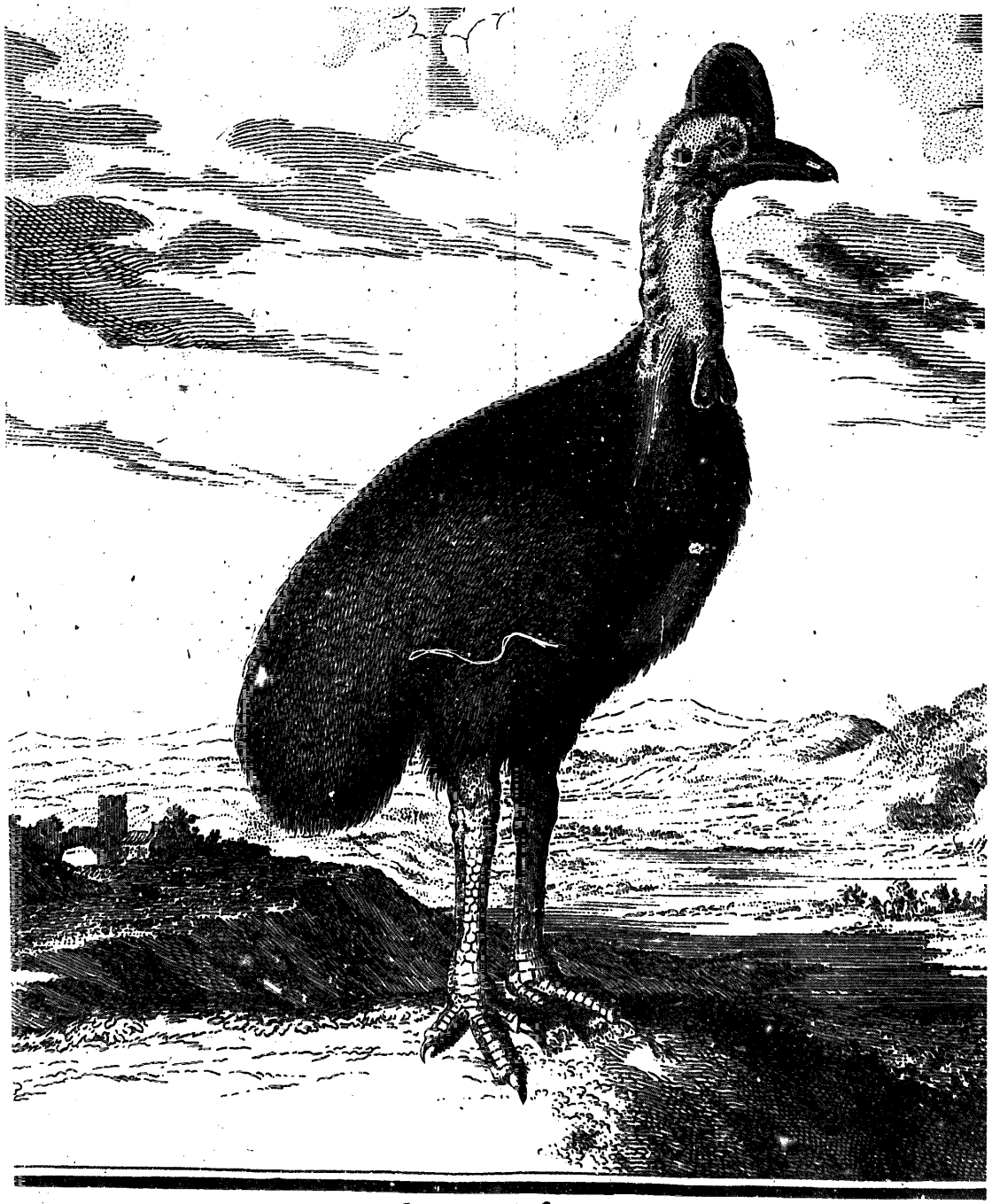
SECTION 1

Overview

The Natural-Human Environment Interface: A Challenge for Endangered Species Recovery



Casoar, 1^ere. figure.

The first cassowary to arrive in Europe.

Collectively, the statistics of species attrition and these studies suggest that the endangered species problem is increasing faster than we as a society - through our professions and organisations - are able to cope with it.

T. W. Clark, R. P. Reading and A. L. Clarke, 1994, p.xi.

Given Australia's relatively small population and the short time that Europeans have occupied the continent, it is doubtful that any group of people has so profoundly altered their environment so rapidly as Australians have done in 200 years of settlement..... In 200 years Europeans have recast the evolutionary biogeography of the continent.

H.F. Recher and L. Lim, 1990, p.287.

Chapter 1

Introduction

1.1 General Overview

1.1.1 The "Crisis"

The world is witness to a "crisis" in the environment that has mobilised the pens of numerous writers, commanded the attention of politicians from all political persuasions, challenged scientists from many disciplines, sustained the interest of the whole spectrum of media, recruited numerous citizens from all countries at all levels of society, and contributed to a whole new way of thinking about and understanding the human-natural environment relationship. A clear demonstration of the cumulative impact this crisis has had on the conscience of these world citizens, in particular leaders of the international community, occurred in June 1992 when 25,000 people attended the world's largest conference ever, the UNCED or Earth Summit held in Rio de Janerio, Brazil (Houghton, 1995; O'Riordan, 1995; Pepper, 1996). The Conference was designed to *take stock* of the state of the world 20 years after the first major Earth Summit, the UN Conference on

the Human Environment held in Stockholm in June 1972 (O'Riordan, 1995). What is that *stock*?

How the environmental crisis is defined, represented and understood varies; it is various things to various people; it is multi-faceted, and it can be measured in a multiplicity of ways. Inherent in the concept are notions of irreversible loss, lasting damage, dysfunctional life support systems, critical time frames and ultimately, the need to recognise and confront the problem. Indicators of the crisis can be scientific facts about the state of the physical surroundings, and psychological and physiological facts about how the state of the physical environment impacts on people. *Participation* in the Earth Summit conference, for example, was one indicator of *concern* , a socio-psychological dimension of the crisis; public opinion polls and health statistics are others.

A decisive physical indicator of the actual extent of the environmental crisis, one most frequently used by biologists and ecologists and one which is central to this dissertation, is *biodiversity loss* (Myers, 1988; Stork, 1994; Wilson, 1988). Simply defined, biodiversity is "the sum of all the different kinds of organisms inhabiting a region" (Dobson, 1996, p.10). Biodiversity loss, therefore, is a matter of empirical fact thereby providing "hard" evidence of a dysfunctional system. Nevertheless, the choice of the physical indicator is critical to the *social construction* of the problem (Evernden, 1992; Machlis, 1992), the second decisive indicator of the crisis and one which is also central to this dissertation. In other words, defining the crisis only in terms of "hard" evidence may distract us from the fact that much of the debate is over community perceptions, representations, and understandings of biodiversity loss.

The most relevant information that provides some indication of general biodiversity loss[1] from a global perspective, relates to deforestation/degradation rates of tropical moist forest because, of all major habitats, they are richest in species, they are in greatest danger, and they are among the most fragile (Wilson, 1988). Tropical biologists provide examples of their extraordinary richness: 300 species of trees in just one hectare of Amazon forest (Gentry, 1988, in Spellerberg, 1992); 700 species of trees in 10 selected 1-hectare plots in Borneo (Ashton in Wilson, 1988); more than 3,000 species of vascular plants in the Wet Tropics rain forests of North Queensland (Ritchie, 1995). Deforestation/degradation statistics for the tropical forests were conservatively estimated at 86,000 to 146,000 square kilometres per year (Myers, 1988, 1990). Ashton (1994) reports the latest FAO (1990) estimates of the conversion of primary tropical forests to degraded forest or other land use at 170,000 square kilometres per year. Grant (1995) reports various estimates of

[1] The operational measures of biodiversity referred to are landscapes, ecosystems and species.

global plant species loss over the next 30 years as 20-25 per cent, and in the tropics 35 per cent is at risk. Recher (1994) has estimated that 95 per cent of Australia's native vegetation has been cleared, fragmented or modified.

The national and global statistics on species loss point to an extinction episode of historic proportion (Kohm, 1991). Estimates of species loss have doubled from 1988 to 1994, that is, from 50 species per day - 18,000 per year (Wilson, 1988) - to 100 species per day world wide[2] (Backhouse & Clark, 1995; Clark, Reading & Clarke, 1994). In the United States at least 500 species and subspecies of plants and animals have become extinct since 1500s (Chadwick, 1995). Waiting in line are over 3,000 officially recognised candidates of plant and animal species (Clark et al., 1994), of which 632 species are classified as endangered (Wooddell, 1994).

Australia has the worst record of mammal extinctions on earth (Clark, Gibbs & Goldstraw, 1995a). Following European settlement in 1788, over 260 species of mammals, birds, reptiles, frogs and plants have been classified as endangered and could become extinct within ten to twenty years (Australian National Parks and Wildlife Service [ANPWS], 1990). Twenty-two unique mammal species have been lost (Recher, 1994) representing 50% of the mammal extinctions world wide. In addition, over one hundred species of birds and plants have become extinct. "Fully 150 of the 1074 bird taxa (14%) that have been recorded living in Australia and its territories are extinct or thought to be threatened: 23 are Extinct, 26 Endangered, 40 Vulnerable, 32 rare, and 29 insufficiently known but possibly threatened" (Garnett, 1992a, p.x). Ninety-seven species of vascular plants are extinct and 3,339 plant species (17% of the total) are either rare or threatened (Campbell, 1994). In response to this Recher (1994) forecasts "there is a real prospect of an accelerating rate of species extinctions and, associated with and driving that, is an accelerating rate of loss of distinctive communities and ecosystems through-out Australia" (p.5). Lines (1991) concludes,

> Nowhere else on earth have so few people pauperised such a large proportion of the world's surface in such a brief period of time. In under 200 years, a natural world millions of years in the making, and an Aboriginal culture of 60 000 years duration,

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[2] The statistics of biodiversity loss and projected loss are presented here in spite of those who have been critical of how such estimates have been established (e.g., Lugo, 1990). Considering that the statistics used have been selected from credible sources and that many would agree with Stork's (1994) comment that many species are more likely to become extinct before being discovered let alone described, the use of these statistics are justified. Instead of the current estimate of 5-15 million species on Earth, of which 1.4-1.8 million have been described (Stork, 1994), Erwin (1988) estimates there are 30 million species of insects alone. Coupled with deforestation rates, it is indisputable that a large extinction event is occurring (Groom, 1994).

vanished before the voracious, insatiable demands of a foreign invasion. (pp.12-13)

With extinctions increasing and habitats disappearing and degrading, the causes and consequences of such biodiversity loss are now being explored with a renewed disquiet. Traditionally, the consequences have been considered from the utilitarian and anthropocentric perspective, that is, the emphasis has been placed on the well-being and survival of humanity (Charlesworth, 1992; Ehrlich, 1988; Grant, 1995; Spellerberg, 1992), over and above the well-being and survival of nature (Grumbine, 1992; Meffe & Carroll, 1994). However, radical new ideas have emerged and ethical rather than just scientific, political or economic considerations of biodiversity loss are now also being addressed (Charlesworth, 1992; Jensen, Torn & Harte, 1993; Naess, 1991; Nash, 1989; O'Riodan, 1995; Pepper, 1996). In addition, the very idea of an evaluation process which assigns "value" to diversity as a means of evaluating its loss, is also being questioned (Ehrenfeld, 1988; Norton, 1988). Whatever the consequences, the rationale most frequently cited is anthropocentric:

> ... this (same) wondrous species of ours now seems bent on putting an end not only to its own evolution but to that of most life on our globe, threatening our planet with ecological catastrophe. (Eisler, 1990, p.xiv)

> For good reasons we are appalled by the damage that has been done to the earth by the ethos of heedless anthropocentric individualism, which has achieved its colossal feats of exploitation, encouraged to selfishness by its world view - of relation-free atoms - while chanting 'reduction' as its mantra. (Ferré, 1994a, p.59)

1.1.2 Endangered Species and Recovery

Clearly there is a crisis in terms of species loss about which there is scientific consensus. The grim statistics well illustrate the current status and urgency of this biodiversity crisis, but is there a crisis in terms of community representations and understandings? Do people really appreciate what these figures mean? The environmental crisis, and particularly extinction of species, has become part of our every day life. We are confronted with it in our daily language, actions, visual experiences, media representations, etc. Nevertheless, it is not a new phenomenon. Rather, it is one that is new only with respect to the full public realisation of cumulative impact and consequences. Writers of the 1960s and 1970's, such as Rachel Carson and Paul and Ann Ehrlich, first shocked the world out of its complacency by drawing attention to the environmental problems of modern industrial society (Carson, 1962; Cosgrove, Evans &

Yencken, 1994; Ehrlich, Ehrlich & Holdren, 1973; Krause, 1993; Naess, 1991; Pepper, 1996). They initiated the first public recognition of the finite nature of the world we are living in and the environmentally destructive course we are pursuing. Their words had a significant impact on the general public, resulting in the environment becoming of central rather than peripheral importance (Matthiessen, 1987; Young, 1991). Thirty years later it seems fitting to ask, what has this impact achieved?

In direct response to the biodiversity crisis more than 150 nations signed the International Convention on Biological Diversity at the Earth Summit in 1992. In doing so they signalled "their commitment to the conservation of biological diversity and their obligation to monitor its status" (Reid, 1994, p.2). Perhaps an even more significant response to this biodiversity crisis, in terms of species extinctions, has been the establishment of a legal framework, the Endangered Species Act (ESA), the primary instrument of federal efforts to protect endangered species (Clark, 1994). This was established in the United States in 1973 after going through Congress in 1966 and 1969 (Dunlap, 1988; Kohm, 1991), and was considered to be one of the most powerful environmental laws of the century (Greenwalt, 1991). In Australia a similar act was drafted in 1989 and was established in law in 1992 (Recher, 1994; Male, 1996). In terms of its importance to Australia, Recher (1994) wrote, "Endangered species legislation is important for Australia as part of the process of placing nature conservation and protection of the environment on equal footing with development" (p.12).

The Australian Endangered Species Protection Act (Anonymous, 1992) sets out a series of steps which are outlined by Garnett (1992a), "As the first step in securing biodiversity we need an *inventory* of those parts we are most likely to lose, an *assessment* of why they may be lost and *proposals* for saving them" (p.1; italics mine). Listing of species as endangered, vulnerable or threatened is the first step. Endangered species is that taxa which are "in danger of extinction and whose survival is unlikely if the causal factors continue to operate. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction" (Garnett, 1992b, p.1). Associated with this listing are various protection and recovery strategies which include: designating habitat that is critical for the survival of the species; providing immediate protection and prohibition of acts that would further jeopardise the species; and developing and implementing recovery plans (Carroll et al., 1996).

Associated with the term *recovery* are many different outcomes, expectations and hence definitions. To some it is a matter of numbers. For example, to Grumbine (1992) recovery means an increase in number toward what conservation biologists consider a

viable population.[3] To others, these numbers have direct implications for management decisions. The use of the viable-population theory as the indicator of recovery has received both praise and criticism (Meffe & Carroll, 1994; Minta & Kareiva, 1994; Shaffer, 1994; Simberloff, 1988). There is no intention here to review this theory but rather to outline some of those concerns expressed by ecologists and conservation biologists about its use or misuse since its influence on management decisions directly impacts on endangered species survival.

Conflicts in how one defines long-term viability have been a major problem (Mattson & Craighead, 1994). In reviewing the 1993 Yellowstone grizzly bear recovery plan, these researchers outline the causes and potential consequences of conflicting definitions.

> Differences in these two definitions (of long-term viability) are obviously a result of different values and perceptions. A bear population with the same characteristics could be considered "recovered" or "not recovered" depending on the time frame and level of confidence used for the evaluation and whether future catastrophes or uncertainties in habitat conditions were considered. In other words, the clash of definitions is rooted at least partly in divergent values focused on question of how long we want grizzly bears in the Yellowstone ecosystem and how confident we want to be that a viable population will exist at the end of that time. From this perspective, it is likely that formal adoption of one or other definition will ultimately be determined by the political clout of the opposing parties, including interests inside and outside management agencies. If these political interests prevail, rather than the interests promoting conservation science, there is little reason to think that the Yellowstone grizzly bear population will survive. (p.111)

Recovery or *recovered* also suggests the species is no longer eligible for protection. A standard of security exists such that species have been systematically differentiated between those which are considered "secure" or "recovered" and not in need of protection from those facing extinction and hence in need of protection (Rohlf, 1991). In addition, recovery implies a process, a policy process. It suggests the development, implementation, evaluation, and monitoring of policies, plans, programs; important strategic tools for management agencies used to prevent further extinctions and to restore

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[3] Population viability analysis is "the process of estimating the probability of persistence of a population for some arbitrary time in the future (Soulé, 1987) - and, frequently the probability of extinction or expected time to extinction (Dennis et al., 1991)" (Minta & Kareiva, 1994, p.287).

threatened species and ecological communities to a secure status in the wild (Stephens, 1995).

Ultimately, recovery of an endangered species is considered to be a performance indicator, a measure of success or failure of the efforts under the Endangered Species Act, the strongest legal tool for conserving biodiversity (Rohlf, 1991), and in the long run, a measure of our own commitment to the natural environment and the survival of species.

In spite of these new laws and regulations the act is not without its critics (e.g., Bean, 1991; Clark et al., 1994; Grumbine, 1992; Meffe & Carroll, 1994; Rohlf, 1991). Clark et al's. (1994) comments reflect the general sentiment, "Twenty years experience with the U.S. Endangered Species Act (ESA) has shown that having a law on the books is not, in itself, a solution to the major problem of the erosion of the earth's biological diversity" (p.xi). Nevertheless, the act does provide a legal (Recher, 1994), as well as symbolic (Clark, 1994) framework for the protection of species, the survival of which is at risk. In addition to working on the level of the endangered species, the Act has been working on another important level, the level that places *Homo sapiens* on the species list as well (Greenwalt, 1991; Kohm, 1991; Leakey & Lewin, 1996). As Kohm (1991) and Greenwalt (1991) point out, "the Endangered Species Act confronts us with an ecological perspective of ourselves in the biosphere" (Kohm, 1991, p.4); and it "has allowed us to gain a better understanding of our species' relationship to all the others with whom our destiny is entwined" (Greenwalt, 1991, p.36).

1.1.3 The Problem with Recovery

After more than two decades of the U.S. Endangered Species Act and considerable expenditure only a few species have been recovered, "Since 1973, only **sixteen** species have been removed from the endangered species list. Of these, **seven** species were removed because they became **extinct**, **four** species were removed because there were errors in the original listing data, ... and **five** species were removed because they recovered" (Clark, 1994, pp.27-28). Hence, for endangered species, achievements have been disappointing (Clark, Crete & Cada, 1989; Clark et al., 1994; Kellert, 1985; Reading, 1993). The failure or ultimate inadequacy of many of the endangered species recovery programs throughout the world (e.g., Alvarez, 1994; Backhouse, Clark & Reading, 1994; Groves, 1994; Grumbine, 1992; Jackson, 1994; La Bastille, 1990; Mattson & Craighead, 1994; Reading & Miller, 1994; Schaller, 1994; Snyder, 1994; Wallace, 1994; Yaffee, 1994a) have prompted a re-evaluation by scientists of the strategies used and the models and understandings which drove practice. The reasons for

these failures are multiple and complex, but one explanation which is explored in this dissertation, one which is believed to address many issues, relates to the exclusive focus on the physical and natural sciences when addressing environmental problems and wildlife management. Due to this exclusive focus substantial gaps exist in the knowledge base on which wildlife management and endangered species recovery programs are developed and implemented because the foundations of such programs lack critical information necessary to build effective programs.

In dealing with the environmental crisis and its management there has often been the tendency for scientists and managers to concentrate on the immediate biological or ecological problems in isolation from the more complex political and social issues inherent in the human dimension of the crisis (Chisholm & Dumsday, 1987; Fairweather, 1993; Young, 1991). This has been particularly true of the traditional approach to wildlife management (e.g., Giles, 1969), and is especially salient to endangered species restoration and conservation (Clark et al., 1994; Noon & Murphy, 1994). Here, the traditional response has been grounded in the belief that, since it is a biological species threatened with extinction, it requires the application of the "rational, disciplined and scientific process" (Brewer & Clark, 1994) of the biological/ecological sciences exclusively (Clark et al., 1994; Kellert, 1994). However, as Brewer and Clark (1994) point out, "to understand how traditional science can contribute most to species conservation, it is essential to understand its limitations" (p.393).

In viewing extinction simply as a biological phenomenon, a population-level process, there has been an exclusive reliance on natural/physical science assumptions, models and cultures. Critical nonbiological dimensions have been overlooked (Brewer & Clark, 1994; Clark et al., 1994; Cosgrove et al., 1994; Fairweather, 1993; Kellert & Clark, 1991; Pepper, 1994). Essential to endangered species recovery is the realisation that many management decisions involve actions aimed at securing the biological requirements of the species, requirements which often conflict with the needs of the human population (Beatley, 1994; Kellert & Clark, 1991; Maguire & Servheen, 1992). In such situations neither scientific data nor knowledge of the species alone will mitigate or ideally address the species threat. Rather, achieving genuine long-term conservation, and in particular endangered species recovery, will require the need for a broader systematic consideration of both the biological and the human dimensions of the crisis. In elucidating this broad systematic approach, Noon and Murphy (1994) observe:

> The requisite skills for effective conservation planning, reserve design, or species management entail more than knowledge of the theoretical and applied principles of population and community ecology. These principles, plus an understanding of relevant species' ecology, life histories, and habitat relationships, are essential components of any effective conservation strategy, but by themselves are insufficient to conserve most of the species about which we are concerned. (p.380)

Furthermore, the prevailing orthodoxy that "certainty" or "scientific proof" can exist in the real world of environmental science is an illusion according to many working in the field (Fairweather, 1993; Grove-White 1993; Grumbine, 1992; Meffe & Carroll, 1994; Noon & Murphy, 1994; Wynne, 1994). Rather, uncertainty and indeterminacy is the reality (Grove-White, 1993). In presenting a postmodernist view of traditional scientific thinking Ferré (1994b) identified institutionalised neglect for quality (a devotion to the quantifiable), disregard for the subtle connectedness of things (the emphasis on reductionism), and the alienation of humanity from nature as the features of scientific thinking which have failed us.

Nevertheless, in spite of the liberal rhetoric and extensive theoretical development, the contribution of the social and behavioural sciences to environmental and endangered species management remains relatively ignored (Freudenburg, 1989; Heberlein, 1988; Kellert, 1994; Machlis, 1992; Milbrath, 1995; Oskamp, 1995). One reason [4] offered for this disregard is that the social sciences are considered subordinate to the precommitments, agenda and epistemology of the natural sciences (Wynne, 1994). This privileging of the scientific mode of thought of the physical and natural sciences has also been an issue for many challenging the authority of this traditional scientific model (e.g., Ferré, 1994b; Figlio, 1996; Grove-White, 1993; Pepper, 1996; Wynne, 1994). In addition to "certainty", this prejudice appears to be embedded, ironically, in the notion of "objectivity".

