NATURAL RESOURCES JOURNAL

Volume 44
Issue 4 *Fall 2004*

Fall 2004

Biological Integrity, Diversity, and Environmental Health Policy and the Attainment of Refuge Purposes: A Sacramento National Wildlife Refuge Case Study

J. Gregory Mensik

Fred L. Paveglio

J. GREGORY MENSIK* & FRED L. PAVEGLIO**

Biological Integrity, Diversity, and Environmental Health Policy and the Attainment of Refuge Purposes: A Sacramento National Wildlife Refuge Case Study

ABSTRACT

National Wildlife Refuges are established with a range of management purposes as a result of a variety of acquisition authorities including legislative mandate, executive order, and establishing memorandum. The National Wildlife Refuge System Improvement Act of 1997 mandates that each refuge shall be managed to fulfill the System mission and its establishing purposes, as well as to maintain the System's overall biological integrity, diversity, and environmental health. We offer the Sacramento National Wildlife Refuge as a case study demonstrating the challenges a refuge staff faces when implementing management practices that achieve refuge purposes while also maintaining and, where appropriate, restoring biological integrity, diversity, and environmental health as well as complying with a multitude of other legislative mandates and policies.

INTRODUCTION

The National Wildlife Refuge System (System) is a national network of lands and waters set aside for the express purpose of conserving fish, wildlife, and plants.[1] The System includes over 540 refuges and 37 wetland management districts covering more than 100 million acres of land.[2] The System also includes roughly three million

* U.S. Fish and Wildlife Serv., Sacramento National Wildlife Refuge Complex, 752 County Road 99W, Willows, CA 95988. Email: Greg_Mensik@r1.fws.gov.

** U.S. Fish and Wildlife Serv., Division of Refuge Operations Support: Branch of Refuge Biology, Vancouver, WA 98665. Email: Fred_Paveglio@r1.fws.gov.

1. U.S. FISH & WILDLIFE SERV., AMERICA'S NATIONAL WILDLIFE REFUGE SYSTEM, *at* http://refuges.fws.gov/policyMakers/mandates/HR1420/missionGoals.html (last visited Dec. 15, 2004).

2. U.S. FISH & WILDLIFE SERV., NATIONAL WILDLIFE REFUGE LOCATOR, *at* http://refuges.fws.gov/refugeLocatorMaps/ (last visited Dec. 15, 2004).

acres of waterfowl production areas and approximately 315,000 acres of coordination areas.[3]

Congress and the Executive Branch established National Wildlife Refuges (NWRs) with a multitude of management purposes. Created via legislative mandates, executive orders, and establishing memoranda, NWR's diverse management purposes vary from establishing "a range and breeding ground for antelope and other species of wildlife"[4] for the Hart Mountain National Antelope Refuge in southern Oregon to providing "habitat for a broad diversity of bird species, with particular emphasis on protecting the nesting habitat of the bald eagle, tufted puffin, rhinoceros auklet, pigeon guillemot, and pelagic cormorant; to protect the haulout area of harbor seals; and to provide for scientific research and wildlife-oriented public education and interpretation"[5] on the Protection Island Refuge in northwest Washington.

The many and diverse habitats that make up the System and the multitude of purposes directing their management are bound together under the direction of the National Wildlife Refuge System Administration Act of 1966 (Administrative Act),[6] as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act).[7] The Administrative Act, identified as an "organic act"[8] for the National Wildlife Refuge System, provides the clear mandate that "wildlife and wildlife conservation must come first."[9] The Improvement Act adds several additional mandates and management requirements for the System. In particular, section 5 of the Improvement Act specifies that "each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was

3. *See* U.S. FISH & WILDLIFE SERV., LANDS REPORT: TABLE 1—SUMMARY BY CATEGORIES, *at* http://realty.fws.gov/AROL/005_Lands_Report.htm (last visited Dec. 15, 2004).

4. Exec. Order No. 7523, 1 Fed. Reg. 2528 (1936).

5. Protection Island National Wildlife Refuge Act, Pub. L. No. 97-333, 96 Stat. 1623 (1982).

6. National Wildlife Refuge System Administration Act of 1966, Pub. L. No. 89-669, 80 Stat. 926 (codified as amended at 16 U.S.C. §§ 668dd-668ee (2000)).

7. National Wildlife Refuge System Improvement Act of 1997, Pub. L. No. 105-57, 111 Stat. 1252 (codified as amended at 16 U.S.C. §§ 668dd-668ee (2000)).

8. U.S. FISH & WILDLIFE SERV., DIGEST OF FEDERAL RESOURCE LAWS OF INTEREST TO THE U.S. FISH AND WILDLIFE SERVICE, *at* http://laws.fws.gov/lawsdigest/nwrsact.html (last visited Dec. 15, 2004).

9. H.R. REP. NO. 105-106, at 9 (1997); *Cf.* National Wildlife Refuge System Administration Act of 1966, Pub. L. No. 89-669, 80 Stat. 926 (codified as amended at 16 U.S.C. § 668dd(a)(1) (2000)) (stating that certain lands designated to protect wildlife are to be administered by the Fish and Wildlife Service and are subject to this act).

established"[10] and "[i]n administering the System, the Secretary shall... ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans."[11] This mission requires that lands and waters of the System be administered for the "conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats for the benefit of present and future generations of Americans."[12]

The Biological Integrity, Diversity, and Environmental Health (BIDEH) policy of the U.S. Fish and Wildlife Service (FWS) defines the general relationship between the System mission and the purposes of individual NWRs by directing that "each refuge will be managed to fulfill refuge purpose(s) as well as to help fulfill the System mission, and we will accomplish these purpose(s) and our mission by ensuring that the biological integrity, diversity, and environmental health of each refuge are maintained, and where appropriate, restored."[13]

The FWS has also developed a series of policies and director's orders to establish the relationship among various directives of the Improvement Act. The relationship between the System mission and the purpose(s) of each refuge is defined in section 3 of the FWS Director's Order No. 132, which states, "we view the System mission, goals, and unit purpose(s) as symbiotic; however, we give priority to achieving a unit's purpose(s) when conflicts with the System mission or a specific goal exist."[14]

At the refuge level, the FWS's biological integrity policy mandates, "We will, first and foremost, maintain existing levels of biological integrity, diversity, and environmental health at the refuge scale."[15] Secondarily, the policy requires refuges to "restore lost or severely degraded elements of integrity, diversity, environmental health at the refuge scale and other appropriate landscape scales where it is feasible and supports achievement of refuge purpose(s) and System mission."[16] As a result of these policies, the primary FWS management

10. National Wildlife Refuge System Improvement Act of 1997, Pub. L. No. 105-57, 111 Stat. 1252 (codified as amended at 16 U.S.C. § 688dd(a)(3)(A) (2000)).

