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Nature and culture in the botanical garden of Palermo, Sicily
The 60th IAVS Annual Symposium 2017 in Palermo, Italy, is approaching fast and its preparation is underway. The annual meetings are always top events of the IAVS, places where people meet each other, present their scientific results, discuss many topics and initiate future collaborations. During the history of IAVS, the meetings were organized throughout the world (see the map next page). During the last 10 years we alternated between European and non-European venues. In 2017, the meeting venue in the heart of the Mediterranean region will give the participants the opportunity to see precious Mediterranean ecosystems developed in long co-evolutionary processes with an active human society. The topic “Vegetation patterns in cultural and natural landscapes” expresses the genuine basis of vegetation science and its application in the modern, fast-changing world. This might be a reason why this year’s Symposium attracted many IAVS members to register. By now, 417 participants have registered coming from 57 countries (see the table next page for comparison with the last ten IAVS symposia). In total, the abstracts of 323 presentations were submitted, 168 of them will be presented as oral contributions. Moreover, the attendees will have a chance to listen to longer plenary lectures given by invited scientists that all have a closer relation to the main topic of the symposium. This year, the plenary speakers will be as follows: Jiquan Chen (Vegetation in Anthropocene: A postcard from Mongolian Plateau), Nigel P. Dunnett (Space for urban wildlife: designing green roofs as habitats), Ladislav Mucina (How to be a biome), David P. Ward (The hidden invasive species: the multiple roles of native invasive plants), and Nicklaus Zimmermann (Alternative forest management strategies to account for climate change-induced productivity and species suitability changes in Europe). Furthermore, a tribute will be given to F. Stuart Chapin (recipient of the von Humboldt award) and Sandro Pignatti (past president of the IAVS), and F. S. Chapin will also present a honorary lecture (Biogeography of social-ecological systems as a basis for predicting future change).

The Global Sponsorship Committee received 94 applications for financial support from 38 countries, mostly from Brazil (22), Portugal and Russia (5 each), and Italy and Estonia (4 each). The evaluation process was not easy as the quality of applications was generally high, and only a limited number of applicants could be supported. Each application (including the abstract, a motivation letter and a CV) was evaluated by at least three (out of five) committee members, based on several criteria such as the quality of the abstract and motivation letter, position of the applicant, country of origin and whether the applicant had received an IAVS award before (applicants from countries with high income or who had received the grant before had their grant adjusted by 70%). Finally, 29 awards (summing up to 19,530 Euros) were offered to applicants from 14 countries, mostly from Brazil (6), Estonia (4), China and Portugal (3 each), but also Indonesia and Iran.

We are looking forward to meeting you in Palermo in June!

Pleasant journey and see you soon,

Martin Diekmann, President of the IAVS
Riccardo Guarino, Organizer of the 60th IAVS Symposium
Alessandra Fidelis, Chair of Global Sponsorship Committee
Monika Janišová, Editor of the IAVS Bulletin
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Geographic distribution of past (*) and future (**) IAVS annual meetings
I’m very honoured to introduce Bob Peet as the 2016 recipient of the IAVS Honorary Membership award. Honorary Membership is the highest award the IAVS can bestow and recognizes sustained contributions of extraordinary merit to the Association or to the field of Vegetation Science. Bob is a worthy recipient on both counts. Today, I will highlight some of his achievements, although I’m unlikely to do them justice.

Bob was born and raised in Wisconsin and received his Bachelor of Arts and Masters degrees at the University of Wisconsin in 1970 and 1971 respectively. He then moved east to Cornell University in upstate New York, where he completed his PhD in 1975 under Robert Whittaker. His first appointment required a move south to the University of North Carolina at Chapel Hill. This must have suited him as he remains there to this day.

Contributions to Vegetation Science

Bob has spent his career focussing on issues at the fundamental core of our discipline. His contributions are exemplars in combining the clear, conceptually-based thinking required to define meaningful ecological questions with robustly designed studies underpinned with real, hard-won, meticulously-collected data. Early in his career, he was highly influential in our thinking of how to best quantify species diversity. He has gone on to encourage us to consider the wide range of drivers of species diversity at different scales, the generality of these mechanisms, what leads to vegetation being hyperdiverse and how diversity can influence other ecological properties and processes, such as invasion.

In the 1970s and 80s, Bob played a significant role in the reformulation of successional theory through adoption of mechanistic approaches. Specifically, he provided a framework to explore whether community structure and ecosystem function outcomes of succession could be predicted from population processes, themselves predictable from species attributes such as life history and physiology and interactions with the environment. This was important to allow us to move ‘beyond species’ in our understanding of succession and discover more general principles.

Another important theme in Bob’s work has been the significance of spatial grain and extent and how these influence ecological pattern and process. He recognised the need for vegetation plot methods that would allow us to tease apart the importance of different processes at different spatial and temporal scales and the flexible methods that he and collaborators devised are now widely applied. Bob and his students and collaborators have increased understanding of the importance of spatial scale in understanding a multitude of patterns and processes – examples include elucidating relationships between composition and the environment, species diversity and invasion, and the consistency of fine-scale species areas relationships.

Bob has also made major contributions to the application of vegetation science. He was...
acutely aware of the risks of not having robust, defensible classifications of vegetation to underpin environmental and conservation planning in North America. This led him to propose and organise (with collaborators) the Ecological Society of America’s Vegetation Panel. This Panel provides professional oversight of vegetation classifications used by a raft of agencies, organisations and academic institutions.

