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Poštovani čitatelju!

Kada bismo se slučajno sreli - recimo - u informativnom punktu Parka u Čigoću, ja bih Vas, kao znatiželjni ravnatelj, upitao, po čemu Vi prepoznajete park prirode Lonjsko polje? Što biste odgovorili? Možda biste uprli prstom u bijele rode na okolnim krovovima? Odlično! Ili biste pokazali drvene posavske kuće? Aha, imate Vi i oko za kulturnu baštinu! Ili biste mi skrenuli pozornost na orla štekavca koji visoko kruži nad šumom Lugmarčica? Oho, Vi ste često u Lonjskom polju! Kad biste me htjeli voditi do čigočke Tišine - starog rukavca rijeke Save, pomislio bih: ili je strastveni ribič ili se bavi problematikom očuvanja ovog zaštićenog područja. Naime, čigočka Tišina ukazuje na nijemi riblji svijet, a on je najuže vezan uz vodu - vladara nad Lonjskim poljem. Za ribe ne samo savskog slijeva već cijelog dunavskog slijeva ovo je područje bitno i jedan je ako ne i najveći preostao refugij za nesmetani mrijest nekoliko značajnih i ugroženih vrsta. Neki etimolozi tvrde da je ime sela Krapje u srcu današnjeg parka prirode nastalo od riječi krap - Karpfen, što bi na hrvatskome značilo šaran. Posavcima su bile ribe jedan od osnovnih resursa za opstanak. Izumili su ribolovne alatke i tehnike kojima su pogodili - ja bih rekao - riblju «dušu». Muzej Moslavina u Kutini je o tome postavio izložbu koja je vrlo vrijedna pažnje. Tradicijski ribolov je dio kulturne baštine i identiteta Posavine, i takvog ga treba očuvati. Međutim, danas, u vrijeme žurbe i napornog života, sve više ljudi traži svoj unutarnji mir u športsko-rekreativnom ribolovu. Uprava Parka o svemu tome mora voditi brigu. I to je zapravo bio razlog zašto je počela odmah izrađivati ihtiološku studiju koja se temelji na terenskim istraživanjima tijekom 2001. i 2002. godine. Smatrajući da bi rezultati studije trebali biti dostupni široj javnosti, odlučili smo joj posvetiti ovaj broj biltena Parka prirode Lonjsko polje. Upravljanje ribljim fondom na području Parka osloniti će se na ovu studiju.

Na kraju mi preostaje da zahvalim prof.dr.sc. Miloradu Mrakovčiću i njegovu timu na izradi studije, a Europskoj komisiji na financijskoj potpori, koja je omogućila pripremu i tisak ovog broja biltena. A Vama, poštovani čitatelju, želim da Vam ovaj bilten na hrvatskom odnosno engleskom jeziku približi nijemi riblji svijet parka prirode Lonjsko polje.

Goran Gugić, ravnatelj

Dear Reader,

If we happened to meet in - for example - the Park's Info Point in Čigoć, and I, as inquisitive director, asked you what you associated Lonjsko Polje Nature Park with, how would you respond? You would perhaps point your finger at the stork nesting on the surrounding rooftops. Great! Or perhaps you would indicate the wooden houses of Posavina - ah, then you have an eye for the cultural heritage! Or perhaps you would indicate the white-tailed eagle soaring high over Lukmarčica Forest. Oh, you're a frequent visitor to Lonjsko Polje, then. If you wanted to take me to Čigoć's Tišina - an old backwater of the Sava River, I would think: either some impassioned angler, or someone who deals with the problem of the conservation of this protected area. For Tišina points to the silent world of fish, and it is tightly linked to the water - the ruler of Lonjsko Polje. For the fish of not only the Sava but also the whole Danube drainage basin, this area is essential, and it is one of the remaining refuges - if not perhaps the largest - for the spawning of several important and imperilled species. Some etymologists say that the name of the village of Krapje, in the heart of the park of today, derives from the word krap, Karpfen (Ger.), carp. For the people of Posavina, fish were one of the basic resources for their survival. They devised fishing implements and techniques that responded to the piscine spirit, if we can put it that way. The Moslavina Museum in Kutina put on an exhibition on the topic that is very worthwhile. Traditional fishing is part of the cultural heritage and identity of Posavina, and should hence be preserved. However, today, in a time of bustle and hurry, of a life that is increasingly exhausting, more and more people seek an inner peace for themselves in angling, fishing for sport and recreation. The Park's Administration has to be concerned with all these things. And this is actually the reason why we initiated this ichthyological study, based on field research undertaken during 2001 and 2002. In our opinion, the results of this study ought to be accessible to the general public, and so we have decided to dedicate this number of the Lonjsko Polje Nature Park Bulletin to it. Management of the fish stocks in the area of the park will be based on this study. At the end, it remains for me to thank Professor Milorad Mrakovčić DSc and his team for elaborating this study, and to the European Commission for financial support, which has enabled us to prepare and print this bulletin. I hope that this bulletin, in either the English or the Croatian version, will make the silent fishy world of Lonjsko Polje Nature Park just a little bit more familiar to our readers.

Goran Gugić, managing director

Značajke ribljih zajednica parka prirode Lonjsko polje

Characteristic of the fish communities in Lonjsko Polje Nature Park

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1. UVOD

1.1. LONJSKO POLJE

U Europi su prirodna poplavna područja već gotovo nestala, a većinu rijeka izmijenio je čovjek svojim djelovanjem. Najbolji su primjeri rijeke Volga, Dunav, Elba, Rhona, Rhina itd. Regulacija i intenzivne protupoplavne mjere posljednjih su desetljeća bitno izmijenile riječne vodne režime i morfologiju rijeka, pa su tek rijetke zadržale tračak izvornih poplavnih područja. S izgradnjom objekata koji zatvaraju rijeku, otvaraju kanale ili smanjuju poplavne zone nastaju promjene i na ribljim populacijama. Na mnogim vrstama riba uočeni su različiti razlozi koji su doveli do promjena brojnosti u vremenu i prostoru (Ackermann, 1973., Appelberg i sur., 1989., Balon, 1967., Biro, 1977., Botnarius., 1967). Zbog reguliranja vodotoka i hidromelioracija na velikim se površinama, osobito u nizinskim područjima, mijenja vodni režim staništa. To ima uočljiv utjecaj na sastav močvarnih i vlažnih šuma i travnjaka, pa se mijenja i sastav biocenoza. Poplavna područja nizinske Hrvatske imaju veliku ekološku vrijednost, pa ih treba štiti, racionalno iskorištavati, a po potrebi i ispravljati izgrađene objekte za upravljanje razinom vode, sve kako bi se postigao najbolji omjer između zaštite nizinskih područja od poplava i prirodnoga, nesmetanoga razmnožavanja i prehrane riba, ptica i ostalih organizama vezanih uz nizinska močvarna područja.

Lonjsko polje smješteno je u aluvijalnoj ravnici rijeke Save, 100 kilometara istočno od Zagreba. Prostire se uz savsku nizinu na oko 150 000 ha. Smatra se da Sava južno od Zagreba počinje poprimiti značajke prave nizinske rijeke. To umnogome određuje njezin tok i izgled okolnoga prostora. Kao i drugi takvi vodotoci, i Sava ovdje počinje meandrirati te stvarati tipična poplavna područja. Tijekom niza godina rijeka u stalnom napredovanju mijenja izgled obala, stvarajući rukavce i mrtvaje, dajući osebujan izgled krajoliku. Samo Lonjsko polje jedna je od najvećih nereguliranih poplavnih nizina u Europi, kompleks poplavnih šuma, močvara, livada, bara i riječnih rukavaca. Na području gotovo cijeloga Lonjskog polja najvažniji je ekološki čimbenik poseban vodni režim. Osim toga posebnoga vodnog režima, koji se

1. INTRODUCTION

1.1. LONJSKO POLJE

Most of the natural wetlands have practically disappeared in Europe, and human activity has resulted in the modification of most of the rivers. The best examples are such rivers as the Volga, Danube, Rhone, Rhine and Elbe. The straightening of the rivers and vigorous and far-reaching anti-flood measures of the last few decades have essentially modified riverine water regimes and the morphology of the rivers, and just a few of them have retained traces of the original floodplains. With river-impoundment, channel-opening or inundation zone-reduction facilities, changes have occurred among the fish populations. In many of the fish species, various factors have been observed leading to changes in their abundance over time and in geographical area (Ackermann, 1973., Appelberg i sur., 1989., Balon, 1967., Biro, 1977., Botnarius., 1967). Because of the straightening of the water courses and reclamation operations, over large areas, particularly in lowland regions, the water regime of the habitats has changed. This has a discernible effect on the composition of wetland and riparian forests and water meadows, and thus the composition of the biocoenosis has changed. The floodplains of lowland Croatia have a very large ecological value, and hence need to be protected, used rationally, and where necessary the mechanisms already built for the management of the water level should be adjusted so as to achieve the best ratio between protection of the lowland areas against flood and the natural and unhampered reproduction and feeding of fish, birds and other organisms related to the lowland wetlands.

Lonjsko Polje is located in the alluvial plain of the Sava River, 100 km east of Zagreb. It extends about 150,000 ha over the Sava plain. South of Zagreb the Sava can reasonably be considered to take on the features of a real lowland river. This to a great extent determines its course and the appearance of the surrounding area. Like other such streams, the Sava too here starts meandering and creating typical floodplain areas. Over the years the river has constantly shifted and changed the appearance of the banks, creating channels and oxbows, imparting a very individual appearance to the landscape. Lonjsko Polje itself is one of the largest unreclaimed

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

sastoji od povremenih i periodičnih poplavlivanja, važnu ulogu u stvaranju velike raznolikosti staništa ima mikoreljef. Već nekoliko desetaka centimetara razmaka između nižih i viših dijelova terena uzrokuje velike razlike u vodnom režimu staništa i opskrbljenosti vodom. Tako se na tom području stvorio mozaik međusobno različitih staništa, tipičnih za poplavna područja, što se, posve razumljivo, pokazuje i u bogatstvu različitih životnih zajednica. To su različiti tipovi poplavnih i vlažnih šuma, poplavnih i vlažnih travnjaka, različiti tipovi močvarnih i vodenih staništa (mrtvi rukavci s vodom, staništa na rubovima uz tekuću i stajaću vodu), ali i iskopi i kanali, kao posljedica višegodišnjega ljudskog utjecaja. Zapravo su sva ta staništa nastala u duljem razdoblju zbog specifičnoga vodnog režima u interakciji s ljudskim utjecajima. Zato svaka veća promjena u vodnom režimu i/ili iskorištavanju toga prostora nužno vodi prema promjeni životne zajednice na svakom pojedinom biotopu.

Rijeke su otvoreni sustavi, sa smjernicama isprepletenim (povezanim) kroz četiri dimenzije: longitudinalno (izvor - riječni tok - ušće), lateralno (rijeka - poplavno područje), vertikalno (rijeka - podzemne vode) i vremenski (vremenska ljestvica). Utjecaj čovjeka očituje se posebno u poremećaju neke od tih dimenzija. Struktura ribljih zajednica u velikim europskim rijekama znatno se promijenila tijekom posljednjih 100 godina. Kanalizacija, isušivanje močvara, sječa šuma, izgradnja hidroakumulacija i onečišćenje od industrije i poljoprivrede znatno su oštetili ekosustave čitavoga dunavskog slijeva. Za svaku rijeku i područja oko nje vrlo su važan čimbenik poplave. Snaga erozije prilikom poplava omogućava izgradnju prostranih bočnih kanala, rukavaca, otoka i močvara, stvarajući veliku raznolikost staništa na kojima se životinje hrane, skrivaju i razmnožavaju. Poplave pomažu u očuvanju bioraznolikosti, pomažući biljkama i životinjama u osvajanju novih ali i postojećih staništa. Poplave pomažu održanju zdravlja rijeke i okoliša oko nje. Životinje su na takvim poplavnim područjima prilagođene tom "poplavnom pulsu", godišnjem napredovanju i povlačenju poplavnih voda na poplavno područje. Posebno značenje poplave imaju za ribe poradi razmnožavanja i zato što im daju znak da je vrijeme za njihove migracije. Kako su ribe najvažniji sastojak biološkog iskorištavanja rijeka, za racionalno gospodarenje vodama prijeko je potrebno poznavati barem neke mehanizme koji uzrokuju promjene u ribljim populacijama.

Od presudnoga je značenja da poplavna područja omogućuju ribama i drugim životinjama mjesto koje

floodplains in Europe, a complex of riparian forests, marshes, meadows, pools and oxbows. Over practically the entire area of Lonjsko Polje the most important ecological factor is the special water regime. Apart from this special water regime, which consists of occasional and periodic inundation, the microtopography too has an important role in the creation of great habitat diversity. A difference of just a few dozen centimetres between the lower and higher parts of the terrain will create major differences in the water regime of the habitat and its water supply. Thus in this area a mosaic of mutually differentiated habitats has been created in the area, habitats typical of floodplain areas, which, naturally, is also seen in the richness of the various biocoenoses. These are various types of riparian and moist forests, water meadows, various types of wetland and water habitats (water-filled oxbows, habitats at the edges of standing and running water), as well as the cuts and channels that are the consequences of many years of human impact. In fact all these habitats were created over a long period of time in response to the water regime in its interaction with anthropogenic factors. And so every major change in the water regime and/or the use of the space necessarily leads to a change in the living community in each individual biotope.

Rivers are open systems, with axes linked in four dimensions: longitudinal (the source the course of the river the mouth); lateral (the river the flood plain); vertical (the river the underground water) and temporal (the time scale). The human impact can particularly be seen in disturbances of these dimensions. The structure of the fish communities in the great European rivers has changed to a major extent in the last 100 years. Sewage systems, the draining of the marshes, the felling of forests, construction of artificial reservoirs and pollution by industry and agriculture have considerably damaged the ecosystems of the whole of the Danube drainage basin. For every river and the area around it, floods are a very important factor. The erosive power generated during a flood enables the development of wide lateral channels, oxbows, islands and marshes, creating enormous diversity of habitats in which animals feed, find refuge and reproduce. The floods help in the preservation of biodiversity, helping plants and animals to occupy new and existing habitats. Floods help in the maintenance of the health of a river and the environment around it. The animals in such floodplain areas have adapted to the pulse of the floods, the annual advance and withdrawal of the flood waters in the flooded area. Floods have a particular importance for fish with respect to reproduction and because they also give them the sign that the time for migration has begun. Since fish are the most important component of the biological use of the rivers, for rational water management it is

im je potrebno za prehranu i razmnožavanje. Barem 70 % svih kralježnjaka oslanja se tijekom svoga života na područje uz riječne rubove. Ti dijelovi stvaraju prijelaznu zonu između rijeke i kopnenih staništa, osiguravajući sklonište, hranu, migracijske koridore za divlje ali i domaće životinje. Na temelju dosadašnjih znanstvenih spoznaja zna se da su ribe vrlo osjetljive na promjene brzine toka, pregradnje rijeke, destrukcije pojedinih biotopa, zagrijavanje vode, kao i na intenzivno iskorištavanje vode (Descy & Empain, 1984.). Poradi toga protok vode i količina kisika, temperatura, prozirnost i onečišćenje određuju strukturu zajednice riba na pojedinim prostorima. Nažalost, u trajno motrenje rijeka, koje bi moglo dati količinske podatke o pojedinim vrstama u vremenu, ihtiološka istraživanja uglavnom nisu bila uključena.

1.2. IHTIOLOŠKE ZNAČAJKE DUNAVSKOGA SLIJEVA

Zbog svoje velike raznolikosti ribe su vjerojatno najslabije poznata skupina kralježnjaka. Prije nekoliko desetljeća vjerovalo se da je fauna europskih slatkih voda sasvim poznata. Međutim, novije su publikacije jako izmijenile shvaćanje o fauni riba Europe. Opisane su brojne nove vrste, podvrste, pa čak i rodovi riba iz dunavskoga slijeva i drugih područja srednje Europe. Općenito gledano, europska slatkovodna fauna vrlo je homogena. Unutar nje dunavski bazen zauzima središnje mjesto, a po raznolikosti faune smatra se najbogatijim područjem u Europi. Poznato je da u čitavom dunavskom slijevu prebivaju oko 103 slatkovodne i brakične vrste riba (u usporedbi s 227 vrsta prisutnih u čitavoj Europi), od čega je nekih 13 vrsta uneseno iz drugih biogeografskih područja. U prošlosti je u čitavom dunavskom slijevu živjelo 10 diadromnih (migratornih) vrsta riba, i to: pet vrsta jesetra (*Acipenser gueldenstaedtii*, *A. nudiventris*, *A. stellatus*, *A. sturio*, and *Huso huso*), europska jegulja (*Anguilla anguilla*), tri haringe (*Alosa caspia*, *A. immaculata*, and *A. maeotica*) i jedna vrsta sleđa (*Clupeonella cultiventris*). Danas se *A. nudiventris* i *A. sturio* smatraju izumrlima za dunavski slijev. Vrste dunavskoga slijeva imaju holoarktičku, palearktičku, eurosibirsku, europsku, srednjoeuropsku ili pontokaspijsku rasprostranjenost. Dunavski slijev jedini je prostor središnje Europe s nešto više endema u fauni riba; ovdje živi osam endemskih vrsta, od kojih tri i na području PP Lonjsko polje.

essential to understand at least some of the mechanisms that bring about changes in fish populations.

What is crucially important is that the inundated areas provide the fish and other animals the space that they need to feed and reproduce. At least 70% of all vertebrates rely during their life on the area alongside the edges of the rivers. These parts create a zone of transition between the river and the land habitats, providing shelter, food and migration corridors for wild as well as domestic animals. According to scientific information gained to date it is known that fish are very sensitive to changes in changes in the speed of the course, the damming of rivers, the destruction of individual biotopes, the heating of the water as well as the intensive use of water (Descy and Empain, 1984). For this reason, the flow of water and the oxygen content, temperature, transparency and pollution determine the structure of the fish community in given areas. Unfortunately, ichthyological research has not generally been involved in long-term river monitoring, and thus the quantitative data about given species in the time that might have been provided have not been available.

1.2. ICHTHYOLOGICAL CHARACTERISTICS OF THE DANUBE DRAINAGE BASIN

Because of their great diversity, fish are probably the most poorly known group of vertebrates. A few decades ago, it was believed that the fauna of European fresh water had been completely identified. However, more recent publications greatly modified the understanding of fish fauna in Europe. Many new species have been described, as well as subspecies and even genera of fish from the Danube basin and other areas of Central Europe. Looked at in general, European freshwater fauna is very homogeneous. Within it, the Danube basin occupies the central place, and in terms of fauna diversity is held to be the richest area of Europe. It is known that in the whole of the Danube basin there are about 103 fresh water and brackish water species of fish (as compared with the 227 species found in the whole of Europe), of which some 13 species have been introduced from other biogeographic areas. In the past 10 diadromic (migratory) species lived in the whole of the Danube basin to be precise: five species of sturgeon (*Acipenser gueldenstaedtii*, *A. nudiventris*, *A. stellatus*, *A. sturio*, and *Huso huso*), the European eel (*Anguilla anguilla*), three shads (*Alosa caspia*, *A. immaculata*, and *A. maeotica*) and one species of herring (*Clupeonella cultiventris*).

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Najugroženija skupina riba su jesetre, od kojih se dvije smatraju izumrlima, a ostale su ili ugrožene ili osjetljive svoje. Jedna od najugroženijih vrsta svakako je i mladica (*Hucho hucho*), koja je kritično ugrožena za dunavski slijev a populacije su joj drastično smanjene u posljednjih 20-ak godina. Ugrožene su i populacije divljega šarana koje polako istiskuju uzgojene ili unesene svoje.

Već je rečeno da je područje Lonjskoga polja pod više-manje pulsanim promjenama vodnog režima i poplava. Oscilacije vodostaja uzrokuju velike promjene, čime se znatno mijenjaju uvjeti hidrobiološke produkcije. Značenje visine vodostaja kao ekološkoga čimbenika riblje proizvodnje proizlazi iz uloge poplavne zone u razmnožavanju riba. Tu su važni čimbenici visina vodostaja i dužina njegova trajanja. Vode nizinskih krajeva u proljeće imaju prosječno viši vodostaj, no dužina njegova trajanja i razina vode rijetko se podudaraju s najboljim uvjetima za razmnožavanje riba. Sprega poplava i razmnožavanja riba očituje se u tome što odrasle ribe u vrijeme visokoga vodostaja masovno migriraju iz riječnih korita u novonastale poplavne zone, gdje, pod utjecajem povišene temperature, teku snažni hidrobiološki procesi, povoljni za intenzivnu prehranu i reprodukciju. Posljedica je dugih poplava - kad se većina riba uspije izmrijeti i nakon toga uspješno othraniti - vrlo velika brojnost populacija u sljedećoj godini, što nije tako u godinama s kratkim poplavama kad je brojnost nekoliko puta manja. Dakle, vodeni minimum i maksimum poklapaju se s maksimalnim i minimalnim ulovima riba. Važno je i vrijeme nastupanja poplave. Izostanu li poplave ili traju li kraće, odrasle ribe se brže povlače u korito rijeke, izmriju se na neprikladnu mjestu, pa tako te godine izostane gotovo čitava generacija riba. To se sljedećih godina jasno uočava na njihovim populacijama, što je u predjelu nizinske Hrvatske bitno za naše ekonomski najvažnije vrste riba - šarana, soma i smuđa.

S ihtiološkoga gledišta, vode na području PP Lonjsko polje pripadaju donjim ciprinidnim (šaranskim) vodama, a to su vode ispod nadmorske visine od 100 metara. Tako su Sava i ostale rijeke zbog slabijega toka meandrirale, stvarajući raznolika staništa: prostrane rukavce, močvare, mrtvaje i ritove, kao karakterističnu sliku ovoga nizinskog krajolika. To je područje, zbog stalnoga nanošenja i taloženja (sedimentacije) mulja i drugoga materijala ispranog iz viših dijelova vodotoka, vrlo bogato organskim i mineralnim tvarima, što ima veliki utjecaj na proizvodnju prirodne hrane, a samim tim i na veličinu i kakvoću ribljih zajednica.

Today *A. nudiiventris* and *A. sturio* are considered extinct in the Danube basin. The species of the basin have Holarctic, Palearctic, Euro-Siberian, European, Central European and Pontic-Caspian distributions. The Danube basin is the only area in Central Europe with a fairly large number of endemic species in the fish fauna; there are eight endemic species here, three of them in the Lonjsko Polje Nature Park area. The group of fish that is the most endangered is the sturgeon, two of them already being considered extinct, the remainder of them being endangered or vulnerable taxa. One of the most endangered species must be the huchen (*Hucho hucho*), which is critically endangered in the Danube basin, the populations of it having been drastically reduced in the last score or so of years. Also endangered are populations of wild carp that are slowly being forced out by cultivated or introduced taxa.

It has already been said that the Lonjsko Polje area is subject to the more or less pulsing alterations of water regime and flooding. Oscillations in the water level bring about great changes, considerably altering the conditions of hydrobiological production. The importance of the water level as ecological factor in fish production derives from the role of the flooded area in the reproduction of fish. Important factors are the level of water and how long it lasts. Waters of the lowland regions have on average a higher water level in spring, but the duration and level of the water rarely coincide with the best conditions for reproduction. The greatest match between flood water and fish reproduction can be seen in the adult fish, during the time of high water level, moving in mass from the courses of the rivers to the newly created flooded areas, where, under the influence of the higher temperatures, powerful hydrobiological processes occur, suitable for vigorous feeding and reproduction. The consequence of long floods when most fish manage to spawn and after that feed successfully is great population abundance in the next year, which is not the same in years with short floods, after which the numbers are several times smaller. Thus the minimum and maximum of the water levels correlate with the maximum and minimum catches. Also important is the time when the floods occur. If they do not happen, or if they occur only a short time, the adult fish go back faster into the river courses, spawn in an unsuitable site, and thus that year almost a whole generation of fish is missing. This is clearly seen in years to come in the populations, and in the area of lowland Croatia is essential for the economically most important species of fish carp, catfish and pike-perch.

From the ichthyological point of view, water in the area of Lonjsko Polje Nature Park is classified as lower cyprinid (carp) water, waters below 100 m amsl. Thus the Sava and the other rivers, because of

1.2.1. Značenje poplavnih područja i močvara za ribe:

- raznolikost staništa daje podlogu za veću raznolikost i brojnost vrsta i tako osigurava mnogim vrstama riba hranu i pogodna mjesta za razmnožavanje; raznolikost zajednica vodi njihovoj većoj stabilnosti
- raznolikost staništa pruža i odlična mjesta za razvoj i odrastanje mladih riba; od osiguravanja dovoljne količine hrane do zaštite od predatora
- omogućuju ribama vezu između vodotoka i drugih vodenih površina
- sadrži stalne vodene površine koje osiguravaju ribama sigurno utočište tijekom suhog razdoblja

1.3. DOSADAŠNJE SPOZNAJE O IHTIOFAUNI

Podaci o strukturi populacije ihtiofaune Lonjskoga polja nisu do sada cjelovito obuhvaćeni, nego ih nalazimo fragmentarno u različitim studijama i drugim publikacijama. Sustavna istraživanja započela su potkraj 19. stoljeća, a temelje se uglavnom na prikupljenim kazivanjima lokalnih ribara o ulovima, njihovim opisima pojedinih vrsta riba te navođenju narodnih i germaniziranih naziva riba. Tako A. Jurinac u svom radu "Prilog fauni zapadne Slavonije" iz 1887. godine spominje 12 vrsta riba ovoga područja (*rodovi Cobitis, Esox, Chondrostoma, Squalus (Leuciscus), Alburnus, Blicca, Rhodeus, Barbus, Cyprinus, Silurus, Lota, Leuciscus, Rutilus*) te još nekoliko vrsta za koje je sakupio samo pučke nazive (lezbaba, kisir, klinarak). Istraživanja nastavljaju Hefe, 1889 i Medić, 1901.. Tek polovicom 20. stoljeća počinju istraživanja ihtiofaune širega područja, utemeljena na znanstvenim metodama i na pravilima moderne taksonomije. U posljednjih 10-ak godina provedena su neka djelomična istraživanja ihtiofaune Lonjskoga polja, među kojima je i diplomski rad (Suić, 1995.) koji se bavio raznolikošću i sastavom ihtiofaune te nekoliko istraživanja zajednice riba širega područja u sklopu ciljanih ekoloških studija (Mrakovčić i Kerovec, 1997.).