11. National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. § 668dd(a)(4)(B) (2000).

12. *Id.* § 668dd(a)(2).

13. U.S. FISH & WILDLIFE SERV., U.S. FISH AND WILDLIFE SERVICE MANUAL, 601 FW 3, *available at* http://policy.fws.gov/series.html (last visited Jan. 11, 2005).

14. U.S. FISH & WILDLIFE SERV., DIRECTOR'S ORDER NO. 132 (Jan. 18, 2001), *available at* http://policy.fws.gov/do132.html (last visited Dec. 10, 2004).

15. U.S. FISH & WILDLIFE SERV., *supra* note 13, 601 FW 3.

16. *Id.*

priority for the System is the achievement of refuge-specific purposes, with the secondary priority being maintenance and, where appropriate, restoration of elements of biological integrity, diversity, and environmental health, where they do not conflict with refuge purposes.

The goal of this article is to identify how the refuge purpose(s); mission of the System; and management for biological integrity are used to determine management direction for each unit of the System. In addition, we will evaluate the application of several principles of biological integrity for the management of the System. Finally, the Sacramento NWR is used as a case study for the following: identifying refuge purposes; identifying conservation targets to maintain biological integrity; and demonstrating how several principles of biological integrity are integrated into the management to achieve refuge purposes and maintain and, where appropriate, restore biological integrity. This case study also illustrates the challenges NWR staff members face when balancing the many legislative mandates as well as FWS policies when determining refuge management priorities.

REFUGE PURPOSES

Section 3 of the Improvement Act states, "'purposes of the refuge and purposes of each refuge' mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit."[17] Section 3 of the Improvement Act House Report further clarifies this definition by indicating "any number of specified documents which establish, authorize or expand a refuge. This includes acquisition purposes in cases where land at a refuge has been acquired under authority other than the establishing authority."[18] Because many refuges were established and/or acquired under one or more of 14 statutes (*e.g.*, the Migratory Bird Conservation Act,[19] the Fish and Wildlife Coordination Act[20]), it is often necessary to search for specific information regarding the original intent for establishing or acquiring a refuge. Although the Improvement Act[21] and the Improvement Act

17. 16 U.S.C. §§ 668dd, 668ee(10) (2000).

18. H.R. REP. NO. 105-106, § 3 (1997), *available at* http://refuges.fws.gov/policyMakers/mandates/HR1420/part2.html (last visited Dec. 10, 2004).

19. Migratory Bird Conservation Act, 16 U.S.C. § 715-715s (2000).

20. Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661-666c (2000); 16 U.S.C. § 668dd (2000).

Report[22] do not refer to specific administrative memoranda, these documents suggest that the FWS should consider a more detailed account of refuge purpose(s) when managing the System.[23]

The determination of specific refuge purpose(s) to identify priorities for refuge management has been incorporated into System management policies, including Compatibility,[24] Habitat Management Plans,[25] and the Comprehensive Conservation Planning Process.[26] The importance of the refuge purpose when addressing the compatibility of refuge uses or determining management priorities for refuge planning would be problematic if a broad interpretation of the refuge purpose from authorizing or establishing authorities is used, rather than a more specific purpose as originally identified in an establishing memorandum. It is therefore necessary to identify the refuge purpose(s) stated in official decision documents for the establishment and/or expansion of an NWR (*e.g.*, Land Protection Plan,[27] Conceptual Management Plan,[28] and environmental compliance documents[29] supporting the National Environmental Policy Act of 1969[30]). These decision documents often provide more detailed information required to obtain support from local and state governments to establish an NWR.

The importance of specific refuge purposes is demonstrated by the System's Comprehensive Conservation Planning Process (CCP) policy, which requires planning teams to "[d]ocument the history of refuge establishment and management, as well as refuge purposes and authorizing authority (*e.g.*, legislation [including wilderness designation, if applicable], executive orders, administrative memoranda)."[31] The

22. H.R. REP. NO. 105-106, *supra* note 18.

23. ROBERT L. FISCHMAN, THE NATIONAL WILDLIFE REFUGES: COORDINATING A CONSERVATION SYSTEM THROUGH LAW 182 (2003).

24. U.S. FISH & WILDLIFE SERV., *supra* note 13, 603 FW 2.

25. *Id.* 620 FW 1.

26. *Id.* 602 FW 3.

27. *See, e.g.*, U.S. FISH & WILDLIFE SERV., LAND PROTECTION PLAN: NI-LES'TUN UNIT ADDITION, BANDON MARSH NATIONAL WILDLIFE REFUGE (1999), *available at* http://pacific.fws.gov/planning/bandon/10lpp.htm (last visited Dec. 16, 2004).

28. *See, e.g.*, FISH & WILDLIFE CONSERVATION COMMISSION, STATE OF FLORIDA, APALACHICOLA RIVER WILDLIFE AND ENVIRONMENTAL AREA CONCEPTUAL MANAGEMENT PLAN UPDATE, 2002-2007: RESOURCE MANAGEMENT GOALS AND OBJECTIVES (2001) (draft document), *available at* http://wld.fwc.state.fl.us/planning/CMP/Apalachicola%20River%20WEA/Apalachicola%20River%20GOPS.pdf (last visited Dec. 16, 2004).

29. *See, e.g.*, NATIONAL AERONAUTICS & SPACE ADMINISTRATION, AUDIT REPORT: COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT, IG-00-030 (2000), *available at* http://www.hq.nasa.gov/office/oig/hq/ig-00-030r.pdf (Mar. 31, 2000).

30. National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4347 (2000), *available at* http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm (last visited Dec. 16, 2004).

31. U.S. FISH &WILDLIFE SERV., *supra* note 13, 602 FW 3.4(C)(1)(b).

planning team is further directed by this policy to consider these authorizing documents through its statement: "These will become driving forces in the process and subsequently be reflected in the refuge vision statement, goals, objectives, and strategies in the CCP."[32]

Examples from two refuges illustrate how refuge purposes can vary depending upon the establishment date of the refuge, its authorizing and expanding authorities, and official historical records available for some of the earlier established refuges. The 10,819-acre Sacramento NWR is located in the Sacramento Valley of California and was originally established under Executive Order No. 7562 on February 27, 1937, by Franklin D. Roosevelt as the Sacramento Migratory Waterfowl Refuge.[33] Roosevelt's executive order states the area was acquired "as a refuge and breeding ground for migratory birds and other wildlife..."[34] In addition to the standard acquisition authority derived from the Migratory Bird Conservation Act (MBCA),[35] the original refuge name also suggests the purpose of the refuge for migratory waterfowl. Although official establishment documents are not available for this refuge, there is ample evidence indicating the area's historical importance to waterfowl, including early written recommendations that the refuge be established as a sanctuary for waterfowl.[36]

A contrasting and more detailed authority exists for the Ridgefield NWR,[37] located in southwest Washington within the Columbia River floodplain. Like the Sacramento NWR, the MBCA was the primary acquisition and establishment authority for the 5149-acre Ridgefield NWR. Specifically, Ridgefield NWR was authorized under the MBCA by the Migratory Bird Conservation Commission on May 18, 1965.[38] Memorandum No. 1 contained within the Commission's meeting notes identifies the purpose of the refuge as providing "wintering habitat for dusky Canada geese and other waterfowl." The memo also provided

---

32. *Id.*

33. Exec. Order No. 7562, 2 Fed. Reg. 537 (Mar. 3, 1937).

34. *Id.*

35. Migratory Bird Conservation Act, 16 U.S.C. §§ 715-715s (2000).

36. *See generally* Frank Arthur Hall, Jr., Environmental History of the Sacramento National Wildlife Refuge (1975) (unpublished Master's thesis, California State University—Chico) (on file with the California State University Library).

