Summary of findings by IBOY Project Leaders
From Workshop *Interdisciplinary Research for International Biodiversity Challenges*, June 16, 2001.

This document is a summary of the findings of participants at a half-day workshop on "Interdisciplinary Research for International Biodiversity Challenges". The workshop participants consisted of more than 30 biodiversity researchers and media professionals, from 14 countries. They were asked to describe: (1) the most significant advances in biodiversity research over recent decades, and (2) significant gaps in biodiversity knowledge and research needs to address them. The advances and gaps identified are grouped into 'conceptual' and 'resource/technical'

This summary of the participants' findings was compiled by the IBOY Secretariat. The participants' suggestions have not been edited for content. Sometimes, an issue is listed both as an advance, a gap/research need. This may reflect both differences in opinion within the group, or the fact that although there have been advances in many areas, there is still much more that needs to be done.

1. Significant Advances in Biodiversity Research

1.A. Advances in Knowledge :

(a) Quantification of biodiversity (or knowing how much biodiversity there is)

We have estimates of how many species there are (although these vary by an order of magnitude (10 million to 100 million)).
Levels of biological organization (genetic, species, functional group, landscape) are better understood and agreed upon. This is an expanded notion of biodiversity.

(b) Mapping of Biodiversity (or knowing where biodiversity is)

Biodiversity is beginning to be mapped (e.g. hotspots) and even in marine domains to some extent. This benefits management and conservation efforts.

(c) Phylogenetics (understanding evolutionary relationships)

Improved understanding of evolutionary relationships, including discovery of many new branches of the 'Tree of Life'. This has led to rejection of some previous classifications.

(d) Recognition of the human dimension of biodiversity, including:

(a) understanding that no location is without human influence and incorporating humans into models
(b) identifying and developing science-based solutions to anthropogenic problems, including over-fishing, coral reef destruction
(c) agrobiodiversity (especially advances in saving agrobiodiversity *in situ*)
(d) environmental economics – concept of biodiversity for use, which has yielded a 'marketing' tool for conservation
(e) recognition of value of biodiversity in addition to value as use (e.g. faiths)

(e) Biodiversity and Ecosystem Functioning

Analysis of the relationship between diversity and function has stimulated functional grouping; a level of classification that has relevance to ecosystem function and ecosystem services. Especially important is recognition of functional importance of microbial species.

(f) Examination of poorly known groups – microscopic and extremeophiles
Very poorly known taxa are starting to be described by taxonomists and ecologists (e.g. soil organisms, microscopic organisms, extreme environments). This is increasing scientific knowledge of the diversity of these organisms and their important role in ecosystems and endeavors such as agriculture.

(g) General acceptance of Darwinism

(h) Holistic understanding
Overall, we have a much more holistic understanding of biodiversity existing at multiple levels of biological organization, and its role in ecosystems and human life.

1.B. Technical/Resource Advances

The above conceptual advances have occurred concurrently with technical advances and developments in methodologies used

(a) New tools
Molecular techniques have enabled dramatic advances in phylogeny and species (particularly microscopic) identification.
GIS and remote sensing has enabled mapping of species distributions.
Relational databases enable complex relationships between organisms, processes and environmental parameters to be analyzed.
Digital technology and internet has enabled greater information transfer and knowledge sharing.

(b) Interdisciplinary research
Taxonomists, ecologists, and anthropologists, etc. are beginning to work together to develop an integrated picture of biodiversity including the human dimension. There has been recognition of the value of combining multiple skills and disciplines.

(c) Inclusion of local peoples in research
Local knowledge is beginning to be incorporated into formal biodiversity studies, and information is increasingly being shared across academic and local communities. Use of indigenous classification and knowledge has increased. Parataxonomy is opening up the ivory tower to people on the ground, leading to participatory research.

2. Gaps and Research Needs

2.A. Knowledge Gaps and Research Needs

(a) How much biodiversity there is and where it is (Quantification and mapping of biodiversity).

Gap:

Very sparse information on species' numbers, identities and distribution for many taxa and areas.

