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ECOLOGICAL SOCIETY OF AUSTRALIA

SYMPOSIUM

on

PHYSIOLOGICAL ASPECTS OF PLANT AND ANIMAL MANAGEMENT

27-29 MAY 1968

to be held in the

DEPARTMENT OF FORESTRY

AUSTRALIAN NATIONAL UNIVERSITY

CANBERRA

ABSTRACTS OF PAPERS

BOTANICAL PROGRAMME

MONDAY 27TH MAY

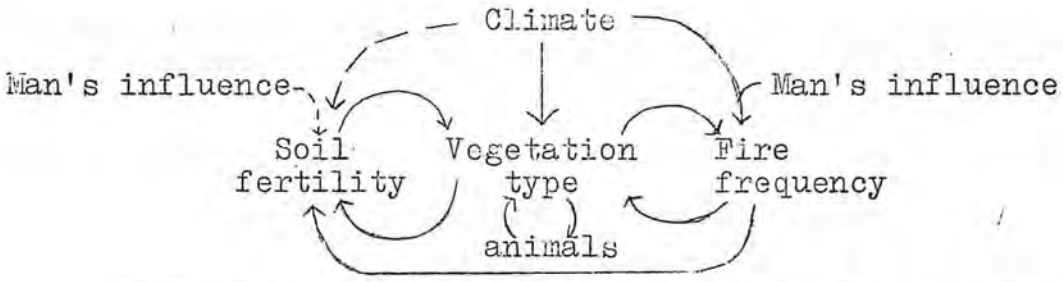
MORNING SESSION CHAIRMAN - Professor R. Slatyer

9.00-9.30a.m. Professor W.D. Jackson (Dept. Botany, Univ. of Tasmania).

Fire, Air, Water and Earth, an elemental ecology of Tasmania.

General surveys of the distribution of major plant communities in Tasmania indicate many apparent anomalies to a conventional view of a simple determination by climate. These apparent anomalies and contradictions appear to stem from our failure to understand the interactions between deflecting influences such as fire and soil fertility on vegetation types and their expression in a given climate. An understanding of these interactions would seem essential to a proper management of the resources and must eventually be related to the physiological reactions and genetical variance in individual species.

Fire must be accepted as one of the major influences controlling the broad aspects of ecological distribution in Australian communities. The sclerophyll species show marked genetical adaption to its influence. This adaption leads to a strong feed back reaction between fire frequency and vegetation type with a second feed back between fire frequency and vegetation types determined by the interaction between soil fertility and vegetation.



The Australian sclerophylls are not merely fire tolerant but are both fire requirers and fire promotors. They have acquired by selection the capacity to tolerate and utilize high fire frequencies in their competitive balance with other communities. They have also in recognition of the second feed back through soil fertility become adapted to low soil fertilities. This has been accomplished by developing high relative productivity in limited nutrient conditions and by accepting symbiotic relationships with microorganisms. Their superior adaption to the effects of fire have allowed them to succeed in competition with the former mesic

vegetation and to resist the changes in the post-pleistocene climate towards wetter conditions. Man's influence on the balance of vegetation types through his influence on the frequency of fires has had a profound effect since the Pleistocene and must continue to dominate our handling of our present resources for a considerable period.

9.30-10.00a.m. Dr. R.D.B. Whalley & Mr. A.A. Davidson (Dept. Botany, Univ. of New England)

Physiological aspects of drought dormancy in grasses

The survival of many perennial plants during annually recurring unfavourable climatic periods is by dormancy. Some types of dormancy are usually induced by thermoperiodic and/or photoperiodic changes preceding the unfavourable season.

Drought dormancy may be defined as dormancy induced by the lack of available soil moisture during the normal growing season; this type of dormancy is broken by the renewed availability of soil moisture. The ability to become drought dormant is important for the survival of perennials in an arid or semi-arid environment.

Patterns of carbohydrate storage and utilisation have been studied for Astrebla lappacea (Lindl.) Domin. Chloris acicularis Lindl. and Stipa aristiglumis F. v. M. during periods of moisture availability and stress. The general pattern of carbohydrate metabolism appears to be similar to that in grasses which undergo seasonal dormancy.

The implications of the above in terms of pasture management for drought survival of the above species are discussed.