Budući da je u Lonjskom polju jedini oblik ribolova športsko-rekreativni, ne čudi što nema točnih novijih podataka o kvalitativnoj i kvantitativnoj strukturi ribljega fonda toga područja koju bi sačinile ribolovne

the slowness of their courses, have formed meanders, creating diverse habitats: broad channels, marshes, oxbows and wetlands, making up the characteristic image of this lowland landscape. This is an area which because of the constant transport and sedimentation of silt and other materials leached from the higher parts of the watercourse is very rich in organic and mineral substances, which has a great impact on the production of natural food, and hence on the size and quality of the fish communities.

1.2.1. The significance of the floodplain and swamps for fish:

- habitat diversity provides a base for great diversity and high numbers of species and thus ensures food and suitable places for reproduction for many species; the diversity of the communities leads to greater stability among them,
- diverse habitats afford excellent places for the young to develop and grow; from the provision of sufficient quantities of food to protection from predators,
- they provide fish with links between the rivers and other water areas,
- they include permanent areas of water that provide a sure refuge for the fish during periods of drought.

1.3. KNOWLEDGE ABOUT THE ICHTHYOFAUNA ACQUIRED TO DATE

Data about the structure of the population of the ichthyofauna of Lonjsko Polje have not been as yet brought together as a whole in a single place, but can rather be found fragmentarily in various different studies and other publications. Systematic research started at the end of the 19th century, and is largely based on the gathered tales of local fishermen about their catches, their descriptions of individual species of fish and the citation of the vernacular and Germanised names for the fish. Thus in his work "Contribution to the Fauna of West Slavonia" of 1887, A. Jurinac mentions 12 species of fish for this area (*the genera Cobitis, Esox, Chondrostoma, Squalus (Leuciscus), Alburnus, Blicca, Rhodeus, Barbus, Cyprinus, Silurus, Lota, Leuciscus, Rutilus*) as well as several species for which he could compile only the vernacular terms (lezbaba, kisir, klinarak). The research was continued by Hefe, 1889 and Medić, 1901.. Only since the mid-20th century has there been research into the ichthyofauna over a

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organizacije, osim na rubnim područjima koja graniče s Lonjskim poljem (Zajednice sportskih ribolovnih društava Zagreb, Ivanić Grad i Sisak). Struktura ulova, koja se utvrđuje izlovom po ribolovnim organizacijama, ne odgovara stvarnoj strukturi zbog izrazite selektivnosti ribolovnih alata i interesa sportskih ribolovaca.

Današnji je sastav ihtiofaune toga područja rezultat utjecaja biotičkih i abiotičkih čimbenika. Sve veća ljudska aktivnost u području gornjega toka Save, kao i u područjima njezinih pritoka, rezultira porastom onečišćenja organskim, anorganskim i radioaktivnim polutantima te porastom temperature vode, tako da se ihtipopulacija nizinskog toka i porječja Save sigurno razlikuje od prvotne autohtone populacije. Mijenjanje karakteristika ekosustava rezultira promjenama unutar populacija riba. Promjene u raznolikosti vrsta naglašen su signal koji pokazuje da se u vodenom ekosustavu dogodila znatna i, obično, dugotrajna promjena jednog ili više čimbenika. S obzirom na to da riblja zajednica djeluje kao složeni bioindikator, u kojemu se promjene nakupljaju, njegova signalizacija mora se odgonetnuti postupnom analizom ihtioloških, gospodarstvenih, hidroloških, kemijskih i drugih podataka, kako bi se odredio uzrok ili uzroci promjena u ribljem fondu vodenoga staništa.

U crnomorskom slijevu na području Hrvatske živi oko 78 vrsta riba. Autohtone su 64 vrste, dok ih je 14, uglavnom u prošlom stoljeću, uneseno iz drugih krajeva. Rijeka Sava i svi njezini pritoci dio su dunavskog ili crnomorskog vodnog slijeva. Područje nizinskoga dijela rijeke Save bogato je mješovitim ribljim populacijama; naseljava ga 50-ak vrsta riba, svrstanih u 13 porodica. Sadašnje stanje ihtiofaune Save i poplavne zone Lonjskoga polja utvrđeno je na temelju literaturnih podataka i na temelju intenzivnih jednogodišnjih istraživanja (2001. - 2002.). U samom PP Lonjsko polje nađene su 33 vrste riba iz osam porodica.

wider area, based on scientific methods and according to modern taxonomic principles. In the last dozen years several partial investigations of the fish fauna of Lonjsko Polje have been carried out, including an undergraduate dissertation (Suić, 1995) dealing with the diversity and composition of the ichthyofauna and several investigations of the fish community of the wider area as part of specifically targeted ecological studies (Mrakovčić and Kerovec, 1997).

Since the only kind of fishing in Lonjsko Polje is sporting and recreational in nature, there is no wonder that there are no more precise data about the qualitative and quantitative structure of the fish stocks of the area made up by the fishing organisations, except for the border areas on the edges of Lonjsko Polje (fishing clubs of Zagreb, Ivanić Grad and Sisak). The structure of the communities, which is determined by the catch according to the fishing organisations, does not match the real structure of the population, because of the markedly selective fishing equipment and interests of anglers.

The composition of the ichthyofauna of this area today is the outcome of the influences of biotic and abiotic factors. Increasing human activity in the area of the upper course of the Sava, as well as in the areas of its tributaries, has resulted in a rise in pollution with organic, inorganic and radioactive pollutants, as well as a rise in water temperature, with the result that the fish populations of the lower course and basin of the Sava of a certainty differ from the original indigenous population. Changes in the characteristics of the ecosystem have resulted in changes in the fish populations. Changes in species diversity are an emphatic signal that shows that a considerable and usually long-lasting change of one or more factors has occurred in the aqueous ecosystem. Since the fish community works as a complex bio-indicator, in which changes accumulate, this signalling must be decoded by a progressive analysis of ichthyological, economic, hydrologic, chemical and other data, in order to determine the cause or causes of the changes in the fish stocks of the aqueous habitat.

About 78 species of fish live in the Croatian part of the Black Sea drainage basin. Sixty-four species are indigenous, while 14 of them were introduced from other areas, mainly in the last century. The Sava River and its tributaries are all part of the Danube or Black Sea basin. The area of the lowland part of the Sava River is rich in mixed fish populations: it is inhabited by about 50 species, classified into 13 families. The current state of the ichthyofauna of the Sava and the inundation zone of Lonjsko Polje is determined according to data from the literature and according to vigorous one year research (2001-2002). In Lonjsko Polje Nature Park itself, 33 species of fish from eight families were found.

1.4. ZNAČENJE RIBA

Ribe su gotovo najbrojniji kralježnjaci u ekosustavu i vrlo su važne za kruženje tvari. Njihova uloga u ekosustavu potpuno je otkrivena i određena tek nedavno Holmlund i Honner, 1999, a svodi se na regulatornu, povezujuću i informativnu.

Regulatorna uloga ribljih zajednica:

- upravljaju dinamikom prehrambenih lanaca
- recikliraju nutrijente
- prestrukturiraju supstrat dna
- pomažu kruženju ugljika iz vode u atmosferu
- održavaju proces sedimentacije
- održavaju raznolikost na razini genoma, vrsta i ekosustava.

Uloga u povezivanju trofičkih razina:

- povezuju trofičke lance unutar akvatičkog ekosustava
- veza su trofičkih lanaca vodenog i kopnenog ekosustava
- transport nutrijenata, ugljika i minerala.

Informativne usluge riba su :

- procjena stresa ekosustava
- procjena stanja ekosustava
- znanstvene i obrazovno-odgojne informacije
- prirodno-povijesne informacije.

1.4.1. Ekonomsko značenje riba

Značenje riba kao hrane mijenja se u pojedinim stoljećima. Nekad je riba iz rijeka imala veliku gospodarsku vrijednost za domaće stanovništvo, koje je maksimalno gravitiralo prema rijeci i njezinim resursima. Danas riba, osim ekonomske, ima i druge vrijednosti: posebno estetsku, informativnu i rekreacijsku.

Ribe su, prema novom "Zakonu o slatkovodnom ribarstvu", dijelovi prirode od posebnog interesa za Republiku Hrvatsku i imaju njezinu osobitu zaštitu, a iskorištavaju se na održivi način koji pridonosi očuvanju biološke raznolikosti ekoloških sustava.

1.4. THE IMPORTANCE OF FISH

Fish are practically the most numerous vertebrates in the ecosystem and are very important in the circulation of substances. Their role in the ecosystem was completely revealed and determined only recently Holmlund i Honner, 1999 and comes down to the regulatory, connecting and informational.

The regulatory role of fish communities:

- they control the dynamics of food changes
- recycle nutrients
- restructure the substrate of the bottom
- help in the circulation of carbon from the water into the atmosphere
- maintain the sedimentation process
- maintain diversity at the level of genome, species and ecosystem

Their role in linking the trophic levels:

- they connect the trophic chains inside the aquatic ecosystem
- they provide a link between the trophic chains of the aquatic and terrestrial ecosystems
- transport of nutrients, carbons and minerals

The informative roles of fish are:

- estimate of ecosystem stress
- estimate of state of the ecosystem
- scientific and educational information
- natural history information.

1.4.1. Economic significance of fish

The importance of fish as food has changed over the centuries. Once, fish from the rivers had a greater economic value for the domestic population, which tended to the maximum towards the river and its resources. Today fish, apart from the economic, have other values too: in particular, aesthetic, informational and recreational.

According to the new Freshwater Fishing Law, fish are parts of nature that are of particular interest to the Republic of Croatia, and enjoy its particular protection, and are exploited in a sustainable way that contributes to the preservation of the biological diversity of the ecological systems.

1.4.2. Športsko-rekreativno značenje riba

Prema Lonjskom polju gravitira velik broj športsko-rekreativnih ribolovaca, a i domaćem je stanovništvu ribolov tradicionalna djelatnost. Općenito gledano, u Hrvatskoj športsko-rekreativni ribolov istiskuje privredni jer je vrijednost ribe u njemu daleko veća. Taj tip ribolova na ovom se području primjenjuje već dugi niz godina, ali katkada donosi parku prirode više štete nego koristi. Negativni utjecaji na kakvoću vode, ometanje riba prilikom mrijesta, nedopušteni ribolovni alati, pregrađivanje ključnih vodotoka unutar parka i dr., sve nas više učvršćuje u zamisli da od športskog ribolova u ovom obliku u parku prirode Lonjsko polje treba odustati. Zakonska podloga se može naći u stavku 1. članka 3. Zakona o slatkovodnom ribarstvu, gdje se ribolovnim vodama ne smatraju vode posebno zaštićenih dijelova prirode, proglašene na temelju posebnoga zakona (nacionalni parkovi i parkovi prirode), ribnjaci, akumulacije, jezera i tekuće vode koje su rezervirane za javnu vodoopskrbu ili iz kojih se zahvaća voda za piće. Športsko-rekreativni ribolov treba dopustiti na otvorenim vodama Save i na posebno određenim prostorima unutar parka.

2. REZULTATI ISTRAŽIVANJA

2.1. REZULTATI TERENSKIH ISTRAŽIVANJA

Svrha je istraživanja bila na temelju sadašnjega stanja ribljih populacija opisati i utvrditi sastav, brojnost i biomasu zajednice riba te predložiti osnovu na temelju koje će se štititi ihtiofauna, ali i gospodariti ihtiofondom.

Ihtiofauna Lonjskoga polja istraživana je tijekom 2001. i 2002. godine na 20-ak lokaliteta, pri čemu se nastojalo obuhvatiti što veći broj različitih vodenih i vlažnih staništa te glavnih vodotoka područja. Uzorkovanje je provedeno pomoću elektroagregata AGK sa 2,5 kW snage i naponom od 700 V istosmjerne struje. Uzorkovalo se i mrežama tipa popuna na onim lokalitetima gdje je konfiguracija terena to dopuštala. Ulovljeno je više od 5000 riba, od čega je 2686 jedinka svih prisutnih vrsta obrađeno različitim ihtiološkim metodama.

Lokaliteti na kojima je istraživano:

1.4.2. The sporting and recreational importance of fish

A large number of sporting and recreational anglers gravitate towards Lonjsko Polje, while for the local population, fishing is a traditional activity. Looked at in general, in Croatia recreational fishing is driving out economic fisheries, because the value of the fish in it is far greater. This type of fishing has been practised in this area for a number of years, but nevertheless sometimes brings the Lonjsko Polje Nature Park more harm than good. The negative effects on the quality of water, disturbance of the fish during spawning, illegal fishing tools, impounding key watercourses in the park and so on all confirm us in the idea that this kind of angling should be abandoned in Lonjsko Polje Nature Park. A foundation in the law for this can easily be found in Article 3 Paragraph 3 of the Freshwater Fishing Law, in which the water of specially protected parts of nature, so pronounced pursuant to a separate law (national and nature parks), fishponds, reservoirs, lakes and running water reserved for public water supply or from which drinking water is taken are not deemed to be fishing waters. Sporting and recreational fishing should be allowed only on the open waters of the Sava and at specially defined areas inside the park.

2. RESULTS

2.1. RESULTS OF FIELD RESEARCH

The purpose of the research was, according to the current state of the fish populations, to describe and establish the composition, numerosness and biomass of the fish community and to propose a base pursuant to which the ichthyofauna can be protected and the fish stocks can be managed.

The ichthyofauna of Lonjsko Polje was investigated during 2001 and 2002 in some score of localities, an endeavour being made to cover as many different kinds of aquatic and moist habitats and the main streams of the area. Sampling was carried out with the use of an AGK generator, 2.5 kW, 700 V, DC. Sampling was also done with gill nets in those areas where the configuration of the land permitted. More than 5000 fish were taken, of which 2686 individuals of all the species present were processed with various ichthyological methods.

These are the sites at which investigations were made:

1. **Čigoć** - excavation in the common by a dike

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

1. **Čigoć** - iskop u polju uz nasip
 2. **Čigoć** - privremena voda u polju
 3. **Čigoć** - mrtvaja u selu
 4. **Mužilovčica** - iskop u polju uz nasip
 5. **Mužilovčica** - privremena voda u polju
 6. **Mužilovčica** - mrtvaja u selu
 7. **Suvoj** - mrtvaja u selu
 8. **Trebež** - kanal iznad ustave
 9. **Trebež** - mrtvaja uz nasip
 10. **Trebež** - stari tok uz selo
 11. **Puska** - mrtvaja zapadno od sela
 12. **Puska** - istočno od sela
 13. **Strug** - kanal kod mosta za Novsku
 14. **Veliki Strug** - od željezničkog mosta prema Mokrom polju
 15. **Mokro polje** - poplavno polje oko Velikog Struga
 16. **Nova Lonja - Trebež** - nizvodno čamcem
 17. **Košutarica** - mrtvaja uz cestu prema Košutarici
 18. **Mlaka** - mrtvaja između ceste i šume, prema Mokrom polju
 19. **Višnjica** - mrtvaja uz selo
 20. **Sava** - kod Jasenovca, utok Une
 21. **Sava** - kod utoka Trebeža u Savu
 22. **Sava** - kod skele Puska Bobovac
2. **Čigoć** - temporary pool in the common
 3. **Čigoć** - oxbow in the village
 4. **Mužilovčica** - excavation in the common along the dike
 5. **Mužilovčica** - temporary pool in the common
 6. **Mužilovčica** - oxbow in the village
 7. **Suvoj** - oxbow in the village
 8. **Trebež** - channel above the sluice/dam
 9. **Trebež** - oxbow by the dike
 10. **Trebež** - old course by the village
 11. **Puska** - oxbow west of the village
 12. **Puska** - east of the village
 13. **Strug** - channel by the bridge to Novska
 14. **Veliki Strug** - from the railway bridge towards Mokro polje
 15. **Mokro polje** - floodplain around Veliki Strug
 16. **Nova Lonja - Trebež** - downstream by boat
 17. **Košutarica** - oxbow along the road towards Košutarica
 18. **Mlaka** - oxbow between road and forest, towards Mokro
 19. **Višnjica** - oxbow by the village
 20. **Sava** - by Jasenovac, confluence with the Una
 21. **Sava** - confluence of the Trebež and the Sava
 22. **Sava** - by the Puska Bobovac ferry

2.2. STRUKTURA ZAJEDNICE RIBA LONJSKOG POLJA

Broj vrsta riba nađenih na području PP Lonjsko polje manji je za oko 20 od broja koji je zabilježen u nizinskom dijelu rijeke Save. U rijeci Savi se pojavljuje veći broj reofilnih vrsta koje rijetko zalaze na poplavna područja, ali je njihov povremeni dolazak na takva staništa moguć. Većina tih "savskih" vrsta zabilježena je i na više lokaliteta uzvodno i nizvodno od Lonjskoga polja, ali pri našim posljednjim istraživanjima nisu ulovljene. Zanimljivo je da nije ulovljena dvoprugasta uklija, iako je vrlo brojna na pojedinim lokalitetima u rijeci Savi. Jedan dio vrsta u posljednje vrijeme nije ulovljen u rijeci Savi, a među te vrste pripadaju: pliska, sabljarka, prugasti balavac i mali vretenac.

Na području PP Lonjsko polje žive većinom one vrste kojima pogoduju mirne vode, dok su stanovnici brzih voda samo gosti. Dvadeset i osam vrsta nastanjuje ovaj prostor oduvijek, dok su ostale unesene, i to iz

2.2. STRUCTURE OF THE FISH COMMUNITY OF LONJSKO POLJE

The number of fish species found in the area of Lonjsko Polje Nature Park is about 20 smaller than the number recorded in the lowland part of the Sava River. Along the Sava there are many rheophilous species that seldom come into the flood plain, although they might well come into such habitats occasionally. Most of the Sava species are recorded at several localities upstream and downstream of Lonjsko Polje, but during our recent research were not actually caught. It is interesting that no schneider was caught, although it is extremely numerous at various different localities in the Sava River. Some of the species have not been caught recently the Sava River, among them being the: Danubian bleak, ziehe, striped ruffe and streber

Most of those species that are suited by calm water live in the area of the Lonjsko Polje Nature Park, while inhabitants of more rapid water are only visitors. Twenty eight species have always inhabited this area, while the others have been introduced, from North America and Asia. Looked at

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

Sjeverne Amerike i iz Azije. Zoogeografski gledano, većina vrsta ovoga prostora su holoarktičke i srednjoeuropske vrste, koje se u ovom prostoru pojavljuju zajedno s mnogim vrstama iz pontokaspijske regije. Promatrano područje prema Banarescu, 1964. pripada europsko-mediteranskom ihtiološkom području, koje obilježava mali broj potporodica. Najzanimljivija i najbrojnija vrstama je porodica šaranki (*Cyprinidae*), koja je zastupljena s dvadeset i jednom vrstom, što čini oko 63 % vrsta Lonjskoga polja i oko 58 % vrsta te porodice koja se pojavljuje u dunavskom slijevu. Velik dio vrsta koje čine tu porodicu izrazito su limnofilne, dakle ribe mirnih, nizinskih vodotoka, kojima je za razmnožavanje potrebna visoka proljetna temperatura vode i bujna vodena vegetacija (bentoska i plutajuća), na koju odlaze svoju ljepljivu ikru (fitofilne vrste). Porodica Percidae zastupljena je s četiri predstavnika. Na prostoru istraživanja ulovljeni su grgeč, smuđ, obični balavac i riječni glavočić. Porodica *Cobitidae* predstavljena je sa tri vrste (vijun, veliki vijun i čikov), dok je alohtona porodica *Centrarchidae* zastupljena s dvije vrste (sunčanica, pastrvski grgeč). Pastrvski grgeč je unesena vrsta koju su nedavno ubacili u Čigočku mrtvaju lokalni športsko-rekreativni ribolovci. *Esocidae*, *Gadidae*, *Ictaluridae* i *Siluridae* zastupljene su sa po jednim predstavnikom u ihtiofauni ovoga područja.

Ribe zabilježene na području PP Lonjsko polje, uključujući i rijeku Savu:

Esocidae

1. štuka (*Esox lucius Linnaeus, 1758.*)

Umbridae

- ? crnka (*Umbra krameri Walbaum, 1792.*)

Gadidae

2. manjić (*Lota lota Linnaeus, 1758.*)

Cobitidae

3. vijun (*Cobitis elongatoides Bacescu & Maier, 1969.*)
4. vijunica (*Cobitis elongata Heckel & Kner, 1858.*)
5. piškur (*Misgurnus fossilis Linnaeus, 1758.*)

Cyprinidae

6. koselj (*Abramis ballerus Linnaeus, 1758.*)
7. krupatica (*Abramis bjoerkna Linnaeus, 1758.*)
8. deverika (*Abramis brama Linnaeus, 1758.*)
9. uklija (*Alburnus alburnus Linnaeus, 1758.*)
10. bolen (*Aspius aspius Linnaeus, 1758.*)
11. mrena (*Barbus barbus Linnaeus, 1758.*)

zoogeographically, most of the species of this area of Holarctic and Central European species, which appear in the area in conjunction with many species from the Pontic-Caspian region. The area under observation, according to Banarescu, 1964. belongs to the European-Mediterranean ichthyological area, which is characterised by the smallness of the number of sub-families. The most interesting and most numerous in species is the carp family (*Cyprinidae*), which is represented by 221 species, making up about 63% of all species of Lonjsko Polje and about 58% of the species of the family that appear at all in the Danube basin. Most of the species that make up this family are markedly limnophilous, that is, they are fish of calm, lowland streams, who need high spring water temperature and a flourishing water vegetation (in the benthos and floating) for reproduction; these phytophil species deposit their sticky eggs on the weed. The Percidae family is represented by four species; in the research area the European perch, pike-perch, ruffe and monkey goby were taken. The *Cobitidae* family is represented with three species (Danubian loach, Balkan loach and weather loach) while the allochthonous family of the *Centrarchidae* is presented by two species (pumpkinseed and largemouth bass). The largemouth bass is an introduced species that sporting and recreational anglers recently released into the Čigoč oxbow. *Esocidae*, *Gadidae*, *Ictaluridae* and *Siluridae* are represented by one species each in the ichthyofauna of the area.

Fish recorded in the area of Lonjsko Polje Nature Park, including in the Sava River:

Esocidae

1. pike (*Esox lucius Linnaeus, 1758.*)

Umbridae

- ? European mudminnow (*Umbra krameri Walbaum, 1792.*)

Gadidae

2. burbot (*Lota lota Linnaeus, 1758.*)

Cobitidae

3. Danubian loach (*Cobitis elongatoides Bacescu & Maier, 1969.*)
4. Balkan loach (*Cobitis elongata Heckel & Kner, 1858.*)
5. weather loach (*Misgurnus fossilis Linnaeus, 1758.*)

Cyprinidae

6. blue bream (*Abramis ballerus Linnaeus, 1758.*)
7. silver bream (*Abramis bjoerkna Linnaeus, 1758.*)
8. common bream (*Abramis brama Linnaeus, 1758.*)
9. common bleak (*Alburnus alburnus Linnaeus, 1758.*)
10. asp (*Aspius aspius Linnaeus, 1758.*)
11. barbel (*Barbus barbus Linnaeus, 1758.*)

Značajke ribljih zajednica parka prirode Lonjsko polje
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12. karas (*Carassius carassius* Linnaeus, 1758.)
13. babuška (*Carassius auratus* Gibelio Bloch, 1783.)
14. podust (*Chondrostoma nasus* Linnaeus, 1758.)
15. šaran (*Cyprinus carpio* Linnaeus, 1758.)
16. bjelopera krkuša (*Gobio albipinnatu* Lukasch, 1933.)
17. krkuša (*Gobio gobio* Linnaeus, 1758.)
? belica (*Lucaspius delineatus* Heckel, 1843.)
18. jez (*Leuciscus idus* Linnaeus, 1758.)
19. klen (*Leuciscus cephalus* Linnaeus, 1758.)
20. bezribica (amurski čebačok) (*Pseudorasbora parva* Schlegel, 1842.)
21. gavčica (*Rhodeus sericeus* Pallas, 1776.)
22. bodorka (*Rutilus rutilus* Linnaeus, 1758.)
23. plotica (*Rutilus pigus* Berg, 1932.)
24. crvenperka (*Scardinius erithrophthalmus* Linnaeus, 1758.)
25. linjak (*Tinca tinca* Linnaeus, 1758.)

Percidae

26. obični balavac (*Gymnocephalus cernuus* Linnaeus, 1758.)
27. grgeč (*Perca fluviatilis* Linnaeus, 1758.)
28. smuđ (*Sander lucioperca* Linnaeus, 1758.)
29. riječni glavočić (*Neogobius fluviatilis* Pallas, 1814.)

Centrarchidae

30. sunčanica (*Lepomis gibbosus* Linnaeus, 1758.)
31. pastrvski grgeč (*Micropterus salmoides* Lacepede, 1802.)