The neglect of the human behaviour domain is also due to the lack of understanding and/or acceptance of the fact that environmental management and species recovery requires managing people and policies, not only physical ecosystems or target species. This often is linked to the human dimension being considered too difficult; not very amenable to the natural/physical science theoretical approach. Milbrath's (1995) observations are particularly apposite:

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[4] Additional reasons are addressed in Chapter 3.

> The neglect is more likely traceable to the fact that societal leaders feel more comfortable when dealing with physical elements that can be readily defined and discussed than they do when dealing with "in the head" elements like culture, ways of thinking, values, feelings, and fears that are difficult to discuss unambiguously. Because physical elements can readily be manipulated by rational thought whereas people resist manipulation, psychological-cultural barriers impeding transformation to a sustainable society are likely to be more difficult to surmount than physical - technological - economic barriers (MacNeill, Winsemius, & Yakushiji, 1993). (p.102)

This challenge to the exclusive focus on traditional approaches to environmental and endangered species management has not been about the comparative value of the pure and applied science nor about the validity of the natural sciences. Rather, this challenge has been about addressing the real point of scientific inquiry in the area of the environmental crisis, that is, addressing the issues that are of relevance for any approach to environmental matters (Warren, 1993), and of crucial importance to endangered species recovery (Clark et al., 1994). Understanding the ecology of the situation, the human causes and consequences of environmental impact, and developing strategies that effectively address impact, environmental quality, sustainability and endangered species issues has to be the major challenge for those agencies responsible for environmental management (Stern, 1992).

As Kellert and Clark wrote in 1991:

> If the wildlife profession is to assume a level of effectiveness equal to the many challenges it currently faces, managers and practitioners will have to become better educated in the complexities of the wildlife-human relationship. To ignore this challenge will lead to compromised effectiveness in the face of growing wildlife demands and conflicts occurring today. (p.17)

1.2 Research Perspectives and Objectives

1.2.1 Toward Endangered Species Recovery

Many objectives for endangered species recovery were developed at a time when managers believed that biological and ecological information of a species was all that was required to ensure its survival, and that humans played a relatively minor role in the management process. Clearly, it is time to rethink the fundamental role of ecological management (Reid, 1994), and this involves challenging the technological determinism which has dominated so much of the environmental debate and environmental policy formation (Benton & Redclift, 1994). Making decisions about real-world issues such as endangered species protection that involves land use, resource use and development, that ensures the species recovery and sustainability, and is at the same time acceptable to the human population, will be the hardest task faced by environmental management agencies in the coming decades. It can no longer be approached as devoid of the human element. There can be little doubt that an endangered species management framework which fully integrates the biological and human dimensions of the crisis would improve the situation.

In proposing that the need for effective environmental management be in keeping with the current concerns of endangered species recovery, the research rationale and methodology adopted in this dissertation falls within the realm of the new scientific methodology proposed by Funtowicz and Ravetz (1991). It is "issue-driven" as opposed to "discipline-driven" research in that it places an emphasis on real-world issues and accepts the world as it is. According to Funtowicz and Ravetz, the driving force behind this new methodology is that, in reality "facts are uncertain, values in dispute, stakes high and decisions urgent". This scientific enterprise attempts to determine the methods, knowledge, and information available or needed for resolving the problem. It focuses attention on qualitative assessment of the quantitative data available, recognising that uncertainty exists (Meffe & Carroll, 1994). Such a methodology would seem appropriate for breaking through disciplinary boundaries and for contributing effectively to endangered species recovery - clearly a "crisis" management issue. Characteristics of this "postnormal, issue-driven paradigm" are outlined in Table 1.1.

Table 1.1 Characteristics of the postnormal, issue-driven paradigm.

• Pragmatism and plurality: use of tools and conceptual frameworks appropriate to the solution to the problem, rather than being limited by the tools and conceptual frameworks of a particular discipline
• Acceptance of uncertainty as given: asking questions about the real world that we at present do not know how to answer
• A focus on data quality rather than data completeness
• Use of a systems approach that is comprehensive, holistic, global, long-term, and contextual
• Incorporation of an explicit concern for future generations, sustainability, and equity
• A concern for dynamics, process, nonequilibrium, heterogeneity, and discontinuity
• Social as well as individualistic points of view
• Concerns for the processes through which the behaviours of individuals and institutions change

Source: Meffe & Carroll, 1994, p.484.

This methodology is very similar to the problem-centred approach developed in recent years by psychologists working on environmental problems. Stern and Oskamp (1987) identify three primary benefits of such an approach for psychology becoming an applied discipline;

1) directs psychologists' attention to issues that policy officials view as important, and thus increases the likelihood that research outcomes will be recognised as relevant;
2) such an approach is inevitably interdisciplinary - it stimulates researchers to draw on theories and variables from various subdisciplines of psychology and even from other disciplines;
3) redirects attention toward actors and actions that psychologists have largely overlooked.

Drawing strength and direction from this issues-driven paradigm, the present research examines a number of conceptual and theoretical perspectives that are relevant to environmental management, in particular the management of an endangered species of particular salience and significance to the Wet Tropics region of North Queensland, the cassowary, *Casuarius casuarius*. A systematic consideration of biological and human dimensions are explored and an integration and synthesis of the information generated is attempted.

The research is premised on a multidisciplinary approach. The approach taken is a synthesis derived from contemporary concepts in ecology, conservation science, social and environmental psychology, environmental and endangered species management, and the real-world problem of the survival of the cassowary. The result is hopefully a more holistic, integrated endeavour which explores not only the biology of the species, but, in addition, the complexity of human psychological and behavioural responses to the environment and wildlife in general, and to the cassowary in particular.

This research cannot claim to be truly interdisciplinary as defined by O'Riordan (1995). According to Ittelson (1991), examples of true interdisciplinary work are hard to find despite consistent reference being made to this as a research design by many researchers. They describe the most successful work as "disciplinary combinations". Apart from the application of a general systems approach to both the *biological* and *human* components of the research, and the tendency for the theorists of environmental psychology to use the term "ecological" to support their theoretical proposals used in this research, no attempt was made to " draw upon common themes of process and evolution that embrace both physical and social systems" (O'Riordan, 1995, p.2). However, the research does go beyond simply being multidisciplinary. It seeks to integrate the information from both the *biological* and *human* systems into effective management strategies by developing a broader and more integrated understanding of what is happening and why.

1.2.2 Research Focus and Aim

The general aim of the research was to examine the reciprocal ecosystem impact and interactions between humans and cassowaries in three North Queensland environments; two of these environments are ranges where humans and cassowaries co-exist, the semiurban Mission Beach environment and the rural hinterland of Mission Beach; a third environment is urban, the coastal city of Townsville, approximately 50 kilometres distant from the nearest existing cassowary habitat and 240 kilometres south of Mission Beach.

This examination requires a focus on two main considerations:

(1) ***Biological and Ecological Considerations***

These considerations deal specifically with the endangered species component of the ecosystem. While logically necessary, it was not considered useful or practical to include biological and ecological considerations with respect to the human population. In the context of cassowaries, they include *population ecology*, (population size, density, composition and dynamics, social and spatial distributions), and *autecology* (activity

patterns, reproductive behaviour, movement patterns and habitat use). Gross information relating to population ecology, socio-spatial organisation and resource and habitat use, were included, as well as a comprehensive and systematic study of some aspects of individual behaviour. However, the decision was made to include only those aspects of biology that would provide the most useful data for the recovery process.

(2) ***Psychological and Human Considerations***

These considerations relate specifically to the human component of the ecosystem and include several *psychosocial* constructs (general and specific attitudes, concerns, information/knowledge level, the behaviour of the study population with respect to their natural environment, and a range of environmental issues and concerns relating specifically to the cassowary), *social-structural* constructs which are of particular salience and consequence (demographics, shared beliefs/values and ideologies which relate to perceived rights, restrictions, and sanctions and perceptions of equality, equity, and justice), and *environmental interaction/transaction* (land use features, land use activity, cassowary habitation). The key psychological and social variables selected for investigation were those which the social science disciplines suggest are most central to understanding human behaviour toward conspecifics and other species, namely general and specific attitudes, understandings, concerns, and motivations with these constructs encompassing "knowledge", "values", and "beliefs". As well, self-reported behaviour was considered an important albeit indirect measure of actual behaviour. Notwithstanding this more conventional "social psychological" focus, the research reflects ten years of participant observation and a life time residence in the communities involved. Hence many direct observations of human behaviour and human-cassowary interaction have been made, along with the extended field study of the cassowary itself.

The data base provided by these two conventional but interfaced research components allows for meaningful and balanced input into a management recovery program. While there are many other salient considerations (such as policies, sanctions, land status, and cost effectiveness), the availability of the in depth and complementary biological and human data for pragmatic decision making provides for very different species recovery interventions and outcomes.

The primary reasons for both the biological and psychological considerations include:

(1) only limited biological information exists on cassowaries;
(2) the need to assess how activities of humans impact on the needs of cassowaries within the same environment, and vice versa;
(3) the need to frame questions and develop solutions to the endangerment of cassowaries with both disciplines in mind.

By adopting this framework, this research aims to clarify:

(1) biological and ecological requirements of the endangered species, the cassowary;
(2) human response to this particular endangered species;
(3) human-natural environment/endangered species interrelationships;
(4) the integration of these two knowledge bases towards the development, implementation and evaluation of an endangered species recovery program.

The ultimate goal is a synthesis of a more encompassing ecosystem science and ecosystem approaches to provide a theoretical and pragmatic framework that links biological, environmental psychological and management research and practice through a holistic and inclusive methodology.

1.3 Facilitating the Links between Ecology, Environmental Psychology, Environmental Management, and Endangered Species Recovery

1.3.1 The Multidisciplinary Framework

In the natural sciences, disciplines such as biology, ecology, ethology, genetics, biogeography, etc., have made a considerable contribution to our understanding of the environmental crisis. However, they have not been alone in addressing this issue. There has been a noteworthy social science investment as well. This has included geography, sociology, anthropology, economics, policy, law, philosophy, environmental ethics and psychology. A classic problem has been that the natural and social sciences have addressed issues in isolation and often ignorance of each other. Often confusion arises because specialists in different disciplines are not able to understand and communicate

with each other, due in many instances to the same terminology being used in different senses (Reser, Bentrupperbäumer & Bragg, 1996; Warren, 1993). Such disciplinary barriers leave the crisis unresolved.

Research into the complex issues associated with environmental crisis management has to draw upon a plurality of disciplines for information, analysis, and insight, particularly in relation to the physical and social systems (Cosgrove et al., 1994; Fien, 1993; Stern, 1992; Webb, 1990). Some in the scientific community responded to the environmental crisis by drawing upon these disciplines and developing a relatively new, synthetic field of science, conservation biology (Figure 1.1), referred to by Soulé (1985) as a "crisis" discipline.

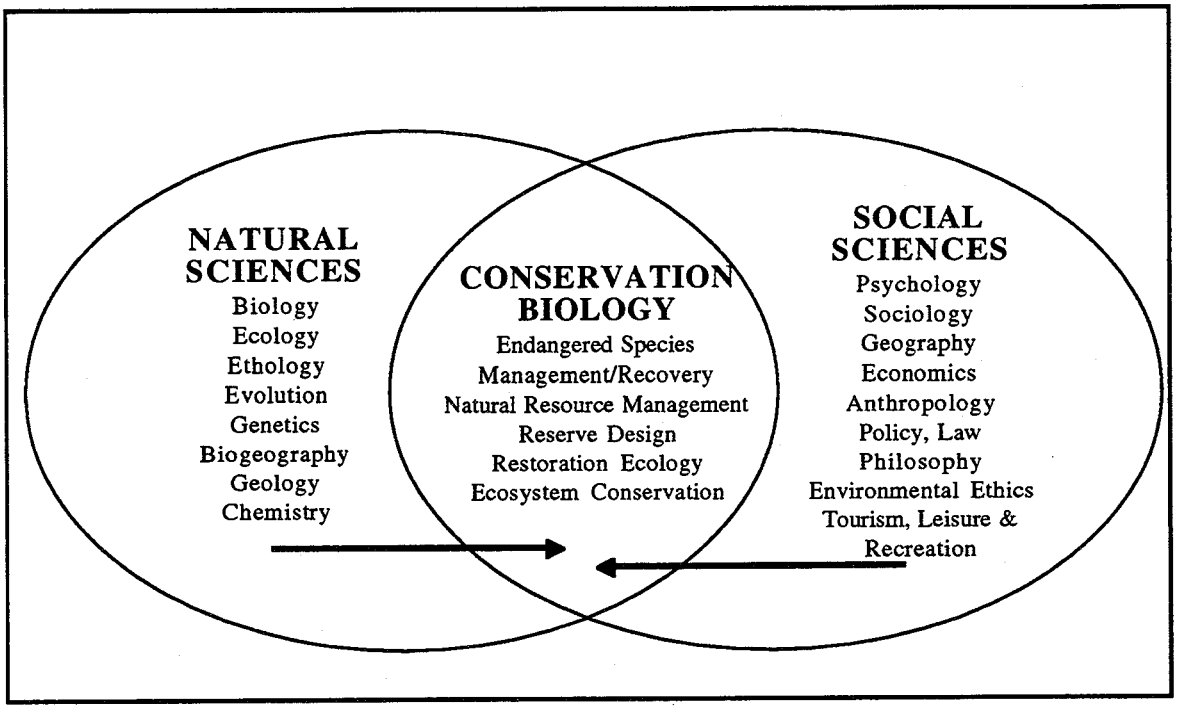

Figure 1.1 The multidisciplinary concept of conservation biology.

(Source: Meffe & Carroll, 1994, modified)

This reference to conservation biology being a crisis discipline implies urgency, a need to focus on application of whatever information is available in order to deal with and manage the crisis at hand. For a species classified as endangered, its future is extinction unless the causal factors are dealt with quickly. Soulé wrote in 1985:

> In crisis disciplines, one must act before knowing all the facts; crisis disciplines are thus a mixture of science and art, and their pursuit requires intuition as well as information. A conservation biologist may have to make decisions or recommendations about design and management before he or she is completely comfortable with the theoretical and empirical bases of the analysis (May, 1984; Soulé and Wilcox, 1980 chap. 1). Tolerating uncertainty is often necessary. (p.727)

The requirement for rapid assessments and recommendations for management based on available information should not, however, "detract from the quality of the data obtained or the rigour with which the theoretical principles are tested and refined" (Moritz & Kikkawa, 1994, p.v).

An important feature of conservation biology as a crisis discipline is that it is issue-driven as opposed to being discipline-driven. This allows for a focus on the knowledge which is required to solve problems, which is defined by the issue and not by the discipline (Meffe & Carroll, 1994). Conservation biology is also considered a "bridge" discipline (Burbidge, 1994; Norton, 1994), "the melding of the formerly 'pure' fields of population biology and ecology with the 'applied' field of natural resource management" ... and having ... "a strong philosophical basis and input from the social sciences" (Meffe & Carroll, 1994, p.20). In acknowledging that it is an inexact science, conservation biology recognises the complexity and unpredictable nature of the real-world situations this science must address. Another unusual characteristic of conservation biology is its acknowledged status as a value-laden perspective. Meffe & Carroll, (1994) stress the hypocrisy of those scientists, particularly the conservation biologists, who believe their science is value-neutral. Grumbine (1992) suggests that those who are trapped by this Western positivist image of science being value-free are missing the initial step to critical thinking. Meffe and Carroll (1994) summarise these characteristics thus:

> Conservation biology has some unusual characteristics not always found in other sciences. It is a *crisis* discipline that requires *multidisciplinary* approaches. It is an *inexact* science that operates on an evolutionary time scale. It is a *value-laden* science that requires long-term vigilance to succeed. It also requires of its

> practitioners innovation, flexibility, multiple talents, and an understanding of the idiosyncrasies of ecological systems. (p.23)

Conceptually, conservation biology is difficult to define given its problem solving orientation. Moritz and Kikkawa (1994) suggest it therefore would be better to define it according to its purpose. The goals of conservation biology are to provide the principles and tools for the *preservation* of biological diversity (Soulé, 1985), and its *restoration* (Recher, 1994); briefly stated, to find approaches to environmental management that are consistent with protecting natural systems.

Conservation biology offers a multidisciplinary and theoretical framework that is particularly applicable to this current research. In the biological/ecological domain it provides for a focus on a species-oriented conservation agenda even though its preference is for the large-scale ecosystem approach. In addition, conservation biology, with its special emphasis on the protection and maintenance of biological diversity, makes it particularly relevant to wildlife and endangered species management. It directly challenges the many assumptions and priorities of the traditional approaches to wildlife management which have included the emphasis on "education and training programs that stress the development of technical skills while downplaying conceptual clarity and intellectual flexibility; and a relatively rigid disciplinary framework that carries over from the classroom to the agency - department - and the landscape" (Meine, 1994, p.311). The perspective of conservation biology also provides a general theoretical framework for linking ecology, environmental psychology and environmental management.

There is a clear ecological sense and character to this perspective which is both intellectually and logically apposite and which maps on to the real world.

1.3.2 Specific Theoretical Frameworks

Despite this apparent holistic vision of conservation biology, it has not explored in any detail the more psychological and behavioural side of the human-natural environment or human-human interface (Altman & Wohlwill, 1983), at least in the Australian context. As is clear from Moritz and Kikkawa's (1994) definition of the goal of conservation biology, "to generate and apply biological data and principles to the maintenance of the ecological and evolutionary processes in natural systems" (p.v), the application of social science data is largely ignored. Many refer to the need to address the socio-economic and political dimensions of the crisis but very few identify how. Nevertheless, in some conservation

biology texts (e.g., Meffe & Carroll, 1994), an attempt has been made to address what is consider as the most difficult task of all, "the transduction of conservation knowledge into human lifestyle changes that are consistent with what we know about the natural world and our effects on it" (p.531). Meffe and Carroll expand on this, "The challenges facing the human species are legion, but none is greater than getting the majority of humanity to recognise the conservation problems facing the world, admit that they are serious problems, and commit to vastly changing the human conditions in appropriate ways" (p.531). These challenges clearly fall within the province of psychology, particularly social and environmental psychology.

Central to an assessment of the human dimension of the environmental crisis are the social and behavioural sciences. These sciences well define the nature and impact of individual and interpersonal behaviour in all human-natural environment relationships (Altman & Wohlwill, 1983; Bell et al., 1990, 1996; Ittelson, Proshansky, Rivlin & Winkel, 1974; Stern, Young & Druckman, 1992), which is considered a prerequisite to bringing about the changes in human behaviour necessary to respond appropriately to environmental change (Stern, 1992). As Oran R Young (1992) writes, "Because human activities interact with physical and biological systems both as driving forces and as critical links in feedback mechanisms, any effort to understand, much less to come to terms with, global environmental change that does not include a sustained commitment to improving our knowledge of the human dimensions cannot succeed" (p. v).

The conventional conservation biological framework adopted in this research has therefore been complemented by a number of theoretical perspectives and themes from the social sciences, in particular, social and environmental psychology.

1.4 The Dissertation Outline

The four main sections to the dissertation include an overview, two principal research components, and the integration and application of the results. For this inquiry, the dissertation focuses on the endangered species, the cassowary, *Casuarius casuarius*, as a case study in the second section and as a reference point for discussions on attitudes, beliefs/values, concerns, behaviour change, and their implications for management in the third and fourth sections. The dissertation outline presented here is consistent with both the sequence in which the research components were conducted in the field and the development of an endangered species recovery paradigm that specifically addresses the cassowary.

1.4.1 Section 1: *Overview*

The Natural-Human Environment Interface:
A Challenge for Endangered Species Recovery

The primary theme of this section is to present an overview of the purpose, perspectives and the theoretical framework on which this dissertation is grounded. In doing so it establishes the relevance of the research topic, provides a context for the research by outlining the shortcomings of present knowledge, and relates the research objectives and goals to this context. It challenges conventional views on environmental management, particularly those concerned with endangered species recovery. An argument for the need to integrate disciplinary areas, if the preservation and recovery of an endangered species such as the cassowary is to be the primary goal of management, is presented. Although recent debates have questioned the effectiveness of current endangered species recovery programs, old ideas remain embedded in management policies. Chapter 2 reviews the three disciplinary perspectives central to this dissertation, ecology, environmental psychology and environmental management. In Chapter 3, three endangered species case histories are reviewed with a particular focus on assessing the research, management and recovery procedures. Frameworks of multidisciplinary integration developed by each of the disciplinary perspectives are explored. The problems and pragmatics of multidisciplinary approaches are addressed in this chapter.

1.4.2 Section 2: Study 1 *The Endangered Species*

A Biological Study of the Cassowary, *Casuarius casuarius*,
an Endangered Species of the Wet Tropical Region
of North Queensland

This section is devoted to the first of the empirical studies conducted for this dissertation, a field study of the cassowary, *Casuarius casuarius* , the first extensive biological study conducted on a "wild" free-living population. It presents results from field studies which were conducted in the lowland coastal wet tropics region of North Queensland. The emphasis in the presentation of results has been placed on those aspects of the cassowary's biology that are most relevant to conservation and recovery, i.e., autecology, population ecology, and habitat considerations. Considerable detailed behavioural information which was collected in the context of a comprehensive biological profile has not all been included in this dissertation. A conservation science perspective provides the theoretical framework for this section. Chapter 4 offers a review of the literature relevant to this study and Chapter 5 outlines the general methodology used. It provides details of the study sites, how birds were individually identified, located, habituated and followed,

and the methods used for recording. This study used a number of innovative techniques, largely because this was the first time this species had been studied in its natural environment and in any detail. Techniques therefore had to be developed to suit the conditions, the species, and the limited resources available. Methods for particular sections of the research are outlined in the relevant chapters. Chapter 6 examines population ecology, spatial distribution and social organisation, a detailed knowledge of which is necessary for understanding conservation problems and assessing management processes (Caughley & Gunn, 1996). Reproductive biology is considered in Chapter 7 and Chapter 8 outlines resource needs and habitat use. Chapter 9 describes and discusses the key conservation and management issues that arise out of this biological study.

