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THE AUSTRALIAN NATIONAL UNIVERSITY

COUNCIL - 11 MAY 1979

REPORT BY THE ACTING DIRECTOR OF THE

RESEARCH SCHOOL OF BIOLOGICAL SCIENCES

The research interests of the School have continued to cover the major growing points of Biological Science, ranging from ultrastructure to community structure and from viruses to humans. The prime aim of these studies remains unaltered. It is to deal with fundamental Biological problems at all levels utilising, wherever possible, material that is uniquely Australian in character. The three topics chosen for a more detailed presentation, not only reflect the range of studies but give some indication of the applied potential inherent in such fundamental research.

Encephalitis viruses and their mosquito vectors

Murray Valley encephalitis is caused by a group of viruses spread by mosquitoes. Work at the John Curtin School has shown that epidemics of the disease occur in unusually wet years when mosquitoes and water birds are exceptionally abundant. Little, however, is known about the population ecology of these viruses, their vectors or their vertebrate hosts and some of these aspects are currently being studied by the Virus Ecology Group, RSBS. This information is essential before an integrated scheme for the control of the disease can be properly planned.

Many mosquitoes are known to occur as a series of sibling species, that is, species which are morphologically indistinguishable yet genetically differentiated to the extent that they will not cross-breed. Such sibling species are most readily distinguished by an analysis of the detailed organisation of the giant banded chromosomes available in the salivary glands of mosquitoes in conjunction with an examination of patterns of variation in certain of their enzymes. Using these approaches the Virus Ecology Group have shown that the plague mosquito Culex annulirostris, which has formerly been treated as a single species, in reality includes at least two sibling species. The behaviour and virus-transmitting ability of these siblings are currently being compared.

Just as mosquitoes may vary so too may their viruses, and it has been possible to isolate attenuated strains of the encephalitis virus. These have potential importance for the production of encephalitis vaccine. The strains may also be of importance as a natural control system since when infected with them host mosquitoes cannot be infected with the parent strains of the virus.

The genetic structuring of Australian fish populations

The Department of Population Biology has been examining the distribution of genetic variants in space and time for a range of commercial species of fish. The purpose of this work, which is being carried out in conjunction with the CSIRO Division of Fisheries and Oceanography and the Commonwealth Department of Primary Industry, has been to determine the number and distribution of stocks of Jack Mackeral, Morwong, Snapper, Australian Salmon and Gemfish around Australia. By an analysis of enzyme variation it has been possible to demonstrate that the first three of these exist in a number of distinct genetic stocks. Attention is now being directed to the environmental factors that play a role in influencing the observed patterns of distribution of these stocks.

A similar, though more wide ranging programme, has been started in the commercially valuable Skipjack Tuna in the Southwest Pacific region. This project has the support both of the South Pacific Commission and the National Governments of the region. To date it has been found that a number of different stocks overlap extensively in the region. Despite this they remain distinct. How the genetic differences between these stocks are maintained in the face of the obvious intermixing of this highly mobile fish is not as yet known but is being investigated.

Biological nitrogen fixation and legume symbiosis

Atmospheric nitrogen can be converted into ammonia by leguminous plants growing in association with an appropriate strain of the soil bacterium Rhizobium. When the bacterium enters the roots of the plant a complex interaction occurs between the two organisms which results in the formation of nitrogen-fixing nodules. Within these nodules the bacteria are transformed into morphologically distinct structures, the bacteroids, which are then able to fix atmospheric nitrogen and the plant uses the ammonia so formed to build its proteins.

The changes which occur at nodulation depend on a correct pattern of recognition and interaction between the plant host and the invading bacterium. The Department of Genetics is currently analysing the molecular signals which operate between the two components of this symbiotic relationship. The factors responsible for inducing the bacteroid to fix free nitrogen appear to be a specific group of chemicals, peptidoglucans, produced by the plant. These enhance the capacity of the bacteria to produce the energy required for the synthesis of ammonia.

Under normal circumstances a particular strain of Rhizobium is only capable of eliciting nodulation in a limited number of host species. This is termed host specificity. This specificity can, however, be broken down by using a mutant form of the bacterium. Additionally it is now possible to use a transferable genetic element to transmit genes controlling the ability to nodulate legumes from one rhizobial strain to another. In this way one can experimentally transfer host range specificity. Studies are currently in progress to broaden host range to a wider group of plants.

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30 April 1979