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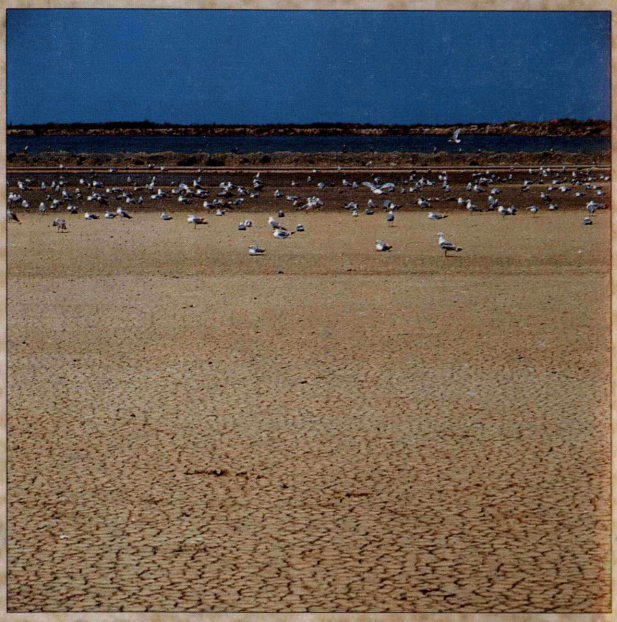

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EKOLOGIJA IN BIOLOGIJA MORJA

ECOLOGIA E BIOLOGIA MARINA

MARINE ECOLOGY AND BIOLOGY

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A SURVEY OF THE INTRODUCED NON-INDIGENOUS SPECIES IN THE NORTHERN ADRIATIC SEA

Martina ORLANDO BONACA
National Institute of Biology, Marine Biology Station, SI-6330 Piran, Fornače 41

ABSTRACT

A synthesis of non-indigenous species being introduced to the northern Adriatic Sea, based on literature records and unpublished information, is given. Thirty-five introduced species were recorded, twenty-six animals and nine algae. The majority of them have been introduced with vessels, for aquaculture purposes (also as accompanying species) or through the Suez Canal (the so-called Lessepsian migrants). The fate of these species is unpredictable not only in the northern Adriatic, but in the entire Mediterranean Sea.

Key words: non-indigenous species, introduction, northern Adriatic Sea

RESOCONTO DELLE INTRODUZIONI DI SPECIE NON-INDIGENE NELL'ADRIATICO SETTENTRIONALE

SINTESI

L'articolo riporta un resoconto delle introduzioni di specie marine non-indigene nell'Adriatico settentrionale, basato su dati di letteratura ed informazioni non ancora pubblicate. In totale è stata registrata la presenza di trentacinque specie alloctone, ventisei delle quali appartenenti al regno animale e nove a quello vegetale. La maggioranza di esse è stata introdotta con le navi, importata per la maricoltura (con rispettive specie accompagnatrici) o attraverso il Canale di Suez (migranti Lessepsiani). La sorte di tali specie appare imprevedibile non solo nell'Adriatico settentrionale, ma nell'intero bacino Mediterraneo.

Parole chiave: specie non-indigene, introduzioni, Adriatico settentrionale

INTRODUCTION

The introduction of species to habitats outside their native ranges is a growing problem due to the unexpected impacts these species might cause on indigenous species and ecosystems (Nolan, 1994; Gollasch & Leppäkoski, 1999). Nowadays, it is quite impossible to predict how a species will behave when it is introduced into a new environment. Because of this unpredictability every effort should be made to prevent or at least to monitor the introduction of species from an ecosystem into another (Verlaque, 2001).

Marine non-indigenous species (also called introduced, non-native, alien, or exotic organisms) are mostly transported intentionally for aquaculture purposes or unintentionally with marine traffic (Zibrowius, 1994; Gollasch & Leppäkoski, 1999). Ships provide habitats for a large variety of organisms due to their transport of ballast water, sediments in ballast tanks and hull fouling (Gollasch & Leppäkoski, 1999).

Compared to the substantial body of knowledge gathered on terrestrial species introductions, data on the dynamics of marine species introduction remain very scarce. Relatively comprehensive inventories of marine flora and fauna are too recent for us to be able to identify in them the species that were probably introduced, without the risk of error being unacceptably high. Often, the authors of inventories have not specified that certain mentioned species were probably introduced, mostly because they feel that this assumption is too hypothetical (Ribera & Boudouresque, 1995).

In the northern Adriatic Sea, only a minor research about the presence of non-native species has been carried out (De Min & Vio, 1998), but scientists have recorded cases of introductions of non-indigenous species that could badly affect local ecosystems. However, some information about non-indigenous species in this area is known from the reports by Lipej (2000), Lipej & Makovec (2000), Lipej *et al.* (2000) and Orlando (2001). David (1999) provided a review of the existing regulations for the accidental introduction of species with ballast waters.

The aim of this paper is to compile the checklist of non-indigenous marine animals and algae found in the northern Adriatic Sea. Data were collected from different sources such as bibliographical references and scientific citations, information available at specific web sites, and information obtained by other researchers and naturalists.

MODALITY OF INTRODUCTION OF SPECIES

According to Boalch (1994), introductions of non-indigenous species can be divided into natural introductions (which may be temporary or permanent), accidental introductions by man (brought in with other organisms, by ships or other vectors or brought in for research or commerce and subsequently escaping), or purposeful introductions. Natural introduction (like in the Mediterranean the natural invasion of species through the Straits of Gibraltar) are frequently the result of local changes in environmental conditions, so that a species normally occurring outside the considered area can extend its range and move into it. These types of introductions do not appear to be harmful. Accidental introductions are much more numerous.

The most ancient vector of species introduction is certainly the transportation on the ships' hulls of fixed (fouling) or non-fixed (clinging) species (Ribera & Boudouresque, 1995). Fouling concerns small-sized species and large species whose life history includes a microscopic stage. Since 1972, antifouling paints of ships have generally contained the highly toxic tributyltin (TBT) (Gollasch & Leppäkoski, 1999). This substance has considerably reduced the number of fouling organisms, but in some areas, like harbors or shipyards, the accumulation of the TBT prevents the reproduction of several gastropod species and also some algae seem to be affected (Gollasch & Leppäkoski, 1999). Therefore, in the beginning of the 1990s the use of TBT was banned for boats smaller than 25 m (Gollasch & Leppäkoski, 1999).

Carlton & Geller (1993) note that ballast water is the least selective means of transportation of species from the ecological and taxonomic points of view, and it is a vector that has no equivalent on land. The survival time in ballast water for some species may exceed 18 days (Salt, 1992), so that many of these organisms are still alive after their intercontinental voyage at the time of deballasting.

Many scientists who are using marine non-native species fail to take the elementary precautions required to prevent the escape of these organisms from their cultures, *e.g.* some laboratories dispose through their own direct outfalls sites for seawater. The survival capacity of such species in fresh water is also poorly known (Ribera & Boudouresque, 1995).

Some economically important alien species have been introduced intentionally for aquaculture purposes, with consequent accidental introduction of accompanying species (Zibrowius, 1994; Ribera & Boudouresque, 1995; Gollasch & Leppäkoski, 1999).

With a few exceptions, the importation, sale and possession of marine species are not subject to any specific regulations. Some companies offer in their catalogues also the invasive marine algae *Caulerpa taxifolia* and *Sargassum muticum* (Ribera & Boudouresque, 1995).

The migration of the Red Sea species through the Suez Canal has added by far the greatest number of newcomers in the Mediterranean Sea. With the inauguration of the Suez Canal in 1869, a remarkable faunal and floral movement started. Hundreds of species are still traversing the canal and settling in the Mediterra-

nean in a process called "Lessepsian migration", after Ferdinand Marie de Lesseps, the French engineer who built the canal (Galil, 1994).

There are four successive phases in the introduction of a species (Ribera & Boudouresque, 1995), first of all the arrival of a few specimens of an exotic species that does not automatically imply its naturalization. During the settlement phase, the species constitute populations of individuals born *in situ*. This phase may results in a naturalization of the species. Once naturalized, the introduced species starts the expansion phase, trying to occupy the whole biotope and the whole of the geographical range to which it may have access. The persistence phase, the last one, may takes two forms: the decline followed by stabilisation at a lower level than the maximum attained during the expansion phase, or a plateau close to the maximum attained.

A species is considered introduced when it has satisfied many criteria (Ribera & Boudouresque, 1995). The most important are that the species is new in the area in question and that there is a geographical discontinuity between its new station and the species' known range (Ribera & Boudouresque, 1995).

INTRODUCED FAUNA

According to the available data, twenty-six non-indigenous animal species are known to occur in the northern Adriatic Sea (Tab. 1).

The increase of marine traffic between the Mediterranean Sea and the Far East that has followed the opening of the Suez Canal, and the import of Indo-Pacific Mollusca for aquaculture purposes, have facilitated the diffusion in the northern Adriatic Sea of twelve exotic species (De Min & Vio, 1998). According to De Min & Vio (1998), the chemical-physical conditions such as those of some subtropical or tropical estuary areas have promoted the colonization of seven non-native species *(Rapana venosa* (Fig. 1), *Bursatella leachii, Scapharca inaequivalvis, Musculista senhousia, Xenostrobus secures, Tapes philippinarum, Crassostrea gigas)* and of five occasional, too *(Strombus decorus, Brachydontes pharaonis, Perna picta, Pinctada radiata, Saccostrea commercialis* (the reproduction of this species in the Venice Lagoon has failed)).

A tropical species of Nudibranchia (Gastropoda) *Halgerda* sp. has been found at the southern tip of Cres Island (Quarnero archipelago) at the end of July 1988, which is also the first record of any *Halgerda* species in the Mediterranean (Turk, 2000). The author supposes that the most probable vector of introduction for this species is ballast water.

There are also some records about the presence of exotic Decapoda (Crustacea) in the northern Adriatic Sea (CIESM, 2000): *Callinectes danae, Callinectes sapidus, Dyspanopeus sayi* and *Rhithropanopeus harrisii.*

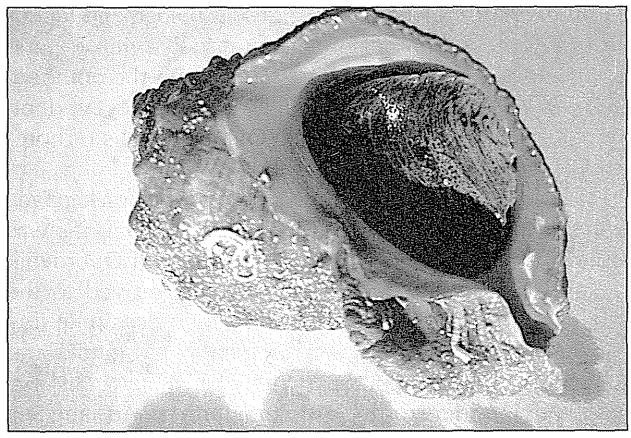

Fig. 1/Sl. 1: *Rapana venosa.* ***(Photo/Foto: T. Makovec)***

In 1987, the Copepoda (Crustacea) *Acartia tonsa* was recorded for the first time in the northern Adriatic in the Lagoon of Scardovari (Occhipinti, 2000). Since then it has supplanted the native congeneric *Acartia margalefi* in the Venice Lagoon and in the Po River Delta (Occhipinti, 2000).

The circumtropical barnacle *Balanus trigonus* (Crustacea) was probably introduced as a fouling organism, and was first recorded in the Adriatic Sea near Trieste (Relini, 1968). In Croatian coastal waters it has been found near Rovinj and Pula (Igić, 1982) and in the Rijeka Bay (Zavodnik, 1998; Zavodnik & Kovačić, 2000).

In the coastal wetlands of the northern Adriatic the fish *Gambusia affinis* has been found, introduced in relation to the problems with mosquitoes (Leiner *et al.*, 1995, Marčeta, 1999). Because of their aggressive behaviour, mosquitofish may negatively affect populations of small native fish through predation and competition (Nico & Fuller, 2000).

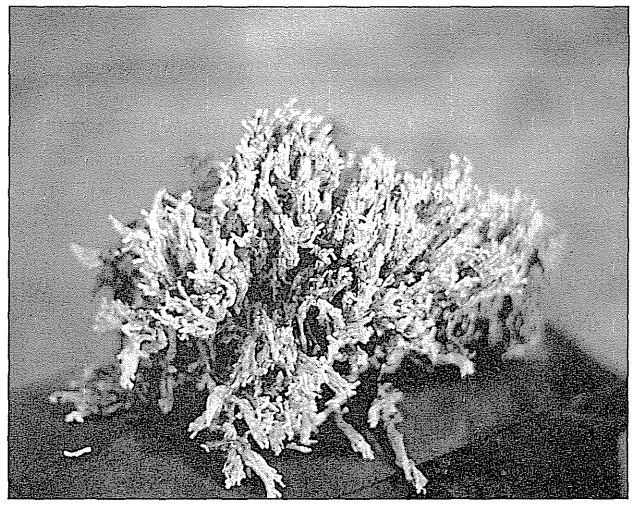

Fig. 2/Sl. 2: *Ficopomatus enigmaticus.* ***(Photo/Foto: T. Makovec)***

In the Sečovlje Salina Landscape Park, the Polychaeta *Ficopomatus enigmaticus* (Fig. 2) (Avčin, 1984) was recorded. This species originates from the Southern Hemisphere and it has probably been introduced on ships' hulls and commercial mollusc shells (Thorp, 2000).

In 1995, the Siphonophora (Hydrozoa) *Muggiaea atlantica*, a representative of the Atlantic fauna, was found for the first time in the Adriatic Sea off Dubrovnik (Gamulin & Kršinić, 2000). The species arrived to the northern Adriatic in 1996, reached a high density in July 1997, followed by its mass extinction a month later (Gamulin & Kršinić, 2000).

Other introduced species in the northern Adriatic Sea are (Cognetti, 1994; Occhipinti Ambrogi, 1994): the Amphipoda (Crustacea) *Echinogammarus pungentoides,* the Isopoda (Crustacea) *Paraceneis sculpta,* the Bryozoa *Tricellaria inopinata,* and the Gastropoda *Littorina saxatilis.*

The data presented in the paper of Arbulla *et al.* (2000) was not taken in consideration, because there were a lot of uncertainties regarding the non-native species.

INTRODUCED FLORA

Nine species of introduced macrophytes are known from the northern Adriatic Sea (Tab. 2).

Nowadays, the most notorious introduced alga in the whole Mediterranean Sea is the tropical alga *Caulerpa taxifolia* (Fig. 3), which has been displayed over the last fifteen years in tropical aquaria at the Oceanographic Museum in Monaco. Its accidental introduction into the natural environment dates from 1984 (Meinesz & Hesse, 1991). The first record of the alga in the Adriatic Sea was in Stari Grad Bay (Hvar Island, Croatia) in the summer of 1994 (Žuljevič & Antolić, 1998). Few months later divers spotted the alga in Malinska, Island of Krk (Žuljević & Antolić, 1998). The third and last recording was in October 1996 on the northwest side of Dolin Island in the Barbat Channel (Žuljević & Antolić, 1998). It was estimated that the alga had been brought into the areas of the Stari Grad Bay and Malinska Harbour in 1991 and into the Barbat Channel in 1995 (Špan *et al.*, 1998; Žuljević & Antolić, 1998). The site in Malinska was only partially eradicated while the site in the Barbat Channel was eradicated in total (Žuljević & Antolić, 1998).

Tab. 1: Non-indigenous fauna in the northern Adriatic Sea.
Tab. 1: Tujerodna favna v severnem Jadranu.

Taxa	Class	Origin	Vector	First record	Source
Acartia tonsa	Crustacea	Indo-Pacific	aquaculture	1987	Occhipinti (2000)
Balanus trigonus	Crustacea	Circumtropical	shipping	1968	Zavodnik (1998)
Brachydontes pharaonis	Bivalvia	Indo-Pacific	Lessepsian introduction	1996	De Min & Vio (1998)
Bursatella leachii	Gastropoda	Circumtropical	Lessepsian introduction	1986	De Min & Vio (1998)
Callinectes danae	Crustacea	Western Atlantic	?	1981	CIESM (2000)
Callinectes sapidus	Crustacea	Western Atlantic	ballast waters	1949	CIESM (2000)
Crassostrea gigas	Bivalvia	Japan	aquaculture	1969	De Min & Vio (1998)
Dyspanopeus sayi	Crustacea	N-W Atlantic	ballast waters	1992	CIESM (2000)
Echinogammarus pungen-	Crustacea	?	aquaculture	?	Cognetti (1994)
Ficopomatus enigmaticus	Polychaeta	Australia	?	?	Avčin (1984)
Gambusia affinis	Osteichthyes	Central America	purposeful introduction	1936	Leiner *et al.* (1995)
Halgerda sp.	Gastropoda	Indo-Pacific	ballast waters	1988	Turk (2000)
Littorina saxatilis	Gastropoda	Atlantic	?	1792	Occhipinti Ambrogi (1994)
Muggiaea atlantica	Hydrozoa	Atlantic	?	1996	Gamulin & Kršinič (2000)
Musculista senhousia	Bivalvia	Indo-Pacific	Lessepsian introduction	1986	De Min & Vio (1998)
Paraceneis sculpta	Crustacea	?	?	?	Cognetti (1994)
Perna picta	Bivalvia	Atlantic	shipping	1996	De Min & Vio (1998)
Pinctada radiata	Bivalvia	Indo-Pacific	Lessepsian introduction	1996	De Min & Vio (1998)
Rapana venosa	Gastropoda	Japan	shipping	1973	De Min & Vio (1998)
Rhithropanopeus harrisii	Crustacea	N-W Atlantic	ballast waters	1994	CIESM (2000)
Saccostrea commercialis	Bivalvia	Australia	aquaculture	1980	De Min & Vio (1998)
Scapharca inaequivalvis	Bivalvia	Indo-Pacific	ballast waters	1969	De Min & Vio (1998)
Strombus decorus	Gastropoda	Indian Ocean	shipping	1996	De Min & Vio (1998)
Tapes philippinarum	Bivalvia	Indo-Pacific	aquaculture	1983	De Min & Vio (1998)
Tricellaria inopinata	Bryozoa	Indo-Pacific	?	1982	Occhipinti Ambrogi (1994)
Xenostrobus securis	Bivalvia	Australia	shipping	1992	De Min & Vio (1998)

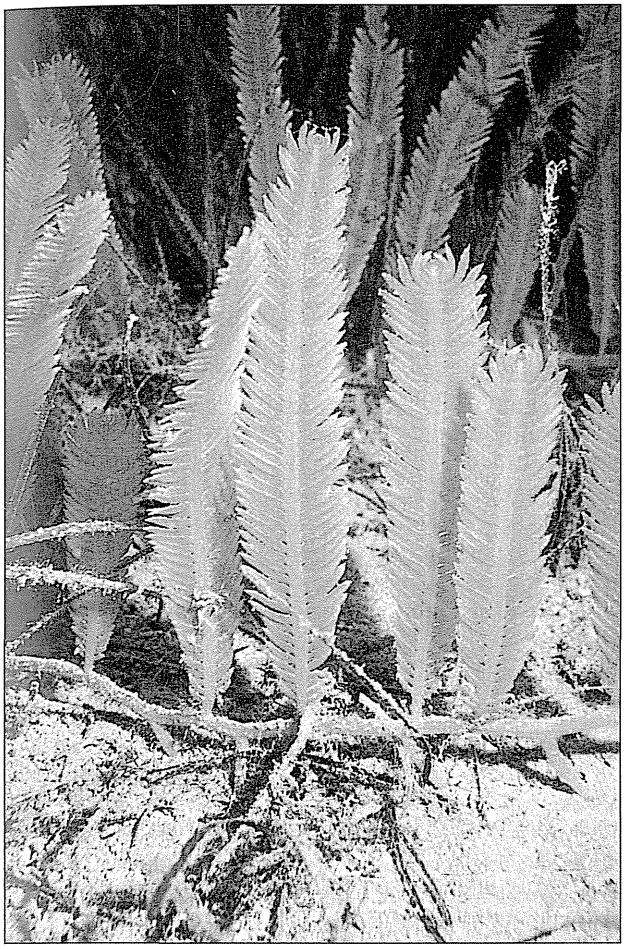

Fig. 3/Sl. 3: *Caulerpa taxifolia.* ***(Photo/Foto: M. Richter)***

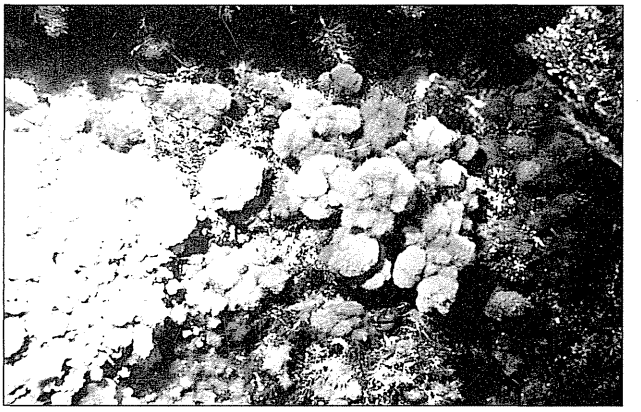

Fig. 4/Sl. 4: *Asparagopsis armata - Falkenbergia rufolanosa* ***phase. (Photo/Foto: M. Richter)***

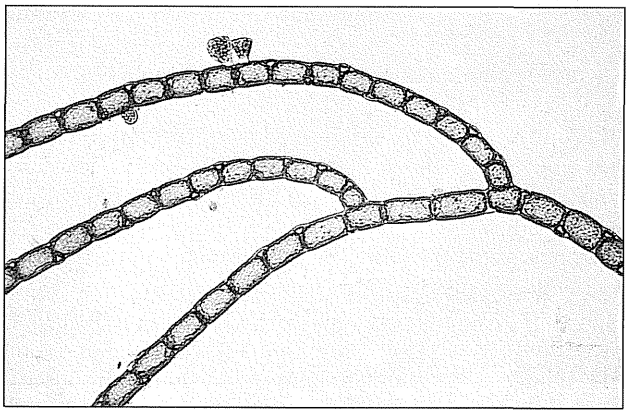

Fig. 5/ Sl. 5: *Bonnemaisonia hamifera - Trailliella* ***phase (Photo/Foto: M. Richter)***

The non-indigenous red alga *Asparagopsis armata* was recorded for the first time in the northern Adriatic, in Slovenian coastal waters, in 1991 (M. Richter, *pers. comm.),* but only the tetrasporophyte - *Falkenbergia rufolanosa* phase (Fig. 4). Six years later the gametophyte plants were recorded in Croatian waters near Senj (M. Richter, *pers. comm.).* This species originates from Australia and/or possibly New Zealand and it was introduced to the Mediterranean Sea unintentionally with oysters (Ribera & Boudouresque, 1995).

In 1995, the red algae *Bonnemaisonia hamifera* was found in Slovenian coastal waters, but only the filamentous tetrasporophyte - *Trailliella* "pink cotton wool" phase (M. Richter, *pers. comm.)* (Fig. 5). This species originates in the Pacific and was probably introduced with shellfish from Japan (Tittley, 2000).

The green alga *Ulva scandinavica* (originating from Sweden and Norway) was recorded for the very first time in the coastal waters of Slovenia in September 1998 (Battelli & Tan, 1998). It was also the first record of this species in the Adriatic Sea. Before that, *U. scandinavica* was recorded in the Mediterranean Sea only on the west and south coast of Italy (Battelli & Tan, 1998).

The presence of *Codium fragile* subsp. *tomentosoides* in the northern Adriatic Sea was noticed for the first time in 1992 (Munda, 1992). Its presence in Slovenian coastal waters was confirmed many times (Munda, 1993; Battelli & Vukovič 1995; Battelli, 1996). This species (Fig. 6) originated in the Pacific Ocean around Japan. It spread remotely either as an associated unintentional introduction attached to shellfish as oysters, attached to ships' hulls or as spores in ballast tanks. In the Mediterranean Sea it was reported for the first time in French waters in 1950, and subsequently appeared at both near and distant sites, with no apparent link with either the direction of the currents or the distance (Fig. 7) (Ribera & Boudouresque, 1995).

The invasive seaweeds *Undaria pinnatifida, Sargassum muticum* and *Antithamnion pectinatum* have been recorded in the Venice Lagoon (Curiel *et al.*, 1994; 1995; 1996; 1998). The brown seaweed *Sargassum muticum* (Fig. 8) was first introduced into France along with *Crassostrea gigas* in the late 1960s (Critchley *et al.*, 1983). The subsequently rapid expansion of the alga has led to a dramatic increase in the number of permanent

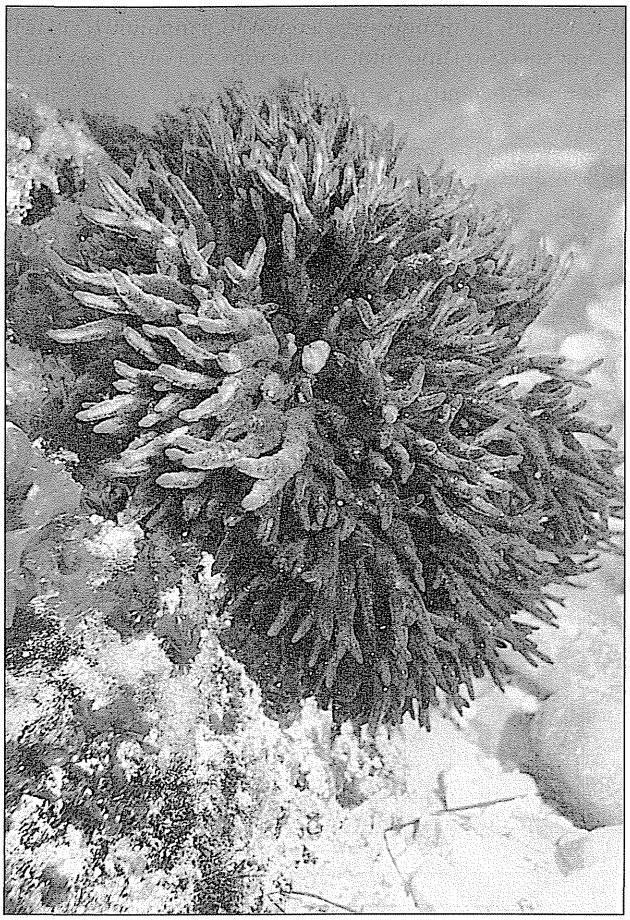

Fig. 6/ Sl. 6: *Codium fragile.* ***(Photo/Foto: M. Richter)***

populations along the European Atlantic coast and in the western Mediterranean. Also the introduction of *Undaria pinnatifida* and *Antithamnion pectinatum* in European waters was caused by the importation of the Japanese oyster in mariculture (Rueness, 1989). All these species have quickly colonized the hard substrata in the Venice Lagoon, competing with indigenous species, and the lack of potential predators in the colonized area (such as sea urchin *Paracentrotus lividus*) probably enhances their spread. According to several authors, manual eradication may be ineffectual, due to their efficient reproduction mechanisms and preliminary data showed quick recolonization of the area (Curiel *et al.*, 1998).

Recently, another alga from the genus *Sorocarpus* has been reported for the Venice Lagoon, which is also the first record in the Mediterranean (Curiel *et al.*, 1999). The authors have not made any hypotheses about the origin and the period of arrival of the settlement, due to the lack of knowledge of its distribution in the lagoon area.

CONCLUSIONS

Although the northern Adriatic Sea is just a small portion of the Mediterranean marine realm, it has been certainly affected by the invasion of non-indigenous species. These organisms have been introduced mostly by shipping, through the Suez Canal or for aquaculture purposes. Twenty-six introduced animals and nine algae have been recorded to date. It is quite reasonable to expect that the list will be expanded in the near future.

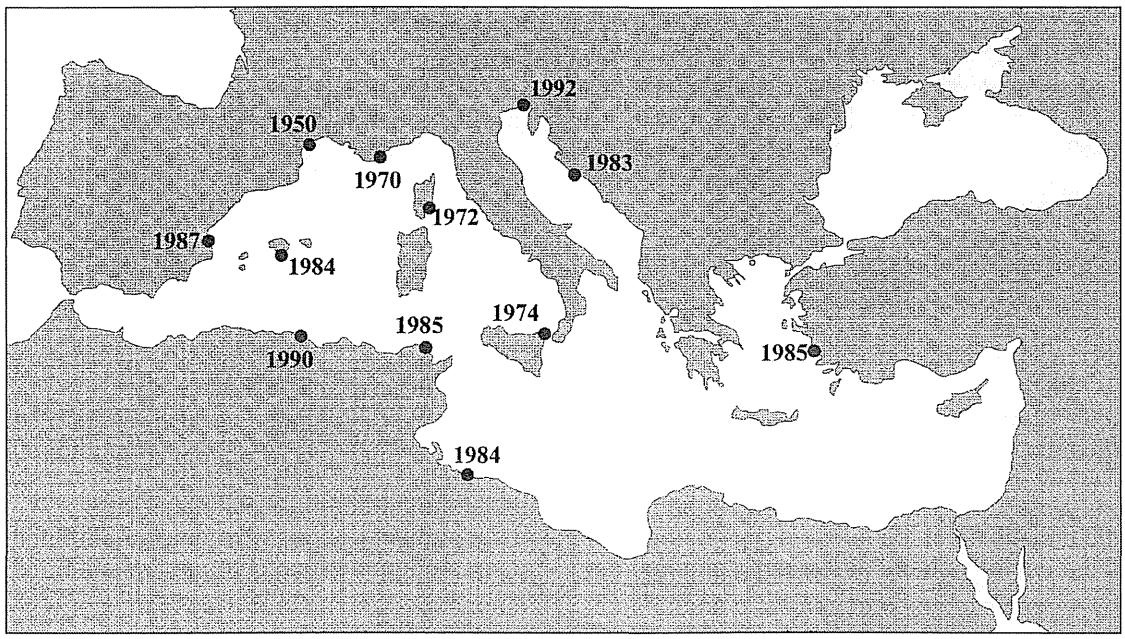

Fig. 7: Chronology of the expansion of *Codium fragile* ***in the Mediterranean (modified from Ribera, 1994).***
Sl. 7: Kronologija širjenja vrste *Codium fragile* ***v Sredozemlju (dopolnjeno po Riberi, 1994).***

Tab. 2: Non-indigenous flora in the northern Adriatic Sea.
Tab. 2: Tujerodna flora v severnem Jadranu.

Taxa	Division	Origin	Vector	First record	Source
Antithamnion pectinatum	Rhodophyta	Japan	aquaculture	1994	Curiel *et al.* (1996)
Asparagopsis armata	Rhodophyta	Australia	Gibraltar	1991	Richter *(oral. comm.)*
Bonnemaisonia hamifera	Rhodophyta	Pacific	Gibraltar	1995	Richter (*oral. comm.*)
Caulerpa taxifolia	Chlorophyta	Pantropical	aquarium	1994	Žuljević & Antolić (1998)
Codium fragile subsp. *tomentosoides*	Chlorophyta	Pacific Ocean	Gibraltar	1992	Munda (1992)
Sargassum muticum	Phaeophyta	Japan	aquaculture	1992	Curiel *et al.* (1995)
Sorocarpus sp.	Phaeophyta	?	?	1996	Curiel *et al.* (1999)
Ulva scandinavica	Chlorophyta	Sweden	?	1998	Battelli & Tan (1998)
Undaria pinnatifida	Phaeophyta	Japan	aquaculture	1992	Curiel *et al.* (1994)

As the future of the introduced species in the whole Mediterranean Sea is unpredictable, it would be necessary to start an international collaborative program to survey the rate of invasion and to develop a global data bank on introduced species and receptive habitats. It would also be proper to set up an international monitoring programme of ballast waters. The exchange of ballast water as far as possible from the coast is nowadays believed to be the most reliable method to minimise the risk of transfer of unwanted organisms (Gollasch & Leppäkoski, 1999).

But if not accompanied with a proper enforcement of existing national and international legislations (above all the articles concerning the transfer of living marine organisms), even the best research and monitoring programs shall have little chance to control and minimize the introduction of potentially harmful marine non-indigenous species. Nowadays, the current legislations appear very inadequate and insufficient (De Klemm, 1994; Verlaque, 2001).

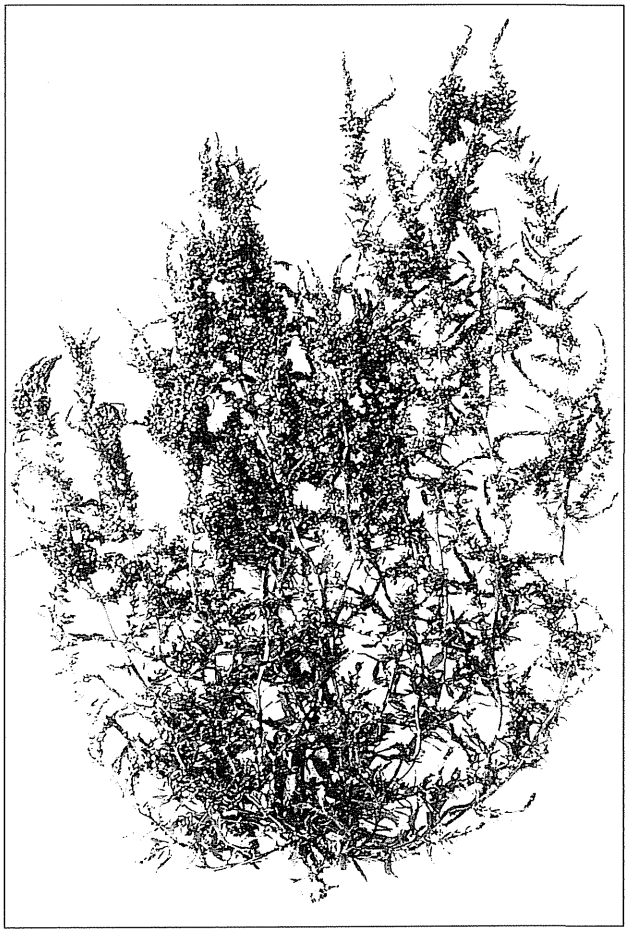

Fig. 8/Sl. 8: *Sargassum muticum.* ***(Photo/Foto: M. Richter)***

ACKNOWLEDGEMENTS

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PREGLED VNOSOV TUJERODNIH VRST V SEVERNI JADRAN

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POVZETEK

Avtorica podaja pregled zabeleženih vnosov tujerodnih vrst v severnem Jadranu, temelječem na bibliografskih zapisih ter še ne objavljenih podatkih. Na tem območju je bilo opaženih petintrideset alohtonih vrst, od tega devet alg in šestindvajset živali. Med algami je najbolj znana eksotična vrsta Caulerpa taxifolia, *ki je bila v severnem Jadranu prvič opažena leta 1994. Mehkužci so najpogosteje vnešene živali.*

Tujerodni morski organizmi se na več načinov nenehno širijo po svetu in tako prihajajo tudi v severno-jadranske vode. Plovba je najpomembnejši vnosni vektor. Strokovnjaki menijo, da so balastne vode z ekološkega in taksonomskega vidika najmanj selektiven način prenosa organizmov. Plovila prevažajo organizme tudi na svojem trupu in dnu. Eksotični organizmi vstopajo v Sredozemsko morje tudi skozi Sueški prekop, ki je bil zgrajen leta 1869. Tretji zelo pomembni vir vnosa tujerodnih vrst pa je marikultura. Japonsko ostrigo (Crassostrea gigas) *so prvič uvozili v Evropo v šestdesetih letih in nehote z njo pripeljali tudi nekatere vrste alg, kot sta* Sargassum muticum *in* Undaria pinnatifida, *ki se zelo hitro širita na trdih podlagah Beneške lagune.*

Strokovnjaki se s tujerodnimi vrstami premalo časa ukvarjajo, da bi lahko natančno ocenili njihov vpliv na novo okolje. Večina teh vrst kmalu pogine, tiste, ki pa preživijo, lahko povzročijo ogromno škodo. Da do takih posledic v severnem Jadranu ne bi nikoli prišlo, bi bilo treba izboljšati obstoječo zakonodajo ter temeljito in kontinuirano nadzorovati vse možne vire vnosa tujerodnih vrst.

Ključne besede: tujerodne vrste, vnos, severni Jadran

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FIRST OBSERVATIONS AT THE ARTIFICIAL REEF SUBMERGED ON THE SANDBANK OFF SANTA CROCE (TRIESTE, ITALY)

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ABSTRACT

At the artificial reef submerged on the sandbank off S. Croce (45°42'02" N, 13°37'24" E), the following was studied at the site on a monthly basis from March 1999 to October 2000: the chemical-physical parameters of the water column, the ichthyoplanktonic and mesozooplanktonic community, the fish community and the structure of the species population. During the summer, the ichthyoplanktonic community constituted mainly of sparids, serranids and blennies, while in the winter it was made up mainly by Pleuronectiformes. The mesozooplanktonic community was composed principally of copepods - except in the summer, when cladocerans were prevalent. According to the fishing catch data, more species were sampled at the artificial reef than at the control site.

Key words: artificial reef, Gulf of Trieste, chemical-physical data, zooplankton catch data, fishing catch data

PRIME OSSERVAZIONI SULLE STRUTTURE ARTIFICIALI SOMMERSE POSTE IN PROSSIMITÀ DEL DOSSO DI S. CROCE

SINTESI

Sulle strutture artificiali sommerse poste in prossimità del dosso di S. Croce (45°42'02'' N, 13°37'24'' E), sono stati effettuati campionamenti mensili da marzo 1999 ad ottobre 2000, al fine di rilevare i parametri chimico-fisici della colonna d'acqua, le comunità ittioplanctonica e mesozooplanctonica, nonché la comunità ittica e la struttura della popolazione. Durante il periodo estivo la comunità ittioplanctonica è risultata composta principalmente da Sparidi, Serranidi e Blennidi, mentre durante il periodo invernale hanno prevalso i Pleuronettiformi. La comunità mesozooplanctonica è risultata composta principalmente da copepodi, tranne nei mesi estivi quando hanno prevalso i cladoceri. In base ai dati delle pescate ittiche, è stato rinvenuto un maggior numero di specie in prossimità delle strutture artificiali che non nel sito di controllo.

Parole chiave: strutture artificiali, Golfo di Trieste, dati chimico-fisici, pescate di zooplancton, pescate ittiche

INTRODUCTION

Artificial reefs are bio-ecological mechanisms able to enhance the fishery biomass (Bombace, 1994). Artificial reefs protect eggs and larval/young stages, increase the availability of food, reduce mortality and increase the curves of growth of different species, therefore provide for an increase in total biomass. According to the census (Grove & Sonu, 1991) conducted in 29 countries of the world, the first effect credited to the artificial reefs is a considerable increase in fish production (from 20 to 4000%), the second function is to prevent over-fishing in some areas, and the third is linked to the clear increase of biomass.

As the very same modules placed in environments with different ecological characteristics may lead to a very different evolution of the community (Bombace, 1987), it is necessary to survey regularly the physical and biological characteristics at the reef site in order to obtain a broad set of data suitable for analysis and comparisons in order to obtain the information that could optimise the biotic development in relation to the scopes defined before the artificial structures were submerged.

In order to study the potentialities of an artificial reef submerged in the Gulf of Trieste, the following was studied at the site: the chemical-physical parameters of the water column, the ichthyoplanktonic and mesozooplanktonic community, the fish community and the structure of the species population subject to the fishing in the area attracted by the artificial structures. The artificial reef is located 3.7 miles offshore at the sandbank off S. Croce (45°42'02" N, 13°37'24" E) on a sandy muddy bottom at a depth of approximately 15 metres (Fig. 1). The artificial reef is composed of a series of different structures: of a wreck iron pontoon sunk in April 1995; 30 prefabricated cube-shaped structures submerged in 1999 and positioned so as to form 6 pyramids each made of five cubic blocks of concrete (2 x 2 x 2 m), the aforesaid blocks are hollow with dividing walls in the middle and with holes on external walls; 10 full concrete cubes with anti trawling poles; 50 M.I.M. (microelements integrating the modules) made of a cement base and polyethylene branching in corrugated tubes in vertical position. Some other structures are now being submerged and installed at the reef site. All the above mentioned structures are supposed to perform various functions, mainly to increase the area's ecological diversity and to prevent trawl fishing. The effect should be not only an increase in commercially interesting fish species but also in overall biodiversity of the alieutic species.

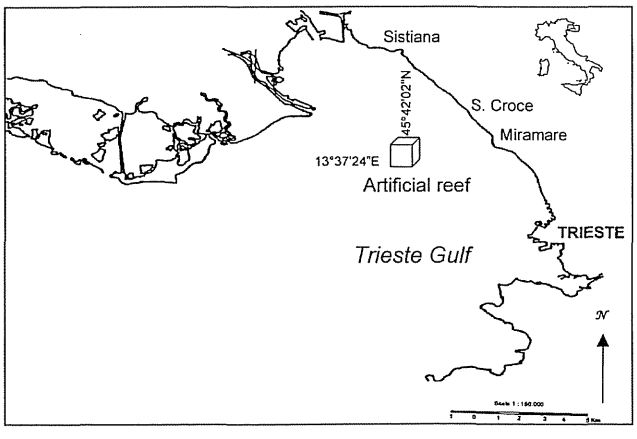

Fig. 1: Position of the artificial reef in the Gulf of Trieste.
Sl. 1: Lega umetnega podvodnega grebena v Tržaškem zalivu.

MATERIALS AND METHODS

Planktonic samplings were carried out from 9 March 1999 to 18 October 2000 every two weeks at the fixed station (S. Croce sandbank) in the Gulf of Trieste. The main chemical-physical parameters of the water (temperature, salinity, oxygen content) were measured with the Multiprobe sounder, as well as the transparency by the use of the Secchi disc. Plankton samplings were carried out with a Bongo 20 type net (236 µm and 335 µm mesh), FAO (236 µm mesh) and WP2 (500 µm mesh) equipped with a flow-meter and double oblique catches from the bottom to the surface. Each sample was fixed in 4% formalin. From the entire sample, the ichthyoplanktonic fraction (teleosts eggs and larvae) was separated by the use of binocular microscope from the mesozooplanktonic for the qualitative-quantitative determination. Thus the total number of eggs and larvae per cubic meter was determined.

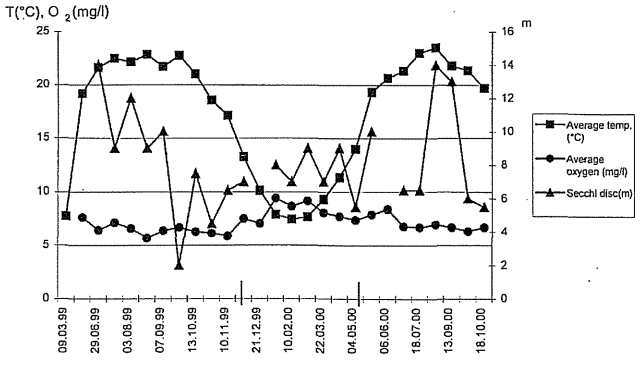

Fig. 2: Average temperature (°C), transparency (m) and oxygen content (mg/l) along the water column during the studied period.
Sl. 2: Povprečna temperatura (°C) morske vode, prozornost (m) in vsebnost kisika (mg/l) v vodnem stolpcu v vzorčevalnem obdobju.

The fishing survey was carried inside the area delimited with submerged artificial structures and at the control site placed one nautical mile away in north-western direction on the same bathymetric and the same type of sea bottom. Catch samplings were conducted with the use of a bottom trammel net measuring 260 m in length, 2 m in height, with 70 mm inner mesh size and 350 mm outer mesh size. The nets were placed in the sea before the sunset and extracted on the following morning with the permanence of approximately 12 hours. Samplings were conducted at both sites at the same time. From December 1999 to November 2000, eleven monthly samplings were carried out. The samples were transported to the laboratory for some successive analyses. The samples were measured (total length in mm) and weighed (in g).

RESULTS

Chemical - physical parameters

The averages of temperature (°C), salinity (PSU) and oxygen content (mg/l) along the water column were calculated. The lowest average temperature during the sampling period was in February 2000 (7.45°C) and the highest in August 2000 (23.50°C) (Fig. 2). Homothermia was noted along the water column during the autumn; temperature values falling in winter (inverse thermal stratification) with a minimum in February. In spring, after a short period of isothermy, thermocline was clearly formed that lasted during the summer. The oxygen content during the period of sampling showed a minimum of 5.68 mg/l in August 1999 and a maximum of 9.42 mg/l in January 2000 (Fig. 2). During the survey period, the highest transparency was observed in the summer 1999 (Fig. 2). In the summer of 2000, low values of transparency for the months of June and July were recorded, probably due to the presence of the floating mucilage in the Gulf of Trieste. The highest values were recorded in August. The lowest transparency values were established during the autumnal-winter period with an absolute minimum (2 m) at the end of September 1999. This is probably related to the contribution of the sediments from the Isonzo and Timavo rivers flowing into the Gulf.

Mean salinity values were the lowest (35.15 PSU) in July 2000 and the highest (38.02 PSU) in February 2000 (Fig. 3). These values reflect the characteristics of the Gulf of Trieste, in which the freshwater inflows are quite remarkable. In substance the salinity of the Gulf of Trieste is pretty low and the haline stratification rather anomalous (Specchi & Famiani, 1976; Mosetti, 1988; Stravisi, 1988; Vinzi & Bussani, 2000).

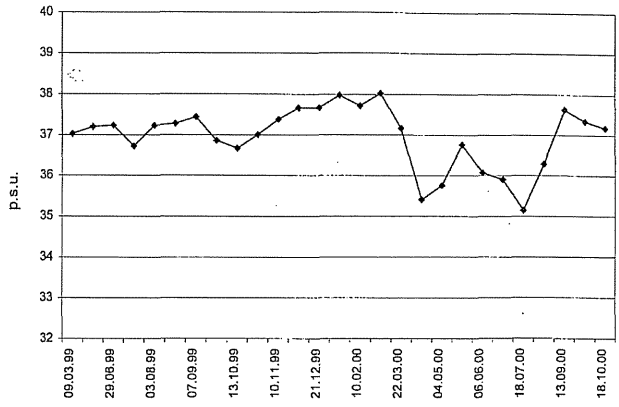

Fig. 3: Average salinity (PSU) along the water column during the studied period.
Sl. 3: Povprečna slanost (PSU) morske vode v vodnem stolpcu v vzorčevalnem obdobju.

Ichthyoplanktonic and mesozooplanktonic survey

According to Specchi & Furlan (1974), *Sardina pilchardus* (Walb.) eggs and larvae were more abundant during spring and autumn, while *Engraulis encrasicolus* (L.) eggs and larvae were more abundant at the end of spring and in summer. During the summer, ichthyoplankton community of the artificial reef constituted of other groups, mainly sparids, serranids and blennies, and in the winter of pleuronectiformes (Tabs. 1 and 2).

The different mesozooplanktonic taxa, which are presented in figure 4, were collected in 4 categories: copepods, cladocerans, eggs and larvae (larval stages of holoplanktonic and meroplanktonic organism, such as molluscs, annelids, echinoderms and teleosts) and others (ctenophores, chaetognaths and urochords). The mesozooplanktonic community constituted principally of copepods during the spring and from the end of the autumn to the end of the winter. During the summer, although copepods were abundant, cladocerans were found in greater numbers due to the presence of *Penilia avirostris*.

Fishing catch data

Fishes, cephalopods and crustaceans caught at the artificial reef (Tab. 3) showed the presence of 25 species (21 fishes, 3 cephalopods and 1 crustacean), while at the control site 19 species were caught (16 fishes, 2 cephalopods and 1 crustacean) (Tab. 4). In total, 31 species were sampled. The distribution of the species and the corresponding number of individuals in the various seasons indicated a greater number of individuals caught in the summer at both sites and a lesser number in the winter (Fig. 5). The highest number of individuals at the artificial reef was caught in July, and at the control site in August.

Tab.1: Abundance of teleost eggs (ind/m^3) sampled at the artificial reef during 1999-2000.
Tab. 1: Število jajc morskih kostnic (ind/m^3) na območju umetnega podvodnega grebena v obdobju 1999-2000.

Legend/Legenda:

S.p.: Sardina pilchardus ***(Walb.)***
S.s.: Sprattus sprattus ***(L.)***
E.e.: Engraulis encrasicolus ***(L.)***
A.l.: Arnoglossus laterna **(Walb.)**
A.t.: Arnoglossus thori ***Kyle***
B.p.: Bothus podas ***(Del.)***
P.m.: Psetta maxima ***(L.)***
S.r.: Scophthalmus rhombus ***(L.)***
P.f.i.: Platichthys flesus italicus ***(L.)***
S.l.: Solea lutea ***(Risso)***
S.i.: Solea impar ***Benn.***
S.v.: Solea vulgaris ***Quens.***
D.a.: Diplodus annularis ***(L.)***
D.v.: Diplodus vulgaris ***(Geoffr.)***
O.m.: Oblada melanura ***(L.)***
C.r.: Ctenolabrus rupestris ***(L.)***
C.f.: *Callionymus festivus* **Pallas**
C.b.: Callionymus belenus ***Les.***
S.sc.: Serranus scriba ***(L.)***
T.t.: Trachurus trachurus ***(L.)***
T.m: Trachurus mediterraneus ***(Stdr.)***
L.s.: Liza saliens ***(Risso)***
M.b.: Mullus barbatus ***L.***
G.m.: Gaidropsarus mediterraneus ***(L.)***
M.m.: Merlangus merlangus ***Geoffr.***

	S.p.	*S.s.*	*E.e.*	*A.l.*	*A.t.*	*B.p.*	*P.m.*	*S.r.*	*P.f.i.*	*S.l.*	*S.i.*	*S.v.*	*D.a.*	*D.v.*	*O.m.*	*C.r.*	*C.f.*	*C.b.*	*G.m.*	*M.m.*	*S.sc.*	*T.t.*	*T.m.*	*L.s.*	*M.b.*
09.03.99									0,41																
23.03.99	0.44								0.15																
07.04.99	0.25								0.37									0.50							0.12
26.04.99	39.90		0.48	0.60			0.12			1.20					0.12	1.44	0.60	3.13							
10.05.99	2.39			0.13												0.13	0.27	0.13							
25.05.99	6.41		0.43														0.21				1.28				
15.06.99			0.66	4.91						2.79						0.53									
29.06.99			0.12	9.80						1.49							0.25							0.50	0.25
15.07.99			2.21		3.73					2.80												11.19		3.73	
03.08.99			0.80			11.86											0.16								
24.08.99																									
07.09.99	0.21				2.11											0.11									
22.09.99	8.32			0.54		1.30											0.11			0.22			0.22		
13.10.99	63.96			0.12																					
28.10.99	17.52			2.10																					
10.11.99	81.09			0.55			0.18																		
25.11.99	0.20																								
21.12.99		1.30							0.19			0.09													
13.01.00		3.41																							
10.02.00		0.64		0.05					0.27			0.21													
24.02.00		0.04		0.04			0.15					0.04													
22.03.00	1.14	0.19		0.19						0.10															
10.04.00	15.92			0.57						1.63	0.24					0.08		2.94							
04.05.00	2.31		1.08	0.12						0.38			0.04					2.92							
24.05.00	6.13		0.19	2.13						0.25			1.31				0.13								
06.06.00			0.54	1.69						0.20			4.81												
27.06.00			0.67	3.67													0.13								
18.07.00				10.14																		2.98			
02.08.00			0.04	2.49												0.08						1.10		0.20	0.24
13.09.00																									
27.09.00	16.95		0.03	3.80												0.10			1.42						
18.10.00	65.74																								

Tab. 2: Abundance of teleost larvae (ind/m^3) sampled at the artificial reef during 1999-2000.
Tab. 2: Število ličink morskih kostnic (ind/m^3) na območju umetnega podvodnega grebena v obdobju 1999-2000.

Legend/Legenda:

S.p.: Sardina pilchardus ***(Walb.)***
E.e.: Engraulis encrasicolus ***(L.)***
A.l.: Arnoglossus laterna ***(Walb.)***
P.f.i.: Platichthys flesus italicus ***(L.)***
D.a.: Diplodus annualris ***(L.)***
L.t.: Lithognathus mormyrus ***(L.)***
C.: Crenilabrus sp. ***(Cuv.)***
C.f.: Callionymus festivus ***Pallas***
G.: Gobius spp. ***L.***
G.m.: Gaidropsarus mediterraneus ***(L.)***
M.m.: Merlangus merlangus ***Geoffr.***
S.sc.: Serranus scriba ***(L.)***
D.l.: Dicentrarchus labrax ***(L.)***
B.p.: Blennius pavo ***Risso***
C.n.: Corvina nigra ***Cuv.***
T.d.: Trachinus draco ***L.***
S.a.: Syngnathus abaster ***Risso***

	S.p.	*E.e.*	*A.l.*	*P.f.i.*	*D.a.*	*L.m.*	*C.*	*C.f.*	*G.*	*G.m.*	*M.m.*	*S.sc.*	*D.l.*	*B.p.*	*C.n.*	*T.d.*	*S.a.*
09.03.99			0.27														
23.03.99	0.44															0.15	
07.04.99		0.12															
26.04.99		0.12															
10.05.99		0.27															
25.05.99																	
15.06.99		0.13			0.53			0.13									
29.06.99		0.25			0.62	0.12											
15.07.99		4.08			1.28			0.12			0.12	0.23					0.12
03.08.99		1.28															
24.08.99																	
07.09.99	1.16																
22.09.99	4.65							0.11									
13.10.99	0.16																
28.10.99	3.33																
10.11.99																	
25.11.99	0.20																
21.12.99														0.09			
13.01.00	0.97		0.11												0.05		
10.02.00			0.11	0.05						0.05							
24.02.00	0.11			0.40						0.04			0.07				
22.03.00				0.10							0.10						
10.04.00																	
04.05.00		0.38												0.04			
24.05.00		0.88						0.44	0.19					0.13			
06.06.00								0.07	0.07								
27.06.00																	
18.07.00		4.47						0.37	1.49					0.09			
02.08.00		0.78	0.04				0.04	0.12	0.08								
13.09.00																	
27.09.00	0.51																
18.10.00	0.87																

Tab. 3: Artificial reef catch data composition.
Tab. 3: Ulov rib, rakov in mehkužcev na območju umetnega podvodnega grebena.

NAME	DEC'99	JAN'00	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL	% of ind.
Dicentrarchus labrax	5											2	7	4.6%
Engraulis encrasicolus								2					2	1.3%
Gobius sp.		1											1	0.7%
Hippocampus hippocampus			1										1	0.7%
Labrus merula							1						1	0.7%
Loligo vulgaris												1	1	0.7%
Merlangus merlangus	1											15	16	10.6%
Mullus surmuletus											1		1	0.7%
Mustelus vulgaris												1	1	0.7%
Octopus vulgaris	3												3	2.0%
Pagellus erythrinus								4		2			6	4.0%
Pagrus pagrus												1	1	0.7%
Platichthys f. italicus		3	1										4	2.6%
Raja stellata												2	2	1.3%
Sardina pilchardus	2									1	3	6	12	7.9%
Scorpaena porcus											2		2	1.3%
Sepia officinalis				1	3	1		9				2	16	10.6%
Serranellus hepatus										1			1	0.7%
Solea hispida								2					2	1.3%
Solea vulgaris						1							1	0.7%
Sparus aurata			1										1	0.7%
Squilla mantis	9					8	4	9	18		4	10	62	41.1%
Trachurus trachurus		1	1										2	1.3%
Trisopterus m. capelanus		4											4	2.6%
Umbrina cirrosa	1												1	0.7%
No. of individuals	21	9	4	1	3	10	5	26	18	4	10	40	151	100.0%
No. of species	6	4	4	1	1	3	2	5	1	3	4	9	25	
% of ind.	13.9%	6.0%	2.6%	0.7%	2.0%	6.6%	3.3%	17.2%	11.9%	2.6%	6.6%	26.5%	100.0%	
Biomass (kg)	4.999	1.22	0.59	0.17	0.56	0.79	0.46	2.586	0.874	0.13	0.65	6.196	19.221	

Tab. 4: Control site catch data composition.
Tab. 4: Ulov rib, rakov in mehkužcev na referenčni postaji.

NAME	DEC'99	JAN'00	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL	% of ind.
Alosa fallax					4								4	1.1%
Engraulis encrasicolus							1	1	44	1	2	2	51	14.4%
Merlangus merlangus	6										1	18	25	7.0%
Mustelus vulgaris							3	2	9	4	17		35	9.9%
Ozaena moschata										1			1	0.3%
Pagellus erythrinus									1	2			3	0.8%
Platichthys f. italicus	11	3											14	3.9%
Raja clavata					2								2	0.6%
Raja stellata							1				2	1	4	1.1%
Sardina pilchardus	9				1			3				3	16	4.5%
Scomber scomber											1		1	0.3%
Sepia officinalis				1	2	4		9		6		1	23	6.5%
Solea vulgaris	1				1								2	0.6%
Sparus aurata							1						1	0.3%
Squilla mantis	7				15	22	9	27		7	27	53	167	47.0%
Trachurus trachurus			1										1	0.3%
Trigla hirundo											2	1	3	0.8%
Trisopterus m. capelanus									1				1	0.3%
Trygon pastinaca										1			1	0.3%
No. of individuals	34	3	1	1	25	26	15	42	55	22	52	79	355	100%
No. of species	5	1	1	1	6	2	5	5	4	7	7	7	19	
% of ind.	9.6%	0.8%	0.3%	0.3%	7.0%	7.3%	4.2%	11.8%	15.5%	6.2%	14.6%	22.3%	100%	
Biomass (kg)	2.38	0.17	0.18	0.14	3.14	1.83	1.33	3.75	5.04	5.2	15.12	6.12	44.38	

Figure 6 shows the yields with 100 m long nets both at the artificial reef and at the control site. The yield at the artificial reef varied between 2.38 kg in November 2000 to 0.05 kg in September 2000. The average data for the 11 months samplings gave a mean fishing yield of 0.61 kg for the 100 m long net. Higher values were recorded at the control site, the mean value reaching 1.41 kg, with a maximum of 5.81 kg in October and a minimum of 0.05 kg in March. According to the Shannon-Weaver index (Tab. 5), the lowest diversity values (H' = O) were recorded in the reef area during the months of March, April and August. The same situation (H' = O) occurred at the control site in the months of January, February and March. The highest diversity value in the reef area was recorded in November 2000 (H'=1.72), whereas at the control site it was registered in September 2000 (H'=1.67).

As a whole, the total diversity highlights a slightly higher value in the reef area (H'=0.90) compared to the control site against (H'=0.81), although these differences are not statistically significant as resulted from the ANOVA analysis (P>0.05).

DISCUSSION

The main chemical-physical parameters recorded at the S. Croce sandbank from March 1999 to October 2000 reflect typical situation in the Gulf of Trieste, in accordance with the data collected by Specchi & Famiani (1976), Mosetti (1988), Aleffi *et al.* (1992). In the period from December 1999 to the end of March 2000, a high value of oxygen content was observed (in compliance with the falling temperatures) as well as a rather increased salinity, which is typical of the winter months in the Gulf of Trieste. The high transparency of the water column during the winter months is due to the small contribution of sediment from the rivers Isonzo and Timavo (with the smallest capacities in this particular period) and to the reduced presence of plankton in the colder months.

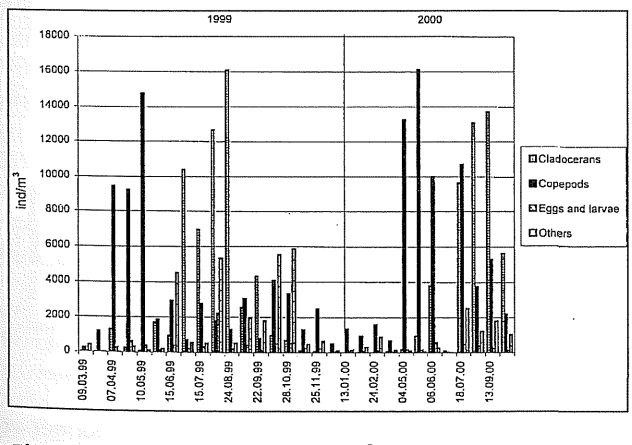

Fig. 4: Mesozooplankton (ind/m³) sampled at the artificial reef during 1999-2000.
Sl. 4: Gostota mezozooplanktona (ind/m³) na območju umetnega podvodnega grebena v obdobju 1999-2000.

The structure of the mesozooplanktonic community confirms the description presented by several authors (Specchi *et al.*, 1979; Fonda Umani *et al.*, 1983-84) both from qualitative and quantitative points of view.

Sampled ichthyoplanktonic fraction constituted of eggs belonging to 24 species, mainly represented by the eggs of two pelagic species, *Sardina pilchardus* and *Engraulis encrasicolus,* which are, however of less interest as far as colonizing of the artificial reef is concerned. Eggs belonging to *Diplodus annularis, D. vulgaris, Oblada melanura, Ctenolabrus rupestris, Serranus scriba, Blennius pavo* are more important for the potential colonization of the site. The same can be said of the larval stages. The study of the ichthyoplankton can give a useful indication on the efficiency of the reef area as a "nursery" site. It is important to notice the abundant presence of larval stages of natural rock reef species such as *Diplodus annularis, Serranus* scriba *etc.* that are going to colonize the artificial reef site giving rise to a new fish community.

According to the fishing catch data, more species were sampled at the artificial reef than at the control site. At both stations, the most abundant species was *Squilla mantis.* At the reef, an exclusive presence of some economically important species was noted, such as *Scorpaena porcus, Dicentrarchus labrax* and *Umbrina cirrosa.* The above data is confirmed by the Shannon-Weaver index that evidences a greater overall value for the artificial reef site (H'=0.90) in comparison with the control site (H'=0.81). In this respect, the results obtained during these first study stages seem to be encouraging, bearing in mind that the pyramidal structures was submerged in 1999.

The fished biomass is in compliance with the expectations of a maximum in the summer and a minimum in the winter. In fact it is known that the nearshore fish communities of the northern Adriatic are characterized by seasonal variations, as most of the fish species move offshore to deep waters in the winter months to avoid the low coastal water temperatures. The amount of fished biomass with 100 m long trammel net was clearly smaller at the artificial reef than that obtained at the control site. These data are in contrast to those obtained by several authors (Bohnsack & Sutherland, 1985; Arculeo *et al.*, 1990; Fabi & Fiorentini, 1994) who reported higher catch rates at the artificial reef than at the control site. The reason for small catch rates at the artificial reef could be, in the present study, the short time passed from the reef deployment and the lack of the visual census data. Different authors (Harmelin-Vivien & Francour, 1992; Relini *et al.*, 1995; Francour, 1999) reported that trammel net fishing and visual census present the same fish community differently. The trammel

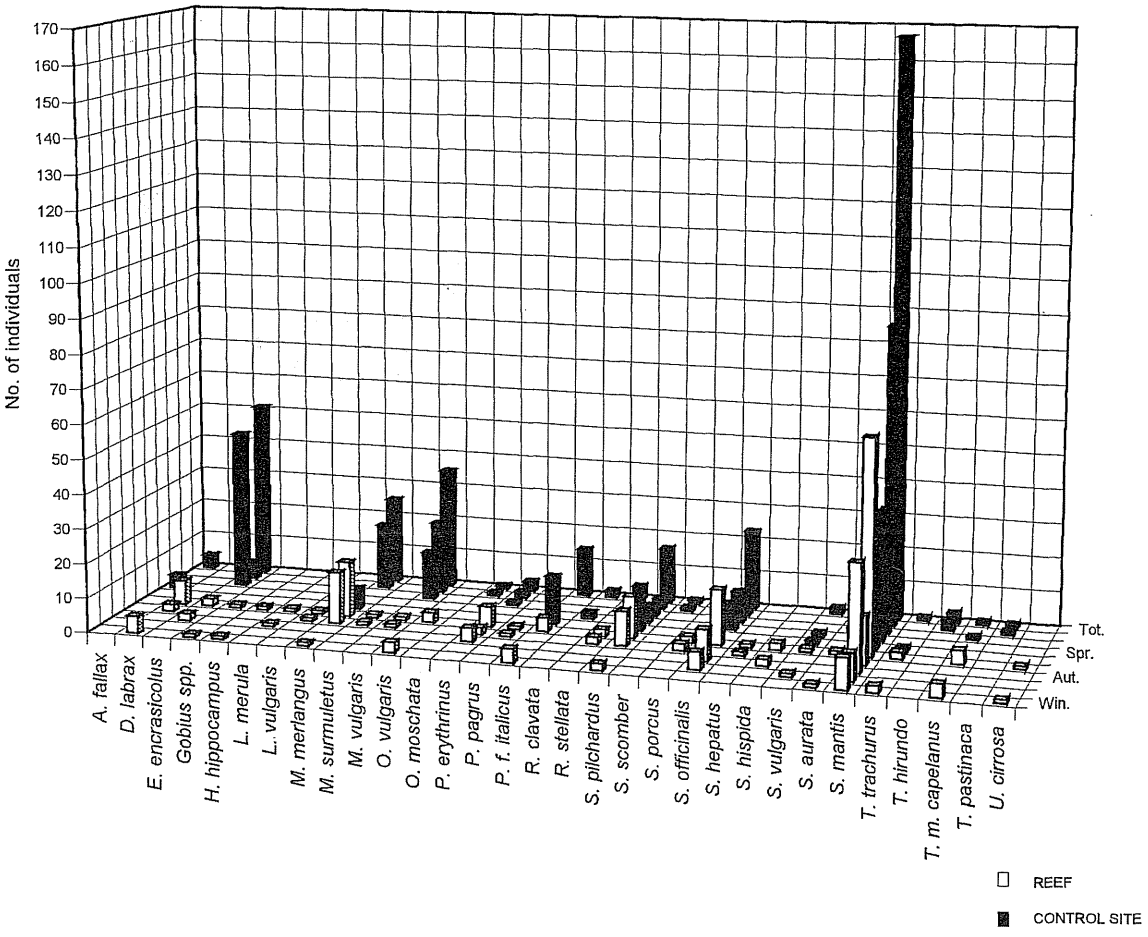

Fig. 5: Seasonal composition of fishing catch data at the artificial reef and at the control site.
Sl. 5: Podatki o sezonski strukturi ulova rib, rakov in mehkužcev na območju umetnega podvodnega grebena in na referenčni postaji.

Tab. 5: Shannon-Weaver index of diversity at the artificial reef and at the control site
Tab. 5: Shannon-Weaverjev diverzitetni indeks na območju umetnega podvodnega grebena in na referenčni postaji.

MONTH	CONTROL SITE	REEF
DEC'99	1.30	1.59
JAN'00	0.00	1.21
FEB'00	0.00	1.39
MAR'00	0.00	0.00
APR'00	1.26	0.00
MAY'00	0.43	0.64
JUN'00	1.17	0.50
JUL'00	1.04	1.42
AUG'00	0.62	0.00
SEP'00	1.67	1.04
OCT'00	1.23	1.28
NOV'00	0.99	1.72
MEAN	0.81	0.90

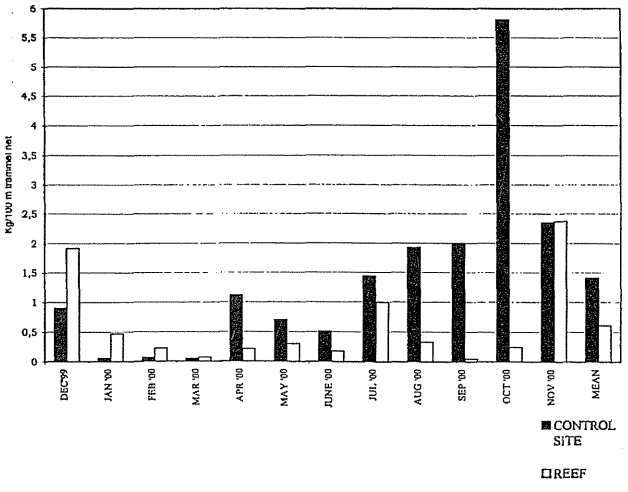

Fig. 6: Monthly fishing yield by 100 m trammel net at the artificial reef and at the control site.
Sl. 6: Mesečni ribolovni izkoristek po vleku s 100 m povlečno mrežo na območju umetnega podvodnega grebena in na referenčni postaji.

net fishing collects more species of the sandy-muddy habitat, while visual census better estimates fast swimming species and some cryptic fish species, such as *Conger conger* or *Scorpaena scrofa*.

In conclusion, bearing in mind that the artificial reef structures were installed in April 1999, the results seem to be encouraging. An increase in biodiversity was indeed noted in the reef area which, together with a reasonably expected increase in biomass, may in time bring positive consequences in the entire ecosystem of the Gulf of Trieste.

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PRVE UGOTOVITVE, OPAŽENE OB UMETNEM PODVODNEM GREBENU NA PEŠČENI PLITVINI V BLIŽINI KRIŽA (TRST, ITALIJA)

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POVZETEK

Na lokaciji umetnega podvodnega grebena, potopljenega na peščeno plitvino v bližini Križa (45° 42' 02" N - 13° 37' 24" E), so avtorji pričujočega članka med marcem 1999 in oktobrom 2000 mesečno opravljali raziskave o kemijsko-fizikalnih parametrih vodnega stolpca, ihtioplanktonskih in mezozooplanktonskih skupnostih, ribjih skupnosti in strukturi populacij različnih vrst. Poleti so ribjo planktonsko skupnost sestavljale predvsem ličinke šparov, zobčastih ostrižev in babic, pozimi pa ličinke bokoplut. Mezozooplanktonsko skupnost so sestavljali v glavnem ceponožci, razen poleti, ko so prevladovale morske bolhe. Glede na podatke o ribjem ulovu je bilo več vrst vzorčenih na umetnem morskem grebenu kot na kontrolni lokaciji.

Ključne besede: umetni podvodni greben, Tržaški zaliv, kemijsko-fizikalni parametri, podatki o ujetem zooplanktonu

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MOLLUSCHI RINVENUTI NEL CORSO DI UNA CAMPAGNA SPERIMENTALE DI PESCA A STRASCICO IN ADRIATICO

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SINTESI

In questo lavoro viene presentata una lista di 74 specie di molluschi rinvenuti durante la Campagna MEDITS (giugno 1995 e 1996) sulla Pesca a Strascico nel Mare Adriatico. Per ogni specie è stata riportata la biocenosi preferenziale in modo da avere un'idea di quale possa essere l'habitat delle stazioni di raccolta. Successivamente sono stati confrontati i dati da noi ottenuti con quelli di pubblicazioni precedenti, inerenti il benthos e la geologia dell'area studiata, che hanno confermato le nostre ipotesi. Tutto ciò sottolinea una volta di più come anche i soli molluschi, ed in particolar modo i bivalvi, possano dare informazioni precise sulla sedimentologia di una determinata area.

Parole chiave: Adriatico, Mollusca, pesca a strascico, biocenosi

MOLLUSCS COLLECTED WITH TRAWL IN THE ADRIATIC SEA

ABSTRACT

In this work a list of 74 species of molluscs which have been found during Cruise MEDITS (June 1995 and 1996) connected with the Trawling in Adriatic Sea, is presented. For every species the preferential biocoenosis has been reported to have an idea about the habitat of the picking stations. Then our data have been compared with those of previous publications about benthos and geology of studied area, and they have confirmed our suppositions. All this underlines one more time as also the only molluscs, and particularly the bivalves, can give exact information about the sedimentology of a determined area.

Key words: Adriatic, molluscs, trawl, biocoenosis

INTRODUZIONE

In questo lavoro vengono presentati alcuni dati inerenti la malacofauna del Mare Adriatico raccolti nel mese di giugno degli anni 1995 e 1996, durante alcuni campionamenti sperimentali condotti nell'ambito della Campagna Internazionale sulla Pesca a Strascico in Mediterraneo (MEDITS, 1995). Tale campagna è stata realizzata con i finanziamenti della Commissione Europea (DG XIV), dell'IEO per la Spagna, dell'IFREMER e della Collettività territoriale della Corsica per la Francia, del Ministero per le Risorse Forestali, Agricole e Alimentari (D.G. pesca e acquicoltura) per l'Italia e del NCMR per la Grecia.

Le prime indagini, riguardanti i popolamenti bentonici dell'Adriatico Settentrionale e Centrale, risalgono al 1949, quando Vatova (1949) prese in esame l'endofauna e la biomassa di quest'area. Per quanto riguarda la pesca, i dati iniziali qualitativi e quantitativi sono stati riportati da Karlovac (1959), che analizzò i campioni raccolti durante la crociera con la nave "Hvar". A questi studi preliminari sul benthos dell'Adriatico, hanno fatto seguito diverse pubblicazioni, tra cui quelle di Gamulin-Brida (1962, 1969, 1974), Scaccini (1967), Zavodnik (1971), Alvisi *et al.*, (1978), Colantoni *et al.*, (1980), Orel *et al.* (1987) e Šimunović (1997).

In questa breve nota vengono elencati i molluschi rinvenuti tra il materiale raccolto con la rete a strascico trainata dal motopeschereccio "Elisa Guidotti", inoltre si correlano le specie determinate alle biocenosi bentoniche preferenziali, per avere ulteriori informazioni o conferme sui diversi tipi sedimentari ed habitat, dei fondi mobili dell'Adriatico.

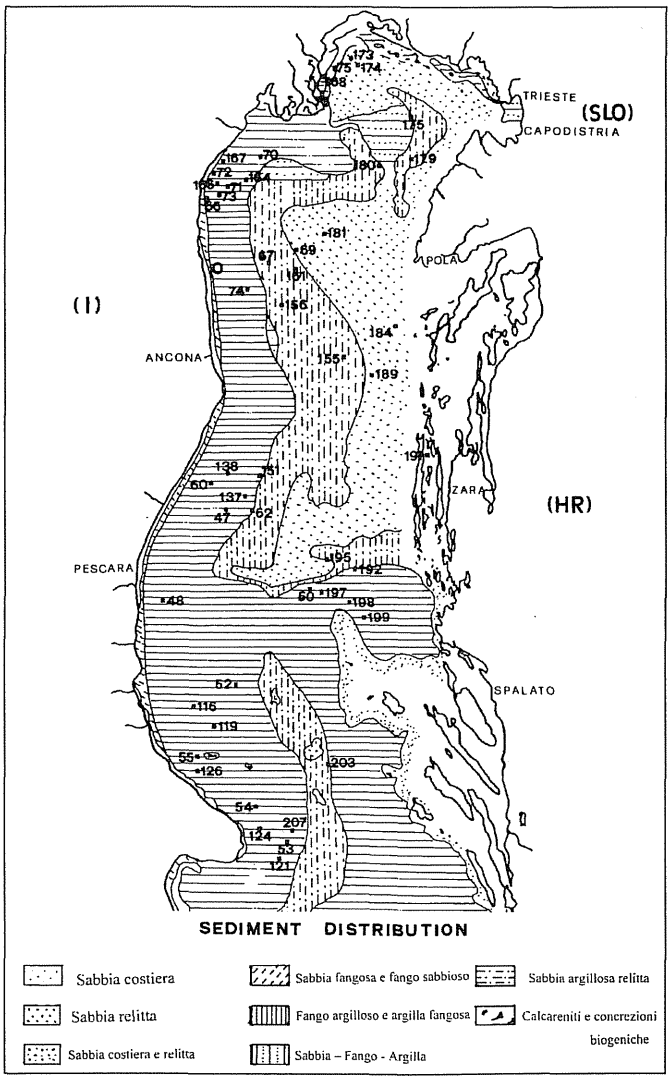

Fig. 1: La distribuzione dei sedimenti dell'Alto e Medio Adriatico.
Sl. 1: Razporeditev sedimentov v severnem in srednjem Jadranu.

MATERIALE E METODI

L'attrezzo da pesca utilizzato è una rete a strascico del modello IFREMER GOC 73, che è stata realizzata in modo tale da poter essere trainata da un motopeschereccio ("Elisa Guidotti") di 69 TSL e motore con potenza pari a 440 HP. Ulteriori particolari inerenti le caratteristiche della rete, quali: galleggianti, catene, corde, divergenti, diametro e lunghezza delle funi di traino, nonché dispositivi per il controllo della geometria e del posizionamento sul fondo della rete, sono riportate nel "Manuel des protocoles – Campagne internationale de chalutage démersal en Mèditerranée (MEDITS)".

Le pescate sperimentali sono state effettuate in ognuno dei due anni nelle medesime stazioni aventi diverse profondità, a livelli costantemente controllati dallo scandaglio ed il più possibile perpendicolari alla costa. E' bene sottolineare che sono stati esclusi dal campionamento i fondi occupati da fanerogame, sia per la difficoltà in cui incorrerebbe l'attrezzo da pesca ad operare correttamente, sia soprattutto per non arrecare danni all'ambiente.

La rete a strascico è stata trainata unicamente durante le ore diurne e precisamente da 30 minuti dopo il levar del sole a 30 minuti prima del tramonto.

La velocità di pesca del mezzo sul fondo è stata mantenuta a 3 nodi, poiché velocità inferiori o superiori avrebbero pregiudicato l'ottimale funzionamento della coccia o strascico da fondo.

