ECOLOGICAL THEORY AND BIOLOGICAL MANAGEMENT OF ECOSYSTEMS : WORKSHOP SUMMARY AND DISCUSSION

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In this chapter we summarize the issues raised by the three introductory papers (Burbidge, Hobbs and Underwood) and the 12 discussion reports (Walker, Mercer, McKenzie, Abbott, Start, Peet, Hopkins, Arnold, Moore, Muller, Wilson and Wallace). We then discuss some of these issues and present what we believe were the conclusions of the workshop. No formal recommendations were sought or made during the workshop and the discussion that follows is our own view of the issues raised.

WORKSHOP SUMMARY

As explained in the Introduction to this publication, the workshop was held to explore some of the issues associated with the management of ecosystems as carried out by land managers in a nature conservation organization. The workshop involved 21 people from the Western Australian Department of Conservation and Land Management and three from CSIRO Division of Wildlife and Rangelands Research. There was equal representation of those involved in policy, planning and operations and those carrying out research. There was also a balance between those involved with timber production from hardwood forests and those involved in nature conservation.

The aim of the workshop was to explore the researchmanagement continuum and examine methods to integrate the two activities. The discussion topics were suggested by the organizing committee and the participants, but few constraints on interpretation of allotted topics or conduct of workshop discussions were given to discussion leaders.

While the title of the workshop was "Ecological theory and biological management of ecosystems" only four of the 12 workshop groups discussed the subject of ecological theory in depth and two of these were the groups discussing biogeography and its use for setting management priorities. Most of the discussion over the two days was concerned with non-biological principles of management - chiefly the mechanisms to ensure that managers of biological systems make the most efficient use of all of the resources (including information) available to them. It is obvious from the various discussions reported here that many participants have doubts about some of the present mechanisms and felt that they could be improved.

The introductory presentation by Burbidge discussed the reasons for managing biological resources and the principles involved with the management process. Four reasons were presented for the necessity of management: that species preservation is demanded on compassionate, aesthetic and/or economic grounds; that many species (often unnamed and unseen) contribute to life-support systems essential for the continued existence of humans; that species currently used by people should be managed on a sustained yield

basis (not mined); and that all species should be preserved for possible future use (the maintenance of genetic diversity). The thrust of the presentation was that our goal should be to prevent the loss of any species so that we and future generations maintain the option of using (practical value) and/or enjoying them (quality of life). This is, of course, an anthropocentric view of nature conservation but the moral view that species should be preserved for their own sake was also discussed.

Burbidge also stated that as conservation and land managers and researchers we need to be aware that we are dealing with extremely complex ecosystems and that we do not know the consequences of most of our actions. This point was also raised and discussed by Hobbs and Underwood. In order to minimize detrimental effects of management we should be both conservative and conservationist in our approach. To manage successfully we need to adopt an environmental ethic and implement a conserver approach to our use of resources. If we, as public servants, are to be successful in this aim we must ensure that a conservation ethic is embraced by the public as well as our own staff. A major step towards this goal would be to ensure that staff devote at least a tenth of their time towards educating the public about ecological values and the importance of managing our biological resources so that they will be available in perpetuity.

Hobbs started by presenting a view of research and management sometimes propounded by critics: management goes on in isolation taking no account of research results and research is largely irrelevant, taking no account of the needs of managers. He went on to show that this view, which is still held by some managers and research workers, is totally out of step with the real world where managers use ecological theories in almost every biological management decision they make. These theories have been developed by relevant research which has then been applied. Hobbs pointed out that there is a need for greater cooperation between researchers and managers so that theoretical developments may go hand in hand with practical requirements. Researchers need to make sure that managers are kept informed of recent developments in ecological theory and practice, and point out the limitations of current theory where necessary.

Hobbs also pointed out that biological systems are extremely complex and that ecology is a science in its infancy. Often, something being manipulated is but a part of a more extensive ecosystem. It is becoming increasingly obvious that we need to manage ecological units in their entirety. An added complication is that a single ecosystem may cross several legal or political boundaries.

Underwood stated that managers have very limited knowledge on which to base decisions. Regardless of their lack of knowledge, they must manage. He proposed a series of steps to minimize the risks associated with managing in uncertainty (an issue that came up several times during subsequent discussions). He reinforced Burbidge's "conservative and conservationist" approach to management by stating that we should seek to oppose (or defer) interventions in ecosystems where the outcome is uncertain.

The need for clearly understood objectives was stressed by Underwood as was the need for a method for allocating priorities (a point raised by 10 of the 12 discussion groups [Table 1]). He suggested that integration of research and management is best fostered by using multidisciplinary teams, improving research extension, effectively communicating research results, involving researchers in management and holding subject-specific workshops like the one reported here.

