Integrating Science with On-the-ground Management: A Two-state Plan for Ground Nesting Birds

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History and Background

Wildlife Habitats of the Prairie Pothole Region

The once extensive and contiguous grasslands and wetlands that dominated North Dakota and South Dakota are now often dissected into islands of habitat buffered by cropland and urbanization. Grasslands lost in North Dakota since settlement are estimated at upwards of 70 percent and are estimated at 50 percent in South Dakota (Conner et al. 2001). More vividly stated, less than 1 percent of the original eastern tall-grass prairie, 30 percent of the mixed-grass prairie and 35 percent of the short-grass prairie remain in the Dakotas (Samson and Knopf 1994, Samson et al. 1998). Although the further western portions of these states incurred less dramatic losses than the eastern portions, natural processes that sustained the grasslands and wetlands were removed or replaced with less compatible management.

The formerly glaciated portions of North Dakota and South Dakota are located in what is known as the Prairie Pothole Region, and they possess some of the most critical habitat in North America for breeding waterfowl. This region occupies only about 10 percent of the waterfowl breeding range and produces approximately 50 percent of the birds (Kantrud 1983). The various wetland complexes that dot the landscape of this region attract breeding pairs, drive nesting intensity and renesting efforts, and provide brood habitat (Kantrud et al. 1989; R. Reynolds, personal communication 2005). According to Ron Reynolds, U.S. Fish and Wildlife Service, Bismarck, North Dakota, the small wetlands (e.g., temporary and seasonal basins) are the key to attracting duck pairs to the Prairie Pothole breeding areas. As an example, for every 10 1-acre (0.0469-ha)

wetlands, there predictably will be 20 pairs. Whereas, for 1 10-acre (4.0469 ha) wetland there predictably will predictably be 7 pairs. The availability of wetlands in the Prairie Pothole Region is a primary factor driving duck breeding in this region (R. Reynolds, personal communication 2005).

According to Conner et al. (2001), the human impacts to the diversity of the biota of the North American grasslands are likely the most significant of all terrestrial ecosystems on the continent. When dramatic environmental changes occur, wildlife and plants may adapt and proliferate. Conversely, they may be reduced and even may become extinct in some cases. When immersed within grasslands, the wetland embedded landscape of the Prairie Pothole Region certainly provides more habitat for wetland-dependent wildlife than in landscapes where the uplands are entirely converted to crop production (Naugle et al. 2001). Several species of waterfowl and other wetland-dependent birds commonly nest in the grassed uplands surrounding wetland complexes; therefore, loss of grasslands results in the loss of productivity. Converting the native sod of this region to cropland directly impacted waterfowl by reducing and fragmenting the available breeding cover for grassland nesting species (Sugden and Beyersbergen 1984, Batt et al. 1989). According to Greenwood et al. (1995), duck nest success in the Prairie Pothole Region increases as the amount of perennial grassland on the landscape increases; further, Reynolds et al. (2001) determined that, with increased perennial cover, the daily survival rates of several duck species also increases. Specifically, for every 1-percent decline of priority grassland in the Prairie Pothole Region, there will be approximately 25,000 fewer ducks in the fall (R. Reynolds, personal communication 2005). Klett et al. (1988) also adds that nest success is usually lowest in cropland, hayland and right-of-ways, while more success is seen in grassland areas, such as planted cover (e.g., Conservation Reserve Program land).

Predator-Prey Dynamics

Across the prairie landscape, habitat conversions specifically changed the predator-prey relationships and actually bolstered the populations of several waterfowl predators. Issues related to waterfowl predation are highly connected to the changes in the landscape and, ultimately, to changes in the predator populations (Sovada et al. 2005). Prior to settlement, the highest ranking predators across the region were the gray wolf (*Canis lupus*) and an occasional grizzly bear (*Ursus arctos*). Less abundant across the landscape were coyotes (*Canis*

