Sustainability: Science, Practice, & Policy
http://ejournal.nbii.org

COMMUNITY ESSAY

Comprehensive conservation planning and ecological sustainability within the United States National Wildlife Refuge System

Richard L. Schroeder

Fort Collins Science Center, United States Geological Survey, 2150 Centre Avenue, Building C, Fort Collins, CO 80526 USA (email: Rick_Schroeder@usgs.gov)

Author's Personal Statement:

For the past ten years, I have had the privilege of working with the National Wildlife Refuge System (NWRS) of the United States Fish and Wildlife Service as it develops Comprehensive Conservation Plans (CCP) for each refuge unit. I have read and studied published CCPs, and paid particular attention to the scientific and biological aspects of these plans. Of particular interest to me has been the mandate to sustain healthy populations of fish, wildlife, and plants and the biological integrity, diversity, and environmental health of the refuge system, or, essentially, the "ecological sustainability" of the system. One of the great difficulties in trying to implement a concept as profound and complex as ecological sustainability is to determine how one might measure progress toward its achievement. In this essay, I have tried to select a few simple but relevant factors to serve as indicators of such progress. A wise older friend of mine, in explaining her personal view of changing the world, said that some of the problems we face are like a huge ball blocking our path. She knew that she alone could not move the ball, but her goal was to at least nudge it in the right direction. It is my hope that this essay serves as a nudge to NWRS as it moves toward the goal of ecological sustainability.

Introduction

The National Wildlife Refuge System (NWRS) of the United States Fish and Wildlife Service (FWS) has been in existence for over 100 years, but it was only recently that these designations received a systemic mandate with passage of the Refuge Improvement Act (RIA) of 1997. Previously, the nation's national wildlife refuges lacked organic legislation that provided a clear, central mission, and individual units were established through a patchwork of executive orders and other laws. The refuges allowed a wide variety of uses that did not always complement the objectives of wildlife management. With passage of RIA, the refuge system received a new statutory mission statement. According to FWS, "This Act states first and foremost that the mission of the National Wildlife Refuge System be focused singularly on wildlife conservation." The RIA directs FWS to provide for the conservation of fish, wildlife, and plants, and their habitats throughout the refuge system. The legislation defines the terms "conserving," "conservation," "manage," "managing," and "management" as meaning to sustain and, where appropriate, restore and enhance, healthy populations of fish, wildlife, and plants. The RIA further requires FWS to ensure that the biological integrity, diversity, and environmental health of the refuges are maintained for the benefit of present and future generations of Americans. As Meretsky et al. (2006) note, the provision related to biological integrity, diversity, and environmental health is "[o]ne of the most emphatic ecosystem conservation directives ever written by Congress." Fischman (2003) provides an excellent history of the earlier laws guiding NWRS management.

Given the RIA mandates, the key ecological sustainability aspects of concern within the refuge system are sustaining healthy fish, wildlife, and plant populations and, on a broader basis, sustaining biological integrity and diversity and environmental health. It should be noted that many definitions of the term "sustainability" refer to three dimensions: social, economic, and ecological. However, the mission of the refuge system focuses strictly on wildlife conservation which falls within the realm of ecological sustainability. Thus, this essay will be restricted to the ecological dimension.

One of RIA's mechanisms for moving toward ecological sustainability of NWRS is the requirement to complete comprehensive conservation plans (CCPs) for the more than 500 units in the system by the year 2012. These plans provide management direction for a 15-year period for each refuge unit. For the past ten years, I have worked closely with FWS in

providing technical assistance in this planning effort, primarily in the development of science-based and detailed biological objectives for the CCPs. The purposes of this essay are: 1) to provide an overview of FWS policies and guidance that relate to ecological sustainability in the comprehensive planning process; 2) to assess the strengths and weaknesses of the planning process in meeting these directives; and 3) to offer ideas for future planning within the refuge system.