Underwood stated that managers are suspicious of scientific theories that have not been thoroughly tested and that managers are dependent on research workers to clarify the distinction between fact and hypothesis. He pointed out that most managers (particularly those in large, complex regions) simply do not have the time to see the scientific literature and keep up with and integrate research findings.

Three important points regarding research were raised by Underwood: effective research direction is the direct responsibility of the research scientist and his/her director and it is up to them to ensure the work is relevant; those responsible for the direction of research should ensure that research staff spend part of their time on extension work; and managers can conduct useful experiments as part of their management activities.

The main issues raised by the 12 discussion groups are shown on Table 1.

The first two groups discussed the initiation of research and the process of carrying it through to management. This involves the identification of areas for research, setting priorities for the work identified and ensuring that results are actually

Table 1 Issues raised in discussion group reports

ISSUES RAISED / WORKSHOP LEADER	Communication/ education	Publication of research results essential	Importance of clear objectives/priorities	Integration of researchers/ managers/ planners	Data gathering by managers	Management Plans used for integration of all staff	Involvement of Public	Review of management/ research	Accountability	Comments
Walker	✓*	✓	✓	✓		✓				*onus researcher → manager
Mercer	✓	✓	✓	✓	✓	✓		✓		
McKenzie			*							*use of biogeographic data for setting priorities
Abbott			*							*use of biogeographic data for setting priorities
Start				✓	✓					
Peet	✓		✓				✓	✓		
Hopkins	✓		✓	✓	✓		✓		✓	
Arnold			✓	✓						
Moore	✓		✓	✓		✓	✓	✓	✓	
Muller	✓*	✓		✓						*onus researcher → manager
Wilson			✓	✓			✓	✓		
Wallace	✓		✓				✓	✓		

applied. Walker's group felt that research projects should be identified by all parts of an organization and will be dictated by organizational objectives, while Mercer's group believed that a list of potential projects has to be drawn up. Possible research projects can come from many sources, including outside bodies (other organizations and the public) as well as organization staff. The list should be widely circulated as it may act to focus on the needs of the organization and attract outside interests to work on some of the problems. Potential projects need to be screened and priorities set so that resources can be allocated. Walker's group listed criteria that could be used to set priorities. These related mainly to avoiding potential degrading changes to the ecosystems being managed.

Both Walker's and Mercer's groups believed that integration between policy makers, researchers and managers was necessary for efficient prosecution of research of relevance to managers. They stressed that communication is an essential part of this process with publication of research results an absolute necessity to disseminate information and to allow for evaluation of research staff and their work.

Walker's group stated that the onus for effective communication lies with the research worker who should be involved in communication at all levels: with peers, managers, planners, policy makers and the public. Mercer's group thought that extension officers could be a useful adjunct here.

Both groups believed that research workers must be involved in the formulation and review of management prescriptions and in the monitoring of the effects of management. Their involvement would foster more efficient integration of research and management as research workers would have a stake in the results and would be less insulated from the "real world".

The next two discussion groups mulled over the topic of biogeography and its use for setting priorities for management. Basically, both groups stated that biogeographical studies were of use for setting management priorities, but some participants felt that the topic was out of place in the workshop - an interesting view since it was the only topic which explored an accepted ecological theory and its relevance to management. McKenzie's group summed up by stating that the setting of priorities for management should have a rational biological base; the more relevant and better the available data, the more effective the decisions are likely to be. This topic also raised the issue of the relative merits of autecological versus synecological studies, an issue discussed further by Wilson's group.

The topic of management in uncertainty and the possibility of adopting an experimental approach to management was explored by Start's and Peet's groups. The former group stated that record keeping is essential so that others may benefit from the results of management experiments. At present in CALM records are not kept in a structured way that allows others access to this information. Staff change and memories blur, with the inevitable consequence that information is lost or distorted. An efficient system for recording, storing and retrieving management decisions must, threfore, be developed. The group also felt that monitoring is important for gathering data for solving management problems or reviewing management prescriptions.

The issue of the amount of latitude allowed to managers was raised by Peet's group; it may be broad for issues like fire but narrow for issues like mining or other forms of exploitation. Influences from outside the managing organization may be strong and constrain management decisions. Cognizance must be taken of all such influences and actions may be needed to counter their effects. For management in uncertainty to be a success, flexibility is required so that managers may react to various and changing situations. External influence may reduce flexibility; so does inertia in the organization. Inertia is a product of various factors including over-specialization of staff, over-commitment to low priority tasks or a large back log of work. To counter inertia, staff and the public should be involved in designing management plans, thus developing a sense of ownership - an important point for fostering an environmental ethic.