Bob has been at the forefront of the development of the discipline of ecological informatics, being one of the lead instigators of the North American VegBank project and of the Botanical Information and Ecology Network (BIEN) which for the first time pulled together an integrated dataset of all available digital plant occurrence and co-occurrence records in the New World. He collaborated in the development of data exchange standards for vegetation plot data, the development of the Global Index of Vegetation Plot Databases and the global sPlot initiative. Among ecologists, Bob was the first person to highlight how changing taxon concepts hinder our ability to meaningfully integrate vegetation plot data across large spatial and temporal scales and to implement an approach to overcome this barrier. Perhaps closest to Bob’s heart is the Carolina Vegetation Survey which he established over 25 years ago and continues to coordinate.

Services to IAVS and Other Societies

Bob attended his first IAVS meeting (Working Group for Data Processing) in 1979 in the Netherlands. He was very impressed with how IAVS was so international, so forward looking and so collaborative. This quickly made it his favourite professional organisation and is the reason he has worked so hard in service to IAVS. His first contribution was to serve on the editorial board of Vegetatio, the then journal of IAVS, from 1981 to 1989.

In 1983, David Glenn-Lewin and Bob established the North American Section to increase the profile of IAVS. This section often works with the Vegetation Section of the Ecological Society of America (also established by Bob in the same year) and jointly they have sponsored field trips, symposia, student awards and workshops in vegetation science at the annual ESA meetings and have promoted the development of a US National Vegetation Classification.

In 1989, Eddy van der Maarel, Bob and Robert Neuhäusl moved most of the Vegetatio Editorial Board to the new Journal of Vegetation Science (JVS) which they started in 1990. JVS became the official organ of IAVS and gave IAVS more control over the price and an ability to provide free subscriptions to those in developing countries. Clearly JVS has been a major success. Bob served as one of the initial three Chief Editors until 1995 and he continues to serve as a Consulting Editor for both JVS and AVS.

In 1995 Bob and Paul Harcombe organized the annual IAVS symposium in Houston and the associated field excursion from Texas to North Carolina.

In 2003 Bob established the Ecoinformatics working group and served as its chair until 2012.

In 2007, Bob was elected President of IAVS and served until 2011. Bob led the effort to reorganise and revitalise our society, resulting in a profound transformation. Two major advances included:

- Arranging that IAVS journals were published by Wiley Blackwell. This provided access to the latest technology for electronic distribution and a stable company, broader circulation and significantly greater income. This income has allowed IAVS to support a much wider range of activities for its current members and to attract new ones.

- Changing the Statutes and Bylaws as well as creating standing committees that have made IAVS more participatory and efficient.

From 2011-2015, Bob served as vice-president and publication officer. He continues to freely give his help to the Governing Board; his memory of details of a number of matters is often better than ours. He has served on IAVS’s Special Committee on Business Management, the Awards Committee, the Publications Committee, and the Organising Committee of numerous annual symposia.
Bob has also provided service to other organisations. His extensive service to the Ecological Society of America led to him being awarded a Distinguished Service Citation in 1995. He has also served as a director or advisor for numerous other societies.

The Plant Ecology lab at UNC

Bob has supervised at least 9 Postdocs, 29 Ph.D. students, 21 Masters students and 8 undergraduate honours students. Bob has always led his students by example (emails at all hours of the evening) and worked behind the scenes to support their projects. He led many memorable field trips, often in association with his course Progress in Ecology, abbreviated to P.I.E. This course involved learning about the vegetation of some distant place while eating fruit pies, all prepared during parties at Bob’s house. Come Spring Break, everyone would hop in a van and drive to that distant place to explore the vegetation.

29 years ago, Bob and his collaborators on the Carolina Vegetation Survey instigated the yearly ‘PULSE’ events where the core scientists and volunteer botanists from across the region intensively study a portion of North Carolina for a 10-day period. Sometimes referred to as a “Bootcamp for botanists” or “Botanical Woodstock”, these events have not only produced a wealth of data from often poorly understood vegetation types, but also provide a great opportunity to interact with others deeply interested in vegetation. With these trips he demonstrated, especially to his students, the value of being in the field.

When I agreed to introduce Bob as the recipient of this award, I contacted Peter White, one of his very close colleagues at UNC for input. What Peter wrote communicated the essence of Bob to me so well, that I’m simply going to read it.

“There are really two Bobs: Bob-1 is the guy with the lab loaded with field equipment, the row after row of filing cabinets filled with plot data, and the room full of computers that makes his lab a hub of vegetation science. This is a serious Bob and one who thinks deeply and insightfully about vegetation ecology, sharing that with students. And then there is Bob-2. Bob-2 is about 20 years younger than Bob-1. He’s the excited (almost bubbly) guy in the field, leading field trips, always cooking up a reason to go touring through the vegetation of the Southeast, whether for credit as part of courses or during various academic holidays or based on the visits from vegetation ecologists from afar. Both Bobs are extremely generous of time, expertise, and data, raising the boats of all grad students who enter the program. He founded and is the heart and soul of the UNC Plant Ecology Laboratory.”