Ictaluridae

32. patuljasti (američki) somić (*Ameiurus nebulosus* Lesueur, 1819.)

Siluridae

33. som (*Silurus glanis* Linnaeus, 1758.)

Na popisu su i dvije tipične limnofilne vrste, karakteristične za bare i mrtvaje, no pri istraživanju nisu nađene. Te ribe su crnka (*Umbra krameri*) i belica (*Lucaspius delineatus*), nađene u šumi Žutici, uzvodno od parka u porječju rijeke Lonje. To su karakteristične vrste za močvarna i poplavna staništa.

S ihtiološkoga stanovišta vrlo je zanimljiv utjecaj rijeke Une koja pripada u salmonidne vode i kao takva utječe na sastav ihtiofaune ovoga područja. Tako se očekuje pridolazak vrsta poput kalifornijske pastrve (*Oncorhynchus mykiss*), potočne pastrve

12. Crucian carp (*Carassius carassius* Linnaeus, 1758.)
13. Prussian carp (*Carassius auratus* Gibelio Bloch, 1783.)
14. common nase (*Chondrostoma nasus* Linnaeus, 1758.)
15. common carp (*Cyprinus carpio* Linnaeus, 1758.)
16. whitefin gudgeon (*Gobio albipinnatu* Lukasch, 1933.)
17. common gudgeon (*Gobio gobio* Linnaeus, 1758.)
? sunbleak (*Lucaspius delineatus* Heckel, 1843.)
18. ide (*Leuciscus idus* Linnaeus, 1758.)
19. common chub (*Leuciscus cephalus* Linnaeus, 1758.)
20. false harlequin (*Pseudorasbora parva* Schlegel, 1842.)
21. bitterling (*Rhodeus sericeus* Pallas, 1776.)
22. common roach (*Rutilus rutilus* Linnaeus, 1758.)
23. Dalmatian roach (*Rutilus pigus* Berg, 1932.)
24. common rudd (*Scardinius erithrophthalmus* Linnaeus, 1758.)
25. tench (*Tinca tinca* Linnaeus, 1758.)

Percidae

26. ruffe (*Gymnocephalus cernuus* Linnaeus, 1758.)
27. European perch (*Perca fluviatilis* Linnaeus, 1758.)
28. pike-perch (*Sander lucioperca* Linnaeus, 1758.)
29. monkey goby (*Neogobius fluviatilis* (Pallas, 1814.)

Centrarchidae

30. pumpkinseed (*Lepomis gibbosus* Linnaeus, 1758.)
31. largemouth bass (*Micropterus salmoides* Lacepede, 1802.)

Ictaluridae

32. brown bullhead (*Ameiurus nebulosus* Lesueur, 1819.)

Siluridae

33. Sheatfish (*Silurus glanis* Linnaeus, 1758.)

There are two typical limnophilous species on the list, which are characteristic of pools and oxbows, although during this investigation they were not found. These fish are the European mudminnow (*Umbra krameri*) and the sunbleak (*Lucaspius delineatus*), and were found downstream from the Park in the drainage area of the Lonja River. They are characteristic species of wetland and riparian habitats.

From the ichthyological point of view there is a great deal of interest in the impact of the Una River, which belongs to salmonid waters, and thus has an impact on the composition of the ichthyofauna of the region.

(*Salmo trutta*), lipljena (*Thymallus thymallus*) i mladice (*Hucho Hucho*), ali i potočne mreke (*Barbus meridionalis*), pijora (*Phoxinus phoxinus*) ili peša (*Cottus gobio*). Mladica (*Hucho Hucho*) je nekad u gornjem toku Save i u Uni bila česta riba, ali je njezina brojnost ozbiljno smanjena i o stanju njezinih populacija danas se malo zna. Na širem području, osim rečenih vrsta, ulove se ili ribiči opaze još neke unesene vrste, kao bijeli amur (*Ctenopharyngodon idella*), sivi glavaš (*Hypophthalmichthys molitrix*) i bijeli glavaš (*Hypophthalmichthys nobilis*). Njihove populacije u divljini vjerojatno nisu brojne i na području PP Lonjsko polje nisu zabilježene. Pretpostavlja se da je većina jedinka tih vrsta pobjegla iz šaranskih ribnjaka bliže okolice ili su namjerno unesene u rijeku iz različitih razloga.

Ribe čiji se pridolazak također može očekivati u rijeci Savi na području PP Lonjsko polje:

Petromyzonidae

1. dunavska paklara (*Eudontomyzon danfordi* Regan, 1911.)

Acipenseridae

2. kečiga (*Acipenser ruthenus* Linnaeus, 1758.)

Salmonidae

3. kalifornijska pastrva (*Oncorhynchus mykiss* Walbaum, 1792.)
4. potočna pastrva (*Salmo trutta* L., 1758.)
5. mladica (*Hucho hucho* Linnaeus, 1758.)

Thymallidae

6. lipljen (*Thymallus thymallus* Linnaeus, 1758.)

Cyprinidae

7. crnooka deverika (*Abramis sapa* Pallas, 1814.)
8. dvoprugasta uklija (*Alburnoides bipunctatus* Bloch, 1782.)
9. potočna mrena (*Barbus meridionalis* Risso, 1828.)
10. velika pliska (*Chalcalburnus chalcoides* Gueldenstaedt, 1772.)
11. bijeli amur (*Ctenopharyngodon idella* Valenciennes, 1844.)
12. keslerova krkušica (*Gobio kesslerii* Dybowski, 1862.)
13. tankorepa krkušica (*Gobio uranoscopus* Agassiz, 1828.)
14. sivi glavaš (*Hypophthalmichthys molitrix* Valenciennes, 1844.)
15. bijeli glavaš (*Hypophthalmichthys nobilis*

Thus it can be expected that species such as the rainbow trout (*Oncorhynchus mykiss*), the brown trout (*Salmo trutta*) the grayling (*Thymallus thymallus*) and huchen (*Hucho Hucho*), as well as southern barbel (*Barbus meridionalis*), common minnow (*Phoxinus phoxinus*) or common bullhead (*Cottus gobio*) will come. Huchen (*Hucho Hucho*) was once a frequent fish in the upper course of the Sava and in the Una, but its numbers have seriously diminished and little is known today of the populations of this fish. Over the broader region, apart from the species mentioned, some other introduced species are either caught or observed by fishermen, such as the grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and the big head carp (*Hypophthalmichthys nobilis*). The populations of these fish in the wild are probably not large and have not been recorded in the Lonjsko Polje Nature Park area. It can be assumed that most of the individuals of these species have escaped from the carp fishponds close by or were deliberately introduced into the river for various reasons.

Fish that can be assumed to come to the Sava River and the Lonjsko Polje Nature Park region.

Petromyzonidae

1. Danubian lamprey (*Eudontomyzon danfordi* Regan, 1911.)

Acipenseridae

2. sterlet (*Acipenser ruthenus* Linnaeus, 1758.)

Salmonidae

3. rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792.)
4. brown trout (*Salmo trutta* L., 1758.)
5. huchen (*Hucho hucho* Linnaeus, 1758.)

Thymallidae

6. grayling (*Thymallus thymallus* Linnaeus, 1758.)

Cyprinidae

7. Danubian bream (*Abramis sapa* Pallas, 1814.)
8. schneider (*Alburnoides bipunctatus* Bloch, 1782.)
9. southern barbel (*Barbus meridionalis* Risso, 1828.)
10. Danubian bleak (*Chalcalburnus chalcoides* Gueldenstaedt, 1772.)
11. grass carp (*Ctenopharyngodon idella* Valenciennes, 1844.)
12. Kessler's gudgeon (*Gobio kesslerii* Dybowski, 1862.)
13. Danubian gudgeon (*Gobio uranoscopus* Agassiz, 1828.)
14. silver carp (*Hypophthalmichthys molitrix* Valenciennes, 1844.)
15. big head carp (*Hypophthalmichthys nobilis*

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Richardson, 1845.)

16. klenić (*Leuciscus leuciscus* Linnaeus, 1758.)
17. sabljarka (*Pelecus cultratus* Linnaeus, 1758.)
18. pijor (*Phoxinus phoxinus* Linnaeus, 1758.)
19. nosara (*Vimba vimba* Linnaeus, 1811.)

Gobidae

20. keslerov glavočić (*Neogobius kessleri* Gunther, 1861.)

Percidae

21. prugasti balavac (*Gymnocephalus schraetser* Linnaeus, 1758.)
22. mali vretenac (*Zingel streber* Siebold, 1863.)
23. veliki vretenac (*Zingel zingel* Linnaeus, 1758.)

Cottidae

24. peš (*Cottus gobio* L., 1758.)

Zbog takve brojnosti i stanja ribljih populacija u rijeci Savi i pritocima na ovom području, vjeruje se da bi na širem području Lonjskoga polja moglo živjeti i više od 33 zabilježene vrste riba.

Zbog raznolikosti staništa koje ribe nastanjuju i različitog sastava ihtiofaune na njima, mogu se razlučiti tri osnovna tipa voda na području PP Lonjsko polje:

1. mrtvaje, bare, iskopi i druge zatvorene vode stajaćega tipa
2. kanali i stari tokovi rijeka kroz polje
3. rijeka Sava.

1) U prvoj grupi voda zabilježene su tipično limnofilne i neutrofilne vrste riba koje preferiraju staništa stajaćih voda: sunčanica, babuška, somić, štika, crvenperka, bodorka, linjak, karas, gavčica, čikov, vijun, grgeč

2) Sastav ihtiofaune u kanalima i starim tokovima sličniji je fauni rijeke Save nego stajaćim staništima. Što je bolja povezanost kanala s rijekom i što je viši vodostaj Save, to je fauna sličnija onoj u rijeci Savi i povećava se raznolikost zajednice riba. Pojavljaju se vrste tipične za riječno korito: koselj, bolen, klen, jez, podust

3) Ihtiofauna rijeke Save puno je brojnija od one u samom Lonjskom polju, pa Sava služi kao izvor raznolikosti pojedinih reofilnih i neutrofilnih vrsta riba koje nastavaju poplavno područje Lonjskoga polja kao privremeno stanište.

U ulovu od trideset i tri vrste riba najzastupljenije su uklija (24,7%), sunčanica (10,5%), bodorka (12,3%),

Richardson, 1845.)

16. common dace (*Leuciscus leuciscus* Linnaeus, 1758.)
17. ziehe (*Pelecus cultratus* Linnaeus, 1758.)
18. common minnow (*Phoxinus phoxinus* Linnaeus, 1758.)
19. vimba (*Vimba vimba* Linnaeus, 1811.)

Gobidae

20. big head goby (*Neogobius kessleri* Gunther, 1861.)

Percidae

21. striped ruffe (*Gymnocephalus schraetser* Linnaeus, 1758.)
22. streber (*Zingel streber* Siebold, 1863.)
23. zingel (*Zingel zingel* Linnaeus, 1758.)

Cottidae

24. common bullhead (*Cottus gobio* L., 1758.)

Because of this kind of abundance and the situation of the fish populations in the Sava River and in the tributaries in the area, it is believed that in the wider Lonjsko Polje area there might be more than the 33 recorded species living.

Because of the diversity of the habitats the fish inhabit and the diverse composition of the ichthyofauna in them, three basic types of water in the area of Lonjsko Polje Nature Park can be distinguished:

1. oxbows, ponds, excavations and other enclosed water of the standing type
2. branches and old courses of rivers through the common
3. the Sava River.

1) In the first group, typical limnophilous and neutrophilous species of fish have been observed, fish that prefer standing water habitats: pumpkin-seed, Prussian carp, black bullhead, pike, common rudd, common roach, tench, Crucian carp, bitterling, weather loach, Danubian loach and European perch

2) The composition of the ichthyofauna in the channels and old river courses is more similar to the Sava fauna than to that of the standing water. The better the connection of the channels with the river, and the higher the Sava water level, the more similar the fauna is to the Sava fauna, and the greater the diversity of the fish community. Species typical of the river course appear: blue bream, asp, chub, ide, common nase

3) The ichthyofauna of the Sava River is much more numerous than the ichthyofauna in Lonjsko Polje itself, and the Sava thus serves as a source of diversity for some of the rheophilous and neutrophilous species of fish that inhabit the floodplain area of Lonjsko Polje as a temporary habitat.

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

crvenperka (7,9%) i babuška (5,7%) (tablica 3.). Među najbrojnije vrste svakako pripada i patuljasti somić, iako nije uziman u velikom broju za laboratorijsku obradu. U relativnim odnosima brojnosti slijede deverika, krupatica, štika i grgeč. Ni brojnost štuke naoko nije velika, ali to je posljedica namjerne selektivnosti prilikom uzorkovanja. Štika je naime osjetljivija na djelovanje elektroagregata (posebno mlade jedinice), pa većina ulovljenih štika nije vađena iz vode, a i one uzete za uzorkovanje vraćene su u vodu. Zato pretpostavljena brojnost nije jednaka rezultatima obrađenih riba. Pretpostavlja se da se relativna brojnost pojedinih vrsta kreće ovako: uklija (~33%), sunčanica (~20%), babuška (~10-15%). Na pojedinim staništima određene su vrste dominantne i prevladavaju brojnošću. Zabrinjavajuće je velika brojnost unesenih vrsta, sunčanice, patuljastog somića i babuške, u mrtvajama i iskopima u polju gdje su to najčešće dominantne vrste. Udio riba grabljivica, smuđa, štuke, soma i grgeča, u Lonjskom je polju od 10 do 15%. U ulovu grabljivica prevladavaju štika i grgeč.

U relativnim odnosima ihtiomase (tablica 4.) prevladavaju babuška (25%), štika (18%), bodorka (6,4%), deverika (5%), sunčanica (4,3%) i patuljasti somić (3,4%). Som (13%) i smuđ (4,4%) imaju naoko veliku ihtiomasu, ali to je posljedica ulova nekoliko velikih jedinka (som 12 kg i smuđevi od 2 do 3 kg) na pojedinačnim lokalitetima. Osamnaest vrsta se javlja s ihtiomasom manjom od 1%.

Ihtiomase po hektaru proračunate iz prirasta kreću se od 30 do 90 kg. Izračunata brojnost jedinka je od 2000 do 4000 riba po hektaru.

Postoje razlike u brojnosti i sastavu vrsta riba između voda u samom Lonjskom polju i rijeci Savi. Uz pojedine vrste koje se podjednako pojavljuju, poput uklije, bodorke, grgeča i koselja, pojedine vrste riba su dominantnije ili češće na određenom tipu staništa. Tako su u samom polju brojnije i češće limnofilne i neke neutrofilne vrste, poput sunčanice, crvenperke, babuške, štuke, patuljastog somića, karasa i linjaka, dok se u Savi javljaju rjeđe ili samo sporadično. Za rijeku Savu dominantne su i češće vrste poput krupatice, balavca, mreke, klena, jeza, manjića, podusta i vijunice. Među ribe Lonjskoga polja uvrštene su i ribe ulovljene u kanalu Trebež koji prema ihtiofauni vrlo slični rijeci Savi, što zbog izravne veze ovih dvaju tokova, što zbog staništa koja Trebež pruža ribljim zajednicama.

In the catch of thirty-three species of fish, the most numerous were the common bleak (24,7%), pumpkinseed (10,5%), common roach (12,3%), common rudd (7,9%) and Prussian carp (5,7%) (Table 3). The brown bullhead certainly belongs among the most numerous species too, although it was not taken in large numbers for laboratory treatment. In relative ratios of abundance then come the common bream, silver bream, pike and European perch. The abundance of the pike also does not seem to be very great, but this is the consequence of the deliberate selectivity exercised during sampling. The pike is very sensitive to the effect of the generator (particularly young individuals) and most of the pike caught were not taken from the water, while those taken for sampling were put back. Thus the assumed abundance is not the same as the results of the fish processed. It can be assumed that the relative abundance of individual species ranges as follows: common bleak (~33%), pumpkinseed (~20%), Prussian carp (~10-15%). In individual habitats certain species are dominant and dominate in terms of numbers. The large numbers of introduced species, the pumpkinseed, brown bullhead and Prussian carp, in the oxbows and pits in the common, where they are most commonly the dominant species, give grounds for concern. The proportion of predatory fish in Lonjsko Polje, of pike-perch, pike, sheatfish and European perch, is from 10 to 15%. The pike and European perch predominate in the catch of predators.

Table 4 shows the relative ratios of ichthyomass: the Prussian carp (25%), pike (18%), common roach (6,4%), common bream (5%), pumpkinseed (4,3%) and brown bullhead (3,4%) are dominant. The sheatfish (13%) and pike-perch (4,4%) would seem to have a large ichthyomass, but this is actually the consequence of the catch of a few very large individuals (a catfish of 12 kg and several pike-perch of 2 to 3 kg) in certain places. Eighteen species appeared with an ichthyomass of less than 1%.

The ichthyomass per hectare calculated from the increment ranges from 30 to 90 kg. The calculated abundance of individuals is about 2000 to 4000 fish per hectare.

There are differences in the abundance and composition of fish between the waters in Lonjsko Polje itself and in the Sava River. Alongside the individual fish that appear equally, like the bleak, common roach, European perch and blue bream, some fish are distinctly more dominant or more frequent in a given type of habitat. Thus in Lonjsko Polje itself the limnophilous and some neutrophilous species are more dominant, including the pumpkinseed, rudd, Prussian carp, pike, black bullhead, Crucian carp and tench, while in the Sava River these appear less frequently or indeed sporadically. In the Sava, species such as the silver bream, ruffe, barbel, chub, ide, burbot, common nase and Balkan loach are more frequent and dominant. Fish classified as Lonjsko Polje species include those caught in Trebež Channel, which according to its ichthyofauna, is very similar to the Sava, because of the direct link between the two streams, and also because of the habitats that the Trebež affords the fish communities.

Značajke ribljih zajednica parka prirode Lonjsko polje
 Characteristic of the fish communities in Lonjsko Polje Nature Park

Tablica 1. Rasprostranjenost pojedinih vrsta riba PP Lonjskoga polja na različitim lokalitetima

Table 1. Distribution of species of fish of Lonjsko Polje Nature Park in different localities.

babuška (<i>Carassius auratus</i>)	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	18	19	20	21	22
bodorka (<i>Rutilus rutilus</i>)	1	3	4	6	7	8	9	10	11	12	13	14	15	18	19	20	21	22		
štuka (<i>Esox lucius</i>)	1	2	3	4	5	6	7	8	9	11	12	13	14	18	19	20	22			
sunčanica (<i>Lepomis gibbosus</i>)	1	3	4	6	7	8	9	11	12	13	14	15	16	20	22					
uklija (<i>Alburnus alburnus</i>)	1	3	4	6	7	8	10	13	14	15	16	18	19	21	22					
crvenperka (<i>Scardinius erythrophthalmus</i>)	1	3	4	6	7	8	10	11	12	13	14	16	18							
grgeč (<i>Perca fluviatilis</i>)	1	2	3	4	6	7	8	9	13	18	20	21	22							
vijun (<i>Cobitis elongatoides</i>)	1	2	4	5	6	12	13	15	16	18	20	21	22							
deverika (<i>Abramis brama</i>)	1	3	4	6	8	9	14	15	19	20										
patuljasti somić (<i>Ameiurus nebulosus</i>)	1	3	4	6	7	11	12	13	14	17										
obični balavac (<i>Gymnocephalus cernuus</i>)	8	13	14	18	12	20	21	22												
koselj (<i>Abramis ballerus</i>)	1	3	4	8	10	13	14	21												
gavčica (<i>Rhodeus sericeus</i>)	2	4	5	13	18	19	20													
karas (<i>Carassius carassius</i>)	1	3	6	11	12	17	19													
jez (<i>Leuciscus idus</i>)	8	14	15	20	21	22														
linjak (<i>Tinca tinca</i>)	3	6	11	12	18															
bolen (<i>Aspius aspius</i>)	8	10	13	14	20															
bezribica (<i>Pseudorasbora parva</i>)	8	11	13	18																
som (<i>Silurus glanis</i>)	13	21	20	22																
krupatica (<i>Abramis bjoerkna</i>)	8	20	21	22																
klen (<i>Leuciscus cephalus</i>)	8	20	21	22																
šaran (<i>Cyprinus carpio</i>)	7	8	5																	
smuđ (<i>Sander lucioperca</i>)	8	14	21																	
vijunica (<i>Cobitis elongata</i>)	20	21	22																	
bjelopera krkuša (<i>Gobio albipinnatus</i>)	8	22	20																	
riječni glavočić (<i>Neogobius fluviatilis</i>)	8	20																		
čikov (piškur) (<i>Misgurnus fossilis</i>)	13	18																		
podust (<i>Chondrostoma nasus</i>)	20	22																		
mrena (<i>Barbus barbus</i>)	20	21																		
plotica (<i>Rutilus pigus</i>)	20	21																		
manjić (<i>Lota lota</i>)	20	22																		
pastrvski grgeč (<i>Micropterus salmoides</i>)	3																			
krkuša (<i>Gobio gobio</i>)	20																			

*1 - Čigoć iskop; 2 - Čigoć privremena voda; 3 - Čigoć mrtvaja; 4 - Mužilovčica iskop; 5 - Mužilovčica privremena voda; 6 - Mužilovčica mrtvaja; 7 - Suvoj mrtvaja; 8 - Trebež kanal; 9 - Trebež mrtvaja; 10 - Trebež stari tok; 11 - Puska mrtvaja zapadno; 12 - Puska mrtvaja istočno; 13 - Strug kanal; 14 - Veliki Strug; 15 - Mokro polje; 16 - Stara Lonja; 17 Košutarica mrtvaja; 18 - Mlaka mrtvaja; 19 - Višnjica mrtvaja; 20 - Sava Jasenovac; 21 - Sava Trebež; 22 - Sava Bobovac

*1 - Čigoć excavation; 2 - Čigoć temporary pool; 3 - Čigoć oxbow; 4 - Mužilovčica excavation; 5 - Mužilovčica temporary pool; 6 - Mužilovčica oxbow; 7 - Suvoj oxbow; 8 - Trebež channel; 9 - Trebež oxbow; 10 - Trebež old stream; 11 - Puska oxbow west; 12 - Puska oxbow east; 13 - Strug channel; 14 - Veliki Strug; 15 - Mokro polje; 16 - Stara Lonja; 17 - Košutarica oxbow; 18 - Mlaka oxbow; 19 - Višnjica oxbow; 20 - Sava Jasenovac; 21 - Sava Trebež; 22 - Sava Bobovac

Značajke ribljih zajednica parka prirode Lonjsko polje
Characteristic of the fish communities in Lonjsko Polje Nature Park

Tablica 2. Brojnost ulovljenih riba na području PP Lonjsko polje po vrstama

Table 2. Abundance of fish caught in the area of Lonjsko Polje Nature Park according to species

Vrsta	Broj jedinka
<i>Alburnus alburnus</i> (uklija)	665
<i>Rutilus rutilus</i> (bodorka)	331
<i>Lepomis gibbosus</i> (sunčanica)	284
<i>Scardinius erythrophthalmus</i> (crvenperka)	214
<i>Carassius gibelio</i> (babuška)	155
<i>Abramis brama</i> (deverika)	131
<i>Abramis bjoerkna</i> (krupatica)	110
<i>Esox lucius</i> (štuka)	106
<i>Perca fluviatilis</i> (grgeč)	100
<i>Ictalurus nebulosus</i> (američki somić)	99
<i>Gymnocephalus cernuus</i> (balavac)	96
<i>Cobitis elongatoides</i> (vijun)	67
<i>Carassius carassius</i> (karas)	45
<i>Rhodeus sericeus</i> (gavčica)	37
<i>Leuciscus idus</i> (jez)	33
<i>Gobio albipinatus</i> (bjelopera krkuša)	32
<i>Abramis balerus</i> (koselj)	24
<i>Barbus barbus</i> (mrena)	23
<i>Leuciscus cephalus</i> (klen)	22
<i>Neogobius fluviatilis</i> (slatkovodni glavočić)	16
<i>Tinca tinca</i> (linjak)	16
<i>Aspius aspius</i> (bolen)	9
<i>Pseudorasbora parva</i> (bezribica)	8
<i>Sander lucioperca</i> (smuđ)	8
<i>Silurus glanis</i> (som)	8
<i>Lota lota</i> (manjić)	7
<i>Cobitis elongata</i> (vijunica)	6
<i>Chondrostoma nasus</i> (podust)	5
<i>Rutilus pigus</i> (plotica)	3
<i>Cyprinus carpio</i> (šaran)	2
<i>Misgurnus fossilis</i> (piškur)	2
Sveukupan zbroj	2686

Značajke ribljih zajednica parka prirode Lonjsko polje
Characteristic of the fish communities in Lonjsko Polje Nature Park

Tablica 3. Ihtiomasa pojedinih vrsta riba u PP Lonjsko polje prema ulovima na 22 lovne postaje

Table 3. Ichthyomass of individual species of fish in Lonjsko Polje Nature Park according to catches at 22 catching stations

Vrsta	Ihtiomasa (g)
<i>Carassius gibelio</i> (babuška)	26357,00
<i>Esox lucius</i> (štuka)	18420,60
<i>Silurus glanis</i> (som)	13696,50
<i>Rutilus rutilus</i> (bodorka)	6684,20
<i>Abramis brama</i> (deverika)	5221,20
<i>Sander lucioperca</i> (smuđ)	4655,60
<i>Lepomis gibbosus</i> (sunčanica)	4558,90
<i>Ictalurus nebulosus</i> (američki somić)	3624,80
<i>Alburnus alburnus</i> (uklija)	3330,60
<i>Scardinius erythrophthalmus</i> (crvenperka)	2841,80
<i>Leuciscus idus</i> (jez)	2675,10
<i>Abramis bjoerkna</i> (krupatica)	2588,40
<i>Perca fluviatilis</i> (grgeč)	2157,90
<i>Carassius carassius</i> (karas)	1502,30
<i>Leuciscus cephalus</i> (klen)	1021,50
<i>Chondrostoma nasus</i> (podust)	838,80
<i>Gymnocephalus cernuus</i> (balavac)	833,60
<i>Aspius aspius</i> (bolen)	647,00
<i>Abramis balerus</i> (koselj)	483,20
<i>Leuciscus cephalus</i> (klen)	437,90
<i>Tinca tinca</i> (linjak)	351,00
<i>Rutilus pigus</i> (plotica)	282,80
<i>Cobitis elongatoides</i> (vijun)	239,55
<i>Barbus barbus</i> (mrena)	157,60
<i>Gobio albipinatus</i> (bjelopera krkuša)	83,30
<i>Neogobius fluviatilis</i> (slatkovodni glavočić)	59,60
<i>Lota lota</i> (manjić)	58,90
<i>Rhodeus sericeus</i> (gavčica)	48,90
<i>Misgurnus fossilis</i> (piškur)	42,80
<i>Cobitis elongata</i> (vjunica)	41,60
<i>Pseudorasbora parva</i> (bezribica)	41,50
<i>Cyprinus carpio</i> (šaran)	21,30
Sveukupan zbroj	104005,75

Rijetke vrste

Od 33 zabilježene vrste riba njih četiri, iz različitih razloga, možemo ubrojiti u rijetke. Neke od njih unesene su u ovaj sustav namjerno ili slučajno, a neke su pripadnici autohtone faune. U PP Lonjsko polje rijetkim vrstama smatraju se crnka, belica, bezribica i pastrvski grgeč. Crnka i belica su izrazito limnofilne ribe koje se pojavljuju na točno određenim staništima i najčešće su točkaste rasprostranjenosti. Bezribica i pastrvski grgeč su alohtone vrste pa je njihova malobrojnost prihvatljiva i dobrodošla.