Two groups, led by Hopkins and Arnold, addressed the question of whether monitoring is of any use in the integration of research and management. Hopkins' group agreed that monitoring has considerable potential for the integration of research and management, but because managers already feel over-committed, it may not be of practical value. Many managers believe that they are unable to take on further responsibilities, despite recognizing the importance of monitoring. The group endorsed the concept of pilot monitoring projects in CALM of perhaps two per management district and suggested that a full-

time coordinator should be appointed to start the monitoring project. They also pointed out that the public should be involved in the monitoring process as it constitutes a large, untapped labour force; also public involvement would educate those involved about management issues and problems and would help to inculcate a conservation ethic. Arnold's group agreed that monitoring may help to integrate research and management, but did not discuss how this could be achieved.

The issues of planning and communication in the management of biological systems were discussed by groups led by Moore and Muller. Moore stated that uncertainty is a characteristic of most natural environments. Planning is a tool that allows for systematic management in the face of uncertainty by encouraging the development of a management vision. Planning has the added benefit of encouraging accountability because planning persuades management organizations to use methods that can be easily explained and justified. Surprisingly, this was one of only two workshops that raised the issue of accountability (Table 1) yet accountability is essential in organizations charged with managing natural resources on behalf of the community and future generations.

Moore's group considered that communication is essential in the planning process, basically because it encourages a wider understanding of management decisions. For communication to be effective we need to be open about our knowledge and activities and the reasons for them. Planning, because it formally involves planners, researchers and managers, must aid their integration and contribute to more efficient management of biological resources. For efficient mamagement to occur, it is essential for all sections of the managing organization to develop and work towards a common set of priorities.

The way ecological theory can assist in planning for management of biological systems was discussed by Muller's group; however, they worried about the possibility of misapplying some theories. To guard against this, they felt a checklist of recognized theories should be prepared and widely circulated. The list could be checked against individual management plans and other relevant documents to see if there is any inconsistency. The group stressed the role of communication and felt that all professional staff should regularly update their knowledge, recognizing that pressures of work can mean that this is neglected. The group placed the onus on research workers to pass information to managers and planners. More use should be made of small workshops on specific themes and perhaps a biennial meeting of a working group of managers, planners and researchers should be held to provide interaction on more general issues. Workshops like the one reported here are one way of overcoming problems associated with having the three groups concentrated in centres that are isolated from one another. The group also raised the possibility of employing liaison officers to help transfer information between researchers and managers and to help apply the work.

The final two groups discussed the problems of drawing up priorities for research and management and the setting of objectives for the management of biological systems. Wilson's group decided that there needs to be a mechanism for obtaining input from staff and outsiders and for regular review with feedback from staff. Organizations need flexibility in their approach to researching biological systems but flexibility is often lost when specialist groups are employed as it is difficult to change their direction. The best opportunity for altering directions of research comes when staff leave and a blend of long and short term positions could provide for some flexibility.

The group raised the issue of autecological studies versus synecological studies and suggested that the balance needs urgent consideration and resolution in the context of setting research priorities. The need to adopt an experimental approach to management was identified, as was the need to hold workshops to discuss specific issues related to management, research and setting objectives and priorities. This group also raised the spectre of pressure resulting from incorrect public perceptions about nature conservation, leading to diversion of funds to lower priority areas. The group saw this as a fact of democratic life.

The issue of internal resistance to change (or inertia) as an important factor in the redirection of an organization was discussed by Wallace's group. It was pointed out that resistance to change could be lessened if all personnel subscribe to a common set of objectives. The group also raised the matter of outside influences and the importance of having an informed public to

help an organization achieve its objectives. The environmental ethic and the organization's role in fostering this discussed. The absence of an environmental ethic in much of the community means that there is no effective lobby group for nature conservation lands, a fact which makes it difficult to allocate adequate resources to the management of biological systems. Outside influences were regarded as important enough to rate (by some of the group) as the first of the criteria to be used for setting priorities. However, applying such a criterion above all others will mean that the organization may be entirely reactive in its management and have constantly changing priorities. This point highlights the importance of having clearly stated organizational objectives to provide stability of direction in the face of changing external influences as well as the necessity of organizations exerting a positive influence on their external environment. The group saw the setting of priorities as a critical step in ensuring the most efficient use of resources; a step that becomes even more important when resources are diminishing. Underlying all of the above are the training and personnel management programs operating within the organization. If these are poorly developed or not relevant then the organization will be incapable of functioning efficiently.