37. *See generally* U.S. Fish & Wildlife Service—Pacific Region: Ridgefield National Wildlife Refuge Complex, *at* http://ridgefieldrefuges.fws.gov/RNWRHome.htm (last visited Dec. 16, 2004).

38. *See* U.S. FISH & WILDLIFE SERV., RIDGEFIELD NATIONAL WILDLIFE REFUGE COMPLEX: CATHLAPOTLE PLANKHOUSE PROJECT—COMPATABILITY [*sic*] DETERMINATION, *available at* http://ridgefieldrefuges.fws.gov/Temporary%20Files/Appendix2.htm (last visited Dec. 16, 2004).

for breeding and migration use and public shooting in the area, with an estimated peak population of 125,000 ducks and 3000 geese.[39]

THE BIDEH POLICY

The authors of the FWS BIDEH policy adopted the definition of "biological diversity" from the FWS Manual, which defines the term as "[t]he variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur."[40] The definition of biological integrity from the BIDEH policy adds the following concepts to the definition of biological diversity: "Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions...."[41]

The most significant concept in the definition of biological integrity is the establishment of historic conditions as a reference for implementation of the BIDEH policy. Historic conditions are defined within the BIDEH policy as "[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."[42]

Two key components of the BIDEH policy definition of historical conditions are the phrases "sound professional judgment" and "prior to substantial human related changes to the landscape." The term "sound professional judgment" requires the refuge manager to consider "the relationship between refuge purpose(s) and biological integrity," the conditions necessary to maintain and restore them, and, most importantly, "incorporates field experience, knowledge of refuge resources, refuge role within an ecosystem, applicable laws, and best available science including consultation with others both inside and outside the Service."[43]

Such judgment on the part of a refuge manager involves a broad range of considerations, including the importance of the refuge within the ecosystem and acknowledgement of competing interests both inside and outside the FWS. These competing interests may result in a wide variety of motivations from preservation to intensive management to

39. MIGRATORY BIRD CONSERVATION COMM'N, MEMORANDUM NUMBER 1—RIDGEFIELD NATIONAL WILDLIFE REFUGE, CLARK COUNTY, WASHINGTON (May 18, 1965).

40. U.S. FISH & WILDLIFE SERV., *supra* note 13, 052 FW 1.12(B).

41. *Id.* 601 FW 3.6(B).

42. *Id.* 601 FW 3.6(D).

43. *Id.* 601 FW 3.7(F).

meet refuge management objectives. This results in inherently complex management decisions required to appropriately balance refuge purpose(s) as well as biological integrity with the needs of the ecosystem and the many divergent perspectives within and outside the System regarding appropriate direction and strategies for refuge management.

Moreover, the BIDEH policy's direction to consider "prior substantial human related changes to the landscape" requires refuge managers to examine a range of existing information to consider when determining the appropriate resources necessary to maintain or restore biological integrity. This information may include archeological records, pictographic accounts, historic vegetation maps, soil sediments, and available research.[44]

Principles of the BIDEH Policy

In addition to identifying important resources for the management and, where appropriate, restoration of biological integrity on NWRs, several principles of biological integrity are presented within the BIDEH policy. The two we will focus on are (1) biological integrity in a larger landscape context and (2) wildlife and habitat management that restores or mimics natural ecosystem processes or functions to achieve NWR purpose(s).[45]

The key concept for the first principle is the following:

> Individual refuges contribute to biological integrity, diversity, and environmental health at larger landscape scales, especially when they support populations and habitats that have been lost at an ecosystem, national, or even international scale. In pursuit of refuge purposes, individual refuges may at times compromise elements of biological integrity, diversity, and environmental health at the refuge scale in support of those components at larger landscape scales.[46]

Because many refuges are located in areas that have fragmented habitats as well as dramatically altered hydrology and vegetation, they are often islands of habitat surrounded by large urban areas or intensive agricultural development. Many of the refuges located along the Continent's four major flyways were established to conserve and intensively manage nesting, migration, and wintering areas for

44. *Id.* 601 FW 3.13.
45. *See generally id.* 601 FW 3.
46. *Id.* 601 FW 3.7(C).

migratory waterfowl and waterbirds.[47] Because these NWRs are often the only remaining habitat in a highly altered landscape, they are intensively and consistently managed to provide habitat for migratory birds that utilize migration flyways spanning the Northern and Southern hemispheres.

This intensive management is not confined to avian species. The National Elk Refuge in Jackson, Wyoming, is another example of a refuge with management that compromises biological integrity at the refuge while contributing to this principle at the landscape level. Development has encroached on the wintering habitat for Rocky Mountain elk in the Greater Yellowstone Valley. Consequently, the refuge supports unnaturally high wintering populations of elk, which have impacted aspen and cottonwood riparian communities, compromising biological integrity at the refuge level.[48]

The key concept for the second principle is "[m]anagement, ranging from preservation to active manipulation of habitats and populations, is necessary to maintain biological integrity, diversity, and environmental health. We favor management that restores or mimics natural ecosystem processes or functions to achieve refuge purpose(s)."[49] Where possible, refuge managers use natural ecosystem processes to maintain serial stages of habitat important in preserving or restoring biological integrity.

An example of this management is the use of prescribed fire at Turnbull NWR to maintain and restore climax Ponderosa pine forest at the edge of the Palouse shrub-steppe of eastern Washington.[50] In addition, refuge staff at the Valentine NWR, located in the Sandhills of western Nebraska, has begun replacing cattle with a captive herd of bison to mimic natural grazing of historic migrating bison herds that, together with naturally occurring fire, maintained the short-grass prairie of this region.[51]

---

47. FISCHMAN, *supra* note 23, at 36.

48. BRUCE L. SMITH ET AL., IMPERFECT PASTURE: A CENTURY OF CHANGE AT THE NATIONAL ELK REFUGE IN JACKSON HOLE, WYOMING 134 (2004).