10.00-10.30a.m. Mr. J.H. Troughton (CSIRO Divn. of Land Research)

The growth of New Zealand White Clover under a Constant Environment

Production from and the productivity of plant communities is significantly influenced by the loss of carbon either through respiration or death of plant organs. Reliable minimum estimates of the respiratory carbon loss on whole plants over twenty-four hours indicate a loss of between 40 and 60% of the carbon fixed in photosynthesis. The problem has been to measure respiration particularly in the light, and to describe the rate of respiration in relation to the environment.

Several studies of photosynthesis and respiration of whole New Zealand White Clover plants were carried out under controlled environment conditions. Prediction of the growth rate of single plants at different light levels from net photosynthesis-light level response curves was only successful when correction was made for a response of respiration to light level. Continuation of this work by following the growth of whole white clover plants for several months established the importance of leaf death to yield and the dependence of respiration of the plants on the rate of photosynthesis and the weight of plant tissue.

11.00-11.30a.m. Dr. J.L. Charley & Mr. S.W. Cowling (Dept. Botany, Univ. of New England)

Changes in soil nutrient status resulting from overgrazing and their consequences in plant community of semi-arid zones.

A common trend in ecosystem development on parent materials of low nutrient status is the incorporation of much of the total nitrogen and phosphorus capital of the system as a whole into the organic pool of the soil, and the accumulation into the surface horizon of the greater part of this reserve.

Such development is very noticeable in soils of arid and semi-arid areas, principally because total nitrogen and phosphorus levels are low overall and most biological activity in the soil is restricted to the immediate surface as a result of shallow average depth of wetting by rain.

Marked surface concentration of nutrients in organic form has a number of serious consequences for plant communities subject to long-continued overstocking. Foremost amongst these is destabilization of the soil and massive removal of crucial nutrients by loss of superficial litter and soil through wind and water erosion.

A number of undisturbed shrub communities examined in Western N.S.W. show abrupt decrease in general soil fertility down the profile, with the bulk of the organic reserve of nutrients concentrated in the top 3 to 4 inches. As a result of long-continued overgrazing, moderate to severe soil deflation and degradation of nutrient status has taken place in many of these plant communities. Associated with these changes are significant alterations in patterns of mineralization of nitrogen-containing organic residues which appear to severely curtail response of the vegetation component of the ecosystem to effective rainfall and thereby preclude successful regeneration in depauperate communities protected from stock.

The paper sets out the results of a study of nutrient distribution and turnover patterns in virgin and eroded soils common in semi-arid N.S.W., together with an analysis of major environmental influences on physiological activity of the nitrifying organisms present; a general discussion of community nitrogen metabolism in relation to dry matter production patterns and water use efficiency is included. Consideration is also given to problems encountered in regeneration measures undertaken on landsurfaces which have been deflated to a degree sufficient to disturb the crucial organic nutrient pool of the surface soil.

The general findings are examined for the light they throw on some central problems of grazing management in semi-arid plant communities generally.

11.30-12.00noon Dr. J.P. Burrell (School of Geography, Univ. of N.S.W.)

Invasion of coastal heathlands by Leptospermum laevigatum

L. laevigatum is now well established in many Victorian heathlands, but it becomes stunted when grown in heath sands in pot experiments and failed to establish in undisturbed heath in field experiments. In pot experiments the stunting of the plant could be overcome by application of P. Once normal growth is established on heath soil, it appears to continue. The ways in which the nutrition level of heath soil may be temporarily raised are discussed and a plan for the conservation of heath against invasion by L.laevigatum is suggested.

12.00-12.30p.m. Dr. R.H. Groves (CSIRO Divn. of Plant Industry)

Physiology of sclerophyll shrubs of South-Eastern Australia

The information available on the physiological aspects of sclerophyll shrubland (heath) in south-eastern Australia is reviewed. It is shown that growth and nutrition of both the plant community and of representative species have been described. The annual growth curve is sigmoid with a maximum rate of dry matter production of the above-ground component occurring at 10-20 years. Seasonal growth of the community depends on species composition and may occur in spring or late summer.

An efficient recycling of mobile nutrients, particularly phosphorus, within shrubs and a conversion of organic phosphorus compounds to readily available phosphorus at a time when growth may proceed are considered to be the main nutritional factors in the continued growth of the shrubland species on soils low in nutrients. Other physiological factors will be considered.

These findings will be related to the management of shrublands for agriculture and for conservation.