DISCUSSION

An environmental, conservation or land ethic. The issue of fostering an environmental or conservation ethic in the community to promote the management of biological systems was raised several times during the workshop, but no definition of such an ethic was given. We discuss it here because we believe it underpins our management and research and we should be clear about our beliefs.

The World Conservation Strategy (1980) defines conservation as:

"The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and the enhancement of the natural environment. Living resource conservation is specifically concerned with plants, animals and microorganisms, and with those non-living elements of the environment on which they depend. Living resources have two important properties the combination of which distinguishes them from non-living resources: they are renewable if conserved; and they are destructible if not".

The word ethic is defined in the Oxford English Dictionary as a set of principles or morals, rules of conduct, concepts of right and wrong.

Aldo Leopold (1949) outlined his concept of a land ethic after stating that there was no ethic dealing with man's relation to land and its biota:

"The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

"This sounds simple: do we not already sing of our love for and obligation to the land of the free and the home of the brave? Yes, but just what and whom do we love? Certainly not the soil, which we are sending helter-skelter downriver. Certainly not the waters, which we assume have no function except to drink, water gardens, turn turbines, float boats and carry off sewerage. Certainly not the plants, of which we exterminate whole communities without batting an eyelid. Certainly not the animals, of which we have already extirpated many of the largest and most beautiful species.

"A land ethic of course cannot prevent the alteration, management, and use of these 'resources', but it does affirm their right to continued existence, and, at least in some spots, their continued existence in the natural state.

"In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such."

The ethic should also promote the maintenance of life-support systems for this and future generations - the ability of the biosphere to withstand change is clearly limited. Leopold expressed this view succinctly by writing that "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise".

If we accept this ethic, we are charged with promoting "the care of 'natural resources' and their protection from depletion, waste and damage, so that they will be readily at hand through perpetuity" (Livingston 1981). This is an awesome task and a guide to achieving it is suggested by Devall and Sessions (1985).

"Furthermore, in order to insure the compatibility of interim measures with long-range

ecology futures, restoration managers and interim managers need to cultivate a biocentric perspective. Some are just beginning to understand the relationship between cultivating one's own ecological consciousness and 'managing'. Any real understanding of the land means attuning oneself to the land, to a specific bioregion, and developing a sense of place. Otherwise, land management will continue to 'manage' on the basis of subjective economic criteria to the detriment of the Earth and the future."

Note the change to a biocentric perspective where we are part of the biotic community as opposed to an anthropocentric view of management where we dominate nature. Working within a land ethic will ensure that we do adopt both a conservationist and conservative approach to management as suggested in the State Conservation Strategy for Western Australia (1987) and reiterated by Burbidge in the introductory chapter to this publication. Leopold (1949) expressed the view that:

"A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity."

Having outlined a land ethic, how does one get such an ethic adopted by all of the staff of an organization managing biological resources and, more importantly, the community as a whole? This is perhaps the biggest challenge facing those involved with conservation and land management because their task would be made a great deal easier if all worked with a common set of objectives based on a common set of beliefs.

Perhaps the greatest barrier to engendering a conservation ethic is the increasing alienation of people from nature. Western Australia is a good example of this situation; occupying approximately one third of the area of mainland Australia, it has a population of around 1.6 million but over 85% of people live in one city - Perth. Many people seldom venture into undisturbed natural environments and have a jaundiced view of nature - a view restricted to their urban gardens, parks or street scapes. Similar restrictions apply to many country town dwellers and even to farmers.

Most people who have a land management problem can solve it with products of technology; they can mow it, snip it or spray it. In contrast, conservation authorities have no easy technological "fix". To compound the problem, they have vast areas and complex ecosystems to manage and too few resources with which to perform the task.

Education. Clearly, education is essential to enable the public to understand conservation issues and adopt a land ethic. However, we should heed Leopold's (1949) words. "The usual answer to this dilemma is 'more conservation education'. No one will debate this, but is it certain that only the volume of education needs stepping up? Is something lacking in the content as well?"

The importance of generating an informed, involved public was recognized by workshop participants and one recommendation was that staff should spend a significant proportion of their time in educating others about their work. Organizations like CALM and CSIRO have several communication outlets open to them, including several popular publications. As stated by Burbidge in his paper, these should promote the development of a land ethic and present nothing that promotes the opposite view. Staff should be required to write and speak to an audience wider than their peers. This important duty needs to be recognized by institutions and duty statements need to be drawn up to reflect this extra role (Saunders et al. 1987). Tertiary institutions should make more effort to train students to communicate with the community as well as with their peers.

