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Prispevek k zgodovini raziskav biotske pestrosti v Sloveniji – kar zadeva nižje nevretenčarje

A contribution to the history of biodiversity research in Slovenia – lower invertebrates mainly

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Uvod

Ko so se v svetu začele raziskave biotske pestrosti, je bilo slovensko ozemlje na obrobju 'Evrope', administrativno in politično razdeljeno, raziskovalci so prihajali od zunaj. Postopoma se jim je pridružila domača inteligenca, v 20. stoletju je bila ustanovljena tudi univerza, ozemlje pa je ostalo razdeljeno vse do konca druge svetovne vojne. Šele v povojni Jugoslaviji se je združilo skoraj vse narodnostno slovensko ozemlje, pretežni del raziskav pa so prevzeli domači raziskovalci. Takšna ostaja Slovenija tudi po osamosvojitvi.

Raziskave biotske pestrosti na ozemlju današnje Slovenije so začeli tuji znanstveniki in amaterji, ki so jih tukaj zaposlili v različne namene, navadno pa kot zdravnike ali uradnike. V tem sestavku izpisujem imena rojenih ali podomačenih Slovencev ali Jugoslovanov polno, drugih pa okrajšano. Do ustanovitve slovenske univerze obravnavam vse raziskovalce biotske pestrosti, po tej pa le tiste, ki so se ukvarjali z nižjimi nevretenčarji (nevretenčarji brez žuželk).

Introduction

In times when the research of the biotic diversity started, the Slovenian territory was on the margins of 'Europe', divided in the political and administrative sense. Researchers were coming from abroad. Step by step the native intellectuals joined them, in the 20th Century also a national university was established. However, the bulk of the ethnic Slovene territory could amalgamate only after the Second World War, when native Slovene and Yugoslav researchers also took the lead in the research. The same remains Slovenia after the disintegration of Yugoslavia.

The research of biodiversity in the territory of the actual Slovenia started by foreign scientists and amateurs, employed here for other purposes, mainly as physicians or as officials. In this account, the names of born or naturalized Slovenes or Yugoslavs will be written in full, while the others will be shortened. Prior the foundation of the Slovene University, all researchers are considered, after that only those dealing with lower invertebrates (insects excluded).

Prvi začetki

Floristično in favnistično so začeli ozemlje raziskovati sredi 16. stoletja (Gosar & Petkovšek 1982; Staut-Turk 1974). Italijanski zdravnik in naravoslovec **P. A. Mattioli**, ki so ga povabili, da bi iztrebil kugo, je ostal v Gorici/Gorizia 12 let ter raziskoval na zahodu današnje Slovenije. V svojih Komentarjih (Mattioli 1570) omenja nekatere rastline in živali, mestoma z imeni krajev. Njegove zbirke imajo večinoma uporaben, medicinski namen, kot velja npr. za *castoreum* – proizvod bobrov, pa čebelji med, vosek in propolis. Omenja tudi v deželi tradicionalen polšji lov. Na rastlinstvo na severovzhodu dežele se je omejil nizozemski botanik **C. Clusius**, ki je bival na Dunaju. Raziskoval je tudi glive.

Tudi v kapitalnem delu Janeza Bojkarta Valvasorja (Valvasor 1689) o Vojvodini Kranjski iz sredine 17. stoletja je vključenih nekaj podatkov o rastlinah in živalih. Razvpita je omemba bodočega proteja, ki pa ga ta avtor ni prav ocenil in je s tem zgrešil pomembno znanstveno ugotovitev. Njegovi dvomi so še posebej kontroverzni, ker je po drugi strani prav zlahka sprejel čarovnice in 'črne race' kot prebivalke bližnjih jam. Sicer pa je bila njegova obravnava favnističnih posebnosti predvsem etnografska. V podrobnosti je opisal polšji lov in legende o teh živalih. Od nevretenčarjev je omembe vreden opis vedenja pijavk v Cerkniškem jezeru; ker medicinske pijavke vsaj danes ni v teh vodah in ker Valvasor nič ne omenja krvi pri 'žrtvah', moramo domnevati, da so to bile konjske pijavke (*Haemopis sanguisuga*).

Prvi korak posodabljanja

Vsaj dva resna terenska raziskovalca sta bila v deželi dejavna v 18. stoletju. Italijan **I. A. Scopoli** je bil prvi zdravnik v rudniku živega srebra v Idriji (1754–1769). Njegove natančne in včasih tvegane terenske in kabinetne raziskave v zahodnih delih Slovenije so obrodile z imenitnima Flora Carniolica (Scopoli, 1760) in Entomologia Carniolica (Scopoli, 1763). Uporabil je Linnejevo taksonomsko poimenovanje, ob tem ko je zbiral tudi ljudska imena. Scopoli je napisal tudi razpravo o glivah v rudniških rovih, pa o proteju, torej se je dotaknil tudi speleobiološke snovi.

First beginnings

Floristic and faunistic research of the country started in the middle of the 16th Century (Gosar & Petkovšek 1982; Staut-Turk 1974). The Italian physician and natural scientist **P. A. Mattioli**, invited to beat the plague, stayed in Gorizia/Gorica for twelve years and investigated the West of the actual Slovenia. In his Commentarii (Mattioli 1570) he mentions some plants and animals, sometimes with toponyms of localities. His collections are mainly utilitarian, medicinal, as is the case with the *castoreum*, the beaver product, and the bees' honey, wax, propolis. He also mentions the traditional dormice hunt in the country. Limited to plants were investigations of the Dutch botanist residing in Wien, **C. Clusius**, in the NE of the country. In fact, he described also fungi.

In the middle of the 17th Century, the Janez Bajkort (Johann Weichert) Valvasor's capital work (Valvasor 1689) on the Herzogtum Krain (Kranjska, Carniola) included some accounts on plants and animals. Famous is the mention of the future *Proteus*, not really recognized by the author who missed here an important scientific statement. His doubts are particularly controversial since he willingly accepted witches and 'black ducks' as inhabitants of the surrounding caves. Otherwise, his treatment of faunistic peculiarities was mainly ethnologic. He described in detail the dormice hunt and legends around that animal. Of invertebrates is worth mentioning his description of the leech behavior in Cerkniško jezero; since the medicinal leech is actually absent from these waters, and since Valvasor does not mention bleeding of the victims, we are forced to suppose that his leeches were *Haemopis sanguisuga*.