latrans) and red foxes (*Vulpes vulpes*), while swift fox (*Vulpes velox*) populations were high. In a precipitous manner, gray wolves were nearly eliminated from the area, followed by a spike in coyote populations. The elimination of the gray wolf from the region had a profound impact on mesopredators, especially the other canids. Wolves are highly territorial and intolerant of other canids. Thus, fox and coyote abundance was limited and somewhat controlled by wolves. However, after the extermination of gray wolves from the prairies, fox and coyote populations grew. Subsequently, coyotes were targeted with a bounty and populations were driven down. This increased the abundance and distribution of the red fox, which adversely affected waterfowl populations because red foxes are a primary predator of nesting waterfowl and their eggs (Sargeant et al. 1993, Sovada et al. 1995). Populations of other species that were scarce and narrowly distributed expanded greatly as well, including raccoon (*Procyon lotor*) and American crow (*Corvus brachyrhynchos*). Predator species composition is noteworthy because of the impacts on waterfowl survival (Greenwood et al. 1995, Sovada et al.1995). Most waterfowl depredation is caused by Franklin's ground squirrels (*Spermophilus franklinii*) and six carnivores (raccoon, mink [*Mustela vison*], striped skunk [*Mephitis mephitis*], badger [*Taxidea taxus*], red fox and coyote) (Sargeant and Arnold 1984). Sargeant et al. (1993) determined that predation rates on waterfowl nests early in the nesting season increased simultaneously with the increase in the abundance of red foxes, badgers and American crows. Whereas, late in the nesting season, predation increased with the abundance of red fox and striped skunk.

Additionally, from a habitat perspective, fragmentation of the landscape caused by the wetland and grassland losses created edge effect, which negatively impacted many indigenous species and exacerbated predation. In theory, predators reside in areas that provide the necessary resources and, likely, will remain in or frequent that area as long as their needs are met at a more efficient level than what is provided by the surrounding landscape (Charnov 1976, Stephens and Krebs 1986). Relating this to the prairie, the patchy grassland habitats that are interspersed throughout the agricultural lands provide attractive food sources to predators, compared to sources from the surrounding croplands (Greenwood et al. 1999). Charnov (1976) indicates that predators will actually spend more time in these isolated grassland patches considering the increased efforts required to access these areas, i.e., they must traverse crop fields, roads and human dwellings to get to grasslands.

Science

Predation on Waterfowl and Other Ground Nesting Birds

Although predation is a natural component of population biology, analyses of waterfowl evidence suggests that it is a significant factor in reducing nesting success (Duebbert and Lokemoen 1980, Klett et al. 1988, Sargeant and Raveling 1992). The hatch rate of duck nests in U.S. Fish and Wildlife Service managed waterfowl production areas and national wildlife refuges on much of the Prairie Pothole Region, is often less than the 15 to 20 percent suggested for stability of populations of the 5 most common species of dabbling ducks (Cowardin et al. 1985, Greenwood 1986, Klett et al. 1988, Greenwood et al. 1990). Further, Sargeant and Raveling (1992) indicate that predation is the primary cause of nest loss of North American waterfowl during the breeding season.

Nesting waterfowl and predators are concentrated in islands of habitat, which further influences the unbalanced relationship between the two. It is likely that the decrease in the abundance of alternative prey increases predation on waterfowl (Sargeant and Raveling 1992). Also, it is well documented that ducks nesting in blocks of dense vegetation are less vulnerable to predation (Duebbert 1969, Duebbert and Kantrud 1974, Duebbert and Lokemoen 1976). Expanses of cover likely provide ducks and predators with increased nesting and foraging options, reducing the predation on waterfowl. Landscape level programs, such as the Conservation Reserve Program, provide more benefits than simply focusing on increasing grassland patch size (Reynolds et al. 2001). Converting cropland to grassland and reducing fragmentation on this level may be a viable solution in theory; however, practicality limits the progression of such activities. In order to improve waterfowl nesting success through cropland conversion, the relationship between patch size and composition must be considered (Clark and Nudds 1991). Reynolds et al. (2001) indicate that, on average and dependent on certain variables, 40 percent of the landscape must be in grassland cover for mallards (*Anas platyrhynchos*) to obtain a nest success of between 15 and 20 percent (population maintenance level).

The major source of mortality for North American waterfowl during the breeding season is predation (Sargeant and Raveling 1992), with greater than 70 percent of nest failures attributed to predation (Sovada et al. 2001). Managers are confronted with this problem because it causes a reduction in the annual production of waterfowl, and it decreases the effectiveness of habitat

conservation activities (Sovada et al. 2001). In cropland-dominated landscapes where nesting habitat is limited and predation is high, restoration efforts on wetlands and uplands may be futile for increased waterfowl production. In these situations, improvements to the habitat alone do not effectively manage predation. Rather, management of predators is a necessary addition. Predation is symptomatic of habitat loss and deterioration (Sovada et al. 2001), and, specifically in the Prairie Pothole Region, nest success is negatively correlated with the percent of cropland (Greenwood et al. 1995, Reynolds et al. 2001). The interactions of a fragmented landscape and unbalanced predator community may limit attempts to increase waterfowl hatch rates (Sargeant et al. 1995). Recently, Devries et al. (2003) found that 50 percent of the mortality in nesting mallard females occurs while they are known to be nesting, despite the fact that they only spend 20 percent of the nesting season on the nest. Further, Hoekman et al. (2002) state that nest success, hen survival and duckling survival are the most critical and important factors in increasing mallard recruitment.

