes Porta Milena, the isthmus which connects the salina with the Adriatic Sea.

**Coordinates:** 19°18'05,71" East  
41°55'25,14" North

**Altitude:** 0–5 m

For a map of the proposed Ramsar site see Fig. 2.

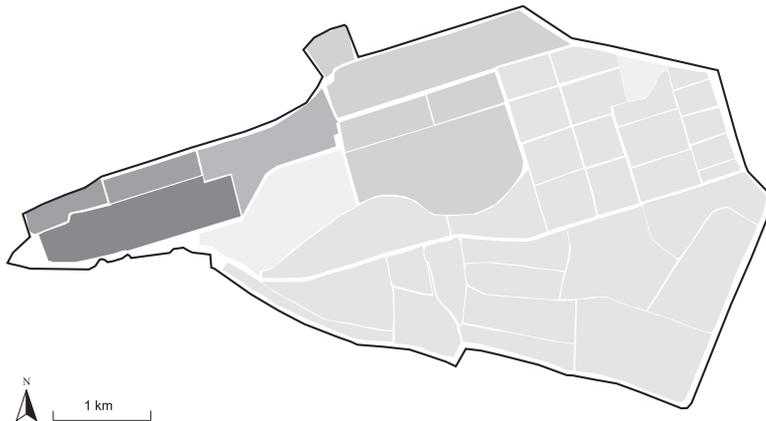


Fig. 2: Delimitation of the proposed Ramsar site "Solana Ulcinj".

### 3.1.2. History

According to the development of continuously elaborated techniques for industrial salt production, SADUL et al. (1998) have distinguished primitive, rudimentary, traditional, and modern salinas. The salina in Ulcinj belongs to the later, most modern type. The history of the transformation of the former Zoganjsko Jezero and adjoining marshlands, and of the construction of the Solana Ulcinj is summarized as follows (for details cf. RADOVIĆ 2008):

**1920–1926** In 1920 the Monopoly Management (monopolska uprava) of former Yugoslavia invited Antun KOLUDROVIĆ and Guido GRISOGONA to select lands, which will be suitable for industrial salt production, along the coast of the Adriatic Sea from Ankaran in Slovenia south to Ulcinj in Montenegro. As the most suitable site both experts designated Zoganjsko Jezero in Ulcinjsko Polje, near Ulcinj.

**1926–1934** Construction of the first salt-pans and other indispensable infrastructure, like buildings, reservoirs, evaporation basins (8,6 km<sup>2</sup>) and transportation equipment.

**1935** First harvest of industrially produced salt (approximately 6.000 tons).

**1952** Record harvest of 41.882 tons of salt (Fig. 3).

**1959** Reconstruction works and expansion of the salt-pans (9,3 km<sup>2</sup>).

**1979** On 15 April an earthquake heavily damaged the salt-pans and the Solana's other infrastructure.

**1980** Reconstruction of evaporation basins which had been damaged by the earthquake and expansion of the salina by including adjoining marshlands, called Kneta (14,5 km<sup>2</sup>).

**2003** The Solana Ulcinj starts to cooperate with EuroNatur aiming to protect the unique ecosystem of the salina and for developing the area for touristic purposes.

**2005** Privatisation of the Solana, with major stake-holders holding more than two thirds of shares.



Fig. 3: Salt harvest in the Solana. 13 August 2004, Ulcinj, Montenegro (Photo: O. Vizi).

Since the first half of the 20<sup>th</sup> century the salina has a significant impact on the economy and cultural identity of the Municipality of Ulcinj. Till today the salina is a symbol for prosperity and wealth in the region (RADOVIĆ 2008). Since 2005 the salina is owned by a private company. According to impacts of the last Balkan War and the embargo of former Yugoslavia by the international community on the economy of Montenegro, the Solana is in urgent need of renovation and reconstruction (REPUBLIKA CRNA GORA 2005).

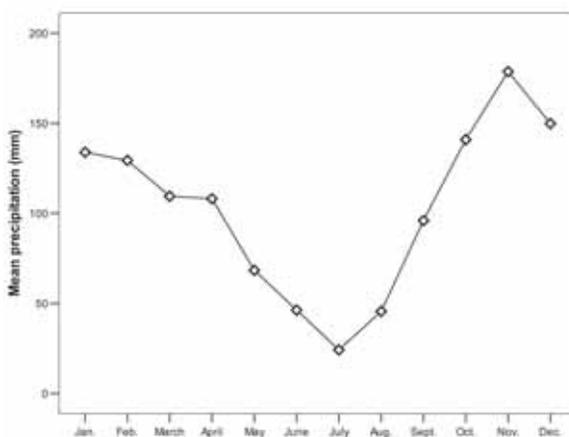
### 3.1.3. Climate

With most rainfall during winter and early spring (Fig. 4), the long-term annual mean of precipitation in Ulcinj amounts to 1.231 mm. Annual mean of air temperature averages to 19,9 °C, with annual means of minimum and maximum temperatures varying between 12,2 °C and 32,3 °C, respectively. Strong southerly winds, locally known as jugo, and inland winds (bura) occur mainly during winter. Across the year annual means of sunshine per month average to 2.567 hours, which is the highest value in Montenegro (HIDROMETEOROLOSKI ZAVOD CRNE GORE 2003).

Regional climates throughout the Bojana-Buna River's catchment area differ widely. While along the coast of the Adriatic Sea a typical Mediterranean climate with hot and dry summers till September/October prevails, the climate in the mountainous hinterlands of the delta is of the Continental-Mediterranean type. The latter is characterized by hot summers and cold winters with heavy snowfall. According to topography, distance from sea and altitude, annual means of rainfall vary between 2.500–3.000 mm in the mountains of the Dinaric Karst, 1.600–2.000 mm in the basin of Lake Skadar and 1.200–1.300 mm in the Bojana-Buna Delta (NIKOLIĆ 1999, HIDROMETEOROLOSKI ZAVOD CRNE GORE 2003). Some 75 % of all precipitation is falling during the period bet-

ween October–May. The mean of air temperature around Lake Skadar amounts to 15 °C, along the coast of the Adriatic Sea to 16 °C, and in the mountains of the Bojana-Buna River’s catchment area to 2–10 °C (cf. KARAMAN & BEETON 1981; www.britannica.com/ebi/article-229097; www.discover-montenegro.com/Climate).

A weather station of the Hydro-Meteorological Institute of Montenegro (HIDROMETEOROLOSKI ZAVOD CRNE GORE 2003), which is incorporated in the international network of meteorological stations, is situated within the Solana Ulcinj (see www.meteo.cg.yu, www.westwind.ch and www.wunderground.com/cgi-bin/findweather/getForecast?query=ulcinj). The station, whose data are updated in one-hour intervals, is placed between the factory buildings and Porta Milena.



*Fig. 4:* Long-term means of precipitation per month (mm) in the Solana Ulcinj, Montenegro (HIDROMETEOROLOSKI ZAVOD CRNE GORE 2003).

### 3.1.4. Protection status and strategies<sup>4</sup>

The Solana Ulcinj is a private property. According to the reorganisation plan for the salina, prepared by the Republic of Montenegro in 2005, the area is formally protected as a Nature Park (REPUBLIKA CRNA GORA 2005). Although several species of plants and their habitats which occur in the salina, are strictly protected under the Nature Act (2008) of the country, under the same act the salina per se, has no legal protection status.

In 2007 Velika Plaža and the Solana Ulcinj (2839,46 ha) have been designated as Emerald Site 11 “Velika Plaža with Solana Ulcinj” by the joint meeting of the Ecological Networks Committee of the Council of Europe in Strasbourg (EMERALD 2007). Based on the habitat types described by SCHNEIDER-JACOBY et al. (2006b) the whole area of the Solana was included into the site as well as some important coastal habitats along Velika Plaža and in the surroundings of the salina. Based on criteria of the Natura 2000 Network and of the Berne Convention the final report lists, (1) mud flats, sand flats, lagoons (including the salina’s evaporation basins) and (2) salt marshes, salt pastures and salt steppes as the most important habitat types of the salina (EMERALD 2007).

<sup>4</sup> For including current decisions concerning the legal status of the Solana this chapter was updated till late September 2008.

For protecting the country's environment and natural heritage the Ministry for Economic Development and the Ministry of Tourism and Environmental Protection of the GOVERNMENT OF THE REPUBLIC OF MONTENEGRO (2007), have agreed to follow the „Activities and Deadlines” of the Strategy for Integrated Coastal Area Management in 2007 as follows:

“1.1.1 Drafting of feasibility studies for putting under protection new protected areas at the coast (priorities: a. Marine areas: Platamuni, island Old Ulcinj and islands Katič; b. Continental areas: Tivatska solila, Solana, Šasko Lake, Knete and Ada Bojana, Buljarica, part of Velika Plaža towards Ada Bojana, Luštica) (2008–2009).”

According to the currently approbated Nature Act of the Republic of Montenegro, for all protection areas of the country a MP will be needed. The Solana Ulcinj is the first site for which a MP has been prepared in cooperation with local stake-holders. In addition, EuroNatur and CZIP have prepared the Ramsar Information Sheet for the area, translated it into local language and offered it to the Ministry of Tourism and Environment and the Institute for Nature Protection in Podgorica for nominating the salina as a Ramsar site.

In the new Spatial Plan of Montenegro (MINISTRY OF ECONOMIC DEVELOPMENT 2008) the Solana Ulcinj is listed as an important representative of the most characteristic landscapes of the country. From a whole of 21 basic landscape units which the Ministry has recognized, the Solana is included in „unit (5) Bojana River Valley, Zoganjsko Mud, Solana Ulcinj and Šasko Lake” (p. 47). The Ministry's report (p. 47) further states: „Variety of landscapes is of great value and represents the richness of any country. In Montenegro this diversity appeared in a combination of exceptional natural values alongside with different local traditions in spatial use, which resulted from reflections of cultural-historical and socio-economic circumstances.” The Solana is a good example for a landscape unit which is harbouring outstanding natural values and reflects the cultural-historical and socio-economic circumstances of the region (RADOVIĆ 2008).

The termination of industrial and military activities along the Albanian border will further provide potentials for the establishment of new tourist zones in coastal areas (MINISTRY OF ECONOMIC DEVELOPMENT 2008: 154). Most probably the Solana Ulcinj will be included into the proposed tourist zone. „The development of tourist accommodations along the coast has to be handled with extraordinary care because the carrying capacity of the municipalities in this region is already almost exhausted.” The development of tourist accommodations will be focused „in the area of Ulcinj municipality in the locations: Valdanos, Velika Plaža with its deep hinterland, and also Solana and Ada Bojana with respect to sustainable principles and natural values” (MINISTRY OF ECONOMIC DEVELOPMENT 2008).

Thus, the present MP offers a good basis for the future development of nature tourism in the Solana Ulcinj, which is based on sustainable development principles and

the preservation of its natural values. As the habitats in the salina are protected as a Emerald Site, nature tourism is the only option for development inside the area of the Solana.

The new Spatial Plan of Montenegro additionally proposes to protect the Bojana-Buna Delta (cf. SCHNEIDER-JACOBY et al. 2006b) as a National Park by „expanding borders of the National Park Skadarsko jezero (Skadar Lake) to the Regional Park Rumija or the area of Šasko Lake/the River Bojana Delta” (MINISTRY OF ECONOMIC DEVELOPMENT 2008: 174). The Solana Ulcinj and its surrounding landscapes will be an invaluable asset for the proposed protection area and the most favourable site for bird-watching.

### 3.2. Salt production

The annual cycle of salt production in the Solana Ulcinj starts in late April, i.e. between 24–30 April during the last years. Initially seawater with concentrations of up to 29 grams NaCl/litre (3,5° Be) is pumped into the evaporation basins from a depth of 6 m in the Adriatic Sea off Porta Milena by a 3 km long channel. With the help of two pumping stations (total capacity 3.000 litres<sup>s</sup>), 1<sup>st</sup> grade evaporation basins (4,2 km<sup>2</sup>) are filled within 15 days (Fig. 5). In the basins of the 1<sup>st</sup> evaporation grade seawater flows passively by gravitation from one basin to the other. Water depths vary between 20–60 cm, with maxima up to 100 cm. The area of 1<sup>st</sup> grade evaporation basins, which was constructed in 1980 and represents the most recently constructed part of the salina, is locally called Kneta (Fig. 5). Older 1<sup>st</sup> grade basins, which have been constructed during the 1920s, include the pans Stojski 1 and Stojski 2. Together both later basins cover a total area of 3,2 km<sup>2</sup>. When fully filled, water in Stojski 1 & 2 is around 30 cm deep.



Fig. 5: Nomenclature of basins (salt-pans) of different evaporation grades and local names for different parts or salt-pans in the Solana Ulcinj.

When leaving the 1<sup>st</sup> evaporation grade salt concentration has increased to 55 grams NaCl/litre (7° Be), which is almost twice the salinity of seawater (Fig. 6). Filling of 2<sup>nd</sup> grade evaporation basins, which cover 3,2 km<sup>2</sup> of the former inland lagoon, takes another 12–15 days (basins Zoganjski 1 & 2, which together cover 44 ha, are not functional). With water depth fluctuating between 20–30 cm, salinity in 2<sup>nd</sup> grade basins reaches up to 115 grams NaCl/litre (12°–14° Be). In the 3<sup>rd</sup> grade evaporation area (0,6 km<sup>2</sup>) salt concentration is 172 grams NaCl/litre (19° Be), while it finally reaches up to 218 grams NaCl/litre (24° Be) in 4<sup>th</sup> grade basins (0,2 km<sup>2</sup>). In both latter sections water depth varies between 10–20 cm. Brine is directed from 3<sup>rd</sup> into 4<sup>th</sup> grade evaporation basins by another pumping station (cf. Fig. 36). Finally, the crystallisation of common salt takes place in very shallow waters with salt concentrations  $\geq 235$  grams NaCl/litre (25,8°–27,0° Be) in small crystallisation pans (0,8 km<sup>2</sup>).

Industrial salt is harvested till the first half of September, but in some years, like in 2004, as late as early November. During the whole cycle of salt production, seawater continues to flow into the salina; the inflow of water will be interrupted only during extended periods of rain. The process of salt crystallisation starts after all basins in the salina have been refilled with seawater or saline waters in late May. From June onwards, the water surface in the salina as well as salt concentrations in basins of different evaporation grades are stable.

At the northern edge of the salina two reservoir complexes are situated (Accumulation 1 & 2). In the reservoirs brine with salt concentrations of 74 grams NaCl/litre (8°–9° Be) and 174 grams NaCl/litre (17°–23° Be) is stored. Brine from both reservoirs is used to trigger the crystallisation process in last grade evaporation basins in spring, before saline waters from 1<sup>st</sup> and 2<sup>nd</sup> grade basins reach the basins of the 3<sup>rd</sup> evaporation grade (see Fig. 6 and 7).

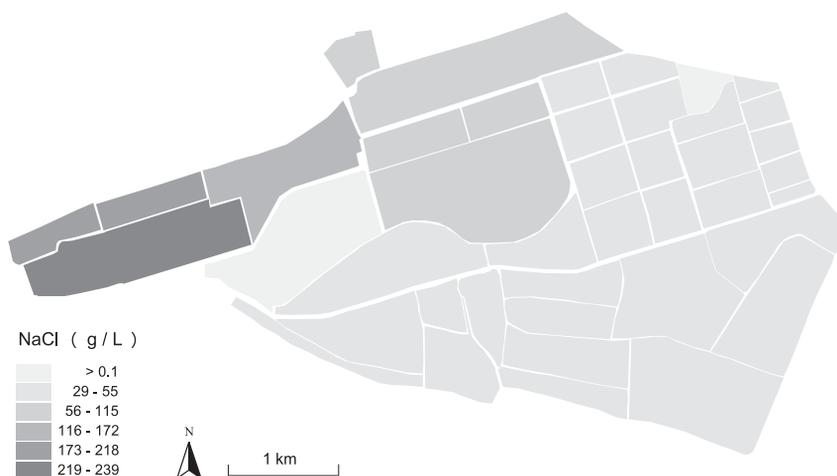
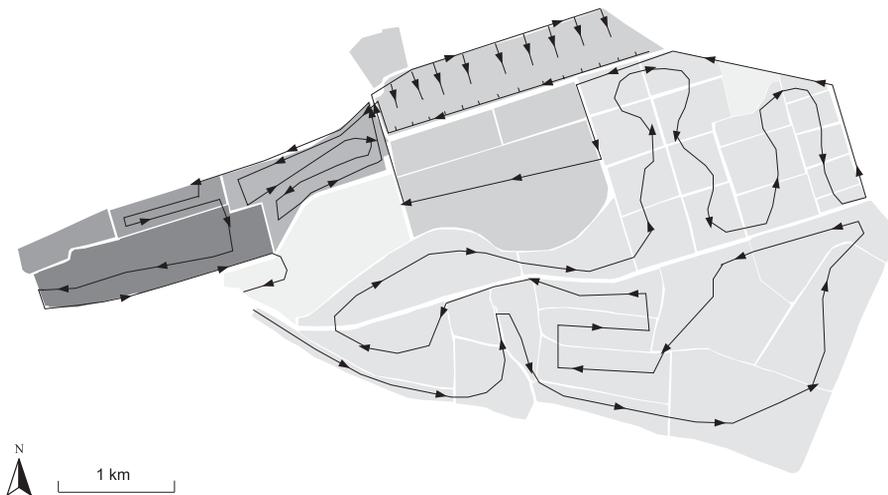


Fig. 6: Salt concentration in basins of different evaporation grades in the Solana Ulcinj.



*Fig. 7:* The flow of seawater and saline waters through the salt-pans of the Solana Ulcinj. Arrows indicate the direction of waterflow.

Seawater and saline waters are flowing between basins, within as well as between basins of different evaporation grades, in > 2 m wide canals. The network of canals which connect the salt-pans, follows the longest possible route through the salina (Fig. 7). The total length of the Solana's levees is calculated at 130 km, with 78,6 km of them > 2 m wide, and 16,6 km of canals < 2 m wide. In addition, the salina is surrounded by an outer drainage canal, which is also in the possession of the Solana (GOMILAINOVIĆ et al. 1988; SCHNEIDER-JACOBY et al. 2006b).

### 3.3. The Solana as habitat

The high species diversity of the Solana's fauna and flora as well as the sheer extent of its salt habitats are unique in the eastern Adriatic region: The salina in Ulcinj is the most important wintering, resting and nesting site for a number of species of waterbirds along the eastern coast of the Adriatic Sea. In addition, situated on the Montenegrin side of the Bojana-Buna Delta, the salina is surrounded by almost undisturbed alluvial forests, marshlands, meadows and pasturelands. Most of the Bojana-Buna Delta's grasslands are traditionally used for hay making or by grazing of domestic cattle with low human impact. With large areas of wetland habitats which surround the salina, still existing much of the former Zoganjsko Jezero is still preserved. In the salina the levees of Jezero 1 & 2 clearly follow the shoreline of the former inland lagoon (Plate 1).

### 3.3.1. General information

The principal function of the ecosystem of the former Zoganjsko Jezero, whose hydrological cycle was characterized by floodings during winter and periodic droughts during summer, is maintained in the salina's evaporation basins (1.383 ha) by the annual cycle of salt production. Currently, 122,1 ha of dikes, levees and an unused basin are covered by grasslands, while stands of halophytes cover 60,2 ha of the basins, reed beds 8,0 ha in basins and canals, *Tamarix* scrubs and softwood 13,0 ha on dikes, levees and in the unused salt-pan, which is called „Meadow”. In addition, 55,0 ha above stony grounds on dams and levees are covered by pioneer vegetation. Dikes are grazed by free-roaming cattle, sheep and goats or burned during summer.

A continuous flow of sea- and rainwater through the salt-pans and the presence of permanent waters are important factors for maintaining the biological diversity of the salina: A third of its total surface area is regularly flooded or permanently covered by water, like Jezero 1 & 2 – both remnants of the former inland lagoon –, parts of Kmeta, Accumulation 1 & 2, and most canals. In particular, open, but regularly flooded mudflats in the evaporation basins are very characteristic for the salina (Fig. 8). The Solana's mudflats represent a habitat type which is extremely rare along the predominantly rocky shores of the eastern Adriatic Sea. While most floodlands in the river mouths and deltas along the 800 km long coastline between northern Italy and Montenegro have been drained and heavily urbanized during the last century.