I appreciate the input of Martin Diekmann, Peter White, Laco Mucina, Jason Fridley, Michael Lee, Rob Allen

Susan Wiser
IAVS Secretary
The Carolina Vegetation Survey works late into the night processing plants (above). Robert Peet on the Brazil Post-Symposium Excursion in 2016 (below).
Introduction

Much of science started out as a search for unifying principles and grand generalizations. Vegetation Science, in contrast, started out as an effort to document and understand the natural variation and diversity in the assemblage of plant communities. In this early focus on natural diversity rather than general principles, it paralleled systematics. Part of the reason for this detail-oriented approach can be found in a quote from Robert May (1986), summarizing the perspective of Robert MacArthur, “…ecology is a science of contingent generalizations, where future trends depend (much more than in the physical sciences) on past history and on the environmental and biological setting”. In short, before we can understand the general patterns and processes, we need to have a clear perception of the diversity of responses in space and time so that we can place the details within the context of the critical contingencies.

Vegetation science has come a long way. Description still plays a major role in vegetation science, from local vegetation to global patterns and how they are changing. These data and their information on context of ecological patterns and process helps us greatly in our efforts to explain and understand vegetation. We see many components of this in our journals, including such topics as community assembly and its linkage to traits, biotic interactions, spatial and temporal dynamics and ecosystem processes. This emerging deeper understanding can then be applied to conservation, policy, management and various forms of prediction.

Many vegetation science activities depend on accumulated data, and the dependency has grown ever stronger. As Keeling et al. (2009) suggest, “…this is true because of the complexity of ecological systems, particularly when viewed at large spatial and temporal scales. Data-intensive science organizes large volumes of data from multiple sources and fields…” Other fields with a need for large quantities of data developed informatics resources well before ecoinformatics emerged as a sub discipline of ecology and vegetation science. One reason for this is the broad range of formats, sampling protocols and data structures within the vegetation science community, much of which results from cultural and regional traditions (Jones et al. 2006).

I am particularly sensitive to the role of data in vegetation science as its emergence and development has paralleled my own career, and I have contributed, albeit modestly, in a number of different ways. Here, strongly influenced by my own history of association with IAVS, I describe some of the evolution of data analysis and data resources in the development of modern vegetation science. I then consider the resources and infrastructure likely to be needed as we move forward. Finally, I look at the challenges these present and how IAVS and other professional organizations could and should play a major role in supporting the information infrastructure needed to advance our field in coming decades.

The Emergence of Data Analysis in Vegetation Science

Early years of computing in Vegetation Science

The 1960s saw the first wide-spread availability of computers for applications in ecology. No longer were vegetation scientists constrained to analyze community data on paper or desktop adding machines. Large-scale classification and ordination analyses had become possible. The opportunities were quickly recognized by a subset of IAVS members, but there was little consensus on how best to exploit them and the approaches were numerous.

In 1968 several members of IAVS, largely under the leadership of Sandro Pignatti, proposed formation of a Working Group for Data-Processing...
in Phytosociology to share methods and facilitate the advance of computer applications in vegetation science (van der Maarel 1971). A series of meetings and symposia followed (van der Maarel 1974). One particularly important change for IAVS was the reorganization of the Association journal Vegetatio in 1974 with a new editorial board that was much more receptive to quantitative analyses and methodological articles. This period culminated in 1979 with a widely-attended meeting of the Working Group hosted by Eddy van der Maarel in Nijmegen (van der Maarel 1980; Fig. 1). This was the first IAVS meeting I attended, and, in my perception, the meeting dramatically and permanently changed IAVS from its historical focus on classical phytosociology to a modern professional association with members spanning a broad range of interests and approaches.

Although computer programs were created and shared by ecologists in the 1960s, it was not until the 1970s that vegetation scientists started to converge on standard methods, comparing their characteristics, and creating widely available packages of programs. Particularly influential in this movement was software included in the Cornell packages (e.g. Gauch 1973, Hill 1979). Meanwhile, synthetic works started to appear that compared methods and attempted to guide users (e.g. Orlóci 1978, Gauch 1982, Pielou 1984).

Transition to greater openness, large-scale synthesis, and big data

The growing breadth of interests of IAVS members and their need to communicate among themselves led to another important transition within the Association. The journal Vegetatio, although the official journal of the Association, was not owned by the Association. This resulted in lack of control, as well as prices beyond the means of most members and many libraries. In 1989 Eddy van der Maarel, in collaboration with Robert Neuhäusl and myself, created a new journal, owned by IAVS, with modest prices and with most of the same editors that had previously been associated with Vegetatio. As Eddy wrote (van der Maarel 1990), this was intended to be “a journal for all vegetation scientists.” This step also demonstrated a growing interest in IAVS with respect to providing critical infrastructure and making information more open.

Increased computational resources for vegetation scientists quickly led to extensive digitization of data and an expectation of larger-scale synthetic works. In particular, national-level syntheses of vegetation were undertaken in a number of European countries, such as Britain (Rodwell 1991-2000), Austria (Mucina et al. 1993) and The Netherlands (Schaminée 1995–99). The combination of this growing number of national-level syntheses and the fall of the Iron Curtain opened new opportunities and inspired work toward a European synthesis (Mucina et al. 1993, Rodwell et al. 1995) following common standards (Mucina et al. 2000). Meanwhile, similar enthusiasm for large-scale synthesis was building in the US. In 1993 several of us convened a symposium held during the annual meeting of the Ecological Society of America (ESA), which catalyzed a national effort to unify the diverse classification initiatives being conducted across the country. This quickly led to

establishment of the ESA Vegetation Classification Panel. The near simultaneous creation of the ESA Vegetation Classification Panel, the emergence of a US Federal Geographic Data Committee mandate for a national vegetation classification standard, and an initiative of the Nature Conservancy to compile a list of the vegetation types of the country, led to a three-way collaboration starting in 1994 and culminating in the first national compilation of vegetation types (Anderson et al. 1998; see Barbour et al. 2000).

