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Janez Potočnik highlights the EU's many new strategies designed to combat both regional and global environmental problems

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**EXCLUSIVE INTERVIEW WITH PROFESSOR
HELGA NOWOTNY, PRESIDENT OF THE
EUROPEAN RESEARCH COUNCIL**

RESEARCH SPOTLIGHT

International Barcode of Life • Global Ocean Observing System
World Water Council • Census of Antarctic Marine Life • Sustainable Energy Week
Convention on Biological Diversity • Scientific Committee on Oceanic Research

Taking a register

The PESI project, led by **Dr Yde de Jong**, is bringing together four major community networks on taxonomic indexing and their respective knowledge infrastructures, and seeks to better define and coordinate strategies for biodiversity management

PESI

Could you give an overview of the Pan-European Species-directories Infrastructure (PEI) aims and objectives, and what prompted its formation?

PEI is a joint initiative of two Networks of Excellence: EDIT (European Distributed Institute of Taxonomy) and MarBEF (Marine Biodiversity and Ecosystem Functioning), funded by the European Union under the Seventh Framework Capacities Work Programme - Research Infrastructures - and is led by the University of Amsterdam. It started in May 2008 and will last three years, involving 40 partner organisations from 26 countries and several non-contracted associated partners.

The correct use of names and their relationships is essential for biodiversity management; therefore the availability of taxonomically validated standardised nomenclatures is fundamental for biological e-infrastructure. PEI is the next step in integrating and securing taxonomically authoritative species name registers, serving to underpin the management of biodiversity in Europe. It will integrate the three main all-taxon registers in Europe, namely the European Register of Marine Species, Fauna Europaea, and Euro+Med PlantBase in coordination with EU-based nomenclators, i.e. Index Fungorum, IPNI, and AlgaeBase, plus the network of EU-based Global Species Databases (GSDs). It is a standardised, quality controlled, expert validated, open-access infrastructure for research, education, and resource management.

How will you manage to successfully bring together the three largest species databases in Europe?

PEI defines and coordinates strategies to integrate the infrastructural components of four major community networks on taxonomic indexing and their respective knowledge (social and technical) infrastructures, namely those of marine life, terrestrial plants, fungi, and animals into a joint work programme.

The integration of the social expertise networks will result in functional knowledge systems of taxonomic experts and regional focal points,

which will collaborate on the establishment of standardised and authoritative taxonomic data and the development of approaches for their long-term sustainability.

The technical integration of these three checklists into a joint e-infrastructure relies on the Common Data Model (CDM) ensuring the conceptual mapping of taxonomic databases. This is hosted in the CDM store as a denormalised relational database management system (the so-called 'PEI data warehouse'). The CDM represents a component of EDIT's Cybertaxonomy Platform.

How important has collaboration and an interdisciplinary approach to research been in the development and implementation of PEI, especially given the scope of the three databases you are consolidating?

A crucial part of this project will be the involvement of various taxonomic expert communities to work collaboratively on the PEI tasks. PEI also addresses the geographic expansion of the European networks to eventually cover the entire Palaearctic biogeographic region, attempting to integrate Anglo-Saxon and Oriental taxonomic communities that have thus far worked in relative segregation using their own research criteria.

In terms of (technical) innovation and interdisciplinary collaboration, the most challenging aspect will be the close cooperation with the global biodiversity informatics community to develop a state of the art information e-infrastructure.

How will you test the effectiveness of PEI with its users? Will you use a feedback system and how will this be managed?

Technology does not work in isolation, and requires parallel development in contributor and user practices. PEI will explore the user needs allowing users to comment and provide feedback on the system performance via an end-users forum and a user feedback. This will also allow other experts to communicate on the quality of the taxonomic data.



In the end do you hope to link all the environmental monitoring and management systems in Europe as well as smaller community projects to provide one umbrella network?

Most of the existing key European management biodiversity systems have already adopted one or more of the pan-European checklists as their taxonomic reference. PEI will expand this network to new stakeholders and coordinate the delivery of this information to relevant users through the inter-operation of the existing data infrastructures and expert networks.

The organisation of national and regional focal point networks is also important for the synergistic promotion of taxonomic standards throughout Europe, and to liaise, for example, with national governmental bodies on the implementation of European biodiversity legislations.

PEI is also involved in supporting international efforts on the development of the 'Global Names Architecture' by building a common intelligent name-matching device in consultation with principal initiatives like GBIF and LifeWatch. This provides a unified cross-reference system to all stakeholders optimising their taxonomic meta-data service functioning.

PESI is arming itself with the best possible tools to confront the Earth's growing loss of biodiversity

Connecting the planet

PESI is overcoming the challenges that have previously faced taxonomy in a move to confront the global problem of biodiversity mismanagement

THE EARTH HAS an estimated five to 30 million species, but only 2 million of those have been formally identified and described. This leaves a frighteningly large deficit, and demonstrates the huge amount of work still left to do. Determining an accurate count of the number of species that live on this planet is not only a challenging task because the number of known species is continually changing, but also because there is no central registry for species.

With technological advances allowing scientists to discover new species, there is an even greater need for an authoritative index. In a recent study 10,000 bacterial species were found in a single gram of Minnesota soil, whilst the previously inaccessible Antarctic seas are teeming with life when they had been assumed barren. This represents a twofold problem: technical advances are making more discoveries possible, but are increasing the burden on

existing taxonomy systems. The very nature of biodiversity also presents taxonomy with a further cataloguing challenge, since 70 per cent of the Earth's species are located in only 12 countries, making distribution a significant issue.