Rijetkim vrstama možemo smatrati i neke od onih koje su navedene kao prisutne u rijeci Savi na ovom području, ali koje nisu ulovljene. Vjerojatno je i mala brojnost populacija jedan od razloga zašto nisu ulovljene pri ovim istraživanjima. Primjeri takvih vrsta kojima se populacije u rijeci Savi smanjuju i nisu zabilježene prilikom naših uzorkovanja bili bi: dunavska paklara (*Eudontomyzon danfordi*), kečiga (*Acipenser ruthenus*), mladica (*Hucho hucho*), velika pliska (*Chalcalburnus chalcoides*), sabljarka (*Pelecus cultratus*), keslerov glavočić (*Neogobius kessleri*), prugasti balavac (*Gymnocephalus schraetser*) i mali vretenac (*Zingel streber*).

Rare species

Of the 33 species of fish recorded, four of them, for various reasons, can be counted as rare. Some of them were introduced into the system deliberately or fortuitously, and some are members of the indigenous fauna. In Lonjsko Polje Nature Park the European mudminnow, sunbleak, false harlequin and largemouth bass are considered to be rare species. The European mudminnow and sunbleak are markedly limnophilous fish that occur in precisely defined habitats and most often have a dotted distribution. The false harlequin and largemouth bass are allochthonous species and so their small abundance is acceptable and welcome.

Some of those that are quoted as present in the Sava River in this region but nevertheless were not caught can also be considered, we think, rare species. Probably the small numbers of the populations is one of the reasons why they were not caught during these investigations. Examples of such species the populations of which in the Sava River are falling and were not recorded during our sampling are: Danubian lamprey (*Eudontomyzon danfordi*), sterlet (*Acipenser ruthenus*), huchen (*Hucho hucho*), Danubian bleak (*Chalcalburnus chalcoides*), ziehe (*Pelecus cultratus*), big head goby (*Neogobius kessleri*), striped ruffe (*Gymnocephalus schraetser*) and streber (*Zingel streber*).

3. STATUS UGROŽENOSTI

Općenito govoreći, najugroženijim ekološkim sustavima Hrvatske pokazale su se plitke slatke vode i močvare. U zajednici riba takvih staništa brojne su vrste ugrožene, a dio ih je s njih i nestao. Na te zajednice riba utječu brojni čimbenici. Među njima prednjače onečišćenja rijeka, melioracije i regulacije vodotoka, unos alohtonih vrsta, goleme potrebe modernoga čovjeka za tehničkom i pitkom vodom, prelov i turizam. Pritom su naročito u opasnosti rijetke i osjetljive vrste.

3.1. Endemi

Sedam vrsta riba širega područja, čija je prisutnost potvrđena ili se pretpostavlja za PP Lonjsko polje, endemi su dunavskoga slijeva. To su crnka (*Umbra krameri*), mladica (*Hucho hucho*), veliki vijun (*Cobitis elongata*), tankorepa krkuš (*Gobio uranoscopus*), plotica (*Rutilus pigus*), prugasti balavac (*Gymnocephalus schraetzer*) i mali vretenac (*Zingel streber*).

3.2. Nestale vrste

Nestale vrste u rijeci Savi su pojedine vrste jesetra koje su u prošlosti nastanjavale to područje, posebno obična moruna (*Huso huso*) i pastruga (*Acipenser stellatus*), ali i sim (*Acipenser nudiiventris*), obična jesetra (*Acipenser güldenstädti*) te crnomorska haringa (*Alosa pontica*). Sim se smatra izumrlom vrstom u čitavom dunavskom slijevu. S obzirom na to da ne postoje prijašnji podaci o rasprostranjenosti crнке (*Umbra krameri*) i belice (*Leucaspis delineatus*) na ovom području, a tijekom ovih istraživanja nisu nađene, teško je tvrditi da su nestale s ovog područja, ali pretpostavka je da su bile šire rasprostranjene i zastupljene brojnijim populacijama. Prugasti balavac je gotovo nestao iz rijeke Save i zadnjih godina nisu ga zabilježili znanstvenici, iako športsko-rekreativni ribolovci povremeno javljaju o njegovu ulovu.

3.3 Ugrožene vrste

Prema IUCN kategorizaciji ugroženosti, svojte se mogu podijeliti na osam kategorija. Na području Europe u skupinu od ranjive do kritično ugrožene svojte ubrajaju se crnka (*Umbra krameri*) i autohtoni riječni šaran (*Cyprinus carpio*). Od riba koje nisu

3. STATUS OF ENDANGERMENT

Speaking in general, the most endangered ecosystems in Croatia have proved to be shallow freshwater areas and wetlands. In the fish community of such habitats, many species are endangered, and some of them have disappeared. Many factors affect these fish communities. In the lead among such factors are river pollution, the engineering and straightening of the streams, the introduction of foreign species, the enormous needs of contemporary human beings for process and drinking water, over-fishing and tourism. And it is the rare and sensitive species that are particularly in danger.

3.1. Endemic species

Seven fish species of the wider area, the presence of which in Lonjsko Polje Nature Park has been either confirmed or can be reasonably supposed are species endemic to the Danube basin. They are: the European mudminnow (*Umbra krameri*), huchen (*Hucho hucho*), Balkan loach (*Cobitis elongata*), Danubian gudgeon (*Gobio uranoscopus*), Dalmatian roach (*Rutilus pigus*), striped ruffe (*Gymnocephalus schraetzer*) and streber (*Zingel streber*).

3.2. Vanished species

The vanished species in the Sava River are individual species of sturgeon that did inhabit the area in the past, particularly the Beluga sturgeon (*Huso huso*) and stellate sturgeon (*Acipenser stellatus*), as well as the ship sturgeon (*Acipenser nudiiventris*), the Russian sturgeon (*Acipenser güldenstädti*) and the Pontic shad (*Alosa pontica*). The ship sturgeon is considered a species that is extinct in the whole of the Danube basin. Since there are no data concerning the previous distribution of the European mudminnow (*Umbra krameri*) and sunbleak (*Leucaspis delineatus*) in this region, and during the investigation they were not found, it is hard to claim that they have vanished from the region, but it can reasonably be assumed that they were once more widely distributed and represented by more numerous populations. The striped ruffe has almost vanished from the Sava River and in the last few years no scientists have reported it, although anglers have occasionally reported catching it.

3.3. Endangered species

According to the IUCN categorisation of threat level, taxa can be divided into eight categories. In Europe,

ulovljene, ali čiji se dolazak očekuje, na popisu su i mladica (*Hucho hucho*), kečiga (*Acipenser ruthenus*) te mali vretenac (*Zingel streber*). Prema Crvenoj knjizi riba Hrvatske (u tisku), na popisu od osjetljivih do kritično ugroženih (VU-CR) 12 je vrsta riba koje žive na području PP Lonjsko polje. Uzevši u obzir i ostale ribe, pretpostavljene za šire područje, ovaj broj doseže 22 vrste.

Najugroženije svojte su mladica (za dunavski slijev kritično ugrožena), crnka i divlji (riječni) šaran, dok su posebno osjetljive mali i veliki vretenac te kečiga. Gledajući samo Lonjsko polje, ugrožene svojte bile bi tipične limnofilne vrste: crnka, belica, čikov, linjak i karas zbog gubitka i smanjivanja staništa, kompeticije invazivnih vrsta i promjene poplavnog ritma. Dvoprugasta uklija, koja se smatra ugroženom vrstom dunavskoga slijeva, u ovom istraživanju nije zabilježena, iako su njezine populacije u Savi, na pojedinim brzotekućim staništima, prilično brojne.

3.4. Zaštićene vrste

Za sada u Hrvatskoj nema zaštićenih vrsta riba. Tako ni na području parka prirode nema posebno zaštićenih vrsta. Za gospodarskih 12 vrsta prema "Zakonu o slatkovodnom ribarstvu" postoji pravilnik o lovostaju. Dvanaest vrsta je na popisu Bernske konvencije (aneks 2 i 3) i ima određenu zaštitu u Europi (tablica 4.), dok je 6 vrsta na popisu Habitat Directive. Uzmemo li u obzir i one vrste čiji se dolazak samo pretpostavlja, onda su ti brojevi veći: Bern 27 i HD 17 vrsta. Na popisu obiju ovih konvencija nalaze se sljedeće vrste: vijun, piškur, bjeloperajna krkušica, gavčica, plotica, ali i kečiga, mladica, lipljen, potočna mrena, velika pliska, tankorepa krkušica, blistavac, mali i veliki vretenac. Prema Bonnskoj konvenciji o zaštiti migratornih vrsta divljih životinja, zaštićene su sve jesetre pa i kečiga koja se ovdje pojavljuje.

the European mudminnow (*Umbra krameri*) and the autochthonous *Cyprinus carpio* belong to the vulnerable-critically endangered group. Of the fish that were not caught, that can be assumed to come, also on the list are the huchen (*Hucho hucho*), sterlet (*Acipenser ruthenus*) and the streber (*Zingel streber*). According to the Red Book of Fish in Croatia (in the press), 12 species of fish that live in the area of the Lonjsko Polje Nature Park are on the list of vulnerable to critically endangered (VU-CR). Taking the other fish into account assumed for the wider area, this number comes to as many as 22 species. The most endangered taxa are the huchen (critically endangered for the Danube basin), the European mudminnow and the wild common carp, while the streber and the zingel and the sterlet are particularly sensitive. Looking at Lonjsko Polje only, the endangered species would be the typical limnophilous species: the European mudminnow, sunbleak, tench and Crucian carp because of loss and reduction of habitats, the competition from invasive species and changes in the rhythm of floods. The schneider, which is considered an endangered species in the Danube basin, was not recorded in this investigation, although its populations in the Sava, in certain fast-water habitats, are fairly numerous.

3.4. Protected species

In Croatia so far there are no protected fish species. Thus also in the nature park there are no specially protected species. For the twelve commercially important species, according to the Freshwater Fishing Law, there are regulations concerning a close season. Twelve species are on the Berne Convention list (Annex 2 and 3) and do have a certain amount of protection in Europe (Table 4), while six species are on the list of the Habitat Directive. If we take into account those species that are only assumed to come, then the numbers will be greater: Berne 27 and HD 17 species. On the list of both of these conventions the following species are found: Danubian loach, weather loach, whitefin gudgeon, bitterling, Dalmatian roach, but also the sterlet, huchen, grayling, southern barbel, Danubian bleak, Danubian gudgeon, blageon, streber and zingel. According to the Bonn Convention concerning the protection of migratory species of wild animals, all the sturgeon as well as the sterlet that can be found here are protected.



Tradicionalni ribarski alat: vrška / Traditional fishery tool: fish pot



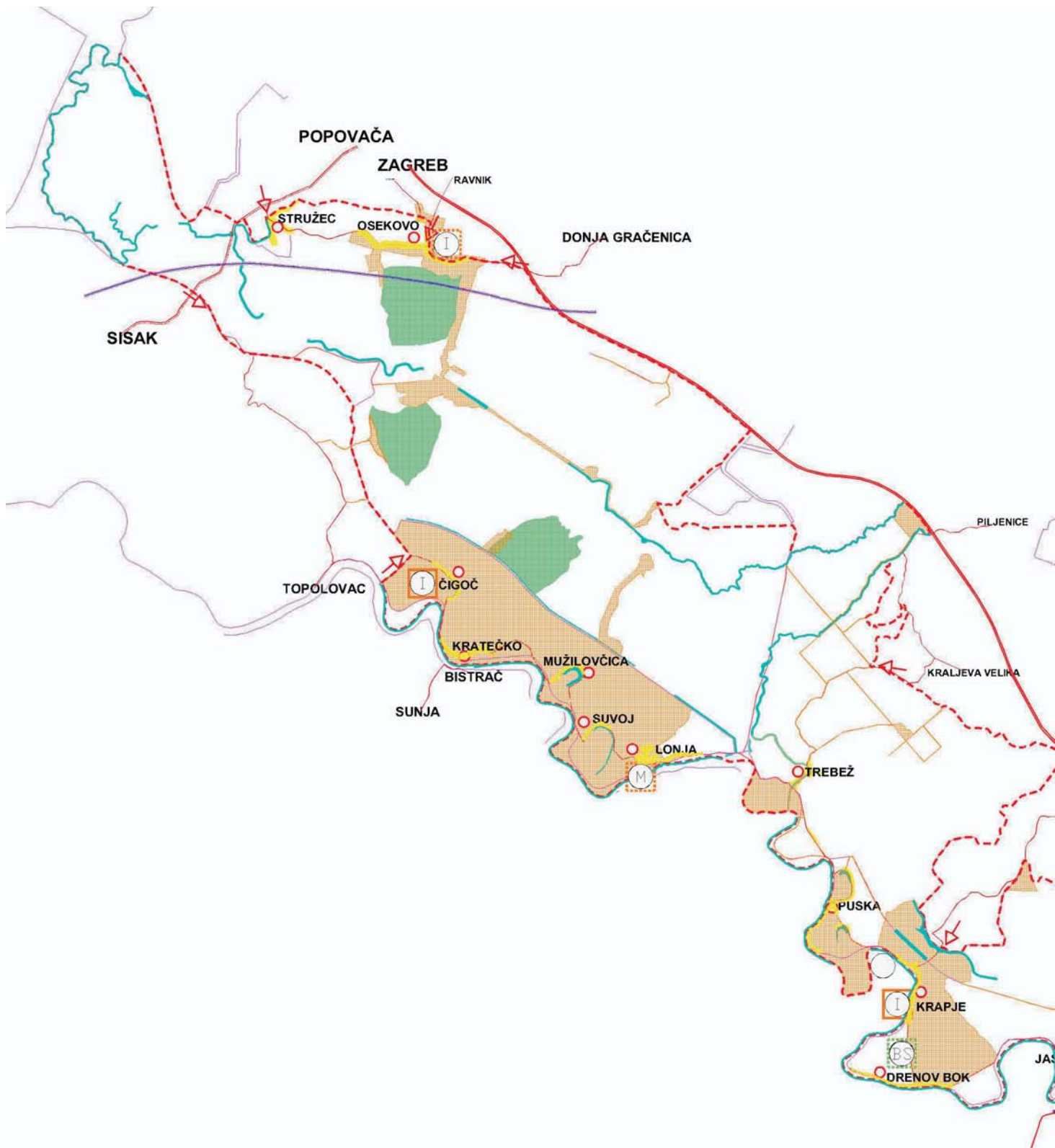
Tradicionalni način ribolova soma «bučka»
Traditional fishery technique for the wels, the “bučka”



Intiološka istraživanja rukavca «Tišina» u Čigoću
Ichthyologic investigation of the Tišina oxbow, Čigoć



Tradicionalni ribarski alat: koš / Traditional fishery device: basket



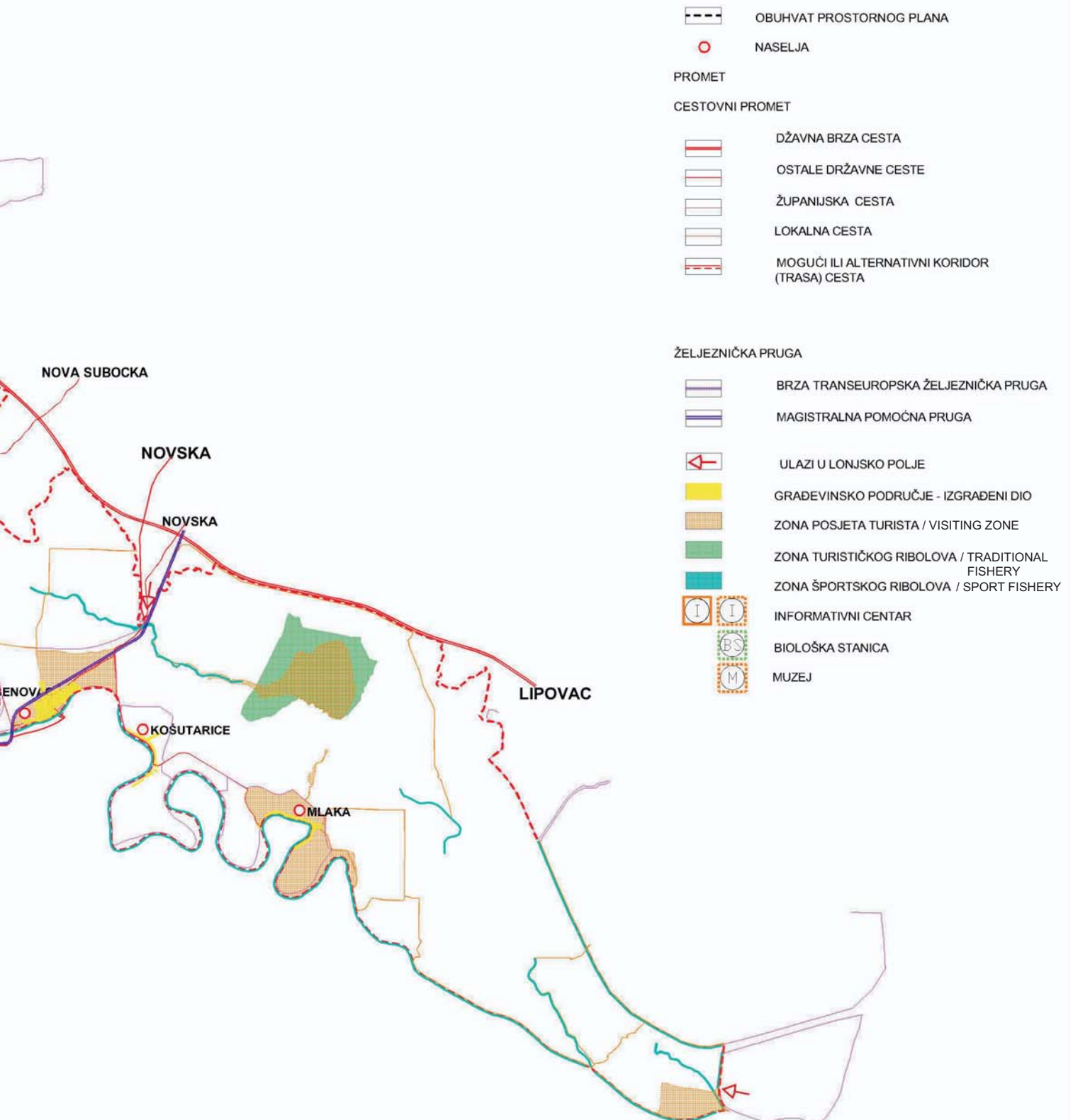
Karta 1.

Predloženi sustav športskog i tradicionalnog ribolova u parku prirode Lonjsko polje. Izvor: Prijedlog Prostornog plana područja posebnih obilježja Park prirode Lonjsko polje. Izradio: Županijski ured za prostorno uređenje i zaštitu okoliša, Sisak.

Map 1.

The proposed angling and traditional fishery system for Lonjsko Polje Nature Park. Source: Draft Physical Plan for Lonjsko Polje Nature Park. Produced by: County Office for Physical Planning and Environmental Protection, Sisak.

PRIJEDLOG UREĐENJA RIBARSTVA U PROSTORNOM PLANU PARKA PRIRODE LONJSKO POLJE





1. Istraživanje riba na ustavi Trebež
Ichthyologic research into the fish population at Trebež Weir



Carassius carassius / Karaš / Crucian carp



1. Som u lokalnoj gastronomskoj ponudi
Wels in the local restaurant trade



Umbra krameri / Cmka / European mud minnow

4. EKOLOŠKE ZNAČAJKE RIBLJIH ZAJEDNICA

4.1 Odabir staništa i sklonost prema brzini toka

Vrste su raspoređene u grupacije prema zadržavanju u određenoj zoni brzine protoka i prema tipu staništa koje nastanjuju tijekom života. Prema brzini protoka vode razlikujemo litofilne (lentičke), neutrofilne i reofilne (lotičke) vrste riba. Od 33 zabilježene vrste u PP Lonjsko polje, 6 vrsta (uz njih limnofilne su i još neregistrirane crnka i belica) je limnofilno, tj. stanovnici su stajaćih voda; 10 vrsta je reofilno, tj. stanovnici su tekućih voda. Svih ostalih 17 vrsta pripada skupini neutrofilnih (eurytopic) koji se smatraju generalistima s obzirom na izbor stanište.

Prema tome koliko se često pojavljuju na poplavnim područjima PP Lonjsko polje vrste možemo podijeliti na stalne, povremene i slučajne vrste.

Stalne vrste

Staništa mrtvaja, ritova i rukavaca, manje ili više povezanih s rijekom, imaju vrlo važnu ulogu u očuvanju populacija pojedinih zajednica riba. Zajednicu riba koja stalno nastanjuje poplavne zone i močvarna staništa čine karas (*Carassius carassius*), linjak (*Tinca tinca*), crvenperka (*Scardinius erythrophthalmus*), čikov (*Misgurnus fossilis*), crnka (*Umbra krameri*) i belica (*Leucaspis delineatus*). Tu skupinu riba naziva se limnofilne vrste ili "crna riba". Za život tih vrsta važne su naplavne bare, depresije i nepovezani kanali, često odvojeni od glavne rijeke. Regulacije rijeka u praksi uklanjaju hidrološki i geomorfološki dinamizam, te odvajaju rijeku od naplavne zone. U prošlosti, prije uređenja korita Save, takva poplavna područja bila su brojna, a danas su gotovo nestala iz njezina porječja. Kako spomenutih jedinka tih vrsta danas ima vrlo malo, o njihovoj prijašnjoj rasprostranjenosti ne znamo mnogo. Ta je zajednica riba u Europi opasno ugrožena i, premda nema ekonomsku vrijednost, za biološku je raznolikost od posebnoga značenja. Linjak i crvenperka, kao fitofili izrazito vezani uz vodenu vegetaciju naplavnih zona, u načelu su manje ugroženi od ostalih vrsta te zajednice.

Unatoč tome što prema sklonosti brzini protoka pripadaju skupini neutrofila, još jedna skupina riba je vrlo česta na takvu tipu staništa. To su štika (*Esox*

4. ECOLOGICAL CHARACTERISTICS OF THE FISH COMMUNITIES

4.1. Selection of habitat and liking for current velocity

Species can be classified into groups according to whether they stay in a given area of current velocity and according to the type of habitat that they inhabit during their lifetimes. According to water velocity we can distinguish lithophilous (lentic), neutrophilous and rheophilous (lotic) species of fish. Of the 33 species recorded in Lonjsko Polje Nature Park, six species (as well as them, the unrecorded European mudminnow and sunbleak are limnophilous) are limnophilous, i.e., live in standing water. Ten species are rheophilous, i.e., inhabit running water. All the other 17 species belong to the neutrophilous or eurytopic group, which are generalists with respect to their choice of habitat.

According to how often they appear in the floodplain of Lonjsko Polje Nature Park, we can distinguish species as residential, occasional and adventitious species.

Resident species

The habitats of the oxbows, marshes and channels more or less linked with the river have a very important role in the preservation of populations of individual fish communities. A community of fish that is permanently resident in the inundated zones and the wetland habitats is constituted by the Crucian carp (*Carassius carassius*), tench (*Tinca tinca*), common rudd (*Scardinius erythrophthalmus*), weather loach (*Misgurnus fossilis*), European mudminnow (*Umbra krameri*) and sunbleak (*Leucaspis delineatus*). This group consists of limnophilous species or "black fish". The alluvial ponds, depressions and unconnected channels often detached from the main river are important for the lives of these species. Straightening of the rivers in practice takes away their hydrological and geomorphologic dynamism, and separates the river from the alluvial zone. In the past, before the course of the Sava was straightened, such alluvial areas were very numerous, although today they have more or less vanished from the basin. Since there are very few individuals of these species today, we do not know much of their previous distribution. This fish community is critically endangered in Europe and, although it has not economic value, it is of particular importance for biological diversity. The tench and the common rudd, which are phytophilous species particularly connected with the water plants of the flood zones, in principle they are less endangered than the other species of this community.

lucius), babuška (*Carassius gibelio*), uklija (*Alburnus alburnus*), grgeč (*Perca fluviatilis*), som (*Silurus glanis*) te bodorka (*Rutilus rutilus*). Zabrinjavajuće je što su na području PP Lonjsko polje na većini takvih staništa ipak brojnošću premoćne dvije alohtone sjevernoameričke vrste: sunčanica (*Lepomis gibbosus*) i patuljasti somić (*Ameiurus nebulosus*).