First step of modernization

At least two serious field researchers were active in country in the 18th Century. The Italian **I. A. Scopoli** was the first physician in the mercury mine in Idrija (1754–1769). His detailed and sometimes hazardous field and cabinet investigations in western parts of Slovenia resulted mainly in the great Flora Carniolica (Scopoli, 1760) and Entomologia Carniolica (Scopoli, 1763). He

Predstavimo Scopolijevo delo (Scopoli 1763, 1772) s primeri. Opisal je 613 vrst nevretenčarjev kot novih, od tega 45 vrst pajkov. Žal brez podatkov o najdiščih. V katalogu Fauna Europaea najdemo 5 vrst, ki jim je Scopoli 1763 avtor; šesta je osasti pajek, *Argiope bruennichi*, zelo razširjena, opazna vrsta, ki jo je opisal pozneje (kot *Aranea Brunnichii* Scopoli 1772). Ena od njegovih vrst je *Metellina merianae* (Scopoli 1763), ki je pogosta v vhodnih rovih kraških jam. Za obe omenjeni vrsti je 'Carniolia' *terra classica*. Opisal je tudi stonogo drobnonožko (Symphyla) *Hanseniella nivea* (Scopoli 1763).

Malo pred Scopolijem je objavil nekaj podatkov o kranjskih nevretenčarjih **N. Poda** (1761). Dobil pa jih je od Scopolija, ko je raziskoval žuželke Štajerske v graškem muzeju.

Proti koncu 18. stoletja imamo torej že nekaj pomembnih zbirnih del o flori in favni velikega dela današnje Slovenije: Flora Carniolica, Flora Norica Phanerogama (F. X. Wulfen 1858), Plantae Alpinae Carniolicae (B. Hacquet 1782), Entomologia Carniolica, Insecta Musei Graecensis.

Prve združbe, ustanove, revije

Pomembni osebnosti na prehodu stoletij sta bili Zois in Schmidt. **Žiga Zois** (1747–1819) je bil podjetnik, pa naravoslovec, tehnik in izumitelj, mecen in pisec. Denarno in duhovno je podpiral krog izobražencev, bil zato zelo pomemben za razvoj slovenske kulture, a njegovo edino tiskano delo je menda članek o proteju in še tega ni podpisal (Annonymus 1807; Aljančič 1997). **Ferdinand Schmidt** (1791–1878), tuj trgovec, ki pa se je končno ustalil v Ljubljani, je bil tudi ljubiteljski zoolog, zelo dejaven pri aktiviranju slovenskih naravoslovcev in v stikih s številnimi tujimi naravoslovci. Njegov krožek je postal jedro bodočega (1839) Muzejskega društva za Kranjsko, kjer so se porodile tudi prve misli o potrebi po varovanju narave. Bil je najboljši poznavalec krajevne favne žuželk, z bogato zbirko. Napisal je prvi seznam kranjskih mehkužcev (Schmidt 1847). Najdba prvega troglobiotskega hrošča (*Leptodirus hochenwartii* Schmidt 1832) ga je napeljala, da je začel iskati(!) jamske živali, kar imamo lahko za začetek speleobiologije (glej spodaj).

applied the Linne's taxonomical nomenclature while collecting also vernacular names. Scopoli wrote an account on fungi in the mine corridors as well as on *Proteus*, touching so the field of speleobiology.

To present the Scopoli's work (Scopoli 1763, 1772) with an example, he described 613 species of invertebrates as new, 45 of them were spiders. Unfortunately, no locality data were given. In Fauna Europaea, one can still find 5 species of spiders with Scopoli 1763 as the author; the sixth is the beautiful *Argiope bruennichi*, a widely distributed conspicuous species, described later (as *Aranea Brunnichii* Scopoli 1772). One of his species is *Metellina merianae* (Scopoli 1763), so common in entrance corridors of karst caves. Both important spider species have 'Carniolia' as *terra classica*. He described also the tiny scutigerellid myriopod (Symphyla) *Hanseniella nivea* (Scopoli 1763).

Slightly earlier were published some data on Carniolian invertebrates by **N. Poda** (1761). He obtained them from Scopoli when studying insects from Styria (including NE of Slovenia) in the Graz museum.

Thus, towards the end of the 18th Century, important synthetic works on the flora and fauna of large parts of the actual Slovenia exist: Flora Carniolica, Flora Norica Phanerogama (**F. X. Wulfen** 1858), Plantae Alpinae Carniolicae (**B. Hacquet** 1782), Entomologia Carniolica, Insecta Musei Graecensis.

First associations, institutions, journals

Important personalities at the transition of the centuries were Zois and Schmidt. **Žiga Zois** (1747–1819) was an entrepreneur, natural scientist, technician and inventor, Maecena, and literary man. Activating and supporting (financially and spiritually) a circle of intellectuals, he was very important for the development of the Slovenian culture, but his only printed work should be an article about *Proteus*, even this one not signed (Anonymus 1807; Aljančič 1997). **Ferdinand Schmidt** (1791–1878), a foreign merchant who eventually settled in Ljubljana, was also an amateur zoologist, very active in moving the Slovenian naturalists and communicating with a number of renowned foreign naturalists.

V začetku 19. stoletja, natančneje lete 1810, je **Franc de Paula Hladnik** v Ljubljani ustanovil **botanični vrt**; ta se je obdržal do danes (kot Botanični vrt Univerze v Ljubljani) kot najstarejša znanstvena ustanova v Sloveniji. **Deželni muzej za Kranjsko** so ustanovili 1821 kranjski deželni stanovi. Vključeval je tudi naravoslovni del, ki je danes samostojni Prirodoslovni muzej Slovenije. Muzej je pozneje dobil v hrambo tudi pomemben del Schmidtove zbirke žuželk.

Od leta 1891 je Muzejsko društvo za Kranjsko izdajalo Izvestja Muzejskega društva za Kranjsko, ki so leta 1910 dobila dodatek k naslovu, 'Carniola', leta 1931 pa so se iz njih izlučile **Prirodoslovne razprave,** ki jih je izdajala Prirodoslovna sekcija Muzejskega društva za Slovenijo. Ta znanstvena revija je objavljala tudi taksonomske članke.

Proti sredini in koncu stoletja je Schmidtovemu seznamu mehkužcev **Fran Erjavec** (1877 in rokopisi) pridružil podatke iz zahodnih delov Slovenije. Erjavec se je pozneje razvil v učitelja in pisca zgodb o naravi. **Simon Robič**, tudi amater, duhovnik po poklicu, je strastno zbiral iz vsega spektra živega sveta: glive, mahove, žuželke, mehkužce. Medtem ko so žuželke iz njegovih zbirk znanstveno opisovali drugi znanstveniki, je Robič napisal prvi preprost zoološki članek v slovenščini (Robič 1869). Ko so njegovo malakološko zbirko v muzeju popisali, je vsebovala 2759 vrst (Sajovic 1908).

Pomembno je, da smo imeli proti koncu stoletja že nekaj določevalnih ključev, ki so – v določenih skupinah – obsegali tudi dele ali celoto slovenske flore in favne. Takšna dela so objavili **J. Pospichal** (1897–1899) in **K. Fritsch** (1897) za floro, **F. Werner** (1897) za dvoživke in plazilce, **S. Clessin** (1887) za mehkužce.