BOTANICAL PROGRAMME

MONDAY 27TH MAY

AFTERNOON SESSION CHAIRMAN - Dr. R.M. Moore

2.00-2.30p.m. Professor B.J. Grieve & Mr. E.O. Hellmuth (Dept. Botany, Univ. of W.A.).

Ecophysiological studies of West Australian plants

A review is given of work being done in the Botany Department, University of Western Australia on the eco-physiology of native shrubs and trees in climatically different areas of the State from the temperate to the arid zone.

The studies on transpiration, osmotic quantities, water deficits, photosynthesis, respiration, leaf temperatures and heat resistance, were designed to throw light on physiological adaptations, if any, in these plants. Most plants tested, whether sclerophylls or xerophytic mesophytes, were found to restrict their water loss in late summer. With advancing season, curves of water loss changed from symmetric one-peak curves to two-peak curves with midday depressions and finally to low level asymmetric one-peak curves.

For Rhagodia baccata growing in an arid area it has been shown that in the dry season critical water deficits develop causing stomata to close and restricting transpiration. In an associated sclerophyll Acacia craspedocarpa increasing cutinization of the epidermis and some internal changes in which pigmentation is involved are associated with decreased transpiration in summer. Curves for net photosynthesis followed a similar pattern to those for transpiration. In most cases a positive CO_2 balance was recorded throughout the year. Leaf temperatures showed significant depressions below air temperatures when transpiration rate was high. Heat resistance in sclerophylls was somewhat lower than for a xerophytic mesophyte tested.

The application of knowledge relating to the physiological characters of the plants examined is discussed.

2.30-3.00p.m. Professor N.C.W. Beadle and Mr. G.J. White (Dept. Botany, Univ. of New England)

Some aspects of the mineral nutrition of Australian woody plants.

The distribution of woody plant communities and species appears to be governed largely by soil nutrients in the frost-free areas of eastern Australia; soil phosphate is probably the most

important nutrient in most cases. The occurrence of species in specific areas is an indication that the soil can supply sufficient nutrients to maintain the population of the species in competition with others in the same community. Some woody species appear to have ecological advantages which enable them to occupy soils of low fertility, one advantage being the ability to withdraw nutrients, particularly phosphorus and potassium, from the inner secondary xylem; it is assumed that these nutrients are utilised again elsewhere in the plant.

Analyses of the trunks of rainforest species indicate that little withdrawal of any nutrients from the inner secondary xylem occurs. However, rainforest species growing in the same stand do not all withdraw nutrients to the same extent - the most mesomorphic e.g. Laportea gigas show least withdrawal, the more xeromorphic e.g. Orites excelsa show the most. Withdrawal therefore is possibly not simply a function of overall requirement of the plant, but the ability to withdraw may have a genetic basis and this ability may indicate an inherent genetic plasticity which enables a taxon to acclimatise itself and ultimately to adapt to a less fertile environment.

In contrast to the rainforest trees, eucalypts growing on soils of low fertility have the power to withdraw nutrients from the inner secondary xylem, particularly P, K and Mg.

Analyses of the woody trunks of three desert species show that in two cases (xeromorphs) withdrawal from the secondary xylem of P and K both occur, whereas withdrawal of Ca does not, which suggests that withdrawal is a response to low nutrient conditions and a nutrient-demand in the living parts of the plant; Ca in the soils supporting these species is abundant, occurring as free $CaCO_3$. On the other hand Flindersia maculosa, a species of rainforest ancestry "stranded" in the desert does not have the same ability to withdraw P from the secondary xylem.

The location of the water soluble nutrients in the secondary xylem of trees will be discussed as far as the data on hand will permit.

3.00-3.30p.m. Dr. O.T. Denmead (CSIRO Divn. of Plant Industry)

Comparative response to environment of wheat and pine trees - a study in micro-meteorology

Studies of the influence of the physical environment on plant growth processes in the field will be described. The work is concerned with the energy and carbon dioxide balances of various plant communities. An immediate aim is to identify sources, sinks and transfer processes for energy, heat, water vapour and carbon dioxide in and above the communities. In the long-term, it is hoped the work will provide a quantitative basis for tackling the

problem: how to make best use of existing climatic resources for plant production; in particular: what dry-matter production can one expect from various plant communities in a given environment, and at what cost in terms of evaporation? Examples of the diurnal exchanges of energy, water vapour and carbon dioxide over an annual community, a wheat field, and a perennial, a forest of Pinus radiata, will be given.