Al di sopra dell'isobata dei 200 m, il tempo di tirata è stato 30 minuti, mentre per profondità maggiori è stato prolungato ad un'ora.

Tab. 1: Stazioni di pesca a strascico sperimentale.
Tab. 1: Postaje, na katerih so bila opravljena eksperimentalna vzorčenja s kočo.

Campione N°	Profondità (m)	Data
43	24	12/06/95
44		12/06/95
45		12/06/95
47	92	13/06/95
48	227	13/06/95
50	226	14/06/95
52	186	14/06/95
53	167	15/06/95
54	116	15/06/95
55	92	15/06/95
58	19	19/06/95
59	21	19/06/95
60	38	19/06/95
61	21	19/06/95
62	100	20/06/95
63	25	20/06/95
66	30	21/06/95
67	54	21/06/95
69	45	21/06/95
70	34	22/06/95
71	41	22/06/95
72	32	22/06/95
73	42	22/06/95
74	56	26/06/95
75	24	27/06/95
76	30	27/06/95
116	148	03/06/96
119	142	03/06/96
121	247	04/06/96
124	106	04/06/96
126	70	04/06/96
137	94	06/06/96

Campione N°	Profondità (m)	Data
138	67	06/06/96
142	19	07/06/96
143	21	07/06/96
144	89	07/06/96
148	21	10/06/96
149	68	10/06/96
151	82	11/06/96
155	66	11/06/96
156	65	11/06/96
158	16	12/06/96
161	46	12/06/96
164	38	12/06/96
166	35	13/06/96
167	12	13/06/96
168	26	13/06/96
169	23	13/06/96
173	24	15/06/96
174	22	15/06/96
175	21	15/06/96
179	27	16/06/96
180	38	17/06/96
181	38	17/06/96
184	49	17/06/96
189	55	18/06/96
191	52	18/06/96
192	88	19/06/96
195	115	19/06/96
197	208	19/06/96
198	183	20/06/96
199	136	20/06/96
203	123	20/06/96
207	163	21/06/96

Tab. 2: Molluschi (escluso i cefalopodi) campionati con la rete a strascico.
Tab. 2: Mehkužci (brez glavonožcev), ujeti s kočo.
Legenda: Biocenosi sensu Peres & Picard (1964).
Legenda: Biocenoze po Peres & Picard (1964).

AF ***Biocenosi delle Alghe Fotofile***
SFMC ***Biocenosi delle Sabbie Fangose di Moda Calma***
SFBC ***Biocenosi delle Sabbie Fini Ben Calibrate***
DC ***Biocenosi del Detritico Costiero***
DF ***Biocenosi del Detritico Fangoso***
FTC ***Biocenosi dei Fanghi Terrigeni Costieri***
SGCF ***Biocenosi delle Sabbie Grossolane con Correnti di Fondo***
MI ***Biocenosi dei Fondi Mobili Instabili***
DL ***Biocenosi del Detritico del Largo***

Specie	Preferenza biocenotica
Diodora graeca (Linné, 1758)	AF
Diodora italica (Defrance, 1820)	AF
Calliostoma zizyphinum (Linné, 1758)	DC
Calliostoma granulatum (Von Born, 1778)	fango
Gibbula magus (Linné, 1758)	DC
Turritella communis Risso, 1826	FTC
Aporrhais pespelecani (Linné, 1758)	MI
Calyptraea chinensis (Linné, 1758)	DC
Capulus ungaricus (Linné, 1758)	DC
Aperiovula adriatica (Sowerby G.B.I, 1828)	coralli bianchi
Trivia arctica (Pulteney, 1789)	roccia ?
Natica stercusmuscarum (Gmelin, 1791)	SFBC
Euspira fusca (Blainville, 1825)	fango
Euspira guillemini (Payraudeau, 1826)	MI
Galeodea echinophora (Linné, 1758)	DC
Epitonium commune (Lamarck, 1822)	SFMC
Melanella polita (Linné, 1758)	DC
Bolinus bradaris (Linné, 1758)	DF
Hadriania oretea (De Gregorio, 1885)	MI
Hexaplex trunculus (Linné, 1758)	SFMC
Coralliophila squamosa (Bivona, 1838)	epibionte
Fusinus rostratus (Olivi, 1792)	DC
Nassarius pygmaeus (Lamarck, 1822)	SFMC
Nassarius reticulatus (Linné, 1758)	SFMC
Nassarius mutabilis (Linné, 1758)	SFBC
Nassarius lima (Dillwin, 1817)	fango
Rapana venosa (Valenciennes, 1846)	DF
Conus mediterraneus Hwass in Bruguiere, 1792	AF
Haminoea navicula (Da Costa, 1778)	AF
Philine aperta (Linné, 1767)	SFBC
Scaphander lignarius (Linné, 1758)	DC
Nucula sulcata Bronn, 1831	DF
Scapharca inaequivalvis (Bruguiere, 1789)	SFBC
Mytilus galloprovincialis Lamarck, 1819	AF
Atrina pectinata (Linnè, 1767)	DF
Pteria hirundo (Linné, 1758)	roccia ?
Pecten jacobeus (Linné, 1758)	DC
Aequipecten opercularis (Linné, 1758)	DC

Specie	Preferenza biocenotica
Pseudamussium clavatum (Poli, 1795)	circalitorale ?
Chlamys varia (Linné, 1758)	AF
Chlamys glabra (Linné, 1758)	SFMC
Chlamys proteus (Dillwyn, 1817 ex Solander ms.)	SFMC
Anomia ephippium Linné, 1758	AF
Pododesmus squamula (Linné, 1758)	DC
Pododesmus patelliformis (Linné, 1761)	DC
Lima exilis Wood S.V., 1839	AF
Ostrea edulis Linné, 1758	AF
Glans aculeata (Poli, 1795)	DL
Acanthocardia aculeata (Linné, 1758)	DC
Acanthocardia deshayesii (Payraudeau, 1826)	DC
Acanthocardia mucronata (Poli, 1795)	DC
Acanthocardia paucicostata (Sowerby G.B.II, 1841)	FTC
Acanthocardia spinosa (Solander, 1786)	DC
Acanthocardia tuberculata (Linné, 1758)	SFBC
Plagiocardium papillosum (Poli, 1795)	DC
Laevicardium oblongum (Gmelin, 1791)	DC
Mactra stultorum (Linné, 1758)	SFBC
Ensis ensis (Linné, 1758)	DC
Tellina serrata Brocchi, 1814	DF
Tellina distorta Poli, 1791	MI
Psammobia fervensis (Gmelin, 1791)	DC
Solecurtus scopula (Turton, 1822)	FTC
Azorinus chamasolen (Da Costa, 1778)	SFMC
Glossus humanus (Linné, 1758)	DF
Clausinella brongniartii (Payraudeau, 1826)	SGCF
Timoclea ovata (Pennant, 1777)	DC
Pitar rudis (Poli, 1795)	DC
Paphia aurea (Gmelin, 1791)	SFMC
Paphia rhomboides (Pennant, 1777)	SGCF
Mysia undata (Pennant, 1777)	SFMC
Corbula gibba (Olivi, 1792)	MI
Hiatella arctica (Linné, 1767)	AF
Bankia minima (Blainville, 1828)	substrato ligneo
Thracia pubescens (Pulteney, 1799)	DC

Tutte le singole manovre inerenti la pesca sono riportate consultabili nel Manuale del Protocollo sopra citato.

Il pescato è stato suddiviso in cinque categorie: pesci, crostacei: decapodi e stomatopodi, cefalopodi, altre specie commerciali e "sporco" (gli organismi non commerciabili); per ognuna di queste, inoltre, si è rilevato il peso.

I dati sulla distribuzione della tessitura dei sedimenti sono stati desunti: da Brambati *et al.* (1983) e dalle relative Carte Sedimentologiche del C.N.R. (1988), per quanto concerne la parte italiana dell'Adriatico Settentrionale e Centrale, e dalle figure riportate nella pubblicazione di Šimunović (1997) riguardo la piattaforma continentale sloveno-croata.

I molluschi determinati sono stati riportati in base alla classificazione proposta dal Catalogo Annotato dei Molluschi Marini del Mediterraneo (Sabelli *et al.*, 1990); mentre la preferenza biocenotica è stata desunta dalle pubblicazioni di Peres & Picard (1964) e Vio & De Min (1996).

RISULTATI

La tabella 1 riporta le stazioni in cui sono state effettuate le pescate sperimentali e le coordinate (latitudine e longitudine) di inizio cala con la relativa profondità di campionamento; come si può osservare, per le stazioni 44 e 45 non sono disponibili tali dati.

Le stazioni sono situate nell'area M5 (Adriatico Settentrionale e Centrale) (Fig. 1), la quale è compresa in un insieme di settori che coprono l'intero bacino del Mediterraneo.

DISCUSSIONE E CONCLUSIONI

Sono state identificate 74 specie di molluschi, tra organismi commerciabili e non, e la maggior parte di queste è stata rinvenuta vivente. Le condizioni di lavoro (scarsità di tempo tra una cala e la successiva, materiale immerso nel fango salpato con la rete, situazioni meteomarine avverse) non hanno reso possibile una più accurata analisi dei campioni, che avrebbe permesso di analizzare i micromolluschi sicuramente presenti. Per tali motivi, sono stati determinati solamente 74 taxa appartenenti alle specie di dimensioni maggiori e come si può desumere dalla Tab. 2, si tratta di 31 gasteropodi (corrispondenti al 41,9% delle specie totali) e di 43 bivalvi (pari al 58,1%).

La predominanza di specie appartenenti alla classe Bivalvia, è dovuta al fatto che questo gruppo è costituito in gran parte da organismi fossori e quindi caratteristici di fondi mobili su cui opera la rete a strascico. Per quel che concerne i Gastropoda è bene rilevare che sono presenti soprattutto specie di epifauna quali i predatori *Bolinus brandaris, Hexaplex trunculus, Rapana venosa* (Fig. 2) e *Galeodea echinophora*; alcune erbivore quali *Diodora graeca, Diodora italica*, viventi su substrati solidi (in questo caso probabilmente trattasi di vecchie mattes di *Posidonia oceanica* strappate dal fondo nelle Staz. 174 e Staz. 175, situate nell'Alto Adriatico), ed altre specie epibionti come *Aperiovula adriatica* (Staz. 151) e *Coralliophila squamosa* (nella Staz. 119, caratterizzata da fanghi argillosi a circa 140 m di profondità).

Dal punto di vista trofico è opportuno ricordare che i bivalvi sono prevalentemente *"suspension feeders"* e *"detritus feeders"*; a quest'ultima categoria appartengono anche alcuni gasteropodi quali *Turritella communis* ed *Aporrhais pespelecani*, i quali presentano una particolare modalità nell'assumere le sostanze organiche del sedimento, inglobandole in filamenti di muco che successivamente vengono aspirate con i sifoni (Yonge, 1946).

Durante le pescate, soprattutto sui fondi mobili, è stata raccolta una notevole quantità di specie di *Atrina pectinata* prive di mollusco (Staz. 74 e Staz. 76). Il motivo è quasi sicuramente riconducibile, almeno per quanto riguarda l'Alto Adriatico, ai fenomeni anossici che hanno colpito i fondali nei mesi estivi degli ultimi anni, causando vaste morie tra gli organismi bentonici privi si motilità.

Molte sonol le stazioni nelle quali sono state campionate specie incrostanti i substrati duri come: *Ostrea edulis* (Staz. 60), *Anomia ephippium* (Staz. 61), *Pododesmus spp.* (Staz. 62 e Staz. 69) e *Pteria hirundo* (Staz. 69) caratteristica di substrati solidi situati ad una certa profondità.

Nella Staz. 181, situata al largo della Sacca di Goro, su di un fondale caratterizzato da sabbie pelitiche a profondità di 38 m, è stato pescato un pezzo di legno colonizzato da diversi esemplari di *Bankia minima*: tale specie è frequente nei relitti lignei spesso pescati dai motopescherecci che operano con le reti a strascico o con i rapidi.

Si ritiene importante sottolineare che a Nord e lungo le coste occidentali dell'Adriatico (come nelle Staz. 66 e Staz. 69 poste rispettivamente sulle congiungenti Cervia-Pola e Ravenna-Pola), i molluschi raccolti con la rete a strascico sono più frequenti, sia per numero di specie, sia per quantità, rispetto a quelli che vengono pescati lungo le coste orientali, dove i fondali sono relativamente più alti. Questo fatto è stato messo in evidenza anche da Šimunović (1997), il quale segnala valori di abbondanza più elevati nelle stazioni dell'Alto Adriatico rispetto a quelle dell'Adriatico Centrale e Meridionale. Lo stesso Autore osserva, inoltre l'importanza della profondità sulla distribuzione degli organismi bentonici, rilevando come ad una profondità maggiore corrisponda una biomassa minore, fatta eccezione per due stazioni poste rispettivamente al largo di Zara e davanti al Gargano. Anche dalle pescate a strascico sperimentali da noi riportate, si confermano

tali osservazioni ed infatti, nelle stazioni in cui sono state registrate profondità superiori ai 140 m (Staz. 50, Staz. 52, Staz. 54, Staz. 116, Staz. 119, Staz. 124, Staz. 197, Staz. 198 e Staz. 267), situate nella parte centro-orientale dell'Adriatico, la malacofauna è risultata scarsa e limitata a specie caratteristiche della biocenosi dei *Fanghi Terrigeni Costieri (FTC)* prevalentemente argillosi, o della biocenosi del *Detritico Fangoso (DF)* insediata al limite della piattaforma continentale, quali *Euspira fusca, Nassarius lima, Glossus humanus* e *Pseudamussium clavatum*. Bisogna considerare però il fatto che la biocenosi del *DF* caratterizzata dalla sovrapposizione di elementi appartenenti ai *FTC* ed al *DC* (Vio *et al.*, 1981).

Le biocenosi costiere e quelle situate nella parte centrale dell'Adriatico Centro-Settentrionale, lungo le coste italiane, sono invece caratterizzate da una fauna più ricca, dovuta probabilmente sia ad un maggior apporto di nutrienti provenienti dai numerosi fiumi che sfociano in mare, sia da profondità.

Analizzando le carte sedimentologiche del C.N.R. si osserva che procedendo dalla costa verso il largo del Mare Adriatico, si passa da fondi caratterizzati da sabbie costiere litorali, che costituiscono in alcune aree una fascia molto ristretta, a sabbie pelitiche, a peliti molto sabbiose, ai fanghi terrigeni grigio scuri e neri (ricchi cioè di un'abbondante componente argillosa) ed a sabbie di piattaforma, più grossolane di quelle di origine fluviale; fra queste ed i fanghi terrigeni si inseriscono sedimenti più o meno ricchi di elementi fangosi e detrito organico. Per tali motivi, effettuando le pescate a strascico e procedendo dalla costa italiana verso il largo, sono state raccolte dapprima specie caratteristiche delle *Sabbie Fini Ben Calibrate (SFBC)* come *Natica stercusmuscarum, Nassarius mutabilis, Philine aperta, Scapharca inaequivalvis Acanthocardia tuberculata* (soprattutto nelle Staz. 60, Staz. 62, Staz. 63, Staz. 75 e Staz. 76); successivamente specie tipiche delle *Sabbie Fangose di Moda Calma (SFMC)* quali *Epitonium comune, Chlamys glabra, C. proteus, Paphia aurea* e *Mysia undata*, pescate principalmente nelle Staz. 124, Staz. 142, Staz. 148 e Staz. 158. Man mano che si procede verso il largo ed il fondale presenta una granulometria più fine e ricca di detrito organico, diventano prevalenti le specie dei *Fanghi Terrigeni Costieri (FTC)* quali *Turritella communis, Solecurtus scopula* e quelle del *Detritico Costiero (DC) Calliostoma zizyphinum* (numeroso nella Staz. 73), *Melanella polita* (Staz. 74), *Scaphander lignarius* (in gran quantità nella Staz. 69), *Thracia pubescens* (Staz. 156 e Staz. 166), *Aequipecten opercularis* e varie specie di *Acanthocardia*, fatta eccezione per *A. paucicostata*, tipica dei fanghi.

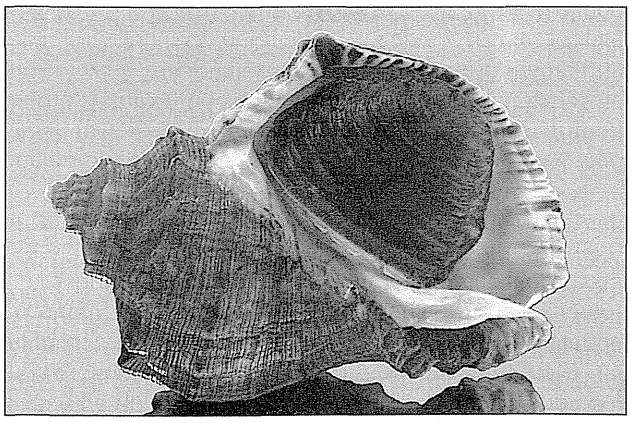

Fig. 2 / Sl. 2: *Rapana venosa* ***(Foto: R. De Min)***

A queste specie di Mollusca si aggiungono, laddove il ritmo sedimentario diviene instabile, alcune specie caratteristiche dei *Fondi Mobili Instabili (MI)* quali *Aporrhais pespelecani*, comunissimo lungo le coste italiane dell'Alto Adriatico ed il piccolo nassaride *Euspira guillemini*.

L'abbondanza sui fondi mobili di *Nucula sulcata* (Staz. 74 e Staz. 142) e di *Tellina serrata* (Staz. 69) indica la presenza di un *Detritico Fangoso (DF)* in prossimità del litorale italiano e rispettivamente al largo di Rimini e di Pescara.

La zona occupata dalle Sabbie di Piattaforma con sedimenti costituiti da sabbie a granulometria media è caratterizzata da alcune aree su cui agiscono correnti di fondo: in queste zone si instaura la biocenosi delle *Sabbie Grossolane* sottoposte a *Correnti di Fondo (SGCF)* (conosciute anche come "sabbie ad Anfiosso"), in cui vive soprattutto il bivalve *Paphia rhomboides*.

Per concludere si può affermare che, benchè i dati si riferiscano alla sola malacofauna, escluse le specie di piccole dimensioni di cui non si è potuto tener conto, le correlazioni tra le biocenosi e le specie caratteristiche da noi riportate, sono confermate e convalidate anche dalle osservazioni sul resto della macrofauna (soprattutto Arthropoda ed Echinodermata) raccolta con la rete a strascico sia durante la medesima campagna sperimentale, sia nell'ambito di altre ricerche.

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Si ringrazia l'equipaggio del M/P "Elisa Guidotti" per la sua fattiva collaborazione.

FAVNA MEHKUŽCEV, ULOVLJENA MED EKSPERIMENTALNIM VZORČENJEM S KOČO V JADRANSKEM MORJU

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POVZETEK

Avtorji predstavljajo podatke o malakofavni Jadranskega morja, zbrane junija 1995 in 1996 med eksperimentalnim vzorčenjem v okviru Mednarodne akcije o ribolovu s kočo v Jadranskem morju (MEDITS, 1995). Vzorčenje je bilo opravljeno s kočo modela IFREMER GOC 73, primerno za vleko z motorno ribiško ladjo "Elisa Guidotti" (69 TSL, 440 HP).

Med nabranimi tržnimi in netržnimi organizmi so avtorji identificirali 74 vrst mehkužcev, med katerimi je bila večina živih. Delovne razmere (pomanjkanje časa med dvema vlekama, v blatu pogreznjen material, slabo vreme) niso omogočili podrobnejše analize vzorcev, ki bi ovrednotila tudi nabrane mikromehkužce. Zaradi teh razlogov je bilo določenih le 74 mehkužcev, med katerimi je bilo 31 polžev (ali 41,9% vseh najdenih vrst) in 43 školjk (ali 58,1% vseh najdenih vrst). Med vlekami je bilo predvsem na mehkem dnu najdeno veliko število lupin vrste Atrina pectinata *(postaji 74 in 76). Njihova smrtnost je vsaj za dno v severnem Jadranu verjetno povezana z anoksičnimi stanji v zadnjih poletjih, ki so pripeljala do množičnih poginov sesilnih bentoških organizmov. Čeprav se podatki nanašajo le na malakofavno, avtorji vnovič potrjujejo (z izjemo le nekaterih vrst) korelacije med biocenozami in najdenimi značilnimi vrstami.*

Ključne besede: Jadransko morje, mehkužci, koča, biocenoza

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ON THE CAPTURE OF A YOUNG PORBEAGLE, *LAMNA NASUS* (BONNATERRE, 1788), IN THE WESTERN ADRIATIC SEA

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ABSTRACT

The authors report the capture of a young porbeagle Lamna nasus *(Bonnaterre, 1788), on July 15th, 2001 in the central Adriatic Sea, off S. Benedetto del Tronto (Italy). Morphometric measurements and macrophotographs of the teeth are reported. The specimen was a female weighing 6.5 kg and measuring 91 cm in total length. Its stomach contained sardines,* Sardina pilchardus. *We estimated its age at 1 to 17 months. The specimen was included in the collections of the Museo Ittico Augusto Capriotti in San Benedetto del Tronto (cat. no. 1850).*

Key words: porbeagle, *Lamna nasus*, sharks, Adriatic Sea

INTORNO ALLA CATTURA DI UN GIOVANE SMERIGLIO, *LAMNA NASUS* (BONNATERRE, 1788), NEL MARE ADRIATICO OCCIDENTALE

SINTESI

Viene riportata la cattura di un giovane esemplare di smeriglio Lamna nasus *(Bonnaterre, 1788), avvenuta il 15 Luglio 2001 nel Medio Mare Adriatico, al largo di S. Benedetto del Tronto (Italia). Vengono presentati i dati morfometrici ed alcune macrofotografie della dentatura. L'esemplare era una femmina di 6.5 kg di peso e 91 cm di lunghezza totale. Il contenuto stomacale era costituito da sardine,* Sardina pilchardus. *L'età dell'individuo è stata stimata tra 1 e 17 mesi. L'esemplare è stato incluso nelle collezioni del Museo Ittico Augusto Capriotti di San Benedetto del Tronto (no. cat. 1850).*

Parole chiave: smeriglio, *Lamna nasus*, squali, Mar Adriatico

INTRODUCTION

The porbeagle *Lamna nasus* (Bonnaterre, 1788) is a member of the Lamnidae Müller & Henle, 1838 family. It is a large species that can reach at least 300 cm and possibly to 370 cm in total length and at least 230 kg in weight (Castro, 1983; Compagno, 1984). It can be easily identified by its spindle-shaped body, strongly conical snout, lunate caudal fin, strong primary caudal keels and small secondary keels, teeth moderately large and bladelike with a pair of lateral cusplets, large rounded dark eyes, dark blue-grey to blackish coloration on the dorsal surface and white on the ventral surface, a conspicuous white rear tip of first dorsal fin (Castro, 1983; Compagno, 1984) (Fig. 1). The porbeagle is fast swimming mackerel shark, its speed and power can be explained by a complex blood vessel heat-exchanging arrangement: in fact, we could consider this condition as warm-bloodedness or endothermy, well known also in other mackarel sharks (Carey *et al.*, 1985). It feeds mainly on small pelagic schooling bony fishes, selachians, squids (Compagno, 1984). Porbeagle may take 5 or more years to reach maturity: in Northern Hemisphere males mature at about 150-200 cm total length, while females at about 218-229 cm (Francis & Stevens, 2000). Its mode of reproduction is aplacental viviparity and embryos are nourished by oophagy. The gestation period is 8-9 months (Francis & Stevens, 2000), and in the North Atlantic birth occurs in spring and summer (Castro, 1983; Francis & Stevens, 2000); litter size is 2-5 (usually 4), and size at birth is 68-89 cm total length (Francis & Stevens, 2000; Mollet, 2001). Porbeagle is an important object of commercial fisheries all around the world for its high-quality meat, mainly caught on pelagic longlines, and also highly considered for sport-fishery. The intensive fishery greatly reduced the population of porbeagle in the North Atlantic Ocean and the Mediterranean Sea (Castro, 1983; Compagno, 1984; Moreno, 1995; Vannuccini, 1999; Watts, 2001). In Italy, where porbeagle meat is widely eaten and usually marketed as "palombo" (smooth-hound, *Mustelus* sp.), it's mainly imported frozen or fresh from North-eastern Atlantic Countries and Japan (De Maddalena & Piscitelli, 2001).

Porbeagle is a littoral and epipelagic species that prefers waters colder than 18°C (Aasen, 1963). Widely distributed in the cold temperate waters of the North Atlantic, South Atlantic, South Indian and South Pacific Oceans. In the Mediterranean, it is indicated as rare or very rare in all waters (Tortonese, 1938; Capapé, 1989; Barrull *et al.*, 1999; Buencuerpo *et al.*, 1998); while only in the waters off North-western Sicily, it is reported as small commun (A. Celona, *pers. comm.).* Muñoz-Chápuli (1984) examined 67 specimens caught during 1981 in an area of the East-central Atlantic Ocean and Alboran Sea: founding only specimens over 119 cm in length, he hypotesized that porbeagle don't reproduce at our latitudes. Recently Orsi Relini & Garibaldi (2001) reported capture of 3 young specimens under 1 m-TL from the Ligurian Sea. In the Adriatic Sea captures of porbeagle were ever been particularly rare (Tortonese, 1956; Pallaoro & Jardas, 1996; Soldo & Jardas, 2001; L. Lipej, *pers. comm.).* In the eastern Adriatic only 5 specimens were recorded after 1950, last being dated September 1993 (Soldo & Jardas, 2001; A. Soldo, *pers. comm.).* Therefore we consider it particularly interesting to report the recent capture of a very young specimen in the west-central Adriatic Sea.

MATERIALS AND METHODS

We collected data on the location of capture and gear from the angler who caught the shark. The porbeagle, brought to the Museo Ittico Augusto Capriotti in San Benedetto del Tronto, was then prepared by the taxidermist Mr. Sergio Giacoia, and added to the collection with the catalogue number 1850. The specimen was examined by one of the authors (M.M.) and detailed morphometric measurements were taken using a digital

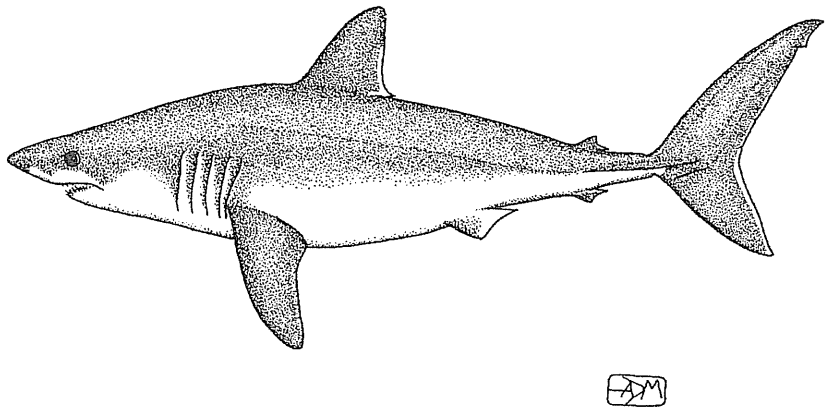


Fig. 1: Porbeagle** Lamna nasus **(Bonnaterre, 1788). (Drawing: A. De Maddalena)
Sl. 1: Atlantski skušolovec** Lamna nasus **(Bonnaterre, 1788). (Risba: A. De Maddalena)

calyper. For the body measurements we used Compagno's guidelines (1984), while teeth were measured according to Mollet *et al.* (1996). The tooth's total height was measured, indicated as H in Mollet *et al.* (1996), that is, total crown and root height, and we considered anterior, intermediate and the last reachable lateral or posterior teeth (measurements were effected on the taxidermy-mounted specimen). Moreover some macrophotographs of the teeth were taken.

RESULTS AND DISCUSSION

On Sunday, July 15th 2001, a young specimen of porbeagle was caught along the Italian coast of the west-central Adriatic Sea, 90° East of S. Benedetto del Tronto (AP), 15 miles offshore (Figs. 2, 3). The shark was captured with big game rod and reel equipment by a sport fisherman, Mr. Piero Crescenzi. The shark was hooked at a depth of 35 m, on a sea floor 85 m deep. It was 10:35 a.m., with a smooth sea and clear weather.

The specimen was a young female weighing 6.5 kg and measuring 91 cm in total length. Its stomach content was 8 sardines, *Sardina pilchardus*, some probably from chum. Minute irregular cusplets, but noticeably smaller than in adult, were observable at the base of some upper lateral teeth, while other teeth lack these lateral denticles (this characteristic is shown even in the photos; Figs. 4, 5). The shape of teeth is much more similar to the shortfin mako *Isurus oxyrinchus* Rafinesque, 1810 than in adult. Coloration was blackish on the dorsal surface and metallic blue-grey on the flanck and the side of head; caudal fin was light in the middle with conspicuous black margins, moreover its posterior margin had a narrow white band. The white rear tip of first dorsal fin was well evident.

Francis & Stevens (2000) reported that juvenile porbeagles grow linearly and rapidly, 16-20 cm per year. On the basis of this data, considering the 91 cm shark total length, we can hypotesize about its age. So with 68-89 cm total length for the size at birth, our specimen had to be 1 to 17 months old and had to be born February 2000 to early June 2001.

Porbeagle is a quite mobile species, capable to move on long distance in short periods. We can only hypotesize that, if compared to adult specimens, young may have less well-developed temperature control which limits their extension into colder water: probably young age groups don't move very far, while as they get bigger we would expect them to start migrating further (J. D. Stevens, *pers. comm.*). Therefore it is not possible to know if this young specimen could be born in an area close where it has been captured, or even in the Adriatic Sea, but we can hypotesize that it could be born in Mediterranean waters.

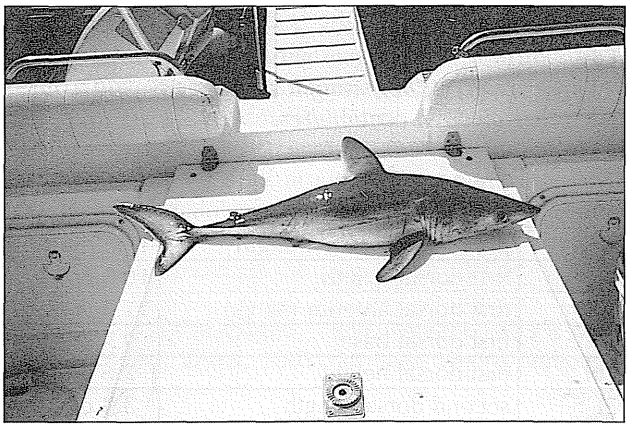
Measurements on body and teeth are presented in tables 1 and 2.

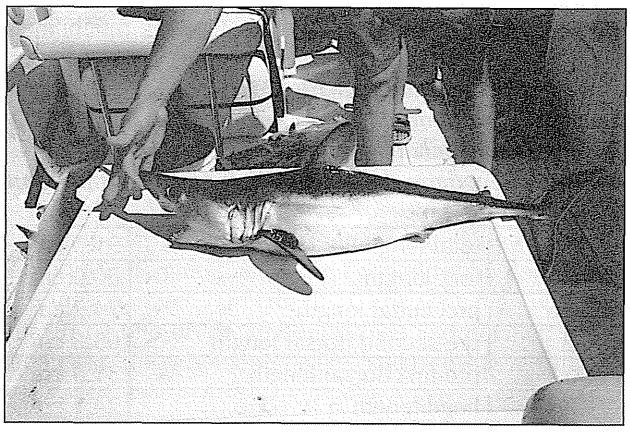
Tab. 1: Measurements of the young porbeagle** Lamna nasus **(Bonnaterre, 1788), caught on July 15th 2001 off S. Benedetto del Tronto (Italy, Western Adriatic Sea). Measurements are given in centimetres.
Tab. 1: Mere mladega atlantskega skušolovca** Lamna nasus **(Bonnaterre, 1788), ujetega 15. julija 2001 v bližini mesta S. Benedetto del Tronto (Italija, zahodni Jadran). Vse mere so v cm.

TOT	total length	91.0 cm	CPV	preventral caudal margin	12.5 cm
FOR	fork length	80.0 cm	D1L	first dorsal length	10.5 cm
PRC	precaudal length	74.2 cm	D1A	first dorsal anterior margin	11.3 cm
PD2	pre-second dorsal length	65.6 cm	D1B	first dorsal base	9.2 cm
PD1	pre-first dorsal length	31.3 cm	D1H	first dorsal height	7.6 cm
HDL	head length	24.1 cm	D2L	second dorsal length	3.4 cm
PG1	prebranchial length	16.7 cm	D2A	second dorsal anterior margin	2.4 cm
PSP	prespiracular length	10.4 cm	D2B	second dorsal base	1.4 cm
POB	preorbital length	4.9 cm	D2H	second dorsal height	1.4 cm
PP1	prepectoral length	21.6 cm	P2L	pelvic length	7.1 cm
PP2	prepelvic length	47.2 cm	P2A	pelvic anterior margin	3.6 cm
PAL	preanal length	63.0 cm	P2B	pelvic base	2.7 cm
PRN	prenarial length	5.4 cm	P2H	pelvic height	1.9 cm
POR	preoral length	1.8 cm	ANL	anal length	3.8 cm
EYL	eye length	2.3 cm	ANA	anal anterior margin	2.8 cm
P1A	pectoral anterior margin	15.3 cm	ANB	anal base	1.7 cm
P1B	pectoral base	5.1 cm	ANH	anal height	1.4 cm
P1H	pectoral height	11.6 cm	MOW	mouth width	6.3 cm
CDM	dorsal caudal margin	19.1 cm	INW	internarial space	3.1 cm

Tab. 2: Measurements of the teeth of the young porbeagle *Lamna nasus* ***(Bonnaterre, 1788), caught on July 15th 2001 off S. Benedetto del Tronto (Italy, Western Adriatic Sea). Measurements are given in millimetres.***
Tab. 2: Mere zob mladega atlantskega skušolovca *Lamna nasus* ***(Bonnaterre, 1788), ujetega 15. julija 2001 v bližini mesta S. Benedetto del Tronto (Italija, zahodni Jadran). Mere so v mm.***

RIGHT UPPER JAW		LEFT UPPER JAW	
1st anterior tooth height (UA1H)	7.85 mm	1st anterior tooth height (UA1H)	7.81 mm
2nd anterior tooth height (UA2H)	8.63 mm	2nd anterior tooth height (UA2H)	8.21 mm
intermediate tooth height (UIH)	4.24 mm	intermediate tooth height (UIH)	4.22 mm
1st lateral tooth height (UL1H)	6.56 mm	1st lateral tooth height (UL1H)	6.61 mm
2nd lateral tooth height (UL2H)	6.86 mm	2nd lateral tooth height (UL2H)	6.80 mm
3rd lateral tooth height (UL3H)	5.75 mm	3rd lateral tooth height (UL3H)	5.67 mm
4th lateral tooth height (UL4H)	5.27 mm	4th lateral tooth height (UL4H)	5.19 mm
5th lateral tooth height (UL5H)	4.63 mm	5th lateral tooth height (UL5H)	4.67 mm
1st posterior tooth height (UP1H)	3.81 mm	1st posterior tooth height (UP1H)	3.86 mm
RIGHT LOWER JAW		LEFT LOWER JAW	
1st anterior tooth height (LA1H)	9.88 mm	1st anterior tooth height (LA1H)	9.90 mm
2nd anterior tooth height (LA2H)	10.16 mm	2nd anterior tooth height (LA2H)	10.12 mm
3rd anterior tooth height (LA2H)	6.79 mm	3rd anterior tooth height (LA2H)	6.80 mm
1st lateral tooth height (LL1H)	6.48 mm	1st lateral tooth height (LL1H)	6.57 mm
2nd lateral tooth height (LL2H)	6.11 mm	2nd lateral tooth height (LL2H)	6.13 mm
3rd lateral tooth height (LL3H)	5.64 mm	3rd lateral tooth height (LL3H)	5.69 mm
4th lateral tooth height (LL4H)	5.01 mm	4th lateral tooth height (LL4H)	4.97 mm
5th lateral tooth height (LL5H)	4.41 mm	5th lateral tooth height (LL5H)	4.43 mm





Figs. 2, 3: Young porbeagle *Lamna nasus,* ***caught on July 15th 2001 off S. Benedetto del Tronto (Italy, Adriatic Sea). (Photo: P. Crescenzi)***
Sl. 2, 3: Mladi atlantski skušolovec *Lamna nasus,* ***ujet 15. julija 2001 v bližini mesta S. Benedetto del Tronto (Italija, Jadransko morje). (Foto: P. Crescenzi)***

CONCLUSIONS

It is certain that many shark species inhabiting the Mediterranean Sea were strongly threatened by increased fisheries due to inefficient fishery regulation. Shark populations are in fast regression due to overfishing, often of immature individuals, mainly by longlines such as those used in tuna and swordfish capture, and also due to overfishing of their prey. This threat is particularly evident for large species such as the shortfin mako *(Isurus oxyrinchus),* the blue shark *(Prionace glauca),* the sandbar shark *(Carcharhinus plumbeus),* the great white shark *(Carcharodon carcharias)* and the porbeagle. Sharks in general, because of their low reproduction rate and late sexual maturity age (see Compagno, 1984), are very sensitive to fishing pressure. This situation in the Mediterranean and worldwide has been denounced by reports of many researchers (see regional reports such as those of Capapé, 1989; Buencuerpo *et al.*, 1998; Soldo & Jardas, 2001; De Maddalena & Piscitelli, 2001, as well as global works such as Vannuc-

cini, 1999; Watts, 2001). Unfortunately, institutions responsible for fishery management still are extremely slow in giving the necessary response to increased fishing pressure, risking the complete disappearance of some of the most important predators of our marine fauna.

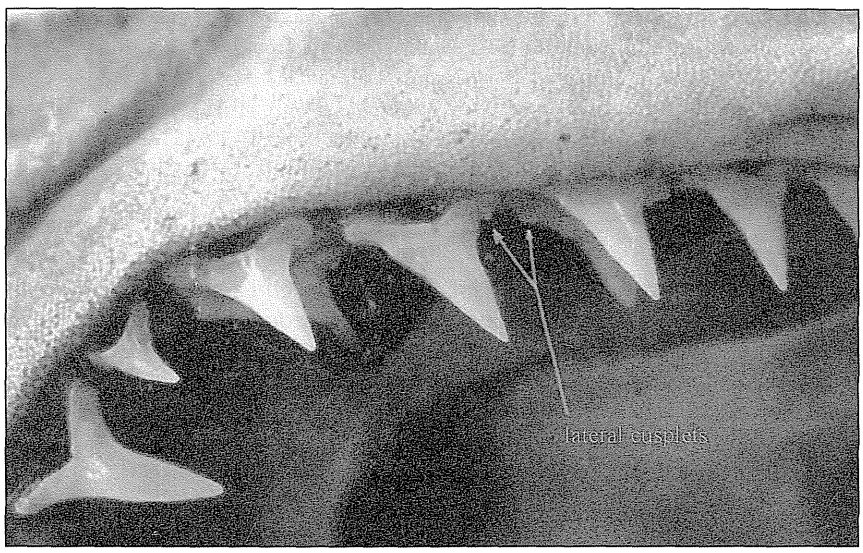


Fig. 4: Upper anterior, intermediate and lateral teeth of the same porbeagle specimen. (Photo: N. Polini & M. Marconi)
Sl. 4: Zgornji prednji, vmesni in stranski zobje istega atlantskega skušolovca. (Foto: N. Polini & M. Marconi)

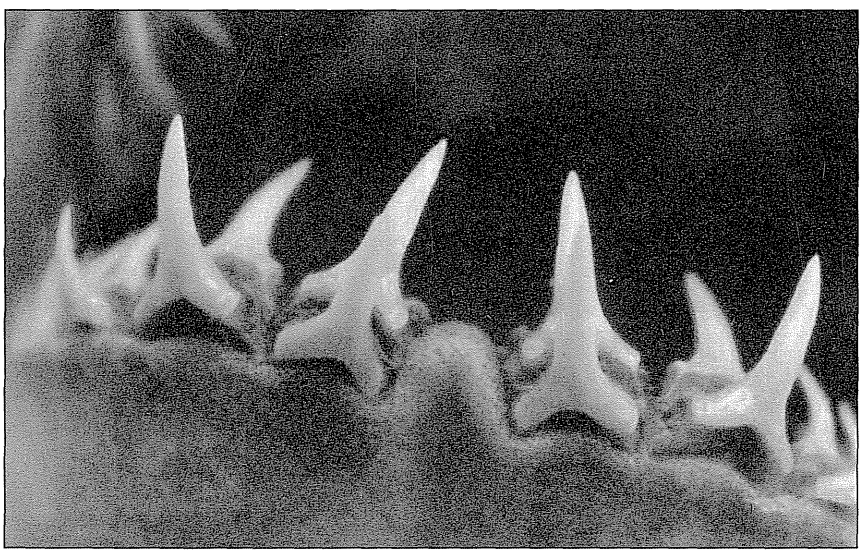


Fig. 5: Lower anterior teeth of the same porbeagle specimen. (Photo: N. Polini & Mario Marconi)
Sl. 5: Spodnji prednji zobje istega atlantskega skušolovca. (Foto: N. Polini & M. Marconi).

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O MLADEM ATLANTSKEM SKUŠOLOVCU *LAMNA NASUS* (BONNATERRE, 1788), UJETEM V ZAHODNEM JADRANU

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POVZETEK

Avtorja pričujočega članka poročata o mladem atlantskem skušolovcu Lamna nasus *(Bonnaterre, 1788), ujetem 15. julija 2001 v srednjem Jadranu v bližini italijanskega mesta S. Benedetto del Tronto. Predstavljene so morfometrične meritve in makrofotografije zob ujete samice, težke 6,5 kg in dolge 91 cm. V njenem želodcu so našli sardine* Sardina pilchardus. *Avtorja ocenjujeta, da je bil osebek, ki je postal del zbirke v Museo Ittico Augusto Capriotti v mestu San Benedetto del Tronto (kat. št. 1850), star med 7 in 17 meseci.*

Ključne besede: atlantski skušolovec, *Lamna nasus*, morski psi, razmnoževanje, Jadransko morje

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PRELIMINARY OBSERVATIONS ON ABNORMAL ABUNDANCE OF *CETORHINUS MAXIMUS* (GUNNERUS, 1765) IN THE CENTRAL AND NORTHERN ADRIATIC SEA

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ABSTRACT

During 2000 and in the first months of 2001, numerous records of Cetorhinus maximus *(Gunnerus, 1765) were made in the Central and Northern Adriatic Sea along the Italian, Croatian and Slovenian coasts. The collected records include 1) sightings of a single specimen and small groups; 2) reports on some accidental captures. The number of records collected in the last two years has highly increased in relation to the records made of basking sharks in previous years, due to which some considerations on the apparent migratory movement in the Adriatic and comparisons with the data concerning the Tyrrhenian Sea are presented. Some hypotheses about the causes of the unusual basking shark abundance in the area are also presented.*

Key words: *Cetorhinus maximus,* basking shark, Central and Northern Adriatic Sea

OSSERVAZIONI PRELIMINARI SULL'ABBONDANZA ANOMALA DI *CETORHINUS MAXIMUS* (GUNNERUS, 1765) IN ADRIATICO CENTRALE E SETTENTRIONALE

SINTESI

Durante il 2000 e nei primi mesi del 2001, sono state registrate numerose segnalazioni di Cetorhinus maximus *(Gunnerus, 1765) in Adriatico centrale e settentrionale, lungo le coste italiane, croate e slovene. Le segnalazioni riguardano: 1) avvistamenti di singoli esemplari e di piccoli gruppi; 2) resoconti di catture accidentali di qualche esemplare. Vengono presentate alcune considerazioni sull'apparente movimento migratorio in Adriatico ed il raffronto con dati provenienti dal Tirreno. Vengono infine formulate alcune ipotesi sulle possibili cause dell'abbondanza inusuale dello squalo elefante nell'area.*

Parole chiave: *Cetorhinus maximus,* squalo elefante, Adriatico centrale e settentrionale

INTRODUCTION

The presence of *Cetorhinus maximus* (Gunnerus, 1765) in the Mediterranean basin has been recorded since 1795 (Macrì, 1819). In the past few centuries the basking shark has been studied, due to its dimensions and behavioural habits, to a greater degree than any other shark. Accordingly, *C. maximus* is one of the species on which the modern marine researches have been focused mostly (Harvey-Clark *et al.*, 1999; Sims, 2000; Sims *et al.*, 2000; Valeiras *et al.*, 2001).

Despite this attention, many aspects of the basking shark biology are still unknown. We do know, however, that basking shark is a highly migratory species, noteworthy for its seasonal appearance at different localities of the Pacific and Atlantic Oceans and its subsequent disappearance (Compagno, 1984). The same case is in the Mediterranean but, if there is any pattern in migratory movements of basking shark in this area, it still needs to be explained. However, periodic or even seasonal occurrences in the Central Mediterranean have been recorded for the Ligurian Sea (Vinciguerra, 1923; Tortonese & Trotti, 1949), Northern and Southern Tyrrhenian Sea (Senna, 1913; Serena & Vacchi, 1996), Sea of Sardinia (Monti, 1910), Sea of Sicily (Monterosso, 1931; La Cascia, 1935) and Tunisian waters (Najai, 1980).

In the Adriatic, the presence of *C. maximus,* has been reported since 1822 (Naccari, 1822), and it has been considered as occasional (Brusina, 1888; Soldo *et al.*, 1999; Lipej *et al.*, 2000). Therefore, the huge increase in the basking shark records, whether captures or sightings, reported in the Adriatic between March 2000 and September 2001 have a notable importance in relation to the actual knowledge on the distribution of the species in the Adriatic. Furthermore, its unusual high abundance in this area has forced researchers of different occupations to carry out more thorough investigations in order to establish the reasons for its unusually large numbers.

MATERIALS AND METHODS

Being a preliminary study, priority has been given to the collecting of all available data that can be useful for a general evaluation of the phenomenon.

All pieces of information, photographic evidences and videos collected have come from different Marine Institutes, Museums, Harbour Offices, fishermen and other private citizens and articles published in scientific as well as popular journals and newspapers. In some cases, the main body characteristics, such as length and weight, have not been measured but merely estimated.

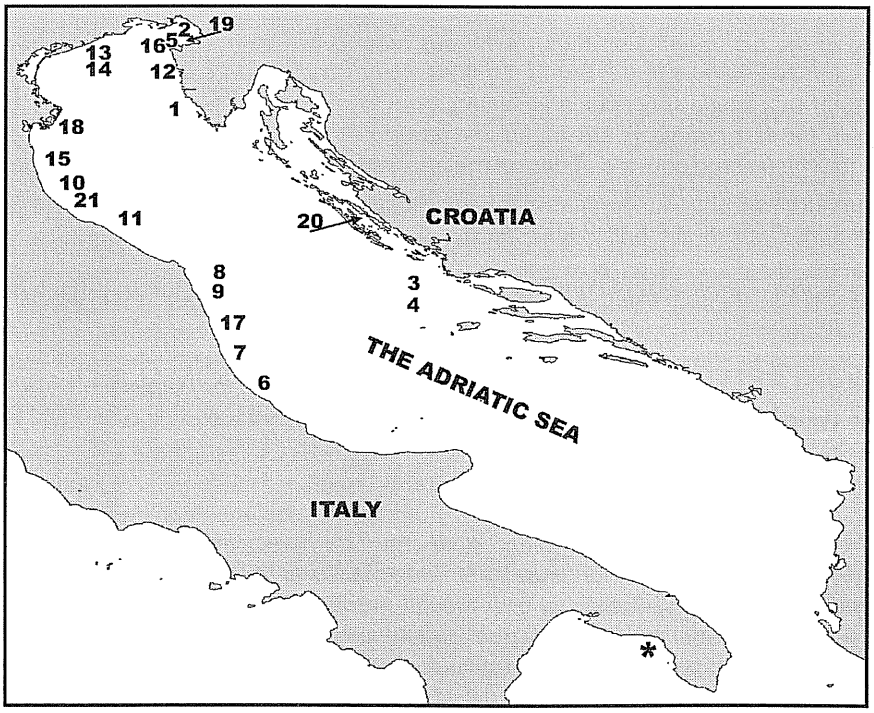

Fig. 1: Distribution of basking shark records in the Adriatic during 2000-2001 according to case numbers, including basking shark recorded on 5th February 2001 near Gallipoli (*).
Sl. 1: Razširjenost morskega psa orjaka v Jadranu v obdobju 2000-2001 glede na poročila iz tega območja, vključno s podatkom o orjaku, ujetem 5. 2. 2001 v bližini Gallipolija (*).

Tab. 1: Data on basking shark records in the Adriatic 2000-2001.
Tab. 1: Podatki o psih orjakih, opaženih v Jadranu v obdobju 2000-2001.

N	DATE	PLACE	LENGTH (in cm)	SEX	NOTES	REFERENCES
1	March 2000	Istran coast near Rovinj (Croatia)	700		Specimen sighted several times. Finally captured by gillnet and released.	Soldo & Jardas, 2001
2	22 May 2000	Piran (Slovenia)	299	male	Captured with net some 7 miles off the coast. Weight 120 kg.	Lipej *et al.*, 2000
3	23 May 2000	Blitvenica area (Croatia)	700		Specimen weighing 2000 kg caught by trawl.	Soldo & Jardas, 2001
4	5 June 2000	Blitvenica area (Croatia)	850		Specimen weighing 2500 kg caught by trawl.	Soldo & Jardas, 2001
5	19 July 2000	Piran (Slovenia)	249		Specimen of 70 kg caught by gillnet 6.4 miles off the coast.	Lipej *et al.*, 2000
6	November 2000	Pescara (Italy)	500		Specimen caught. Recorded by G. Cugini.	De Maddalena, *pers. comm.*
7	5 February 2001	San Benedetto del Tronto (Italy)	600	male	Specimen caught by net. Examined by S. Giacoia and A. Bugari.	Anonymus, 2001b
8	5 March 2001	Ancona (Italy)	420	male	Specimen of about 300 kg caught by net some 16 miles off the coast. Verified by photographer L. Caretta and local fisherman V. Renzi.	Anonymus, 2001c
9	15 March 2001	Ancona (Italy)	1000-1200		Group of some 10 specimens sighted 12-13 miles off the coast. Harbour Office representatives neared and photographed only 1 individual.	Anonymus, 2001d
10	15 March 2001	Cesenatico (Italy)	800		Specimen sighted some 5 miles off the coast and photographed by Harbour Captain.	Drudi, 2001
11	20 March 2001	Fano (Italy)	700		Group of 5 specimens photographed by Harbour Office Captain G. Greco 5 miles off the coast.	Anonymus, 2001e
12	22 March 2001	Umag (Croatia)	600		Sighting. Photographed.	Soldo, *unpubl. data*
13	28 March 2001	Caorle (Italy)	500		Specimen sighted twice on the same day 3 miles off the coast and photographed by Harbour Office Captain G. Scattola Caorle.	Prevarin, 2001; Anonymus, 2001f
14	29 March 2001	Caorle (Italy)	<500		Specimen sighted several times by the same person as in the previous case is most probably not the same individual, as it may be concluded from the photo.	Prevarin, 2001
15	2 April 2001	Ravenna (Italy)	1000 (?)		Specimen caught by net 18 miles off the coast and released.	Anonymus, 2001g
16	April 2001	Istran coast between Izola and Piran (Slovenia)	-		Group of around 8 specimens observed several times by fishermen and researchers of the Slovene Marine Biology Station.	Lipej, *pers. comm.*, Anonymus, 2001h
17	25 April 2001	Porto San Giorgio (Italy)	600 – 800		Sighting of 2 specimens.	Anonymus, 2001i
18	7 May 2001	Goro (Italy)	535	female	Specimen of 900 kg caught by net 2 miles off the coast and examined by G. Gavanelli and other researchers.	Anonymus, 2001j
19	9 May 2001	Trieste (Italy)	600		Sighting.	Anonymus, 2001k
20	20 May 2001	Kali / Ugljan Island (Croatia)	800		Specimen sighted several times.	Soldo, *unpubl. data*
21	12 September 2001	Cattolica (Italy)	430		Capture.	Zuffa, *unpubl. data*

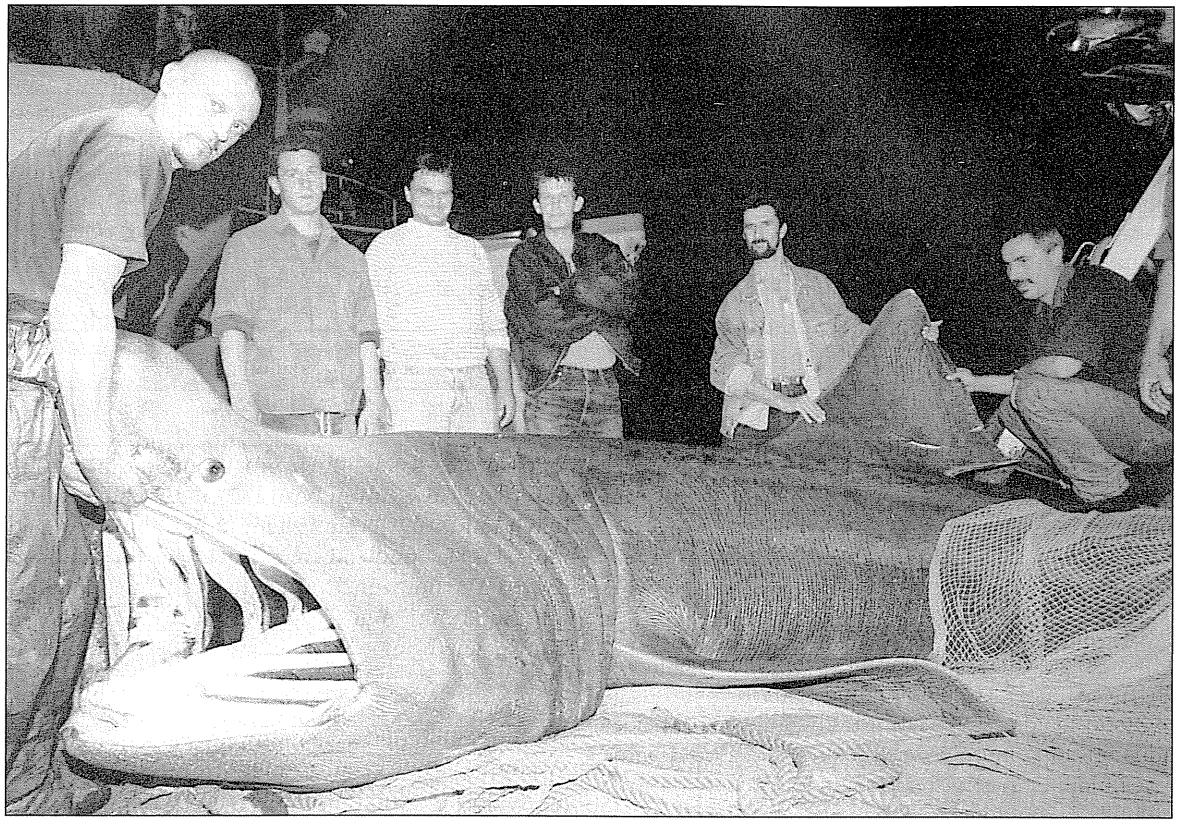

Fig. 2: Photo relative to case 3.
Sl. 2: Fotografija orjaka, ujetega 23. 5. 2000.

All the data have been carefully examined and cross-compared by eyewitnesses in order to verify every single case.

To answer the questions raised by this case, some hypotheses are presumed in the light of the first analysis of the recorded data and the investigations into different elements influencing the migratory behaviour of the species.

RESULTS AND DISCUSSION

The recent abundance of *Cetorhinus maximus* in the Adriatic basin (Fig. 1) is indeed anomalous in comparison with the records collected in the last 20 years in the same area. The first examination of 21 cases (Tab. 1) shows the presence of male (cases 2, 7 and 8) and female (case 18) specimens of various dimensions (Figs. 2, 3, 4). This observation underlines the contemporary presence of specimens with varied stages of development. In fact, those stages ranged from young specimens (cases 2 and 5) up to adults of grandiose dimensions (cases 4 and 15).

Aggregations of 5-10 sharks have been often observed (cases 9, 11 and 16), which speaks of a true migration than of occasional passage by single specimens. A meaningful sign of the migratory movement from south to north, coming from the Ionian Sea, was the capture and eventual release of a large specimen estimated to be 800-900 cm long (Anonymus, 2001a; A. De Maddalena, *pers. comm.).* It took place on February 5th 2001 on the open sea in front of Gallipoli and was the start of a series of recorded sightings and captures during the year of 2001.

The case 7 is particularly interesting. Despite the fact that the capture was made during the winter (February 5th 2001 off S. Benedetto del Tronto), the specimen was showing gillrakers perfectly developed and apparently functional (S. Giacoia, *pers. comm.).* This case, together with similar capture of a basking shark with functional gillrakers that was made off Baleares Islands on February 3rd 1985 (Gallego & Alemany, 1985), could suggest that the loss of such organs during the winter season is not obligatory as suggested (Compagno, 1984). This morphological aspect could have a relevant importance on the knowledge of the shark's feeding behaviour, as some authors presumed that during the period without gillrakers, the basking shark could develop a lethargic behaviour (Ellis, 1983; Mojetta, 1997) or change its diet (Lipej *et al.,* 2000).

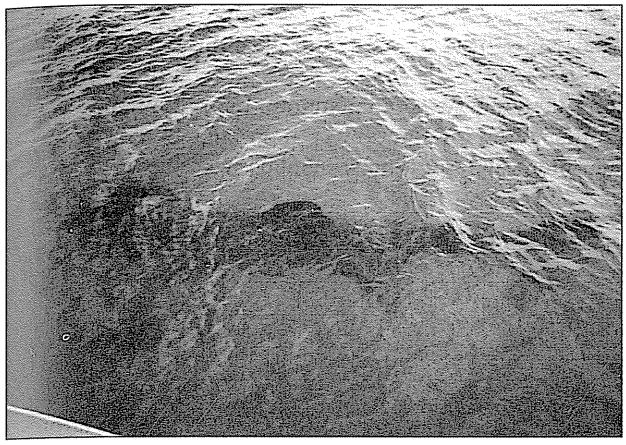

Fig. 3: Photo relative to case 13.
Sl. 3: Fotografija orjaka, opaženega 22. 3. 2001.

A preliminary investigation along the Tuscany coasts (about 120 km in length), frequently visited by *Cetorhinus maximus* (Storai & Zuffa, *unpubl. data),* shows almost (single record in July 2000) total absence of sighting or capture records in this area, while at the same time an increase in the frequency of the basking shark records in the Adriatic Sea has been observed.

If this observation could be confirmed by some other cross-comparisons, which would include other factors necessary for a better and true understanding of the basking shark behaviour, this could indicate a true pattern of migration for the basking shark population in the Central Mediterranean.

Unfortunately, the collected data do not allow us, at the moment, to make any final conclusions as to the causes of the dealt with phenomenon.

Different hypotheses have been taken into consideration, including various elements, as possible causes for the changes in the basking shark behaviour in the Adriatic. The hypotheses, which can throw light on the strange phenomenon presented, are as follows:

1. Climate changes

Certain changes in the Adriatic ichthyofauna due to climate changes in the Adriatic have been already observed (Dulčić *et al.*, 1999). Eleven subtropical and tropical fishes have been recorded for the first time, and several species, fairly rare or very rare until now, are more abundant. The main reason for such changes is the warmer seawater that is affecting marine ecosystem. Along with other hydrodynamic factors, such as salinity, this can explain the reasons for the increase of the basking shark records in this area.

2. Changes in zooplankton abundance

It is known that basking shark feeds exclusively on small planktonic organisms, such as small copepods, barnacles, decapod larvae and fish eggs (Compagno,

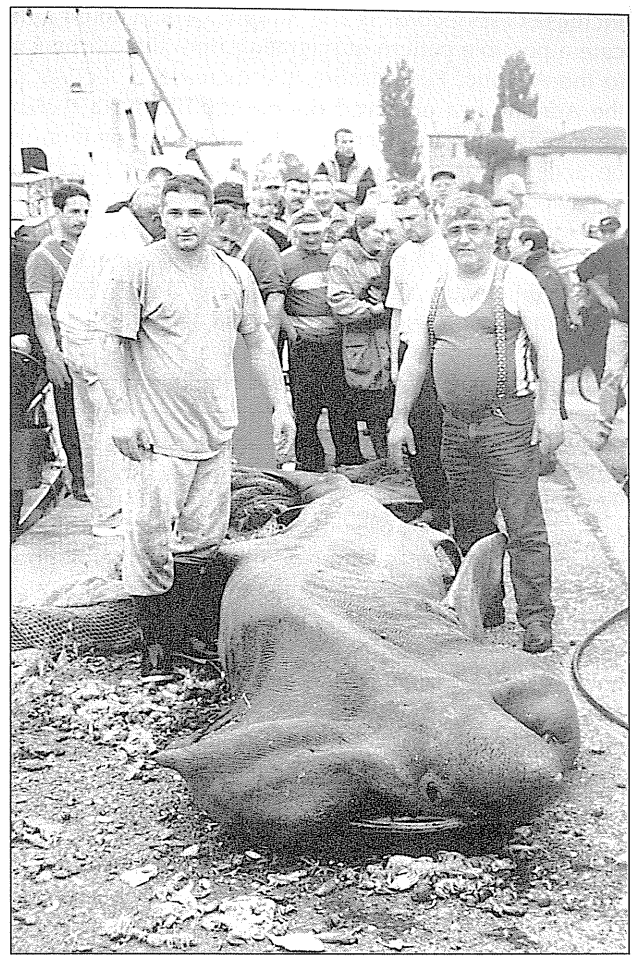

Fig. 4: Photo relative to case 18.
Sl. 4: Fotografija orjaka, ujetega 7. 5. 2001.

1984). Climate changes affect primary and secondary production, so it is possible that changes in abundance and species composition of zooplankton are causing basking shark to respond and follow these changes in the Adriatic. To prove such hypotheses, we would need new data on the monthly changes of zooplankton in the Adriatic. Currently, some projects regarding this subject are being conducted at the Institute of Oceanography and Fisheries in Split, and as soon as these data and comparison with basking shark data are made, this hypothesis could be proved either right or wrong.

3. Unknown aspects of the basking shark metabolism and behaviour

As there are numerous basking shark biology factors that are still unknown, a more thorough investigation on that subject would be necessary in order to fully understand the pattern of its response to different conditions.

At present, the main objectives would be monitoring and a more careful investigation into the absence of basking shark records in the Tyrrhenian Sea and into the

increase of its records in the Adriatic, which could indicate a possible pattern of migration from the Tyrrhenian to the Adriatic. Furthermore, the increase of records in the Adriatic Sea observed during 2000 and 2001 must be repeated for a longer period of time, before it could be accepted as a true change in the shark's migratory behaviour.

However, this abnormal occurrence of the basking shark has attracted the attention of numerous researchers of different occupations to carry out preliminary plans of tagging, photoidentification, genetic analysis, etc. Such plans have been made by a number of international researches joined in the Mediterranean Shark Research Group, whose intention is, among other scopes, to collect and monitor all the basking shark records made in the Mediterranean. Such collaboration and exchange of information between researchers, different groups and institutes studying this subject are certainly most welcome in order to obtain reliable results and extend our knowledge of this giant species.

ACKNOWLEDGEMENTS

A particular thanks is due to the numerous Harbour Offices that enabled us to collect information and to photograph a number of basking sharks. Another particular thanks go to the Research Institutes that has helped us to verify certain data. Hence, thanks to Sergio Giacoia, Albano Bugari, Luigi Carretta, Gianluca Cugini and Boris Šuligoj. Finally, many thanks to Gildo Gavanelli, for his precious help.

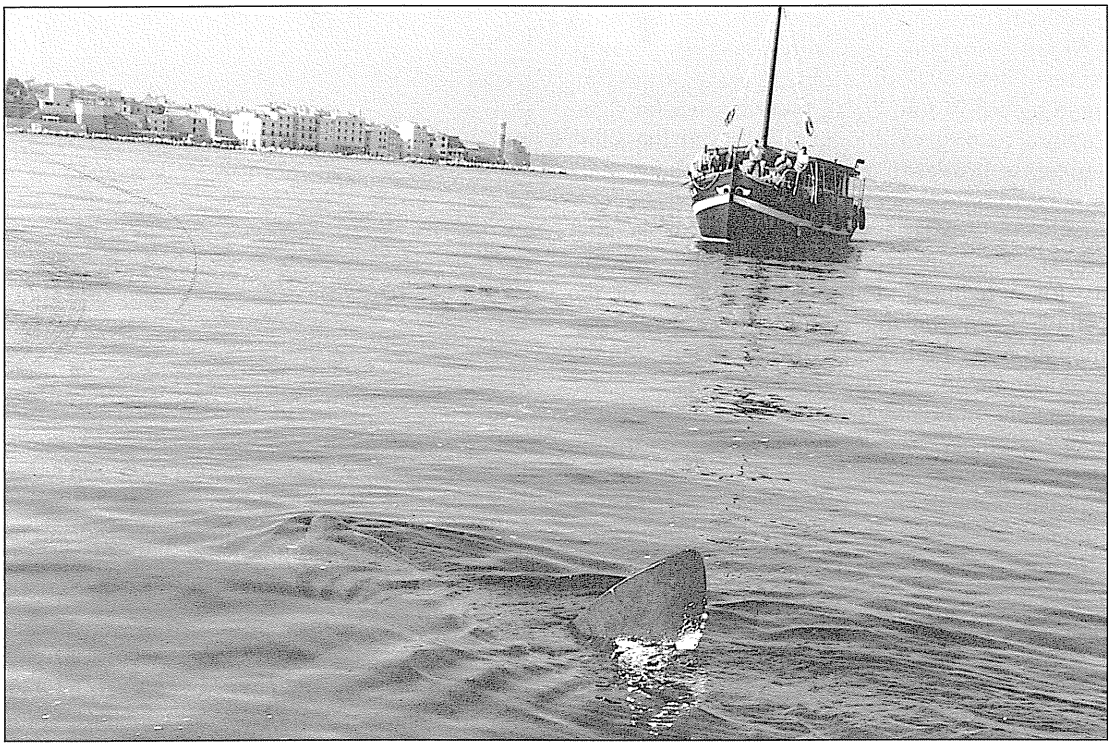

Fig. 5: Photo relative to case 16. (Photo: B. Šuligoj)
Sl. 5: Fotografija orjaka, opaženega aprila 2001 pred Piranom, Slovenija. (Foto: B. Šuligoj)

PRVE UGOTOVITVE O NENAVADNO POGOSTEM POJAVLJANJU MORSKEGA PSA ORJAKA *CETORHINUS MAXIMUS* (GUNNERUS, 1765) V SREDNJEM IN SEVERNEM JADRANU

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POVZETEK

V letu 2000 in v prvih mesecih leta 2001 so iz srednjega in severnega Jadrana poročali o nenavadno pogostem pojavljanju psa orjaka Cetorhinus maximus *(Gunnerus, 1765) vzdolž italijanskega, slovenskega in hrvaškega obrežja. Zbrani podatki govorijo o: 1) opažanjih enega osebka in majhnih skupin in 2) naključnih ulovih teh orjakov. Sicer pa se je število opažanj, zbranih o tej vrsti v zadnjih dveh letih, močno povečalo glede na opažanja v prejšnjih letih, kar je tudi razlog, da so v članku predstavljena razmišljanja avtorjev o očitnih selitvenih gibanjih psov orjakov v Jadranskem morju in primerjave s podatki te vrste iz Tirenskega morja. Avtorji nas seznanjajo tudi z nekaterimi domnevami o vzrokih za pojavljanje tako nenavadnega števila psov orjakov v obravnavanem območju.*

Ključne besede: *Cetorhinus maximus,* pes orjak, srednji in severni Jadran

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Anonymus (2001c): Toh, uno squalo. Corriere Adriatico, Ancona, 6 marzo.
Anonymus (2001d): Squali balena avvistati al largo di Ancona. Il Resto del Carlino, Ancona, 16 marzo.
Anonymus (2001e): Famiglia di squali nuota a pochi metri dalla costa adriatica. Il Resto del Carlino, Bologna, 21 marzo.
Anonymus (2001f): Salvore, avvistato dai pescatori uno squalo elefante di 6 metri. Il Piccolo, Trieste, 23 marzo.
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AN ANALYSIS OF THE PHOTOGRAPHIC EVIDENCES OF THE LARGEST GREAT WHITE SHARKS, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), CAPTURED IN THE MEDITERRANEAN SEA WITH CONSIDERATIONS ABOUT THE MAXIMUM SIZE OF THE SPECIES

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ABSTRACT

We analysed photographic evidences of the largest white sharks Carcharodon carcharias *caught in the Mediterranean Sea, reported in literature as measuring near to 6 metres or even more in length. We studied 7 specimens and estimated their lengths as TOT (total length with the caudal fin in the depressed position), TLn (total length with the caudal fin in the natural position) and PRC (precaudal length) on the basis of the measurements of a 583 cm TOT specimen preserved in the Museum of Zoology in Lausanne. The following TOT were obtained: 507 cm (Procida, Italy, June 1924), 597 cm (Enfola, Isola d'Elba, Italy, 12 August 1938), 666 cm (Ganzirri, Sicily, Italy, 19 June 1961), 492-547 cm (Piran, Slovenia, 22 October 1963), 594 cm (Favignana, Isole Egadi, Italy, May 1974), 668-681 cm (Filfla, Malta, 17 April 1987), 591 cm (Sète, France, 9 January 1991). Five specimens therefore measured over 590 cm and at least two of these, Ganzirri 1961 and Malta 1987, grossly exceeded the 6 m mark both as TOT and as TLn. Also, these two specimens could be the largest ever recorded world-wide. We discuss the more solid cases of other white sharks in the same size range (Kangaroo Island, Australia, 1987; Castillo de Cojimar, Cuba, 1945; Dakar, Senegal, 1982). We conclude that* C. carcharias *can reach at least 640-660 cm TOT and very probably even more.*

Key words: great white shark, *Carcharodon carcharias*, size, Mediterranean Sea

UN'ANALISI DELLA DOCUMENTAZIONE FOTOGRAFICA DEI PIU' GRANDI SQUALI BIANCHI, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), CATTURATI NEL MARE MEDITERRANEO, CON CONSIDERAZIONI SULLE DIMENSIONI MASSIME DELLA SPECIE

SINTESI

E' stata esaminata la documentazione fotografica relativa ai più grandi squali bianchi Carcharodon carcharias *catturati nel Mare Mediterraneo, la cui lunghezza è riportata in letteratura come uguale o superiore a 6 metri. Abbiamo preso in considerazione 7 esemplari, e stimato le loro lunghezze come TOT (lunghezza totale con il lobo superiore della pinna caudale disteso lungo l'asse del corpo dell'animale), TLn (lunghezza totale con la pinna caudale in posizione naturale) e PRC (lunghezza precaudale), sulla base delle dimensioni di un esemplare di 583 cm TOT conservato nel Museo di Zoologia di Losanna. Abbiamo quindi ottenuto le seguenti TOT: 507 cm (Procida, Italia, Giugno 1924), 597 cm (Enfola, Isola d'Elba, Italia, 12 Agosto 1938), 666 cm (Ganzirri, Sicilia, Italia, 19 Giugno 1961), 492-547 cm (Piran, Slovenia, 22 Ottobre 1963), 594 cm, (Favignana, Isole Egadi, Italia, Maggio 1974), 668-681 cm (Filfla, Malta, 17 Aprile 1987), 591 cm (Sète, Francia, 9 Gennaio 1991). Pertanto 5 esemplari misuravano oltre 590 cm e almeno due di questi, Malta 1987 e Ganzirri 1961, superavano ampiamente 600 cm sia come TOT che come TLn. Questi due esemplari potrebbero inoltre essere i più grandi mai registrati a livello mondiale. Vengono discussi i più solidi casi di squali bianchi situati nello stesso range di lunghezza (Kangaroo Island, Australia, 1987; Castillo de Cojimar, Cuba, 1945; Dakar, Senegal, 1982). Concludiamo che* C. carcharias *può raggiungere almeno 640-660 cm TOT e molto probabilmente anche dimensioni maggiori.*

Parole chiave: squalo bianco, *Carcharodon carcharias*, dimensioni, Mare Mediterraneo

INTRODUCTION

The maximum size of the great white shark *Carcharodon carcharias* (Linnaeus, 1758) has long been debated and remains a subject of controversy. It has been proved that this species can reach at least 594.4 cm in length (Randall, 1987; Mollet *et al.*, 1996). Although if the methods to obtain the length of the white sharks from usually preserved skeletal parts (teeth, jaws, vertebrae) have been investigated and applied by various authors (Randall, 1973, 1987; Gottfried *et al.*, 1996; Mollet *et al.*, 1996), the best and irrefutable way to obtain the length of a large white shark remain accurate measurements directly taken on the complete specimen, if possible following the standards presented in Compagno (1984) and Mollet *et al.* (1996).

The three largest white shark specimens accurately measured and confirmed so far seem to be the 594.4 cm female captured off Ledge Point, Australia, on March 22nd 1984 (Randall, 1987; Mollet *et al.*, 1996), the 574 cm TLn female caught in Bunbury, Australia, on July 2nd 1991 (Mollet *et al.*, 1996), and the 583 cm TOT (565 cm TLn) female caught in Sète, France, on 13th October 1956, whose mould is kept in the Museum of Zoology in Lausanne, Switzerland (De Maddalena *et al.*, 2002) (TOT is total length with the caudal fin in the depressed position, while TLn is total length with the caudal fin in the natural position).

Many larger specimens, reaching and exceeding 6 metres, are cited in the literature, but almost always without the necessary evidence as to their precise length. The most interesting cases reported are listed in table 1. On some of the specimens cited herewith we shall return later in the Results and Discussion as well as in the Conclusions sections.

In this work we investigate the large white shark specimens reported as reaching or exceeding 6 metres in length, captured in the Mediterranean Sea, through examination of the preserved photographic evidences, looking for solid evidences demonstrating which is the maximum size that *C. carcharias* can reach.

Tab. 1: Most interesting cases of white sharks reaching or exceeding 6 metres in length reported in previous literature
Tab. 1:Najzanimivejši podatki o belih morskih volkovih, za katere so v literaturi navedli, da so merili 6 ali več metrov.

DATE	LOCATION	SEX	REPORTED LENGTH (cm)	SOURCE	NOTES
February 1839	Civitanova, Italy	-	ca. 600	Bonaparte (1839), Metaxà (1839), Vinciguerra (1885-1892), De Maddalena (2000b).	Estimated to be 602 cm TL on the basis of the largest vertebra (De Maddalena, 1998).
1886	Piombino, Italy	-	800-1000	Biagi (1995)	
1945	Cojimar, Cuba	F	640.8	Bigelow & Schroeder (1948), Guitar-Manday & Milera (1974)	Length contested by Randall (1987).
16 March 1954	Camogli, Italy	F	700	Tortonese (1965)	Length contested by Fergusson (1996).
19 June 1961	Ganzirri, Sicily, Italy	F	> 600	Celona (2001)	Estimated to be ca. 640 cm long (Celona, 2001).
9 March 1965	Ganzirri, Sicily, Italy	-	620	Berdar & Riccobono (1986), Celona *et al.* (2001)	Hypothesised to be measured over the curve of the body; estimated about 560 cm TOT from photograph (Celona *et al.*, 2001).
18 September 1979	Gallipoli, Italy	M	620	Piccinno & Piccinno (1979)	
1982	Dakar, Senegal		> 800 TL	Barrull & Mate (2001)	Not accurately measured.
4 August 1983	Alberton, Prince Edward Island, Canada	F	609.6	Mollet *et al.* (1996)	Never measured (Ellis & McCosker, 1991).
17 January 1987	Gansbaai, South Africa	F	567-600 cm TOT	Gottfried *et al.* (1996), Mollet *et al.* (1996)	Never measured (De Maddalena *et al.*, 2002).
1 April 1987	Kangaroo Island, Australia	F	> 690	Jury (1987), Cappo (1998), Mollet *et al.* (1996)	Never measured.
17 April 1987	Filfla, Malta	F	714 cm TOT	Abela (1989)	Reported length doubtful (Mollet *et al.*, 1996). Estimated to be 520-550 cm (Fergusson, 1998).
16 July 1996	Malindi, Kenya	F	ca. 640	Cliff *et al.* (2000)	Estimated 570 cm TLn from vertebral size (Cliff *et al.*, 2000).

MATERIALS AND METHODS

We examined the photographic evidences of the largest specimens collected in the Italian Great White Shark Data Bank (Banca Dati Italiana Squalo Bianco), a program of data collection on the presence of *C. carcharias* in the Mediterranean Sea instigated in 1996. For every case examined, we searched for all available information, looking for all related bibliographical sources, trying to contact eyewitnesses and all other persons that were able to furnish us with new and unpublished details or unknown photographs of the specimens we are dealing with in our study. We considered it more useful and clear to include the so reconstructed reports of the captures in the Results and Discussion section instead of in the Material and Methods section.