Semkaj bomo priključili začetke 20. stoletja, s pomembnimi projekti, kot je bila priprava določevalnih ključev v slovenščini za rastline (**Julij Glowacki**), pa Flora exiccata Carniolica (**Alfonz Paulin**), navodila za zbiralce metuljev (Julij Bučar 1919). Razcvet ljubiteljske entomologije je obrodil bogate in primerno urejene zbirke. **Gvidon Sajovic** je prispeval nov seznam mehkužcev (Sajovic 1908), poleg ornitoloških in herpetoloških prispevkov. **Ivan Hafner** (1909, 1910, 1912) je podal seznam 'makrolepidopterov'. Posebej pomembne za usodo naše biotske pestro-

His circle appeared to be the core of the future (1839) **Muzejsko društvo za Kranjsko** (Museum Society for Carniola), from which also the first nature protection ideas arose. He was the best connoisseur of the local insect fauna, with a rich collection of insects. He wrote the first list of Carniolian mollusks (Schmidt 1847). The finding of the first troglobiotic beetle (*Leptodirus hochenwartii* Schmidt 1832) moved him to start to search for cave animals, which we may consider the beginning of speleobiology (see below).

At the beginning of the 19th Century, exactly in 1810, **Franc de Paula Hladnik** grounded in Ljubljana the **botanical garden**; this botanical garden still exists (Botanični vrt Univerze v Ljubljani) as the oldest scientific institution in Slovenia. Carniolian States (kranjski deželni stanovi) grounded **Deželni muzej za Kranjsko** (Carniolian Country Museum) in 1821. It included also natural sciences, a part, which is now the independent Prirodoslovni muzej Slovenije (Slovenian Museum of Natural History). The Museum obtained later also an important part of Schmidt's insect collection.

Since 1891 the Museum Society for Carniola issued the journal Izvestja Muzejskega društva za Kranjsko, which in 1910 obtained a preposition 'Carniola', while in 1931 from it evolved **Prirodoslovne razprave** (Natural Science Papers), issued by the Natural History Section of the Museum Society of Slovenia. It kept publicating also taxonomical papers.

Towards the middle and the end of the century, Schmidt's list of continental mollusks were joined data for the West of Slovenia **Fran Erjavec** (1877 and manuscripts); he developed later into a teacher and writer of stories about nature. **Simon Robič**, again an amateur, a priest by profession, eagerly collected the entire spectrum of biota: fungi, mosses, insects, and mollusks. While scientific descriptions of his insects were published by other scientists, he wrote the first simple zoological treatise in Slovenian language (Robič 1869). When his malacological collection was catalogued in the Museum, it contained 2759 species (Sajovic 1908).

A very important fact is the existence, towards the end of the century, of identification keys including also parts or entirety of the Slovenian flora and fauna: **J. Pospichal** (1897–1899) and

sti pa je bila pobuda nekaterih članov Muzejskega društva, leta 1920 (Skoberne 1995), s katero je začelo v Sloveniji naravovarstvo.

Ustanovitev nacionalne univerze

(Od tod dalje bomo upoštevali le raziskovalce nižjih nevretenčarjev.)

Leta 1919 je bila ustanovljena **Univerza v Ljubljani**. Moramo sicer ugotoviti, da to ni imelo izrecnega neposrednega vpliva na raziskovanje biotske pestrosti. Imelo pa je ugoden daljnosežen vpliv; znanost je dvignilo na višjo raven in povečalo je delež slovenskih raziskovalcev. Univerza v Ljubljani je omogočila zainteresirani mladeži študij doma in 'produkcija' biologov za pouk in raziskovanje je stalno naraščala. Pred nekaj desetletji je še naraščalo zanimanje študentov za 'moderne' panoge (za fiziologijo, molekulsko biologijo), a proti koncu 20. stoletja sta spet postali privlačnejši ekologija in biotska pestrost. To je posebej izraženo prav zdaj, ko lahko kandidati izberejo tudi povsem samostojen študij (zunaj biologije) biotehnologije in mikrobiologije. Že vsaj 20 let sprejemamo na študij biologije po približno 70 kandidatov letno; v drugem letniku lahko izbirajo med tremi usmeritvami in v zadnjih letih jih je v povprečju skoraj polovica (48 %) izbrala 'ekološkosistematski blok'. V zadnjih desetih letih je diplomiralo v povprečju 68 študentov letno.

Mladega zoologa **Jovana Hadžija** (npr. Hadži 1909) so povabili na novoustanovljeno Univerzo, da bi oblikoval inštitut za zoologijo. Postal je prvi profesor zoologije, znan zlasti po svojih zelo originalnih pogledih na filogenijo mnogoceličarjev. Vendar pa je ponudil tudi zoogeografsko shemo Jugoslavije (Hadži 1930) in prispeval k poznavanju njene favne. Taksonomsko je v svojih delih obravnaval Ciliata, Cnidaria, Scorpiones, Pseudoscorpiones, Opiliones. Bil je tudi pomemben za razvoj speleobiologije.

Kot pomembno publikacijo obdobja med vojnama moramo omeniti 'vodnik' po zooloških zbirkah tedaj že samostojnega Prirodoslovnega muzeja; napisali so ga direktor **Fran Kos** in sodelavci (Kos et al. 1932). Ta vodnik je bil lepa predstavitev slovenske favne, kjer so bile omenjane tudi 'redke' vrste, pa endemi in podobne posebnosti; postal je brevir za zainteresirano mladež

K. Fritsch (1897) for flora, **F. Werner** (1897) for herpeta, **S. Clessin** (1887) for Mollusca.

We will join here the beginning of the 20th Century with important projects, like preparation of an identification key for plants in Slovenian language (**Julij Glowacki**), the Flora exiccata Carniolica (**Alfonz Paulin**), instructions for butterfly collectors by **Julij Bučar (**1919). The burst of the amateur entomology gave rich and well kept collections. **Gvidon Sajovic** contributed a new list of Mollusca (Sajovic 1908), beside ornithological and herpetological papers. **Ivan Hafner** (1909, 1910, 1912) gave a list of 'macro-Lepidoptera'. Particularly important for the future of the biodiversity is finally the initiative of some people in the Muzejsko društvo in 1920 (Skoberne 1995), which started the nature protection in Slovenia.

Foundation of the national University

(From here on, only researchers of lower invertebrates will be considered.)

In 1919 was founded the **University of Ljubljana**. One has to note that this fact had no explicit immediate influence to the biodiversity research. Its beneficial influences were however long-term and far-reaching ones; it raised the science to a higher level and raised the share of Slovenian researchers. Ljubljana University enabled the interested youth to study at home and the 'production' of biologists for teaching and research was steadily increasing. Some decades ago the interest of students on 'modern' branches (physiology, molecular biology) was increasing, while towards the end of the 20th Century, the ecology and biodiversity became more attractive. This is particularly expressed very recently, when candidates can take independent studies (outside biology) in biotechnology and microbiology. Since 20 years ago or more, to the biology curriculum are accepted ca 70 candidates per year; they may choose between three directions in the second year and in last years nearly half (48%) of them in average select the emphasis on the ecology and systematics topics. In the last decade have been graduating 68 students in average per year.

