On the Wings of Checkerspots: A Model System for Population Biology

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Source: BioScience, 55(5) : 451-452

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1641/0006-3568(2005)055[0451:ATOTS]2.0.CO;2

When Scoundrels Rule

The Last Refuge: Patriotism, Politics, and the Environment in an Age of Terror. David W. Orr. Island Press, Washington, DC, 2004. 172 pp. $20.00 (ISBN 1559635282 cloth).

Like most scientists, I like to think of myself as politically neutral. Most natural and social scientists try (even if they do not always succeed) to impose on themselves and their colleagues a strict separation of their science from both religion and partisan politics. Partisan politics is distinct from policy, which for the purposes of this discussion has to do with the elaboration of the implications of scientific findings for important policy questions. Scientists abhor (as well they should) faith-based or politically driven conclusions to important questions of science and policy. But what happens when these rules of conduct are disrespected, as they have been in the last four years? What happens when religious beliefs and political power are allowed to influence science and policy? As a recent Union of Concerned Scientists report has documented (UCS 2004), attempts to influence and distort science for political purposes have reached unprecedented levels.

Oberlin environmental scientist David Orr's book, *The Last Refuge: Patriotism, Politics, and the Environment in an Age of Terror,* puts these issues into perspective. He points out that politics in America have never been as mean and bitter as they are today, and that it has all come at the worst possible time. Just when we need to be taking farsighted steps to deal collectively with climate change, the loss of biodiversity, and a host of other environmental and social problems, American politics have become worse than impotent in addressing these issues. *The Last Refuge* documents this wrong turn in American politics and its implications for the environment.

The book is a series of essays, many first published in the journal *Conservation Biology,* supplemented with some new material. Together they tell the compelling and disturbing story of what is going wrong with politics in America today. The opening chapter documents a meeting Orr and several other top environmental thinkers were invited to attend with high-ranking representatives of the Bush administration early in that administration's first term. The Orr group prepared a thoughtful and balanced paper to lay out a broad, scientific, bipartisan consensus on these issues. That document (reprinted as an appendix to the book) contains analysis and policy recommendations that are compatible with wise stewardship of the nation's resources. They are the extensions of policies espoused by every Republican and Democratic administration since Teddy Roosevelt. The group never met with the promised high-ranking administration officials (only aides spoke with them), and their analysis and recommendations were completely ignored. In fact, the administration's environmental policies are, for the most part, the exact opposite of the group's recommendations.

Orr's book goes on to document a string of abuses of science, the environment, and the democratic process by the current administration and the Republican Congress. He points out that the current powers that be are not "conservative" by any stretch of the real meaning of that word. They are both anticonservative and antiliberal, and they endanger the health and well-being of all of us, including their intended audience—the wealthiest Americans. In a chapter titled "Rewriting the Ten Commandments," Orr discusses 10 political rules that seem, unfortunately, to govern current American politics. A glance at a few of these rules serves to give their flavor. Rule #1: "Appeal always to people's resentments and fears, not to their rationality, compassion, or farsightedness." Rule #3: "Demonize your opponents and promise to restore honor and 'character,' implying that the other side has neither." Rule #5: "Applaud scientific evidence when it supports corporate profits, oppose it when it has to do with human health, biotic impoverishment, and climate change." Rule #6: "Politicize everything, particularly the courts."

The title of Orr's book, *The Last Refuge,* is taken from a famous quote by Samuel Johnson: "Patriotism is the last refuge of a scoundrel." If scoundrels now rule, then the democratic and truly patriotic solution to the problem is to throw them out. It is interesting to note that the original Greek definition of the word *idiot* is "politically uninvolved person" (Prugh et al. 2000). As scientists and citizens, we have to stop being idiots and encourage our friends and colleagues to do likewise, if we hope to replace the scoundrels with the more reasonable, farsighted, and enlightened leaders we so desperately need at this critical juncture to achieve a sustainable and desirable future. Orr presents 10 new commandments for the conduct of public business, which are so important to achieving this goal that they bear repeating here:

1. Appeal to voters' rationality, compassion, and vision.
2. Instruct, clarify, elevate the political dialogue.
3. Honor your adversaries—politics ought not to be a war, but a conversation.
4. Find common ground.
5. Never corrupt, politicize, or ignore scientific evidence.
6. Maintain the separation of executive, legislative, and judicial power.