3.45-4.15p.m. Mr. K.G. Eldridge (Forest Research Institute & Dept. of Forestry, A.N.U.)

A physiological study of ecotypes of Eucalyptus regnans

Seedlings derived from stands at the extremes of the altitude range of Eucalyptus regnans F.v.M. on Mount Erica, Victoria, showed distinct differences when grown at controlled temperatures in the C.S.I.R.O. Phytotron, Canberra, under luxury conditions of nutrients and water.

The low altitude ecotype, from 900 ft above sea level, grew slightly faster at all temperatures with the greatest difference at the lowest temperature, 9°C, and short days. Under these conditions it was much more susceptible to artificial frost of -5°C than the high altitude ecotype from 3500 ft only three miles away.

It was concluded that the high altitude ecotype has been selected for a tendency to winter dormancy which apparently leads to greater frost resistance and also helps to explain the slower growth in long term field experiments.

4.15-4.45p.m. Dr. E.P. Bachelard (Dept. of Forestry, A.N.U.)

Weedicides - an ecological tool in forest management

Weedicides can be an effective tool in controlling the composition of plant species in many situations. Important factors in the selection of a weedicide for a specific task include efficiency of weedicide, and possible damage to the crop plant. In this paper, relative efficiencies of many weedicides in controlling the composition of a commercial forest stand are examined, and the potential damage to a crop plant (Pinus radiata D.Don) by direct exposure to weedicide spray, or by uptake of weedicide from the soil are discussed.

Limitations in knowledge of factors affecting uptake and translocation of weedicides within the plant, and of the fundamental physiological action of weedicides are barriers to the most

efficient use and formulation of weedicides. Work aimed at examining some of these problems is described.

4.45-5.15p.m. Mr. A.G. McArthur (Forest Research Institute).

The resistance of eucalypts to fire

Eucalypts are recognised as one of the more fire resistant group of trees in the world. Yet within the genus comprising around 640 species, there is a wide range of variation in relative fire resistance.

The particular adaptations which enable the eucalypts to survive fires of very high intensity are the nature and thickness of the bark covering; the presence of a very large number of dormant bud strands along the bole and branches and the presence of lignotubers at or below ground level.

The various factors affecting susceptibility to damage are discussed, with particular reference to the role of bark thickness as a protective mechanism.

The true fire resistance of a particular species can only be determined in relation to the development of the protective mechanisms on the tree and to the environmental factors of the site in which the particular species is growing.

The amount of combustible material produced by the site determines fire intensity and the extent of the thermal heat pulse to which the tree is subjected. Frequently eucalypts growing on sites which produce large quantities of combustible material have thin barks and either a poorly developed or complete absence of a lignotuber system.

The persistence of flaming combustion determines the duration of the heat pulse and this factor is discussed in relation to the fire resistance of various eucalypt associations.

A method of assessing fire damage and so the fire resistance of an individual eucalypt species is presented.

5.15-5.45p.m. Dr. L.J. Webb (Rain Forest Ecology Section, Divn. of Plant Industry, CSIRO)

Some biological aspects of forest management

Abstract will be available on day.

ZOOLOGICAL PROGRAMME

TUESDAY 28TH MAY

MORNING SESSION CHAIRMAN: Assoc. Professor J.Le Gay Brereton

9.00-9.35a.m. Professor A.R. Main (Zoology Dept., Univ. of Western Australia).

Physiology in the management of kangaroos and Wallabies.

Following a statement of the general aims of management this paper sets out the contribution that physiological studies might make to management procedures.

In particular the contribution of eco-physiology is discussed in relation to:-

(a) the maintenance requirement in terms of nitrogen energy etc.
(b) the ability of animals to endure harmful conditions, e.g. heat and drought.

It is concluded that management procedures will vary as maintenance requirements are unsatisfied or harmful environmental conditions induce mortality. Field examples are briefly cited. The results are summarised in a general table.

