lish unifying principles for the conservation of both natural and domesticated plants and animals.

Population genetics has a lot to say about dynamic processes in small populations, including such phenomena as inbreeding and consequent depression, bottlenecks in population size and loss of genetic variation, and breeding structure and fitness. Frankel and Soulé aim to apply these and other notions to creatures made rare through human intervention, and they largely succeed at this ambitious and important synthesis.

Both contemporary extinctions, such as that of the Stephen Island wren, and historical episodes of faunal depletion, such as occurred during the Permian, are the basis for Frankel and Soulé's ecological analysis of "precarious" taxa. Next they consider more theoretical genetics for small populations and how evolution should operate in group sizes typical of nature reserves. Although the reasoning behind these discussions seems pristine and balanced with adequate qualifiers, a reader may feel less than assured that a few of the genetic processes invoked as a basis for conservation decisions have as much firm empirical confirmation as they have force of logic. For example, what is the evidence behind the contention that populations lacking detectable genetic variation have higher probability of local extinction? Evidence is rather weak for other key principles, for instance, that small population size results in reduced heterozygosity in rare organisms. Frankel and Soulé remark often and with justification that conservationists cannot have the luxury of waiting until generalizations on small populations become universally valid. Extinction proceeds while scientists waffle. But our reasoning about the way the world logically ought to operate (as opposed to demonstrably does) may lead us completely astray. At what point do we become reluctantly content with guidelines which make perfect sense but for which even moderately sound verification is lacking? The difficulty cannot be eliminated by citation of social panic or scientific optimism, and only sound studies can replace the guesswork.

The complex controversy over whether island biogeographic theory is applicable to the design of nature reserves is presented from a balanced, nonadversarial point of view, and the treatment of reserves is one of the most skillful portions of the book. The authors then shift to the captive propagation of animals in reserves and zoos, the role of botanical gardens and germ plasm collections in conserving the genetic diversity of plants, and livestock preservation. Here the book becomes a kind of handbook, and these aspects show its originality and great potential utility to practicing conservationists. For instance, the authors provide recommended population sizes for captive animals to minimize undesirable effects of inbreeding, manipulations of breeding and social structures to maximize effective population size, and criteria for inclusion of cultivars into collections for preserving variability.

Curiously absent is a consideration of why plants and animals are threatened by extinction or why the diversity of cultivars is declining. One might say that my approach represents a reviewer's ploy of criticizing a book on the grounds that it is not what she would have written. However, Frankel and Soulé's omission of the causes underlying their central concerns creates an odd tone that permeates the book. Without an analysis of how it arises, the depletion of natural habitats or erosion of genetic variability seems to take on an inevitability, like a force of nature. Though the authors call for immediate and vigorous action from scientists and conservationists, this activity comes across as recouping from a disaster, in the manner of the Red Cross after a flood. The disappearance of tropical forests is most frequently lamented, but its causes are passed over with brief attribution: "lost to a rising sea of humanity."

From excellent recent analyses (including Norman Myers, *Conversion of Tropical Moist Forests*, National Academy of Sciences, 1980), it is straightforward to summarize why tropical moist forest is rapidly declining. The direct social and economic causes of conservation problems are often clear, for instance the timber trade in Asia or cattle production in Latin America. At best, nature reserves, germ plasm centers, and zoos are second-rate answers, as Frankel and Soulé repeatedly comment. Perhaps fundamentally different answers to the conservation of biotic diversity are possible, and scientific myopia can hinder biologists from finding them. Better solutions to the predicament of wildlife will be discovered only through the difficult but unavoidable scrutiny of the human condition and the social and economic forces that foster abuse of the biosphere.

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The Biology of Hibernation

Survival in the Cold. Hibernation and Other Adaptations. Proceedings of a symposium, Prague, July 1980. X. J. MUSACCHIA and L. JANSKY, Eds. Elsevier/North-Holland, New York, 1981. xiv, 226 pp., illus. $50.

Hibernation is one of the most intriguing adaptations currently studied in physiology. An overt sign of hibernation is a precipitous drop in body temperature, which can reach near freezing, depending on ambient temperature. Usually an animal will maintain a low body temperature for several days before rewarming to normal body temperatures. The ability to arouse to normal body temperature is maintained at all times and can be accomplished without external heat. Another sign of hibernation is the regression of the gonads and ovaries in hibernating animals. The effect of the reproduction cycle on the hibernation cycle has received much attention in recent years, primarily owing to research aimed at understanding the function of the pineal gland. The pineal gland is thought to regulate gonadal function, and because gonadal function changes during the hibernation season the pineal may be involved in timing the hibernation and reproduction cycles. It is with this subject that this book begins.

The opening paper, by Russel Reiter, examines the relationship between changes in day-length and the hibernation and reproduction cycles. Reiter offers an interesting and testable model of the relationship between these two cycles in the Syrian hamster (*Mesocricetus auratus*). He argues that the reproductive status of the hamster, a hibernator, is altered by changes in day-length according to season. During short days gonads regress whereas during long days there is a period of refraction when the gonads spontaneously recrudesce. The seasonal variation in day-length is thought to influence the reproduction cycle by affecting the pineal gland's secretion of antigonadotropic hormones. These hormones, which include melatonin, act to suppress reproduction. Short days promote an increase of antigonadotropic-hormone secretion, causing gonadal involution. Long days are not necessary for gonadal regrowth, however, since the gonads can become fully functional even though animals are kept in constant dark. Reiter concludes that the photoperiod, acting through the pineal gland, synchronizes these cycles so that long-day breeding mammals do not reproduce young at a time of year when the

probability of their survival is very low. Reiter's paper is noteworthy for two reasons. First, he integrates endocrine regulation with the natural history of the animal. Much of the early work on hamsters was performed without regard to season or to the photoperiod under which the animal had previously been kept, thus producing equivocal results. Second, this paper and several others bury the idea that the endocrine glands are not capable of functioning during hibernation.