Overview of FWS Policies and Guidance Related to Planning and Ecological Sustainability

Subsequent to the passage of RIA in 1997, FWS issued several policies that provide more specific guidance and direction for planning and management of the refuge system. The first of these was *Refuge Planning* (602 FW) (U.S. Fish and Wildlife Service, 2000). The specific chapter on the CCP process (602 FW 3) provides the following guidance related to ecological sustainability: "[CCPs] describe the desired future conditions of a refuge and provide long-range guidance and management direction to achieve refuge purposes; help fulfill the National Wildlife Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System."

In April 2001, FWS issued a policy titled *Biological Integrity, Diversity, and Environmental Health* (601 FW 3) that provided detailed guidance on the meaning of the terms "biological integrity," "diversity," and "environmental health" and how to manage units to maintain or restore these attributes (U.S. Fish and Wildlife Service, 2001). In discussing management goals, this policy notes, "The highest measure of biological integrity, diversity, and environmental health is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions." This policy also links the goal of ecological sustainability to the planning process by noting that through the CCP process FWS will determine the appropriate management direction to maintain and, where appropriate, restore biological integrity, diversity, and environmental health, while achieving refuge purpose(s).[1]

The FWS policy on *National Wildlife Refuge System Mission and Goals and Refuge Purposes* (601 FW 1) states that the refuge system's overarching goal is to conserve a diversity of fish, wildlife, and plants and their habitats for the benefit of current and future generations (U.S. Fish and Wildlife Service, 2006a). Three of the five specific goals outlined in this policy contain provisions related to ecological sustainability:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life-history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.

This policy states that these goals will help guide development of specific management priorities during development of CCPs, and thus links the goal of ecological sustainability to the planning process.

The above summary of key FWS policies indicates that the concepts of ecological sustainability and planning are tightly interrelated in the refuge system. The FWS has had ten years since the passage of RIA to develop refuge plans and to move toward ecological sustainability. In the following section, I use several criteria to assess the strengths and weaknesses of the current planning effort in building a NWRS capable of sustaining biological integrity, diversity, and environmental health, including healthy populations of fish, wildlife, and plants. This essay focuses on FWS planning outside of Alaska.[2]

Assessment of Comprehensive Conservation Planning and Ecological Sustainability within the Refuge System

Based on FWS policies, I selected four key considerations to help evaluate the success of the CCPs in sustaining healthy populations of fish, wildlife, and

[1] The FWS defines historic conditions as the "[c]omposition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human related changes to the landscape." In practice, the historic time frame often refers to pre-European settlement. Historic conditions are often determined from an assessment of early explorer records, archeological data, or historic vegetation maps (e.g., Marschner, 1974).

[2] The Alaska National Interest Lands Conservation Act of 1980 directed FWS to prepare and periodically update conservation plans for all NWRs in Alaska. The first such plans were completed between 1985 and 1988 and are now being revised according to current FWS policies.

plants and the biological integrity, diversity, and environmental health of the refuge system. These considerations are:

- Use of science
- Maintenance or restoration of historic conditions;
- Inclusion of an ecosystem perspective; and
- Incorporation of adaptive management and monitoring.

Use of Science

The importance of science in achieving sustainability was emphasized by Mooney & Sala (1993) and more recently by Palmer et al. (2005). The FWS Planning Policy (602 FW 3) states that a CCP goal is "[t]o support management decisions and their rationale by using a thorough assessment of available science derived from scientific literature, on-site refuge data, expert opinion, and sound professional judgment." A cornerstone of CCPs is their biological objectives that describe the desired future conditions for wildlife and refuge habitats. Developing objectives is similar to formulating hypotheses and should be guided by the scientific method to provide a transparent and rigorous approach that can be empirically tested and subjected to peer review (Tear et al. 2005).

In an analysis of the first 60 completed CCPs covering refuges distributed widely across the system (completion dates ranged from 1997 to 2004) I found that the amount and quality of the science used to support the biological objectives were both often quite limited (Schroeder, 2006). My evaluation used the following question and ranking criteria:

How well was available science used in the development of the biological objectives?
(Note: general sources include materials such as field guides and overview texts; high quality sources include materials such as articles from scientific journals).