9.35-10.00a.m. Dr. G. Brown (CSIRO Divn. Animal Physiol., Prospect)

The nitrogen and energy requirements of the euro (Macropus robustus) and other species of macropod marsupials

The nitrogen and energy requirements of herbivores are commonly expressed in terms of the minimum requirements sufficient to maintain nitrogen or energy equilibrium under well defined conditions in laboratory experiments. The additional requirements for activity, reproduction and growth are also usually determined under these conditions. Even for domestic species, this information is insufficient to allow precise estimates of the nutritional requirements for protein and energy of animals which are functional units of populations in field conditions. The data available for wild animals is extremely limited. However, on the basis of studies of the nitrogen requirements of the euro and some other species of macropod marsupials a statement about the lower limits of the nutritional requirements of these animals can be made. Such a statement may provide a yardstick for those involved in the management of natural populations of macropods which could be used as a basis for anticipating conditions likely to result in

nutritional stresses.

The minimum nitrogen requirements of the euro were found to be about 1 gm of digestible nitrogen per day. Preliminary investigations of the minimum nitrogen requirements of a further four species of macropod marsupials have been carried out. It was found that the requirements of these species were of the same order as those previously determined for the euro when compared on the basis of metabolic body size (Kg $W^{0.73}$). The minimum nitrogen requirements of these species were considerably lower than levels given in the literature for comparable eutherian species.

Indirect evidence (pulse rate, voluntary food consumption, endogenous urinary nitrogen excretion) suggests that the level of energy metabolism of these species of macropod marsupials may be somewhat lower than that of eutherian species. It is suggested that the nitrogen and energy requirements of these species of macropod marsupials are lower than those of domestic ruminants. Such a reduction in nutritional requirements may be of adaptive significance in an arid environment. It may also be of importance in terms of survival in those areas in which severe seasonal aridity is experienced.

10.00-10.25a.m. Mr. K.D. Casperson (CSIRO, Divn. Wildlife Res.)

Influence of environment upon some physiological parameters of natural populations of rabbits

The data of this paper represent some of the results obtained during a systematic sampling of rabbit populations in each of four climatically distinct areas in eastern Australia over a period of 16 months. Within each site data were obtained on hematocrit (PCV), total serum proteins, body weights and size, weights of heart, spleen, stomach, liver, adrenals, kidneys, testes, ovaries, and reproductive condition. Estimates of body fat stores were made by means of a subjective index of kidney fat and determination of fatty acids present in the liver and marrow of the right femur.

Results have indicated significant variation both within and between sites in regard to hematocrit (PCV), total serum protein, body weight and size, weight of kidneys, liver, adrenals, spleen, testes, ovaries, reproductive condition and body fat stores. Variations in the foregoing show a close relationship to rainfall which was significantly correlated with the level of crude protein and crude fibre present in samples of recently ingested food obtained from the forepart of the rabbit stomach.

10.55-11.20a.m. Dr. J.J. Lynch (CSIRO, Pastoral Res.Lab., Armidale)

Shelter and the physiology and behaviour of newly shorn sheep

Some Merino ewes and wethers shorn in winter at Armidale, N.S.W. were kept in unprotected pens, some in paddocks with different types of shelter and some were kept in an unsheltered paddock.

The behaviour of the free grazing sheep in attempting to ameliorate their environment is described. The sheep in the paddocks with shelter returned to their normal grazing pattern more rapidly than the non-sheltered group. The group with the best shelter were virtually undisturbed in their grazing routine.

The 15 shorn penned sheep were most severely affected of all sheep with 2 dying and 2 others showing severe hypothermia before management procedures saved them. Shivering, food intake and respiratory rate of the penned sheep were measured and the results are discussed.

11.20-11.45a.m. Dr. G. Alexander (CSIRO, Divn. Animal Husbandry, Prospect).

The environment and neonatal survival in sheep in Australia

This paper reviews the evidence about environmental factors contributing to the Australian average mortality of about 20 per cent amongst young lambs, within the first weeks of life.

Factors operating prenatally include nutrition of the pregnant ewe, infectious disease, and environmental heat. Factors operating post-natally include aberrations in maternal behaviour and the effects of cold on teat-seeking activity in the lamb. The homeothermic mechanisms in lambs are physiologically well developed at birth, but the climatic limits to homeothermy are often exceeded during lambing in winter or spring in southern Australia.

These factors are considered in relation to the various types of husbandry systems encountered in Australia, for management of lambing flocks. The systems range from complete non-interference, through the inefficient "average" system, to drift lambing and supervised pen-lambing of individual ewes.