Seven of the 11 papers in *Survival in the Cold* discuss some aspect of endocrine regulation in hibernation, leaving the reader with the correct impression, that hormones are very important during hibernation. Several of the papers are up-to-date reviews of current research in endocrine regulation. Two papers, however, stand out by providing new evidence concerning hibernation.

Barbara Cannon and co-workers present strong evidence that a protein, which they name thermogenin, is involved in heat production in brown fat tissue. The total amount of thermogenin in brown fat may determine the total amount of heat produced by nonshivering thermogenesis (NST) in the tissue and, consequently, the absolute amount of NST capable of being produced in the animal. An increase in the amount of thermogenin in a hibernator during the hibernation season may be an explanation for the increase in total NST reported by L. C. H. Wang and Bruce Abbotts in the preceding paper. The other paper that sheds new light on central nervous system problems in hibernation is that by H. Craig Heller and co-workers. Using ^{14}C-labeled 2-deoxy-D-glucose, they have begun to carefully explore the tremendous potential autoradiography has for elucidating changes in neuronal activity during hibernation. The advantage this technique holds for neuronal studies is that 2-deoxy-D-glucose is taken up by active neurons but is not metabolized once inside the cell. Therefore, the rate of accumulation is an indicator of relative activity. The amount of 2-deoxy-D-glucose inside the cell can be visualized by autoradiography. The autoradiographic studies by Heller and co-workers of neuronal activity in hibernating golden-mantled ground squirrels (*Citellus lateralis*) clearly suggest that sensory stimuli are very important to hibernating animals. Seven of the ten most active neuronal structures the authors report are sensory. For example, temperature fluctuations are important sensory stimuli even though an animal is several feet underground. Although there are many problems still to be worked out with the technique (as pointed out by Heller), this approach to hibernation studies will undoubtedly further our understanding of central nervous system function during all aspects of hibernation.

The book contains a wealth of information about endocrine function and thermogenesis during hibernation. Each paper is largely self-contained, well written, and thoroughly referenced. The book is an excellent reference for those working on hibernation, and I suspect that biochemists and ecological physiologists might also profit from a stroll through its pages.

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Coastal Ecology

The Shore Environment. Proceedings of a symposium, Portsmouth, England. J. H. PRICE, D. E. G. IRVINE, and W. F. FARNHAM, Eds. Published for the Systematics Association by Academic Press, New York, 1980. In two volumes. Vol. 1, Methods. xx pp. + pp. 1–322, illus., + index. $60. Vol. 2, Ecosystems. xx pp. + pp. 323–945, illus., + index. $116. Systematics Association Special Volume No. 17.

The concern of the symposium of which this book is the proceedings was with integrating studies of coastal ecology. The volumes offer a good mixture of zoology, phycology, and even meiofauna work. They also offer accounts of methods and many examples of the use of systems analysis to present data from large-scale monitoring programs. Evaluating the "well-being" or "stability" of shore communities is a recurrent theme.

Several papers in the volume consider the objectives and methods of coastal ecology as a scientific discipline, and others discuss the value and methods of monitoring. Bringing together these concerns may be the most important contribution of the symposium. Environmental protection programs are increasingly criticized by ecologists, regulatory and management agencies, and private business as being of questionable quality and value. Because regulatory agencies and many ecologists are uncomfortable with the highly probabilistic nature of ecology, there is a tendency, often a legal necessity, for impact studies to be very detailed and specific and to collect reams of data that have no underlying logic and defy generalization or test. This prevents the growth of coastal ecology as a science.

J. R. Lewis explicitly addresses these issues in a wonderful introductory essay on the questions and procedures of shore ecology. It begins with a strong statement supporting good observation and description as the basis of all good ecology. Lewis also considers the relationship between extensive but qualitative and intensive, quantitative approaches and argues persuasively that a certain amount of the former is necessary to give a proper perspective to the latter. Finally and most important, he reminds us of the commitment of science to understanding the systems in question. He argues that an understanding of ecological systems requires three broad phases of investigation: basic description, mechanistic understanding of the dynamics of communities, and, finally, appreciation of the importance of long-term, broad-scale climatic factors. Lewis's own research has clearly entered the third phase. In the essay he observes that many colleagues are stuck in the first phase and wonders what the continued descriptive research is really contributing. He observes also that many large-scale surveys and computer-produced relationships lack "natural history awareness." His essay is pulled together with a ringing call to shore ecologists to incorporate into phase two a better understanding of the biological and physical relationships along exposure shelter gradients and the role of larval recruitment, especially settling behavior.

The rest of volume 1 emphasizes methods and includes an elementary paper on how to teach a field course (W. E. Jones) and a lengthy discussion of how to use photography (J. D. George), both of which seem misplaced in a symposium volume such as this. There follow discussions of monitoring and exposure scales (D. H. Dalby), monitoring intertidal systems (W. E. Jones *et al.*), classification and ordination of intertidal vegetation (G. Russell), and the use of permanent quadrats in salt marshes (P. J. Polderman) and a demonstration of how to use cluster analysis to show that the vegetation on porous chalk cliffs differs from that on hard, impervious material (I. Tittley and K. M. Shaw). Coulson *et al.* advocate remote sampling by means of aerial photography, and John *et al.* discuss still another ordination exercise, this time of subtidal vegetation. Papers by R. C. Earll and by S. J. T. Knight advocate the use of computers to summarize large bodies of data.