1. Poor (very few or no science sources cited)
2. Fair (limited number of science sources provided and sources mostly general)
3. Good (limited to many science sources provided and sources mostly of high quality)
4. Excellent (extensive number of science sources provided, from high quality sources, as described above)

The average score for the amount and quality of the science in the biological objectives in the 60 CCPs was 1.38 (with a range from 1.00 to 3.62). CCPs that scored the lowest provided no scientific documentation to explain the biological objectives, whereas the CCP with the highest score provided over 200 high-quality science citations and extensive explanations of how this science was used to develop the biological objectives. Average scores for the science criteria for the 60 CCPs were calculated for each year (1997 to 2004) and regression of average scores against year of plan completion showed a significant positive relationship ($R^2 = 0.66$, $P = 0.015$), indicating improved use of science over time.

Maintenance or Restoration of Historic Conditions

As discussed earlier, FWS policy on biological integrity, diversity, and environmental health notes that intact and self-sustaining habitats and wildlife populations that existed during historic conditions (defined in the policy as prior to substantial human-related changes to the landscape) represent the highest measure of biological integrity, diversity, and environmental health. Thus, it follows that restoration of historic conditions should be a major emphasis of current NWR planning. Indeed, this appears to be the case, as the first 55 CCPs expressed intent to conduct some form of ecosystem restoration in accordance with this aim (Schroeder, 2004). Specific examples include:

- Rydell NWR CCP (Minnesota) – "The majority of refuge wetlands, uplands, and woodlands will be restored to reflect the original natural character of the landscape."
- Windom Wetland Management District CCP (Minnesota) – "Restore native prairie plant communities of the Northern Tallgrass Prairie Ecosystem."
- Ten Thousand Islands NWR CCP (Florida) – "Restore natural sheetwater flows to the Refuge."

Many refuges were established on lands with a history of providing crops (e.g., corn, soybeans) and following designation many areas continued to be cropped to provide a food source for wildlife or to ameliorate crop-depredation problems by wildlife on adjacent private lands. In recent years, however, cropland acres have been reduced. A theme repeated in many CCPs is reduction or elimination of croplands and restoration of these areas to native plant communities. Refuges with pine or other tree plantations also plan to restore these areas to native plant communities. In an article concerning the management of refuges to restore historic conditions, Schroeder et al. (2004) note that in almost all instances it will be impossible to completely restore conditions that existed prior to substantial human-related changes. Difficulties could include the pres-

ence of upstream dams that have altered the hydrology, the relatively small size of areas available to reintroduce extirpated large carnivores or herbivores, or the inability to mimic natural processes such as wildfire. Hilderbrand et al. (2005) offer similar warnings and provide an excellent discussion of the difficulties inherent in restoration ecology, while Meretsky et al. (2006) issue a cautionary note that factors such as climate change may further restrict restoration to historic conditions. Restoration of federally listed threatened or endangered species will also be a significant challenge, as the current refuge system only supports 186 of the 514 listed animal species (Czech, 2005).

Inclusion of an Ecosystem Perspective

The importance of an ecosystem-level approach for biodiversity conservation and ecological sustainability has long been recognized. Franklin (1993) argues strongly that "[l]arger-scale approaches—at the levels of ecosystems and landscapes—are the only way to conserve the overwhelming mass—the millions of species—of existing biodiversity." In accordance with this analysis, the FWS Planning Policy (602 FW 3) encourages an ecosystem approach for refuge planning (U.S. Fish and Wildlife Service, 2000). The policy further states that CCP objectives should consider regional and FWS ecosystem objectives. Five years before this publication, FWS developed a specific policy on the Ecosystem Approach to Fish and Wildlife Conservation that called for the creation of "ecosystem teams" and the development of "ecosystem plans" with measurable objectives (U.S. Fish and Wildlife Service, 1995). However, plans have been developed for few of the 52 watershed-based ecosystems of the lower 48 states and the majority of the published plans lack specific and quantitative wildlife and habitat objectives at the ecosystem level. An assessment carried out by Christensen et al. (1998) found that FWS personnel have a wide variety of definitions for the Ecosystem Approach and that the concept and associated activities had not been integrated into daily FWS business.