1.4.3 Section 3: Study 2 *The Human System*
Exploring the Human Component of the Ecosystem

This study focuses on another inhabitant of the very same environment as cassowaries, humans, *Homo sapiens*. This is a species which presents many challenges for any researcher wishing to explore their perceptions, representations and understandings of the natural environment, and their behaviour and the determinants and implications of that behaviour for an endangered species and environmental management. Chapter 10 reviews the literature that is particularly relevant to the study of the human component of the ecosystem. A number of conceptual frameworks within which the human-natural environment interface have been discussed are examined in this chapter. As with any species, the relationship between humans and the natural environment is not straightforward. Instead it is highly complex, presenting many methodological and analytical difficulties. An outline of these difficulties and how this research has addressed them is presented in Chapter 11. In addition, details of the study area, target communities, survey instrument development, administration, and analysis are outlined. The next three chapters 12, 13, and 14 focus on three core constructs, environmental attitudes, belief/value systems, and environmental concern. The last chapter of this section draws on these three core constructs to assess interrelationships between humans, the natural environment, and the endangered species, the cassowary.

1.4.4 Section 4: *What Does This all Mean?* Integration and Application: Links between Cassowaries, Community, and Conservation.

This section presents the closing chapter of the dissertation. It attempts to integrate the empirical and conceptual approaches of the two studies as a means of understanding the highly complex and dynamic nature of endangered species management. The chapter incorporates a review of the key findings by drawing on the conclusions of each of the empirical components of the research and, together with a number of theoretical proposition, summarises the findings and identifies key management issues. A meaningful synthesis of all components is pursued. This process is used to address the implications of this integration for environmental management, endangered species recovery and future research.

1.5 Situating the Author

1.5.1 Research Considerations

I have written this dissertation in the hope of contributing, in however modest a way, to preventing the extinction of a species. The information I have collected on endangered species and their recovery will, I trust, assist other biologists, ecologists, environmental psychologists and environmental managers in their endeavours to address the biodiversity crisis as those before me have provided for me. In the process I have had the privilege of spending a number of years with yet another of this worlds' most unique creatures, the cassowary, *Casuarius casuarius*. The research began as a biological study of this endangered species but soon progressed into the realm of conservation and management once the forests began to fall.

My interest in drawing on three major disciplinary fields, ecology, environmental psychology, and environmental management was motivated by what I and many before myself (see for example, Clark et al., 1994; Kellert & Clark, 1991; Reading, 1993) considered to be the ineffectual and often uncertain way in which endangered species recovery was proceeding. After exploring the endangered species management literature I began with a series of readings and discussions in social and environmental psychology, a science most often relegated to the not-so-important basket by biologists and environmental managers so as not to interrupt ongoing involvements. These social

science perspectives presented many challenges for an ordinary biologist like myself. The concepts were unfamiliar, broadly defined, and difficult to understand. Nevertheless, a picture eventually began to emerge that I thought would be valuable for environmental management and specifically endangered species recovery. I do not pretend to have become a social or environmental psychologist in the process. In fact, what I have learned and can present here is only a sampling of the wide, deep and highly complex discourses of social and environmental psychology, discourses for which I have gained an immense respect. I was always well aware and concerned that I was indeed only sampling these disciplines and that realistically, for a project such as this, it would be impossible to do justice to such encompassing disciplinary perspectives. I was also well aware that research of this nature risks criticism from both sides of the natural-social science debate. In spite of continuous tensions between my proceeding, being fully aware of the limitations, dangers of simplification and criticisms, and not proceeding thereby giving in to this conflict and continuing on "as normal" with a biological perspective only, as is demonstrated in this dissertation proceeding has won out.

I have attempted to draw on my biological knowledge of the cassowary, my insights into government management procedures and community conservation processes, and my newly acquired knowledge of social and environmental psychology and provide a coherent, holistic picture relevant to endangered species recovery. I have attempted to heed the current call for multidisciplinary research into the area of environmental management and have taken courage from the knowledge that more biologists, ecologists, psychologists, and other environmental scientists seem willing to cross disciplinary boundaries and levels of organisation in an endeavour to contribute to solving the extinction crisis. The integration of a number of disciplines relevant to endangered species recovery is therefore a central theme and objective of this dissertation.

Like many research projects on endangered species (e.g., Bennett, Backhouse & Clark, 1995; Clark et al., 1994; Schaller, 1994; Stephens & Maxwell, 1996) this one has not been without its difficulties. In fact many of the difficulties encountered by other researchers, I have also experienced. Despite the harsh and demanding physical and climatic conditions of the field, the actual biological component of the field work presented the least difficulties. Cassowary "politics" inevitably came to the fore, on many occasions threatening to terminate the project. Two examples out of many illustrate, from the perspective of a biologist working in the field, the real, everyday problems faced when dealing with the extinction crisis. These were denial of land access to my major study site half way through the biological study, and an attempt by a local conservation organisation to terminate the human population study component of the research.

The first was a response by the landowner who became concerned about the possible implications the results of my study would have on the future of his property. The State Government was at that time preparing the Nature Conservation Legislation. This private property completely land locked the northern boundary of the study site, a 319.2 hectare World Heritage listed National Park. The other boundaries included the sea and a mangrove river. This private property had been classified as critical habitat for cassowaries (Goosem, 1992). In addition to denying my access to the study site, the landowner proceeded to clear extensive areas of this property preempting the potential restrictive status of the critical cassowary habitat classification - his right of unfettered use. This action resulted in the redundancy of the critical habitat classification.

The second example relates to the response of a local conservation organisation to my disengagement from their group[5], the acceptance of my research as a PhD project, and the inclusion of a human component to my research. While a situation-specific history of changes in group membership, focus and funding, and individual personalities were involved, more generic and generalisable matters included "ownership" of the issue, a perceived loss of control over a study being undertaken under the auspices of a university and a federal government management agency, the threatened expertise and credibility of the conservation organisation, etc. The salience of conservation versus development issues and concerns, the polarisation of the local community with respect to rapid change and development speculation, and the sustained attempt of the local conservation organisation to undermine the credibility of myself and the value and relevance of the research project were both instructive and sobering, as well as personally very difficult to accept. The unfolding history and changing directions and priorities of such "community" groups, and the role in environmental management and decision-making in an emotionally charged and politically volatile community environment underscore the difficulties of "field work" with human communities.

But, as Schaller (1994) notes:

> A biologist must not only study nature but also induce action on behalf of conservation, and this guarantees problems for any project. (p.xiii)

[5] I was responsible for coordinating this conservation organisation in its first year of inception, 1991, at the request of the then State Minister for the Environment. However, in 1993 I withdrew my active role once my PhD research began and in 1994 formally disassociated myself from the organisation following their accusations and threats of legal action against my research.

1.5.2 Presentation and Terminology

In addition to the different theories and concepts, language and meanings, methodologies and research approaches, this multidisciplinary endeavour highlights the very different ways in which natural and social scientists communicate their ideas, present their arguments, and analyse their research findings. The challenge for this dissertation has been to present two very different studies, a biological study of an endangered species and a psychosocial study of the human population, in a way that is consistent with the traditional styles of each discipline, but without the product appearing too disjointed. I have therefore written the biological study, Study 1, in the first person, a style consistent with the presentation of most contemporary biological studies. In the analysis chapters I have followed the classic format of Introduction, Methods, Results and Discussion. On the other hand, the psychosocial study, Study 2, is written in the passive voice. Furthermore, in the analysis chapters Results and Discussion are combined and the final section is written as a Summary and Conclusion. However, a consistent referencing style has been adopted throughout the dissertation, that of the American Psychological Association (APA, 1994).

Notwithstanding this difference in the nature and presentation of the studies and the findings, an attempt has been made to make them not only intelligible and useful to readers of differing disciplines and persuasions, but complementary and mutually informative with respect to management issues and challenges. Their side by side existence in this dissertation hopefully highlights important differences but also their critical interdependence with respect to endangered species management.

Finally, in the title of this dissertation I refer to human beings as *Homo sapiens* because I wish to emphasis that our species is just one among millions of species in the ecosystem although we are the most powerful animal to have evolved here in terms of both number and destructive ability (Soulé, 1995). I also use the term *endangered species* in the title and throughout this dissertation to refer to species formally listed or being considered for listing by federal or state governments. My concern here is not so much for legal classification as for uncertainty in future existence and how to address it (Salwasser, 1991).

Chapter 2

Links Between Ecology, Environmental Psychology, and Environmental Management

2.1 Introduction

In an attempt to further develop the theoretical framework for this mulidisciplinary research endeavour, this chapter explores theoretical themes from three disciplinary areas central to the dissertation - ecology, environmental psychology and environmental management. As will be shown, not only do these disciplines share similar concepts but each in turn offers a disciplinary-specific perspective which is important to this research.

The first disciplinary area, ecology, a major discipline of the natural sciences, is chosen to communicate the ecological themes that link ecology, environmental psychology and environmental management. Ecological principles are shown to be applicable to more than just natural systems. Ecology, as a study of interrelationships, essentially deals with

complexity and connection, with interconnected wholes and with change and survival. It overcomes the alienation of humanity from nature and provides guidelines for environmental management. The concept of *ecosystem* is the core concept and "bridge" between the disciplines.

The second disciplinary area is environmental psychology. A number of environmental psychologists are particularly interested in exploring the person-environment relationship using both structural and functional concepts from ecology such as ecosystem, and the implied interaction, interdependence and integration (e.g., Altman & Rogoff, 1987). Ecosystem is a concept which has served as a framework for analysing the human-environmental system as a whole, and in terms of interaction and integration. In this way, the intentions of environmental psychologists in exploring system structure and process, situation context and dynamic, and interactional and transactional process parallel those of ecologists. Both disciplines share a common denominator, the intent to describe, analyse and explain the behaving and functioning of organisms in their environment. For both ecologists and environmental psychologists, ecology and the ecosystem constitute an encompassing and necessary orientation.

In the third disciplinary area, environmental management, ecology is used as the "fusion point" of environmental science and management (Leopold, 1939, in Norton, 1992). Environmental management is the application of scientific expertise from ecology and social science to a societally defined problem. Ecological and social science understandings of the "system" are integrated in order to manage the system's dynamic, and/or address perturbations to the system. In the context of endangered species recovery, concepts from the policy sciences approach and organisational theory are particularly relevant.

The primary aim of this chapter is to review principal areas where ideas from ecology, environmental psychology (as a representative and particularly relevant domain of the social sciences), and environmental management have a role in explaining aspects of the human-natural environment relationship, and to introduce biologists/ecologists, social scientists, and environmental managers to concepts developed by each of these disciplines that promise to be useful tools in future analysis of the human-natural environment relationship. Both social and environmental psychology are very *applied* areas of psychology, with environmental psychology in particular being very *problem-focused* and intrinsically sensitive to and aware of larger environmental and multidisciplinary perspectives and insights. Social psychology, on the other hand, offers theories, models, and methodologies which are particularly useful for assessing community attitudes, understandings and concerns, as well as actual behaviour. The challenge today for all

scientists is how to answer pressing ecological questions by using theoretical concepts from ecology, social science and environmental management.

2.2 From Ecology: Ecological Principles and the Ecosystem Concept

Ecology is considered by many natural and social scientists as the most important and all-embracing of the sciences (Peters, 1991). According to the psychologist, Sells (1974a):

> A major concern of the biological and social sciences has long been the nature of the interaction of organisms and populations with the embedded environment, which supports, influences, and determines its limits of structure and function for the life that exists within its domain. The generic term representing scientific study or organism-interaction is ecology. (p.45)

2.2.1 "Nature" and the Ecosystem Concept

Ecology is the "science of organisms in relation to their total environment; the inter-relationship of organisms inter-specifically and between themselves" (Darling in Parks, 1980, p.33). It is a science aimed at understanding the underlying principles of operation of natural systems (Arms & Camp, 1982; Putman & Wratten, 1984; Smith, 1976). Basic to the science of ecology is the knowledge that no organism lives in isolation, but rather it shares its environment with other organisms of the same and different species (Putman & Wratten, 1984).

A concept ecologists have used which encompasses the total observed integration of all components of the living and non living world is the ecosystem; an arbitrarily delineated space; a self-contained ecological entity of both organisms and their complete biotic and abiotic environment (Bormann & Likens, 1974; Haila, Saunders & Hobbs, 1993; Odum, 1976; Putman & Wratten, 1984; Sabath & Quinnell, 1981; Wilson, 1974). The term ecosystem was originally proposed by A.G. Tansley in 1935 (Mannion, 1991; Sabath & Quinnell, 1981; Smith, 1976) in the attempt by this early ecologist to find a concept which would encompass this total integration.

In ecological literature, the focus is on the ecosystem as an entity (King, 1993) where distinctions are made between its structural and functional entities (e.g., Haila et al., 1993;

Putman & Wratten, 1984; Sabbath & Quinnell, 1981). The structural entities can be hierarchical: one of scale (individuals aggregate into populations, populations assemble into communities, communities, with their physical environment combine to form ecosystems); or, from a global perspective, one of life status (the abiotic or non-living components known as the hydrosphere, lithosphere, and atmosphere together with the earth's biotic or living components of the biosphere). But an ecosystem is considered to be more than just a collection of communities or of communities and their abiotic environment. The whole is something far beyond the sum of its component parts. It is a complete new entity with characteristics and properties of its own. It is a functional unit with the components intimately linked by a variety of biological, chemical and physical processes (Bormann & Likens, 1974; Putman & Wratten, 1984) through a richly detailed budget of inputs and outputs (Bormann & Likens, 1974) expressed in terms of energy flow through the system and nutrient cycling within the system (Haila et al., 1993). The notion of a dynamic integrated system is a valuable one.

Colinvaux highlights the views of the many ecologists who enthusiastically rallied around this new concept, "the ecosystem concept is one of the most powerful ideas in ecology, a concept which allows us to examine the workings of the natural world in an objective and understanding way" (in Park, 1980, p.107). This ecosystem approach was considered to have a potentially large contribution to make to the study of the environment from both an ecological and management point of view (Park, 1980). In focusing on interrelationships in particular, ecology, with its ecosystem concept, addresses many fundamental questions in a number of the ecological sciences covering a range of topics such as species adaptation, diversity, and abundance, cooperation and conflict, and extinctions. The main benefits of the approach include, convenience of scale, flexibility of framework, fundamentality of the unit and assets of the systems approach per se (Park, 1980). In addition, the ecosystem concept promotes a holistic approach to the study of the environment (Smith, 1976).

2.2.2 Humans and the Ecosystem Concept

> Darwin and Huxley put humans squarely within nature and therefore as part of the ecosystem. (Pepper, 1996, p.187)

To many contemporary scientists from a range of disciplines including ecology (Caldwell, 1976; Darling & Dasmann, 1976; Odum, 1976), geography (Bennett & Chorley, 1978; Berry, 1980; Mannion & Bowlby, 1992; Park, 1980), environmental science (Fairweather, 1993), anthropology (Borgerhoff Mulder, 1991), psychology (Barker,

1974; Moos, 1974; Sells, 1974a, 1974b), sociology (Spaargaren & Mol, 1992), cultural and human ecology (Bateson, 1972a, 1972b; Cox, 1973; Dubos, 1965; Shepard, 1982), and environmental management (Born & Sonzogni, 1995; Burroughs & Clark, 1995; Slocombe, 1993), ecology and the ecosystem concept was also considered as a framework for analysing human relations with their biological, physical, and psychological environments. The expansion of the concept to include humans was based on the recognition that, for many ecosystems, *Homo sapiens* are a part of nature; the human ecosystem is its basic unit of analysis (Hockett, 1973; Fairweather, 1993; Machlis, 1992; Odum, 1976; O'Riordan, 1976a; Pepper, 1985; Shepard & McKinley, 1971). After all, humans are biological organisms, bound to their biological heritage (Eibl-Eibesfeldt, 1989; Wilson, 1993). The roots of this human ecological perspective lie in general ecology, geography and anthropology (Borgerhoff Mulder, 1991; Machlis, 1992; Moos, 1976; Park, 1980).

In geography, for example, for those geographical methodologists who viewed their discipline in terms of human-environment relationships, "the older teleology of the 'web of God's design' had begun to decline .... the work of Darwin was to replace it by considerations of environmental adaptations and interrelationships (the 'web of Life') which culminated in the twentieth century concept of ecology" (Bennett & Chorley, 1978, p.14). Many geographers considered that the ecosystem framework had properties of significance to geographic analysis of the environment such as: its monistic nature, its structured form, the functional entities, and the application of general systems theory in analysis (Parks, 1980).

Anthropologists such as Gregory Bateson (1972a, 1972b), Bruce Cox (1973), René Dubos (1965), C.J. Hockett (1973), Ashley Montagu (1968), R.A. Rappaport (1968, 1971) also came to recognise the promise of employing ecological factors in their studies. Attention to ecological and environmental influences on culture has developed through a number of stages, ecosystem approaches taking on a wide variety of forms (Milton, 1996). For example, the original emphasis on ecological analysis and historical explanations of the development of human culture was replaced by the concept of cultural ecology which developed the point of view that the forms which a culture evolves can and must be understood as adaptations to its habitat (Berry, 1980). In addition, some contemporary anthropological and archaeological researchers (e.g., Borgerhoff Mulder, 1991) have been increasingly influenced by theoretical advances in behavioural ecology evident in their use of concepts such as resource choice, foraging group size, food sharing, etc. These concepts have been used to explore how ecological and social factors affect behavioural variability within and between human populations. "Behavioural ecological anthropology can be seen as adding the study of function to investigations of

causations, development and historical constraints that were already well established in the social sciences" (Borgerhoff Mulder, 1991, p.69). Other anthropologists have used the ecosystem approach as an integrating framework for human-environment interaction studies using systems models of matter, energy and information flow (e.g., Moran, 1984, in Slocombe, 1993).

In yet another discipline, urban sociologists of the so-called Chicago school of the 1920s and 1930s coined the term "human ecology" (Gaziano, 1996; Mannion & Bowlby, 1992; Moos, 1976). Believing that competition was the basic process in human relationships, they applied the theoretical schemes of plant and animal ecology to studies of human communities. Due to many criticisms of this classic human ecological theory it was slowly reconceptualised with cultural factors becoming increasingly important as evident by Moos's (1976) comments, "Human ecology is distinguished from plant and animal ecology specifically by the unique characteristics of man and the human community. Unlike plants and animals, human beings can construct their own environment" (p.11). The human ecologists applied descriptions of system structure and simulations of dynamics, similar to how an ecologist would approach the study of an ecosystem (Slocombe, 1993).

In addition to these disciplinary perspectives, there have been many natural history writers and essayists who have been addressing humans in the context of ecological principles and the ecosystem concept for some time, for example, Paul Shepard (1971, 1982, 1995, 1996), Henry David Thoreau (1960), to mention just a few. Discourses such as deep ecology (Naess, 1991), ecophilosophy (Roszak, 1992), environmental ethics (Nash, 1989; Singer, 1975), and environmental philosophy (Attfield & Belsey, 1994), have also extensively addressed this linkage. In the non-human species and early human species studies, the ecosystem concept has, in general, been confined to tangible biotic and abiotic components and their interactions. But it was this very principle of ecological interdependence that has been increasingly recognised by scientists from several disciplines (Stern & Oskamp, 1987) and has contributed significantly to the extension of the concept into other areas of science.

2.2.2.1 Psychology and the Ecosystem Concept

What is exceptional about the human ecosystem perspective in psychology is that an added dimension to the ecosystem concept is included, that of the unobservable psychological processes which environmental studies have been unable to address in non-human species. McDougal was arguably the first social psychologist from the early part

of this century who saw all attitudes and instincts in the context of an evolutionary model, thus integrating theories and concepts from the science of ecology into social psychology (Allport, 1968). McDougal clarified the implications of Darwinism, building a coherent system of social psychology upon the instinct hypothesis, leading the way toward pluralistic explanations of social behaviour. For many contemporary psychologists ecology has contributed to the development of theory in several ways, basic to which is the assumption that to fully understand a person's behaviour we need to gain an ecological perspective which requires us to look at all the levels where processes are taking place that are influencing this behaviour. The need for this holistic approach which characterises the ecosystem concept has been aptly expressed by the ecologist Eugene Odum[1] (in Zimbardo, 1979, p.722).

> It is self-evident that science should not only be reductionist in the sense of seeking to understand phenomena by detailed study of smaller and smaller components, but also synthetic and holistic in the sense of seeking to understand large components as functional wholes. A human being, for example, is not only a hierarchical system composed of organs, cells, enzymes systems, and genes as subsystems, but it is also a component of supraindividual hierarchal systems such as populations, cultural systems, and ecosystems. Science and technology during the past half century has been so preoccupied with reductionism that supraindividual systems have suffered benign neglect. We are abysmally ignorant of the ecosystems of which we are dependent parts. As a result, today we have only half a science of man.

Good examples of a modified ecological theory which have been developed in psychology are Brunswick's *ecological validity* of perceptual cues, Lewin's *field theory* or *psychological ecology,* Barker's *ecological psychology,* Gibson's *ecological theory* of perception, Bronfenbrenner's *ecological approach*, the *interaction models* of Murray, Sells, Craik and Kaplin, and the *transactional* approach of Pervin, Altman, Wapner and others. These principal theoretical models utilise some of the basic principles of ecological theory (Altman & Christensen, 1990). The use of the term ecological both supports their theoretical proposals and identifies characteristics of the proposed approach (Bell et al., 1996; Bonnes & Secchiaroli, 1995).

In general psychology, an ecological approach was first promoted by Egon Brunswik in 1947 (Berry, 1980; Moos, 1976) who considered that behaviour should be examined in

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[1] Goldsmith (1988, p.160) refers to Eugene Odum as "possibly the last holistic ecologist in academia."

its natural-cultural habitat and that the task of psychology was the analysis of the interaction between two systems, the environment and the behaving subject (Berry, 1980). Brunswick was also considered the first psychologist (in the United States) to consider the correspondence between perceived reality and characteristics of the environment (Bonnes & Secchiaroli, 1995).

Another important pioneer in the field of ecological approaches was Kurt Lewin who, in the 1940s, developed the field theory and psychological ecology. The fundamental contribution of the field theory was the proposition that human behaviour was a function of both the person and the environment. The property of the field theory stressed by Lewin was that all actions are influenced by the field in which they take place. Analysis, therefore, must be based on the situation as a whole and must consider interchanges between parts of the system (Brehm & Kassin, 1990; Deaux & Wrightsman, 1988; Moos, 1976; Sampson, 1976).

This theory, together with the intellectual tradition fostered by Brunswik, was further developed by Barker in ecological psychology, an approach to psychology concerned with understanding the psychosocial interdependence between the individuals in a community and their physical and biological environment (Barker, 1974; Zimbardo, 1979). Barker's theory included elements of Brunswik's emphasis on the ecological setting of behaviour and elements of Lewin's concern with the psychological environment (Moos, 1976). The ecological approach of this theory addresses ongoing behaviour in its physical and social context, the systems in which behaviour occurs, and the two-way influences of person and environment - how they affect each other (Barker, 1974). Barker was interested in the "total picture", the ecological environment, the exploration of which necessitated the development of a "naturalistic" methodology (Kaminski, 1992). This was quite a change for psychology in the United States which at the time considered laboratory research or the clinical method as the only pertinent and accepted methodologies (Bonnes & Secchiaroli, 1995).

