Targeting Conservation for Waterfowl Habitat and Ecological Goods and Services

Ecological goods and services (EGS) are the benefits to humans and other living organisms arising from healthy functioning ecosystems. Landscape ecosystems represented by numerous types of wetlands, grasslands, and forests are important for the survival of waterfowl -- and people. Common examples of ecological services include purification of air and water, flood-water storage and groundwater recharge, and maintenance of biodiversity. Often overlooked are the valued services related to soil renewal, decomposition of wastes, pollination of agricultural crops and natural vegetation, seed dispersal, greenhouse gas mitigation, and visually pleasing landscapes also common to quality waterfowl habitats.

There is a growing recognition of the importance to society that EGS provide for health, social, cultural, and economic needs. Unfortunately, we are losing healthy ecosystems and their EGS at an unsustainable rate, and therefore land managers must devise a host of tools to retain and restore landscapes and their EGS. The North American waterfowl management community recognizes this need and included the following goal in the 2012 NAWMP: ***Wetlands and related habitats sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecological services that benefit society.*** The NAWMP (2012) provides examples of the functions and values to people of wetlands and other waterfowl habitats (Table 1), and recently the NAWMP Science Support Team (NSST) developed recommendations for developing decision support maps to conserve waterfowl habitat and social values (Soulliere et al. 2012).

Table 1. Examples of ecosystem services and functions often associated with wetlands but some of which may be provided by grasslands, forest, and other waterfowl habitat (based on Olewiler 2004).

Ecosystem Service	**Ecosystem Function**	**Values to people**
Water supply	Storage and retention of water	Water storage by wetlands, watersheds and aquifers
Water stabilization	Stabilization of hydrological flows	Moderation of flood events; supply water for agriculture and industry
Nutrient cycling	Storage, internal cycling and processing of nutrients	Nitrogen fixation, nutrient absorption and cycling
Wildlife and fish habitat	Habitat for resident and migratory species	Nurseries, migratory bird habitat, regional habitat for locally harvested species
Genetic resources	Sources for unique biological materials and products	Medicine, products for materials, genes for plant resistance, ornamental species
Recreation	Provides opportunities for recreation	Ecotourism, hunting, fishing, boating
Cultural	Opportunities for non-commercial uses	Aesthetic, artistic, education, spiritual, scientific
Waste treatment	Recovery of mobile nutrients and removal of excess nutrients and compounds	Waste treatment, pollution control, detoxification
Climate stabilization	Regulation of global temperature, precipitation and other climate processes	Greenhouse gas sequestration, cloud formation
Erosion and sediment control	Retention of soil	Prevent soil loss by runoff, wind and other processes

Conservation Decision Support Tools

Building an unbiased decision support system to target conservation that maximizes waterfowl recruitment and survival during the annual cycle requires objective criteria and reliable, scientific information. Already a significant challenge, integrating social values like EGS (Table 1) – which can differ by region – will be even more difficult. The NSST recommends a model-based and scalable approach, recognizing the need for stakeholder participation and transparency. Although priorities for conservation decision makers may vary by state, region, and or flyway, the process used to target integrated conservation can be the same. Moreover, an accepted system for prioritizing conservation can provide mutual terminology and a forum for communication among conservation partners and with other stakeholders.

The NSST developed a draft decision support matrix as a starting point for discussing why and how conservation resources may be targeted in an integrated way, considering waterfowl demographics, habitat factors, and stakeholder and social values including EGS (Soulliere et al. 2012). This weighted-parameter matrix or similar effort must seek to transfer knowledge and make the decision process understandable, repeatable, and adjustable over time with new information or changing priorities. The process allows for adding or deleting alternative criteria, depending on the decision context. Conservation issues, objectives, and measurable criteria are identified and weighted by perceived importance. "Weights" in the matrix represent the relative value decision makers place on different objectives. Thus, adequate stakeholder participation in refining objectives and determining weights to prioritize landscape features will be essential and involve expertise and negotiation.