Povremene vrste

Zajednicu povremenih korisnika naplavne zone, odnosno riječnih riba koje su načinom života u pojedinim sezonama vezane uz poplavne i plitke litoralne zone čini sedam vrsta. U ovoj zajednici dolaze: šaran (*Cyprinus carpio*), smuđ (*Stizostedion lucioperca*), deverika (*Abramis brama*), koselj (*Abramis balerus*), krupatica (*Abramis bjoerkna*), gavčica (*Rhodeus sericeus*) i balavac (*Gymnocephalus cernuus*). To su vrste koje nazivamo neutrofilne, tzv. "siva riba", a nalazimo ih jednako u stajaćim i tekućim vodama. Sa smanjenjem poplavnih područja, na posredan način, i ova je skupina riba pod sve većim ljudskim utjecajem uz smanjenje brojnosti populacija.

Među povremene korisnike poplavne nizine ubraja se i jedna reofilna vrsta, podust (*Chondrostoma nasus*). Ta holobiontska migratorna vrsta je najbrojnija riba prirodnoga korita rijeke. Populacije podusta u Europi se smanjuju i sve su više ugrožene djelovanjem čovjeka.

Slučajne vrste

Neke vrste mogu se smatrati slučajnima, s obzirom na to da najčešće nastanjuju druge tipove staništa. Pripadaju im sve vrste matice koje rijetko napuštaju rijeku, primjerice, jez (*Leuciscus idus*), mrena (*Barbus barbus*), manjić (*Lota lota*), plotica (*Rutilus pigus*) i klen (*Leuciscus leuciscus*). Te vrste više vole staništa s bržom tekućom vodom bogatom kisikom, a pripadaju grupi reofilnih vrsta ili tzv. "bijeloj ribi". Pri istraživanju nisu nađene neke ribe koje pripadaju ovoj skupini, a realno ih je očekivati u ovom dijelu rijeke Save. To su dvoprugasta uklija (*Alburnoides bipunctatus*), klenić (*Leuciscus leuciscus*), nosara (*Vimba vimba*), crnooka deverika (*Abramis sapa*), kečiga (*Acipenser ruthenus*), prugasti balavac (*Gymnocephalus schraetser*) i mali vretenac (*Zingel streber*). Zadnje dvije vrste već duže vrijeme nisu nađene u Savi, a zna se i da je prugasti balavac češći u Dunavu. Zbog utjecaja rijeke Une i njezine ihtiofaune mogu se očekivati i neke reofilne

Although according to their liking for flow velocity they belong to the neutrophilous group, one other group of fish is very common in this type of habitat. This is composed of the pike (*Esox lucius*), Prussian carp (*Carassius gibelio*), common bleak (*Alburnus alburnus*), European perch (*Perca fluviatilis*), sheatfish or catfish (*Silurus glanis*) and the common roach (*Rutilus rutilus*). It is worrying that in the area of Lonjsko Polje Nature Park in most of such habitats, two allochthonous North American species are dominant in terms of numbers: the pumpkinseed (*Lepomis gibbosus*) and the brown bullhead (*Ameiurus nebulosus*).

Occasional species

The community of occasional users of the flood zone, that is, of the river fish that, in their manner of life in given seasons are connected with the flooded area and the shallow littoral zone, consists of seven species. In this community there are the common carp (*Cyprinus carpio*), pike-perch (*Stizostedion lucioperca*), common bream (*Abramis brama*), blue bream (*Abramis balerus*), silver bream (*Abramis bjoerkna*), bitterling (*Rhodeus sericeus*) and the ruffe (*Gymnocephalus cernuus*). These are species that are called neutrophilous, the so-called grey fish, and they can be found equally in stagnant and in running water. With the reduction of the flood areas, in an indirect way, this group of fish is increasingly becoming subject to human influence, with a reduction of numbers of populations.

Among the occasional users of the inundated lowlands there is one rheophilous species, the common nase (*Chondrostoma nasus*). This holobiontic migratory species is the most numerous fish of the natural course of the river. The common nase populations in Europe are reducing and are increasingly endangered thanks to human activities.

Adventitious species

Some species can be considered adventitious in that they most often inhabit other types of habitat. All species of the mainstream, which seldom leave the river, can be considered to belong to this type, for example the ide (*Leuciscus idus*), barbel (*Barbus barbus*), burbot (*Lota lota*), Dalmatian roach (*Rutilus pigus*) and chub (*Leuciscus leuciscus*). These species are fonder of habitats with fast running water rich in oxygen, and they belong to the group of rheophilous species, the so-called "white fish". During our investigation, some fish belonging to this group were not found, fish that could realistically be expected in this part of the Sava River. These are the schneider (*Alburnoides bipunctatus*), common dace (*Leuciscus leuciscus*), vimba (*Vimba vimba*), Danubian bream (*Abramis sapa*), sterlet (*Acipenser ruthenus*), striped ruffe (*Gymnocephalus*

salmonidne vrste, poput mladice, potočne pastrve, kalifornijske pastrve, lipljena, peša i dr.

4.2. Reproductive značajke i mrijesna staništa

Zajednicu riba ovoga područja možemo podijeliti i prema reproduktivnoj strategiji i supstratu na koji polažu jaja, a koji ima veliku ulogu u opstanku vrste prilikom promjena pojedinih činitelja (Balon, 1975., Balon, 1990.). Riba se služe različitim strategijama kako bi reprodukcija bila što uspješnija. Većina vrsta (25) ne čuva svoju ikru niti mlade, sedam vrsta čuva, a jedna vrsta skriva buduće potomstvo. Prema podlozi, tj. supstratu neophodnom za odlaganje jaja, tu skupinu riba dijelimo na litofilne (3 vrsta), fitofilne (11 vrsta te crnka i belica), fitolitofilne (8 vrsta), psamofilne (2 vrste) te ostrakofilne, litopalgofilne i polifile sa po jednom vrstom. Od onih riba koje čuvaju potomstvo možemo razlučiti one koje prave gijezdo (4 vrste) i one koje pričvršćuju ikru na određene strukture čuvajući je (3 vrste uz dodatak crnke i belice). Gavčica je jedina vrsta koja skriva ikru (ostrakofil), i to u slatkovodnu školjku.

Među nezabilježenim vrstama riba prevladavaju litofili, što je također jedna od odlika riječnih ihtiocenoza.

4.3. Prehrana

Zajednica riba Lonjskoga polja sastoji se od 10 nespecializiranih omnivora (sveždera) i oportunih vrsta bentivora (prehrana pridnenim organizmima) (14) piscivora (prehrana ribama) (7), planktivora (prehrana planktom) (2) i invertivora (prehrana beskralježnjacima) (2).

4.4. Dobna struktura

Dobna struktura ispitivanih populacija posljedica je utjecaja okoliša, antropogenih faktora, količine hrane i cijeloga niza interspecijskih i intraspecijskih odnosa u populaciji. Dobna struktura jedan je od najbitnijih elemenata cjelokupne populacije za procjenu ihtiomase i produkcije po jedinici površine. Najčešće vrste zastupljene su zadovoljavajućim rasponom godišta. U većine vrsta najbrojnije su jedinice godišta

schraetser) and the streber (*Zingel streber*). The last two species have not been found in the Sava for quite a long time, and it is known that the striped ruffe is more frequent in the Danube. Because of the impact of the Una River and its ichthyofauna, some kind of rheophilous salmonid species could be expected, such as the huchen, brown trout, rainbow trout, grayling, common bullhead and others.

4.2. Reproductive features and spawning habitats

We can divide the fish community of this area according to their reproductive strategies and the substrate on which they lay their eggs, and which has a great role in the survival of the species during changes of given factors (Balon, 1975., Balon, 1990.). Fish use various strategies to try to ensure as much reproductive success as possible. Most species (25) do not guard their eggs or fry, seven species do guard them, and one species conceals its future progeny. According to the base, or substrate necessary for the deposition of the eggs, we can divide this group of fish into lithophilous (3 species), phytophilous (11 species and the European mudminnow and sunbleak), phytolithophilous (8 species), psamophilous (2 species) and ostracophilous, lithopalgophilous and polyphilous, one species of each. Of those fish that protect their young we can distinguish those that make nests (4 species) and those that fix the eggs to given structures and watch over them (3 species, with the addition of European mudminnow and sunbleak). The bitterling is the only species that hides its eggs (ostracophylous), in the freshwater mollusc.

Among the unrecorded species of fish, the lithophilous prevail, which is also one of the features of riverine ichthyocoenoses.

4.3. Food

The Lonjsko Polje fish community consists of 10 unspecialised omnivores and opportunist species of benthivores (bottom feeders) 14 piscivores, (7) planktivores (2) and invertivores (feeds on invertebrates) (2).

4.4. Age structure

The age structure of the populations investigated is the consequence of environmental impact, anthropogenic factors, quantity of food and a whole sequence of inter- and intraspecies relations in the population. The age structure is one of the most essential elements of the overall population for the estimation of ichthyomass and production per unit of area. The most frequent species were found with a satisfactory range of years. In most species the most

0+, jednogodišnje i, nešto manje, dvogodišnje jedinke.

Ulovi vrlo mladih riba su relativno bogati, posebno u plitkim poplavljenim dijelovima područja. Najviše mlađi je zabilježeno tijekom svibnja i lipnja u samom polju nakon mrijesta šarana i deverike. Ulovljeni primjerci su starosti 0+ bodorke, uklije, šarana, babuške, jeza, grgeča, smuđa, kruptice, patuljastog somića i sunčanice. Ulovi starijih starosnih kategorija su rjeđi pa je zabilježeno samo nekoliko jedinka starijih od šest godina, poput soma, šarana i bolena.

4.5. Migratorne vrste

Značenje migracija u riba dugi niz godina nije bilo vrjednovano. Otkriveno je da ribe imaju transverzalne i longitudinalne migracije te da bi bez mogućnosti migriranja u pojedina staništa ubrzo drastično smanjile svoje populacije. Staništa laguna, ritova i rukavaca povezanih s glavnom rijekom imaju vrlo važnu ulogu kao povremena staništa u populacijama pojedinih zajednica riba. Nažalost, čovjek je dugogodišnjom regulacijom rijeka na mnogima uklonio hidrološki i geomorfološki dinamizam, odvojio rijeku od naplavne zone i tako ugrozio brojne vrste. Neke ribe su zbog tih zahvata naposljetku i izumrle.

Kod transverzalnih migracija zajednica riba, u kojoj se pojavljuju linjak, crvenperka, čikov, karas i bjelica, ne mogu opstati bez naplavnih bara, depresija i nepovezanih kanala, često odvojenih od glavne rijeke. Danas je poznato da je ta zajednica naplavne zone opasno ugrožena.

U riba Lonjskoga polja razlikujemo nekoliko tipova migracija. Dvadeset i jedna vrsta je stagnofilni holobionski migrant, osam vrsta su reofilni holobionski migranti a osam vrsta stanarice. Anadromne migracije vezane su uz gotovo izumrle jesetre: morunu (*Huso huso*) i pastrugu (*Acipenser stellatus*). Migracije holobionskih selica za ovaj prostor su najvažnije. Sve rjeđa kečiga (*Acipenser ruthenus*), klen (*Leuciscus cephalus*), podust (*Chondrostoma nasus*), mrena (*Barbus barbus*), nosara (*Vimba vimba*), sabljarka (*Pelecus cultratus*), manjić (*Lota lota*), veliki vretenac (*Zingel zingel*) i som (*Silurus glanis*) migriraju duž riječnog toka i na poplavnu zonu.

numerous were individuals of age groups 0+, one year, and, somewhat fewer, two year old individuals. Catches of very young fish were relatively rich, especially in the shallow flooded parts of the area. Most fry were recorded during May and June in the common (pasture) itself after spawning of common carp and common bream. Specimens caught of age class 0+ were the common roach, common bleak, common carp, Prussian carp, ide, European perch, pike-perch, silver bream, brown bullhead and pumpkinseed. Catches of older age categories were older, and only a few individuals older than six years were recorded, such as the sheatfish, common carp and asp.

4.5. Migratory species

The importance of migration in fish for many years was not considered of importance. It was discovered however that fish have transversal and longitudinal migrations, and without the opportunity of migrating to given habitats, their populations would soon become drastically reduced. Habitats of lagoons, marshes and channels linked with the main river have a very important role as temporary habitats in the populations of individual fish communities. Alas, through many years of hydraulic engineering, people have stripped many rivers of their hydrological and geomorphologic dynamism, have separated the river from the flood zone and thus endangered many species. Because of these operations, some of these fish have become extinct.

In the case of transversal migrations of fish communities, in which the tench, common rudd, weather loach, Crucian carp and sunbleak or belica figure, they cannot survive without the flood pools, depressions and unconnected channels often split off from the main river. Today it is known that this community of the floodplain area is critically endangered.

Several types of migration can be distinguished in the fish of Lonjsko Polje. Twenty-one species are stagnophilous holobiontic migrants, eight species are rheophilous holobiontic migrants and eight species are non-migratory. Anadromous migrations are related to the almost extinct sturgeons: the huchen (*Huso huso*) and stellate sturgeon (*Acipenser stellatus*). Migrations of holobiontic migratory fish are the most important for this area. The increasingly rare sterlet (*Acipenser ruthenus*), chub (*Leuciscus cephalus*), common nase (*Chondrostoma nasus*), barbel (*Barbus barbus*), vimba (*Vimba vimba*), ziehe (*Pelecus cultratus*), burbot (*Lota lota*), zingel (*Zingel zingel*) and the sheatfish (*Silurus glanis*) migrate along the course of the river and into the floodplain.

5. IHTIOPRODUKTIVNOST

Za razumijevanje funkcioniranja ekosustava treba poznavati raznolikost živoga svijeta nekog područja, a potom gustoću i brojnost populacija jer one nisu uvijek stalne. Kako su ribe važan element biološkog iskorištavanja rijeka, za racionalno gospodarenje vodama nužno je istražiti mehanizme koji uzrokuju promjene u ribljim populacijama. Mnoge vrste pokazuju znatne fluktuacije, koje su uvjetovane različitim prirodnim čimbenicima (biotičkim i abiotičkim), a mogu biti i važan indikator promjena u okolini.

Ribe su, kao konzumenti, na različitim razinama u trofičkoj piramidi, pa je stoga njihova prisutnost u vodotocima važna za ravnotežu u biocenozi. Broj prisutnih vrsta ovisi o raznolikosti staništa nekoga područja. Što je veći broj vrsta, to su i složeniji prehrambeni odnosi među različitim članovima prehrambenih lanaca te se tako stvara kompleksna prehrambena mreža. Stabilnost ekosustava ovisi o njegovoj složenosti; on je stabilniji što je složeniji. Ribe su, kao osnova u svim prehrambenim lancima, važne i za brojčano stanje svih ostalih skupina kralježnjaka. Nestanak neke ključne vrste mijenja cijelu riblju zajednicu koja se stabilizira na nekoj novoj razini. I smanjenje prehrambene osnove imat će za posljedicu smanjenje svih ostalih skupina u prehrambenom lancu.

Osim o tim čimbenicima, proizvodnja riba u otvorenim vodama ovisi i o svjetlosti, kemizmu vode uoči mrijesta, za vrijeme mrijesta i nakon mrijesta, kvantitativnom i kvalitativnom sastavu biljne i životinjske proizvodnje kojima se ribe hrane (bogatstvu fito- i zooplanktona, bentoskih pridnenih organizama, kao i mikroorganizama), stanju matičnog fonda pojedinih ribljih vrsta, poplavama (veličini poplavljenih zone i dužini poplave), kvalitativnom sastavu zemljišta poplavljenih zone u smislu pedoloških karakteristika, stupnja obraštaja vegetacije i, naposljetku, utjecaju čovjeka na ritam razmnožavanja.

Mehanizam produkcije riba u slatkim vodama, u kvantitativnom i kvalitativnom smislu, dakle, ovisi o sljedećim čimbenicima:

- temperaturnom režimu voda uoči mrijesta i za vrijeme mrijesta, prema najpovoljnijim temperaturama za vrste koje naseljavaju te vode;
- vjerojatnosti pojave niskih temperatura, stvaranja i kretanja leda te trajanja zaleđenosti vodene

5. ICHTHYOPRODUCTIVENESS

For an understanding of the functioning of the ecosystem it is necessary to know the diversity of the living world of an area, and then the density and abundance of the populations, because they are not always constant. Since fish are an important element of the biological use of rivers, for a rational management of waters it is necessary to investigate the mechanisms that bring about changes in the fish populations. Many species show considerable fluctuations, which are condition by various natural factors (biotic and abiotic) and they can be an important indicator of environmental changes.

As consumers, fish occupy various levels in the trophic pyramid, and thus their presences in streams is important for the equilibrium in a biocoenosis. The number of species present depends on the diversity of habitats of a given area. The greater the number of species, the more complex the food relations among the various members of the food chain, a complex food network being created. The stability of an ecosystem depends on its complexity, the more complex it is, the more stable it will be. As the base of all food chains, fish are important for the abundance of all other groups of vertebrates. The absence of some key species will change the whole fish community that will then stabilise at some new level. A reduction of the food base will have the consequence of reducing all the other groups in the food chain.

The production of fish in open waters depends, as well as on these factors, on light, water chemistry just before spawning, during and after spawning, the quantitative and qualitative composition of plant and animal production on which the fish feed (ample phytoplankton and zooplankton, benthic organisms and microorganisms), the state of the breeding stock of given fish species, floods (size of the flood zone and the length of the flooding), the quality composition of the land of a floodplain, with respect to pedological characteristics, the degree of vegetation growth and finally the impact of people on the rhythm of reproduction.

The mechanism of fish production in fresh water, thus, depends, quantitatively and qualitatively, on the following factors:

- the temperature regime of the water before, and during spawning, according to the optimum temperatures for the species that inhabit the water;
- the likelihood of the appearance of low temperatures, the creation and movement of ice and the duration the surface is iced over;

- površine;
- kemijskom stanju vode pred mrijest, za vrijeme mrijesta i nakon mrijesta;
 - kvantitativnom i kvalitativnom sastavu biljne i životinjske produkcije, posebno planktona, bentosa (faune dna) i mikroorganizama kojima se ribe hrane;
 - stanju matičnoga fonda pojedinih ribljih vrsta, tj. brojnosti i stanju ukupno raspoloživoga broja spolno zrelih mužjaka svake vrste riba toga vodenog staništa
 - pojavi variranja vodostaja uoči mrijesta, za vrijeme i nakon mrijesta;
 - poplavama, veličini poplavljenih zona, tj. površine zemljišta u hektarima koje voda pokriva u uvjetima minimalnog, srednjeg i maksimalnog vodostaja;
 - kvalitativnom sastavu zemljišta poplavljene zone u smislu njegovih pedoloških značajka, stupnja obraštaja vegetacije i sl.;
 - utjecaju čovjeka (antropogeni faktor) na ritam razmnožavanja u prirodi.

Kao prostor visoke biološke produkcije, Lonjsko polje je najveće prirodno mrijestilište riba na području Posavlja, posebno za fitofilne i fitolitofilne vrste riba otvorenih supstrata. Vjeruje se da je poplavna zona parka jedna od najvažnijih za repopulaciju ovoga dijela crnomorskoga slijeva. Poplavna područja važna su kao mrijestilišta, posebno za fitofile, a tamo gdje nema poplavnih područja brojnost fitofila je vrlo mala (Holčik i Bastl, 1976.; Holčik i sur., 1981.). To područje ima funkciju izvora hrane koji se stalno obnavlja te opskrbljuje i glavni tok rijeke. Ujedno služi i kao utočište ribama koje borave u takvim staništima ili dolaze iz uzvodnih dijelova gdje nema poplavnih područja (Holčik i Bastl, 1976.; Holčik i sur., 1981.). Zahvaljujući golemoj raznolikosti poplavnih staništa, broj ribljih vrsta relativno je velik. Posebno je izražena gustoća njihovih populacija, ekološka produkcija i ulov, osobito u dijelovima rijeka koje graniče s poplavnim područjima.

Proces povećane eutrofikacije prate znatne promjene u strukturi riblje zajednice. U ranom oligotrofnom stadiju prevladavaju pastrvske vrste. U našim vodama to je obično potočna pastrva (*Salmo trutta m. fario*). Povećano opterećenje hranjivim tvarima i buduće promjene u abiotičkom i biotičkom okolišu rezultiraju stupnjevitom zamjenom salmonida grgečkama koje su značajka mezotrofnih voda. U

- the chemical state of the water before spawning, during and after spawning;
- qualitative and quantitative composition of plant and animal production, particularly of plankton, of the benthos (bottom fauna) and the microorganisms on which the fish feed;
- the condition of the breeding stock of the individual fish species, i.e., the numbers and condition of the total available number of sexually mature males of each of the species of fish of this aquatic habitat;
- the appearance of variation of the water level before, during and after spawning;
- floods, the size of the flooded zone, i.e., area that the water covers in conditions of minimum, mean and maximum water level;
- qualitative composition of the land of the flood zone in the sense of its pedological features, degree to which it is overgrowth with vegetation and so on;
- anthropogenic impact on the rhythm of reproduction in nature.

An area of high biological production, Lonjsko Polje is the greatest natural spawning area in the Posavina area, in particularly for phytophilous and phytolithophilous species of fish of open substrates. It is believed that the flood zone of the park is one of the most important for the repopulation of this part of the Black Sea basin. Flood areas are important as spawning grounds, particularly for phytophilous species, and where there are no flood regions, there are very few phytophilous species (Holčik and Bastl, 1976; Holčik et al., 1981.). This area has the function of food source that is constantly renewed and also supplies the main course of the river. It also serves as a refuge for fish that live in such habitats or come from the upstream parts where there are not flood areas (Holčik and Bastl, 1976; Holčik et al., 1981). Thanks to the greater diversity of flood habitats, the number of fish species is fairly large. The density of their populations, ecological production and catch, particularly in the parts of the rivers that border on the flood zones, are particularly pronounced.

The process of increased eutrophication is accompanied by marked changes in the structure of the fish community. In the early oligotrophic stage salmonid species dominate. In Croatian water this is usually the brown trout (*Salmo trutta m. fario*). Increased load of nutrients and future changes in the abiotic and biotic environment result in the gradual replacement of salmonids with perches, which are indicators of mesotrophic waters. In European waters

europskim vodama *Perca fluviatilis* (grgeč), *Stizostedion lucioperca* (smuđ) i *Gymnocephalus cernuus* (balavac) obično se povećavaju u toj fazi. U eutrofnoj fazi struktura riblje zajednice potpuno se promijeni. Populacija grgečki je potisnuta i dominaciju preuzimaju šaranke. Među njima deverika (*Abramis brama*), bodorka (*Rutilus rutilus*), krupatica (*Blicca bjoerkna*) i babuška (*Carassius auratus gibelio*) često čine većinu ihtiomase.

Ribe i na druge načine odgovaraju na uznapredovalu eutrofikaciju. Prvo se poveća stopa rasta, a zatim, kad se dosegne određeni prag, naglo se smanji. Količina mlađa naglo opada, a promijene se i navike mriješćenja i hranjenja, dok ponekad nastupi i velika invadiranost. Raspodjela riba također se mijenja kao odgovor na smanjenje koncentracije kisika, smanjenu prozirnost i povećanu mutnoću. Vrste se često pomiču iz hipolimniona u epilimnion i iz litoralne u pelagičku zonu. Promjena ribljih vrsta unutar zajednica povezana je s promjenama u veličini i sazrijevanju vrsta: velike vrste koje dugo žive i kasnije sazrijevaju postupno zamjenjuju male, kratko živuće i rano sazrijevajuće vrste. Također, na tom putu zamjenjivanja ribljih vrsta, početna zajednica riba nespecijaliziranih omnivora zamijeni se karnivorima, zooplanktonofagima dna i herbivornim vrstama koje se hrane perifitonom. Zatim nestaju zooplanktonofagi, vrste koje se hrane na dnu, te karnivori. Na kraju preostaju jedino omnivori, primjerice, grgeč (*Perca fluviatilis*) i karas (*Carassius carassius*). Razlog te sukcesije nije nedostatak hrane, nego manjak pogodnoga tla za mriješćenje. U terminima reproduktivnih skupina, početna oligotrofna faza obilježena je dominacijom litofila koji skrivaju (zaklanjaju) leglo. Oni će biti zamijenjeni s litofilima i litopelagofilima otvorene podloge. Sljedeću fazu obilježava dominacija pelagofila, fitolitofila i fitofila otvorene podloge.

5.1. Kondicijsko stanje ribljih zajednica

Kondicijsko stanje riba je uz sastav ribljih vrsta i njihove međusobne odnose vrlo dobar pokazatelj značajka pojedinoga staništa te izraz svih ekoloških čimbenika toga područja. Osim tih prirodnih čimbenika, vrlo važnu ulogu za kondicijsko stanje riba imaju i antropogeni utjecaji, izravni ili posredni.