The structural and chemical diversity as well as the spatial and temporal variability of the open water bodies is essential for the maintenance of the biological diversity

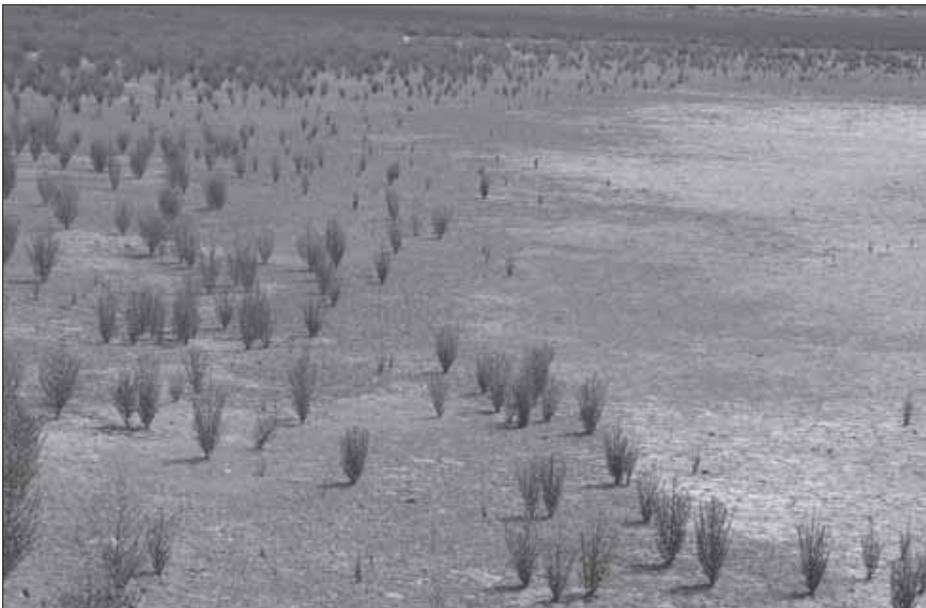


Fig. 8: Periodically flooded mudflats with extensive stands of *Salicornia herbacea* are characteristic for Jezero 1. 22 July 2004, Solana Ulcinj (Photo: O. Vizi).

of the salina. The ecosystems of shallow waters and periodically flooded mudflats are characterized by the production of large biomasses of arthropods and other invertebrates. Both, the area's high species diversity and high abundances of arthropods, crustaceans and marine mollusks are responsible for large numbers of birds which nest, overwinter or rest during spring and autumn migration in the salina.

### 3.3.2. Fauna

#### 3.3.2.1. Mammals

Currently, no detailed studies on the mammal fauna of the Solana are available. In 2005 tracks of Eurasian Otter (*Lutra lutra*) were found in the main canal, 400 m ahead of pumping station no. 16. We regularly noted large numbers of otter spraints along the Bojana-Buna River and in its river mouth close to the Solana. During bird surveys, since 2003 the EuroNatur team has further confirmed the presence of Red Fox (*Vulpes vulpes*), Golden Jackal (*Canis aureus*), Brown Hare (*Lepus europaeus*) and Gleaner Mouse (*Mus spicilegus*) in the salina. Besides dikes, both canids use dried-out basins and shallowly flooded salt-pans for foraging. In one occasion a Golden Jackal was encountered in a mixed-species breeding colony of Black-winged Stilts and Collared Pratincoles, while it was heavily attacked by the birds. The Solana further appears to be important for bats (Chiroptera). The new observation tower, erected by EuroNatur, was almost immediately accepted by bats for roosting. But more research on mammals in the area is needed.

#### 3.3.2.2. Birds

Birds are the best studied taxon in the Bojana-Buna Delta and the Solana Ulcinj (VASIĆ 1979, PUZOVIĆ 2002, STUMBERGER et al. 2005). From a total of some 250 species, which are on record for the Bojana-Buna Delta, more than 70 or 28 % protected under the Bird Directive of the European Union.

**Breeding birds:** During 2003 – 2006 we recorded a whole of 55 species of birds which breed in the Solana, i.e. almost the half of all breeding species known for the Bojana-Buna Delta (STUMBERGER et al. 2005). For eight species the salina is the only nesting site in Montenegro (see Appendix 2). The population numbers since 1988 for the waterbirds, breeding in the salina, are summarized in Tab. 1.

**Wintering waterbirds:** According to mid-winter counts (IWC) conducted by EuroNatur since 2003, during January 2004 – 2006 the Solana was frequented by 12.354, 16.879 and 17.157 waterbirds, most of it waders.

**Autumn migration:** IWC data indicate that population numbers during autumn migration are comparable to total numbers of mid-winter counts. In November 2003–2006, 14.281, 10.134, 18.510 and 10.831 waterbirds, again mainly waders, were counted in the salina. Besides waders, in November large numbers of herons, Pygmy Cormorants and Dalmatian Pelicans – the latter according to WPE3 reaching the 3 % threshold of the Ramsar Convention – were present.

Species	Year				
	1988*	2000**	2003***	2005***	2006***
Common Shelduck			5	1 - 5	1 - 7
Garganey				2 - 3	0 - 1
Mallard					0 - 1
Northern Shoveler				1	1 - 3
Common Moorhen					1
Eurasian Oystercatcher	1			1	1 - 3
Black-winged Stilt	100	1	82 - 106	40 - 100	80 - 130
Pied Avocet	7		1		0 - 2
Stone-curlew	30		7 - 9	> 6	6 - 16
Collared Pratincole	75 - 90		28 - 81	100	80 - 95
Little Ringed Plover		?	3 - 11	5	1 - 3
Kentish Plover	50	30	44 - 52	30 - 50	30 - 40
Redshank			44 - 60	35 - 40	4 - 60
Slender-billed Gull			0 - 2		
Yellow-legged Gull		25	26	30 - 50	30 - 51
Little Tern	80 - 90	6	97 - 133	90 - 120	100 - 150
Common Tern		8	24 - 26	33 - 60	50 - 80
Caspian Tern				0 - 5	
Common Kingfisher	?	?	?	?	3 - 5
<b>Total</b>	<b>333 - 368</b>	<b>70</b>	<b>329 - 480</b>	<b>374 - 546</b>	<b>436 - 649</b>

\* Puzovic et al. 1992, \*\* Saveljic 2002, \*\*\* EuroNatur (unpubl. data)

Tab. 1: Population numbers of waterbirds nesting in the Solana Ulcinj (minimum – maximum bp.).

**Spring migration:** With a peak count of 32.336 waterbirds in March 2006, the Solana represents a key resting site for migrating waterbirds along the eastern coast of the Adriatic Sea during spring migration. Again waders are dominant, but in contrast to autumn migration and winter large numbers of ducks are present in spring (see 3.4., Criterion 5).

**Dalmatian Pelican:** In late summer and autumn the salina offers adequate feeding and roosting conditions for Globally Threatened Dalmatian Pelicans. Since 2003 we noted maximum numbers around 50 birds, with a peak of 99 pelicans in October 2007. Each year the species was present for at least four months between August–November. In addition to autumn and winter visitors, during the species' nesting season we regularly noted small feeding flocks of 2–5 pelicans. According to time of season, behaviour and

flight directions we suppose that the later birds belong to the local nesting population at Lake Skadar (SAVELJIĆ et al. 2004). Resightings of colour-ringed Dalmatian Pelicans indicate that, during late summer and autumn, the salina is frequented by birds which originate from coastal nesting sites in Albania and the Gulf of Amvrrikakos in western Greece. While up to now we recorded no birds from inland colonies in Mazedonia and Greece, together with birds from Lake Skadar, Dalmatian Pelicans which winter in the Solana Ulcinj, represent the westernmost – and a probably discrete – (sub)population.

Since April 2003, we have noted most pelicans in basins of the 1<sup>st</sup> and 2<sup>nd</sup> evaporation grade, while in 3<sup>rd</sup> grade evaporation basins the birds were seen only along canals during low water-level (Fig. 9). By evidence, the species prefers the larger, more open salt-pans, and adjoining dams and levees, which are not overgrown by tamarisk and other shrubs. The open character of the latter may help pelicans to avoid terrestrial predators and human disturbances (Fig. 10). Night-time roosting sites, which were used for longer periods of at least 2–3 weeks since 2003, are located in Stojski 1 & 2, Jezereo 1, and – in some cases, after the birds had been heavily disturbed during the day by hunters and bird shooting – in basins no. 6, 8 and 9 of the Kneta. Aside of the basins of the highest evaporation grade, and when undisturbed by hunting activities, Dalmatian Pelicans use almost the whole salina for feeding, resting and roosting.

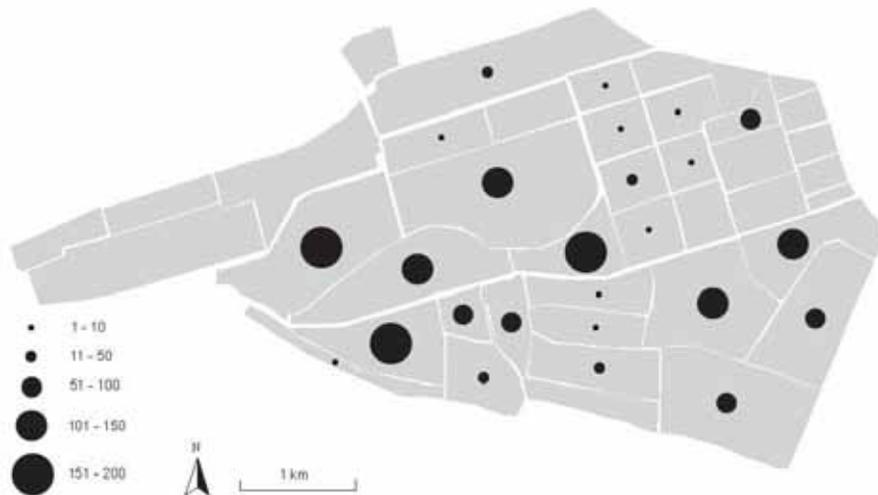


Fig. 9: Maximum numbers of Dalmatian Pelicans (*Pelecanus crispus*) recorded per basin in the Solana Ulcinj, 2003 – 2008 (n = 507).

**Cormorants, herons and ibises:** Up to 838 bp. of colonially breeding waterbirds, i.e. Pygmy and Great Cormorant, Black-crowned Night Heron, Squacco Heron, Little Egret, Grey Heron, Purple Heron, and Eurasian Spoonbill, currently nest in the immediate surroundings of the salina. Significant numbers of cormorants, herons and spoonbills breed on Paratuk and Ada Islands, and in the marshlands of Velipoja Reserve in Albania (STUMBERGER et al. 2005, SCHNEIDER-JACOBY et al. 2006b). In addition, in spring Glossy



Fig. 10: Group of Dalmatian Pelicans (*Pelecanus crispus*) resting on the Solana's inner main dam. 1 November 2005, Solana Ulcinj (Photo: P. Sackl).

Ibises are regularly present on Paratuk Island, but up to now we found no active nests of the species. Although, currently no breeding colony exists in the salina, the salt-pans and canals of the Solana represent the most important feeding habitats for colonial waterbirds, which nest throughout the floodplains of the lower Bojana-Buna River (Plate 3). The diet of most colonial waterbirds, like cormorants, herons and spoonbills, consists of fish, small mammals, insects, mollusks, and other aquatic invertebrates, which are abundant in the salina.

**Greater Flamingo:** In spring each year flamingos are reported by Solana's employees and local hunters. Usually small flocks of up to 10 Greater Flamingos are present (cf. Puzović 1994). Between March and May 2006 a small flock spent the whole spring in the area. In autumn 2006 a colour-ringed bird was seen, who originated from the breeding colony Salinas de la Trinitat in Spain's Ebro Delta (JOHNSON & CÉZILLY 2007). Since 2003 we noted Greater Flamingos while feeding in Jezero 1 & 2, Stojski 2, basin no. 17, and in crystallisation basins (see enumeration of basins in Fig. 31). Flamingos use special techniques for filtering large numbers of small invertebrates, in particular brine shrimps of the genus *Artemia*, from brackish and saline waters. During winter, when adult brine shrimps are not available, flamingos feed on chironomid larvae, tubificid worms, small mollusks, and the eggs (cysts) of *Artemia* shrimps (SADUL et al. 1998, JOHNSON & CÉZILLY 2007).

**Ducks:** Like in other freshwater and brackish marshland habitats of the Bojana-Buna Delta, ducks breed only in very small and largely scattered numbers in the salina. Presumably, the main reasons are uncontrolled hunting, shooting and other human disturbances. During migration and winter eight species, mainly dabbling ducks, like Eurasian Wigeon, Northern Pintail, Common Teal, and Garganey, are regularly present. Peak

numbers with up to 11.000 ducks were counted during mass stop-overs of Gargeneys in March (Fig. 11; cf. also Appendix 5). Dabbling ducks feed mainly on water plants, like *Ruppia* sp., by 'tipping-over' in shallow waters and pulling plants out from water with their bills. In the salina we regularly saw ducks foraging on aquatic plants and insect larvae in evaporation basins covered by shallow water. During winter most ducks use the salina for daytime roosting, but fly out for feeding during dusk.

**Waders:** Between 50–70 % of all waterbirds, which we have counted in the salina since 2003, belong to this group. The most abundant species with maximum numbers of > 1.000 birds are Northern Lapwing, Dunlin, Ruff, Common Snipe, Black-tailed Godwit, Spotted and Common Redshank (see Appendix 5). In winter large numbers of Dunlin, Northern Lapwing, Common Snipe and Eurasian Golden Plover feed in the shallow waters and mudflats of the salt-pans. Maximum numbers are normally present in March, when the Solana hosts up to 20.000 waders. A lower peak in early May with up to 2.300 birds consists mainly of Curlew Sandpiper (Fig. 12).

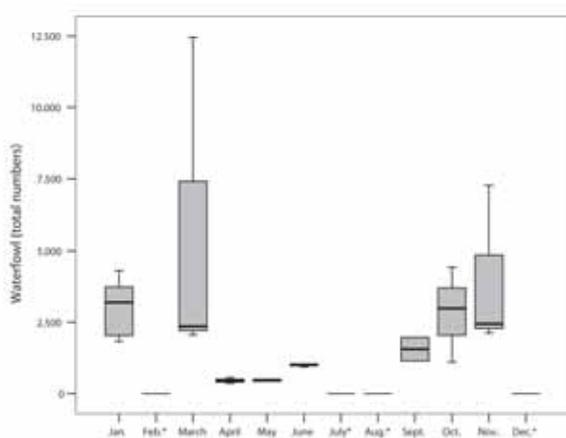


Fig. 11: Seasonal fluctuation of total numbers of waterfowl in the Solana Ulcinj, 2003 – 2007 (24 counts). \* no counts available.

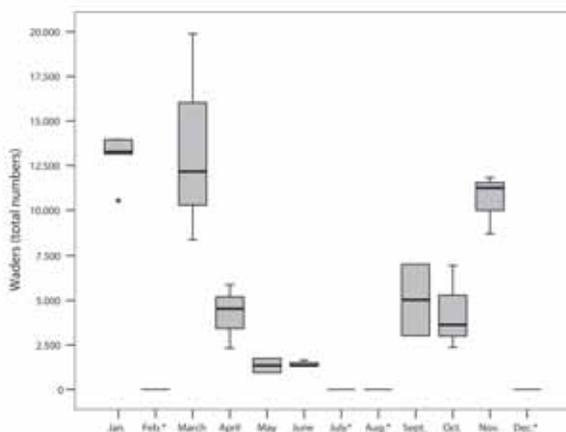


Fig. 12: Seasonal fluctuation of total numbers of waders in the Solana Ulcinj, 2003 – 2007 (24 counts). \* no counts available.

**Other Non-Passerines and passerines:** Besides waterfowl and waders, we have noted an additional number of 36 species of non-passerines which breed in the Solana or use the area during migration (see also VASIĆ 1979). A group of predominantly insectivorous species, which are endangered in most of their former western and central European breeding range, is of particular conservation concern: Lesser Kestrel (former nesting species in the salina, but currently a rare migrant visitor), Little Owl (1–2 bp.), European Roller (0–1 bp.), Eurasian Hoopoe (2–3 bp.), and European Bee-eater (0–5 bp.). Passerines, who breed regularly and in good numbers in the salina, include Crested Lark, Barn Swallow, Red-rumped Swallow, House Martin, Tawny Pipit, Yellow Wagtail (ssp. *feldegg*), Great Reed Warbler, Zitting Cisticola, Spanish Sparrow (Fig. 13) and Corn Bunting. During migration and winter large numbers of Meadow Pipit, Yellow Wagtail (maxima of > 1.000 birds/day), European Robin, Whinchat, Moustached Warbler, Spotted Flycatcher, Golden Oriole and Reed Bunting were noted on dams, in reed beds and in the mudflats of the salina. But for a more comprehensive assessment of the importance of the area for migrating and wintering passerines additional field work will be needed.



Fig. 13: Male Spanish Sparrow (*Passer hispaniolensis*) feeding chicks in the Solana's observati-on tower. 18 June 2007, Solana Ulcinj (Photo: P. Sackl).

### 3.3.2.3. Fishes

The only document concerning the fish fauna of the salina which is currently available, is a list of 18 species, which was prepared by Montenegrin experts for the 1<sup>st</sup> EuroNatur workshop in November 2003 (Appendix 3). By comparing this list with the respective list of fish species which have been recorded in the Bojana-Buna River ecosystem (SCHNEIDER-JACOBY et al. 2006b), we expect that much more species may be present in

the salina. Because the outer drainage canal, which surrounds the Solana, is still connected with adjoining marshlands and the Bojana-Buna River, even some endangered species may exist in the area (cf. SCHNEIDER-JACOBY et al. 2006b).

#### **3.3.2.4. Brine shrimps (Anostraca)**

Worldwide brine shrimps of the genus *Artemia* (family Artemiidae) are known from about 500 natural and artificial salt lakes and salinas (DUMONT 2004). *Artemia* shrimps are adapted to aquatic habitats of high salinity of 70–250 grams NaCl/litre, which are free of fishes, and other vertebrate and invertebrate competitors or predators. In saline lakes and ponds brine shrimps may occur from the first inundation, when salt concentration is low, up to the point of saturation. Because *Artemia* shrimps are incapable of active dispersion, wind and waterbirds, particularly flamingos, are the most important natural dispersion vectors. Brine shrimps colonize new habitats by eggs (cysts) shed freely into water, and which manage to adhere themselves to the feet or feathers of waterbirds. For the case to be ingested, cysts are able to remain intact for at least a couple of days within the digestive tract of birds (DUMONT 2004).

Like in other natural and artificial salt lakes of the Balkan Peninsular, in the Solana Ulcinj the species *Artemia parthenogenetica* is known to occur (LEVENS & SORGELOOS 1996). In October 1999 HEGEDIS et al. (in lit.) investigated the population numbers and biomass production of the Solana's native *Artemia* shrimps. With a total biomass of 24,2 tons, i.e. 54,2 grams/m<sup>3</sup>, the population density and biomass production of brine shrimps in the salina is exceptionally high.

#### **3.3.2.5. Insects**

Few data concerning the insect fauna of the salina exist. Occasional observations, which we noted mainly during bird surveys for EuroNatur, indicate seasonally fluctuating, but sometimes large numbers of some grasshoppers (Orthoptera), like *Anacridium aegyptiacum*, *Locusta migratoria*, *Oecanthus pellucens*, *Xya* cf. *variegata*, and *Pteronemobius heydenii*. During spring and summer large numbers of butterflies (Lepidoptera) were noted along dams, while in late summer and autumn we saw large numbers of dragonflies (Odonata) along canals and in the low halophytes of some basins. In 2006 and 2007 numerous monarch butterflies of the species *Danaus chrysippus* (Nymphalidae) were present in the halophyte vegetation of evaporation basins.

#### **3.3.2.6. Mollusca**

Like other invertebrate taxa, the mollusca fauna of the salina is poorly studied. During a preliminary study of the benthos fauna of the salt-pans in September 2000, BOROVIĆ & SAVELJIĆ (unpubl. data) found marine gastropoda of the genus *Nassa* (family Nassariidae) in 1<sup>st</sup> grade evaporation basins and in evaporation II as well as the introduced bivalve *Tapes philippinarum* in evaporation I–IV. In addition, a population of the autochthonous mussel *Mytilus galloprovincialis* was confirmed in evaporation IV.

### 3.3.3. Flora

A whole of 114 species of plants is on record for the Solana (Appendix 4). Aside of extensive stands of halophytes and reeds of the type *Phragmites communis* W. KOCH, traditionally used meadows, pastures and different plant communities dominated by pioneer plants exist on levees, dams, and in most basins. On several levees VUKSANOVIĆ & PETROVIĆ (2004) noted the taxon *Beta vulgaris* ssp. *maritima* which was originally described from Montenegro in 1913, and is actually known in the country from only one other location. Aside of a number of other orchids, VUKSANOVIĆ & PETROVIĆ (2004) noted *Ophrys bertolonii*, a species which is strictly protected in Montenegro. On some dikes and levees extensive stands of *Orchis laxiflora* and *Narcissus tazetta* exist. The later species also occurs in large numbers in meadows in the hinterlands of Velika Plaža. Concerning the international importance of the plant communities of the salina, see Criterion 2 in chapter 3.4.