The young zoologist **Jovan Hadži** (e.g. Hadži 1909) was invited to the newly established

in za dolgo obdobje edina predstavitev celotnega spektra domače biodiverzitete. **Roman Kenk** je objavil pomembna dela o sladkovodnih trikladnih vrtinčarjih, preden se je leta 1938 izselil. **Ljudevit Kuščer** je opisal številne polžke iz jamskih voda. Nekatera dela so bila objavljena med drugo svetovno vojno. Raziskovalci iz drugih delov Jugoslavije in iz tujine so se zanimali zlasti (vendar ne izključno) za jamsko živalstvo, obdelovali so bogato gradivo, ki so ga zbrali sami ali pa dobili od slovenskih jamarjev in speleobiologov. Tu naj bo omenjen **Stanko Karaman**, tedaj delujoč v Skopju, ki je obdeloval zlasti postranice. **H.-J. Stammer** je bil dejaven raziskovalec jam in taksonom širokega znanja, ki je opisoval vse od protozojev do rakov. **E. Racoviţa (Racovitza)** je opisoval sladkovodne izopode, **H. Strouhal** kopenske in vodne izopode. **K. W. Verhoeff** je raziskoval mokrice in dvojnonoge, **K. Strasser** in **Carl Attems** pa le dvojnonoge. Drugi pomembni raziskovalci so bili **W. Schneider** z nematodi, **M. Beier** s paščipalci, C. **Willmann** s pršicami, **F. Kiefer** s ceponožci in **W. Klie** z dvoklopniki. **Franc Mihelčič** je raziskoval tardigrade in nekatere skupine pršic. **C. Zelinka** je opisal več vrst kinorinhov prav iz slovenskega morja.

Po Drugi svetovni vojni

Kmalu po vojni se je raziskovalna dejavnost popestrila. Poleg nekaterih tujcev so raziskovali zlasti sodelavci Zoološkega inštituta na ljubljanski Univerzi ter Biološkega inštituta Akademije znanosti in umetnosti (danes Biološki inštitut Jovana Hadžija, ZRC SAZU). J. Hadži, S. Karaman, J. Kratochvil, M. Beier, C. Attems, K. Strasser so nadaljevali z objavljanjem podatkov o slovenski favni.

Od leta 1952 izhaja biološka znanstvena revija **Biološki vestnik**; po krajši krizi se ta revija od 1997 nadaljuje kot **Acta biologica slovenica** (ali **ABS**). Slovenska akademija znanosti in umetnosti izdaja svoje **Razprave-Dissertationes** z naravoslovnim delom. Obe reviji objavljata tudi zoološke taksonomske članke.

Jože Bole je raziskoval mehkužce, pomembne so njegove taksonomske in favnistične monografije o manjših skupinah kopenskih (*Zospeum*; Bole 1974) in vodnih troglobiontov (endemne vrste *Belgrandiella*; Bole 1967). Njegov prispevek je

University to create an institute of zoology. He became the first professor of zoology, known mainly for his very original ideas about phylogeny of metazoans. But, he offered also a zoogeographical scheme of Yugoslavia (Hadži 1930) and contributed also to the knowledge of its fauna. Taxonomically, he published about Ciliata, Cnidaria, Scorpiones, Pseudoscorpiones, and Opiliones. He was also important for the development of the speleobiology.

As an important publication of the time between the Wars has to be mentioned the 'guide' to the zoological collections of the now independent Natural History Museum by its director **Fran Kos** (Kos et al. 1932). This ‘guide’ was a nice presentation of the Slovenian fauna, mentioning also ‘rare’ species, endemics etc; it became a breviary for the interested youth and for long time the only presentation of the whole spectrum of the indigenous biodiversity. **Roman Kenk** published some important papers on freshwater Turbellaria Tricladida, before emigrating (in 1938). **Ljudevit Kuščer** described numerous Gastropoda from cave waters. Some of their accounts were published already in the war times.

Researchers from the rest of Yugoslavia and from abroad were particularly (but not only) interested on the cave fauna, they studied rich materials collected either by themselves or obtained from the Slovenian cavers and speleobiologists. Such was e.g. **Stanko Karaman**, then in Skopje, studying mainly amphipods. **H.-J. Stammer** was an active cave researcher and taxonomist of a wide knowledge describing protozoans to crustaceans. **E. Racoviţa (Racovitza)** described aquatic isopods, **H. Strouhal** terrestrial and aquatic Isopoda. **K.W. Verhoeff** studied onscids and myriapods, while **K. Strasser** and **Carl Attems** only the myriapods. Other important researchers were **W. Schneider** with Nematoda, **M. Beier** with Pseudoscorpiones, **C.-F. Roewer** with Opiliones, **J. Kratochvil** with Aranea, C. **Willmann** with Acarina, **F. Kiefer** with Copepoda and **W. Klie** with Ostracoda. **Franc Mihelčič** studied Tardigrada and some Acarina. **C. Zelinka** described some Kinorhyncha from the Slovenian sea.

bistveno dopolnil **Pavle Radoman** (1983, 1985). Posebej zanimivo je odkritje cele kopice vrst epizoičnih vrtinčarjev Temnocephalida na jamskih kozicah, ki jih je obdelal **Janez Matjašič** (1990).

S. Hrabě je napisal nekaj prispevkov k poznavanju vodnih maloščetincev, podobno tudi **Spasenija Karaman** in končno **N. Martinez-Ansemil, B. Sambugar & E. Giani.**

C. Deeleman-Reinhold je raziskovala jamske pajke. **Anton Polenec** je gozdne pajke raziskoval bolj ekološko, manj taksonomsko in to pretežno kot soavtor; bil pa je izjemno dejaven kot pisec poljudnoznanstvenih zooloških del. **Božidar Ćurčić** je prispeval k poznavanju paščipalcev, **B. Condé** k poznavanju palpigradov. **Kazimir Tarman**, sicer posvečen ekologiji tal, je raziskoval pršice oribatide. **Marjan Rejic** je raziskoval vodne bolhe in ceponožce, **Trajan Petkovski** rake ceponožce in dvoklopnike, **D. Danielopol** pa le dvoklopnike. **Z. Matic** je taksonomsko obdelal nekaj vzorcev strig.