49. U.S. FISH & WILDLIFE SERV., *supra* note 13, 601 FW 3.7(E).

50. U.S. FISH & WILDLIFE SERV., TURNBULL NATIONAL WILDLIFE REFUGE: PLANNING UPDATE #1: HABITAT MANAGEMENT PLANNING COMPLETE 1 (2000), *available at* http://pacific.fws.gov/planning/draft/docs/wa/Turnbull/tbupdate1.pdf (last visited Jan. 11, 2005).

51. U.S. FISH & WILDLIFE SERV., VALENTINE NATIONAL WILDLIFE REFUGE: COMPREHENSIVE CONSERVATION PLAN 30 (1999), *available at* http://mountain-prairie.fws.gov/planning/States/Nebraska/valentine/finalccp/valccpfinalpdf.pdf (last visited Jan. 11, 2005).

Although FWS policy favors management that mimics natural ecosystem processes, it also recognizes that "[s]ome refuges may differ from the frequency and timing of natural processes in order to meet refuge purpose(s) or address biological integrity, diversity, and environmental health at larger landscape scales."[52] Because many refuges are located in highly altered landscapes where natural conditions no longer exist, this policy exception gives refuge staff sufficient flexibility to achieve refuge purposes as well as to manage or restore biological integrity.

It is often necessary to manage NWRs intensively because they are located in highly altered areas where natural systems no longer exist. For example, a large number of the System's MBCA-authorized waterfowl refuges were established in conjunction with other federal projects, such as reservoirs and irrigation drainage projects, or were simply created to preserve migration or wintering habitat in rapidly developing areas along migration corridors. Because these NWRs frequently represent a significant portion of the remaining wetland habitat in the landscape, they are often intensively managed to provide consistent quality and quantity of habitat to support the migratory bird resource. The creation and management of wetland impoundments or development of a consistent water supply (*e.g.*, using wells and pumps or delivered irrigation water) mimics the natural processes of wetlands, but at a frequency and timing that is not entirely consistent with natural ecosystem processes. NWRs in the Central Valley of California are an excellent example of this type of management and will be discussed in detail.

SACRAMENTO NATIONAL WILDLIFE REFUGE: A CASE STUDY

The Sacramento Valley, located in the northern portion of California's Central Valley, is divided into eastern and western "halves" by the Sacramento River, California's largest.[53] By early accounts, the western half of the Valley, known as the Colusa Plains, was noteworthy for its "intolerable lack of water and abundance of black flies during the dry season."[54] With the exception of "The Willows," a small, tree-

52. U.S. FISH & WILDLIFE SERV., *supra* note 13, 601 FW 3.7(E).

53. *See generally* U.S.D.A. FOREST SERV., SACRAMENTO RIVER BASIN, *available at* http://www.fs.fed.us/r5/publications/water_resources/html/sacramento_river_basin.html (last visited Jan. 11, 2005).

54. Joseph G. Silveira, *Alkali Vernal Pools at Sacramento National Wildlife Refuge*, FREMONTIA, Jan. 2000, at 10, 11, *available at* http://www.vernalpools.org/jan2000/2silveira.pdf (last visited Jan. 11, 2005).

abundant watering hole, the area was a vacant, windswept plain.[55] Referred to as harsh, dry "goose land," the Colusa Plains spanned thousands of acres, extending from The Willows to Knights Landing.[56]

This "worthless alkali," however, looked quite different during the traditional wet season in the late winter and early spring.[57] During this period, hundreds of thousands of Canada geese grazed upon the tender, stunted, alkali grasses.[58] After sufficient rainfall, the plains and abundant ephemeral lakes that dotted the landscape gave way to wildflowers of every color.[59] Meanwhile, the winter flooding of the Sacramento River floodplain produced vast acres of seasonal wetlands that supported millions of waterfowl, along with a rich diversity of other resident and migratory wildlife species.[60]

The Sacramento Valley's harsh environment was a great obstacle to early settlement. The wetlands were often thought of as insect-infested, economically unproductive lands of little value to anyone. Further, the water that created them each year was likely considered wasted. Capturing and manipulating this water supply was a major objective of local businessmen because, until the early 1900s, most agricultural crops grown in the area could not be irrigated and were dependent on rainfall to bring them to maturity.[61] These dry-land crops, primarily wheat, also attracted numerous subspecies of Canada geese. In fact, the geese were so plentiful in the Valley that locals were employed and provided guns and ammunition to herd geese off of winter wheat crops.[62]

With the advent of numerous irrigation districts (including "one of the first large-scale water users within the Sacramento Valley," the Glenn-Colusa Irrigation District,[63] established in 1920), the Sacramento River was tapped for its more dependable water supply.[64] During the 1940s, the Bureau of Reclamation's Central Valley Project created the Shasta Dam, a structure capable of impounding nearly five million acre-

55. *Id.*; *see also* Ellen Hubbard Keith, *Northern Colusa County*, 6 WAGON WHEELS: JOURNAL OF THE COLUSI COUNTY HISTORICAL SOCIETY, 1956, at 13.

56. Silveira, *supra* note 54, at 11.

57. *Id.*

58. *Id.*

59. *Id.*

60. *Id.*

61. CAL. FARM WATER COALITION, NATURAL RESOURCES FACTS SHEET: AGRICULTURAL WATER (2003), *available at* http://www.cfaitc.org/Commodity/pdf/agricultural_water.pdf (last visited Jan. 11, 2005).

62. THELMA B. WHITE, GLENN COUNTY SKETCHBOOK (1995).

63. CYNTHIA F. DAVIS, WHERE WATER IS KING: THE STORY OF THE GLENN-COLUSA IRRIGATION DISTRICT 75 (1984).

64. *See id.*

feet of water that once made its way down the Sacramento River, flooding wetlands clear to the San Francisco Bay and Delta.[65] Channeling the riverbed and riprapping its banks to control water flow further minimized flooding of the surrounding landscape.[66] These engineering projects provided a more dependable and controllable water supply and secured an additional land base that could be dedicated to agricultural purposes.

The cumulative impact of such irrigation efforts throughout California resulted in an estimated loss of 90 percent of the wetland acreage that existed during the late 1850s.[67] In the Central Valley, this equated to a decrease from five million wetland acres to between 250,000 and 320,000 acres.[68] Despite this dramatic loss of habitat, Pacific Flyway waterfowl populations continued to depend upon the Sacramento Valley from September to March.[69] However, because many Valley wetlands were converted to rice crops beginning in the 1930s, new waterfowl/farmer crop-depredation conflicts (this time involving primarily ducks), soon resulted.[70]

The 1930s were characterized by economic crises wrought by the Great Depression as well as a decade-long drought in the Midwest.[71] Economic hardship and wetland destruction occurred throughout the United States.[72] This unfortunate combination of circumstances brought additional pressures to bear, as landowners became desperate to bring in crops due to decreased yields caused by foraging waterfowl that, in turn,

---

65. *See* CAL. DEP'T. OF WATER RESOURCES, PLANNING AND LOCAL ASSISTANCE: NORTHERN DISTRICT, *at* http://www.nd.water.ca.gov/PPAs/RecPlanning/LakesReservoirs/ShastaLake/index.cfm (last visited Dec. 15, 2004).