The lengths of the specimens investigated were not clearly reported as measured accurately and following precise standards, such as those indicated in scientific literature (see Compagno, 1984 and Mollet *et al.*, 1996), and as in some cases the size reported are merely declared estimates, we believed it necessary to revise the reported data. In almost all cases even weights were reported in the sources, but it is never clearly specified whether the specimen was really weighed or merely estimated (as it is often likely) and in which condition (whole, gutted, beheaded or other). Moreover, it should be taken into consideration that it is not suitable to estimate the total length from the weight without consider-

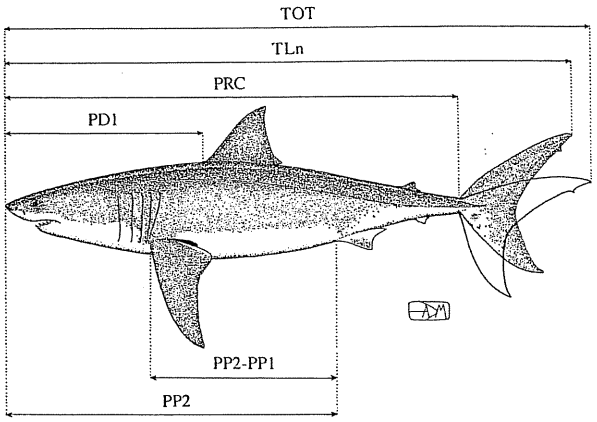


Fig. 1: Measurements of the white shark** Carcharodon carcharias **(Linnaeus, 1758) used in this work, based on Compagno (1984) and Mollet et al. (1996): total length with caudal fin in depressed position (TOT), total length with caudal fin in natural position (TLn), precaudal length (PRC), prepelvic length (PP2), pre-first dorsal length (PD1), prepelvic-prepectoral space (PP2-PP1). (Drawing: A. De Maddalena)
Sl. 1: Mere belega morskega volka** Carcharodon carcharias **(Linné, 1758), uporabljene v tem delu na osnovi Compagna (1984) in Molleta et al. (1996): celotna iztegnjena dolžina (TOT), celotna dolžina v naravni legi (TLn), predrepna dolžina (PRC), dolžina do trebušne plavuti (PP2), dolžina do korena prsne plavuti (PD1), razdalja od začetka prsne plavuti do začetka trebušne plavuti (PP2-PP1). (Risba: A. De Maddalena)

ing the girth of the body (Casey & Pratt, 1985), but precise girth was never reported by the sources. For these reasons we commented on the weight reported only in a few cases.

The model of a white shark preserved in the Museum of Zoology in Lausanne, Switzerland, is a mould reconstructed via casts from the original body of the specimen caught in Sète, France, on 13th October 1956: this is the largest white shark specimen whose complete morphometrics (made following Compagno, 1984) are available world-wide (De Maddalena *et al.*, 2002). Considering that the size of this specimen is very close to 6 metres (583 cm TOT, 565 cm TLn and 458 cm PRC), its measures can be utilised as a useful reference to effect precise estimates of the size of other specimens within 5-7 metres length range (Tab. 2).

For every specimen we estimated three lengths (from Compagno, 1984 and Mollet *et al.*, 1996): the total length with the caudal fin in the depressed position (TOT), which is also the maximum length, the total length with the caudal fin in the natural position (TLn), and the precaudal length (PRC) (Fig. 1). To effect the estimates we proceeded as follows. First of all we chose a reference of the valuable size, as is the height of a man (estimated by comparison with other persons near him) very close to the shark. On this basis we then estimated the length of a segment of the shark that was in the photo not or just slightly distorted by the perspective, choosing the most suitable one from the parameters indicated by Compagno (1984), depending on the case: the prepelvic length (PP2), the pre-first dorsal length (PD1), the space between the origin of the pectoral and the origin of the pelvic fin, corresponding to the difference between prepelvic length and prepectoral length (we called it the prepelvic-prepectoral space, and we indicated it as PP2-PP1) (Fig. 1). Finally we made a ratio between this partial length to the same partial length of the Lausanne specimen reported in De Maddalena *et al.* (2002), and thus obtained the three lengths TOT, TLn and PRC (Tab. 2).

The problems encountered at the moment when an accurate estimate of the size of a large white shark from photographic evidences was effected were several. Greater difficulties occurred due to the following factors: a) position of the photographer not exactly lateral in respect to the shark; b) distance subject-photographer much too short; c) excessive closeness of the subject to the edges of the field of vision; d) difficulties in the evaluation of the size of the reference; e) different distances between shark and photographer and between reference and photographer; f) the smaller the segment of the shark that can be correctly estimated, the greater the possibility of an error.

All these factors made it impossible to use, in this work, the numerous photos collected in the Italian Great White Shark Data Bank, and thus included herewith only some of those that seem suitable for this kind of study. The necessity to choose correctly the longer segment not distorted by the perspective for the estimate has emerged clearly. We saw that the prepectoral length (PP1) could be noticeably deformed and shortened when the shark was suspended in vertical position. Namely, the reference has to be large, such as the entire height of a man or at least a large part of him, and it has to be placed exactly on the same plane as the shark: that is particularly important when a close-up was made. Evaluating the height of the man by comparison with other persons in proximity, we also considered that in some cases, being very old photos, the mean height of the persons had to be somewhat smaller than today. All the estimates of the men's height indicated herewith include the heels of their shoes and hats, if present. The estimates presented herewith are not the maximum sizes possible for these specimens, but are the sizes that, in our opinion, are closer to the real ones.

Tab. 2: Relations between the dimensions used in this study, obtained from morphometric data reported in De Maddalena et al. (2002) of the 583 cm TOT white shark *Carcharodon carcharias* ***kept in the Museum of Zoology in Lausanne.***
Tab. 2: Razmerja med dimenzijami, uporabljenimi v tej študiji na osnovi morfometričnih podatkov, ki so jih predstavili De Maddalena et al. (2002) o 583 cm dolgem (celotna iztegnjena dolžina) belem morskem volku *Carcharodon carcharias,* ***razstavljenem v lausannskem Zoološkem muzeju.***

MEASUREMENTS	TOT	TLn	PRC
TOT - total length (caudal fin in depressed position)	100.00%	103.19%	127.29%
TLn - total length (caudal fin in natural position)	96.91%	100.00%	123.36%
PRC - precaudal length	78.56%	81.06%	100.00%
PD1 - pre-first dorsal length	37.74%	38.94%	48.03%
PP2 - prepelvic length	56.60%	58.41%	72.05%
PP2-PP1 - prepelvic-prepectoral space	31.73%	32.74%	40.39%

RESULTS AND DISCUSSION

Procida, Italy, June 1924

In mid-June 1924, a large white shark was caught near Procida (Italy) with the tuna-trap (commonly called "tonnara" in Italian) "Simeone". In Anonymous (1924), where it is erroneously identified as a porbeagle *Lamna nasus*, it is said to measure ca. 6 m, with a weight of almost 12 q.

The source also features a photo of the shark (Fig. 2), where it is visible in whole, even if the body is not in a straight position. In any case, this caused no problem in the estimate of its length. The problems are the rather bad quality of the reproduced picture at our disposal and the fact that none of the several persons present on the photo, even if very close to the shark, can be seen in full (with the exception of the child sitting on the shark which, however, is not particularly fit for use); consquently the references turned out to be not accurate enough. To make an estimate we took, as reference, the visible part of the man holding the shark's caudal fin. Assuming that he was 175 cm tall, the shark's TOT was estimated at 507 cm, corresponding to 491 cm TLn and 398 cm PRC.

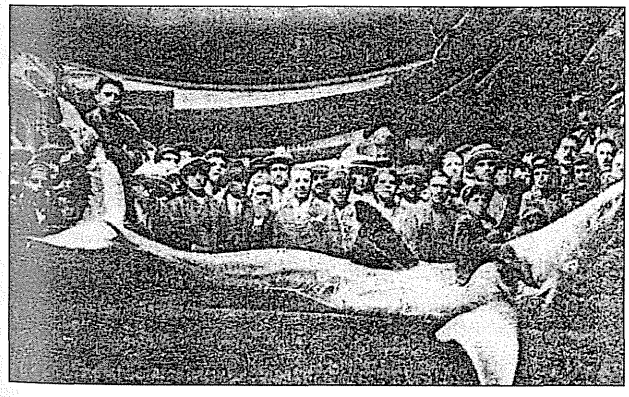


Fig. 2: Specimen caught off Procida (Italy) in June 1924. (Photo: from "La Domenica del Corriere" 15th June 1924)
Sl. 2: Primerek, ujet v bližini Procide (Italija) junija 1924. (Foto: iz časnika "La Domenica del Corriere" 15. junija 1924)

Enfola, Isola d'Elba, Italy, August 12th 1938

During the night of August 12th 1938, a white shark was caught with a small tuna-trap (tonnara) belonging to the Ridi brothers at Enfola, Isola d'Elba (Thyrrenian Sea, Italy). Killed with harpoons and rifles, the shark was then towed to land, where, in its stomach, 2 dolphins were found. The shark was cut in pieces, carried to Florence and its meat sold at the market. It seems that the same specimen had been sighted a little earlier in the same area feeding on dolphins and tunas. The specimen is reported in Anonymous (1938), and afterwards cited in De Maddalena (1999) and probably in Fergusson (1996) (where it is reported without precise capture location and it is said to be probably a female). Anonymous (1938) state that it was ca. 6 m long, its girth exceeding 4 m, and weighing 1800 kg. Fergusson (1996) reported a total length of over 510 cm.

Two photographs of this specimen appear in Anonymous (1938) and in De Maddalena (1999) (Fig. 3), but these are not easily applicable to produce an accurate estimate. We had the chance to examine another photograph (Fig. 4), evidently taken only some seconds after the one reproduced in De Maddalena (1999), and from side. We assumed as reference the visible part of the girl on the left, close to the shark's snout, who appears to be almost on the plane of the animal. The same girl is well visible on the photo that appears in De Maddalena (1999), and we assumed her height to be 170 cm. We estimated the PP2 at 338 cm, corresponding to 597 cm TOT, 579 cm TLn, 469 cm PRC. We calculated that if the girl's height was 175 instead of 170 cm (and this is surely possible by comparison with the heights of other persons) the shark's length would increase to 613

Fig. 3: Specimen caught off Enfola, Isola d'Elba (Italy), on August 12th 1938. (Photo: courtesy of A. Zanoli)
Sl. 3: Primerek, ujet v bližini Enfole, Isola d'Elba (Italija), 12. avgusta 1938. (Foto: z dovoljenjem A. Zanolija)

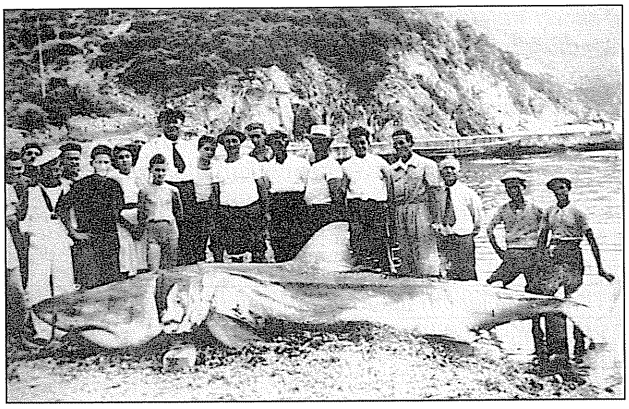


Fig. 4: Specimen caught off Enfola, Isola d'Elba (Italy), on August 12th 1938. (Photo: courtesy of A. Zanoli)
Sl. 4: Primerek, ujet v bližini Enfole, Isola d'Elba (Italija), 12. avgusta 1938. (Foto: z dovoljenjem A. Zanolija)

cm TOT, 594 cm TLn, 482 cm PRC. We noted that, according to Mollet & Cailliet (1996), our estimates agreed with the weight reported by Anonymous (1938).

Ganzirri, Sicily, Italy, June 19th 1961

In 1961, a great female white shark was captured off Ganzirri, Sicily (Italy). It was June 19th: the specimen was harpooned offshore by the fisherman Domenico Sorrenti from his boat, at 12 o'clock. The shark was estimated to be about 640 cm long and weighing about 1500 kg; in its stomach a large dolphin cut in two parts was found (Celona, 2001).

A photo of this specimen appears in Celona (2001) (Fig. 5). The shark is not shown in full, but the position from which the picture was taken, exactly laterally from it, and the closeness of the shark and the people on the photo allowed us to make a very good length estimate. We chose as reference the man wearing a white shirt and short pants located very close to the shark's snout and on the same plane. We assumed its height to be 170 cm. We estimated the PP2 to be 377 cm, corresponding to 666 cm TOT, 645 cm TLn, 523 cm PRC.

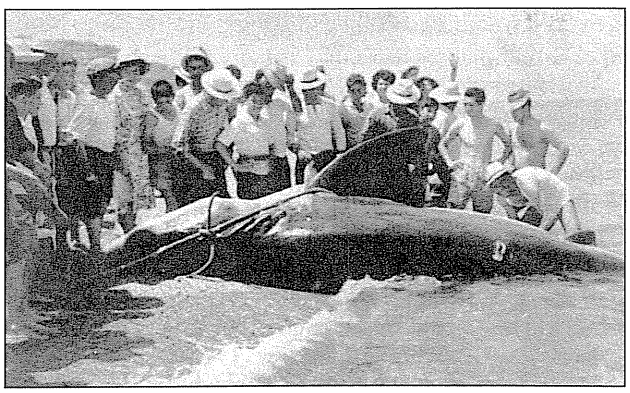


Fig. 5: Specimen caught off Ganzirri, Sicily (Italy), on June 19th 1961. (Photo: courtesy of D. Sorrenti)
Sl. 5: Primerek, ujet nedaleč od Ganzirrija na Siciliji (Italija) 19. junija 1961. (Foto: z dovoljenjem D. Sorrentija)

Piran, Slovenia, October 22nd 1963

On October 22nd 1963, a large white shark was caught off Salvore in the Gulf of Piran (Slovenia and Croatia) (Fig. 6). It approached a fishing boat belonging to the Delamaris fish processing company, while fishermen were turning in their nets, and was killed with 23 rifle shots. Its stomach contained a dolphin weighing about 200 kg. This case has been reported by Bošnjak & Lipej (1992-1993), Lipej (1993-1994), De Maddalena (2000a), and Soldo & Jardas (2001). One of the authors (L. Lipej) interviewed a fisherman who had at that time been on board the fishing boat, and the latter declared that the shark must had been about 6 m long and weighing about 1100 kg (Bošnjak & Lipej, 1992-1993; Lipej, 1993-1994), while the local newspaper "Primorske novice" indicated it to be 4 m long and weighing ca. 700 kg (Anonymous, 1963).

Photos of the specimen have been published in Bošnjak & Lipej (1992-1993) and Lipej (1993-1994): unfortunately these pictures cannot be used for an accurate estimate of the specimen's size on the basis of the people appearing near the shark. One of the authors (L. Lipej) eventually went to the Izola harbour to examine the precise place where the shark had been photographed after its landing. The blocks of cement of the harbour paving have sides measuring from 45 to 50 cm. On the two photos of this specimen, there are almost exactly 10 blocks in line from the shark's snout to the

Fig. 6: Specimen caught off Piran (Slovenia) on October 22nd 1963. (Photo: L. Lipej's archive)
Sl. 6: Primerek, ujet v bližini Pirana (Slovenija) 22. oktobra 1963. (Foto: Arhiv L. Lipeja)

apex of the upper lobe of its caudal fin. Considering that the shark is even in a slightly curved position (its axis being not perpendicular to the parallel lines of the paving), its length was estimated at 477-530 cm TLn, corresponding to 492-547 cm TOT, 387-430 cm PRC. Due to the 5 cm difference in the reference's size, no precise estimate could be made. We also noted that, according to Mollet & Cailliet (1996), our estimates agreed with the approximate weight reported by the fisherman.

Isola la Formica, Isole Egadi, Italy, May 1974

The capture of a female white shark took place on a May 1974 morning with the tuna trap (tonnara) off Isola la Formica (Italy). At that time, the chief of this tuna-trap called "rais" in Sicilian, was Michele Grimaudo. Nitto Minneo, the diver who worked as inspector of the tuna-trap nets, examined the shark underwater when already dead with its head trapped in the net. The man extracted all the teeth form the large shark's mouth and eventually distributed them among the men working on board the tuna-trap (N. Minneo, *pers. comm.).*

This case has been reported by Anonymous (1974) and Fergusson (1996). Anonymous (1974) erroneously indicated the capture location to be the near the island of Favignana, where another important tuna-trap was

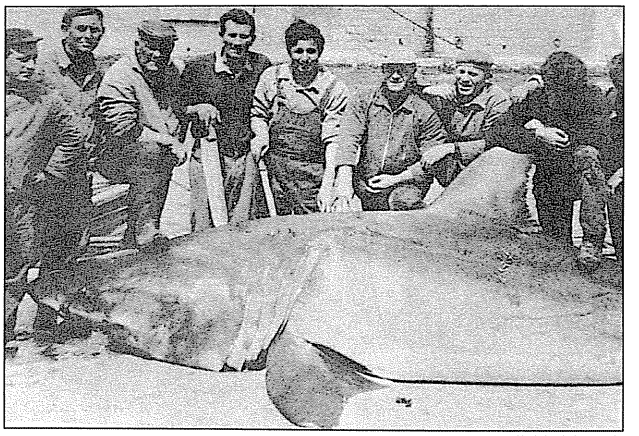


Fig. 7: Specimen caught off Isola la Formica, Isole Egadi (Italy), in May 1974. (Photo: A. De Maddalena's archive)
Sl. 7: Primerek, ujet v bližini otoka Isola la Formica, otočje Egadi (Italija), maja leta 1974. (Foto: Arhiv A. De Maddalene)

located. In Fergusson (1996), the specimen is cited three times, but every time with some minor differences. In its stomach were found a goat *(Capra hircus),* plastic bottles and plastic bags. The length was reported by Anonymous (1974) to be "almost 7 m", while Fergusson (1996) indicated it to be ca. 520-530 cm. The weight reported by Anonymous (1974) corresponds to 1500 kg, and this author also stated that the weight of the liver exceeded 300 kg.

Nitto Minneo reported its total length at 620-640 cm and specified that this measurement had been taken several times by the "rais", the fishermen and also by some tourists, when the shark was exposed to the curiosity of the people, as always when a large shark was captured with the tuna-trap. Mr. Minneo, too, reported that the shark weighed 2400-2600 kg. In his opinion, this specimen was probably the largest ever caught by tuna-traps off la Formica and Favignana. Moreover, even Gioacchino Cataldo, the "rais" of the Favignana tuna-trap, recalled the length of "640 cm, about 6 metres".

A good photo of the specimen is published in Anonymous (1974) (Fig. 7). For the estimate we chose, as reference, the man with a cap on his head and standing to the right of the man with his foot on the shark's head: since the two men are very close, even the one chosen as reference has to be very close to the shark. Presuming that the man was 175 cm tall, the PP2 was estimated at 336 cm, corresponding to 594 cm TOT, 575 cm TLn, 466 cm PRC.

Filfla, Malta, April 17th 1987

A large female white shark was caught in the morning of April 17th 1987 in the waters off Filfla, Malta, by

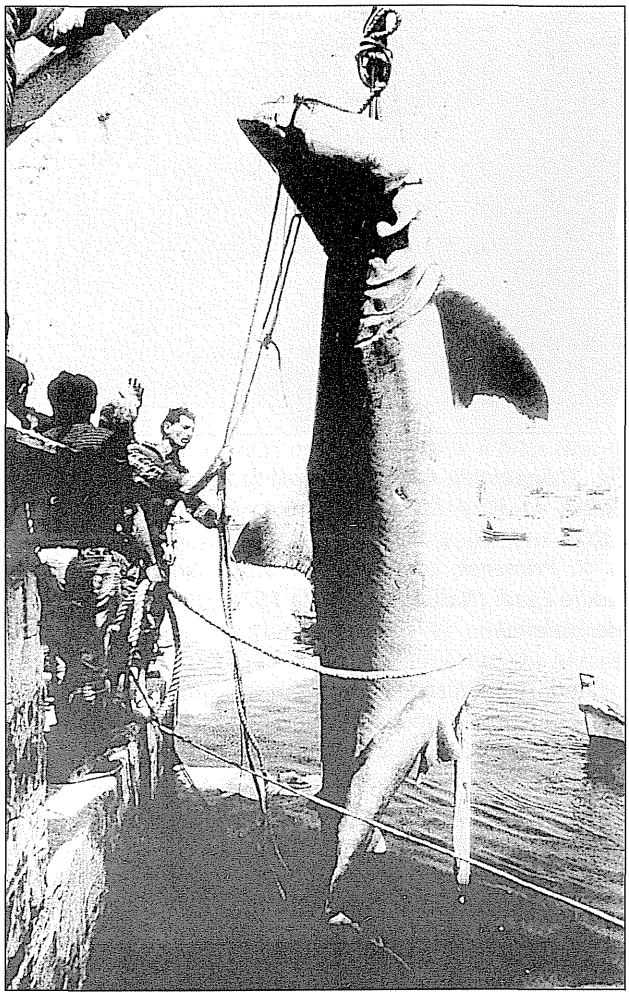
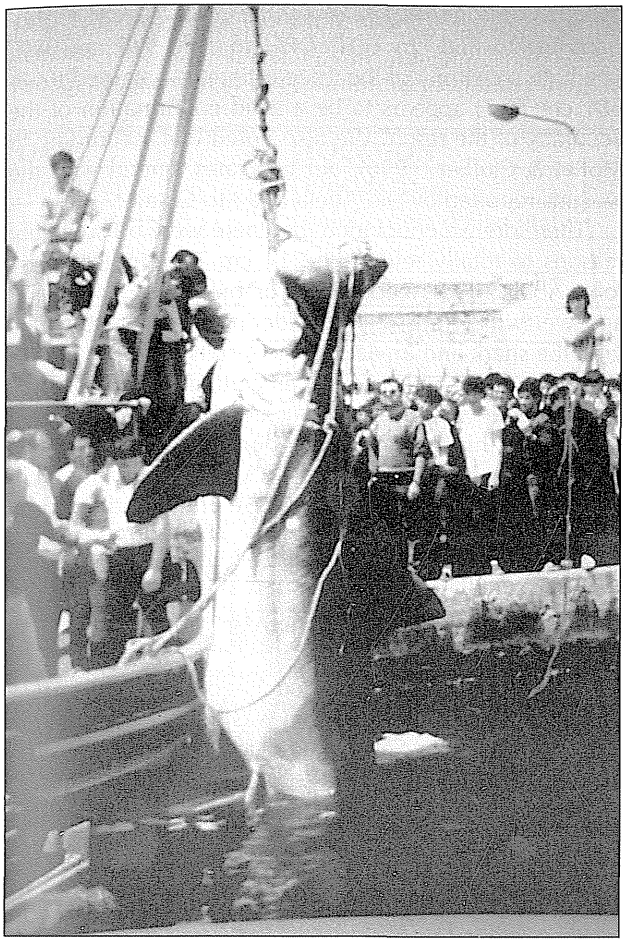
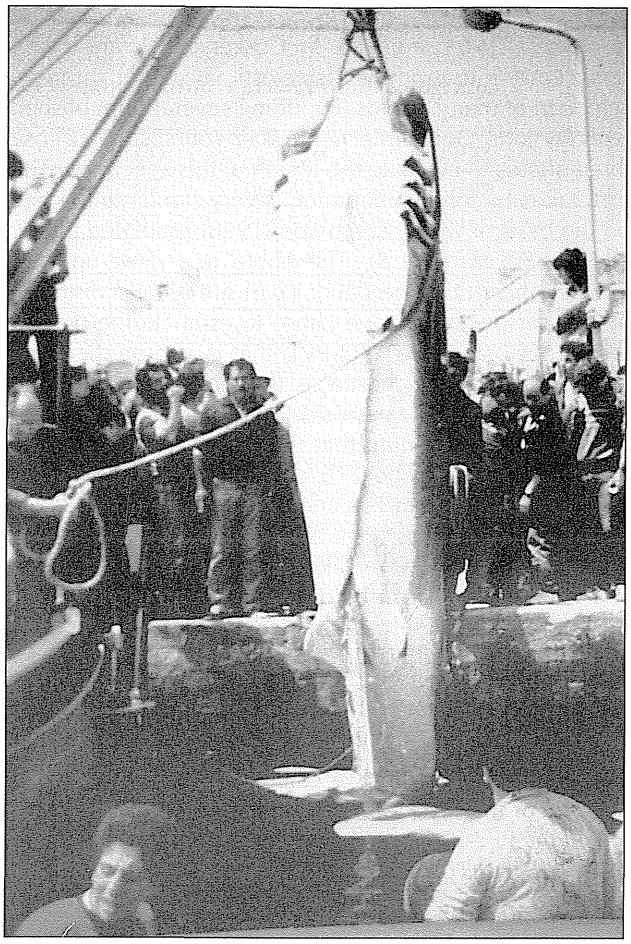


Fig. 8: Specimen caught off Filfla (Malta) on April 17th 1987. (Photo: J. Gullaumier)
Sl. 8: Primerek, ujet nedaleč od Filfle (Malta) 17. aprila 1987. (Foto: J. Gullaumier)

fishermen Alfredo Cutajar and Vince D'Amato. The catch took place 3 miles off Blue Grotto, south of Filfla. The shark was caught with a fixed surface long-line belonging to Mr. D'Amato, but the line snapped and got entangled with a line belonging to Mr. Cutajar, who eventually landed the shark. The latter was taken to Wied-Iz-Zurrieq, but since it was too heavy for the harbour winch, it was landed in Marsaxlokk. In its stomach a whole 220 cm blue shark, *Prionace glauca*, a 250 cm dolphin of unidentified species and bitten in two (or three according to some other sources), a marine turtle, *Caretta caretta*, having a 60 cm diameter carapace, and a plastic bag containing garbage were found (it is not known whether the lengths were originally taken in cm or in feet, and other sources reported the following sizes of these contents: blue shark 6 feet - 183 cm, dolphin 8 feet - 244 cm, marine turtle 2 feet - 61 cm). In the evening the shark was taken to Zurrieq and kept in a large garage. A day later (April 18th) it was taken to the Valletta fish market. The jaws were preserved by John Abela and exhibited in the Museum of History and Culture on Gozo Island. The case was reported and discussed by several authors (Abela, 1989; Ellis & McCosker, 1991; Mollet *et al.*, 1996; Fergusson, 1996; Fergusson, 1998; De Maddalena, 1999; Fergusson *et al.*, 2000; De Maddalena, 2001). Unfortunately no fisheries officer measured the shark (M. Darmanin, *pers. comm.).* Abela (1989) reported to have measured accurately the shark's total length in a straight line (as TOT, according to Fergusson, 1998), measuring 714 cm, and he also specified a weight of 2730 kg. In a letter that the shark's capturer, Alfredo Cutajar, wrote in May 1991 to Mr. Giuliano Chiocca, it was stated that it was 723 cm long and weighing 2880 kg. A few years after, in the mid-1990s, Alfredo Cutajar and John Abela were interviewed for the Jeremy Taylor's documentary "Jaws in the Med": here Mr. Cutajar reported a length of 23 feet (701 cm) for this specimen, while Abela confirmed that he had accurately measured the shark twice while lying flat on the floor; apparently it was 23 feet 5 inches (714 cm) long. Recently, in 2001, Mr. Cutajar stated to have estimated the shark as being 23 feet (701 cm) long on the basis of the length of the pick-up truck on to which it was placed with its caudal fin hanging out (this statement clearly indicates that he did not measure the shark's length); moreover he declared that an approximate weight of 3 t was estimated on the basis of the shark's individual parts cut up and sold at the fishmarket (M. Darmanin, *pers. comm.).* Mollet *et al.* (1996) wrote, on the basis of discordant testimonies by John Abela, that Abela did not measure the shark's length but only estimated it. Fergusson (1998) stated that this shark's length was in the 520-550 cm TL range: he reached this conclusion after examining the photograph of this specimen taken by photographer John Gullaumier and published by the Maltese newspaper "In-Nazzjon-Taghna" (Anonymous, 1987), based also on the judgement by a forensic investigator who analysed the picture on the request of the BBC Natural History Unit. Some time after, Fergusson *et al.* (2000) again confirmed this estimate, stating that this specimen was no longer than 550 cm TL. This length agrees with the size reported by Anonymous (1987) who reported the shark's weight at 1.5 t and its length at "about 18 feet" (549 cm). According to Fergusson (1998), in an interview given by Abela to the BBC, he admitted that "he may have made a mistake in taking the measurement". Recently, in 2001, Abela reconfirmed the 714 cm total length, but added that he had taken the shark's measure with a rope which he eventually measured (M. Darmanin, *pers. comm.).* However, the "about 18 feet" length reported by Anonymous (1987) was not measured but merely estimated (A. Buttigieg, *pers. comm.),* and the same may be said of the 1.5 t weight reported by the same source (Anonymous, *pers. comm.).*





Figs. 9, 10: Specimen caught off Filfla (Malta) on April 17th 1987. (Photo: A. De Maddalena's archive)
Sl. 9, 10: Primerek, ujet nedaleč od Filfle (Malta) 17. aprila 1987. (Foto: Arhiv A. De Maddalene)

In the end, it was not possible to find anyone else that measured the shark, so it seems certain that John Abela was effectively the only person to have done it. We were able to collect testimonies of three eyewitnesses that had seen the shark. Mr. Alex Buttigieg, a person that asked to remain anonymous, and the fisheries officer Mr. Grezzju Grech. None of them had a chance to measure the shark (the anonymous witness went to the Valletta fish market early in the morning with a camera and measuring tape only a minute before the shark was cut up, but had no permission to take photos or measurements). Alex Buttigieg and the anonymous witness declared to have estimated the shark's length to be conspicuously less than the 714 cm TOT reported by John Abela, but larger than the 520-550 cm TL estimated by Fergusson (1998) and Fergusson *et al.* (2000). The anonymous eyewitness estimated the length at approximately "18,5-19,5 feet" (564-594 cm) or "close to 20 feet" (610 cm), made at a distance of about 12 feet, when the shark was placed on the floor at the Valletta fishmarket. Alex Buttigieg estimated it to be "less than 20 feet" (610 cm), from a distance of about 20 m. Mr. Grezzju Grech, who was present when the shark was landed, affirmed that in his opinion it is possible that the specimen was 7 m long (M. Darmanin, *pers. comm.).* The several requests for more information about this case made recently by one of the authors (A.D.) to John Abela remained unanswered, but we have had some replies to our questions from him via Mr. Michael Darmanin, Senior Fisheries Officer at Malta Centre for Fisheries Sciences (Department of Fisheries and Aquaculture, Fort San Lucjan, Marsaxlokk): this last information, together with those from Mr. Buttigieg and the anonymous witness, helped us to reconstruct the entire story as reported herewith.

There are many photographs of this specimen, but most of them simply cannot be used for a reasonably good estimate to be made; the ample photographic evidence as far as this specimen is concerned demonstrates how much can be distorted as well as difficult to evaluate the size of a large specimen if photo is not taken adequately. For the reasons exposed in the Materials and Methods section, photos as the one showing the head of the shark suspended in vertical position with the

hand of a man placed near the axis of the pectoral fin (see Abela, 1989 or Ellis & McCosker, 1991) are totally unacceptable to produce a size estimate. After a careful selection of many photos (including several unpublished ones by John Gullaumier and other sources), we chose three photos to evaluate the length of this specimen. The first, taken by John Gullaumier, is very similar to the one on the basis of which Fergusson (1998) estimated the TL at 520-550 cm (Fig. 8). The photo is a close-up, and both the head and the caudal part are clearly distorted by the perspective, so we chose to estimate the prepelvic-prepectoral space, PP2-PP1, that is also on the same level of the person chosen as reference (the man with his hand raised and tartan shirt, and on the same plane as the shark). Assuming that the man was 175 cm tall, the PP2-PP1 would be 216 cm, which corresponds to 681 cm TOT, 660 cm TLn and 535 cm PRC.

Two other photos (Figs. 9, 10) were also taken into consideration that were taken from a longer distance, and for this reason can be quite suitable for an estimate to be made. In these cases, too, we estimated the PP2-PP1, since the head was in a strongly unnatural position. In both of these, we chose as reference the man with glasses and a rope in his hand, located on the same plane as the shark and, on the basis of his total height, assumed to be 175 cm, we calculated his visible partial height. For the first of these two photos (Fig. 9) we estimated the PP2-PP1 at 215 cm, corresponding to 678 cm TOT, 657 cm TLn, 532 cm PRC. For the second photo (Fig. 10), the PP2-PP1 was estimated at 212 cm, corresponding to 668 cm TOT, 647 cm TLn, 525 cm PRC. The high proximity of the three estimates obtained (668-681 cm TOT) appears to be a solid confirmation of the accuracy of the result. We also noted that, according to Mollet & Cailliet (1996), our estimates agreed with the weights reported by Mr. Abela and Mr. Cutajar.

Therefore we concluded that there were no sufficient reasons to totally refute the 714 cm TOT indicated by John Abela. If he made an error measuring the shark, and we think it possible considering the way he measured the shark and in view of the results obtained by our study, the true shark's TOT was certainly not conspicuously shorter (33-46 cm by our estimates) than the one reported by him. According to our estimates and to the observations by 5 eyewitnesses (Abela, Cutajar, Grech, Buttigieg, Anonymous), the 520-550 cm TL indicated by Fergusson (1998) and Fergusson *et al.* (2000) is not acceptable.

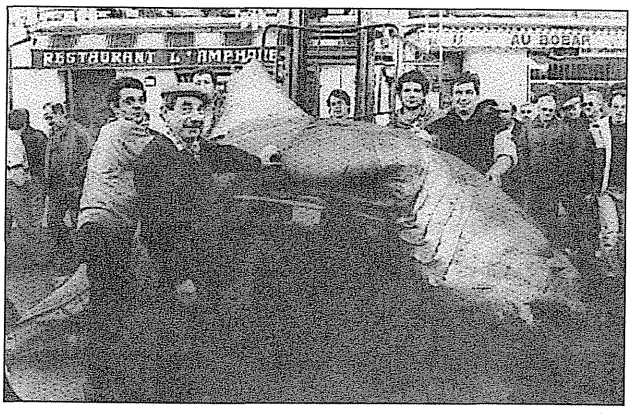


Fig. 11: Specimen caught off Sète (France) on January 9th 1991. (Photo: R. de Neuville)
Sl. 11: Primerek, ujet blizu Sèteja (Francija) 9. januarja 1991. (Foto: R. de Neuville)

Sète, France, January 9th 1991

A female white shark was caught on January 9th 1991 off Sète, France. This specimen was bought by a wholesale fishmonger in Sète, offered for sale in the Rungis market, and bought by a supermarket in Montargis (Anonymous, 1991; Quignard & Raibaut, 1993; Séret, 1996; De Maddalena *et al.*, 2001). It was reported by Anonymous (1991) as being 6 m long, by Sèret (1996) and Fergusson (1996) as about 4.5 m long. The photograph published in Anonymous (1991). The same photo (Fig. 11) has been used here to produce a more precise estimate (after the photograph made by today already deceased Raymond de Neuville it has been impossible to find any other photographs or a better reproduction of the same).

The interpretation of the picture is particularly difficult, not only due to the position of the animal, but also because of the proximity of the photographer to the subject and the strong deformation given by the perspective. The persons cannot be used directly as references, since none of them is on the same plane as the shark; for this reason it has been necessary to project in perspective on the plane of the shark the man located on the left to be used as reference. We assumed that he was 175 cm high and estimated the PRC at 464 cm, corresponding to 591 cm TOT, 572 cm TLn. Considering even the particular position of the body of the specimen, we validated this estimate on the basis of PD1: we estimate it to be 222 cm, corresponding to 588 cm TOT, 570 cm TLn, 462 cm PRC. These last results strongly confirm those previous obtained.

Tab. 3: Estimates of the white shark lengths (in centimetres) obtained through examination of photographic evidences.
Tab. 3: Ocene dolžin (v centimetrih) primerkov belih morskih volkov na osnovi preučevanih fotografij.

DATE	LOCATION	TOT	TLn	PRC
June 1924	Procida, Italy	507	491	398
12 August 1938	Enfola, Isola d'Elba, Italy	597-613	579-594	469-482
19 June 1961	Ganzirri, Sicily, Italy	666	645	523
22 October 1963	Piran, Slovenia	492-547	477-530	387-430
May 1974	Isola la Formica, Isole Egadi, Italy	594	575	466
17 April 1987	Filfla, Malta	668-681	647-660	525-535
9 January 1991	Sète, France	591	572	464

CONCLUSIONS

Of the 7 examined specimens, 5 were estimated to measure over 590 cm TOT (Tab. 3). Of these, at least two (Malta 1987 and Ganzirri 1961) greatly exceed 600 cm, both in TOT and in TLn. These two specimens could even be the largest ever recorded world-wide. But we should also consider the most solid cases of other possibly larger specimens reported until today. These are the following three.

The discussed specimen caught off Kangaroo Island, Australia, in May 1987 and reported to be over 7 m in length, but never measured (Jury, 1987; Cappo, 1998; Mollet *et al.*, 1996). The only photographic evidences known to us (published in Jury, 1987 and Ellis & McCosker, 1991) show the head only, cut at the level of the second gill slit, and a pectoral fin, but this picture, for the position of the photographer and of the reference, cannot be considered useful for a reliable estimate. Mike Cappo reported that Peter Riseley (the fisherman that caught the shark) measured the head length from first gill slit to be 53 inches (135 cm) (H. Mollet, *pers. comm.),* almost surely as PG1 (prebranchial length); Mollet *et al.* (1996) reported this PG1 as "estimated value". On the basis of the Lausanne specimen, 135 cm PG1 corresponds to 645 cm TOT, 625 cm TLn, 507 cm PRC.

About the specimen caught in 1945 off Castillo de Cojimar, Cuba, that was reported to be 640 cm in length (Bigelow & Schroeder, 1948; Guitart-Manday & Milera, 1974), the contestation of this case presented in Randall (1987) is not acceptable, since it is based on wrong assumptions. In fact we noticed that: a) the preserved vertebra was not necessarily the largest of the vertebral column, and therefore it could not be used to obtain the precise length of the specimen, b) in general it has came out that the size of the largest anterior tooth of the upper jaw cannot be considered as a sufficiently reliable index of the length of a large white shark, c) the girth of the body (and consequently the height of the body at the level of the first dorsal fin) shows wide variation from specimen to specimen, and depending even on the state of preservation of the specimen, thus it is impossible to use it to estimate the length of the shark. In the end we believe that there is no reason to refute the 640 cm length reported for this specimen by the source. The only doubt remains about the fact that it is unknown whether this measure was taken as TOT, TLn or in another way.

In the end let us refer to the enormous specimen cited in Barrull & Mate (2001), reported by Dr. Juan Antonio Moreno. The shark was caught in 1982 off Dakar, Senegal. Dr. Moreno eyewitnessed the landing of the specimen, but he did not get the permission to measure the shark with a ruler, nor to take photographs. Dr. Moreno estimated its total length at over 800 cm: he reached this conclusion measuring it as TLn, twice, with its feet. Jaws of this specimen were sold to an American customer for 1000 U.S. dollars (J. A. Moreno, *pers. comm.).* Although the measure reported cannot be regarded as accurate, considering the unusual way it was taken (this is the reason why Dr. Moreno never published a report on this specimen), this case is undoubtedly of a special interest, being the only in which a so large specimen was examined by an ichthyologist and specialist in the study of sharks.

With this work we believe to have definitively demonstrated that *C. carcharias* can, in rare and exceptional cases, exceed 6 meters in length, reaching at least 640-660 cm TOT and very probably even more.

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ANALIZA FOTOGRAFIJ NAJVEČJIH BELIH MORSKIH VOLKOV *CARCHARODON CARCHARIAS* (LINNÉ, 1758), UJETIH V SREDOZEMSKEM MORJU

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POVZETEK

Avtorji pričujočega članka so analizirali fotografije največjih belih morskih volkov Carcharodon carcharias, *ujetih v Sredozemskem morju in glede na obstoječo literaturo dolgih blizu 6 metrov ali celo več. Preučili so 7 primerkov in ocenili njihovo TOT (celotna iztegnjena dolžina), TLn (celotna dolžina v naravni legi) in PRC (predrepna dolžina), in sicer na osnovi mer, ki so jih predstavili De Maddalena* et al. *(2001) o 583 cm (TOT) dolgem primerku, razstavljenem v lausannskem Zoološkem muzeju. Celotne iztegnjene dolžine teh belih morskih volkov so: 507 cm (Procida, Italija, junij 1924), 597 cm (Enfola, Isola d'Elba, Italija, 12. avgust 1938), 666 cm (Ganzirri, Sicilija, Italija, 19. junij 1961), 492-547 cm (Piran, Slovenija, 22. oktober 1963), 594 cm (Favignana, Isole Egadi, Italija, maj 1974), 668-681 cm (Filfla, Malta, 17. april 1987), 591 cm (Sète, Francija, 9. januar 1991). Pet primerkov je torej merilo v dolžino več kot 590 cm, in vsaj dva od njih (Ganzirri 1961 in Malta 1987) sta temeljito presegala dolžino 6 m tako kar zadeva TOT kot TLn. Sicer pa bi ta dva primerka lahko bila največja, kar so jih kdaj ujeli na svetu. Avtorji obravnavajo tudi nekaj otipljivejših primerov drugih belih morskih volkov teh dolžin (Kangaroo Island, Avstralija, 1987; Castillo de Cojimar, Kuba, 1945; Dakar, Senegal, 1982) in zaključujejo, da je* C. carcharias *lahko dolg najmanj 640-660 cm (TOT), a da je po vsej verjetnosti še daljši.*

Ključne besede: beli morski volk, *Carcharodon carcharias*, velikost, Sredozemsko morje

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L'ITTIOFAUNA DELLA RISERVA NATURALE MARINA DI MIRAMARE (GOLFO DI TRIESTE, ALTO ADRIATICO)

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SINTESI

La Riserva Naturale Marina di Miramare (Golfo di Trieste, Alto Adriatico) recentemente ha istituito un centro di raccolta e archiviazione di informazioni denominato Osservatorio del Litorale (O.d.L) L' O.d.L. collega i dati storici con le informazioni biologiche e chimico-fisiche raccolte durante attività di monitoraggio sul campo. Dagli studi effettuati sino ad ora, la RNMM risulta essere un importante sito di conservazione relativamente alla presenza di specie di Osteitti endemiche a limitato range di distribuzione geografica ed inoltre l'importanza biologica è sottolineata dal fatto che la maggior parte delle specie completano il loro ciclo riproduttivo entro l'area protetta.

Parole chiave: ittiofauna, biodiversità, Riserva naturale Marina di Miramare (TS), Osservatorio del Litorale

THE ICHTHYOFAUNA OF MIRAMARE NATURE RESERVE (GULF OF TRIESTE, NORTHERN ADRIATIC)

ABSTRACT

In Miramare Nature Reserve near Trieste (Gulf of Trieste, Northern Adriatic), a special data collection centre called Littoral Observatory (O.d.L. – Osservatorio del Litorale) was opened recently, its main objective being integration of the older data with the new biological and physical-chemical records within the framework of the field monitoring of the quality of the sea. On the basis of the research carried out so far, it has become clear that in view of the endemic teleost species with limited geographical range occurring there, the Miramare Nature Reserve is certainly a very important protected area, particularly due to the fact that the majority of fish species reproduce and develop within this protected area.

Key words: ichthyofauna, biodiversity, Miramare Nature Reserve, Littoral Observatory

INTRODUZIONE

La Riserva Naturale Marina di Miramare (RNMM) (Golfo di Trieste, Alto Adriatico) ha un'estensione totale di 121 ettari che rientrano in un range batimetrico compreso tra 0 e 20 metri. Recentemente ha istituito un centro di raccolta e archiviazione di informazioni denominato Osservatorio del Litorale (O.d.L). L' O.d.L. è un centro di raccolta dati che si basa sul confronto spaziale e temporale di informazioni raccolte nel corso di attività scientifiche condotte principalmente all'interno della Riserva Marina - quale stazione preferenziale di rilievi e studi rappresentativi dell'ambiente marino – e nel Golfo di Trieste per un costante confronto tra aree protette ed aree antropizzate. Tale verifica permette di acquisire un aggiornamento della situazione ambientale ed un corretto inquadramento dell'area tutelata con l'ambiente circostante.

L' O.d.L. collega i dati storici con le informazioni raccolte durante attività di monitoraggio sul campo (censimenti visuali, controlli su stazioni fisse, microprelievi, video-transetti) e quanto acquisito dall'attività di raccolta dati chimico-fisici (boa oceanografica con sonda profilante, mini termometri, campagne oceanografiche).

Il Data Base (D.B.) rappresenta il supporto informatico atto all'archiviazione delle diverse informazioni raccolte (sistematiche, biologiche, ecologiche, *ecc.).* L'interrogazione del D.B. consente di ottenere delle risposte inerenti la distribuzione, la biologia e l'ecologia delle specie nella RNMM. e nel Golfo di Trieste.

Il Golfo di Trieste risulta un sito estremamente importante per la sua posizione geografica, la sua centenaria tradizione scientifica in campo marino e la tipologia degli ambienti marini che negli anni hanno subito importanti modificazioni (Odorico & Bressan, 1993). Tali modificazioni non sempre vanno ricondotte all'attività dell'uomo, ma anche a variazioni meteo - climatiche (Stravisi *et al.*, 1996; Dulčić *et al.*, 1999).

MATERIALE E METODI

Il monitoraggio biologico utilizzato all'interno dell'area tutelata è il "visual census". Si tratta di una tecnica non invasiva di monitoraggio delle specie ittiche (Harmelin-Vivien & Francour, 1992; Francour *et al.,* 1999) consistente nella determinazione e conteggio delle stesse da parte di operatori muniti di semplice lavagna o di videocamera subacquea.

Il monitoraggio viene eseguito mensilmente lungo transetti fissi che intendono rappresentare le principali tipologie della Riserva. Pertanto si snodano parallelamente alla scogliera di Miramare (due transetti orizzontali a 5 m, due transetti superficiali a 1,5 m), ma anche parallelamente alla zona del Bagno ducale con un transetto ad una profondità di 3 metri ed un altro a 0,50

Fig. 1: Il Promontorio di Miramare con la scogliera lungo la quale si effettuano le osservazioni mediante visual census. Altri transetti costieri sono localizzati nella zona sabbiosa antistante il porticciolo e nella zona del Bagno ducale. (Foto: R. Odorico)
Sl. 1: Obrežni del rezervata pri Miramaru s pečevjem, kjer so bila opravljena opazovalna vzorčevanja. Drugi obrežni transekti so locirani na peščenem predelu pred mandračem in v predelu Bagno ducale. (Foto: R. Odorico)

m finalizzato esclusivamente alle specie a distribuzione superficiale (Blenniidae). I transetti relativi ad una stazione vengono sovente raccordati da brevi transetti perpendicolari agli stessi onde verificare e correggere eventuali spostamenti e movimenti della comunità ittica. Nelle aree di osservazione come scogli isolati o in particolare nella Barriera di Miramare (aree a lunghezza ridotta), che vengono utilizzate a corredo nella raccolta dei dati, non è stato ritenuto valido il transetto lineare, ma l'utilizzo di un sistema fisso di osservazione. Un operatore all'occorrenza si posiziona nelle stazioni fisse di osservazione e provvede alla raccolta dei dati.

Nel percorrere i transetti viene mantenuta una velocità costante di osservazione e viene adeguata al tipo di raccolta dati. Per il percorso del transetto più impegnativo in quanto finalizzato all'osservazione delle specie bentoniche di piccole dimensioni si può arrivare ai 5m/min. A titolo esemplificativo, l'operazione che negli anni è stata ottimizzata per la scogliera di Miramare consiste in una serie di transetti lineari lunghi 50 m ad una profondità di 1,5 m e 5m. Ciascuno percorso a due velocità per trarre maggiori informazioni e dopo opportuno intervallo di tempo (15 min) per non turbare le misure successive. Le modalità utilizzate sono confermate anche da ricerche bibliografiche specifiche (D'Anna *et al.,* 1999; Vacchi & La Mesa, 1999). Nel corso degli anni '90 sono state definite le specie più rappresentative della popolazione di scogliera del Promontorio di Miramare (Fig. 1) desunte dai dati relativi ai transetti della scogliera

Tab. 1: La tabella illustra le principali specie ittiche avvistate nei transetti di Scogliera nel corso del 2000. I valori da 1 a 6 rappresentano lo stato di aggregazione degli individui: + : singoli avvistamenti /individuo casuale/ banco casuale; 1 : singoli avvistamenti/ individuo solitario; 2 : fino a 5 individui solitari lungo il transetto; 3 : frequenti individui solitari lungo il transetto; 4 : gruppi (5-15 individui); 5 : banchi (15-30 individui), 6 : grossi banchi (più di 30 individui).

Tab. 1: Tabela prikazuje glavne vrste rib, opažene na transektih ob pečevju v letu 2000. Vrednosti od 1 do 6 ponazarjajo različne stopnje združevanja osebkov: +: posamezna opažanja/naključni osebek/naključna jata; 2: do 5 posameznih osebkov vzdolž transekta; 3: pogosti posamezni osebki vzdolž transekta; 4: skupine (5-15 osebkov), 5: jate (15-30 osebkov), 6: velike jate (več kot 30 osebkov).

Specie	gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic
Atherina hepsetus	-	-	-	6	5	6	6	6	-	6	6	6
Atherina boyeri	-	-	6	6	6	6	6	6	6	6	6	6
Spicara maena	-	-	-	-	-	4	4	4	1	-	-	-
Mugil cephalus	-	-	-	-	-	6	6	6	6	-	-	-
Mullus barbatus	-	-	-	-	-	1	1	3	3	4	-	-
Dicentrarchus labrax	-	-	1	1	3	4	4	4	4	4	+	+
Diplodus puntazzo	-	-	-	-	-	4	3	3	3	3	-	-
Dentex dentex	-	-	-	-	+	+	+	2	+	+	-	-
Diplodus annularis	-	-	-	-	4	3	4	3	3	3	-	-
Diplodus sargus	-	-	-	-	4	3	4	3	4	3	-	-
Diplodus vulgaris	-	-	-	-	-	1	3	4	1	1	-	-
Oblada melanura	-	-	-	-	4	5	5	5	1	1	-	-
Sparus auratus	-	-	-	-	-	4	5	4	4	4	4	-
Lipophrys adriaticus	-	-	-	2	1	2	2	2	2	2	2	-
Lipophrys canevai	-	-	+	1	1	2	2	2	2	2	2	-
Lipophrys dalmatinus	-	-	1	1	1	2	2	2	2	2	2	-
Parablennius gattorugine	-	+	+	+	1	2	2	3	3	3	-	3
Parablennius incognitus	-	-	+	1	1	1	1	1	1	1	1	-
Lipophrys nigriceps	-	-	+	-	-	+	1	1	1	1	-	-
Parablennius pavo	-	-	+	1	2	2	2	2	2	2	2	2
Parablennius rouxi	-	-	+	2	2	1	1	1	1	1	1	-
Parablennius sanguinolentus	-	-	-	1	1	3	3	1	1	3	3	3
Aidablennius sphinx	-	-	1	1	1	1	1	+	+	+	+	+
Parablennius tentacularis	-	-	-	1	1	1	1	1	1	1	1	1
Parablennius zvonimiri	-	-	-	+	1	1	1	1	2	2	1	1
Conger conger	-	-	1	1	1	1	2	2	2	2	2	2
Gobius auratus	+	+	+	+	+	+	+	+	+	+	+	+
Gobius bucchichii	-	+	-	3	3	3	3	3	3	3	3	3
Gobius cruentatus	-	-	-	3	3	3	3	3	3	3	2	-
Gobius cobitis	-	-	-	+	1	2	2	2	2	2	2	2
Gobius paganellus	-	-	-	-	-	-	1	-	1	1	-	-
Zebrus zebrus	-	-	-	-	1	1	1	1	1	1	1	1
Symphodus cinereus	-	-	-	-	-	1	1	1	1	1	+	-
Symphodus mediterraneus	-	-	-	-	1	2	2	2	2	1	-	-
Symphodus melops	-	-	-	-	-	1	2	2	2	2	2	-
Symphodus ocellatus	-	-	-	-	-	1	1	2	2	-	-	-
Symphodus roissali	-	-	-	-	-	2	2	2	2	2	-	-
Symphodus rostratus	-	-	-	-	-	1	1	1	1	1	1	-
Symphodus tinca	-	+	+	1	3	3	3	3	3	3	3	3
Labrus merula	1	1	1	1	2	2	2	2	2	2	2	2
Chromis chromis	-	-	+	4	4	4	5	5	5	5	4	1
Sciaena umbra	-	-	-	-	4	4	6	6	6	6	-	-
Scorpaena porcus	-	+	+	1	1	1	1	1	1	1	1	-
Scorpaena scrofa	-	-	-	-	1	1	1	1	1	1	1	-
Serranus hepatus	1	-	-	1	1	2	2	2	2	2	2	2
Serranus scriba	1	1	+	+	3	3	3	3	3	3	1	1
Sarpa salpa	-	-	-	-	5	5	5	6	6	6	-	-
Spondyliosoma cantharus	-	-	-	-	-	-	-	+	-	-	-	-
Tripterygion tripteronotus	-	-	+	1	2	2	2	2	2	2	2	1
Tripterygion delaisi	-	-	-	1	1	1	1	1	1	1	1	1

(4 transetti) ed a quelli della zona del Bagno Ducale. Per gran parte delle specie rilevate è stato definito il periodo di comparsa stagionale, presenza massima ed il successivo abbandono di questa stazione di osservazione. L'unione dei dati relativi a più transetti, 8 nell'ambito delle batimetriche più superficiali (utilizzando la metodica del transetto lineare) e 2 punti fissi nella zona profonda (barriera artificiale posta a 150 metri dalla scogliera ad una profondità di 17 m) rappresentano il quadro più completo possibile di una zona estremamente diversificata. L'acquisizione di una serie storica desunta da transetti, peraltro confermata da osservazioni ripetute nel tempo, permetterà di formulare ulteriori importanti valutazioni sulle comunità ittiche per determinare eventuali cambiamenti in seguito all'eccezionalità delle ultime annate. Per evidenziare l'importanza della Riserva rispetto all'Adriatico si è utilizzato un Indice di Ricchezza Specifica (IRS) dato dal rapporto tra le specie di ogni singola Famiglia presente in Riserva, con le specie totali adriatiche:

$IRS = S\text{-}1/Ln_e N$

S è il numero di specie per famiglia nella RNMM, N è il numero totale di specie in Adriatico.

I dati vengono raccolti ed analizzati correlando tra loro i diversi ambiti di studio. Allo stato attuale nell'aggiornamento e lettura del database, particolare attenzione è rivolta a specie ed associazioni vulnerabili, definite secondo la *List of endangered species and associations,* elaborata dall'UNEP nel corso del *Meeting of experts on habitats* (AA.VV., 1998), in cui le risorse biologiche del Mediterraneo sono state suddivise in base a criteri di rarità, vulnerabilità, diffusione, *ecc.* Tali criteri sono stati vagliati dai rappresentanti scientifici di tutti gli stati rivieraschi del bacino del Mediterraneo e si è tentata una stesura obiettiva dei criteri di importanza di specie ed associazioni con una particolare attenzione al Mediterraneo Orientale e particolari regioni biogeografiche.

RISULTATI E DISCUSSIONE

Nel corso del 2000 sono state definite alcune procedure standard per mettere a confronto i transetti di Miramare (Tab. 1) con altri ambienti del Golfo di Trieste. Barriere artificiali sperimentali ed afferrature al largo presenti nel Golfo di Trieste (Odorico & Costantini, 2001), scogliere costiere che costituiscono importanti elementi di aggregazione ittica sono state inserite in particolari indagini e riferite, oltre che alla scogliera di Miramare, anche alla barriera di ripopolamento sita all'interno del comprensorio protetto. Nella tabella 2 vengono confrontate le situazioni costa-largo dell'ambito protetto di Miramare (Tab. 2). I valori da 1 a 5 s'intendono relativi al numero di osservazioni efficaci per le singole specie secondo il seguente riferimento:

1: da 1% a 10% specie osservata su totale giornate di campionamento, **2**: da 10% a 25% specie osservata su totale giornate di campionamento, **3**: da 25% a 50% specie osservata su totale giornate di campionamento, **4**: da 50% a 75% specie osservata su totale giornate di campionamento, **5**: da 75% a 100% specie osservata su totale giornate di campionamento. Nell'anno 2000 il totale delle giornate di campionamento ritenute idonee al campionamento sono risultate 48.

Il dato qualitativo (presenza-assenza) riferito a 4 stazioni nel Golfo di Trieste (Tab. 3) è stato anch'esso integrato da considerazioni sul grado di diffusione di certe specie espresso in numero di avvistamenti sul totale delle osservazioni secondo la scala ordinata da 1 a 5. Tali osservazioni effettuate secondo le tecniche del visual census più idonee (De Gerolamo *et al.*,1998; Odorico & Costantini, 2001; Verginella, 2001) sono state rilevate nel corso dell'estate ed in periodi ben precisi della giornata, ripetuti nel corso dei diversi censimenti, onde evitare le eventuali interferenze dovute ai ritmi fisiologici e variazioni ambientali.

Si è posta particolare attenzione alla classe degli Osteitti. Grazie ai censimenti effettuati sono state identificate 37 famiglie per un totale di 101 specie. Le specie di Osteitti presenti in RNMM, sono state confrontate con gli Osteitti dell'Adriatico e del Mediterraneo (Tab. 4). Al fine di evidenziare maggiormente il concetto di biodiversità sono state prese in considerazione le sole famiglie presenti nella RNMM. Si è voluto mettere in relazione il numero di specie per famiglia presenti nella RNMM, rispetto alle specie delle medesime famiglie presenti in Adriatico ed in Mediterraneo.

Dal grafico (Fig. 2) è possibile osservare che la Famiglia più rappresentativa in Mediterraneo è quella dei Gobidi. In Mediterraneo risultano censite 66 specie di Gobidi, in Adriatico 35 e nella Riserva 11. Nella RNMM rispetto al bacino adriatico e mediterraneo assumono particolare importanza le famiglie Blenniidae, Labridae e Sparidae. Per quanto riguarda i Blennidi, in Mediterraneo sono presenti 25 specie, in Adriatico 16 ed in Riserva 14; i Labridi censiti in Mediterraneo sono 23, in Adriatico 18 ed in Riserva 9; infine gli Sparidi in Mediterraneo risultano essere 23, in Adriatico 19 ed in Riserva 12.

La diversità specifica all'interno delle famiglie sopracitate può essere utilizzata come criterio ecologico nella definizione dell'area come sito di conservazione (Medmaravis, 1995).

L'indice ha identificato che le Famiglie numericamente più rappresentative sono: Blenniidae, Labridae, Sparidae, ed evidenzia inoltre l'importanza dei Gobidi presenti in Riserva rispetto alle specie presenti in Adriatico (Tab. 5).

Un'analisi accurata ha messo inoltre in luce la presenza di alcune specie endemiche (Tab. 6) che tendono ad evidenziare l'importanza della RNMM quale sito di conservazione biologica in ambito adriatico e più ampiamente in Mediterraneo.

Tab. 2: Confronto tra costa e largo in prossimità del promontorio di Miramare. Gli asterischi evidenziano specie pescate nella zona di Grignano. Le sigle corrispondono agli ambienti in cui sono avvistate: SR – permanentemente a contatto con fondale roccioso, NEC – specie comunque avvistata in prossimita' della scogliera, SS – specie tipicalmente in fondale sabbioso, FR – tipicamente in zona fanghi del largo.
Tab. 2: Primerjava ihtiofavne na obrežnem območju in na odprtem morju pri Miramaru. Zvezdice označujejo vrste, ulovljene na območju Grignana. Kratice ustrezajo okolju, v katerem so bile vrste opažene: SR – vrste v stalnem stiku s skalnatim dnom, NEC – vrste ob pečevju, SS – vrste, značilne za peščeno dno in FR – vrste, značilne za muljevito dno odprtega morja.

Specie	Famiglie	Amb	Pescati	costa	largo
Atherina hepsetus	Atherinidae	NEC	*	3	2
Belone belone	Belonidae	NEC	*	3	
Lipophrys adriaticus	Blenniidae	SR		4	5
Lipophrys dalmatinus	Blenniidae	SR		4	5
Parablennius gattorugine	Blenniidae	SR		5	4
Parablennius incognitus	Blenniidae	SR		3	4
Parablennius rouxi	Blenniidae	SR		4	
Tripterygion delaisi	Tripterygiidae	SR		4	4
Tripterygion tripteronotus	Tripterygiidae	SR		4	5
Parablennius tentacularis	Blenniidae	SR		5	3
Lichia amia	Carangidae	NEC	*	+	1
Trachurus trachurus	Carangidae	NEC		+	
Seriola dumerili	Carangidae	NEC	*	+	1
Spicara maena maena	Centracanthidae	SR	*	3	3
Spicara maena flexuosa	Centracanthidae	SR	*	2	1
Conger conger	Congridae	FR	*	3	5
Boops boops	Sparidae	SR	*	1	
Boops salpa	Sparidae	SR		5	
Gaidropsarus mediterraneus	Gadidae	FR			2
Micromesistius potassou	Gadidae	FR			
Merlangius merlangius	Gadidae	FR	*		
Trisopterus minutus capelanus	Gadidae	FR	*	1	
Lepadogaster lep.lepadogaster	Gobiesocidae	SR		2	
Gobius cobitis	Gobiidae	SR		3	
Gobius cruentatus	Gobiidae	SR	*	3	3
Gobius jozo	Gobiidae	SS	*	3	
Symphodus cinereus	Labridae	SR		2	
Symphodus tinca	Labridae	SR		5	5
Symphodus ocellatus	Labridae	SR		4	2
Symphodus roissali	Labridae	SR		2	3
Lophius piscatorius	Lophidae	FR	*	+	
Liza aurata	Mugilidae	NEC	*	5	
Mugil cephalus	Mugilidae	NEC	*	5	1
Mullus barbatus	Mullidae	SS	*	3	
Chromis chromis	Pomacentridae	SR		5	2
Platichthys flesus italicus	Pleuronectiidae	SS	*	2	
Sciaena umbra	Sciaenidae	SR	*	5	3
Scomber scombrus	Scombridae	NEC	*		
Scomber japonicus	Scombridae	NEC	*		
Dicentrarchus labrax	Serranidae	NEC	*	5	4
Serranus hepatus	Serranidae	SR	*	4	5
Serranus scriba	Serranidae	SR		4	
Polyprion americanum	Serranidae	SR			
Scorpaena porcus	Serranidae	SR		2	2
Phrynorhombus unimaculatus	Bothidae	SR		1	
Solea kleinii	Soleidae	SS		1	
Solea impar	Soleidae	SS		1	
Solea vulgaris	Soleidae	SS		1	
Solea lascaris	Soleidae	SS		1	
Diplodus puntazzo	Sparidae	NEC	*	4	3
Diplodus annularis	Sparidae	NEC		4	4
Diplodus sargus	Sparidae	NEC	*	4	5
Diplodus vulgaris	Sparidae	NEC		3	5
Lithognathus mormyrus	Sparidae	NEC	*	2	1
Pagellus erythrinus	Sparidae	NEC	*	2	
Dentex dentex	Sparidae	NEC	*	2	1
Sparus auratus	Sparidae	NEC	*	5	3
Oblada melanura	Sparidae	NEC	*	4	2
Hippocampus hippocampus	Syngnathidae	SS		2	
Hippocampus ramulosus	Syngnathidae	SS		2	
Syngnathus acus	Syngnathidae	SS		2	2
Trigla lyra	Triglidae	FR			
Trigla lucerna	Triglidae	FR	*		
Zeus faber	Zeidae	FR	*		

Tab. 3: Confronto delle comunità ittiche in aree al largo caratterizzate da strutture "ad oasi" in mezzo a substrato molle: Miramare – barriera di ripopolamento; Dosso di S.ta Croce – transetti sulle piramidi e sul relitto: strutture sperimentali – siti di ripopolamento sotto alle mitticolture; piramidi LBM – piramidi presso i Filtri d'Aurisina.

Tab. 3: Primerjava med ribjimi združbami v "oazah trše podlage" na muljevitem dnu odprtega morja: Miramare – umetni podvodni greben; Dosso di Santa Croce – transekti na piramidah in na razbitini; eksperimentalne strukture – postaje za repopulacijo pod gojišči školjk; piramide ustanove Laboratorio di biologia marina (LBM) pri Nabrežini (Aurisina).

Pisces	Famiglie	Miramare	Dosso di S. Croce	Strutture sperimentali	Piramidi LBM
Atherina hepsetus	Atherinidae	2	3	2	
Belone belone	Belonidae		1	1	
Lipophrys adriaticus	Blenniidae	5		1	1
Lipophrys dalmatinus	Blenniidae	5	3	2	1
Parablennius gattorugine	Blenniidae	4	2	3	
Parablennius incognitus	Blenniidae	4	3	3	2
Parablennius rouxi	Blenniidae		3		
Tripterygion delaisi	Tripterygiidae	4			1
Tripterygion tripteronotus	Tripterygiidae	5	1	1	
Parablennius tentacularis	Blenniidae	3	2	3	2
Lichia amia	Carangidae	1			
Seriola dumerili	Carangidae	1	1		
Spicara maena maena	Centracanthidae	3	4	3	
Spicara maena flexuosa	Centracanthidae	1	1		
Conger conger	Congridae	5	1		
Boops boops	Sparidae		2		
Boops salpa	Sparidae				3
Gaidropsarus mediterraneus	Gadidae	2	3	2	
Micromesistius potassou	Gadidae		4		
Merlangius merlangius	Gadidae		2		
Trisopterus minutus capelanus	Gadidae		2		
Lepadogaster lep.lepadogaster	Gobiesocidae		1	2	
Gobius cobitis	Gobiidae		2	3	
Gobius cruentatus	Gobiidae	3		2	2
Gobius jozo	Gobiidae		5	5	1
Symphodus cinereus	Labridae		3	2	
Symphodus tinca	Labridae	5	5	3	
Symphodus ocellatus	Labridae	2	3	2	1
Symphodus roissali	Labridae	3	2	4	
Lophius piscatorius	Lophidae				1
Liza aurata	Mugilidae				1
Mugil cephalus	Mugilidae	1			2
Mullus barbatus	Mullidae		1		
Chromis chromis	Pomacentridae	2	3	3	2
Platichthys flesus italicus	Pleuronectiidae		1		
Sciaena umbra	Sciaenidae	3			
Dicentrarchus labrax	Serranidae	4	2	3	2
Serranus hepatus	Serranidae	5	5	1	2
Serranus scriba	Serranidae			2	3
Scorpaena porcus	Serranidae	2		2	
Phrynorhombus unimaculatus	Bothidae		1		1
Solea impar	Soleidae				1
Solea vulgaris	Soleidae		1		
Solea lascaris	Soleidae		2		
Diplodus puntazzo	Sparidae	3			2
Diplodus annularis	Sparidae	4	3		3
Diplodus sargus	Sparidae	5	4		
Diplodus vulgaris	Sparidae	5	3		2
Lithognathus mormyrus	Sparidae	1			
Pagellus erythrinus	Sparidae		1		
Dentex dentex	Sparidae	1		1	
Sparus auratus	Sparidae	3		2	3
Oblada melanura	Sparidae	2	3	2	3
Hippocampus hippocampus	Syngnathidae		3		
Hippocampus ramulosus	Syngnathidae		3		
Syngnathus acus	Syngnathidae	2	1		
Trigla lyra	Triglidae		1		
Trigla lucerna	Triglidae		1		

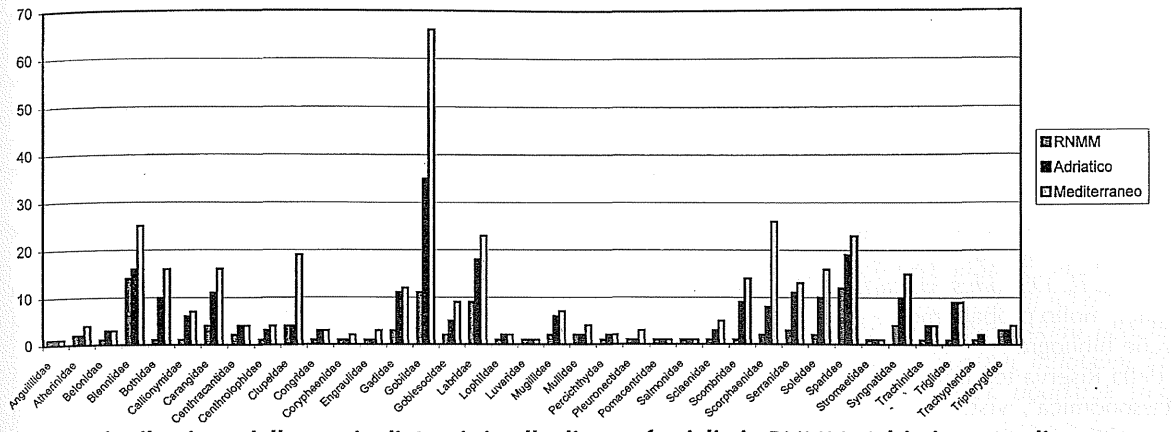

Fig. 2: Distribuzione delle specie di Osteitti nelle diverse famiglie in RNMM, Adriatico e Mediterraneo.
Sl. 2: Razširjenost kostnic iz različnih družin na območju naravnega rezervata Miramare, v Jadranskem morju in v Sredozemskem morju.

Delle 116 specie endemiche del Mediterraneo, 16 sono presenti in RNMM (Tab. 6), di queste cinque appartengono alla famiglia dei Blenniidi, quattro alla famiglia dei Gobidi e due alla famiglia dei Labridi. Per quanto riguarda le specie endemiche adriatiche, solo una è presente in Riserva e precisamente *Platichthys flesus italicus* Gunther, 1862. A questo proposito è necessario fare una precisazione. Studi genetici recenti (Berrebi, 1988), definiscono l'esistenza di tre sottospecie appartenenti al genere *Platichthys*: *Platichthys flesus luscus* Pallas, 1814, *P. flesus italicus* Gunther, 1862, *P. flesus flesus* Linnaeus, 1758.

Secondo Tortonese (1971), le sottospecie *P. flesus italicus* Gunther, 1862 e *P. flesus luscus* Pallas, 1814, sarebbero invece in sinonimia (Vanzo *et al*, 1998).

L'analisi biogeografica (Fredj, 1974; Whitehead *et al.*, 1984-1986; Froese & Pauly, 1998) ha evidenziato che la Riserva è sito di protezione di cinque specie a limitato range di distribuzione geografica. Queste sono localizzate in limitati distretti del Mediterraneo ed in Adriatico sono limitate al bacino settentrionale e talora centrale.

Le specie a limitato range di distribuzione biogeografica sono: *Platichthys flesus italicus* (Pleuronectidae) endemico dell'Alto Adriatico; *Syngnathus tenuirostris* (Syngnathidae) (in accordo con Bombace, 1990) localizzato in Alto Adriatico, nel Mar Nero e nella regione centro-occidentale del Mediterraneo; *Lipophrys adriaticus* (Blenniidae) localizzato in Alto e Medio Adriatico, Mar Nero e nella regione Nord-Occidentale del Mediterraneo; *Pomatoschistus quagga* (Gobiidae) che si distribuisce in Mediterraneo Occidentale e in Adriatico settentrionale e centrale; *Trypterigion melanurus* (Tripterygiidae) di cui molto probabilmente è presente la

Tab. 4: Confrontitra Osteitti presenti a Riserva Naturale Marina di Miramare (RNMM), Adriatico e Mediterraneo.
Tab. 4: Primerjava med kostnicami, ugotovljenimi v naravnem rezervatu Miramare (RNMM), v Jadranskem morju in Sredozemskem morju.

	RNMM	Adriatico	Mediterraneo
Ordine	13	24	25
Famiglia	37	97	134
Genere	65	273	364
Specie	101	361	580

Tab. 5: Indice di Ricchezza Specifica (IRS).
Tab. 5: Indeks specifične pestrosti vrst (IRS).

Famiglia	RNMM	Adriatico	IRS
Anguillidae	1	1	0,00
Atherinidae	2	2	0,18
Belonidae	1	3	0,00
Blenniidae	14	16	2,37
Bothidae	1	10	0,00
Callionymidae	1	6	0,00
Carangidae	4	11	0,55
Centhracanthidae	2	4	0,18
Centhrolophidae	1	3	0,00
Clupeidae	4	4	0,55
Congridae	1	3	0,00
Coryphaenidae	1	1	0,00
Engraulidae	1	1	0,00
Gadidae	3	11	0,37
Gobidae	11	35	1,83
Gobiesocidae	2	5	0,18
Labridae	9	18	1,46
Lophildae	1	2	0,00
Luvaridae	1	1	0,00
Mugillidae	2	6	0,18
Mullidae	2	2	0,18
Percichthydae	1	2	0,00
Pleuronectidae	1	1	0,00
Pomacentridae	1	1	0,00
Salmonidae	1	1	0,00
Sciaenidae	1	3	0,00
Scombridae	1	9	0,00
Scorphaenidae	2	8	0,18
Serranidae	3	11	0,37
Soleidae	2	10	0,18
Sparidae	12	19	2,01
Stromaetidae	1	1	0,00
Syngnathidae	4	10	0,55
Trachinidae	1	4	0,00
Triglidae	1	9	0,00
Trachypteridae	1	2	0,00
Tripterygiidae	3	3	0,37

sottospecie *T. m. minor* che si distribuisce infatti in Francia, mar Tirreno, Sicilia Orientale, Adriatico e mar Egeo, a differenza dell'altra sottospecie: *T. m. melanurus* che invece si trova alle Isole Baleari, nel sud della Sardegna, Algeria, Tunisia, Israele, Libano, Cipro e a sud della Turchia (Whitehead *et al.*, 1984-1986).

L'analisi video ha messo in evidenza la presenza nel periodo estivo e precisamente da giugno a settembre di individui di taglia piccola appartenenti alle specie *Diplodus annularis, Diplodus vulgaris* e *Oblada melanura* (Sparidae), molto probabilmente di un anno di età.

Le ricerche bibliografiche ed i monitoraggi effettuati all'interno della Riserva tendono a sottolineare l'elevata "diversità tassonomica", vista la presenza di numerose specie di osteitti appartenenti alle famiglie elencate precedentemente.

Ricerche bibliografiche (Tortonese, 1971; Fredj, 1974; Whitehead *et al.*, 1984-1986; Froese & Pauly, 1998) hanno evidenziato che il 46,5% delle specie analizzate depone uova demersali. A questa categoria appartengono le famiglie aventi l'Indice di Ricchezza Specifica più elevato; questo denota l'importanza della Riserva relativamente all'ecologia ed alla biologia riproduttiva di questi animali.

La particolarità del Golfo di Trieste e conseguentemente della RNMM, è di estendersi entro il range batimetrico dei 20 metri, questo fattore è strettamente associato alla localizzazione di specie che tendono a distribuirsi entro batimetriche di limitata profondità, è il caso infatti dei Blenniidi, e di numerose specie di Labridi e Sparidi.

La RNMM, risulta essere un sito fondamentale all'ecologia ed alla biologia riproduttiva dei Blenniidi, pesci territoriali che costruiscono i loro nidi tra ciottoli e rocce nella zona intertidale dove depongono le uova.

I Labridi vivono tra gli scogli, sui bassi fondi algosi, presentano sia uova pelagiche che demersali; durante il periodo riproduttivo la preponderanza delle specie presenta uno spiccato istinto territoriale, dovuto alla strategia riproduttiva, che consiste nella preparazione dei nidi da parte dei maschi ad eccezione di *S. tinca,* che attacca le uova nelle piante acquatiche.

L'abbondanza degli Sparidi è probabilmente legata al sottile equilibrio trofico che persiste entro un'area protetta ed al fatto che la RNMM è una probabile area di "recruitment" per questa famiglia di Osteitti, il tutto è evidenziato dalla massiccia presenza in Riserva di individui di piccole dimensioni nel periodo estivo, ovvero post riproduttivo.

In conclusione si può affermare che, limitatamente agli studi effettuati sino ad ora, la RNMM risulta essere un importante sito di conservazione relativamente alla presenza di specie di Osteitti endemiche a limitato range di distribuzione geografica ed inoltre l'importanza biologica è sottolineata dal fatto che la maggior parte delle specie completano il loro ciclo riproduttivo entro l'area protetta.

La prima stesura di una check-list relativa ad altre stazioni risponde all'esigenza di rapportare la stazione di Miramare alla dinamica del Golfo di Trieste. In tale contesto risulta evidente la disparità (quantitativa e qualitativa) negli avvistamenti effettuati nelle stazioni di Miramare con la situazione all'esterno del comprensorio protetto. Appare evidente che l'indispensabile confronto risulterà maggiormente significativo all'intensificarsi di un'attività standardizzata anche negli altri siti.