### 3.4. International importance

With > 1.000 ha the Solana Ulcinj is one of the largest salinas, which are currently in active operation in the eastern Mediterranean region (SADUL et al. 1998). Following rules of the Ramsar Convention the significance of the Solana Ulcinj for waterbirds and other species is summarized as follows:

**Criterion 1:** According to the European Union's Habitat Directive 92/43/EEC and the Emerald Network, established under the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention), the area is situated within the Mediterranean biogeographic region. Following the delimitations of the European Ecological Region concept (DMEER), the Solana is situated within the Illyrian Deciduous Forest region. Within both concepts, the sheer extent of the salina's brackish and saline wetland habitats is unique for the respective biogeographic region. The Solana Ulcinj is an outstanding example for an operational salina at the eastern coast of the Adriatic Sea. In addition, during seasonal floodings of the Bojana-Buna River, the salina is a functional element for natural water retention in the lower Bojana-Buna river valley.

**Criterion 2:** Referring to the IUCN Red List of Threatened Species (2006) the proposed Ramsar site supports the Critically Endangered Slender-billed Curlew (last sighting 2005), the Endangered Lake Scutari Water Frog (*Rana shqipericana*), a recently described species of green or water frogs (Ranidae) which is endemic to Lake Skadar and the lowlands of northern Albania (Fig. 14), and three bird species assessed as Vulnerable (Tab. 2).

Apart of the Solana Ulcinj, stands of halophytes in comparable size exist in the Republic of Montenegro only in the abandoned salina of Tivat (Boka Kotorska). While in other parts of the country as well as along most of the eastern coast of the Adriatic Sea (HORVAT et al. 1974), only few and largely fragmented stands of euryhaline plant communities remain (S. VUKSANOVIĆ in SCHNEIDER-JACOBY et al. 2006b). The preservati-

on of the Solana's euryhaline plant communities depends on the annual cycle of salt production and a careful management of the area. The salina further harbours a endemic plant community, *Salicornietum herbaceae*, which was recently described by JANKOVIĆ & STEVANOVIĆ (1983).



Fig. 14: Green frog with characteristics of the recently described Lake Scutari Water Frog (*Rana shqipERICA* HOTZ, UZZELL, GÜNTHER, TUNNER & HEPPICH, 1987). 6 May 2006, Gjo-Lulit, Albania (Photo: T. Petras-Sackl).

Species	Conservation status
<b>Amphibia</b>	
Lake Skutari Water Frog	EN - B1ab(iii)
<b>Birds</b>	
Dalmatian Pelican	VU - A2ce + 3ce
Lesser White-fronted Goose	VU - A2bcd + 3bcd
Greater Spotted Eagle	VU - C1
Slender-billed Curlew	CR - C2a(ii), D

Tab. 2: Conservation status of species listed in the IUCN Red List of Threatened Species (2006).  
 EN = Endangered,  
 VU = Vulnerable,  
 CR = Critically Endangered.

**Criterion 3:** In comparison to other wetlands in the Republic of Montenegro and the Balkan Peninsular, the Solana Ulcinj harbours a unique assemblage of freshwater, brackish and saline wetland habitats. Apart of the high diversity of bird species (PUZOVIĆ 2002, STUMBERGER et al. 2005), some other vertebrates, like Mediterranean Killifish (*Aphanius fasciatus*), have their strongholds at the eastern coast of the Adratic Sea in

Taxon	Number of species	
	Bojana/Buna delta	Solana Ulcinj
Fishes	141	22
Amphibians	13	?
Reptiles	28	?
Birds	237	175
Mammals	31	?

Tab. 3: Comparison of the species diversity of birds and other vertebrate taxa in the Bojana-Buna Delta and in the Solana Ulcinj (data adapted from SCHNEIDER-JACOBY et al. 2006b).

the Bojana-Buna Delta. A comparison of the species diversity of birds and other vertebrate taxa in the Bojana-Buna Delta (Tab. 3) indicates that the Solana Ulcinj is at both, the national and international levels, a outstanding site for the conservation of the biodiversity of the western Balkan's (SCHNEIDER-JACOBY et al. 2006b).

**Criterion 4:** During prolonged periods of severe weather with low temperatures and/or heavy winds, large numbers of wintering waterfowl and waders are concentrated in the salina, where dams and levees offer shelter from wind, and the alkaline environment prevents mudflats and shallow waters from freezing-over (cf. SACKL et al. 2006 for the Tivat Solila). Recent data indicate, that during adverse weather conditions in winter and during dry summer months many waterbirds, like Great White Egret and other herons, may leave Lake Skadar and other wetland habitats along the Bojana-Buna River for feeding and roosting in the salina. The Solana Ulcinj is a key-site for wintering and migrating waterbirds, and for most colonial waterbirds which nest in the Bojana/Buna River-Lake Skadar ecosystem (cf. Plates 3 and 4). In addition, the area is regularly visited by the most western population of Globally Threatened Dalmatian Pelican (3 % of the species' global population).

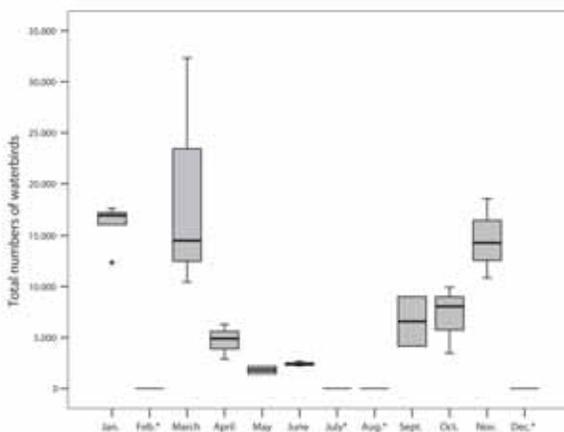


Fig. 15: Seasonal fluctuations of total numbers of waterbirds in the Solana Ulcinj, 2003 – 2007 (24 counts). \* no counts available.

**Criterion 5:** Between 2003–2006 the Solana has hosted 15.000–20.000 waterbirds in autumn and winter. Peak numbers of up to 32.000 waterbirds/day, mostly shorebirds and ducks, are present in March during spring migration (Fig. 15). According to high turn-over rates of some species, like Garganeys, with maxima of 1.200 birds/hour arriving in the salina in spring, population numbers of waterbirds which use the salina for resting and refuelling during migration, may be much higher (EuroNatur Database).

Species	WPE3	WPE4
Pygmy Cormorant	1%	0,5%
Dalmatian Pelican	3%	2%
Little Egret	1,5%	1%
Great White Egret	1%	1%
Eurasian Spoonbill	1%	1%
Common Shelduck	1%	1%
Black-winged Stilt	1%	1%
Collared Pratincole	1%	1%
Kentish Plover	1%	0,5%
Grey Plover	1%	1%
Dunlin	1%	1%
Black-tailed Godwit	3%	3%
Slender-billed Curlew	1%	1%
Spotted Redshank	1,5%	3%
Marsh Sandpiper	1,5%	2%

*Tab. 4:* Waterbirds which reach or exceed the 1 % threshold of the Ramsar Convention in the Solana Ulcinj, 2003–2007.

**Criterion 6:** Bird species whose population numbers exceed the 1 % criterion of the Ramsar Convention, are listed in Tab. 4. According to occasional records of exceptionally dense aggregations another three species may reach the 1 % threshold: Garganey (1 %), Common Redshank (1 %) and Little Tern (1 %). Detailed data and information on the application of the 1 % criterion of the Ramsar Convention are summarized in Tab. 5.

The salina is currently designated as IBA „Ulcinj salt pans – Ulcinjska solane” (national code YU045) by BirdLife International (HEATH & EVANS 2000). The Solana is further proposed to be included in the planned transfrontier Biosphere Reserve „Skadar Lake – Bojana/Buna Delta” (SCHNEIDER-JACOBY et al. 2006a). In November 2005 the Albanian government established the respective protection area and has designated it as Ramsar site in February 2006. In accordance with the zonation of the forthcoming transboundary conservation area, it appears to be most appropriate to nominate the Solana Ulcinj as a Special Management Area, which will be included in the buffer zone of the proposed Biosphere Reserve or the extended Lake Skadar National Park (cf. 3.1.4.).

Species	Biogeographic Population	Count max. (2003–2006)	1% level		Solana		1% level		Min. estimate (2003–2006)	1% level	
			WPE3	WPE4	Ulcinj	WPE4	Ulcinj	WPE4		WPE4	
<i>P. pygmeus</i>	SE Europe, Turkey	485	400	1000	1%	1000	0.5%	1000	1000	0.5%	1%
<i>P. crispus</i>	Black Sea, Mediterranean (non-bre)	96	30	45	3%	45	2%			2%	
<i>E. garzetta</i>	garzetta, C and E Europe, Black Sea, E Mediterranean (bre)	680	580	580	1.5%	580	1%	1000	1000	1%	1.5%
<i>E. alba</i>	alba, C and E Europe, Black Sea, E Mediterranean (bre)	501	470	470	1%	470	1%			1%	
<i>P. leucorodia</i>	leucorodia, C, SE Europe (bre)	112	120	120	1%	120	1%	200	200	1%	1.5%
<i>T. tadorna</i>	Black Sea, Mediterranean	620	750	750	near 1%	750	near 1%				
<i>A. penelope</i>	Black Sea, Mediterranean (non-bre)	1228	3000	3000	0	3000	0				
<i>A. querquedula</i>	W Africa (non-bre)	8279	20000	20000	0	20000	0	20000	20000	0	1%
<i>A. clypeata</i>	Black Sea, Mediterranean, W Africa (non-bre)	1158	4500	4500	0	4500	0				
<i>H. himantopus</i>	himantopus, C and E Europe, E Mediterranean (bre)	304	340	340	1%	340	1%	500	500	1%	1.5%
<i>G. pratinctola</i>	pratinctola, Black Sea, E Mediterranean (bre)	300	240	240	1%	240	1%				
<i>C. alexandrinus</i>	alexandrinus, Black Sea, E Mediterranean (bre)	380	410	410	1%	410	0.5%	600	600	0.5%	1%
<i>P. squatarola</i>	SW Asia, E Africa (non-bre)	481	900	900	near 1%	900	near 1%	1000	1000	near 1%	1%
<i>C. alpina</i>	alpina, W Europe (non-bre)	10503	13300	13300	near 1%	13300	near 1%				
<i>C. alpina</i>	centralis, SW Asia, E Africa (non-bre)	10503	3000	3000	3%	3000	3%				
<i>L. limosa</i>	limosa, E Europe (bre)	3423	1300	1300	3%	1300	3%				
<i>N. tenuirostris</i>	Mediterranean basin (non-bre)	1	1	1	1%	1	1%				
<i>T. erythropus</i>	Europe (bre)	1471	1000	530	1.5%	530	3%				
<i>T. totanus</i>	totanus, E Europe (bre)	1988	3400	3400	0.5%	3400	0.5%	3000	3000	0.5%	1%
<i>T. stagnatilis</i>	Europe (bre)	500	370	270	1.5%	270	2%	1000	1000	2%	3%
<i>S. caspia</i>	Europe (bre)	14	65	95	0	95	0	?	?	0	?
non-bre / bre = non-breeding / breeding											
<i>S. albitrons</i>	albitrons, E Europe (bre)	295	960	880	0	880	0	600–700	600–700	0	near 1%

Tab. 5: Application of 1 % criterion of the Ramsar Convention according to WPE3 (2002) and WPE4 (2006) for waterbird counts in the Solana Ulcinj, 2003–2007 (EuroNatur Database).

## 4. Management objectives

### 4.1. Main goals

**Goal 1:** The area is regularly guarded and controlled by rangers.

**Goal 2:** Main nesting sites of waterbirds are save from terrestrial predators, uncontrolled flooding and human disturbances. The following minimum numbers are continuously preserved in the salina:

Dalmatian Pelican	1–5 bp. (former breeding species)
Greater Flamingo	new colony established
Black-winged Stilt	100 bp.
Avocet	2–10 bp.
Slender-billed Gull	2–10 bp.
Common Tern	30 bp.
Little Tern	100 bp.

**Goal 3:** Population numbers of birds which nest in dry grasslands and salt steppes, i.e. Collared Pratincole and Stone-curlew, amount to > 100 bp. and > 10 bp., respectively.

**Goal 4:** Ducks breed again in significant numbers in the Solana, Great Bitterns regularly breed in at least 1–2 bp., and Common Shelduck in minimum numbers of 10 bp.

**Goal 5:** Insectivorous bird species regularly breed in following minimum numbers:

- Lesser Kestrel breeding colony established (former breeder)
- Little Owl 3 bp.
- European Roller 2–4 bp.
- European Bee-eater 50 bp.
- Eurasian Hoopoe 5–10 bp.

**Goal 6:** During winter the Solana regularly hosts 20.000 waterfowl and waders.

**Goal 7:** During spring migration the Solana regularly supports 40.000 resting waterbirds.

**Goal 8:** Until 2012 during the period from August–November, peak numbers of Dalmatian Pelicans will increase to 200 birds, with minimum numbers of 100 pelicans between September and November.

**Goal 9:** All protected or endangered plants, e.g. all species of orchids, are preserved in original numbers, and all stands of euryhaline plant communities are preserved in its original extent.

**Goal 10:** The Solana Ulcinj is established as a Nature or Landscape Park according to IUCN category V or maintained as a Managed Protected Area (category IV) as part of a larger protection area (National Park, Regional Park or Biosphere Reserve).

## 4.2. Salt production

The existing, seasonal cycle of salt production which is based on the natural evaporation process (cf. chapter 3.2.), is acknowledged as the optimal use of the salina and the foundation of the MP.

### 4.2.1. Maintenance of dikes

All dikes have to be maintained by the Solana's management as a crucial infrastructure for salt production. EuroNatur supports its maintenance with a mini excavator. The open character of dikes with scattered stands of low *Tamarix* shrubs, dry grasslands and meadows, offers adequate nesting conditions for waterbirds and dry grassland birds as well as access to the salina for renovation and visitor activities. Existing practices for maintaining dikes include grazing by free-roaming domestic animals, cutting of grasses and renovation of damaged dams and levees.

Concerning the maintenance of dikes and levees, a simple classification is appropriate:

- Dikes without nest sites of waterbirds, which could be maintained by grazing cattle or mowing
- Dikes with breeding colonies, which have to be maintained by active conservation management

Apart of Collared Pratincole and Yellow-legged Gull, currently no colonial waterbirds nest on the main dike in the northern and southern parts of the salina. Most breeding colonies are located on remnants of the old dike which separates Jezero 1 & 2. The remnants of this dike, which are surrounded by open water, are inaccessible for terrestrial predators, bird-watchers and other visitors. A large portion of the nest sites of waders, who currently nest on the islets, will be lost due to reconstruction work during the next years.

For mitigating the loss of nest sites on the damaged dike between Jezero 1 & 2, the key priority is to maintain and to transfer the old dike in Jezero 1 into small islands for nesting waterbirds (see chapter 6.9.). In 2005 a pilot project during which parts of the old dike in Jezero 1 were transferred into artificial nesting islets, has been, with the establishment of a nesting colony of 25 bp. of Little Tern, a first success of active conservation management. According to current population numbers of colonially nesting waterbirds in Jezero 2 and experiences with the pilot project in Jezero 1, a whole area of at least 1 ha or 800 m in length of artificial islands will be needed along the old dike in Jezero 1.

**Grazing agreements:** Till 2005 up to 500 sheep and 80 cattle, owned by local stockholders in Stoj and Zoganj, have been grazed along the dikes and levees of the Solana. Domestic animals, which graze in the salina, belong to local breeds of Pramenka sheep (Zackelschafe), like *ljaba*, *baljusa* and *bardoka*, and some cattle to the grey, native *busha* strain (Fig. 16 and 17).



*Fig. 16:* The Solana's outer dam is grazed by free-roaming sheep. 25 April 2003, Solana Ulcinj (Photo: P. Sackl).



*Fig. 17:* Cattle grazing on the southern main dam between Kneta and Jezero 2. 24 April 2003, Solana Ulcinj (Photo: B. Stumberger).

Currently, signs for over-grazing are evident on the inner main dam between Evaporation II and basins Zoganjski 1 & 2, and on the dikes in Kneta. The over-grazed dams harbour significant nesting sites of Collared Pratincole, Stone-curlew and smaller numbers of Common Redshank. To preserve adequate nesting conditions for Collared

Pratincoles and Stone-curlews it will be essential to maintain open grassland habitats with low vegetation which is intermingled with patches of open ground, on dams.

Until 2005 grazing was practised by local people without any agreements with the Solana's management, and damages of dikes caused by cattle were regularly reported. In contrast to grazing fees, it may be more practicable for keeping dikes, dams and levees free from shrubs and high grasses by cattle, to make grazing agreements with 4–6 local stockbreeders. Although cost benefits are important for the Solana, a simple regime for the grazing of sheep and cattle should be accepted:

- Year-round grazing of domestic animals in the presence of shepherds is possible only on the Solana's outer dike.
- Grazing of inner main dams and smaller levees is possible only with free-roaming animals.
- During herding cattle and sheep into and back home from the salina it is not allowed to cross dry salt-pans, which may potentially damage the petola layer of the evaporation basins.
- Grazing is prohibited in all basins of the 3<sup>rd</sup> and 4<sup>th</sup> evaporation grade, and in crystallisation basins.

Alternatively, it may be more practicable to limit grazing by temporarily fencing-off sensible areas or to limit the access of cattle to special management areas. Good examples for the latter are given by the grasslands along Porta Milena and in the unused basin called „Meadow” (cf. chapter 6.5.).

**Dike between crystallisation basins and Porta Milena:** 11 ha of the dam, which is currently heavily overgrown by low scrubs, should be managed as an extensively grazed pastureland (1,8 cattle/ha). This will offer the opportunity to establish a nucleus herd of up to 20 animals of the critically endangered Montenegrin busha cattle in vivo. By installing a 2,5 km long electric fence it's possible to create a pasture which is safe for cattle as well as visitors. The proposed pastureland is separated from the visitor trail, which is running along the dam, by a narrow, but deep canal. Internationally operating NGOs, like the Monitoring Institute – SAVE in Switzerland and the National Institute for Agriculture in Montenegro, should be contacted for help with the establishment of the nucleus herd.

**Mowing:** Besides grazing, mowing offers a practicable alternative for preserving low vegetation on dikes. In comparison to grazing, mowing will be more cost intensive in terms of working time and fuel, but offers a better control of the area, and damages of dikes and levees by cattle will be avoided. For the case the Solana decides to use mowing for the maintenance of main dikes and levees, the following regulations should be implemented:

- During the nesting season of birds, i.e. between March 1<sup>st</sup> and September 1<sup>st</sup>, only already existing tracks for vehicles on top of main dikes, which are necessary for patrolling the salina, should be mown.
- All other dikes and smaller levees should be mown in autumn, after salt harvest is finished.

**Burning:** Burning should be used only under special circumstances and following careful planning. Burning of the dike between Jezero 2 and Zoganjski 1 in late winter till March 10<sup>th</sup>, before birds start to nest, may be a option for creating nesting habitats for Collared Pratincoles (SCHNEIDER-JACOBY & SAVELJIĆ 2006). But, the effects of burning on vegetation, habitat use and nesting success of the species has to be carefully monitored (Fig. 18).



Fig. 18: Low grasslands intermingled with patches of bare soil offer adequate habitat for Collared Pratincoles (*Glaucopis tricolor*) on heavily over-grazed dams. 28 April 2006, Solana Ulcinj (Photo: T. Petras-Sackl).

#### 4.2.2. Water regime

Although the water regime and ecology of the former Zoganjsko Jezero was heavily altered by the construction of the salina, the former inland lagoon is still maintained as a wetland habitat. At least the extent of wetland habitats, which are permanently or periodically covered by water, in the Montenegrin part of the Bojana-Buna Delta has remained unchanged during the last century. In winter, after the harvest of industrial salt in late summer, most of the salina's salt-pans are free of seawater, but will be covered by heavily fluctuating levels of rainwater following local rainfalls, which permanently refill the basins between October and May. In winter a minimum of one third of the salt-pans is permanently covered by water, while other basins, depending on local rainfall, wind conditions and relief, are covered by shallowly flooded, wet or partially dried-out mudflats. By their ecological function as artificially created intertidal wetland habitats, the latter basins attract large numbers of waders and of other waterbirds during migration and winter.

Because during winter, until a new cycle of salt production will start in late spring, shallowly flooded or dried-out mudflats offer no adequate conditions for aquatic plants and animals, which are not resistant to prolonged periods of desiccation, like chironomids, tubificid worms, some mollusks and fish (SADUL et al. 1998), water management is the most important factor which is limiting the numbers of migrating and nesting waterbirds.