11.45-12.05p.m. Mr. J.N. Epworth & Assoc. Prof. J. Le Gay Brereton (Depts. Zool., & Biochem. & Nutrition, Univ. N.E.)

Studies on bull behaviour and implications for management

Low reproductive efficiency is often quoted as an important factor limiting productivity in the cattle industry. To date most research into reproductive problems has been strictly biochemical and physiological and little attention has been given to reproductive behaviour and its physiological basis.

The performance of bulls during mating depends on their general health. It also depends on their basic behavioural patterns, which are partly innate and partly learned and which may vary with breed. Studies have been made on the development of social and reproductive behaviour patterns during adolescence in two bull herds near Armidale.

A description is given of these patterns and particular reference is made to an important problem in studs, homosexual mounting. The possible physiological basis for this and the implications for management are discussed. The interdependence of behavioural and physiological studies is stressed. An indication is given of how the information obtained from these studies could be used to explain observed differences in breeding performance, to guide in the selection of bulls, and to give a framework in which physiological studies can be evaluated. A knowledge of behavioural patterns of cattle should indicate which of the patterns should be retained or encouraged to increase productivity. It should also aid in the formulation of breeding management practices.

12.05-12.30p.m. Dr. G. McBride (Dept. Psychology, Univ. Queensland)

Social organization and stress in animal management

Stresses are applied to animals in the form of stimuli of various types, and social stress in stimuli from conspecifics, usually in the form of aggression. The result of such stimuli is a series of physiological changes, collectively referred to as strain. The distribution of social stresses within animal species is organized through the social structure in such a way that a class of alienated animals is usually created. These animals have limited freedom to control their movements and so escape stresses either from dominant individuals or from other environmental sources.

A number of factors operate to determine the severity of social stresses present in any species, and thus the size of the alienated group and the degree of strain of such individuals. Of these density, limitations on available space and disturbance seem most important. In addition the spatial requirements of animals are not constant in time, but vary seasonally as a result of endocrine changes and on daily cycles with activities. Thus social stresses are likely to be more severe at periods of high space requirements. The implications for the management of different classes of animals will be discussed.

AFTERNOON SESSION CHAIRMAN: Dr. L. Barton-Browne

2.15-4.15p.m. Dr. R.D. Hughes (CSIRO, Divn. Entomology,

Ecologists and physiology

When the ecology of an insect pest is studied, many of the relationships observed have their basis in the physiological mechanisms of the species. The distribution, activity levels and development rates of all the organisms involved depend directly on the physical characteristics of the environment, light, temperature, rainfall, etc. Variations in the physiology of the components of the food chain which alter the quality of availability of nutritional requirements also affect a wide variety of relationships directly. Even the more complex relationships of behaviour patterns and population dynamics may be initiated, modified and terminated by physiological mechanisms. So the ecologist must frequently make physiological observations and experiments and also analyse them. Any insect management programme must take into account and perhaps manipulate direct and indirect physiological relationships of the subject species.

The need for physiological study of a problem often appears before the full ecological implications have been worked out. Then, because it is often possible to advance more rapidly on the physiological study, there is a temptation for the ecologist to give it a lot of attention. However, the logical analysis of a physiological problem is a considerable undertaking, which its importance to the ecological study may not warrant. If it does warrant a full analysis the possibility of farming out the problem to a physiologist should be considered. In either case the immediate ecological limits of the problem should be closely defined before the physiological approach is made, otherwise the latter can produce answers not relevant to the field study. Furthermore, if the physiological answers are not critically reappraised in relation to the ecology of the species, even the best analysis can lead to misleading conclusions.

An example of this can be seen in the published work on the facultative pupal diapause of the Cabbage Rootfly, where physiologists have extended studies on the induction effects of temperature and day length beyond the normal ecological limits of these factors. The resulting conclusions concerning the relative importance of the two factors have been accepted by workers involved in field control programmes. However, reference back to the ecology of the species shows these conclusions to be wrong in practice.

2.15-4.15p.m. Dr. J. Madden (CSIRO, Divn. Entomology, Hobart)

Physiological aspects of tree host favourability for Sirex

The selection of potential breeding sites by the wood wasp Sirex noctilio F. involves both attraction to the host tree and assessment of the site by trial insertions of the ovipositor. The attractiveness of trees and their acceptability as oviposition sites depend on their physiological state but the characteristics eliciting each response are not always precisely linked. Attraction may be followed by rejection in the assessment phase while, in certain circumstances, unattractive material may be found suitable for oviposition.

