NATURAL HISTORY MUSEUM

ESFRI Innovation Case

SYNTHESYS RI - Bio-econom

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Introduction to SYNTHESYS RI

- FP6 & 7 funded RI which encompasses 20 of the leading natural history collection holding institutes in Europe from 11 countries
- NHM, London is the consortium coordinator
- Under the FP6 & 7 funded RI 37,000 User days will be provided to more than 2,500 Users
- Networking Activities will improve collections access for external user & collections management
- Joint Research Activities focuses on unlocking DNA in collections with minimised specimen damage

Natural History Collections as RIs

- Collections, work well in arrays and can look back in time and help to predict future trends/ events e.g. climate change & species distribution
- A large collection (e.g. NHM) holds 70 m specimens, value over €7.5 billion; SYNTHESYS consortium as a whole has 337 m specimens
- almost unique to RIs, value increases over time

The Name Game

- 1.5 million named species to-date
- Circa. 10,000 new species described per annum
- Innovations in databasing technology and use of molecular techniques are helping to speed up the naming process significantly
- Physical collections developed over 200 years can now begin to be integrated *virtually* to provide a map of Earth's diversity through time
- Collections act as the **best available model of the Earth's diversity**

SYNTHESYS RI: broad context contribution to the knowledge economy

- Key role in:
  - *Providing data for improved public policy* e.g. biodiversity action plans and EIAs
  - *Training Europe's workforce in transferable skills* e.g. molecular biology and informatics
  - *Improving performance of existing businesses* e.g. ecosystem services, geo-referenced maps for mining industry, phyto-sanitary regulation via **DNA barcodes**
  - *Improving the scientific literacy of the public e.g.* NHM has over 3million visitors through the doors per year taking away a message about responsible use of the environment

Why does biodiversity matter to the bio-economy?

- Economic Driver:
  Ecosystem services that support life on Earth (e.g. crop pollinators, air and water quality regulators) valued at $30-40 trillion
- Risk:
  UN-sponsored Millennium Ecosystem Assessment states 60% of these essential services are being degraded/ used unsustainably
- Challenge to Taxonomic Research Community:
  Deliver an accurate document of diversity so management plans can be more robust

Innovation exemplar: DNA Barcoding

- Barcode = a short DNA sequence, from a uniform locality on the genome, used for identifying a species.
- Collecting fresh material to generate the DNA barcode reference library for all species is not only prohibitively expensive but also legally challenging due to increasing restrictions in collecting permits in some of the most biodiverse countries on Earth
- Collections provide the most *accurately identified* catalogue specimens of all known species

DNA barcoding: innovation grounded in natural history collections based RIs

- Works with fragments e.g. bird strikes on jet engines
- Works for all stages of life e.g. pest larvae and disease vectors
- Makes expertise go further
- Opens the way for an electronic handheld field guide, the Life Barcoder
- Speeds writing the encyclopaedia of life
- In time will democratize access and assist in generating a more scientifically literate population

Examples of Users of Natural History Collections

- Public Health Officials: working on vectors of diseases and monitoring their spread in Europe
- Agriculturalists: identifying of wound causing pests in cattle
- Fisheries researchers: species distribution monitoring in European waters (inc invasives e.g. in ballast water)
- Biostratigraphers: micropalaentological analysis of core samples for global oil and gas exploration
- Biodiversity Planners: mapping global species distribution
- Environmental Change Modellers: developing lichens as bioindicators of air quality

Future Challenges

- Continue the task of filling the gaps in the encyclopaedia of life, ultimately build a complete species list & DNA barcode reference collection
- Integrate the collections data with other environmental data sets (e.g. oceanographic data) to help enhance the robustness of environmental modelling
- Making high quality virtual access a reality e.g. via remote microscopy, online 3D-images for verification of field samples
- Miniaturised tools for DNA sample collection