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Managing Conflict and Biotic Diversity in the Prairie Dog Ecosystem

by

Brian Miller and Gerardo Ceballos

The worldwide destruction of habitat and decline in biodiversity have been the focus of numerous publications in the last fifteen years (e.g., Myers 1979; Wilcox and Murphy 1985; Wilson 1988). Environmental degradation in tropical regions has been especially well documented. Yet, the problems of habitat degradation and loss of biodiversity are not confined to the tropics, as the destruction of the North American short and mixed-grass prairies graphically illustrates. This highly specialized ecosystem, which once covered nearly 20% of North America, has undergone a decline for several reasons, including the following: agricultural manipulation, introduction of exotic species, water management, and prairie dog (*Cynomys spp.*) poisoning campaigns. In this paper, the origin of these poisoning programs and their ecological and fiscal consequences will be discussed, and an integrated and ecologically sound approach to conservation of the prairie dog ecosystem will be proposed.

Poisoning Programs

North America is inhabited by black-tailed (*C. ludovicianus*), Gunnison's (*C. gunnisoni*), Mexican (*C. mexicanus*), Utah (*C. parvidens*), and white-tailed (*C. leucurus*) prairie dogs. [*C. mexicanus* and *C. parvidens* are listed as endangered and threatened, respectively, under the Endangered Species Act (ESA).] At the beginning of this century, colonies of these five species of prairie dogs covered over 40,000,000 hectares of native short and mixed-grass prairies across the Great Plains of southern Canada, the United States, and northern Mexico. By 1960, this area had been reduced by 98% to approximately 600,000 hectares (Marsh 1984). State and federally sponsored prairie dog poisoning programs in the United States, the heart of the prairie dog's range, were largely responsible for this reduction of grassland habitat. These programs were intended to benefit the livestock industry.

Prairie dog poisoning occurred as early as the late 1800s, but was conducted in a haphazard manner. Pressure to eradicate prairie dogs intensified after Merriam (1902) estimated that these animals reduced range productivity by 50 to 75% (an overestimation by an order of magnitude). In 1915, the federal government began appropriating money to the Biological Survey for the purpose of poisoning prairie dogs (Bishop and Culbertson 1976). By 1929, these poisoning activities were substantial enough to merit the formation of a new division—the Predatory Animal and Rodent Control (PARC) division. The Animal Damage Control Act of 1931 provided statutory authority to the poisoning of prairie dogs and sanctioned the partnership between public and private interests in these poisoning efforts. This act remains the primary statute for animal damage control. In 1939, the PARC division was transferred to the newly created U.S. Fish and Wildlife Service (USFWS) (DiSilvestro 1985); in 1986, animal control efforts were transferred to the Department of Agriculture.

Current Poisoning Efforts

Millions of acres of North American grassland have been destroyed as a result of prairie dog poisoning programs (Bell 1921; Day and Nelson 1929; Anderson et al. 1986; and Dunlap 1988). Despite studies indicating minimal resource competition between prairie dogs and livestock and economic analyses demonstrating that poisoning programs operate at a net financial loss (Collins et al. 1984), federally sponsored eradication of prairie dogs continues today. From 1980 to 1984, the U.S. government spent $6,200,000 to poison 185,600 hectares of prairie dog habitat in South Dakota. In 1986 and 1987, a poisoning program eliminated the largest black-tailed prairie dog (*C. ludovicianus*) complex (approximately 110,000 hectares) in North America (Tschetter 1988).

Only small, isolated prairie dog colonies remain as a result of these poisoning programs. These highly fragmented colonies are susceptible to extirpation by disease, especially sylvatic plague (*Yersinia pestis*), demographic events, genetic problems, and natural catastrophes. In addition, habitat alteration between colonies and loss of sources of immigration have decreased possibilities of recolonization or genetic exchange. Because of these factors, risk of extinction from habitat disruption is not linearly proportional to reduction of habitat, but may in fact increase disproportionately (Wilcox and Murphy 1985; Wilcove et al. 1986).