Tab. 6: Sedici specie endemiche mediterranee trovate a Miramare e loro distribuzione nel Mediterraneo (Dist. – distribuzione, MLD - Specie endemica del Mediterraneo a limitata distribuzione geografica, M - specie endemica del Mediterraneo, NA - specie endemica dell' Alto Adriatico, MW – Mediterraneo Occidentale, AD – Adriatico, ME – Mediterraneo Orientale, MN – Mar Nero, n – nord, c – centro, s - sud).

Tab. 6: Podatki o 16 vrstah sredozemskih endemičnih rib, ki so bile ugotovljene na obravnavanem območju in njihova razširjenost (Dist. – razširjenost, MLD – sredozemski endemit z omejeno geografsko razširjenostjo, M – sredozemski endemit, NA – endemit severnega Jadrana, MW – zahodni Mediteran, AD – Jadran, ME – vzhodni Mediteran in MN – Črno morje, n – severni del, c – osrednji del, s – južni del).

Famiglia	Specie	Dist.	MW			AD			ME			MN
			n	c	s	n	c	s	n	c	s	
Blennidae	*Lipophrys adriaticus*	MLD				*	*		*			*
	Lipophrys dalmatinus	M	*	*	*	*	*			*		
	Lipophrys nigriceps	M	*	*			*			*		
	Parablennius zvonimiri	M	*	*	*		*			*	*	
	Aidablennius sphynx	M	*	*	*	*	*	*		*	*	*
Gobiidae	*Zebrus zebrus*	M	*	*	*	*				*	*	
	Zosterisessor ophiocephalus	M		*	*	*				*	*	
	Pomatoschistus quagga	MLD	*	*		*	*					
	Gobius fallax	M	*	*	*	*	*		*	*	*	
Labridae	*Symphodus rostratus*	M	*	*	*	*	*	*	*	*	*	*
	Symphodus ocellatus	M	*	*	*	*	*	*	*	*	*	*
Pleuronectidae	*Platichthys flesus italicus*	NA				*						
Sparidae	*Diplodus sargus*	M	*	*	*	*	*	*	*	*	*	*
Syngnathidae	*Syngnathus tenuirostris*	MLD				*				*		*
Tripterygiidae	*Trypterigion melanurus*	MLD			*					*	*	
	Trypterigion tripteronotus	M	*	*	*	*				*	*	*

IHTIOFAVNA V NARAVNEM REZERVATU MIRAMARE (TRŽAŠKI ZALIV, SEVERNI JADRAN)

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POVZETEK

V Naravnem rezervatu Miramare pri Trstu (Tržaški zaliv, severni Jadran) smo pred kratkim odprli poseben center za zbiranje in arhiviranje podatkov. Namen centra, ki smo ga imenovali Obalni observatorij (O.d.L - Osservatorio del Litorale), je povezovanje starejših podatkov z novejšimi biološkimi in fizikalno-kemijskimi podatki v okviru spremljanja kakovosti morja na terenu. V tem prispevku podajamo rezultate o obrežni ihtiofavni na območju naravnega rezervata, ki smo jih dobili z uporabo različnih tehnik in metod. Poseben poudarek smo dali tudi pregledu ihtiofavne, ki se zadržuje na umetnih podvodnih grebenih in razbitinah.

Na podlagi dosedanjih raziskav se je izkazalo, da je Naravni rezervat Miramare glede na pojavljanje endemičnih rib kostnic z omejeno geografsko razširjenostjo zelo pomembno območje. Še posebej pa je pomembno, da se večina ribjih vrst razmnožuje in razvije znotraj zavarovanega območja. Od 116 endemičnih vrst rib v Sredozemlju jih kar 16 naseljuje območje v Naravnem rezervatu Miramare. Ena od teh, Platichthys flesus italicus *Gunther, 1862, je tudi endemit severnega Jadrana.*

Ključne besede: ihtiofavna, biodiverziteta, Naravni rezervat Miramare, obalni observatorij

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DESERTIFICATION PROCESSES IN THE ADJACENT MEDITERRANEAN HILLY REGION (BRKINI AND ČIČARIJA)

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ABSTRACT

The hilly region of Brkini and Čičarija (NW Slovenia) is situated along the line that divides the Mediterranean part of Slovenia from its more continental part. The changes in its socio-economic conditions, particularly in land-use, as well as its depopulation processes and afforestation have in the last two hunderd years had a strong impact on the structure of bird and plant species of the area. In spite of all these changes, however, the marginal Mediterranean area of Brkini and Čičarija still have a great value in respect of biodiversity and especially regarding the number of endemic and threatened species, as well as species that in this area reach the edge of their range.

Key words: Mediterranean, flora, vegetation, forest, avifauna, sustainable development, nature conservation, desertification

PROCESSI DI DESERTIFICAZIONE NELLE MONTAGNE MEDITERRANEE LIMITANTI (BRKINI E CICERIA, SLOVENIA SUD-OCCIDENTALE)

SINTESI

La zona di Brkini e della Ciceria (Slovenia sud-occidentale) funge da area limitante tra le parti mediterranea e continentale della Slovenia. I cambiamenti delle condizioni socio-economiche (soprattutto quelli nell'utilizzo del suolo e i processi di depopolazione) nonché il rimboschimento dell'area negli ultimi duecento anni, hanno influenzato la struttura e la composizione di uccelli, piante ed associazioni vegetali. Nonostante tali cambiamenti, l'area mediterranea limitante di Brkini e della Ciceria mantiene un valore particolare in termini di biodiversità, in particolare in merito al numero di specie endemiche, minacciate, o specie che in quest'area raggiungono il limite dell'areale di estensione. Nell'area mediterranea limitante, con fattori climatici discreti, il potenziale naturale di rigenerazione risulta maggiore che nel Mediterraneo centrale. Alcuni dei processi di desertificazione, come ad esempio l'erosione, gli incendi boschivi e le attività antropogeniche tradizionali (es. l'agricoltura) si rivelano necessari e bramati per il mantenimento di alcune specie strettamente specializzate. L'abbandono delle attività di utilizzo del suolo, l'allargamento boschivo e i processi di depopolazione influenzano lo sviluppo socio-economico dell'area, l'aspetto naturale e le particolarità floristiche e faunistiche della zona.

Parole chiave: Mediterraneo, flora, vegetazione, bosco, uccelli, utilizzo durevole, tutela dell'ambiente, desertificazione

INTRODUCTION

Edges and transitional geographical regions have an important role in the study of the changes occurring in our environment. Through analyses of the past human involvement in nature phenomena and the socio-economic characteristics, ecosystem parameters such as vulnerability, recoverability and predictability can be defined and recommendations for sustainable management proposed. On the basis of the study of the northernmost part of the Mediterranean bordering mountainous range in Slovenia we present a description of the boundary state of the Mediterranean basin environment. Climate in the research area, also described as adjacent Mediterranean hilly regions, is not as extreme as in typical Mediterranean mountainous areas, so the interference between nature and humans and disturbances due to inappropriate management of the area have different consequences on ecological and socio-economic stability. The objectives of the study are thus to give a fair evidence of the past and present the state of the ecological and socio-economical conditions of the Slovenian Mediterranean mountainous region, to identify the relationships between human and natural influences on the region's degradation of natural resources, to assess the future desertification trends, and to propose measures for sustainable management of the area.

METHODS

The first land-use data were provided by the Austrian Monarchy, whose cartographers divided the Monarchy into cadastral communities and established land-use and ownership data base through maps (1:2880) and tables (Korošec, 1978). The first land-use table data for cadastral units in the research area (Fig. 1) are available for the end of the 18th century (Območna geodetska uprava Koper, 1995a). They have been mostly renewed at the beginning of the 20th century and in the 60's

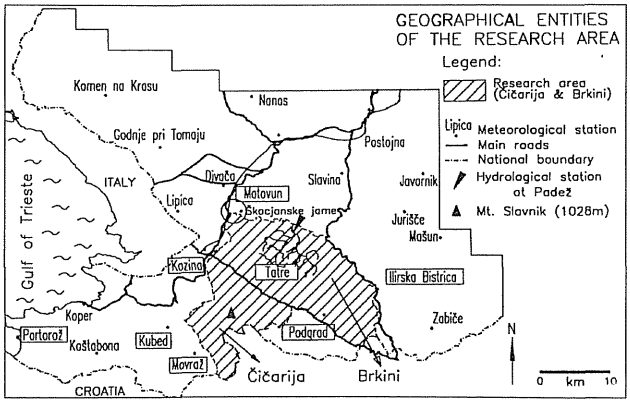

Fig. 1: Geographical position of the research area.
Sl. 1: Geografski položaj raziskovanega območja.

(Republiška geodetska uprava, 1994; Območna geodetska uprava Koper, 1995b). The National Institute of Agriculture has recently carried out a land-use census for cadastral units (Republiška geodetska uprava, Zavod RS za statistiko, 1983), interpreted from aerial photography (Kmetijski inštitut Slovenije, 1995). The two historic maps from 1780 in scale 1: 28,000 (Rajšp & Trpin, 1997) and 1900 in scale 1: 33,000 (retrieved from a private archive; Korošec, 1995), give the oldest geographical information on forest cover. For the 20th century, some ample cartographic material is at hand (Korošec, 1995): the Italian army map from 1929, the first Yugoslav Army map from 1955, and the latest national topographic maps on scales of 1: 5,000, 1: 25,000 and 1: 50,000. In the analysis, data on forest cover extension, digitalised from maps on a scale of 1: 50,000 (Vodnogospodarski inštitut, 1993) are used. Most data on climate are available from 1951 (Ministrstvo za okolje in prostor, Hidrometeorološki zavod RS, 1988a, 1988b, 1995a, 1995b), on hydrology from 1971 (Ministrstvo za okolje in prostor, Hidrometeorološki zavod RS, 1998). Data on demography and socio-economy have been compiled from the national statistical data sources (Zvezni zavod za statistiko, 1953, 1961, 1971, Zavod RS za statistiko, 1981, 1984, 1991) and other studies (Vilfan, 1953; Savnik, 1968; Valenčič, 1984, 1989, 1994; Bilc, 1994; Orožen *et al.*, 1995).

Geographical descriptions of the area (Vilfan, 1953; Melik, 1960; Savnik, 1968; Roglič, 1987) as well as geological (Zvezni geološki zavod, 1975), climatological, pedological (Stepančič *et al.*, 1980; Vodnogospodarski inštitut, 1990, Zavod za pogozdovanje in melioracijo krasa Sežana, 1990, 1992, 1993a, 1993b), hydrological (Vodnogospodarski inštitut, 1987), floristic/vegetational (Kaligarič, 1992a, 1992b), historical (Kos, 1953; Vilfan, 1953; Melik, 1960; Valenčič, 1989; Darovec, 1992) and socio-economic data were collected, integrated and analysed (Globevnik *et al.*, 1996). Cartographic material, national cadastral data and land-use data were georeferenced and integrated into geographical information system. Analysis of land-use and forest cover characteristics was made for four different units of the research area, *i.e.* Čičarija SW, Čičarija NE, Brkini W and Brkini E (see figure 2). Comparison of historical data and current state of the environment was also made to show degradation or improvement of human and natural resources in the area. For the period from 1800 to 1995, land-use characteristics were defined and demographic/economic description of the area made.

Flora and vegetation types are described for the three vegetation subunits in the Čičarija area [Kraški rob (Karst Edge, subunit 1a), Kraška planota with Mt. Slavnik (Karst plateau with Mt. Slavnik, subunit 1b), Matarsko podolje (subunit 1c)] and for the Brkini area (subunit 2). Refer-

ence map for the vegetation subunits is shown in figure 2. The importance of the vegetation (flora) of the areas is described with the use of natural value parameters, such as endemic species (E), rare species (R), endangered species (En), species in their range border (BA) and special indicator species (SI). The ornithofauna was chosen as the main ecological indicator. Basic information on the avifauna of the area was collected through available data from literature (Vallo, 1885; Škornik *et al.*, 1990; Tome, 1991, 1992; Geister, 1995; Sovinc, 1995) and some field excursions. The recent as well as historic data on birds were collected for the period of some last 200 years.

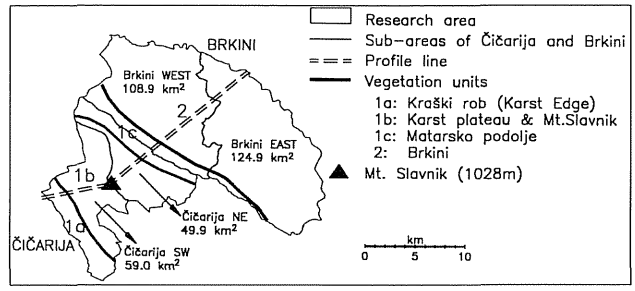

Fig. 2: Reference map for vegetation (sub)units (1a – Karstic plateau (Karst edge), 1b – Karst plateau & Mt Slavnik, 2 – Brkini).
Sl. 2: Referenčna karta vegetacijskih (pod)enot (1a – Kraški rob, 1b – kraška planota s Slavnikom, c – Brkini).

Study area

The research area is part of the Dinaric mountain range bordering the Adriatic Sea on its eastern side. It is divided into two subregions, Čičarija and Brkini. Brkini is a border region of the Mediterranean water catchment basin to the Black Sea water basin and is a kind of transitional area between the Mediterranean geo-region and the inland. It is also a buffer zone for the Mediterranean to Central Europe with interesting nature and social indicators of both. Brkini (233.75 km²) is a hilly, rural area with well-developed water network. The area of Brkini was further divided into Brkini West and Brkini East. From Brkini to the coast spreads a karst region of the littoral NW edge of the Dinaric range (108.9 km²) named Čičarija with the highest peak of Mt. Slavnik (1028 m). The region (Matarsko podolje) between Brkini and Čičarija is a flat area, with the main transit road between Rijeka (Croatia) and Trieste. For a more detailed analyses, Čičarija was further divided into two subareas, *i.e.* Čičarija South-West (Čičarija SW) and Čičarija North-East (Čičarija NE).

Geology, relief: Brkini is mostly composed of Eocene flysch (sandstone, marlstone, breccia), while Čičarija consists of Cretaceous limestone and dolomite, with its mountainous region on the south-western part consisting of Palaeocene limestone. The northern part of Brkini is made up of limestone as well. The karst phenomena are clearly present in all limestone and dolomite areas. The Brkini area is extremely varied in its relief, due to its well-developed water network. Valleys are deep and narrow, while hill ridges are flat. The higher mountainous region of Čičarija extends in NW-SE direction.

Climate: The climate of the research area is sub-Mediterranean in Čičarija, but with a great continental influence in Brkini. The highest annual rainfall goes to Ilirska Bistrica, situated in the easternmost (inland) part of the area. The lowest precipitation was recorded at Kubed and Movraž, the westernmost (coastal) part of the area. The average annual precipitation is 1400 mm on the western side and 1500 mm on the eastern side of the research area. In the wettest year of the study period (1965), Čičarija had 1800 mm of rain on the coastal side and 2200 mm of rain on Mt. Slavnik. The driest year was 1983 with 1000 mm of rain on the western side and 1400 mm on the eastern side. On the westernmost (coastal side) of the research area (Kubed), the average temperature was 11.6 °C, while on the inlandmost side (Ilirska Bistrica) it reached 9.5 °C. January was the coldest, with the average 3.2 °C (Kubed), July the warmest month (20.1 °C at Kubed and 18.3 °C at Ilirska Bistrica).

Pedology: Čičarija: The limestone substratum is covered by rendzina, terra fusca and terra rossa. Rendzina is the most important soil type. Terra fusca covers the northern side of Mt. Slavnik. These is eutric deeper brown soil. At the edge of Matarsko podolje occurs alluvial terra fusca with very shallow humose layer and acid reactions. Typical terra rossa is found only locally at the foothills of Mt. Slavnik. At the junction between flysch and limestone, calcocambisol had developed. These areas are more stable, with fewer erosion processes. Brkini: On the flysch background, different types of dystric cambisols, regosol and ranker had developed. In this region, some carbonate substratum also occurs, where rendzina, litosol, calcocambisol, luvisol and eutric cambisol had developed.

Hydrology: The Brkini area has a strong hydrographic network on the northern part, where surface water flows to the Reka river. The general flow direction of the Reka river is SE-NW. The river valley borders Brkini to the inland and ends at the Škocjan Caves. The caves, where Reka has its swallowhole (ponor) to the karst region of Tržaško-Komenski Kras (Trieste-Komen Karst) is under UNESCO's protection as a World Natural Heritage Site. The Reka river then flows underground and reappears in many springs along the coast of the Gulf of Trieste. The main source of the underground course of the Reka is the Timavo at Duino in Italy. The Timavo spring has been declared a potential drinking water supply for the town of Trieste. Surface water from the southern part of Brkini flows into the streams in the dead karst dolines (Krivic *et al.*, 1989; Mihevc, 1994). The streams disappear into

numerous holes to the subsurface and flow through underground connections mainly to the Rižana spring (Krivic *et al.*, 1989), which is the main drinking water supply for the Slovenian coast.

RESULTS AND DISCUSSION

Sociological and economic characteristics

History

The history of human settlements began in the times of Haalsttat culture. Under the Roman rule (178 AD - 476 AD), the inhabitants were primarily hunters and peasants. Beside the fact that agriculture as well as certain trades and architecture were well developed in it, the area was an important transportation zone. At the end of the Antiquity, the power over Istra was changing in the same direction as the power over the northern Italic states (Odoacer, Ostrogoths). In 553, Istra came, together with the Venetian state, under the rule of Byzantium. This lasted until 788, when Istra came under the rule of the Franks. In 952, Otto the Great, king of the Franks, annexed Istra and Friuli to the German state as part of the Duchy of Carinthia. The period from the 11th to the 15th centuries was characterised by feudal land particularities and different political power holders in specific parts of Istra (the patriarch of Aquileia, the counts of Duino and Gorizia, the Venetian Republic, and the 14th century Habsburgs). After 1516 (Austrian-Venetian war), Istra was divided by two political rulers, the Habsburgs and Venice. The period of Napoleonic Wars changed the political organisation of the area. With the French victory at Wagram (1809), the Habsburgs had to cede the Carinthia, Carniola, Istra and Gorizia provinces to Napoleon. Istra was returned to Austria in 1813 after declaring war to France. Until 1918, Brkini and Čičarija administratively belonged to Austria. Such political regime lasted until 1919/20, when the Istran part of the Habsburg Monarchy became part of Italy. During the Second World War, the Italian Army surrendered, and from 1943 to 1945 this area was under German military rule. After the war, *i.e.* from 1945 to 1954, the area was under Yugoslav military administration. With the international agreement in 1954, the area became part of Yugoslavia. Since 1991, when Yugoslavia ceased to exist, this area has belonged to the Republic of Slovenia. The estimated number of inhabitants is shown in table 1.

Tab. 1: Estimated number of inhabitants until 1850.
Tab. 1: Ocenjeno število prebivalcev do leta 1850.

Year	0 AD	500 AD	1000 AD	1350 AD	1400 AD	1600 AD	1850 AD
Estimated No. of inhabitants	1500	2000	3500	11000	10500	8400	16200

Socio-economic status of the people and householdses

There are 68 villages in Brkini. They are situated on flat hill slopes. In the narrow and steep valleys abandoned watermills and sawmills can be seen. In the Čičarija area (108.9 km^2), there are only 8 villages. The tables present some basic statistics of the socio-economic character.

Tab. 2: Number of inhabitants and population density (per km^2) (Slovenia in 1991-98).
Tab. 2: Število prebivalcev in gostota prebivalstva (na km^2) (Slovenija v letih 1991-98).

Year		**1869**	**1880**	**1900**	**1910**	**1931**	**1948**	**1953**	**1961**	**1966**	**1971**	**1981**	**1991**
No. of inhabitants	BRKINI	13987	14403	14898	14795	13444	12177	11479	9708	9105	8419	7727	7469
	ČIČARIJA	2218	2481	2647	2616	2662	1961	1799	1535	1381	1223	1011	874
Population density	BRKINI	59.8	61.6	63.7	63.3	57.5	52.1	49.1	41.5	38.9	36.0	33.1	32.0
	ČIČARIJA	20.4	22.8	24.3	24.0	24.4	18.0	16.5	14.1	12.7	11.2	9.3	8.0

Tab. 3: Social structure of inhabitants.
Tab. 3: Socialna struktura prebivalstva.

	Sex structure		**Age structure**				**Education: over 15 years**			
	Male	Fem.	0-14 years	14-65 years	over 65 years	Ageing Index	Without elem. sch.	Elemen. school	High school	Univers. College
BRKINI	49.8%	50.2%	17.9%	64.7%	17.4%	97	35.2%	27.9%	33.6%	3.2%
ČIČARIJA	51.1%	48.9%	14.2%	60.5%	25.3%	178	51.2%	15.8%	31.2%	1.8%
SLOVENIA	48.5%	51.5%	20.6%	65.5%	10.9%	53	17.3%	30.3%	43.4%	8.9%

Ageing Index = (No. of inh. over 65 years/No. of children up to 15 years)*100

Tab. 4: Percentage of employed people per sectors of employment.
Tab. 4: Odstotek zaposlenih po posameznih sektorjih zaposlovanja.

	Employed	**Primary sector**	**Secondary sector**	**Tertiary sector**	**Quartary sector**	**Day migration of employed inhab. (% of the employed)**
BRKINI	44.7%	24.2%	47.7%	19.7%	8.4%	59.7%
ČIČARIJA	36.3%	19.2%	38.3%	31%	11.5%	72.8%
SLOVENIA	40.9%	15%	44.2%	22.4%	17.9%	55.3%

Primary Sector: Agriculture, Forestry, Fishery; **Secondary Sector**: Industry, Minery, Watermanagement, Craft; **Tertiary Sector**: Transportation, Marketing, Tourism, Hotel-Restaurant-Pub facilities, Municipal infrastructure; **Quartary Sector**: Education, Science, Culture, Medical & Social Care

Tab. 5: Number of households with/without farming for 1981 and 1991.
Tab. 5: Število gospodinjstev, ki so se leta 1981 in 1991 ukvarjala s kmetovanjem ali pa ne.

	1981	**1981**	**1981**	**1991**	**1991**	**1991**
	No. househo.	No. househo. with agriculture(%)	No. househo. without agriculture(%)	No. househo.	No. househo. with agriculture(%)	No. househo. without agriculture(%)
BRKINI	2,369	71.2	28.8	2,465	51.9	48.1
ČIČARIJA	295	74.2	25.8	280	54.0	55.0
SLOVENIA	6,487	49.5	50.5	640,195	24.5	75.5

Tab. 6: Number of livestock for 1971, 1981, 1991 (source: Institute of Agriculture of the Republic of Slovenia, 1995).
Tab. 6: Število glav živine za leta 1971, 1981 in 1991 (vir: Kmetijski inštitut Slovenije, 1995).

	1971 (sum: 9255)				**1981 (sum: 7220)**				**1991 (sum: 5047)**			
	cattle	pigs	sheep	horses	cattle	pigs	sheep	horses	cattle	pigs	sheep	horses
BRKINI W (38 villages)	2223	985	150	163	1540	824	198	71	1138	167	121	23
BRKINI E (32 villages)	2557	1967	138	520	1995	1205	45	266	1961	1196	54	263
ČIČARIJA (7 villages)	381	156	10	5	323	103	249	1	158	41	24	1
Sum	**5161**	**3108**	**298**	**688**	**4258**	**2132**	**492**	**338**	**3257**	**1304**	**199**	**287**

Infrastructure

The central road passing through Matarsko podolje is also a transit road between Trieste and Rijeka. In the 70's, the "Brkini hill ridge road" was built, but it was too late for the severe depopulation rate of that time. The Brkini water supply system was built in the 80's, but there are still 21 villages without drinking water in West Brkini and in the entire Čičarija. Regular water supply is guaranteed only along Matarsko podolje. The system for waste removal has also been partially solved. All of the villages have been recently given waste containers. There are still 65 wild dump sites in the test area. Sewage system has been built only for the major settlements (Kozina-Hrpelje and Podgrad).

Economic and social activities in the area

The test area has only one urban centre, *i.e.* Kozina/Hrpelje, where all vital socio-economic activities are held. The town is the administrative centre of the Hrpelje/Kozina county with 4,163 (1991) inhabitants (NE part of Čičarija, southern part of West Brkini and Matarsko podolje). There are an elementary school (350 children in the county), children day care centre, health/social centre, county administrative offices, banking and trading posts with traffic/transportation facilities. There is only one more elementary school in the county, *i.e.* at Materija. In East Brkini, there is a school at Podgrad. Children go to school also to Ilirska Bistrica and Divača (both outside Brkini). Industry has developed in few centres, *i.e.* at Podgrad, Hrpelje, Gradišče, Kozina, Hrpelje, Materija. In Čičarija, there is no industry, no schools, and no food stores. Inhabitants migrate every day either to Matarsko podolje or to the Koper region.

Land-use

In table 7, today's land-use characteristics of the Brkini and Čičarija area (divided into SW and NE part) are presented. Land-use changes from 1800 to 1995 are presented in table 8.

Tab. 7: Land-use in 1995.
Tab. 7: Raba tal v letu 1995.

	ČIČARIJA SW	ČIČARIJA NE	BRKINI
No. cadastral units	5	12	35
Total area of cadastral units	5530 ha	13211 ha	16437 ha
Unproductive	111 (2%)	264.2 (2%)	657.5 ha (4%)
Fields, gardens	183.1 ha (3.3%)	333.7 ha (2.5%)	1448.4 ha (8.8%)
Grassland (meadows, pastures)	2138.0 ha (38.7%)	3090.2 ha (23.4%)	3674.1 ha (22.4%)
Orchards, vineyards	7.0 ha (0.1%)	27.5 ha (0.2%)	364.9 ha (2.2%)
Agric. land under overgrowing process (not fully developed forest)	1,291.6 ha (23.4%)	6763.7 ha (51.2%)	3273.4 ha (19.9%)
Developed forest	1797.3 ha (32.5%)	2731.7 ha (20.7%)	7018.7 ha (46.7%)
Forest area (sum)	55.9%	71.9 %	66.6%

Tab. 8: Historical view of land-use in % of the area (numbers in parenthesis for subareas).
Tab. 8: Zgodovinski pogled na rabo prostora v % raziskovanem območju (s številkami za podobmočja v oklepajih).

	Land-use (%)	1800	1900	1930	1955	1975	1995
BRKINI F: 233.8 km²	unproductive	(3;5) **4%**		(3;5) **4%**	(3;5) **4%**	(3;5) **4%**	(3;5) **4%**
	fields, orchards	(15;19) **17%**		**16%**	**14%**	**10%**	**10%**
	grassland	**69%**		**50%**	**46%**	**43%**	**21%**
(West, East)	-meadows	(16;20) 18%			25%		
(West, East)	-pastures	(54;48) 51%			21%		
(West, East)	forest-	(12;8) **10%**			**36%**	**43%**	**67%**
(West, East)	cadastral -maps	(28;14) 15%	(30;19) **24%**	(43;20) **30%**			
ČIČARIJA F: 108.9 km	unproductive	(2;2) **2%**		(2;2) **2%**	(2;2) **2%**	(2;2) **2%**	(2;2) **2%**
	fields, orchards	(8;10) **9%**			**5%**	**3%**	(3;3) **3%**
	grassland	**81%**			**70%**	**53%**	(39;23) **32%**
(SW, NE)	-meadows	(5;9) 7%			5%		
(SW, NE)	-pastures	(81;65) 74%			65%		
(SW, NE)	forest-	(4;14) **8%**	(19;30) **14%**	(14;25) **9%**	**25%**	**42%**	**63%**
(SW, NE)	cadastral -maps	(4;16) 9%					

The socio-economic potential of the research area is not favourable. The area that has had a rural character for centuries is losing its cultural and landscape identity. People do not subsist on local natural resources, but mostly depend on the national economic processes. The abandoning of farming has been noticeable mainly in the last few decades, though the processes of depopulation, which began already in the previous century, reached their peak during the world economic crisis (1930) but became more moderate after WWII. The population density today is one third of the Slovene average in Brkini, but less then one tenth in Čičarija. Age and education structure of the population in Brkini and Čičarija is far under the Slovenian average, especially in Čičarija. The communities that have reached the national level are those along the main road, with administrative, transportation or industrial centres (Hrpelje, Podgrad and Gradišče). The percentage of the people employed in Brkini exceeds the Slovenian average, while the percentage of those in Čičarija is smaller. Day migration is by far greater than the Slovenian average in Čičarija. People go to work mainly to the coast and to the main centres in Matarsko podolje and Ilirska Bistrica.

At the beginning of the eighties, three quarters of the households cultivated the land, today a little more than

half are still sustaining their farms, but the economic revenue from agricultural products concerns just one quarter of them. The number of persons in one farm-household is smaller than the Slovenian average. The trend of abandoning farming has been strong due to the reconstruction of the socio-economic profile of the rural society: employment, depopulation and abandoning livestock raising. Traditionally, the farm character of households in the area is changing to the non-farm character. Young people tend to move to larger urban centres. If they stay in the area, they do not engage in farming. The number of households with income from agriculture is under the national average. In Čičarija, the non-agricultural income has almost completely prevailed. In Brkini, the income situation in farm households follows that in Slovenia, as well as the structural change of farming recently. There are some villages that are different. In the Tatre community, 90% of farms do not get any income through farming, in Gradišče 86,7%. The number of cattle decreased by 60% in Čičarija in the 1971-1991 period, by 50% in Brkini West, and by 77% in Brkini East. Livestock has been an important source of income for the people in Brkini, but in the last thirty years the number of livestock decreased by more than half. The same is true for the number of pigs and this clearly shows that people have lost their interest in farming. The abandonment of intensive sheep raising and the decrease in cattle numbers corresponds with the intensive overgrowing processes that started four decades ago.

General conclusion is that the area still has rural character with small farms, although they have lost their basic productive function. The age and education structures of the people do not favour land cultivation in the future development of the area. The sex structure of the population shows that the area cannot easily support regeneration of the human potential.

Water

The land-use changes, predominantly overgrowing of pastures and meadows in the Brkini area, may have in turn changed the hydrological regime (Globevnik, 1999). To test this possibility, we made a hydrological analysis of the river Padež, which collects water from the Brkini central area (watershed area 41.6 km^2). The minimal discharge in the 1958-1994 period is 0.010 m^3/s, yearly average 1.03 m^3/s. The highest measured peak was 74.5 m^3/s. Linear trends of the annual average and maximum peak discharges are negative (y = -0.0094 x +1.2059, y = -0.6521 x +40.166), whereas the trend of minimum peak discharges is slightly positive (y = 0.001x+0.0283). The trend of annual precipitation quantities is negative (Tatre: y = -13.626 x +1778). The trend analysis of frequency of appearance reveals that the number of days of drought water flow (0.0 - 0.125 m^3/s) is decreasing, but that the number of days with discharges between 0.125 to 0.50 m^3/s is increasing. Duration of higher water flows (0.5 - 20.0 m^3/s) is decreasing. The reason might be the forest cover expansion in the last 30 years (from 40% to 70% of the area), where water storage capacity and use is higher than in grassland areas. We may thus conclude that water is distributed more equally over the year today as it was decades ago. There are less drought days and less days with high water peaks.

Water pollution risk is high in the entire area, moreover, drinking water supply for all Slovenian coast regions is under high risk due to the highly fissured area of the karst (Kranjc *et al.*, 1991). Water of the Reka river is also under risk of pollution, due to the uncontrolled waste water seepage into the river, wild dump sites and residuals of the past chemical pollution in the river bottom (Kogovšek, 1988). The ecological state of underground habitats (karst caves) is degraded and vulnerable as well (Globevnik *et al.*, 1996).

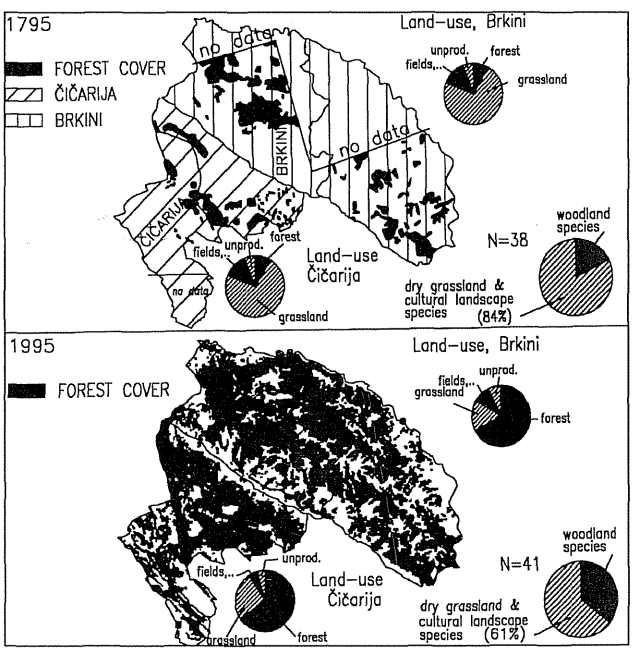

Fig. 3: Changes in land use (forest, arable, grassland and other areas) and characteristics bird species of cultural landscape (1795-1995).
Sl. 3: Spremembe v rabi tal (delež gozda, obdelanih, travniških in drugih površin) ter značilnih ptičjih vrst kulturne krajine (1795-1995).

Flora and vegetation cover

Flora and vegetation types are given in table 9 for the Kraški rob (Čičarija, subunit 1a), Karst plateau, Mt. Slavnik and Matarsko podolje (Čičarija, subunits 1b and 1c) and Brkini (unit 2).

Tab. 9: List of plant species of special value.
Tab. 9: Seznam floristični vrst posebne vrednosti.

ČIČARIJA, subunit 1a	ČIČARIJA, subunit 1b, 1c	BRKINI, unit 2
(1) Quercus ilex - R, En, BA, SI	**(1)** Jurinea mollis - R, SI	**(1)** Quercus petraea - SI
Phyllirea latifolia - R, En, BA	Gentiana lutea symphiandra - R, En, SI	Melampyrum vulgatum - SI
Laurus nobilis - R, En, BA	Narcissus radiiflorus – SI	Castanea sativa - SI
Pistacia terebinthus - R, SI	Linum narbonense – SI	Quercus cerris - SI
Smilax aspera - R, BA, SI	Laserpitium siler – SI	**(2)** Fagus sylvatica - SI,
Rubia peregrina - R, BA, SI	Lilium carniolicum -R, En, SI	Luzula albida - SI
(2) Cleistogenes serotina - R	Asphodelus albus - SI	Quercus petraea - SI,
Onobrychis arenaria tommasinii - R, En	Eryngium amethystinum - SI	Carstanea sativa - SI
Trigonella gladiata - R, BA	Satureja subspicata liburnica - SI	**(3)** Carpinus betulus - SI,
Teucrium flavum - R, BA	Gentiana tergestina - E	Ornithogallum pyrenaicum - SI,
Hyssopus officinalis - R	Stipa eriocaulis - SI	Galanthus nivalis - an example of
(3) Quercus ilex - R, E, BA	Echinops ritro rutenicus - R, SI	carpinental mesophilous species
Moehringia tommasinii - R, En, E, SI	Centaurea rupestris - SI	Melittis melisophyllum - an example of submediterranean thermophilous species
Sedum maximum - SI	Carex humilis - SI	Lamium orvala - an example of
Teucrium flavum - R, BA	Serratula radiata - SI, R, BA	non-acid illiric species
Campanula pyramidalis - SI	Pulsatilla montana - SI	**(4)** Anacamptis pyramidalis - SI,
Cephalaria leucantha - R, SI	Crepis chondrilloides - SI	Linum flavum, SI, R,
Sempervivum tectorum - SI	Astragalus carniolicus - R, SI, E	Nepeta pannonica - R
Iris illyrica - SI	Pedicularis frederici-augusti - R, E, E, BA	**(5)** Arrhenatherum elatius. (SI)
(4) Genista sericea - SI	Iris errerhiza - (Kojnik locus class.) - R, E	**(6)** Gladiolus illyricus (SA)
Athamantha turbith - SI	**(2)** Serratula lycopifolia - R, E, SI	
Scorzonera austriaca - SI	(IUCN Globally threatened species in Europe).	
Ruta divaricata - SI	Scorzonera villosa - SI, Knautia illyrica - SI	
Iris illyrica - En, SI	Senecio lanatus - En, Senecio doronicum - R	
Globularia cordifolia - SI	Gladiolus illyricus - R, En,	
Daphne alpina - SI	Scorzonera hispanica - R, Nepeta pannonica - R	
	Danthonia alpina SI,	
	(3) Helleborus multifidus istriacus - SI, E	
	Quercus pubescens - SI, Sorbus domestica - R	
	(4) Helleborus multifidus istriacus - SI, E,	
	Digitalis laevigata - SI, R, BA	
	Paeonia officinalis - SI, Ostrya carpinifolia - SI	
	(5) Fagus sylvatica - S,Sesleria autumnalis - SI	
	(6) Fagus sylvatica - SI, Lamium orvala - SI,	
	Hacquetia epipactis - SI, Vicia oroboides - SI,	
	Dentaria spec. - SI, Epimedium alpinum - SI	

As Čičarija and Brkini spread along the border of the Mediterranean area and Central Europe, they constitute a kind of a climate border. This implies specific vegetation cover. Climax vegetation is not evergreen but deciduous thermophilous vegetation. Oak, black beech and beech forest includes in its bottom layer (herb vegetation) many Mediterranean species, which are giving this area its Mediterranean character. This type of vegetation is called sub-Mediterranean. In Čičarija and Brkini, different profiles of this environment are followed. The vegetational particulation of this relatively small territory is large and distinct due to human/nature interference, such as forest cutting and changing landscape to mosaic structure of dry meadows, stony pastures and bush fences. The contrasts in the areas of Brkini and Čičarija resemble natural factors (Čičarija: warm climate, low precipitation, limestone substratum, Brkini: harsh climate, high precipitation, flysch substratum) and diverse land-use (Čičarija: small population density, pastures, Brkini: greater population density, livestock agronomy, agriculture) as explained in previous chapters.

The natural value indexes (NVI), such as endemity, rarity, threat status and species on the border of the range (E, R, En, BA), show that Kraški rob with Kraška planota, Mt. Slavnik and Matarsko podolje are of great natural importance. There are 16 plant species at Kraški rob and 26 at Kraška planota reported as important. Some species have more than one value of natural importance. In Brkini, there are 2 rare species (national level). Because the area exerts a strong continental climatic influence, there are numerous miscellaneous

vegetation communities of Illyrian, Central-European and sub-Mediterranean character. The area acts as an important buffer zone between the inland and the Adriatic. The natural value importance corresponds with the percentage of grassland area. This fact is further discussed in the following chapters.

Forest

The forest exploitation began in the Neolithic, but the forests had not been overexploited until the Roman times. Due to the extensive use of wood, clear cutting (ship building and deforestation for grazing), the karst area became bare in the Middle Ages. It stayed deforested until the previous century. The forest of Brkini was also overexploited by farmers and wood traders (Globevnik *et al.,* 1996). Probably the land has never been completely bare, but the percentage of the forest cover has fallen under 10% in the Middle and New Ages. In the mid-twentieth, an extensive afforestation programme began with the black pine *(Pinus nigra),* which is a nonindigenous species, but was best suited to the ecological conditions there. In the 20th century, some large spruce plantations were introduced to Brkini due to their important economic value. The non-deciduous forest is nonindigenous in the area. At the beginning of the 19th century, less than 10% of the area was covered with forests in Čičarija and less than 20% in Brkini. The use of forest as an energy source was very intensive. The majority of land had been cleared in the past and used for grazing at the end of the 19th century. The extensive overgrowing began in the first decades of the 20th century, following the depopulation trends. The extreme progression of the forest landscape is characteristic of the last two decades due to the changes in the socio-economic conditions in Slovenia and to the different life style. Today the forest landscape is typical of almost 70% of Brkini and more than 60% of Čičarija.

Ownership characteristics

Most of the forest cover in Brkini area is private, but the opposite is true of the karst Čičarija. Čičarija is traditionally scarcely populated area, the forest has never been economically interesting due to unfavourable ecological conditions. These are the reasons why the state owns the majority of the forest land.

Ecological state of forest communities

Past distinctive management practices in the forest have led to the vulnerable ecological conditions of the forest today (Čehovin, 1992). There are many different development stages of areas under forest cover, such as young forest cover, pole forest cover, trunk forest cover, coppice forest cover, bush cover, plantage forest cover (Zavod za pogozdovanje in melioracijo krasa Sežana, 1990, 1992, 1993a, 1993b). In Brkini, the forest is mostly coppice and bush forest. The coppice forest is old, ecologically unstable and very susceptible to severe climatologic events. In Čičarija, the bush and poles forest cover spread with pine plantation islands. There is almost 11% of the entire area covered with non-deciduous forest (17% of forest cover), whereas on the karst plateau 50% of the forest is black pine.

Avifauna

Altogether, 8 of the so-called dry-grassland species were typical of the study area. *Melanocorypha calandra, Calandrella brachydactyla, Oenanthe oenanthe* and *O. hispanica* have become extinct (or nearly so) in the period of intensive afforestation with pine and changes in land-use and agricultural practices. The remaining four dry grasslands species are also declining. The most important fact is that it was only in this sub-Mediterranean region of Slovenia that these dry grassland species have had suitable conditions needed for their survival. For some of them *(M. calandra, C. brachydactyla, O. hispanica),* this region was, of course, also on the northernmost edge of their breeding range (Harrison, 1982). After the period of dominating dry grasslands, the so-called traditional cultural landscape has become typical of the study area, still offering conditions for some dry grassland species, but at the same time very attractive for another group of endangered birds. These are species favouring mixture of grasslands, small fields and scattered settlements in a mosaic manner. Typical representatives are: *Upupa epops, Otus scops, Circaeetus gallicus, Lullula arborea, Hippolais polyglotta, Emberiza* spp., *etc.* The historic data for the last decades of the 19th century (dominating traditional cultural landscape) have shown that the abundance of the traditional cultural landscape species was much higher than nowadays. Besides the great decline of almost all those species, at least 3 species have become extinct (or nearly so). For two of them, namely *Sylvia hortensis* and *Emberiza melanocephala,* the study area was the only breeding area for this region and on the edge of their global range. The main reasons for the disappearance of these species and large decline in the populations of other "cultural landscape" species is the overgrowing of the area.

On the other hand, a comparison of the historic data shows that the number of species as well as populations of some woodland species have dramatically increased within the last 200 years. Among them, the following species could be outlined: *Dendrocopus major, Dryocopus martius, Certhia brachydactyla, Sitta europaea, Parus ater, Parus palustris, Parus cristatus, Regulus regulus, Turdus philomelos, Erithacus rubecula* (Schiavuzzi, 1883). Some of these species, *Regulus regulus,*

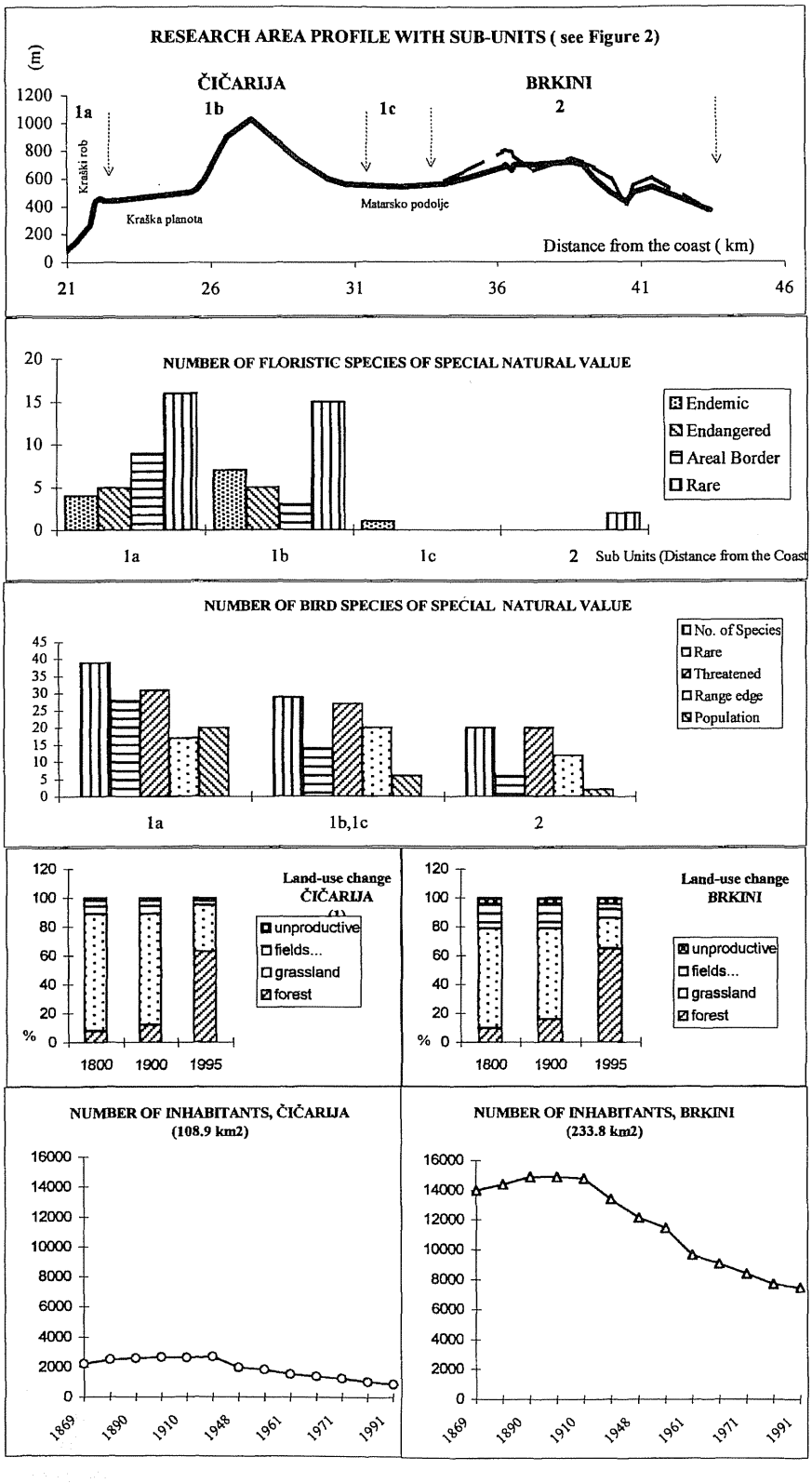

Fig. 4: Floristic and bird natural value index along the research area as per land-use and population census.
Sl. 4: Indeks naravne vrednosti floističnih in ptičjih vrst vzdolž profila razskovanega območja glede na rabo tal in popis prebivalstva.

Parus ater, Parus cristatus (Geister, 1994), have inhabited the study area only after the period of intensive afforestation with pine. The great majority of these "newcomers" are not endangered species (IUCN, 1994; Tucker & Heath, 1994).

CONCLUSIONS

The area was almost deserted two hundred years ago, due to the extensive exploitation of natural resources by humans that had started in the Middle Ages. When man began to artificially afforestate the area with introduced species (mostly black pine) at the end of the 19th century, the economic value of natural resources (wood production) began to increase and erosion declined. After some time, the spreading of black pine continued in a natural way. The depopulation processes, which started at the beginning of the 20th century, consequently caused additional overgrowing of the agricultural land. The benefit of this recovering process for the natural value of the area is questionable. With the increase of overgrown land and related changes in land-use (Fig. 3), the proportion of dry grassland and cultural landscape species in relation to woodland bird species has changed. Nowadays, the number and abundance of forest species is higher (they constitute almost 40% of the selected characteristic bird species from the area), while 200 years ago this percentage was lower, reaching only 16%. Though the number of bird species and their population have increased, the "quality of species" decreased. Highly sensitive and specialised birds, especially dry grassland and cultural landscape species (Tucker *et al.*, 1991; Marčeta, 1993; Bračko *et al.*, 1994), are decreasing or have even become extinct and replaced by more common, mainly woodland species.

The special natural value, the species endemity, threat status, rarity or biogeographical particularities (species on their range edge) show that Kraški rob, with its Kraška planota, Mt. Slavnik and Matarsko podolje, is of a great natural importance. There are 16 plant species on Kraški rob and 26 on Kraška planota with high natural value index (NVI). In the Brkini area, there are 2 species that are rare at the national level. The same counts for the bird species. On the Kraški rob, there are almost 80 different bird species of special natural value (NVI 140), 40 on Kraška planota with Mt. Slavnik (NVI 100) and 35 in Brkini (NVI 60). The area is of a special conservation value as it includes the northernmost edge of the global range of many Mediterranean species. Populations on their range edge are of special importance for their global survival.

The described natural character of the area is also supported by human activities that in fact sustain ecological conditions for many flora and bird species. Due to the socio-economic reasons, such as recent depopulation and decline in traditional agriculture, degradation of cultural landscape is present in the area. Once traditional farm character of households in the area is changing to the post-industrial/non-farm character that implies land-use changes. Pastures are being abandoned in Čičarija and meadows, orchards and more remote fields in Brkini. The rate of overgrowing processes by bush, pioneer tree species and aggressive nonindigenous tree species (progression of forest, regression of cultivated land) is high, which is also discussed herewith (Čehovin, 1992; Košiček, 1993). The forest in Brkini is degraded due to the prolonged exploitation practices in the past. The sociological potential, sex, age and education structures of the people of Brkini and Čičarija are not in favour of progress, though the depopulation almost stopped (Globevnik *et al.*, 1996). The development potential is concentrated along the main, central road in Matarsko podolje, where industrial, marketing, educational, social and cultural centres of the area are concentrated. Details regarding flora, bird natural value, land-use and population are shown in Fig. 4.

Uncultivated areas exposed to erosion (bare substratum and solid limestone rocks) constitute an extremely important habitat for wildlife. Desertification phenomena, such as erosion and wildfires, are therefore desired to a certain degree. Erosion (water, wind), wildfires, slow regeneration of the substratum in connection with dry and warm climate on the limestone basis generate conditions for some highly ecologically specialised species, once commonly distributed over the research area. Without regular maintenance (grazing, moving) and possible managed nature reserves, the future of these important habitats is uncertain. We conclude that desertification processes, shown as land abandonment, overgrowing and human resources decline, have had, in general, impacts on the socio-economic development of the area, landscape character and on the wildlife and habitats.

Recommendations for sustainable development

On the basis of our study, the following general recommendation for sustainable development are proposed: (a) to initiate modern farm products market network, (b) to support traditional fruit production (apple, plum) in Brkini, (c) to support sustainable sheep breeding in Čičarija, (d) to organise better employment opportunities for no-farmers, (e) to prevent further abandoning of agricultural land, (f) keep remote pastures and fields to sustain natural and landscape diversity), (g) to follow sustainable forest management measures (diverse structure, non-leaf picking, indigenous species...), (h) to promote clean environment (keep waste dumping under control, solid waste and waste water neutralisation, modern concept industry/manufacture), (i) to develop programmes to support sustainable use of natural resources (soft tourism, bio-agriculture, traditional craft),

(j) to protect natural monuments and nature conservation important areas and declare more nature reserves within the region, and (k) to promote the entire area as a landscape protected area.

DEZERTIFIKACIJSKI PROCESI V ROBNEM SREDOZEMSKEM HRIBOVJU (BRKINI IN ČIČARIJA, JZ SLOVENIJA)

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POVZETEK

Območje Brkinov in Čičarije (JZ Slovenija) leži na ločnici med sredozemskim in celinskim delom Slovenije. Zaradi sprememb v socio-ekonomskih razmerah (predvsem sprememb v rabi tal in depopulacijskih procesov) in pogozdovanja območja v zadnjih dvesto letih sta se med drugim spremenila tudi vrstna sestava in zastopanost ptic, združb in rastlinskih vrst. Kljub tem spremembam ima robno sredozemsko območje Brkinov in Čičarije še vedno posebno vrednost v pogledu biodiverzitete, predvsem po številu endemičnih, ogroženih vrst ali pa vrst, ki tu dosežejo rob areala razširjenosti. Na robnem sredozemskem območju z zmernimi klimatskimi dejavniki je naravni regeneracijski potencial višji kot v osrednjem Sredozemlju. Nekateri dezertifikacijski procesi, kot npr. erozija in gozdni požari pa tudi tradicionalne človekove dejavnosti (npr. kmetijstvo), so potrebni in zaželeni za obstoj nekaterih ozko specializiranih vrst. Opuščanje rabe tal, zaraščanje z gozdom in depopulacijski procesi vplivajo na socio-ekonomski razvoj območja, krajinsko sliko ter floristične in favnistične posebnosti območja.

Ključne besede: Sredozemlje, flora, vegetacija, gozd, ptice, trajnostna raba, varstvo narave, dezertifikacija

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OPPORTUNITIES FOR NEW RAMSAR SITES: EXPERIENCES OF A TERRITORIALLY SMALL COUNTRY

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ABSTRACT

Rivers and their riparian systems play an extremely important role as eco-corridors by providing a network of interconnected habitats. The idea is to designate as Ramsar Sites clusters of small wetlands within catchments, to ensure that the hydrological conditions needed to sustain the ecological character of each of these wetlands are maintained. Another opportunity for including wetlands on the Ramsar List is provided by man-made water reservoirs. While evaluating such reservoirs for inclusion on the Ramsar List, the river sections between the reservoirs should be considered as they are important daily or seasonal corridors for waterfowl, and they provide feeding and breeding habitats for waterfowl.

Key words: wetlands, river corridors, reservoirs, Ramsar Convention, nature conservation, Slovenia

OPPORTUNITÀ PER NUOVE ZONE RAMSAR: ESPERIENZE DI UNA TERRITORIALMENTE PICCOLA NAZIONE

SINTESI

Nell'articolo vengono discusse due possibilità di includere ambienti umidi nella Lista delle zone umide d'importanza internazionale. I fiumi e i loro sistemi rivieraschi ricoprono l'estremamente importante ruolo di ecocorridoi, fornendo una rete di habitat interconnessi. L'autore presenta l'idea di designare come zone Ramsar gruppi di piccole aree umide all'interno di bacini di raccolta, al fine di assicurare che le condizioni idrologiche necessarie a sostenere il carattere ecologico di ciascuna di esse vengano mantenute. Un'altra opportunità di includere ambienti umidi nella Lista Ramsar è fornita dai bacini di riserva acquiferi artificiali. Nella valutazione di tali serbatoi, al fine di includerli nella Lista Ramsar, i tratti di fiume compresi tra di essi dovrebbero venir presi in considerazione in quanto importanti corridoi giornalieri o stagionali per gli uccelli acquatici, fungenti da siti di riproduzione e di alimentazione per tali volatili.

Parole chiave: zone umide, corridoi fluviali, bacini di riserva, Convenzione di Ramsar, tutela dell'ambiente, Slovenia

INTRODUCTION

The first obligation of any Contracting Party to the Ramsar Convention is the designation of at least one wetland for inclusion on the List of Wetlands of International Importance. Consequently, the contracting party is obliged to maintain the ecological character of this site. The designating of a site for inclusion on the Ramsar List is not only an obligation, it is also a great privilege. The Ramsar Convention recognizes all wetlands as valuable although, some are more important to conserve than others. Article 2.2 of the Convention states that only internationally significant wetlands in terms of ecology, botany, zoology, limnology or hydrology should be selected for the List. A wetland is identified as internationally important if it meets at least one of the Ramsar criteria given below (Hails, 1996; Ramsar Convention Bureau, 1997):

a) Criteria for representative or unique wetlands;
b) General criteria based on plants or animals;
c) Specific criteria based on waterfowl;
d) Specific criteria based on fish.

The criteria in group (c) are based on "measurable tools" for identification of internationally important wetlands. Following the principles for waterfowl for example, a wetland is considered internationally important if it regularly supports 20,000 individuals, or 1% of the biogeographical population of certain species or subspecies of waterfowl. These measures are considered the most objective, and thus enable inclusion of wetlands on the Ramsar List. Paragraph 10, of the Brisbane Conference of Parties (COP) Resolution VI.4, calls upon Contracting Parties to use waterfowl population estimates, and 1% thresholds as a basis for site designation in the succeeding triennia (Ramsar Convention Bureau, 1996). Although these are the most objective criteria, measures based on population estimates and 1% thresholds are often difficult to apply. This fact is particularly relevant for territorially small countries.

It is difficult to imagine that a small country such as Slovenia, with a surface area of 20,000 km² (an area comparable to the Parapol Valley Ramsar Site in the Russian Federation), where wetlands represent less than 1,000 km² (approximately 4% of the territory) could hold 1% of the Eastern European population of one waterfowl species. Consequently, meeting the afore mentioned population criteria in a country where the surface area of the two largest water bodies does not exceed 3.6 km² each, and where natural wetlands comprise only 20 km² is difficult, if not impossible. Furthermore, the surface area of the Republic of Slovenia is less than 1% of the whole biogeographical region.

Although other norms for the designation of Wetlands of International Importance are equally important and relevant, the above criteria are mainly used to illustrate the importance of protecting wetlands at the national level, and to stimulate the consideration of new possibilities for the designation of Ramsar sites. However, the ultimate goal for a country should not be to merely include as many wetlands as possible in the Ramsar list. Every wetland, whether on the Ramsar List or not, is important for the conservation of a country's biodiversity. There are numerous ways to conserve wetland values.

WETLANDS OF INTERNATIONAL IMPORTANCE: OPPORTUNITIES FOR DESIGNATION

As previously mentioned, all standards for the designation of Wetlands of International Importance are equally important and relevant. Following the Ramsar criteria, two proposals for the inclusion of wetlands to the Ramsar List in a territorially small country will be presented and illustrated in the following two case studies (Figs. 1, 3).

Case Study 1: Wetland clusters in the Lower Posavje Region, and in the lowlands of the Sava, Krka and Sotla rivers

In recent years, several ornithological surveys have been carried out in the middle reaches of the Sava River, and at the confluences of its tributaries, the Krka and Sotla rivers in Eastern Slovenia. Survey results indicate that the area, known as the Lower Posavje region, can be considered as one of the most important wetlands in Slovenia. Although various human interventions, notorious irrigation schemes in particular, have reduced the surface area of the former wetland to narrow but well preserved strips along the three rivers. Greatly reduced, the wetlands today consist of a flood-

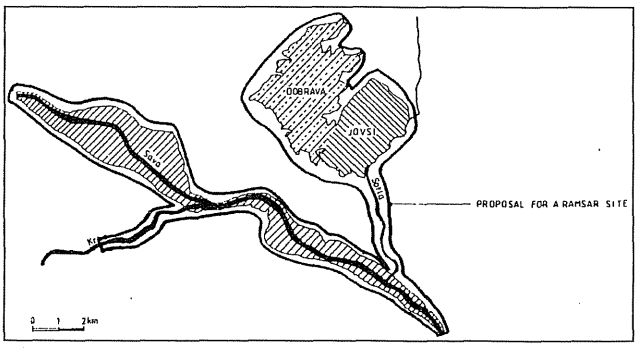

Fig. 1: Position of the proposed cluster of wetlands along the Sava river (Jovsi, Dobrava, Vrbina) and proposed boundaries for a cluster Ramsar Site.
Sl. 1: Lega predlagane skupinice mokrišč vzdolž Save (Jovsi, Dobrava, Vrbina) in meje predlagane ramsarske lokalitete.

plain of oak forest (Dobrava) and a relatively extensive alluvial plain that includes wet grasslands (Jovsi), the Vrbina forest and gravel pits. Each locality covers an area of about 5 km^2.

Jovsi is the only one of the three wetlands protected at the national level. It is designated as a nature reserve, corresponding to IUCN protected area management category IV. Currently, none of the three areas have international protection status. The Dobrava and Vrbina forests may have difficulties qualifying under any of the Ramsar criteria. The Dobrava forest, for example, is one of the two last floodplain forests in this part of Slovenia, but smaller, less representative and supporting fewer rare, vulnerable, or endangered species than the nearby Krakovski gozd (Fig. 2).

All three areas need protection at the national level. Moreover, all of them require at least some management activities to maintain their current ecological character. The questions therefore are:

Would it be feasible to propose designation of a cluster of the three wetlands as one Ramsar site and,

Can such a cluster of wetlands meet any of the Ramsar Criteria?

All the above mentioned wetlands are within the same catchment. Without considering a larger part of the watershed the ecological character of individual sites will be difficult to preserve. Designating a Ramsar site over a larger territory than covered by the individual wetlands could provide a useful instrument for prevention of major threats to the hydrological regime of the catchment *(i.e.* changes in groundwater flows). Additionally, designation of a nature reserve would prevent direct negative activities such as drainage.

The conservation value of a cluster of wetlands along the three rivers can be regarded as an important eco-corridor, a unique unit consisting of different ecosystems. The cluster of wetlands can easily comply with Ramsar criteria based on representative or unique wetlands and general criteria based on plants or animals, whereas the separate areas would not. By summing up the numbers of waterfowl present at the site during migration or wintering periods, the area comes close to meeting the specific waterfowl measures.

In this context, it is particularly important to underline the conservation value of several small gravel pits scattered throughout the floodplain. These areas are used as breeding and feeding areas for several bird species. The gravel pits in the Vrbina forest comprise one of the most important breeding area for Sand Martins *(Riparia riparia)* in Slovenia. Moreover, (in our country) the only natural breeding sites of this species are preserved along the Sava River and within the cluster area under consideration. Cumulative numbers of migratory and wintering waterfowl, especially grebes (Podicipedidae), cormorants (Phalacrocoracidae), herons (Ardeidae), ducks (Anatidae) and waders are extremely high in this area.

Fig. 2: Krakovski gozd is a part of the proposed cluster Ramsar site along the confluence of the Sava, Krka and Sotla Rivers. (Photo: A. Sovinc)
Sl. 2: Krakovski gozd je sestavni del predlaganega območja za Ramsarsko lokaliteto ob sotočju Save, Krke in Sotle. (Foto: A. Sovinc)

To conclude: although Ramsar designation is not a protected area management category (meaning it does not require special management prescriptions), it can provide an effective general protection for a cluster of separate wetlands in the same catchment area. Such a cluster can also comply with the Ramsar criteria for designation of the Wetlands of International Importance. A cluster of wetlands can link different ecosystems as well as similar habitat types scattered over a large area. A good example of the benefits of cluster designation is illustrated by the group of gravel pits discussed above, which have proven to be extremely important wetland habitats, despite their artificial origin.

Case study 2: Proposal for extension of the Ramsar site to the river section in-between the two separate wetlands: the Drava River between the Ptuj and Ormož reservoirs

The Drava is the largest river in Slovenia. Sadly, due to numerous past interventions, the river and its floodplain are ranked as one of the most degraded watercourses in the country. Since beginning of the 20th century, several hydroelectric power plants have been constructed on the river. The large reservoirs associated with the power plants, their channels and canals, have destroyed the rich riverine ecosystems. Important breeding areas of waterfowl species, such as the globally endangered Ferruginous Duck *(Aythya nyroca),* the last breeding pairs of Stone-Curlews *(Burhinus oedicnemus)* in Slovenia and one of the few breeding colonies of Little Terns *(Sterna albifrons)* were once found in the riparian zone. It is controversial that the main factor contributing to the extinction of the above mentioned endangered species, are the large reservoirs which usurp the natural floodplains. It is these same reservoirs that have become the most important areas for migratory and wintering waterfowl in Slovenia (Fig. 4).

During migration, the high turnover of certain waterfowl species is very impressive. Up to 10,000 Black Terns *(Chlidonias niger)* and up to 100 Ospreys *(Pandion haliaetus)* can be observed on the reservoirs during spring migration (Štumberger, 1995). Up to 167 Honey Buzzards *(Pernis apivorus)* were counted in a few hours during one such migration (Božič, 1992). The international importance of the Drava River and its major reservoirs is especially remarkable during the wintering period. Bean and White-Fronted Geese *(Anser fabalis, A. albifrons),* Mallards *(Anas platyrhynchos),* Tufted Ducks *(Aythya fuligula),* Goldeneyes *(Bucephala clangula)* and Goosanders *(Mergus merganser)* reach or very nearly reach the 1% thresholds of their bioregional wintering populations (Sovinc, 1994; Štumberger, 1995). The vast majority of these birds have been counted on the two major reservoirs at Ptuj and at Ormož.

Despite the extraordinarily high numbers of wintering waterfowl on these two reservoirs, the conservation value of the river section between them has somehow been neglected. Detailed ornithological surveys carried out in recent years (Štumberger, 1995; Bračko, 1997) have pointed out the importance of the floodplain area between the two reservoirs, especially as breeding habitat for certain species. Between 1980 and 1996, out of 234 species recorded, 88 were breeding in this area (Bračko, 1997). It is also one of the very few breeding areas for species such as the Black-Headed Gull *(Larus ridibundus),* and the Common Tern *(Sterna hirundo)* in Slovenia. The following birds are among the species reaching more than 10% of the national breeding population: Little Grebe *(Tachybaptus ruficollis),* Tufted Duck *(Aythya fuligula),* Little Ringed Plover *(Charadrius dubius),* Common Sandpiper *(Actitis hypoleucos)* (Štumberger, 1995).

Due to steep concrete banks and deep water, large reservoirs provide very limited breeding opportunities for waterfowl. This situation could be effectively improved by the construction of artificial islands and shallow water areas.

The river reach between the Ptuj and Ormož reservoirs, plays an important role as a breeding area for waterfowl and other animal species. As a daily and seasonal corridor, and a feeding area for the birds, it is of extremely high ecological value. It has kept this function in spite of the fact that human activities and interventions (*e.g.* lowering of the ground water tables and extraction of water for hydropower needs) have badly damaged the riverine ecosystems.

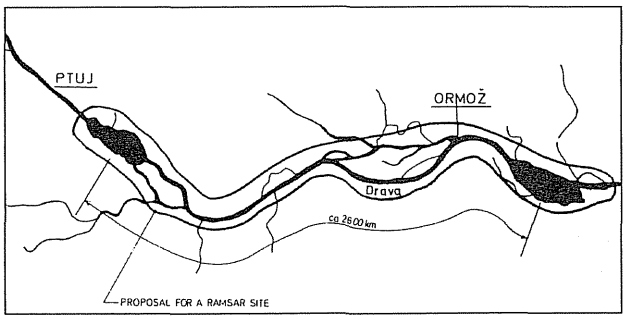

Fig. 3: Extension of the boundaries for the proposed Ramsar Site to the river section between the two major reservoirs (Ptuj and Ormož lakes) on the Drava river.
Sl. 3: Podaljšanje meja predlagane ramsarske lokalitete do rečnega odseka med dvema glavnima akumulacijskima jezeroma (Ptujskim in Ormoškim) na reki Dravi.

Fig. 4: Along the former river bed of the Drava River between Ptuj and Ormož reservoirs remains of the oxbows are still present. (Photo: A. Sovinc)
Sl.4: Ob stari dravski strugi med akumulacijama Ptuj in Ormož še najdemo ostanke nekdanjih mrtvic. (Foto: A. Sovinc)

Presently, this reach of the Drava River has no protection at the national level. The area consists of highly urbanized and intensive agricultural lands. For this reason, it may be difficult to achieve protection of this section at the national level, since some restrictions in land use could be required. Therefore, the proposal to include this area adjacent to the river along with Ptuj and Ormož lakes to the Ramsar List could provide the minimum protection necessary to prevent further deterioration of the area.

CONCLUSIONS

A cluster of wetlands, often comprised of different wetland habitats in the same catchment area, can provide an excellent opportunity for small countries to include sites on Ramsar's List of Wetlands of International Importance. Using the cluster approach, we can extend the boundaries of proposed or existing 'point' Ramsar Sites on one river to intermediate river sections. This has been proposed for a reach of the Drava River between the two major reservoirs where waterfowl concentrate. Such river sections are important migration corridors and provide feeding and breeding grounds for birds and other animal species. Clustering wetlands and designating artificial reservoirs could be interesting for countries with small territories and small, scattered wetlands seeking to designate sites to the Ramsar List.

Designation as a Ramsar Site provides the necessary protection for a cluster of wetlands or the narrow riparian ecosystems between separate, but protected reservoirs. Such a designation is especially important in cases where the protection of wetlands is difficult to achieve at the local level, because it would require new restrictions in land-use. It is often the case that protection at the national or lower levels is easier to achieve after a wetland has been recognized as an internationally important site.

ACKNOWLEDGMENTS

I would like to thank Dr Gordana Beltram and Robert Bolješič, members of the Slovenian National Ramsar Committee, for their valuable comments and help in preparation of the article.

MOŽNOSTI ZA NOVE RAMSARSKE LOKALITETE: IZKUŠNJE OZEMELJSKO MAJHNE DRŽAVE

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POVZETEK

Ozemeljsko majhne države so pogosto omejene z možnostjo razglasitve novih mokrišč mednarodnega pomena po merilih Ramsarske konvencije, saj je zaradi manjše površine države manjše tudi število mokrišč. V prispevku sta prikazani dve možnosti za uvrščanje mokrišč na seznam mokrišč mednarodnega pomena, ki sta še posebej zanimivi za ozemeljsko majhne države pri pripravi seznama potencialnih novih ramsarskih lokalitet.

Rečni odseki in mokrišča vzdolž rek in potokov ponujajo možnosti za uporabo predlaganih možnosti. V okviru tipov mokrišč, ki jih vključuje Ramsarska konvencija, so tudi reke in obrečna mokrišča. To so izredno pomembni eko-koridorji, posamezna mokrišča pa tvorijo omrežje medsebojno povezanih habitatov in vmesnih postajališč. Pogosto posamezno takšno mokrišče ne izpolnjuje meril za razglasitev mednarodno pomembnega mokrišča, če pa je več manjših mokrišč povezanih v skupek, ustrezajo vsaj enemu izmed štirih skupin ramsarskih meril (merilo rastlinske in živalske diverzitete, merilo ogroženih ali endemičnih vrst, ali merilo ptičjih ali ribjih populacij; Hails, 1996). Po tem predlogu naj bi podpirali razglasitev ramsarskih lokalitet, povezanih v skupke na skupnem povodju. S tem bi pripomogli tudi k celovitemu pristopu ohranjanja ekološkega značaja posameznih mokrišč v skupku.

Naslednji predlog za uvrščanje mokrišč na ramsarski seznam pa se kaže v razglasitvi umetnih rečnih akumulacij. Posamezne velike akumulacije že izpolnjujejo ramsarska merila glede na velikost populacije prezimujočih, golečih se ali selečih se vodnih ptic. V drugih primerih pa je izpolnitev teh meril možna le, če sta najmanj dve akumulaciji na isti reki obravnavani kot ena lokaliteta. Pri obravnavanju takih primerov je nujno treba upoštevati tudi vlogo, ki jo imajo rečni odseki med akumulacijami. To so namreč pomembni dnevni ali sezonski koridorji za vodne ptice. Še pomembnejša je njihova vloga prehranjevališča in gnezdišča za vodne ptice, saj ponavadi teh tipov habitatov ni na velikih akumulacijah z globoko vodo in strmimi brežinami. Predlagana ramsarska lokaliteta naj torej poleg vodne akumulacije vključuje še rečne odseke nad in pod akumulacijo.

Ključne besede: mokrišča, rečni koridorji, vodne akumulacije, Ramsarska konvencija, varstvo narave, Slovenija

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POLLUTION HOT SPOTS AND SENSITIVE AREAS ALONG THE SLOVENIAN COAST

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ABSTRACT

Pollution hot spots and sensitive areas on the Mediterranean coast of Slovenia were identified according to recent data and UNEP/WHO guidelines. The Bays of Koper and Piran have been considered sensitive areas, since they can be affected by polluted waters of the Gulf of Trieste as well as by land-based sources of pollution along the Slovenian coast. The inner part of the Bay of Koper is receiving effluents from the municipal wastewater treatment plant and individual industries and agglomerations along the Rižana and Badaševica rivers. Domestic and agricultural discharges into the inner part of the Bay of Piran by the Dragonja river, tourism and intensive aquaculture reduce the quality of the water and may cause local changes in the marine ecosystem.

Key words: pollution of coastal waters, wastewater disposal, wastewater treatment, loads, pollution hot spots, sensitive areas, Gulf of Trieste, Adriatic Sea, Mediterranean Sea

AREE CRITICHE E AREE SENSIBILI ALL'INQUINAMENTO NELL'AREA COSTIERA DELLA SLOVENIA

SINTESI

Uno dei maggiori problemi inerenti le acque internazionali comprende il degrado delle risorse acquifere e degli habitat nelle zone marine e costiere, causato da una gestione non appropriata. Nell'articolo vengono presentate le aree critiche e le aree sensibili all'inquinamento situate sulla costa slovena, identificate grazie a dati recenti e alle direttive UNEP/WHO. Gli autori classificano le baie di Capodistria e Pirano come aree sensibili, in quanto possono venir condizionate da acque inquinate provenienti dal Golfo di Trieste come da fonti di inquinamento situate sulla costa slovena. La parte centrale della baia di Capodistria riceve effluenti dall'impianto di depurazione delle acque di scarico municipali eda singole industrie ed agglomerati situati in prossimità dei fiumi Risano e Cornalunga. Tramite il fiume Dragogna, invece, scarichi domestici e agricoli arrivano alla parte centrale della baia di Pirano, dove la qualità dell'acqua viene ridotta pure dalle attività turistiche ed acquacolturali, che sono dunque fonte di disturbo per gli ecosistemi marini.

Parole chiave: inquinamento delle acque costiere, smaltimento delle acque di scarico, trattamento delle acque di scarico, aree critiche, aree sensibili, Golfo di Trieste, mare Adriatico, Mediterraneo

INTRODUCTION

Human activities all around the semi-enclosed Mediterranean Sea produce, in a long term, a strong environmental impact in the form of coastal and marine degradation and a heightened risk of more serious damage. About one third of the Mediterranean population lives within 50 km of coastaline. Urban, industrial developments and agriculture are resulting in mounting pressures on already hard-pressed area.

International efforts to protect the Mediterranean Sea resulted in adoption of the Mediterranean Action Plan (MAP) (1975), Barcelona convention (1976) and related protocols by all Mediterranean countries. Marine pollution control was the initial subject of high priority activities of MAP, requiring a harmonized regional policy and strategy. The Coordinating Unit of MAP in Athens with its six Regional Activity Centers around the Mediterranean has carried out numerous studies in order to assess the environmental problems. The overview of the data and information regarding the state of the Mediterranean Sea is presented in the State of the Marine and Coastal Environment in the Mediterranean Region (UNEP 1989, 1996).

The assessment of main problems and past experience confirmed that sectorial approach to mitigation of coastal pollution has to be replaced by integral coastal zone planning and management. A targeted Strategic Action Program for the Mediterranean Sea (SAP MED) was prepared to address pollution from land-based activities and approved in 1996 (UNEP, 1999). One step of the program was identification and assessment of problems and causes including pollution "hot spots" and "sensitive areas".

By definition, pollution hot spots are point sources on the coast of the Mediterranean Sea which potentially affect human health, ecosystems, biodiversity, sustainability or economy in a significant manner. They are the main points where high levels of pollution loads originating from domestic or industrial sources are being discharged (UNEP/WHO, 1999). Hot spots are also coastal areas where the coastal marine environment is subject to pollution from one or more point or diffuse sources on the coast of the Mediterranean which potentially have significant impact (UNEP/WHO, 1999).

The estuaries and coastal waters of natural or socio-economic value are considered sensitive "if they are at higher risk to suffer negative impacts from human activities". Natural characteristics may determine the vulnerability of a coastal system, human activities determine the level of risk, hence planned development may increase the risk of environment degradation. Both vulnerability and risk contribute to the sensitivity of a particular area or system in the context of this assessment (UNEP/WHO, 1999).

Slovenia has been involved in the Long-term Pollution Monitoring and Research in the Mediterranean Sea (MED POL) since 1976. The overview of activities of Slovenian institutions within the framework of MED POL Phase I and MED POL Phase II and data concerning the state of chemical and sanitary pollution of the marine environment in the southeastern part of the Gulf of Trieste was presented in UNEP (1988) and IAEA/UNEP reports (1993), as well as in yearly reports and numerous other publications. Within monitoring programs, contamination of selected organisms and surface sediments by heavy metals (Kosta *et al.,* 1978; Tušnik & Planinc, 1988; Planinc *et al.,* 1993), organochlorine pesticides (Salihough *et al.,* 1980), anion detergents (Gorenc *et al.,* 1993), contamination by TBT and other compounds used in antifouling paints (Tolosa *et al.,* 1996) were studied in the eastern part of the Gulf of Trieste. More recently the composition, distribution and the sources of polycyclic aromatic hydrocarbons (PAHs) in the water column, sediments and organisms were investigated along the Slovenian coast (Bajt, 2000) and throughout the Gulf of Trieste (Notar *et al.,* 2001). Among heavy metals, mercury distribution and biogeochemistry have been studied as critical contaminant in the Gulf of Trieste in the last few years (Covelli *et al.,* 1999; Horvat *et al.,* 1999; Hines *et al.,* 2000).