The Solana has offered four basins, where water levels could be managed exclusively for conservation purposes: Jezero 1, Zoganjski 1 & 2, and the basin called „Meadow“ (Fig. 19). For compensation of the proposed reconstruction of Jezero 2, which currently harbours significant numbers of nesting waders, the appropriate management of the water regime in Jezero 1 will be of great importance for colonial waterbirds. Main measures for maintaining water levels in Jezero 1 which are compatible with conservation, are (cf. 6.9.3.):

- Construction of a dam or low levee along the southern side of the former, central canal in Jezero 1 to divide the basin in two parts: Jezero 1a, with a naturally fluctuating, and Jezero 1b, with an artificially controlled water level.
- The installation of three sluices along the dam between Jezero 1a & 1b.
- Installation of a year-round monitoring system and management of water levels in Jezero 1b, Stojski 1 & 2 by continuously measuring water levels with a water-gauge.
- During winter (October–April), i.e. between annual cycles of salt production, the existing water regime in Jezero 1 should be not artificially altered. With water covering 25–75 % of the basin, dikes and levees will be not damaged by waves.

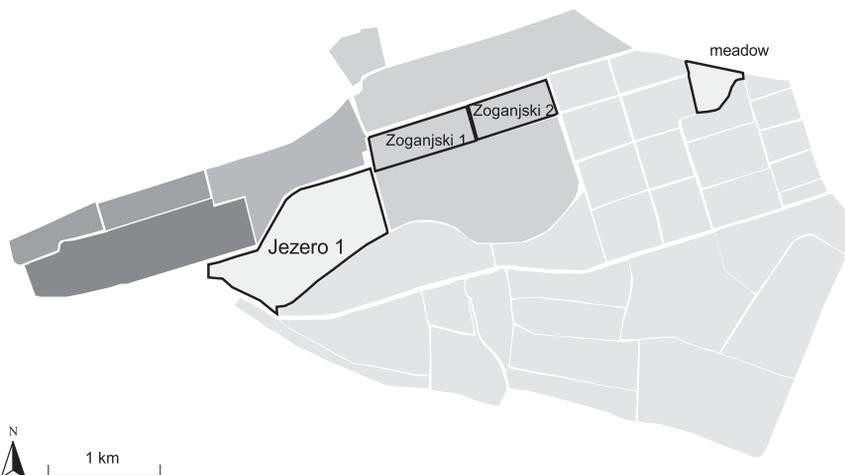


Fig. 19: Map showing non-functional basins offered by the Solana's management for conservation and habitat management.

### 4.2.3. Vegetation

Only 8 ha of the salina's total area are covered by reeds, while associations of halophytes cover 60,2 ha in salt-pans and canals. It is well known that, in comparison to open water surfaces, evapotranspiration rates are substantially higher above reed banks and stands of aquatic vegetation. Therefore, it's in the Solana's interest to preserve or to increase the vegetation cover in the salt-pans.

For preserving the vegetation in the basins two main rules should be followed:

- According to their effects on evapotranspiration, reeds and other stands of semi-aquatic and aquatic vegetation should be not cut or burned.
- All stands of halophytes have to be preserved as far as possible from any damage by reconstruction and renovation works (e.g. in Jezero 2).

For preserving open grassland habitats and pasturelands on dikes and levees the following points are important:

- Regular grazing by domestic animals (see 4.2.1.) or 1–2 cuttings p.a.
- Mapping of plant communities and of all protected plant species on dikes and levees.

By comparing economical aspects of grazing vs. mowing, mowing will be more expensive, but grazing has to be more closely guarded. The mapping of plant communities will help to identify segments along dams where grazing or mowing will be the better or only practicable option.

### 4.2.4. Medicinal use of the salt-pans

For creating additional revenues and for contributing to the development of the wellness section of tourism in the region, the Solana's management is planning to use euryhaline soils of the salt-pans for medicinal purposes. According to a preliminary study, ordered by the Solana, Jezero 1 harbours the best soils for this purpose. For preserving the basin's significance for waterbirds (see chapter 6.9.) all mud should be taken:

- Outside the nesting season, and in small quantities only, between September 1<sup>st</sup> and March 1<sup>st</sup>.
- Close to the first hide (see Fig. 25) along the northern dike of Jezero 1.

With left-overs from the extraction of mud additional islands for nesting waterbirds or observation facilities for visitors, close to the already existing hide, should be constructed.

## 4.3. Rangers

The constant guarding of the salina by rangers will be the key for a successful implementation of the MP. The tasks of rangers include the security of the Solana's property, guarding of protected areas, and the information of visitors on flagship species, like pe-

licans and flamingos, and on other natural values in the salina. Thus, the main tasks of rangers include:

**Standard route:** The salina is controlled daily along the outer dam. Because sportsmen, like hunters and fishermen, regularly enter the salina illegally during dusk and dawn, it is most important to patrol during evening and morning hours. For demonstrating the Solana's best intention to protect the area from illegal access and bird shooting at least two night patrols per week, two hours after sunset and two hours prior to sunrise, will be appropriate.

**Temporary route:** Temporary patrol routes cover the salina's inner dams and levees. Along temporary routes guarding should be done once a week, or even lesser, and, so far appropriate, a car could be used for patrolling. Because dams in the Kneta and in some older parts of the salina are core roosting areas for Dalmatian Pelicans, they should be used for patrolling only carefully and as less as possible.

**Control points:** For locating illegal sportsmen and other unauthorized visitors constant control points should be used by rangers by 30 minute stops. Patrolling routes and control points shown in Fig. 20 are selected to avoid disturbances in core conservation areas and, simultaneously, to ensure the most effective patrolling of the salina.

In addition to patrolling, rangers should accomplish the following activities:

- Counting and regular reporting on the presence of flagship species, i.e. pelicans, flamingos and other waterbirds, including species, date of observation, location (number of basin), and numbers of birds.
- Promptly and regular reporting to the Solana's management on all illegal activities, like shooting, hunting, fishing, unauthorized visitors, hides, rafts, bridges and unauthorized fishing equipment in the outer canal by recording date, time of day, activities and numbers of people involved.
- Disposing of waste left on trails, on the observation tower and in hides by visitors.
- Helping visitors with information.
- Checking tickets of visitors and urging visitors not to leave trails.
- Guiding groups of visitors along the inner trail.
- Year-round monitoring of water levels in Jezero 1, Zoganjski 1, and, between April and September, in Stojski 1 & 2.
- Noting of all activities and observations in a diary.

**Equipment:** The standard field equipment of rangers includes a bicycle and/or motor cycle, mobile phone, binocular, note book, pens, maps showing the standard enumeration of basins (Fig. 31) and a bird field guide.

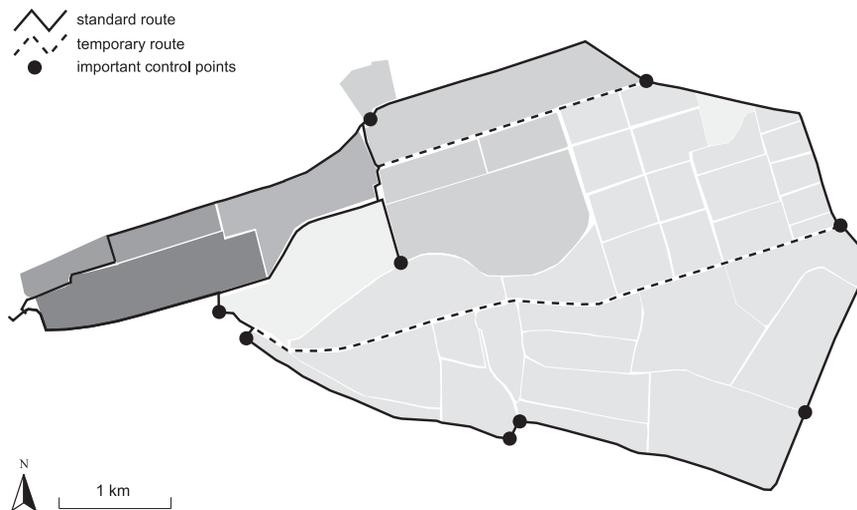


Fig. 20: Standard and temporary patrol routes of rangers.

#### 4.4. Protected areas

Throughout the Mediterranean region, active as well as abandoned salinas are important wetland habitats for nesting and migrating waterbirds (SADUL et al. 1998). In the same way, the Solana Ulcinj is a key-site for nature conservation, the sustainable use of the Bojana-Buna Delta ecosystem (SCHNEIDER-JACOBY et al. 2006b), and for the national biodiversity strategy of the Republic of Montenegro. Accordingly, the Solana should be established as a protected wetland under IUCN category V (Protected Landscape/ Seascape).

The Solana further fulfills criteria of the Ramsar Convention. Besides its significance as a key-site for 15.000–30.000 waders and other waterbirds along the Central European Flyway (Adriatic Flyway), and its potential to attract endangered waterbirds for nesting, like Dalmatian Pelican and Greater Flamingo, the area offers great potentials for the development of eco-tourism. For achieving both objectives, it is necessary to establish a strictly protected core conservation area in the salina, which will be prohibited for people (Fig. 21), and to implement a special habitat and species management in basins, which the Solana has already offered to put permanently out of operation for conservation purposes (Fig. 19).

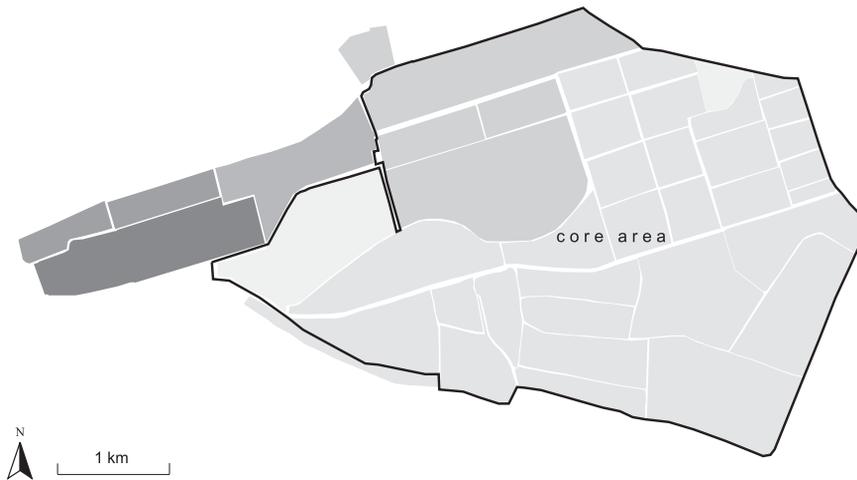


Fig. 21: Map showing the delimitation of the proposed core conservation area in the Solana Ulcinj.

Following current Montenegrin law the whole area of the salina has to be considered as an industrial area, in which according to hunting regulations of the Republic of Montenegro, all hunting activities are prohibited. Under the same rules, according to current hunting regulations of the provincial government of the Opština Ulcinj any hunting and bird shooting is strictly prohibited in the Solana. Despite legal regulations, CZIP and EuroNatur have recorded a lot of illegal hunting and bird shooting by local and foreign hunters in the salina and along Velika Plaža since 1999 (Fig. 22–23). A considerable part of Velika Plaža is, like the Solana, protected by current Montenegrin law (SCHNEIDER-JACOBY et al. 2006b, RASCHKE 2005).

Therefore, under Goal 1 (see chapter 4.1.) the present MP targets to (re)enforce existing regulations and to implement a strictly guarded hunting ban in the salina (see chapter 4.3.).

Further objectives of the proposed core conservation area in the salina are as follows:

- To preserve and to improve breeding conditions for colonially nesting waterbirds, in particular for waders, ducks, and dry grassland birds.
- To preserve and to improve conditions for resting and over-wintering waterfowl and shorebirds.
- To establish the natural and cultural heritage of the salina as an integrated element of the Solana's cooperative identity.
- To develop the non-functional basins Jezero 1, Zoganjski 1 & 2, and „Meadow” as special conservation areas, managed for nesting waterbirds and dry grassland birds (see chapter 6.).



Fig. 22: Common Redshank (*Tringa totanus*) wounded by bird-shooters. January 2001, Solana Ulcinj (Photo: D. Saveljić).



Fig. 23: Juvenile Grey Heron (*Ardea cinerea*) wounded by gunshots. January 2001, Solana Ulcinj (Photo: D. Saveljić).

## 4.5. Nature tourism and environmental education

Until 2006 the Solana offered a guided tour for outside visitors through its factory buildings, which was mainly used by local schools, while visitors were generally excluded from the salt-pans. Nature tourism and environmental education started with the cooperation of the Solana with EuroNatur, and first facilities for visitors, like a visitor trail, hides, and an observation tower were erected between 2005 and 2006. In spring 2006 an exhibition was opened by EuroNatur in the Solana's new museum space in cooperation with the Natural History Museum of Montenegro in Podgorica.

For promoting awareness for the salina's natural values, with help from EuroNatur, the company has organized two workshops for staff members (see chapter 2.). In the future the presence and information responsibilities of rangers will further help to develop the educational potentials of the Solana. The salt company is an important employer for local people and an important partner for the development of tourism in the region. Aside of the economic situation of the salt market, environmental education and eco-tourism are new challenges for the Solana which will allow the marketing of salt products in situ.

### 4.5.1. Information centre

A preliminary information centre with appropriate infrastructure, like information stands and a Powerpoint projector, is already existing in the new museum of the Solana. Responsibilities of the head/guide of the information centre during guided tours for school classes and other visitor groups include:

- Welcome note to visitors (1 min.).
- Guided tour through the exhibition (10 min.).
- Powerpoint presentation or film, "Solana – Salt is Life" (10 min.).
- Answering questions and discussing with visitors.
- Guiding visitors through the factory buildings and salt-pans, and explaining the process of salt production.
- Guiding visitor groups along the inner trail to the observation tower.

Concerning the organisation of the information centre main responsibilities include:

- Organisation of guided tours and group visits.
- Regular information of the media.
- Keeping contact with the Solana's management and with rangers.
- Coordination of the visitor programme "Salt Production".

An important responsibility of the information centre will be to inform visitors on the aims, methods and the implementation of conservation activities, e.g. water-level management for waders, hunting ban, habitat management for colonial waterbirds. The main task of the information centre is to share information with the public. By doing so it will be an important tool for increasing the Solana's image and for marketing its products. A dynamic person, who is able to speak Montenegrin, Albanian and English, should be posted as its head. EuroNatur is able to offer accurate training for the head of the information centre and for guides.

#### 4.5.2. Educational trail

In the salina an inner and outer trail already exists which are both suitable for visitors, without affecting core conservation areas. Both trails allow self-guided tours, but should offer information stands for people of different ages, education and interests. The inner trail is 3,9 km long and takes a 3 hour walk. With the construction of an observation tower (Fig. 24), hides, nest-boxes, nesting islets and signs since 2005, visitor facilities along the inner trail are already under active construction. The outer trail, which will surround the salina, is 17,6 km long and will take an 8 hour walk (Fig. 25). Additional infrastructure, like a bicycle trail with watch towers around the salina, has been suggested by the proposed GEF project of the World Bank.

For the future along both trails additional information facilities will be needed. To inform visitors on the ecological and economic values of the salina, information stands explaining water gauges, salinity and evaporation grades, pumps, canals, vegetation, birds and the management of water-levels should be erected *in situ*.

Along both trails visitors have to accept the following rules:

- Access for visitors is possible only along marked trails on dikes. A simple sketch of both, the inner and outer visitor trail, should be printed on entrance tickets.
- Visiting the salina is possible only during the day (summer: 8 a. m.–20 p. m., winter: 8 a. m.–17 p. m.).
- Throughout the salina camping, camp-fires and any artificial noise is prohibited.
- Visitors, who intend to take the outer trail on foot have to start at least 8 hours before dusk. The entrance and checkpoint for visitors using the outer trail is at basin no. 1 (refreshment stall in Fig. 25).



Fig. 24: Construction of the central observation tower along the inner visitor trail on the dike between Jezereo 1 and Jezero 2. 25 September 2006, Solana Ulcinj (Photo: M. Vernik).



Fig. 25: Map of already existing visitor facilities along the inner visitor trail and the proposed outer trail on the Solana's surrounding dam.

#### 4.5.3. Visitor train

In the salina a narrow-gauge railway exists, which was originally erected for transporting salts from crystallisation basins to the Solana's depots. This railway offers a good opportunity for an additional service for visitors. Although the railway needs renovation, it could be used to connect the Solana with seaside resorts and hotels, close to the isthmus of the Porta Milena channel, at Velika Plaža, which are only a few hundred metres away from the salina. The visitor train, which will be unique for the Balkan region, is expected to attract many visitors from Velika Plaža, the main tourist destination in the outskirts of Ulcinj.

The train line should start in front of the information centre and will connect the latter directly with Jezero 1 (Fig. 26). This appears to be the best way to deal with visitor groups in the future.

During the tourist season traffic jams prevail in the city of Ulcinj and in main resorts along Velika Plaža. Therefore the idea of the visitor train, developed by EuroNatur, is a challenge for the whole community which offers the potential to solve traffic and many related problems of the Ulcinj community. In addition, the proposed visitor train will help to establish the conservation image of the region. The Solana Ulcinj should find partners which are interested in the project.

#### 4.5.4. Bicycle trail

A bicycle trail along the outer dam of the salina was already proposed by the World Bank's GEF project (see 4.5.2.). According to current conditions, biking on the salina's outer, surrounding dam is possible only with mountain-bikes. In different segments the dam is in need of smaller renovation works with bulldozers. Bike rentals in the Solana's information/visitor centre could be an interesting offer for tourists.

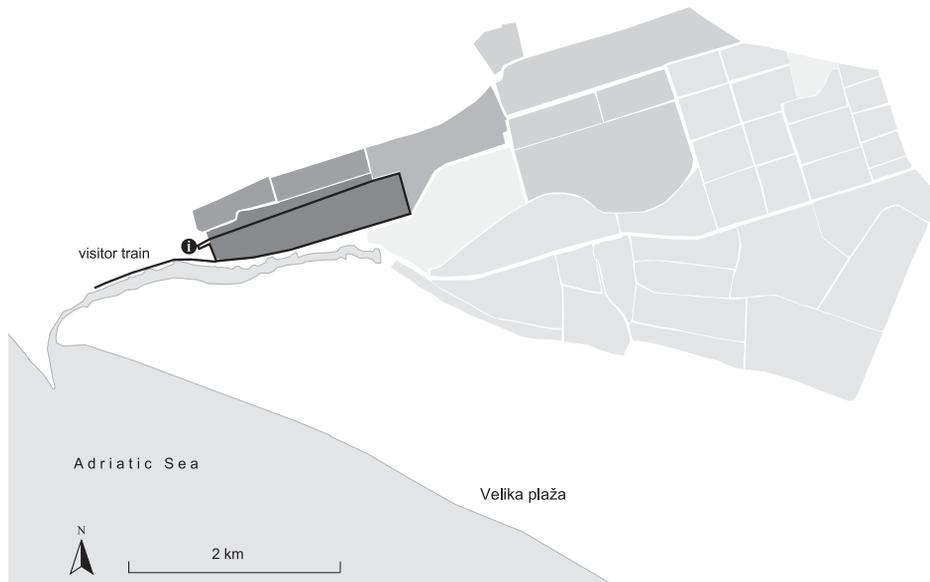


Fig. 26: Map of the proposed visitor train which will connect the inner trail with the Solana's visitor centre and seaside resorts at Velika Plaža in the outskirts of Ulcinj.

#### 4.5.5. Salt festival

A salt festival "Berba soli" in the factory buildings of the Solana may be an important and powerful social event for promoting the natural and cultural values of the region. The best time for a festival will be at the end of the annual salt harvest in August/September. In the long term, tourism is the main sector that produces the greatest added values from Marine Protected Areas (e.g. KELLEHER et al. 1995). In this way a salt festival will be a potentially powerful contribution to the development of tourism, based on the natural and cultural resources of the Bojana-Buna Delta in Montenegro and Albania. The idea has to be discussed with the Solana's staff, because they often have the best ideas for promoting their own place.

#### 4.5.6. Visitor programme "Salt Production"

The Solana Ulcinj has great experience and a long-time tradition in guiding and informing visitors on salt production in the salina. In the future a booklet, which should be developed by the company and should be offered to all visitors, will be needed for the information centre. In addition, new information stands and visitor facilities will be vital for technical explanations of salt production along visitor trails (see 4.5.2.).