Kondicijski čimbenici za većinu čestih vrsta Lonjskoga polja veći su od istih čimbenika riba rijeke

the *Perca fluviatilis* (European perch), *Stizostedion lucioperca* (pike-perch) and *Gymnocephalus cernuus* (ruffe) usually dominate in this phase. In the eutrophic phase the structure of the fish community has changed completely. The perch population has been expelled and carps take over the dominant position. Among them the common bream (*Abramis brama*), common roach (*Rutilus rutilus*), silver bream (*Blicca bjoerkna*) and the Prussian carp or gibel carp (*Carassius auratus gibelio*) often make up the major part of the ichthyomass.

Fish respond in other ways too to advanced eutrophication. First of all the rate of growth increases, and then, when a certain threshold is reached, suddenly drops. The quantity of fry falls, and the feeding and spawning habits changed, while sometimes there is a great degree of invasiveness. The distribution of the fish also changes, as response to the reduction of oxygen, reduced transparency and increased turbidity. Species often move from the hypolimnion to the epilimnion and from the littoral to the pelagic zone. Change in fish species within the communities is related with changes in the size and maturation of species; the large species that live long and mature later gradually replace the small, short-lived and early maturing species. In addition, during the process of the replacement of the species, the initial community of unspecialised omnivores is replaced by carnivores, the zooplanktonphagous species of the bottom and the herbivore species that feed on the periphyton. Then the zooplanktonphages, the species that feed on the bottom, and the carnivores, vanish. At the end only the omnivores remain, for example the European perch (*Perca fluviatilis*) and the Crucian carp (*Carassius carassius*). The reason for this succession is not lack of food, rather shortage of bed suitable for spawning. In the terms of the reproductive groups, the initial oligotrophic phase is marked by the domination of the lithophilous species that conceal their eggs. They are replaced by the lithophiles and the litho-pelagophiles of the open base. The next phase is marked by the domination of pelagophiles, phyto-lithophiles and phytophiles of the open bed.

5.1. Fish community condition factors

The condition factors of the fish are, along with the composition of fish species and their interrelations, a very good indicator of the features of a given habitat and an expression of all the ecological factors of the area. Apart from these natural factors, anthropogenic impacts, direct and indirect, have a very important part to play in the condition state of the fish.

The condition factors for most of the frequent

Save, a u usporedbi s pojedinim literaturnim podacima stranih autora uglavnom pokazuju i veće vrijednosti. Iznimku čine grgeč i bodorka čije su vrijednosti CF-a za rijeku Savu veće negoli za Lonjsko polje, ali tome je možda razlog premali broj analiziranih uzoraka iz Save. Ribe Lonjskoga polja obično pokazuju i brži dužinsko-maseni rast u mlađoj dobi, u usporedbi s onima iz rijeke Save. Prema tome, može se zaključiti da vode Lonjskoga polja imaju veću trofičnost i pružaju bolju prehrambenu osnovicu za odrastanje i rast riba, tj. za ihtioprodukciju.

species of Lonjsko Polje are greater than the same factors of the fish in the Sava River, and in comparison with some of the literature figures of foreign authors mainly show even greater values. An exception is in the European perch and common roach, the CF values of which for the Sava River are greater than for Lonjsko Polje; however, the reason for this is perhaps that too few samples from the Sava have been analysed. The fish of Lonjsko Polje usually show a faster length-mass growth in their fry period, as compared with those from the Sava. Accordingly, it can be concluded that the water of Lonjsko Polje has greater trophicity and offers a better food base for the growth and development of fish, i.e., for ichthyoproduction.

6. KAKVOĆA STANIŠTA I INDIKATORSKE VRSTE

Indikatorske vrste riba koje za područje Lonjskoga polja mogu pokazati promjenu kakvoće staništa su: karas (*Carassius carassius*), čikov (*Misgurnus fossilis*), linjak (*Tinca tinca*) i crvenperka (*Scardinius erythrophthalmus*) te belica (*Leucaspis delineatus*) i crnka (*Umbra krameri*), kao dvije vrste kojima još treba utvrditi prisutnost. Nestanak tih vrsta iz područja Lonjskoga polja značio bi potpuno promijenjene uvjete staništa. Poznavanje stanja i stupnja poremećenosti vodenog ekosustava preduvjet je optimalnoga gospodarenja njima, njihove zaštite i obnove. U novije vrijeme, klasične analitičke metode i načini određivanja i mjerenja promjena koje se događaju u vodenim ekosustavima sve se više dopunjuju pristupima u kojima se primjenjuju bioindikatorske sposobnosti živih organizama. Najveći dio slatkih voda nastanjen je ribama koje mogu signalizirati ne samo trenutačne promjene nego i one koje se događaju unutar dužih vremenskih razdoblja. Odnos čovjeka prema ribama obično je vrlo pozitivan, pa javnost naglašeno odgovara na štetu napravljenu na ribama (a time i na vodi). Masovna smrtnost riba dramatičan je znak koji upozorava da je vodena zajednica u kritičnom stanju i da se tamo događa nešto što bi moglo biti pogibeljno za ribe. Sposobnost neke ribe za osjetljivo odgovaranje na promjene u složenom vodenom okolišu, na odstupanja od normalnih vrijednosti njegovih različitih čimbenika te za označavanje čak i kratkotrajnih nepravilnosti ili za bilježenje dugotrajnih, ali vrlo malih količina zagađivala, predodređuje takvu ribu za ulogu bioindikatora. Na taj način ribe mogu zamijeniti analize i praćenje koje bi inače moralo biti izvedeno pomoću složene i skupe aparature. Ribe imaju potrebne osobine za funkciju bioindikatora u okolišu u kojemu žive. Tijekom života ribe su vezane uz vodeni okoliš, koji ne mogu ni povremeno napustiti. Bioindikatorsko očitovanje i signalizacija riba mogu biti istraživani i procjenjivani na razini zajednica, populacija ili na razini jedinka. Riblje zajednice (raznolikost vrsta, kvantitativni čimbenici) pokazuju kakvo je stanje vodenog okoliša u cjelini. Sastav vrsta riblje zajednice prvotno je određen kakvoćom vode, posebno temperaturom, režimom kisika te također hidrološkim i morfološkim svojstvima vodenog okoliša. S druge strane, na stvaranje prirodne riblje zajednice u danim uvjetima utječu i biološke osobine te ekološki zahtjevi pojedinih ribljih vrsta. Međudjelovanja abiotičkih i

6. HABITAT QUALITY AND INDICATOR SPECIES

Indicator species of fish that can show changes in habitat quality in Lonjsko Polje are: the Crucian carp (*Carassius carassius*), weather loach (*Misgurnus fossilis*), tench (*Tinca tinca*) and common rudd (*Scardinius erythrophthalmus*) as well as the sunbleak (*Leucaspis delineatus*) and European mudminnow (*Umbra krameri*), in addition to two species the presence of which is still to be established. The disappearance of these species from the Lonjsko Polje area would mean total change of habitat conditions. Knowledge of the state and degree of derangement of the aquatic ecosystem is a precondition for optimum management of it, its protection and renewal. In recent times, classical analytical methods and manners of determining and measuring changes that are going on in water ecosystems are increasingly being supplemented with approaches in which the bioindicator capacities of living organisms are employed. Most fresh water is inhabited by fish that can signalise not only current changes but also those that go on within a longer period of time. The human attitude to fish is usually very positive, and the public makes a strong response to hard done to fish and hence to the water. Mass mortality of fish is dramatic sign, warning that the aquatic community is in a critical state and that something is going on that could be fatal for the fish. The capacity of some fish to respond sensitively to changes in the complex aquatic environment, to deviations from the normal values of its various factors and to indicate even short-term irregularities or the marking of long-term but very small quantities of pollutants predetermines such fish for the role of bioindicator. In this manner fish can replace analysis and monitoring that would otherwise have to be carried out with complex and expensive apparatus. Fish have the necessary traits for the function of bioindicator in the environment in which they live. During their lifetimes fish are related to the aquatic environment, which they cannot leave even for a short time. The bioindicator response and signals of fish could be investigated and evaluated at the level of community, population or individual. Fish communities (species diversity, quantitative factors) show what the state of the aquatic environment as a whole is. The species composition of the fish community is primarily determined by water quality, the oxygen regime and by hydrological and morphological characteristics of the aquatic environment. On the other hand, biological factors and the ecological demands of given piscine species do also affect the creation of the fish community in the given conditions. The interaction of biotic and abiotic

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

biotičkih čimbenika određuju stvaran sastav ihtiofaune u vodotoku, jezeru, bazenu ili akumulaciji.

U vrijeme kada je utjecaj ljudskih aktivnosti na vodene ekosustave bio najmanji, sastav vrsta ribljih zajednica bio je u skladu s osobinama prirodnog vodenog okoliša. Sastav vrsta ribljih zajednica koje nastanjuju neku vodu rezultat je kompleksa biotičkih i abiotičkih čimbenika, uključujući ribarsko gospodarenje njima. Promjene u raznolikosti vrsta naglašen su znak koji upućuje na to da se u vodenom ekosustavu dogodila znatna i, obično, posredna promjena jednog ili više čimbenika. Promjene na koje upućuje nestajanje ili pojavljivanje određenih ribljih vrsta mogu biti posljedice promjena kakvoće vode ili hidroloških i morfoloških obilježja vodotoka. S obzirom na to da riblja zajednica djeluje kao složen bioindikator u kojemu se promjene nakupljaju, njegova signalizacija mora se odgonetnuti postupnom analizom ihtioloških, gospodarstvenih, hidroloških, kemijskih i drugih podataka kako bi se odredio uzrok ili uzroci promjena u ribljem fondu vodenoga staništa.

Nestanak ribljih vrsta osjetljivih na pogoršanje kakvoće vode zbog organskoga onečišćenja (i proizlazeće mijenjanje režima kisika) najčešća je pojava koja se uočava ispod brojnih točkastih izvora kanalizacijskog onečišćenja. Bioindikatorski signali, premda u velikim vodotocima sporiji nego u malim, ipak su dovoljno jasni.

Uređivanje velikih vodotoka dovodi do postupnoga nestanka određenih vrsta i do promjena međusobnog odnosa pojedinih vrsta. Broj ekološki određenih, ali neprilagodljivih vrsta, koje su ekonomski najvažnije, iscrpljen je i zamijenjen manje određenim i prilagodljivijim vrstama. Takav se proces dogodio u većini velikih europskih rijeka, kojih su korita kanalizirana (Dunav, Rajna, Majna, Elba i druge).

Ribe se obično povezuju s bioindikacijom negativnih procesa ili negativnih pritisaka koji se pojavljuju u vodenom okolišu. Riblji fond se pokazao kao vrlo prikladan bioindikator revitalizacijskih i renaturalizacijskih prilagođavanja tokova. Ribe se primjenjuju i kao test organizmi u biološkim analizama vode pri kritičnim onečišćenjima. Promjene populacijskih čimbenika vrsta u vodenim staništima također imaju veliko bioindikatorsko značenje. Promjene na razini populacije umnogome su posljedica djelovanja različitih utjecaja (odstupanja od normale). Promjene broja i biomase unutar populacije prvotno su uzrokovane pogoršanjem vodenog okoliša, što djeluje na

factors determine the real composition of the ichthyofauna in a stream, lake, pool or reservoir.

In the time when the impacts of human activities on the aquatic ecosystems were the least, the species composition of the fish communities was in harmony with the features of the natural aquatic environment. The species composition of fish communities that inhabit some stretch of water is the result of a complex of biotic and abiotic factors, including the management of the fishery. Changes in species diversity are a pronounced sign that indicates that some major and usually indirect change of one of more factor has happened in the aquatic ecosystem. Changes that indicate the disappearance of appearance of given fish species can be the consequences of changes in water quality or of the hydrological and morphological traits of the stream. Since the fish community acts as a complex bioindicator in which changes are cumulative, this signal must be decoded by a gradual analysis of the ichthyological, economic, hydrological, chemical and other factors so as to determine the cause or causes of changes in the fish stock of the aquatic habitat.

The disappearance of fish species sensitive to deterioration of water quality as a result of organic pollution (producing changes in the oxygen regime) is the most frequent phenomenon that can be seen below the numerous scattered sources of effluent pollution. Bioindicator signals, although slower in large streams than small ones, are nevertheless clear enough.

The straightening of the major streams leads to a gradual disappearance of certain species and to changes of the interrelations of the given species. A number of ecologically fixed and inadaptible species that are the economically most important are exhausted and replaced by less specific and more adaptable species. This kind of process occurred in most of the great European rivers the courses of which have been impounded (Danube, Rhine, Main and Elbe).

Fish are usually connected with the bioindication of negative processes of negative pressures that occur in the aquatic environment. Fish stocks have shown to be a very suitable bioindicator of revitalised and renaturalised adjustments of streams. Fish are used as test organisms in biological analyses of water in critical pollution events. Changes of population factors of species in aquatic habitats also have major bioindicator importance. Changes at the population level are very much the consequence of the effect of differing influences (deviations from the norm). Changes in number and biomass inside a population are primarily caused by deterioration of the aquatic environment, and affect the chemical and physical characteristics (eutrophication, primarily) as well as

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

kemijska i fizikalna obilježja (ponajprije eutrofikacija) te na hidrološka svojstva i morfologiju korita rijeke. Smanjenje brojnosti populacije prvotno je rezultat smanjenoga uspjeha prirodne reprodukcije, kao i povećane smrtnosti određene starosne skupine u populaciji. Sve dok se takve promjene na razini populacije ne uspore i ne zaustave (drugim riječima, sve dok jačina uzročnoga čimbenika raste), postupno smanjenje brojeva populacija može, u krajnjem slučaju, dovesti do nestajanja vrsta iz nekog staništa. Opisani proces prati smanjenje prosječne starosti u populaciji zbog povećane smrtnosti i smanjenja maksimalne dugovječnosti. Takve manifestacije na razini populacije mogu se proučavati zasebno, posebno u populacijama ribljih vrsta koje sadrže jedinke srednje i visoke starosti.

Nepravilnosti u starosnoj strukturi ribljih populacija (npr. nedostatak predstavnika nekoga godišta) obično su posljedica neuspjele reprodukcije ili katastrofalnog uništenja mlađa. Ta je pojava osobito opasna za održanje kratkoživućih vrsta. Npr., bujice nakon oluja, koje donose veliku količinu suspendiranih čestica gline, tijekom inkubacije obično uništavaju sva jaja pojedinih vrsta. Posebno su ugrožene vrste koje se odjednom mrijeste u ograničenim područjima, kao npr. podust (*Chondrostoma nasus*).

Na razini jedinke promjene u vodenom okolišu postaju očite, ponajprije po različitim posljedicama na biološke procese pojedinih riba. Npr., intenzitet rasta se usporava kao odgovor na loše uvjete kisika i nedostatak hrane zbog oslabljenih uvjeta za organizme koji čine hranu ili zbog natjecanja za hranu između autohtonih i unesenih vrsta. Isto tako, u vrlo zagađenim vodama može se zapaziti oslabljeno ukupno stanje pojedinih riba, uključujući potvrđene manifestacije lošijeg zdravlja. Smanjena reproduktivna sposobnost jedinka može biti još jedna posljedica nepovoljnih uvjeta okoliša.

Naglo povećanje upotrebe kemijskih sredstava u gotovo svim ljudskim djelatnostima dovelo je do brojnih negativnih posljedica čije bi određivanje i mjerenje u vodenom okolišu bilo teže bez iskorištavnja riba kao bioindikatora. Vrlo vrijedna osobina riba je sposobnost nakupljanja zagađivala (kemijskih sastojaka) iz vode, što omogućuje određivanje izrazito kratkotrajnoga zagađenja (ako ono ne ubije ribe) ili vrlo niskih razina dugotrajnih zagađivala. Takva zagađivala uključuju teške metale, pesticide, PCB spojeve, radionuklide i druge tvari čije nakupljanje u ribljim organizmima omogućuje njihovo uspješno otkrivanje.

the hydrological characteristics and the morphology of the profile of the course of the river. Reduction of the abundance of a population is primarily the result of the reduction in natural reproduction success and increased mortality of certain age groups in the population. Until such changes at the population level are slowed or halted (in other words, as long as the strength of the causal factor grows), the gradual reduction of the numbers of the populations may, ultimately, lead to the disappearance of species from some habitat. This process is accompanied by a reduction of the mean age in the population because of increased mortality and reduction of maximum longevity. Such manifestations at population level can be studied separately, especially in populations of fish species that contain individuals of average and great age.

Irregularities in the age structure of fish populations (for example, the shortage of representatives of some year class) are usually the consequence of reproduction failure or some catastrophic decimation of the fry. This is a phenomenon that is particularly dangerous for the viability of short-lived species. For example, a torrent after a storm, bringing with it a great quantity of clay particles will often destroy all the eggs of some species during incubation. Species that all spawn together in limited areas, such as the common nase (*Chondrostoma nasus*), are particularly endangered.

At the level of individual, changes in the aquatic environment become manifest primarily according to the various consequences to the biological process of the given fish; for example, vigour of growth slows as response to poor oxygen conditions and shortage of food because of the weakening of the conditions for the organisms that constitute the food or because of the food competition among indigenous and introduced species. Similar, in very polluted waters, an overall debilitated state of given individual fish can be seen, including recognised manifestations of poor health. The reduction of the reproductive capacity of individuals can be one more consequence of unfavourable environmental conditions.

A sudden increase in the use of chemicals in almost all human activities has led to many negative consequences, the determination and measurement of which in the aquatic environment would be much more difficult without the use of fish as bioindicators. A very valuable feature of fish is their ability to concentrate pollutants (chemical components) from the water, which enables the determination of very short-term pollutants (if they do not kill the fish) or very low levels of long-term pollutants. Such pollutants include heavy metals, pesticides, PCB compounds, radionuclides and other substances the accumulation of which in the fish organisms enable them successfully to be detected.

7. PROBLEMATIKA I ŠTETE OD UNESENIH VRSTA

Jedna od najozbiljnijih posljedica antropogenog utjecaja na naše ribe, izuzmemo li fizičke i kemijske promjene staništa, svakako je unos stranih vrsta u neko područje. Pojedine introdukcije znače veću opasnost od, primjerice, zagađenja, melioracije i sl. Naime, dok se ti utjecaji lako uklone uklanjanjem uzroka, novoprilagođenu je vrstu, nažalost, nemoguće uništiti. Bez obzira kako ih mi zvali (invazivne, nenativne, strane, egzotične, introducirane ili unesene vrste), to su one vrste koje su evoluirale drugdje i ne nalaze se na području svoje prirodne rasprostranjenosti jer su slučajno ili namjerno prenesene u novo stanište. Baš su unošenja novih invazivnih vrsta, zajedno s drugim utjecajima, od kojih je najveći uništavanje prirodnih staništa, jedan od glavnih razloga izumiranja vrsta u posljednjih stotinjak godina. Ako se održi u novoj sredini, novounesena vrsta može znatno promijeniti zajednicu riba, što često dovodi do nestajanja osjetljivih domaćih vrsta. Degradacija staništa i sve veće onečišćenje omogućile su novounesenim vrstama lakšu prilagodbu i mogućnost da postanu invazivne.

Invazivne vrste mogu na više načina utjecati na domaće vrste: jedući ih, konkurirajući im za hranu i stanište, razmnožavajući se s njima i smanjujući genetičku raznolikost, unoseći nove bolesti i nametnike. Alohtone vrste najčešće su unesene u ovaj sustav djelovanjem čovjeka, s ciljem koji najčešće nikad i nije bio postignut. Takve zahvate izvode uglavnom ribolovna društva ili čak pojedinci na svoju ruku, bez prethodne konzultacije s ekologima ili ihtiolozima. Posljedice su jednostavno nesagledive te u vodenim biotopima dolazi do burnih promjena u kompliciranim hranidbenim lancima, do pojave raznih oblika interakcija među pojedinim vrstama, pa čak i do potpune ekstinkcije nekih vrsta. Opće je prihvaćen stav da se na današnjem stupnju znanja ne mogu predvidjeti dugoročne posljedice koje će unos nove vrste prouzročiti.

Na istraživanom području Lonjskoga polja pet se introduciranih (alohtonih) vrsta dobro aklimatiziralo. To su sunčanica (*Lepomis gibbosus*), patuljasti somić (*Ameiurus nebulosus*), babuška (*Carassius gibelio*), bezribica (*Pseudorasbora parva*) i pastrvski grgeč (*Micropterus salmoides*). One ne utječu povoljno na sastav ihtiopopulacija i areal rasprostranjenosti sve im se više širi. Postoje još

7. THE PROBLEM OF AND HARM FROM INTRODUCED SPECIES

One of the most serious consequences of anthropogenic impacts on fish in this country, if we except the physical and chemical changes of habitat, is certainly the introduction of foreign species into a given area. Some introductions constitute an even greater danger than, for example, pollution, reclamation and so on. While these impacts are easily obviated by the removal of the causes, the non-adapted new species often cannot, unfortunately, be eradicated. Irrespective of what they are called (invasive, non-native, foreign, exotics, introduced species), these are nevertheless species that evolved elsewhere and here are not in the area of their natural distribution, because they have been accidentally or fortuitously transferred to a new habitat. These introductions of new invasive species, together with other impacts, the greatest of which is the destruction of the natural habitats, are one of the main reasons for the extinction of species in the last hundred or so years. If it can maintain itself in the new habitat, the newly introduced species can considerably modify the fish community, often thus leading to the disappearance of vulnerable domestic species. The degradation of habitats and the ever-greater pollution have enabled newly-introduced species to be able to adapt more easily and to become invasive.

Invasive species can affect domestic species in several ways: preying on them, competing for food and habitats, reproducing with them and reducing the genetic diversity, bringing in new sicknesses and parasites. Allochthonous species are most often brought into the system by the activities of people, their objective most often never being achieved. Such operations are carried out mainly by angling clubs or even individuals on their own initiative, without consultation with ecologists or ichthyologists. The consequences are often enormous and the water biotopes experience agitating changes in the complicated food chains, the appearance of various forms of interaction among the species, even to the total extinction of some species. It is a generally accepted view that at the level of knowledge of today, it is impossible to predict the long-term consequences that can be brought about by the introduction of a new species.

In the area of Lonjsko Polje investigated, five introduced or non-indigenous species have become well acclimatised. These are the pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ameiurus nebulosus*), Prussian carp (*Carassius gibelio*), false harlequin (*Pseudorasbora parva*) and the

četiri unesene vrste riba koje se pojavljuju u Savi i Uni, a čija je prisutnost na području PP Lonjsko polje također moguća. Među tim četirima vrstama su bijeli i sivi glavaš, bijeli amur i kalifornijska pastrva.

Zakoni o slatkovodnom ribarstvu i zaštiti prirode naše zemlje strogo zabranjuju unos novih vrsta u definirane otvorene ekosustave. Štete koje su nove vrste izazvale u ihtiofauni Lonjskoga polja vrlo je teško količinski procijeniti jer se brojčani odnosi pojedinih vrsta intenzivno prate tek nekoliko desetaka godina, ali je brojnost pojedinih alohtonih vrsta na određenim lokacijama zabrinjavajuća.

Najbrojnija je i najprisutnija na svim istraživanim lokalitetima sunčanica, koja je u Hrvatsku unesena već početkom 20. stoljeća. Dok je u rijeci Savi manje-više sporadično prisutna, u Lonjskom polju je najbrojnija riba na većini stajaćih staništa. Mrtvaje i iskopi čitavog područja prepuni su riba te vrste, što je vrlo zabrinjavajuće.

Druga je po brojnosti, ali i po šteti koju čini, patuljasti ili američki somić. Na području Hrvatske pojavljuje se također od početka 20. stoljeća. Vrlo guste populacije zabilježene su u većini mrtvaja i iskopa.

Veliki je problem za autohtonu ihtiofaunu Hrvatske, pa i ovoga područja, babuška. Od gotovo nepoznate vrste u pedesetim godinama 20. st., ona je do danas prešla put do invazivne vrste zbog vrlo brojnih populacija, zabilježenih u mnogim vodama. Prisutna je u velikim količinama u svim vodama i crnomorskog i jadranskog slijeva. Babuška je izravni suparnik šaranu (divljim populacijama) čije su se populacije razmjerno smanjile. Njezini utjecaji i posljedice na ostalu ihtiofaunu nisu poznate.

Ribarski stručnjaci slažu se da je u Hrvatskoj unos bezribice (*Pseudorasbora parva*) izazvao promjene u zajednicama riba. Ta mala ribica unesena je oko 1960. u Rumunjsku iz Kine (pokrajina Yang Tse Kiang). Točan datum unosa u našu zemlju nije poznat, ali se pretpostavlja da je 70-ih godina već bila prisutna. Osamdesetih godina nađena je u svim ribnjacima i u većini vodotoka. Danas ta vrsta naseljava gotovo sve vode gdje je provođeno poribljavanje šaranom. Promjene i prilagodbe ribljih zajednica tek slijede.

Rijekama Hrvatske u plovama pluta i bijeli amur. Brojnost te vrste u Dravi je navodno tako velika da ozbiljno ugrožava prirodne populacije ostalih vrsta, dok za Savu nema nikakvih podataka. Čak se postavlja pitanje odakle tolike populacije te vrste kad je poznato da se ona ne mrijesti u otvorenim vodama. Unesen je u naše vode 60-ih godina radi akvakulture.

largemouth bass (*Micropterus salmoides*). They do not have a positive effect on the composition of the ichthyopopulation and the area of their distribution is constantly expanding. Four other introduced species appear in the Sava and Una, and their presence in the area of Lonjsko Polje Nature Park is also very possible. Among these four species are the big head carp and silver carp, grass carp and rainbow trout.