Managing Habitat and Predation for Ground Nesting Birds

Prairie grasslands and wetlands evolved with natural disturbances, and changes or interruptions in these processes alter species composition by reducing native species and by increasing invasive species. Across North Dakota and South Dakota, these natural regimes are, by most accounts, absent due to human interventions that modified the physical and biotic conditions of the landscape (Hobbs and Huenneke 1992). Wildlife managers often use various tools to emulate the defoliation activities by which prairie plants evolved, including prescribed fire and herbivore grazing. These activities are necessary for maintaining the integrity and viability of habitats to support wildlife. Managing grasslands and wetlands for wildlife productivity is a labor-intensive and costly effort. Many organizations tasked with managing lands fail to meet habitat objectives because of limited funding and staff.

Managers are also tasked with attempting to balance predator-prey relationships of the current landscape. Waterfowl production is impacted differently by individual predators based on the behavior, food needs and abundance of a particular predator species (Sargeant et al. 1993). Raccoons, as an example, adapted to the monotypic grain crops that replaced the native sod, and found habitat in planted tree rows and buildings dotting the landscape. Raccoons substantially depredate waterfowl eggs and may partially or totally

destroy a clutch (Sargeant and Arnold 1984). Additionally, Phillips et al. (2003) determined that, on landscapes with a low grassland composition, red fox gravitate to the isolated patches of planted cover. Striped skunks, on the other hand, are attracted to the edges of agricultural wetlands, meaning that ducks nesting closer to wetlands may be more vulnerable to skunk predation (Phillips et al. 2003). Unless predator populations change or agricultural practices change, the waterfowl and predator imbalance will remain unresolved (Sargeant and Arnold 1984). Adequate habitat management over the long term, integrated with predator management strategies, may increase the nest success of prairie nesting ducks (Duebbert 1969, Duebbert and Kantrud 1974, Sovada et al. 2001).

Other studies indicate that the removal of mammalian predators increases upland and overwater nest success, and it enhances duckling survival. Garrettson and Rohwer (2001) reported significant increases from the control to trap blocks (16-square-mile [41.44-km^2] blocks) in Mayfield nest success; the controls were 23 percent and the trapped blocks were 42 percent. This large and highly replicable study encompassed 9 pairs of trapped and untrapped blocks over a 3-year period. Mense (1996) evidenced that nest success of diving ducks increased significantly on trapped sites as well, going from 29 percent Mayfield nest success on the control sites to 57 percent on the trapped sites. Further, Zimmer (1996) assessed the impacts of predator reduction on duckling survival. Overall duckling survival in northern shovelers (*Anas clypeata*) increased from 50 percent to 71 percent on untrapped to trapped sites, respectively, and brood size was 70 percent higher on the trapped compared to the controls (Zimmer 1996). Hoff (1999) assessed the impact of predator removal on 36-square-mile (93.24-km^2) blocks and determined that the Mayfield on the trapped sites averaged 36 percent, compared to 15 percent on the untrapped sites. Also, trapping results from the intensively farmed prairies of Canada showed an increase in duckling survival with 33 percent on untrapped sites, compared to 54 percent on trapped sites (Pearse and Ratti 2004). Additionally, Chodachek and Chamberlain (2006) assessed small trap blocks (1-square-mile [2.59-km^2] blocks) and even saw an improvement in nest success in these areas. The nest success nearly doubled, even on these smaller blocks, resulting in an average of 53.4-percent Mayfield nest success on the trapped blocks and a 28.7-percent success on the control blocks (Chodachek and Chamberlain 2006).