Nekaj pomembnih seznamov, ki zadevajo biotsko pestrost, je bilo objavljenih v obdobju 1964–1980. Odbor pri SAZU, v okviru zvezne akcije in po pooblastilu zveznega Consilium Academiarum Scientiarum RPSFJ, je izdajal ***Catalogus faunae Jugoslaviae***. To so seznami vrst s sinonimi in grobimi podatki o razširjenosti (o tipski lokaliteti in prisotnosti po republikah nekdanje Jugoslavije, vključno s Slovenijo). Za nižje nevretenčarje je do l. 1980 izšlo osem zvezkov (Oligochaeta, Araneae, Pseudoscorpiones, Opiliones, Oribatei, Amphipoda, Isopoda aquat., Diplopoda). Janez Matjašič in **Jože Štirn** (1975) sta objavila seznam vrst iz slovenskega dela Jadrana, a bogat vir tozadevnih podatkov je tudi skupinsko delo **Avčin** s sod. (1973). Okoli 1990 so izšli **Rdeči seznami** (ur. **Jana Vidic** 1992) ogroženih rastlinskih in živalskih vrst, kjer pa so za nekatere skupine vključeni kar popolni seznami slovenske favne. Biološko društvo Slovenije in Biološki inštitut Univerze sta izdajala **Ključe za določevanje živali** (za Jugoslavijo; ur. B. Sket), a od nevretenčarjev sta izšla le ključa za mehkužce in za višje taksone nevretenčarjev (Bole 1969; Sket 1968). Posebej dragocen je priročnik za določitev običajnejših morskih vrst, **Fauna und Flora der Adria** (ur. **R. Riedl** 1963), ki je seveda uporaben tudi ob slovenskem delu Jadrana.

After the World War II

Soon after the War, the research activity diversified. Beside by some foreigners, the research was mainly performed by the Zoological Institute at the University and the Biology institute at the Slovenian Academy of Sciences and Arts (now Biološki inštitut Jovana Hadžija, ZRC SAZU). J. Hadži, S. Karaman, J. Kratochvil, M. Beier, C. Attems, K. Strasser continued their activity, at least publishing about Slovenian fauna.

The scientific journal **Biološki vestnik** had been published from 1952 to 1995; after a short crisis it continued as **Acta biologica slovenica** (or **ABS**) since 1997. The Academy of Sciences and Arts is issuing its **Razprave-Dissertationes** with a natural history part. Both journals are publishing also articles regarding zoological taxonomy.

Jože Bole studied Mollusca; important are his taxonomic and faunistic monographs on some small groups of terrestrial (*Zospeum*; Bole 1974) and aquatic troglobionts (endemic *Belgrandiella*; Bole 1967). His contribution was remarkably completed by **Pavle Radoman** (1983, 1985). Particularly interesting is the discovery of a series of Turbellaria Temnocephalida on cave shrimps by **Janez Matjašič** (1990).

S. Hrabě wrote some contributions about aquatic Oligochaeta, so did also **Spasenija Karaman** and finally **N. Martinez-Ansemil, B. Sambugar & E. Giani.**

C. Deeleman-Reinhold investigated cave spiders. **Anton Polenec** investigated forest spiders ecologically, less taxonomically and mainly as a co-author; but he was extremely active as a popular zoology writer. **Božidar Ćurčić** contributed to the knowledge of Pseudoscorpiones, **B. Condé** of the Palpigradi. **Kazimir Tarman**, mainly a soil ecologist, studied oribatid mites. **Marjan Rejic** studied Cladocera and Copepoda, **Trajan Petkovski** Copepoda and Ostracoda, **D. Danielopol** only Ostracoda. **Z. Matic** described new species from some samples of Chilopoda.

Some important lists regarding the biodiversity were published in 1964–1980. A Committee at SAZU, in charge of a federal action (under Consilium Academiarum Scientiarum RPSFJ) was issuing the series ***Catalogus faunae Jugoslaviae***, a list of species with synonyma and rough distribution data (type locality, presence in federal republics of Yugoslavia, including Slovenia). For

V mlajši generacijo zoologov je bil posebej dejaven prezgodaj preminuli **Narcis Mršić**. V katalogu Fauna Europaea lahko najdemo kar 46 sprejetih vrstnih imen za Lumbricidae in 17 za Diplopoda, ki jim je Mršić avtor. Posebej pomembna je monografija o deževnikih Balkana (Mršić 1991). **Franc Potočnik** se je nekaj časa ukvarjal z mokricami. Svoje čase zelo dejaven je bil **Andrej Avčin** kot specialist za Polychaeta, a njegova disertacija ni bila dokončana in objavljena. Zgodaj preminuli **Milan Velikonja** je obdeloval sladkovodne spužve in mahovnjake. **France Velkovrh** je opisal nekaj novih vrst in rodov mehkužcev, pomembna pa je tudi njegova izjemno bogata zbirka, ki je zdaj v Prirodoslovnem muzeju Slovenije. **Marjanca Markič** in **Mihael J. Toman** sta raziskovala kotačnike, **Natalija Budihna** pa razširjenost potočnih rakov (Astacidae). **Janez Brglez** je objavil nekaj obsežnih del z opisi ploskavcev, ki zajedajo v kontinentalnih vretenčarjih, medtem ko je delo **Vesne Paradižnik** o zajedalskih helmintih morskih rib ostalo v rokopisu.

Za 2. kongres jugoslovanskih sistematikov smo pripravili **pregled stanja v poznavanju** jugoslovanske favne (Sket et al. 1991). Ta pregled je nepričakovano pokazal, da favna v Sloveniji ni bila le najbolje raziskana (znotraj Jugoslavije), temveč da je tudi sorazmerno zelo pestra. To bogastvo smo pozneje nekoliko bolj obdelali, primerjali, Mršić (1997) pa je na ta račun dvignil Slovenijo v 'vročo točko Evrope'. Pomemben dosežek je bila izdaja poljudne, a znanstveno korektne, monografije Živalstvo Slovenije (ur. B. Sket, M. Gogala, V. Kuštor 2003); poleg poglavij o vseh skupinah mnogoceličarjev so tudi poglavja o biotski pestrosti in njenem ohranjanju, o zgodovini biodiverzitete (paleontologija), o biogeografiji. Okoli 40 avtorjev je prispevalo specialna poglavja, 14 od njih o nižjih nevretenčarjih; vendar pa nekateri avtorji niso specialisti za obravnavane skupine.

Sedanje stanje

Danes poteka raziskovanje nižjih nevretenčarjev v nekaj bioloških ustanovah. Noben predlog usklajenega raziskovanja biodiverzitete ni naletel na primerno administrativno in finančno podporo državnih agencij. Zbrani podatki o biotlower invertebrates, eight issues (Oligochaeta, Araneae, Pseudoscorpiones, Opiliones, Oribatei, Amphipoda, Isopoda aquat., Diplopoda) have been published till 1980. Janez Matjašič and **Jože Štirn** (1975) published a list of species from the Slovene part of the Adriatic Sea, but rich in faunistic data is also the contribution of a group of researchers Avčin et al. (1973). Around 1990 were issued **Red lists** (ed. **Jana Vidic** 1992) of endangered plant and animal species, which present for some groups complete lists of Slovenian fauna. The Biological society of Slovenia and the University Biological Institute issued **Identification keys** for Yugoslav fauna (edit B. Sket), but only mollusks and a key for higher taxa represented the lower invertebrates (Bole 1969; Sket 1968). Particularly precious was a manual for identification of most common marine species, **Fauna und Flora der Adria** (edited by **R. Riedl** 1963), applicable also in the Slovene part of that sea.