Large-scale national and international analyses require databases for management of the many thousands of vegetation plots involved. To support the national classification initiative of The Netherlands, Stephan Hennekens developed the program TurboVeg (Hennekens 1995, 2001), which was soon employed broadly across Europe. The initial design was kept relatively simple so as to facilitate adoption by multiple groups. In addition, data were assumed to conform to the standard relevé methods used widely in Europe. The program was run on local computers, each supporting its own unique database. Subsequent versions of this program form the backbone for a number of more recent, large-scale initiatives (e.g. Chytrý et al. 2016, Mucina et al. 2016, Walker et al. 2016).

In the US, vegetation ecologists tend to be idiosyncratic in their data collection methods, so adoption of a simple data model based on the relevé method or an equivalent methodology was not a viable option. To solve the problem, the ESA Vegetation Classification Panel asked me to lead an effort to provide a national vegetation data framework. This led to creation of VegBank, first released for public use in 2003 (Duke 2006, Peet et al. 2012). This is a large-scale database, built with open-source software, publically accessible over the web, and which has considerable flexibility in the format of data submitted and served. It is designed to allow users to easily submit, search, view, annotate, aggregate, cite, and download diverse types of vegetation plot data. Unique digital identifiers are assigned to individual plots as well as user-created plot datasets.

Of particular importance to vegetation scientists, and ecologists more broadly, has been the emergence of the new field of ecoinformatics. This was made possible by the growing availability of large datasets, particularly the opportunity to intersect those that contain information about species occurrences, species co-occurrences, and the many types of site data ranging from climate to soils to remotely-sensed information. A necessary first step was to make data more available, which was greatly enhanced by various initiatives for long-term data sharing. For example, as part of an ESA initiative toward open data, I implemented, as Editor-in-Chief of Ecology and Ecological Monographs, such innovations as digital supplements to journal papers and data papers dedicated to describing and archiving important ecological datasets (Peet 1998). At roughly the same time, a large ecoinformatics initiative was built at the US National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, California, and its staff have subsequently devoted considerable effort to the development of tools for archiving, interpreting and integrating ecologically relevant data (see Michener & Jones 2012). These, and many parallel initiatives, were finally making it possible to analyze ecological data in such a way as to address the need for contingent generalizations as described by May (1986).

The initiatives at NCEAS, including development of VegBank by our international group of vegetation scientists, led to significantly increased awareness of the importance of ecoinformatics to the vegetation science community. This, in turn, led several of us to organize a full-day session on ecoinformatics at the 2003 IAVS meeting in Napoli. The participants met there and organized a new IAVS Working Group for Ecoinformatics, which was immediately approved by the IAVS Council. Finally, the participants developed a charge to the new Working Group to focus their activities, all components of which are still active concerns of the ecoinformatics community within vegetation science. The charge contained the following components: 1) develop for plot data an international data exchange standard including an XML schema; 2) recommend standards and requirements for archiving plot data; 3) communicate with … other organizations regarding taxonomic database needs; and 4) address issues related to requirements for extended queries, intellectual property rights, and confidentiality.

Data in Contemporary Vegetation Science

Vegetation survey and synthesis

Increased availability of vegetation plot data has greatly accelerated efforts to compile and homogenize large-scale regional classifications. In Europe, the IAVS European Vegetation Survey meets annually. Their efforts have produced a database of well over one million plots across 57 countries (EVA, see Chytrý et al. 2016), plus a synthetic treatment of 1,108 alliances of vascular plant communities spanning all of Europe and adjacent islands (Mucina et al. 2016). In the US a collaboration by ESA and NatureServe led to the Federal Geographic Data Committee adopting new standards for vegetation classification and coordinated revisions based on plot data (FGDC 2008, Jennings et al. 2009; Fig. 2). The content of the current, 8-level classification has been peer reviewed and an editorial process is in place.
for proposed revisions. Currently there are 1,263 alliances and 6,168 associations recognized and described for natural vegetation of the continental US (Faber-Langendoen 2017). Similarly, a large-scale effort is underway to compile plot data across all of the arctic (Walker et al. 2016) and to develop a coordinated classification based on Braun-Blanquet methods (Walker et al. 2017).

Large database initiatives

Many sources of data are now widely available to vegetation scientists including not only plot data, but also environmental data, species distribution data, species trait data, and phylogenetic data. Inevitably, a number of initiatives have developed to integrate and simultaneously analyze these diverse types of data. Two projects I am particularly familiar with are BIEN (Botanical Information and Ecology Network; Enquist et al. 2016) and sPlot (Dengler et al. 2014, Purschke 2015). In the BIEN project we have attempted to bring into one database all open-source species occurrence records, vegetation plot data, trait data and phylogenetic data for plant species of the New World. The data are publicly available, as are derived distribution maps and models for ~92,000 New World plant species. With the sPlot initiative, we are trying to bring together vegetation plot records from across the globe and integrate them with trait data and phylogenetic data. As of 2016 there were over 1.1 million plots in the sPlot database. Both of these projects have multiple working groups generating diverse and innovative synthetic publications. Doubtless there will be

Fig. 2. Meeting of the Cyberinfrastructure Design Committee for the US National Vegetation Classification, October 2015. Participants included, left to right, Michael Lee (VegBank Manager, University of North Carolina), Christina Justice (Consultant, Innovative System Solutions Corporation), Robert Peet (University of North Carolina; Principal Investigator, VegBank Project; Executive Committee, ESA Vegetation Classification Panel), Kristin Snow (Ecology Database Analyst, NatureServe), Cliff Duke (Director of Science Programs, Ecological Society of America), Alexa McKerrow (US Geological Survey; Coordinator, US National Vegetation Classification), and remotely on screen Marianne Burke (US Forest Service; Chair, US Federal Geographic Data Committee Vegetation Subcommittee) and Don Faber-Langendoen (NatureServe; Chair, US National Vegetation Classification Peer Review Board).
other groups of this sort that integrate and analyze the accumulating digital information on plants and vegetation. However, it would be most efficient for vegetation science to maintain and grow a few specific projects to assure long-term preservation and maintenance and to avoid unnecessary costs and redundant efforts.