Gibson's ecological approach of the 1960s differed from that of Barker in that it was a theory centred on perception. This theory proposed that the perceptual phenomenon should be considered as the direct result of "ecological characteristics" of environmental stimuli (Bonnes & Secchiaroli, 1995); that is, receptive information that comes directly from the environment. These authors go on to point out that "this (Gibsonian) position of strong environmental realism ... is mitigated by the evolutionary perspective of the ecological approach, which affirms the existing correspondence between organism and environment established through the process of phylogenetic adaptation of every species

to its environment, including the perceptual one" (p.30). Again this approach was contrary to the tradition of experimental studies (Kaminski, 1992).

Another to further develop Lewinian theory was Bronfenbrenner whose theoretical work led him to define "the ecology of human development" (Bonnes & Secchiaroli, 1995). Bronfenbrenner's approach to individual-environment relationship problems was to refine the Lewinian proposal of psychological ecology so that it could be applied to child development and social change. His "ecological approach" aimed primarily at recovering the interactive and holistic perspective of naturalistic ecology (Bonnes & Secchiaroli, 1995). Bronfenbrenner was critical of traditional psychological research because it was based on the model of unidirectional causality. Instead, his model of ecological environment outlines the reciprocal and bidirectional nature of interactions.

Interactive models of Murray, Sells, Craik, and Kaplan develop new concepts bypassing the traditional human/environment dichotomy. They examine the role of personality in human-environment interactions (Levy-Leboyer, 1982). These models are based on the "principle of interaction" which states that "behaviour ... represents the result of some form of mediated transaction between organism and environment" (Sells, 1974b, p.548). A complex personality theory which gave attention to the issue of individual-environment interaction was that developed by Henry Murray in 1938 (Pervin, 1974; Walsh, Craik & Price, 1992a). It included concepts of individual needs and environmental press (Moos, 1976). Sell's (1974b) adaptive interaction theory was derived directly from the principle of adaptation in ecology which involves the self-regulating tendency of living organisms to maintain themselves by various means of accommodating or adjusting to changes in the environment. Craik and McKechnie (1977) applied an ecological concept when describing human-environment relations in what they saw as the interplay between personal, societal and environmental systems. The revisited modern version of this classic theory is the transactional approach of Pervin. According to Pervin (1974), transactionalism "involves objects relating to one another within a system ... organism and environment influence one another as part of a total transactional field" (p.581). This differs from an interaction approach which only involves objects in the causal interconnection of one object acting upon the other. According to Levy-Leboyer (1982), this approach exercises increasing influence over research and interpretation.

Adoption of these ecological approaches in psychology has provided the theoretical roots for the development of environmental psychology, a relatively new and inherently interdisciplinary perspective, grounded in human experience, biological, historical and ecological context.

2.2.1.2 Environmental Management and the Ecosystem Concept

Ecology has played a varied but important role in environmental management. Findings, approaches and concepts in ecological theory have proved a rich source of ideas and analogies in the development of sound environmental management programs. As Park (1980) points out:

> The traditional view of ecology as the science of living things in relation to their environment has helped to place it in a valuable strategic position from which it can make important contributions to environmental management. Indeed, to many people ecology is almost synonymous with conservation and the environment. This is in part because, as Frederichs points out , 'ecology has ceased to be a synthesised branch of biology ... it has become a *viewpoint.* (p.33)

Ecological principles have been employed in a number of different management contexts. Concepts such as the ecosystem, for example, have had a significant role to play, both in terms of defining structure (unit) and function (state) of the management system (see for example, Armitage, 1995; Born & Sonzogni, 1995; Costanza, Norton & Haskell, 1992; Lajeunesse et al., 1995; Montgomery, 1995; Slocombe, 1993; Woodley, Kay & Francis, 1993). On the other hand, environmental management has provided extremely useful tests of basic ecological understanding (Pickett, Kolasa & Jones, 1994).

Slocombe (1993) identifies Robert S. Dorney as the ecologist who, in the early 1970s, looked at ecosystems in a planning context. He then went on to develop an ecosystem approach to environmental management. The ecosystem as the fundamental ecological unit was adopted as a important management unit promoting the notion that, "the big picture becomes the focus ... think big and think connected" Grumbine (1994, pp.184, 187). Adoption of ecological principles and the ecosystem concept into management provided scientific support to that school of conservation thought that was formed in the late 1800s and early 1900s by Marsh, Thoreau and Muir, who saw conservation to be of value in spiritual terms as opposed to economic terms (Eckersley, 1988; Reid, 1994; Thoreau, 1960). In contrast, it represented a radical departure to those traditional forms of management promoted by Pinchot and Roosevelt, who viewed conservation in utilitarian terms (Dunlap, 1988; Matthiessen, 1987; Shabecoff, 1993). Consistent with these views, landscapes were managed for short-term economic benefits (Montgomery, 1995). This was followed by a "crisis mode" of management which involved species-specific and/or site-specific management (Grumbine, 1992; Montgomery, 1995; Soulé, 1985).

According to Smith (1976), the concept of ecosystem management must be viewed more broadly than that held by some traditional ecologists. The unit of analysis must include the human population as a vital component of the system. The human ecosystem which includes political, social and economic systems is superimposed upon the environment. Sustainable ecosystem management, therefore, must consider all components of the system. Many ecosystem-based frameworks now seek to incorporate ecological, socioeconomic, political and institutional elements in environmental planning and management (e.g., Armitage, 1995; Born & Sonzogni, 1995; Slocombe, 1993).

Ecosystem health and ecosystem integrity are key terms used extensively throughout environmental management literature as metaphors "for guiding our general goal of protecting biological systems, for avoiding biotic impoverishment in all its dimensions" (Karr, 1992, p.227). Norton (1992) considered the notion of ecosystem health as a new paradigm for environmental management, a notion evolving out of the necessity to explore the idea that there is an obligation to protect the health and integrity of ecological systems. From the traditional ecological perspective ecosystem health and ecosystem integrity are used in environmental management as "macro-descriptors that define a state of nature against which to measure degradation" (Reid, 1994, p.7). According to this description, key environmental management objectives are defined in terms of the *state* of ecological systems. This notion of ecosystem health and ecosystem integrity is addressed within a purely biophysical scientific framework and as such the emphasis should be placed on quantitative and unambiguous measures of ecosystem state (Steedman & Haider, 1993).

Although this notion of ecosystem health and ecosystem integrity is broadly used in ecology and environmental management, Reid (1994) presents a critical review of the scientific validity of these concepts. He argues that they cannot be formulated into scientifically defensible biological indicators that underlie ecological management goals. Instead, as ecological management objectives, they do not fit with ecological reality. Reid develops his argument on the basis that the traditional view of ecologists and environmental managers that ecosystems are basically stable, "natural" assemblages of species with population levels tending toward equilibrium and undisturbed by humanity, is flawed. Instead, ecological systems are neither static nor balanced but highly dynamic, complex systems "undergoing both sudden and gradual change through both deterministic and chaotic processes" (Reid, 1994, p.9). The use, therefore, of ecosystem health and biological integrity as "macro-descriptors that define a state of nature against which to measure degradation" will not succeed. Reid goes on to point out that:

> Ecologists seem to be bent on exhausting every possible medical and mechanical metaphor before recognizing the unique nature of ecological systems.....Just as ecologists sought measures of stability and failed, it seems that the metaphors of health and integrity are also doomed to failure. Establishing when an ecosystem is 'sick' or disintegrating is entirely subjective. (p.8)

In spite of the problems associated with the purely biophysical scientific framework for defining ecosystem health and ecosystem integrity, many still argue that the concepts can play a role in management. Reid (1994), for example, admits to them serving important political and educational roles, while others believe that both scientific and social aspects of ecosystem health and ecosystem integrity have to be incorporated into management decisions (Steedman & Haider, 1993).

2.2.3 Criticisms

2.2.3.1 Of the Use of Ecology

Despite a number of eminent ecologists who consider ecology as the link between the natural and the social sciences (Odum, 1971; 1975), who include humans as an integral component of the environment (Peters, 1991), and who have taken an ecosystem view of human society (Darling & Dasmann, 1976), there are those who criticise its use beyond the science of natural history and into the realm of the social sciences (e.g., Puttman & Wratten, 1984). This is interesting considering "the provenance of ecology was social thought" (Gaziano, 1996). Gaziano goes on to explain the unfolding of economic and ecological metaphors:

> Beginning in 1866, biologists began using the economy as a metaphor for the natural environmental organisation of plants and animals. During the next half century, biologists refashioned 'the economy of nature' into 'ecology'. Then, during the late 1910s, sociologists began employing the concepts of ecology as metaphors for urban organisation and change. During this period, biologists made yet another foray into social scientific ideas, this time emerging with the concept of society. The simultaneous use of the ecological metaphor in sociology and the society metaphor in biology created a perception of convergence in two otherwise distinct fields of knowledge. (p.879)

The systems nature of economics, a social science, facilitated a problematic shift on the part of biologists from the *economics of nature* to the *nature of economics*, such that

systems approaches within ecology and environmental management began, subtly, to take on other features of "economic thinking" finding contemporary expression in many management concepts, such as "sustainable development" and "contingent valuation".

2.2.3.2 Of the Ecosystem Concept

Despite its application, there are critics of the use of the ecosystem concept in the fields of ecology, social and behavioural sciences, and environmental management. In ecology, the criticism is aimed at issues such as the *misuse of the term* (e.g., Gould, 1977; Polunin & Worthington, 1990; Putman & Wratten, 1984), the *vagueness of constructs* (e.g., Peters, 1991), the *problem of relativity, scale* and *definition of boundaries* (e.g., Haila et al., 1993; Park, 1980), and the *problem of measurement of ecosystem form* and *processes* (e.g., Park, 1980). The comments by Polunin and Worthington (1990) capture the discontentment of these ecologists with what they consider to be the ever increasing and indiscriminate application of the term, "It is ***not*** a mere smart-sounding catch word for any kind of system or quasi-system that, involving biota and inert components, may seem desirable to a would-be user needing a term that sounds learned or technical" (p.274). They believe the problem has evolved due to the need to "imply the holistic but less integrated nature of particular and usually major entities that are held together in some way by an ecological factor or consideration while embracing more or less numerous ecosystems" (p.274). Peters's (1991) criticisms are due to what he considers to be a crisis in ecology. In classifying it as being "sometimes a weak or soft science" he sees it as one which, because of subjective criteria, is moving toward uncertainty. With so much of the science being phrased ambiguously the meaning of most constructs are uncertain and open to reinterpretation. Haila et al. (1993) see the problem of relativity as being inherent in the definition of ecosystems and hence they find the application of the concept to specified cases problematic. All ecosystems are internally heterogeneous and consequently they are not scale independent. In addition, with nature being a continuum, sharply defined natural boundaries are rare. But for ecological analysis, measurement, modelling and application, boundaries have to be fitted to the study of an ecosystem (Park, 1980).

In the social and behavioural context, most notably in the area of geography, criticism of the ecosystem concept is also evident. The geographers Bennett and Chorley (1978) are critical of the ecological model because of what they consider to be its "environmentally deterministic perspective". According to Park (1980), this is a perspective which stresses that humans are subordinate to, and hence largely controlled by, the natural environment. Bennett and Chorley disagree with this perspective. Instead, they see humans becoming

increasingly dominant, exerting control. However, Park's (1980) "ecological perspective", which stresses that humans are an integral part of nature, presents a alternative view to the determinists. Here a distinction is made between the environmental models of humans as a component of the ecosystem and humans as stewards.

In the selected review of environmental sociology presented by Spaargaren and Mol (1992), they identify a tension existing between sociology, biology and ecology and proclaim environmental sociology to be in disarray as far as methodology; its conceptual identity. They suggest that "environmental sociology would benefit from a further emancipation from the dominance of bioecological schemes and models, which form the socioecological kernel of the subdiscipline, in analyzing the relations between societies and their environments" (p.326). Instead, they insist, it should use sociological theory as its main frame of reference. Central to their critique is the fact that, "as social systems, societies do not mechanically adapt to their environments. *Their members* choose to give priority to solving the environmental crisis by making it a central concern in the reflexive organisation of society" (p.326).

Mannion and Bowlby (1992) highlight the difficulties in using the ecosystem concept to examine human-environment interactions where an analysis of potential human reactions and adaptations is required. They refer to the human ecology approach proposed by the Chicago school of urban sociologists who attempted to apply such concepts to the analysis of human behaviour. These sociologists adapted the notion of invasion, competition, and succession in plant communities to the changing patterns of human land use in the city. Suggestions that humans were driven by similar competitive type behaviour to plants and animals were highly criticised (Gaziano, 1996). A criticism that is leveled at social science in general in terms of the ecosystem concept is that it is built on abstract theoretical systems models - never really coming to terms with the biological and management realities. In other words, there is no real interface between humans and other species or nature (Benton, 1994).

Environmental managers and researchers have also identified limitations and constraints in using the ecosystem concept for planning and management (see for example, Shrader-Frechette & McCoy, 1994). The ecosystem approach has been criticised as being vague and abstract for those responsible with developing and implementing management policies. This, according to Armitage (1995), is characteristic of the development of approaches and models that aim to understand the "whole" which leads to a wrestling between the need for holistic analysis of the increasingly complex relationships while remaining methodologically limited.

2.3 From Environmental Psychology: Person-Environment Relationships and the Interactional / Transactional Concepts

The likelihood of enormous species loss due to human activity suggests that an effective response to the species extinction crisis requires a fundamental re-assessment of the relationship between human society and the natural world, the person-environment relationship. Placing *Homo sapiens* in perspective biologically, sociologically and psychologically in relation to the changing environment is crucial (Webb, 1990). Psychology in general, and environmental psychology in particular, have an important role to play in the development of this perspective through its understanding of the human dimension of environmental change. It is in a position to offer some clear wisdom, ways of framing issues of central interest and concern as well as substantial and relevant research evidence.

In highlighting the significance of social and behavioural science expertise in the understanding of the anthropogenic nature of environmental change, Stern (1992) identifies the role of psychology as improving our understanding of the function of individual and interpersonal behaviour so that changes in human behaviour which are critical to preventing further distruction can be brought about.

Environmental psychology arose out of a worldwide concern for a number of social and environmental issues during the 1960s and 1970s (Altman & Rogoff, 1987; Bell et al., 1996; Bonnes & Secchiaroli, 1995; Stokols, 1995). It has developed from and is further developing a number of theoretical perspectives on the person, the environment, and the person-in-environment. During the last 30 years, environmental psychology has contributed a considerable number of theoretical concepts and methods for the analysis of the person-environmental relationship. An overview of some of the early contributions and two contemporary approaches to the study of the person-environment relationship is presented.

2.3.1 Early Contributions

Early contributions[2] to assessing and understanding the person-environment relationship provided the foundations for the development of environmental psychology.

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[2] Those which specifically adopted the ecosystem concept have been referred to in the previous section.

Psychologists such as Kantor and Koffka, for example, first distinguished between the physical and psychological environment; Kantor, in 1924, referring to the physical as the biological; and Koffka, in 1935, as the geographical environment - representative of the environment as it exists in reality. Both referred to the psychological environment as the behavioural environment, which was represented by the environment as experienced by the person (Walsh et al., 1992a). To Koffka the behavioural environment is the only reference system for describing behaviour (Bonnes & Secchiaroli, 1995). Koffka's proposal was reaffirming the phenomenological viewpoint of perception of the Gestaltists, who, with their theory of "isomorphism", "denies any hypothesis of individuals' idiosyncratic interpretations of the perceptual experience" (Bonnes & Secchiaroli, 1995, p.23).

According to Levy-Leboyer (1982), even though Kurt Lewin was initially trained in the phenomenological orientation of the European Gestalt school, he did not limit his studies to processes of perception. Once in the United States he became involved in the pragmatistic climate which meant approaching "the problem of the relationship between psychological processes and environmental characteristics in a 'total' way, not in a general or in a solely spatio-physical way" (Bonnes & Secchiaroli, 1995, p.38). Lewin considered that both physical and psychological environments must be analysed in order to assess and understand an individual's behaviour.

Besides his considerable theoretical contribution to psychology, Lewin also contributed on the methodological level. He was seen as an action researcher, studying changes as they occurred in the real-world context; in situ study that was not devoid of experimental method nor rigorous observation (Levy-Leboyer, 1982).

Lewinian theory has had considerable influence on the evolution of environmental psychology. It has been developed and refined by various researchers such as Barker and Bronfenbrenner and is seen by many to be for environmental psychology an "obligatory point of reference" (Bonnes & Secchiaroli, 1995). Other researchers of the 1940s who were particularly interested in the nature of the person-environment relationship and the metatheoretical assumptions implicit in the physical, biological, and social science, were Dewey, Bentley, and Pepper (Altman & Rogoff, 1987). According to Altman and Rogoff (1987):

> These authors distinguish three approaches to the pursuit of knowledge - self-action, interaction and transaction - corresponding to early or prescientific approaches, the Newtonian perspective, and the Einsteinien view of science, respectively. (p.8)

These three world views or philosophical approaches are those which underlie research and theory in psychology. The following sections examine two of these approaches to the study of psychological phenomena, the interactional approach and the transactional approach. They are both applicable to environmental psychology's exploration of the human-environment interface. These approaches are also sympathetic to and intuitively appealing to the ecosystem approach.

2.3.2 The Interactional Approach

The interactional approach has been the dominant approach in contemporary psychology for exploring the person-environment relationship (Altman & Rogoff, 1987; Stokols, 1995). According to Dewey and Bentley, in the interaction approach physical and psychological components are separate entities (Altman & Rogoff, 1987). They have their own characteristics, they exist independently of one another, they will act on each other and react to each other in addition to being affected by interaction with other elements. The goal is to study the impact of one set of entities on another with the emphasis placed on prediction where antecedent or causal factors, such as environmental characteristics (independent variables), are examined for their effect on psychological processes/behaviour (dependent variable). This implies a linear or unidirectional process (Altman & Rogoff, 1987).

Another important feature of the interactional perspective in psychology is its treatment of time and hence change. It views time as an independent dimension, "it assumes that temporal factors are not integral factors of a phenomenon, since time and the properties of a phenomenon are defined independently of one another" (Altman & Rogoff, 1987, p.8). Despite this fundamentally static perspective, temporal variations in psychological functioning are assumed and change is determined by comparisons of various snapshots of phenomena taken over time.

Altman and Rogoff (p.16) outline the steps of the interactional approach.

1. identify separate and independent situational and personal or psychological entities and describe their characteristics and properties.

2. examine their independent and interactive effects on psychological outcomes and functioning (as with analysis of variance statistical models, with main effects and interactions).

The interactional approach has been used extensively in social and environmental psychology. Early research in environmental psychology evolved specifically out of the need to address the relationship between human behaviour and the physical environment from the unidirectional perspective of environmental impact on human behaviour. Some of these research areas include: natural disaster research (Sorensen & White, 1980); weather research (Moos, 1976); population density, crowding, and use of space (Stokols, 1972 in Moos, 1976), noise and air pollution (Sommers, Dort & Moos, 1976).

2.3.3 The Transactional Approach

The transactional approach developed in psychology following disenchantment and criticism by those who no longer wished to treat the person as a 'separate often reactive entity' to the environment (Pacheco & Lucca-Irizarry, 1995). Instead, they considered that the contextualised persons should be the focus of psychological inquiry. The term 'transaction' was proposed by Dewey and Bentley in 1949 when they were cautioning against analyzing people and environments as separate entities (Wapner, 1995), and were attempting to come up with a model that would explain the person-in-environment phenomenon. An early example of transactionalism existed in Lewinian theory which treated person and environment as part of one field (Bonnes & Secchiaroli, 1995; Wapner, 1995). Fundamentally, the difference between the interactional and transactional approaches lies in the nature of the relations between the person and the environment. The transactional approach "emphasizes the reciprocal or bidirectional nature of people-environment relations - individuals not only respond to environmental conditions but also take steps to influence and restructure their surroundings" (Stokols, 1995, p.825), whereas the interactional approach emphasises the linear or unidirectional nature of the people-environment relations. The transactional approach highlights interdependency between people and environment as opposed to independency. Attention is focused on the process of exchange existing between these two elements rather than to their specific features.

The unit of analysis in transactionalism is the person-in-environment. According to Wapner (1995) the "holistic assumption, namely, that the person-in-environment system operates as a unified whole, (which) means that a perturbation to one (or more) aspect(s) of the person or environment impacts the whole" (p.16).

The concept of transactionalism has been incorporated into several areas of psychology. Gibson's theory of perception, for example, treats context and psychological processes as aspects of a holistic unit. Within this unit, "transformation and change are not regarded as

following a fixed, unidimensional course toward a predetermined end point. Rather, the organism and environment uniquely differentiate to fit one another, thereby forming a distinctive ecological niche" (Altman & Rogoff, 1987, p.27). Lewinian theory also exhibits aspects of transactionalism. Lewin defined a psychological "field" or "life-space" which consisted of properties of the psychological environment and personal characteristics embedded in a physical setting. This was the holistic unit of analysis. In addition, it was a highly dynamic space where continuous interaction and change between the person and environment was occurring.

Environmental psychology has also given considerable attention to the transactional theories as a means of understanding the dynamic and complex person-environment interface (Stokols, 1995). The attention, however, has been confined to the theoretical level, with only occasional empirical research being conducted because, as Altman and Rogoff (1987) point out, "we do not yet quite know 'how to do it'" (p.37). Barker's (1968) ecological psychology and concept of behaviour setting is an example of the adoption of the transactional perspective as is Wicker's further development of this theory (Altman & Rogoff, 1987; Stokols, 1995). Wapner's (1995) approach to the person-environment also reflects a transactional perspective. His key principles include: person-in-environment is the unit of analysis; person-in-environment system operates in dynamic equilibrium directed toward long and short-term goals; disturbance in one part of person-in-environment system affects other parts in the transactional system as a whole (Altman & Rogoff, 1987). Mayo, Pastor and Wapner (1995) have extended Wapner's (1995) proposal of a holistic, development, systems-oriented perspective to the analysis of organisational behaviour. They have done this by extending the person or organism aspect of the unit to include a group of individuals (a complex organisation), which has enabled them to deal with research questions which are central to organisational psychology by taking into account the contextual aspects of the environment.