In efforts to assess the effects of predator removal under typical management conditions, the U.S. Fish and Wildlife Service cooperated with

partners in North Dakota to apply direct predator management on sites in the heavily cropped and fragmented Drift Prairie physiographic region. Simulating Hoff (1999), predators were removed from 36-square-mile (93.24-km^2) blocks, resulting in an average Mayfield nest success from 2001 to 2006 of 51.62 percent (Figure 1). Although studies show that nest success is the greatest contributor to variation in waterfowl production (Johnson et al. 1992, Hoekman et al. 2002), brood survival is the second major component in waterfowl recruitment (Hoekman et al. 2002). As described, predator reduction may enhance both of these variables.

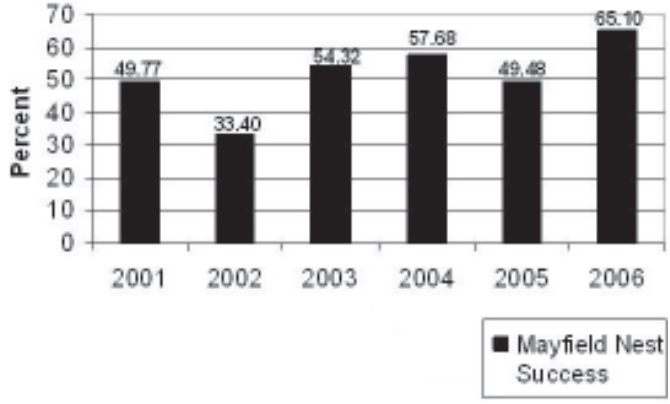

Figure 1. This documents the average percent Mayfield nest success per year for 36-square-mile (93.24-km^2) trap blocks in North Dakota, between 2001 and 2006. The long-term average for these years is 51.62 percent.

In addition to waterfowl, predation on passerines, on other nongame birds and even on upland game birds is considered an important cause of nest failure (Martin 1988, 1995). Specifically, predator communities in fragmented landscapes, such as the Prairie Pothole Region, do not provide safe nesting sites for songbirds (Dion et al. 2000). An independent group of ornithologists indicated that the sedge wren (*Cistothorus platensis*), common yellowthroat (*Geothylpis trichas*), dickcissel (*Spiza americana*), clay-colored sparrow (*Spizella pallida*), lark bunting (*Calamospiza melanocorys*), savannah sparrow (*Passerculus sandwichensis*), song sparrow (*Melospiza melodia*), bobolink (*Dolichonyx oryzivorus*) and red-winged blackbird (*Agelaius phoeniceus*) would benefit from predator fence exclosures designed to reduce the impact of medium to large mammals. They also concluded that predator barriers, such as fences, are very beneficial to larger nongame migratory birds, including northern harriers

(*Circus cyaneus*), short-eared owls (*Asio flammeus*), and American bitterns (*Botaurus lentiginosus*) (Berkey et al. 1993). Additionally, Helmers and Gratto-Trevor (1996) determined that predation causes a significant impact to shorebird nest success, especially in southern areas of their breeding range. Finally, Witmer et al. (1996) indicate that two factors, protection or restoration of habitat and predator management, may curtail listing and extinction rates of avian species.

There is also evidence that predator management may provide benefits to upland nesting game birds, such as ring-necked pheasants (*Phasianus colchicus*). In a study by Trautman et al. (1973), the overall pheasant population on 3 study areas increased 338 percent after 5 years of reduced predation, due to intensively controlled predator populations (fox, raccoon, skunk, badger). In comparison, 3 associated nonpredator control areas increased only 53 percent (Trautman et al. 1973).

Concept

For the purpose of this manuscript, a cropland-dominated landscape is an area altered to such a degree that, even though habitat protection is implemented, it does not guarantee migratory bird recruitment above maintenance levels on a consistent basis. Likely, such areas consist of less than 40 percent grassland cover, generally indicative of the drift prairie physiographic region in eastern North Dakota and South Dakota where conventional cropland tillage dominates the landscape (Dixon and Hollevoet 2005). Current wildlife managers of such landscapes must, therefore, implement management that emulates the ecological process of more pristine times to sustain and increase ground nesting bird populations.