66. JEFFREY F. MOUNT, CALIFORNIA RIVERS AND STREAMS: THE CONFLICT BETWEEN FLUVIAL PROCESS AND LAND USE 193, 193–97 (1995).

67. CAL. ENVTL. RESOURCES EVALUATION SYS., CAL. RESOURCES AGENCY, CALIFORNIA WETLANDS INFORMATION SYSTEM: PAST MANAGEMENT PRACTICES, *at* http://ceres.ca.gov/wetlands/introduction/wetland_past.html (last visited Dec. 15, 2004).

68. R. Spell et al., *Evaluation of Winter Flooding of Ricelands in the Central Valley of California Using Satellite Imagery*, *at* http://www.agen.ufl.edu/~klc/wetlands/kempka.htm (last visited Dec. 15, 2004).

69. *See* U.S. FISH & WILDLIFE SERV., SACRAMENTO NAT'L WILDLIFE REFUGE COMPLEX: WILDLIFE OBSERVATION, *at* http://sacramentovalleyrefuges.fws.gov/observation.htm (last visited Dec. 15, 2004).

70. Hall, *supra* note 36, at 64.

71. *See generally* LIBRARY OF CONGRESS, THE LEARNING PAGE: GREAT DEPRESSION & WWII, 1929–1945, *at* http://memory.loc.gov/ammem/ndlpedu/features/timeline/depwwii/depwar.html (last visited Dec. 15, 2004).

72. *See* Thomas E. Dahl & Gregory J. Allord, *Technical Aspects of Wetlands: History of Wetlands in the Conterminous United States*, U.S. Geological Survey, National Water Summary on Wetland Resources, *at* http://water.usgs.gov/nwsum/WSP2425/history.html (last visited Dec. 20, 2004) ("In the 1930's, the U.S. Government, in essence, provided free engineering services to farmers to drain wetlands.").

were compensating for lost wetland habitat.[73] This was certainly true in the Sacramento Valley, where early migrating ducks, especially pintail, would often flatten and eat up to forty acres of a farmer's rice crop in a single night.[74] Unharvested rice fields were so attractive that the waterfowl initially became much more abundant in the region during the months of August and September than they had been prior to the introduction of the non-native crop.[75]

In 1937, as a means of addressing both habitat loss and crop depredation, the federal government purchased the Spalding Ranch, located south of The Willows, and christened it the Sacramento National Waterfowl Refuge.[76] Totaling nearly 11,000 acres, the land primarily consisted of dry alkaline plain, with fewer than 1000 wetland and 4800 deteriorated crop acres present.[77] A vegetation survey of the entire refuge conducted during the summer of 1937 determined that only 10 species (mostly grasses) covered 90 percent of the refuge.[78] As a result, early refuge managers made the expansion of existing refuge wetland areas a high priority that continued for the next several decades.[79] Beginning with the Civilian Conservation Corp's "Camp Sacramento" during the late 1930s, levees, water control structures, and delivery ditches were constructed to create and better manage wetlands across a majority of the refuge.[80]

Today the Sacramento NWR comprises over 7500 acres of intensively managed wetlands, supporting peak populations of approximately 600,000 ducks and 200,000 geese.[81] While most of these habitats no longer reflect what once existed on the land, the management programs do attempt to mimic a natural landscape that once occurred throughout the Sacramento Valley on a much grander scale.[82] As a

73. Joseph G. Silveira, *A Historical View of the Colusa Plains: Hunting Wild Geese in an Era Before Sacramento National Wildlife Refuge*, CAL. WATERFOWL, Oct.-Nov. 2001, at 34.

74. Hall, *supra* note 36, at 64.

75. Interview by Frank Hall with George Lenahan, Colusa County Historian, Ass'n for Northern California Records & Research, California State University, Chico, Cal. (1972).

76. Silveira, *supra* note 73, at 35.

77. Silveira, *supra* note 54, at 11.

78. HARRY ANDERSON, VEGETATIVE SURVEY: SACRAMENTO NATIONAL WILDLIFE REFUGE (1937) (*cited in* Hall, *supra* note 36, at 87, 88).

79. *See* J. Gregory Mensik & Patrick O'Halloran, *Monitoring Marsh Management on the Sacramento National Wildlife Refuge Complex*, 26 TRANSACTIONS W. SECTION WILDLIFE SOC'Y 24, 24-28 (1990).

80. Hall, *supra* note 36, at 84, 85.

81. *See* U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE, *at* http://refuges.fws.gov/profiles/index.cfm?id=11619 (last visited Dec. 20, 2004).

82. *See* U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX: RESOURCE MANAGEMENT-HABITAT MANAGEMENT, *at* http://sacramentovalley refuges.fws.gov/habmanage.htm (last visited Dec. 20, 2004).

result, the FWS must now intensively manage this refuge in order to provide a consistent quantity and quality of habitats to compensate for habitat lost to agricultural and urban development.[83] Indeed, California's regulated water supply, coupled with the state's ever increasing human population and its associated impacts, has resulted in wintering waterfowl becoming increasingly dependent upon these artificially created and maintained wetland habitats. Providing for waterfowl and controlling their potential to do damage to agricultural crops such as rice remains a top priority for the Sacramento Refuge managers.

Establishing Management Priorities

In addition to the explicit refuge purposes already discussed, several new legislative mandates must also be considered when determining Sacramento's contemporary management priorities. For example, passage of the Endangered Species Act (ESA) brought additional management responsibilities to the System beginning in the 1970s.[84] In addition to waterfowl, the refuges were directed to take endangered, threatened, or rare flora and fauna into account when setting goals and objectives.[85]

The Improvement Act emphasized giving wildlife and wildlife conservation top priority and also identified priority wildlife-dependent public uses.[86] At the Sacramento refuge, the Improvement Act did not establish a "wildlife first" attitude; instead, it merely strengthened the idea. In addition, the Improvement Act directed the System's managers to maintain the biological integrity of each refuge and to establish priority wildlife dependent public uses whenever such uses were found to be compatible with refuge purposes.[87] Refuge managers used these new directives to establish the following management priorities:[88]

1. Wetland habitat management for migratory birds, especially waterfowl.
2. Rice crop depredation prevention.
3. Endangered species habitat protection.
4. Recreation and environmental education/interpretation.