#### 4.5.7. Regional programmes

National and international cooperations of the Solana should include joint ventures and promotion programmes with other protected salinas in the Mediterranean region. As part of the Adriatic Flyway Project<sup>5</sup>, EuroNatur is actually preparing a nature guide for

the east coast of the Adriatic Sea which, besides the Solana Ulcinj, will include other salinas in Slovenia, Croatia and Albania. Another important site along the Adriatic Flyway in Montenegro represents the abandoned salina in Tivat (Tivat Solila), which is already under protection and according to the new Spatial Plan of Montenegro in urgent need of accurate visitor management (SACKL et al. 2006).

Another powerful option for both, the Solana and the Ulcinj community, is the cooperation with Shkodra and Velipoja on the Albanian side of the Bojana-Buna Delta. The proposed trans-boundary Marine Park which will incorporate all conservation areas along the Bojana-Buna river corridor between Lake Skadar and the river's mouth at the Adriatic Sea, offers great potentials for the development of nature tourism, with the Solana as one of the key attractions in Montenegro (SCHNEIDER-JACOBY et al. 2006b). In addition, by incorporating the Solana Ulcinj and its information/visitor centre into the European Green Belt initiative, it will be able to promote the Bojana-Buna Delta and the Solana throughout Europe (ENGELS & GERLING 2006, SCHNEIDER-JACOBY et al. 2006a).

## **4.6. Management of the Nature Park “Solana Ulcinj”**

### **4.6.1. Management of the privately owned conservation area**

The Solana will manage the nature park with its own staff. The main activity of the company is the production of commercial salt, which forms the basis for the preservation of the natural values of the salina (see chapter 3.3.). The Solana company covers all costs for the production and the maintenance of equipment which is necessary for salt production. Because the maintenance of the salt-pans was largely ignored during the last Balkan War, and after the company's insolvency 2005, the salina has to be rebuilt by the new leadership of the Solana. In particular, for maintaining salt production a large-scale reconstruction and renovation of Jezero 2 is necessary.

Because hunting, fishing and other illegal activities by outsiders have regularly caused damage and conservation problems, a private security agency is guarding the property since spring 2007. Costs for guarding the area are paid by the Solana.

The Nature Park and core conservation areas in the salina are managed by the Solana in close cooperation with EuroNatur. In cooperation with Darko SAVELJIĆ from the National Institute for the Protection of Nature of the Republic of Montenegro, EuroNatur is responsible for monitoring bird populations in the salina. Although the EuroNatur team is holding permanent meetings, so far no formal board for the implementation and a constant evaluation of the MP has been nominated. EuroNatur has suggested the establishment of a voluntary board which should include representatives of the local com-

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<sup>5</sup> The Adriatic Flyway is part of the Central European Flyway of bird migration from western Eurasia to Africa. In autumn large numbers of birds from eastern Europe, central and northern Asia migrate in south-western directions across the Adriatic Sea via southern Italy, Sicily and Malta to North Africa.

munity in Ulcinj, the Ministry of Environment and Tourism, the National Institute for Nature Protection, the Natural History Museum of the Republic of Montenegro and international partners, to support the Solana with the implementation of the MP.

By organizing meetings and workshops EuroNatur supports the Solana to maintain and to create additional visitor facilities. During a workshop in autumn 2006, in which volunteers from BirdLife Slovenia and BirdLife Austria have participated, breeding islets for terns, observation hides and nest-boxes for Common Shelduck, European Roller and Bee-eaters have been erected along the inner and outer visitor trails (Fig. 27–29).



Fig. 27: Construction of artificial nesting islands by employees of the Solana in Jezero 1. April 2004, Solana Ulcinj (Photo: B. Stumberger).



Fig. 28: Installation of nest-boxes for Common Shelduck (*Tadorna tadorna*). April 2005, Stojski 1, Solana Ulcinj (Photo: B. Stumberger).



Fig. 29: Installation of nest-boxes for European Roller (*Coracias garrulus*) on electric poles. 29 September 2006, Solana Ulcinj (Photo: M. Vernik).

#### **4.6.2. Financing and entrance fees**

EuroNatur is supporting the implementation of the MP and the Nature Park within the framework of the project “Protection and Sustainable Development of the ‘Solana Bajo Sekulić, Ulcinj – Bojana-Buna Delta (Montenegro)”, which is financed by the MAVA Foundation. The assistance and cofinancing by EuroNatur is justified by the national and international significance of the natural values of the salina and the site's importance for preserving the Lake Skadar-Bojana/Buna River ecosystem (chapter 3.3. and 3.4.). In addition, the salina represents an outstanding cultural and natural heritage for the municipality of Ulcinj. Therefore, the preservation of the Solana should be additionally supported by other national and international funds. The formal protection of the salina under the Ramsar Convention as a wetland of international importance will stimulate further efforts for generating funds. In the future support for education programmes and conservation projects by the Republic of Montenegro will be of great importance.

On the local scale tourists and other guests which visit the Solana for bird watching or environmental education, will generate additional sources of income for the Nature Park. We propose entrance fees of 2 € for adult visitors and a minimum fee of 8 € for visitor groups, but special offers for children and school classes are recommended. Generated income should be used for guarding the area, the maintenance of basins and for conservation activities. Further offers for visitors should include souvenirs and special products of the Solana (e.g. fleur du sol).

#### **4.6.3. Wise use of the Solana's natural resources**

While the basic income of the salina is the production of industrial salts, by entrance fees, merchandising and fundings for conservation projects, the Nature Park will generate additional income for the Solana. Like in other salinas of the Mediterranean region, it will be important for the Solana to explore supplementary income by the sustainable use of its natural resources, like grazing fees for cattle or for mowing. Additional income, already mentioned, may be generated by the use of euryhaline soils for medicinal purposes (see 4.2.4.).

Currently, the Solana is discussing supplementary income by fish farming, and a pilot project has been already conducted in the main canal along crystallisation basins close to the Solana's headquarters. In accordance with conservation targets, outlined in the MP, EuroNatur suggests to establish a fish trap in front of the main pumping station, where fish could be removed from the main canal, before it will be killed or heavily damaged by pumps. In any case, the installation of an ‘otter-exist’ for securing otters and other animals to be killed in the fish trap, is recommended. And for avoiding conflicts with the conservation of fish-eating birds, all fishing should be restricted to basin no. 1.

## 5. Monitoring

Environmental monitoring is based on the regular examination and recording of the abundances of organisms or other indicators, with the help of standardized methods which offer the potential to reveal changes of the environment (FURNESS & GREENWOOD 1993). The status and population numbers of birds are internationally accepted indicators for assessing environmental change. While the departure of population numbers from target values helps conservation authorities and wildlife managers to raise alarms, illuminate the reasons for any failure to achieve targets, and for determining remedial action (GREENWOOD 2000). Therefore, monitoring schemes are long-term activities which have to be well prepared.

Already existing monitoring in the Solana Ulcinj includes:

- Meteorological data and the monitoring of some hydrological parameters; i.e. long-term data on air temperature, precipitation, wind speed, wind direction, humidity and air pressure.
- Ongoing record of salt production (since 1935).
- In 2003 EuroNatur started a long-term monitoring scheme for migrating and wintering waterbirds. IWC data for the salina include information on species' numbers per basin, actual water surface per basin and human impacts, like hunting and fishing activities. Reference numbers (= targets) for waterbirds and other bird species are outlined in the main objectives of the MP (see chapter 4.1.). During summer population numbers of nesting waterbirds (Tab. 1) and for some flagship species, like Dalmatian Pelicans and Greater Flamingos, detailed data on habitat use and behaviour are recorded.

In addition to already established waterbird counts and breeding bird surveys, for an appropriate evaluation of the effects of habitat management and related conservation activities it will be necessary to monitor mortality and annual nesting success of key-stone species (SADUL et al. 1998), like Common Shelduck, Black-winged Stilt, Pied Avocet, Stone-curlew, Common Redshank, Collared Pratincole, gulls and terns. According to proposals of the Solana for changing grassland management on dams and for renovation work in some basins, this scheme of integrated monitoring (GREENWOOD 2000) should be implemented as soon as possible.

During all monitoring activities utmost care has to be taken to avoid breeding failures or to cause other disturbances for nesting birds or resting migrants. Since 2003 the EuroNatur team is conducting waterbird counts by car and on foot following a standard route with fixed observations points which cover the whole area of the salina (Fig. 30). During autumn and winter when < 20.000 waterbirds are present (cf. Fig. 15), it is possible for a single, but experienced field ornithologist to count the salina during one day. During spring migration between mid-March and late April, when larger numbers of birds are present, a minimum of two observers are needed to count the salina simultaneously in one day. Beside binoculars, for an appropriate identification of birds it is necessary to use telescopes ( $\geq 30x$ ) in most basins. During all moni-

toring activities each basin has to be counted separately by using the enumeration of basins in Fig. 31. For the case that the surrounding dam will become accessible by car, it will be acceptable to change the standard route shown in Fig. 30 appropriately.

For a further improvement of the existing monitoring, some additional studies and long-term monitoring schemes are recommended:

- For a better understanding and interpretation of IWC data, seasonal fluctuations of waterbird and wader populations should be investigated during a 3–5 year period.
- A continuous monitoring scheme on the spatial distribution, population size, nesting performance, and on human impacts for key-stone species, in particular colonially nesting waterbirds, should be established throughout the Bojana-Buna Delta. Preliminary data during a rapid assessment of the conservation significance of the delta indicate for almost all colonial waterbirds which nest in the Bojana-Buna Delta, that the salina is the most important feeding area (STUMBERGER et al. 2005, SCHNEIDER-JACOBY et al. 2006b).
- Continuous monitoring of the use and acceptance of education facilities, and the salina's information centre with the help of tickets sold per month.
- A monitoring scheme for the in-/outflow of water in the salina's basins should be established.
- For a better understanding of the ecology of the salt-pans we recommend a 2–4 year study on the species diversity and seasonal abundances of the invertebrate fauna in basins of different evaporation grades.

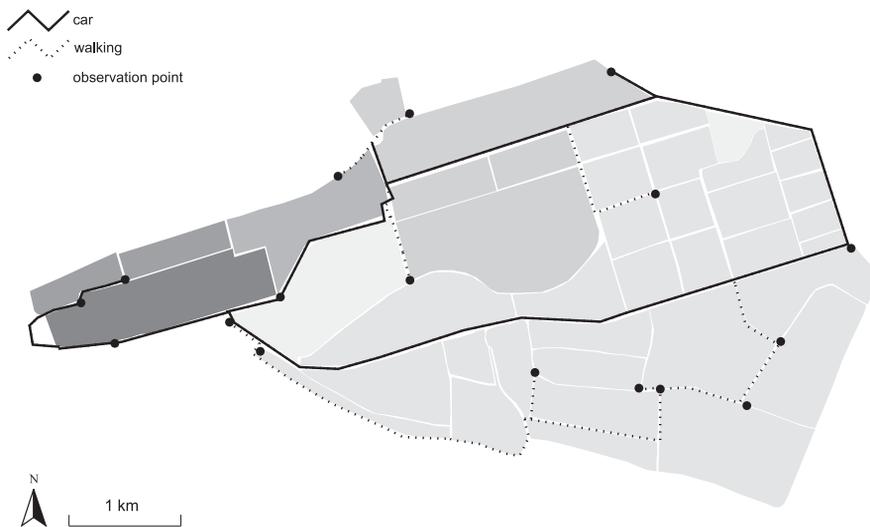


Fig. 30: Map showing standard route and observation points used by EuroNatur for waterbird counts in the Solana Ulcinj.

## 6. Action plan

To achieve the goals outlined in the MP it will be necessary to realize a number of projects throughout the salina. In the following chapter these projects are described separately for each beach or, when it appears more feasible, for a set of different basins. The names and enumeration of basins are given in Fig. 31.



Fig. 31: Enumeration of evaporation basins in the Solana Ulcinj. Basins no. 1–13 in the southern part of the salina are locally called Knetas.

### 6.1. Basin 1 (Knetas)

**Description:** With a surface area of 15 ha and a total length of 1,8 km basin no. 1 is the longest and narrowest salt-pan in the Solana. Maximum water depth: up to 1 m.

**Conservation significance:** When seawater is pumped through the basin during summer, basin no. 1 functions like a lagoon channel. Between autumn and spring the basin is used for feeding by herons, Pygmy Cormorants and other waterbirds, including Dalmatian Pelican. Following local rainfalls, mudflats and shallow waters are present, which are frequented by foraging waders during winter.

**Management:** Currently the Solana has suggested to use the basin for aquaculture or fish farming. Although aquaculture will not destroy the salina's ecosystem, the implementation of extensive fish farming or other aquaculture will lead to major loss of biological diversity (SADUL et al. 1998). By protecting the basin with nets and/or wires against fish-eating birds, most other birds and otters will be excluded. In addition, alien

and/or invasive species, accidentally introduced by aquaculture, may inflict disastrous damage for autochthonous species. Therefore, before implementing aquaculture in basin no. 1 – and in other parts of the salina – potential conflicts should be carefully evaluated.

For the case the Solana decides to place aquaculture or fish farming in basin no. 1, it has to be taken care that:

- Access for managing aquaculture and fish farming will be only along the outer dam.
- No disturbances of pelicans and other sensitive species in adjoining salt-pans will be caused.
- No alien fishes or other allochthonous species, like non-native crustaceans and other invertebrates, will be introduced.
- An action plan for fish breeding or any other aquacultural use will be prepared by the Solana.
- Warding-off fish-eating birds is done by scaring birds and other potential predators by the Solana's staff and no artificial noise, e.g. explosives, or netting will be used.

## 6.2. Basins 2–13 (Kneta)

**Description:** The Kneta covers a whole area of 5 km<sup>2</sup>, and includes a number of large basins which vary in size between 12 and 68 ha. During the winter season between September and April, most basins in the Kneta are covered by large areas of shallow water and extensive mudflats.

**Conservation significance:** In the basins of the Kneta halophytes are present mostly in small and scattered stands, but well-developed and more extensive patches exist in basin no. 5. With > 10.000 birds during autumn and winter the Kneta represents the most important 'intertidal' feeding zone for waders in the Solana (Fig. 32). Between 2003 and 2006 all basins of the Kneta were constantly covered by shallow waters. The water surface in the pans varied from 20–80 %. With annual numbers of 0–3 bp. since 2003, the Kneta is the only nesting site of Eurasien Oystercatcher in the salina and the last save breeding place for the species in the Bojana-Buna Delta. A significant portion of Black-winged Stilts and > 50 % of the salina's Yellow-legged Gulls use the halophyte vegetation of the Kneta for nesting. The extensive salt-pans are important feeding and roosting sites for Dalmatian Pelican, Greater Flamingo, Common Crane and geese, while on the dam between basins no. 5 and 6 Zitting Cisticola is nesting.



Fig. 32: Flock of Eurasian Golden Plover (*Pluvialis apricaria*) resting in basin no. 7, Kneta. 11 January 2008, Solana Ulcinj (Photo: P. Sackl).

**Management:** With long-term planning the sheer extent of the Kneta's salt-pans will allow the creation of nesting and roosting sites for many colonial waterbirds. All breeding colonies of ibises, herons and cormorants in the Bojana-Buna Delta are heavily disturbed by people: Out of three colonies which we found 2003, only one remained in 2006 (STUMBERGER et al. 2005). The high diversity of feeding habitats in the Kneta and in adjacent marshlands are excellent pre-conditions for creating a mixed-species breeding colony of colonial waterbirds in the salina. Although long-term planning is necessary for attracting ibises, spoonbills and herons for nesting, first actions should be taken as soon as possible:

- Planting of 200 saplings of deciduous trees on the island in basin no. 6 for attracting tree-nesting waterbirds.
- Construction of artificial nesting islets for Dalmatian Pelican (36 m<sup>2</sup>) and Greater Flamingo (1500 m<sup>2</sup>) in basin no. 8.
- Preserve the existing water regime in the Kneta which allows flooding of the basins by rainwater outside the production season.
- Preserve existing pasture- and grasslands on dams and dikes.
- Investigating the breeding ecology of the local population of Eurasian Oyster-catcher.
- Implementation of a core conservation area which is prohibited for people.

The success of management actions in the Kneta depends on the strict control of illegal access, hunting and bird shooting (see chapter 6.9. Jezero 1).

### 6.3. Stojski 1 & 2

**Description:** Outside of the salt production season the shallow basins of Stojski 1 (63 ha) and Stojski 2 (28 ha) are covered by extensive, and partially flooded mudflats.

**Conservation significance:** Both basins are almost free of vegetation. Stojski 1 & 2 are core roosting sites for Dalmatian Pelicans and one of the most important feeding and roosting areas for migrating waders in the salina.

**Management:** In 2005 EuroNatur constructed a nesting islet for colonial waterbirds in Stojski 1. In addition, artificial nest-boxes for Common Shelduck have been installed on the island.

In the near future the following management measures have to be taken:

- Remove a considerable part of at least 10 m of the former levee in Stojski 1 adjacent to the southern main dam (Knetza) and close to the basin's northern dike in front of the observation tower, to create nesting habitats on the former levee which are inaccessible for people and terrestrial predators.
- Take actions to prevent Stojski 1 (water surface 20–40 %) from drying-out during winter.
- Both basins have to be included into the core conservation zone of the salina.
- Close to the already existing observation tower at the end of the inner visitor trail, artificial islets which are surrounded by shallowly flooded mudflats should be constructed for creating optimum observation possibilities for bird-watching.

### 6.4. Basins 17–27

**Description:** This part of the salina which includes 10 basins, covers a whole area of 194 ha. With a maximum area of 20 ha per basin, all salt-pans in this group are of similar size.

**Conservation significance:** In basins no. 20 and 21 extensive stands of halophytes are present which harbour significant numbers of nesting Black-winged Stilts, while in most other basins scattered patches of reeds and sedges exist. Aside of their significance for nesting waders, the dikes host some of the salina's scattered bp. of Zitting Cisticola. Additional nest sites of the species exist in nearby "Meadow" and on the dike between basins no. 5 and 6. Apart from unsuccessful breeding attempts in Jezero 1 and in basin no. 9, we irregularly noted small numbers of Slender-billed Gulls in basins no. 18 and 24. The area further appears to be the most important feeding and resting habitat for

dabbling ducks, like Garganey and Common Teal, and for over-wintering Northern Lapwings and Common Snipes.

**Management:**

- For preserving the high grassland vegetation and lower scrubs on dikes the number of grazing cattle should be restricted to a maximum of 5 cattle or, alternatively, to 30 sheep.
- For the case artificial nesting islands in Jezero 1 will be not used by Slender-billed Gulls, additional islets should be placed in basins no. 18 and 17.
- All basins of this group have to be included into the core conservation area.
- For Slender-billed Gulls and a number of waders, like Black-winged Stilts, which breed in the area, constant water levels have to be ensured during the nesting season (May–August).

## 6.5. “Meadow”

**Description:** Together with the main dams and the dike along Porta Minela (cf. 3.3.1. and 4.2.1.), this basin which is not longer in use for salt production, is the most extensive continuous grassland area (12 ha) in the salina (cf. Fig. 19).

**Conservation significance:** In addition to low grasses which are more abundant on the basin’s dams and dikes, according to fluctuating water levels and periodical floodings the grassland habitats of the “Meadow” are dominated by different *Juncus* and *Carex* species. Currently the significance of the basin for waterbirds and waders is negligible, but during January counts we found a number of wintering Water Rails.

**Management:**

- The “Meadow” should be transformed into a shallowly flooded, brackish pastureland, grazed by free-roaming horses, which will function as adequate feeding habitat for Glossy Ibis, Little Egret and Eurasian Spoonbill. Grazing intensity should not exceed 15 animals.
- For establishing a small nucleus herd of horses in “Meadow” local breeds, like the small mountain horse of the Balkans *brdski konj*, is recommended. *Mysekaja*, the lowland type of *brdski konj*, which is endemic to the Bojana-Buna Delta, will be the best choice.
- For maintaining the herd a small bridge has to be created across the main canal, and the levees have to be fenced-off.
- The area has to be included into the core conservation area, and besides for maintaining the horses, access by people has to be prohibited.
- The amphibia, dragonfly and grasshopper fauna of the basin should be studied and results included into a forthcoming draft of the MP.

## 6.6. Basins 28–32

**Description:** The small, 4–9 ha large basins cover a total area of 35 ha. Some basins of this group harbour remnants of former dikes which form rows of small islets, as well as extensive stands of halophyte vegetation. Above maximum water level, most islets are overgrown by grasses and low scrubs. All basins, which represent the most diversified pans of the Solana (Fig. 33), are in use for salt production. Parallel to the outer, surrounding drainage canal along the eastern side of the basins, the salina's inner canal is running. The latter is used for directing saline waters from evaporation II into the basins of evaporation III.



Fig. 33: Map of existing islets and remnants of former dikes in basins no. 30–32.

