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I The need for insect diversity conservation

Never use the words higher and lower . . . Certainly, they are difficult words, not only descriptive but value laden . . . while bald eagles are an endangered species, so are 129 species of American freshwater mussels . . . Is it more important to save the eagle than ten dozen species of mussels? . . . Perhaps eagles and mussels are just there, and neither is higher or lower. Of the animal biomass on our planet, 90 percent is invertebrates, who account for 95 percent of all animal species.

Charles Darwin (a penned note)

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The diversity of insect life today is, as far as we know, the richest it has ever been. The variety is so great that insects make up three-quarters of all species. Insects have radiated into so many diverse forms that we have been able only to describe a small fraction of them. They are a major component of all life we see around us. Out of simple beginnings, the earliest life forms continued to radiate through the process of variation/selection/retention to endow the earth with a fantastically rich tapestry of form and colour, of development and dispersal, that has enriched every corner of terrestrial systems with insect character of some sort. Humans are a latter-day arrival who hold in their palms the future of the insect mosaic. This insect variety is losing its spatial and compositional integrity as we enter the new era, the Homogenocene, which is a mere Blink of a geological eyelid.

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1 Ethical foundation for insect conservation

We may notice . . . that the tree-hopper, called by the Greeks *Tettix*, by the latins *Cicada*, received also from the former the title of "Earth-born," – a title lofty in its lowliness, because it was an implied acknowledgment from men of Athens and of Arcady of a common origin with themselves – an admission that the insect was their brother, sprung (as they fabled) from the earth, their common parent, – whence, also, they wore golden tree-hoppers in their hair.

Acheta domestica (1851)

We feel our world in crisis.

David Rothenberg (1989)

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1.1 Introduction

Conservation action must have a sound philosophical and ethical foundation. This gives the action meaning and direction. It is the 'why' we are doing it. At the most superficial level, that of utility, nature is at our service to be used, ideally sustainably. In this philosophy, humans have complete dominion over nature, and this is the language of most international agreements and conventions.

Deeper levels require more wrestling with thoughts and ideals. Among these is one philosophical approach where humans and nature are still separate, but nature is to be admired and enjoyed. An alternative view is that humans are part of the fabric of nature, and nature is used sustainably yet respected deeply.

In recent years, a more profound environmental philosophy has emerged, where organisms, including insects, have the right to exist without necessarily being of any service to humans. A powerful epithet to this deep ecology view has emerged: that we should appreciate and love other organisms without the expectation of anything in return.

Different world religions have recognized the environmental crisis and have made declarations that bridge their faith for the future well-being of the world. While philosophy is an essential foundation for how we approach conservation activities, religion is a spiritual complement, which in some countries such as India can play a significant role at the local scale.

Insect diversity conservation has received an enormous upsurge in recent years, principally with the recognition of the major role that insects play in maintaining terrestrial ecological processes. Yet there is recognition too, that insect individuals and species are being lost at an enormous rate. Stemming this loss of diversity is a vast task. A philosophical base helps decide on which value systems we should use to approach the challenge. Religion then provides spiritual recognition that what we are doing is a good thing. These lead to the scientific pursuit of insect diversity conservation, which is the subject of the following chapters.

1.2 Environmental philosophy and insect conservation

1.2.1 Ethical foundations

No conservation effort can meaningfully begin without a firm foundation of human value systems or ethics. Such ethics are the language of conservation strategies. Without some moral guidelines, it is difficult to define our goals and hence the expected outcomes of conservation activity.

There is little to separate insects from other organismal aspects of biodiversity in environmental philosophy. A noteworthy exception is that not all insects are good for each other, or for us. Insects can be parasitoids or disease vectors. Indeed, we exploit parasitoids as biological control agents.

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1.1 A ramification of the Resource Conservation Ethic. Mopane 'worms' (larvae of the emperor moth *Gonimbrasia belina*) are harvested and dried, and considered an important source of protein and fat to people in Africa.