A particular development of transactional models has been in the area of proximal environmental control in which control as "competence" is presumed to be a universal motivation in human behaviour and absence or erosion of control indicates some slippage in ongoing transaction (e.g., Reser & Scherl, 1988). Conceptualisations of control have been used to address and understand phenomena ranging from privacy, to crowding, to stress response, to hazard perception and response, to environmental ergonomics and design (Bell et al., 1996). The usefulness of "control" in models is that they are premised on biological, adaptive understandings of human-environment transactions, are inherently transactional in that they address the process and quality of transactions, and allow for an understanding of the *experience* of individuals transacting with environments (Reser & Scherl, 1988). Psychology is seeing an impressive proliferation and application of

control models to all aspects of behaviour, for example, stress and coping, self efficacy and learned helplessness, conflict resolution, and reactance. Reactance clearly demonstrates the importance and relevance of such conceptualisations for environmental management for example, in that limits and negative sanctions to behaviour may actually increase the frequency of such behaviour.

2.4 From Environmental Management: Management Principles, Decision Making and the Policy Science Approach

2.4.1 Management Principles

Environmental management that targets the biodiversity crisis, and particularly endangered species recovery, very often is an "intervention to reverse or mitigate the negative consequences of human activities"(Meffe & Carroll, 1994, p.308). Management, therefore, is a complicated mix of biological, social and psychological concerns. There is no theoretical base specific to endangered species management and good management approaches essentially rely on the wealth of theoretical and empirical studies in ecology, social and environmental psychology, and organisational and environmental management theory. Meffe and Carroll (1994) have identified five basic principles which they consider are essential to guide management (Table 2.1).

Table 2.1 Management principles.

1.	Critical ecological processes must be maintained.
2.	Goals and objectives must come from a deep understanding of the ecological properties of the system.
3.	External threats must be minimised and external benefits maximized.
4.	Evolutionary processes must be conserved.
5.	Management must be adaptive and minimally intrusive.

Source: Meffe & Carroll, 1994.

These principles were developed to guide environmental managers toward a systematic approach to management that allows for an identification and anticipation of management needs. They certainly do not intend to promote a static approach to management. Instead, the principles were developed in full recognition that management approaches vary considerably, depending on the situation and circumstances. Management is seen to be a continuously evolving process as understandings of problems, causes, and consequences of the biodiversity crisis broaden and deepen.

2.4.2 Decision Making

Decision makers concerned with environmental management are now subjected to a variety of pressures due to the increasing interlinkage between ecological, socio-psychological, and political sectors of an environment (Chechile & Carlislie, 1991; Doyle & Kellow, 1995; Eckersley, 1992). Simplistic decision-making models (e.g., Bennett & Chorley, 1978) are no longer appropriate in these highly complex and dynamic circumstances. In these early models "goals and objectives were thought to emerge clearly and unambiguously from needs alone; a finite number of separate alternatives appeared to present themselves; and actions were viewed as dominantly deterministic rather than stochastic" (Bennett & Chorley, 1978, p.250). With the realisation that catastrophic and irreversible effects can result from very small and seemingly unimportant decisions (Bennett & Chorley, 1978; Meffe & Carroll, 1994), a shift has occurred in the techniques now employed in decision-making processes. The aim is to optimise the decision makers' actions in a stochastic environment governed by risk and uncertainty (Bennett & Chorley, 1978; Caughley & Gunn, 1996; Meffe & Carroll, 1994).

2.4.2.1 The Decision-Making Environment

The decision-making environment has largely been governed by the degree of interaction with other decision makers (Bennett & Chorley, 1978) and with those who provide the information. This interaction varies in complexity. Problems amongst organisational and professional systems are clearly evident in the majority of literature concerning endangered species recovery (e.g., Beatley, 1994; Clark et al., 1994; Reading, 1993; Yaffee, 1994a). As a consequence, the decision-making environment is not without considerable conflict resulting in professional and organisational performance being compromised (Chechile, 1991; Reading & Miller, 1994; Wondolleck et al., 1994). Reading (1993) addresses some of these interaction problems at the organisation level,

including the multiple and often conflicting goals which result from the differences between individuals and groups within the organisation.

> Goals established by high level decision makers may not be embraced by lower levels of the organisational hierarchy, or they may be interpreted differently. As a result, organisations, especially government agencies, often have vague, non-operational goals and poor methods of evaluating performance (Strausman, 1985; Warick, 1975; Simot, 1986; Starling, 1988; Weimer & Vining, 1989). (p.62)

The issue of power and authority can also dominate relationships between key actors in decision making (Reading, 1993). They too must be understood in terms of their impact on the decision-making environment. As Reading and Miller (1994) point out:

> Whenever several parties are working toward a common goal, issues of control, based on power and authority, often come to dominate their interactions. ... Power and authority relationships among key figures evolve as programs are carried out. As a result, recovery goals often become secondary to, or displaced by, control goals. (p.84)

Interprofessional and interagency interaction is equally fraught with problems (Clark & Reading, 1994; Jackson, 1994; Reading & Miller, 1994; Yaffee, 1991, 1994a) which impacts on the decision-making environment. Many professionals are deeply entrenched in the philosophy and techniques of their discipline (Clark et al., 1994) which ultimately determine the interactions between each other and other organisations. However, there are those who now recognise that professionals must become more flexible and knowledgeable in the decision-making process if they are to be effective contributors to endangered species recovery (Clark et al., 1994; Risser, 1995).

2.4.2.2 Decision Making and the Public

The social context The social context of decision making is an important consideration for endangered species recovery. People have to be seen in the context of whole ecosystem even though they are considered by some to be a foreign negative element (Naess, 1989), and by others as having equal rights (Einarsson, 1993). Conservation decisions have to involve more than simply the biology of endangered species or the conservation of natural habitats. They have to involve human affairs within and outside the protected areas (Meffe & Carroll, 1994). Such affairs include a vast array

of needs, which, when pitted against each other, have the potential for considerable conflict.

Endangered species, particularly the larger terrestrial vertebrates, use a wide range of landscapes, much of it outside the legal protection of reserve systems. Interaction between such species and the public is therefore inevitable. In the case of private landholders, issues of property rights have to be addressed as both inhabitants are in need of the resources the landscape provides (Bennett et al., 1995; Dodds, 1994; Kellert & Clark, 1991; Meffe & Carroll, 1994). The perceived infringement of basic rights is a very salient, emotional, and all-determining equity issue in community responses to management, policies and government control (Bennett et al., 1995; Dodds, 1994; Lehman, 1995).

In addition to the primary issue of habitat modification, urban expansion highlights a different set of issues (Beatley, 1992; Bosakowski et al., 1993; Dowd, 1992). Many are associated with individual rights such as domestic animal control, road expansion and traffic speed, supplementary and hand feeding. Tourism adds yet another dimension to the social context of the decision-making process (Burger & Gochfeld, 1993; Norton & Roper-Lindsay, 1992; Scherl, 1991; Valentine & Cassells, 1991). With the ever-increasing expansion of this industry into the area of "ecotourism", considerable pressure is mounting on the remaining reserve lands. And finally, there are those members of the public whose interest lies in just knowing that these areas and these species are being preserved, the vicarious users (Reser et al., 1996).

Public participation Environmental managers have traditionally made decisions concerning the environment in isolation from the public. They have taken the role of technician, presenting their professional assessment of the crisis and directing management according to that assessment (Fairweather, 1993; Selin & Chavez, 1995). Reasons given for this approach include: resource management was considered too complex to involve the public (McMullin & Nielsen, 1991); the public was considered too emotional and irrational, given to "unscientific" outbursts (Grove-White, 1993); and the public was uninformed (O'Riordan, 1976a). These claims are now being challenged, particularly by the public - the various stakeholders, interest groups[3] - who are increasingly exercising their right to become involved.

[3] So-called because they seek to protect and advance the interests of their members (Doyle & Kellow, 1995).

What is now recognised is that despite the assumption that scientific inquiry "provided the true litmus test for whether or not issues are indeed issues" (Grove-White, 1993, p. 21), official science investigation was in fact responding to existent public recognition of and concerns about environmental problems. The startling fact is that, "almost all of the most significant environmental issues, global or domestic, were crystallized first not by governments responding to or using 'science', but to poorly resourced NGOs and sundry individual environmentalists .... Indeed, too often, the role of scientists and official scientific institutions was to patronize so-called 'emotional' and 'irrational' expressions of public environmental concern - on issues much later acknowledged by official scientific bodies and institutions to be indeed genuine and serious problems" (Grove-White, 1993, pp. 20-21). This clearly demonstrates the significant and very rational role the public has played in the environmental crisis (Kellert & Clark, 1991; Yaffee, 1994a). Important questions that arose out of this imbalance in science and public understanding of environmental issues include: how and why the public understood the issues in advance of the arrival of official science; why did their intuitions resonate so powerfully with wider social attitudes; and why was this not considered a matter of significance to government agencies (Grove-White, 1993).

Environmental management agencies' response Environmental management agencies now have to improve their ability to integrate public participation and to recognise the social context of their decision making. To achieve collaborative decision making, managers have to acquire new skills that enable them to move from an opinion role in the traditional sense of environmental management to an empowerment role as mediator, catalyst, or broker. Clearly, the lateral decisions needed to sustain effective collaboration will be difficult for those managers entrenched in the hierarchical decision making of public agencies (Selin & Chavez, 1995).

Nevertheless, public participation does not mean conflict will not occur. Attempts to involve the public are not without considerable challenges for established bureaucratic structures (Scherl, Cassels & Gilmore, 1994). The involvement of multiple participants leads to multiple needs, goals, and objectives which increases the likelihood of conflict and can lead to a kind of decision-making paralysis. In addition, public participation does not mean that conservation principles should be compromised nor should various interest groups dominate the decision-making process. The problem of interest groups having undue influence on government policies is well documented (Backhouse et al., 1994; Doyle & Kellow, 1995; Samways, 1994; Scherl et al., 1994). For example, Backhouse et al. (1994) found that in the case of the Australian eastern barred bandicoot, in some instances decision making and thereby the restoration program was being dominated by interest groups concerned with parochial issues, resulting in the exclusion of the broader

statewide perspective. Milbrath (1995) and O'Riordan (1976a) also express concern about the motives behind interest groups. Milbrath refers to ecotourism as a disguise for pursuing policies that are actually giving priority to goals other than environmental conservation, even though many in the industry claim to be environmentalists. And O'Riordan (1976a) targets certain environmentalists who he sees as shielding "narrow political aims with the armour of environmental morality". What must be remembered is that the overriding objective of public involvement is to *improve* resource management decisions for the well being of the environment, not hamper them. McMullin and Nielsen (1991) conclude:

> Public involvement does not eliminate controversy. The process simply provides a forum for rational exploration of management alternatives prior to the time when allocation decisions have been made. Public involvement's major achievement is the psychological empowerment of resource users, due to meaningful involvement in the decision-making process, that leads to agreement on desired management actions. (p.97)

2.4.3 The Policy Sciences Approach

It is now readily acknowledged that environmental management agencies and researchers from diverse disciplines need to collaborate in order to first "put into policy" and then "put into practice" the cumulated theory, knowledge and experience that all have to offer if endangered species recovery is to be a reality (Clark et al., 1991; Clark et al., 1994). It is also readily acknowledged that this is not an easy task. Rather it is a complex process constantly evolving, subjected to several voices articulating different human perceptions, values, and needs which can very often translate into conflict and process paralysis. Technical, biological and social information, problems and their solutions are often perceived very differently among biological scientists, social scientists, environmental managers, the public and ultimately decision makers. The very recognition of the dynamics of participant relations, the information required, available and used, and the problems and their solutions is critical.

For Lasswell (in Brewer & Clark, 1994), the policy sciences offer a framework for addressing these complex issues, and for Brewer and Clark (1994) such a framework recognises that at the center of policy processes are human values. In particular, they consider that "the policy sciences perspective views endangered species conservation as a social problem"; that, "the problems that policy scientists try to solve are created by society, not by the theoretical interests of a scientific discipline"; and that, "the policy

scientist must consider numerous human perspectives to find solutions" (p.395). Brewer (in Clark et al., 1991) argues that the integration of ecological and policy science approaches to complex problem-solving such as endangered species survival is a means of maximising the production and use of policy relevant information. Clark (1992) considers the policy sciences to be a means of improving decisions and policies through scientific inquiry, a very significant contribution to effective environmental management. Brewer and Clark (1994) summarise the contribution of policy sciences as follows:

> The policy sciences center on problem-oriented, multimethod, comprehensive, and human-centred inquiry leading to purposeful action; they derive from the cumulative work of many scholars, researchers, practitioners, and analysts over the last half century. (p.396)

2.4.3.1 Policymaking in Conservation

If endangered species are to recover, the concepts, theories, and knowledge gained from biological/ecological and human studies must be recreated in the form of rational policies that reflect our understandings of the requirements of the species and the human needs and influence on the natural environment. Sound conservation policy and action are essential to any management process and should reflect the worth of the knowledge gained. Transforming knowledge into practice is the domain of policy making (Meffe & Carroll, 1994). Simply defined, policy can be a broad strategic statement of intent to accomplish aims (Brewer & deLeon in Clark, 1992); a formulation of solutions to solve problems (Clark, 1992); a proposed course of action to reach a goal or realise an objective or purpose (Tober in Brewer & Clark, 1994); a set of rational, explicit, and specific goals and procedures (Kellert & Clark, 1991). When choosing between policy options both values and consideration of means of advancing values will be involved (Doyle & Kellow, 1995).

Policy and the policy process is not simply a procedure that involves problem recognition and formulation followed by development and implementation of solutions (Kellert & Clark, 1991). Rather, it a highly complex and dynamic process that is continuously changing and evolving in response to circumstances. Meffe and Carroll (1994) identify three core principles they consider essential to understanding and guiding policymaking.

1. Humility Principle:	recognise and accept the limitation of human knowledge.
2. Precautionary Principle:	need for caution when making decisions about systems that are not fully understood.
3. Reversibility Principle:	never make irreversible changes.

These principles all foreshadow the concept of uncertainty and risk, which is influenced by the quality and quantity of available information and the complexity and nonlinearity of process (Meffe & Carroll, 1994). Brewer and Clark (1994) also identify operational principles which serve as a guide across the policy processing landscape. These principles are particularly relevant to endangered species recovery.

1. It is essential to portray all significant parts of the endangered species policy process - social and biological sciences theory and practical experience.

2. To address the complexities of endangered species conservation, theory must be connected appropriately and realistically with on-the-ground application.

3. To locate a problem with respect to its form, content, status, and age is to begin to solve it.

4. To learn how to organise, compare, and accumulate knowledge about the overall policy process itself and its manifestations, is a key activity.

2.4.3.2 A Policy Process Model

The formulation of a response to the endangerment of a species sets out a number of prescriptions; a course of action which can be defined as the policy process.
A model which conceptually and pragmatically frames the endangered species policy process is that developed by Brewer and deLeon (Brewer & Clark, 1994). It identifies six stages to the process (Table 2.2). Among these stages, *estimation*, *selection*, *implementation* and *evaluation* are key considerations. In addition, all must involve multi-disciplinary perspectives as each perspective provides information that is critical to the whole process.

Table 2.2 Six stages of the endangered species policy process.

1. Initiation:	recognition of a problem; creative thinking about it; preliminary investigation of concepts and claims (problem is defined, evaluated and assessed, Kellert & Clark, 1991).
2. Estimation:	scientific study of the problem, likely impacts, and outcomes; normative assessments; development of outlines of a programmatic response.
3. Selection:	focused debate on the issues; choice about a program to solve the problem.
4. Implementation:	development and application of a specific program.
5. Evaluation:	comparison of estimated performance of the program with what was actually attained; reconciliation of the differences.(questions effectiveness, efficiency and equity raised and examined (Kellert & Clark, 1991).
6. Termination:	stopping the program or changing it to solve a new problem.

Source: Brewer & Clark, 1994, p.400.

Estimation Before any management or recovery process can be formulated, a multidisciplinary study of the problem must first be undertaken. A focus on biological, social and psychological, professional and organisational aspects of the problem is central to the policy process.

Selection/Knowledge Transforming knowledge into practice is the domain of policy making (Meffe & Carroll, 1994). The policy process also involves construction, application, and monitoring of long term indicators of environmental quality which includes several biological/ecological and social variables (Clark et al., 1991).

Implementation Once recommendations from this baseline data have been formalised, there must then be an execution of the selected policy options. Implementation is a very complex process and is the phase where the majority of activity occurs. It is where, ultimately, actions are done to or for the endangered species (Brewer & Clark, 1994). It has been the failure in the past of this stage of the process that has alerted scientists to the need to reassess endangered species management.

Evaluation/Monitoring The *evaluation /monitoring* component is also critical to overall program success, providing an important feedback mechanism between

each policy stage (Bennett & Chorley, 1978; Posavac & Carey, 1997). Since the policy process is considered a "learning process" (Clark, 1996; Doyle & Kellow, 1995), it is critical that mistakes are detected and corrected. It must allow for dynamic changes and uncertainty within a continuous planning process (Bennett & Chorley, 1978). Evaluation of effectiveness, efficiency, and equity of agency policies and programs is as important as assessment or estimation of needs and wants of the agency's constituent groups (Wright, Backman & Wicks, 1991).

This model is very similar to the rational-comprehensive policy process model discussed by Doyle and Kellow (1995), a model "which accords with the holistic demands of ecology". Doyle and Kellow, however, are critical of this model on the basis of the following assumptions: that reliable causal information of policy problems is available; that goals can be specified in isolation; and means of achieving these goals evaluated rationally.

2.4.3.3 Challenges to Policy Development

Information collection Information collection is based upon the ideal of reducing uncertainty and complexity (Bennett & Chorley, 1978). What is evident in the real-world of the biodiversity crisis is that solutions do not lend themselves to "watertight guarantees of success" (Doyle & Kellow, 1995), nor to strict disciplinary approaches (Meffe & Carroll, 1994). The biodiversity crisis rejects being defined in these terms. Consequently, Meffe and Carroll (1994) suggest that knowledge needed for the solution of problems needs to be defined by the issue and not by the discipline if it is to contribute effectively to policy formation and implementation. Issue-driven research as opposed to disciplinary-driven research encompasses broader perspectives. It breaks through disciplinary and interdisciplinary boundaries. Thus, policy development involves construction, application, and monitoring of long term indicators of environmental quality (Clark et al., 1991), which includes several biological/ecological and social variables. Even with high quality information, rarely are resource policy issues defined by single disciplines (Heberlein, 1988). In addition, the problem of scepticism and even hostility towards the value of social and behavioural science research in policy development still remains (Freudenburg, 1989; Milbrath, 1995).

Insufficient knowledge or inadequate information collection is also cited as an obstacle to policy development (Backhouse et al., 1996; Miller et al., 1994). Miller et al. (1994) highlight the consequence of insufficient knowledge issue, "When biological data are

scarce, unequal power, rigid organisational hierarchies, traditional philosophies, and dominant personalities can play significant roles in a program" (p.639).

In addition, all of this must be premised and predicated on individual, community, and professional and government understandings of what environmental management, conservation, and endangered species recovery is all about. How do we get at such understandings? How do we address such understandings in terms of participation and policy? How do we change and/or educate for such understandings? This primarily is central to the social science component of this dissertation.

Information use While knowledge generated from extensive biological studies of endangered species and social and psychological studies of their human co-inhabitants is critical to endangered species recovery, gathering, ordering, analysing and communicating this information takes time, leaving the process open to many problems (Doyle & Kellow, 1995). Selection of what information is essential to a species' survival and recovery is just the first but difficult step in a complex management process. It equips environmental managers with relevant information to proceed with policy formation but very often can be biased, coloured by the preferences of those providing it (Doyle & Kellow, 1995). In addition to quality and quantity of information available, the final call is the appropriate use of this information in decision and policy-making processes. As Clark (1992) points out, "Many professionals have experienced situations in which their data about wildlife and needed conservation measures were, to their consternation, discounted or ignored in decision and policy processes" (p.423). The rural sociologist Freudenburg (1989) and the social psychologist Oskamp (1995) also note this experience.

Failure to correctly interpret and use information in the past has led to a number of ineffective recovery processes (Clark, 1992; Mattson & Craighead, 1994). Information distortion has been a significant problem. Mattson and Craighead (1994) found four factors to which information distortion could be attributed: insufficient time and resources to locate and integrate available information; insufficient training to provide necessary theoretical and conceptual context; the (management) agency's resistance to outside collaboration; and subtle but real coercion of lower echelons to meet the expectations of supervisors. In addition, these researchers identified an unwillingness of management agencies to incorporate information available from nonagency scientists as a barrier to effective policy formulation and hence recovery processes. Doyle and Kellow (1995) provide the following explanation for this behaviour:

> Information is the currency of bureaucratic life. Organisations (and individuals within them) have interests and aims, such as self-advancement, which do not necessarily have much to do with rational decision making. Information can be deliberately distorted, withheld or released in order to secure these ends. Knowledge, as the saying goes, is power, and there is no more subtle exercise of power than the careful control of information so that the desired decision is made 'on best available information'. (p.139)

Ecologists and social scientists also must take some responsibility for misuse of information in decision making and the policy process. In many instances, ecologists have failed to provide responsible guidance to decision-makers, instead, insisting on educating decision-makers about the theory and behaviour of ecological systems (Risser, 1995). Miller et al. (1994) recommends that critical but constructive outside review would prevent the misuse, or ignoring of data as well as ensuring the scientific collection of future data.

Problem recognition and formulation Early detection of the problem is essential in order to avoid the "crisis management" scenario which is a considerable consumer of resources and is less likely to be successful (Miller et al., 1994). However, many endangered species recovery programs have a history of a failure to recognise and/or admit that a problem exists (Backhouse et al., 1994; Biggins & Thorne, 1994; Yaffee, 1994a). This ultimately causes a delay in development of policy. Miller et al. (1994) identified organisational reluctance to problem recognition as being bound to public image, fear that problem recognition leads to public criticism about the ability and certainty of organisational decision making. Clark et al. (1989) provide two explanations for the "reluctance or inability of bureaucies to reformulate their understanding of problems and situations":

> First, people who recognise the need to approach a problem or situation differently often lack the power to be heard in the bureaucracy. Second, a bureaucratic organisation is by definition a set of restrictions for focusing attention and for narrowing the cognitive style to certain accepted standard operating procedures (Katz and Kahn 1978, Douglas 1986). The options for a wider search for what the problem is and what accepted solutions might be are severely limited (see Lasswell 1971). Learning and improved performance are blocked. The consequences for species recovery may be disastrous. (p.167)

Recovery teams Recovery teams are set up as part of the requirement of the Endangered Species Act. As an advisory group, their decisions are critical and very influential to policy development and recovery programs. Nevertheless, there has been widespread criticism about the structure of these teams and their effect on endangered species recovery (e.g., Miller et al., 1994; Snyder, 1994). Miller et al. (1994) suggest that "stacking" or "eliminating" recovery teams is a common problem which "allows one group to limit the role of others and consolidate its power" (p. 640). Issues of power, authority, self-interest and self-promotion dominate the literature on problems with recovery teams (Mattson & Craighead, 1994; Miller et al., 1994; Snyder, 1994). The problems of "stacked" recovery teams is discussed by Miller et al. (1994).