Marine eutrophication has been described as one of the major effects of anthropogenic activities and is particularly evident in marine waters with limited water exchange such as the Adriatic Sea. Anthropogenic nutrient contribution to the increasing coastal marine pollution and eutrophication was studied in the Gulf of Trieste already in the early seventies (Štirn, 1971; Štirn *et al.,* 1974). Different concepts and aspects of natural or cultural eutrophication have been published in the last few decades (UNESCO, 1988; Štirn, 1993). However, there is a great diversity of phenomena considered as the symptoms of marine eutrophication, and they are still poorly understood (EEA, 2001). The treatment and disposal of sewage is a problem in populated coastal areas. The main sources of potential pollutants, including those of fresh water inflows and emissions to the whole Gulf of Trieste, were presented by Olivotti *et al.* (1986a, b). Anthropogenic impacts on small stratified estuary was studied in the Rižana estuary (Faganeli *et al.,* 1984, 1988; Faganeli & Turk, 1989; Turk & Faganeli, 1990), as well as the distribution of pollutants and impact of diluted wastewaters discharged into the inner part of the Bay of Koper (Lenarčič, 1980; Turk *et al.,* 1982). Annual inputs of some pollutant fluxes from land-based sources of pollution based on the results of five year monitoring (1983-88) were estimated by Tušnik *et al.* (1989).

In the seventies and eighties, several studies examined the impact of untreated sewage on ecosystems (Malej *et al.,* 1979; Fanuko, 1984; Vukovič, 1994), and the impact of the underwater sewage outfall in the Bay of Piran (Avčin *et al.,* 1979; Malej, 1980; Faganeli,

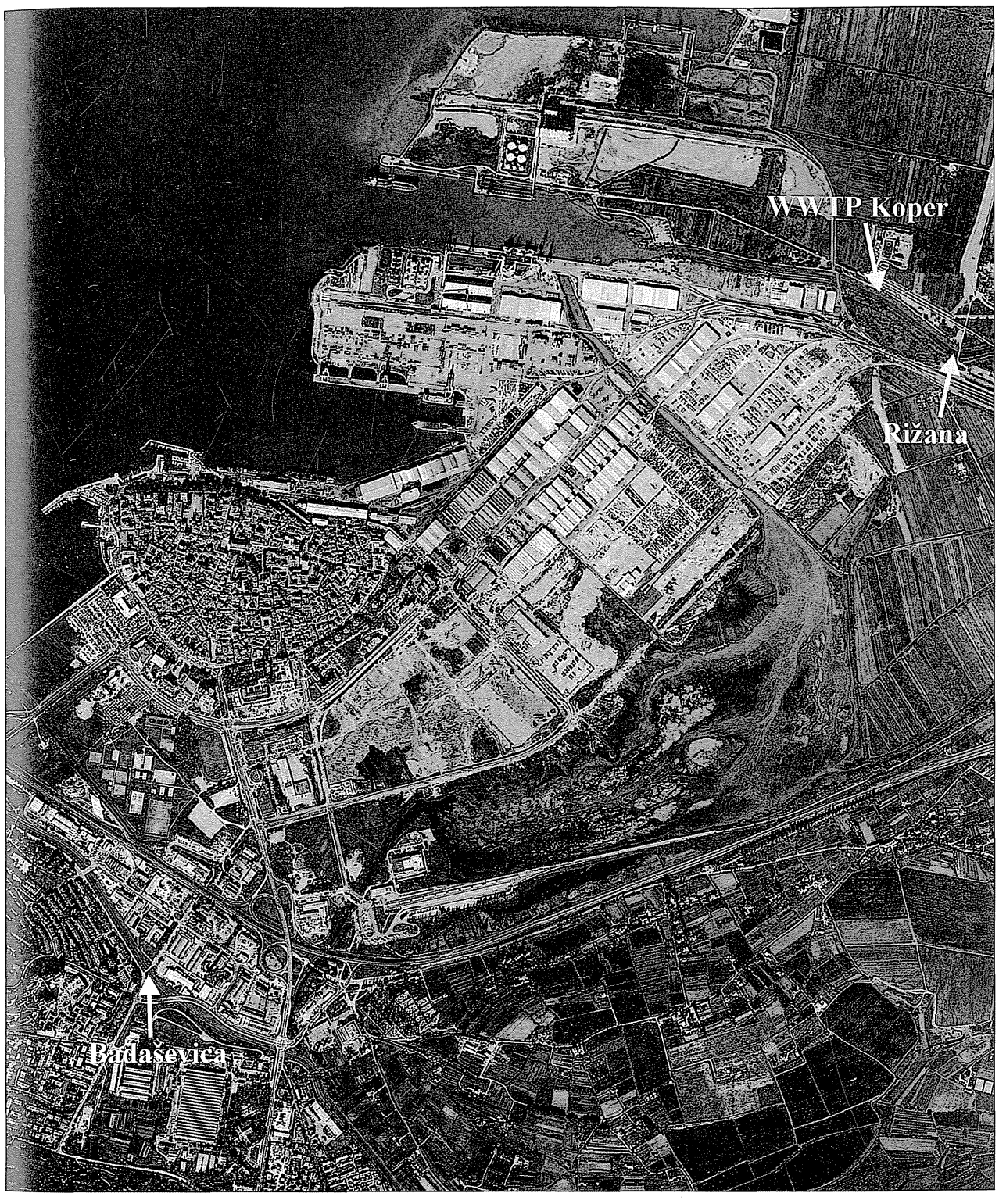

Fig.1: Sampling locations of the main pollution hot spots in the inner part of the Bay of Koper (WWTP Koper - wastewater treatment plant Koper, the river Rižana and the river Badaševica). (Photo: Ministry of Environment and Spatial Planning, Surveying and Mapping Authority of the Republic of Slovenia)
Sl. 1: Prikaz vzorčevalnih mest žariščnih točk onesnaženja v notranjosti Koprskega zaliva (WWTP Koper - čistilna naprava Koper, reka Rižana in reka Badaševica). (Foto: Ministrstvo za okolje in prostor, Geodetska uprava Republike Slovenije)

Fig. 2: Sampling locations of the main sources of pollution in the inner part of the Bay of Piran (WWTP Piran - wastewater treatment plant Piran, the river Drnica and the river Dragonja). (Photo: Ministry of Environment and Spatial Planning, Surveying and Mapping Authority of the Republic of Slovenia)
Sl. 2: Prikaz vzorčevalnih mest žariščnih točk onesnaženja v notranjosti Piranskega zaliva (WWTP Piran - čistilna naprava Piran, reka Drnica in reka Dragonja). (Foto: Ministrstvo za okolje in prostor, Geodetska uprava Republike Slovenije)

1982). Recently, more studies examined the distribution of the fluorometric signal in the wastewater near-field around the diffusers of Piran wastewater treatment plant (Malačič & Vukovič, 1997) and different nutrients were analysed in relation to microbiological indicators (Mozetič *et al.,* 1999).

In this paper, review of the existing list of hot spots and sensitive areas for Slovenia determined in MAP Technical Reports Series No. 124 (UNEP/WHO, 1999) were presented according to recent data on discharges from coastal cities or urban coastal agglomerates and from main industries discharging directly into the sea. The report summarizes evaluation of the impacts of priority hot spots within criteria on transboudary effects (UNEP, 1997).

CHARACTERISTICS OF SLOVENIAN COASTAL WATERS

Slovenian transitional and coastal waters are considered an ecological unit within the Gulf of Trieste, the northernmost part of the Adriatic Sea with an approx. surface area of 600 km² and volume of about 9.5 km³. The Gulf is a shallow (max depths 20-25 m) marine basin, influenced by freshwater inflow, bottom sediment resuspension and increasing pollution. The Gulf is significantly affected by the general anticlockwise circulation pattern of the Adriatic Sea that brings southern oligotrophic waters. The seasonal variation of water circulation is moreover controlled by fluctuations of the freshwater inflow. Average inflow from the northwestern part is about 120 m³/s with peaks higher than 1000 m³/s (Naudin *et al.,* 1999). The general anticlockwise circulation pattern in the Gulf of Trieste is modulated by local winds, tidal currents, density currents and inertial effects (Stravisi & Cristiani, 1986; Malačič, 1991). Characteristic of the gulf are large temperature (6-26°C) and salinity amplitudes (32-38.5 PSU in the surface layer, 36–39 PSU in the bottom water). The density stratification in the water column starts in spring and intensifies until the late summer, which is often associated with hypoxia/anoxia in bottom waters (Faganeli *et al.,* 1985; Malej & Malačič, 1995). The physical properties of the Gulf of Trieste affect the chemistry and dynamics of the biology of the system (see Malone *et al.* (1999) and Hopkins *et al.* (1999) for review and references).

Slovenia is a country with a total surface area of 20,255 km². Its coastline along the Adriatic Sea is 46.6 km in length. Along most of the length a very narrow belt with flysch cliffs and solitary lime rocks prevail between the flat-bottomed valleys of the Rižana and Dragonja rivers. The coastal area can be subdivided into two parts: the deeper part of the Gulf of Trieste, which is widely open to the rest of the Northern Adriatic, and the second part comprising small shallow bays (the Bay of Koper, the Bay of Strunjan, and the Bay of Piran), which have similar origins but different pollution loading.

MATERIAL AND METHODS

Identification of pollution hot spots

Pollution hot spots were identified on the basis of analyses of available data, adequate questioners and UNEP/WHO guidelines dealing with municipal discharges from coastal cities or urban agglomerates and main industrial sources discharging directly into the sea (UNEP/WHO, 1999):

- *for municipal discharges:* data on permanent population and average seasonal increase, major industries, existence of sewage treatment plan, wastewater flow, type of treatment before discharge, total wastewater discharge, type and location of discharge, pollution loads at the discharge point and quality of the receiving environment;
- *for industrial discharges:* type of industry, data on industrial wastewater treatment (type), way of discharge, wastewater quantity, quality and pollution loads at point of discharge and estimation of pollution loads discharged into receiving waters.

Sampling stations

Monitoring of loads was carried out at the outlet of sewage from urban agglomerations in Izola (Izola outlet - 45°32.33 N, 13°39.75 E), at the outlets of wastewater treatment plant in Piran (WWTP Piran - 45°31.17 N, 13°34.20 E) and Koper (WWTP Koper - 45°33.60 N, 13°45.08 E), and at the outlet of industrial effluents discharged by the fish canning industry "Delamaris" in Izola (DELAMARIS - 45°32.50 N, 13°39.85 E). Monitoring of contaminants in hot spot areas was carried out at the rivers Rižana (45°33.40 N, 13°45.47 E), Badaševica (Semedelski kanal) (45°32.20 N, 13°43.67 E), Drnica (45°28.65 N, 13°37.00 E) and Dragonja (45°27.92 N, 13°36.93 E). Station locations are shown in figures 1 and 2. Sampling of effluents and river waters were carried out seasonally during the year 2000 (Turk *et al.,* 2000).

Evaluation of pollution hot spots

The quality of wastewater and receiving environment were determined according to regular measurement of parameters such as biological and chemical oxygen demand (BOD_5, COD), nutrients (total nitrogen – TotN, total phosphorous – TotP), total suspended material (TSS), detergent (Det), heavy metals (mercury – Hg, cadmium – Cd, lead – Pb, zinc – Zn, copper Cu, nickel – Ni) and microorganisms (faecal coliforms - FC). Data from the monitoring activities for the year 2000 were

collected and analyzed (Turk *et al.*, 2000). Pollution loads at the discharge point were calculated according to yearly mean concentration for each parameter and data on the flow capacity of the pumps at the sewage treatment plants for the year 2000 (Turk *et al.*, 2000), or total river flows (HMZ/MOP, 1999, 2000).

To show the severity of each of the effects on the identified hot spots, a ranking system from 1-6 (1-no effect; 6-extreme effects) was prepared using the criteria with effects on public health, drinking water quality, recreation, other beneficial uses (transportation, sport activities, aquaculture), aquatic life (including biodiversity), economical and welfare (including marine resources of economic value) (UNEP/WHO, 1999).

RESULTS

Human pressure and pollution sources

The coastal area has been exposed to strong development pressure shown in the rapid growth of population, town planning and development of business sectors (traffic, trade, tourism, processing activities, agriculture).

The coastal region extends over the territory of three municipalities (Koper, Izola and Piran) with an area of 384 km² (about 1.7% of the total national territory) and with a population of slightly over 80,000 people (about 4% of the total population in Slovenia) (Tab. 1). The population density of the area (232 inhabitants/km²) is more than twice the national average (98 inhabitants/km²). The most of the coastal population (> 80%) lives within the 1.5 km wide strip. The population growth is slightly higher in the coastal region than at the national level, but in the last decade (in the 90's) the population growth stagnated (0.1% increase).

Tab. 1: Population and tourist overnight stays with percentage of average seasonal increase in the coastal region in the year 2000*.
Tab. 1: Število prebivalcev in nočitev turistov z odstotki sezonske rasti v obalni regiji v letu 2000*.

	Area (km²)	Population	Population (%) served by municipal sewer system	Number of total overnight stays	Average seasonal increase (3 months)
Koper	311.2	48,251	57	239,000	5.4%
Izola	28.6	14,590	80	222,818	16.6%
Piran	44.4	17,440	86	1,306,454	81.4%

*Statistical yearbook of the Statistical Office of the R Slovenia (2000)

The principal industries in coastal region include metal manufacturing, production of chemicals and food industry. Economic development caused regression in agriculture activities that now mainly include wine, fruit and olive growing, and vegetable cultivation. Because of good inland transport connections, the Port of Koper has become the most important export-import port in Central Europe and is increasing its activities every year. The Port of Koper handles about 10 million tons of cargo per year (over 1,500,000 tons of oil and oil products and over 100,000 tons of chemicals and inflammable liquids). At the Port of Koper, there is a general cargo terminal (coffee, metal, paper, fruits and vegetables, cotton, textiles), a RO-RO and car terminal, a timber terminal, a terminal for iron and coal, a liquid cargo terminal (chemicals, phosphoric acid, vegetable oil, Latex), a terminal for fertilizers and other bulk cargoes, and a silos for cereals and oilseeds, aluminum). The oil terminal is operated by OMV-ISTRABENZ – Instalacije d.o.o. The main sources of pollution in the port are tank cleaning, inadequate drains, volatile emissions and general spillage during the emptying of hoses. Preliminary estimation of organic loads from industries represents 22,550 PE (population equivalent) (individual loads have been calculated where data were available) (Tab. 2).

Tab. 2: Estimates of pollution load (PE - population equivalent) from industries along the Slovenian coastline.
Tab. 2: Ocena obremenitev slovenske Obale (PE - populacijski ekvivalent) z industrijskimi odplakami.

Contribution from	Load in PE
Delamaris	7,000
Ladjedelnica – shipyard	100
Mehano	200
Argo	100
Droga	1,800
Frigomar	800
Hospital	1300
Cimos – Koper	500
Tomos	800
Intereuropa	250
Kemiplas & Polisinteza	2,500
Luka Koper	2,000
Vina Koper	6,500
Industry total	**22,550**

The sea is also used for bathing and recreation (including sports like sailing, wind surfing, rowing), fishing and mariculture:

- along the Slovenian coastline 29 registered beaches are located;

- fishing (about 2000 tons/y) and mariculture (shellfish: annual production about 50 tons; fish: annual production is about 100 tons (Marčeta, 1997; Statistical yearbook of the Statistical Office of the R Slovenia 2000);
- transportation - in addition to the Port of Koper there are three marinas (in Portorož, Izola and Koper) (Novak *et al.*, 1998). A two-fold increase in moorings and yachting harbors in the last 10 years (from 898 to 1618) indicates the growth of "yachting" tourism (Statistical yearbook of the Statistical Office of the R Slovenia 2000).

Main loads and hot spots

The Rižana river receives mainly untreated urban and industrial wastewater from the town of Koper and inland agglomerations along the river. The combined sewer system (which also collects storm waters) is connected to a mechanical wastewater treatment plant (WWTP), with total yearly effluent about $4.7x10^6$ m³/year. About 34% of the wastewater is from industry/enterprises/public sector; 66% is household wastewater. The sewage effluent is discharged into the estuary of the Rižana river. The system also collects effluents from the following industries: VINA KOPER wine production (combined sanitary and technological effluents, pretreatment); CIMOS car industry (combined sanitary and technological effluents, pretreatment); I&I bus service (combined sanitary and technological effluents, pretreatment); INTEREUROPA, AVTOPLUS, CESTNO podjetje, SGP, TOMOS, car washing, lacquering, electroplating (combined sanitary and technological effluents, pretreatment); Port of Koper, washing containers, trucks, cars, store-house (combined sanitary and technological effluents, pretreatment).

There are also some industries with direct discharge into the Rižana river: KEMIPLAS, chemical industry (combined sanitary and technological effluents, pretreatment), INSTALACIJE (combined sanitary and technological effluents, biological treatment), and LAMA - metal manufacturing (combined sanitary and technological effluents, biological treatment). The expected organic load from industries in the Koper Municipality is around 12,550 PE (Tab. 2).

The sewage of the community of Izola is collected in a treatment basin and discharged without treatment into the sea about 300 m from the shore, with a flow rate of about $3.5x10^3$ m³/day. In addition, there are several small outlets discharging directly into the sea and discharge from the DELAMARIS fish-cannery pre-treatment plant (discharge rate 82,000 m³/year). The system collects effluents from the following industries:

LADJEDELNICA shipyard, pretreatment, some activities in the dock – wastes directly into the sea; City HOSPITAL, DROGA – food processing, MEHANO – toy factory, other small enterprises. Expected organic load from industries in Izola is app. 10,000 PE (Tab. 2).

The sewage system in the community of Piran has a central sewage treatment plant with a capacity of 30,000 PE and total yearly effluent about $2.7x10^6$ m³/year. After mechanical treatment (screening, sand and grease removal, sedimentation), the sewage water is discharged into the sea, through two submarine pipes, 3450 m and 3600 m from the shore, with diffusers at the end. No industry is connected to the wastewater treatment plant.

Tab. 3: Present and future loads (PE) on wastewater treatment plants (WWTP) and the Izola's pumping station*.
Tab. 3: Trenutne in pričakovane obremenitve (PE) čistilnih naprav in črpališča v Izoli*.

	Present winter load	Present summer load	Future winter load	Future summer load	Existing treatment capacity
WWTP Koper	31,569	34,686	52,490	58,605	WWTP for 50,000 PE
WWTP Piran	14,953	27,101	17,780	32,980	WWTP for 30,000 PE
Izola outlet	19,575	23,195	22,330	29,530	none

*Future loads on wastewater treatment plants estimated on the base of demographic industrial and tourism development.
*Pričakovane obremenitve čistilnih naprav ocenjene na osnovi demografskih kazalcev, razvoja industrije in turizma.

Some present and future preliminary individual loads on wastewater treatment plants Koper and Piran as well as on Izola outlet have been calculated separately for summer and winter, since summer loads are higher due to the increase of tourist population (Tab. 3). Future loads on wastewater treatment plants have been estimated by contribution of potential future connections to WWTP-s. These potential factors are population, industrial and tourism development. A net 0.5% population increase per year has been estimated according to the review of Demographic analyses. The contribution to the wastewater treatment plants of pollution originating from the industries is based on figures from the report as performed by IEI Engineering (1999), the pilot testing project in Izola performed by BIO-TEHNA (1991), and the future policies concerning the connection of industrial wastewater to the public wastewater treatment plants.

Assessment of the pollution level

Estimated yearly freshwater input into the Gulf of Trieste from the Slovenian coast is $206x10^6$ m^3. The total quantity of urban and industrial wastewaters is $11x10^6$ m^3/year, taking account that the existing flow measurements contain rain water as well as intrusion seawater.

The gross fluxes of some pollutants have been estimated for the entire region according to the available data of mean annual concentration and flow rates. The estimated yearly input from the wastewater treatment plants Koper and Piran, and Izola outlets is presented in tables 4a and 4b and for rivers in tables 5a and 5b.

The Rižana and Badaševica rivers are the main pollution hot spots according to data and criteria of severity of effects on public health, drinking water quality, recreation, other beneficial uses (transportation, sport activities, aquaculture), and aquatic life (including biodiversity). For the inner part of the Bay of Koper the pollution loads were estimated from data collected at the sampling stations at both rivers, and at the outlet of primary treated sewage of the WWTP Koper. The estimated gross flux for suspended solids is 1281 t/y, for nitrogen 710 t/y, for phosphorous 23 t/y (Tabs. 4a, 5a), and for heavy metals, such as nickel 2.7 t/y, zinc 2.2 t/y, copper 1.0 t/y and 0.7 t/y for lead (Tabs. 4b, 5b). Both hot spots having mixed sources of pollution account for 56% of total BOD_5 load and 63% for COD. Much lower inputs were estimated for the Bay of Piran for total suspended solids 322 t/y, for total nitrogen 153 t/y, for total phosphorous 9.3 t/y, 0.14 t/y for nickel, 0.6 t/y for zinc, 0.38 t/y for copper and 0.13 t/y for lead (Tabs. 4, 5).

Sites of biological and ecological value

Various economic activities have developed over roughly 80 % of Slovenia's coastline, leaving only about 8 km (20 %) of the coast in its natural state. It is obvious that even on these few kilometers we can not speak of true naturalness since there are numerous indirect and direct impacts from various human activities due to sewage and industrial outlets, traffic and other activities on the urbanized part of the coastal area. Direct impacts on the remaining parts of the natural coastline are derived mainly from tourism (leisure boat traffic, anchoring), fishing and collecting mussels. Salt-pans, flysch cliffs and solitary lime rocks are important littoral ecosystems in terms of biodiversity. The list of landscape parks, nature reserves, and nature monuments of great importance needing protection for their natural assets and biological diversity is presented in table 6 (Turk & Odorico, 1993; Turk & Vukovič, 1994; Turk, 1999).

Tab. 4a: The gross flux of some pollutants estimated on the effluent data for the year 2000.
Tab. 4a: Celoten vnos nekaterih polutantov, ocenjen na osnovi meritev odpadnih voda v letu 2000.

Loads	Flow rate(m^3/y)	Pollutants						
		COD (t/y)	BOD_5 (t/y)	TotN (t/y)	TotP (t/y)	TSS (t/y)	FC* (No./100 ml)	Det (t/y)
WWTP Koper	4.7×10^6	2054	583	126	14.6	662	6.3×10^5	12.4
WWTP Piran	2.7×10^6	594	270	92	8.1	270	1.4×10^7	5.4
IZOLA	3.1×10^6	1976	641	88	16.2	641	2.4×10^7	5.1
DELAMARIS	8.2×10^4	399	16	15	2.0	91		0.3
Total	**1.1×10^7**	**5023**	**1658**	**321**	**40.9**	**1664**		**23.2**

* mean concentration of seasonal measurements
* srednja koncentracija sezonskih meritev

Tab. 4b: The gross flux of selected heavy metals estimated from seasonal measurements of effluents during the year 2000.
Tab. 4b: Celoten vnos izbranih težkih kovin, ocenjen na osnovi sezonskih meritev odpadnih voda v letu 2000.

Loads	Heavy metals					
	Hg (kg/y)	Cd (kg/y)	Pb (kg/y)	Zn (kg/y)	Cu (kg/y)	Ni (kg/y)
WWTP Koper	0.804	47.3	236.0	520.5	236.0	47.3
WWTP Piran	0.440	13.5	21.6	602.3	280.9	27.0
IZOLA	1.257	46.0	61.3	953.5	371.0	24.5
DELAMARIS	0.021	0.41	0.6	0.018	5.9	1.88
Total	**2.5**	**107**	**319**	**2076**	**888**	**99**

Tab. 5a: The gross flux of some pollutants estimated from the riverine inflow data along the Slovenian coastline for the year 2000.
Tab. 5a: Celoten vnos nekaterih polutantov, ocenjen na osnovi podatkov rečnih vnosov vzdolž obale Republike Slovenije v letu 2000.

Loads	Flow rate (m^3/y)	Pollutants						
		COD (t/y)	BOD_5 (t/y)	TotN (t/y)	TotP (t/y)	TSS (t/y)	Det (t/y)	FC* (No./100 ml)
Rižana	1.5×10^8	2138	688	547	7.4	507	2.3	70,000
Badaševica	1.0×10^7	909	47	38	0.5	112	1.0	33,000
Dragonja	3.0×10^7	85	9	9	0.1	10	0.02	680
Drnica	1.6×10^7	602	28	52	1.1	42	0.3	1860
Total	**1.69×10^8**	**3734**	**772**	**645**	**9.1**	**671**	**3.6**	

* maximum concentration of seasonal measurements
* najvišja koncentracija sezonskih meritev

Tab. 5b: The gross flux of selected heavy metals estimated from the riverine inflow data along the Slovenian coastline during the year 2000.
Tab. 5b: Celoten vnos izbranih težkih kovin, ocenjen na osnovi podatkov rečnih vnosov vzdolž obale Republike Slovenije v letu 2000.

Loads	Heavy metals					
	Hg (kg/y)	Ni (kg/y)	Cr (kg/y)	Cu (kg/y)	Zn (kg/y)	Pb (kg/y)
Rižana	0.42	1308.8	120.0	637.5	945	210.0
Badaševica	0.07	19.8	10.4	24.7	68	10.6
Dragonja	0.002	3.1	1.8	4.9	u.d.l.*	3.5
Drnica	0.01	9.0	7.9	13.7	u.d.l.	6.7
Total	**0.50**	**1341**	**140**	**681**	**1013**	**231**

*u.d.l. Under detection limit
*u.d.l. pod mejo detekcije

Priority hot spots and sensitive areas

Priority hot spots and sensitive areas have been ranked according to the relative importance of their impacts in descending order (Tab. 7). In order to weigh the risk in an equal manner, a multiplier depending on the importance of the effects on the several issues has been applied to the grades: for public health 1.0, for drinking water quality 0.9, for recreation 0.8, for other beneficial uses 0.8, for aquatic life 0.7, for economical and welfare including marine resources of economic value 0.7 (Tab. 7). According to the monitoring data regarding the pressure on and sensitivity of the area, the following pollution hot spots were identified along the Slovenian coast: the Rižana river with Koper wastewater treatment plant, Izola which is without treatment plant, the Badaševica river, the Piran wastewater treatment plant with submarine outfall, and the Dragonja river. The Bay of Koper has been considered a sensitive area, since it can be endangered by polluted water of the Gulf of Trieste as well as by land-based sources of pollution along the Slovenian coast. The inner part of the Bay of Koper is receiving effluents from the municipal wastewater treatment plant and individual industries and agglomerations along the Rižana and Badaševica rivers.

Domestic and agricultural discharges into the inner part of the Bay of Piran by the Dragonja river, tourism and intensive aquaculture reduce the quality of the water and may cause local changes in the marine ecosystem.

Tab. 6: Sites of conservation interest on the Slovenian coast (LP - landscape parks, NR - nature reserves, NM - nature monuments).
Tab. 6: Območja vzdolž obale Republike Slovenije pomembna z vidika varstva narave (LP - krajinski park, NR - naravni rezervat, NM - naravni spomenik).

Protected area	Type	Main characteristics	Area	Protected since
Cape Debeli rtič	NM	geomorphology, great diversity of the underwater life	24.3 ha: sea 21.8 ha, coastal 2.5 ha	1991
Škocjanski zatok	NR	brackish lagoon, important ornithological site	120 ha: lagoon 80 ha, coastal 40 ha	1998
Molet		*Posidonia* meadow	approx. 5 ha	–
Cape Korbat		geology	approx.1 ha	–
Strunjan	NR	unique geomorph. features, submediterranean vegetation, diverse marine plant and animal life	160 ha: coastal 45 ha, sea 115 ha	1990
Strunjan	LP	important natural and cultural heritage	approx. 471.8 ha	1990
Stjuža lagoon	NM	marine lagoon, spawning area	approx.2 ha	1990
Fiesa lakes	NM	freshwater and brackish habitat	2.1 ha	1990
Cape Madona	NM	underwater ridge, diversity of marine life	12.8 ha	1990
Sečovlje saltworks	LP	outstanding natural and cultural assets; more than 200 bird species	864.2 ha	1990, 2001*, Ramsar site since 1993

**Governmental decree replaced previous municipal decree*

DISCUSSION

The degradation of water resources, caused mainly by pollution from land-based activities, and physical habitat degradation of coastal and near shore marine areas and watercourses, as a result of inappropriate management, are major environmental concern relating to waters. Identification of priority pollution hot spots and sensitive areas in the Mediterranean was result of the various activities performed within the framework of the Mediterranean Action Plan: Pollution Monitoring and Research Program, Blue Plan, Priority Actions Program, Specially Protected Areas and Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (UNEP/WHO, 1999). According to results of 20 country reports, 101 priority hot spots have been identified and 51 sensitive areas in the Mediterranean region. To show severity of each of the effects on the identified hot spots in an equal manner, a total weight of the risk was calculated according to the importance of the effect on public health, drinking water quality, recreation, other beneficial uses (transportation, sport activities, aquaculture), aquatic life (including biodiversity), economical and welfare (including marine resources of economic value) (UNEP/WHO, 1999). Only one hot spot (lake Manzala in Egypt) scored a total weight impact greater than 25. Slovenia with 2 main pollution hot spots scored a total weight impact between 15 and 20 (Tab. 7), as one half (45%) of the Mediterranean hot spots determined in MAP Technical Reports Series No. 124 (UNEP/WHO, 1999).

The uneven distribution of human activities and the number of inhabitants along the Slovenian coastal area result in a number of factors that in consequence generate some of the conflicts in the area (growth of the everyday car traffic to the coast and back, designation of large areas for car parking, environmental pollution, increasing pressure on the remaining parts of the natural coastline, *etc.)*. Phenomena such as algal blooms and accumulation of gelatinous masses have been frequent over the last decades, reducing tourism and affecting the benthic community. Anoxic events, harmful algal bloom, habitat loss, the exploitation of living resources and translocation of non-indigenous species are obvious examples of alterations caused by the man impact (review and references in Malone *et al.,* 1999 and Hopkins *et al.,* 1999). Within the context of the amended Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources and Activities, regional plans should be elaborated for the elimination of pollution deriving from land-based sources and activities. Internationally, some activities have already been coordinated through MED POL, MAP, CAOS Committee/IOC and trilateral (Slovenian-Croatian-Italian) Commission for the Protection of the Adriatic Sea. An assessment of the vulnerability of the Slovenian coastal belt and its categorization was proposed in view of human pressure, various activities and land – use (Turk,

Tab. 7: Identification of hot spots along Sloevenian coast according to ranking system (1- no effect; 6- extreme effects) and the importance of the effects (depending grade) on public health, drinking water quality, recreation, other beneficial uses, aquatic life (including biodiversity), economical and welfare (UNEP/WHO, 1999).*
Tab. 7: Razvrstitev žarišč onesnaženja vzdolž obale Republike Slovenije glede na stopnjo (1- brez vpliva; 6- najvišja stopnja) in pomen vpliva (*) na zdravje ljudi, na kakovost pitne vode, na kakovost vode za rekreacijo in druge namene, na kvaliteto življenja (vključno z biodiverziteto), na ekonomijo in naravne dobrine (UNEP/WHO, 1999).

Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other Beneficial use	Welfare and economy	Weighted total	Category	Nature of investment
		*(1)**	*(0.9)**	*(0.7)**	*(0.8)**	*(0.8)**	*(0.7)**			
Rižana river	Domestic, Industrial	3	1	3	5	4	5	16.7	C	WWTP extension + sewage system reconstruction
Izola	Domestic, Industrial	3	1	3	5	4	4	16.0	C	WWTP construction + sewage system reconstruction
Badaševica	Domestic, Industrial	3	1	3	4	4	3	14.5	D	See Rižana river and WWTP Koper
Piran	Domestic	3	1	3	4	3	1	12.3	D	WWTP extension + sewage system reconstruction
Dragonja	Domestic, Agricultural	2	1	2	2	2	2	8.9	E	

1999). Being aware of the severe pressure of conflict activities, an integrated coastal management programs (Malačič *et al.*, 1994, 1995; Slovenian coastal zone management - Report 1996) and other activities (Malačič *et al.*, 2000) have been already developed and proposed in the coastal region.

In order to solve the problem of municipal and industrial wastewater, an appropriate management project has to be implemented for a long-term solution of pollution in the region. The future projects should provide a determination of the most cost–effective integrated investment solution for sewage collection and wastewater treatment facilities for the municipalities of Koper, Izola and Piran. The project should cover the preparation of detailed technical specifications for the most cost-effective investment projects and the completion of all the necessary project documentation, such as an identification of the optimal locations for the new wastewater treatment plants, an evaluation of the environmental impacts of the proposed facilities, and the Environmental Impact Assessment.

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ŽARIŠČA ONESNAŽENJA IN OBČUTLJIVA OBMOČJA VZDOLŽ OBALE REPUBLIKE SLOVENIJE

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POVZETEK

Žarišča onesnaženja slovenskega obrežnega pasu in občutjiva območja smo določili na osnovi dolgoletnih podatkov onesnaženja s kopnega in kvalitete obalnega morja po metodologiji in priporočilih Agencije združenih narodov za okolje (UNEP/WHO). Upoštevali smo kriterije naravnih značilnosti morskega okolja Tržaškega zaliva kot ekološke celote severnega Jadrana, vplive številnih dejavnosti in pritiskov s kopnega, ki ogrožajo ekosistem, zdravje ljudi in ekonomski razvoj.

Vnos nekaterih polutantov v obalno morje Republike Slovenije smo ocenili na osnovi razpoložljivih podatkov kvalitete in kvantitete komunalnih in industrijskih odplak, srednjih letnih vrednosti izmerjenih koncentracij izbranih polutantov, pretoka rek in čistilnih naprav ali črpališč za leto 2000. Najbolj obremenjeno je območje notranjega dela Koprskega zaliva, kamor se izlivajo odpadne vode koprske čistilne naprave in reki Rižana in Badaševica. Ocena letnega vnosa za lebdeče delce je 1281 ton, 710 ton za dušik in 23 ton za fosfor, razmeroma visok je tudi vnos nekaterih težkih kovin in mikroorganizmov fekalnega izvora.

Kakovost obalnega morja lahko izboljšamo le z omejevanjem onesnaževanja, ohranjanjem naravnih delov obale, nadzorom nad različnimi dejavnostmi in pravilno zastavljenim razvojem tega prostora. Med prioritete zmanjševanja onesnaževanja sodi vsekakor sanacija komunalnih in industrijskih odplak ter graditev ustreznih čistilnih naprav in izpustov.

Ključne besede: onesnaženje, obalne vode, odpadne vode, čiščenje odpadnih vod, obremenitve, žarišča onesnaženja, občutljiva območja, Tržaški zaliv, Jadransko morje, Sredozemsko morje

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SEČOVELJSKE SOLINE V MEDNARODNEM NARAVOVARSTVENEM KONTEKSTU

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IZVLEČEK

Sečoveljske soline (in z njimi povezane Strunjanske soline) so v javnosti poznane kot eden izmed biserov naravne dediščine v Sloveniji. Sodobna dognanja o ogroženosti morskih solin v Sredozemlju pa kažejo, da imajo v mednarodnem pogledu še večji naravovarstveni potencial kot redek in ogrožen habitat. V prispevku je prikazana umeščenost Sečoveljskih solin v globalni okvir zavarovanih območij in stanja morskih solin v Sredozemlju, analiziran pa je tudi njihov ornitološki pomen ter vrednost, ki jo imajo kot območje redkih in ogroženih habitatov. V mednarodnem naravovarstvenem merilu so Sečoveljske soline najpomembnejše predvsem kot eden zadnjih habitatov te vrste v Sredozemlju, imajo pa tudi neprecenljivo vrednost v krajinskem, kulturnem, tehničnem in etnološkem pomenu.

Ključne besede: Sečoveljske soline, mokrišče, varstvo narave, Slovenija

LE SALINE DI SICCIOLE IN UN CONTESTO INTERNAZIONALE DI TUTELA DELL'AMBIENTE

SINTESI

Le saline di Sicciole (e le connesse saline di Strugnano) sono ben note all'opinione pubblica come una delle perle del patrimonio naturale sloveno. Gli attuali accertamenti sui fattori che minacciano le saline nel Mediterraneo dimostrano quanto esse abbiano, nell'ottica internazionale, un potenziale ancora maggiore se viste come habitat raro e minacciato. Nell'articolo viene presentato l'inserimento delle saline di Sicciole nella cornice globale delle aree protette nonché la situazione attuale delle saline mediterranee. Viene inoltre analizzato il loro significato ornitologico e il valore di area comprendente habitat rari e minacciati. Secondo le stime internazionali nell'ambito della tutela dell'ambiente, le saline di Sicciole rappresentano uno dei pochi habitat di questo tipo rimasti nel Mediterraneo e pertanto hanno un valore naturale, culturale, tecnico ed etnologico inestimabile.

Parole chiave: saline di Sicciole, zona umida, tutela dell'ambiente, Slovenia

UVOD

Sečoveljske soline (in z njimi povezane Strunjanske soline) so v javnosti poznane kot eden izmed biserov naravne dediščine v Sloveniji. Veliko zaslug za osveščanje javnosti o pomembnosti solin v naravovarstvenem pogledu imajo ornitologi, ki so z raziskavami favne ptic in publiciranjem svojih izsledkov (npr. Gregori, 1976; Geister & Šere, 1977; Šmuc, 1980; Škornik *et al.*, 1990; Lipej *et al.*, 1997, Makovec *et al.*, 1998) že pred desetletji zahtevali zakonsko zavarovanje območja. Sečoveljskih solin se še iz tistih časov drži pridih mednarodno pomembnega območja zaradi ptic, ki tam gnezdijo, prezimujejo, letujejo ali se ustavljajo na selitvi. Sodobna dognanja o ogroženosti morskih solin v Sredozemlju pa kažejo, da imajo v mednarodnem pogledu še večji naravovarstveni potencial kot redek in ogrožen habitat.

V prispevku je prikazana umeščenost Sečoveljskih solin v globalni okvir zavarovanih območij in stanja morskih solin v Sredozemlju, analiziran pa je tudi njihov ornitološki pomen ter vrednost, ki jo imajo kot območje redkih in ogroženih habitatov.

MEDNARODNI OKVIR – ZAVAROVANA OBMOČJA

Zavarovana območja oziroma naravni parki veljajo za najbolj učinkovito orodje varovanja biodiverzitete *in situ* (McNeely & Miller, 1984).

IUCN-ova definicija zavarovanega območja, ki zaobsega vse omenjene varstvene kategorije, je naslednja (IUCN, 1994a, b):

"Območje kopnega ali morja, namenjeno zavarovanju in ohranitvi biotske raznovrstnosti, naravnih in pripadajočih kulturnih virov z upravljanjem na podlagi pravnega zavarovanja ali drugih učinkovitih sredstev".

Mednarodni sistem razvrščanja zavarovanih območij (IUCN, 1994a, b) temelji na ciljih upravljanja (management objectives). Na osnovi teh varstvenih ciljev se zavarovana območja delijo na šest varstvenih kategorij, ki so prikazane v tabeli 1.

Tab. 1: Razdelitev zavarovanih območjih po varstvenih kategorijah.
Tab. 1: Classification of protected areas according to the protected area management categories.

Kategorija I	Strogi naravni rezervat/naravno območje
Kategorija II	Narodni park
Kategorija III	Naravni spomenik
Kategorija IV	Zavarovani habitati določenih rastlinskih in živalskih vrst
Kategorija V	Zavarovana krajina in morje
Kategorija VI	Zavarovana območja naravnih virov

IUCN-ova klasifikacija torej razvršča zavarovana območja glede na njihove značilnosti in cilje upravljanja. Pri tem ni prav nič pomembno, kako posamezna država poimenuje svoja zavarovana območja: tako so npr. angleški narodni parki po načinu upravljanja in stopnji človekovega vpliva bolj podobni našim regijskim parkom. Med zavarovana območja sodijo tako tista, ki so razglašena po nacionalni klasifikaciji (npr. v Sloveniji Zakon o ohranjanju narave (ZON, 1999) določa kot zavarovana območja naslednje varstvene kategorije: naravni spomenik, naravni rezervat, upravljani naravni rezervat, krajinski park, regijski park in narodni park), kot tudi tista, ki so razglašena po mednarodnih dogovorih. Mednje sodijo npr. mednarodne konvencije (Ramsarska konvencija, Konvencija o svetovni dediščini, Barcelonska konvencija, Predpisi Evropske zveze (Smernice za varstvo ptičev in Smernice FFH) ali zavarovana območja v okviru UNESCO (biosferni rezervati).

Sodobna naravovarstvena stroka priporoča, da naj bi bila zavarovana območja čim večja oziroma celovita, s čimer se zmanjšuje tveganje, da bi vrste izginile ali izumrle, in povečuje zastopanost različnih ekosistemov in vrst (IUCN, 1994a, b).

STATISTIČNI PODATKI O ZAVAROVANIH OBMOČJIH V SVETU IN V EVROPI

Po podatkih Svetovnega centra za ohranitev narave (World Conservation Monitoring Center (WCMC), 1994) je na Zemlji 30.361 zavarovanih območij, ki pokrivajo 13.245.527 km² ali 8,84% zemeljske površine. Največja zavarovana območja na svetu so Greenland National Park (972.000 km²; velikost skoraj 50 Slovenij!), Northern Wildlife Management Zone, Savdska Arabija (640.000 km²), Great Barrier Reef Marine Park, Avstralija (344.800 km²), Cape Churchill Wildlife Management Area, Kanada (137.072 km²) in Qiang Tang Nature Reserve, Kitajska (247.120 km²). Isti vir navaja za Evropo 9.335 zavarovanih območij s površino 612.674 km² (12,1% površja Evrope).

Najmanjša zavarovana območja, t.i. mikro-rezervati (npr. rastišča posameznih rastlin), ne presegajo vsega nekaj m². Okoli 59% zavarovanih območij na svetu obsega manj kot 1.000 ha, po podatkih WCMC (1994) pa je povprečna velikost posameznega zavarovanega območja 893 ha (podatki so izračunani na osnovi 8.055 zavarovanih območij, za katere je poznana digitalna skica meja območja).

Tabela 2 prikazuje število, površino in delež posameznih kategorij zavarovanih območij v svetovnem merilu (WCMC, 1994).

Tab. 2: Število, površina in delež posameznih kategorij zavarovanih območij v svetovnem merilu (WCMC, 1994).
Tab. 2: Number, surface area and share of separate categories of protected areas to the world scale (WCMC, 1994).

Varstvena kategorija po IUCN	Ia	Ib	II	III	IV	V	VI
Število	516	77	218	457	5,332	2,659	76
Km^2	77.600	6.700	79.871	1.630	84.391	349.433	12.976
%	1,53	0,13	1,58	0,03	1,66	6,90	0,25

SEČOVELJSKE SOLINE – ZAVAROVANO OBMOČJE

Krajinski park Sečoveljske soline

Zavarovano območje Sečoveljskih solin je občina Piran leta 1989 razglasila za krajinski park (po IUCN-ovi kategorizaciji upravljalska kategorija V, v katero sodi skoraj polovica zavarovanih območij v Evropi) s štirimi naravnimi rezervati (Stojbe, Ornitološki rezervat Curto-Picchetto, Ob rudniku in Stare soline s halofitnim travnikom; Uradne objave SO Piran, št. 5/90). Območje meri 835 ha. To je torej skoraj enako velikosti povprečnega zavarovanega območja v svetovnem merilu. Z drugimi besedami: Krajinski park Sečoveljske soline (Fontanigge in Lera) torej sploh ne sodi med zelo majhna zavarovana območja, še posebej, ker ga obkroža kompleks aktivne pridelave soli na Leri, ki skupaj z morjem v Piranskem zalivu tvori "mirno" območje ali blažilno cono pred agresivnimi vplivi iz okolice. Podrobnejši pregled varstvenih prizadevanj za zavarovanje in ohranitev Sečoveljskih solin podaja Križan (1999).

Pred kratkim je bila sprejeta Uredba o Krajinskem parku Sečoveljske soline, ki uvršča to območje med parke državnega pomena (Ur. list RS 29, 20. 4. 2001). Uredba deli območje na tri cone z različnim varstvenim režimom, vendar ne opredeljuje vplivnega območja (s posebnimi pravili pa predpisuje posege zunaj parka na način, ki ne poslabšuje kakovosti vode v zavarovanem območju). Uredba tudi ne obravnava območja polotoka Seča, ki je po občinskem odloku sodilo v okvir krajinskega parka, prav tako pa so izločeni letališče in objekti Droge – Začimba.

Po novi Uredbi bo upravljanje parka, nadzor, monitoring, informacijsko-vzgojne dejavnosti prenešeno na koncesionarja, ki bo moral zagotoviti tudi nadaljevanje opravljanja solinarske dejavnosti.

Poleg zavarovanja v nacionalnem merilu, ki Sečoveljske soline razglaša za krajinski park (IUCN-ova kategorija V), pa so soline tudi na seznamu nekaterih mednarodnih varstvenih instrumentov, ki obravnavajo zavarovana območja mednarodnega pomena.

Sečoveljske soline – ramsarska lokaliteta

Sečoveljske soline so uvrščene na Seznam mokrišč mednarodnega pomena, ki je sestavni del *t.i.* Konvencije o mokriščih, ki imajo mednarodni pomen, zlasti kot prebivališča močvirskih ptic (Ramsarska konvencija) (Sovinc, 1999). Sečoveljske soline so bile do pred kratkim (leta 2000 so se jim pridružile še Škocjanske jame, kot prvo evropsko podzemno mokrišče mednarodnega pomena) edina slovenska lokaliteta na tem seznamu, kamor so bile uvrščene ob sprejemu Slovenije med podpisnice te Konvencije (1993). Novembra 2000 je bilo 123 držav podpisnic Ramsarske konvencije in med njimi so tudi vse evropske države. Na Seznamu mokrišč mednarodnega pomena je bilo takrat 1039 lokalitet. Ramsarska konvencija ima izdelana posebna merila, po katerih se mokrišče uvrsti na Seznam mokrišč mednarodnega pomena.

Merila so naslednja:
- značilno ali enkratno mokrišče v biogeografski regiji,
- mokrišče, ki je pomembno za rastlinstvo ali živalstvo,
- mokrišče, kjer se pojavlja določen delež populacije močvirskih ptic v biogeografski regiji, in
- mokrišče, ki je posebnega pomena za ribjo favno.

Sečoveljske soline – Mednarodno pomembno območje za ptice (IBA) in njihov pomen v nacionalnem ornitološkem merilu

Mednarodno pomembno območje za ptice (IBA) je projekt, ki ga vodi mednarodna organizacija za varstvo ptic BirdLife International. IBA so osnova za države Evropske skupnosti, ki so po *t.i.* Smernici Evropske unije za varstvo ptičev (smernice EU imajo v posameznih državah *status* zakona!) dolžne razglašati *t.i.* SPA-Special Protected Areas (Posebna zavarovana območja) pod varstvom Smernice za varstvo ptičev. Ornitološko pomembna območja veljajo tudi za območja, ki bodo ob primernem upravljanju in varstvu ohranila večji del populacij evropskih ptic in so pomembna pri celovitem pristopu ohranjanja biotske pestrosti.

V Sečoveljskih solinah ne gnezdi nobena izmed tistih vrst ptic, ki so deležne globalne (svetovne) varstvene pozornosti (Tucker & Heath, 1994), kljub temu pa so uvrščena med *t.i.* Mednarodno pomembna območja za ptice (Polak, 2000). Na seznam IBA-jev jih po ornitoloških merilih uvrščata predvsem dve vrsti galebov, ki se tu (preletna oziroma negnezdeča populacija!) pojavljata v številu, ki presega 1% biogeografske populacije vodnih ptic, ki se združujejo v jate. Ti vrsti sta rumenonogi *Larus cachinnans* in črnoglavi galeb *L. melanocephalus*.

Sl. 1: Soline so čedalje bolj ogrožen habitat v Sredozemlju. Od 90 sredozemskih solin so Sečoveljske edine ob vzhodnem Jadranu, kjer proizvodnja še poteka na tradicionalen način. (Foto: T. Makovec)
Fig. 1: Salt-pans are one of the most endangered habitats in the Mediterranean. Of the 90 salt-pans in the Mediterranean, the Sečovlje pans are the only ones along the Eastern Adriatic where salt is still produced in traditional way. (Photo: T. Makovec)

Sečoveljske soline – potencialna lokaliteta omrežja Natura 2000

Sečoveljske sòline so morda v naravovarstvenih krogih najbolj poznane po pticah, v globalnem pogledu pa so morda še pomembnejše predvsem zaradi habitata: morske soline, posebej takšne, kjer proizvodnja poteka tudi še na tradicionalen način (Sl. 1), sodijo po merilih MedWet (iniciative za varstvo mediteranskih mokrišč, ki deluje pod pokroviteljstvom Ramsarske konvencije) za enega najbolj ogroženih habitatov v Sredozemlju (MedWet, 1996). Delež mokrišč v Sredozemlju se je drastično znižal; po zbranih podatkih se je v tem stoletju delež mokrišč v nekaterih sredozemskih državah, npr. v Grčiji, Italiji in Španiji, znižal za več kot 60% (Barbier *et al.*, 1997). Evropska skupnost, ki se ji bo Slovenija predvidoma pridružila že v naslednjem krogu širitve, je poleg že omenjenih Smernic za varstvo ptic sprejela tudi *t.i.* smernice FFH. Te obvezujejo države Skupnosti, da poleg že omenjenih SPA (katerih pomembna osnova so IBA) razglašajo tudi Posebna območja varstva (SAC-Special Areas of Conservation): omrežje obeh posebnih območij (torej SPA in SAC) se imenuje Natura 2000. Posebna območja varstva se razglašajo na podlagi seznamov ogroženih vrst in habitatov, ki so pripeti kot Dodatki k smernicam FFH.

Med njimi je tudi Dodatek, ki določa habitatne tipe in izloča *t.i.* "prednostne habitate", ki naj bi čimprej postali SAC oziroma del omrežja Natura 2000. V Sečoveljskih solinah najdemo vsaj dva prednostna habitatna tipa (lagune, sredozemska začasna vodišča), zraven pa je še cela vrsta drugih habitatnih tipov iz omenjenega dodatka.

Sečoveljske soline – Posebno varstveno območje v sredozemskem okviru (SPAMI)

Sečoveljske soline izpolnjujejo tudi pogoje za razglasitev Mediterranean Sea Specially Protected Areas (po novem: Specially Protected Areas of Mediterranean Importance - SPAMI) pod pokroviteljstvom Barcelonske konvencije, ki naj bi ohranili reprezentančna obalna in morska območja, ogrožene habitate in tiste, kjer živijo ogrožene in endemične vrste, ter območja s posebnim znanstvenim, estetskim, kulturnim ali izobraževalnim pomenom.

NARAVOVARSTVENI POTENCIAL SEČOVELJSKIH (IN STRUNJANSKIH) SOLIN

Ornitološki pomen v mednarodnem in nacionalnem okviru

Že pri pregledu meril, ki uvrščajo Sečoveljske soline med Mednarodno pomembna območja za ptice (IBA), je bilo ugotovljeno, da sta v mednarodnem pogledu najpomembnejši vrsti ptic na solinah rumenonogi in črnoglavi galeb. Zanimivo je, da v "domačih" ornitoloških krogih tem dvem vrstam ne posvečamo posebne pozornosti; nista v aktualnem Rdečem seznamu ogroženih ptic gnezdilk Slovenije (Bračko *et al.*, 1994; črnoglavi galeb sploh ne gnezdi v Sloveniji), rumenonogi galeb zaradi svoje številnosti in prehranjevanja na neuglednih smetiščih velja za "mrhovinarja", vedenje o črnoglavih galebih, ki množično letujejo na obeh omenjenih solinah in se ustavljajo na preletu, pa šele v zadnjem času prodira v zavest naravovarstvenikov (predvsem po zaslugi mlajše generacije slovenskih ornitologov, ki je ta fenomen predstavila javnosti).

Mnogo bolj pomembno vlogo imajo Sečoveljske soline v nacionalnem ornitološkem pomenu, kot gnezdišče cele vrste v Sloveniji redkih in ogroženih vrst ptic. Tako gnezdi tu nekaj vrst ptic, ki drugje v Sloveniji sploh ne gnezdijo ali pa le na posameznih lokalitetah oziroma imajo tu v nacionalnem merilu najpomembnejše gnezditvene populacije (npr. polojnik, rumenonogi galeb, mala čigra, navadna čigra, beločeli deževnik). So pa te vrste razširjene in številnejše v širši okolici, npr. drugje v Sredozemlju, in tako nekaj deset "slovenskih" osebkov bistveno ne dopolnjuje slike njihove globalne razširjenosti ali pojavljanja.

V ornitološkem pogledu so Sečoveljske soline pomembnejše v preletnem in prezimovalnem obdobju. Omenimo le nekatere skupine ptic, ki tu prezimujejo ali se ustavijo na preletu: slapniki, ponirki, kormorani, čaplje, race, pobrežniki, galebi ... Za mnoge izmed vrst je tu edino ali najpomembnejše prezimovališče v Sloveniji (Sovinc, 1994; Makovec *et al.*, 1998). Skupno število registriranih vrst ptic v Sečoveljskih solinah (254 vrst; Makovec *et al.*, 1998) ni bistveno manjše kot v mnogo obsežnejšem območju Beneške lagune (F. Perco, *ustno),* res pa je, da se nekatere vrste tu pojavljajo mnogo redkeje in v mnogo manjšem številu kot v bližnjih (a skupno mnogo obsežnejših) lagunah med izlivoma rek Soče in Pada.

V splošnem so morske soline pomembne za enocelične organizme, vodne in kopenske rastline, vodne nevretenčarje, ribe, žuželke in druge skupine. Podatke o favni, flori in habitatih (ki v tem prispevku niso podrobneje analizirani) v Sečoveljskih solinah povzema Polak (2000).

Morske soline – ogroženi habitat v Sredozemlju in na slovenski obali

V 18 sredozemskih državah je bilo registriranih 168 solin, od katerih jih 90 še deluje, 64 je opuščenih, namembnost 11 nekdanjih solin je spremenjena, za 3 pa ni podatkov (Sadoul *et al.*, 1998). Isti vir navaja, da obsegajo soline v Sredozemlju od 1 do 12.000 ha in da je tri četrtine sredozemskih solin v Španiji, Grčiji, Italiji, Franciji in na Portugalskem. Samo redke izmed njih so zavarovane, in tudi v tem je ena od posebnosti Sečoveljskih solin. Sadoul *et al.* (1998) jih uvrščajo tudi med edine soline ob vzhodni obali Jadranskega morja, kjer proizvodnja še poteka na tradicionalen način.

Opuščanje proizvodnje soli se je najprej pričelo v manjših solinah (v tridesetih letih 20. stoletja), ki niso bile več sposobne preživetja na tržišču v boju z velikimi in moderniziranimi solinami; proces opuščanja rabe pa se je še posebej pospešil med letoma 1950 in 1990 (Sadoul *et al.*, 1998). Najbolj očitni spremembi v proizvodnji soli se kažeta v spreminjanju polj z različnimi stopnjami slanosti v ogromne kristalizacijske bazene s povečano produkcijo soli in v spremembi načina iz periodične žetve soli v stalno pobiranje soli (Petanidou, 1997). Poleg omenjenih tehnoloških sprememb, ki ogrožajo tudi biodiverzitetno, etnološko in kulturno vrednost solin, je treba omeniti še večjo stopnjo mehanizacije in s tem povezano opuščanje sistema preplavitve solinskih polj, intenzivno in agresivno marikulturo, predvsem pa razvoj množičnega turizma in z njim povezane infrastrukture (hotelski kompleksi, letališča, ...). Okoli 40% sredozemskih solin je bilo opuščenih ali predrugačenih v zadnjih 50 letih (Walmsley, 1997).

Soline so območja z bogato biodiverziteto, kar je posledica dejstva, da gre za zelo produktivne ekosisteme (mokrišča), pri čemer je jasno, da je visoka biodiverzitetna vrednost tudi in predvsem posledica človekovega poseganja, ki je omogočilo kroženje vode v sistemu. Hkrati veljajo soline tudi za območja, kjer so vplivi motenj s strani človeka razmeroma majhni ali omejeni in kjer so ekološke razmere kljub nepredvidljivemu sredozemskemu podnebju dokaj stabilne.

Prepletanje plitvih lagun, polojev in solnih polj, prepreženih z nasipi, in različna stopnja slanosti vode v bazenih v povezavi s sredozemskim podnebjem ponujajo ohlapno povezano omrežje različnih ekoloških razmer. Raznovrstnost habitatov in bogastvo njihovih rastlinskih in živalskih vrst je močno odvisno od velikosti solin, kar je povezano tudi z njihovo izoliranostjo, vodnim režimom in stopnjo slanosti (Sl. 2). Soline so torej edinstveni habitat, ki se razlikuje od sladkovodnih, morskih ali brakičnih mokrišč drugje ob morski obali. Njihova posebnost je tudi v dejstvu, da gre za izrazito antropogeno preoblikovano območje, ki za svoj obstoj kot tudi za obstoj biodiverzitete potrebuje človekovo poseganje oziroma sodelovanje.

Sl. 2: Trstišče namaka reka Dragonja, hkrati pa je izpostavljeno plimovanju. (Foto: T. Makovec).
Fig. 2: The reed-beds are constantly watered by the Dragonja river as well as exposed to tides. (Photo: T. Makovec).

Solinski habitati so med najbolj ogroženimi in tudi najredkejšimi mokrišči. Samo pet držav v Sredozemlju se lahko pohvali z več kot desetimi solinami! V Sloveniji za zdaj še imamo Sečoveljske in Strunjanske soline. Predvsem usoda slednjih je zaradi njihove majhnosti še posebej vprašljiva. Tudi nad prihodnostjo Sečoveljskih solin se zbirajo temni oblaki, ki bi lahko odnesli žetev soli za vedno! V boju za njihovo ohranitev bodo morali sodelovati vsi, od predstavnikov države do občine in lokalne skupnosti, od gospodarskih do nevladnih organizacij.

Sečoveljske in Strunjanske soline – vmesno območje med drugimi jadranskimi mokrišči

Strunjanske in Sečoveljske soline so – skupaj s Škocjanskim zatokom – prvo obalno mokrišče, s katerim se srečajo seleče se močvirne in druge ptice s severnomorskih obal, ko preletijo celinsko Evropo. Del teh ptic nadaljuje svojo pot ob verigi podobnih habitatov v Beneški laguni, druge pa se selijo vzdolž vzhodne jadranske obale. Zanjo je značilno, da so v pretežno skalnati geološki osnovi obalna mokrišča razmeroma redka in tudi močno degradirana. Kot primer lahko vzamemo prvo naslednje obalno mokrišče – izliv reke Mirne pri Novigradu. Številne melioracije in drugi posegi v preteklosti so močvirne habitate tega območja močno skrčili. Ptice, kot najbolj očitno mobilna bitja, so bila tu uporabljena le kot opazen primer povezave med podobnimi habitati. Povezava med podobnimi habitati (*t.i.* koridorji) je zelo pomembna tudi za druge vrste.

ZAKLJUČEK

S prispevkom sem želel osvetliti mednarodni pomen ohranitve Sečoveljskih in z njimi povezanih Strunjanskih solin. Pri tem je še posebej pomembno, da se pričnemo zavedati, da glavni argument naravovarstvenih prizadevanj za ohranitev solin niso le ptičje vrste (kot velja to v zavesti širše javnosti) ali druge živalske in rastlinske vrste. V mednarodnem naravovarstvenem merilu so naše soline najpomembnejše predvsem kot eden zadnjih habitatov te vrste v Sredozemlju! Seveda pa imajo tudi neprecenljivo vrednost v krajinskem, kulturnem, tehničnem in etnološkem pomenu.

SEČOVLJE SALT-PANS IN THE INTERNATIONAL CONSERVATIONIST CONTEXT

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SUMMARY

Sečoveljske soline (Sečovlje salt-pans) have been designated not only as a Landscape Park and a Ramsar Site but have also met the criteria to be proclaimed an Important Bird Area. Once Slovenia becomes a member of the European Union, this area will be designated as a Special Protected Area and will form a part of the Natura 2000 network of protected areas in Europe. In addition, the area should become a Specially Protected Area of Mediterranean Importance (SPAMI) under the Barcelona Convention. The article present a comparison of the Sečovlje salt-pans in the context of the global network of protected areas.

Initial efforts for the legal protection of the Sečovlje salt-pans have been supported predominantly upon the ornithological importance of the area. Analyses of international conservation criteria have shown, however, that the area is internationally even more important as a Mediterranean wetland comprising priority habitat types, according to the Annex to the EU FFH Directive. These globally endangered habitats require immediate and effective protection.

Key words: Sečovlje salt-pans, wetland, nature conservation, Slovenia

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PRIME NIDIFICAZIONI DI GABBIANO REALE MEDITERRANEO *(LARUS CACHINNANS MICHAHELLIS)* SUL CARSO

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SINTESI

Nei mesi di giugno e luglio 1999 sono stati localizzati i primi due nidi di Gabbiano reale mediterraneo sul Carso: il primo a Sesana (Sežana, Slovenia), il secondo a Villa Opicina (Trieste), entrambi non lontani da una discarica in territorio sloveno. Soprattutto nella stagione riproduttiva del 2000 (aprile-luglio) sono stati raccolti dati sulla fedeltà al sito, la disponibilità di cibo, la cronologia e il successo riproduttivo delle due coppie nidificanti. In tutti e due i casi si tratta probabilmente di adulti provenienti da Trieste che hanno trovato sufficienti fonti alimentari nei due borghi carsici e nella discarica menzionata. La presenza del Gabbiano reale sull'altopiano carsico, con diversi esemplari anche immaturi segnalati a Padriciano, Sistiana, Aurisina, è nota da alcuni anni ed è inquadrabile in una espansione sia territoriale che numerica della colonia di Trieste.

Parole chiave: Gabbiano reale mediterraneo, *Larus cachinnans,* Carso, nidificazione

FIRST RECORD OF THE YELLOW-LEGGED GULL *LARUS CACHINNANS MICHAHELLIS* BREEDING IN THE KARST

ABSTRACT

Two Yellow-legged Gull's nests were located in the Karst during the summer of 1999. One was found in Sežana (Slovenia), the other in Villa Opicina (Trieste). Both were not far from a dump near Sežana, where flocks of 20-30 gulls (and even up to 120-150) have been observed. During the last breeding season (April-July 2000), data about the bird's breeding success, presence of other gulls and food availability were collected. The two breeding pairs probably came from Trieste, where the species has been nesting on rooftops since 1987. In recent years, small flocks of Yellow-legged Gulls, probably searching for food, have been observed in the Karst highland, in compliance with the territorial expansion and numerical increase of this species' urban nesting population.

Key words: Yellow-legged Gull, *Larus cachinnans,* Karst, nesting

INTRODUZIONE

La città di Trieste ospita dal 1987 una colonia urbana di Gabbiano reale mediterraneo *(Larus cachinnans michahellis)*. La specie, numericamente sempre crescente fino alle 300 coppie censite nel 2000, nidifica in un'area compresa tra il castello di Miramare e Muggia utilizzando tetti, camini, terrazzi, grondaie, vasi e rocce ed è seguita regolarmente dall'Osservatorio Faunistico e dall'Amministrazione comunale (Benussi *et al.*, 1993, 1994). Altre colonie di grosse dimensioni sono presenti sia lungo le coste del Friuli-Venezia Giulia (Valle Cavanata, Grado, Marano Lagunare) che dell'Istria.

La presenza di *Larus cachinnans* in certe zone del Carso, per lo più centri abitati, era nota da alcuni anni ma ritenuta accidentale e temporanea fino al 1999, quando sono state accertate due nidificazioni su tetti a Villa Opicina (Trieste) e Sesana (Sežana, Slovenia).

METODI

L'individuazione delle coppie nidificanti in ambito urbano avviene di solito con binocolo e cannocchiale (30x) da punti elevati tramite ricerca diretta dei soggetti in cova, oppure più di rado indirettamente osservando gli adulti che trasportano materiale vegetale per la costruzione del nido. Anche le eventuali segnalazioni da parte dei cittadini, se ritenute attendibili, vengono verificate sul campo con lo stesso sistema.

Per i due nidi presenti nei borghi carsici non era possibile la ricerca da punti elevati abbastanza vicini, perciò, una volta nota la presenza della specie nella zona, si sono individuati i pulli osservando l'atteggiamento di allarme degli adulti, contraddistinto anche da un tipico richiamo ("kek-call"; Cramp & Simmons, 1983), in presenza di persone vicino a determinati edifici. Per ognuno dei due siti si sono registrate le date di schiusa e involo, il numero di pulli nati e involati, la presenza di altri adulti o immaturi nella zona, le caratteristiche del sito riproduttivo, la presenza di fonti di cibo nelle vicinanze.

RISULTATI

La prima nidificazione sull'altopiano carsico è stata accertata il 27 giugno 1999 a Sesana, a circa 3 chilometri dal valico di Fernetti (Fig. 1), con l'individuazione di un *pullus* di 40 giorni su un tetto in tegole. La posizione del nido, incassato tra le tegole e un abbaino, non ha permesso una valutazione anche approssimativa della profondità della coppa quindi non è possibile fare ipotesi su una eventuale presenza sul posto in annate precedenti. Oltre alla coppia nidificante, che si mostrava leggermente in allarme, erano presenti lo stesso giorno, in volo tra Sesana e Fernetti, altri quattro adulti e un immaturo del secondo anno. L'età del pullo, non ancora in grado di volare, fa risalire la nascita al 15-17 maggio e la deposizione intorno alla metà di aprile, in accordo con i dati registrati a Trieste.

Un secondo nido, con tre giovani pronti al volo, è stato localizzato il 14 luglio 1999 sopra un tetto inerbato a Villa Opicina (Fig. 1), frazione di Trieste distante dal centro città, e dal grosso della colonia, 5 chilometri. In questo caso erano presenti, oltre alla coppia nidificante, altri dieci adulti e due soggetti immaturi del secondo anno, tutti posati sopra tetti vicini. Vista l'età dei pulli (circa 45 giorni) la nidificazione risultava un po' in ritardo rispetto a quella di Sesana (schiusa a fine maggio, deposizione circa a fine aprile) ma ampiamente entro i limiti dei dati registrati per le coppie di Trieste, dove qualche esemplare in cova viene osservato anche in giugno inoltrato. La coppa del nido, composta da materiale vegetale secco, appariva ben sagomata e piuttosto alta, il che suggerisce un utilizzo almeno per l'anno prima. Ciò confermerebbe anche alcune segnalazioni della specie a Villa Opicina già dal 1996 (O. Malalan, *com. pers.)* e ripetuti avvistamenti nel 1998 *(oss. pers.)*.

Nella primavera ed estate del 2000 le due coppie sono state seguite con uscite effettuate ogni dieci giorni circa.

A Sesana è stato utilizzato lo stesso nido del 1999 e la nidificazione è stata più o meno sincrona con la colonia urbana: deposizione sicuramente prima del 17 aprile, un *pullus* nato il 17 maggio e ancora almeno un uovo covato dopo il 20 maggio; il tetto ospitante il nido non è accessibile quindi non è possibile sapere con certezza il numero di uova deposte. Dopo la fine di maggio non è stato osservato più alcun pullo sul tetto; è ipotizzabile che il giovane sia stato predato da qualche corvide o sia caduto dal tetto a causa del maltempo (due episodi temporaleschi dopo l'ultima osservazione). Vicino al sito sono sempre rimasti presenti uno o entrambi gli adulti fino a fine luglio ma non vi è stata una seconda deposizione; ad ogni uscita altri adulti e immaturi sono stati regolarmente visti in volo sopra il paese.

Anche a Villa Opicina la coppia è tornata a nidificare utilizzando lo stesso nido dell'anno prima. La deposizione è avvenuta tra il 10 e il 15 aprile, due pulli sono nati circa il 15 maggio e involati durante la prima decade di luglio, con probabili ritorni al nido fino a fine luglio (segnalati con continuità sul sito per tutto il mese). Anche qui, similmente all'estate 1999, diversi soggetti erano sempre presenti sia posati sui tetti che in volo.

Tab. 1: Cronologia, successo riproduttivo e caratteristiche dei siti riproduttivi.
Tab. 1: Kronološki pregled, gnezditveni uspeh in značilnosti obeh gnezdišč.

	Villa Opicina		Sesana	
anno	1999	2000	1999	2000
n. uova	3?	?	?	almeno 2
n. pulli	3	2	1	1
n. pulli involati	3	2	1	0
data deposizione	25-30 aprile	10-12 aprile	circa 15 aprile	prima 17 apr.
data schiusa	25-30 maggio	12-15 maggio	15-17 maggio	17 maggio
data involo	dopo 14 luglio	10-20 luglio	dopo 27 giugno	-
substrato	erba e ciottoli, copertura 70% ca.		tegole	
esposizione del nido	NE		NW	
altezza s.l.m.	320 m		360 m	
distanza dal mare	3.2 km		10 km	
dist. nido più vicino	2.8 km		7 km	
distanza discarica	6 km		2.5 km	
aggressività	molto aggressivi		poco aggressivi	
presenti (nel 2000, n=12)	5,5		2,6	

Nella tabella 1 sono riportati, oltre ai dati relativi alla riproduzione e alle caratteristiche del sito, anche la distanza dei siti riproduttivi dalla discarica del monte Piccolo Orsario (Mali Medvedjak, 463 m) in territorio sloveno non lontano da S. Maria di Sesana (Šmarje), presso la quale si sono spesso osservati gruppi di 20 o 30 Gabbiani reali (fino a 100-120 nei primi mesi del 2001) con presenza però non regolare. Soggetti di varie età sono stati visti anche in altri punti del Carso italiano: a Padriciano in zona Monte Spaccato, a Sistiana, ad Aurisina e soprattutto sulla congiungente Gretta (Trieste) con la discarica del monte Piccolo Orsario (Poggioreale, Opicina, Fernetti). Una eventuale presenza di altre coppie nidificanti, soprattutto a Opicina, non è da escludere, considerato anche che il sistema di localizzazione usato (individuazione di adulti in allarme e successiva osservazione dei pulli), come pure la ricerca da punti elevati, non permettono di trovare tutti i nidi.

La voce "aggressività" fa riferimento ad una scala empirica di tre valori, assegnati agli adulti nidificanti a seconda del comportamento dimostrato verso le persone (non aggressivi, poco aggressivi, molto aggressivi), utilizzata dal 1997 per la colonia di Trieste, dove i contatti tra la specie e l'uomo sono frequenti. Infine, nell'ultima riga è riportato il numero medio di gabbiani, esclusi i due nidificanti, contati ad ogni osservazione nelle due località.

DISCUSSIONE

Le due nidificazioni di *Larus cachinnans* sul Carso confermano che la scelta di nuovi siti è fortemente influenzata dalla disponibilità di cibo; in entrambi i casi descritti è probabile si tratti di coppie provenienti da Trieste, spostatesi sull'altopiano in cerca di rifiuti presso la discarica menzionata e che hanno trovato opportunità di alimentarsi, anche se non in modo regolare, nei due centri carsici: per Sesana è accertata la ricerca di cibo nei cassonetti di un supermercato a meno di 100 metri dal nido, a Opicina, visto il comportamento osservato (diversi adulti e immaturi posati sui tetti in apparente attesa), è possibile che vi sia qualche fonte trofica più vicina della discarica o che il cibo sia dato direttamente dall'uomo, analogamente a quanto succede a Trieste.

Inoltre, la scelta del sito non risulta molto influenzata da un ambiente circostante inusuale né dall'assenza di specchi d'acqua; il territorio attorno ai due nidi, un altopiano collinoso, con altezza tra i 350 e i 750 metri, coperto per lo più da boschi (querceti e pinete a *Pinus*

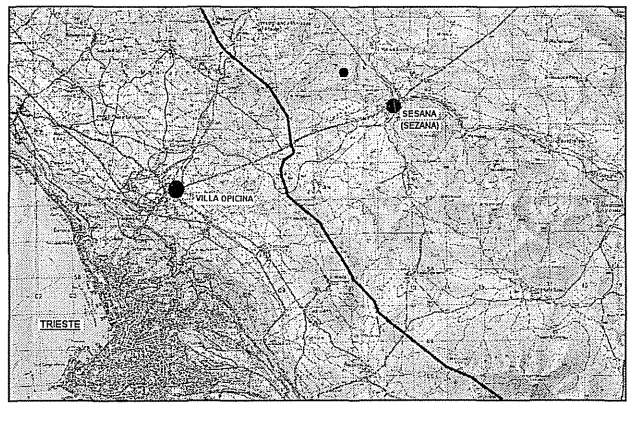

Fig. 1: I punti grandi indicano la posizione dei due siti riproduttivi, il punto piccolo la posizione della discarica comunale di Sesana.
Sl. 1: Veliki točki označujeta gnezdišči, majhna točka pa sežansko smetišče.

nigra), tratti a boscaglia carsica *(Ostrya carpinifolia, Fraxinus ornus),* prati falciati, superfici coltivate limitate, privo di corpi d'acqua di una certa dimensione, è complessivamente inconsueto per la specie (Cramp & Simmons, 1983; Perco *et al.,* 1986). Infine, la specie tende in alcuni casi a nidificare con coppie sparse o staccate dal resto della colonia (Perco *et al.,* 1986).

L'assetto della colonia urbana comprende una parte centrale con densità più alta (ma a struttura comunque "lassa"; Benussi *et al.,* 1994), una parte periferica con coppie sparse e rarefatte e infine dei siti riproduttivi molto più isolati. Nidificazioni molto isolate sono state osservate in passato tra Miramare e Trieste, con circa 4,5 chilometri tra una coppia e il nido noto più vicino, e alla periferia sud della città. In questo secondo caso l'area in questione ha visto poi crescere abbastanza regolarmente il numero di coppie, entrando infine in continuità con il resto dell'area urbana per quanto riguarda il numero di siti. Da questo punto di vista i due nidi sul Carso possono essere considerati come un prolungamento della colonia che da Gretta e Roiano va verso il sito di alimentazione (discarica di Sesana).

Data la notevole aggressività che il Gabbiano reale dimostra verso altre specie soprattutto durante il periodo riproduttivo (nell'area di Trieste si sono registrati attacchi regolari a Sparviere *Accipiter nisus,* Gheppio *Falco tinnunculus,* Poiana *Buteo buteo,* Gazza *Pica pica,* Taccola *Corvus monedula,* Cornacchia grigia *Corvus corone cornix,* occasionali ad Airone cenerino *Ardea cinerea,* Cicogna *Ciconia ciconia,* Falco cuculo *Falco vespertinus,* Rondone *Apus apus,* Corvo imperiale *Corvus corax),* in futuro potrebbe essere opportuno verificare se la presenza regolare sul Carso di coppie nidificanti possa influire su specie più esigenti o di maggior interesse naturalistico.

RINGRAZIAMENTI

Desidero ringraziare Enrico Benussi per l'attrezzatura e i consigli dati, Alessandro Mezzina e Cristiano Covacich per il contribuito alla realizzazione dell'articolo.

PRVO GNEZDENJE RUMENONOGEGA GALEBA *LARUS CACHINNANS MICHAHELLIS* NA KRASU

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POVZETEK

Poleti 1999 sta bili na Krasu odkriti dve gnezdi rumenonogega galeba, eno v Sežani, drugo pa v Opčinah (Villa Opicina). Ne prvo ne drugo gnezdo ni bilo daleč od smetišča pri Sežani, kjer je bilo pogosto opaziti jate 20-30 galebov (in celo jate, ki so štele med 120 in 150 osebkov). V zadnjem gnezditvenem obdobju (april-julij 2000) je avtor zbiral podatke o galebovem gnezditvenem uspehu, pojavljanju drugih galebov v kraškem območju in o razpoložljivosti hrane za te ptice.

Gnezdeča para sta najbrž prišla iz Trsta, kjer ta vrsta gnezdi na mestnih hišah že od leta 1987. V zadnjih nekaj letih pa so bile majhne jate rumenonogih galebov, stikajoč za hrano, opažene tudi više na Krasu, v skladu s teritorialno ekspanzijo in možno povečano urbano gnezdečo populacijo teh ptic.

Ključne besede: rumenonogi galeb, *Larus cachinnans,* Kras, gnezdenje

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prejeto: 16. 11. 2001

UDK 598.3(497.4 Sečoveljske soline)

PRVA GNEZDITEV SABLJARKE *RECURVIROSTRA AVOSETTA* V SLOVENIJI

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IZVLEČEK

Junija leta 2001 je v Sečoveljskih solinah gnezdil par sabljark Recurvirostra avosetta, *kar je prva gnezditev te vrste iz reda pobrežnikov (Charadriiformes) v Sloveniji. V gnezdu na peščini sredi opuščenega solinskega polja sta bili dve jajci, izvalil pa se je en mladič, a je po nekaj dneh izginil.*

Ključne besede: *Recurvirostra avosetta*, razširjenost, gnezditev, Sečoveljske soline, Slovenija

PRIMA NIDIFICAZIONE DELL'AVOCETTA *(RECURVIROSTRA AVOSETTA)* IN SLOVENIA

SINTESI

Una coppia di avocette (Recurvirostra avosetta) *ha nidificato nelle saline di Sicciole nel giugno 2001. Si tratta della prima nidificazione di questa specie dell'ordine dei Caradriformi in Slovenia. Delle due uova presenti nel nido, situato su terreno arenoso in un campo abbandonato delle saline, uno solo si è schiuso, ma il pulcino è scomparso dopo un paio di giorni.*

Parole chiave: *Recurvirostra avosetta,* distribuzione, nidificazione, saline di Sicciole, Slovenia

UVOD

V razpravi *Pričakovane in nepričakovane gnezdilke v Sloveniji* (Geister, 1990) sem na našem ozemlju gnezditveno sumljive vrste ptic razdelil v tri skupine: a) nemožne gnezdilke, b) izjemno možne gnezdilke in c) pričakovane gnezdilke, s pripisom *"Kajpak bi si enako obravnavo zaslužila tudi sabljarka in rdečenogi polojnik, a o njiju kdaj drugič"*. Dogodki so me prehiteli, še preden sem izpolnil obljubo, zakaj še isto leto je v Sloveniji prvič gnezdil polojnik *Himantopus himantopus* (Makovec & Škornik, 1990), samo vprašanje časa pa je še bilo, kdaj bo začela gnezditi tudi sabljarka *Recurvirostra avosetta*. Pričakovanja so temeljila na okoliščini, da obe vrsti gnezdita v naši soseščini na Madžarskem (več lokalitet), v Avstriji (Nežidersko jezero) in Italiji (Padska nižina)(Hagemeijer & Blair, 1977; Dvorak *et al.*, 1993). Vprašanje je bilo le, ali ti dve vrsti na ozemlju Slovenije lahko najdeta primerno gnezditveno prebivališče.