The freshwater fishing and nature protection laws of our country strictly ban the introduction of new species into defined open ecosystems. The damage that the new species have caused in the ichthyofauna of Lonjsko Polje is difficult to estimate in quantitative terms, because the numerical relations of the individual species has been vigorously monitored only for a few dozen years; nevertheless, the numbers of some allochthonous species in certain locations is perturbing.

The most numerous and most omnipresent species at all the research sites is the pumpkinseed, which was introduced into Croatia as early as the beginning of the 20th century. While in the Sava River it figures more or less sporadically, in Lonjsko Polje it is the most numerous fish in most of the standing habitats. The oxbows and pits in the whole area are full of this species, which gives cause for deep concern.

The second in terms of numbers and in terms of the damage it does is the brown bullhead. It has also been found in Croatia since the beginning of the 20th century. Very dense populations have been recorded in most of the oxbows and excavations.

One great problem for the indigenous ichthyofauna of Croatia and of the whole problem is the Prussian carp. While it was an almost unknown species in the 1950s, today it has become an invasive species, because of the very large populations recorded in many waters. It is present in great quantities in all waters of the Black Sea and Adriatic drainage areas. The Prussian carp is a direct competitor of the carp (wild populations) the populations of which have been reduced in proportion. Its impacts and consequences on the remainder of the ichthyofauna are not known.

Fishing experts concur that the introduction of the false harlequin (*Pseudorasbora parva*) has caused changes in fish communities. This small fish was introduced into Romania about 1960 from China (Yang Tse Kiang province). The precise date it entered our country is not known, but it can be assumed that it was present as early as the 1970s. In the eighties it was found in all fishponds and in most streams. Today this species has colonised almost all waters where the introduction of carp has been carried out. Changes and adjustments of the fish communities are still to come.

U rijeci Savi se mogu naći još dvije azijske vrste, bijeli i sivi glavaš (tolstolobik). Obje su također unesene 60-ih godina 20. stoljeća u svrhu uzgoja u ribnjacima, a koriste se i za smanjivanje količine fito i zoo planktona u stajaćim vodama. Njihova brojnost u Savi je relativno mala jer su tu dospjeli slučajno, bijegom iz šaranskih ribnjaka.

The grass carp too swims in shoals in the rivers of Croatia. The numbers of this species in the Drava are allegedly so great that it seriously jeopardises the natural populations of the other species, while there are no data for the Sava. Often asked is the question whence such large populations of this species, when it is well known that it does not spawn in open waters. It was introduced into our waters in the 1960s for the sake of fish farming.

Two more Asiatic species, the big head carp and silver carp (tolstolobik) can also be found in the Sava river. Both were also imported in the 1960s, for the sake of fish farming, and they are also used for reduction of the quantities of phyto- and zooplankton in stagnant water. Their abundance in the Sava is quite small because they arrived only fortuitously, escaping from the carp fishponds.

8. STRUKTURA ZAJEDNICA RIBA OPISANA POMOĆU INDEKSA RAZNOLIKOSTI

Raznolikost vrsta riba na pojedinom staništu određena je brojem različitih vrsta, brojnošću i strukturom, a prikazana indeksom raznolikosti. Riba su nepristupačne vizualnom promatranju, a sakupljanje uzoraka da bi se dobila čak i površna slika strukture zajednice zahtijeva dugotrajan napor.

Riba služe kao hrana posebno pticama, a svojom brojnošću i masom uključene su u gotovo sve prehrabne lance viših kralježnjaka. Poznato je da riba svojom brojnošću mogu ozbiljno promijeniti biocenoze u kojima se nalaze. Zato su od velikoga značenja spoznaje o kvantitativnim pokazateljima stanja ihtiocenoza, kroz ihtiomasu po hektaru, kao i kvantitativnim odnosima pojedinih vrsta. Koje vrste i njihove biomase dolaze na području PP Lonjsko polje treba dati kroz osnovne numeričke parametre zajednice riba. Nju treba opisati uz pomoć

8. THE STRUCTURE OF FISH COMMUNITIES DESCRIBED WITH THE USE OF THE INDEX OF DIVERSITY

The diversity of fish species in a given habitat is determined by the number of diverse species, the abundance and structure, and is shown by the index of diversity. Fish are inaccessible to visual checks, and the collection of a sample to get even a superficial image of the structure of a community demands a lasting effort.

Fish serve as food in particular to birds, and with their abundance and mass are involved in almost all the food chains of the higher vertebrates. It is known that with their abundance fish can seriously change the biocoenosis in which they are located. So knowledge of the quantitative indicators of the state of the ichthyocoenosis, through the ichthyomass per unit of area (per hectare) as well as quantitative relations of individual species are of great importance. Which species come to the area of Lonjsko Polje Nature Park and what the biomass of

Indeksi raznolikosti	Ukupno
Broj vrsta	33
Broj jedinka	2686
Simpsonov indeks	0,89
Recipročni Simpsonov indeks	9,39
Shannon-Wienerov indeks	3,6
Broj jednako čestih vrsta	12,1
Brillouinov indeks	3,55
Maks. mogući Simpsonov indeks	0,96
Ujednačenost za Simpsonov indeks	0,93
Maks. mogući Shannon-W. indeks	5.0000
Ujednačenost za Shannon-W. indeks	0,7510
Maks. mogući Brillouinov indeks	4,55
Ujednačenost za Brill. Indeks	0,78
α - vrijednost	3,88
Varijabilnost	0,66
x – vrijednost	1,00
Bogatstvo vrsta	7,28
Dominantnost	0,19

neparametričkih modela (6 najčešćih indeksa raznolikosti) i modelom logaritamske serije.

Tablica 4. Indeks raznolikosti ihtiofaune za neka područja Lonjskoga polja

Shannon-Wienerov indeks kao mjera raznolikosti zajednice riba pokazuje nešto više vrijednosti za Savu. Povećana raznolikost zajednice riba u Savi u odnosu prema Lonjskom polju tumači se limnofilnim karakterom zajednice Lonjskoga polja.

Simpsonov indeks, koji preferira česte vrste, za postaje Lonjskoga polja za koje imamo podatke iznosi 0,89. Shannon-Wienerov na svim istraženim postajama zajedno iznosi 3,60, Brillouinov indeks cijele kolekcije iznosi 3,55.

Strukturu zajednice treba opisati modelom logaritamske serije (Williams, 1964.). Na taj način kvalitativna zajednica riba određena je sa dva parametra: vrijednošću alfa (vrijednost = 3,88) i brojem prisutnih jedinka.

Teorijski pravac i ukupna serija prilično se dobro podudaraju, premda se vidi lagana tendencija prema log normalnom modelu. Naime, čitava krivulja, koja bi u logaritamskom obliku trebala biti pravac, ima donekle oblik s krivulje. Bogatstvo vrsta, R izraženo u obliku $R=s/\log(N)$, iznosi 7,28.

Cilj je odrediti stvarnu raznolikost i strukturu zajednice teoretskim vrijednostima koje se mogu primijeniti i u drugim prostorima i u drugom vremenu. Te vrijednosti uz čitav niz ribarskih teoretskih parametara važne su za dobivanje teoretskih spoznaja o ihtiocenozama i stupnju njihova iskorištenja.

them is should be given through the basic numerical parameters of the fish community. This has to be described with the use of non-parametrical models (the six most common diversity indices) and the logarithmic series model.

Table 4. Index of diversity of ichthyofauna for some regions of Lonjsko Polje

The Shannon-Wiener index as diversity criterion for a fish community shows a somewhat higher value for the Sava. This increased diversity of the fish community in the Sava than in Lonjsko Polje can be interpreted by the limnophilous character of the Lonjsko Polje community.

The Simpson index, which prefers frequent species, comes for the Lonjsko Polje for which we have data to 0.89. The Shannon-Wiener amounts in all stations investigated to 3.60. The Brouillon index of the whole collection comes to 3.55.

The structure of the community should be described by the logarithmic series model (Williams, 1964). In this way the qualitative fish community is determined by two parameters: the alpha value and the number of individuals present. (vrijednost = 3,88)

The theoretical plot and the whole series correlate fairly well, although a slight tendency can be seen towards log normal model. That is, the entire curve that in logarithmic form should be the plot has to some extent the shape from the curve. The species richness, R, expressed in the form of $R=s/\log(N)$, comes to 7,28

The objective is to determine the real diversity and the structure of the community with theoretical values that can be applied in other spaces and in another time. These values in conjunction with an entire sequence of theoretical fish parameters are important to obtain theoretical understanding of the ichthyocoenoses and the degree to which they are used.

9. PROBLEMI POVEZANI SA SMANJENJEM RIBLJIH POPULACIJA

Posljednjih desetljeća u cijelom je toku Dunava zabilježen drastičan pad ulova riba (Holčik, 1998.; Mero i sur., 1998.; Vasilescu, 1998.), ponegdje čak i na samo četvrtinu prethodnoga, kao posljedica više antropogenih čimbenika. Posebno važni čimbenici nestanka riba su melioracije riječnoga korita, pregradnje rijeka branama, zatim eutrofizacija vode i unos teških metala, kao i mjestimično vrlo izražen krivolov i prelov riba. U posljednjih 20 godina uočen je višegodišnji drastični pad razine vode, povezan s usporenim tokom rijeke i smanjenjem poplavnih zona. Posljedica je smanjenje područja za mrijest i prehranu riba. Istovremeno, unošene su alohtone riblje vrste i vršen prelov postojećih ihtipopulacija. Uz to, pregrade na Dunavu, a poglavito Đerdap, dovele su gotovo do istrjebjenja riba iz porodice jesetrovki (Acipenseridae).

9.1. Nestanak i promjena prirodnih uvjeta staništa

Na zajednice riba utječu mnogi hidrološki i geomorfološki čimbenici, onečišćenja itd., a njihovi kumulativni zajednički učinci, često međuovisni i naoko pojedinačno mali, imaju jak utjecaj na populacije riba. Grubo možemo reći da najveći utjecaj na promatrane populacije i tip zajednice riba imaju abiotički čimbenici, poput brzine i kakvoće vode, i s tim u vezi povećanje eutrofije, a osobito veličina poplavne zone.

9.2. Onečišćenje

Danas su rijeke Dunav i Sava, pa tako i Lonjsko polje, sve opterećenije otpadnim vodama. Opterećenja su zasad uglavnom organskoga porijekla i u letalnim dozama nema otrova biocidnoga karaktera. Dapače, najvjerojatnije zbog organskih otpadnih voda dolazi do jače eutrofizacije, a s time do povećanja riblje produkcije. Sve aktivnosti u parku prirode Lonjsko polje koje dovode do onečišćenja vode mogu nepovoljno utjecati na ribe i ribarstvo. Kakvoća vode - prvenstveno glavnih opskrbljivača parka vodom - je bitna.

9. PROBLEMS RELATED WITH THE REDUCTION OF FISH POPULATIONS

In the last few decades, over the whole course of the Danube, a drastic fall in the catch of fish has been registered (Holčik, 1998.; Mero et al., 1998.; Vasilescu, 1998.), the consequence of several anthropogenic factors. Factors that are particularly important in the disappearance of fish are melioration of the course of the river, impounding the river with dams, the eutrophication of the water and the input of heavy metals, as well as poaching and over-fishing, which are very pronounced in places. In the last 20 years, a long-term drastic fall in the water level has been noted, connected with the decelerated course of the river and the reduction of the flood zones. The consequence of this is a reduction of the areas for fish spawning and feeding. At the same time, allochthonous species of fish have been introduced, and existing ichthyopopulations have been over-fished. In addition, the dams on the Danube, particularly Đerdap, have led practically to the extirpation of fish from the sturgeon family (Acipenseridae).

9.1. Disappearance and change of natural habitat conditions

Many hydrological and geomorphologic factors and pollution and so on affect fish communities, and their cumulative common effects, often interdependent and seemingly small individually, have a powerful impact on fish populations. Roughly we can say that the greatest impact on the observed populations and type of fish community is exerted by abiotic factors, such as speed and quality of water, and in connection with this increased eutrophication, and in particular, the size of the flood area.

9.2. Pollution

Today the Sava and Danube rivers, and so Lonjsko Polje too are loaded with effluent. These loads are for the moment mainly of organic origin and even in lethal doses do not have any poison of a biocidal character. On the contrary, very likely because of the organic effluent, there is stronger eutrophication, and hence increased fish production. All activities in Lonjsko Polje Nature Park that lead to water pollution may however in excess have an unfavourable impact on fish and fishing. Water quality mainly of the main water supplies of the park is essential.

Značajke ribljih zajednica parka prirode Lonjsko polje

Characteristic of the fish communities in Lonjsko Polje Nature Park

Do onečišćenja opskrbljivača parka vodom može doći zbog:

- upuštanja nedovoljno pročišćenih komunalnih i industrijskih otpadnih voda,
- spiranja s okolnoga terena, osobito s poljoprivrednih površina na kojima se provodi intenzivna poljoprivredna proizvodnja.

Od tih aktivnosti najvažniji su:

- ispuštanje nepročišćenih otpadnih voda iz farma u vodotoke,
- spiranje s poljoprivrednih površina na kojima se provodi intenzivna biljna proizvodnja koju prati primjena agrokemikalija, u prvom redu umjetnih gnojiva i zaštitnih sredstava.

9.3. Melioracije

Na smanjenje poplavnoga područja i dužinu trajanja plavljenja, odnosno na prostornu i vremensku dinamiku vodostaja na području parka prirode Lonjsko polje, kao što je već naglašeno, veliki utjecaj imaju promjene uvjeta veoma složenoga mehanizma punjenja i pražnjenja Lonjskoga polja. Promjena uvjeta mehanizma punjenja i pražnjenja Lonjskoga polja posljedica je poglavito:

- smanjenja visine vodostaja Save,
- smanjenja visine vodostaja poplavnoga područja Save,
- regulacije vodotoka izvan područja parka prirode Lonjsko polje,
- melioracije poljoprivrednih površina izvan područja parka prirode Lonjsko polje.

9.4. Turizam

Turizam i ribarstvo u okviru tradicionalnih aktivnosti ne ugrožavaju ihtiocenoze Lonjskoga polja. Suvremenom koncepcijom razvoja, koji istovremeno podrazumijeva zaštitu prirode i iskorištavanje resursa, došlo bi do turističkog aktiviranja zaštićenoga područja, a planirane aktivnosti imale bi i šire gospodarske učinke za čitavo područje parka prirode, pa i za područje cijele Posavine. Pri posjećivanju treba težiti organiziranom i skupnom posjetu, pod vodstvom poučenih vodiča, svjesnih vrijednosti područja. Posjetilačke aktivnosti i programe treba razvijati u za to predviđenim dijelovima

Pollution of the water supplies of the park can arise because of

- discharge or release of insufficiently treated municipal and industrial wastewater
- run-off from the surrounding land, particularly from agricultural land on which intensive farming is carried out

Of these activities the most important are:

- discharge of untreated farm effluent into the streams
- run-off from farmland on which intensive arable farming is carried out, accompanied by applications of agricultural chemicals, primarily artificial fertilisers and protective preparations.

9.3. River engineering

A major part in the reduction of the flood zone and the duration of inundations, that is the spatial and temporal dynamics of the water-level in the area of Lonjsko Polje Nature Park, as already stated, is played by changes of conditions of the very complex mechanisms of the filling and emptying charging and discharging of Lonjsko Polje. A change in the conditions of the mechanisms of the filling and emptying of Lonjsko Polje is the consequence primarily of:

- reduction of the water level of the Sava
- reduction of the water level of the Sava floodplain
- regulation of the streams outside the area of Lonjsko Polje Nature Park,
- reclamation of agricultural areas outside the area of Lonjsko Polje Nature Park

9.4. Tourism

Tourism and fishing within the framework of the traditional activities do not jeopardise the ichthyocoenoses of Lonjsko Polje. In the contemporary concept of development, which simultaneously assumes nature conservation and the exploitation of resources, the protected area would be put to use in the tourist industry, and the planned activities would have broader economic effects for the whole area of the nature park, and for the area of the whole of Posavina. In visiting, organised and group visits should be preferred, guided by trained guides, aware of the values of the area. Visiting activities and programmes should be developed in parts of the park set aside for this, and in this manner all the values of

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

parka i na taj način prikazati sve vrijednosti parka, a istovremeno ostaviti biološke vrijednosti neoštećene. U tom smislu potrebno je napraviti studije kapaciteta i smještaja posjetitelja za vrijeme boravka u tom području, mogućnost njihova zadržavanja i bavljenja određenim tradicionalnim aktivnostima.

Mogućnosti ribarskog turizma su mnogobrojne, a treba ih usmjeriti domaćoj obnovi kuća i malim seoskim gazdinstvima, tradicionalnom ribolovu, muzejskim aktivnostima, itd. Turizam nosi i svoje opasnosti.

Izravni pritisci turizma na okoliš mogu se sažeti ovako:

- iscrpljivanje prirodnih resursa, što razumijeva zauzimanje najvrjednijega prostora kopna i vode, destrukcije zbog požara i sl.;
- vizualnu degradaciju prostora proizašlu iz neprimjerena i neprihvatljiva načina građenja;
- onečišćenje vodotoka otpadnim vodama;
- neodgovarajuće zbrinjavanje komunalnog i drugog otpada;
- povećano onečišćenje zraka i buka zbog povećanoga prometa; većina gostiju dolazi privatnim automobilima;
- oštećenje prirodne i kulturne baštine zbog prekobrojnih turista te zbog skupljanja endemičnih vrsta biljaka i životinja;
- stvaranje monokulture i napuštanje tradicionalnih djelatnosti (poljoprivreda, ribarstvo) praćeno s koncentracijom stanovanja i aktivnosti u intenzivnim turističkim područjima;
- ugrožavanje lokalnoga načina života i socio-kulturnog identiteta;
- nekontrolirana (i često nezakonita) gradnja vikendica koje zauzimaju područja namijenjena drugim aktivnostima.

9.5. Ostali razlozi

Ovdje valja naglasiti značenje ihtiofaune u prehrani ptica. Ptice također na neki način ugrožavaju ihtiofond Lonjskoga polja. Od više od 150 vrsta ptica, 40-ak vrsta se isključivo ili povremeno hrani ribom, iz čega proizlazi da se 30-ak % ornitofaune stalno koristi ribom kao hranom. U čitavoj Europi sve brojnije populacije crnog vranca čine velike štete na ihtiopopulacijama određenih područja i sve su veći povici i zahtjevi da se ta vrsta skine s popisa zaštićenih i da se dopusti selektivni odstrjel.

the park can be shown, at the same time leaving its biological values undamaged. From this point of view it is necessary to make studies concerning visitor capacities and accommodation facilities during stays in the region, the ability for them to stay longer and to take part in certain traditional activities.

There are manifold opportunities for fishing tourism, and they should be headed towards the domestic renovation of houses and to small rural holdings, traditional fishing, museum activities and the like. Tourism has its own dangers as well.

The direct pressures of tourism on the environment can be summed up as follows:

- exhaustion of natural resources, which means occupation of the most valuable land and water spaces, destruction because of fires and so on;
- visual degradation of the space because of inappropriate and unacceptable development;
- pollution of streams with effluent'
- inappropriate municipal and other wastewater management;
- increased air pollution and noise because of increased traffic; most visitors arrive in private cars;
- damage of natural and cultural heritage because of supernumerary tourists and because of the collection of endemic species of flora and fauna;
- creation of monoculture and abandonment of traditional activities (agriculture, fishery) accompanied by concentration of housing and activities in the vigorous tourist areas;
- jeopardising the local manner of life and the socio-cultural identity;
- uncontrolled and often illegal building of second-homes that occupy areas meant for other activities.

9.5. Other reasons

Here one should certainly stress the importance of ichthyofauna in the food of birds. Birds too in a sense endanger the fish stocks of Lonjsko Polje. Of the more than 150 bird species, 40 or so feed exclusively or occasionally on fish, from which it derives that as much as 30% of all avifauna feed constantly on fish. In the whole of Europe the increasingly numerous populations of cormorant do great damage to the fish populations of certain areas and there are increasing demands to have the bird taken off the list of protected birds and to allow a cull.

10. DOSADAŠNJI NAČIN KORIŠTENJA RIBARSTVA

Ribolov je u Savi, kao i u samom Lonjskom polju oduvijek imao znatno i višestruko značenje. Sve populacije nastanjene na obalama ovoga prostora hranile su se ribom, koja je bila važna sastavnica njihove prehrane, posebno tražena za vjerskih blagdana. Stoljećima su ribolov i prerada ribe bile osnovne gospodarske aktivnosti lokalnoga stanovništva u ovom području. Tijekom posljednjih 50 godina smanjivana su ribolovna prava tradicionalnim ribarima, sve do postupnog izumiranja njihova zanata. Vrijednost ribe kao namirnice stalno se mijenja i ne možemo biti sigurni da ona u nekoj budućnosti opet neće imati veliku vrijednost, međutim ribarenje lokalnog stanovništva vjerojatno više neće imati onu ekonomsku funkciju kakvu je imalo tijekom 19. i 20. stoljeća.

Lonjsko polje je najvažnije mrijestilište riba u ovom dijelu Hrvatske. U prošlosti je procijenjeno da prosječni godišnji ulov po hektaru površine poplavnog područja iznosi 92 kg. Iako dosad nije bilo opsežnijih istraživanja, pod pretpostavkom da nije došlo do pada ukupne ihtioprodukcije, vjerujemo da se na tekućim i poplavnim površinama ribolovnih područja može prosječno uloviti oko 500.000 kg ribe.

10.1. Utjecaji na riblji fond

Najveći utjecaj na ribe i ribarstvo PP Lonjskog polja imaju hidrološke i hidrogeološke promjene, ponajprije kao posljedica promjena punjenja i pražnjenja Lonjskog polja izazvanih promjenama vode rijeke Save. Njihovi kumulativni zajednički učinci, često međuovisni i pojedinačno naoko mali, imaju jak utjecaj na populacije riba.

10.1.1. Antropogeno djelovanje

Od dosadašnjih aktivnosti na prostoru parka nepovoljno djelovanje na raznolikost zajednice riba mogle su imati intenzivna poljoprivredna proizvodnja, odnosno spiranje agrokemikalija s poljoprivrednih površina i aktivnosti usmjerene na isušivanje vodenih staništa, kao što su isušivanje i prenamjena prostora, regulacija vodotoka, melioracije poljoprivrednih površina.

10. FISHING AS PRACTICED TO DATE

Fishing in the Sava River, and in Lonjsko Polje itself, has always had a considerable and multifaceted importance. All the populations inhabiting the banks of the area fed on fish, which was an important component of their food, and was particularly much in demand on holydays. For centuries fishing and the processing of fish was the basic economic activity of the local population in the area. During the last 50 years the rights of the traditional fishermen were curtailed, until their craft gradually died out. The value of fish as foodstuff constantly changes, and we cannot be sure that in some future it will not have a greater value; however, the fishing of the local population probably will not have the same economic function it had during the 19th and 20th centuries.

Lonjsko Polje is the most important spawning ground for fish in this part of Croatia. In the past it was estimated that the annual average catch per ha of the floodplain came to 92 kg. Although there has been no more capacious research, on the assumption that there is not fall in total ichthyoproduction, we believe that in the running water and flooded areas of the fishing areas some 500,000 kg of fish could be caught today.

10.1. Impacts on the fish stocks

The major impacts on fish and fishing in Lonjsko Polje Nature Park are made by hydrological and hydro-geological changes, mainly as a result of the changes in the flooding and draining of Lonjsko Polje brought about by changes in the water of the Sava River. The cumulative joint impacts of them, often interdependent, and at first sight small, have a powerful influence on the fish populations.

10.1.1. Human activities

Of the activities in the park to date, a negative impact on fish community diversity might have been played by intensive farming, that is, the run off of agricultural chemicals from the land, and activities aimed at draining the aquatic habitats, as well as the draining and changing land use, straightening of the watercourses, reclamation of agricultural land.

10.1.2. Športsko-rekreativni ribolov

Neprijeporno je park prirode Lonjsko polje ribarski vrlo zanimljiv kraj, kako za lokalno stanovništvo, tako i za veliki broj športskih ribiča, koji bi upravo u njemu željeli loviti ribu. Tom kraju gravitira velik broj športsko-rekreativnih ribolovaca Siska, Zagreba, Novske, Kutine i drugih okolnih mjesta. Iskorištavanje bioloških resursa, a posebno ribe, u samom parku mora se provoditi vrlo oprezno i pod stalnim nadzorom znanstvenika. Naime, ribe su, kao osnova u svim prehranbenim lancima, važne za brojčano stanje svih ostalih skupina kralježnjaka. Smanjenje prehranbene osnove imat će za posljedicu smanjenje i svih ostalih skupina u prehranbenom lancu.

Mogući negativni utjecaji ribolova na vrijednosti parka prirode mogu nastati samo zbog nepridržavanja zadanih ograničenja i mjera zaštite. Osobito nepovoljne posljedice mogu nastati zbog pregrađivanja ribljih putova i kanala tijekom mrijesta, nekontrolirana izlova matica, te nekontrolirana selektivnog izlova pojedinih komercijalno vrijednih vrsta. Međutim, uz pomoć nadzorne službe i redovite kontrole načina obavljanja ribolova te nepovoljne posljedice se mogu izbjeći. Veliko je pitanje koliko sadašnja razina iskorištavanja ihtiocenoza parka prirode Lonjsko polje ima utjecaja na biološku raznolikost cijeloga parka.