Effects of Prairie Dog Declines on Other Species

Prairie dogs have been determined to be ecosystem regulators that influence soil chemistry, soil structure, primary productivity, species composition, and species diversity (Sieg 1988; Detling and Whicker 1988; Reading et al. 1989). Compared to surrounding areas, prairie dog colonies support higher numbers of arthropods, small mammals, and terrestrial predators, and support higher avian species diversity and density (Hansen and Gold 1977; O'Meilia et al. 1982; Agnew et al. 1986; Krueger 1986; Reading et al. 1989). Plant diversity also is increased in the presence of prairie dogs.

The presence of prairie dogs is beneficial to livestock for several reasons. First, the nutrient content and digestibil-

ity of forage is greater in the presence of prairie dogs (O'Meilia et al. 1982; Coppock et al. 1983; Krueger 1986). Indeed, domestic cattle and bison preferentially graze in prairie dog towns because the grass is more succulent (Coppock et al. 1983; Wydeven and Dahlgren 1985; Krueger 1986; Knowles 1986; Detling and Whicker 1988). Second, perennial grasses and forbs grazed by livestock are more abundant in prairie dog colonies than in surrounding areas (Bonham and Lerwick 1976). Finally, prairie dogs in the southwest naturally control mesquite (*Prosopis glandulosa*), a plant that reduces the availability of grass for livestock and makes roundups difficult (Miller 1991), and prickly pear cactus (*Opuntia polycantha*), a plant that is not eaten by cattle but that proliferates in areas overgrazed by livestock (Summers and Linder 1978). In fact, recent studies have reported no significant difference between market weights of steers living with or without prairie dogs (Hansen and Gold 1977; O'Meilia et al. 1982), and only a 4-7% level of competition between livestock and prairie dogs (Uresk and Paulson 1989). Thus, conclusions that prairie dogs reduce the amount of forage available to livestock and result in financial losses to ranchers are simply overexaggerated.

Black-footed ferrets (Mustela nigripes) depend on prairie dogs for food and habitat. This young male from the wild ferret population near Meeteetse, Wyoming, was photographed in 1985. Photo by Brain Miller.

Because their presence and biological activities result in the creation of food and habitat upon which many other species depend, prairie dogs can be considered a keystone species. Loss of prairie dog populations, then, threatens biodiversity throughout the entire prairie dog ecosystem (Clark et al. 1989; Sharps and Uresk 1990). For example, the black-footed ferret (*Mustela nigripes*), a highly specialized carnivore that depends upon prairie dogs for habitat and sustenance, was almost driven to extinction as a result of prairie dog eradication programs. Several other species that utilize prairie dog colonies are currently in the process of being listed under the ESA. These species include the Mountain Plover (*Charadrius montanus*), Ferruginous Hawk (*Buteo regalis*), and swift fox (*Vulpes velox*). The Burrowing Owl (*Athene cunnicularia*), which also utilizes prairie dog colonies, is listed as rare by several states.

Conservation of Prairie Dogs

U.S. government sponsored prairie dog poisoning programs initiated in an effort to reduce conflict between livestock interests and prairie dogs have served only to destroy habitat and decrease biodiversity in the North American grasslands. As a result, managers are now spending increasing amounts of money and time trying to rescue species that depend on prairie dogs. Unfortunately, these conservation efforts have met with little success, perhaps because they traditionally have focused only on the biological aspects of biodiversity decline. This decline, however, is intricately intertwined with history, economics, politics, and social and cultural attitudes and values. In order to successfully conserve valuable resources, all of these factors must be addressed. In this article, we propose a strategy for conserving biological diversity on the North American grasslands that employs legal action, ecosystem management, sustainable use of protected prairie dog habitat,

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A forum for information exchange on endangered species issues

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Readers include a broad range of professionals in both scientific and policy fields. Articles should be written in an easily understandable style for a knowledgeable audience. For further information, contact the editor.

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Cover: White-tailed prairie dog (*Cynomys leucurus*). Photo by Dean Biggins, U.S. National Biological Survey.

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positive economic incentives, education, flexible planning, interdisciplinary advisory groups, and international cooperation (see Miller et al. 1994a; 1994b).