**Conservation significance:** The small islands in the basins host significant breeding numbers of Black-winged Stilt, Pied Avocet, Kentish Plover, Common Redshank, Common Tern, Collared Pratincole and Yellow-legged Gull. During winter the shallow waters and mudflats are used by large numbers of waders, in particular Dunlin, Spotted Redshank, Grey Plover, European Golden Plover, Northern Lapwing and Common Snipe.

**Management:** The already existing structures offer good breeding opportunities for many solitary and colonially nesting waterbirds (Fig. 33). Because access to the basins is rather easy for people, EuroNatur proposes the construction of additional, more undisturbed nesting islands:

- In particular for Pied Avocets, it will be necessary to prepare undisturbed nesting islets which are inaccessible for terrestrial predators. Nesting islets for the species should be 1–1,5 m<sup>2</sup> in size, with flat, slip-off slopes and a total height between 30–40 cm above maximum water levels in the respective basin. In addition, the islets have to be cleared regularly from grasses and scrubs, with one half of the island each year and the other half each second year.
- A number of the existing islets which are currently heavily overgrown, should be prepared as nesting habitats for Common and Little Tern, Collared Pratincole and Kentish Plover. To afford this, large areas on existing islands or former dikes have to be cleared from grasses and other vegetation. To attract Little Terns for nesting it will be necessary to prepare a 1-2 m wide layer of mollusk shells parallel to shoreline. In the future bare ground on nesting islands and dikes have to be maintained by mowing.

The improvement of nesting conditions in basins no. 28–32 is of high priority, because the higher, outer dam at the eastern edge of the basins offers good opportunities for observing nesting shorebirds by children, school classes, bird-watchers and other visitors. Removing of grasses and scrubs from islets and former dikes will also offer a possibility to prevent the further increase of Yellow-legged Gulls in the salina.

For a successful establishment of additional nesting islands it is fundamental:

- To regulate water levels in a way that all basins in this group are permanently flooded, but water levels should not exceed maximum height during the nesting season (May–August).
- That access to core conservation areas in the basins for people and all other potential disturbances are strictly prohibited and controlled.

## 6.7. Jezero 2

**Description:** Together with Jezero 1, Jezero 2 is a remnant of the central, permanently flooded part of the former inland lagoon. With a total area of 110 ha Jezero 2 is the largest salt-pan in the salina. Originally the basin was largely segmented by lower levees (Fig. 34). Because the inner levees have been not maintained for decades, currently all dikes inside Jezero 2 are flooded during medium and high water levels. The Solana plans to restore the basin by reconstructing the inner levees and by constructing a new canal which will replace the old, largely damaged canal.

**Conservation significance:** In the eastern part and along the northern and southwestern edge of the basin extensive stands of halophyte vegetation exist. During late spring and

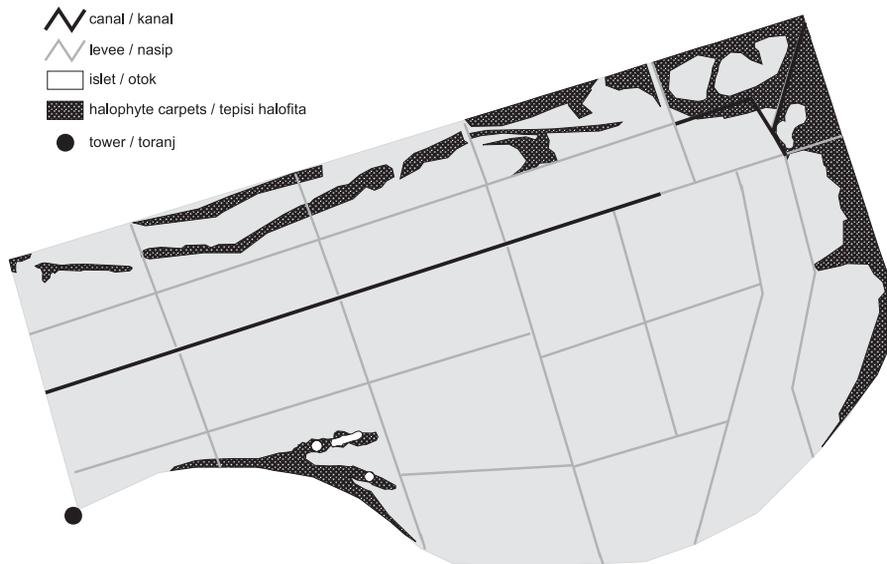


Fig. 34: Map showing the old canal and the system of inner levees in Jezero 2.

summer the inner, low-lying levees are the most important nesting habitats in the salina for Little Tern, Common Tern and Kentish Plover. In addition, with up to 5.000 birds Jezero 2 represents a core feeding area for waterbirds during migration and winter.

**Management:** For mitigating effects of the proposed restoration of the basin, the following management measures should be taken (see also 4.2.2. and 6.9.3.):

- Jezero 2 has to be included into the core conservation zone of the salina, which will be prohibited for people.
- Following the reconstruction of inner levees, measures have to be taken to prevent the access of terrestrial predators. To prevent access to inner levees, the construction of fences or gates at the base of inner dikes along the outer dam is recommended.
- For creating optimum observation opportunities for visitors a number of smaller islets for nesting and resting birds, close to the already existing observation tower, should be constructed.

## 6.8. Zoganjski 1 & 2

**Description:** Like Jezero 1 and Jezero 2, both basins represent remnants of the former Zoganjsko Jezero. With maximum water depths between 20–30 cm, Zoganjski 1 (24 ha) and Zoganjski 2 (20 ha) are rather shallowly flooded basins with high salt concentrations of up to 115 grams NaCl/litre.

**Conservation significance:** With extensive areas of bare ground and large stands of low halophytes above halomorphic soils both Zoganjski basins represent a habitat type which is unique throughout the Bojana-Buna Delta. The dry and sparsely vegetated mudflats provide optimal nesting habitat for > 60 bp. of Collared Pratincoles. During winter both basins harbour large numbers of Common Snipes.

**Management:** Due to irregular floodings in Zoganjski 1 & 2 and in other basins, and the overgrowing of some dams with bushes, between 2000 and 2003 the breeding population of Collared Pratincole dropped below an estimated maximum of 60–80 bp. For regaining its international importance, it will be necessary to manage potential nesting habitats for the species in both Zoganjski basins and on adjacent dams:

- Both basins have to be included into the salina's core conservation zone.
- In both basins water levels have to be artificially regulated. While both basins should be temporarily flooded outside the nesting season between October and March (maximum water depth: < 30 cm), during the breeding season (April–September) water levels should be extremely low which will allow up to 80 % of the area in both basins to dry-out.
- The reconstruction of inner levees and dikes in Jezero 1 provides an excellent opportunity to install an artificially regulated water regime which will be adequate for the nesting of Collared Pratincoles (details see 4.2.2. and 6.9.3.).
- Fencing-off against terrestrial predators, like Red Foxes and Golden Jackals, will probably enable population numbers of Collared Pratincoles to increase to international significance (240 bp. according to WPE4).
- For creating additional nesting habitat for the species the northern dike of both basins should be fenced-off and grazed by free-roaming cattle between September and mid-May.
- Strictly controlled burning of the dike between Jezero 2 and Zoganjski 1 & 2 may be necessary to maintain adequate nesting conditions for Collared Pratincoles. But the effects of burning on the dam's vegetation and breeding birds should be closely investigated (see 4.2.1.).

## 6.9. Jezero 1

**Description:** At present Jezero 1 (80 ha) is not used for salt production. Like both Zoganjski basins, Jezero 1 represents a remnant of the former inland lagoon which is situated below sea level. The basin is used as a reservoir for surplus rain- and saltwater, which is pumped out of the salina by pump no. 16 via Porta Milena channel. Surplus water is collected by the old canal which is running through the whole basin. Because this canal as well as the lower, inner levees in Jezero 1 were not maintained for years, currently the central canal is partly blocked by sediments and most of the lower levees are regularly flooded.

**Conservation significance:** Because the micro-relief of the basin closely resembles that of a naturally formed lagoon, Jezero 1 is of great significance for conservation. According to its brackish waters and largely fluctuating water level, the edges of the basin are covered by wide belts of halophytes. With peak numbers of > 13.000 waterbirds, Jezero 1 is a key-site for bird protection in the Solana for both, nesting and migrating waterbirds.

**Management:**

- Jezero 1 has to be included into the core conservation zone.
- Along the former, inner levees of Jezero 1 a system of artificial islands for nesting waterbirds have to be created to mitigate the loss of nesting habitat following restoration of Jezero 2 (see 4.2.1.).
- The lateral dike along the central canal should be rebuilt along the southern side of the canal. Soil, excavated from the canal, should be used to repair and for reconstruction of the old dike along the canal's southern side. When necessary the dike could be used for dredging the canal.
- After restoration the northern dike along the central canal will separate the southern part of Jezero 1. This will allow the regulation of water level in Jezero 1b (see 4.2.2.).
- In the future the newly separated basin, Jezero 1b, has to be managed for colonially nesting waterbirds, in particular Greater Flamingo and Dalmatian Pelican, which usually start to breed in early spring. The new basin should be refilled with water in late winter (early February), so that potential nesting sites for flamingos and pelicans are covered by shallow water and will be safe from terrestrial predators.
- The new dike, which will separate Jezero 1a from Jezero 1b, should be strictly closed for people by installing fences on both ends that will additionally prevent terrestrial predators from entering the dike. Because the same will be necessary on the dam to Stojski 1, a total of 4 fences have to be erected in Jezero 1.
- The northern dike along the central canal should be further developed as nesting habitat for Little and Common Tern, Black-winged Stilt and other waders (Fig. 35), and additional nest-boxes for Common Shelduck should be placed on the dike (Fig. 28).
- Because the water level in Jezero 1a depends on precipitation and the Solana's overall water management for salt production, it is not possible to regulate water level in Jezero 1a separately from that in other basins. Anyway, to prevent terrestrial predators from entering nesting islands all measures should be taken that Jezero 1a will be covered by at least 10–20 cm deep water or to prevent the basin from drying-out completely during the breeding season.

- All reed beds, stands of halophytes and other natural vegetation have to be preserved as far as possible during restoration.
- Excavation of soil has to be strictly restricted to the non-breeding season and a special management plan for the use of soil from Jezero 1 for medicinal purposes has to be prepared (see 4.2.4.).
- A new, approximately 50 m long dike which should be bounded on both sides by rows of low *Tamarix* trees, from the main dam for the access of visitors to an additionally erected observation hide on the northern edge of the basin has to be constructed (Fig. 35).

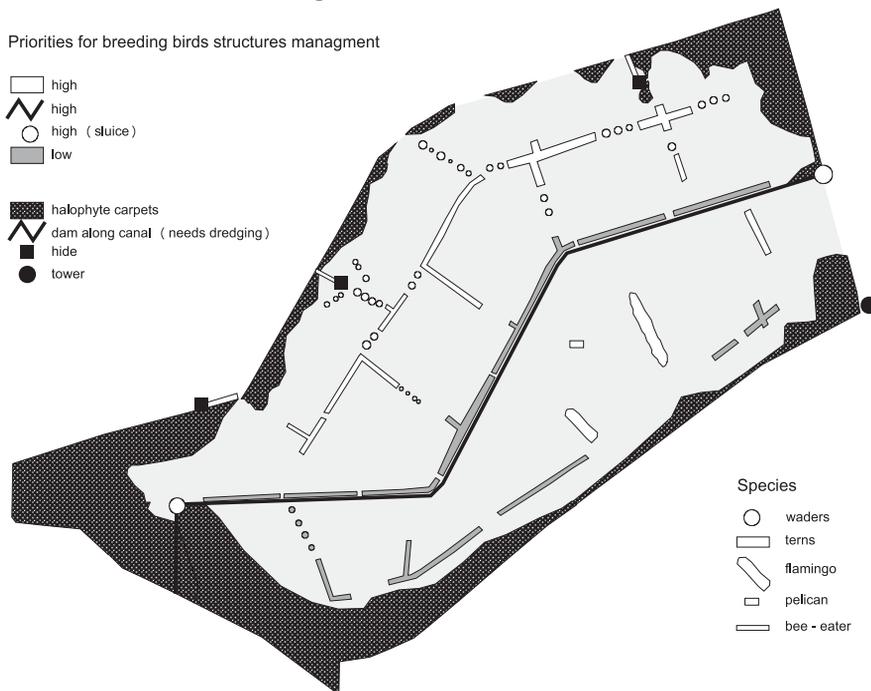


Fig. 35: Proposed management measures in Jezero 1.

## 6.10. Evaporation II

**Description:** Evaporation II consists of a number of smaller basins which are separated by a network of lower narrow levees. In particular, the central and western parts of the 90 ha large area is covered with small and very scattered stands of Common Reed (*Phragmites communis*). The canal along the southern edge of evaporation II is partly covered with dense reed beds.

**Conservation significance:** Apart of small numbers of Black-winged Stilts and Collared Pratincoles, good numbers of Kentish Plover and Common Redshank breed in evaporation II, while the area is the only nesting site for Great Bittern in the Solana.

Nesting of the latter species depends on the presence of dense patches of reed. In addition, large areas in evaporation II are covered by different communities of halophytes. Outside the nesting season the area harbours concentrations of up to 1.000–2.000 shorebirds.

**Management:**

- The area has to be included into the core conservation zone.
- All stands of reeds in evaporation II have to be preserved. In the future reed beds should be whether burnt nor cutted.
- For the case that the canal along the southern edge of evaporation II has to be excavated for maintaining, the canal's reed beds and aquatic plant communities should be protected at least along one side of the canal.

### 6.11. Evaporation III – IV

**Description:** Because of the high salinity of brine waters of up to 172 grams NaCl/litre (evaporation III) and 218 grams NaCl/litre (evaporation IV) which cover the small basins during summer, the 55 ha and 20 ha large surface area of evaporation III & IV is dominated by open soils. With very fragmented stands of halophytes, most basins are sparsely covered by vegetation.

**Conservation significance:** When flooded for salt production, evaporation III & IV are important feeding areas for Little and Common Terns. Apart of smaller numbers of nesting Kentish Plovers and Black-winged Stilts, during migration and winter the area is frequented by significant numbers of Kentish Plover and Northern Lapwing of up to > 100 birds of each species.

**Management:**

- On pump no. 31 a nest-box for Little Owls and on nearby pylons along the northern dam two nest-boxes for European Rollers have been placed by Euro-Natur. Because pylons and electric wires along the outer dams are regularly used by both species for hunting, wires should be not destructed and an additional number of 5 nest-boxes for European Roller and Hoopoe should be placed.
- Both areas should be included into the core conservation area and access by people has to be restricted to the visitor trail.
- The existing water regime with irregular floodings following heavy rains outside salt production should be preserved.

## 6.12. Crystallisation

**Description:** For many visitors the 76 ha large network of shallow crystallisation basins which are separated by low, rectangular levees, is the most interesting part of the salina. Above halomorphic soils, most basins are dominated by bare ground.

**Conservation significance:** In crystallisation basins we noted small numbers of nesting Little Ringed Plover, Kentish Plover, Collared Pratincole and Stone-curlew, the later species regularly feeding in the pastures of nearby Ulcinjsko Polje. The central and northern basins of the area are used by large numbers of gulls, Grey Herons and Great White Egrets for roosting.

**Management:**

- Like evaporation III & IV, all crystallisation basins should be included into the core conservation zone and access for visitors restricted to the visitor trail.
- Like in evaporation III & IV, existing pylons and electric wires should be not destructed.
- Although 4 nest-boxes for European Roller and a nest-box for Little Owl have been already placed on pylons along the visitor trail, the installation of 5 additional nest-boxes for European Rollers and Hoopoes is recommended (see Fig. 29).

## 6.13. Reservoirs 1 & 2

**Description:** Both reservoir complexes (= Accumulation 1 & 2) consist of 3–4 basins which together cover a whole area of 28 ha. All basins are situated above the surface level of the salina's salt-pans. This allows brine of high salinity to flow passively from both accumulation complexes into the salt-pans for triggering salt crystallisation in spring (see chapter 3.2.). Water depths in reservoirs are fluctuating between  $\geq 1$  m and up to 3–4 m. The inner slopes of dams are constructed of stones, while the outer embankment is covered by ruderal plants, dry grasslands and scattered bushes.

**Conservation significance:** Reservoir 1 (13 ha) is an important roosting site for Common Redshank. During heavy bird shooting in the salina we counted > 1.000 redshanks roosting tightly together on the inner dam. In addition to scattered bp. of Tawny Pipit along dams of both accumulation complexes, on the dikes of reservoir 2 (15 ha) we found the only nesting site of Short-toed Lark in the salina. In both reservoirs Eurasian Hoopoes nest in narrow hollows between stones of the dams inner embankment.

### Management:

- No access for bird-watchers and other visitors to both reservoirs' inner dikes which separate the basins.
- No burning of dams between March and August.

## 6.14. Canals

**Description:** The network of deep canals differs from all other habitat types in the Solana: In contrast to the salt-pans, most canals are permanently covered by at least shallow water and never dry-out completely. Three pumps are in use for pumping saline water through the canals into evaporation II and III, and for pumping fresh- or seawater out of Jezero 1, where all surplus water of the salina is collected (Fig. 36). With a maximum width of up to 15 m the cumulative length of canals amounts to 26,5 km. Pumps, bridges and sluices are technical facilities along canals.

**Conservation significance:** The linear network of canals, which connects the basins of the salt-work, represents the most important migration corridor for fishes and Eurasian Otter. Because many canals are covered by marshland and aquatic plants, like reeds, sedges and rushes, they are important nesting and feeding habitats for many bird species. In particular, a large portion of the local breeding population of Common Redshank is concentrated in canals (Plate 6). Besides Common Redshank, smaller numbers of Black-winged Stilt and Kentish Plover as well as Great Reed Warbler, Yellow Wagtail (ssp. *feldegg*) and Water Rail nest in canals and on adjoining dikes. Pumping stations, bridges and sluices are used as nesting substrates by Little Owl, Barn and Red-rumped Swallow, House Martin, Pied Wagtail, Tree Sparrow, House and Spanish Sparrow.

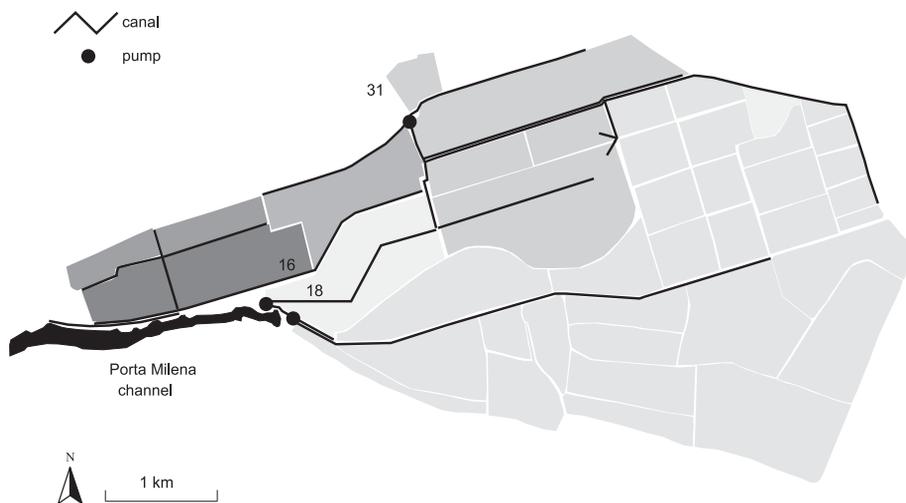


Fig. 36: Main canals and enumeration of pumping stations in the Solana Ulcinj.