The host location response is primarily olfactory. Factors favouring attraction are growth suppression and abnormally high rates of host tissue respiration. Circumstantial evidence indicates that due to such adverse physiological changes the permeability of the phloem tissue is increased and the Sirex attractant is released.

Acceptability seems to depend largely on the osmotic qualities of the phloem substrate; low osmotic pressure being more favourable for oviposition than high. Tree debilitation generally produces these favourable conditions.

The primary attractiveness and suitability of host trees is reinforced by secretions deposited by Sirex in the tree during oviposition. These secretions intensify the original stress, cause further debilitation of the host tree and favour the establishment of the symbiotic fungus of Sirex, Amylostereum sp., within the tree.

Trees in which eggs have been laid are capable of resisting attack by producing excess resin flow which may invade oviposition shafts and occlude the eggs; and by the forming of fungiostatic polyphenols around the site of oviposition which effectively isolates the fungus from the living tree tissue.

Dominant trees are rarely attacked and when they are the attack is usually unsuccessful. Physiological stress of trees arising from environmental influences appears to be the chief factor predisposing them to Sirex attack although the possibility of a genetic source of resistance cannot be excluded.

2.15-4.15p.m. Drs. G. Bennett & R.H. Wharton (CSIRO, Divn. Entomology, Yeerongpilly).

Variability of host tolerance to the cattle tick Boophilus microplus (Canestrini)

The cattle tick Boophilus microplus (Canestrini) is parasitic on various bovine species in tropical and sub-tropical climates. Although cattle are regarded as the normal hosts, B. microplus has been recorded from a variety of animals, not uncommonly from water buffalo, horse, goat, sheep and deer, rarely from dog and cat, and doubtfully from marsupials. With the possible exception of deer, it is unlikely that cattle tick could survive in nature in the absence of cattle.

Cattle exhibit varying degrees of resistance to infection with the cattle tick but resistance is usually associated with Zebu-type cattle (Bos indicus). However, all cattle are resistant to some degree and highly resistant cattle occur in all breeds. Under field conditions resistance is measured by counting semi-engorged females and within a herd ranking for resistance remains relatively constant.

Under stall conditions resistance is measured by the yield of engorged females following infestation with known numbers of larvae. Observations on individual cattle have shown that resistance varies widely. Cattle with no previous experience have low resistance but respond to infection and acquire a level of resistance which may remain relatively constant or may fluctuate widely. Factors which influence host resistance can be considered under (a) the effect of environment on host and/or parasite and (b) the physiology of the host. External temperature is known to influence the ability of tick larvae to attach and to affect the duration of the parasitic life-cycle. Factors controlled by the host are incompletely known, but comprise immunological, behavioural (including grooming), nutritional (including lactation, starvation) and possibly physical (coat-type) characters.

Resistance of the host to the cattle tick is thus highly variable, governed by numerous factors, and carefully controlled experiments are required to elucidate cause-effect relationships.

2.15-4.15p.m. Dr. R. Bartell (CSIRO, Divn. of Entomology, Canberra)

The role of pheromones in the life cycle of the light brown apple moth.

The necessity for airborne chemical communication between male and female moths in order to effect their coincidence and eventual mating makes for a vulnerable point in the life cycle open to manipulation for control purposes. If, by some measure, we are able to interrupt, block or misdirect the males' response to the sex pheromone in the field so preventing their location of a female we may be in a position to institute a suitable control. The question now posed is; how may we so manipulate the system? It is evident that with any such undertaking we will be competing with the wild females in the population in some manner and for control to be at all effective we must remove or otherwise interfere with practically 100% of the males. Such a control calls for a high degree of precision in field application. We may consider two general categories of technique:

1. Pheromone baited traps. This approach is designed to directly outcompete the females and attract in excess of 99% of the males orienting toward the pheromone source, and either to destroy them at the traps or sterilise and release them to dilute the residual viable male population still further. Field trials of the method on other lepidoptera have failed to reduce the number of mated females over untreated controls, probably due to the inability to construct a "super-female".