> "Stacked" (biased) advisory groups are sometimes established by representatives of a dominant, control-oriented organisation to recommend politically self-interested actions, thus lending a veneer of credibility and legitimacy to the plan or program. These stacked groups can be composed of members of the dominating agency or people who first and foremost desire cooperative relations with that agency (sometimes at any cost), instead of task-oriented specialists focused on finding solutions to the problems. Such groups often make decisions in areas where they have little expertise. (p. 639)

2.4.3.4 Challenges to Policy Implementation

Implementation is considered a key step in the policy process (Brewer & Clark, 1994), defined as the real indicator of whether the policy program that has been developed is actually delivered. Implementation is that stage in the policy process that is no longer governed by natural science information alone. It is a complex and important social process (Brewer & Clark, 1994) that requires the mobilisation of skills not called upon previously. There are numerous challenges to successful implementation of endangered species recovery policy and not all can be covered in this outline. Some have been briefly referred to previously. The focus here is on organisational constraints to successful or real implementation as outlined by Miller et al. (1994) and Brewer and Clark (1994).

Social politics In defining implementation as a social process, Brewer and Clark (1994) have identified participants, their perspectives, values, strategies, and desired outcomes as key reference issues. Organisational theory has developed a number of conceptual models of the social process in policy implementation. In Bullis and Kennedy's (1991) research conducted on professional and organisational

subcultures, they emphasise the importance of value systems as guides in the decision making process.

Parochial politics Local political, economic and cultural pressures can also affect policy implementation (Miller et al., 1994). This is predominantly bound to economic benefits from exploitation of natural resources, whether it be for industry, agriculture, residential development, or tourism and the cultural rights of inhabitants (for example, dog ownership rights and indigenous rights to hunting). These pressures in many instances override the long-term biological, social, political, and financial consequences, "In the United States, the ESA supposedly precludes agencies from considering economic or political factors during the process of identifying species in danger of extinction (Gibbons, 1992), but it fails to preclude these same inhibitive factors from affecting the planning and implementation of recovery efforts" (Miller et al., 1994. p.641).

Critical evaluation of implementation Evaluation of implementation is critical to defining success or failure of the program and policies (Oskamp, 1995). However, there seems to be a general reluctance on the part of agencies to critically review their own implementation performance or to agree to outside critiques. Miller et al. (1994) document various ploys utilised by agencies to block effective reviews of implementation performance. These include closure of channels for outside critiques, selection of biased evaluating teams, and provision of huge documents accompanied by brief review period. They go on to identify reasons behind this strategy, "When objective evaluation of performance is not permitted, neither individuals nor organizations can be held accountable for their actions. As a result, the recovery plan may be executed inefficiently or actually diverted from the predetermined path" (p.641).

Chapter 3

Seeking an Endangered Species Recovery Framework:

A Review of Selected Case Histories on Endangered Species Management, Conceptual Frameworks that Integrate Natural and Social Sciences, and the Problems and Pragmatics of Multidisciplinary Research

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3.1 Introduction

This chapter presents evidence for the need to build stronger links between the natural and social sciences in an effort to understand the endangered species crisis and to devise public policies to respond in an effective manner. It also reviews several "big picture" frameworks that have been developed in response to the call for a multidisciplinary approach to the environmental crisis and discusses the problems and possibilities of these frameworks in the context of this dissertation. In order to pursue integration of discrete disciplines it is necessary to identify the constraints to integration. The final section of this chapter summarises the problems and pragmatics of a multidisciplinary approach.

3.2 Selected Case Histories of Endangered Species Management

Studies on endangered species are now quite extensive, a legacy of the biodiversity crisis and our inability to effectively address this issue. It is not the purpose of this review to cover this vast endangered species literature, which is full of complex biological, professional, organisational, and management issues, and of scientific, political and legal turmoil. Rather, three endangered species' case histories have been selected to provide an insight into the wide range of issues and problems that arise out of the need to save species. Furthermore, the selection of the case histories has been made on the basis that information is available on biological and ecological aspects of research, management and recovery procedures, and for which some critical assessment has been made of these procedures. In some of the case histories psychosociological as well as professional and organisational considerations have contributed to the knowledge base.

Although these case histories deal in each instance with species-specific issues, all provide information on underlying complex management concerns and programmatic difficulties common to endangered species recovery efforts in general. They reflect conflict and controversy, real and perceived mistakes as well as successes. They also give emphasis to the notion that success or failure in management and recovery efforts is often determined by skills other than ecological knowledge, an argument central to this dissertation. Furthermore, the diversity of issues and concerns covered provides a number of very important lessons outlining reasons for failure. If seriously considered and attended to these will be very instructive to other endangered species recovery efforts in the future, regardless of the species and its geographic location. The underlying message of these case histories is that a multidisciplinary approach is essential to any endangered species recovery process.

The northern spotted owl (*Strix occidentalis caurina*) and the black-footed ferret (*Mustela nigripes*) are two, North American, high-profile, endangered species which have received considerable scientific, public, and media attention. Associated with these species have been confrontations, disputes, political pressure, litigation, media distortion, intense public and scientific disagreement, organisational and professional incompetence, and political involvement. Both can be seen to "epitomize the struggle between groups representing disparate value systems in a land of limited resources and unlimited demands" (Noon & Murphy, 1994, p.381). Together, the history of their management and recovery efforts is considerable and complex. The black-footed ferret, for example, has the oldest recovery program for an endangered species in the United States. In contrast, management agencies refused to even list the northern spotted owl until the late 1980s. The eastern barred bandicoot, the Australian endangered species selected as a case study, has received little of the notoriety of its American counterparts. Nevertheless, it is equally likely to become extinct within a very short time and its recovery effort has also been plagued with problems. Since the Australian Endangered Species Act did not appear until 1992, management has not been confined to the guidelines of this legal document.

3.2.1 The Northern Spotted Owl *Strix occidentalis caurina*

3.2.1.1 Biological and Ecological Considerations

The Northern Spotted Owl *(Strix occidentalis caurina)* is one of three subspecies of spotted owls, with a 1991 population estimate of approximately 3,500 pairs (Yaffee, 1994a). Its range extends across the Pacific Northwest of North America, from Canada to Mexico. Within that range the northern spotted owl requires large tracts of old-growth forest (Jensen et al., 1993; Meffe & Carroll, 1994). The average size of the home range for a pair is from 1,411 to 14,271 acres (Dobson, 1996; Yaffee, 1994a), which is the area required to find sufficient prey and hence is linked to reproductive success (Simberloff, 1994). Northern spotted owl habitat studies indicated a preference for old-growth forests or forests that retain the characteristics of or some residual old growth component (Dobson, 1996; Forsman & Meslow in Yaffee, 1994b; Noon & Murphy, 1994). These studies have highlighted the importance of habitat pattern as well as type, quantity, and quality as determining factors in the owl's survival (Shaffer, 1994).

Demographic studies of the northern spotted owl based on two long term studies, found the rate of population change was significantly less than 1.0 - the population was declining. According to Noon and Murphy (1994), additional study sites and years of data indicated that populations of resident, territorial females declined significantly, at an

estimated rate of 7.5% per year during the 1985-1991 period. No studies found areas of stable or increasing populations. In addition, it had been estimated that the number and distribution of the species had been reduced by 50% during the past 50 year period (Noon & Murphy, 1994). The Interagency Spotted Owl Scientific Committee (ISC) had evidence of significant habitat declines with a estimated 1 to 2 percent annual decline (Yaffee, 1994a). The majority of remaining habitat existed on federally-owned land, much of the private and state-owned areas having been logged. With the northern spotted owl being a territorial species with obligate juvenile dispersal, Noon and Murphy (1994) point out two particular concerns. The first relates to reduction and fragmentation of habitat being so extensive that difficulty in finding suitable territory would be encountered by dispersing juveniles, hence a barrier to the population's persistence. The second relates to population densities being so low that the probability of finding a mate drops below that required to maintain a stable population. Extensive fragmentation has also resulted in increased predator kills of young dispersing males (up to 80%) and females (up to 30%) (Simberloff, 1994).

3.2.1.2 Issues surrounding Management and Recovery Efforts

Yaffee (1994a, 1994b) identifies a range of issues surrounding the controversy of the northern spotted owl management and recovery, the extent and complexity of which was significant. What follows is a brief overview of just some of the most striking issues in terms of their multidisciplinary dimensions - their biological, socio-psychological, sociopolitical, and management implications.

Researchers and managers in the Pacific Northwest were apparently sufficiently knowledgeable of the nature of problems facing the owl's survival, its likely solution, and its biology by the mid-1970s, yet they were unable to deal with it effectively over the ensuing twenty years (Yaffee, 1994a, 1994b). The biological and ecological information clearly indicated that the northern spotted owl was threatened, that loss and degradation of habitat (the old growth forests) was a cause of its continued decline, and that if appropriate action, such as changing federal forest management, was not taken the species would become extinct and conflict could not be avoided (Meffe & Carroll, 1994; Noon & Murphy, 1994; Yaffee, 1994a, 1994b). As with many threatened and endangered species (e.g., Alvarez, 1994; Backhouse et al., 1994; Snyder, 1994), early warnings of potential threats to the survival of the northern spotted owl went unheeded by management agencies and it was not until considerable pressure from the public, in the form of environmental groups, that they were forced to treat the owl issue seriously (Yaffee, 1994a). There appeared to be a reluctance on the part of management agencies to publicly acknowledge the problem, and hence take appropriate action at a time when conflict and a

crisis management scenario could have been avoided. According to Yaffee (1994a), the Forest Service was continuously trying to shelve or ignore the problem, even though they were responsible for regional planning process guidelines of the Pacific Northwest national forests. In fact, "in the early 1970s, the agency refused to deal with the issue, claiming that land set aside to protect the owl would violate multiple-use principles (Nietro n.d.:2-3)" (Yaffee, 1994a, p.50).

In addition, Miller et al. (1994) suggest that the actual listing of the species was subjected to political pressure from the US Department of Interior and the timber industry despite the Endangered Species Act stipulation that economic and political pressures were to be precluded from the listing process. According to Yaffee (1994a), there was an element of fear of listing bound to concerns of control, political backlash, and performance failure. In the end the US Fish and Wildlife Service was actually forced by public pressure and finally court intervention to list the owl. Ensuing court battles over listing, designation of critical habitat, and resultant restrictions on timber harvest, placed the "burden on the scientists to prove an adverse effect of timber harvest on Spotted Owl persistence" (Noon & Murphy, 1994, p.386). Scientists were being confronted with having to deal with scientific uncertainty in the courtroom. As a result uncertainty in the scientific process was exploited. Yaffee (1994a) explains the "owl issue" as follows:

> The owl issue, like many endangered species management controversies, was a surrogate for a much broader set of concerns. And the problematic way in which it was handled reflects the nature of the broader sociopolitical context of public policy decision making - including multiple and conflicting values, public choice processes that are ineffective at dealing with issues like the owl controversy, a legal situation that is complex and ambiguous, and a wide array of legitimate and illegitimate political behaviour. Just as children and owls strongly reflect the environment in which they live, policy and management decisions are shaped by their sociopolitical context. To understand why things are the way they are, professionals and organisations need to understand this context. To ensure that good technical ideas are implemented effectively, they need to be able to deal with, and influence, this sociopolitical environment. (p.53)

Underlying the northern spotted owl controversy was a range of important socio-psychological concerns critical to understanding the human dimension of this crisis. However, these remained unresearched and unresolved. Yaffee (1994a) recognised this deficit of information, identifying a "clash of values" as being most important in this controversy and suggests that agencies must learn about the values and interests of those

outside the agency. In addition, he recommends a diversification of the agency's own value base; that cultural and value differences inherent in a pluralistic society must be acknowledged and hence reflected in the agency's decision-making processes; and that efforts must be made to accommodate these diverse set of values without an 'unnecessary trade off' scenario. This clash of values is represented, "on the one hand, the federal forest management agencies and their economic and political constituents and, on the other, a broader set of public values concerning the ecological, spiritual, aesthetic, and recreational dimensions of public wildland" (Yaffee, 1994a, p.59). However, Noon and Murphy (1994) considers that presenting the debate as "a choice between employment and economic vitality on one hand, versus species survival and rich functioning ecosystems on the other" (p.381), is an oversimplified dichotomy, yet one responsible for considerable provocation.

Social science research recently undertaken by the psychologists Levi and Kocher (1995) attempted to explore the northern spotted owl controversy from the perspective of the rural communities of the Northwest. This research revealed a number of important issues that are particularly relevant to understanding this human dimension of the controversy. It is one that presents a local and utilitarian perspective separate to political, professional and organisational influences. Results of the research revealed that for this rural population a number of immediate challenges to the survival of communities existed. Despite the issue being defined as an "owl versus jobs" issue, decline of old-growth forests was just one factor affecting the economy and in fact may not have been the most significant. Others included modernisation[1] of saw mills, Japanese markets requiring raw rather than processed timber, and expansion of operations to private lands. The northern spotted owl controversy added a new dimension of uncertainty and instability to the severe economic conditions of these rural communities. Use of this environmental conflict was made to divert attention away from an inevitable economic crisis and acted as a target for attributing blame for economic and social problems. According to Levi and Kocher (1995), this was an issue that residents believed they could have some influence on through political action. Markets and technological changes on the other hand were beyond their control. It was also discovered that the northern spotted owl controversy led to substantial polarisation in the rural communities with devastating consequences. This polarisation, in addition to its considerable social impact, was discouraging residents from uniting in an effort to solve the economic crisis. As Levi and Kocher (1995) noted:

[1] Modernisation resulted in a decrease in employment by one third between 1970 and 1990 despite constant timber production levels (Levi & Kocher, 1995).

> Rural communities in the Northwest are faced with a trade-off between environmental quality and traditional, extraction-based employment. If these rural communities *do not* harvest their local timber resources, unemployment will reduce their quality of life and force many residents to leave for the urban areas. If they *do* log their forests, the high environmental quality that makes these communities attractive will be damaged. This trade-off decision is made more difficult because it is being made within the context of a larger political debate. The spotted owl controversy has diverted people's attention away from their communities' long-term economic problems and focused their attention on an environmental conflict.(p.647)

In December 1994, the Clinton administration's compromised plan for logging and conservation in federally owned forests of the Northwest was given legal approval, a verdict which "marked a crucial turning point in the protracted, bitter struggle between environmentalists and timber interests" (Beardsley, 1995, p.18). However, the endangered species act is itself now endangered with threats from influential representatives of Congress who openly show contempt for any efforts aimed at protecting rare flora and fauna (Beardsley, 1995).

3.2.2 Black-Footed Ferret *Mustela nigripes*

3.2.2.1 Biological and Ecological Considerations

The black-footed ferret (*Mustela nigripes)* is a member of the weasel family (mustelids), the closest relatives of which are the European (*Mustela putorius)* and the Siberian (*Mustela eversmanni)* polecats (Biggins & Thorne, 1994; Kellert, 1996). Their weight range is between 600-1400 g. The original habitat range of the black-footed ferret extended from Saskatchewan to Texas and overlapped that of the prairie dogs (*Cynomys* spp.). Prairie dogs are important to the survival of the ferret, constituting approximately 90% of their diet (Biggins & Thorne, 1994; Reading, 1993). In addition, prairie dog burrows provide shelter and dens for raising young (Caughley & Gunn, 1996; Reading, 1993; Reading & Kellert, 1992). Ferrets are subjected to high predation rates (Reading, 1993).

Ferret numbers have declined considerably this century. However, notes on the black-footed ferret by Seton in 1900, though few, declared then that it was a species with a dim future (Dunlap, 1988). In the 1920s the wild population of ferrets was estimated at about one million to 800,000 (Caughley & Gunn, 1996; Kellert & Clark, 1991). Dunlap's (1988) review of the general files of the Division of Wildlife Service reveals that it was

not until 1953 that any record of interest as to its status exists. The first field studies conducted in 1964 recorded that this free-ranging but now low-density population was in danger of extinction. It was then listed as endangered on the 1973 Endangered Species Act. Within ten years the population had completely disappeared from the first study location, Mellette County, South Dakota and was hence thought to be extinct since additional extensive surveys provided no evidence of their existence. In 1981 a larger population, estimated at between 80 and 100 was discovered in Meeteetse, Wyoming, following the discovery of one which had been killed by a dog (Caughley & Gunn, 1996; Kellert & Clark, 1991; Matthiessen, 1987). This population continued to be studied and by 1984 approximately 128 individuals were recorded (Dobson, 1996). By 1985 only 10 know individuals remained of this population; six were captured and placed into captive breeding programs, all of which died. By 1987 the last surviving animals were captured, 4 adults and 8 juveniles. The recovery of the species was now totally dependent on this captive population. In 1993 the captive population was estimated at over 300 individuals (Reading, 1993).

The initial cause of decline of the species was inextricably linked to the decrease in prairie dog numbers which provided an important food and shelter source. Prairie dogs were considered pests and hence large numbers were eliminated due to government-sponsored poisoning campaigns. In addition, the conversion of large tracts of land into cropland resulted in extensive loss of habitat. Finally, sylvatic plague and canine distemper caused massive losses in the prairie dog population and, by being 100 percent fatal to ferrets, this catastrophic effect impacted on this species as well. With these causal agents in operation, together with severely fragmented habitat, the ferret population could no longer re-establish by normal dispersal.

The black-footed ferret, millions of years old, was now extinct in the wild, "the secrets of the long journey that brought it from Siberia to North America many thousands of years ago will disappear" (Matthiessen, 1987, p.281).

3.2.2.2 Issues surrounding Management and Recovery Efforts

During 1972 and 1974 nine ferrets had been captured and a breeding program initiated which proved unsuccessful (Biggins & Thorne, 1994). 1974 and 1978 saw the establishment of the first black-footed ferret recovery team and an approved recovery plan. However, ferrets had declined to near extinction by the time the plan was adopted (Biggins & Thorne, 1994).

Several detailed reviews of the issues surrounding the black-footed ferret management and recovery effort exist, essentially presenting two perspectives: one which is internal - that of the management agencies (e.g., Biggins & Thorne, 1994); and one which is external - that of the universities (e.g., Kellert & Clark, 1991; Reading & Miller, 1994). Although these reviews highlight a number of very important concerns, one which is most relevant to this dissertation is the argument for the need for a multidisciplinary approach to endangered species recovery. This overview therefore presents a focused examination of the issues that are particularly relevant to this approach.

Kellert and Clark (1991) strongly argue the case for a multidisciplinary holistic approach to endangered species management in their review. Reading (1993) takes their theoretical argument one step further in an extensive empirical study on the development of a black-footed ferret reintroduction paradigm. Biggins and Thorne (1994) also consider that forces beyond the biological present 'road blocks to recovery' but do not identify how or what should be analysed.

In their detailed examination of management and recovery efforts and the endangerment of the black-footed ferret, Kellert and Clark (1991) identified four classes of forces as those responsible for endangerment of the species and which continued to have an impact on recovery efforts: biophysical; social-structural; valuational; and institutional-regulatory[2]. Although these forces were presented as separate factors, interaction between each was considered a critical part of this dynamic process. The biophysical force refers to biological and ecological requirements of the species. This was an area of investigation slowly consolidating its knowledge base simply because "wildlife professionals working in endangered species restoration programs often view recovery policy primarily as a biological problem" (Kellert & Clark, 1991, p. 32).

Despite this biological emphasis, Reading and Miller (1994) outline a number of problems with this research area. It appears there was a reluctance on the part of the management agencies to consider external research and to accept credible experimental design and rigorous scientific methodology as critical components of a reliable biological and ecological knowledge base in spite of strong protests from a number of scientists and nonscientists from several organisations. The unwillingness of the management agency which was responsible for the ferret's recovery, to incorporate "more and better science" which was grounded in conservation science theory was identified as causing considerable delays in the recovery effort. In addition, Reading and Miller (1994) point

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[2] Details of the Kellert/Clark (1991) Wildlife Policy Framework which include these forces are presented in Section 3.3.3.

to the lack of external peer review of ferret research conducted by management agencies themselves as severely constraining the move towards a more efficient and effective recovery program. They write, "Continual citation of unpublished and hence unreviewed reports lends a false air of credibility to manuscripts that often never proceed past a draft stage. Reports should be exposed to critical outside evaluation and review in a timely fashion. Otherwise the program is guided by inaccurate and misleading information with potentially inefficient, ineffective, or even disastrous consequences" (p.90). In such circumstances, biological and ecological research can neither progress nor be of any value to the recovery effort.

Kellert and Clark (1991) also identified critical nonbiological forces as determining the fate of the ferret. These they refer to as social-structural and valuational forces, which in psychological terms relate to the socio-psychological dimensions of the human-environment relationship and include issues of power, property rights and equity as well as attitudes, values, perceptions, and wildlife/environment value considerations. This was an area of research they found wildlife managers very reluctant to consider. Because restoration of this species required reintroduction, private landowner acceptance and participation of this program was critical (Biggins & Thorne, 1994; Reading, 1993).

However, it appeared that the interests of farming and ranching communities was essentially opposed to a preservation strategy (Kellert, 1996; Reading, 1993). To them maximising farm output was the priority, preserving rangeland rodents such as prairie dogs and indirectly ferrets, was not in line with high agricultural productivity (Kellert & Clark, 1991).

Reading and Kellert (1993) and Reading (1993) saw these social aspects of the ferret's reintroduction as crucial to conservation efforts. Their research investigated knowledge, values, attitudes and perceptions of prairie dogs, black-footed ferrets, the recovery program and involved government agencies. Their sampling frame drew from a wide selection of communities including rural and urban residents, ranchers and environmentalists. The results revealed information about these communities and their relationship to this endangered species, information critical to consolidating a knowledge base from which effective recovery efforts could evolve. Many landowners, for example, exhibited negative responses to prairie dogs, black-footed ferrets and the reintroduction program. Their reaction to prairie dogs was due to a perception of competition with livestock, an agricultural pest. They feared ferret reintroduction because of a perception of government interference and restrictions, forced changes in lifestyle and livelihood. Addressing the concerns of this resource-dependent group was essential since they in particular played a key role in the future of any recovery effort. The results of this human

population study further highlighted the critical nature of this knowledge base in endangered species recovery efforts.