The Law and Ecosystem Management. Legal experts and biologists have recently advocated a move from managing individual species to managing entire systems (Smith 1984; Scott et al. 1987; Rolhf 1991). Historically, protecting each species individually served an important purpose in slowing the decline toward extinction. During the early years of environmental action, a number of species were already in crisis situations and action was necessary to prevent further loss. However, acting after a full-blown crisis exists diminishes opportunities for success, increases costs, and escalates conflict between conservation and local interests (Wemmer and Derrickson 1987).

Handling species individually is also a slow process. Approximately 650 species currently are listed as threatened or endangered under the ESA; another 600 U.S. candidate species are being reviewed for possible inclusion on the list (U.S. General Accounting Office [GAO] 1992). Because the USFWS has placed an average of only 44 species a year on the list, it could take years to individually address these candidate species even if no other species are added (U.S. GAO 1992). Additionally, according to available data, between 3000 and 5000 other species in the U.S. may be threatened (U.S. GAO 1992). Managing entire systems would handle plants and animals in groups and speed the process of protection. However, this assertion necessitates a caveat. Ecosystem management is a current "buzzword," but what will be managed, how, and by whom is rarely defined. Implementation of a poorly defined management approach could weaken single species protection without providing an adequate substitute.

The prairie dog, as a keystone species, provides an excellent opportunity to forge a transition from traditional single species management to management of a system (Miller et al. 1994a).

The Mountain Plover (Charadrius montanus), a species that utilizes prairie dog colonies, is currently in the process of being listed under the Endangered Species Act. Photo by Fritz Knopf, U.S. National Biological Survey.

The ESA can play an enormous role in broad scale preservation of biodiversity by offering some level of protection to keystone species, and consequently, to species dependent upon the keystone animal (Rolhf 1991).

Protecting a threatened keystone species would provide educational, biological, and fiscal benefits. By focusing educational efforts on keystone species, managers would have a means of teaching the public about the value of ecosystem conservation and the links between animals and their habitat. The biological integrity of ecosystems would quickly benefit from protection afforded keystone species. Also, the federal government would be spared the financial burden of maintaining an expensive support system for other species that would become imperiled if keystone species continued to decline.

Protection of a keystone species, no matter how politically controversial the situation, would be far more cost-effective than trying to protect each individual species that depends on it. For example, the government financially subsidizes both the poisoning of prairie dogs and the preservation of species dependent upon the prairie dog for survival. As a result of expenditures in the former category, expenditures in the latter category will continue to rise as more species reach threatened status.

Habitat Protection and Sustainable Use. Conservation of most species depends on more than legal action. Habitat conservation and sustainable use of that habitat are also necessary components of any species conservation effort. The value of initiating sustainably usable areas on the grasslands of Canada, the U.S., and Mexico cannot be overemphasized. Currently, plans exist to establish a protected area in northern Chihuahua, Mexico. This area would include a 55,000 hectare black-tailed prairie dog complex, the largest colony remaining in North America (Ceballos et al. 1993).

Habitat conservation and protection does not preclude human land uses. Arid grassland regions can be sustainably used for economic benefits by harnessing the potential as it exists rather than trying to impose exotic agricultural techniques or over-exploitive practices (Cloudsley-Thompson 1988). With an integrated plan, the economic needs of local populations and preservation of biodiversity could both be balanced.

Establishing sustainably usable areas of protected habitat on grasslands could prevent further decline of the prairie dog ecosystem as well as integrate ecologically sound agricultural opportunities with conservation goals (Miller et al. 1994a). This proactive integration could address both long-term resource preservation as well as the present economic needs of the local human population, and could be a large step in the elimination of conflicts that arise when legal protection is initiated after a species is on the verge of extinction (e.g., the Northern Spotted Owl, *Strix occidentalis caurina*).

Positive Economic Incentives and Education. Protected areas alone are not sufficient to preserve most declining species. Reduced habitat and effects of fragmentation often do not permit the existence of viable populations of large or highly specialized species (Ceballos and Navarro 1992). An alternative to the conflicting directives of federally sponsored prairie dog poisoning policies and endangered species management has been proposed that is designed to restore ecological integrity without harming local livestock interests (Miller et al. 1990). This proposal basically calls for

the conversion of U.S. federal funds allocated to the poisoning of prairie dogs into a positive incentive for ranchers who manage for both wildlife and livestock. If a provision for this incentive were written into the ESA, managers could supply a level of "user-friendly" legal protection to the prairie dog and its ecosystem.

