projects targeting the protection and restoration of aquatic biodiversity in the Danube Region, to attract all Danube countries and motivate scientists to become pro-active IAD members and promoters, and to further increase IAD visibility at the regional level.

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Six decades of scientific cooperation in the Danube River Basin

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In 2020, the International Association for Danube Research (IAD) looks back to almost 65 years of investigating the second largest river system of Europe. Since 1956, IAD has passed turbulent times. Scientific cooperation across the political divide between 'west' and 'east' is without any doubt among the biggest achievements which was attained until the turn from the 1980s to the 1990s (Bloesch 2019). Using among others previous publications on the history of IAD and the extensive IAD-library hosted at the University of Vienna this article summarizes major research topics and their change over time (e.g. Daubner 1982, Berczik 1995, Bloesch 1999, Bloesch 2009).

Development of Danube research and main scientific achievements of IAD

Efforts to establish an international association for Danube research started much before the Iron Curtain divided the Danube countries. In 1935, the 'Internationale Kommission zur wissenschaftlichen Erforschung der Donau' (International Commission for the Scientific Investigation of the Danube) was founded. The Austrian fishery scientist Adolf Cerny, his famous Romanian colleague Grigori Antipa and the Hungarian Danube researchers Rezsö Maucha and Emil Unger were important promoters (Liepolt 1959, Berczik 1995). Already in 1935, A. Cerny undertook a first river survey by ship to get in touch with other scholars and to exchange on the most needed research activities. Water samples were taken during the travel and analyzed either directly on place or at the 'Hydrobiologische Donaustation' in Vienna. Following contemporaneous European research trends in hydrobiology, monitoring fish migration was identified as a major task. Emil Unger was designated to lead this endeavor envisaged for 1936. A large number of fish specimen should have been marked, and (re-)captures being reported back by fishermen similar to studies of the Upper Danube, the Rhine or the Main (see e.g. Steinmann et al. 1937). Soon after, the deteriorating economic situation and World War II prevented coordinated activities among scientists for many years. But the Danube Commission of 1935 is proof that researchers in the Danube River Basin exchanged and cooperated already before World War II. One might speculate that these efforts have helped to set up and implement a comprehensive joint scientific program shortly after the foundation of IAD in 1956. In many countries, the formation of IAD speeded up long-lasting initiatives. For example, in Hungary, it gave the necessary impetus to establish internationally connected Danube research via the foundation of the 'Danube Research Institute' at the Hungarian Academy of Sciences (Berczik 1995).

Within few years, IAD organized and accomplished a joint survey of the Danube from Vienna to the Black Sea and from the source to Vienna in 1960 and 1961, respectively. Based on a wealth of field observations, IAD published the outstanding edited volume 'Limnologie der Donau' in 1967 (Limnology of the Danube, Liepolt 1967). It covers a wide range of scientific topics, reflects nicely the full scope of limnology and integrates societal aspects. On almost 600 pages it addresses climate, hydrology, palaeography, physics, chemistry, radiology, biotic processes, biology, biological impacts of human interventions as well as human uses. The volume closes with a brief overview on history, culture and the interaction between men and the Danube. As R. Liepolt states in his preface, in the late 1960s IADscientists were concerned with the expected changes of the Danube due to increasing societal imprint by pollution and hydromorphological alteration. At that time large hydropower plants had been completed on the Upper Danube, others were project here and on the Middle and Lower Danube, such as the Iron Gates dams. On the lowest river section, the extensive floodplains were increasingly threatened by plans to modernize and industrialize Romanian agriculture. Most of the projects suggested in the 1950s and 1960s were realized in the following decades. But the scholars contributing to the first IAD Danube survey could still pass, e.g., the island Ada Kaleh which was soon to be drowned in the Iron Gates impoundment, and they found the huge inundation zones at Braila still untouched from large scale drainage systems (figures 1-3). The scientific data collected are thus of tremendous importance because they show river conditions before the major impacts of the second half of the 20th century. With respect to comprehensiveness and scientific detail, Liepolt's 'Limnologie der Donau' remains without a comparable successor publication to date despite important reviews of the ecological conditions of the Danube and its major tributaries had been published in recent years (e.g. reports on the findings of the Joint Danube Surveys or Sommerwerk et al. 2009).

Another vital sign of IAD activities was made possible due to its official recognition as part of the Societas Internationalis Limnologiae (SIL) in 1959. Cooperation with SIL not only offered opportunities for fruitful scientific exchange outside of the Danube river basin. It also paved new ways of promoting research findings. Between 1963 and 1992, IAD issued 'Veröffentlichungen der Arbeitsgemeinschaft Donauforschung' (Publications of the Association for Danube Research) as supplements to 'Archiv für Hydrobiologie', the official journal of SIL. The eight volumes and almost 30 issues address all aspects of limnology research on the Danube. In 1986, a bibliography on the 'Limnologie der Donau und ihrer Nebengewässer' was compiled, impressively showing the scientific output 30 years after the foundation of IAD (Limnology of the Danube and its tributaries; Godeanu & Popescu-Marinescu 1986). A systematic analysis of all these publications and its contents is still lacking.