In the younger generation of zoologists, the early deceased **Narcis Mršić** was particularly active. In Fauna Europaea one can find 46 accepted species names of lumbricids and 17 of diplopods with Mršić as the author. Particularly important is his great monograph on Lumbricidae of the Balkans (Mršić 1991). **Franc Potočnik** was for a shorter period working on Isopoda Oniscida of Slovenia. For a time very active was **Andrej Avčin** as a specialist on Polychaeta; unfortunately, his thesis remained unfinished and unpublished. The early deceased **Milan Velikonja** studied freshwater sponges Spongillidae and Bryozoa. **France Velkovrh** described new species and genera and established an extraordinarily rich collection of Mollusca; the collection is now in the Natural History Museum. **Marjanca Markič** and **Mihael J. Toman** studied Rotatoria, **Natalija Budihna** the distribution of Astacidae.

Janez Brglez published a number of extensive papers with descriptions of plathelminths, parasitic in vertebrates of continental Slovenia, while a contribution of **Vesna Paradižnik** about parasites (Plathelmintha, Nematoda) of marine fishes remained in manuscript.

For the 2nd Congress of Yugoslav systematicians, a review of the **state of the knowledge** of Yugoslav fauna (lower invertebrates) was performed (Sket et al. 1991). This review has unexpectedly shown that the Slovenian fauna

ski pestrosti so večidel le stranski proizvod širše zastavljenih raziskav. Te pa financira ARRS skozi 'projekte' in 'programe'.

Na Biološkem inštitutu Jovana Hadžija ZRC SAZU **Rajko Slapnik** nadaljuje malakološke raziskave, ki jih je začel J. Bole; objavlja predvsem o polžih iz jam. **Matjaž Kuntner** je specialist za pajke.

Na Nacionalnem inštitutu za biologijo je **Anton Brancelj** specialist za Copepoda in Cladocera. Opisal je številne podzemeljske nove vrste, presenetljivo tudi dve troglobiotski vodni bolhi. Posebej se zanima za favno preniklih voda v jamah. Na inštitutski Morski biološki postaji v Piranu raziskuje **Alenka Malej** plankton, **Borut Vrišer** pa intersticialne ceponožce.

Na Kmetijskem inštitutu Slovenije, Ljubljana, **Gregor Urek** in **Saša Širca** raziskujeta na rastline vezane nematode. Te raziskave je vzpodbudil **Aleksander Hržič**, ki je leta 1963 začel z zdravstveno kontrolo tal na navzočnost krompirjevih nematodov.

Center za kartografijo favne in flore, ki ga vodi **Mladen Kotarac,** je zasebni zavod, ustanovljen leta 1996, in zdaj zaposluje 15 biologov. Glavni namen zavoda je zbiranje, organiziranje in posredovanje podatkov o razširjenosti rastlinskih in živalskih vrst v Sloveniji. Predvsem pripravlja gradivo za namen naravovarstva.

V prirodoslovnem muzeju raziskuje **Tomi Trilar** klope. Ta ustanova tudi hrani zbirke raziskovalcev, ki niso več aktivni.

Na Oddelku za biologijo Fakultete za naravoslovje in matematiko Univerze v Mariboru **Tone Novak** taksonomsko, favnistično in ekološko raziskuje suhe južine.

Na Oddelku za biologijo Biotehniške fakultete Univerze v Ljubljani se ukvarja s taksonomskimi, favnističnimi in biogeografskimi študijami predvsem Raziskovalna skupina za speleobiologijo in zoologijo. Posveča se zlasti podzemeljskim živalim in dinarskem območju, a se niti na eno niti na drugo ne omejuje. Raziskujejo predvsem Hirudinea (**Peter Trontelj** in **Boris Sket**), sladkovodne Isopoda (**Simona Prevorčnik, Rudi Verovnik** in B. Sket), Amphipoda (**Cene Fišer**, P. Trontelj in B. Sket), Decapoda (Astacidae in Atyidae; **Yoichi Machino** kot gost, P. Trontelj, B. Sket, **Valerija Zakšek** kot mlada raziskovalka). Posebej pomembna je dejavnost molekulsko

was not only the most studied within Yugoslavia, but probably also comparatively very rich. This richness was later further elaborated, compared, and raised as a 'hot spot of Europe' in a popular booklet (Mršić 1997). An important achievement is the publication of a popular, but nevertheless scientifically correct monograph Živalstvo Slovenije (Fauna of Slovenia; B. Sket, M. Gogala, V. Kuštor edit. 2003); beside chapters on all metazoan groups, there are also chapters about the biodiversity and protection of it, history of biodiversity (paleontology), biogeography. Approximately 40 authors contributed special chapters, 14 of them on lower invertebrates only (but many groups could only be authored by non-specialists).

The actual situation

Nowadays, all research work on biodiversity of lower invertebrates is carried out in a number of biological institutions. None of the proposed programs on correlated faunistic investigations obtained an adequate administrative and/or financial support from the state authorities. The gathered biodiversity data are mainly just a byproduct of more widely conceived investigations. They are financially supported through 'programs' and 'projects' at the ARRS (Agency for Research of RS).

At the Biološki inštitut Jovana Hadžija, ZRC SAZU, **Rajko Slapnik** is continuing malacological investigations initiated by J. Bole; he published mainly on gastropods from caves. **Matjaž Kuntner** is a specialist for spiders.

In the Nacionalni Inštitut za biologijo, Ljubljana (National Institute of Biology), **Anton Brancelj** is a specialist for Copepoda and Cladocera. He described many new subterranean species, surprisingly also two troglobiotic cladocerans. He is particularly interested in the fauna of percolating waters in caves. At the institute's Marine Biology Station in Piran, **Alenka Malej** is studying plankton, and **Borut Vrišer** interstitial copepods.