Education is another important component of conservation plans. However, because the attitudes of the western agricultural community are entrenched in the issue of prairie dogs, a positive incentive will be necessary before educational efforts can be successful. In Montana, Reading (1993) demonstrated that knowledge was only one part of attitude, and that different levels of knowledge alone did not change negative perceptions of black-footed ferrets and prairie dogs. Similar results were obtained from other wildlife studies (Arthur et al. 1977; Kellert 1990).

The traditional agricultural community holds strong beliefs about competition between prairie dogs and livestock, but another important factor influences those values—federally sponsored poisoning programs. Education efforts will not be able to address misconceptions about the prairie dog ecosystem while the U.S. government continues to subsidize prairie dog poisoning. By providing poison to ranchers, the U.S. government is reinforcing misconceptions about the prairie dog ecosystem. The continuation of federally subsidized poisoning programs will undermine all other efforts to conserve biological diversity on the western grasslands (Miller et al. 1994a).

Planning, Interdisciplinary Teams, and International Cooperation. Just as political, social, economic, legal, educational, and biological features are important to conservation efforts, so are the organizational aspects of management bodies. Addressing all variables in conservation requires an efficient, flexible, and effective planning process. Switching the emphasis from individual species to the ecological system allows us to rethink traditional procedures for conserving biodiversity.

We propose establishing advisory teams that integrate the best expertise into the conservation planning process. Representatives from the biological disciplines can contribute technical skills to the team, but equally importantly, social scientists can assess attitudes, economists can predict economic benefits and costs, and education/public relations experts can present the program to the public and raise necessary funds. Responsibilities should be dispersed from a national level with contractual accountability for actions undertaken by implementing organizations (Miller et al. 1994b). Although decisions may be made across a broad geographic area, local goals and circumstances differ. Formation of policies should not exclude local concerns, but rather integrate them into a national and international context.

Because the prairie dog ecosystem spans two international borders, international cooperation will be necessary in conservation planning processes. Indeed, the many sensitive species presently managed separately in each country could all benefit from the cooperative bonds formed from this single venture. Many people now recognize this fact; thus, the opportunity has never been better to jointly promote preservation of hemispheric biodiversity.

Conclusion

Conservation is a multi-faceted discipline that extends far beyond the mere technical aspects of biology. Without addressing social, attitudinal, political, and economic issues surrounding destruction of the prairie dog, we will only continue to degrade the western grasslands, reduce biotic diversity, and impose unnecessary expenses on government budgets. Protection of the prairie dog, a keystone species, will provide a gradual and defined transition from single species management to management of all animals and plants dependent upon the prairie dog ecosystem.

However, management of this system will fail unless the conflict between prairie dogs and livestock interests is adequately addressed. As long as the government subsidizes prairie dog poisoning programs, any attempts at education will fail, negative attitudes toward the prairie dog ecosystem will remain unchanged, and the conflict between ranchers and prairie dogs will continue.

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Book Review

Ecological Integrity and the Management of Ecosystems

Edited by Stephen Woodley, James Kay, and George Francis. 1993. St. Lucie Press. Delray Beach, FL. $55.00 hardcover. 220 pp.

Reviewed by David J. Zaber

"Ecosystem Management" has become the new buzzword of many in resource management, conservation, and environmental science fields. One cannot pick up a journal or book covering environmental issues without the term being discussed, promoted or deconstructed. This is not surprising because the concept of ecosystem management is so appealing.

In the back of our minds, we hope ecosystem management will allow us to protect the environment without having to make difficult choices we know, deep down, we need to make. Proponents see it as a solution to our environmental degradation problems; we can take what we want from the environment as long as we somehow "manage" it in a "better" way. Opponents of the concept, or more appropriately those that remain skeptical of its utility, question such practices as ecosystem definition and delineation and decry the lack of scientific rigor in testing emerging concepts. Both sides seem to agree, however, that current policies and practices governing resource use are failing and that we must find a better way to exist within earth's ecological systems.