---

83. *Id.*
84. Endangered Species Act, 16 U.S.C. §§ 1531-1544 (2000).
85. *Id.* § 1536.
86. National Wildlife Refuge System Improvement Act of 1997, Pub. L. No. 105-57, § 2(2)-(7), 111 Stat. 1252, 1252-53 (codified as amended at 16 U.S.C. § 668dd (2000)).
87. 16 U.S.C. § 668dd(a)(4)(H) (2000).
88. *See* Mensik & O'Halloran, *supra* note 79, at 24.

5. Management oriented research.

As discussed earlier, the System's BIDEH policy[89] takes historical conditions of refuge lands into consideration when determining contemporary management practices. In the case of the Sacramento Refuge, a redirection of such magnitude is cause for serious consideration: Does the intensive habitat management on the Sacramento NWR amount to noncompliance with the BIDEH policy? If so, should the refuge manager now direct staff to systematically remove wetland impoundments that have been created over the past six decades? Would waterfowl and other species of wetland dependent fish, wildlife, and plants be better served by fewer wetland acres flooded each year? Should we expect that "human related changes"[90] such as the Shasta Dam will be removed and waters of the Sacramento River will once again flow freely and create wetlands throughout the Valley? Does the new policy mean that the artificially created and maintained habitat of the Sacramento refuge lacks biological integrity? We believe the answer to each of these questions is an emphatic "No!"

But, how should the Sacramento NWR maintain and, where appropriate, restore biological integrity while dealing with today's ever increasing biological expectations? The achievement of such management priorities is dependent upon the development and management of appropriate habitat types. Proper identification of priorities for types of habitat development has two critical components: (1) species management concerns and (2) historic hydrology.

With respect to species management concerns, it is important to consider habitat requirements, including the approximate magnitude and timing of expected habitat use. For example, as discussed earlier, the choice of establishing name (*i.e.*, "Sacramento Migratory Waterfowl Refuge") clearly identifies the refuge's management priority for migratory waterfowl. The approximate timing of the waterfowl migration is the wintering period and the number of birds, at least historically, has reached millions.[91] In addition, Sacramento's refuge managers must also take into consideration the value of such habitats to other fish and wildlife species.

When considering the natural hydrology of the Sacramento Valley, refuge managers can estimate the quantities and qualities of wetland habitats historically available and the associated magnitude and chronology of migratory and resident wildlife use. Historically, shallow,

89. *See generally* U.S. FISH & WILDLIFE SERV., *supra* note 13, 601 FW 3.
90. *Id.* 601 FW 3.6(D).
91. Silveira, *supra* note 54, at 11.

semi-permanently flooded wetlands were more numerous than permanent wetlands located adjacent to the river and its major tributaries.[92] Uplands were also important to wildlife because some river adjacent areas were not flooded, even during the wettest of years. Riparian forests were limited and were probably confined to margins along the river and its major tributaries.[93] As a result of these findings, and in an attempt to mimic the habitats once provided by the natural hydrology, refuge managers developed the following habitat goals for the Sacramento NWR:[94]

(a) 50% Seasonally-flooded wetlands.

(b) 20% Uplands.

(c) 15% Semi-permanent wetlands.

(d) 10% Permanent wetlands.

(e) 5% Riparian forest.

Based upon these goals, Sacramento NWR managers created a habitat management program for the refuge. While methodology may vary somewhat throughout the System, the annual habitat management planning process that has been employed by the Sacramento NWR since the mid-1980s provides a useful example, particularly because it takes into account nearly all refuge programs and their associated disciplines.[95] The result is an annual plan for each habitat unit within the Sacramento NWR.[96] Such monitoring efforts should not be limited to any one aspect of the plan, as a review of all components will be needed to help direct management changes in the future.[97]

Biological inventory and monitoring data can help elucidate a refuge's relative contribution to biological integrity at the refuge,

---

92. M.E. HEITMEYER ET AL., THE CENTRA.L, IMPERIAL, AND COACHELLA VALLEYS OF CALIFORNIA 3 (1988) (from the proceedings of Habitat Management for Migrating and Wintering Waterfowl in North America, Symposium, Jan. 24–28, 1988, Jackson, Miss.).

93. *See generally* SACRAMENTO RIVER ADVISORY COUNCIL, SACRAMENTO RIVER CONSERVATION FORUM HANDBOOK: RESTORING THE RIPARIAN FOREST OF THE SACRAMENTO RIVER 2-1 (2004), *available at* http://www.sacramentoriver.ca.gov/publications/handbook/2003_handbook/Webready_chapters/Ch2_SacRivHand03_webready.pdf (last visited Dec. 20, 2004).

94. SACRAMENTO NAT'L WILDLIFE REFUGE COMPLEX, ANNUAL NARRATIVE REPORT § F1 (CY 1993).

95. Mensik & O'Halloran, *supra* note 79, at 25.

96. *See generally* U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE: MANAGEMENT ACTIVITIES, *at* http://refuges.fws.gov/profiles/index.cfm?id=11619 (last visited Dec. 20, 2004).

97. Mark A. Strong et al., *Converting Rice Fields to Natural Wetlands in the Sacramento Valley*, 26 TRANSACTIONS W. SECTION WILDLIFE SOC'Y 29, 29–30 (1990).

ecosystem, national, and international levels. In the case of the Sacramento NWR, the quality of wetland habitats and their availability to—and use by—migratory waterfowl address biological integrity at the refuge scale. At the ecosystem scale, peak duck populations supported by the refuge represent 25 percent of the entire Sacramento Valley's midwinter population index.[98] From national and international perspectives, the Sacramento Valley supports nearly 65 percent of California's wintering ducks, while California accounts for approximately 65 percent of the Pacific Flyway's total.[99] As a result, Sacramento's peak duck population amounts to 10 to 15 percent of the Pacific Flyway's entire Midwinter Waterfowl Survey duck population index. The comparison is even more dramatic when considering individual species. For example, the total fall population index for the Pacific Flyway's Greater White-fronted goose population in recent years has ranged from, approximately, 350,000 to 450,000.[100] Recent fall survey totals for the Sacramento NWR have exceeded 180,000, or 40 to 50 percent of the Flyway total.

Although Sacramento's waterfowl numbers are impressive, one of the greatest benefits of adopting a habitat management program that mimics natural hydrology is providing habitats that support a diversity of native fish, wildlife, and plant species that had evolved with historic ecosystem processes. This biological diversity is reflected in Sacramento's species list, which currently includes approximately 400 species of plants, 300 species of birds, and 50 species of mammals, reptiles, and amphibians.[101] The majority of these species are dependent upon wetland habitats. While many of the waterfowl are migratory, crossing state and national boundaries as they move from summer breeding grounds to wintering habitats and back again, Sacramento's

98. *Compare* Carmen M. Thomas et al., *Sacramento National Wildlife Refuge, Effects of Tillage on Lead Shot Distribution in Wetland Sediments, at* http://sacramento.fws.gov/ec/lead%20shot%20report.htm (last visited Dec. 14, 2004), *with* U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE: WILDLIFE OBSERVATION, *at* http://sacramentovalleyrefuges.fws.gov/observation.htm (last visited Dec. 14, 2004).