ZGODOVINSKI IN NOVEJŠI PODATKI

Če ne upoštevamo rokopisa barona Žige Zoisa s konca 18. stoletja z neavtoriziranim naslovom *Nomenclatura carniolica*, kjer gre le za navedbo v seznamu, je v slovenski ornitološki literaturi sabljarka prvič fenološko navedena kot jezerska ptica v knjigi Henrika Freyerja *Fauna der in Krain bekannten Vögel, Reptilien und Fische* iz leta 1842 (Freyer, 1842). V *Verzeichnis in Krain beobachteten Vögel* iz leta 1890 pa Ferdinand Schulz pravi, da imajo v Rudolfinumu (danes Prirodoslovni Muzej Slovenije) en sam primerek in da ta vrsta ptice na Kranjskem ni bila več opazovana že petnajst let (Schulz, 1890). Bernardo Schiavuzzi (1883) v svojem *Materiali per un avifauna del territorio di Trieste fino a Monfalcone e dell'Istria* prizna, da se s to vrsto ptice v svojem življenju še ni srečal, pripominja pa, da je v Eggenhöffnerjevem spisku *Vögel um Triest* iz leta 1842 navedena kot redka selivka.

V 20. stoletju je bilo do leta 1996 v Sloveniji dokumentiranih 13 opazovanj, ko je bilo opazovanih 26 osebkov sabljarke (Komisija za redkosti DOPPS, 1993; Sovinc, 1999).

Tab. 1: Dosedanji podatki o opazovanju sabljarke v Sečoveljskih solinah (KR – komisija za redkosti).
Tab. 1: The so far existing data on the observation of Avocets at Sečovlje Salina (KR – Committee for rarities).

Datum Date	Število No.	Opazovalec Observer	Vir Reference
22. 05. 1961	1	J. Gregori	KR (1993)
31. 05. 1987	2	M. Gjerkeš, L. Lipej, I. Škornik	Lipej (1987)
22. 08. 1987	1	M. Perušek	KR (1993)
15. 08. 1989	1	T. Jančar	KR (1993
09. 03. 1991	2	T. Jančar	Sovinc (1993)
27. 04. 1994	3	B. Rubinič	Senegačnik *et al.*, (1998)
04. 06. 1994	1	B. Rubinič, A. Vrezec	Senegačnik *et al.*, (1998)
06. 05. 1995	1	B. Rubinič	Senegačnik *et al.*, (1998)

Spomladi 2001 je osebka gnezditveno sumljivih sabljark in značilno hlinjenje večkrat opazoval Lovrenc Lipej *(ustno)*.

Sl. 1: Svarilni let sabljarke *Recurvirostra avosetta* ***nad Sečoveljskimi solinami. (Foto: I. Geister)***
Fig. 1: Warning flight by the Avocet *Recurvirostra avosetta* ***above Sečovlje Salina. (Photo: I. Geister)***

Sl. 2: Begavec sabljarke, prvi dan življenja v Sečoveljskih solinah. (Foto: I. Geister)
Fig. 2: Avocet's downy young, the first day of life at Sečovlje Salina. (Photo: I. Geister)

REZULTATI

Par sabljark je v letu 2001 gnezdil na območju opuščenega solinskega bazena Fontanigge (Sl. 1). Tridesetega junija je bilo na pol otoškem poloju sredi opuščenega solinskega polja najdeno gnezdo z jajcem in jajčno lupino, ki je s svojo skrotovičenostjo dajala vedeti, da se je mladič ravnokar izlegel. Gnezdo je bilo zgrajeno iz blata, postlano z rastlinskimi stebelci in okrašeno s školjčnimi lupinami. Mladič se je tega dne še zadrževal na matični peščini (Sl. 2, 4), naslednjega dne pa se je pod vodstvom staršev oddaljil od gnezda za kakih 100 metrov, pri čemer je prečkal plitvino in pokazal, da zna plavati. Iz drugega jajca se ni izlegel mladič, bilo je gluho (Sl. 3).

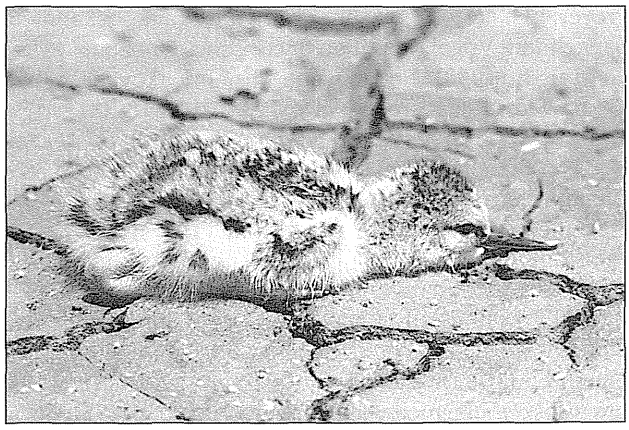
Oba dneva sta starša glasno in razburjeno opozarjala mladiča na opazovalca, pri čemer sta tako v zraku kot na tleh spektakularno razkazovala kontrastno obarvano perje. Pogosteje kot hlinjenje poškodovanosti sta uprizarjala upočasnjena, skorajda lebdeča preletavanja s široko razprostrtimi perutmi in iztegnjenimi nogami nizko nad vodo.

Tretjega julija sta odrasli ptici tesno skupaj anemično čepeli sredi solinskega bazena. Takšno vedenje je bilo v popolnem nasprotju z vedenjem izpred treh dni, po čemer se je dalo sklepati, da je mladič propadel. Ker na sipini ni bilo sledov potencialnega talnega plenilca, je mogoče sklepati, da je mladič končal kot plen plenilca iz zraka.

RAZPRAVA

Sodeč po datumu izvalitve sta bili jajci zleženi v prvih junijskih dneh (valjenje traja 24-25 dni), kar je na sredini iz literature znanega gnezditvenega obdobja od maja do julija. V obdobju graditve gnezda je bila gnezditvena peščina nedvomno otok, po vsej verjetnosti pa je bila v času graditve in valjenja tudi kdaj poplavljena, o čemer priča razmeroma visoko, najbrž sproti poviševano gnezdo. Toda če sta graditev gnezda in začetek valjenja za sabljarko nekaj povsem običajnega, pa česa takega ni mogoče trditi za asocialno gnezdenje in velikost legla. Sabljarka običajno gnezdi v kolonijah, posamezne gnezditve so sodeč po strokovni literaturi zelo redke, domala nepoznane. Tako so tudi legla s štirimi jajci skorajda pravilo, manjša legla, še posebno takšna z enim jajcem, pa pripisana nepravilnostim pri gnezdenju (Glutz von Blotzheim *et al.*, 1977). Mislim, da lahko oboje, tako asocialno gnezditev kot nizkoštevilčno leglo, nenazadnje pa tudi izvalitev enega samega mladiča, pripišemo mladostni neizkušenosti staršev. Sabljarka namreč spolno dozori šele v tretjem koledarskem letu življenja, pa še takrat ne celotna populacija, zato so v drugem koledarskem letu življenja pogostejše gnezditvene anomalije. Vendar propada mladiča ne gre pripisati izključno mladostni neizkušenosti, saj je gnezditveni uspeh sabljarke nasploh zelo majhen, še posebno tam, kjer v bližini domujejo galebi (Glutz von Blotzheim *et al.*, 1977).

Sl. 3: Neizvaljeno jajce sabljarke v gnezdu v Sečoveljskih solinah. (Foto: I. Geister)
Fig. 3: Unhatched egg in Avocet's nest at Sečovlje Salina. (Photo: I. Geister)



Sl. 4: Begavec sabljarke v pritajeni drži v Sečoveljskih solinah. (Foto: I. Geister)
Fig. 4: Avocet's downy young in a crouching posture at Sečovlje Salina. (Photo: I. Geister)

THE FIRST CONFIRMED BREEDING BY THE AVOCET (*RECURVIROSTRA AVOSETTA*) IN SLOVENIA

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SUMMARY

In spring 2001, a pair of Avocets Recurvirostra avosetta *bred at the Sečovlje Salina (Piran, Slovenia), which is the first confirmed breeding by this species of the order of Charadriiformes in Slovenia. The nest was built on a patch of sandy ground and contained two eggs. Only one chick, however, was hatched, and even this disappeared in a couple of days time. Judging from the date of hatching, the eggs were laid in early June. At the time of nest building the sandy patch was undoubtedly an islet, which was testified by the relatively high and probably simultaneously raised nest. But if the nest building and the beginning of hatching are something completely usual with this bird, this cannot be claimed of its asocial nesting and the clutch size. The author believes that both, the asocial nesting as well as the smallness of the clutch - and after all the fact that only one chick was hatched - can be attributed to the inexperience of the parents. Namely, the Avocet becomes sexually mature only in the third calendar year of its life, which is the reason why in the second calendar year the nesting anomalies are more recurrent than otherwise. The young's ruin, however, cannot be ascribed solely to the youthful inexperience, for the Avocet's breeding success is generally very low, particularly in places with gulls dwelling nearby (Glutz von Blotzheim* et al., *1977).*

Key words: *Recurvirostra avosetta*, distribution, breeding, Sečovelje Salina, Slovenia

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NEKAJ ZNAČILNOSTI AVIFAVNE PIVŠKIH JEZER

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IZVLEČEK

Prispevek opisuje avifavno šestih pivških jezer. Zaradi presihajočega značaja jezer na tem območju najdemo predvsem vrste, ki so značilne za kulturno krajino. Za gnezditev ptic sta pomembni le Petelinjsko in Palško jezero. Čeprav število gnezdečih parov posameznih vrst ni veliko, so gnezditvene gostote pisane penice (Sylvia nisoria), *rjavega srakoperja* (Lanius collurio) *in velikega strnada* (Miliaria calandra) *med najvišjimi v Sloveniji. Visoke gostote dosegajo tudi prepelica* (Coturnix coturnix), *kosec* (Crex crex) *in rjava penica* (Sylvia communis). *Obe jezeri sta lahko referenčni območji za izračune potencialne velikosti populacij ptic v kulturni krajini notranjskega dela Slovenije.*

Ključne besede: pivška presihajoča jezera, avifavna

ALCUNE CARATTERISTICHE DELL'AVIFAUNA DEI LAGHI DI PIVKA

SINTESI

L'articolo descrive l'avifauna dei sei laghi di Pivka. A causa del periodico dissecamento di tali laghi, nell'area troviamo soprattutto specie caratteristiche del paesaggio culturale. Per gli uccelli in periodo di nidificazione sono particolarmente importanti i laghi di Petelinje e Palčje. Sebbene il numero di coppie nidificanti di ogni singola specie non sia alto, le densità di nidificazione della bigia padovana (Sylvia nisoria), *dell'averla piccola* (Lanius collurio) *e dello strillozzo* (Milaria calandra) *sono tra le più alte in Slovenia. Presentano valori alti di densità anche la quaglia* (Coturnix coturnix), *il re di quaglie* (Crex crex) *e la sterpazzola* (Sylvia communis). *Entrambi i laghi possono venir considerati stazioni di riferimento per il calcolo della grandezza potenziale delle popolazioni di uccelli nel paesaggio culturale della regione interna della Slovenia.*

Parole chiave: laghi intermittenti di Pivka, avifauna

UVOD

O pticah pivških jezer do sedaj ni bilo veliko napisanega. V 100 številkah ornitološke revije Acrocephalus obstoja le en zapis (Kmecl & Rižnar, 1995). Razlog za skope podatke je v dolgoletni nedostopnosti terena (svojčas je bilo tu zaprto vojaško območje) in v dejstvu, da presihajoča jezera za vodne in močvirske ptice niso preveč vabljiva. Zaradi neredne vodnatosti v jezerih ni večjih vodnih živali, predvsem rib - hrane za številne vodne in močvirne vrste ptic, ki jih je v Sloveniji po nekaterih ocenah prek 50 vrst (Gregori, 1995). Ravno vodne in močvirne vrste pa so med opazovalci najbolj priljubljena tarča (Tome, 2000).

Drugače je s pticami, ki niso ozko vezane na vodo. Pivška polja zaradi poplavljanja niso primerna za intenzivno gospodarjenje, kar je lahko močan magnet predvsem za ptice kulturne krajine. Namen raziskave je bil napraviti kvantitativne popise prezimovalcev in gnezdilcev ter s primerjavo rezultatov z rezultati iz podobnih območij ugotoviti, kakšen je avifavnistični pomen tega območja za Slovenijo.

MATERIAL IN METODE

Opis območja

Pivška jezera sestavlja 13 presihajočih vodnih teles, ki pripadajo sistemu kraške Ljubljanice (Sl. 1). Na vzhodnem robu Pivške doline se nizajo v smeri S-J. Zapolnjena so le ob visokih vodah, sicer so suha, poraščena s travo. Največji sta Palško (125 ha) in Petelinjsko (55 ha) jezero, v katerih se voda zadržuje od nekaj do 6 mesecev na leto. Palško jezero je do polovice

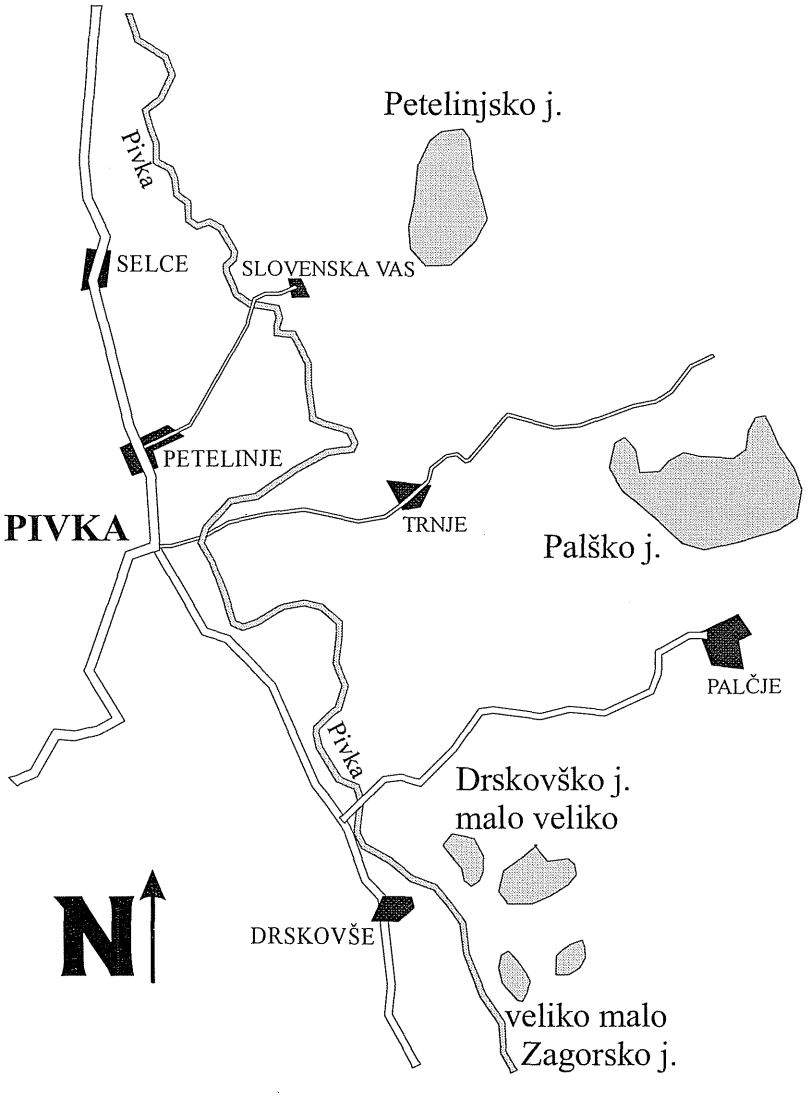

Fig. 1: Pivka lakes.
Sl. 1: Pivška jezera.

preraščeno z mozaično grmovno-travniško vegetacijo, druga polovica so travniki. Na Petelinjskem jezeru so samo travniki. Druga obravnavana jezera so bila še: Veliko Drskovško jezero (16,5 ha), Malo Drskovško jezero (4 ha), Veliko Zagorsko jezero (4 ha) in Malo Zagorsko jezero (cca 2 ha) (geografske, varstvene in nekatere biološke podatke glej: Gorkič *et al.*, 1996).

V poletnem času daje jezerom pečat ekstenzivno gospodarjenje s travniki. Njiv ni, s košnjo lastniki večinoma začnejo ob koncu maja, nekaterih površin ne pokosijo vse do avgusta. Nekaj manjših površin ne kosijo več in se že zaraščajo z lesno vegetacijo. Nekaj je tudi pašnikov.

Metode dela

Ptice sem popisoval v jesensko-zimskem in pomladnem delu leta. Vrste sem določal po petju in z optičnimi pripomočki (8x24, 30x60). V gnezditvenem času sem štel pojoče samce (en samec je en gnezdeči par) po metodi popolnega štetja na površini. Ker so vrednosti pri tej metodi običajno nekoliko podcenjene, podajam število gnezdečih parov kot rang, pri katerem je spodnja vrednost število preštetih osebkov, zgornja pa ista vrednost povečana za 20%. Pozimi sem ptice popisoval prek celega dneva, spomladi pa le v jutranjih in večernih urah (od sončnega vzhoda do 10h in od 17h do sončnega zahoda). Ogroženost vrst podajam po seznamu ogroženih gnezdilk Slovenije (Bračko *et al.*, 1994).

Za pomoč pri vrednotenju popisov ptic pivških jezer sem kvantitativno popisal tudi gnezdilce v bližnji Pivški dolini. Popise sem napravil po metodi transekta z dvema pasovoma, od katerih je notranji meril v širino 100 m. Transekt je potekal med vasema Selce in Trnje (dolžina 3500 m), v eno stran po mešani travniško-grmovni krajini, na drugo pa pretežno po travnikih. Transekta sta bila med seboj oddaljena najmanj 200 m. Pri vrstah, kjer sem preštel najmanj 5 osebkov, sem gostoto izračunal po metodi Järvinen & Väisänen (1975), pri manj pogostih pa sem preračunal gostoto na podlagi števila osebkov, opaženih samo v notranjem pasu.

REZULTATI

Teren sem pregledal šestkrat: 26. 10. 1999, 14. 12. 1999, 20. 1. 2000, 19. 4. 2000, 25. 5. 2000 in 1. 6. 2000. Popise v Pivški dolini sem napravil 26. 4. 2000 in 1. 6. 2000.

V zimskem obdobju sem na območju jezer odkril 20 vrst ptic (Tab. 1), med katerimi se jih je 13 zadrževalo v okoliških gozdovih, ena pa je območje preletela. Kljub temu, da so bila 14. 12. 1999 vsa jezera razen Malega Zagorskega pod vodo, so se vodne ptice zadrževale le na Petelinjskem, in sicer mlakarice *(Anas platyrhynchos)*. Ob januarskem pregledu so bile vse vodne površine zamrznjene.

Tab. 1: Seznam ptic na pivških jezerih pozimi. Legenda: ŠT - največje število osebkov, opaženih ob enem obisku, x - ni podatka o njihovem številu; ST - vrsta opažena ob vseh obiskih (x); OJ - vrsta opažena samo v okolici jezer (x), vrsta jezera preletela (L).
Table 1: The list of birds of Pivka lakes in winter. Legend: ŠT - greatest number of individuals observed during a single visit, x - no data as to the species abundance; ST - species observed during every visit (x); OJ - species observed only in the surroundings of the lakes (x), species observed only in flight over the lakes (L).

Rod/Genus	*Vrsta/Species*	ŠT	ST	OJ
Anas	*platyrhynchos*	40		
Circus	*cyaneus*	1		
Falco	*tinnunculus*	1		
Erithacus	*rubecula*	x	x	x
Turdus	*merula*	x	x	x
Turdus	*pilaris*	10	x	
Turdus	*iliacus*	1		
Parus	*palustris*	x	x	x
Parus	*cristatus*	x	x	x
Parus	*ater*	x	x	x
Parus	*caeruleus*	x	x	x
Parus	*major*	x	x	x
Sitta	*europaea*	x	x	x
Lanius	*excubitor*	1		
Garrulus	*glandarius*	x	x	x
Corvus	*corax*	2		L
Fringilla	*coelebs*	x	x	x
Chloris	*chloris*	x	x	x
Pyrrhula	*pyrrhula*	x	x	x
Coccothraustes	*coccothraustes*	x	x	x

V gnezditvenem času sem na jezerih odkril 33 vrst ptic (Tab. 2). Od tega jih je 11 gnezdilo prav na jezerih, 16 v okolici in so na jezeru le nabirale hrano, pet pa jih je bilo na preletu ali na klatenju. Status hribskega škrjanca je ostal nerazjasnjen. Med gnezdilci z jezera jih je bilo sedem (64%) z rdečega seznama.

Na Palškem jezeru so dosegale visoke gnezditvene gostote prepelica *(Coturnix coturnix)*, pisana penica *(Sylvia nisoria)*, rjava penica *(S. communis)*, veliki strnad *(Miliaria calandra)* in rjavi srakoper *(Lanius collurio;* Tab. 3). Slednja sta dosegla visoko gostoto tudi na Petelinjskem jezeru. Veliko gostoto na razmeroma majhni površini Palškega jezera lahko pripišemo tudi koscu *(Crex crex)*, medtem ko repaljščica *(Saxicola rubetra)* na jezerih ni gnezdila.

*Tab. 2: Kvantitativni seznam gnezdilcev pivških jezer: RS - vrsta je na rdečem seznamu kot: E - ogrožena, V - ranljiva, R - redka, NK - premalo znana vrsta. Okrajšave imen jezer: Dma - Drskovško malo jezero, Dve - Drskovško veliko jezero, PA - Palško jezero, PE - Petelinjsko jezero, Zma - Zagorsko malo jezero, Zve - Zagorsko veliko jezero. SKg - ocena skupnega števila gnezdečih parov: x - vrsta gnezdi v okolici, na jezerih se le prehranjuje, * - vrsta opažena na jezerih, a tam ni gnezdila.*

*Tab. 2: Quantitative list of the birds of Pivka lakes: RS - species appears on the Red List as: E - endangered, V - vulnerable, R - rare, NK - not sufficiently known. Abbreviations of the lakes: Dma - Drskovško malo jezero, Dve - Drskovško veliko jezero, PA - Palško jezero, PE - Petelinjsko jezero, Zma - Zagorsko malo jezero, Zve - Zagorsko veliko jezero. SKg - estimated total number of breeding pairs: x - species breeding in the vicinity and merely feeding on the lakes, * - species observed on the lakes, but did not breed there.*

Rod/Genus	Vrsta/Species	RS	DMa	DVe	PA	PE	ZMa	ZVe
Circus	*aeruginosus*	NK			1*			
Coturnix	*coturnix*	V			8-10			
Crex	*crex*	E			4-6	1-2		
Cuculus	*canorus*				2			
Jynx	*torquilla*	V			x			
Picus	*canus*	V		x				
Dendrocopos	*mjor*			x			x	
Lullula	*arborea*	E			2*	1*		
Alauda	*arvensis*	R			10-12	10-12		
Anthus	*trivialis*			x	3-4	2-3	x	
Anthus	*spinoletta*			4*				
Erithacus	*rubecula*		x		x			
Saxicola	*rubetra*	E				1*		
Oenanthe	*oenanthe*					2*		
Turdus	*merula*		x	x	10-12	1-2		x
Turdus	*pilaris*						x	
Turdus	*philomelos*					x		
Sylvia	*nisoria*	V			10-12			
Sylvia	*curruca*				2*			
Sylvia	*communis*	V		2	15-18	2-3		
Sylvia	*atricapilla*		x	3	7-8		1	x
Phylloscopus	*collybita*		x	x	x	x	x	x
Aegithalus	*caudatus*		x					
Parus	*ater*		x			x	x	
Parus	*major*		x	x	x	x		
Sitta	*europaea*						x	
Oriolus	*oriolus*						x	x
Lanius	*collurio*	R	1	3	20-24	10-12	1	1
Garrulus	*glandarius*			x				
Corvus	*corone cornix*							x
Fringilla	*coelebs*				x		x	
Emberiza	*citrinella*						x	x
Miliaria	*calandra*	V		2	9-11	5-6		
SKUPAJ	V JEZERU / IN THE LAKE		1	5	11	7	3	1
SKUPAJ	V RS		1	3	7	5	1	1

RAZPRAVA

V zimi 1999/2000 presihajoča pivška jezera za ptice niso bila posebno pomembna. Dne 14. 12. 1999 je bila na vodni površini odkrita jata mlakaric, sicer pa je bila voda večino časa, ko so bila jezera poplavljena, zamrznjena in tako za vodne ptice nedostopna. V drugačnih razmerah (mokra in topla zima) pa je lahko tudi povsem drugače. Kmecl & Rižnar (1995) opisujeta opažanje štirih polarnih slapnikov *(Gavia arctica),* črnogrlega ponirka *(Podiceps nigricollis),* 150 mlakaric, petih žvižgavk *(Anas penelope)* in treh dolgorepih rac *(Anas acuta)* 7. 11. 1993 na zalitem Petelinjskem jezeru. Toda ptice uporabljajo ta jezera bržkone le kot počivališče, ne pa kot dolgotrajnejše zatočišče ali celo prezimovališče. Za kaj takega je v njih verjetno premalo hrane.

Tab. 3: Primerjava gostot (število gnezdečih parov/km²) nekaterih gnezdilcev Palškega (PA) in Petelinjskega jezera (PE) z gnezdilci v Pivški dolini (PI), v dolini Reke (RE; Polak, 2000), v porečju Nanoščice (NA; Polak, 2000), na Ljubljanskem barju (LB; največje preštete gostote na površini 1 km²; neobjavljeni podatki), na Cerkniškem polju (Polak, 1993) in v Jovsih (Trontelj & Vogrin, 1993); + = manj kot 1 par. Vrednosti zaradi različnih površin niso neposredno primerljive med seboj.

Tab. 3: Comparison between densities (No. of breeding pairs/km²) of some breeders of Palško jezero (PA) and Petelinjsko jezero (PE) and those of the Pivka valley (PI), Reka valley (RE; Polak, 2000), the Nanoščica catchment (NA; Polak, 2000), Ljubljansko barje (Ljubljana Marshes) (LB; greatest established densities on the surface of 1 km²; unpublished data), at Cerknica polje (Polak, 1993) and at Jovsi (Trontelj & Vogrin, 1993); + = less than 1 pair. Due to the different surfaces, the values are not directly comparable.

Rod/Genus	Vrsta/Species	PA	PE	PI	RE	NA	LB	CE	IO
Coturnix	*coturnix*	6-8	-	3-8	1	1-2	20	0,6	4-11
Crex	*crex*	3-5	1-2	0-1	2-3	2-3	13	2-3	1,3
Alauda	*arvensis*	8-10	18-22	27-40	2-3	3-4	55	8-40	3,2
Saxicola	*rubetra*	-	-	18-28	1	1	52	5-25	0,6
Sylvia	*nisoria*	8-10	-	+	0-1	0-1	10	+	-
Sylvia	*communis*	12-14	4-5	16-26	1-2	1-2	28	?	5-14
Lanius	*collurio*	16-20	18-22	1-6	2	1-2	24	+	1-2
Miliaria	*calandra*	7-9	9-11	5-11	2-3	2-3	10	+	1-2
POVRŠINA	km²	1,25	0,55	3-4	17	14,2	1	35	4,6

V gnezditvenem času sta se izkazali kot zanimivi le Petelinjsko in Palško jezero. Druga za gnezditev niso pomembna, pticam rabijo le kot prehranjevalna območja.

Število vrst gnezdilcev na Petelinjskem in Palškem jezeru ni veliko, pomembni pa sta vrstna sestava in gostota osebkov. Večina je vrst, ki jih običajno pripisujemo kulturni krajini, več kot polovica med njimi je na rdečem seznamu. Najbolj ogrožen je kosec. Dne 1. 6. 2000 so se med 16. in 17. uro na Palškem jezeru oglašali štirje samci, na Petelinjskem pa 25. 5. 2000 eden. Ker se ta vrsta običajno najintenzivneje oglaša ponoči, sklepam, da je bil na jezerih v resnici še kakšen več. Ugotovljeno število koscev ni veliko (v Sloveniji se jih vsako pomlad oglaša okoli 500), je pa primerljivo s številom pojočih koscev na celotnem Štajerskem ali na celotnem Dolenjskem in večje od števila koscev na Gorenjskem ali v Prekmurju (Trontelj, 1995). Prepelica je v letu 2000 gnezdila le na Palškem jezeru, na Petelinjskem pa ne. Razlog za manjše število koscev in dejstvo, da prepelic ni na Petelinjskem jezeru, je verjetno v režimu poplav. Petelinjsko jezero je bilo v letu 2000 poplavljeno vse do sredine aprila, medtem ko je bilo Palško jezero po jesenskih poplavah vso zimo in pomlad nepoplavljeno. Med najbolj prilagodljive travniške gnezdilce sodi poljski škrjanec *(Alauda arvensis)*, kar se je izkazalo tudi v tej raziskavi. Kljub razlikam v poplavljenosti je na obeh jezerih gnezdilo približno enako število parov.

Repaljščica, pogosta gnezdilka v bližnji Pivški dolini, na jezerih ni gnezdila. Tudi tu gre razlog verjetno iskati v pomlad segajočim poplavam, ki vplivajo na strukturo in vrstno sestavo travne ruše.

Največje gostote na Palškem jezeru dosegajo vrste, ki gnezdijo v grmovju (prevladujejo vrbe, *Salix* sp.), prehranjujejo pa se na travnikih. To so pisana penica, rjava penica, rjavi srakoper in veliki strnad. Rjavi srakoper in veliki strnad sta gnezdila v veliki gostoti tudi na Petelinjskem jezeru, kjer grmovja ni. Za gnezdenje sta izkoriščala ozek grmovni pas na robu med jezerom in gozdom. Na velike gostote rjavih srakoperjev in velikih strnadov na zahodu notranjskega dela Slovenije je opozoril že Surina (1999). Ocenjujem, da so gostote pisane penice, rjavega srakoperja in velikega strnada na Palškem jezeru med najvišjimi v Sloveniji. Izračuni v tabeli 3 so narejeni za celotno površino jezera, v resnici pa ga je za te vrste primernega le okoli polovica, saj so na drugi polovici jezera odprti travniki brez grmovja. Ekološke gostote vrst so torej vsaj še enkrat višje od predstavljenih.

Zanimivost Palškega jezera z okolico je tudi to, da na majhni površini gnezdijo kar štiri vrste penic: pisana, siva, črnoglavka *(Sylvia atricapilla)* in mlinarček *(S. curruca)*.

ZAKLJUČKI

Med preiskanimi presihajočimi jezeri sta bili v obdobju raziskave pomembni za ptice le Petelinjsko in Palško jezero, in še to le v gnezditvenem obdobju. Zaradi majhnih površin je bilo število gnezdečih parov ptic za Slovenijo zanemarljivo majhno. Kljub temu dajejo velike gnezditvene gostote pisane, rjave penice, rjavega srakoperja in velikega strnada ter ne prav majhne gostote koscev in prepelic območju poseben pomen.

V prispevkih, kjer obravnavamo ptice kulturne krajine, vse pogosteje opisujemo spremembe v številu gnezdečih parov posameznih vrst med popisi, narejenimi v več časovno oddaljenih obdobjih. Ugotovljena razlika nam običajno rabi kot naravovarstveni argument za ogroženost območja. Kvantitativni popisi ptic se pri nas opravljajo šele zadnjih 5 ali 10 let, ko je praktično vsa

kulturna krajina Slovenije že padla pod vpliv intenzivnih posegov. Za verodostojno beleženje sprememb vpliva intenziviranja gospodarjenja pa bi potrebovali podatke o številu še iz časov pred začetkom intenzivnih posegov. Te vrednosti lahko imenujemo tudi potencialne velikosti populacij, saj nam prikazujejo število ptic, ki bi pri nas še danes lahko gnezdile, če bi bile razmere ugodne. Do vsaj nekoliko objektivnih ocen o teh velikostih lahko pridemo s pomočjo podatkov o gostotah ptic v malo izkoriščanih območjih, ki jih tu in tam najdemo in popišemo še dandanes. Podatki o pticah Petelinjskega in Palškega jezera so gotovo lahko ena izmed referenčnih vrednosti za izračune potencialnih velikosti populacij ptic v kulturni krajini notranjskega dela Slovenije.

SOME CHARACTERISTICS OF THE AVIFAUNA OF PIVKA INTERMITTENT LAKES

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SUMMARY

The present contribution deals with avifauna of the six Pivka lakes. Due to their intermittent character, however, largely birds typical of cultural landscape are found in the district. Only Petelinjsko jezero and Palško jezero are important as birds' breeding habitats. Although the numbers of separate species' breeding pairs are not high, the densities of the breeding Barred Warbler (Sylvia nisoria), *Red-backed Shrike* (Lanius collurio) *and Corn Bunting* (Miliaria calandra) *are amongst the highest in Slovenia. High densities are also reached by Common Quail* (Coturnix coturnix), *Corn Crake* (Crex crex) *and Common Whitethroat* (Sylvia communis).

In the articles dealing with the birds of cultural landscape, we are more and more frequently describing the changes that took place in the numbers of separate species' breeding pairs between the surveys carried out in several temporally distant periods. The assessed differences are normally used as a nature conservationist argumentation for the district's threat status. Quantitative surveys have been carried out in our country only in the last 5 or 10 years, when practically the entire Slovene cultural landscape has been strongly influenced by intensive human pressures. For an authentic recording of the changes as a result of intensive farming, however, data on the numbers of birds prior to the pressures being carried out would be needed. These values could be called potential population sizes, for they indicate the number of birds that could still breed in our country if the conditions were favourable enough. At least partly objective estimate as far as these sizes are concerned could be reached with the aid of the data on densities of the birds in lowly exploited districts that can still be found and surveyed here and there. The data on the birds of Petelinjsko jezero and Palško jezero can certainly be one of the reference values for the estimate of bird populations' potential sizes in cultural landscape in the Notranjska region of Slovenia.

Key words: Pivka intermittent lakes, avifauna

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FLORA

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NOVA SEGETALNA ZDRUŽBA IZ ZVEZE *CAUCALIDION LAPPULAE* TX. 50 IZ SEVEROZAHODNE ISTRE (SLOVENIJA)

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IZVLEČEK

Segetalna vegetacija je na flišnih tleh severozahodne Istre zaradi ugodnih klimatskih, fitogeografskih, edafskih razmer in specifičnega tradicionalnega gospodarjenja razmeroma bogato razvita. Zbrane popise smo uvrstili v toploljubno bazifilno zvezo Caucalidion lappulae *Tx. 50 (red* Centauretalia cyani *(Tx. 37) Tx., Lohm.* et *Preisg. 50). Glede na floristično sestavo, ki je nekje vmes med pravimi mediteranskimi in osiromašenimi toploljubnimi srednjeevropskimi segetalnimi sestoji, smo opisali novo asociacijo* Galio tricornuti-Ranunculetum arvensis *assoc. nova, ki jo karakterizira predvsem bogata zastopanost značilnic zveze in reda ter dominanca vrste* Galium tricornutum.

Ključne besede: segetalna vegetacija, žitni pleveli, *Caucalidion lappulae, Centauretalia cyani, Galio tricornuti-Ranunculetum arvensis,* Istra, Slovenija

NUOVA ASSOCIAZIONE SEGETALE (ALLEANZA *CAUCALIDION LAPPULAE* TX. 50) DELL'ISTRIA NORD-OCCIDENTALE (SLOVENIA)

SINTESI

La vegetazione segetale risulta ben sviluppata sul terreno flyshoide dell'Istria nord-occidentale, grazie a condizioni climatiche, fitogeografiche ed edafiche favorevoli nonché ad una specifica economia tradizionale. L'autore inserisce gli rilievi raccolti nell'alleanza termofila Caucalidion lappulae *Tx. 50 (ordine* Centauretalia cyani *(Tx. 37) Tx., Lohm.* et *Preisg. 50). In base alla composizione floristica, compresa tra i tipici raggruppamenti mediterranei e gli impoveriti raggruppamenti termofili segetali dell'Europa centrale, l'autore descrive l'associazione* Galio tricornuti-Ranunculetum arvensis *assoc. nova, caratterizzata principalmente dall'abbondanza di specie caratteristiche dell'associazione e dell'ordine, nonché dalla dominanza della specie* Galium tricornutum.

Parole chiave: vegetazione segetale, granaglie, *Caucalidion lappulae, Centauretalia cyani, Galio tricornuti-Ranunculetum arvensis,* Istria, Slovenia

UVOD

Gojenje žit v Slovenski Istri ni temeljna kmetijska panoga, pač pa sestavni del tradicionalnega kolobarjenja. Različni vzroki, predvsem fitogeografski (vpliv mediterana), edafski (bazična podlaga) in antropogeni (tradicionalni način pridelave žita) omogočajo bogat razvoj segetalne vegetacije na sicer redkih in majhnih žitnih poljih v tem območju.

Vzorčenje – iskanje dovolj bogatih žitnih njiv – je potekalo v Slovenski Istri v prvi polovici devetdesetih let 20. stoletja. Predvsem v porečju Dragonje in na priobalnih gričih od Kopra do Sečovelj so tamkšnje njive še razmeroma pogoste, kar smo opazovali tudi še v kasnejših letih.

Pri uvrščanju popisanih segetalnih sestojev oziroma sestojev vegetacije žitnih plevelov iz Slovenske Istre smo se naslonili na eno novejših razdelitev, kakršno prinaša Mucina (1993), ki pojmuje plevelno vegetacijo nekoliko drugače kot Oberdorfer (1993). Tako je plevelna in okopavinska vegetacija združena v en razred *Stellarietea mediae*. Pri tem je razred, za katerega so v glavnem značilni terofiti na antropogenih rastiščih, razdeljen v dva redova, od katerih je *Centauretalia cyani* tradicionalno "segetalen", čaprav ga Mucina pojmuje širše in označuje za "plevelne združbe na bazičnih tleh". V nasprotju s tem je red *Chenopodietalia albi* tradicionalno "okopavinski", Mucina pa ga označuje kot "združbe na tleh, revnih z bazami". Preprosta je tudi uvrstitev v zvezo, saj se ta ponuja sama po sebi: toploljubna zveza *Caucalidion lappulae* (v zvezo *Centauretalia cyani* jo je uvrstil že Tüxen (1950)) ima submediteransko-srednjeevropski značaj in nastopa na tleh, bogatimi s karbonati. Ta zveza je razširjena v celotnem osrednjem delu Evrope (od severne Francije, Nemčije, Poljske, Ukrajine), južno pa sega do severne Italije, severnega Jadrana, Hrvaške in Romunije (Ferro, 1990). Tako lahko takoj ugotovimo, da so naši popisi z južne meje areala te zveze in kot taki zelo bogati s (sub)mediteranskimi in drugimi toploljubnimi elementi.

Nekoliko drugačno razdelitev segetalne vegetacije prinaša Ferro (1990), ki je izdelal revizijo mediteranske in evropske segetalne vegetacije. Pri tem je ohranil stare Braun-Blanquetove (1949) sinonime, to je razred *Secalietea*, ki ga deli v redova *Secalietalia* (apnena tla) in *Aperetalia* (zakisana tla). Toda uvrstitev naših popisov tudi pri tej razvrstitvi ostaja ista - zveza *Caucalidion lappulae* je z enako oznako uvrščena v *Secalietalia*, ki ga ima Mucina (1993) za sinonim reda *Centauretalia*. Navidezno enotnost pa "kvari" mnenje Ferra (1990), ki omenjena redova nima za sinonima, zvezo *Caucalidion* pa pripisuje mediteranskemu redu *Secalietalia*, ker "predstavlja pomembno skupino mediteranskih vrst", ne pa "srednjeevropskemu" redu *Centauretalia*. Strinjamo se z znatnim deležem različnih vrst takšne ali drugačne mediteranske razširjenosti, po drugi strani pa je res, da so te (sub)mediteranske vrste razpršene po velikem delu srednje in deloma tudi vzhodne in zahodne Evrope. Z drugimi besedami - le redke srednjeevropske združbe vsebujejo toliko (sub)mediteranskih vrst, kot ravno segetalne združbe iz te zveze. Evropska razširjenost vrst iz zveze *Caucalidion* je prikazana tudi na zemljevidu v Ferrovi monografiji (Ferro, 1990).

METODA

Pri popisovanju vegetacije smo uporabili standardno Braun-Blanquetovo (1964) srednjeevropsko metodo, nomenklatura taksonov je povzeta po Trpin & Vreš (1995), sintaksonov pa po Mucini (1993).

Delo temelji na terenskih popisih z naslednjih lokalitet (Tab. 1):

1. Sočerga, 6. 6. 1989 (0549/1), 2. Šared nad Izolo, 25. 6. 1989 (0447/4) 3. Nad Krkavčami, 19. 5. 1990 (0548/1) 4. Dolina Dragonje med Kaštelom in Krkavčami, 7. 6. 1989 (0548/1) Sirči, 6. 5. 1989 (0549/1) dolina Dragonje pod Krkavčami, 7. 6. 1989 (0548/1) 7. Dolina Dragonje med Krkavčami in Kaštelom, 7. 6. 1989 (0548/1) dolina Dragonje pod Kaštelom, 7. 6. 1989 (0548/1) 9. Marezige, 3. 7. 1989 (0448/4) 10. Med Pučami in Krkavčami, 19. 5. 1990 (0448/1 med Kavaliči in Marezigami, 3. 7. 1989 (0448/4) 12. Šared nad Izolo, 25. 6. 1989 (0447/4) 13. Belveder nad Izolo, 11. 6. 1990 (0447/4) Truške, ob cesti za Boršt, 13. 7. 1989 (0548/2) 15. Popetre, severna stran vasi, 13. 7. 1989 (0549/1) 16. Pri Galantičih, 13. 7. 1989 (0549/1) 17. Mala Seva pri Maliji, 4. 7. 1989 (0447/4) 18. Mala Seva, 4. 7. 1989 (0447/4) 19. Med Šaredom in Kortami, 25. 6. 1989 (0547/2) 20. Šared nad Izolo, 25. 6. 1990 (0447/4) 21. Šared nad Izolo, 25. 6. 1990 (0447/4)22. Pod Župančiči, 7. 6. 1989 (0548/2) 23. Pomjan, 3.7.1989 (0548/2) 24. Pomjan, 3. 7. 1989 (0548/2) 25. Med Koromači in Žrnjovcem, 6. 6. 1989 (0549/1) 26. Dolina Dragonje pod Krkavčami, 7. 6. 1989 (0548/1) 27. Dolina Dragonje med Kaštelom in Krkavčami, 7. 6. 1989 (0548/1) 28. Dolina Dragonje med Pučami in Koštabono, 7. 6. 1989 (0548/1) 29. Babiči, 3. 7. 1989 (0448/4) 30. Med Babiči in Pomjanom, 3. 7. 1989 (0548/2) 31. Med Malo Sevo in Lucanom nad Portorožem, 4. 7. 1989 (0447/4) 32. Med Medljanom in Šaredom nad Izolo, 4. 7. 1989 (0448/3) 33. Med Medljanom in Šaredom nad Izolo, 4. 7. 1989 (0448/3) 34. Labor, vzhodno od cerkve, 13. 7. 1989 (0548/2) 35. Lucan nad Portorožem, 4. 7. 1989 (0447/4) 36. Med Pomjanom in Šmarjami, 3. 7. 1989 (0448/3) 37. Lucan nad Portorožem, 4. 7. 1989 (0447/4) 38. Med Malo Sevo in Lucanom nad Portorožem, 4. 7. 1989 (0447/4) med Malo Sevo in Malijo, 4. 7. 1989 (0447/4) med Malo Sevo in Lucanom nad Portorožem, 4. 7. 1989 (0447/4) 41. Hrastovlje, vzhodno od vasi, 3. 7. 1989 (0449/3) 42. Med Rižano in Hrastovljami, 3. 7. 1989 (0449/3).

REZULTATI IN DISKUSIJA

Galio tricornuti-Ranunculetum arvensis assoc. nova hoc loco (Tab. 1/1-42; holotypus Tab. 1/3)

Floristična sestava asociacije

Izbrane popise smo tabelirali in primerjali z drugimi segetalnimi popisi iz sicer oddaljenih območij (srednjeevropsko območje - Nemčija, nekdanja Češkoslovaška, Poljska, Avstrija; Balkan oziroma Kvarner) ter iz bližnje Furlanije. Fitogeografske in edafske razmere so v severozahodni flišni Istri tako drugačne od razmer, od koder je segetalna vegetacija poznana, da smo že v začetku raziskave pričakovali novo asociacijo. To je pokazala tudi kasnejša poglobljena primerjava, ki jo povzemamo v tekstu. Nova asociacija je prikazana v analitični tabeli (Tab. 1).

Za značilne vrste smo izbrali štiri vrste zveze oziroma reda, ki so izrazito segetalne in se pojavljajo stalno in obilno v naših sestojih. Poseben pečat ji dajeta *vrsti Galium tricorne* in *Bifora radians* (Sl. 1), ki sta v Sloveniji le mediteransko razširjeni, zelo pogosti pa sta tudi v srednjeevropskem prostoru razširjeni vrsti *Consolida regalis* in *Ranunculus arvensis*. Bogat je spisek termofilnih submediteranskih vrst reda *Caucalidion lappulae*, čeprav te vrste – v nasprotju z zgoraj omenjenimi, ki smo jih vzeli kot značilnice - niso pogoste. Razmeroma slaba zastopanost je popolnoma "normalna", če vemo, da gre za botanične redkosti, arheofite, ki so v nekaterih pokrajinah srednje Evrope praktično že izumrli. Takšne vrste so npr. *Vaccaria pyramidalis, Lithospermum arvense, Legousia hybrida, Adonis flammea* subsp. *cortiana, Melampyrum arvense, Bupleurum rotundifolium* in *Myagrum perfoliatum*. Večjo frekvenco v sestojih imajo še vedno termofilne bazifilne vrste reda *Centauretalia*, ki pa so že manj izrazito mediteransko razširjene. Takšne so *Papaver rhoeas, Agrostemma githago, Rapistrum rugosum* (po Ferru (1990) celo značilnica zveze *Secalion!), Euphorbia falcata, Sinapis arvensis, Lolium temulentum* in številne vrste iz rodu *Vicia*. Fitogeografsko značilna je popolna odsotnost vrste *Centaurea cyanus*, ki je sicer značilna segetalna vrsta v združbah opisovanega reda in zveze. Izključiti moramo dejstvo, da je morda za to, sicer v srednji Evropi povsod pojavljajočo se segetalno vrsto, pretoplo, saj smo jo opazovali tudi južneje v Istri in tudi na Krasu ter drugod, medtem ko je na flišu za zdaj še nismo zasledili.

Primerno so zastopane vrste razreda *Stellarietea*, kjer naj posebej omenimo le visoko frekvenco in abundanco vrste *Anagallis arvensis*. Vrste drugih sintaksonov so redke, posebej smo označili le tiste iz razreda *Artemisietea*. Večje pokrovnosti med spremljevalkami dosežejo tako vrste *Polygonum aviculare, Galium aparine, Mentha arvensis, Agropyron repens, Medicago lupulina, Rumex crispus* in *Medicago sativa* - torej ruderalne vrste z različno sintaksonomsko pripadnostjo.

Sintaksonomska problematika in razširjenost asociacije

Segetalna vegetacija reda *Centauretalia cyani* je na ozemlju srednje Evrope in Balkana dobro preučena. Jasno se ločijo združbe acidofilnega značaja od bazifilnih termofilnih združb zveze *Caucalidion*. Na širšem ozemlju srednje Evrope in Balkana je opisanih veliko združb iz te zveze. Mucina (1993) navaja za Avstrijo štiri, za Jugoslavijo jih Kojić (1985) povzema kar sedem, medtem ko je v Ferrovi (1990) monografiji, ki zajema vso Evropo in Sredozemlje, vsega osemnajst tipičnih in še šest netipičnih združb oziroma združb s problematično uvrstitvijo.

Naši sestoji iz obmorskega fliša niso podobni nobenim od zunaj submediteranskega ali mediteranskega območja razširjenih združb iz Avstrije, Nemčije in drugih srednjeevropskih držav, saj so te združbe neprimerno siromašnejše, manjkajo predvsem vrste zveze in reda. Kot primer omenimo združbo *Consolido regalis-Anthemidetum austriacae* Kropač & Mochansky 90 z ozemlja nekdanje Češkoslovaške (Kropač & Mochansky, 1990), ki ima iz zveze *Caucalidium lappulae* le tri vrste. Z iste države poročajo tudi o nekaterih združbah, kot sta npr. *Lathyro-Adonidetum* Krop. *et* Hč. 71 in *Caucalo-Adonidetum* Tx. 50 em. Oberd. 57 (Kropač 1978, 1981), v katerih se vselej pojavljata vrsti *Neslia paniculata* in *Aethusa cynapium*, ki ju pri nas ni (redki južnoevropski

Sl. 1: Škrlatno rdeči kokalj** (Agrostemma githago) **in žarkasta dvoglavka** (Bifora radians) **z belimi cvetovi sta tipična predstavnika izumirajočih žitnih plevelov, razmeroma pogosta v novoopisani segetalni združbi** Galio tricornuti-Ranunculetum arvensis. **(Foto: M. Kaligarič)

Fig. 1: Purple-flowering** Agrostemma githago **and** Bifora radians **with white flowers are typical segetal weeds on the verge of extinction. They are still relatively common in the new-described association** Galio tricornuti-Ranunculetum arvensis. **(Photo: M. Kaligarič)

Tab. 1: Analitična tabela združbe *Galio tricornuti-Ranunculetum arvensis* ***assoc. nova.***
Tab. 1: Analytical table of the association *Galio tricornuti-Ranunculetum arvensis* ***assoc. nova.***

Nadmorska višina (m)	30	25	20	5	40	4	5	7	28	30	28	25	10	30	37	32	20	19	25	25	25	10	35	35	41	5	6	19	30	15	25	20	32	20	40	12	15	20	15	17	10	
Površ. pop. ploskve (m²)	5	5	10	10	5	10	10	5	5	10	5	10	10	10	10	5	5	5	5	5	5	5	10	5	10	5	2	5	5	10	10	10	10	10	20	10	10	5	5	8	10	
Pokrovnost (%)	60	60	60	50	40	70	70	40	70	40	40	60	75	80	40	40	70	80	50	40	30	70	60	60	60	40	40	60	70	40	60	60	50	20	40	60	80	30	80	70	80	
Zaporedna številka popisa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	FR
Značilne vrste združbe (characteristical species of the association) GALIO TRICORNUTI-RANUNCULETUM ARVENSIS assoc. nova																																										
Galium tricornutum	3	2	2	1	1	1	2	2	2	1	2	+	+	3	+	+	+	+	1	+	+	+	+	.	.	+	+	2	2	+	2	1	.	+	.	1	.	+	.	.	.	V
Ranunculus arvensis	1	2	2	1	1	1	+	+	+	+	1	2	1	+	1	1	+	+	+	+	+	+	3	2	1	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	III
Consolida regalis	.	1	2	+	.		+	.	.	+	1	+	3	3	+	2	1	2	+	1	+	3	2	2	2	.	.	+	3	+	.	.	+	.	2	2	1	.	2	.	.	III
Bifora radians	.	.	+	2	.	2	4	.	.	2	.	.	.	.	.	.	3	2	+	.	.	1	.	.	+	1	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	II
Značilne vrste zveze (characteristical species of the alliance) CAUCALIDION LAPPULAE Tx. 50																																									
Ajuga chamaepytis	.	.	.	1	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	+	+	.	.	.	.	.	+	.	.	.	.	+	.	+	.	+	.	+	II
Legousia speculum-veneris	+	.	.	+	.	.	.	.	.	.	.	4	.	.	.	1	.	.	.	.	.	.	.	.	+	.	+	+	.	1	.	+	.	1	.	.	.	1	.	+	.	II
Vaccaria pyramidalis	.	+	.	.	.	.	.	.	.	.	2	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	+	.	1	2	.	.	.	I
Lathyrus aphaca	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Anthirrhinum minus	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Lithospermum arvense	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Legousia hybrida	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Adonis flammea / cortiana	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Melampyrum arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Stachys annua	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Bupleurum rotundifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Kickxia spuria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	I
Anchusa azurea	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sherardia arvensis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scandix pecten-veneris	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Myagrum perfoliatum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lathyrus tuberosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	I
Značilne vrste reda (characteristical species of the order) CENTAURETALIA CYANI (Tx. 37) Tx., Lohm. & Prsg. 50																																									
Bilderdyckia convolvolus	+	+	+	+	+	+	+	+	2	.	+	.	+	1	+	+	+	2	.	2	1	.	1	1	.	1	+	2	.	+	1	+	+	+	2	1	+	+	3	1	1	V
Papaver rhoeas	+	+	1	+	.	+	.	+	+	1	.	+	1	1	.	.	+	1	+	+	.	+	+	+	1	.	+	2	+	+	+	2	.	.	.	+	.	+	+	.	+	IV
Vicia sativa	+	+	+	+	+	+	.	1	1	.	1	.	+	.	1	+	.	.	.	.	3	.	1	+	1	+	.	.	+	+	.	2	.	+	.	.	.	.	2	.	III
Avena barbata	.	.	.	.	.	+	+	.	.	.	+	.	2	2	1	+	2	1	.	.	.	.	.	+	.	.	.	2	.	.	+	1	2	+	.	+	3	+	.	.	+	III
Athemis arvensis	.	+	+	.	.	.	.	.	.	.	.	1	+	.	.	.	1	1	1	1	+	.	.	.	+	.	.	.	+	2	1	2	.	+	+	3	2	+	2	.	.	III
Agrostemma githago	+	.	3	1	1	+	+	+	+	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	2	+	.	.	2	.	+	.	.	.	.	.	+	III
Rapistrum rugosum	.	.	.	.	.	+	+	+	.	+	.	.	.	2	+	+	+	+	.	.	.	.	.	.	.	+	+	.	+	.	+	+	.	.	.	.	.	+	.	.	II
Euphorbia falcata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	+	+	II
Sinapis arvensis	1	.	+	3	+	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	II
Vicia varia	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	2	.	.	.	+	+	.	.	.	.	.	.	+	+	II
Lolium temulentum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+	+	.	.	.	.	.	.	I
Vicia hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
Viola arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Vicia peregrina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	I
Značilne vrste razreda (characteristical species of the class) STELLARIETEA MEDIAE (Br. - Bl. 32) Tx. , Lohm. & Prsg. 50																																									
Anagallis arvensis	1	+	.	.	.	.	2	1	1	.	+	.	+	1	2	1	+	+	.	1	+	.	1	.	.	1	+	1	.	.	1	1	1	+	1	.	.	+	1	1	1	IV
Chenopodium album	.	+	+	.	+	.	.	.	.	+	+	.	.	+	+	+	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	1	.	.	.	.	+	.	+	.	II
Cirsium arvense	+	.	.	.	.	+	.	.	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.	+	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	+	II
Veronica persica	.	.	.	+	.	+	.	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Fumaria officinalis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
Mercurialis annua	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Polygonum persicaria	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Diplotaxis muralis	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Picris echioides	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	I
Anthyrrhinum orontium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lactuca serriola	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Sonchus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Sonchus oleraceus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	I
Stellaria media	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Bromus tectorum	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Conyza canadensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Sorghum halepense	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Euphorbia platyphyllos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Značilne vrste razreda (characteristical species of the class) ARTEMISIETEA VULGARIS Lohm. , Prsg. & Tx. in Tx. 50 em. Görs 66																																										
Polygonum aviculare	.	.	1	.	.	.	.	.	1	.	.	.	+	+	+	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	II
Galium aparine	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	1	.	.	.	2	2	I
Daucus carota	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	.	.	+	I
Pastinaca sativa	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	+	I
Cerinthe minor	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	I
Melilotus officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	I
Reseda lutea	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	I
Picris hieracioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	I
Erigeron annus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	I
Cichorium intybus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Linaria vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Melilotus albus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Spremljevalke (companion species)																																										
Mentha arvensis	.	.	.	.	.	.	.	+	.	2	.	+	1	.	2	+	1	1	.	3	+	+	+	.	.	.	+	.	.	+	+	.	.	.	3	.	.	.	.	.	.	II
Agropyron repens	+	.	.	.	+	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	II
Convolvulus arvensis	.	.	.	.	.	.	.	.	.	+	.	.	+	+	1	1	.	.	.	.	.	.	+	+	+	.	.	.	+	.	+	.	1	.	.	.	.	.	.	1	+	II
Medicago lupulina	.	+	.	.	.	.	.	.	+	.	.	+	+	.	+		1	+	.	.	.	.	.	+	.	.	.	.	+	1	.	.	+	.	.	+	.	.	+	+	+	II
Rumex crispus	+	.	+	+	+	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	+	.	+	.	.	+	II
Medicago sativa	.	.	.	.	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	2	.	.	.	.	+	.	1	.	+	.	.	.	+	.	.	.	.	II
Lolium multiflorum	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Arenaria serpyllifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	I
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Trifolium pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Galeopsis ladanum	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lolium rigidum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Medicago falcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Rubus fruticosus aggr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I
število vrst (No. of spec.)	13	14	19	17	10	13	11	13	14	14	12	11	21	29	31	20	15	19	11	13	9	7	12	17	13	13	12	11	13	15	18	13	17	13	14	16	9	13	15	14	22	87
FR - frekvenčni razred (class of frequency)																																										
I - vrsta prisotna v manj kot 20% popisov (species present in less then 20% of the relevés), II - 20-40%, III - 41-60%, IV - 61-80%, V - 81-100% popisov (releves)																																										

vrsti!). V omenjenih združbah manjkajo nekatere vrste, ki jih najdemo v naših sestojih. Druge združbe temeljijo na dominanci ene ali dveh vrst zveze, prevladujejo pa značilnice reda in razreda (npr. *Kickxietum spuriae* Krusm. & Vlieg. 39, *Lathyro-Melandryetum noctiflori* Oberd. 57, *Papaveri-Melandryetum noctiflori* Nassch. 41 ipd.). O njih poročajo iz Nemčije (Hofmeister & Garve, 1986) in Poljske (Aniol-Kwiatkowska, 1990; Kacki *et al.*, 1999).

Naši sestoji se tudi ne ujemajo z združbami, navedenimi z ozemlja nekdanje Jugoslavije, saj gre za fitogeografsko popolnoma drugo območje z drugimi vrstami. Še najbolj podobna združba je *Consolido-Polygonetum avicularis* Kojić *et al.* 1973 iz Vojvodine, Mačve, Pomoravja, zahodne in srednje Srbije, Kosova in Bosne (Kojić, 1985). Veliko vrst zveze in reda je skupnih, s tem da imajo sestoji iz flišne severozahodne Istre več mediteranskih vrst, ki jih v združbi *Consolido-Polygonetum* ne najdemo. Take so *Scandix pecten-veneris, Legousia hybrida, Adonis flammea* (Sl. 2), *Bupleurum rotundifolium* in *Rapistrum rugosum*. Druge združbe imajo bodisi manj mediteranskih vrst ali pa imajo druge toploljubne (južnoevropske, lahko tudi mediteranske) vrste, ki pa jih v naših sestojih ni.

Razmere v SV Sloveniji – na Štajerskem, v Pomurju in v Prekmurju – so enake srednjeevropskim razmeram v Avstriji, Nemčiji, na Poljskem *ipd.* Gre za pomanjkanje toploljubnih bazifilnih segetalnih vrst ali pa segetalnih vrst sploh. Pogosto so segetalni sestoji razviti v žitih na nekoliko kislih peščenih tleh, ki jih uvrščamo v zvezo *Aperion.* Tam je segetalne združbe preučeval Lešnik (1995, 1997), ki je ugotovil 3 združbe, vendar nobene ni uvrstil v zvezo *Caucalidion.* Seljak (1989) je preučeval plevelno vegetacijo na Goriškem in na Krasu, vendar se segetalne vegetacije ni lotil. Že skoraj zgodovinski so podatki Zalokarja (1939) iz okolice Ljubljane, ki prinaša nekaj segetalnih popisov, vendar ne toploljubnih, pač pa mezofilnih in kisloljubnih.

Problematičen je edino odnos naših sestojev do južneje ležečih mediteranskih združb, predvsem do dveh, ki ju različni avtorji (Horvatić, 1939; Kojić, 1985) navajajo za Dalmacijo, Kvarner in Istro: *Anthemido-Bupleuretum lancifolii* H-ić 34 in *Bunio incrassati-Galietum tricornuti* Br.-Bl. 36. Ti dve združbi, ki ju različni avtorji navajajo ločeno, je Horvatić (1939) interpretiral kot eno združbo, in sicer kot Braun-Blanquetova *Bunio-Galietum,* opisana iz južne Francije. Horvatić piše, da je Braun-Blanquet (1949) Horvatićevo združbo *Anthemido-Bupleuretum* označil le za facies svoje združbe in se tudi sam pridružil temu mnenju. Floristična sestava te združbe z otokov Paga in Raba torej spominja na segetalne sestoje iz Slovenske Istre, saj je precej mediteranskih oziroma submediteranskih vrst skupnih (npr. *Galium tricornutum, Lathyrus aphaca,*

Bifora radians, Euphorbia falcata, Consolida regalis, Ajuga chamaepytis, Vaccaria pyramidalis, Anchusa azurea, Myagrum perfoliatum, Agrostemma githago, Stachys annua, Anthemis arvensis, Rapistrum rugosum, Adonis flammea, Ranunculus arvensis in *Lolium temulentum).* Glavni pečat pa kljub vsemu dajeta tej združbi vrsti *Anthemis cotula* in *Bupleurum lancifolium,* po katerih se združba imenuje in jih v naših popisih iz Slovenske Istre ni. Prav tako manjkajo vrste *Lathyrus ochrus, L. annuus, Lolium strictum, Valerianella echinata, V. dentata, Anthemis brachycentros, A. altissima, Asperula arvensis, Filago spathulata* in še katera. Če pa pogledamo francoske sestoje te združbe iz Languedoca,

Sl. 2: Žareči zajčji mak *(Adonis flammea* ***subsp.*** *cortiana)* ***je bil v zadnji izdaji rdečega seznama Slovenije iz leta 1989 že označen za izumrlo vrsto, a smo ga v Slovenski Istri ponovno našli kot sestavni del novo-opisane segetalne združbe*** *Galio tricornuti-Ranunculetum arvensis.* ***(Foto: M. Kaligarič)***

Fig. 2: *Adonis flammea* ***subsp.*** *cortiana* ***was red data book-listed as extinct in Slovenia in 1989. Eventually it was found as part of the new-described association*** *Galio tricornuti-Ranunculetum arvensis.* ***(Photo: M. Kaligarič)***

pa se še bolj utrdimo v prepričanju, da gre za drugo združbo, saj je v njej še nekaj dodatnih toploljubnih mediteranskih vrst, ki jih pri nas ni. V svoji monografiji pa Ferro (1990) tako popise te združbe iz Francije kot tudi iz Kvarnerja sploh ne uvršča v zvezo *Caucalidion,* pač pa v južnejšo in izrazito mediteransko zvezo *Secalion* Br.-Bl. 36 em. Sissingh 46. Tako moremo trditi, da so naši sestoji pravzaprav na južni meji zveze *Caucalidion,* zveza *Secalion* pa je po svoji floristični sestavi še bolj mediteranska in termofilna, tako da je naši sestoji ne dosegajo.

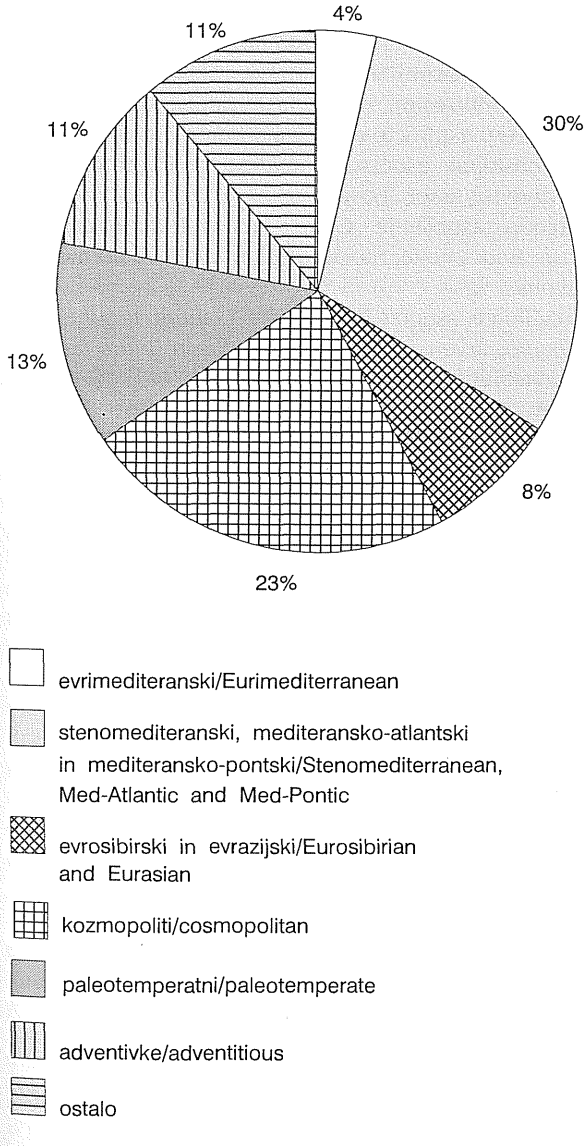
V zadnjem času sta bili opisani dve segetalni združbi iz sicer geografsko bližnje, vendar pa geomorfološko, pedološko in tudi klimatsko precej različne Furlanije (Poldini *et al.,* 1998). Gre za združbo *Galeopsido tetrahit-Galinsogetum* Poldini, Oriolo & Mazzolini 1998 in združbo *Papaveretum apuli* Poldini, Oriolo & Mazzolini 1989. Prva je precej mezofilnejša od istrskih sestojev (vrste iz rodu *Mentha, Galeopsis, Stachys palustris, Galium aparine* namesto *G. tricornutum),* sploh pa je značilna odsotnost vrst zveze *Caucalidion lappulae.* Nekoliko bolj podobna našim segetalnim sestojem je združba *Papaveretum apuli,* katere značilnica je vrsta *Papaver apulum,* ki je v naših sestojih nismo našli. Pojavlja se ponekod v Slovenski Istri na ruderalnih mestih, ne pa med žitom. Prav tako manjkajo številne vrste iz zveze *Caucalidion,* ki pa uspevajo v Istri. V združbi *Papaveretum apuli* najdemo tako od skupnih vrst te zveze le vrste *Ajuga chamaepytis, Ranunculus arvensis, Legousia speculum-veneris, Consolida regalis* in *Chaenorrhinum minus.*

Asociacijo *Galio-Ranunculatum* smo doselj zasledili le na flišu slovenskega in delno hrvaškega dela severozahodne Istre. Vezana je na topla in vlažna ter bazična (ali tu in tam nevtralna do zakisana) tla submediteranskega podnebja v vegetacijskem pasu črnega gabra in puhastega hrasta, torej toploljubne listopadne vegetacije submediteranskega značaja. V južnejših delih Istre, v klimatsko manj namočenih in toplejših predelih na terrarosi tamkajšnjih numulitnih apnencev smo opazovali drugačno segetalno vegetacijo, ki je glede na našo združbo obogatena za 5 - 10 segetalnih vrst mediteranske razširjenosti, vsebuje pa tudi sicer pogosto segetalno vrsto plavico *(Centaurea cyanus).* Tako lahko predvidevamo, da je potencialna razširjenost te asociacije le v smeri sever (Kras, Brkini, Vipavska dolina in Goriško) ali vzhod (notranjost Istre na flišu).

Geoelementi

Kot nam pokaže geoelementna sestava združbe *Galio-Ranunculetum* na sliki 3, je ta pravzaprav razdeljena na tri skupine geoelementov, ki zelo dobro označujejo floristično sestavo segetalne vegetacije Slovenske Istre. Odločilni pečat ji dajejo evrimediteranski in drugi mediteranski (stenomediteranski, mediteransko-

atlantski, mediteransko-pontski) elementi. To so pomembnejše vrste, vrste zveze in reda, ki označujejo to asociacijo. Druga skupina so vrste, ki so ekološko vezane na žitne sinuzije, to so kozmopoliti in adventivke, ki skupaj dosegajo četrtino vrst. Tretja skupina vrst pa sestavlja tiste "obvezne" vrste antropogenih sestojev, ki so ponavadi obilno zastopane, v naših sestojih pa je njihova frekvenca pojavljanja nizka. Tu gre seveda za evrosibirske, evrazijske in paleotemperatne vrste, ki skupaj dosegajo 34% vseh vrst v sestojih te združbe.



Sl. 3: Geoelementna sestava združbe *Galio tricornuti-Ranunculetum arvensis* ***assoc. nova.***
Fig. 3: Geoelemental structure of the association *Galio tricornuti-Ranunculetum arvensis* ***assoc. nova.***

Tako lahko zaključimo, da je združba izrazito mediteransko obarvana, ne manjka pa tudi velik delež elementov zmernega pasu in ekološko vezanih plevelov, ki jih označuje to, da so adventivke ali kozmopoliti.

Ekologija in variabilnost znotraj asociacije

Ekologija segetalne sinuzije je vsaj toliko, kolikor je odvisna od fitogeografskih in klimatskih dejavnikov, odvisna od načina pridelovanja žit. Za srednjo Evropo je značilna drastična sprememba načina pridelovanja pšenice in drugih žit. Majhna, družinska žitna polja skoraj ne obstajajo več, saj pridelovanje moke za kruh ni več vezano na zadovoljevanje potreb ene kmetije (kot je to ostalo v veljavi za večino drugih kultur), temveč so žitne njive danes veliki agrarni kompleksi z mehaniziranim obdelovanjem. Drugačen mehanski postopek je eden glavnih razlogov za odsotnost žitnih plevelov v sodobno obdelovanih žitnih njivah (Kaligarič, 1993). Podobno ugotavlja za Gorce v Zahodnih Karpatih na Poljskem tudi Kornaš (1988), ki primerja stanje v petdesetih, šestdesetih in osemdesetih letih dvajsetega stoletja.

Drugi razlog za odsotnost cele skupine vrst je uporaba hibridnih semen žit, ki ga pridelovalci kupijo vsako leto znova. V preteklosti, pred nekaj desetletji, ko so kmetje uporabljali za setev seme, ki so ga pridelali sami, so se s temi semeni prenašala tudi semena segetalnih plevelov, ki so podobne velikosti kot žitna semena, zato je potekala selekcija teh plevelov tudi na tem nivoju: žitna semena so presejali, s tem pa se niso znebili semen nekaterih najbolj značilnih vrst zveze in reda. Tako so posejali vsako leto znova z žitom tudi spremljajoče plevele. Pomembno pa je dejstvo, da ostaja v sami prsti na parcelah, na katerih so kolobarili z žitom, semenska banka teh plevelov, ki s posejanim žitom tvorijo spremljajočo sinuzijo.

Tretji razlog izginjanja teh plevelov je tudi uporaba kemičnih sredstev proti zatiranju.

Na našem obravnavanem območju v Slovenski Istri govorimo o tipični tradicionalni kulturni krajini. Tu so zaradi izredne razdrobljenosti parcel, razgibanega reliefa in delno še ohranjenega tradicionalnega načina pridelovanja pšenice razmere drugačne. Ta tradicionalni način se kaže v uporabi domačega semena in manjši uporabi herbicidov.

Vsi našteti antropogeni, celo socioekonomski dejavniki imajo najbolj bistven vpliv na pojavljanje segetalne sinuzije na tem območju. Seveda pa k razmeroma obilnemu razvoju in takšni geoelementni sestavi pripomoreta tudi submediteransko podnebje s približno 1000 do 1500 mm padavin letno in geološka podlaga, eocenski fliš z osnovo apnenca, ki reagira bazično. Tu in tam najdemo tudi sestoje, kjer se pojavlja več ruderalnih, včasih tudi nitrofilnih vrst, npr. iz rodu *Chenopodium, Rumex crispus, Convolvolus arvensis* ipd., ali pa npr. vrsta *Equisetum arvense*, kot kazalec akumuliranja vla-

ge, delne acidifikacije oziroma glinenih, manj prepustnih tal. Takšnih sestojev, ki so tudi osiromašeni za bazifilne termofilne segetalne plevele, v glavnem nismo obravnavali v okviru opisovane združbe. V drugi smeri, torej v smeri termofilnosti in bazifilnosti, skoraj ni omejitev za uspevanje vrst zveze in reda; v takem primeru je ekološka situacija le v škodo kulture pšenice same.

Naravovarstveni poudarki

Ker gre za redke vrste in redko združbo tipično antropogenega nastanka, smo v zvezi z varovanjem razmišljali v več smereh. Najbolj realna možnost je ohranjati vzorčne površine tradicionalno gojenih žitnih njiv z vnosom plevelnih vrst v pšenično seme. O tem smo razmišljali po končani akciji kartiranja ogroženih žitnih plevelov (Kaligarič, 1996). Vir semen redkih žitnih plevelov je semenska banka, ki jo vzpostavljamo ločeno, hkrati pa poskrbimo, da semena iz naravnih populacij *"in situ"* razmnožimo in jih razdelimo interesentom (Kaligarič, 1995). Interesenti - pridelovalci pšenice - morajo biti za to seveda ustrezno finančno kompenzirani. Tak način se je za uspešnega izkazal tudi v praksi, in sicer na Dravskem polju na Štajerskem. Razmišljali smo tudi dalje, in sicer, kako bi takšno tradicionalno žitno polje z redkimi pleveli prikazali kot del ekološko zasnovanega botaničnega vrta (Kaligarič, 1998).

ZAKLJUČEK

Vegetacija žitnih plevelov (segetalna vegetacija) je v Evropi, predvsem v njenem srednjem delu in severnem Sredozemlju, sredi procesa drastičnega siromašenja na račun izginjanja značilnih segetalnih arheofitov, predvsem zaradi spremembe mehanske tehnologije pridelovanja žit in uporabe zaščitnih sredstev.

Na območju severozahodne Istre je zaradi specifičnih ugodnih fitogeografskih (rob Mediteranskega bazena) in ekoloških (rodovitna flišna, dovolj bazična podlaga), predvsem pa antropogenih dejavnikov (še ohranjen tradicionalni način pridelovanja žit) segetalna vegetacija specifična, bogato razvita in razmeroma pogosta.

Glede na specifično floristično sestavo, ki je nekje med mediteranskimi in topoljubnimi bazifilnimi srednjeevropskimi sestoji, smo naše popise iz severozahodne Istre uvrstili v zvezo *Caucalidion* Tx. 50, in sicer kot samostojno asociacijo *Galio tricornuti-Ranunculetum arvensis* assoc. nova.

Holotip asociacije *Galio tricornuti-Ranunculetum arvensis* assoc. nova, fitocenološka tabela 1, popis št. 3, holotypus.

Značilnice asociacije so vrste *Galium tricornutum, Ranunculus arvensis, Consolida regalis* in *Bifora radians.* Delež vrst zveze in reda je v novi asociaciji dobro zastopan.

Ugotavljamo, da se tehnologija pridelovanja žit tudi v Istri spreminja oziroma žito kot kultura izginja. V ta namen načrtujemo naravovarstvene ukrepe, kot so vzpostavitev semenske banke ogroženih segetalnih plevelov, reintrodukcija in gojenje v botaničnem vrtu.