The third dimension identified as operating on the endangerment of the black-footed ferret was the institutional-regulatory forces or the professional and organisational dimension. Again wildlife professionals gave little attention to this dimension of the crisis, concentrating instead on biological problems. Kellert and Clark (1991), Reading and Miller (1994) and Reading (1993) identified several major problems in this professional/organisational dimension which were extensive and complex. While it is beyond the scope of this overview to do justice to them all, what it once again highlights is the critical nature of developing a better understanding of organisations. The management agencies, like the public and in particular the landowners, play a vital role in both the endangerment of the species and its restoration. As Reading and Miller (1994) point out:

> Despite the glowing stories of success in newspapers, newsletters, and popular magazines, ferrets remain far from recovered and the ferret recovery program suffers from a host of professional and organizational inadequacies. (p.95)

3.2.3 Eastern Barred Bandicoot *Perameles gunnii*

The significance of this case history is that it outlines the research, management, and recovery process within an Australian context. It highlights the point that conservation issues and problems surrounding management and recovery efforts are not restricted to geographic location. Rather, the issues and problems faced in American are similarly faced in Australia. The notable difference with the eastern barred bandicoot, *Perameles gunnii,* is that it has not achieved the national and/or international profile of the northern spotted owl and black-footed ferret, nor has there been the considerable political controversy associated with its conservation.

3.2.3.1 Biological and Ecological Considerations

The eastern barred bandicoot was historically distributed across 23,000 km^2 of the Western district plains of Victoria and South Australia (Clark et al., 1991a; Clark et al., 1995b; Humphries & Seebeck, 1995). A separate subspecies is known to exist in Tasmania (Backhouse et al., 1994; Sherwin et al., 1991). The weight range of this marsupial is between 500-900g, average 660 g (Seebeck, 1983). Unlike the remaining

eight species of peramelids, the eastern barred bandicoot is the most conspicuously marked with three to four bars on its hindlegs. It appears they are opportunistic, nocturnal foragers, with a diet consisting primarily of invertebrates such as earthworms, insects, and insect larvae. Berries and other plant material have also been recorded in their diet (Backhouse et al., 1994; Seeback, 1983). Breeding age for females is three months, males four months and when conditions are optimal twenty young per year can be produced by a single female (Backhouse et al., 1994; Clark et al., 1991a).

The 1972 field studies revealed that there had been over a 99 percent loss in the historic range and abundance of the eastern barred bandicoot, and that the remaining wild population was reduced to a single population near Hamilton in Victoria (Clark et al., 1995b; Humphries & Seebeck, 1995; Seeback, 1979). The catastrophic decline in population has been the consequence of a considerable number of threats acting on this species. These include: clearing and destruction of habitat; predation by introduced animals such as cats and foxes; road kills; disease particularly toxoplasmosis; toxic pesticides acting on bandicoots and their invertebrate food supply; and catastrophic events such as fire and drought (Backhouse et al., 1994; Clark et al., 1991a; Clark et al., 1995a, 1995b). The critical decline in the last remnant population mirrored that of range decline. From the 1970s to 1992 the bandicoot's range declined from 3000 hectares to 80 hectares. Clark et al. (1995b) describe a precipitous decline in the wild population of the eastern barred bandicoots between 1988 and 1991. Although they note that true population numbers were not known, they present capture rate figures for the period 1988 to 1992 which highlight this decline: *200* - 1988, *49* - 1989, *16* - 1990, *3* - 1991, *3* - 1992. They also noted that in the latter years of this standardised monitoring program, large portions of the study area experienced complete loss of bandicoots. The results of their population modelling indicated that median time to extinction was 10 years without removals (capture), and with removals this time to extinction declined to three years, "removal of bandicoots to stock a captive population hastened the demise of the wild population by about seven years" (Clark et al., 1995b, p.289). Eastern barred bandicoots are on the brink of extinction. Reading et al. (1996) suggest they are in fact "functionally extinct". How has this happened?

3.2.3.2 Issues surrounding Management and Recovery Efforts

From 1937 to the present represents a sixty year period from the first noted public concern for the eastern barred bandicoot's survival to the reduction of the last known remnant wild population to only a few individuals (Clark et al., 1995a, 1995b; Reading et al., 1996). This is the end result of an endangered species management and recovery

effort which began with early but persistent public warnings during the 1960s and 1970s, followed by field surveys and the first captivity of animals in 1972, various field studies between 1980 and 1989, the first management guidelines in 1982, draft management plan in 1987, final management plan in 1989, recovery team established in 1989, the establishment of a captive-breeding program in 1988 and its upgrading in 1991. In brief, over two decades of public warnings, "research, intensified management, and the commitment of considerable resources" (Backhouse et al., 1994, p.256), has ended in a "functionally extinct" wild population of eastern barred bandicoots. In addition, many of the researchers note that the biology and ecology of the species still remains unknown (Reading et al., 1996).

Backhouse et al. (1994) and Clark et al. (1995b) provide an assessment of the eastern barred bandicoot recovery effort, highlighting its strengths and weaknesses and drawing on this collective information to prescribe lessons for improved performances. Here was clearly a case of recovery program failure with a diversity of issues surrounding that failure. What follows is a focus on those aspects of these assessments that are considered particularly relevant to the argument of this dissertation - the lack of a holistic knowledge base.

A deficit in the knowledge base was considered by Backhouse et al. (1994) to be one of the major weaknesses of the recovery effort and one which impacted severely on the recovery process. According to Backhouse et al. (1994), the biological and socio-psychological knowledge base providing the foundations of this recovery effort was either severely flawed or simply lacking. For example, critical and credible biological information on which to base conservation strategies was not available. This included lack of information on true status of the population, mortality rates and their causes, and habitat use patterns, all important for understanding trends in the wild population. Most of the information that was available was "largely anecdotal, descriptive, and based on unsystematic data collection, casual observation, or opinion" (Backhouse et al., 1994, p.256). In addition, standardised yearly monitoring of eastern barred bandicoots was only put into place after the wild population had so severely declined that extinction was just a matter of years away. Data management was also a concern since this was not coordinated nor centralised. Many studying endangered species and their management have pointed to the unwillingness to share information as a strategy for maintaining power and control by those individuals, government and nongovernment organisations over the recovery program (Backhouse et al., 1996; Clark et al., 1994; 1995b).

Beyond the biological, additional dimensions of the problem, such as social, economic, organisational and political, were not considered. Backhouse et al. (1994) argue that the

deficiency and unreliability of information due to the lack of attention to nonbiological factors led to "inadequate problem definition - which in turn led to delays in management action, an underappreciation of the situation's urgency, failure to explore the full array of causes of bandicoot decline" (p.257). The "excessively narrow focus" of key recovery program figures resulted in this lack of recognition of "essential nonbiological dimensions of the problem". According to Benton (1993) the technological determinism implied in this narrow perspective can immobilise policy making and thereby the recovery process. In addition to this narrow focus, Backhouse et al., (1994, p.261) suggest that, "Social, economic and political considerations were largely ignored because they were poorly understood, considered too hard to solve, or not relevant". In conclusion, Backhouse et al. (1994) point out that, "the program's weaknesses were primarily human and organisational, rather than biological" (p.266).

3.3 Integration of Natural and Social Science in Environmental Research: Exploring some existing Frameworks

A variety of "big picture" frameworks from several disciplines have emerged over the years in response to the environmental crisis. This review has selected one from each of the three disciplinary areas central to this dissertation, ecology, environmental psychology, and environmental management. The purpose is to illustrate how each of these disciplines have attempted to confront the challenge of a multidisciplinary approach to environmental studies. What is evident is that each is dominated by the specific disciplinary perspective from which it evolves. Nevertheless, together they provide an important insight into the integration of the natural and social sciences and are highly instructive for this research. In addition, the problems and possibilities of each of the frameworks are summarised.

3.3.1 From Ecology: UNESCO's "Man and the Biosphere"

On the international level, UNESCO launched a program in the 1970s termed "Man and the Biosphere" (MAB) which even today is considered innovative because of the methods which were proposed then for addressing environmental problems (Bonnes & Secchiaroli, 1995) and sustainability (Meffe & Carroll, 1994). An integrative way of approaching these issues, which would require collective efforts from the natural and social sciences, was considered essential. As an international program of applied research on the interactions between humans and their environment, this innovative approach

focused specifically on sources of scientific information needed by decision-makers for managing natural resources (Bonnes & Secchiaroli, 1995).

The program was essentially an evolution of the 1964 International Biological Program (IBP), an ecological study mounted on a global scale which addressed spatial primary productivity and productive capacity of the biosphere (Parks, 1980). The basic philosophy of the MAB program shifted from nature centred to include the human factor. "Man" was considered a central element of the biosphere, of bio-ecological processes and was framed as a biological as well as cultural being. "Man"' was also seen as "the eminently active and intentional actor of physical-biological phenomena occurring in the biosphere" (Bonnes & Secchiaroli, 1995, p.15). The unit of analysis therefore became the human-use system, with psychological-environmental phenomena taking on a central role together with physical-biological phenomena.

The intentions of this program were primarily to integrate knowledge and develop intervention strategies which would be founded on multidisciplinary perspectives, specifically on the biological and social sciences (Bonnes & Secchiaroli, 1995). The dimensions identified as characterising the human-use system included: the biological aspects and forces; and the environmental representation dimension which was defined as "all psycho-social phenomena regarding both cognitive and affective processes aimed at representing the environment and its features at both the individual (psychological) and collective (socio-cultural) level" (Bonnes & Secchiaroli, 1995, p.16). The MAB program considered the processes of environmental representation fundamental to the way human activity shaped the human-use system.

With environmental representation becoming a central feature of the human-use system, it was essential to realise that for different actors within the system this representation would be constructed differently. Three core actors were identified, the environmental decision-makers, environmental technicians/experts, and environmental users (utilitarian, normative). The different representations of the environment corresponded with the different relationship to or role played in the environment by these actors. The first two groups of actors were seen as belonging to specialist areas and hence their environmental representation was constructed in a way which was more in line with an analytic-evaluative procedure. The environmental users on the other hand, who were interacting in a utilitarian or normative way with the environment, constructed their representation of the environment based on psychological processes involving the integration of cognitive and affective components. This apparent dichotomy of environmental representation construction on the part of the human actors performing differently within the system can be a major source of conflict and certainly creates problems for reciprocal communication

and acquisition of information, all essential to decision making (Bonnes & Secchiaroli, 1995).

This MAB framework provided a means of addressing "human-use ecosystems" in terms of functioning and maintenance and has been taken up by a number of ecologists addressing natural environments (e.g., Rosado-May, 1994), and environmental psychologists addressing urban environments (e.g., Bonnes & Secchiaroli, 1995). An outcome of the program, one for which it is most noted, is the concept of the biosphere reserve. A biosphere reserve consists of an expanse of protected land which incorporates human activity (Figure 3.1).

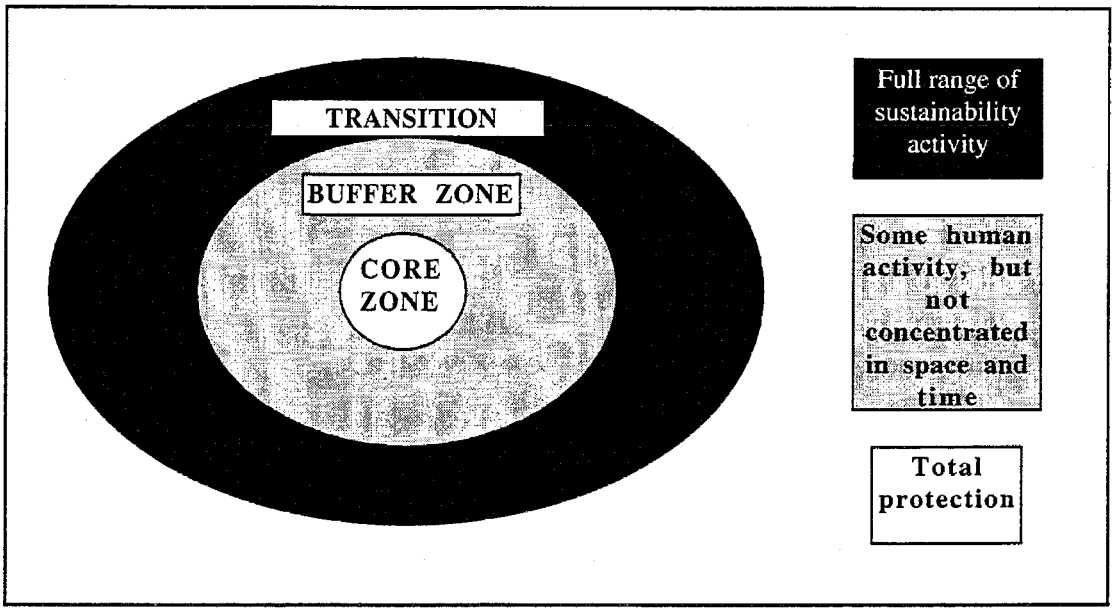

Figure 3.1 Diagrammatic representation of a typical biosphere reserve.

(Source: Bridgewater, 1994)

The concept was to provide an integrated landscape management framework, formulated to wed conservation and sustainable development (Bridgewater, 1994; Rasker, 1993) by incorporating, at least in theory, limited and sustainable human activities into the planning and management of the area (Rosado-May, 1994). There are now over 266 biosphere reserves in seventy nations (Grumbine, 1992). Although the concept of the biosphere reserve is now being re-visited (Bridgewater, 1994), it has not been without its critics (e.g., Grumbine, 1992; Rasker, 1993).

Grumbine's (1992) comments summarise the problems with the MAB concept:

> The concept generated a provocative spatial model of management: There would be a large protected core (that is, a national park) surrounded by a buffer zone, a restoration zone, and a stable cultural area where "people live in harmony with the environment." Human use would be allowed in the concentric rings, surrounding the core, increasing with distance away from the core. This early systems approach did not recognize the dynamic aspect of nature, nor did it treat people as anything more than abstract actors in a idealised world. It was vintage preservationism with a nod at scientific research ... After almost twenty years few biosphere reserves fit the idealized pattern, and there are none with fully integrated human communities ... Overall, this first model of management beyond administrative boundaries suffers from nebulous goals that offer something for everybody. The hard questions are left unanswered. Biosphere reserves may yet have a future, but they are not the panacea that some wish them to be. (p. 157)

3.3.2 From Environmental Psychology: Stern's Global Environmental Change Framework

Over the past 30 years, in line with the emphasis on and centrality of environmental issues, environmental psychology has contributed several new concepts and methods for analysing human-environment transactions. Since the 1980's, increasing attention has been given to the development of transactional theories in an effort to better understand the complex interdependencies between people and their environments (Altman & Rogoff, 1987; Stern 1992; Stern et al., 1992; Stokols, 1995; Walsh et al., 1992a, 1992b; Wapner, 1995). These theories emphasise the reciprocal or bidirectional nature of human-environment relations (see Section 2.3).

Stern's (1992) human-environment transactional model is an exciting, apposite and useful framework deriving from social environmental psychology for developing and understanding the links between the biological or natural environmental system and the human system (Figure 3.2).

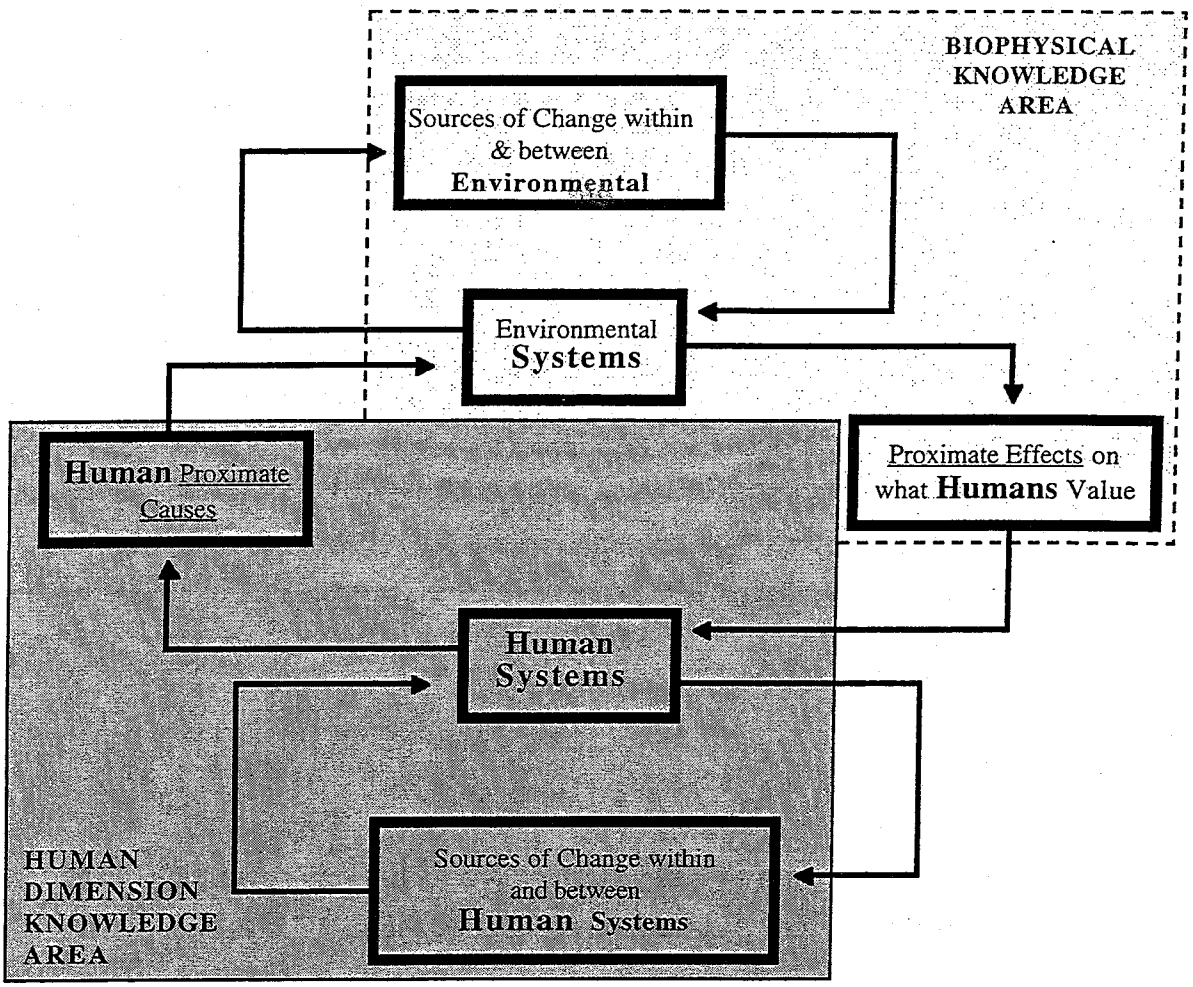

Figure 3.2 Interaction between human and environmental systems.

(Source: Stern, 1992; modified)

Stern is actually one of the most recent social scientists to apply the ecosystem concept directly to the development of his model. He considers it to be the appropriate strategy for the scientific analysis of global environmental change. Stern sees what he refers to as the subsystems, environmental and human, as the two components of this concept. The definition and structural entity he has chosen for the environmental system is consistent with that of ecological theory. Stern refers to the environmental subsystem as one which consists of complex interacting forces between the abiotic components, the hydrosphere, lithosphere and atmosphere and the biotic component, the biosphere. The human system is referred to as the anthroposphere, which is the economic, political, cultural and sociotechnical dimensions of the system. This conceptualisation of the global environment allows for an understanding of how environmental systems at the global

level affect or are affected by changes in any one of these spheres or subsystems. "The key to this study is understanding the feedback mechanisms between subsystems that either amplify or dampen the initial impacts" (Stern 1992, p.26).

In Stern's model, the human and environmental systems interact at two critical interfaces. Humans are seen to affect the environment through a subset of activities that alter environmental conditions (for example, land clearing); these are the *human proximate causes of environmental change.* The environment in turn affects humans through a subset of events that directly change things people value (for example, the survival of endangered species); these are the *proximate effects of environmental change.* Stern uses the term value in both an anthropocentric and ecocentric sense.

This human-environment transaction model also draws on concepts from basic psychological research and its application to environmentally relevant attitudes, beliefs and actions. In terms of this schematic diagram, Stern sees the role of social and behavioural science as improving our understanding of the function of individual and interpersonal behaviour in the human-environment relationships such as the human causes of global environmental change (a subset of activities that alter environmental conditions), and the human consequences of and responses to global environmental change. In this multi-stage causal model of environmentally relevant behaviour, behaviour and its direct effects can feed back into the system. The human behaviours that are the most important proximate causes of destruction have to first be identified. It is when humans see the negative impact of their behaviour that they are motivated to behave in a particular way. What is particularly important and what presents a critical intervention opportunity, is when environmental damage registers on individuals so that they understand that their own behaviour is having this negative impact on the environment - an understanding that carries implications of "responsibility for" and "responsibility to do".

3.3.3 From Environmental Management: Kellert/Clark Wildlife Policy Framework

With protecting endangered species being one of the most difficult tasks facing management agencies, the demand for a new and integrative environmental management paradigm has been largely driven by the ineffectual and often undesired management outcomes evident today (Born & Sonzogni, 1995), particularly in the area of endangered species recovery (Clark et al., 1989; Clark et al., 1994; Kellert, 1994, 1996; Miller et al., 1994). As outlined previously, increased management performance can only proceed once an understanding of the nature of human-environment and human-human

transactions as well as the species' biology is secured. A management framework that integrates these knowledge areas is therefore required.

Figure 3.3 is a schematic view of such a framework. It was first developed by Kellert and Clark (1991), with the aim of increasing wildlife managers' understandings of the wildlife policy process.

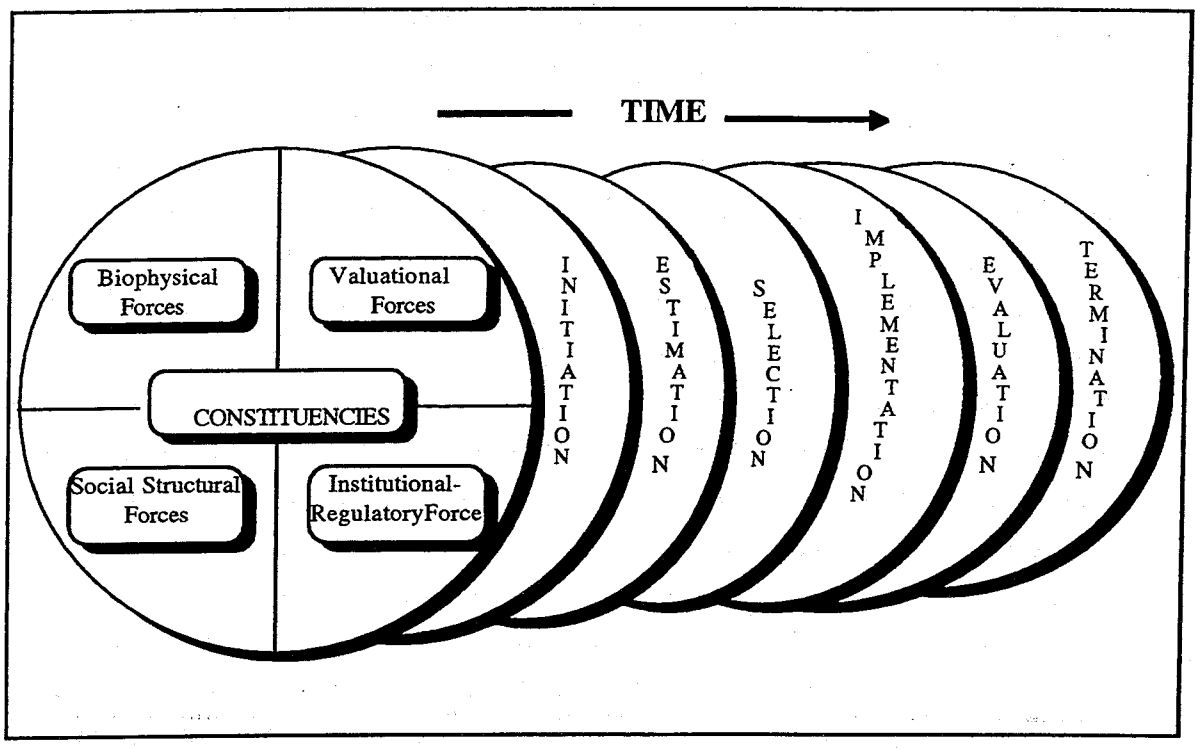

Figure 3.3 Conceptual framework for analysing wildlife conservation issues.
(Source: Kellert, 1994, 1996).

