Paul Williams

Character Diversity

Born 1959 in London. M.A., Ph.D. in Natural Sciences from the University of Cambridge (1985). Postdoctoral research at The Natural History Museum, London, on behaviour, distribution and systematics of bumble bees, working particularly in Kashmir. Since 1990 as part of the NHM Biogeography and Conservation group, working on measures of biodiversity, design of computer tools for biodiversity analysis, and in joint work at the Royal Botanic Gardens, Kew, on applying methods for choosing conservation areas for rainforest trees in the Amazon basin. — Address: Biogeography and Conservation Laboratory, The Natural History Museum, Cromwell Road, London SW7 5BD.

My part during five months at the Kolleg was primarily to write or co-ordinate two of the chapters for the "Schwerpunkt Biodiversität" book and to develop implementation of methods in the form of computer software. These chapters cover how to measure biodiversity (in the absence of an agreed definition) and how to make the most of existing data (in the absence of appropriate data).

Biodiversity has been seen as including all of the complexity of life on Earth. Consequently, no single measure can capture all its aspects, and conservationists must choose which aspect they most value for conservation. In the past, different interest groups have placed value at the level of either genes, species or ecosystems. Discussions with other Fellows — Sandra Mitchell and Gustav Ranis — and with visitors — Katrina Brown and Norman Myers — helped to clarify economic arguments for the value of biodiversity. This led to a focus on *option value* (analogous to a form of insurance) as a justification for conserving the variety of underlying characters (homologous attributes) of organisms. These characters can also be seen as depending on expressed genes and as governing interactions within ecosystems.

Unfortunately, character diversity cannot simply be added up in the field. Work in Berlin has helped to clarify how character diversity may be estimated from taxonomy for small groups of well-known organisms. Patterns of ownership of characters by species can be predicted from the

pattern of genealogical relationships among species using process models for how characters evolve.

Another problem for biodiversity accounting is that the total number of different organisms in even quite small patches of land cannot be counted directly. The narrowly circumscribed problem of estimating diversity for small, well-known groups of organisms may be far removed from considering the diversity of all life, but its solution can be used to justify other very different approaches, such as the use of land classifications, as less direct surrogates for character diversity. These more remote surrogates may be less precise, but should not be viewed as necessarily inferior. They may be both practical to measure as well as providing functional links among species that are important for the future viability or persistence of biodiversity.

During the year, I continued to develop computer software (WORLDMAP) as a test platform for ideas from the biodiversity group, enabling the consequences to be explored with real data. This involved changes in the algorithms for diversity measures. In addition, heuristic procedures to identify those near-minimum sets of areas required to account efficiently for all species (or other attributes) among areas were introduced and refined. These setwise procedures have to be able to cope with multiple as well as single representations of species, and to convey information on the irreplaceability or flexibility of area choices, in order to aid negotiations in land-use planning.

Inevitably, prior commitments to other papers and reports intruded and several new projects were initiated. I took the opportunity to spend time at the entomology department of the Humboldt museum, where collections include important type material of bees described by H. Friese and others. This contributed to long-term projects on a catalogue of bumble bees of the world (c. 3000 names), a revision of species concepts (c. 250 species), and an atlas of species distributions world-wide, all necessary foundation work for investigating questions in historical biogeography.

Predictably, the greatest difficulty at the Wissenschaftskolleg was in allocating time among Berlin, life at the Kolleg, and the biodiversity project. The year was a unique opportunity and has definitely been successful in harmonising the diversity of views within this group project.