2. Atmospheric pheromone dispersal. This method relies on pheromone permeation reaching such a general high level that the local smaller increment produced by wild females is not perceived by males whose response threshold has thus been raised. The principle is such that the males' normal behavioural response to the sex-pheromone is inhibited rather than stimulated but misdirected as in method 1. Male inhibition for control purposes has been recognised by several workers and successfully tested on a limited scale by Shorey and Gaston (1967).

Before pheromones may be utilised for such control measures much information has to be gathered not only in the ecological but in the total biological sense. It is necessary to know the fundamental processes involved in the maintenance of a population of insects under normal environmental conditions and to become intimately acquainted with the underlying limiting factors.

The sex pheromone of light brown apple moth falls into the category of so called "releaser pheromones" and is a volatile chemical (as of yet undetermined nature) released by the female and perceived by the male in which it releases a definite and experimentally reproduceable response. Characterisation of this release and response is a prerequisite to the possible future use

of the pheromone to facilitate control of field populations. Essential biological information within this framework includes, rate and duration of pheromone release by females, daily release times and release seasons, male activity periods, response periods, response thresholds and modification of the parameters by such factors as light intensity and quality, temperature and age of individuals. Features of these studies must be worked into a suitable bioassay for testing biological activity of crude extracts, refined extracts, single compounds and, eventually, synthetic model products. The latter may be formulated for use in the field in such a manner that a constant release rate is maintained during operation. A suitable dispenser which controls this release during a period of the day encompassing the mating time and which also compensates for temperature fluctuations must be devised.

WEDNESDAY 29TH MAY

9.15-10.00a.m. Dr. S.J.J.F. Davies (CSIRO, Divn. of Wildlife Res.)

A study of emus in semi-arid Australia

The emu is a herbivore in so far as it is dependent upon plants for the bulk of its food. In the semi-arid regions of Western Australia productivity of the plants correlates closely with the fluctuations in rainfall and temperature. The area under study receives two inches of rain in almost all years, one in summer and one in winter, but in some years the annual total can exceed 30 inches. The animals and plants of the area are adapted to exploit this variability overlying a basic regularity, timing their breeding or flowering seasons on the regular rainfall and responding to any excess by increased productivity. Population control in emus appears normally to take the form of non-breeding and/or the death of very young chicks. In poor years following several good ones death and emigration of adult birds is also observed, and the latter give rise to observations of spectacular 'emu eruptions'.

10.30-11.15a.m. Dr. O.B. Williams (CSIRO, Divn. of Animal Physiology, Prospect)

That uneasy state between plant and animal in the manipulated situation

Three manipulated situations will be outlined. They are (a) manipulations for animal production with scant regard for the flora, (b) manipulation for animal production by the construction of particular assemblages of plants, and (c) manipulation for the production and maintenance of a particular faunal and floristic array.

Australian and overseas examples will be used as illustrations, and attention will be drawn to the fact that sheep are not the total faunal spectrum, and plants are more than forage. The seral possibilities inherent in animal and plant communities, and the manipulations needed to construct these seral stages can probably be outlined by some reworking and reorganization of data collected for other, more prosaic purposes.

BIOLOGICAL ASPECTS OF FOREST MANAGEMENT

L.J. Webb

ABSTRACT

The forest and the land base

Estimations of Australian agricultural and pastoral potential which repudiate the principles of biological diversity, and mass clearing of forest vegetation which ignores the grave risks of deterioration of our physical and psychic environments, are criticized.

The individual and the community

The parameters of a community may not be obtained by summing those of the individual elements, and tropical-subtropical rain forests present additional problems because of the great diversity of species: the stability of complex forests is a direct result of diversity, complex forests provide a wide range of ecological niches for wildlife, and the production of timber from certain species requires a knowledge of species relationships.

The physiology of diversity

Co-actions at the intraspecific and interspecific levels result in the regulation of numbers but the causes of density-induced mortality are obscure. The mechanisms apparently vary for gregarious and non-gregarious species, and there is some evidence for the influence of organic factors in the rhizosphere including microbial activity. The evolution of ecological combining ability among species in complex rain forests maintains diversity and the community acquires its own distinctive physiology.

The implications for forest management

Practical problems raised by monocultures, the influence of the forest on subsequent plant growth, and the characterization of forest niches for the conservation of wild life are discussed.

The role of synecology, with the assistance of computer analysis, in formulating problems which are relevant for physiological study is stressed.