Future Directions and Opportunities

Addressing challenges associated with big data

The development of large databases for vegetation science not only has provided invaluable resources, but has also made clear a number of challenges that our community should address (Wiser 2016). In many cases solutions have been proposed and at least partially implemented. IAVS could greatly benefit vegetation science, and ecology more broadly, by taking a leadership role in providing solutions to these problems.

1. Data discovery and maintenance

Even if data are digitized, this does not mean they are discoverable or that they will persist. Indices of databases can be very valuable tools. One such tool is GIVD, the Global Index of Vegetation Databases (Dengler et al. 2011). Registration of plot databases in GIVD is voluntary, but already there are 244 databases registered representing in excess of 3.1 million plots. We should encourage the development of more such registries and attempt to assure their long-term maintenance. IAVS could also serve as a home for databases in much the same role as, for example, GenBank serves the genomic community. Just as importantly, many of our current databases lack a clear mechanism for long-term support (e.g. BIEN, sPlot, VegBank). IAVS could work with the managers of such databases in an effort to ensure their continued survival and improvement as their initial, short-term funding fades away, and ultimately to bring their critical data together into a large, global resource.

2. Data formats and protocols

Ecologists across the globe are remarkably inconsistent in their data formats and protocols. Increased consistency in data collection protocols and formatting would be immensely constructive. IAVS should suggest a set of standard protocols and formats. Moreover, we ought to develop consistent vocabularies. The various efforts to develop ecological ontologies have the potential to greatly help in this regard (Madin et al. 2008), as do large database initiatives with carefully assembled constrained vocabularies.

An important initiative undertaken by the IAVS Ecoinformatics Working Group is to develop and maintain data exchange standards so that computer programs and databases with different formats can seamlessly exchange data. A first attempt was VegX, an XML standard for exchange of vegetation plot data in different formats (Wiser et al. 2011). Subsequently, a TDWG Observations Task Group was formed to update VegX, and more broadly to create a core semantic model for observations across the ecological sciences (http://www.tdwg.org/activities/osr/obs/). Completion of this task has the potential to greatly benefit vegetation science, and ecology more broadly.

Although various large groups within IAVS, and vegetation science more broadly, are striving to develop regional synthetic classifications of vegetation, these groups are not coordinated in a way that would facilitate the eventual development of a global synthesis. De Cáceres et al. 2015 recognized this problem and provided a framework for classification activities to facilitate such an eventual global synthesis. The IAVS Vegetation Classification Working Group is discussing how to build on the De Cáceres et al. framework to develop a unified approach for a global vegetation classification. IAVS should support such efforts and encourage greater international coordination and cooperation in vegetation classification.

3. Quality control and consistency

Database content is notoriously prone to errors. For example, BIEN found many thousands of terrestrial plant occurrences with coordinates that map to oceans. Moreover, not only are geo-coordinates often incorrect, species and location names are also prone to inconsistencies and errors. Tools are needed to identify and correct such errors in location and taxonomy. Some tools are already available such as BioGeomancer for geographic validation (e.g. Guralnick et al. 2006) and the Taxonomic Name Resolution Service (Boyle et al. 2013) for matching plant names against various authoritative lists. Moreover, the sPlot group has created a separate database for determining whether species are native to a particular region (GloNAF, see Van Kleunen et al. 2015). Still, these represent first steps and we need more powerful tools.

A particularly difficult challenge is presented by situations where there is a many-to-many relationship between names and categories. This is best known in biological nomenclature where one name can refer to many different sets of organisms and one organism can have many different names. This challenge, as well as potential solutions, was first clearly articulated by Berendsdohn (1995). Efforts to merge plot data from multiple investigators working in different areas at different times and following different taxonomic authorities have reinforced this
problem (e.g. Jansen & Dengler 2010, Peet et al. 2012) and led to potential database solutions (e.g. Franz et al. 2008, Franz & Peet 2009; Fig. 3), but such solutions require that large databases maintain information on the relationships among various taxon concepts. This information has, for the most part, not been consistently reported by the taxonomic community or embraced by that community as a disciplinary imperative. Nonetheless, vegetation scientists, and ecologists and biologists more generally, need to be able to unambiguously match and integrate organism names from a myriad of sources. We should partner with other organizations to bring about creation of the needed infrastructure.

4. Repeatability
The wealth of new analytical and statistical techniques used in the ecological community has led to wide use of R packages that assure that methods are easily and consistently used. The need for such tools is particularly strong in the case of extraction and analysis of data from large and complex databases. Recognizing this, both BIEN and sPlot have created R packages to facilitate data query and extraction. The next step is likely to be broader availability of work flows that automate certain kinds of analysis and that span multiple data sources (see Ludäscher et al. 2006, Reichman et al. 2011). IAVS could serve the community well by providing lists of critical and validated code (particularly R packages), and by advocating and documenting automated workflows for use by our community and others.