At the arguably lowest level of ethical consideration, insects have utilitarian or instrumental value for us. This includes aesthetic, food, adornment, ornament, service, spiritual and cultural, heuristic, scientific, educational, conservation planning and ecological values. These utilitarian values have two facets. The first is that they are there for us to enjoy aesthetically and be left alone. This is the Romantic-Transcendental Preservation Ethic (Callicot, 1990). This goes beyond just the insects themselves. It considers all their interactions and ramifications with other aspects of nature. It is an ethic that we adopt when we visit a nature reserve. The second utilitarian facet is that insects are there for sustainable use (Figure 1.1). This is the Resource Conservation Ethic. The harvesting of honey from honeybees is an example. But this ethic may apply to a wider, indirect set of services that insects supply, such as pollination and natural biological control. Where insects do not fit snugly into this ethic is when many actually do a disservice to our resources by nibbling, piercing and burrowing into plants, transmitting disease and killing animals. To entertain this ethic may indeed involve some control of insects.

In both the Romantic-Transcendental Preservation Ethic and Resource Conservation Ethic, humans are essentially separate from the rest of nature and

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1.2 Building an Evolutionary-Ecological Land Ethic at the smaller spatial scale into Resource Conservation Ethic at the larger spatial scale. Here remant linkages of grassland are maintaining ecological and evolutionary processes, while the landscape as a whole is also being utilized to produce timber for export (KwaZulu-Natal, South Africa).

organisms have positive, negative or neutral value. In contrast, Leopold (1949) articulates in a subtle and charming way that other species have come about through the same ecological and evolutionary means as humans, and as such, deserve equal consideration. Humans nevertheless, reserve the right to use and manage nature as well as there being recognition of the intrinsic value of other species and the integrity of ecosystems (Figure 1.2). This is the Evolutionary-Ecological Land Ethic. Rolston (1994) goes a step further, and points out that culture has now emerged out of nature, which brings with it a responsibility for humans to nurture other organisms. Samways (1996d) then illustrates that culture has now become an evolutionary path and the human self-manipulating genome the driving force. Ideally, we now need to build into our new genome an environmental ethic.

1.2.2 World in crisis

The sharp increase in consumerism and human population growth over the last few decades has stimulated an acute awareness of the adverse impacts on the natural environment. A feeling has developed that not all is well in the world, and that wild nature, unsullied by humans, may even have ended (McKibben, 1990). There is also a growing awareness and accumulating evidence that our world is in crisis – but not necessarily doomed (Cincotta and Engleman,

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2000). Out of these changes has developed a strong movement, that of deep ecology, which provides a sense of wisdom combined with a course for action (Naess, 1989). Pessimism is not allowed to prevail, and a sense of joy is the spirit behind the philosophy.

Deep ecology is not something vague as some have claimed. It is an ontology, which posits humanity as inseparable from nature, and with an emphasis on simplicity of lifestyle and on communication with all critics. Naess (1989) termed this approach ecophilosophy (shortened to ecosophy). It is the utilization of basic concepts from the science of ecology, such as complexity, diversity and symbiosis, to clarify the place of our species within nature through the process of working out a total view (Rothenberg, 1989). This is especially relevant to insect conservation, as the insect world is indeed complex and diverse, and it is one where symbioses in the widest sense are widespread. Also, it is at the core of the landscape approach to conservation, where focusing on individual species and interactions is insufficient to conserve the vastness of insect diversity. This emerging arena of ecophilosophy, ecopsychology or transpersonal ecology is likely to play a role in future conservation (Fox, 1993). Indeed, Johnson (1991) advances a potent argument on behalf of the morally significant interests of animals, plants, species and ecosystems. He notes that in a moral world, all living things, insects included, have a right to survival (Figure 1.3).

1.2.3 *Overcoming the impasse between utility and deep ecology theories*

Although deep ecology and even some schools of thought in landscape ecology (Naveh and Lieberman, 1990) include humans in the global ecological equation, it is nevertheless this very human factor that is threatening the planetary processes that in the past have led to the current, rich world-ecology. Although deep ecology purports a human omnipotence, the risk here is that a sense of place, and, in turn, places of wild nature, are left out. To ignore ecological differentials across the globe and to homogenize all would simply be sad. After all, it is the essence of conservation biology to conserve diversity, which, quite literally, is all the differences within nature and across the globe.

Norton (2000) argues persuasively that utility (instrumental value) and deep ecology (intrinsic value) theories are confrontational, and he then asks whether there is perhaps an alternative, shared value that humans may place on nature. The instrumental and intrinsic value theories share four questionable assumptions and obstacles: (1) a mutual exclusion of each other, (2) an entity, not process, orientation, (3) moral monism, and (4) placeless evaluation. To overcome these impasses, Norton (2000) suggests an alternative value system, which recognizes a continuum of ways that humans value nature. Such a spectrum would value processes rather than simply entities, is pluralistic and values biodiversity in place. Such a universal earth ethic values nature for the creativity of its

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1.3 A road sign at Ndumo Game Reserve which emphasizes the ecophilosophy approach where all creatures have the right to survival, no matter how small or ecologically significant.

processes (Norton, 2000). This ethic is vital when we consider not only the sustainability of nature, whether for itself or for humans, but arguably and more importantly, it is crucial for maintaining the evolutionary potential of biodiversity, especially in extensive wild places (Samways, 1994).