7. Hold your own side to rigorous standards of fairness and decency.

8. Maintain the separation of religion and state.

9. Insist on the same kind of separation between money and politics.

10. Be willing to risk losing elections for the right reasons.

Although implementing these new rules of conduct may seem naively idealistic in the aftermath of the last presidential election, they are in fact the only hope we have of surmounting the significant and growing challenges we now face. How can we do it? Orr summarizes: "In practical terms this will mean not merely reforming the way we finance elections, but throwing private money out of the election process altogether. It will mean reclaiming words like 'patriotism' that have been appropriated by zealots. And it will mean rebuilding civic competence and the public capacity to solve public problems." To the skeptics, Orr replies, "We've risen to the challenges before and we must do it again." The first time Americans rose to the challenge was at the founding of the American democracy. It is interesting to note that the American Revolution was fought not against the British crown per se, but more against British corporate interests (the British East India Company) that were attempting to monopolize the tea trade with the colonies (Nace 2003). The founding fathers must be rolling over in their graves to see the corporate plutocracy we have become. We must rise to the challenge again if we hope to recover the vision of democracy on which America was founded, one that embodies Orr's new 10 commandments for the conduct of public business. Ultimately, we need to redirect the political process away from the means—the mechanics of voting, funding, and winning elections—and toward what democracy is really about: envisioning shared goals and building effective institutions to achieve them. Fortunately, work is under way in many places to create this shared vision of a sustainable and desirable America. The future of American democracy depends on the success of these efforts.

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May 2005 / Vol. 55 No. 5 • BioScience 450

A TALE OF TWO SPECIES

On the Wings of Checkerspots: A Model System for Population Biology. Paul R. Ehrlich and Ilkka Hanski, eds. Oxford University Press, New York, 2004. 371 pp., illus. $64.50 (ISBN 019515827X cloth).

Forty-five years ago, Paul Ehrlich was hired as an assistant professor at Stanford University. There he initiated research, which continues today, on the Bay checkerspot butterfly (*Euphydryas editha bayensis,* family Nymphalidae, subfamily Nymphalinae, tribe Melitaeini) on Jasper Ridge, adjacent to the Stanford campus, to uncover processes at the population level of biological organization. He is currently Bing Professor of Population Studies and president of the Center for Conservation Biology at Stanford. As many know, Ehrlich was also the founder of ZPG, Zero Population Growth, now known as Population Connection. Ehrlich's concerns about human population growth come through at times in the book under review, but human population pressure is an ongoing threat to the world's biodiversity and ecosystems, so that is totally appropriate.

Ilkka Hanski has been professor of ecology at the University of Helsinki since 1988, but he began working on the Glanville fritillary (*Melitaea cinxia*) only in 1991. Before that, he had worked on mechanisms of coexistence of ecologically similar species that exploit highly ephemeral resources, including dung beetles and blowflies (dung and carcasses both arrive as small, temporary patches). Hanski had not, however, previously studied metapopulations in the field. In 1991, he changed emphasis when he was working with Matts Gyllenberg, a mathematician specializing in cancer cell populations. He convinced Gyllenberg that "real" populations would be much more interesting, and being familiar with Ehrlich's work, he began searching for an Old World relative of *E. editha* to study. He had never seen a Glanville fritillary alive, but inquiries suggested that it might be the right species and that the Åland Islands might be the right place to study it (especially since it had gone extinct in the rest of Finland in the 1970s).

Readers who are not population biologists or geographers have probably never heard of the Åland Islands, and neither had I. They are inconspicuous or absent on most maps, but an Internet search proved enlightening. They are a group of nearly 7000 islands, fewer than 100 of them inhabited, at the entrance to the Sea of Bothnia, slightly north of a line drawn between Helsinki and Stockholm, and substantially closer to Sweden.

I am not a population biologist, having done most of my work in systematics and biological control, but both of those subjects are intimately related to population biology; hence, the title of the book was intriguing. The volume is a synthesis of the research and writing of 15 contributors, but Ehrlich has contributed to six chapters and Hanski to nine, and they alone wrote chapters 1 and 15, so their involvement is significant.

The preface is fascinating because it gives the history of both the Ehrlich and the Hanski research programs and their collaborations with others. Following are chapters on checkerspot taxonomy and ecology, and on the structure and dynamics of populations of the Bay checkerspot and metapopulations of the Glanville fritillary; four chapters on aspects of reproductive and larval biology and on the species' natural enemies; two chapters on dispersal behavior and genetics; a comparison of checkerspots with other species; a discussion of their use as a model system; and a chapter on their conservation biology. Summary chapters on "What have we learned?" and "A look to the future" draw the most compelling strands together.