99. *Compare Statewide Count Shows Increased Duck Numbers: Mid-Winter Inventory Shows 3.26 Million*, GRASSLAND TODAY, Jan.-Feb. 2004, *at* 2, *at* http://www.grasslandwetlands.com/grasslandtodayvol14no3/page2.html (last visited Dec. 15, 2004), *with* ROBERT E. TROST & MARTIN S. DRUT, U.S. FISH & WILDLIFE SERV., 2004 PACIFIC FLYWAY DATA BOOK: WATERFOWL HARVESTS AND STATUS, HUNTER PARTICIPATION AND SUCCESS, AND CERTAIN HUNTING REGULATIONS IN THE PACIFIC FLYWAY AND UNITED STATES 97 (2004), *at* http://pacificflyway.gov/Documents/PF_databook.pdf (last visited Dec. 14, 2004).

100. TROST & DRUT, *supra* note 99, at 94.

101. U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE: DRAFT CCP/EA app. at G-1-G-24 (2004), *at* http://pacific.fws.gov/planning/draft/docs/CA/sacriver/Appendices.pdf (last visited Dec. 15, 2004).

wetlands do not occur with precisely the same timing as would have been found historically. Based upon existing information, seasonal wetlands did not begin flooding during August.[102] However, the wetland habitat base was much larger a century ago.[103] If five or ten percent of the receding wetlands from the previous flooding cycle remained inundated by late summer (also known as permanent and semi-permanent wetlands), that acreage would have equaled or exceeded the present day total wetland acres.[104] Because early fall migrant shorebirds and waterfowl depended upon those remaining acres in the past, the "early" flood release practiced today replaces wetland habitat that would have existed naturally.

Maintaining Biological Integrity

Given this evidence, it might be easy for some to claim success in addressing refuge biological integrity. However, given the constant changes in regional agricultural practices, challenges to refuge water supplies, human population growth, and resulting requests by special interest groups, maintaining the Sacramento NWR's biological integrity may prove to be even tougher than restoring it in the first place. Once again, there is a clear benefit to employing a habitat management program that incorporates monitoring, documentation, and analysis capabilities.

For example, consider a request made for expansion of the refuge public tour route. Such a request is realistic because the majority of the refuge's public use is associated with wildlife observation and the tour route is extremely popular during the fall and winter months.[105] In response to our hypothetical, refuge staff can, with minimal disturbance, use monitoring data to compare wildlife use on habitat units immediately adjacent to the existing tour route with those from units in more isolated refuge locations. The comparative wildlife use statistics can then be used to determine if expansion of the tour route would likely

102. Ted Sommer et al., *California's Yolo Bypass: Evidence That Flood Control Can Be Compatible with Fisheries, Wetlands, Wildlife, and Agriculture*, 26 FISHERIES 6, 8 (2001), *available at* http://wfcb.ucdavis.edu/www/Faculty/Peter/petermoyle/Yolo%20FishEries%20Paper%202001.pdf (last visited Dec. 15, 2004).

103. U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX: RESOURCE MANAGEMENT: REFUGE HISTORY, *at* http://sacramentovalleyrefuges.fws.gov/history.htm (last visited Dec. 15, 2004).

104. *See* N. CAL. WATER ASS'N, LAND ACQUISITION PROGRAMS FOR HABITAT PROTECTION IN THE SACRAMENTO VALLEY 13 (1999), *at* http://www.norcalwater.org/pdf/land%20acq%20report.pdf (last visited Dec. 15, 2004).

105. *See* SACRAMENTO NATIONAL WILDLIFE REFUGE, *at* http://www.stateparks.com/sacramento.html (last visited Dec. 15, 2004).

have a significant impact on refuge wildlife. If the data indicate that wildlife use in habitat units along the existing tour route is similar to more isolated units, then the expansion would not likely significantly impact wildlife use. On the other hand, if the monitoring data indicated lower wildlife use in habitat units along the tour route when compared with more isolated units, refuge staff would likely deduce that tour route expansion would have a significant impact on wildlife use.

Although this example is simplistic, the assessment is the first and most important step in any "wildlife first" policy. In addition, other variables must also be considered to adequately assess expanded public use, including the extent of the impacted habitat relative to the total availability of similar quality habitat on the refuge. Considering the FWS "wildlife first" directive[106] and applying sound professional judgment, a refuge manager can use these assessments to determine the appropriateness of new or expanded uses on the refuge.

Another hypothetical might involve waterfowl hunters requesting that the refuge produce more ducks. Specifically, the refuge manager may be asked to convert seasonally flooded wetlands to permanent ponds in order to provide more brood-rearing habitat for ducks. To assess the effects of such an action, the refuge manager could analyze monitoring data to assess potential effects on the priority species identified in the refuge purposes. For the Sacramento NWR, this analysis would indicate that permanent or semi-permanent wetlands required for breeding ducks receive comparatively less use by wintering waterfowl and other wetland dependent migratory birds than do seasonally flooded wetlands.[107] Based upon sound professional judgment, the refuge manager could deny the request because the loss of wintering waterfowl carrying capacity, for which the refuge was created, would be too great.

While these are only two of any number of examples that could occur and have occurred, both demonstrate the challenges to achieving refuge purposes while maintaining biological integrity at multiple landscape scales.

Improving Upon the Refuge's Biological Integrity

Do the examples discussed in this article mean that refuge management can only involve those actions that directly benefit wintering waterfowl and other wetland dependant migratory species, as

106. U.S. FISH & WILDLIFE SERV., *supra* note 14.

107. *See* SACRAMENTO NAT'L WILDLIFE REFUGE, REFUGE BIO MONITORING DATA SUMMARY (2003).

referenced in the original refuge purposes? What about restoring or improving upon biological integrity where appropriate? Is this possible? We believe the answer is "yes," so long as individual refuges continue to fulfill the roles and responsibilities for which each was originally established. Two additional examples from the Sacramento NWR illustrate our point.

Cooperative Rice Program

In the early eighties, the Sacramento refuge addressed much of its responsibility for preventing crop depredation through a cooperative farming program.[108] A local farmer was employed to grow hundreds of acres of rice on refuge land each year. As payment, the farmer was allowed to commercially harvest approximately two-thirds of the standing crop.[109] The remaining one-third was left for consumption by local and early migrant waterfowl, primarily Pintail and Mallard ducks.[110] By providing an alternate crop, the refuge hoped to attract and hold these birds off of the surrounding, unharvested rice fields.