Research Need:

The is an urgent need for a massive biodiversity inventory effort, in particular we need to:

- identify biodiversity hotspots
- identify the 'dulls' (less charismatic biodiversity in less diverse areas)
- update floras (these should have a clade approach, rather than a regional approach. E.g. the legumes of the world, rather than the flora of Nebraska)

(b) Classification and Phylogenetics (or taxonomic relationships)

Gap:

Existing classifications (species, DNA based lineages, functional groups) are often not compatible.

Research Need:

We need to better understand relationships between species and between species and other levels of organization in the structure of communities. (In addition to yielding more complete understanding of biodiversity, this will assist understanding of species invasions) .
Need coordinated effort to map the Tree of Life.

(c) Theories for marine biodiversity

Gap:

Knowledge of marine biodiversity is very poor relative to terrestrial biodiversity and lacks conceptual theories, which it currently mostly borrows from terrestrial spheres. Lack of theoretical foundation prevents predictive knowledge.

Research Need:

There is much taxonomic descriptive work to be done in marine ecosystems particularly. This is needed to provide a foundation from which to develop conceptual theories to support predictive assessments

(d) Integrated, holistic datasets

Gap:

There is a lack of physical information associated with inventory areas.

Research needs:

We need a major integrated research effort to coordinate global inventory efforts across disciplines, including multidisciplinary field trips and all taxa exploration of key environments. In addition to species lists, information is need on abundances, interactions, geographic range

maps, phylogenetic information . This will require standardized methodologies, data management and analyses.
We should compile natural history information for species including DNA sequence, species, location, sex, population. Efforts should also be made to determine phylogenies. Once a 'critical mass' of species in a particular group have been identified, the focus should be on gathering this complete natural history information, rather than finding every last species in a group. Once this information is fairly complete and credible, it should be put into public domain.

(e) Human dimensions of biodiversity

Gap:

Although the human dimension of biodiversity is beginning to be incorporated into research (See section 1) the following human dimensions represent significant barriers to our understanding and conservation of biodiversity:

- economic values of biodiversity are not quantified or agreed upon
- management strategies for conservation – there is not clear consensus on whether we should we have protected areas, conserve within human communities, or manage all because we affect all.
- relationship between conservation and sustainability is not established. Are they compatible, linked, separate?

Research Needs:

Research should focus on the following human dimensions of biodiversity:

- importance of biodiversity for human health
- development and sustainability
- biodiversity economics
- conservation
- the role of biodiversity in restoration.

An example: Large areas of wild lands in tropics should be conserved, and less pristine lands in between restored to connect them. Non-damaging use *in situ* should be developed and for all *ex-situ* uses, royalties should be returned to the source.

(f) Biodiversity and ecosystem functioning

Gap:

We lack general theories on the relationship between biodiversity and ecosystem functioning.

Research Needs:

Need experimentation on ecosystem services to quantify relationship between biodiversity and ecosystem functioning and understand the functional role of biodiversity

(f) Biodiversity and change

Gap:

We need information on the response of biodiversity to change. Invasive species were singled out as a particular gap in knowledge, see below.

Research needs:
Need to assess impact of global changes on biodiversity, namely climate change, land use change, atmospheric change and invasive species. (Invasive species were singled out as a special research need, see below). Particular research needs are:

- do we theorize [model] or monitor to evaluate global biodiversity change?
- what systems do we study to be more effective when problems arise?
- develop assessments of vulnerability of species/ecosystems to change
- develop criteria for interpreting change, at local, regional and global scales, and its significance.

Data should be collated for a website that displays habitat change

(g) Invasive species

Gap:
Lack of information on species invasions hinders development of effective prevention and control measures.

Research Need:
Need information on properties of invasive and invaded species , especially:

- how resistant communities are
- what is the threshold for invasion
- models of the way that invasive species adapt.

(h) Bioindicators

Gap:
Do not have bioindicator tools needed by managers for rapid assessments of biodiversity, ecosystem health, or ecosystem change. There is currently a lack of appropriate indicators, and poor baseline knowledge for indicators.

