

1993). Principles of kin selection dictate that humans of the present generation sacrifice some comfort today to provide a better (or simply livable) world for their offspring. Cheaters would be ostracized, and their numbers would likely be too small to be of consequence.

Also, Kay's claim is contingent upon the notion that attitudes toward reproduction are heritable. I see several problems with this idea. First, the general implication is that reproductive beliefs are "hard-wired," in a sociobiological sense, into us. This idea, like other assertions that ethical concepts can be traced to specific neurological pathways, is at best highly controversial, and at worst simply wrong (Kitcher 1982; Gould 1977, 1981, 1987, 1993). Second, if such attitudes are culturally heritable, this heritability does not have the force of natural selection. People are always free to choose their own attitudes and belief systems, regardless of their upbringing. Should we, then, despair of education as a tool for controlling population growth as Hardin (1968) suggests?

Cultural evolution, or "social selection" (Hardin 1989), holds the key to this problem. Cultural evolution allows for the rapid turnover of ideas and belief systems in societies much more rapidly than would be required for any one idea or set of ideas to be hard-wired into our brains in a Wilsonian sense (Gould 1981). It is here that the twin tools of coercion and education can succeed where other methods may fail.

In the long run, neither Gehrt (1996) nor Kay (1997) is entirely correct or incorrect. Education about ethics provides only a stepping stone to the real solution to the human population quandary. To resolve this dilemma, it will be necessary to relinquish some of the freedoms that the Western world cherishes. As Hardin points out (1968, 1969, 1978, 1993), the ethical foundation of our legal system is one of a mutual agreement *not* to engage in certain activities,

thereby curtailing our own freedom. If Sartre (1956) is correct that human freedom is only truly restricted by the physically impossible and the restrictions to which humans consent, then the problem is one of obtaining the consent of individuals *not* to engage in acts detrimental to the society of which they are a part. No one would imply that reaching this stage will be easy; however, reaching it will be necessary if we are to avoid the unpleasant alternative of a more crowded, and ultimately, more miserable world for our children.

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The Miracle of Universities

In a recent editorial about the failure of universities to produce conservation biologists, Reed Noss (*Conservation Biology* 11:1267-1269) explains how his quest for academic jobs was unsuccessful despite his practical background and experience in conservation-related activities and governmental offices. Noss explains how narrowly trained professors can hardly lead the development of open-minded and well-rounded professionals. Meffe (*Conservation Biology* 12:259-260), in a later editorial, argues that boundaries in academia should be softened, giving students an interdisciplinary education with hands-on experience. While I agree with Noss and Meffe, I maintain that acceptance into graduate programs is subject to the same prejudices that Noss describes in his search for jobs. Work experience, genuine research and conservation interest, and involvement in conservation programs are not considered pluses (rather, they might be minuses) for applicants to graduate programs.

After reading about the bias that the universities have in hiring faculty, it occurred to me that the same bias might be present in admissions processes for graduate programs (be-

cause the selection is done by basically the same people). I believe that many graduate programs make selections based exclusively on academic accomplishments, such as graduation from an ivy league institution or specific honors program, while ignoring other traits that might be as important. A legitimate vocation for conservation, as well as clear goals toward practical environmental activities (however hard they might be to assess), should be heavily considered by the graduate acceptance committees. Highly competitive students in academia are in as good a position as any to work successfully towards environmental commitments, but they will not necessarily have the motivation or the resistance and resilience to frustration that is required for working in conservation. Thus, traits other than academic ones must also be considered in the selection of graduate students.

Not only are graduates unable to carry out the jobs available, as Noss and Meffe explain, but we also lack people with the skills needed for the jobs. We all know that we will not protect biodiversity by merely running gels or modeling extinctions. We also need to take action, communicate with the public, convince decision makers, fight and lose countless battles, and still pull ourselves together on short notice to face the next challenge.

The traits important for working in conservation are not necessarily ranked properly in the selection criteria of universities. The curricula rarely consider instruction in critical fields of this discipline, and the professors involved in the programs seldom have real-world experience in conservation. All of these facts select against the production of good conservation biologists. Thus, I believe it is a miracle that universities still produce some good professionals who can actually accomplish something for conservation.

Because of the relative newness of conservation biology, it is not surpris-

ing that universities are not fit to attend to its needs. The time is due, however, when universities and graduate programs must be reorganized to fulfill the new requirements of the real world. Basic theoretical research must continue, but the ivory tower of academia must also be opened to professionals who will form the type of biologists needed for conservation.

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Revisiting the Human Dimension in Conservation Biology

Much attention has recently been directed toward increasing awareness of the human component in conservation biology (Cannon et al. 1996; Noss 1997; Jacobson & McDuff 1998; Meffe 1998). These and papers cited therein make many good points that should be taken to heart by all conservation biologists. But some cautionary remarks need to be expressed before we are stampeded into diminishing the science component in conservation to accommodate additional non-science training. While not denying the legitimacy of the basic message expressed by the above authors, I want to call attention to some potentially damaging corollaries and to put these issues in a more balanced framework.

Few of us would deny the critically important non-science components of conservation, even from within the bastions of academic ecology. The problem is not increasing awareness of this aspect of conservation among conservation biologists, as seems implicit in some of the above opinion pieces, but rather modernizing academic programs that support the education of future conservation biologists (Noss 1997; Meffe 1998).

Such changes must enable rather than disadvantage undergraduate and graduate students in preparing for non-academic jobs (Noss 1997). Conservation is inherently interdisciplinary, so how do we train interdisciplinarians in a discipline-oriented academic environment? Much can be done within existing academic structures to improve the quality and quantity of interdisciplinary approaches, and I have been much involved with this effort for at least the last three decades. Faculty evaluation and reward structures are pivotal in this regard and are arguably the most difficult barriers to overcome (Noss 1997; Meffe 1998). Part of the problem, as emphasized by Noss (1997), is that academic administrators and many faculty members still cling to prejudices against students interested in non-academic or interdisciplinary jobs and discourage faculty who want to abet such career objectives.

In our zeal to modernize curricula, however, we should not lose sight of the limitations inherent in a four-year undergraduate experience, or, for that matter, in a graduate career. With our current level of knowledge, four years is simply not enough time to produce the super-human graduates called for in appeals for more interdisciplinarians. Our goal should not be to produce lots of graduates who know a little about many subjects, and consequently not much about anything. Instead, I suggest two models for the training of interdisciplinarians. One model is illustrated by the person who knows one subject in depth and also has sufficient knowledge of other disciplines to communicate with specialists in these areas and to participate in team research involving two or more disciplines. The second model is someone who actually knows more than one discipline in depth. The first type of interdisciplinarian can be produced, barely, in a four-year undergraduate program and should be actively encouraged at the graduate level. The