A NEW SEGETAL ASSOCIATION (ALLIANCE *CAUCALIDION LAPPULAE* TX. 50) FROM THE NORTHWESTERN PART OF ISTRA (SLOVENIA)

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SUMMARY

A new segetal association from northwestern Istra is described. Due to the specifically favourable phytogeographic (edge of the Mediterranean Basin) and ecological (fertile flysch, basic enough substratum) conditions and especially owing to the anthropogenous factors (still preserved traditional manner of growing varieties of grain), the segetal vegetation in this area is specific, richly developed and relatively common. In view of the specific floristic structure, which places our relevés somewhere between pure Mediterranean and Central European conditions, our relevés from northwestern Istra were classified into the termophilous and basiphilous alliance Caucalidion *Tx. 50,* i.e. *as an independent new association* Galio tricornuti-Ranunculetum arvensis *assoc.*

nova. Holotypus of the association Galio tricornuti-Ranunculetum arvensis *assoc. nova is in phytoassociation Table 1, relevé No. 3. The typical representative of the new-described association are species* Galium tricornutum, Ranunculus arvensis, Consolida regalis and Bifora radians. *The share of species of the alliance and order is well represented in the new association, for no less than 17 species of the alliance and 14 species of order* Centauretalia cyani *were found. Considering that these species are in rapid decline in Central Europe and in North Mediterranean, actually on the verge of extinction, it is obvious that their frequency in the relevés is relatively low, since we are dealing with botanical rarities* (e.g. Vaccaria pyramidalis, Adonis flammea, Bupleurum rotundifolium, Myagrum perfoliatum, Lolium temulentum, Vicia peregrina, *etc.). The geoelemental structure indicates that a good third covers the species of the Mediterranean origin, that a third belongs to the Eurosiberian and paleotemperate geoelement, and that the remaining third goes to cosmopolitans, adventives and other species. It has been established that in Istra, too, the technology of cereal growing has changed and that grain as an arable crop is disappearing. Thus some nature conservation measures are proposed. Mapping of rare cereal weeds was carried out, and we began to collect a seed-bank of endangered species. Also planned and partially already implemented is the project to reintroduce some rare segetal weeds in cereal fields, i.e. in places where these weeds are rare or already extinct. Growing of weeds in cornfields within the framework of ecologically conceived botanical gardens is also planned.*

Key words: segetal vegetation, cereal weeds, *Caucalidion lappulae, Centauretalia cyani, Galio tricornuti-Ranunculetum arvensis,* Istra, Slovenia

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ALI JE *RUPPIA CIRRHOSA* (PETAGNA) GRANDE EDINI SLOVENSKI PREDSTAVNIK TEGA RODU?

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IZVLEČEK

Prispevek obravnava problematiko rodu rupij (Ruppia) *v Sloveniji. Izkazalo se je, da je na slovenski obali razširjena le vrsta* Ruppia cirrhosa, *za katero so avtorji druge polovice 20. stoletja uporabljali napačno ime* R. maritima, *medtem ko prava* R. maritima *na območju Slovenije še ni bila najdena, vendar njeno pojavljanje tod ni izključeno.*

Ključne besede: *Ruppia cirrhosa, Ruppia maritima,* ključ za določevanje, Slovenija

RUPPIA CIRRHOSA (PETAGNA) GRANDE È VERAMENTE L'UNICO RAPPRESENTANTE DI QUESTO GENERE IN SLOVENIA?

SINTESI

L'articolo tratta il problema della presenza del genere Ruppia *in territorio sloveno. Dopo un'accurata revisione di materiale d'erbario e di materiale fresco è stata confermata la presenza di un'unica specie, ossia* Ruppia cirrhosa, *erroneamente chiamata* R. maritima *dagli autori sloveni nella seconda metà del ventesimo secolo. Il fatto che la "vera"* R. maritima *non sia stata ancora trovata in territorio sloveno, non esclude la possibilità di un suo ritrovamento nell'area presa in considerazione.*

Parole chiave: *Ruppia cirrhosa, Ruppia maritima,* chiave per la determinazione, Slovenia

UVOD

Rupija *(Ruppia)* je rod, na katerega v Sloveniji ne naletimo ravno vsak dan, saj njegovi predstavniki uspevajo le v obmorskih predelih, kjer pa se v plitvih bazenih in jarkih s somornico lahko pojavljajo kar množično. Celinski botaniki zatorej to rastlino - zaradi razmeroma redkih srečanj z njo - kar pridno nabiramo in tako sem pred kakima dvema letoma med nabiranjem materiala v Strunjanu postal pozoren na dolge, spiralasto ukrivljene plodne peclje, za katere sem vedel, da so značilni za vrsto *R. cirrhosa*, ki dotedaj za Slovenijo še ni bila navedena (Sl. 1).

RAZLIKOVANJE VRST V RODU *RUPPIA*

S pomočjo različne tuje določevalne literature (Casper & Krausch, 1980; Dandy, 1980; Sell & Murrell, 1996) sem nabrani material kasneje lahko tudi nedvomno določil za *R. cirrhosa*, ko pa sem želel material primerjati tudi s herbarijskim materialom iz svojega lastnega herbarija in iz herbarija Ljubljanske univerze (LJU), sem presenečeno ugotovil, da v resnici ves na ozemlju Slovenije nabrani material pripada "novoodkriti" vrsti *R. cirrhosa* - polžasti rupiji. Poglejmo si, kakšne so razlike med obema omenjenima vrstama (ključ je sestavljen na podlagi omenjenih del in preizkušen ter modificiran med revizijo herbarijskega materiala):

1 Listi okoli 0,5 mm široki, večinoma koničasti ali z nepravilno nazobčanim vrhom, listne nožnice niso napihnjene, cvetenje protogino (?), pod vodo, oprašitev večinoma avtogamna, cvetni klas 1-2 mm dolg, prašnice 0,5-1 mm dolge, pelodna zrna okoli 60 µm dolga, pecelj socvetja ob zrelosti plodov nikoli polžasto zvit, (0,5) 1-3 (5) cm dolg, največ dvakrat daljši od najdaljših pecljev plodov, plodovi 2-2,8 mm dolgi, zelo asimetrični, skorajda polmesečasti, zoženi v okoli 0,5 mm dolg kljunec, 2n=20 (40?); tudi v somornici, na bolj blatnih tleh.

R. maritima L.

— Listi 0,5-1 mm široki, večinoma z zaokroženim do prisekanim ± pravilno drobno nazobčanim vrhom, cvetenje protandrično, nad vodo, oprašitev alogamna, cvetni klas 3-4 mm dolg, prašnice 1-2 mm dolge, pelodna zrna okoli 80 µm dolga, pecelj socvetja ob zrelosti plodov večinoma razločno polžasto zvit, 4-30 (70) cm dolg, mnogokrat daljši od pecljev plodov, plodovi 2,7-3,4 mm dolgi, približno simetrični, jajčasti, zoženi v 0,5-1 mm dolg kljunec; 2n=40 (60?); dobro prenaša visoke koncentracije soli, uspeva lahko v globlji vodi kot druga vrsta; na bolj peščenih tleh.

R. cirrhosa (Petagna) Grande

Sl. 1/Fig. 1: *Ruppia cirrhosa* ***(Petagna) Grande.***

IN KAKO JE PRIŠLO DO TE NENAVADNE SITUACIJE V SLOVENSKI FLORISTIČNI VEDNOSTI?

Obmorsko rupijo (*R. maritima* L. =*R. rostellata* Koch, =*R. maritima* var. *rostrata* Agardh.) navaja Hayek (1933) za Kvarner, iz neposredne soseščine Slovenije pa je znanih nekaj navedb s Tržaške obale (Marchesetti, 1896-97, sub *R. rostellata!),* kjer naj bi bila tudi edina vrsta tega rodu z nedavno potrjenim uspevanjem (Poldini, 1991). Na podlagi Pospichalove navedbe (Pospichal, 1897) o uspevanju pri Devinu jo ima Mayer (1952) navedeno tudi za slovensko (etnično!) ozemlje pod imenom *R. maritima* var. *rostrata.* Očitno se kasnejši avtorji, ki so obravnavali pojavljanje tega rodu na območju Slovenije, s problematiko varietet, ki jih omenja še Mayer, niso ubadali, in tako se od prve izdaje Male flore Slovenije dalje (Ravnik, 1969) navaja za Slovenijo preprosto *"R. maritima L.".* Že omenjena revizija herbarijskega materiala v herbariju LJU in avtorjevem herbariju ter terensko delo v zadnjih nekaj letih pa sta pokazala, da za zdaj ta vrsta (pojmovana v ožjem smislu) na ozemlju današnje Slovenije še ni bila najdena. Glede na njeno sicersnjo razširjenost pa jo lahko pričakujemo tudi na slovenski obali, kjer bi morali biti pozorni predvsem na brakične vode ob izlivih rek in potokov ter v jezeru v Fiesi.

Starejši viri, ki razlikujejo med obema taksonoma rupije, navajajo z jadranske obale tudi več rastišč polžaste rupije *(R. cirrhosa* (Petagna) Grande, = *R. maritima* auct., non L., = *R. spiralis* L. ex. Dum.), za območje današnje Slovenije pa Pospichal *(ibid.)* sploh navaja izključno ta takson, ki ga sicer imenuje *R. maritima,* a iz omembe druge vrste pod imenom *R. rostellata* in iz opisa *("...peduncoli fruttiferi molto lunghi ravvolti a spira alla base...", ibid.:* 516) je jasno, da je imel v mislih polžasto rupijo. Marchesetti (1896-97) vrst ne razlikuje. Tudi revizija herbarijskega materiala, nabranega v Sečoveljskih in Strunjanskih solinah ter v opuščenih solinah v Luciji, je v vseh primerih potrdila, da gre pri nas le za pojavljanje polžaste rupije.

Površen odnos slovenskih botanikov druge polovice dvajsetega stoletja do rupije, na katerega sem opozoril že v komentarju k prvi obravnavani vrsti, je opazen v več floristicnih delih. Površno in celo napačno je ta rod predstavljen v prvih dveh izdajah Male flore Slovenije (Ravnik, 1969, 1984). Tu je rupija obravnavana kot "sladkovodna rastlina", ki raste v "stoječih vodah in mlakah", steblo naj bi imela "10 do 15 cm visoko" in "plodove oble"; ti so predstavljeni s sliko, ki pa niti približno ni podobna rupiji v fazi zrelosti plodov. Žal je obravnava tega rodu tudi v tretji izdaji Male flore Slovenije (Turk, 1999) skorajda dobesedno povzeta, le slika je nadomeščena z novo, ki je v resnici podobna plodeči obmorski rupiji. Tudi Wraber & Skoberne (1989) in kasneje Kaligarič (1990), ki so se ukvarjali z naravovarstveno problematiko rupije, niso opazili, da se pri nas pojavlja pravzaprav polžasta rupija in ne obmorska, kot navajajo.

IS *RUPPIA CIRRHOSA* (PETAGNA) GRANDE THE ONLY SLOVENE REPRESENTATIVE OF THE GENUS?

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SUMMARY

The paper deals with the problem of occurrence of the genus Ruppia *in the territory of Slovenia. After the revision of herbarium material and field sampling, the occurrence of* R. cirrhosa *has only been confirmed, for which the name* R. maritima *was misapplied by Slovene authors of the 2nd half of the 20th century. Despite the fact that the "real"* R. maritima *has not been recorded in the discussed territory as yet, its occurrence here is not improbable.*

Key words: *Ruppia cirrhosa, Ruppia maritima,* key for determination, Slovenia

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MISCELLANEA

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NUMULITI IZ APNENČEVEGA TURBIDITA PRI FIESI (SLOVENIJA)

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IZVLEČEK

Pri Fiesi nedaleč od Pirana ob slovenski obali so v delu srednjelutecijskega apnenčevega turbidita številni numuliti. Večina pripada vrsti Nummulites millecaput, *nekateri so tej vrsti podobni in bi jih ob boljšem materialu kazalo opisati kot novo vrsto ali podvrsto. Podane so pripombe k opisom numulitov iz različnih dežel.*

Ključne besede: foraminifere, fliš, eocen, Slovenija

NUMMULITI NELLA TORBIDITE CALCAREA DI FIESSO (SLOVENIA)

SINTESI

Nella torbidite calcarea medio-eocenica della località di Fiesso, situata sulla costa slovena, sono stati trovati numerosi nummuliti. La maggioranza di questi appartiene alla specie Nummulites millecaput. *L'autore suppone che, avendo a disposizione materiale migliore, altri esemplari assomiglianti a tale specie potrebbero venir descritti come nuova specie o sottospecie. Nell'articolo vengono commentate le descrizioni di nummuliti provenienti da varie nazioni.*

Parole chiave: foraminiferi, flysch, eocene, Slovenia

UVOD

V slovenskem delu Dinaridov je zelo veliko numulitin tako v apnencih kot v flišnih plasteh. Nekatera nahajališča so posebej zanimiva predvsem zaradi načina nastajanja. Eno takšnih je tudi ob jadranski obali pri Fiesi blizu Pirana (Sl. 1). V spodnjem delu apnenčevega turbidita je izredno veliko numulitov (Sl. 2) in mnogo manj drugih fosilov. Ta plast se vleče od Pirana mimo Fiese proti Strunjanu ter naprej proti Izoli, kjer množina numulitov pojenjuje. Preučevali smo numulite v tej plasti in skušali razložiti, zakaj je samo v enem horizontu toliko te favne.

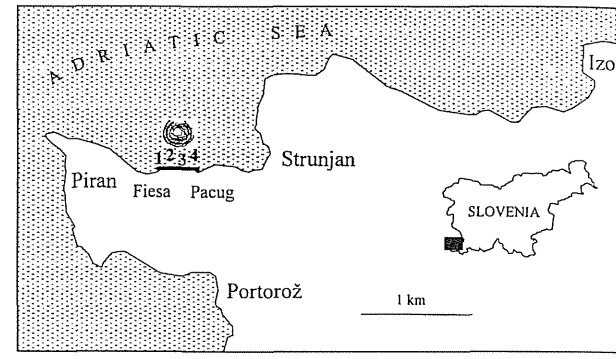
FIESA

Apnenčev turbidit je dobro viden med Fieso, Strunjanom in Izolo. Zlasti v spodnjem delu je poln numulitov. Prevladujejo megalosferične oblike vrste *Nummulites millecaput* Boubée (Pavlovec, 1963, 1969). Drugi numuliti so redki. V kamricah je pogosto limonit. Horizont z numuliti je skoraj monospecifičen. Poleg numulitov je največ diskociklin, redke so asiline, precej je drobcev litotamnij, nekaj je dentalijev, še redkeje je opaziti bodice morskih ježkov in drobce nekaterih drugih nedoločljivih fosilov.

V spodnjih 10-15 cm apnenčevega turbidita so številne dobro ohranjene hišice numulitov. Ponekod je večina hišic položena glede na potek plasti pod kotom 45°, drugod so hišice skoraj vzporedne s plastmi. Nad tem horizontom se dokaj hitro začenja 10-15 cm debel horizont, v katerem je polno bolj ali manj zdrobljenih ali skoraj zmletih manjših delcev numulitnih hišic. Vse to kaže na rahlo razporejanje delcev po velikosti med sedimentacijo. Navzgor postaja sediment še bolj drobnozrnat, menjavajo se apnenčevi deli s tankimi peščenimi vložki. Sedimentološko in paleontološko sta obravnavani fliš preučevala predvsem s pomočjo nanoplanktona Pavšič in Peckmann (1996). Horizont s številnimi numuliti ("lower limestone turbidite") sta postavila v srednji eocen blizu sredine biocone NP 16 (str. 126).

Tolikšna množica numulitnih hišic kaže na prenašanje s tokovi ali manjšimi plazovi. Material je prihajal iz tistega dela karbonatne platforme, kjer je bilo polno predstavnikov vrste *Nummulites millecaput* in je bilo morda od tam večje nanašanje s platforme samo v nekaterih obdobjih (Pavlovec, 1982). Ugotovljeno je tudi bilo, da kažejo tokovnice v turbiditnem delu fliša pri Fiesi drugo smer kot orientacija večine numulitnih hišic (Pavlovec, 1969). To pomeni, da je kamninski material prihajal od drugod kot numulitne hišice. Brez dvoma je bilo na platformi še veliko drugih organizmov, ki jih je v flišnih plasteh pri Fiesi malo.

Bogata nahajališča z *Nummulites millecaput* in drugimi numulitinami, rdečimi algami, koralami, morskimi ježki, školjkami, polži in še drugimi fosili so pri Gračišću med Pazinom in Pićnom pa tudi drugod v Istri. Nahajališče pri Gračišću uvrščajo v mlajši del lutecija (Hagn *et al.*, 1979). V teh nahajališčih je veliko A in B oblik, hišice imajo pogoste anomalije (Pavlovec, 1976b).



Sl. 1: Položaj nahajališč pri Fiesi ob slovenski obali.
Fig.1: Localities at Fiesa on the Slovenian coast.

Numuliti iz Fiese

Iz apnenčevega turbidita pri Fiesi je bilo pregledano večje število numulitnih hišic megalosferične generacije (Tab. 1). Nabrane so bile v naslednjih nahajališčih:

Fiesa 1: ob obali blizu Fiese
Fiesa 2: ob obali med Fieso in Pacugom, okrog 300 m pred Pacugom
Fiesa 3: ob obali med Fieso in Pacugom, okrog 200 m pred Pacugom
Fiesa 4: ob obali okrog 100 m od Pacuga proti Strunjanu

Pri številčnih podatkih v spodnji tabeli so uporabljene naslednje oznake:

Dm = premer hišice v milimetrih / the test diameter in mm
R = polmer hišice v milimetrih / the test radius in mm
W = število zavojev / whorl number
M = premer melagosfere v milimetrih / protoconch in mm
S1, S2, S3, S4 = število sept v prvem, drugem, tretjem in četrtem zavoju / number of septa in the first, second, third and forth whorl

Tab. 1: Številčni podatki za vrsto *Nummulites millecaput,* ***oblika A.***
Tab. 1: Numeric data for species *Nummulites millecaput,* ***form A.***

	Dm	R	W	M	S1	S2	S3	S4
Fiesa 1	3,5-5	1,8-2,4	3,1-4,5	0,55-0,95	7-12	13-19	18-36	22-36
Fiesa 2	3,7-5,2	1,9-2,6	3-5	0,5-0,9	6-13	12-24	16-35	22-40
Fiesa 3	3,5-4,9	1,7-2,4	3-4,3	0,37-0,92	7-15	14-23	20-33	26-39
Fiesa 4	3,3-6,2	1,6-3,1	3-5	0,32-1,17	8-12	14-21	20-33	26-39
Gračišće	3,3-4,9	1,6-3,3	3-4,9	0,67-0,9	7-11	13-18	18-24	21-31

Po zgoraj navedenih podatkih pripadajo numuliti iz Fiese vrsti *Nummulites millecaput* (Tab. 1, Sl. 1-7). Vmes je nekaj primerkov, ki povsem ne ustrezajo tej vrsti (= *Nummulites* aff. *millecaput;* Tab. 1, Sl. 8-9). Njihov protokonh je manjši in variira od 0,4 do 0,47 mm. Še večja je razlika pri septah. Tipičen *Nummulites millecaput* ima srpasta in pogosto valovita septa, zato so tudi nekoliko daljše kamrice. Tej vrsti podobne oblike iz Fiese imajo krajše kamrice in gostejša septa, ki so velikokrat enakomerno usločena po vsej dolžini. Zavojni rob je tanjši in zavoji so nekoliko višji kot pri tipičnem *Nummulites millecaput.* Obliki *Nummulites* aff. *millecaput* (Schaub, 1981, Tab. 68) je zelo podoben tudi opisani numulit iz Fiese (Pavlovec, 1963, Sl. 21). Podatki za vrsti *Nummulites millecaput* podobno obliko so na tabeli 2. Primerki iz Fiese imajo nekaj anomalij tako pri *Nummulites millecaput* kot pri *Nummulites* aff. *millecaput.* Pogosta je različna debelina zavojnega roba, septa so nepravilno ukrivljena ali lomljena, redko so razcepljena.

Tab. 2: Podatki za** Nummulites **aff.** millecaput, **oblika A iz Fiese.
Tab.2: Data for** Nummulites **aff.** millecaput, **form A from Fiesa.

Dm	R	W	M	S1	S2	S3	S4
3,9-5,5	2-2,8	3-4,5	0,4-0,47	7-10	15-23	21-33	24-44

Stratigrafski podatki

Sorodne lutecijske oblike pripadajo naslednjim stratigrafskim horizontom:

Nummulites polygyratus Deshayes - zgornji cuisij, deloma še najstarejši lutecij (Gidai, 1971; Blondeau, 1972; Schaub, 1981; Pavlovec, 1982)

Nummulites alponensis Schaub - spodnji lutecij in spodnji del srednjega lutecija (Schaub, 1981)

Nummulites millecaput Boubée - srednji lutecij (Schaub, 1981)

Nummulites aff. *millecaput* - spodnji lutecij in najbrž še spodnji del srednjega lutecija (Schaub, 1981, Tab. 68)

Nummulites maximus D'Archiac - zgornji lutecij (Schaub, 1981)

Nummulites dufrenoyi D'Archiac & Haime - zgornji lutecij in bartonij (= "biarritzij"; Schaub, 1981).

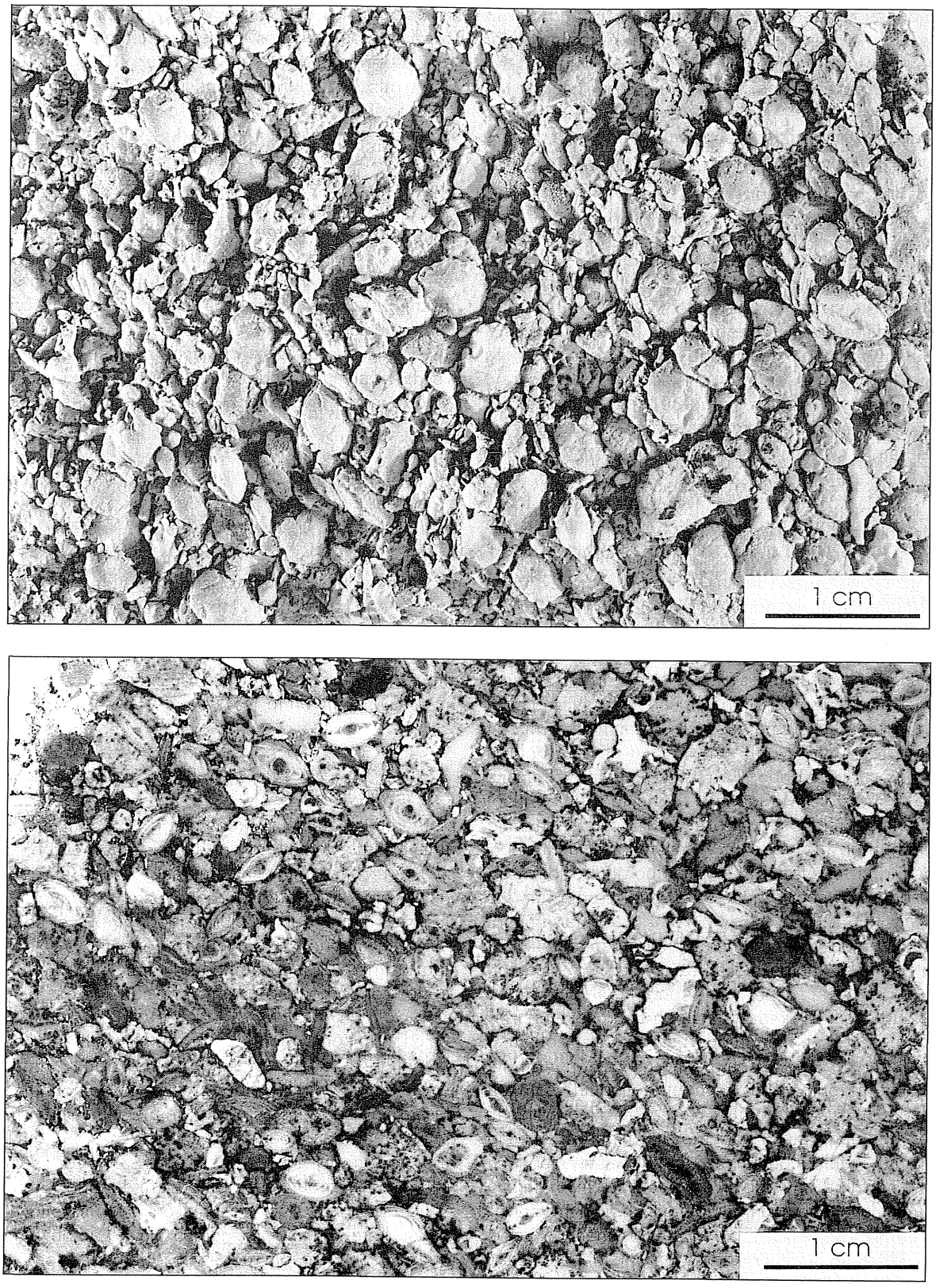
Skupina avtorjev (Serra-Kiel *et al.,* 1998) postavlja *N. millecaput* v "shallow benthic zone 15", kar je mlajši del srednjega lutecija (srednji lutecij 2), oziroma spodnja polovica NP 16 in P 12.

Pri Miletićih v severni Dalmaciji je *N. millecaput* najden v apnencih iz spodnjega in srednjega dela srednjega lutecija (Pavlovec, 1993). Zelo veliko teh numulitov je pod plastmi s številnimi predstavniki podvrste *Assilina spira planospira* Boubée, medtem ko jih je skupaj s to asilino bolj malo (Pavlovec, 1987).

Za vrsto *Nummulites polygyratus* smo tudi v Dinaridih ugotovili, da je živela še v začetku spodnjega lutecija. Pri Gračišču nedaleč od Kubeda so nad alveolinsko-numulitnim apnencem laporne in še više nekoliko peščene plasti z glavkonitom. Navzgor slede sivi do rjavi trdi laporji, še više mehkejši laporji, nad njimi je fliš. V nekaterih horizontih alveolinsko-numulitnega apnenca zahodno od ceste Gračišče - Buzet je veliko operkulin, med katerimi prevladuje spodnjelutecijska vrsta *Assilina praespira* (Douvillé). Peščeno laporne plasti vključujejo rakovice. Severno od Gračišča je bila najdena podvrsta *Harpactocarcinus punctulatus istriensis* Bachmayer & Nosan (Bachmayer & Nosan, 1959). Avtorja sicer pravita, da ni jasno, kateremu delu lutecija pripadajo plasti z rakovicami. V geološkem zemljevidu in komentarju (Pleničar *et al.,* 1973) prištevajo plasti z rakovicami spodnjemu luteciju. V teh plasteh je tudi *N. polygyratus.* Ker so pod plastmi z rakovicami apnenci s spodnjelutecijsko favno *(Assilina praespira,* alveoline in drugo; Pavlovec & Pavšič, 1987; Drobne, 1977), je jasno, da je *N. polygyratus* živel še v spodnjem luteciju, kjer pa se že lahko sreča z majhnimi predstavniki, podobnimi vrsti *N. millecaput.*

Nummulites millecaput je bil najden tudi v Krappfeldu v Avstriji (von Hillebrandt, 1993), kjer ga zaradi nekoliko manjših velikosti postavljajo v starejši del srednjega lutecija.

Rozlozsnik (1929) je napisal, da o široko razširjeni vrsti *Nummulites millecaput* vemo še zelo malo *("herzlich wenig bekannt ist").* Gidai (1971) je poročal o tej vrsti z Madžarske, Schaub (1981) je v diskusiji opozoril, da pod vrsto *Nummulites "millecaput"* združujejo različne oblike, med njimi bolj ali manj sploščene, večje in manjše. Med drugim je bila opisana oblika *Nummulites verconensis* De la Harpe, ki je manjša od tipičnega *N. millecaput.* Novejša dognanja o filogenetskem nizu od zgornjecuisijskega in spodnjelutecijskega *Nummulites polygyratus,* prek srednjelutecijskega *N. millecaput* do *N. maximus,* ki sega do meje lutecij - bartonij (cona z *N. aturicus* Joly & Leymerie) so prinesla veliko novega. Vendar še niso dovolj razčiščeni taksonomski znaki, po katerih je mogoče ločiti podobne in sorodne oblike, deloma tudi zaradi variacijskih širin posameznih elementov hišic. Zato še vedno nastajajo nepravilnosti in nejasnosti v determinaciji vrst. Že samo pri nagnjenosti sept so velike podobnosti. *Nummulites alponensis* ima v notranjih zavojih večinoma manj nagnjena septa kot *N. millecaput.* Prav tako ima manj nagnjena septa tudi *Nummulites polygyratus.* Prepletajoče številčne podatke vidimo tudi v tabeli 3.



Sl. 2: Številni numuliti v apnenčevem turbiditu pri Fiesi.
Fig. 2: Numerous nummulites in calcareous turbidite at Fiesa.

Tab. 3: Primerjava podatkov za nekatere sorodne oblike (po Schaub, 1981).
Tab.3: Comparison of data for some related forms (after Schaub, 1981).

Nummulites oblika A / form A	premer v mm / diameter in mm	protokonh / protoconch	zavoj/polmer / whorls/radius		
millecaput	4-8	0,8-1,2	4/2,7	6/3,2-3,8	
alponensis	5-7	0,4-0,8	4/2,5-2,75	5/3,1	6/3,1-3,4
polygyratus	4-8	0,6-1,1	3/2,2-3	4/2,7-3,3	
distans	3-5	0,6-0,7	3/1,8-2,8		

PRIPOMBE K PODATKOM V LITERATURI

Srednja in Zahodna Evropa

Vialli (1951, Tab. 5, Sl. 19) ugotavlja vrsto *Nummulites millecaput* pri Padernu v severni Italiji v srednjem in zgornjem luteciju. Čeprav slika ni najboljša, je mogoče to vrsto prepoznati po velikem protokonhu, majhnem devterokonhu in močno srpastih septah. V okolici Rovereta v Italiji je *Nummulites millecaput* v zgornjem luteciju (Castellarin, 1962). V okolici Modene v Apeninih je ta numulit pogost v srednjem luteciju (Sirotti, 1966), vendar primerki niso posebno veliki in je vprašanje, če res pripadajo omenjeni vrsti. Do 70 mm velike mikrosferične primerke iz okolice Loretta v Italiji omenja Blondeau (1968). Arni in Lanterno (1976) uvrščata plasti z *Nummulites millecaput* iz Gargana v Italiji v zgornji del srednjega eocena in so pod plastmi z *N. meneghinii* D'Archiac & Haime, ki je živel v zgornjem luteciju.

V francosko italijanskih Alpah je *Nummulites millecaput* v srednjem delu zgornjelutecijske cone z *Asilina exponens* (Sowerby) (Blondeau, 1968, Tab. 3). Drugi francoski avtorji (Bodelle *et al.*, 1968; Blondeau *et al.*, 1968) so ugotovili vrsto *Nummulites millecaput* v najmlajšem luteciju skupaj z *N. brongniarti* D'Archiac & Haime, *N. perforatus* (De Montfort), *N. striatus* (Bruguière), *N. praefabianii* (Varentsov & Menner), *Assilina exponens* (Sowerby) in *Orbitolites complanatus* Lamarck. Ni verjetno, da bi vse te vrste res živele skupaj.

Gómez Llueca (1929) opisuje obe generaciji vrste *Nummulites millecaput.* Deloma determinacijam ni oporekati (Pavlovec, 1963), vendar se zdi, da so nekateri po višini zavojev in debelini zavojnega roba bliže *Nummulites polygyratus,* drugi morda celo *N. maximus.*

Najzaneslivejše in v mnogih profilih preverjene podatke je dal Schaub (1981). Tipičen *Nummulites millecaput* je živel v srednjem luteciju, medtem ko nastopa v spodnjem in deloma srednjem luteciju manjša oblika *N.* cf. *millecaput* (Hottinger *et al.*, 1956, 1964). Ti manjši primerki verjetno pripadajo novi vrsti *Nummulites alponensis,* ki jo je postavil Schaub leta 1981, čeprav omenja v tem delu tudi spodnjelutecijskega predhodnika vrste *N. millecaput* (= *N.* aff. *millecaput).* V monografiji prikazuje Schaub (1981) razvoj lutecijskih oblik od *Nummulites distans Deshayes,* preko *N. polygyratus, N. millecaput* do *N. maximus.* Po našem mnenju (Pavlovec, 1982, 1987) ta razvoj ni šel direktno, ampak je od izhodne oblike *Nummulites distans* ena linija potekala v smeri *N. polygyratus - N. maximus,* druga pa *N. alponensis - N. millecaput.* Vsekakor je potekal skozi lutecij razvoj teh sorodnih oblik, med katerimi so večkrat zelo majhne razlike in je ločitev težka. Razvoj se je končal z *Nummulites maximus,* ki je največji numulit sploh. Južnovzhodno od Irakliona na Kreti smo blizu mlina na veter severno od vasi Kalo Chorio nedaleč od južne obale Merabelskega zaliva našli najmanj 19 cm velik primerek. Odkril ga je grški geolog Apostolos Alexopoulos. Žal je bilo v apnencu videti samo aksialni presek, ki morda ni potekal skozi sredino in bi v tem primeru bila hišica še nekoliko večja. Že po velikosti ga lahko uvrščamo v *Nummulites maximus.*

V monografiji navaja Schaub (1981) holotip vrste *Nummulites millecaput* v zgornjem delu srednjega lutecija skupaj z *Nummulites crassus* Boubée, *N. lorioli* De la Harpe in *Assilina spira planospira.*

Dinaridi

Iz Furlanije omenja Dainelli (1915) redke mikrosferične oblike vrste *Nummulites millecaput.* Vendar glede na starost tamkajšnjih plasti te oblike ni pričakovati. Morda je Dainelli našel majhne spodnjelutecijske predstavnike, ki so vrsti *Nummulites millecaput* podobni, morda so to *N. polygyratus* ali *N. distans.*

V Dinaridih je vrsti *Nummulites millecaput* nekaj podobnih oblik. Zamenjavali so jih tudi z vrsto *Nummulites polygyratus,* ki je bila iz Istre prvič omenjena razmeroma pozno (cf. Pavlovec, 1976a). Med drugim jo omenja Regè (1928) iz fliša in breč pri Labinu, Pićnu, Roču, Pazinu, Buzetu, Trstu in drugod. Pravi, da je tam pogosta. Zelo verjetno ne pripadajo vsi primerki tej vrsti. V coni z *Nummulites laevigatus* Bruguière so v severni in srednji Istri majhni numuliti, podobni vrsti *N. millecaput* (= *N.* aff. *millecaput),* ki nekoliko spominjajo tudi na *N. polygyratus,* so pa v coni z *N. uranensis* De la Harpe (Pavlovec, 1976a; Mikuž & Pavlovec, 1995). Problem teh sorodnih oblik iz Istre ni zadovoljivo rešen.

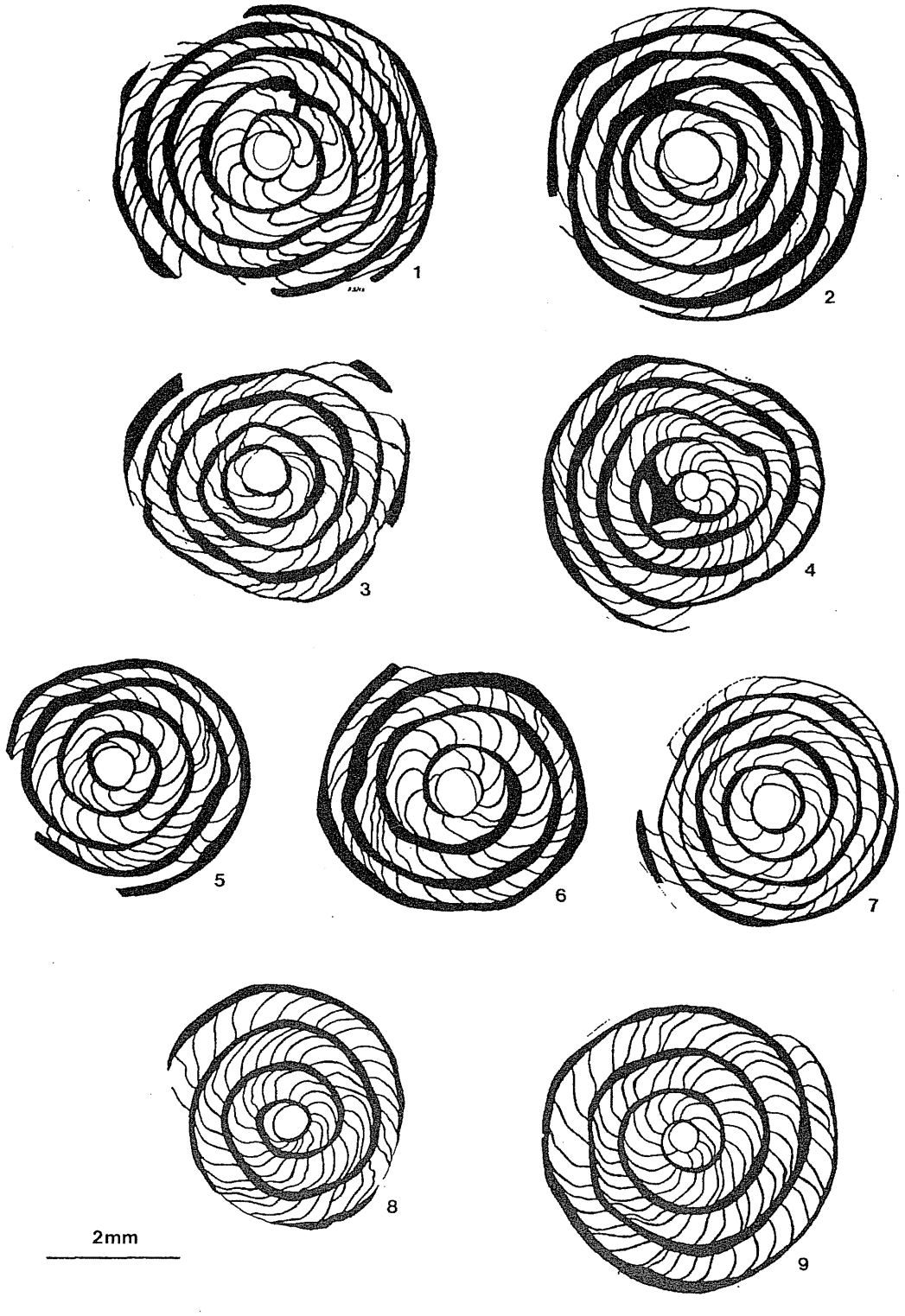


TABLA 1/PLATE 1:
Ekvatorialni prerezi megalosferičnih oblik numulitov iz Fiese.
Equatorial sections of megalospheric forms of nummulites from Fiesa.
Sl. 1-7/Figs. 1-7: *Nummulites millecaput* ***Boubée.***
Sl. 8-9/Figs. 8-9: *Nummulites* ***aff.*** *millecaput* ***Boubée.***

Podobno je tudi v Dalmaciji, kjer so prav tako v spodnjem luteciju majhni, v srednjem pa veliki numuliti iz te skupine.

Tudi starost alveolinsko-numulitnih apnencev v Sloveniji kaže, da je pravi *Nummulites millecaput* lahko samo tam, kjer so apnenci srednjelutecijski. Pod temi plastmi so spodnjelutecijski apnenci z *Nummulites laevigatus, Assilina praespira, Ass. spira abrardi* Schaub in drugimi numulitinami. Tudi Drobne (1977) je na podlagi alveolin ugotovila, da se fliš v južnozahodni Sloveniji začne že v spodnjem luteciju ali še prej, v srednji Istri pa v srednjem luteciju. Zato tipičnih predstavnikov *Nummulites millecaput* v delih južnozahodne Slovenije zunaj Istre ne moremo pričakovati.

Petrović in Živković (1960) omenjata *Nummulites millecaput* iz srednjeeocenskega fliša 500 m vzhodno od Buj v Istri. Skupaj s to vrsto navajata *Nummulites laevigatus* in *N. aturicus,* ki pa je zgornjelutecijski. Vsaj zadnja vrsta je zanesljivo napačno določena.

Madžarska

V Transdanubiji je *Nummulites millecaput* v mlajšem delu srednjega eocena pod plastmi z glavkonitom, nad katerimi je zgornjeeocenski *N. fabianii* (Prever). Med srednjim in zgornjim eocenom je diskordanca (Nagy *et al.,* 1968). Enako starost pripisuje vrsti *Nummulites millecaput* Gidai (1971). Vendar starost te vrste v Transdanubiji ni povsem jasna. V vrtini Dudar (Kecskeméti, 1974) je *Nummulites millecaput* nad plastmi z *N. perforatus,* obe vrsti pa so našli tudi skupaj. Vprašanje je, ali gre za presedimentirane numulite ali za netočno določene. E. Köhler (1967) celo trdi, da ločitev na coni z *Nummulites millecaput* in *N. perforatus* ni mogoča, ker sta v Karpatih obe vrsti skupaj.

V Bakonjskem gozdu sta v apnencu *Nummulites millecaput* in Assilina spira (De Roissy), nad temi horizonti je apnenec z *Nummulites millecaput* in diskociklinidami. Plasti z *N. millecaput* uvrščajo v zgornji lutecij (Kopek & Kecskeméti, 1961). Enako starost pripisuje tej vrsti Jámborné Kness (1988), vendar nekateri madžarski primerki zaradi dolgih kamric, premalo srpastih in zgoraj premalo nazaj upognjenih sept niso tipični predstavniki vrste *Nummulites millecaput* (cf. Jámborné Kness, 1967, Tab. 3, Sl. 23). Zanimiva so opažanja iz Bakonjskega gozda. Kecskeméti (1973) pravi, da razvojni niz *Nummulites distans - N. millecaput* tam ni v celoti razvit. V starejših horizontih je majhen *Nummulites millecaput* z nizkimi zavoji in debelim zavojnim robom. V zgornjem luteciju je tipičen *Nummulites millecaput.* Poleg teh oblik je še numulit z višjimi zavoji, debelejšim zavojnim robom in sorazmerno višjimi kamricami, kar vsaj delno ustreza vrsti *Nummulites dufrenoyi.* Majhni predstavniki te vrste so skupaj s spodnjelutecijskim *Nummulites laevigatus,* v zgornjem luteciju pa je skupaj z *N. perforatus* (Kecskeméti, 1969). V najmlajšem luteciju je živela vrsta *Nummulites maximus* D'Archiac, vendar navajajo iz tega časa tudi *N. millecaput* (Kecskeméti & Vaňová, 1972), omenjajo pa celo zgornjeeocensko starost te vrste. Iz Bakonjskega gozda ima vrsta *Nummulites millecaput* premer hišice 100 do 110 mm (Kopek *et al.,* 1971). Tako velik je lahko *Nummulites maximus,* medtem ko imajo topotipi *N. millecaput* premer 30-55 mm (Schaub, 1981), drugi primerki tudi nekaj več. Poleg tega navajajo madžarski avtorji (Kopek & Kecskeméti, 1965; Kopek *et al.,* 1971) poleg *Nummulites millecaput* še *Assilina exponens, N. perforatus, N. puschi* D'Archiac, *N. brongniarti, N. striatus,* kar vse kaže na mlajši horizont kot oni z *N. millecaput.*

V delu Jámborné Kness (1967) numulita na tabeli 3, sliki 22 in 23, zanesljivo ne pripadata vrsti *Nummulites millecaput.* Od nje se ločita po površinski skulpturi, po poteku zavojev in po dolžini kamric. Te oblike ista avtorica v monografiji ne navaja niti med sinonimiko (Jámborné Kness, 1988). Pač pa so v tej monografiji na tabli 7 numuliti, ki gotovo pripadajo vrsti *Nummulites millecaput.* Moti le asociacija, ki jo navaja Jámborné Kness (1988), ker so pomešane numulitine iz različnih stratigrafskih horizontov, tudi tistih, v katerih *Nummulites millecaput* ni več živel.

Karpati

Tudi na področju Karpatov in južneje od tod v Bolgariji (Belmustakov, 1959) daje večina *Nummulites millecaput* v lutecij. O natančnejšem horizontu so mnenja nekoliko deljena. Nemkov (1955) pravi, da v Pokutsko-marmaroških Karpatih ta vrsta ne sega do konca srednjega eocena. Golev in Sovčik (1971, Tab. 1) jo na področju Karpatov postavljata v srednji in celo zgornji eocen. Vendar so ti numuliti presedimentirani ali napačno določeni, zakaj skupaj z njimi so vrste iz različnih stratigrafskih horizontov, kot so *Nummulites distans, N. gallensis* Heim, *N. laevigatus, Assilina exponens.* Med temi je nekaj izrazitih spodnjelutecijskih oblik, ki s pravim *Nummulites millecaput* na primarnem mestu ne morejo biti skupaj. Ista avtorja navajata, da sta v Karpatih dve provinci, ena z *Nummulites millecaput - N. perforatus,* druga z *N. distans - N. irregularis* Deshayes. To gotovo nista dve provinci, ampak dva različna stratigrafska horizonta. Golev in Sovčik (1971) sta prepričana, da se *Nummulites millecaput* pojavlja v južnejšem prostoru (Egipt, Sirija, Armenija) prej kot v južnozahodnih Karpatih. To pojasnjujeta s prodiranjem sredozemskih toplih tokov proti severu, zaradi otočnih kordiljerov pa naj bi bila tudi v različnih delih morja temperatura različna. Tudi takšna razlaga nima trdnih dokazov, ker se opira na različne stratigrafske podatke.

Bombiță (1961, 1963, 1973) omenja vrsto *Nummulites millecaput* v vzhodnih Karpatih skupaj s spodnje in srednjeeocenskimi oblikami, kot so *Assilina (Opercu-*

lina) douvillei Abrard & Fabre, Ass. spira in *N. uranensis.* Omenjeno je že bilo, da nekateri primerki zelo verjetno ne pripadajo vrsti *Nummulites millecaput* (Pavlovec, 1963). Poleg tega primerki na slikah (Bombiță, 1961, Sl. 38; 1973, Tab. 2, Sl. 11, 12) niso značilni predstavniki vrste *Nummulites millecaput.* Nekateri so preveliki, drugi premajhni, tako da so nekateri bliže obliki *Nummulites* aff. *millecaput* (Schaub, 1981), drugi morda celo blizu vrste *N. dufrenoyi.* Na prostoru zahodnih Karpatov uvršča Bieda (1959) *Nummulites millecaput* v zgornji lutecij skupaj z *N. perforatus in N. brongniarti.* Pozneje jo ugotavlja (Bieda, 1960, 1963, 1968) v srednje in zgornjeeocenskem flišu, vendar se vedno nagiba k višjemu delu srednjega eocena.

Köhler (1967) našteva iz zahodnih Karpatov srednjeeocenske oblike *Nummulites millecaput, N. perforatus, N. sismondai* D'Archiac & Haime in *Assilina exponens* skupaj z zgornjeeocenskimi *N. chavannesi* De la Harpe in predstavniki rodu *Operculinoides.* Trdi, da ne gre za mešano favno, ampak da so to oblike, ki so dosegle višek v srednjem eocenu, izumrle pa šele v spodnjem delu zgornjega eocena.

V zahodnem delu Karpatov omenjajo iz okolice Šturova na Slovaškem v zgornjem luteciju podvrsti *Nummulites millecaput millecaput* in *N. millecaput minor* (Heim). Skupaj z njima so *Nummulites perforatus, N. gallensis, N. incrassatus incrassatus* De la Harpe in *Assilina exponens,* torej numulitine iz horizontov od spodnjega lutecija do spodnjega priabonija (Vaňová, 1972). Zanimiva je predvsem oblika *Nummulites millecaput* minor, ki ima protokonh nekoliko manjši kot tipični *N. millecaput,* vendar so razlike zelo majhne. Če primerjamo obliko *Nummulites millecaput minor* s Schaubovim (1981, Tab. 68) *N.* aff. *millecaput,* sta si zelo podobna. Od tipičnega *Nummulites millecaput* se ločita po nekoliko redkejših septah in po nekoliko tanjšem zavojnem robu, medtem ko višina zavojev pri obeh precej variira. Najbrž bi *Nummulites millecaput minor* iz Karpatov lahko uvrstili v skupino *N.* aff. *millecaput,* če ne celo blizu *N. alponensis.*

Bombiță (1963, Sl. 14) omenja obliko *Nummulites* aff. *millecaput.* To ni ista oblika kot Schaubov (1981) *Nummulites* aff. *millecaput.* Primerek iz Romunije ima bistveno višje zavoje. Poleg tega navaja v nahajališču Cetatea numulitinske vrste iz različnih horizontov, vse pa postavlja v spodnji lutecij.

Vzhodna Evropa in Mala Azija

Belmustakov (1969) omenja iz severne Bolgarije *Nummulites* cf. *millecaput.* Primerka na tabli 52, sl. 2-4 po višini zavojev in številu sept nista značilna predstavnika *Nummulites millecaput.* Nista pa tudi povsem podobna obliki *N.* aff. *millecaput* (Schaub, 1981).

Kačarava (1967) postavlja *Nummulites millecaput* sicer v lutecij, vendar omenja, da nastopa v Armeniji in v Tatrah tudi v najnižjem delu zgornjega eocena. Če je navedba starosti pravilna, bi bil lahko zgornjelutecijski *Nummulites maximus* ali *N. dufrenoyi.* Poleg tega je (Kačarava, 1967) objavila statistične podatke o vrsti *Nummulites millecaput* iz Gruzije in te primerjala z numuliti z različnih nahajališč. Pokazalo se je, da imajo primerki iz Gruzije ekstremno velik prolokul (1,2 mm), čeprav tako velike omenja tudi Schaub (1981), septa pa so zlasti v četrtem (7-8) in petem zavoju (8-9) redkejša kot pri tipičnih primerkih megalosferične generacije te vrste. Kačarava leta 1975 ponovno omenja vrsto *Nummulites millecaput* iz Gruzije in objavlja celo iste slike kot leta 1967 (Sl. 5-6, Tabla 9). Starostno uvršča tega numulita v zgornji lutecij oziroma "biarritzij". Pri megalosferični generaciji so septa v spodnjem delu skoraj pravokotna na prejšnji zavoj ali so le malo nagnjena. Takšna oblika sept ni najbolj značilna za *Nummulites millecaput,* čeprav vidimo podobno značilnost tudi pri nekaterih Schaubovih primerkih (Schaub, 1981, Tab. 68-69). Precej podobna septa ima oblika *Nummulites arcanus* Golev & Sovčik (1971, Tab. 1, Sl. 17-18). Zdi se mi, da je ta oblika blizu skupini *N. pratti* D'Archiac & Haime. Vendar tudi njen stratigrafski položaj ni jasen, saj navajajo *Nummulites arcanus* skupaj z numuliti in asilinami iz spodnjega in srednjega eocena.

Iz Krima omenja Zerneckij (1960) okrog 125 mm velike mikrosferične oblike *Nummulites millecaput,* do 50 mm velike predstavnike *N. distans* in do 82 mm velike hišice *N. polygyratus.* Na edini sliki, ki pa nima navedene povečave, lahko sklepamo po nizkih zavojih na *Nummulites millecaput.* Vprašanje je, ali je Zerneckij opisoval prave predstavnike vrst *Nummulites distans* in *N. polygyratus,* ali večji primerki pripadajo vrsti *N. millecaput,* če ne celo *N. maximus,* čeprav tudi Schaub (1981) omenja 82 mm velike predstavnike te vrste iz Krima. Vsekakor omenjeni primerki glede navedbe dimenzij sodijo med večje predstavnike omenjenih vrst. Zanimivo je še to, da je pri 35 mm velikem primerku iz Krima ugotovil Zerneckij 50 zavojev s 3000 kamricami.

Bagmanov (1966) postavlja *Nummulites millecaput* iz Malega Kavkaza v srednji eocen. Vendar misli, da sega ta vrsta v Armeniji še v zgornji del srednjega eocena, nikakor pa ne v zgornji eocen, kot so mislili nekateri.

Tudi za vse numulite iz Rusije (Ńemkov, 1967) nisem prepričan, da glede na dolžino kamric sodijo vsi v vrsto *Nummulites millecaput.*

Iz Turčije omenjata vrsto *Nummulites millecaput* Sirel in Gündüz (1976) pod imenom *N. helveticus* (= megalosferična generacija vrste *N. millecaput).* Primerki na tabli 7 imajo manj zavojev kot tipični *Nummulites millecaput.* Od tega se ločijo tudi po površinski skulpturi, ki ni podobna oni pri *Nummulites millecaput.* Septa so zelo srpasta. Nastopajo pa v spodnjelutecijskih plasteh še pred plastmi z *Nummulites lehneri* Schaub, *Assilina spira, Ass. exponens* in deloma celo skupaj s

temi vrstami. Numuliti iz Turčije najbrž niso tipični predstavniki vrste *Nummulites millecaput*. Decrouez in Selçuk (1981) pravita, da je *Nummulites millecaput* iz Turčije podoben primerkom iz Fiese.

Drugi kraji

Vrsto *Nummulites millecaput* omenja iz Alžirije Flandrin (1938). Že sam pravi, da je potek zavojnega roba pri mikrosferični generaciji bolj podoben onemu pri *Nummulites distans*. Primerek na tabli 2, slika 8 ima za vrsto *Nummulites millecaput* previsoke zavoje in premalo gosta septa. Flandrin omenja pri polmeru 10 mm 21 zavojev, kar bolj ustreza vrsti *Nummulites alponensis*. Tej je najbliže tudi po nagnjenosti sept.

K. Matsumaru (1996) omenja s področja Ogasawara na Japonskem vrsto *Nummulites millecaput*. Žal po slikah ni mogoče ugotoviti, ali pripadajo vsi primerki tej vrsti.

ZAKLJUČEK

V apnenčevem turbiditu pri Fiesu ob slovenski obali Jadrana je v spodnjem delu zelo veliko hišic vrste *Nummulites millecaput*. Ta vrsta je na teh nahajališčih skoraj monospecifična, saj je neprimerno manj nekaterih drugih fosilov. To kaže, da so podmorski plazovi prinašali material z mesta, kjer so prevladovali omenjeni numuliti, manj je bilo drugih organizmov. Deloma so tokovi in plazovi lahko tudi sortirali material, tako da so druge organizme prenašali drugam.

V luteciju so živele vrsti *Nummulites millecaput* še nekatere podobne oblike, ki jih je večkrat težko ločiti. Zdi se, da je omenjena oblika *Nummulites* aff. *millecaput* nova vrsta ali podvrsta. Od značilnega *Nummulites millecaput* se loči predvsem po tanjšem zavojnem robu in nekoliko višjih zavojih. Septa so pravilnejša in nekoliko manj potegnjena nazaj. Znaki obeh oblik pa se precej prepletajo. Dobiti bi bilo treba številčno zadovoljiv in dobro ohranjen material, ki bi ga lahko primerjali z vrsto *Nummulites millecaput*. Gradivo bi bilo treba statistično obdelati in ugotoviti točne stratigrafske horizonte obeh oblik.

NUMMULITIDS FROM CALCAREOUS TURBIDITE AT FIESA, SLOVENIA

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SUMMARY

In the calcareous turbidite between Fiesa, Strunjan and Izola along the Slovenian Adriatic coast (Fig. 1) occurs, especially in its lower part, an abundance of test of species Nummulites millecaput *(Fig. 2). Megalospheric forms are prevalent. Along with them few discocyclinas occur, as well as rare assilinas and spicules of sea urchins, many lithothamnian fragments, several dentalia and nondeterminable fossils. In the lower 10 to 15 cm, the tests of nummulitids lie mostly at an angle of 45° to the stratification, whereas elsewhere they are almost paralell to it. Above this horizon lies a 10 to 15 cm thick bed consisting mainly of broken tests. Upwards the sediment are finer grained, limestone parts alternate with thin sandy intercalations. This is an indication of sorting of particles by size during transport by currents of smaller slumps. The profusion of nummulitid tests suggests that the material was supplied into the flysch sea especially from the part of the carbonate platform, on which many nummulites of the mentioned species lived. However, transport of this material occurred only sporadically.*

Age of the beds is Middle Eocene. Pavšič and Peckmann (1996) attributed them close to the centre of biozone NP 16.

Numeric data for the species Nummulites millecaput *are given in table 1. Most nummulits from Fiesa belong to this species (Pl. 1, Figs. 1-7). Table 2 contains data for similar forms* (Nummulites *aff.* millecaput; *Pl. 1, Figs. 8-9). These have a somewhat thinner marginal cord and somewhat higher whorls. Septa are more regular, a little less drawn backwards, and the protoconch is somewhat smaller. This is perhaps a new species or subspecies, but certain characteristics of the two forms overlap.*

Since taxonomic marks of Lutetian representatives of the group Nummulites millecaput *overlap, or they are very similar, we listed a few remarks to previous descriptions. Among others, a 19 cm large nummulite* (Nummulites ? maximus) *from the locality Kalo Chorio southeast of Iraklion on Crete is also mentioned. Unfortunately a single axial section was found that could not get isolated.*

Key words: foraminifers, flysch, Eocene, Slovenia

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GRGUR BUČIĆ – SVESTRANI PRIRODOSLOVAC (1829-1911)

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IZVLEČEK

Grgur Bučić (1829-1911) je eden najbolj znanih hrvaških prirodoslovcev 19. in 20. stoletja. Ukvarjal se je z meteorologijo, oceanografijo, mareografijo, zoologijo, ribištvom, botaniko, fenologijo, seizmologijo, petrografijo, geologijo, mineralogijo, predzgodovino in arheologijo, hkrati pa je bil navdušen numizmatik, filatelist in pesnik. Svetovno znan je postal po poskusih umetne vzgoje in raziskovanju spužev skupaj s slovitim zoologom tistega časa, prof. E. Haecklom. Mnoge vrste so dobile ime po njem: glavač Gobius bucchichi, *ravnokrilec* Orellia bucchichi, *postranica* Nicea bucchichi, *spužve Tethya bucchich,* Anphoriscus bucchichi *in* A. gregorii *ter mnogoščetinec* Myzostoma bucchichi. *Bil je član številnih domačih in tujih prirodoslovnih društev. Na graški univerzi so mu podelili častni doktorat, prejel pa je tudi številne druge domače in tuje nagrade.*

Ključne besede: Grgur Bučić, naravoslovje, oceanografija, meteorologija, entomologija, ihtiologija, spužve

GRGUR BUČIĆ – FAMOSO NATURALISTA (1829-1911)

SINTESI

L'autore presenta la biografia ed il lavoro di Grgur Bučić, rinomato scienziato croato proveniente dall'isola di Lesina (Hvar), nel novantesimo anniversario della sua morte. Grgur Bučić raggiunse i suoi maggiori successi nei campi dell'oceanografia, meteorologia, entomologia ed ittiologia. Diventò famoso grazie agli ottimi risultati raggiunti nello studio delle spugne. Alcune specie portano il suo nome: il pesce Gobius bucchichi, *l'insetto* Orellia bucchichi, *l'anfipodo* Nicea bucchichi, *alcune spugne quali* Tethya bucchich, Anphoriscus bucchichi *ed* A. gregorii, *nonché il policheta* Myzostoma bucchichi. *Bučić fu membro di numerose societa internazionali e ricevette diversi premi nazionali ed internazionali.*

Parole chiave: Grgur Bučić, oceanografia, meteorologia, entomologia, ittiologia, spugne

UVOD

Početkom 2001. godine navršilo se 90 godina od smrti vrhunskog znanstvenika Hvaranina Grgura Bučića. Premda su prije stotinu godina mogućnosti komunikacija sa svijetom bile neusporedivo lošije nego danas, Bučić je bio u neprekidnoj i intenzivnoj vezi sa "znanstvenom Europom". Rijetki su znanstvenici koji su se istaknuli na toliko različitih znanstvenih područja kao Bučić. Bavio se meteorologijom, oceanografijom, mareografijom, zoologijom, ribarstvom, botanikom, fenologijom, seizmologijom, petrografijom, geologijom, mineralogijom, prethistorijom i arheologijom, a u isto vrijeme je bio i strastveni numizmatičar, filatelist, te pjesnik.

U Hvaru, kao administrativnom središtu bivšeg hvarskog kotara, bilo je u 19. stoljeću školovanih ljudi, među kojima se posebice isticala skromna i učena ličnost Grgura Bučića, tamošnjeg telegrafiste, savjesnog promatrača prirode, koji je svojim neumornim radom na polju meteorologije i zoologije, stekao za znanost trajnih zasluga, te mu stoga veliki broj stručnjaka daje priznanje u prirodoslovnoj literaturi.

U ovom kratkom pregledu života i rada hvarskog prirodoslovca posebice će biti riječi o njegovom utjecaju i interesu na meteorologiju, oceanografiju, te spužvarstvo i ribarstvo.

ŽIVOTOPIS

Grgur Bučić (Sl. 1), kao jedno od devetoro djece, rođen je u Hvaru 7. siječnja 1829. godine od oca Petra i majke Kate, rodene Giaxa. Osnovnu školu završio je u Hvaru, klasičnu gimnaziju u Splitu, a Filozofski institut Biskupije u Dubrovniku. Studirao je u Beču i Padovi, ali zbog materijalnih razloga nije apsolvirao sveučilišne studije, te je upisao tečaj za telegrafiste pri geografskom inspektoratu u Zadru, koji završava s odličnim uspjehom. Od 1858. godine je počeo u Hvaru promatrati meteorološke i klimatske pojave, o čemu je svakog dana telegrafski izvješćivao centralni zavod za meteorolgiju i zemaljski magnetizam u Beču. Napredovao je vrlo brzo u službi i postaje šef ureda u Hvaru, a 1870. godine dobiva zvanje telegrafskog asistenta. Znanošću se bavio paralelno sa svojim službenim poslom. Živio je vrlo skromno, jer mu materijalna primanja nisu uvijek bila dovoljna da bezbrižno hrani i liječi svoju mnogobrojnu djecu, koja su često bila bolesna. 1896. godine, dakle s nepunih 67. godina života, podnosi molbu za mirovinom, te je i dobiva 1898. godine. Prema knjizi umrlih Grgur Bučić je umro 11. siječnja 1911. godine u Hvaru u pet sati ujutro u svojoj skromnoj kući.

ZNANSTVENI I STRUČNI RAD

Znanstveni i stručni rad G. Bučića bio je raznovrstan i iz svega onoga što je radio i o tome pisao ili izvještavao vidi se da je vrlo savjesno obrađivao materijal. Iako nije završio fakultet, ipak mu je znanstveni svijet bio vrlo blizak i bio je s njime u neprestanom dodiru, bilo preko mnogobrojnih knjiga i časopisa, bilo preko korespodencije s mnogim ondašnjim poznatim prirodoslovcima. S njima je dolazio i u osobni kontakt, jer su češće posjećivali Hvar i po njegovoj okolici sakupljali raznovrstan materijal. U svojoj molbi za mirovinom Bučić navodi da od jezika poznaje njemački, talijanski, ilirski i francuski, a učio je latinski i grčki, što mu je u znanstvenom radu vrlo dobro poslužilo. Osim toga što je bio meteorolog, oceanograf i prirodoslovac (ihtiolog, entomolog, botaničar), Grgur Bučić je bio i svestrani arheolog, geolog, paleontolog, numizmatičar, filatelist i pjesnik.

Njemački biolog svjetskog glasa Ernst Haeckel (1834-1919) održavao je s Bučićem ne sam znanstvene već i prijateljske veze. Ta međusobna suradnja dolazila je naročito do vidnog izražaja kada je Haeckel u travnju i svibnju 1871. godine boravio u Hvaru radi lova i istraživanja raznovrsnih morskih spužava i drugih organizama, medu kojima je otkrio veliki broj novih vrsta. Treba se priznati da je i Bučićeva velika zasluga što je Haeckel imao velikog uspjeha u svome znanstvenom radu istražujući biologiju mora oko Hvara. To priznaje i sam Haeckel u svome posljednjem pismu upućenom Bučićevoj obitelji prilikom njegove smrti 1911. godine. No nije Bučić kontaktirao samo sa Haeckelom, već je bio u korespodenciji sa još preko 60 stranih prirodoslovaca. Tijekom svog života dobio je čitav niz pohvala i posveta među kojima su recimo: priznanje cara F. Josipa I 1889. godine kao poštanskom službeniku i šefu Telegrafskog ureda u Hvaru; zatim memorijalna tabla povodom njegova odlaska u mirovinu od strane činovnika Brzojavnog ureda u Hvaru; na knjizi "Kunst Formen der Natur", Leipzig-Wien, 1889. piše: *"Svome visokopoštovanom prijatelju gospodinu dr. fil. Grguru Bučiću mnogo zaslužnom neumornom pustinjaku znanosti u Hvaru uz srdačne pozdrave"* – Ernst Haeckel, Jena.; te iako je od smrti Bučića, počasnog doktora Filozofskog fakulteta u Grazu, prošlo 90 godina, njemu je 1963. godine ukazana naročita počast, u društvu još dvojice svjetski poznatih prirodoslovaca, u knjizi *Fauna und Flora der Adria* od austrijskog biologa Ruperta Riedla. Autor je ovu svoju knjigu posvetio istraživačima živog svijeta Jadrana: opatu Josipu Olivi, Chioggia 1769-1795, Josipu Romanu Lorencu od Liburnije, Linz 1825-1911 i Grguru Bučiću, Hvar, 1829-1911. Bučića je poštovao i zoolog Franz Wagner koji je jednog crva mnogočetinaša (Polychaeta) nazvao *Myzostoma bucchichi*. Na polju istraživanja kukaca Bučić je također bio jako plodan, pa se tu istakao i pronalaženjem nekih novih vrsta. Između ostaloga nađene su bilješke i o kukcu *Orellia bucchichi* v. Frauenfeld, kojeg je Bučić otkrio i proučio 1867. godine. Bučić je napisao i jedan samostalan rad o rav-

nokrilcima pod naslovom *Gli ortotteri di Lesina e Curzola, con alcune notizie biologiche che li riguardano* kojeg je 6. svibnja 1885. godine podnio na sjednici Zoološko-botaničkog društva na talijanskom jeziku i tiskan je u časopisu *Verhandlungen d. k. k. zoologisch-botanischen Gesellschaft*, XXXV B., Wien 1885, 377-382.

Bučić kao meteorolog i oceanograf

Prva Bučićeva promatranja prirode bila su na polju meteorologije i oceanografije, i to od 1858. godine pa dalje. U samom početku je promatranja obavljao u kući sa svojim skromnim instrumentima, od kojih je neke sam konstruirao, i o tome izvješćivao centralni zavod za meteorologiju i zemaljski magnetizam u Beču. Od meteoroloških instrumenata konstruirao je anemograf, kako ističu neki autori, ali ga nitko ne opisuje. Isto tako konstruirao je oceanografske sprave batoskop i rebatoskop. Nakon što je dobio suvremene instrumente, osniva u Hvaru Meteorološku stanicu u kuli Venerandi, koja na istom mjestu djeluje i danas. Godine 1861. Državni geološki zavod u Beču imenovao je Bučića članom dopisnikom svoje ustanove i on je pedeset godina pratio sva otkrića fosila i sve geološke pojave na Hvaru, te izvješćivao stručnjake o tim nalazištima i pojavama. Iako Bučić nije pisao neke znanstvene rasprave, on je ipak u sve ono što je pisao, opisujući pojedine prirodne pojave, savjesno unosio sve one elemente koji su tu pojavu pratili i u svojim je izlaganjima tražio uzroke postanka tih pojava. Obavljao je i oceanografska promatranja pomoću mareografa, dovodeći u vezu u određenim trenutcima jedne pojave s drugima i uočavao je odgovarajuće komparacije. Radio je i za Jadransku komisiju Bečke akademije obavljajući meteorološka opažanja. Istražujući oborine, temperature i tlak, te njihove odnose u zemljama priobalnog pojasa Austro-Ugarske, klimatolog Hann poslužio se višegodišnjim Bučićevim mjerenjima iz čega se može zaključiti da je Hvar bio najbolje istražen u čitavom području zahvaljujući upravo Bučićevu radu. Bučićeve bilješke i članci iz meteorologije i oceanografije prvo su bili tiskani u bečkom časopisu *Zeitschrift der österreichischen Gesellschaft für Meteorologie* od 1869. do 1889. godine. Bučić je prvi obavljao oceanografska promatranja u kojima prikazuje visinu mora i dovodi je u zavisnost s tlakom zraka. Neobična pojava u lipnju 1869. godine kada se more "zacrvenilo" u pristaništu Hvara (puna dva tjedna) dala mu je povoda da pomoću mikroskopa otkrije da su to prouzrokovale ogromne količine infuzorija. Ni najnoviji dubinski termometar kojeg je izumio Casella, nije promakao Bučićevoj pozornosti. Uspio ga je nabaviti i pomoću njega ispitivao temperaturu mora, pa je svoja kritička zapažanja o rukovanju tim aparatom iznio u stručnoj literaturi. Njegova ljubav za promatranje pojava u moru i ostalih pojava u vezi s njim bila je dobro poznata Komisiji za istraživanje Jadrana Akademije znanosti u Beču, koja je 1869. osnovala na Rijeci, Hvaru i Krfu stanice za taj znanstveni rad. Taj je posao u Hvaru bio povjeren Bučiću, koji je stalno svoja zapažanja slao u Beč. Iz oceanografije je napisao slijedeće radove:

1. *Zusammenhang der Höhe des Meeres mit dem Barometerstande*, I, 217; 1866.
2. *Rothe Färbung des Meeres zu Lesina*, IV, 346; 1869.
3. *Über den Gebrauch des Tiefenthermometers von Casella*, V, 397, 1872.
4. *Beobachtungen über Meteorologie, Temperatur, Salzgehalt des Meereswassers, Ebbe und Fluth* v. 1871-1873, BCA, 1878.

Osim tih radova iz ovog područja na njemačkom tiskani su mu neki i na talijanskom jeziku. Tako se u godišnjaku *Rapporto annuale dell' Osservatorio Marittimo di Trieste* - Trieste u rubrici *Osservatorio giornaliere di nove stazioni dell' Adriatico e di tre dell' altipiano di Trieste* nalaze Bučićevi oceanografski izvještaj u izdanju za godinu 1890., tiskani 1892. Vol. VII. Poslije toga tiskani su mu slični izvještaji i u *Rapporto annuale dell I. R. Osservatorio astronomico-meteorologico*, Trieste, u godištima 1891-1895, s go-

Sl. 1/Fig. 1: Grgur Bučić.

dinama izdanja 1894-1898, VII-XII. Bučića je posebice interesiralo i djelovanje bure te na posebnu vrstu oblaka u vezi s burom i na njihovo rasprostiranje. U vezi s burom napisao je nekoliko članaka. Kao svakom marljivom promatraču prirode čije su interesne sfere bile široke, tako ni Bučiću nisu izbjegle ni optičke pojave u atmosferi. On zapaža zamućivanje zraka, nesvakidašnje pojave pri sutonu, crvenilo neba ujutro i navečer, zemljotrese i suhe magle, a pored toga promatra i visinu sunca gledanu s Hvara. Isto tako u svojim bilješkama iznosi Bučić zapažanja o sjevernoj polarnoj svjetlosti.

Bučić i ribarstvo

Bučić, i sam sportski ribolovac, bio je izuzetno zainteresiran i za profesionalni ribolov, pa i za ribare kao ljude. Prema sačuvanoj literaturi u njegovoj ostavštini vidi se da je imao izuzetnog smisla za ihtiologiju. Pronažene su mnoge njegove bilješke o ribarstvu i crteži raznih riba, a posebno je pravio bilješke na svim praznim prostorima oko teksta pročitanih knjiga o ribarstvu. Osobitu je pozornost posvećivao električnim organima drhtulje šarulje *Torpedo marmorata* Risso.

Na Bučića su obraćali mnogi znanstvenici za informacije o nekim ribama u Jadranu. U jednom pismu iz 1880. godine sam Bučić izvještava na njemačkom jeziku izvjesnu osobu da je ribu "die Schollen" vrlo teško uloviti, pošto ova riblja vrsta stalno leži na morskom dnu, a za lov bi trebalo imati posebnu mrežu. Pošto Bučić ovu vrstu nije mogao točno determinirati, on ju je nacrtao i naznačio da bi to mogla biti *Trachittera spinolae (Cristatus rondoletti).* Ovdje je došlo do zabune jer onaj koji se obratio Bučiću nije naveo latinsko ime vrste već je samo napisao njemačko ime, a prema tom imenu izgleda da se radilo o vrsti iz obitelji Pleuronectidae. U Bučićevim bilješkama postoji napomena da je ta riba, misleći na *T. spinolae*, zapažena samo u Jadranu. Također dalje navodi da je po poznatom profesoru Juraju Kolombatoviću ta vrsta znanstveno nazvana *Trachitter cristato*, i još da je jedan primjerak takve ribe netko već prije otpremio u Beč. Prema Kolombatoviću postoji 26 vrsta *T. cristatus*, a da je onaj primjerak ulovljen 1862. u okolini Hvara bio *T. cristatus spinolae C. V.* Da bi Bučić bio sigurniji u odgovoru, on ribu u potpunosti opisuje i dotičnom još šalje i njenu fotografiju, a u njegovoj ostavštini se uz ovaj koncept čuvaju još tri fotografije izrađene u Zadru. Također je pronađen crtež *T. filicando* s potpisom talijanskog istraživača Da Coste. Na stražnjoj strani crteža Bučić je svojom rukom napisao: *"Spedita la fotografia del Trachittero... al Prof. Costa 1889".* Osim navedenih, nađeni su crteži i drugih *Trachypterusa*, kao i nekih drugih riba bez oznake naziva. Uz to su u njegovom kabinetu nađene razne tablice s Bučićevim bilješkama (u ovom slučaju radilo se o vrsti *Zu cristatus).*

Bučić je bio i vrlo zainteresiran i za profesionalni ribolov, odnosno želio je znati koliko se kvintala ribe ulovi godišnje na otoku Hvaru, pa je o svemu tome vodio bilješke i tabelarne zapise i grafikone za pojedina mjesta. Osobiti interes je pokazivao za lov plave ribe "pod sviću". Iznosi i svoja razmišljanja o nerentabilnosti načina ribolova sa svićalom na luč, primitivnim osvjetljavanjem mora, pa je nastojao nagovoriti ribare kako ta svićala treba zamijeniti svjetiljkama na karbid, kako se već upotrebljavaju u stranome svijetu. U tu svrhu je naručivao prospekte s modelima takvih ferala.

Poznati ihtiolog tog vremena Fr. Steindachner, koji je napisao poznati rad *"Die Fische",* tiskan u Beču 1901. godine, u kojem je opisao nekoliko novih ribljih vrsta, među njima i neke iz Jadrana, jednu od njih, jednog glamoča, nazvao je po Bučiću *Gobius bucchichi*, ulovljenog oko Hvara. Ovaj rad tiskan je u knjizi *Geschichte der Zoologie in Österreich von 1850-1900.* Cijeneći Bučićeva zalaganja na polju znanstvenog i praktičnog ribarstva, mnoge strane ustanove i društva birali su ga za člana ili za počasnog suradnika. Tako npr. *Società austriaca di pesca e piscicultura marina* u Trstu (Austrijsko društvo za ribarstvo i uzgajanje morskih riba) imenovalo ga je za svog doživotnog člana 1888. godine, a Lučka kapetanija u Splitu imenovala ga je 1899. godine za svog znanstvenog procijenitelja pri Komisiji morskog ribarstva. U njegovoj arhivskoj ostavštini nađene su i neke zahvalnice za poslane ribe i rakove znanstvenim ustanovama. Tako mu se Prirodoslovni muzej u Beču zahvaljuje za razne vrste poslanih riba, a naročito za primjerak psa mlata dugačkog 1.5 m. Lovio je i druge organizme i slao ih ovome muzeju kao i mnoge primjerke bezlubanjaca koje je lovio u jednoj pjeskovitoj uvali nedaleko od grada Hvara. Narodnom muzeju u Pragu poslao je veliki primjerak raka *Scyllarus latus*, kako je nađeno i zabilježeno u izvješću tog muzeja.

Bučić se zanimao i za druge morske organizme, kao što su mali račići kojima se ribe hrane, zatim su ga interesirale morske školjke i puževi. Naročitu je pozornost obraćao sitnim morskim organizmima koji su živjeli na podmorskom telegrafskom kablu kada je bio vađen iz mora između Visa i Hvara 1887. godine. U njegovoj prirodopisnoj zbirci nađeno je dosta ljuštura morskih školjaka i puževa i neke morske alge. Dakle, morski život ga je izuzetno privlačio, razumije se, pored spužava. Posebice su ga interesirale razne vrste račića (posebice Amphipoda), koje je marljivo sakupljao i slao prof. Helleru u Beču. Prof. Heller navodi da se njegova zbirka Amphipoda povećala zahvaljujući materijalu kojeg je sakupio Bučić i u jednom svom radu navodi da je utvrdio 17 novih vrsta iz mora oko Hvara i jednu od njih je naznačio kao *Nicea bucchichi* nov. sp. Hvar.

Čim je 1874. godine u Zadru pokrenuta ideja za osnivanje društva koje će se brinuti za što racionalniji ribolov, lov spužava i koralj, Bučić se učlanio i birali su ga u osnivački odbor. Naziv društva bio je "Societa per

la pesca" (Društvo za ribolov). Cilj društva je bio da se promovira racionalan ribolov, lov spužava i koralja, pošto nije bilo dovoljno nadzora od nadležnih pomorskih vlasti. Ovo je društvo radilo u suglasnosti s društvom "Societa Adriatica di Scienze naturali" (Jadransko prirodoslovno društvo) u Trstu. Bučić je vodio preciznu evidenciju rada podružnice ovog društva u Hvaru, što se može vidjeti iz njegova dnevnika u kome su zabilježeni svi novčani izdaci i da je poslan doprinos društvu u Zadar. Vodio je evidenciju o ulovu pojedinih vrsta riba, zatim o pokusima s novim feralima na karbid i petrolej pri ulovu plave ribe.