Research Need:
Need to develop appropriate bioindicators for diversity and ecosystem health
E.g., indicators for sustainable forests.
We need to assess whether it is possible to come up with indicators, e.g. through validation of existing data and work on poorly known organisms.
This will require collaboration of maths, economy, GIS, political sciences, human sciences

(i) Scaling

Gap:
Lack of information on how to integrate knowledge of biodiversity among scales, taking into consideration from plot to landscape, regional to global. Boundaries are critical.

Research Needs:
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(j) Communicating

Gap:

Too little emphasis is put on education. There is lack of appreciation of importance of biodiversity by the public. Need to make people understand interconnectivity between biodiversity and their lives, across the globe, e.g. why the disappearance of Cape flora is important to people in the Himalayas, and why scientists think it is important to conserve biodiversity.

Too much emphasis is placed on value of biodiversity for human usefulness. We need to take into account ethics, beauty, spirituality. Strong coalitions for biodiversity conservation can be developed with religious groups, not just politicians.

Research Needs:

Need to overcome barriers of communication. Need to make collaborations with social scientists/educators. Need stories and a continuous supply of new stories to demonstrate the importance of biodiversity and what is being done to conserve it. Need appropriate multi-tiered education.

E.g. There should be programs to promote bioliteracy in the tropics, since the population is becoming increasingly urban and losing its appreciation of biodiversity.

2.B. Technical/Resource Gaps and Research Needs

(a) Human resources

Gap:

There are declining numbers of whole organism biologists/systematists. The older generation is not being replaced, largely because there are few career opportunities for bright young people in this area.

(b) Patch protection

Gap:

There is insufficient sharing of resources. Limited access to genetic resources, specimens and data within nations and corporations impedes sharing of knowledge and development of large-scale holistic understanding

(c) Uneven resource distribution

Gap:

There is research and resource neglect of the most biodiverse countries, which are often poor. Distribution of human, logistical and financial resources is concentrated in the Northern, less diverse hemisphere.

(d) Observation tools for inaccessible species

Gap:

Cannot observe life well in ocean floor, soils and microscopic habitats. Need new tools and technologies to access these domains.

(e) Tools for identifying 'difficult' taxa

Need:

Need molecular toolkits for resolving species identifications in difficult groups.

(f) Tools for conservation

Need:

Molecular techniques for ex-situ preservation of endangered or threatened taxa are needed to complement in-situ conservation programs

4. Recommended IBOY Events to make a big impact

IBOY Synthesis/Summary Meeting – fall 2002
Location – divided opinion as to whether to attach it to large international event such as Rio + 10. Some believed this would provide necessary high impact arena and be essential, especially if fundraising in short time. Others believed it would cause the IBOY event to be side-lined.
Theme:
synthesis across various flagship projects to evaluate advances in biodiversity research over last decade
assess directions and challenges for future decade
possibly launch new programs to address challengers. Electronic conference before hand.
Communicate locally, regionally, nationally.

Internationally Coordinated BioBlitz (or other event such as streamwatch) - to engage and educate public and get support

A day in the Life of the Earth - pictures from around the world put on the internet. Webcams (perhaps for Earth Day)

Concerts – to celebrate artistic elements of biodiversity, and use dance, music etc. as educational tool

Traveling art show ($2m per year)

TV commercial ($50K)

Media day for IBOY (as part of Earth Day)

IBOY showcase to sponsors and philanthropists – biodiversity briefing

Launch major promotion of the conservation biology discipline

Compile and a list of research and communication needs for biodiversity

Give scientific input to CBD

Establish on ground training for professionals to keep them updated with latest information and techniques

Expand/develop Kids page on IBOY website – in conjunction with curricula

Website competition for kids. Content on biodiversity. Corporate Sponsorship (Joris would have god ideas for this).

Program of scientists in schools, or school children in the laboratory, shadowing a scientist – in conjunction with professional educators

IBOY project leaders regularly send information to IBOY to keep webpage up to date and to expand projects and links pages

IBOY Project leaders to communicate program at home. IBOY Secretariat to send IBOY slides to project leaders.

IBOY Project leaders put the IBOY URL at bottom of all emails – generate and IBOY worm