S obzirom na to da vode u posebno zaštićenim dijelovima prirode nisu ribolovne vode u smislu novoga Zakona o slatkovodnom ribarstvu, odredbe Zakona o slatkovodnom ribarstvu ne odnose se na vode unutar granica parka prirode Lonjsko polje, ali se odnose na riblji fond matičnog vodotoka Save. Stoga Park prirode Lonjsko polje mora Pravilnikom o unutarnjem redu odrediti poseban režim iskorištavanja ihtiofaune Lonjskoga polja glede ribolova i zaštite ribljeg fonda jer je opće poznato da stanovništvo ovog područja tradicionalno obavlja ribolov, i to ne samo alatima športsko-rekreacijskog ribolova, nego i različitim vrstama mreža i vrša, dakle alatima gospodarskoga ribolova. Također se riba izlovljava i ilegalno prijestorima, upravo prilikom prolaska kroz ustavu Trebež (kao i na Strugu i drugim lokacijama) kada ribe u velikom broju ulaze u Lonjsko polje na mrijest.

Studija treba dati osnovne odgovore na pitanja je li moguće i koliko ribe loviti u području parka. Posebno je osjetljiva lokalna zajednica koja u smanjenju ribolovnih prava vidi ugrožavanje vlastite egzistencije. Ribarstvo treba uklopiti u tradicionalni održivi razvoj naselja u zaštićenom području. Dosad za športsko-rekreativni ribolov uglavnom nije bilo

10.1.2. Sporting and recreational fishing

It is incontrovertible that Lonjsko Polje Nature Park is a very interesting area for angling, both for the local population and for a large number of anglers who would like to fish in it. A large number of sporting and recreational anglers from the areas of Sisak, Zagreb, Novska, Kutina and other places gravitate towards the area. And yet exploitation of the biological resources of the park, particularly of the fish, has to be carried out very carefully and under constant scientific supervision. For the fish, the base of the food changes, are very important for the abundance of all the other groups of vertebrates. Any attrition of the food base will result in the reduction of all the other groups in the chain.

Possible negative impacts of fishing on the values of the nature park can occur only if the set restrictions and protection measures are ignored. Particularly harmful consequences can occur if the fish paths and channels during spawning are impounded, by uncontrolled fishing of the mainstream and uncontrolled selective fishing of individual commercially valuable species. However, with the help of a monitoring service and regular control of the way fishing is carried out, these detrimental effects can be forestalled. A great matter is how much the current level of the use of the ichthyocoenoses of Lonjsko Polje Nature Park has had an impact on the biological diversity of the whole park.

Because the waters in the particularly protected parts of nature are not fishing waters in the sense of the new Freshwater Fishing Law, the provisions of this law do not refer to water inside the borders of Lonjsko Polje Nature Park, but do refer to the fish stock in the main stream of the Sava River. Thus Lonjsko Polje Nature Park must have its own House Rules determining a special regime for the exploitation of the ichthyofauna of Lonjsko Polje concerning fishing and the protection of the fish stocks, because it is generally known that the population of this area carries out fishing not only with the implements of the angler, but also with various kinds of net and pot, with the implements, that is, of commercial fisheries. The stocks are also fished out illegally with barriers just as they pass through the Trebež sluice (as at Strug and other locations) when the fish enter Lonjsko Polje in large numbers for spawning.

A study should provide the basic answers to the question of whether it is possible to fish in the park at all, and if so in what quantities. A particularly sensitive issue is that of the local community, which sees a threat to its own ability to earn a living in the reduction of fishing rights. Fishing should be fitted into the traditional sustainable development of the settlements in the protected area. So far there have

Značajke ribljih zajednica parka prirode Lonjsko polje *Characteristic of the fish communities in Lonjsko Polje Nature Park*

ograničenja ni zabrana. Radi zaštićenosti područja športsko-rekreacijski ribolov treba prakticirati na otvorenim vodama Save i na pojedinim, unaprijed određenim, mjestima unutar polja.

Postoje i mišljenja da športsko-rekreacijskom ribolovu unutar parka prirode nema mjesta, kako stoji i u zakonskim propisima prema Zakonu o slatkovodnom ribarstvu. Isto tako, članak 5. Zakona o slatkovodnom ribarstvu predviđa proglašavanje i zaštitu prirodnih mrijestilišta ako je mriješćenje riba u tim vodama od osobite gospodarske važnosti. Lonjsko polje ima sve elemente jednog od najvažnijih i najvećih mrijestilišta porječja Save, pa bi ga prema tome trebalo proglasiti važnim prirodnim mrijestilištem, važnim za očuvanje ihtiopopulacija čitavoga podunavskog slijeva.

Iz svega toga možemo zaključiti da športsko-rekreacijski ribolov, uz pridržavanje svih ograničenja i mjera zaštite, ne bi trebao imati prevelik utjecaj na stanje ribljih populacija. Veliki je problem, međutim, znanstvena provjera takvih iskustvenih podataka.

10.1.3. Ugroženost ribljih vrsta

Većina vrsta riba za sada nije ugrožena. Najveći su problemi promjene zajednica pod utjecajem alohtone vrste babuške i kakvoća vode. U posljednjih 50 godina neke vrste su smanjile svoju brojnost, neke su nestale, ali ukupne ihtiomase ribe Lonjskog polja su jednake. To područje još je najveće i najznačajnije mrijestilište riba Dunava i Drave. Očuvana prirodna sredina omogućava život velikom broju vrsta, pa i onima koje su u drugim dijelovima Europe već iščezle.

been no restrictions on sporting and recreational fishing. For the sake of protecting the area, this kind of fishing should be practised only on the open waters of the Sava and at certain set places inside the common.

Some people are of the opinion that there is no room for sporting and recreational fishing inside a nature park, as stated by the regulations of the Freshwater Fishing Law. Article 5 of this Law provides for the proclamation and protection of natural spawning grounds if the spawning of the fish in these waters is of particular economic importance. Lonjsko Polje has all the elements of one of the most important and largest spawning grounds of the Sava basin, and accordingly should be pronounced an important natural spawning ground that is important for the preservation of the fish population of the Danube basin.

From all this we can conclude that sporting and recreational fishing, assuming the adherence to all constraints and protection measures, should not have too great an impact on the state of the fish populations. A large problem does, however, inhere in obtaining scientific confirmation of such experience-derived data.

10.1.3. Endangerment of fish species

For the moment, most fish species are not endangered. The greatest problems are the changes of the communities brought about by the allochthonous species the Prussian carp and by water quality. In the last 50 years some species have had their abundance reduced, some have vanished, but the total ichthyomass of the fish of Lonjsko Polje has remained the same. This area is still the greatest and most important spawning ground of fish of the Danube and Drava rivers. The preserved natural environment makes possible the life of many species, even those that have already vanished in other parts of Europe.

11. PRIJEDLOG ZAŠTITNIH MJERA

11.1. Zaštita mrijestilišta i ostalih otvorenih voda

Jedna od najvažnijih mjera za povećanje ukupne ihtioproductivnosti je očuvanje prirodnih mrijesnih područja i staništa gdje se ribe razmnožavaju. Posebno su zanimljivi stari plitki rukavci i plića mjesta bogata biljem, kao i raznolikost staništa za pojedine vrste. Takva područja treba popisati i o njima voditi brigu. Neke od tih voda bilo bi nužno regulirati tako da se ne mogu isušiti. Nekad je za pojedine reofilne vrste potrebno umjetnim mrijestilištima nadomjestiti nestala prirodna mrijestilišta. To je u posljednje vrijeme u svijetu vrlo popularna metoda.

Čimbenici koji pogoršavaju uvjete razmnožavanja na prirodnim mrijestilištima su:

- regulacija voda kojom se isušuju vodena područja s idealnim uvjetima za mriješćenje pojedinih vrsta riba
- promjena razine voda na mrijesnim područjima za vrijeme mrijesta, inkubacije i ranog razvoja ličinki
- onečišćivanje voda (deterdžentima, insekticidima ili pesticidima i drugim kemijskim sredstvima)
- preintenzivno nasađivanje biljojednih vrsta riba koje mogu opustošiti biljem obrasla područja prirodnih mrijestilišta šaranskih vrsta
- aktivnost ljudi koji u doba mrijesta na području mrijestilišta svjesno ili nesvjesno ometaju ribe
- krivolov riba za vrijeme mrijesta
- radi očuvanja mjesta na kojima se mrijeste pojedine vrste riba potrebno je osigurati stalnu razinu vode za šaranske vrste u razdoblju razmnožavanja. Uspjeh mrijesta, između ostalog, ovisit će i o ukupnoj količini vode u doba mriješćenja.

Ribarstvo na otvorenim vodama, osim nesumnjiva ekonomskog učinka, ima i čitav niz dodatnih socioekoloških utjecaja, koji su možda i preči. Ribolov i uzgoj ribe jedna je od najvažnijih djelatnosti

11. PROPOSAL OF CONSERVATION MEASURES

11.1. Protection of spawning grounds and other open waters

One of the most important measures for increasing the total ichthyoproductivnost is the preservation of the natural spawning grounds and the habitats where the fish reproduce. Particular interest is attached to the old shallow branches and the shallow places that are rich in vegetation, as well as the diversity of the habitats for the individual species. Such areas should be scheduled and attention should be paid to them. Some of the waters should be regulated in such a way as to prevent them drying out. Sometimes for individual rheophilous species it will be necessary to compensate for vanished natural spawning grounds with artificial spawning areas. This has become a very popular method globally of late.

Factors that have a detrimental effect on reproduction conditions in the natural spawning areas are:

- regulation of water that dries up the watery areas with ideal conditions for the spawning of various species of fish,
- changes in the level of the water in the spawning grounds during the time of spawning, incubation and early development of the larvae
- pollution of the water (detergents, insecticides and pesticides, other chemicals)
- over-intensive planting of herbivorous fish species that can lay waste plant covered areas that are the natural spawning grounds of carp species,
- human activities in spawning time in the area of the spawning grounds that deliberately or unwittingly disturb the fish,
- poaching during spawning,
- for the sake of the preservation of the sites at which individual fish species spawn, it is necessary to maintain a constant level of water for carp species during the reproduction period. Spawning success, among other things, depends on the total quantity of water during the spawning season.

Open water fishing, apart from its undoubted economic effect, has a whole series of additional

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neposrednog iskorištavanja prirodnih bogatstava rijeka i naplavnih nizina. U okviru višenamjenskog iskorištavanja vodoprivrednog objekta ribarsko gospodarstvo ne dolazi u sukob s ostalim korisnicima, pod uvjetom da se pri razvoju pojedinih djelatnosti poštuju osnovna ekološka načela. Te ribolovno-gospodarstvene mjere vodotocima date su na temelju niza fizikalno-kemijskih, bioloških i ekoloških parametara, skupljenih od različitih pojedinaca i institucija.

Predlaže se u poribljavanje otvorenih voda uključiti mrijestilišta za ekonomski zanimljive vrste, na razini čitave regije. (Takva mrijestilišta postoje u Jelas polju, Jasinju, Poljani ili treba izgraditi priručno mrijestilište uz vodotok Save.) Ministarstvo poljoprivrede i šumarstva te pojedina športsko-ribolovna društva imaju trajnu potrebu za većim količinama divljih vrsta riba (koje se gotovo i ne mogu kupiti na tržištu) pa, s obzirom na izvanredne mogućnosti ovog područja, preporučujemo vodoprivredi da u sklopu ekološko-edukacijskih programa potpomogne uvođenju tehnologije mrijesta divljih riba, kao i ekonomski zanimljivih vrsta, naročito smuđa i šarana. Izmiještene ličinke raznih vrsta treba nasađivati u rukavce i zajezerene prostore uz glavni vodotok, s eventualnom mogućnošću ispuštanja mlađa u otvorene vodotoke.

U različitim vodenim staništima teži se stvaranju riblje populacije koja će u najvećem stupnju iskoristiti sve prehrambene niše, a pojedine vrste i godišta reducirat će se športskim ribolovom.

Praktično je nemoguće izraditi točan plan nasađivanja s vrstama, količinama i veličinama riba u optimalnom razdoblju, a koji bi vrijedio dulje vremena. Najčešće se događa da na tržištu nema odgovarajućih vrsta u potrebnoj veličini ili količini. U načelu, na tržištu slatkovodne ribe mogu se kupiti samo ekonomski važnije ribe (šaran, amur, srebrni i sivi glavaš, som i linjak).

Neka mrijestilišta bave se i mrijestom štuke. Mrijest smuđa u praksi se provodi uglavnom pomoću naseljavanja smuđevskih gnijezda iz otvorenih voda.

Zatvaranjem ustave onemogućava se prolazak riba na mrijest, kao i dotok hranjivih tvari, što u krajnjem slučaju utječe i na cijeli hranidbeni lanac. Prema novom Prijedlogu Zakona o slatkovodnom ribarstvu, najstrože je zabranjeno na bilo koji način sprječavati migratorna kretanja riba na poplavljena područja i njihov povratak u matični vodotok. Čitav niz mjera iznesen je u prilogu uvjeta za izgradnju ustave Trebež II. U vodnogospodarskoj dokumentaciji treba odrediti

socio-ecological impacts that are perhaps even more important. Fishing and the cultivation of fish are among the most important activities of the immediate exploitation of the natural riches of rivers and floodplains. Within the framework of a multi-purpose use of water facilities, fish management does not conflict with other users, on condition that during the development of the individual activities the basic ecological principles are respected. These fishing management measures are applied to streams on the basis of a series of physical, chemical, biological and ecological parameters collected from various individuals and institutions.

It is recommended that in the fish stocking of the open waters, spawning grounds should be included, for the economically more interesting species, at the level of the entire region. Such spawning areas exist in Jelas polje, Jasinje, Poljana; a convenient spawning ground could be established by the Sava. The Ministry of Agriculture and individual angling clubs have a permanent need for major quantities of wild species (which can hardly be bought on the market) and with respect to the outstanding opportunities of this area, we recommend the water management institution that as part of ecological education programmes it help in the introduction of wild fish spawning technology, as well as that for economically interesting fish, particularly pike-perch and carp. The spawned larvae of various species should then be stocked in the branches and lake areas alongside the mainstream, so that the young can in the end be released into the open streams.

In the various aquatic habitats, the endeavour should be to create a fish population that will to the greatest possible extent use all the food niches, while individual species and year classes will be reduced by angling.

It is practically impossible to work out a precise plan for stocking species, quantities and sizes of fish in the optimum period capable of being valid over the years. It most often happens that on the market there is a shortage of suitable species in the necessary size or quantity. In principle, on the market for freshwater fish, only the economically more important can be bought (common carp, grass carp, big head and silver carp, catfish and tench),

Some spawning areas deal with the spawning of pike. The spawning of the pike-perch in practice is carried out mainly with the transfer of pike-perch nests from open water.

The closing of sluices frustrates the passage of fish to the spawning grounds and the inflow of nutrient matter, which ultimately affects the whole food chain. According to the new Freshwater Fishing Bill, it is strictly forbidden in any way to prevent the migratory movement of fish to the floodplain and their return to

namjenu, svrhu i način korištenja retencije Mokro polje. Potrebno je izraditi pravilnik o načinima upuštanja vode, vremenu i trajanju vremena kad se vrlo pažljivo mora manipulirati pregradom. Plan gospodarenja biološkim resursima, posebice ribom, najbolje će se provesti ako se ostvari gotovo prirodni tijek trajanja poplava u Mokrom polju.

Razmatrano područje koristi se uglavnom za športski ribolov. Gospodarski ribolov na ovom području dopušten je na ribolovnim područjima rijeke Save nizvodno od Siska. U području djeluju brojna športsko-ribolovna društva koja upravljaju vodama koje su im dane na korištenje. Promatrano područje koristi oko 10 - 15 000 ribolovaca.

Valja imati na umu da bogatstvo ribljih vrsta, kao i ihtioproductivnost Lonjskoga polja nije primarno ekonomska kategorija. Velika ihtioproductivnost nužna je za opstanak, brojnost i raznolikost velikoga broja životinja koje tu žive, primjerice vidre, velikih populacija i vrsta ptica, žaba, malih sisavaca, predatora itd. Daleko manje treba gledati na klasične ribarske učinke proizvodnje konzumne ribe.

U zaštiti ribljega fonda određenu ulogu imaju i međunarodna tijela. Dobra strana međunarodnih strategija zaštite riba ostvaruje se poštivanjem Bernske konvencije, koja štiti europsku floru i faunu i prirodna staništa, te smjernica Europskoga vijeća u vezi sa "zaštitom prirodnih i poluprirodnih staništa, kao i faune i flore". Iste konvencije dovele su do popisa staništa i uočavanja skupina životinja i biljaka kojima treba zaštita.

11.2. Monitoring

Monitoring je veoma važan u ribarstvu jer omogućava izračunavanje mogućeg prinosa. Monitoring bi trebalo započeti sakupljanjem podataka od tradicionalnih ribara, uz eksperimentalni izlov ovlaštenih institucija. Osnova monitoringa bilo bi praćenje stanja ihtiomase i inventarizacija bogatstva vrsta riba. Znanstveni pristup, koji uključuje znanstveni rad na terenu promatranoga područja, nezamjenjiv je pri optimizaciji ihtiocenoza. Iz godišnjeg ulova možemo utvrditi masu čitavog ihtiofonda, količinu ribe koja ostaje za druge potrošače itd. Kod krivolova, općenito uzevši, masa preostalih riba manja je od trostruke, a kad slabog ribolova viša od peterostruke. Omjer između vrijednijih i manje vrijednih riba kod ulova upućuje na vrijednost fonda.

Kvalitetan program monitoringa može se dati tek nakon podrobnih istraživanja. Međutim, općeniti

the mainstream. A whole series of measures have been put forward in the matter of conditions for building the Trebež II sluice. In the water management document the purpose, intention and manner of use of the Mokro polje retention should be stated. It is necessary to draw up Regulations concerning the manner of releasing the water, the time and duration when the sluice has to be manipulated very carefully. The manner of managing the biological resources, particularly the fish, will be best carried out if the duration of the flooding in Mokro polje is kept more or less to the natural occurrence of it.

The area under consideration is used mainly for angling. Economic fisheries in this area are allowed in the fishing areas of the Sava River downstream from Sisak. In this area there are many angling clubs that manage the water that they have been allotted. The area under observation is used by some 10 to 15 thousand anglers.

It should be borne in mind that the richness of fish species, and the ichthyoproductivness of Lonjsko Polje is not primarily an economic category. Large ichthyoproductivness is necessary for the survival, abundance and diversity of a large number of animals that live here, such as the otter, large populations and species of birds, frogs, small mammals, predators and so on. It is necessary to look much less at the classical fishery effects of the production of fish for the table.

In the protection of the fish stocks, a certain role has to be played by international bodies. A good side of international fish protection strategies is effectuated by the observing of the Berne Convention, which protects European flora, fauna and habitats, and the directives of the European Council in connection with the "protection of natural and semi-natural habitats as well as of fauna and flora." The same conventions have led to the scheduling of habitats and the registering of the groups of animals and plants that need protecting.

11.2. Monitoring

Monitoring is extremely important in fisheries because it enables the calculation of the possible yield. Monitoring should start with the collection of data from traditional fishermen, with experimental catches by authorised institutions. The basis of the monitoring should consist of the monitoring of the state of the ichthyomass and the inventorisation of fish species richness. A scientific approach, including scientific field work in the area, is essential in the optimisation of the ichthyocoenosis. From the

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modeli monitoringa močvarnih i riječnih ekosustava postoje. Ovdje valja poseban naglasak dati trofiji ekosustava, kao i posebnim vrstama koje dolaze samo u poplavnim nizinama. Uobičajena je metoda promatrati staništa i abundanciju vrsta kao *Cyprinus carpio*, *Leucaspis delineatus*, *Abramis balerus*, *Umbra krameri* i *Misgurnus fossilis*. To su ključne vrste za kakvoću ovakvih ekosustava.

Na svim ribolovnim vodama treba ustrajati na vođenju odgovarajuće evidencije i na prikupljanju te obradi statističkih podataka o slatkovodnom ribolovu.

11.3. Suradnja s lokalnim pučanstvom

Suradnju s okolnim pučanstvom treba održavati. Lokalno pučanstvo ključno je u otkrivanju nepoznatih a često prisutnih osoba ili vozila u parku i njihovo pravovremeno prijavljivanje policiji ili čuvarskoj službi Parka prirode. Zato treba naglasiti nužnost eventualne edukacije kako bi se postiglo potpuno suživljavanje s ovim prostorom i upozorilo na opasnosti od krivolova i drugih nedopuštenih aktivnosti. Posjećivanje je svakim danom sve izraženije i osjeća se nedostatak prikladnih smještajnih kapaciteta za turiste u neposrednoj blizini Parka prirode, gdje veliku ulogu može odigrati upravo lokalno pučanstvo uvođenjem seoskog turizma.

11.4. Obaviještenost javnosti

Obavješćivanje i promidžba lokalnog stanovništva važni su preduvjeti za dobru i kvalitetnu zaštitu. U podizanju razine zanimanja veliku ulogu imaju različiti promidžbeni materijali, prospekti, leci, naljepnice, popisi ugroženih riba, popisi vrsta po staništima i slično. Razvijanje svijesti o važnosti ribarstva osobito je značajno za mlađe generacije. U važne oblike aktivnosti ubraja se i prikazivanje filmova i dijapozitiva posjetiteljima te stručna vođenja i edukacija, organiziranjem škola u prirodi.

Važno je podizanje razine različitih oblika edukacije i svih sudionika u slatkovodnom ribarstvu.

11.5. Inspeksijske i čuvarske službe

Kako županijski ribarski inspektori, kao ni ribarski inspektori Državnog inspektorata, prema novom

annual catch we can determine the mass of the whole fish stock, the quantity of fish remaining for other consumers and so on. In poaching, considered generally, the mass of fish remaining is less than three-fold, and with weak fishing, more than five-fold. The ratio between the valued and the less-valued fish in a catch indicates the value of the stocks.

A quality monitoring programme can be established only after detailed investigations. However, general models for the monitoring of wetland and riverine ecosystems do exist. Here the main emphasis needs to be given to the trophic state of the ecosystems and to particular species that are found only in lowland floodplains. A common method is to observe the habitats and abundance of species such as *Cyprinus carpio*, *Leucaspis delineatus*, *Abramis balerus*, *Umbra krameri* and *Misgurnus fossilis*. These are the key species for the quality of such ecosystems.

In all fishing waters, the keeping of the proper records and the collection and processing of statistical data on freshwater fishing have to be insisted upon.

11.3. Collaboration with the local population

Collaboration with the local population must be maintained. This local population is crucial for the detection of unknown but frequently present persons or vehicles in the park and their being promptly reported to the police or warden service of the Lonjsko Polje Nature Park. And so it is necessary to emphasise the important of education so as to achieve total identification with the area and to warn of the dangers of poaching and other illegal activities. There are greater numbers of visitors every day, and the lack of suitable accommodation facilities for guests in the immediate vicinity of the Park can be increasingly sensed; here, a major role can be played by the local population through the introduction of farmhouse tourism.

11.4. Public information

Public relations with and information of the local population are vital conditions for quality conservation. In raising the level of interest, a great role can be played by various forms of PR material, brochures and fliers, stickers and lists of endangered fish, lists of species according to habitats and so on. The development of awareness of the important of fishing is particularly important for the young. Also

Prijedlogu Zakona, nemaju ovlast nadzora u parku prirode, nadzor nad ribolovnim aktivnostima na ovom području trebali bi provoditi inspektori Državne uprave za zaštitu prirode i okoliša. Problemi čuvarske i inspeksijske službe slični su, dakle, kao i u ostalim parkovima prirode. Ribarstvo je u organizaciji Slatkovodnog ribarstva Hrvatske imalo reguliranu pravnu osnovu, no ona je, prelaskom nadležnosti ribarstva u zaštićenim područjima pod Zakon o zaštiti prirode, postala nefunkcionalna. Uočljiv je manjak ljudi, nepostojanje ribarsko - gospodarskih osnova, krivolov je razvijeniji nego na drugim područjima itd. Bit je u tome da se ribarstvo u parkovima prirode, pod pritiskom velikog broja športskih ribiča i domaćeg stanovništva, prakticira na nižoj znanstvenoj razini od one uobičajene na ostalim vodama. Razvijanje nadzorničke službe sve je neophodnije radi što bolje zaštite na terenu. Nadzornici u tom smislu mogu biti aktivni čuvari i provoditelji Pravilnika o unutarnjem redu, vodiči skupina, edukatori i voditelji ekoškola. Isto tako mogu pružiti značajniju tehničku potporu pri terenskim istraživanjima (sakupljanje uzoraka vode, tla, biljaka ili pojedinih skupina životinja). Nadzornici se mogu koristiti i u pojedinim programima praćenja u parku pri čuvanju prostora od ribokradica.

important activities are the showing of films and slides to visitors, as well as qualified guide services and education, the organisation of nature-schools.

The raising of the level of various forms of education of all those involved in freshwater fishing is of great importance.

11.5. Inspection and warden services

Since neither the county nor the central government fishing inspectors, according the Bill, have any authority to carry out their work in the nature park, control of fishing activities in this area has to be carried out by inspectors of the National Administration for Nature and Environment Protection. The problems of warden and inspection services are the same as in other nature parks of course. Fishing as organised by the Croatian Freshwater Fisheries had a regulated legal basis, but this, when the authority was transferred under the nature protection law, ceased to function. A shortage of personnel can be observed, the absence of fishing management rules, and poaching is more common than in other areas. The essence of the matter is that fishing in the nature parks is under great pressure from both anglers and the local population, and is practised at a scientific level that is lower than in other waters. The development of a control service is increasingly essential for the sake of protection in the field that is as effective as possible. In this sense, the superintendents can be the active keepers and implementers of the Internal Order Regulations, the educators and guides of the eco-schools. Similarly they can provide considerable technical support in field research (collecting samples of water, soil, plants and individual groups of animals). The superintendents can be used in individual programmes of monitoring in the park in the protection of the area against fish-poachers.

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