An additional concern at the ecosystem level is that many refuges are becoming islands within a landscape increasingly dominated by urban and agricultural development (Scott et al. 2004). Future management will need to be concerned not only with refuge lands, but more and more with management practices on adjacent and surrounding acreage.

A few recent CCPs have developed their biological objectives in consideration of other ecosystem-level planning efforts such as the North American Waterfowl Management Plan (2004) or Joint Ventures Plans (U.S. Fish and Wildlife Service, 2007).[3] For example, the CCP for the Lake Ophelia NWR in Louisiana calls for reforesting over 1,000 acres of cropland to contribute to creating forest blocks of 100,000 acres for the benefit of neotropical migratory birds as identified in the Mississippi Alluvial Valley Migratory Bird Conservation Plan (U.S. Fish and Wildlife Service, 2005a).[4] However, such integration of local and regional planning is rare and appears to rely on the initiative of specific FWS personnel.

Incorporation of Adaptive Management and Monitoring

The FWS Planning Policy (602 FW 3) contains a section that addresses both monitoring and adaptive management. The policy notes that biological objectives and management activities should be monitored and modified as needed through adaptive management, a strategy closely related to a requirement in the policy to develop detailed CCP objectives that can be measured during monitoring to assess progress. Martin (2006) states that objectives related to sustainability must have an empirical basis that provides the ability to measure the steps necessary for achievement.

In my reviews, I have not yet encountered a CCP that has a detailed explanation of how adaptive management will be approached and that provides information on the level of monitoring that will be conducted. In fact, most CCPs contain only a short section on monitoring, which tends to have fairly generic and boilerplate wording. Excerpts from two published CCPs illustrate this point:

> Seedskadee NWR CCP (Wyoming) – "Monitoring and evaluation will utilize the adaptive management process which includes goal and objective setting, applying management tools and strategies, and monitoring and feedback to validate objectives. Adaptive management provides a framework within which biological measures can be evaluated by comparing the results of management, to results expected from objectives" (U.S. Fish and Wildlife Service, 2002).

[3] The North American Waterfowl Management Plan (NAWMP) is a joint effort of the United States, Canadian, and Mexican governments to develop a strategy to restore waterfowl populations through habitat protection, restoration, and enhancement. Joint Ventures Plans are partnerships involving federal, state, provincial, tribal, and local governments, businesses, conservation organizations, and individual citizens that work to implement NAWMP at the regional level, focusing on areas of concern identified in the plan.

[4] For the complete plan, see Twedt et al. (1999).

> Sherburne NWR CCP (Minnesota) – "Monitoring will be developed to measure progress toward meeting the objectives set forth in this plan. Based on the results of monitoring, the objectives will be reviewed and revised as necessary" (U.S. Fish and Wildlife Service, 2005b).

The lack of specific and measurable details in many of the biological objectives, combined with the very general guidance on monitoring and adaptive management in most plans, indicates that it will be difficult for FWS to monitor progress toward ecological sustainability through the current CCPs (Schroeder, 2006). Johnson (1999) notes that most agencies face rigorous time and money constraints and I believe that these may be limiting factors in the application of adaptive management throughout the refuge system. The challenge of monitoring was emphasized by Bernhardt et al. (2005) who analyzed more than 37,000 river-restoration projects across the entire United States and noted that only 10% of project records document any form of monitoring.

Ideas for the Future

The FWS has made progress in the first round of developing and publishing CCPs. As initiated by the mandates in RIA, a major shift in emphasis has occurred toward planning and managing for biological integrity and diversity and environmental health and, thus, the ecological sustainability of the refuge system. However, far more improvement is feasible based on the criteria that policy and other published guidance have established. Specifically, CCPs could be improved by strengthening their scientific foundation, providing more detailed and measurable objectives related to ecological sustainability, and integrating approaches across ecosystems.

What are some areas to look toward in the future as the first CCPs begin to be revised and the next phase of long-term planning begins?