"Ecological Integrity and the Management of Ecosystems" is the latest in a series of texts and symposia on ecosystem management. Consisting of eleven separate papers, this edited volume focuses on two primary elements of ecosystem management: theoretical constructs and applied concepts. The first section of the book deals with the development of ecosystem management's theoretical underpinnings, including hierarchy theory and scale, selection of ecological indicators, and the conceptual basis for ecological and cultural integrity. Section two focuses on applications of concepts in the development of environmental monitoring programs, with an emphasis on Canadian programs. Topics included in this section range from general monitoring of aquatic ecosystems to regional monitoring of Canada's Atlantic Maritime region to development of biological guidelines for evaluating contaminated sediments in the Detroit River.

Promoted as a guide for land managers, scientists, and policy makers, this book brings together a wide range of issues. Rather than focusing on ecosystem management, however, most chapters deal with ecosystem integrity and its assessment. Unfortunately, only three papers present quantitative data; the remainder essentially comprise a series of normative prescriptions on how to monitor ecosystems, with virtually no discussion of testing proposed concepts. This lack of rigorous, critical evaluation of concepts is a significant impediment to development of the science of ecosystem monitoring, a drawback one hopes will be addressed in the future.

Even when critical issues are considered, discussions too often are muddled by an excessive use of jargon and over-generalizations. For example, chapter one, "The Notion of Ecological and Cultural Integrity," includes a listing of critical characteristics that should be present in any intact ecosystem. Unfortunately, virtually all these characteristics are so abstract as to be essentially useless. For example, how is the land manager to judge whether any given ecosystem of interest functions in such a way "that external energy is dissipated through a nested holarchical process in which the 'elements' (actually processes from a Bertalanffian perspective), at different spatio-temporal scales, exhibit some self-similar fractal features..."? Only when specific programs are discussed (i.e., monitoring Canada's Atlantic Maritime Region) do more tangible ideas finally emerge.

While the use of confusing jargon may seriously limit the utility of some chapters, there are other more problematic errors in logic. For example, a statement such as "a system with rare species almost certainly has high integrity" is a generalization that may be flat out wrong. One wonders if the authors believe the presence of Black-crowned Night Herons in remnant wetlands in the heart of south Chicago (one of the highest concentrations of industry in the world) indicates high system integrity. Similarly, does the presence of breeding colonies of Caspian Terns in the Great Lakes mean the lakes are healthy systems? Given today's environmental conditions, the presence of rare species in a wetland (or any ecosystem), may indicate degradation rather than integrity, especially when remnants of natural systems function as islands in a sea of human development.

Other chapters contain questionable assertions. For example, authors of the chapter on hierarchy and scale contend that "[m]easuring output at the point of watershed discharge provides an integrated, holistic, measure for the entire system over the spatial extent of the watershed. Only a single point measurement at the weir is needed to characterize the entire spatial extent of the watershed." While this may be true for certain parameters in small basins (e.g., the Hubbard Brook watershed study site), whether or not it is applicable to higher order streams with higher heterogeneity is a hypothesis for testing. Blanket statements such as this are misleading to say the least.

Perhaps most problematic is the overall thrust of the book: that ecosystems can indeed be effectively managed. Interestingly, the question of whether or not ecosystems *should* be actively managed by humans in the first place is never discussed. Yet, when we look critically at past practices, we find that we have far too often managed ecosystems into continuing degradation. Contrary to the primary focus of this text, the most important questions may not necessarily be those that ask what ecosystems with integrity are. Rather,

we should be asking why humans continue to degrade ecosystems when species extinction continues to accelerate. For the most part, our focus is confined to assessing and managing all ecosystem components except the one that is most important in their demise: humans. Only by fully understanding the ecology of human resource use can we begin to understand what steps we must take to stop the destruction of earth's ecological systems. This book fails to explore this aspect of ecosystem management and is limited by this omission.

Increasing our understanding of ecosystem function is a critical component of environmental protection and the concept of ecosystem integrity appeared to offer exciting possibilities toward that end. Unfortunately, the state of the science seems not to have advanced or expanded much beyond where it was several years ago, although the non-equilibrium thermodynamic approach to ecosystem assessment discussed in the summary chapter by James Kay of the University of Waterloo, offers an exciting theoretical basis for hypothesis testing and scientific inquiry.