However, this arrangement also resulted in several hundred refuge acres of harvested rice stubble. Given the local cropping pattern, rice stubble was not a "habitat type" that was in short supply, as there were tens of thousands of such acres created in Glenn County annually.[111] What was in short supply, of course, were seasonally flooded wetlands, which historically provided habitat for wintering waterfowl and other migratory birds. Despite being used to accomplish a goal that was central to Sacramento NWR's establishment (*i.e.*, preventing crop depredation), the cooperative farming program became a significant concern of the refuge manager and his staff.[112]

After reviewing data on existing habitat management strategies, refuge managers determined that producing a more natural moist-soil plant community would provide approximately the same food resources for migratory waterfowl and, at the same time, would more closely approximate the historical wetland system.[113] Therefore, the refuge manager decided to terminate the farming program.[114] In its place, the

108. U.S. FISH & WILDLIFE SERV., NARRATIVE REPORT: SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX § F.4 (CY 1983) [hereinafter NARRATIVE REPORT 1983].

109. *Id.*

110. HEITMEYER & RAVELING, *supra* note 92, at 22.

111. GLENN COUNTY DEP'T OF AGRIC., 1988 ANNUAL CROP AND LIVESTOCK REPORT.

112. U.S. FISH & WILDLIFE SERV. & CAL. DEP'T FISH & GAME, PACIFIC FLYWAY WATERFOWL IN CALIFORNIA'S SACRAMENTO VALLEY WETLANDS II (1983).

113. *See, e.g.*, NARRATIVE REPORT 1983, *supra* note 108, §§ F.1, F.4.

114. *Id.*

refuge manager grew a rice crop on a smaller proportion "force-account," utilizing the equipment and refuge staff.[115] It was the manager's belief that these two sources of alternate feed, coupled with the careful staging of the fall flood-up of seasonally flooded refuge wetlands, would collectively serve to prevent crop depredation.[116]

Under our proposed policy, refuge waterfowl use and depredation complaints would be monitored and compared to past years to determine the outcome. If crop depredation prevention was successful, the amount of rice grown each year would be decreased gradually, with the goal of all refuge acres returning to seasonal or moist-soil management reached as soon as practicable.

Today, no rice is grown in the Sacramento NWR. In its place, hundreds of acres of wetlands of various types have been developed.[117] No "cookbook" existed on how to go about converting these rice fields. Refuge managers, through the planning, implementation, monitoring, and evaluation processes described earlier, developed the methodology to successfully accomplish this task.[118] These techniques have since been made available to private landowners throughout the Sacramento Valley via the FWS Conservation Easement[119] and Partners for Fish and Wildlife Technical Assistance Programs.[120] Wildlife that have benefited include all species—whether endangered, threatened, or abundant; resident or migratory; game or non-game—that are dependent upon wetlands at some point in their life cycle.[121]

Vernal Pools

Vernal pools are shallow basins scattered throughout some refuge uplands.[122] They are not artificially flooded like the managed wetland units. Instead, they flood as a result of persistent winter rainfall and then evaporate in the late spring or summer as temperatures

115. U.S. FISH & WILDLIFE SERV., NARRATIVE REPORT: SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX § F.4 (CY 1984).

116. *Id.*

117. U.S. FISH & WILDLIFE SERV., NARRATIVE REPORT: SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX § F.4 (CY 1989).

118. Strong et al., *supra* note 98, at 29-30.

119. *See* CAL. WATERFOWL ASS'N, INCENTIVE PROGRAMS: WETLAND CONSERVATION OPTIONS FOR PRIVATE LANDOWNERS IN THE SACRAMENTO VALLEY, *at* http://www.calwaterfowl.org/incentive_programs.htm (last visited Dec. 15, 2004).

120. *See* U.S. FISH & WILDLIFE SERV., PARTNERS FOR FISH AND WILDLIFE PROGRAM: WORKING TOGETHER TO RESTORE HABITAT, *at* http://partners.fws.gov/ (last visited Dec. 15, 2004).

121. *See id.*

122. Silveira, *supra* note 54, at 11.

warm.[123] Representative of biological integrity at the refuge scale, these pools are carefully monitored for numerous indigenous, rare, threatened and endangered species.[124] These unique uplands, some of which were once considered for diking and additional wetland impoundments, are now recognized and preserved for their biological integrity.[125] Water levels in surrounding managed wetlands are carefully controlled and water diversion points are monitored to protect the pools from artificial inundation.[126]

In addition to preserving those pools already in existence, the Sacramento NWR managers have attempted to restore vernal pools in areas where they once naturally occurred.[127] Similar to the conversion of rice crops, there is limited information regarding vernal pool restoration, consisting mainly of old aerial photos, U.S. Geological Survey quad maps, and soil surveys. These sources gave the refuge staff clues to what once existed prior to significant human disturbance and helped direct restoration efforts. The preliminary results of these restoration projects are encouraging. Data monitoring and the experience gained by refuge staff serve to continuously refine refuge management strategies and improve opportunities to increase the biological integrity of the refuge.

CONCLUSION

This brief recounting of the Sacramento NWR story has illustrated how a refuge can be managed to establish, maintain, and increase the biological integrity of an individual refuge and the System as a whole. Despite the fact that historic conditions no longer exist, the land can be managed to provide tremendous biological value, whether measured on a refuge or an international scale. A management process that takes into account the history of the area while considering both the refuge's original purposes and newly mandated responsibilities has the greatest chance of success. The Sacramento NWR has a history of doing exactly that—continuing to honor responsibilities to wildlife and to the

123. *Id.*

124. SACRAMENTO FISH & WILDLIFE OFF., VERNAL POOL ENDANGERED SPECIES, *at* http://sacramento.fws.gov/ecosystems/vernal_pools/vernal_spp.htm (last visited Feb. 17, 2004).

125. *See generally* THE RESOURCE AGENCY, DEP'T OF FISH & GAME, STATE OF CAL., CALIFORNIA VERNAL POOL ASSESSMENT: PRELIMINARY REPORT: INTRODUCTION (1998), *available at* http://www.dfg.ca.gov/whdab/wetlands/vp_asses_rept/index.htm (last visited Dec. 13, 2004).

126. *See* U.S. FISH & WILDLIFE SERV., SACRAMENTO NATIONAL WILDLIFE REFUGE, *at* http://refuges.fws.gov/profiles/index.cfm?id=11619 (last visited Dec. 13, 2004).

127. Silveira, *supra* note 54, at 18.

public for which it was established while also attempting to expand upon its value system in order to maintain and, where appropriate, restore biological integrity, diversity, and environmental health whenever possible.

The Sacramento NWR does not stand alone as an example. Rather, it is representative of lands and waters managed by refuge employees who are dedicated to achieving refuge purposes while maintaining the biological integrity, diversity, and environmental health of the National Wildlife Refuge System.