Bučić i spužvarstvo

Neki od velikih znanstvenika prirodoslovaca tog doba imali su veliki utjecaj na Bučića, a jedan među njima bio je i Oskar Schmidt, priznati stručnjak za spužve, inače sveučilišni profesor zoologije i uporedne anatomije, zatim direktor Zemaljskog zoološkog muzeja u Grazu. Njegovo je djelo *Die Spongien des Adriatischen Meeres* bilo opće poznato. Schmidt u svome djelu tiskanom 1862. godine iznosi prvi put zamisao o umjetnom uzgajanju spužava. Svoje prvobitne pokuse je započeo u okolici Zlarina 1863. godine, no kasnije je prenio svoje pokuse u neke uvale Šibenskog kanala, pa zatim u uvalu Sokolica (Vela i Mala Vira) sa sjeverne strane poluotoka Pelegrina na otoku Hvaru. U početku, zajedno s prof. Hellerom, prof. Schmidt vodi pokuse, no već 1866. predaje taj zadatak Bučiću koji to preuzima s puno ljubavi, žara i poštovanja, kao i sa solidnim razumijevanjem i usavršavanjem u tom pravcu. Bučić se bio toliko osamostalio u tom radu, kako navodi u svojim bilješkama, da je radio po svojim metodama i tehničkim inovacijama. Svoja promatranja spužava u vivariju bilježio je u obliku tabela. U početku je imao dosta uspjeha, no postupno uslijed čitavog niza problema (radna snaga, nevremena, drvotočac, ribari) 1873. godine prestaje sa svojim radom i pokusima. No, za uspjehe u uzgoju spužava Ministarstvo poljoprivrede ga je odlikovalo srebrnom medaljom i dobio je novčanu pomoć i to je ujedno bilo i priznanje za izlaganje spužava u Grazu 1870. godine. Glas o Bučićevom radu na uzgajanju spužava bio je dosegao i do Francuske, Belgije, Italije, Turske i Sjedinjenih Američkih Država, pa je iz tih zemalja bio počašćen ili nekom diplomom, ili je bio upitan za savjet kako se taj posao izvodi, ili je dobijao na poklon znanstvene knjige, ili je postajao član nekog znanstvenog društva u tim zemljama. Smatra se da danas neke njegove inovacije i ideje (npr. nanizane spužve na bakrenim žicama obloženim kaučukom umjesto na običnom konopu) danas koriste u Japanu. No osim rada na regeneraciji jadranske podvrste obične spužve on se zanimao za razne vrste mnogobrojnih spužava iz Jadrana. Neke od njih, koje je pronašao u moru oko otoka Hvara i Paklenih otoka, bile su sasvim nove vrste, druge, poznate vrste slao je pojedinim stručnjacima za njihove zbirke. Iz pisma koje mu je uputio "Zool. Zoot. Institut der K. K. Carl-Franzes-Universität in Graz" 3. srpnja 1886. godine vidi se da je toj ustanovi poslao mnoge nepoznate i nove vrste spužava, na čemu mu se ona zahvaljuje. Bučić je i objavio jedan rad o spužvama: *Alcune spugne dell'Adriatico sconosciute e nuove (con. una tav. lit.)* u časopisu Bolletino della Società Adriatica di Scienze in Trieste, 1886, 222-225 (napisao ga je u Hvaru 1885. godine). R. v. Ledenfeld u *"Spongien der Adria"*, Leipzig 1891., spominje da mu je prijatelj Grgur Bučić pomagao u radu, i dvije spužve naziva po njemu *(Ebnerella buccichii* i *E. gregorii)*. Prema autoru Kornhuberu u *Abhandlungen der k. K. Geol. Reichsanstalt*, Band XVII, Heft 5, 1901, Bučić je otkrio još i ove spužve: *Tethya bucchich* O. Schmidt 1885, *Anphoriscus bucchichi* V. v. Ebner 1887, i *A. gregorii* v. Lendenfeld 1891.

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GRGUR BUČIĆ – THE VERSATILE CROATIAN NATURALIST (1829-1911)

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SUMMARY

The author present the biography and work of Grgur Bučić, the renowned Croatian natural scientist (from the island of Hvar), at the 90th anniversary of his death. G. Bučić was most successful in the fields of oceanography, meteorology, entomology and ichthyology. He was particularly famous for his research on sponges, where he obtained some exceptional results. There are a few species that even carry his name: fish Gobius bucchichi, *insect* Orellia bucchichi, *amphipod* Nicea bucchichi, *some sponges* Tethya bucchich, Anphoriscus bucchichi *and* A. gregorii, *and polychaeta* Myzostoma bucchichi. *He was member of numerous international societies and received many prizes at home and abroad.*

Key words: Grgur Bučić, oceanography, meteorology, entomology, ichthyology, sponges

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DELO NAŠIH ZAVODOV IN DRUŠTEV / OCENE

ATTIVITÀ DEI NOSTRI ISTITUTI E DELLE NOSTRE SOCIETÀ / RECENSIONI

ACTIVITIES BY OUR INSTITUTIONS AND ASSOCIATIONS / REVIEWS

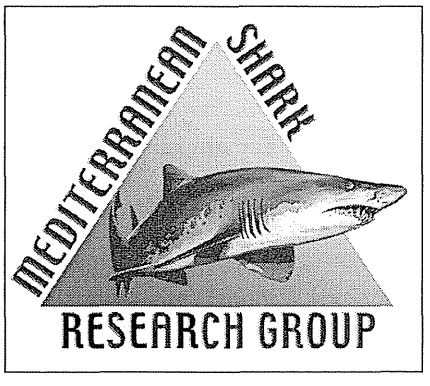
DELO NAŠIH ZAVODOV IN DRUŠTEV ATTIVITÀ DEI NOSTRI ISTITUTI E DELLE NOSTRE SOCIETÀ ACTIVITIES BY OUR INSTITUTIONS AND ASSOCIATIONS,

Alessandro De Maddalena

THE MEDITERRANEAN SHARK SPORTFISHERY PROGRAM

Many shark species inhabiting the Mediterranean Sea have been strongly threatened by the ever increasing fisheries due to the inefficient fishery regulation. Several shark populations are now thus in fast regression due to overfishing. Because of their low reproduction rate and late sexual maturity age, sharks are highly vulnerable to overexploitation. As recommended by organizations such as FAO and WildAid, it is necessary to immediately improve data collection and monitoring of shark fisheries. Nevertheless, the main institutions responsible for fishery management in our area still are extremely slow in giving a concrete response to this problem. Sharks are often unduly considered as something of minor importance, being mostly caught as bycatch. People forget, however, that sharks are top predators, an indispensable element of the marine food webs. In the Mediterranean Sea, sharks are not only caught in commercial fishery, but also in sportfishery. While commercial fishery is scarcely monitored in our area, sportfishery is totally unmonitored.

As a result of these considerations, as a first important step, the Mediterranean Shark Research Group (for information see pages 336-337 in Annales Ser. hist. nat. 10/2) started in the summer 2001 its Mediterranean Shark Sportfishery Program (Programma sulla Pesca Sportiva degli Squali del Mediterraneo), a program of data collection on captures of sharks in sportfishery in all Mediterranean waters. All sportfishermen, independent or belonging to clubs or associations, can take part in this project giving a fundamental help. All of some 50 species of sharks present in our waters are considered, both large-sized such as thresher shark *(Alopias vulpinus)* or blue shark *(Prionace glauca)* and small-sized such as smooth-hound *(Mustelus mustelus)* or piked dogfish *(Squalus acanthias)*.



Logo of the Mediterranean Shark Research Group. (by Juan Antonio Moreno)
Logotip Sredozemske skupine za raziskovanje morskih psov. (avtor: Juan Antonio Moreno)

Whenever possible, sportfishermen should report the following: shark species, date and location of the encounter (preferably with precise position), distance from the coast, depth of the sea, total length (in a straight line from the tip of the snout to the apex of the upper lobe of caudal fin), mass (specify if whole or gutted), sex (as in all sharks, male has two well evident cylindrical intromittent organs, the claspers, originating from the pelvic fins), specify if the shark was released alive, a photograph (if not possible, indicate on the basis of which features the species was identified), name and contact address of the fisherman and its boat (if possible, include e-mail address). Please do not hesitate to report even those captures for which data collected are incomplete.

We reduced the data requested to the minimum to make the work of the fishermen willing to collaborate with us in this program easier. In any case, if someone is able to note more details, other data not strictly necessary but useful will be the following: time of capture, weather, state of the sea, stomach contents, behaviour, details of the embryos in the case of pregnant females (number, total length, mass, sex), presence of other species in the immediate area, any other additional comments.

It is strongly recommended that sharks are released alive: in this case it will be not important if the form to report capture data is not filled in full.

Data are to be sent to the following address:

Dr. Alessandro De Maddalena - Italian Great White Shark Data Bank (Banca Dati Italiana Squalo Bianco), via L. Ariosto 4, I-20145 Milano, Italy.

E-mail: ademaddalena@tiscalinet.it

At the same address it is even possible to obtain forms on paper version (in Italian). Moreover, in Slovenia the following contact is possible:

Dr. Lovrenc Lipej - Marine Biology Station, National Institute of Biology, Fornače 41, SI-6330 Piran, Slovenia.

E-mail: lipej@nib.si

Information about the Mediterranean Shark Sportfishery Program, together with the form to be filled to communicate data on captures of sharks, can be found inside the new web site of the Mediterranean Shark Research Group, located at:

http://alessandrodemaddalena.supereva.it/index.html

For the diffusion of information on the Mediterranean Shark Sportfishery Program, an important role

is played by the media (wildlife and sportfishing magazines, web sites on fishing and sea, *etc.).* Much in this sense has already been done, but every additional collaboration is welcome.

The Mediterranean Shark Research Group thanks everyone who wishes to collaborate in data collection on captures of sharks from the Mediterranean Sea.

Robert Turk

PROJEKT ALAS – VSE O SOLI (ECOS-OUVERTURE 1998-2001

Projekt ALAS pomeni začetek uresničevanja želje štirih različnih solinarskih mest z različnih koncev stare celine - ohranitev in oživitev tradicionalne proizvodnje soli ter varovanje izjemne naravne in kulturne dediščine solin. Izjemno hvalevredna želja v času, ko sredozemska mokrišča, ki sodijo med najproduktivnejše ekosisteme na Zemlji, še posebej pa soline, marsikje izsušujejo, zasipavajo, skratka spreminjajo do te mere, da izgubljamo izjemno kulturno dediščino, ostajamo pa tudi brez pomembnega dela mozaika, ki mu danes pravimo biotska in krajinska raznovrstnost.

ALAS je mednarodni projekt, ki ga financira Evropska skupnost s sredstvi Phare in v katerem sodelujejo Lesvos (Grčija), Figuera da Foz (Portugalska), Pomorie (Bolgarija) in Piran (Slovenija). V slovenski del projekta so vključeni Občina Piran (kot glavni partner), Medobčinski zavod za varstvo naravne in kulturne dediščine Piran, Pomorski Muzej "Sergej Mašera" in Ornitološko društvo Ixobrychus. Vrednost piranskega dela projekta je ocenjena na 359.000,00 EUR, pri čemer 75% sredstev zagotavlja Evropska unija, preostalih 25% pa partnerji sami.

Cilji, ki so si jih predstavniki posameznih območij zastavili v okviru projekta, se medseboj sicer razlikujejo, vendar se v grobem nanašajo na:

- vzpostavitev trajnega sodelovanja med partnerji ter izmenjavo znanja in izkušenj;
- ohranitev tradicionalne oblike proizvodnje soli in njene prodaje kot enega izmed elementov lokalne ekonomije, ustanovitev oz. vzpostavitev struktur, ki bi jim država podelila
- koncesijo za proizvodnjo in prodajo soli ter posledično oblikovanje možnosti za nova delovna mesta;
- sodelovanje pri reševanju specifičnih lokalnih problemov, s katerimi se srečujejo partnerji projekta;
- iskanje različnih možnosti javnega in zasebnega financiranja vsebin projekta, vključno z možnostjo izrabe strukturnih skladov Evropske unije;
- podporo ustreznemu gospodarjenju z naravnimi vrednotami in kulturno dediščino kot pomembnemu elementu regionalnega razvoja, posebej razvoja turizma;
- ozaveščanje širše javnosti o pomenu naravnih vrednot in kulturne dediščine solin ter njihovega razvojnega potenciala;
- konkretne aktivnosti z "dolgoročnimi posledicami", npr. različni pilotni projekti ali projekti, namenjeni predstavitvi in obisku solin, publikacije idr.

Pomemben del aktivnosti, predvidenih za območje Sečoveljskih solin, se nanaša na izboljšanje infrastrukture, vezane na obisk Muzeja solinarstva in posledično zmanjšanje takšne obremenitve območja, na obnovo muzejske zbirke in na izdelavo projekta obnove tretje solinarske hiše, ki bo namenjena predstavitvi naravnih vrednot solin. Drugi del aktivnosti je namenjen manjšim posegom v infrastrukturo delujočega dela solin, opredelitvi odnosov med turizmom in solinarstvom oz. krajinskim parkom ter zagotavljanju osnov za ustrezno upravljanje parka. Vzporedno z navedenim bodo potekale aktivnosti, vezane na predstavitev in popularizacijo solinarstva ter varstva kulturne dediščine in naravnih vrednot.

Projekt je izjemnega pomena tako za občino Piran kakor tudi za državo Slovenijo, saj pomeni konkreten prispevek k uresničevanju nedavno sprejete vladne Uredbe o krajinskem parku Sečoveljske soline.

Tamara Lah

40 LET NACIONALNEGA INŠTITUTA ZA BIOLOGIJO

Štirideset let inštituta za biologijo je pravzaprav kratko obdobje, če človek pomisli, kako stara je biologija - veda o življenju. Verjetno bi lahko posegli po začetnih zapisih prav do časov nastanka pisane besede, saj je človek opazoval življenje na Zemlji prav tako radovedno tedaj kakor danes. Od opažanj različnih oblik živega, zbiranja in konzerviranja zanimivih primerkov, povezovanj teh v sisteme in odkrivanje zakonitosti evolucije smo prek stoletij prišli do moderne

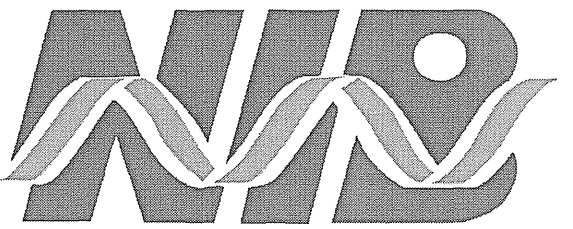
biologije. Temu je seveda botroval tudi razvoj drugih tehničnih in naravoslovnih ved in tako smo danes priče tudi mnogim drugim spremembam v družbi, ki jim včasih pravzaprav težko sledimo in jih mnogokrat niti dobro ne razumemo. Za romantično biologijo ni več prostora. In če pomislimo na skokoviti razvoj biologije danes, se pravzaprav zdi štirideset let zelo dolgo obdobje.

Danes biologija ni ena, biologij je veliko! Z razvojem optičnih in analiznih tehnologij lahko raziskovalci Inštituta danes posegamo v drobovje mikroorganizmov, lahko povezujemo življenjske cikluse organizmov več deset metrov pod gladino morja, lahko poslušamo prej nezaznavne utripe žuželk, šepetanja rastlinskih korenin in pogovarjanje celic našega telesa. Od čistih biologij posameznih organizmov prihajamo danes do razumevanja ekosistsemov, od razumevanj genetskih zapisov posameznih vrst prihajamo počasi do razumevanj njihovih interakcij. Tako nam postaja jasno, da moramo ob vedno večji poglobljenosti specifičnih bioloških ved znati ohranjati tudi celovito sliko, mozaik, ki ga sestavlja in sproti spreminja narava. Mi ji lahko samo sledimo.

In vendar, ker smo le del narave, se enako, nam skoraj nezavedno, spreminja tudi naša miselnost in postopoma razumevamo naš vpliv na naravo in prek tega tudi na svet, v katerem živimo. In tu se ljudje različnih pogledov razhajamo. Iste pojave obravnavamo kaj različno na različnih koncih sveta. Različni so pogledi na to, kako gradimo svet okoli nas, kako bomo živeli jutri in kakšna bo naša resničnost. Odgovorov ne bomo našli, če jih ne bomo iskali tudi v biologiji.

Nacionalni inštitut za biologijo v Ljubljani združuje različna področja biologije, ki so se v teku teh štirih desetletij razvijala glede na možnosti, sposobnosti in interese posameznih raziskovalcev. Danes raziskujemo bakterijske sisteme na kopnem in v vodah, rastlinsko fiziologijo, komunikacije med insekti ter med žuželkami in rastlinami, večje združbe in njihov odnos do okolja, pa tudi nekatere bolezni, povezane s poškodbami dednine, ki jih predvsem in v veliki meri povzroča vedno bolj onesnaženo okolje. Inštitut za biologijo je bil ustanovljen leta 1961 kot univerzitetni inštitut in tako tesno povezan z Oddelkom za biologijo Biotehniške fakutete v Ljubljani. V sedemdestih letih se je priključil tudi pred tem delujoči Zavod za morsko biologijo, danes Morska biološka postaja Piran. V začetku osemdesetih let so raziskovalci ustanovili neodvisni raziskovalni inštitut. Ta se je leta 1991 konstituiral kot javni raziskovalni zavod, katerega ustanovitelj je bilo tedanje Ministrtvo za znanost in tehnologijo RS. Danes sodi NIB po obsegu med prve štiri naravoslovne inštitute v državi in je najprodornejši in najsodobnejši raziskovalni potencial v temeljnih, uporabnih in razvojnih bioloških raziskavah v Sloveniji!

Od skoraj sto sodelavcev dela na Inštitutu danes trintrideset doktorjev in dva magistra znanosti, in sicer na šestih raziskovalnih programih. Ti obsegajo temeljne in aplikativne raziskave v bioloških, biotehniških in biotehnoloških, v medicinskih vedah ter v ekologiji. Te programe podpira ustanovitelj, to je Ministrstvo za šolstvo, znanost in šport, večinoma preko programskega in projektnega financiranja.



Menimo pa, da je naše poslanstvo širše in da svoja znanja lahko prenašamo v praktične rešitve, n.pr. pri urejanju okolja, saj je varstvo narave in ohranjanje biodiverzitete ena naših najpomembnejših nalog. Tako smo pridruženi člani Centra za trajnostni razvoj, ki deluje v okviru UNIDA in se mu je pridružilo kar nekaj najvidnejših raziskovalnih institucij v Sloveniji. Druge uporabne in razvojne raziskave, ki potekajo na Inštitutu, pa deloma oziroma v celoti financirajo druga ministrstva, javne ter gospodarske organizacije, kakršna sta LEK in KRKA, pivovarna Laško, pa tudi nekaj manjših zasebnih podjetij, n.pr. BIA, Limnos in druge.

Nacionalni inštitut za biologijo deluje v Biološkem središču v Ljubljani, kjer deli prostore z Oddelkom za biologijo Biotehniške fakultete. Spet pod isto streho skušamo z Oddelkom ustvariti dobro infrastrukturno osnovo in znanstveno klimo za kakovosten in dinamičen razvoj biologije. Poleg raziskovanja bi si želeli še boljše vključevanje v pedagoške procese. Seveda že danes vzgajamo lepo število, povprečno okoli dvajset mladih raziskovalcev na leto. Nekateri sodelavci Inštituta opravljajo tudi pedagoško delo na do- in po-diplomskih izobraževalnih programih na drugih visokih šolah oziroma fakultetah.

Pomembna usmeritev Inštituta so torej raziskave širšega področja ekologije in varstva okolja. Človeštvo je vedno iskalo krivdo za svoje nesreče nekje drugje. Samozaverovanost in egocentrizem – antropopocentrizem - botrujejo napredku, kakršen pač je. Danes postaja vedno bolj jasno, da za izumrtje številnih vrst živih bitij ne moremo kriviti vulkanov, meteoritov in klimatskih sprememb, ampak da je za to kriv človek s svojim najbolj uničujočim orožjem, razumom. Ta proces se neustavljivo nadaljuje in žal se javnost obrača na znanost kot krivca! Včeraj sta bila to dinamit in atomska energija, danes je to biološka bomba v obliki genetskih raziskav. Krivdo moramo iskati v nas samih, verjetno jo najdemo v osnovnem gibalu vsega živega na našem planetu, v nagonu po samoohranitvi in moči. Ta žene posameznike, narode, politike in gospodarstvenike v

osvajanje prostora ne glede na posledice. Naloga znanstvenikov biologov pa je, da opozarjamo ne samo na pravico do drugačnih oblik življenja na tem planetu, marveč tudi na neobhodnost sožitja. Zavedati se moramo, da travniki, gozdovi, živali, reke in oceani niso tu le zaradi nas in da brez njih tudi nas ne bi bilo več. V bodoče bomo svoja prizadevanja še bolj usmerili na ekologijo, na preučevanje krhkih vezi, ki se prepletajo med živim in neživim. Še glasneje bomo opozarjali na posledice rušenja teh ravnotežij.

Drugo področje, kjer vidimo svoje možnosti razvoja, pa je biotehnologija. Del prizadevanj je usmerjen v genetiko in preučevanje poškodb DNA, ki jih povzroča okolje, in molekularni razvoj tumorskih celic. Pomembna usmeritev je tudi rastlinska fiziologija, kjer ustvarjamo diagnostični center za okužene rastline, preučujemo pa seveda tudi možnosti, kako z gensko tehnologijo rešiti rastline pred sicer neustavljivimi epidemijami bakterijskih in virusnih okužb. Tu ne izključujemo tudi raziskav na gensko spremenjenih organizmih in njihovo uvajanje v naš vsakdanjik. Spreminjanje genetskega materiala je osnova razvoja in prilagajanj. To se v naravi dogaja že milijarde let. V kmetijstvu že tisočletja posegamo v genski zapis, kar je pripeljalo do kulturnih rastlin in domačih živali. Danes imamo na voljo veliko učinkovitejših tehnik, ki nam omogočajo spremembe, do katerih bi po naravni poti morda prišli šele po nekaj stoletjih. Tako ustvarjamo novo biotsko raznovrstnost in iluzorno je misliti, da bomo ta proces ustavili. Naša naloga je, da opozarjamo na možne negativne posledice in preprečujemo nestrokovno uporabo znanja. Istočasno moramo zaščititi vse, kar se je v naravi do sedaj razvilo in preživelo. Kako se ob upiranju gensko spremenjenim organizmom sprenevedamo in slepimo, postane očitno, kadar gre za naš osebni obstoj in zdravje. Vse ideologije, etike in estetike v trenutku zanemarimo, kadar gre za lastno življenje. Tako laže sprejemamo gensko tehnologijo prav pri zdravljenju bolezni in presajanju organov in s tem rešujemo najprej svoj obstoj. Pred nami se pravzaprav šele odpirajo možnosti razumevanja našega delovanja in rešitve žive narave pred ekološko katastrofo, ki nas čaka, če ne bomo ukrepali. To je revolucija, na katero se šele moramo skrbno pripraviti.

Biologija je tako kompleksna, zapletena in prepletena, da je prave odgovore težko najti še pri tako izčrpnem delu posameznika. Šele več strokovnjakov skupaj ob stalni izmenjavi mnenj, se lahko dokoplje do kakovostnih rešitev. Tako Nacionalni inštitut za biologijo, ki praznuje štirideset let dela, stalno sodeluje z različnimi raziskovalnimi inštitucijami doma in po svetu. Mreže stikov razpredamo od Kitajske, prek ZDA in Latinske Amerike do Avstralije. Največ imamo seveda stikov s svojimi bližnjimi sosedi, z Italijo, Hrvaško in Avstrijo. Tudi intenzivno vključevanje v Evropske programe, tako že v 4, še bolj v 5 in v bodoče šesti, govore o tem, da naše raziskave segajo prek Rožnika čez okvire naših meja, kar kaže na to, da je tudi to področje raziskav pri nas na visoki strokovni ravni. Upajmo, da bo tako tudi v prihodnje!

Boris Kryštufek

RAZISKOVALNA DELAVNICA "VZORCI IN PROCESI V BIODIVERZITETI BALKANA" KOPER 25. – 28. SEPTEMBRA 2001

S konferenco v Rio de Janeiru se je pojem biodiverziteta premaknil iz ozkih strokovnih krogov v zavest povprečnega zemljana. Propadanje svetovne biodiverzitete *(t.j.* raznovrstnosti vsega živega) je namreč dobilo krizne razsežnosti, to pa je mobiliziralo znanstveni potencial in ga usmerilo k poglobljenemu preučevanju biodiverzitetnih vzorcev in procesov, ki te vzorce generirajo.

Balkanski polotok je eno glavnih žarišč evropske biodiverzitete, kar je vsaj deloma odsev geološke zgodovine ter pomena polotoka kot ledenodobnega zatočišča in njegove vloge pri izmenjavi elementov z Malo Azijo. Še posebej edinstveni so podzemski ekosistemi, katerih izvor je kontroverzen. Dosedanji pristopi k preučevanju problematike so bili fragmentarni in sporadični, kar je v veliki meri posledica političnih in ideoloških delitev pa tudi jezikovnih preprek.

Jugovzhodna Evropa je ena izmed zibelk zahodne civilizacije, zato so balkanski ekosistemi že tisočletja pod močnim človekovim pritiskom. Kot posledica etične fragmentacije ("balkanizacije") je za regijo značilna kronična politična nestabilnost, zaradi katere je negotova tudi usoda biodiverzitete. Učinek tega poudarjajo ekonomske težave na eni strani in temeljno nerazumevanje biodiverzitetnih vzorcev in procesov na drugi. Vse to otežuje aplikacije integralnih in trajnostnih oblik rabe naravnih virov. Z namenom, da prebrodimo te ovire, sta Znanstveno raziskovalno središče Republike Slovenije Koper (ZRS RS Koper) in britanska Univerza v Hullu (The University of Hull) jeseni 2001 organizirala raziskovalno delavnico (Exploratory workshop) *"Vzorci in procesi v biodiverziteti Balkana"* (Pattern and Process in the Balkan Biodiversity). Namen srečanja je bil dvojen: (1) zbrati vrhunske strokovnjake s področja balkanske biodiverzitete in (2) okrepiti stike med znanstveniki z Balkana in njihovo sodelovanje s kolegi iz zahodne Evrope.

Srečanje je finančno omogočila Evropska znanstvena fundacija (European Science Foundation), ki je krila stroške potovanja in namestitve za vabljene udeležence. Izvedbo delavnice je finančno podprlo tudi Ministrstvo za šolstvo, znanost in šport R Slovenije (MŠZŠ). Programski in organizacijski odbor (doc. dr. Darko Darovec, prof. dr. Boris Kryštufek, dr. Huw I. Griffiths,

doc. dr. Lovrenc Lipej) je povabil 23 raziskovalcev iz Slovenije, Hrvaške, ZR Jugoslavije, Bolgarije, Grčije, Nemčije, Češke, Ukrajine in Velike Britanije. Srečanja se je udeležilo dvajset vabljenih raziskovalcev, dva odsotna pa sta poslala pisne prispevke. Povzetki prispevkov in urnik srečanja so bili natisnjeni v reviji Annales (23/'2001, Series historia naturalis 11 (suplement): 1-18), v celoti pa bodo objavljeni v samostojni knjigi, ki bo izšla pri nizozemskem akademskem založniku Kluwers Academic Publishers (urednika H. I. Griffiths in B. Kryštufek). Z založbo smo decembra 2001 že podpisali pogodbo.

Delo je potekalo v petih tematskih sklopih: (1) izvor in starost elementov v balkanski favni, (2) prispevek balkanskega refugija h genomu severne Evrope, (3) evolucijski prispevek balkansko-anatolskega mostu, (4) varstveni status "vročih točk" in "zbiralnikov" ter (5) paleoklima, paleovegetacija in teorija speciacije.

Delavnica je samo prvi korak k doseganju popolnejšega in integralnejšega pogleda na vzorce in procese v balkanski biodiverziteti. Cilj bo dosežen, če bomo razvili nov, sintetičen pogled na strukturo balkanske biodiverzitete in na dejavnike, ki jo porajajo. V naslednji fazi pripravljamo kandidaturo za financiranje raziskovalne mreže, v okviru katere bomo lahko vzpostavili temelje za pristop k izvedbi obsežnejšega raziskovalnega projekta. Podobno aktivnost nam je predlagal tudi prof. dr. Gabor Vida, ki se je udeležil delavnice kot predstavnik Evropske znanstvene fundacije. Decembra 2001 smo že pripravili izhodišče za kandidaturo na razpis raziskovalne mreže (Exploratory network). Delo bomo predvidoma organizirali v treh sklopih: (1) biodiverzitetni vzorci (vodja B. Kryštufek), (2) evolucijska genetika (J. Zima) in (3) paleo-okolje (H. I. Griffiths). Težišče aktivnosti bo predvidoma v gorovju Pindos v severozahodni Grčiji. Delavnica je namreč pokazala, da so bile okoljske razmere na tem območju stabilne skozi daljše časovno obdobje in da se tu prekrivajo "vroče točke" številnih taksonomskih skupin. Če bomo z raziskovalno mrežo uspešni, potem bo prišel na vrsto glavni korak, ki bo, ob ugodnem razpletu, omogočil organizacijo kompleksnih in dolgoročnejših terenskih in laboratorijskih raziskav.

Biodiverzitetne raziskave imajo v programu Znanstveno-raziskovalnega središča RS Koper že daljšo tradicijo, z vzpostavitvijo Inštituta za biodiverzitetne raziskave (IBR) v letu 2001 pa so postale eno prednostnih raziskovalnih področij ZRS. Dejstvo, da je IBR že v prvem polletju svojega obstoja so-organiziral mednarodno znanstveno posvetovanje, ni naključje. Gre za zavestno umeščanje biodiverzitetnih raziskav v mednarodno okolje. Dve veliki področji bioloških znanosti se danes razvijata z bliskovito naglico: molekularna biologija in biodiverzitetne raziskave, skupaj z varstveno biologijo. V molekularni biologiji so stvari laže pregledne že zaradi sofisticirane tehnologije, brez katere tovrstne raziskave sploh niso mogoče. Skratka, brez kompetentnosti tudi rezultatov ne more biti, in to nikakršnih. Biodiverzitetne raziskave, katerih pomembni del je vezan na taksonomijo ter floristiko in favnistiko, pa so prav zaradi obremenjenosti s tradicionalnimi panogami v Sloveniji zašle v slepo ulico. V državi, ki ji obilnemu proračunskemu financiranju navkljub ni uspelo pravočasno niti inventarizirati nacionalne biodiverzitete, bi bilo naivno pričakovati, da se bo institucionalizirani floristiki in favnistiki posrečilo z lastnimi močmi dvigniti na višji nivo kompleksnih biodiverzitetnih raziskav. Tragikomično je dejstvo, da so danes v Sloveniji najbolje preučena živalska skupina vretenčarji, ko pa so bile prav vertebratološke študije ves čas 20. stoletja na obrobju financiranih dejavnosti, ali pa so celo potekale v povsem ljubiteljskem okviru. Največ, kar je slovenski biologiji uspelo doseči na biodiverzitetnem področju, so zaščitni ukrepi pri financiranju državnih ustanov, katerim kakovosti biodiverzitetnih raziskovalnih produktov ni več treba dokazovati v mednarodnem merilu. V takšnem grotesknem ozračju je potekala mednarodna delavnica v Kopru. Predvsem zaradi tega upam, da se bo pokazala za eno od lastovk slovenske biodiverzitetne pomladi.

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Claudio Pericin: FIORI E PIANTE DELL'ISTRIA DISTRIBUITI PER AMBIENTE. 464 strani, Rovinj in Trst, 2001. (Izšlo kot zunajserijsko delo štev. 3 v zbirki Aktov Središča za zgodovinske raziskave/Centro di ricerche storiche v Rovinju, kjer je tudi dosegljiva (Rovinj, Piazza Matteotti 13, info@crsrv.org)

30. novembra 2001 je bil v Poreču velik dan, ki smo ga razumeli kot praznik vseh, ki jih zanima istrska flora, a tudi kot praznik italijanske narodne skupnosti v Istri. V poreški mestni hiši so veljaki javnega življenja, predvsem pa tržaški botanik dr. Fabrizio Martini kot boter in puljski veterinar, a že dolgo v Baslu živeči Claudio Pericin kot avtor, predstavili knjigo o istrski flori. Novica o tej knjigi je bila povsem nepričakovana in zato tudi presenetljiva. Podpisani se je z avtorjem spoznal šele v letu 2001, na zgodnjespomladanski ekskurziji v okolico Premanture, in nato še poleti v slovensko Čičarijo. Tedaj sploh ni zaslutil, da ta ljubeznivi in skromni človek pripravlja oz. da je medtem že natisnjeno tako pomembno in obsežno delo.

Zgodovina raziskovanja istrske flore je stara, saj sega v 16. stoletje (P. A. Mattioli) in doživi, še vedno v predlinnéjevskem obdobju, prvi bogati prispevek s poročilom G. H. Zanichellija (1730) o ekskurzijah v letih 1722 in 1725, ki se ju je udeležil in pravzaprav vodil *(Amicos habui comites, praecipue Dominum Petrum Antonium Michaelium, eorundem studiorum & participem & Ducem,* piše v predgovoru Zanichelli) italijanski botanik P. A. Micheli. Floristična dejavnost kulminira v 2. polovici 19. stoletja z lokalnimi florami A. Loserja (1860, 1864), J. Freyna (1877, 1881), A. Stefanija (1884, 1894-1895), C. de Marchesettija (1896-1897) in E. Pospichala (1896-1899). Na prehodu iz 19. v 20. stoletje so bile objavljene florule manjših območij (Poreč: M. Calegari 1897, 1899 in 1904; Rovinj: N. Benacchio 1939), ves čas vse do danes pa so floristi objavljali manjše ali večje floristične prispevke.

Pisec raziskovalce istrske flore dokaj podrobno navaja v posebnem poglavju in jih tudi našteva v seznamu literature. V zadnjih letih pa izdajo istrske flore - nepovabljeno - pripravlja neki avstrijski botanik.

Glavni in daleč najobsežnejši del knjige obsegajo predstavitve posameznih taksonov, razdeljenih na 6 ekoloških skupin: skalna obmorska obala, peščine, školji, slanišča in polslanišča, makije, garige in borovja (alepski in črni bor ter pinija), gozdovi, travniki in pašniki, bukovja in suha gorska območja (večina v tem poglavju poglavju predstavljenih vrst izvira z Učke in njene bližnje soseščine), vodna rastišča in notranja (sladkovodna) močvirja ter kulture in od človeka vplivana območja. Kot dodatek so prikazane še praproti in mahovi. Prikaz vsake ekološke skupine se začenja s splošnimi opombami in zgovornimi, nemalokrat kar razpoloženjskimi ilustracijami, ki jim sledijo po abecedi latinskih imen naštete vrste. Poudarek je na ilustraciji, morfološke opise je pisec namenoma izpustil. Latinskemu imenu in morebitnim sinonimom sledijo podatki o družinski pripadnosti ter knjižna imena v italijanščini, hrvaščini, slovenščini, francoščini, angleščini in nemščini. Pisec je posebno pozornost posvetil istrskim narečnim imenom, ki jih je, seveda predvsem italijanska, tudi sam zbiral in objavljal. Navedeni so še tip rastišča, čas cvetenja, splošna razširjenost, morebitna užitnost ali drugačna uporaba, morebitna opomba (naravoohranjevalna dejstva, taksonomska novost) in kraj fotografiranja.

V knjigi je objavljenih nad 1700 fotografij, ki pa niso samo rastlinske, temveč tudi krajinske in rastlinsko-združbene. Njihova kvaliteta je odlična, zavedati pa se je treba tudi izredno velikega in potrpežljivega dela, ki ga je avtor opravil s številnimi ekskurzijami, brez katerih ne bi mogel doseči slikovno tako popolnega prikaza istrske flore. Mnogo rastlin je prikazanih s po 2 fotografijama, npr. cvetoče in plodeče rastline, ali pa širšim in bližnjim pogledom. Tehnični urednik je iz predloženih diapozitivov računalniško ustvaril manjše ali večje izreze, zaradi česar se splošni pogled na strani zdi morda nekoliko izumetničen. Ko pa gledaš le posamezne slike, spoznaš, da so nastali večinoma zelo povedni rastlinski portreti. Kot primer naj navedemo le sliko orhideje *Spiranthes spiralis,* ki v knjigi (str. 97) v resnici nastopa kot pravi "zviti zvitocvet". Kdor ve, kako nefotogenična je *Athamanta turbith,* bo občudoval njeno sliko na str. 193. In tako še neštetokrat!

Avtor knjige je Istro omejil z njenimi mejami v času Avstro-Ogrske. Sega torej od Glinščice na severozahodu in Čičarije z Učko na severu do rta Kamenjak na skrajnem jugu, v manjši meri pa so zastopane tudi nekatere le na kvarnerskih otokih razširjene vrste (npr. *Astragalus vegliensis).* Z lošinjske Osoršćice je slika vrste *Cardamine maritima,* ki je sicer znana tudi z Učke na "terri fermi". Večji del slik je posnetih v hrvaški, kar nekaj pa tudi v slovenski Istri. Poznavalec slovenske adventivne floristike ne bo presenečen, ko bo pri vrstah *Ambrosia artemisiifolia, Artemisia annua, Echinochloa crus-galli, Senecio inaequidens* in *Tagetes minuta* kot kraj posnetka odkril Valdoltro.

Ob pregledovanju dobiš občutek, da komaj katera istrska rastlina manjka. Zelo kritični presojevalec bi sicer našel to ali ono vrsto, ki je v knjigi ni, zlasti iz taksonomsko kritičnih skupin, a so ravno iz rodu škržolic *(Hieracium)* zastopane številne, tudi mnogim botanikom povsem neznane vrste. Avtor se ni ustavljal pred manj očitnimi ali manj privlačnimi vrstami in je tako v knjigo

sprejel tudi mnoge ščire *(Amaranthus),* metlike *(Chenopodium),* dresnovke *(Polygonum, Bistorta, Persicaria, Fallopia)* ter tudi trave in ostričevke. Tako je knjiga pravi vodnik v spoznavanje istrskih rastlin, v katerem ne manjkajo tudi takšne redkosti, kot so *Ophioglossum lusitanicum, Senecio caroli-malyi* in *Staehelina dubia,* ali pa pred kratkim opisane vrste, kakršni sta *Serapias istriaca* in *Ophrys tetraloniae.* Zelo popolno so prikazane tudi gojene vrste, od granatnega jabolka do agave. Med brstnicami se je znašla neka parožnica *(Chara spec.),* avtorjevo pozornost pa je zbudila tudi šiška, ki jo je na hrastu v Padni povzročila osa šiškarka *Andricus (Cynips) quercus-tozae.*

Pri določanju je avtor poiskal pomoč mnogih poklicnih botanikov, kar po svoje zagotavlja strokovno zanesljivost knjige. Nekaj taksonomskih pripomb pa vendarle imamo, saj pri tako obsežnem delu ne more biti drugače. Ali je res, da v Istri rastejo vse iz skupine *Potentilla verna* navedene vrste (pomislek nam zbuja vrsta *P. tabaernemontani)?* V Jugovzhodnih apneniških Alpah endemična *Centaurea dichroantha* (str. 197) je seveda lahko le *C. x sordida (C. scabiosa* subsp. *fritschii x C. rupestris), Cirsium freyerianum* (str. 199) ni samostojna vrsta, temveč križanec med vrstama *C. acaule* in *C. pannonicum, Ballota nigra* (str. 301) je - po obliki čašnih zobcev sodeč - prejkone *B. alba (B. nigra* subsp. *foetida). Bupleurum falcatum* s Kojnika (str. 194) je lahko le *B. falcatum* subsp. *cernuum,* saj tipska podvrsta v Istri ne raste, z imenom *Ranunculus ficaria* predstavljena lopatica (str. 90) pa je *R. calthifolius.*

Pisec se zaveda (str. 15), da so v knjigi objavljene tudi floristične novosti. Po naši vednosti je prvi, ki je v Istri objavil nahajališče vrste *Anthericum liliago* pri Dvigradu, izpred nekaj let sicer znano tudi nam. Slovenska floristika dobiva podatke in večkrat tudi spodbudo z navedenimi kraji fotografiranja, a tudi s sliko smetlike *Euphrasia marchesettii* iz Pirana.

Slika potrošnika *Cichorium pumilum* iz Podpeči je nasploh novost za slovensko floristično vednost.

Knjiga naj bi, kot to v njeni predstavitvi poudarja avtor italijanske flore, rimski (nekoč tržaški) univerzni profesor botanike in avtor Flore Italije Sandro Pignatti, premostila vrzel med znanstvenim spoznanjem in temu ustreznim jezikom ter vsakomer, ki se rastlinam približuje z zanimanjem in občudovanjem ter potrebuje splošno razumljivo izražanje. Takšno vlogo bi lahko imel priročnik za v žep ali vsaj nahrbtnik, knjiga velikosti 25 x 34,5 cm in težka 3,5 kg pa je komaj primerna celo za v avto, sploh pa ne za v nahrbtnik. Tako je pred nami knjiga, po kateri lahko listamo predvsem na (dovolj veliki) mizi doma. Koliko bo pomagala nepoklicnim ljubiteljem rastlinstva, mi je kot zastopniku poklicnih težko presoditi, vsekakor pa naj zatrdim, da je odličen pripomoček, zaradi svoje vrstne popolnosti pa mnogostranska spodbuda tudi in morda celo predvsem tem drugim. Avtor, puljski domačin, je od otroških izkušenj naprej z istrsko rodno grudo povezan z neštetimi vezmi, kar je v knjigi na mnogo krajih razločno prepoznavno in s čimer je knjiga poleg strokovne dobila tudi veliko etično vrednost. Pripravil nam je prvo slikovno knjigo istrske flore, h kateri mu iskreno čestitamo.

Tone Wraber

Claudio Battelli: PRIROČNIK ZA SPOZNAVANJE MORSKE FLORE TRŽAŠKEGA ZALIVA. Zavod Republike Slovenije za šolstvo, 2000, 170 strani.

Pred nedavnim je na police knjigarn prišla v naslovu omenjena knjiga, ki v podnaslovu natančneje opredeljuje svojo vsebino kot: *"Kako nabirati, shranjevati in določevati nekatere najpogostejše predstavnice morskih alg in semenk vzhodnega dela Tržaškega zaliva".* Slovenska algološka bibliografija ni ravno bogata, saj bi vse doslej v slovenskem jeziku izdane knjige s tega področja lahko prešteli na prste ene roke, še posebej pa to velja za morsko algologijo. Drugače rečeno, Battellijev priročnik je prvo obširnejše delo, posvečeno morskim algam, ki je bilo izdano v slovenskem jeziku, tako da je tudi pred piscem ocene nekoliko zahtevnejša naloga.

Pa začnimo s suhoparnim pregledom zgradbe knjige. Kazalu vsebine in uvodu (ki je bolj predgovor) sledi kakih 20 strani dolg uvodni del, v katerem so predstavljeni osnovni pojmi o morski obali in obalnem morju, z najpomembnejšimi značilnostmi so predstavljene morske alge (značilnosti posameznih skupin, kako se jih lotiti) in semenke, sklep tega dela pa so navodila za določanje morskih alg in semenk. Sledi ključ, ki obsega okoli 120 strani in je tudi bogato ilustriran s fotografijami Marjana Richterja. Na koncu ključa je (na zelo nedostopnem mestu) nekakšno kazalo (pravega stvarnega abecednega kazala knjiga žal nima), ki mu na 8 straneh sledijo slovarček z razlago nekaterih manj znanih v knjigi uporabljenih pojmov in 4 strani literaturnih virov (na katere pa nikjer v besedilu ni opaziti kakega sklicevanja).

Ena splošnih in načelnih pripomb na vsebino ključa je, da je v njem predstavljen le izbor "najpogostejših" vrst. Uporabnik namreč nikoli ne more vedeti, ali morda ni nabral ene od preostalih vrst, živečih na tem območju, ki jih je vsaj trikrat toliko, kot jih je predstavljenih v knjigi. Res pa je, da je to dejstvo v knjigi večkrat poudarjeno, in le upamo lahko, da se bo naslednja izdaja priročnika približala enemu izmed osnovnih meril za uporabnost ključa, ki je: popolna pokritost obdelovane skupine na obravnavanem območju.

Pa si nekoliko podrobneje oglejmo, kaj nam Battel-

lijev ključ pove o tem, "kako nabirati, shranjevati in določevati ...".

Kako "nabirati" in "shranjevati"?

Tej témi je posvečenih 5 strani, ki so skrite v poglavju *"Temeljne informacije o algah"*. Glede na to, da je téma ena od naslovnih in vsekakor pomembnih, bi ji bilo smiselno posvetiti vsaj samostojno poglavje. Popolnoma izpuščena pa je ta téma pri morskih travah, ki vsekakor imajo svojo specifiko in potrebno podrobnejše predstavitve. Napotki o nabiranju in shranjevanju so sicer dovolj izčrpni, vendar nekoliko nepregledno razporejeni. Tako je npr. na več mestih omenjen fiksativ, katerega natančnejšo sestavo pa najdemo opisano šele pod podnaslovom *"Priprava suhih zbirk - algarij"*, kamor vsekakor ne sodi. Nadalje je interpretacija priprave 3-5% raztopine formaldehida nejasna: kaj je formalin (komercialno ime za približno 35-40% vodno raztopino formaldehida), kaj je formaldehid in česa mora biti v končnem preparatu 3-5%? Prav tako je nejasno, kaj naj bi bil "10 mm debeli furnir" (verjetno vezana plošča), pri omembah temperatur v zamrzovalniku so pozabljeni minusi, algarija kot suhe zbirke pa vsekakor ne ogrožajo "paraziti", ampak različne drobne živali (prašne uši, nekateri hrošči), ki se prehranjujejo z odmrlim rastlinskim materialom, torej kaj takega kot detriti-herbivori, ki pa jim žal le "1- do 2-urno" zamrzovanje ne pride do živega (vsaj njihovim jajčecem in bubam ne).

Kako "določevati"?

Kot je bilo že omenjeno, sta ključu namenjeni približno dve tretjini knjige in prvi vtis ob prelistavanju tega dela je dober. Opazimo, da ima vsaka stran tega dela v povprečju kake 3 lepe barvne fotografije, in ker vemo, da je v knjigi podrobneje predstavljenih kakih 60 vrst, lahko enostavno izračunamo, da prideta na vsako od njih kaki dve strani besedila skupaj s kakimi 6 fotografijami, kar bi bila prav razkošna podrobnost obdelave.

Ko pa se ključa lotimo podrobneje, smo žal nekoliko razočarani. Hitro lahko opazimo, da je razdeljen na nepregledno kopico različno oblikovanih ključev, povezave (prek številke strani npr.) med njimi na več mestih manjkajo, če si zgradbo ključa ponazorimo grafično (brez tega jo je res težko razumeti), pa vidimo, da je to nekakšen kontinuirano politomen ključ z 22 točkami, število alternativ na posamezno točko pa je od 2 (izjemoma) do 9 (!), pri čemer seveda tudi medsebojna antitetičnost alternativ ni vedno mogoča, da o izgubi časa med določevanjem in nezanesljivosti odločitev niti ne govorimo. Večina točk ključa je tabelarnih, zaradi razkošne opreme tabel s slikovnim materialom pa so alternative iste točke pogosto raztegnjene na več strani. Slikovna oprema je na prvi pogled pozitivna plat ključa, a kritični pogled nanjo nam kaj hitro razkrije vsaj dve bistveni metodološki napaki: 1) slike pri alternativah iste točke pogosto niso primerljive, saj so posnete pod popolnoma različnimi povečavami (od pomanjšave do več 100x povečave), ob sliki pa je označeno le, ali je posneta z navadnim fotoaparatom ali s pomočjo povečevalne naprave; 2) uporaba posameznih fotografij, ki seveda vedno predstavljajo le neko konkretno vrsto, na višjem hierarhičnem nivoju ključa (torej na začetnih točkah), je skrajno zavajajoča; na teh točkah bi bile narisane sheme veliko bolj primerne, konkretne fotografije pa je smiselno uporabiti šele na koncu vej ključa, ko v resnici pridemo do določitve vrste (ali izjemoma rodu). Nadalje so razmeroma kompleksne definicije glavnih v ključih uporabljenih pojmov razmetane, namesto da bi bile zbrane na enem mestu na začetku celotnega ključa, prav tako pa so razmetane tudi predstavitve posameznih vrst, ki jih najdemo po koncu ključa za vsako skupino alg, vrste pa so spet razvrščene po vrstnem redu iz ključa. Ob tem, da v knjigi ni pravega stvarnega kazala, je ta način nizanja vrst seveda skrajno nepregleden. Toliko na kratko o metodoloških značilnostih ključa.

V vsebino ključa za določevanje alg se ne bom spuščal, saj popolnoma zaupam avtorjevi strokovnosti, ocenil bi le še uporabnost prve točke v ključu za določevanje alg, na kateri se odločamo med rdečimi, zelenimi in rjavimi algami. Ta odločitev na podlagi makroskopskega ogleda materiala je tudi za strokovnjaka včasih težavna, zato Battelli predlaga razmeroma zamudno metodo ugotavljanja tipov barvil v steljkah. Za začetnika pri algah ni ravno vzpodbudno, da že pri prvi točki izgubi pol ure, ali pa sploh čisto obupa, če ima opravka z algarijskim listom, materiala, s katerega ne želi kuhati ali namakati v alkoholu ali destilirani vodi. Vsekakor bi bilo odločitev o višji sistematski pripadnosti alg smiselno pustiti za kasneje in dati prednost morfologiji steljk.

Na kratko pa bi komentiral še vsebino ključa za določanje "vseh vrst morskih semenk", saj so té tudi meni ljuba skupina.

Pri teh so popolnoma zanesljivi razlikovalni znaki že ožiljenost (število, medsebojna lega in velikostni odnosi žil) listne ploskve, oblika njenega vrha in zgradba listne nožnice; najpogosteje nam tudi edino ti razlikovalni znaki pridejo prav, saj želimo določiti na obalo naplavljene odtrgane liste. Precej manj uporabni so znaki na podzemnih organih, skoraj neuporabni pa znaki v cvetni regiji, saj le dve od obravnavanih štirih vrst v severnem Jadranu kolikor toliko redno cvetita, in še ti zelo neopazno. Avtor pa od znakov na listih v ključu navaja le dolžino in širino listov (ki se med vrstami precej prekrivata) ter obliko listnega vrha, pri opisu katere pa uporablja tudi neustrezne ("zaobljen" namesto zaokrožen) ali napačne ("asimetričen" namesto izrobljen) izraze.

Med "vsemi" našimi morskimi semenkami vsekakor manjka *Ruppia cirrhosa* (=*R. maritima* auct. slov.).

In na koncu še beseda ali dve o slovarčku. V njem so načeloma ponovno predstavljeni in razloženi strokovni pojmi, ki jih uporabnik priročnika ne utegne razumeti. Glavno pripombo imam na več razlag pojmov, povezanih z izmeno generacij (prerodom), ki so premalo natančno definirani. Tako se sporofitska generacija ne "konča" s tvorbo katerihkoli spor, ampak so za to pomembne mejospore, iz katerih se nato razvijejo rastline gametofitske generacije. Katerakoli generacija pa seveda lahko tvori različne mitospore, ki pa jih ne smemo mešati s prehodom med generacijami, saj le obnavljajo isto generacijo. Tudi uporaba pojma "rod" kot sinonima za "generacijo" je neprimerna in nepotrebna, saj je "rod" v biologiji zelo dobro definiran. Bolj lepotni popravki v tem kontekstu so: "heteromorfen krog" bi bilo pravilno pisati "heteromorfni prerod" ali "heteromorfna izmena generacij", saj gre za določno rabo pridevnika, uvajanje pojma "krog" kot sinonima za "izmeno generacij" ali "prerod" pa je vsekakor nepotrebno. In v tem kontekstu še nekaj pripomb: pojma gametocista ne bi smeli enostavno uporabljati namesto pojma gametangij, ne da bi razložili smiselnost razlikovanja in v navezavi na to predlagali tudi spremembo imena za enocelični sporangij, ki seveda ob svoji enoceličnosti ne more biti "organ", nespolno razmnoževanje v ožjem smislu pomeni razmnoževanje s specializiranimi, navadno enoceličnimi strukturami (sporami), v nasprotju z vegetativnim razmnoževanjem, pri katerem nastopajo večcelične strukture, ki so lahko specializirane (propagule) ali ne (v primeru fragmentacije), zigota ne nastane le z združitvijo "ženske in moške spolne celice", marveč v splošnem z združitvijo dveh gamet, ki se po definiciji sami ne moreta dalje razvijati.

Ob koncu bi se komu utegnilo zazdeti, da predstavljenega dela nisem dovolj pohvalil, da sem se s pisanjem ocene le, kakor bi nekdo porekel, "... v veliki znanstveni skupnosti diskreditiral ...". Še enkrat želim poudariti, da je delo kot prvo tovrstno v slovenskem jeziku gotovo pomembno, da je kot tako vsekakor tudi bolj izpostavljeno kritiki, kot bo morda njegova druga ali tretja izdaja, za kateri pa lahko upamo, da bosta prav zaradi upoštevanja kritike bistveno boljši. Krivdo za pomanjkljivosti pa poleg avtorja gotovo nosita tudi strokovni recenzent in lektor, ki se z delom očitno nista dovolj trudila.

Battellijev priročnik torej vsekakor sodi na polico vsakogar, ki ga morske alge, morsko življenje ali narava nasploh zanima, a navaditi se ga moramo uporabljati in biti do rezultatov uporabe kritični.

Nejc Jogan

KAZALO K SLIKAM NA OVITKU

SLIKA NA NASLOVNICI: Žareči zajčji mak *Adonis flammea* je bil v zadnji izdaji Rdeče knjige redkih in ogroženih vrst Slovenije iz leta 1989 že spoznan za izumrlo vrsto, a smo ga v začetku devetdesetih vnovič odkrili v Slovenski Istri. Le redka žitna polja se še lahko "postavljajo" s takšno botanično redkostjo, ki je hkrati tudi imeniten okras zoreče pšenice (foto: M. Lipovšek).

Slika 1: Za Krajinski park Strunjan so značilne slikovite flišnate brežine, ohranjena naravna kamnita obala in tradicionalna kulturna krajina (foto: D. Podgornik).

Slika 2: Kulturna krajina Brkinov, mejnega sredozemskega območja, se zaradi socio-ekonomskih vzrokov hitro spreminja: nekdanji travniki se zaraščajo, med drugim tudi z redko panonsko mačjo meto *Nepeta pannonica* (na fotografiji v ospredju), ki je tudi v slovenski Rdeči knjigi redkih in ogroženih vrst (foto: M. Kaligarič).

Slika 3: Pogled čez kraški rob Čičarije pri Istrskih vratih na Istro: v ospredju ilirska perunika *Iris illyrica* (foto: M. Kaligarič).

Slika 4: Jeseni se ametistasta možina *Eryngium amethystinum*, ki raste na kraških travnikih, obarva kovinsko modro (foto: D. Podgornik).

Slika 5: Rumenonogi galebi *Larus cachinnans* so po nekaterih evropskih merilih med najpomembnejšimi vrstami ptic v Sečoveljskih solinah (foto: D. Podgornik).

Slika 6: Sabljarka *Recurvirostra avosetta* je leta 2001 prvič zanesljivo gnezdila v Sečoveljskih solinah in v Sloveniji nasploh (foto: I. Geister).

Slika 7: Zavarovana območja imajo izjemno pomembno vlogo pri varovanju in ohranjanju biotske raznovrstnosti. Med jadranskimi zavarovanimi območji so slapovi dalmatinske reke Krke v istoimenskem naravnem parku nekaj izjemnega (foto: L. Lipej).

Slika 8: Polžasta rupija *Ruppia cirrhosa* uspeva v skrajnostnih razmerah solinskih jarkov (foto: D. Podgornik).

INDEX TO PICTURES ON THE COVER

FRONT COVER: In the last edition of the Red Book of Rare and Endangered Species in Slovenia (published in 1989), the glowing pheasant's-eye *Adonis flammea* was considered extinct. The species, however, was rediscovered in the early 1990s in Slovene Istra. There are only a couple of cornfields that can boast such botanical rarity, which is also a superb adornment of the ripening wheat (photo: M. Lipovšek).

Figure 1: Strunjan Landscape Park is best known for its picturesque flysch slopes, well preserved stony coast and traditional cultural landscape (photo: D. Podgornik).

Figure 2: The Cultural landscape of Brkini, a frontier Mediterranean area, is in the process of rapid changes for socio-economic reasons: the former meadows are being overgrown by various plants including the rare and red data book-listed catnip *Nepeta pannonica* species (in the foreground of the photo by M. Kaligarič).

Figure 3: View of Istra over the karst edge of the Čičarija mountains near Istrska vrata, with an iris *Iris illyrica* in the foreground of the photo (by M. Kaligarič).

Figure 4: In the autumn months the thistle *Eryngium amethystinum*, a karst meadow plant, acquires a metal blue colour (photo: D. Podgornik).

Figure 5: According to some European criteria, the Yellow-legged Gulls *Larus cachinnans* are amongst the most important birds of the Sečovlje Salina (photo: D. Podgornik).

Figure 6: In 2001, the Avocet *Recurvirostra avosetta* bred for the very first time at Sečovlje Salina and in Slovenia in general (photo: I. Geister)

Figure 7: Protected areas play an exceptional role in the protection and conservation of biodiversity. The waterfalls of the Dalmatian Krka river are something exceptional as far as the Adriatic protected areas are concerned (photo: L. Lipej).

Figure 8: *Ruppia cirrhosa* thrives in the exceptional conditions of salt-pan ditches (photo: D. Podgornik).

NAVODILA AVTORJEM

1. ***ANNALES:*** *Anali za istrske in mediteranske študije - Annali di Studi istriani e mediterranei - Annals for Istran and Mediterranean Studies* (do 5. številke: *Anali Koprskega primorja in bližnjih pokrajin - Annali del Litorale capodistriano e delle regioni vicine - Annals of the Koper Littoral and Neighbouring Regions)* je znanstvena in strokovna interdisciplinarna revija humanističnih, družboslovnih in naravoslovnih vsebin v podnaslovu opredeljenega geografskega območja.

2. Sprejemamo prispevke v slovenskem, italijanskem, hrvaškem in angleškem jeziku. Uredništvo ima pravico prispevke jezikovno lektorirati.

3. Prispevki naj obsegajo največ 24 enostransko tipkanih strani s po 30 vrsticami. Na levi pustite 3 do 4 cm širok rob. Zaželjeno je tudi (originalno) slikovno gradivo, še posebno pa oddaja prispevka na računalniški disketi v programih za PC (osebne) računalnike.

4. Naslovna stran tipkopisa naj vsebuje naslov in podnaslov prispevka, ime in priimek avtorja, avtorjeve nazive in akademske naslove, ime in naslov inštitucije, kjer je zaposlen, oz. domači naslov vključno s poštno številko in morebitnim naslovom elektronske pošte.

Uredništvo razvršča prispevke v naslednje **kategorije:**

Izvirni znanstveni članki vsebujejo izvirne rezultate lastnih raziskav, ki še niso bili objavljeni. Dela pošlje uredništvo v recenzijo. Avtor se obvezuje, da prispevka ne bo objavil drugje.

Pregledni članki imajo značaj izvirnih del. To so natančni in kritični pregledi literature iz posameznih zanimivih strokovnih področij.

Predhodno sporočilo in *Gradiva* imajo ravno tako značaj izvirnih del.

Strokovni članki prikazujejo rezultate strokovnih raziskav. Tudi te prispevke uredništvo pošlje v recenzijo in avtor se obveže, da prispevka ne bo objavil drugje.

Poročila vsebujejo krajše znanstvene informacije o zaključenih raziskovanjih ali kratek opis strokovnih in znanstvenih knjig ali srečanj. Taki prispevki ne smejo presegati 5 strani.

Mladinske raziskovalne naloge morajo biti urejene kot strokovna dela.

Komentarji so namenjeni aktualnostim s strokovnega področja. Ne smejo presegati 2 strani.

Obvestila so namenjena društvenemu življenju. Obsegajo 1 stran.

5. Prispevek mora vsebovati **povzetek** in **izvleček.** Izvleček je krajši (cca. 10 vrstic) od povzetka (cca. 30 vrstic) in v nasprotju s povzetkom tudi ne vsebuje komentarjev in priporočil.

V *izvlečku* na kratko opišemo namen, metode dela in rezultate. Navedemo, čemu smo delo opravili ali napisali dokument. Na že objavljeno gradivo se sklicujemo le, če je to glavni motiv dela. Na kratko opišemo metode in tehnike dela - kolikor je potrebno za razumevanje. Nove tehnike opišemo le, kjer se razlikujejo od že znanih. Če v delu ne opisujemo eksperimentalnega ali praktičnega dela, opišemo vire informacij. Rezultate in zaključke lahko združimo. Kar se da informativno navedemo le, kaj smo ugotovili oziroma odkrili.

Povzetek začnemo s stavkom, ki vsebuje glavno sporočilo dela. Stavki naj bodo popolni in ne predolgi. Pišemo v tretji osebi, le izjemoma uporabimo glagole v neosebni obliki. Uporabljamo pravilni strokovni jezik in se izogibamo slabše znanim kraticam. Ohraniti moramo osnovno informacijo in poudarke iz glavnega besedila. V povzetku ne sme biti ničesar, česar glavno besedilo ne vsebuje.

6. Avtorji so dolžni definirati in pripisati ustrezne **ključne besede** (pod izvlečkom) članka. Zaželjeni so tudi **angleški (ali slovenski) prevodi** ključnih besed, podnapisov k slikovnemu in tabelarnemu gradivu. Priporočamo se še za angleški (ali slovenski) prevod povzetka, sicer bo za to poskrbelo uredništvo.

7. V besedilu se po možnosti držimo naslednjih poglavij:

1. Uvod.
2. Pregled dosedanjih objav.
3. Materiali in metode (Dokazni postopek).
4. Rezultati.
5. Razprava ali diskusija.
6. Zaključek (Sklepi).
7. Zahvala - če avtor želi.
8. Priloge - če je potrebno.
9. Literatura (Viri, Bibliografija).
10. Povzetek (Summary).
11. Izvleček.
12. Ključne besede (neobvezno).

8. Ločimo **vsebinske** in **bibliografske** *opombe.* Vsebinske opombe besedilo še podrobneje razlagajo ali pojasnjujejo, postavimo jih *pod črto.* Z bibliografsko opombo pa mislimo na citat - torej sklicevanje na točno določeni del besedila iz neke druge publikacije (navedemo tudi točno stran, kjer je citat objavljen) ali na publikacijo (članek) kot celoto (točne strani, kjer smo besedilo prevzeli, ne navajamo).

Bibliografsko opombo sestavljajo naslednji podatki:

Avtor, leto izida in - le če citiramo točno določeni del besedila - tudi navedba strani.

Celotni bibliografski podatki citiranih in uporabljenih virov so navedeni v poglavju *Literatura* (Viri, Bibliografija).

Primer citata med besedilom:

(Grafenauer, 1993, 11).

Primer navajanja vira kot celote, brez citiranja: (Grafenauer, 1993).

Popolni podatki o tem viru v poglavju Literatura pa se glasijo:

Grafenauer, B. (1993): Miti o "Istri" in resnica istrskega polotoka. V: Acta Histriae I. Koper, Zgodovinsko društvo za južno Primorsko, 9-52.

Če citiramo *več del istega avtorja iz istega leta*, poleg priimka in kratice imena napišemo še črke po abecednem vrstnem redu, tako da se viri med seboj razlikujejo. Primer:

(Grafenauer, 1993a); (Grafenauer, 1993b).

Bibliografska opomba je lahko tudi del vsebinske opombe in jo zapisujemo na enak način.

Posamezna dela ali navedbe virov v isti opombi ločimo s podpičjem. Primer:

(Gombač, 1996; Grafenauer, 1993b).

9. Pri **citiranju arhivskih virov** navedemo najprej arhiv, nato ime fonda ali zbirke in signaturo. V članku navajamo kratico arhivskega vira v oklepaju med besedilom. Kratico pa razložimo v poglavju o virih na koncu prispevka.

Primer navajanja arhivskega vira v oklepaju med besedilom: (PAK. RAG, 1)

Primer navajanja arhivskega vira v poglavju o virih: PAK. RAG - Pokrajinski arhiv Koper, Rodbinski arhiv Gravisi, a. e. (arhivska enota) 1.

Podobno poskušamo ravnati pri uporabi časopisnih virov.

10. Poglavje o literaturi in virih je obvezno. Bibliografske podatke navajamo takole:

- Opis zaključene publikacije kot celote - knjige:

Avtor (leto izida): Naslov. Zbirka. Kraj, Založba. Npr.:

Verginella, M., Volk, A., Colja, K. (1995): Ljudje v vojni. Druga svetovna vojna v Trstu in na Primorskem. Knjižnica Annales 9. Koper, Zgodovinsko društvo za južno Primorsko.

V zgornjem primeru, kjer je *avtorjev več kot dva*, je korekten tudi citat:

(Verginella et al., 1995)

Če navajamo določeni del iz zaključene publikacije, zgornjemu opisu dodamo še številke strani, od koder smo navedbo prevzeli.

- Opis prispevka v **zaključeni publikaciji** - npr. prispevka v zborniku:

Avtor (leto izida): Naslov prispevka. V: Avtor knjige: Naslov knjige. Izdaja. Kraj, Založba, strani od-do. Primer:

Verginella, M. (1995): Poraženi zmagovalci. Slovenska pričevanja o osvobodilnem gibanju na Tržaškem. V: Verginella, M. et al.: Ljudje v vojni. Druga svetovna vojna v Trstu in na Primorskem. Knjižnica Annales 9. Koper, Zgodovinsko društvo za južno Primorsko, 13-51.

- Opis članka v **reviji:**

Avtor (leto izida): Naslov članka. Naslov revije, številka. Kraj, Založba, strani od-do. Primer:

Gombač, B. (1996): Osvoboditev Trsta maja 1945. Annales 8/'96. Koper, Zgodovinsko društvo za južno Primorsko - Znanstveno-raziskovalno središče Republike Slovenije Koper, 141-150.

- opis ustnega vira:

Informator (leto izporočila): Ime in priimek informatorja, leto rojstva, vloga, funkcija ali položaj. Način pričevanja. Oblika in kraj nahajanja zapisa. Primer:

Baf, A. (1998): Alojzije Baf, r. 1930, župnik v Vižinadi. Ustno izporočilo. Magnetofonski zapis pri avtorju.

- opis vira iz internetnih spletnih strani:

www. home page ustanove (leto-mesec izpisa): celoten naslov podstrani. Primer:

www.zrs-kp.si (2000-07):
http://www.slo-istra.com/koper/zrs/zrs.html

Članki so razvrščeni po abecednem redu priimkov avtorjev ter po letu izdaje, v primeru da gre za več citatov istega-istih avtorjev.

11. Tiskarski znaki za poudarke naj bodo:
podčrtano za **polkrepko,**
valovito podčrtano za *ležeče.*
Računalniški zapis naj vključuje ustrezne oznake za bold in *italics.*

12. Kratice v besedilu moramo razrešiti v oklepaju, ko se prvič pojavijo. Članku lahko dodamo tudi seznam uporabljenih kratic.

13. Pri **ocenah publikacij** navedemo v naslovu prispevka avtorja publikacije, naslov, kraj, založbo, leto izida in število strani (oziroma ustrezen opis iz točke 10).

14. Prvi odtis prispevkov uredništvo pošlje avtorjem v **korekturo.** Avtorji so dolžni popravljeno gradivo vrniti v treh (3) dneh. Besedilo popravljamo s korekturnimi znamenji, ki jih najdemo na koncu Slovenskega pravopisa (1962), Ljubljana, ali v: Slovenski pravopis 1. Pravila (1990). Ljubljana, SAZU-DZS, 13-14.

Širjenje obsega besedila ob korekturah ni dovoljeno. Druge korekture opravi uredništvo.

15. Uredništvo prosi avtorje, naj navodila vedno upoštevajo. Ob vseh nejasnostih je uredništvo na voljo za vsa pojasnila.

UREDNIŠTVO

INSTRUCTIONS TO AUTHORS

1. ***ANNALES:*** *Annals for Istran and Mediterranean Studies - Anali za istrske in mediteranske študije* (up to No. 5: *Annals of the Koper Littoral and Neighbouring Regions - Anali Koprskega primorja in bližnjih pokrajin*) is a scientific and research interdisciplinary review covering the humanities, sociology and natural science in the area as stated in the review's subtitle.

2. Articles (papers) written in Slovene, Italian, Croatian and English languages will be accepted. The Editorial Board reserves the right to have them linguistically revised and corrected.

3. Articles should be written on max. 24 pages with double spacing and on one side of the sheet only. On the left side of each page, a 3-4 cm wide margin is to be left. Original photographs, drawings and tables are welcomed, as well as diskettes containing the texts, together with reference to the programme used.

4. Title page of typescript is to include title and subtitle of the article (paper), author's name, any (academic) titles and name of institution by which employed or personal address with eventual E-mail address.

Articles are arranged in the following eight **categories:**

Original scientific papers containing not yet published results of the author's own research. Such works will be reviewed by scientists chosen by the Editorial Board. Authors oblige themselves not to offer their material to any other journal or magazine.

Review articles bearing the character of original works. These are critical and detailed reviews of literature from various interesting fields of research.

Preliminary communication and Materials also bearing the character of original works.

Professional papers presenting results obtained through research. They too will be reviewed, and authors oblige themselves not to publish them elsewhere.

Reports include short scientific information on integral research work or a short description of scientific or specialist books or meetings of experts. Such articles are not to exceed 5 pages.

Youth research compositions are to be presented in the same was as research works.

Explanatory comments include topical issues from various fields of research and are not to exceed 2 pages.

Notices include news from various associations and should not exceed 1 page.

5. Articles should include both **summary** and **abstract.**

Abstract is the shorter of the two (with up to 10 lines) and does not include, in contrast to summary (with up to 30 lines), explanatory comments and recommendations.

Abstract is to contain a short description of the purpose and methods of the work and its results. Author should also state why the work has been carried out and why a document has been written about it. References to the already published material are made only if this is the main purpose of the work. Methods: if necessary, work methods and techniques are to be briefly described (new techniques are to be stated only if differing from the already known ones). If no experimental or practical work is described, sources of information are to be given. Results and conclusions may be incorporated. Findings are to be presented as briefly as possible.

At the beginning of summary the essential points of the carried out work are to be presented. Sentences should be concise and not too long. The text is to be written in the third person; verbs may be used in impersonal form only exceptionally. The not so well known abbreviations are to be avoided. Summary is to retain the basic information from the main part of the text, and should not contain anything that does not appear in the main text itself.

6. Authors are obliged to define and state **key words** (below abstract) in their articles. **English (or Slovene) translation** of key words, texts accompanying figures and tables are welcomed, as well as English (or Slovene) translation of abstracts; if this is not convenient, the Board of Editors will provide for it.

7. Texts should include, if at all possible, the following chapters:

1. Introduction
2. Works published to date
3. Material and methods
4. Results
5. Discussion
6. Conclusions
7. Acknowledgements (if desired by author)
8. Supplements (if necessary)
9. References (Sources, Bibliography)
10. Summary
11. Abstract
12. Key words

8. Two kinds of *notes* are distinguished: those regarding the **contents** of the text, and those referring to **bibliography.** The first elucidate the text in even greater detail and are to appear *at the bottom of the page (under line).* Bibliographical notes, which are to appear in brackets in the text itself, deal with quotations and refer to a precisely stipulated part of the text from some other publication (the page on which quotation appears is to be therefore stated as well) or to a publication (article) as a whole (in this case no page from which the text has been taken is to be stated).

Bibliographical notes are made up of the following details:

Author, year of its publication, and page (but only if a precisely stipulated part of the text is quoted).

The entire bibliographical data of the quoted and used sources are to be stated under *References* (Sources, Bibliography).

Example of quotation referring to a precisely stipulated part of the text: (Sommerville, 1995, 11).

Example of source quotation as a whole, with no citation: (Sommerville, 1995).

The entire data of this source are to be stated in the references and sources chapter as follows:

Sommerville, M. R. (1995): Sex and Subjection. Attitudes to Women in Early-Modern Society. London-New York-Sydney-Auckland, Arnold.

If a number of works *by the same author from the same year* are quoted, letters in alphabetical order are to be stated apart from the author's surname and abbreviation of his first name, in order that the sources are clearly divided between each other. Example:

(Sommerville, 1986a); (Sommerville, 1986b).

Bibliographical note can also be a part of the note referring to the contents and is to be written in the same way, i.e. in brackets within the note referring to the contents.

Separate works or source quotations under the same note are to be separated with semicolon. Example: (Sommerville, 1986b; Caunce, 1994).

9. When **quoting archive sources,** the archive is to be stated first, then the name of the fund or collection and shelfmark. The abbrevation of archive source is to be stated in brackets in the text of the article. The abbrevation is to be explained in the references chapter at the end of the article.

Example of citing archive source in brackets in the text itself: (ASV. CSM, 240).

Example of citing archive source in the reference chapter: ASV. CSM - Archivio di Stato di Venezia. Cinque Savi alla Mercanzia, fasc. 240.

Review sources are to be stated in the same way.

10. The **references and sources** chapter is compulsory. Bibliographical data are to be stated as follows:

- Description of **integral publication:**

Author (year when published): Title. Volume - Collection. Place of publication, published by. Example:

Caunce, S. (1994): Oral History and the Local Historian. Approaches to local history. London and New York, Longman.

If there are *more than two authors,* the work can be also cited as:

(Matthews et al., 1990, 35)

If a specific part from an integral publication is quoted, the page numbers from which the quotation has been taken are to be added to the above description.

- Description of the **article (paper) in integral publication** - e.g. text in a collection of scientific papers: Author (year of its publication): Title of the paper. In: Author of the book: Title of the book. Volume - Collection. Place of publication, published by, pages from - to. Example:

Matthews, R., Anderson, D., Chen, R. S., Webb, T. (1990): Global Climate and the Origins of Agriculture. In: Newman, L. F. (ed.): Hunger in History. Food Shortage, Poverty, and Deprivation. Oxford-Cambridge, Blackwell, 27-55.

- Description of **article in certain review:** Author (year of its publication): Title of article. Name of review, its number. Place of publication, published by, pages from - to.

Example:

Sluga, G. (1996): Identity and Revolution: The History of the "Forty Days" of May 1945. Annales 8/'96. Koper, Zgodovinsko društvo za južno Primorsko - Znanstveno-raziskovalno središče Republike Slovenije Koper, 125-140.

- description of personal communication:

Informant (year when communication was given): Name and surname of informer, year of birth, function or position held. Manner of the testimony's presentation. Form and place where record was made. Example:

Baf, A. (1998): Alojzije Baf, 1930, priest at Vižinada. Personal communication. Tape recording at author's place.

- description of source from the Internet websites:

www. home page of institution (year-month when registered): full address of sub- page. Example:

www.zrs-kp.si (2000-07):

http://www.slo-istra.com/koper/zrs/zrs.html

If the same author(s) is (are) cited a number of times, the articles are to appear in alphabetical order of the authors' surnames and year of publication.

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underlined for **semi-bold,**

undulatory line for *italics.*

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12. Abbreviations in the texts are to be explained in brackets when appearing for the first time. A list of used abbreviations can be added to the article.

13. When **assessing a publication,** its author, title, place, publishing house, year of publication and page numbers (or appropriate description from Item 10) are to be stated in the title of the article.

14. First copies of printed articles will be sent to authors for **proof-reading.** Authors are obliged to return them in three (3) days. No new sentences are allowed to be added during proof-reading. The second (printing) proofs will be read by the Editorial Board.

15. Authors are kindly requested to consider these instructions at all times. In case of any indistinctness, please do not hesitate to contact the review's Editorial Board.

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KOPER 2001

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Series historia naturalis.

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ANNALES
Annals of the Koper Littoral and the Nearby Regions (subtitle until 1994).

Annals for Istran and Mediterranean Studies (subtitle until 1994, when the journal was divided into two entities: ANNALES series historia et sociologia and ANNALES series historia naturalis).

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Key

Letn. = letnik = annata = Volume
št. = številka = numero = No.
str. = stran = pagina = page
Ilustr. = ilustracije = illustrazioni = illustrations

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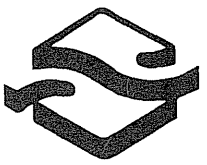

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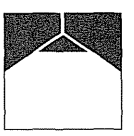

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