This book is a thorough series of essays on population biology as viewed through checkerspot biology. The authors point out that long-term studies have many difficulties, not the least of which are the problems ensuring continuity of funding and the likelihood that the composition of research groups will change. Another major difficulty is that of locating research sites in places where the habitats are not going to be destroyed by development or the research terminated for other reasons, especially in politically unstable countries.

On the Wings of Checkerspots includes extensive coverage of the development of methods for carrying out the authors' research on the Glanville fritillary and the Bay checkerspot. Both species occur over vast areas in patchworks of open meadows. *M. cinxia* is found from Spain to Lake Baikal in Siberia and from the Arctic to the Atlas Mountains in North Africa. *E. editha* occurs in much of the mountainous West of the United States and southern Canada. Both species have highly fragmented populations and neither moves much, resulting in great diversity, even from one habitat patch to another nearby. This has resulted in the development of a lot of interesting biological data, some of which are presented in detail. Ehrlich and Hanski were surprised to find that local extinctions, colonizations, and recolonizations were common in both species, but that they occurred most often in the *M. cinxia* populations.

The authors recommend butterflies as research subjects because they have the advantage of being easily spotted and identified in the field, and are easily marked with felt-tipped markers. They can then be released without injury or serious disturbance. I totally agree. In my experience of catching butterflies in many habitats and countries, checkerspots are ideal. They inhabit open meadows (not shrubs, treetops, undergrowth, or the like), they are easy to approach and catch even when they are not feeding, and they do not take flight into the next county when they are disturbed. Ehrlich and Hanski suggest that their studies should be used as model systems for organisms other than butterflies, with *E. editha* as a model for modern population concepts and *M. cinxia* for classic metapopulation concepts.

The color plates add much to an appreciation of the variation and similarity of checkerspot larvae and adults. They also provide good views of where the research was carried out, giving the reader an impression of the small patches that constitute many of the habitats. The sim-

ilarities of some of the species are amazing. The plate of adults of a Pyrenees checkerspot community shows upper and lower views of males, and upper views of females, for six species of *Melitaea* and one of *Euphydryas.* These would be indistinguishable on the wing and difficult to identify in the hand for anybody without prior extensive experience.

The authors present an overview of the conservation status of butterflies in Europe and North America, together with a series of conservation lessons and 25 suggestions for their application. One important conclusion is that informed conservation decisions can often be made without exhaustive research. The authors also assert that humans are the insects' biggest problem, and that there is one contribution we can all make to butterfly conservation—to greatly expand the public's knowledge and appreciation of butterflies, so that more people will press decisionmakers to maintain butterflies as a valued component of the human environment.

In the "What have we learned?" chapter, Ehrlich and Hanski suggest that taxonomists, ecologists, and evolutionists should have concentrated their efforts on carefully chosen model systems instead of on the phylogenetic revisions of taxonomists or the isolated bits of information on a vast array of organisms gathered by ecologists. They also point out, however, that with the decimation of tropical rainforests, checkerspots are becoming more plentiful, because they are adapted to second-growth brushy vegetation. The argument is made that because tropical checkerspots are poorly known, a good cladistic analysis would be useful.

The philosophy of conservation comes through strongly, and it is emphasized in the final chapter, "A Look to the Future," by the following statement: "In the case of the checkerspots, our knowledge of many aspects of their taxonomy, life histories, and population and metapopulation biology is already comprehensive enough to allow us to make useful predictions for science and conservation. Many lessons have been learned that, combined with those from studies of other organisms, should help us and others forge answers to much broader issues, ultimately to questions about humanity's relationship with the rest of the world" (p. 301).

The book is well written, well produced, and error free. My only suggestion would be that it should have had some notation indicating the chapter at the upper right corner of each page, since there are many references to other chapters that are difficult to locate.

Overall, this is an excellent book, even for those who do not have a strong interest in population dynamics. The history of the projects, the biology of the butterflies, and the philosophies promoted are worthy of anybody's time.

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PRODUCING FOOD, PROTECTING BIODIVERSITY

Agrodiversity: Learning from Farmers across the World. Harold Brookfield, Helen Parsons, and Muriel Brookfield, eds. United Nations University Press, New York, 2003. 343 pp., illus. $32.00 (ISBN 9280810871 paper).