The value of wild places is high, and such places are often the seat of interesting, curious and irreplaceable biodiversity. The problem with placing great emphasis on wild places is that reserves constitute less than 4% of the Earth's land surface (World Resources Institute, 1996). This emphasizes that much of nature is now within a stone's throw of humans, and the degree of anthropogenic modification varies from very little to very much. This spectrum has various degrees of ecological integrity. As such, a major goal of conservation is to conserve as much as possible of this remaining integrity, with due respect

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to the role of critical processes in maintaining that integrity (Hunter, 2000a). Indeed, even wild places are only likely to survive in the long run if recognized as wildland gardens that continue to be used with minimum of damage (Janzen, 1999).

Rolston (1994) has illustrated that there are various types or levels of values: natural and cultural, diversity and complexity, ecosystem integrity and health, wildlife, anthropocentric and natural intrinsic. All enter the essence of conservation biology, and all impinge on insect diversity conservation. It is this diversity of values, when maintained, that enrich the world, not just for us, but also for all the other organisms and all the processes that make this, as far as we know, a unique planet.

1.3 Insect utility

Although in practice insects are rarely harvested in the way of many other organisms, the principle of utility value still applies to them. The most significant feature of insects in terms of this utilitarian philosophy is to ensure continuance of their ecological services, so that ecological integrity and health are maintained (see Chapter 3). This is where we largely do not understand the consequences of our actions. To name one example, landscape fragmentation and attrition of landscape patches influence the insect assemblages such that the services they normally supply may no longer be possible (see Chapters 4 and 5).

In the agricultural context, it is not always possible to maintain ecological integrity, even though specific insects are being conserved and human intentions are good. Natural ecosystems adjacent to agricultural fields are often utilized for pools of natural enemies that invade the crop and control pests. On harvesting of the crop, the natural enemies then flood back to the surrounding natural ecosystem where they exert strong, albeit local, impact on natural hosts. This is a manifestation of the human demand for harnessing the interaction between host and parasitoid or predator. Biological control is one of the most sought-after services of insects, and one which is not without risks to ecological integrity (Figure 1.4).

Ecological services from insects include more than predation and parasitism. Technical details of these are addressed in Chapter 3. Among these is pollination of crops, both by wild insects and by captive honeybees. Encouragement of these pollinating insects can hardly be in excess, as the same insects can play a major role in maintaining indigenous plants, and hence in their conservation (Kwak *et al.*, 1996).

One area where insect overexploitation requires caution is in the case of colourful butterflies. Regulations need to be called into play, with many species on the *IUCN Red List of Threatened Species* (Hilton-Taylor, 2000). Local laws also

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1.4 The parasitoid *Aphytis melinus* an important biological control agent against scale insects (Diaspididae). Biological control is one of the most sought after services from insects, but does carry risks (see Chapter 6). Although introduced specifically against Red scale (*Aonidiella aurantii*) in South Africa, *A. melinus* is now known to parasitize at least ten other species.

play a significant part, as does blanket protection of wild areas containing the habitats of these sought-after species. Insect farming can take pressure off the wild populations by providing reared specimens that are often in visibly better condition than wild-caught specimens.

Perhaps the utilitarian aspects of insects have been underexploited. While we are likely to see only limited progress in the direct harvesting of insects (simply because they are generally unpredictable, small and difficult to harvest) there may be some future for medical and novel silk products.

However, the heuristic value of insects in genetic research is undeniable, with *Drosophila melanogaster* virtually a household name. The future is likely to see particular insect genes, rather than the whole animal, having utilitarian value in many aspects of our lives.

Caring for the Earth (IUCN/UNEP/WWF, 1991), which is a world conservation strategy, implicitly addresses many facets of insect diversity conservation that underpin the well-being of humans. Insects and their activities are vital for conserving our life-support systems and for renewing our resources through services in addition to pollination, such as soil maintenance, population regulation, and

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