The FWS, in partnership with other federal, state, and private groups, is currently developing a long-term plan for Strategic Habitat Conservation (SHC) and ecological sustainability is a key provision (National Ecological Assessment Team, 2006). The document specifically notes the importance of SHC in future refuge planning:

> The Refuge System will incorporate information derived from the SHC framework into the refuge planning process. This information will provide valuable assistance to refuge staffs and planners when evaluating and identifying the appropriate contribution that each refuge can make to larger landscape conservation priorities. Considered with Refuge System mandates, policies, and guidance, the SHC framework will help facilitate development of wildlife and habitat management goals and objectives for comprehensive conservation plans (CCPs) and habitat management plans (HMPs) that will guide future management on over 540 refuges.

If the SHC effort is successful it will offer tools and models of tremendous value in allowing future CCPs to provide biological objectives stepped down from higher level ecosystem objectives. However, earlier cautions should be revisited and considered anew, for instance those generated by the assessment of the 1995 Ecosystem Approach (Christensen et al. 1998). These concerns include the lack of a clear definition of the "ecosystem approach," the poor integration that exists across all programs within FWS, the need to use the "best science," and the importance of improved use of partnerships.

The FWS Ecosystem Approach Concept document (052 FW 1) states that management decisions will "consider the full array of biological and socioeconomic parameters" (U.S. Fish and Wildlife Service, 1996). However, this type of all-encompassing statement is exceedingly difficult to incorporate into land-management plans and has potentially far-reaching implications. The wildlife-management field increasingly perceives a conflict between continued economic growth and the sustainability of wildlife resources. Czech (2000) states that "[a] plethora of evidence indicates that economic growth is the limiting factor for wildlife conservation."

Scientific information has become much more readily available in recent years. For instance, FWS has an excellent online system that provides access to scientific abstracts and electronic journals. However, an ongoing challenge for field biologists is finding the time to review the literature (Pullin et al. 2004; Schroeder, 2006). This situation suggests the need for a coordinated system to synthesize scientific information for key species and habitats, perhaps similar to the Habitat Suitability Index models that FWS developed in the 1980s (U.S. Fish and Wildlife Service, 1981). The FWS could also benefit by evaluating new tools and methods being developed to assess ecological conditions. Meretsky et al. (2006) recommend that the refuge system gives serious consideration to multimetric indices, for example of biological or ecological integrity, to assess extant conditions. Other recent and relevant tools include indices of grassland integrity (Coppedge et al. 2006) and an ecological integrity index for littoral wetlands

(Ortega et al. 2004). As individual refuges in the national system implement their current CCPs, FWS will accumulate both quantitative and anecdotal information on various habitat-management and restoration activities. It would be helpful to future planning efforts to document these results and establish improved mechanisms for networking between refuge units, perhaps in the form of Internet-based approaches, including online "blogs."

In addition, as CCPs are implemented and results monitored there will be enhanced need to practice adaptive resource management. The biological objectives in CCPs represent hypotheses and, as these are evaluated, publication of the results will create a permanent record. An increased emphasis on publication would allow for long-term documentation of refuge-management successes and failures to benefit future managers and researchers. FWS field staff could collaborate with outside scientists to facilitate such publications.

The management of natural systems is extremely complex; ecologist Frank Egler (1977) notes that "ecosystems are not only more complex than we think, but more complex than we can think." On a very pragmatic note, it will be important for FWS to review and update appropriate training courses (such as the national CCP course) and various guidelines and directives to reflect new knowledge and "lessons learned" in the first round of CCP publication.

The goal of long-term sustainability of fish, wildlife, and plants, as well as the biological integrity, diversity, and environmental health of the refuge system as a whole is both admirable and daunting. One mechanism to move toward this goal is to continue a science-based, ecosystem-oriented, and adaptive system of planning. The CCP effort is likely to be critical in determining the level of ecological sustainability that NWRS is eventually able to achieve.

Acknowledgement

I would like to acknowledge Brian Czech and Natalie Sexton for their valuable feedback on an earlier draft of this essay.

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