Adaptive management in cropland-dominated landscapes requires collaboration among partners to ensure science-based development and progression. The partners involved with various current management regimes in North Dakota and South Dakota developed *Ground Nesting Bird Management on Cropland Dominated Landscapes within the Prairie Pothole Region of North Dakota and South Dakota* (Dixon and Hollevoet 2005) to articulate their strategies for adaptive management. This document steps down the objectives stated in the Prairie Pothole Joint Venture Implementation Plan (PPJVIP) in a way that is locally applicable to wildlife managers and biologists. Working within the framework of the PPJVIP expands the partnership opportunities and collaboration that can occur from a local, state,

regional, national and even a continental level to accomplish more for the resource. The prominent purposes of the Dixon and Hollevoet (2005) plan include:

1. to increase recruitment of ground nesting birds in cropland-dominated landscapes of North Dakota and South Dakota
2. to protect, restore and enhance habitat to address landscape level habitat needs
3. to synthesize the background and the research related to ground nesting bird management on cropland dominated landscapes
4. to serve as a management plan for federal and state agencies in North Dakota and South Dakota, specifically for field staff use
5. to manage risk by ensuring that optimal habitat will be available across physiographic regions when climatic variables provide for optimal conditions
6. to provide background documentation for potential partners and contributors.

These purposes echo visions of the designers of the North American Waterfowl Management Plan (NAWMP), which address the need to reverse the population declines of waterfowl caused by habitat fragmentation and degradation. The NAWMP focused much effort on habitat management, while recognizing that habitat improvements in heavily fragmented areas may not effectively manage predator populations (Sovada et al. 2001). The 2004 NAWMP strategic guidance document presents strategies to meet the challenges, and one of these strategies addresses the deficiencies in the breeding habitat in the midcontinent prairie region, including eastern North Dakota and South Dakota. Predator management is one tool that will address these deficiencies, and, as Sovada et al. (2001) indicate, the long-term conservation of waterfowl must incorporate strategies to limit predation impacts.

The Dixon and Hollevoet (2005) plan provides the long-term framework to increase waterfowl and other wetland-grassland bird production in cropland-dominated landscapes of the Prairie Pothole Region of North Dakota and South Dakota. The vision, goals and objectives provide the structure necessary to bring the intended purposes to fruition. As a vision statement, this plan states: "In a partnership effort, local individuals, private donors, grass roots groups, state and federal agencies, and nongovernment organizations will strive to ensure the long-term viability of breeding waterfowl and other birds throughout the

cropland-dominated areas of North Dakota and South Dakota" (20). The development of the goals and objectives incorporates the findings of Hoekman et al. (2002), which suggest that variations in mallard-population growth are primarily dependent on nest success, on survival of adult females during the breeding season and on duckling survival. Further, as a visual approach to conceptualizing the necessary steps for effective bird conservation within the Prairie Pothole Region, the Hollevoet pyramid (Figure 2)—developed by Roger Hollevoet, U.S. Fish and Wildlife Service, Devils Lake, North Dakota—was also integrated in the development of goals and objectives. This approach provides a hierarchy for providing optimal management for grassland nesting birds in the cropland-dominated landscapes of the Prairie Pothole Region.

Figure 2. The Hollevoet-pyramid approach to ground nesting bird management in cropland-dominated landscapes of the Prairie Pothole Region of North Dakota and South Dakota. *(Developed by Roger Hollevoet, U.S. Fish and Wildlife Service, Devils Lake, North Dakota)*

Implementation—The Pyramid Approach

Habitat Securement and Management

The science reveals that landscape changes and the resulting predator population changes challenge modern managers and biologists. Striving to remediate the challenges associated with the losses of grasslands and wetlands

in cropland-dominated landscapes requires a multifaceted approach. First, it is vital that habitat securement and protection be the major baseline effort, especially to ensure that current losses are not worsened or expanded. Strategies to carry out this foundational level of the Hollevoet pyramid (Figure 2) include fee-title and conservation-easement purchases, which are perpetually managed and protected by a government agency or nongovernment group. Additionally, conservation-oriented, private-land programs often associated with government agencies, such as the U.S. Fish and Wildlife Service, state wildlife agencies and the U.S. Department of Agriculture, provide at least short-term protections. In the case of programs like the Conservation Reserve Program, millions of acres of land were under protection for at least a 10-year period. Also, assemblages of government and nongovernment groups propagate the North American Waterfowl Management Plan, which continues to provide framework and funding for habitat protection, especially in migratory bird breeding areas.

Management of protected habitats is also crucial to ensure long-term functionality of these lands for associated wildlife. The prairie landscape evolved by natural disturbances caused by large herds of grazing ungulates and by uncontrolled fires. Current wildlife managers strive to emulate these natural processes by implementing a repertoire of management, including prescribed fire, mechanical haying and herbivore grazing. Further, the management of lands within cropland-dominated landscapes requires controlling and eliminating invasive plants using integrated pest-management strategies.