At Kmetijski inštitut Slovenije, Ljubljana (Agricultural institute of Slovenia), **Gregor Urek** and **Saša Širca** study plant related Nematoda. These studies were initiated by **Aleksander Hržič** for the Potato Cyst nematode.

filogenetskega laboratorija, ki ga vodi P. Trontelj in je začel delovati 1998. Pobuda za ta laboratorij izhaja iz težav s taksonomijo pijavk, vendar pa je omogočil filogenetiko nevretenčarjev, razmejitve nekaterih taksonov in odkrivanje 'kriptičnih' vrst. Več diplomskih del je bilo izpeljanih v tem laboratoriju. Drug pomemben projekt skupine je katalog podzemeljske favne 'širšega dinarskega območja' ali 'zahodnega Balkana s soseščino' (dejansko vsega območja nekdanje Jugoslavije) in večstranska analiza biodiverzitete v tem območju (**Maja Zagmajster** in B. Sket, z **D. Culver**jem kot gostom). Predvsem favnistično in ekološko obravnavajo strige (**Ivan Kos**), pajke (**Rok Kostanjšek**, Cene Fišer), kotačnike (**Mihael J. Toman**) in gole polže (**Marjan Vaupotič** kot gost).

Leta 1999 je začela izhajati **Natura Sloveniae – Revija za terensko biologijo** (editor R. Kostanjšek), namenjena tudi hitremu publiciranju favnističnih podatkov; je tudi prosto dostopna na spletu (http://web.bf.uni-lj.si/bi/NATURA-SLOVENIAE/index.php).

Vloga speleobiologov in amaterjev

Speleobiologija

Ena od posebnosti slovenske zoologije je pomembnost vloge, ki jo v njej igra speleobiologija. Prvič, speleobiologija se je rodila na tem območju; drugič, raziskovanje slovenske favne je v veliki meri stimulirala zanimiva in zelo bogata podzemeljska favna; tretjič, slovenski speleobiologi so bili dokaj zaslužni za tukajšnjo zoologijo, kot tudi za jamarsko dejavnost.

(1) **Janez Bajkort** (Johann Weichert) **Valvasor** (1689) je bil prvi evropski pisec, ki je omenil (čeprav ne tudi prepoznal) kako jamsko žival. Proteja so kmalu nato tudi taksonomsko poimenovali (Laurenti 1768), pozneje pa so ga opisovali tudi nekateri avtorji iz Slovenije. V Sloveniji je bil najden tudi prvi troglobiotski nevretenčar, hrošč *Leptodirus hochenwartii*, zaradi katerega je njegov avtor, F. Schmidt, začel z iskanjem dodatnih osebkov in tudi drugih vrst v jamah. To imamo lahko za začetek novega raziskovalnega področja – speleobiologije (ali biospeleologije). Danski entomolog **J. M. C. Schiödte** je napisal prvo kratko monografijo (1849, 1851) o svojem

Center za kartografijo favne in flore (Center for Cartography of Fauna and Flora) headed by **Mladen Kotarac** is a private non-profit institute founded in 1996 and employing now 15 biologists. The main aim of the Center is to collect, classify, process and disseminate the data and information about the occurrence of plant and animal species in Slovenia. This institute mainly prepares data for the purpose of nature conservation.

At the Prirodoslovni muzej Slovenije, **Tomi Trilar** is investigating Ixodidea. This institution also keeps collections of researchers that are not any more active.

At the Oddelek za biologijo, Fakulteta za naravoslovje in matematiko, Univerza v Mariboru (Department of Biology, Faculty of Natural Sciences and Mathematics), **Tone Novak** studies taxonomy and fauna (and biology) of Opiliones.

At the Oddelek za biologijo, Biotehniška fakulteta, Univerza v Ljubljani (Biology Department, Biotechnical Faculty), mainly its Research Group for Zoology and Speleobiology is studying taxonomy, faunistics, and biogeography, with emphasis on subterranean and Dinaric biota, but not limited to either of them. Their main groups are Hirudinea (**Peter Trontelj** and **Boris Sket**), aquatic Isopoda (**Simona Prevorčnik, Rudi Verovnik** and B. Sket), Amphipoda (**Cene Fišer**, P. Trontelj and B. Sket), Decapoda (Astacidae and Atyidae; **Yoichi Machino** as guest, P. Trontelj, B. Sket, **Valerija Zakšek** as Ph.D. candidate). Particularly important is the activity of the molecular phylogenetic laboratory, headed by P. Trontelj and founded in 1998. The foundation of this laboratory was triggered by difficulties in the taxonomy of Hirudinea, but it allowed also studies in invertebrate phylogeny, delimitations of some taxa and discovery of a number of cryptic species. A number of graduation theses have been performed in this laboratory. Another important project of this group is the subterranean fauna catalogue for the entire 'broader Dinaric area' or 'Western Balkans with neighborhood' (in fact, all states of the former Yugoslavia) and many-sided analysis of the subterranean biodiversity in this region (**Maja Zagmajster** and B. Sket, with **D. Culver** as guest). Mainly faunistically (and ecologically) studied are also Chilopoda (**Ivan Kos**), spiders (**Rok Kostanjšek**, Cene Fišer),

raziskovanju okoli Postojne. Tudi ena od prvih obsežnih monografij o jamskem živalstvu, avtor je bil **O. Hamann** (1896), je bila napisana s posebnim ozirom na kranjsko jamsko favno. Končno, prvi poskusi ekološko-evolucijske klasifikacije jamskih živali po Schiödteju in po Schinerju (Schiner 1854; Sket 2008), slonijo na izkušnjah iz jam okoli Postojne. Sorazmerno zgodaj, v petdesetih letih prejšnjega stoletja, se je speleobiološko raziskovanje v Sloveniji razširilo tudi na intersticialne vode.

(2) Največ raziskovalcev nevretenčarske favne med obema vojnama je bodisi prišlo zbirat jamsko favno ali pa obdelovat gradivo, ki so ga zbrali slovenski jamarji in biologi v jamah. K sreči je to gradivo vsebovalo tudi vzorce s površja, bodisi okoli jam ali pa iz izvirov. Nekatere slovenske raziskovalce sedanje generacije je najprej zamikala jamska favna in so šele pozneje razširili svoje zanimanje na površinske pripadnike zadevnih skupin. In končno, raziskovalna skupina, ki je pri raziskovanju živalske pestrosti danes najbolj dejavna, ima podzemeljsko favno za glavni objekt, a raziskuje tudi površinske vrste, da bi lahko razumeli filogenezo in biogeografijo.

(3) Prvo slovensko jamarsko društvo, Antron, je bilo ustanovljeno 1889 v Postojni, drugo Društvo za raziskovanje podzemeljskih jam, z resnimi raziskovalnimi ambicijami, pa 1910 v Ljubljani. Da so Društvo po prvi svetovni vojni ponovno vzbudili, je zaslužnih nekaj dejavnih biologov. J. Hadži, R. Kenk, L. Kuščer, A. Seliškar so bili polovica 'marljivih članov' (kot jih omenja P. Kunaver 1957). Biologi so organizirali morda najpomembnejšo akcijo Društva za raziskovanje jam – odpravo na Popovo polje, ki je bilo tedaj še dokaj eksotično območje. Raziskovanje jamske favne je ostalo ena od pomembnejših dejavnosti tega društva. Kot poročajo, je bil prof. Hadži tisti, ki je uspel skriti in rešiti jamski arhiv pred okupatorjem v času druge svetovne vojne. Po vojni so bili spet tudi biologi vseskozi dejavni člani Društva in eden izmed njih je bil pozneje tudi predsednik Jamarske zveze Slovenije, ki se je ob društvu razvila. Tudi danes so nekateri biologi jamarji, dejavni tudi organizacijsko. In isti kolegi spodbujajo delo v zoologiji. Končno, molekulsko filogenetske raziskave, čeprav so začele zaradi pijavk, večidel napredujejo zaradi zanimanja speleobiologov.