The framework is grounded on the principle that wildlife management and policy are both complex and dynamic and to be effective a number of key knowledge areas must be integrated. As Kellert (1994) notes, "It is my contention that the success of most, if not all, endangered species programs depends greatly on systematic consideration of various human dimensions rather than just assessing biological and technical elements" (p.371). The approach of Kellert and Clark was therefore essentially multidisciplinary. They combined theoretical perspectives of many disciplinary fields including ecology,

conservation science, sociology, psychology, resource management, policy science and organisational theory.

The framework identifies and categorises different analytical approaches to wildlife management. It consists of what Kellert and Clark refer to as three primary elements - constituencies, forces, and time. The constituencies are the major interest groups involved in shaping wildlife policy. They include: the utilitarians (consumptors and nonconsumptors of wildlife and natural resources); the technical groups (legislative bodies, judiciary, and regulatory agencies); the nongovernment organisations (conservation groups); and the vicarious users (general public). Despite this being only a general overview of the groups involved, Kellert and Clark (1991) point out that, "it emphasizes a view of wildlife policy as resulting from the competitive interactions of diverse groups as values clash, information is unevenly held, preferred outcomes differ, and power relationships are expressed" (p.19).

The core feature of the framework is viewing management of endangered species as the product of the four basic forces: *biophysical, valuational, social-structural* and *institutional/regulatory*. These are "expressed primarily through the competitive interactions of varying constituencies and changing over time depending on the stage of the decision-making process" (Kellert, 1994, p.371). The *biophysical* dimension generates information on species distribution and abundance, mortality, life history, habitat use and requirements, movements, reproductive strategy and has traditionally been the focus of endangered species management programs. Essentially this information represents the limitations of the species.

In addition to the biological considerations, this framework emphasises the role of a social science perspective to protection and recovery of endangered species. This additional perspective is included for a number of reasons including: the uncertainty of biological and technical information; how that uncertainty leads to policy being driven by competing and interacting social, political and economic forces; and how, despite this scientific uncertainty, managers place more importance on biological considerations, ignoring socio-psychological and political considerations. The *valuational* dimension in this framework takes on this social science perspective, one based on socio-psychological theory of human attitude/value/perception/behaviour relations. It refers to the importance or value worth of wildlife for people and society as factors profoundly influencing species recovery. General classifications of values include economic, ecological, and socio-psychological. In Kellert's earlier research (1980, 1984) he identified twelve basic wildlife value categories which attempted to address a much broader range of values than just economic. In developing this value typology, Kellert recognised the need for

managers and the policy makers to understand that there was a considerable range of values that people and society held for wildlife and that these value/attitudinal variations could alter the course of endangered species recovery. Kellert (1994) writes:

> A consistent problem has been the underestimation of the significance of these variations among critical social groups essential to species recovery. A related failure has been the limited use of this information to clarify values among opposing groups, to educate varying constituencies, and to work toward the resolution of conflicts. These value differences are often regarded as being minor political considerations, as possessing limited relevance, or as being unworthy of scientific consideration. This narrow disciplinary emphasis can frequently result in naive and inadequate endangered species program formulations and recovery efforts. (p.373)

The *social-structural* dimension includes a variety of sociological, economic, and political factors, issues relating to power and property relationships. Central to this dimension is the issue of property rights, landownership, and equity. The recovery of many endangered species, particularly those species with large home range areas which cross reserve and private property boundaries, is clearly reliant on the relationship between landowners and the use of the land (Bennett et al., 1995). These relationships cannot be ignored.

The fourth dimension in this management and policy framework is organisational, the *institutional/regulatory* forces. This again requires a social science approach. Understanding the diverse and highly dynamic interacting forces at work within the institutional and regulatory organisations requires some knowledge of socio-psychological and organisational theory. Organisational behaviour needs to be understood if endangered species recovery programs are to improve because "inadequate organisational performance, particularly among government agencies, may be among the foremost reasons for the ineffectiveness and failure of many endangered species programs" (Kellert (1994, p.377). This variable category includes factors evident at all levels of government in addition to the activities and characteristics of nongovernment organisations which influence the institutional/regulatory aspects of endangered species management and policy.

The integration of Brewer and deLeon's model (Brewer & Clark, 1994) forms the third element of this management/policy framework - *time*. The six stages of the time frame identified highlight the dynamics of the management and policy process as it evolves over time (Kellert & Clark, 1991). The various constituencies and elements of the forces

change in response to the needs of these six stages. Each plays a vital role in the evolution of the management and policy process, their success or failure dependent on the proceeding stage and feedback mechanisms.

The application of such an integrative biological, social and institutional analytical framework to endangered species management serves to extend management beyond the centrality of biology. Research which has applied an adapted version of this framework is that of Reading (1993). He used this framework to establish the endangered black-footed ferret (*Mustela nigripes*) reintroduction paradigm.

3.3.4 Problems and Possibilities

The problems and possibilities of the above natural-social science frameworks as overall pragmatic frameworks onto which the whole of this research could be located, are essentially linked to the different viewpoints of biologists, environmental psychologists, and environmental managers. To be adopted as the analytical point of departure for the integrative methodological framework discussed in this dissertation, these viewpoints need to be considered. Firstly, each framework is a special case for the respective perspective and not really representative. Secondly, each is also, necessarily, multidisciplinary in its scope, applied and problem-focused in its conception and motivation, and outcome oriented.

As a model that addresses and situates *psychological* variables and processes, Stern's Global Environmental Change framework (Figure 3.2) takes the primary management/policy question of the Kellert/Clark model, "how do we manage the extinction crisis?" into the psychological domain by asking the more psychological question in terms of environmental management; "how can we intervene as effective behaviour change agents to ultimately solve the extinction crisis?" Social and environmental psychology and the more interdisciplinary environmental literature provide the context for this discussion. The advantages of Stern's model are that it specifically addresses environmental-related behaviours and is able to both frame and situate environmental concern issues and communicate with planners and government. Stern in particular emphasises the potential role of psychology in conceptualising how human proximate causes impact on environmental systems, and on how people perceive, respond to, and are affected by perceived environmental costs and global change. Stern's approach is one of the few approaches that does attempt to link human behaviour and psychology to global environmental change. Furthermore, it is an encompassing, systems approach which consciously and critically addresses the nature and measurement

of environmental concern. The problems with the approach centres on issues such as the focus on global rather than specific, local issues. In addition, there are problems with the operationalisation of constructs, omissions of the nature of appraisal and coping processes, and the lack of addressing some psychological processes and variables.

The advantage of Kellert / Clark's wildlife management/policy paradigm (Figure 3.3) is that of all the frameworks it is one which focuses on the endangered species domain. On a general level, this model provides a pragmatic all-encompassing framework that brings together all components of the endangered species recovery process. In addition, despite the considerable array of studies and measures to consider, the studies proposed are the most relevant. In the context of this framework this research could be viewed as the first stage of a complex integrative process aimed at piecing together the key components of the research within the context of a number of conceptual and theoretical perspectives which address the environmental and human dimensions. But not all of the study components outlined in the model were considered in this research. Rather, those that were particularly relevant to the integrative process as it progresses towards an understanding of the human-environment relationship and the immediate consequences for endangered species survival, have been selected. The stage of the recovery effort which involves organisational or institutional-regulatory systems have not been studied. Time and resources have prevented this.

While the application of this integrative biological, social and institutional analytical framework to endangered species management serves to extend management beyond the centrality of biology, nevertheless, the question remains, why would a social scientist or a psychologist have a problem with the Kellert/Clark model? Basically because of its lack of in depth considerations of social psychological dimensions. It ignores intraindividual psychological processes and experience and much behaviour change wisdom. For a social and environmental psychologist the actors and the action are the key considerations. Of particular interest is the profile of the communities and other interest groups, the nature of belief, value, attitude, concern, knowledge -behaviour connections, and how to be effective in changing behaviour. This requires a disciplinary specific and theoretical digression into the social psychology of belief, value, attitude, concern, knowledge formation and change. Landownership, for example, is seen as conferring *rights* which are considered by some members of the public to be unfairly disregarded by government agencies. This sense of *injustice* then strongly colours perceptions and behaviours. Therefore, the *law* as *policy* or practice is "social-structural" but the impact on people is "valuational" in Kellert/Clark terms.

3.4 The Problems and Pragmatics of Wedding Species-Specific Biological Studies to Reciprocal Human-Target Species Impacts

3.4.1 Integration and Synthesis

Endangered species recovery encompasses many subject areas comprising diverse domains of understanding. The integration of these domains is clearly a desirable goal for advancing and applying this understanding. Such a goal can be achieved by forging links across these domains of understanding or disciplines and by focusing on issues and critical questions that lie at the intersection of these disciplines. Gaps in this understanding will inevitably appear at the interfaces between these domains, and understandings will change through the interaction among the different domains (Pickett et al., 1994). This is simply due to the fact that for different disciplines representations and understandings are constructed differently (Bonnes & Secchiaroli, 1995).

As outlined, many conceptual and theoretical frameworks and endangered species studies now exist which advance the possibilities of these multidisciplinary and integrative approaches in environmental science. Nevertheless, in reality, integration is a complex and difficult process. Both the problems and the pragmatics of wedding two seemingly independent studies such as biological and ecological studies of the endangered species, the cassowary, and the co-existing human population studies are embedded in the "dualistic mode of thought" of the natural and social sciences (Benton, 1994). It is arguably beyond the scope of this dissertation to meaningfully address this dualism. To do so would necessarily entail a very complex process that "involves the daunting creative task of developing new concepts for analysing and thinking through the relationships and processes which were previously allocated to their respective conceptual 'boxes' and posted to the appropriate address: 'natural science' or 'social science'" (Benton, 1994, p.30). Furthermore, the dualist strategy of analysing the natural and human dimensions as distinct realms offers a pragmatic way of including information in an environmental management process that can be understood, will be acceptable and applied. It is an approach which suggests that each has an independent but complementary role to play despite the limitations pointed out by the sociologist Benton (1994):

> So long as the natural science ('nature')/social science ('society') division of labour *itself* remains unchallenged, it remains possible (and, indeed, comfortable) for social scientists to bracket off 'nature' as something the natural scientists will deal with while *they* get on with studying the 'social' side of things. Subsequently

> 'nature' comes to be understood only by way of its cultural representations in the social movements, environmental organisations, or policy debates ... The *interface* between human social practices and their material conditions and consequences is lost from view. (pp. 30-31)

Although the above description of the limitations of the natural/social science dualism is generally applicable, the sociological view that the *interface* between human social practices and their material conditions and consequences is lost, is not one that is acceptable to the environmental psychologist. Environmental psychology has attempted to deal with the *interface* between human social practices and their consequences on the natural environment for some time now (Altman & Wohlwill, 1983). Several conceptual and theoretical frameworks have been developed and advanced by psychologists out of the recognition of the need to specifically address the human-environment interface (see Chapter 2, Section 2.3 for detailed discussion).

3.4.2 The Problems

While the call for multidisciplinary approaches to conservation and environmental management issues has intensified (Clark et al., 1994; Cosgrove et al., 1994; Fairweather, 1993; Redclift & Benton, 1994; Stern, 1992; Webb, 1992), the role of the social sciences is still predominantly confined to rhetoric (Freudenburg, 1989; Heberlein, 1988). The prediction of many social scientists is that while in some instances their work may be represented in policy frameworks of environmental management, in ultimate decisions it is ignored (Freudenburg, 1989; Heberlein, 1988; Wynne, 1994). Barriers to multidisciplinary research are numerous and complex (Oskamp, 1995), some examples of which include: specialisation of disciplines (Peters, 1991; Pickett et al., 1994); perceived supremacy of natural sciences (Grove-White, 1993; Midgley, 1989; Wynne, 1994); punishments of interdisciplinary involvement (Jacobson & Robinson, 1990; Stern & Oskamp, 1987); issues of power and control (Heberlein, 1988; Midgley, 1989); subjectivity versus objectivity (Reading, 1993); weakness and lack of disciplinary structure of social science disciplines (Heberlein, 1988); and perceived illegitimacy of social sciences (Freudenburg, 1989; Heberlein, 1988; Swap, 1991; Wynne, 1994). In addition, cross-disciplinary wedding of information is a complex and difficult task. According to Pickett et al. (1994), integration is limited by personal talents and training, methods available and modes of understanding, scholastic lineages and associated rewards - all sociological constraints on integration.

3.4.2.1 Specialisation

The specialisation of disciplines has left little room for progress. It has been equated with "tunnel vision" because of its focus on one aspect of the system - which means the full system is never adequately known (Ferré, 1994a; Peters, 1991). Most scientists work with a finite set of ideas which are very limiting, restricting the scope of the view they can have on their work. Underlying specialisation is the principal of reductionism which reflects "the erstwhile hope that behind the manifest complexity of the world there lurks a beautiful simplicity, such that a few very basic laws could account for all phenomena" (Peters, 1991, p.110).

Specialisation is embedded in traditions of scientific theory development (Peters, 1991), and reflected in academic institutions (Jacobson & Robinson, 1990). As Clark et al. (1994) point out, it is maintained by professional societies and employing organisations:

> Professional knowledge comes packaged in disciplines and organised in universities around departments such as biology, sociology, and political science. Each discipline trains its professionals in specialised knowledge via specialised language. Each discipline is held together by central concepts around which its knowledge is organised. (p.6)

3.4.2.2 Different Objectives and Training

One form of specialisation is "scholasticism" (Pickett et al., 1994) which reflects the training of scientists within a school or discipline and which often results in fairly narrowly defined objectives and hence the vertical integration of that specialised field. The purpose served by such specialisation is, according to Pickett et al. (1994), the need to communicate with others within the same school of thought. Examples of scholasticism are found in biology/ecology, environmental psychology, and environmental management.

The focus of biologists, ecologists and environmental managers on scientific and technical dimension of environmental problems, which they strive to understand and solve, dominates the environmental studies literature. Spaargaren and Mol (1992) suggest that the strong bias toward "hard" science and technology can be linked to the fact that most environmental problems are the direct outcome of science and technology and so there is the expectation that solutions will come from there. On the other hand, Stern and Oskamp (1987) suggest that because of their training, "environmental experts think in terms of

physical and biological transformations and their technological applications - they see technologies as more controllable than they see people, and they direct policy toward technological innovations and technological solutions" (p. 1068).

The objectives and training of psychologists differ from those of ecologists, biologists and environmental managers, and again Stern & Oskamp (1987) offer an explanation for this:

> The training and culture of psychology militates against psychologists examining environmental problems in terms relevant to environmental policy. Psychologists get greater professional rewards from "pure" research than "applied" research, and when they do applied work, most of the rewards come from the development, extension, and testing of psychological theory rather than from problem-centred or interdisciplinary efforts. (p.1069)

It is well acknowledged that each of these disciplines had to focus relatively specifically to make progress. By building on these foundations, however, contemporary environmental managers should now see the intellectual landscape in which cross-paradigm building is necessary (Pickett et al., 1994).

3.4.2.3 Different Methodologies and Modes of Understanding

Another factor limiting integration is methodological. Basically, the different methodologies and modes of understandings of natural and social sciences reflect dualistic modes of thought which go very deep (Benton, 1994). It is also the case that the chasm between biological and social science research, particularly in the environmental arena, is partly the product of vastly different methodological cultures in which ideology drives methodology and vice versa (Benton, 1994; Fairweather, 1993; Oskamp, 1995). Ecological methodology is bound to classical scientific thinking, which stresses: *quantity versus quality,* "what is truly real is mathematical and measurable, but what cannot be measured cannot have true existence" (Pepper, 1996, p.138); *objectivity versus subjectivity* which rejects explanations involving purpose or mind in nature (Ferré, 1994b); and *reductionism versus holism,* the view that the whole can be understood by breaking it down to its more elementary and basic constituents (Pepper, 1996).

Quantity versus Quality O'Riordan wrote in 1976a, " the appeal of quantification is an appeal to 'rational' calculation because numbers sometimes have a spurious, but undeniable, aura of respectability and credibility" (p.16). According to

Goldsmith (1988), the 1940s was the time of the transition of ecology from a holistic science to an "exact" science, one which is expressed in terms of mathematics. Goldsmith's criticism of this dominance of the *quantifiable* in contemporary ecology is based on the loss of those features of ecological scientific investigation that are not easily quantifiable, such as features of ecosystems (organisation, hierarchy, stability, interactions, competition), nor, Goldsmith argues, are they easily definable.

Objectivity versus Subjectivity Different modes of understanding can also clearly be barriers to integrating ecology and psychology. The difference is bound to classical science and presents the most fundamental dualism in modern thought, that between mind and matter (Pepper, 1996). This Cartesian dualism is often defined in terms of objectivity versus subjectivity. In investigating the organism (wildlife and/or human) and their environmental interactions, two events arise. First, there is the actual "objective" linkages which the ecologists claim to be exploring and which they define as ecological facts - the systems and relationships we are trying to understand. Second, there is the perceived and/or experienced "subjective" linkages which psychologists are exploring - how we see and represent these systems. The latter potentially influences the former. How we understand the system is going to influence how it actually exists, therefore, how we interpret and react to the system.

To the ecologist, objective knowledge is "true", and correct, while subjective knowledge is not (Pepper, 1996). The distinction is made between what is objectively "out there" and what is subjectively in human perception. The ecologists Pickett et al. (1994) define ecological understanding as, "an objectively determined, empirical match between some set of confirmable, observable phenomena in the natural world and a conceptual construct. In other words, understanding is a state that refers to the degree of match between reality and theory, a match between what scientists observe and what they think" (p.28). This clearly equates ecological scientific observation with "truth". They go on to suggest that individual bias is cancelled and hence objectivity results by the active participation of a diverse community of scientists in open-ended discussions and peer reviews. As is evident, scientific objectivity, the separation of emotion and intellect (Webb, 1992) is still cherished by many scientists (Lowe, 1992) and bound to the belief that scientists are unbiased in the sense of being detached or separated from their social context, such as, vested interested groups, personal agendas, social, political or economic factors (Pepper, 1996).

In contrast to the "objective" mode of ecological understanding, social scientists essentially take a "*social constructionist, relativist* view, implying that the findings of science are never totally objective in that they mirror or even depend on the influences

from society. In social constructionism, scientific findings, 'facts' and 'truths' are not, then, absolute and universal, but are relative to the society from which the scientists come" (Pepper, 1996, p.241). This argument is taken up by Goldsmith (1988) who points to enlightened epistemologists such as Popper and Kuhn as those who have discredited the notion that the truth of an ecological proposition is radically different from other propositions. In fact, subjective, value-laden, metaphysical assumptions underlie all scientific propositions (Goldsmith, 1988). In conclusion, Goldsmith (1988) writes:

> Ecology is a way of looking at the world, a subjective and emotional way, not just an objective and rational one ... the elimination of such emotionalism as subjectivity from science - and hence from modern scientific ecology - is an illusion, as is clear from the outbursts of emotional indignation with which the scientific establishment greeted the publication of works such as Rachel Carson's *Silent Spring* and Denis and Donella Meadow's *Limits to Growth*, both of which undermined basic scientific assumptions and thereby threatened their status and prestige. (p. 163)

Reductionism versus Holism The reductionist method of science is linked to the *quantifiable* and hence the *objective* . Notions of quality and subjectivity are irreconcilable with the paradigm of reductionist science (Goldsmith, 1988). Reductionists science only looks at ever smaller parts in isolation from the whole system. The reason that most ecologists appear to be reductionists is because they work within mechanistic research programs which sanction the analysis or decomposition of ecological systems into component processes and structures (Peters, 1991).

Reductionist methodology, however, is not confined to the natural sciences. Sociologists refer to *sociological reductionism* as a variant form of the nature/society dualism (Benton, 1994). In contrast to naturalistic reductionism in which human society is seen as a part of the wider totality of nature, in social reductionism, nature becomes transmuted into its symbolic representations (Benton, 1994).

3.4.3 The Pragmatics

3.4.3.1 Going Beyond Technological Determinism

Technological determinism and technocentric environmental management approaches have dominated wildlife and endangered species management (Clark et al., 1994). Such determinism is embedded in the notion of progress and development and is utilitarian to

the core (O'Riordan, 1976a). The technocentrics are associated with professional and managerial elitism, scientific rationality, the objective appraisal of means to achieve given goals, and optimism and faith in the technology of intervention and manipulation (O'Riordan, 1976a, 1977). Even though many recognise technical solutions can play a role and are available for the environmental problems we face, the problems nevertheless remain and even grow worse today (Oskamp, 1995; Stern & Oskamp, 1987). Many critics of this current situation blame our past failure to contain environmental problems on our overly narrow technical focus which has failed to address the underlying sociopolitical causes of ecological deterioration and natural resources' depletion (Benton, 1994; Clark et al., 1994; Cotgrove, 1982; Jacobson & Robinson, 1990; Naess, 1991; O'Riordan, 1976a, 1976b; Pepper, 1996). An understanding of the interrelationships among ecological, social, and economic, constraints is rarely evident, because few people have training outside their own disciplines (Jacobson & Robinson, 1990).

The time for the "technological optimist" perspective with their classic "technical fix" responses to the environmental crisis is running out (Benton, 1994; Cotgrove, 1982; Pepper, 1996). The traditional role of environmental managers as technicians is being challenged (Selin & Chavez, 1995). The current crisis demands it. What is now recognised by many in the field of environmental science is that technology can be used to provide technical assessments of problems, but, ultimately the wider public is involved in determining the desirability of action based on scientific evidence (Fairweather, 1993).