5. Insufficient data
Compilation of large databases also serves to reveal where data are sparse and more are needed. Examination of the distribution of the >1.1 million plots in sPlot reveals vast areas where it appears very few plots are available, such as Northern Africa and Siberia. In addition, certain types of data are limited in availability. For example, although several authors have advocated collection of data containing observations across multiple scales (e.g. Stohlgren et al. 1995, Peet et al. 1998, 2014, Dengler 2009), very few such datasets are available (but see Fig. 4). In addition, although the importance of long-term studies is broadly appreciated in vegetation science, few public archives contain plot data spanning long periods. The most notable exceptions include the system of plots maintained by the Center for Tropical Forest Science of the Smithsonian institution, with 63 large plots distributed over 24 countries and containing over 6 million trees representing over 10,000 species (http://www.forestgeo.si.edu/) and the US Forest Service Forest Inventory and Analysis plots (Gray et al. 2012). Another emerging example is the US National Ecological Observatory Network (NEON), which promises to provide at least 30 years of data for all taxa of plants (and many other organisms) across a geographically broad network (Kao et al. 2012). IAVS could serve the community by compiling information on what we view to be the most critical data needs, and advocating collection of such data to our membership and to various funding agencies.

6. Open culture
The number of journals and funding agencies that mandate open access to data has increased greatly over the last decade. Nonetheless, professional societies need to push harder for data to be open. IAVS could participate in the establishment and curation of archives of open data. Of course, this will require consistent policies and protocols with respect
to such issues as managing intellectual property and the need for confidentiality to protect rare species and critical sites. Moreover, the need for greater openness goes beyond data. For example, sharing of computer code is not limited to R packages and should be mandated for most publications to ensure repeatability (Barnes 2010, Rocchini & Neteler 2012). At a minimum, IAVS should adopt and promote a set of best practices for openness with respect to data and code.

Time to think bigger!

Vegetation science lags behind other disciplines in the adoption of data protocols and the creation and maintenance of cyberinfrastructure. Genetic sequence data from around the world are nearly all in GenBank or equally accessible databases. Scientists do not hesitate to place their sequence data in such archives, or to extract data to support their on-going research. Other professional societies, such as the American Chemical Society, have standard repositories for critical types of data. Another model is TAIR, a comprehensive compilation of data from research on Arabidopsis that is curated and maintained by staff and to which research institutions subscribe so that their scientists have access (Huala et al. 2001). Perhaps the closest thing to a global vegetation science database that is both well populated and frequently used is TRY, the database for plant traits (Kattge et al. 2011), though some might question rules for access to TRY data.

There are at least three important ways in which vegetation data systems lag behind other disciplines. First, our data systems are rarely global, but more typically serve a subset of the world and often in different ways such that data from different systems do not integrate well. Second, participation in and curation of data systems is not yet a widely-embraced value in our field. We need for vegetation scientists to routinely deposit vegetation data in large repositories, and we need mechanisms to assure that the data are well curated so as to maintain high quality. Finally, many of our data systems are fragile in that they were created with short-term funding, and in most cases there is no clear vision for how to maintain these systems into the future and upgrade them as software requirements evolve.

Potential long-term roles for IAVS

Professional societies once served almost exclusively to publish journals and host meetings. Although both of these roles remain important, there are many other ways that professional societies could and should advance their fields. I have already observed many roles IAVS could play in the future to sustain and advance the growing role of data in our field. Among these are providing access to critical tools, hosting and curation of global data resources so as to assure their quality and longevity, providing mandates for archiving data and workflows, improving guidance and mechanisms for managing intellectual property and confidentiality, and providing advocacy for international programs for both one-time and long-term data collection following IAVS mandated protocols and with an emphasis on recognized data needs. There are many other possibilities.

How should we start? I have several suggestions. First, we need to collectively identify the needs and

Fig. 4. Collaborative data collection on a multi-scale permanent plot on Öland by Eddy van der Maarel, Robert Peet and Marijke van der Maarel, June 1985.
opportunities. Essentially, this is a call for a Vision Statement. I recommend that a special committee be created for this process. Second, we need to find ways to train a new generation of vegetation scientists with respect to recommended practices. We could sponsor workshops and we could develop materials for both undergraduate and graduate curricula. Finally, we need to develop a sustainable plan to accomplish these goals. In short, we need to develop a Business Plan. We should at least consider funding models from other fields. Certainly there is some potential in the Phoenix Bioinformatics Model followed by TAIR and BioCyc (e.g. Huala et al. 2001) where the user community pays a fee, which would generally be lower than if they were to do the work themselves. Finally, we should be aware that other professional societies face similar challenges and we should look for opportunities to collaborate with these other organizations so as to share the costs and enhance the benefits.

Acknowledgements

I cannot begin to recognize all the many friends, colleagues, students and family members who have supported my career and my participation in IAVS. However, two individuals stand out as having strongly shaped my goals, my career and my participation in IAVS. These are Robert Whittaker and Eddy van der Maarel. To them, and the many others, I am eternally grateful.

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GrassPlot

The New Database of Multi-scale Plant Diversity of Palaearctic Grasslands

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The Database of Scale-Dependent Phytodiversity Patterns in Palaearctic Grasslands (GrassPlot) was established on 10 March 2017 in Bayreuth during an international workshop organized by Jürgen Dengler and supported by the BayIntAn program of the Bavarian Research Alliance (BayFor) and BayCEER.