In 1988, an initiative for a second Danube survey in the section between Vienna and Vilkovo was taken. The results were presented in 'Ergebnisse der Internationalen Donauexpedition 1988' (Results of the International Danube Expedition 1988, IAD 1990), again a comprehensive œuvre of 350 pages covering a wide array of topics though less complete in thematic scope than 'Limnologie der Donau'. The publication attracted less attention of the scientific community as only few copies were published by IAD itself. Three further monographs released between 1993 and 1998 dealt with water quality (Weber 1993, Schmid 1994) as well as with planktonic and benthic communities of the Danube (Kusel-Fetzmann et al. 1998).

When the Danube River Protection Convention, signed by eleven Danube states and the European Commission in 1994, came into force in 1998, the International Commission for the Protection of the Danube River (ICPDR) got active in monitoring and standardized scientific sampling of the river. Due to the long lasting international cooperation and the experiences in joint field surveys, it is not surprising that IAD became an official observer in ICPDR from its very beginning. Until today, IAD offers scientific support to the different ICPDR-expert groups. Efforts concentrated e.g. on the Danube Sturgeons and resulted in a Sturgeon Action Plan to which IAD members contributed substantially (Bloesch et al. 2005). ICPDR not only benefits from scientific knowledge of IAD but also from the long involvement in both theoretical and applied research and exchange with stakeholders. Since the early 2000s, four Joint Danube Surveys were organized by ICPDR and supported by IAD (see Schwarz 2019).

Expert groups, scientific programs and conference resolutions

In the six decades of its existence, IAD has developed as an association of scholars and river managers (Bloesch 2019). Also the scientific programs and objectives evolved, on the one hand in line with scientific progress in limnology and hydrobiology but also as a response to changing environmental problems of the Danube. The development of the scientific targets is reflected in the evolution of expert groups, in the topics of the regular conferences (Tittizer & Cyffka 2019) but also in the decadal scientific programs formulated by IAD members between 1956 and 2006 or in the resolutions adopted for many years as outcomes of IAD conferences.

In the first decade from 1956–1966, the activities of IAD were dedicated to establishing and agreeing cooperation. In particular, the organizational and administrative details for the first joint Danube survey were set. The resolution issued after the IAD conference of October 1966 in Varna, Bulgaria, made a plea to use the research findings of the association as basis for water management as well as for international cooperation. As the adverse effects of economic growth and increasing industrial activities on



Figure 1: Remains of Ada Kaleh – an island close to Orșova. After 1968, the population was resettled as the island was to be drowned in the Iron Gates impoundments (Eberhard Nabel, cc-license)



Figure 2: One of the Iron Gates dams soon after completion as a theme of a postal card (© Al. Comănescu)

the Danube had become clearly visible, the 108 participants of the event strongly recommended to governments and administration to take any possible endeavour to limit pollution for the sake of sufficient water supply, irrigation and fisheries. IAD offered support in water management issue to be dealt with by river managers.

In the following period (1967–1976) coordinating research and in particular standardizing field sampling methods were a focus. River pollution remained a major and unifying subject, acknowledging the tight connection between upstream and downstream sections. IAD intensified its engagement in (national) river management. Joint norms for the physical and chemical conditions of the Danube water and for sewage waters to be released into rivers were envisaged. In 1967 - the year when 'Limnologie der Donau' had been published - the resolution formulated during the IAD-conference in Kiev stressed the importance of an integrated approach of river investigation, including at least the larger tributaries. Again, the negative effects of industrial and domestic pollution, the presence of pathogens and parasites, as well as toxic substances, all of which potentially harmful for humans were emphasized. Hydropower figured prominently in the conference presentations as well as in the resolution one year later. The IAD-members joining the event claimed explicitly that large scale engineering measures should not be planned and implemented without preceding scientific investigation to estimate the ecological effects.