Restoration and Species Management

In cropland-dominated areas of eastern North Dakota and South Dakota, often restoration of grasslands and wetlands is necessary to return at least some portion of the landscape functionality. Reseeding cropland areas to grass and restoring hydrology to drained and filled wetlands are intense and costly measures that are routinely undertaken for the benefit of breeding waterfowl and other ground nesting birds. Cropland-dominated landscapes may also require the use of specific species-management techniques that address issues, such as hen survival, nest success and brood survival. A combination of habitat-restoration efforts and species-specific management will be necessary to improve viability for wildlife. The Hollevoet pyramid (Figure 2) includes habitat restoration and species management as necessary intensive management efforts that attempt to remediate historical changes prevalent on cropland-dominated landscapes.

Science and Limiting Factors

Nearing the peak of the Hollevoet pyramid (Figure 2), it is evident that science-based management decisions are necessary to lead the efforts described for the base of the pyramid. The art of habitat management in cropland-dominated landscapes requires a symbiotic relationship between management and biology that strives to make sense of the optimal functionality that can be achieved in balance with the overriding limitations. It is imperative to review the management practices through monitoring or research and to react to any limiting factors that may inhibit success. Essentially, current managers, in places like the Prairie Pothole Region of North Dakota and South Dakota, take on the role of bison, wildfire and the dominant predator. This concept of applied management increases the likelihood of success as managers attempt to provide the ecological functions of the prairie.

Partnerships

There is no doubt that conserving migratory bird species, such as waterfowl and other prairie nesting birds, is an incredibly challenging task. Birds, such as ducks, move across several international borders and rely on increasingly fragile and valuable habitat. Securing breeding waterfowl and other bird populations in cropland-dominated areas, such as North Dakota and South Dakota, is an uphill battle against the immense and sometimes immovable forces of agricultural economics. Although it is not necessarily an innate role, wildlife managers and biologists must foster partnerships to identify methods to integrate wildlife conservation into an agriculture-commodity-based landscape. A major step in this partnership effort was the development of the North American Waterfowl Management Plan (NAWMP) in 1986, which initiated or enhanced a new age in the conservation of waterfowl and habitats. NAWMP articulates that the success of a broad-scale conservation strategy would consist of landscape-level ventures being led and carried out by a large, cooperative, adaptive, conservation community. This community needs to include federal, state and local governments, conservation organizations, natural resource groups, private donors, and landowners. The original plan identified general objectives for habitat conservation in various regions with the belief that each region would further enhance and implement these broad objectives through the development of local action plans.

Stepping down this overarching partner framework, are the joint ventures that exist across the United States and Canada. These were intended to develop

a means for governments, private organizations and individuals to plan, fund and implement local waterfowl conservation efforts. The joint ventures have grown into successful organizations that are now regional and are models for planning and delivering cooperative projects protecting important habitats and wildlife. These successful joint ventures also show a need to step down the implementation process to local action plans, such as the plan entitled *Ground Nesting Bird Management on Cropland Dominated Landscapes within the Prairie Pothole Region of North Dakota and South Dakota* (Dixon and Hollevoet 2005).

In the uncertain world of conservation that exists within cropland-dominated areas, partnerships are paramount to success. Not only do groups need to pool monetary and human resources to be successful, but they also need to capitalize on respective organizational strengths. For the progression of future partnerships, incorporating elements of creativity and seeking nontraditional partners is necessary for the protection of natural resources. As an example, cropland-dominated areas in North Dakota and South Dakota attract increasing numbers of tourists for recreation, especially recreation related to hunting, fishing and bird watching. Conservation groups in these two states are making strides to collaborate with new partners, such as state tourism groups who may actually be able to provide avenues to protect and restore grasslands and wetlands in these respective areas.

The apex of the Hollevoet pyramid (Figure 2) includes partnerships and science. Visually, these may appear as the pinnacle of this hierarchical image and are essentially resting on or are a product of the base. As a conceptual image though, the pyramid could easily be rotated to rest on the apex, demonstrating that partnerships and science support the other factors in the pyramid. Essentially, as partnerships and science develop and expand, elements in the base of the pyramid will follow suit. This adaptive process—be it science driven or innovation driven—will be a key to insuring that our planning and management actions are successful. Adaptive management is here for the duration.

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