This book from the United Nations University Press comprises information gathered from smallholder farmers, primarily in developing nations, and compiled by 40 authors representing 60 institutions in 17 nations. Edited by Harold Brookfield, Helen Parsons, and Muriel Brookfield, *Agrodiversity: Learning from Farmers across the World* describes how smallholder farmers conserve biodiversity on their farmland and in the surrounding environment. The effort is based on the fieldwork of the United Nations University Project on People, Land Management and Ecosystem Conservation (PLEC). This PLEC report examines in detail how farmers use knowledge and skill to manage resources, and illustrates diverse food production practices that have successfully protected diversity.

Food production is vital to farmers and the communities they serve because, as the World Health Organization (WHO) recently reported, approximately 3.7 billion humans are currently malnourished in terms of protein and calories, iron, vitamins, or iodine. Most hungry people are located in developing countries, and the WHO report documents the largest number of malnourished people in history. Cropland, as noted in *Agrodiversity,* is vital to food production and to farmers' economic well-being. The Food and Agriculture Organization of the United Nations (FAO) reports that more than 99.7 percent of world food (in calories) is produced from the land, and less than 0.3 percent comes from the oceans and other aquatic ecosystems. The percentage from the oceans is declining because of overfishing, pollution, and rapid human population growth.

Because cropland and pastureland are vital to farmers, PLEC places some emphasis on soil and water conservation. Some of the technologies that have been recommended for PLEC farms are using physical barriers such as logs and big rocks, planting across slopes, using minimum tillage, placing crop and weed residues on the soil surface, strip cropping, rotating crops, using living mulches, and using agroforestry. Ideally, soil erosion rates should be no more than 1 metric ton per hectare per year, because this is the rate of soil formation and thus of sustainability. High levels of organic matter in the soil are essential to keep the soil productive and to conserve water for the crops. Soil organic matter can act as a sponge to store water for crops when conditions become dry. A crop such as maize can require nearly 5 million liters of water per three-month growing season.

Large quantities of soil organic matter, along with the biomass above the ground, play an important role in conserving both below- and aboveground biodiversity. The farmers associated with PLEC recognize this relationship. Most of the crops grown by the farmers, such as rice, corn, wheat, and bananas, are exotic

species introduced for food production; this is true worldwide. Humans have cultivated up to 20,000 species of plants for food, but today only 15 plant species provide about 90 percent of the world's food.

Although crop and livestock species cultured in agriculture are beneficial and essential to our food security system, some invasive species can be serious pests of agriculture, forests, and public health. In the United States, 73 percent of weed species in crops, and 65 percent of plant pathogens, are introduced species (Pimentel et al. 2000).

This volume on agrodiversity suggests that most plant, animal, and microbe species are associated with managed agricultural and forest ecosystems. In a crop ecosystem, as many as 95 plant species can be cultured by one farmer (Brookfield 2001). A current study in Guinea reported one household with 64 herbaceous species and an orchard with 39 species. The arthropods in a productive habitat may include 600 to 1000 species, and in the soil habitat bacterial species may number 20,000 (Pimentel et al. 2005).

The farmers associated with PLEC recognize that abundant plant biomass and belowground organic matter support the largest number of species. Therefore, one of their goals was to increase the abundance of plant biomass both above and below the ground. Of course, this increases not only the biodiversity of the agricultural ecosystems themselves but the biodiversity of the animal and microbe species that are associated with these systems.

Recent trends in crop production are not encouraging, as suggested by Harold Brookfield in his earlier book *Exploring Agrodiversity* (2001). The high costs of inputs (fertilizers, pesticides, and crop seeds) place significant stress on small farmers in developing countries. Although crop yields per hectare are still increasing, they are increasing more slowly than in the past because of shortages of cropland, degradation of agricultural land, and declining irrigation and fertilizer use per capita worldwide. Moreover, the FAO reports that grain production per capita has been decreasing for the past two decades. The decline in the per capita availability of these basic food grains, which make up about 80 percent of the world's food, is contributing to the incidence of malnourishment.

Brookfield, his coeditors, and the other 40 contributors are to be commended for assembling valuable information concerning PLEC. The authors provide insight on how innovative farmers around the world manage their natural resources with an interest in both conserving biodiversity and engaging in efficient food production. *Agrodiversity* offers technically detailed information, based on the successful experiences of smallholder farmers, to agriculturists, agronomists, geographers, biologists, ecologists, plant breeders, agricultural engineers, anthropologists, and others interested in a world outlook on agrodiversity.

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