### **Management:**

- During maintenance work all existing reedbeds and other vegetation should be preserved as far as possible, e.g. by cleaning only one side or cleaning both sides of canals alternatively, with longer intervals in between, which will allow plants to regrowth.
  - Otter exits, nets or cages to prevent accidentally drowning of otters should be installed in pumping stations no. 16 and 31.
  - Already existing hollows in bridges, sluices and pumping stations, suitable for the nesting of swallows, sparrows and hole-nesting birds, should be mapped and 15–20 artificial nesting structures should be placed for Red-rumped Swallows on sluices and pumping stations.
  - Because canals represent the main migration corridor for fishes into the salina and between basins within the salina, a comprehensive study of the fish fauna and on fish migrations in canals are urgently needed (see 3.3.2.3).
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## Appendix 1

German and scientific names of birds mentioned in the text

Barn Swallow	Rauchschwalbe	<i>Hirundo rustica</i>
Black-crowned Night Heron	Nachtreiher	<i>Nycticorax nycticorax</i>
Black-tailed Godwit	Uferschnepfe	<i>Limosa limosa</i>
Black-winged Stilt	Stelzenläufer	<i>Himantopus himantopus</i>
Caspian Tern	Raubseeschwalbe	<i>Sterna caspia</i>
Collared Pratincole	Rotflügel-Brachschwalbe	<i>Glareola pratincola</i>
Common Crane	Kranich	<i>Grus grus</i>
Common Kingfisher	Eisvogel	<i>Alcedo atthis</i>
Common Moorhen	Teichhuhn	<i>Gallinula chloropus</i>
Common Redshank	Rotschenkel	<i>Tringa totanus</i>
Common Shelduck	Brandgans	<i>Tadorna tadorna</i>
Common Snipe	Bekassine	<i>Gallinago gallinago</i>
Common Teal	Krickente	<i>Anas crecca</i>
Common Tern	Flussseeschwalbe	<i>Sterna hirundo</i>
Corn Bunting	Graumammer	<i>Miliaria calandra</i>
Crested Lark	Haubenlerche	<i>Galerida cristata</i>
Curlew Sandpiper	Sichelstrandläufer	<i>Calidris ferruginea</i>
Dalmatian Pelican	Krauskopfpelikan	<i>Pelecanus crispus</i>
Dunlin	Alpenstrandläufer	<i>Calidris alpina</i>
Eurasian Golden Oriole	Pirol	<i>Oriolus oriolus</i>
Eurasian Golden Plover	Goldregenpfeifer	<i>Pluvialis apricaria</i>
Eurasian Oystercatcher	Austernfischer	<i>Haematopus ostralegus</i>
Eurasian Spoonbill	Löffler	<i>Platalea leucorodia</i>
Eurasian Wigeon	Pfeifente	<i>Anas penelope</i>
European Bee-eater	Bienenfresser	<i>Merops apiaster</i>
European Hoopoe	Wiedehopf	<i>Upupa epops</i>
European Robin	Rotkehlchen	<i>Erithacus rubecula</i>
European Roller	Blauracke	<i>Coracias garrulus</i>
Garganey	Knäkente	<i>Anas querquedula</i>
Great Bittern	Große Rohrdommel	<i>Botaurus stellaris</i>
Great Cormorant	Kormoran	<i>Phalacrocorax carbo</i>
Greater Flamingo	Rosaflamingo	<i>Phoenicopterus ruber roseus</i>
Greater Spotted Eagle	Schelladler	<i>Aquila clanga</i>
Great Reed Warbler	Drosselrohrsänger	<i>Acrocephalus arundinaceus</i>
Great White Egret	Silberreiher	<i>Egretta alba</i>
Grey Heron	Graureiher	<i>Ardea cinerea</i>
Grey Plover	Kiebitzregenpfeifer	<i>Pluvialis squatarola</i>
House Martin	Mehlschwalbe	<i>Delichon urbicum</i>
House Sparrow	Hausperling	<i>Passer domesticus</i>
Kentish Plover	Seeregenpfeifer	<i>Charadrius alexandrinus</i>
Lesser Kestrel	Rötelfalke	<i>Falco naumanni</i>
Lesser White-fronted Goose	Zwerggans	<i>Anser erythropus</i>
Little Egret	Seidenreiher	<i>Egretta garzetta</i>
Little Owl	Steinkauz	<i>Athene noctua</i>
Little Ringed Plover	Flussregenpfeifer	<i>Charadrius dubius</i>

Little Stint	Zwergstrandläufer	<i>Calidris minuta</i>
Little Tern	Zwergseeschwalbe	<i>Sterna albifrons</i>
Mallard	Stockente	<i>Anas platyrhynchos</i>
Marsh Sandpiper	Teichwasserläufer	<i>Tringa stagnatilis</i>
Meadow Pipit	Wiesenpieper	<i>Anthus pratensis</i>
Moustached Warbler	Mariskensänger	<i>Acrocephalus melanopogon</i>
Northern Lapwing	Kiebitz	<i>Vanellus vanellus</i>
Northern Pintail	Spießente	<i>Anas acuta</i>
Northern Shoveler	Löffelente	<i>Anas clypeata</i>
Pied Avocet	Säbelschnäbler	<i>Recurvirostra avosetta</i>
Pied Wagtail	Bachstelze	<i>Motacilla alba</i>
Purple Heron	Purpureiher	<i>Ardea purpurea</i>
Pygmy Cormorant	Zwergscharbe	<i>Phalacrocorax pygmeus</i>
Red-rumped Swallow	Rötelschwalbe	<i>Hirundo daurica</i>
Reed Bunting	Rohrhammer	<i>Emberiza schoeniclus</i>
Ruff	Kampfläufer	<i>Philomachus pugnax</i>
Short-toed Lark	Kurzzehenlerche	<i>Calandrella brachydactyla</i>
Slender-billed Curlew	Dünnschnabel-Brachvogel	<i>Numenius tenuirostris</i>
Slender-billed Gull	Dünnschnabelmöwe	<i>Larus genei</i>
Spanish Sparrow	Weidensperling	<i>Passer hispaniolensis</i>
Spotted Flycatcher	Grauschnäpper	<i>Muscicapa striata</i>
Spotted Redshank	Dunkler Wasserläufer	<i>Tringa erythropus</i>
Squacco Heron	Rallenreiher	<i>Ardeola ralloides</i>
Stone-curlew	Triel	<i>Burhinus oedipnemus</i>
Tawny Pipit	Brachpieper	<i>Anthus campestris</i>
Tree Sparrow	Feldsperling	<i>Passer montanus</i>
Water Rail	Wasserralle	<i>Rallus aquaticus</i>
Whinchat	Braunkehlchen	<i>Saxicola rubetra</i>
Yellow-legged Gull	Mittelmeermöwe	<i>Larus michahellis</i>
Yellow Wagtail	Schafstelze	<i>Motacilla flava</i>
Zitting Cisticola	Cistensänger	<i>Cisticola juncidis</i>

## Appendix 2

List of birds nesting in the Solana Ulcinj, 2003–2006.

Species	Nesting habitats in the salina	other breeding places in Montenegro
<i>Tadorna tadorna</i>	dams, islets (artificial nest-boxes in banks)	NO
<i>Botaurus stellaris</i>	reedbeds ( <i>Phragmites communis</i> ); tall, dense cover	YES
<i>Accipiter brevipes</i>	deciduous trees (fragmented alluvial forest)	YES
<i>Falco tinnunculus</i>	buildings and trees	YES
<i>Phasianus colchicus</i>	dams	YES
<i>Rallus aquaticus</i>	canals ( <i>Phragmites</i> , <i>Carex</i> , <i>Juncus</i> , <i>Typha</i> , <i>Salix</i> )	YES
<i>Gallinula chloropus</i>	canals ( <i>Phragmites</i> , <i>Carex</i> , <i>Juncus</i> , <i>Typha</i> , <i>Salix</i> )	YES
<i>Himantopus himantopus</i>	shallowly flooded mudflats, halophytes ( <i>Salicornia</i> )	NO
<i>Haematopus ostralegus</i>	islets or levees (?)	NO
<i>Recurvirostra avosetta</i>	islets (sparse vegetation)	NO
<i>Burhinus oediconemus</i>	dams, levees, islets (sparse vegetation)	YES
<i>Charadrius dubius</i>	levees, mudflats in basins (sparse or no vegetation)	YES
<i>Charadrius alexandrinus</i>	levees, islets, basins (sparse vegetation)	YES
<i>Glareola pratincola</i>	dry basins with <i>Salicornia</i> , grazed dams/levees with low vegetation	NO
<i>Tringa totanus</i>	canals, dams with lower, more densely vegetation	YES
<i>Sterna hirundo</i>	islets, levees (no or sparse vegetation)	NO
<i>Sterna albifrons</i>	islets, levees (no or sparse vegetation)	NO
<i>Larus michahellis</i>	islets, levees (covered with grasses and low scrubs)	YES
<i>Larus genei</i>	islets	NO
<i>Streptopelia turtur</i>	park (factory building)	YES
<i>Clamator glandarius</i>	breeding parasite (host species?)	?
<i>Athene noctua</i>	buildings (pumps, factory etc.)	YES
<i>Merops apiaster</i>	dams (bankment)	YES
<i>Coracias garrulus</i>	old trees, buildings?	YES
<i>Upupa epops</i>	embankments of stone, buildings, old trees	YES
<i>Galerida cristata</i>	dams (scattered, low vegetation), parking lot	YES
<i>Calandrella brachydactyla</i>	higer embankments of stone with short grasses	YES
<i>Hirundo rustica</i>	buildings, pumps, bridges	YES

<b>Species</b>	<b>Nesting habitats in the salina</b>	<b>other breeding places in Montenegro</b>
<i>Hirundo daurica</i>	bridges, pumps	YES
<i>Delichon urbicum</i>	buldings, pumps	YES
<i>Motacilla alba</i>	buildings, dams, bridges	YES
<i>Motacilla flava</i>	dams, levees (grazed), dry mudflats with halo- phytes	YES
<i>Luscinia megarhynchos</i>	scrubs, park	YES
<i>Phoenicurus ochruros</i>	buildings, pumps, dams (embankments of stone)	YES
<i>Oenanthe oenanthe</i>	embankments of stone	YES
<i>Oenanthe hispanica</i>	embankments of stone	YES
<i>Turdus merula</i>	scrublands, park, <i>Tamarix</i>	YES
<i>Acrocephalus arundinaceus</i>	reedbeds ( <i>Phragmites communis</i> )	YES
<i>Acrocephalus scirpaceus</i>	reedbeds ( <i>Phragmites communis</i> )	YES
<i>Hippolais pallida</i>	scrublands, alluvial forest, <i>Tamarix</i>	YES
<i>Sylvia atricapilla</i>	scrublands, alluvial forest, <i>Tamarix</i>	YES
<i>Sylvia communis</i>	scrubs, fragmented alluvial forest	YES
<i>Muscicapa striata</i>	forest, park	YES
<i>Lanius senator</i>	meadows, scrub (dam)	YES
<i>Lanius minor</i>	dams, trees (power lines for hunting)	YES
<i>Sturnus vulgaris</i>	buildings, pumps	YES
<i>Oriolus oriolus</i>	park, alluvial forest	YES
<i>Pica pica</i>	park (coniferous trees)	YES
<i>Corvus corone cornix</i>	trees, scrubs	YES
<i>Passer montanus</i>	buildings, pumps	YES
<i>Passer domesticus</i>	buildings, pumps, trees	YES
<i>Passer hispaniolensis</i>	buildings, pumps, trees	YES
<i>Carduelis cannabina</i>	dams, levees (meadows, scrubs, pastures)	YES
<i>Emberiza melanocephala</i>	meadows, pastures (nesting only in one basin)	YES
<i>Miliaria calandra</i>	dams, levees (pastures, meadows, scrubs)	YES

## Appendix 3

Fish species recorded in the Lake Skadar-Bojana/Buna River ecosystem and in the Solana Ulcinj (SCHNEIDER-JACOBY et al. 2006b). Bojana/Buna & Adriatic Sea: + species recorded only in Albania, ++ species recorded for Albania and Montenegro

Species	Skadar Lake	Bojana/Buna River	Sasko Lake	Bojana/Buna & Adriatic Sea	Viluni Lagoon	Solana Ulcinj
<i>Anguilla anguilla</i>	+	+		++	+	+
<i>Aphanius fasciatus</i>				+	+	+
<i>Atherina boyeri</i>				+	+	+
<i>Chelon labrosus</i> <sup>1</sup>				+	+	+
<i>Dicentrarchus labrax</i>	+	+	+	++	+	+
<i>Delentosteus</i> sp.						+
<i>Diplodus annularis</i>				++	+	+
<i>Diplodus vulgaris</i>				++	+	+
<i>Diplodus sargus sargus</i>				++	+	+
<i>Gobius</i> sp.						+
<i>Lithognathus mormyrus</i>						+
<i>Liza ramada</i>	+	+		++	+	+
<i>Liza saliens</i>					+	+
<i>Liza aurata</i> <sup>1</sup>				+		+
<i>Lipophrys</i> sp.						+
<i>Mugil cephalus</i>	+	+	+	++	+	+
<i>Mullus surmuletus</i>						+
<i>Platichthys flesus luscus</i>	+	+	+	++	+	+
<i>Pomatoschistus</i> sp.						+
<i>Sarpa salpa</i> <sup>1</sup>				+		+
<i>Solea lascaris</i>					+	+
<i>Solea vulgaris</i>				++	+	+

<sup>1</sup> data available only for Montenegro

## Appendix 4

List of plants recorded in the Solana Ulcinj (prepared by Snezana VUKSANOVIĆ and Danka PETROVIĆ).

- Ajuga chamaepitys* (L.) Schreb.  
*Alkana tinctoria* (L.) Tausch  
*Anemone hortensis* L.  
*Anagalis arvensis* L.  
*Anchusa officinalis* L.  
*Anthemis arvensis* L.  
*Aristolochia rotunda* L.  
*Arum maculatum* L.  
*Asphodelus microcarpus* Viv.  
*Aster amellus*  
*Avena barbata* Pott. ex Link.  
*Bellis perennis* L.  
*Bidens tripartita* L.  
*Bituminaria bituminosa* (L.) Stirton  
*Blackstonia perfoliata* (L.) Huds.  
*Calepina irregularis* (Asso) Thell  
*Capesella bursa-pastoris* (L.) Medicus  
*Cardamine hirsuta* L.  
*Centaurea alba* L.  
*Centaurea calcitrapa* L.  
*Centaurea solstitialis* L.  
*Centaureum erythraea* Rafn.  
*Cichorium intybus* L.  
*Cirsium arvensis* (L.) Scop.  
*Clematis viticella* L.  
*Clinopodium vulgare* L.  
*Convolvulus arvensis* L.  
*Conyza canadensis* (L.) Cronquist  
*Cynoglossum creticum* Miller  
*Daucus carota* L.  
*Delphinium peregrinum* L.  
*Ditrichia viscosa* (L.) Greuter  
*Dorycnium hirsutum* (L.) Ser.  
*Echium vulgare* L.  
*Epilobium hirsutum* L.  
*Erigeron annuus* (L.) Pers.  
*Erodium cicutarium* (L.) L'Her  
*Erodium malacoides* (L.) L'Her  
*Eryngium amethystinum* L.  
*Eupatorium cannabinum* L.  
*Euphorbia helioscopia* L.  
*Euphorbia peplis* L.  
*Euphorbia peplus* L.  
*Euphorbia terracina* L.  
*Filago vulgaris* Lam.  
*Geranium columbinum* L.  
*Geranium dissectum* L.  
*Geranium robertianum* L.  
*Geranium brutum* Gasparr.  
*Hyacinthus orientalis* L.  
*Helichrysum italicum* (Roth.) G. Don  
*Heliotropium europaeum* L.  
*Hordeum vulgare* L.  
*Hypericum perforatum* L.  
*Inula britannica* L.  
*Inula crithmoides* L.  
*Juncus acutus* L.  
*Juncus maritimus* Lam.  
*Kickxia commutata* (Bernh. ex Reichenb.) Fritsch  
*Lamium purpureum* L.  
*Lathyrus cicera* L.  
*Linaria vulgaris* Miller  
*Linum nodiflorum* L.  
*Linum usitatissimum* L.  
*Lotus corniculatus* L.  
*Medicago minima* (L.) L.  
*Melilotus officinalis* (L.) Pallas  
*Moenchia mantica* (L.) Bartl.  
*Muscari comosum* (L.) Miller  
*Narcissus tazetta* L.  
*Nigella damascena* L.

*Ornithogalum* sp.  
*Oxalis corniculata* L.  
*Parentucellia latifolia* (L.) Caruel  
*Petrorhagia prolifera* (L.) P. W. Ball & Heywood  
*Picris hieracioides* L.  
*Plantago lanceolata* L.  
*Plantago major* L.  
*Polygonum aviculare* L.  
*Portulaca oleracea* L.  
*Prunella laciniata* (L.) L.  
*Prunella vulgaris* L.  
*Pulicaria dysenterica* (L.) Bernh.  
*Reseda phyteuma* L.  
*Romulea bulbocodium* (L.) Sevast. & Mauri  
*Rosa canina* L.  
*Salvia verbenaca* L.  
*Salvia verticillata* L.  
*Scandix pecten-veneris* L.  
*Scolymus hispanicus* L.  
*Senecio rupestris* Waldst. & Kit.  
*Sherardia arvensis* L.  
*Silene conica* L.  
*Silene gallica* L.  
*Silene nocturna* L.  
*Solanum nigrum* L.  
*Sonchus arvensis* L.  
*Stellaria media* (L.) Vill.  
*Taraxacum officinale* Weber  
*Teucrium chamaedrys* L.  
*Trifolium campestre* Schreber  
*Trifolium incarnatum* L.  
*Trifolium nigricens* Viv.  
*Trifolium resupinatum* L.  
*Trifolium subterraneum* L.  
*Trigonella esculenta* Willd.  
*Verbascum sinuatum* L.  
*Verbena officinalis* L.  
*Veronica arvensis* L.  
*Veronica chamaedrys* L.  
*Vicia grandiflora* Scop.  
*Vicia sativa* L., ssp. *nigra* (L.) Ehrh.  
*Vincetoxicum hirundinaria* Medicus

## Appendix 5

Results of waterbird counts in the Solana Ulcinj, 2003–2008 (n=24).

Species	Presence	Total	Min.	Max.	$\bar{x}$ +/- SE	Excess
<i>Tachybaptus ruficollis</i>	13 (54,2 %)	306	1	85	23,5 +/- 6,6	1,61
<i>Podiceps cristatus</i>	5 (20,8 %)	10	1	4	2,0 +/- 0,6	1,36
<i>Podiceps auritus</i>	1 (4,2 %)	1	1	1	-	-
<i>Podiceps nigricollis</i>	9 (37,5 %)	149	1	68	16,6 +/- 7,0	2,20
<i>Phalacrocorax carbo</i>	17 (70,8 %)	705	2	198	41,5 +/- 13,0	1,95
<i>Phalacrocorax pygmeus</i>	23 (95,8 %)	2073	1	370	90,1 +/- 20,9	1,54
<i>Pelecanus crispus</i>	14 (58,3 %)	507	2	99	36,2 +/- 10,1	0,77
<i>Botaurus stellaris</i>	3 (12,5 %)	4	1	2	1,3 +/- 0,3	1,73
<i>Nycticorax nycticorax</i>	1 (4,2 %)	95	95	95	-	-
<i>Ardeola ralloides</i>	1 (4,2 %)	2	2	2	-	-
<i>Egretta garzetta</i>	24 (100 %)	2892	2	457	120,5 +/- 20,4	1,79
<i>Egretta alba</i>	21 (87,5 %)	1787	1	501	85,1 +/- 28,9	2,36
<i>Ardea cinerea</i>	24 (100 %)	1800	1	269	75,0 +/- 13,5	1,21
<i>Ardea purpurea</i>	3 (12,5 %)	4	1	2	1,3 +/- 0,3	1,73
<i>Ciconia nigra</i>	1 (4,2 %)	3	3	3	-	-
<i>Ciconia ciconia</i>	1 (4,2 %)	1	1	1	-	-
<i>Plegadis falcinellus</i>	4 (16,7 %)	16	2	7	4,0 +/- 1,1	1,19
<i>Platalea leucorodia</i>	19 (79,2 %)	744	5	112	39,2 +/- 7,8	0,81
<i>Phoenicopterus r. roseus</i>	4 (16,7 %)	15	1	7	3,8 +/- 1,3	0,56
<i>Cygnus olor</i>	2 (8,3 %)	13	4	9	6,5 +/- 2,5	-
<i>Anser albifrons</i>	2 (8,3 %)	20	4	16	10,0 +/- 6,0	-
<i>Anser erythropus</i>	1 (4,2 %)	3	3	3	-	-
<i>Tadorna tadorna</i>	21 (87,5 %)	987	1	620	47,0 +/- 28,9	4,46
<i>Anas penelope</i>	18 (75,0 %)	8309	6	1671	461,6 +/- 113,8	1,18
<i>Anas strepera</i>	8 (33,3 %)	224	2	107	28,0 +/- 14,3	1,52
<i>Anas crecca</i>	10 (41,7 %)	5260	4	3460	526,0 +/- 342,0	2,71
<i>Anas platyrhynchos</i>	12 (50,0 %)	624	1	506	52,0 +/- 41,4	3,43
<i>Anas acuta</i>	20 (83,3 %)	5782	1	793	289,1 +/- 52,4	0,28
<i>Anas querquedula</i>	7 (29,2 %)	8391	3	8279	1198,7 +/- 1180,1	2,65
<i>Anas clypeata</i>	18 (75,0 %)	2262	2	1158	125,7 +/- 64,7	3,54
<i>Aythya ferina</i>	3 (12,5 %)	339	1	330	113,0 +/- 108,5	1,73
<i>Aythya fuligula</i>	1 (4,2 %)	18	18	18	-	-
<i>Pernis apivorus</i>	1 (4,2 %)	1	1	1	-	-
<i>Circaetus gallicus</i>	2 (8,3 %)	2	1	1	1,0 +/- 0,0	-
<i>Circus aeruginosus</i>	18 (75,0 %)	44	1	8	2,4 +/- 0,4	2,20
<i>Circus cyaneus</i>	9 (37,5 %)	28	1	6	3,1 +/- 0,6	0,31
<i>Circus macrourus</i>	2 (8,3 %)	2	1	1	1,0 +/- 0,0	-
<i>Circus pygargus</i>	3 (12,5 %)	8	1	5	2,7 +/- 1,2	1,29
<i>Accipiter gentilis</i>	1 (4,2 %)	1	1	1	-	-
<i>Accipiter nisus</i>	10 (41,7 %)	27	1	6	2,7 +/- 0,6	0,66
<i>Accipiter brevipes</i>	1 (4,2 %)	1	1	1	-	-
<i>Buteo buteo</i>	15 (62,5 %)	61	1	11	4,1 +/- 0,84	0,88
<i>Aquila clanga</i>	1 (4,2 %)	1	1	1	-	-
<i>Pandion haliaetus</i>	2 (8,3 %)	8	2	6	4,0 +/- 2,0	-
<i>Falco tinnunculus</i>	5 (20,8 %)	5	1	1	1,0 +/- 0,0	-
<i>Falco vespertinus</i>	1 (4,2 %)	1	1	1	-	-
<i>Falco columbarius</i>	6 (25,0 %)	7	1	2	1,2 +/- 1,7	2,45
<i>Falco subbuteo</i>	2 (8,3 %)	3	1	2	1,5 +/- 0,5	-