Rotatoria (**Mihael J. Toman**) and slugs (**Marjan Vaupotič** as guest).

In 1999 started the new **Natura Sloveniae – Journal of field biology** (editor R. Kostanjšek), dedicated also to a quick publication of faunistic data; it is freely accessible on the net (http://web.bf.uni-lj.si/bi/NATURA-SLOVENIAE/index.php).

The role of speleobiologists and amateurs

Speleobiology

One of the striking peculiarities of the Slovenian zoology is the important role speleobiology (biospeleology) plays in it. First, speleobiology was born in this country; second, the research of Slovenian fauna was in great part stimulated by the interesting and particularly rich subterranean fauna; third, Slovenian speleobiologists were quite meritorious for the local zoology, as well as for the local caving activity.

(1) **Janez Bajkort** (Johann Weichert) **Valvasor** (1689) was the first European author mentioning (although not recognizing!) a cave animal. *Proteus* was soon thereafter taxonomically named (Laurenti 1768) and later described also by some authors from Slovenia. In Slovenia was found also the first troglobiotic invertebrate, *Leptodirus hochenwartii*, which motivated its author, F. Schmidt to start a campaign for finding additional specimens of this and new species in caves. This can be regarded the beginning of the new research field – speleobiology (or biospeleology). The Danish entomologist **J. M. C. Schiödte** (1849, 1851) wrote his first short speleobiological monograph on his research around Postojna. One of the first extensive monographs on the cave fauna, by **O. Hamann** (1896) was issued 'with particular respect to the Carniolian cave fauna'. Finally, first attempts of ecological-evolutionary classification of cave inhabitants, by Schiödte and by Schiner (Sket 2008), based on experiences from the caves around Postojna. Comparatively early, in 1950s, the speleobiology research in Slovenia was expanded also to interstitial waters.

Pomen ljubiteljstva

Vse od začetka so bili neprofesionalni raziskovalci pomembni za poznavanje slovenske biotske pestrosti. Pravzaprav je sploh težko razlikovati profesijo od amaterske dejavnosti v času, ko so naravoslovje (zlasti pa botaniko) poučevali v sklopu medicine in biologije kot znanstvene panoge sploh ni bilo.Vendar pa so bile v začetku 19. stoletja pomembne osebnosti iz zgornjega pregleda čisti amaterji: Ž. Zois je imel klasično izobrazbo, F. Schmidt je bil trgovec, S. Robič duhovnik in H. Freyer je študiral farmacijo. Podobno tudi drugi: malakolog Heinrich Hauffen je bil trgovski pomočnik, Josip Stussiner poštni uslužbenec. To se je nadaljevalo do današnjih dni, vendar pa so ravno raziskave nižjih nevretenčarjev (vključno s sodobno malakologijo) izrazito neprimerne za ljubiteljsko dejavnost, zato se ljubitelji ukvarjajo predvsem z entomologijo. Vendar je **Egon Pretner**, spet trgovec po poklicu, svoja zrela leta posvetil raziskovanju jam. Postal je svetovno znan specialist za nekatere skupine hroščev in daleč najboljši poznavalec jam v bivši Jugoslaviji. Kar je nadvse pomembno, poleg hroščev je zbiral še vse druge živali, celo vodne. Mnoge jamske nevretenčarje so opisali po Pretnerjevih vzorcih. Zelo zaslužna za poznavanje slovenske favne so in bodo tudi v prihodnosti društva, v katerih so tudi amaterji. Vendar se ta društva menda brez izjeme posvečajo žuželkam in vretenčarjem.

(2) Most researchers of invertebrate fauna between the wars were either coming to collect subterranean fauna or studying materials collected by Slovenian cavers and biologists in caves. Fortunately, these materials contained also samples from the surface, either around caves or in springs. Some Slovenian researchers of the recent generation were first intrigued by the cave fauna and only secondarily they widened their research to surface members of the groups of interest. Finally, the research group which is the most active in the animal biodiversity research nowadays, has subterranean fauna as its central topic, but again, it includes the surface relatives to understand the cavernicoles' phylogeny and biogeography.

(3) The first Slovene caving club, Antron, was founded 1889 in Postojna, the second, Društvo za raziskovanje podzemeljskih jam, with serious research ambitions, in 1910 in Ljubljana. To reactivate this society after the World War I, some active biologists were necessary. J. Hadži, R. Kenk, L. Kuščer, A. Seliškar are 50% of 'diligent members' (mentioned by P. Kunaver 1957). Biologists also organized probably the most important action of the Društvo za raziskovanje jam (Society for cave research) – an expedition to Popovo polje, the then still an exotic area. Cave fauna research remained one of important activities of this society. During the World War II, it was reportedly prof. Hadži, who succeeded to hide and rescue the rich society's cave archive from the occupier's forces. After the War, biologists have throughout been active members of the Society and one of them was also the president of the later developed Speleological Union of Slovenia. Recently again, some biologists are cavers, active also in organization. And the same colleagues are intriguing the research work in zoology. Finally, the molecular phylogenetic research, although started for leeches, has been mainly promoted by interests of speleobiologists.

Importance of amateurs

Since the very beginnings, non-professional researchers were important for the knowledge of the Slovenian biodiversity. It is difficult to distinguish profession from amateur activity

in times when natural sciences (and botany in particular) were taught within medicine and biology as a science did not exist at all. But note that at the beginning of the 19th Century, important personalities from the above review were pure amateurs: Ž. Zois enjoyed classical education, F. Schmidt was a merchant, S. Robič was a priest, and Freyer studied mainly the pharmacy. The malacologist Heinrich Hauffen was a shop assistant, Josip Stussiner a postal official. This continued into recent times, but the up-to-day research of lower invertebrates (even modern malacology) is explicitly unsuitable for an amateur activity, therefore it was mostly entomology carried on by amateurs. However, **Egon Pretner**, again a merchant by profession, devoted his ripe years to the cave research. He became a world known specialist for some groups of Coleoptera and by far the best connoisseur of Yugoslav caves. What is particularly important, beside beetles, he collected all other animals, including the aquatic ones. Many cave invertebrates have been described from Pretner's samples. Very meritorious for the knowledge of the Slovenian fauna are and will be in future some societies which include also amateurs, but they are exclusively devoted to vertebrates and insects.

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