Public views can be shaped by involving the community in land management issues and activities. This is already done widely by CALM in planning (Wallace and Moore 1987) and makes for a more concerned, supportive community. Public involvement should be extended to involvement in monitoring programs and in management programs. An example of limited involvement in management is provided by the many voluntary Bush Fire Brigades, but the scope of management activities involving the community must be broadened as it is beyond the capacity of government land management agencies to adequately manage all of the land under their control. Active involvement in planning and management will go a long way towards achieving successful management of biological systems in Australia.

Integrating managers, planners and researchers to achieve more efficient management of biological resources. The issue of integrating managers, planners and researchers took up a significant

proportion of time at the workshop and several points were aired. The subject of integration was discussed by Hopkins and Saunders (1987, fig. 5) and they advocated a change in the role of planners, managers and researchers. Planning should include assessment and analysis of information and prescription of management procedures. Management should include implementation of management plans and establishment of sites to monitor the effectiveness of management. Research should include helping managers with the design and interpretation of experimental and monitoring programs. Hopkins and Saunders viewed monitoring and re-evaluation as key factors for successful integration. This means that every management action is assessed and the results fed back into the information base so there is a gradual improvement of knowledge about the systems being managed.

The objectives of the organization must be clearly stated, understood and agreed on. Without clear objectives it is impossible to allocate priorities and, without a system for allocating priorities, available resources are not efficiently allocated to tasks. Objectives and priorities must be understood throughout the organization and be accepted by the community on whose behalf the organization is acting. Having agreed on priorities, a multidisciplinary team approach to planning and management is an effective way to make the most efficient use of human resources. The team approach uses individual skills to achieve objectives and it is imperative that all members communicate with each other and keep themselves informed about advances in their field.

The onus should be on all managers, planners and researchers to keep abreast of the current literature and draw others' attention to articles of relevance. This can be done informally by circulation of papers, or more formally by organizing workshops around particular papers, ideas, theories, etc. It should not be the sole responsibility of the research worker, as suggested by some discussion groups - policy makers, planners and operations staff have an equal responsibility to ensure that they retain and improve their professional knowledge. We are not arguing that researchers should not take the initiative in helping managers keep abreast of advances - research scientists will spend more time keeping up with the scientific literature than managers and are more likely to come across articles of interest.

Accountability. Given the importance of the task facing all those involved in managing biological resources (policy makers, managers, planners and researchers) and the inadequate resources available, it is imperative that mechanisms are developed to ensure that resources are used efficiently. The prospects of an organization meeting the goals and objectives it has set depends on the nature of those objectives, the setting of priorities, the amount of available resources and the quality of its staff. All four are vitally important. The first three were discussed at length at the workshop but the quality of staff and their direction received little attention - monitoring of individual performance is as necessary as monitoring biological systems.

There is a tendency in large organizations for individuals to be insulated from the consequences of their actions as they can shelter under the "corporate umbrella". Staff need to be aware that they are accountable for their actions. As land and conservation management organizations we are trustees of community assets and the community has the right to question us about our goals and the use of their resources. Individuals within the organization need to be accountable both to the organization and to the public. Mechanisms are needed to assess individual performance in the light of corporate objectives and accountability. Such mechanisms should make it easier to redirect and train staff where necessary as well as counteracting the inertia inherent in large organizations.

CONCLUSIONS

The workshop on ecological theory and the biological management of ecosystems was very successful. In particular we believe it achieved the following results.

1.It provided a forum where policy makers, planners, managers and research scientists could exchange ideas and discuss common goals.

2.It identified important issues and problems that these groups felt needed solving.

3.It went some way to fostering a better understanding of the roles of the various groups and the problems they face.

Major outcomes of the workshop are listed below.

1.More time should be committed to fostering a land ethic in land management and research agencies as well as in the community.

2.There is a need for a common set of goals and objectives and for a method for allocating priorities that is understood and accepted at all levels.

3.Better integration of research scientists and conservation managers is needed and the multidisciplinary team approach to problem solving was agreed as one method.

4.There is a clear need to develop a method of recording, storing and retrieving management decisions and the reasons they were taken. Without such a system we will not be able to learn from experience and the value of biological monitoring will be lessened.

5.Small, select, thematic workshops that examine specific topics of biological resource management (e.g. managing for biological diversity) should be organized and the results widely disseminated.

Perhaps the most obvious shortcoming of the workshop was its failure to come to grips with the title; little time was spent actually talking about the use of ecological theory by managers. This was due to the general view that integrating the different groups of professionals was more important at this stage.

The success of this workshop suggests that it could be repeated, perhaps every two years, with some change in topic and participants.

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