GrassPlot is a collaborative initiative within the framework of the Eurasian Dry Grassland Group (EDGG), a working group of the IAVS. The GrassPlot database succeeds the former database of nested-plot data from grasslands in Europe founded in 2010, which consisted mainly of the data collected during the EDGG Research Expeditions/Field Workshops. Now the scope of GrassPlot has been widened (see below), and everyone with suitable data can join the Consortium. The purpose of GrassPlot is to establish and maintain a common data repository of high-quality vegetation-plot observations (relevés) of grasslands and related vegetation types from the whole Palaearctic biogeographic realm, and to facilitate the use of these data for non-commercial purposes, mainly academic research and applications in nature conservation and ecological restoration.

The GrassPlot database aims at complementing existing broad-scale vegetation databases such as the European Vegetation Archive (EVA) and the global database “sPlot”. The special focus of GrassPlot is on multi-scale and multi-taxon sampling in precisely delimited plots with extensive environmental data.

During the GrassPlot workshop in Bayreuth the participants developed Bylaws aiming at balancing the interests of data providers and data users in a fair and transparent manner. The data owners can decide on the data access regime of their data; either restricted, semi-restricted or free. Persons who are willing to contribute their own published or unpublished plot records or plot records of other authors which they digitised from the literature can apply to become a member of the GrassPlot Consortium. Data must be provided in an electronic format, but exceptionally unpublished data in paper format will be accepted if they fill important gaps.
Obligatory requirements for data contributions to GrassPlot are:

(a) origin in the Palaearctic biogeographic realm;
(b) grassland vegetation in the wide sense, i.e. terrestrial and semi-terrestrial vegetation types dominated by hemicyryptophytes, therophytes, geophytes, and occasionally bryophytes, lichens and chamaephytes (forests, shrublands, aquatic, ruderal and segetal vegetation are not considered);
(c) careful sampling of precisely delimited plots with the aim of complete species lists;
(d) providing details of sampling methodology (in particular, whether rooted or shoot presence was recorded and which plot shape was used); and
(e) meeting one of the following criteria (or a combination of these): (i) data for one or several of our eight standard grain sizes (0.0001; 0.001 or 0.0009; 0.01; 0.1 or 0.09; 1; 10 or 9; 100; 1000 or 900 or 1024 m²) or (ii) nested-plot series with at least four different grain sizes.

Additional desired (but not obligatory) criteria are:

(f) precise GPS coordinates;
(g) complete sampling of one or several macroscopic non-vascular taxa of the terricolous vegetation (bryophytes, lichens, “algae”) in addition to vascular plants;
(h) multi-scale, nested-plot sampling;
(i) direct cover estimates of species in percent for at least one grain size; and
(j) extensive environmental variables measured or determined at the plot scale (vegetation structure, topography, soil, land use).

GrassPlot is represented and governed by its Governing Board elected by the GrassPlot Consortium for two-year renewable terms. The first Governing Board for the period March 2017 – March 2019 consists of Idoia Biurrun (ES), Timo Conradi (DK/DE), Iwona Dembicz (PL), Jürgen Dengler (DE), Riccardo Guarino (IT), Alireza Naqinezhad (IR) and Viktoria Wagner (CZ/AT), with Jürgen Dengler being Custodian and Idoia Biurrun Deputy Custodian.
By now (as of 8 May 2017), substantial amounts of data have been collected in the GrassPlot Database, including 87 datasets from 116 data owners and 29 countries. This comprises 1,144 nested-plot series (with at least four grain sizes) and 27,355 plots with vascular plant data of which 12,278 plots have additionally data on bryophytes and lichens.

The establishment of the GrassPlot database opens new opportunities for extensive studies on grassland ecology and biodiversity in the Palaearctic realm. The members of the GrassPlot Consortium are informed about and invited to forthcoming paper projects using the GrassPlot data and they can propose paper projects themselves. You are welcome to join the GrassPlot Consortium with your data to advance science and to take advantage of these benefits.

For further information on GrassPlot and its database, please visit the GrassPlot webpage at http://www.bayceer.uni-bayreuth.de/ecoInformatics/en/grassplot/ or contact Jürgen Dengler and Idoia Biurrun.
Data collected during the EDGG Research Expeditions/Field Workshops are a significant contribution to the GrassPlot database. The steppes of the Kuznetsky Alatau Mountains, (Republic of Khakassia, Russia) were the destination of the EDGG Research Expedition in 2013.

Semi-natural temperate grasslands despite having anthropogenic origin can be extremely species-rich at small grain sizes. This colourful meadow is typical for subalpine belt of the Krivánska Malá Fatra Mountains in the Slovak Western Carpathians.
The EcoVeg Approach and the Classification and Description of World Formation Types

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An ecological vegetation classification approach (termed the EcoVeg approach) has been developed in which a combination of vegetation attributes (physiognomy, structure, and floristics) and their response to ecological and biogeographic factors are used as the basis for classifying vegetation types (Faber-Langendoen et al. 2014). The purpose of the EcoVeg classification approach is to describe the diversity of terrestrial ecosystems across the globe and inform decisions about conservation and resource management. The approach provides the scientific basis for the U.S. National Vegetation Classification, Canadian National Vegetation Classification and NatureServe’s International Vegetation Classification, and has encouraged international and national collaborations elsewhere in the Americas.