The project PESI (Pan-European Species-directories Infrastructure), led by Dr Yde de Jong, is seeking to address this growing problem for Europe. Its aim is to tackle these common difficulties related to conservation and sustainable use of biological resources by bringing together four of the major community networks on taxonomic indexing and their respective knowledge infrastructures.

PRE-EXISTING LIMITATIONS

Formerly in taxonomy there have been unavoidable problems that have always restricted its success and impact. By concentrating on overcoming these limitations, PESI is seeking to

provide a more user friendly, better managed and sustainable system. Historically, the lack of standardisation in taxonomic reference practices has created communal difficulties, as has the poor quality and incomplete nature of existing data sets.

Another key factor that PESI is combating is the need for integrated access to available taxonomic information. A system like theirs would also prevent repetitious studies and allow access to available and current research, providing an expert-validated, quality controlled and standardised infrastructure, with a wide range of users and services, from scientists to teachers. The information will also supply key educational tools, and will build a public, interactive, multilingual web portal to implement the dissemination of the developed species' names service, supporting the use of the pan-European species data in the e-science arena.

INTELLIGENCE

PESI

A PAN-EUROPEAN SPECIES-DIRECTORIES INFRASTRUCTURE

OBJECTIVES

PESI will contribute to the strengthening of the respective scientific, social, political, technological, and information capacities in Europe, needed for a proper biodiversity assessment. The project is the next step in integrating and securing taxonomically authoritative species name registers that underpin the management of biodiversity in Europe.

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DR YDE DE JONG has an academic background in systematics, evolutionary biology, bioinformatics, epistemology, and marine botany. He is head of the department Biodiversity Informatics of the Zoological Museum Amsterdam, coordinator of the PESI project and EDIT's task leader on integrating Europe's taxonomic information infrastructures. Beside he is the executive manager of the Fauna Europaea project, chair of GBIF's ECAT work area, and involved in several biodiversity informatics initiatives and work groups.

PESI is responding to these pre-existing issues by not only cross-validating all European, national and regional taxonomic checklists, as well as the Global Species Databases (which in itself is an impressive task), but also by providing a detailed investigation of those taxon names that are mentioned in legislative reports. These will include endangered species and those of highest priority for maintaining and improving international regulation, as well as the monitoring and documenting of invasive (alien) species; organisms related to human health and pest control; and finally, of fundamental importance, indicator species for environmental change.

The issues that PESI is trying to deal with are myriad, and often rely on other related difficulties. For example, currently, the uncertainty of identified species is often seen to hamper the implementation of these policies, thereby making the standardisation of taxonomic references and PESI's cooperation with their supporting organisations integral to its approach.

Through an improved management of Europe's biodiversity needs, PESI is answering the taxonomy information deficit, and by means of knowledge sharing, is strengthening the respective scientific, social, political, and technological capacities of Europe. It is only through systems such as PESI that a true assessment of biodiversity gain and loss can be measured, monitored and tackled. Scientists and governments cannot protect what they do not have proof of, and this is why the work of PESI and other organisations is so essential in the protection of our planet's biodiversity.

IMPROVING THE FUTURE OF BIODIVERSITY

PESI has already enjoyed much success, and with many new initiatives the future looks very promising. By coordinating the delivery of standardised and reliable taxonomic information and through the inter-operation of the existing data infrastructures and expert networks, PESI is arming itself with the best possible tools to confront the Earth's growing loss of biodiversity.

PESI's work has been recognised for leading the way in establishing a 'European Taxonomic Backbone' as well for their effort in coordinating the European contribution to the Global Names Architecture developments. It has also been involved in organising the taxonomic expert networks into a virtual research community. These endeavours have led to many positive spin-offs and fresh possibilities, including partnerships with other international biodiversity research programmes like LifeWatch, GBIF, EoL, and CoL.

To further fulfill its biodiversity management targets, PESI is planning to increase its involvement with non-professional taxonomists (so-called 'Citizen Scientists') in its biodiversity

indexing and monitoring of behaviour. The project is also keen to broaden its reach in terms of biodiversity standards and information infrastructures to incorporate other bio-informatics projects and data domains – for example genomics, DNA barcodes and ecology. They see the need to perform this using the common framework of LifeWatch, whilst taking on the task of expanding the Global Names Architecture capacity.

The vastness of the taxonomic data left to

PESI is arming itself with the best possible tools to confront the Earth's growing loss of biodiversity

document makes the challenges that PESI faces extensive, with the complex nature of the project adding to this strain. However the project is being seen to confront these difficulties by means of a multidisciplinary approach, which in itself can present many trials. De Jong is keen to emphasise that due to the large number of partners and the heterogeneity of the infrastructural components, PESI is providing a solution to these problems: "We are achieving this by inviting chief scientists and leading institutes as project partners; through accurate project management and coordination, and via close collaboration with principal biodiversity informatics initiatives," he states.

SUSTAINABLE NETWORK

De Jong sees the questionable sustainability of the taxonomic expert network as the most threatening issue to PESI's success, since Europe is experiencing a decline in its number of professional taxonomists. PESI is addressing this concern by collaborating with the European Distributed Institute of Taxonomy (EDIT) project and the Consortium of European Taxonomic Facilities (CETAF), as well as reaching out to non-professional taxonomists and taxonomic societies in a hope to revive this vital science.

PESI's challenge is multi-fold, but de Jong is leading the way in providing the vital organisation and e-infrastructures that taxonomy has been in such desperate need of in recent years. If the global problems facing biodiversity are going to be successfully and realistically targeted, then a collaborative approach is an essential part of the battle plan. Partnerships underpin the nature of PESI, and together with accurate project management and knowledge-sharing initiatives, the study looks set to record the future of our Earth and provide critical answers for the sustainable use of its biological resources and their conservation.