Species	Presence	Total	Min.	Max.	$\bar{x}$ +/- SE	Excess
<i>Falco biarmicus</i>	2 (8,3 %)	2	1	1	1,0 +/- 0,0	-
<i>Rallus aquaticus</i>	15 (62,5 %)	82	1	13	5,8 +/- 0,8	0,64
<i>Porzana porzana</i>	1 (4,2 %)	1	1	1	-	-
<i>Gallinula chloropus</i>	13 (54,2 %)	40	1	14	3,1 +/- 1,0	2,70
<i>Fulica atra</i>	4 (16,7 %)	649	1	601	162,3 +/- 146,6	1,98
<i>Haematopus ostralegus</i>	7 (29,2 %)	15	1	5	2,1 +/- 0,6	1,45
<i>Himantopus himantopus</i>	14 (58,3 %)	1847	1	270	131,9 +/- 30,0	-0,01
<i>Recurvirostra avosetta</i>	8 (33,3 %)	125	1	101	15,6 +/- 12,2	2,80
<i>Burhinus oedicnemus</i>	13 (54,2 %)	204	1	82	15,7 +/- 5,8	3,12
<i>Glareola pratincola</i>	8 (33,3 %)	568	1	225	71,0 +/- 33,9	1,19
<i>Charadrius dubius</i>	14 (58,3 %)	514	2	201	36,7 +/- 14,1	2,62
<i>Charadrius hiaticula</i>	13 (54,2 %)	213	1	58	16,4 +/- 5,5	1,38
<i>Charadrius alexandrinus</i>	23 (95,8 %)	4115	25	472	178,9 +/- 24,7	0,87
<i>Eudromias morinellus</i>	1 (4,2 %)	1	1	1	-	-
<i>Pluvialis apricaria</i>	11 (45,8 %)	2040	1	514	185,6 +/- 63,4	0,64
<i>Pluvialis squatarola</i>	23 (95,8 %)	5034	4	481	218,9 +/- 28,1	0,13
<i>Vanellus vanellus</i>	15 (62,5 %)	9304	1	3186	620,3 +/- 241,7	1,83
<i>Calidris canutus</i>	10 (41,7 %)	70	1	21	7,0 +/- 1,7	2,06
<i>Calidris alba</i>	7 (29,2 %)	50	2	26	7,1 +/- 3,2	2,49
<i>Calidris minuta</i>	21 (87,5 %)	4644	10	950	221,1 +/- 50,9	1,64
<i>Calidris temminckii</i>	5 (20,8 %)	56	1	51	11,2 +/- 10,0	2,23
<i>Calidris ferruginea</i>	5 (20,8 %)	666	2	363	113,2 +/- 71,8	0,90
<i>Calidris alpina</i>	21 (87,5 %)	94.217	1	10.503	4486,5 +/- 732,9	0,15
<i>Philomachus pugnax</i>	17 (70,8 %)	6589	1	2618	387,6 +/- 183,9	2,38
<i>Lymnocyptes minimus</i>	2 (8,3 %)	2	1	1	1,0 +/- 0,0	-
<i>Gallinago gallinago</i>	19 (79,2 %)	8121	1	2445	427,4 +/- 159,7	2,07
<i>Limosa limosa</i>	14 (58,3 %)	3867	1	3423	276,2 +/- 242,6	3,71
<i>Limosa lapponica</i>	3 (12,5 %)	3	1	1	1,0 +/- 0,0	-
<i>Numenius phaeopus</i>	6 (25,0 %)	111	1	105	18,5 +/- 17,3	2,45
<i>Numenius tenuirostris</i>	1 (4,2 %)	1	1	1	-	-
<i>Numenius arquata</i>	22 (91,7 %)	393	1	75	17,9 +/- 4,0	1,53
<i>Tringa erythropus</i>	23 (95,8 %)	10.477	11	2249	455,5 +/- 118,4	2,07
<i>Tringa totanus</i>	24 (100 %)	23.850	8	1988	993,8 +/- 131,8	-0,38
<i>Tringa stagnatilis</i>	18 (75,0 %)	467	1	138	25,9 +/- 8,0	2,38
<i>Tringa nebularia</i>	24 (100 %)	1055	1	113	44,0 +/- 6,5	0,54
<i>Tringa ochropus</i>	19 (79,2 %)	240	1	113	12,6 +/- 5,8	3,91
<i>Tringa glareola</i>	8 (33,3 %)	654	1	486	81,8 +/- 59,4	2,55
<i>Actitis hypoleucos</i>	10 (41,7 %)	83	1	51	8,3 +/- 4,8	3,02
<i>Arenaria interpres</i>	2 (8,3 %)	3	1	2	1,5 +/- 0,5	-
<i>Larus melanocephalus</i>	5 (20,8 %)	13	1	5	2,6 +/- 0,7	1,12
<i>Larus minutus</i>	4 (16,7 %)	41	1	32	10,3 +/- 7,3	1,93
<i>Larus ridibundus</i>	20 (83,3 %)	11.454	3	1673	572,7 +/- 117,8	0,84
<i>Larus genei</i>	1 (4,2 %)	8	8	8	-	-
<i>Larus fuscus</i>	4 (16,7 %)	4	1	1	1,0 +/- 0,0	-
<i>Larus michahellis</i>	24 (100 %)	3275	23	495	136,5 +/- 21,9	1,95
<i>Sterna caspia</i>	8 (33,3 %)	45	1	17	5,6 +/- 1,8	1,73
<i>Sterna hirundo</i>	7 (29,2 %)	262	7	144	37,4 +/- 18,3	2,37
<i>Sterna albifrons</i>	6 (25,0 %)	1004	15	391	167,3 +/- 60,1	0,74
<i>Chlidonias hybridus</i>	2 (8,3 %)	9	4	5	4,5 +/- 0,5	-
<i>Chlidonias niger</i>	5 (20,8 %)	7	1	2	1,4 +/- 0,3	0,61
<i>Chlidonias leucopterus</i>	2 (8,3 %)	48	5	43	24,0 +/- 19,0	-
<i>Alcedo atthis</i>	15 (62,5 %)	254	1	71	16,9 +/- 5,1	1,53
<b>Total</b>		<b>240.356</b>	<b>1453</b>	<b>32.336</b>	<b>10.014,8 +/- 1528,6</b>	<b>1,10</b>

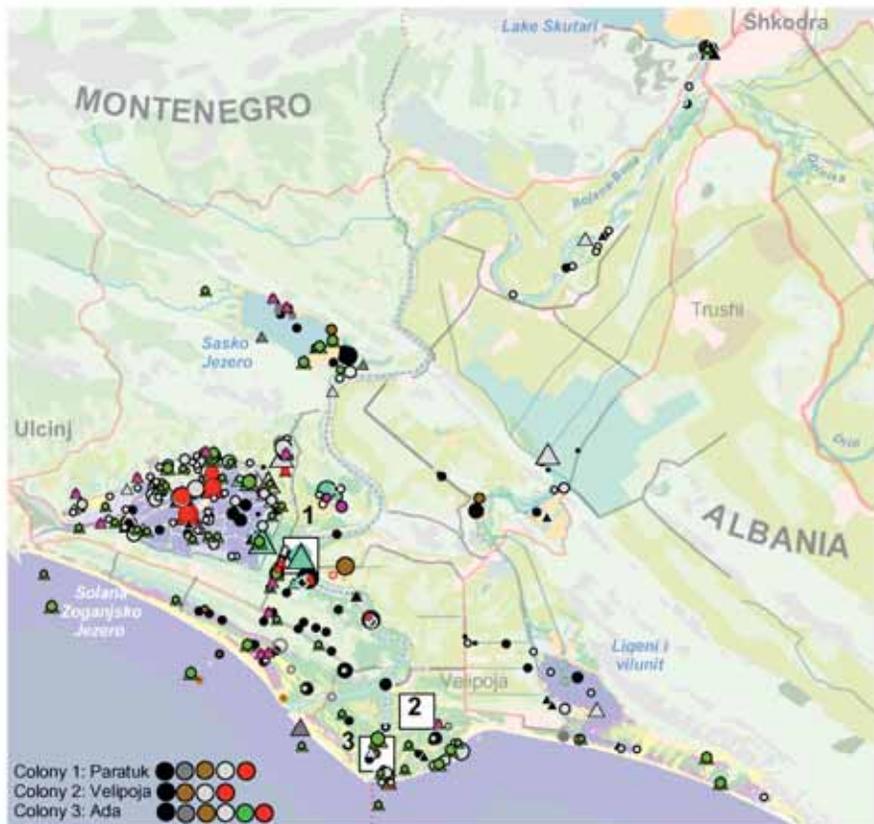


*Plate 1:* Aerial view of the Solana Ulcinj. In the foreground basins of the 1<sup>st</sup> evaporation grade and the basin called "Meadow"; centre Jezero 2, dry mudflats in Zoganjski 1 & 2, and in smaller basins of the 2<sup>nd</sup> evaporation grade; in the far back (left) Porta Milena channel and Velika Plaža (Photo: M. Schneider-Jacoby).



*Plate 2:* Small, almost rectangular crystallisation basins characterize the pans of the highest evaporation grade. 19 June 2008, Solana Ulcinj (Photo: T. Petras-Sackl).

### Rapid Assessment of the ecological value of the Bojana-Buna Delta Herons, Cormorants and Ibis colonies (April - June 2003)



**Legend**

- Border
  - International Roads
  - Main Roads
  - Local Roads
  - Small roads
  - Railways
  - Major rivers
  - Other rivers
  - Permanent canals
  - Small canals
  - Embankments
- Habitats**
- Submontains
  - Open area
  - Coastal waters (2 km from shoreline)
  - Lagoons, brackish water
  - Sandy beach, stone bar
  - Dune with grasses and reeds
  - Shallow banks, shallow brackish waters
  - Shallow meadows with Carex, Juncus
  - Main Rivers
  - Main Canals
  - Lakes
  - Flood grasslands
  - Macrophyte wetlands
  - Sand and gravel bars, islands
  - Shores of dry grassland
  - Secondary wooded pastures
  - Cereals, Arvensis heavily overgrown
  - Wood (Populus, Tamarix)
  - Shrubly Tamarix shrub
  - Shrubly Softwood
  - Shrubly Hardwood
  - Mediterranean oak with herbaceous meadow
  - Mediterranean hardwood
  - Mediterranean shrub, Maquis rock
  - Pine plantation
  - Apple orchard
  - Small arable agriculture
  - Meadows and pastures (in low waterlogged area)
  - Submontain pastures
  - Vineyards, orchards

1-2 3-5 6-10 11-30 31-50 51-100 (number per observation)

- Feeding
  - Flying
  - ▲ Resting
  - Colony
- Species:**
- *Phalacrocorax\**
  - *Nycticorax nycticorax*
  - *Ardeola ralloides*
  - *Egretta garzetta*
  - *Egretta alba*
  - *Ardea cinerea*
  - *Ardea purpurea*
  - *Plegadis falcinellus*
  - *Platalea leucorodia*
  - *P. carbo*, *P. pygmaeus*, *P. aristotelia*

0 5 10 Kilometers  
1: 180.000

Map Credit:  
Ordnungsbüro  
PLUVIUS 2006



Plate 3: Distribution of breeding colonies and main feeding areas of cormorants, herons and ibises in the Bojana-Buna Delta, April – June 2003.

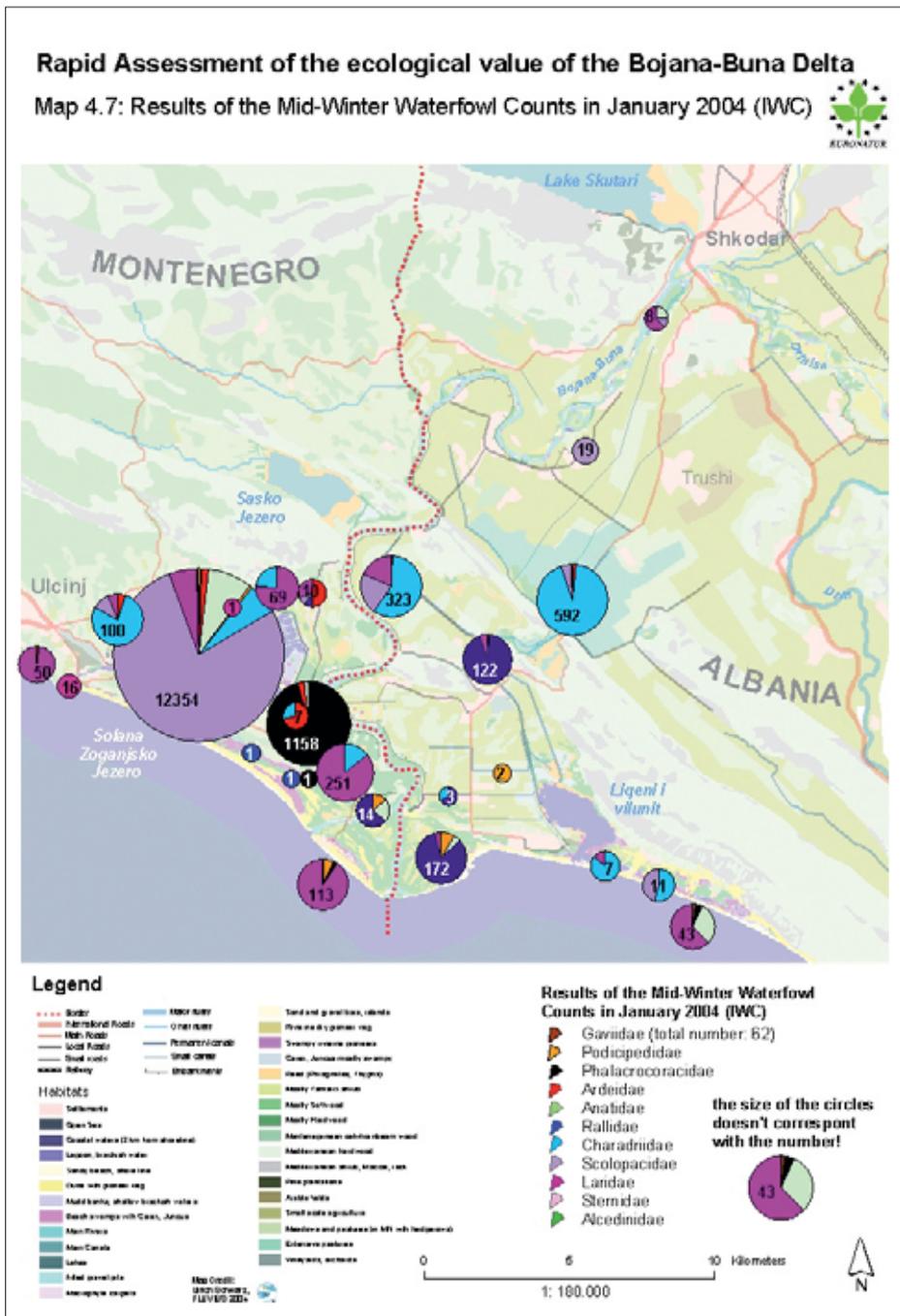


Plate 4: Distribution of wintering waterbirds in the Bojana-Buna Delta, January 2004.



Plate 5: Black-winged Stilt (*Himantopus himantopus*) nesting in the Solana's inner canal. 18 June 2007, Solana Ulcinj (Photo: P. Sackl).

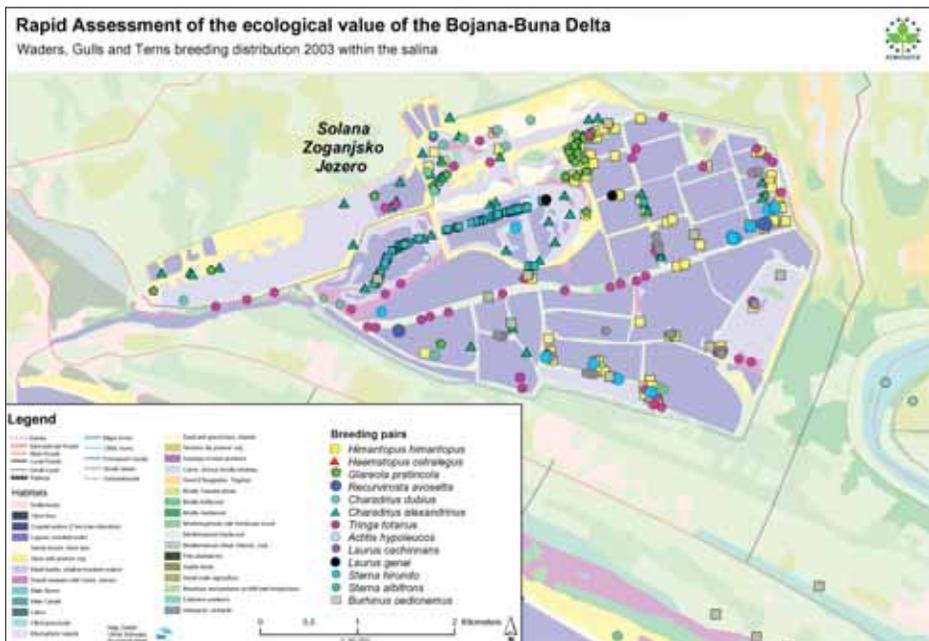


Plate 6: Breeding distribution of waders, gulls and terns in the Solana Ulcinj, June 2003.



*Plate 7:* Dalmatian Pelicans (*Pelecanus crispus*) pass the Solana's central observation tower. 3 November 2006, Solana Ulcinj (Photo: T. Petras-Sackl).



*Plate 8:* Greater Flamingo (*Phoenicopterus ruber roseus*). 26 September 2006, Solana Ulcinj (Photo: M. Tiefenbach).



*Plate 9:* Little Terns (*Sterna albifrons*) nesting on recently constructed breeding islet in evaporation III. 17 June 2008, Solana Ulcinj (Photo: P. Sackl).



*Plate 10:* The remnants of former levees in basin no. 32 are important nesting habitats for terns, Pied Avocet and other waders. 19 June 2003, Solana Ulcinj (Photo: B. Stumberger).



*Plate 11:* Extensive stands of *Salicornia herbacea* characterize both Zoganjski basins. 26 September 2006, Solana Ulcinj (Photo: M. Tiefenbach).



*Plate 12:* Collared Pratincole (*Glaucopis pratensis*). 19 June 2008, Zoganjski 1, Solana Ulcinj (Photo: P. Sackl).



*Plate 13:* During winter the inner canals, here between evaporation II und Zoganjski 2, are important feeding habitats for cormorants and herons. 19 March 2003, Solana Ulcinj (Photo: B. Stumberger).



*Plate 14:* Pygmy Cormorant (*Phalacrocorax pygmeus*) wing-drying after foraging in the Solana's inner main canal. 3 November 2006, Solana Ulcinj (Photo: P. Sackl).

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Joannea Zoologie](#)

Jahr/Year: 2008

Band/Volume: [10](#)

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Artikel/Article: [Management plan for the conservation and sustainable use of the natural values of the privately owned Nature Park 'Solana Ulcinj', Montenegro. 5-84](#)