From 1977 to 1986, assessing ecological conditions and anthropogenic impacts became more significant. Restoring the ecological functioning of the Danube started to guide research and scientific cooperation. Still, the IAD resolutions acknowledged the importance of the Danube for humans. Keeping an ecologically but also societally functioning river was a major target, as addressed explicitly for example in the resolution adopted in 1974 as a result of the 17th IAD-conference in Galați, Romania. From the late 1980s onwards – in the decade from 1987–1996 – the impact of harmful substances figured again prominently in the decadal program. Efforts strived for regular monitoring and the establishment of early warning systems. IAD-scientists referred increasingly to impacts of water engineering projects on the ecosystem and ecological integrity. The last decadal program (1997–2006) aimed at contributing to integrative river basin management and river protection, conservation and restoration but also at promoting sustainable river uses. Major research activities accomplished by IAD expert groups between the 1990s and 2006 are summarized in Danube News 13/14.

Although no scientific programme was issued after 2006, integrated management and sustainability remained major targets for IAD. It actively supports the implementation of the macro-regional EU-Strategy for the Danube Region as a step towards sustainable development. New expert groups have been established focusing on floodplain ecology, invasive species, sustainable development and public participation or Long-Term Socio-Ecological Research and environmental history. Training of students and young researchers plays an important role to attract new scholars but also to help reducing the brain drain in some countries of the Middle and Lower Danube.

IAD expert groups – an example of joint macrophyte surveys since 35 years

The expert groups are at the centre of scientific research of IAD. The first expert groups focused on chemistry & physics, radiology, (eco-)toxicology, microbiology & hygienics as well as on different biological groups (fish, zoo-& phytoplankton, zoo- & phytobenthos), biotic processes and saprobiology; another expert group still active deals with the delta/fore-delta. As stated above, some of the currently 12 expert groups are relatively new; but many can look back to long-lasting cooperation and research within the whole Danube River Basin. Representative for transnational



Figure 3a and b: Vast stands of reed along the Sulina canal (left) and fishermen in the Sulina canal (right), about 1960 (© IAD)

scientific collaboration, the development of the macrophyte expert group will be briefly summarized below.

Triggered by a novel methodology for assessing aquatic plant growth in running waters, published by Kohler et al. in 1971, the program of the IAD Conference in Bratislava (1973) included an excursion to a small channel full with 'aquatic macrophytes' (Trachaeophytes and some filamentous algae). Several IAD members instantly got interested in this methodology and a first 'survey' was carried out. Representatives of almost all Danube Basin Countries had been present, and the application of the new method was met with approval by all participants. At the IAD-Board Meeting in Szentendre in 1984 the Expert Group Macrophytes (EGM) was established, followed by its first meeting in 1985 during the IAD-Conference in Bratislava. In the period 1998–1999 work for a Pilot Study was started by the partner teams, focused on assuring a harmonised method for field survey and the description of results (published in 2003). This was proof of concept regarding the ability of the partner teams to carry out a survey along the River Danube, covering each individual river-kilometre from source to mouth, including the two source streams. This project was funded by the then named Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (Vienna), and by the Austrian Committee of IAD. In 2018, the results of this trans-national project were published by ACADEMIA - Publishing House of the Academy of Sciences, Prague (Janauer et al. 2018).

To this day the EGM is still active, i.a. providing the methodological background – and some new collaborators – for the macrophyte assessment during the Joint Danube Surveys (JDS 1 to 3), supervised by ICPDR, and a fourth survey recently carried out in 2019 (Schwarz 2019). All JDS campaigns provide basic results for the continuing implementation of the Water Framework Directive and the success in reaching 'good ecological status' in European running waters and lakes, especially in the Danube River Basin.

At the 2019 EGM-Meeting in the village of Susa, near the Kopacki Rit natural reserve, new topics were already offered: (i) river-bed incision and the future of oxbow systems; (ii) 'excavating' so far unpublished data from the Danube Macrophyte Project; (iii) comparison of the macrophyte flora and diversity in Danube river branches like the Mosoni Duna (HU) and the Maly Dunaj (SK); (iv) interpreting 'Terrestrialisation' processes in floodplain water bodies, and several other ideas regarding the future development of aquatic landscapes. EGM will be busy in the future still, to have a close look on problems related to the aquatic vegetation, like invasive aquatic plant species. Even if some topics may look simple, all results will add to achieving a better future for aquatic environments.

History as a foundation for the future

IAD's history brings to light the close link between the development of the association on the one hand and poli-

tical as well as socio-economic circumstances on the other hand. The major scientific topics reflect the pressing environmental problems of the Danube River and their changes over the last six decades. Scholars of IAD investigated the Danube in a period of enormous economic growth, unprecedented use of environmental resources and ever increasing impacts to river ecosystems. As the perspectives for the future provided in this issue of Danube News demonstrate, IAD is prepared to face the present and forthcoming challenges of the Danube River. A sound and comprehensive appraisal of the long-lasting cooperation of scholars in the river basin and in particular of the wealth of ecological data collected and published in six decades can form an extremely valuable basis to reconstruct the main ecological alterations in the Danube since the foundation of IAD in 1956.

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