The classification structure was largely developed by the Hierarchy Revisions Working Group (HRWG), which contained members from across the Americas. The HRWG was authorized by the U.S. Federal Geographic Data Committee (FGDC), which is chaired by the U.S. Forest Service, to develop a revised global vegetation classification to replace the earlier versions of the structure that guided the U.S. National Vegetation Classification and the International Vegetation Classification. These classifications formerly relied on the UNESCO (1973) global classification. The HRWG worked closely with the Ecological Society of America’s Vegetation Classification Panel, NatureServe staff, U.S. federal agencies, and members of the Canadian National Vegetation Classification Technical Committee, to complete the revision. Within the U.S. and Canada, strong collaborations exist between the national efforts and provincial or state jurisdictions.

A published report is now available that summarizes the development of the upper formation levels (Faber Langendoen et al 2016; https://www.treesearch.fs.fed.us/pubs/44504). Our report first describes the history of the Hierarchy Revisions Working Group and discusses the three main parameters that guide the classification - it focuses on vegetated parts of the globe, on existing vegetation, and includes (but distinguishes) both cultural and natural vegetation for which parallel hierarchies are provided. Part I of the report provides an introduction to the overall classification, focusing on the upper formation levels. Part II provides a description for each type, following a standardized template format. These descriptions are a first preliminary effort at global descriptions for formation types, and are provided to give some guidance to our concepts.

EcoVeg provides a consistent thematic framework to support extensive vegetation classification and mapping. The approach is global, but most advanced in the western hemisphere, where a comprehensive set of vegetation types have been developed down to the macrogroup and group levels (Faber-Langendoen et al. 2017, Supplement S4). For the Americas, the conservation or at-risk status of macrogroups, groups and associations are being evaluated using both the IUCN Red List of Ecosystems and NatureServe Conservation Status Assessment protocols.
Various types of Cool Temperate Forests from around the world: Western Eurasian Forest & Woodland division: European beech (*Fagus sylvatica*) forest in Czech Republic (top left). Eastern North American Forest & Woodland division: Eastern Hemlock-Sugar Maple (*Tsuga canadensis-Acer saccharum*) forest in central Wisconsin, United States (top right). Southeast Australian Cool Temperate Forest & Woodland division: Australian Alps - mainly Mountain Ash (*Eucalyptus regnans*) (bottom left). Valdivian Forest division: Southern beech (*Nothofagus* spp.) forest in Altos de Lircay National Reserve, Chile (bottom right).

References


Phytocoenologia, the International Journal for Vegetation Survey and Classification, was re-launched in 2015 in close collaboration with the IAVS. Leading members of the IAVS from all over the world serve as Chief Editors, Associated Editors and members of the Editorial Board, while at the same time Phytocoenologia has become a prominent publication venue for the output of five Working Groups of IAVS. The re-launch came along with a more focused scope, updated author guidelines and modernised layout. Taken together these measures contributed to a significant and continuous increase of the journal’s impact and visibility. We are glad to report that also the number of high-quality submissions has increased so that we are now back to a regular publication schedule with four issues a year.

Our authors (as well as our Editorial Team) are very international (see the figure of distribution of editorial team members, authors, and the studies next page), including many colleagues from countries where English is not the mother tongue and who often do not have access to or cannot afford professional linguistic editing. It is the mission of Phytocoenologia to cover the vegetation of any place on Earth, but particularly of those regions with very diverse and at the same time understudied vegetation types. Thus, we thought about a solution of how to overcome the bias of typical international journals towards authors/articles from the United States, Canada, Australia, New Zealand and Western Europe. To this end, Phytocoenologia appointed Linguistic Editors, whose task it is to check and improve the linguistic correctness and clarity of articles written by non-native speakers after acceptance. Our Linguistic Editors, like Chief Editors and Associate Editors, do their job voluntarily. As a token for their service, they are listed on the imprint of the Phytocoenologia and receive a free online subscription of the journal.

We believe that the rather unique service of our Linguistic Editors greatly contributes to the geographic breadth and quality of our articles and thus to the success of the journal, while at the same time it helps overcoming the disadvantage non-native speakers of English experience after acceptance. Our Linguistic Editors, like Chief Editors and Associate Editors, do their job voluntarily. As a token for their service, they are listed on the imprint of the Phytocoenologia and receive a free online subscription of the journal.

honourable service to vegetation science, can help young scientists getting into editorial practice and certainly is something that can be added to a CV. Our requirements are that you have English as your mother tongue, have a good feeling for formalities and style of scientific writing, have a background in vegetation ecology and have published some of your own papers in peer-reviewed international journals. We believe that becoming one of our Linguistic Editors could be particularly attractive for PhD students and young Postdocs but perhaps also for retired colleagues. If you yourself would like to join our team or recommend someone else, please contact the Acting Chair of Editors.

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Photo Memories

2016 Pre-symposium excursion to the Atlantic rain forests near Paraty, Brazil (above).
2016 Post-symposium excursion into the cerrado landscape near Pirinópolis, Brazil (below).
Two remembrances to the Annual Symposium in Swansea, Wales, in July 2007.
Calendar of Events

ITALY
10th EDGG Field Workshop, 3-11 June 2017

ITALY
60th IAVS Symposium, 20-24 June 2017

LATVIA & LITHUANIA
14th EDGG Conference, 4-11 July 2017

SPAIN
26th EVS Meeting, 13-16 September 2017
Vegetation plot on a granite flatrock community with pools dominated by *Amphianthus pusillus*, *Diamorpha smallii* & *Minuartia uniflora* – Forty Acre Rock Preserve, Lancaster County, South Carolina