Although "Ecological Integrity and the Management of Ecosystems" constitutes a useful review of ecosystem monitoring issues, it falls short of what is needed to significantly advance our understanding of ecosystems or improve ecosystem management. This shortcoming is especially problematic because management, per se, hinges on successful implementation of policies and programs; only one chapter includes a discussion of the relationship between policy sciences and ecosystem management, and even that is rather cursory. Still, chapters dealing with monitoring do cover some important issues. Thus, while both the scope and approaches of the papers presented in this book are fraught with numerous problems, those with a limited background in ecosystem management should find useful information for development of new environmental monitoring programs.

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Brian Miller and Gerardo Ceballos are professors with the Centro de Ecologia, UNAM, Apartado Postal 70-275, Mexico D.F., 04510 Mexico. Both authors are working to protect a grassland area in Chihuahua, Mexico, that contains the largest black-tailed prairie dog complex in North America.

Bulletin Board

Call for Papers

The International Association of Wildland Fire (IAWF) is soliciting manuscripts for a conference entitled, "Fire and Rare and Endangered Species and Habitats," to be held November 13-15, 1995 in Coeur d'Alene, Idaho, USA. IAWF's goal for this conference is to bring together policy makers, managers of public lands, and conservation groups to promote dialogue and information sharing about the possible interactions between fire and rare and endangered species and habitats. Abstracts should be submitted by February 1, 1995 to: Dr. Jason Greenlee, IAWF, P.O. Box 328, Fairfield, WA, USA 99012. The conference fee is $120 before February 1, 1995, and $145 afterwards. Conference materials, refreshment breaks, lunches, a banquet, and proceedings are included in this fee. To register or obtain more information, call 1-800-697-3443.

California Conference on Ecosystem Management

University Extension, University of California Davis, is offering "The California Conference on Ecosystem Management: Designing with Nature" on October 25-27, 1994, at the Hilton Inn Convention Center in Sacramento. Topics will include management of California's land and resources in conformity with ecological, social, and political realities. Practical management issues to be addressed include relations between agencies and their publics within current economic and budgetary constraints. Speakers are from governmental agencies, environmental organizations, and the professional resource management community.

The conference fee is $150 for enrollment before October 7, 1994, and $170 afterwards. This fee includes course materials, lunches, a poster session, and a reception. For more information, please call toll free in California (800) 752-0881; from Davis, Dixon, Woodland, or outside California, call (916) 757-8777.

Wildlife Trade and CITES Issues

The World Conservation Monitoring Centre, Cambridge, England, announces "CITES-L," a list for discussion and postings of issues relating to the trade in wildlife and the Convention on International Trade in Endangered Species (CITES). The World Conservation Monitoring Centre (WCMC), where the list will be maintained, has had over 12 years of experience dealing with wildlife trade issues and maintains a database of all reported trade in CITES-listed species on behalf of the CITES Secretariat. WCMC has regular contact with the CITES Secretariat in Geneva, which will also be a source of up-to-date information. The 9th Conference of the Parties of CITES will be held in November of this year in Fort Lauderdale, Florida, USA; WCMC hopes to post decisions and results of discussions at this conference as they take place.

Messages sent to CITES-L are distributed automatically and authors are solely responsible for the content of their posts. WCMC and CITES do not verify the accuracy of submitted messages, nor do they endorse what is expressed. Anyone interested in joining the list should send a one line message to LISTPROC@WCMC.ORG.UK with the command line (in message body): SUBSCRIBE CITES-L <Yourname>, e.g., SUBSCRIBE CITES-L Ronald MacDonald. Please note that replies to messages from the list will be sent to *everyone* on the list unless precautions are taken to ensure otherwise. Please direct questions to the list manager: Helen Corrigan, Wildlife Trade Monitoring Unit, World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge CB3 0DL, U.K.; Tel: (44) 223 277314; Fax: (44) 223 277136; e-mail: helen.corrigan@wcmc.org.uk.

Bulletin Board information provided in part by Jane Villa-Lobos, Smithsonian Institution. Announcements for the Bulletin Board are welcomed

Endangered Species UPDATE

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