Valuing the contribution of ecosystem services to humans through economic, ecological, and social accounting demands robust methods to define and quantify these services, and numerous examples for mapping and modeling ecosystem services exist (Crossman et al. 2013). These efforts have often been limited by lack of key spatial data, but scientists have used proxies to represent individual EGS in large-scale analyses. Integrated conservation for waterfowl will likewise be challenged by shortcomings in spatial data, but waterfowl scientists can be informed by what landscape ecologists modeling EGS have learned during recent years.

References

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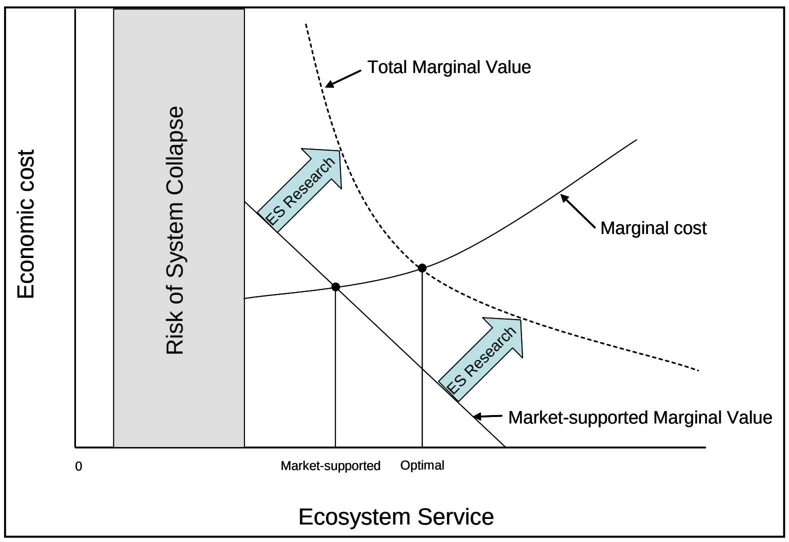
Appendix: Theoretical background using mid-continent agricultural landscape

Public Net Benefits:

Important wetland habitats are being lost, in part, because many benefits society derives from these areas are undervalued, or not valued at all. Typical market valuations provide socially optimal solutions only for goods that are both rival and excludable (i.e. those goods that when consumed prevent simultaneous consumption by others and where it is possible to prevent people access to goods for which they have not paid); but fail for all other types of goods (Gripne 2009). Wetlands provide an excellent example where many of the goods they produce are either not rival (groundwater recharge), not excludable (clean water, wildlife habitat) or neither rival nor excludable (carbon sequestration). In situations where market valuations fail, policy instruments can provide incentives for conservation under certain circumstances where (1) public net benefits exceed private net costs (policy to provide positive incentive) or, (2) where public net costs outweigh private net benefits (policy to provide negative incentive; Parnell 2008). However, an antecedent to policy action is an ability to quantify the public and private values of a landuse practice. The following diagram adapted from Fisher et al (2008), frames the discussion in terms of marginal costs and values.



As ecosystem services decline, the marginal value of each remaining unit increases. However, because markets fail to recognize all benefits provided by natural systems, the market-supported marginal value falls below the total marginal value. In contrast, marginal costs for each additional ecosystem service unit increase. Optimal solutions occur where marginal cost and value lines intersect. Where marginal costs are lower than marginal values, we might expect public policy to provide incentives to acquire or secure additional units of the ecosystem service. Because market-supported values are below total values, additional quantification of the values of ecosystem services through ES research should move the optimal solution to the right, hence, increasing the amount of the service that should be conserved though policy instruments. In situations where marginal costs are higher than marginal values, DUC may need to provide financial incentives for conservation directly or through social marketing that exploits imperfect data.

Individual Net Benefits:

In general, landowners should adopt the land uses that they expect maximize the returns on their investments (Rashford 2008). Both changes to the upland component of an individual farm and decisions about draining wetlands can be portrayed using a generalized logit model:

$$\ln(p/1-p) = \alpha + \sum_k \beta_k X_k + \varepsilon$$

where,

p = the probability of a given landuse
α - intercept
β = the expected effect of each explanatory factor,
X = a vector of all explanatory variables,
and ε = unexplained variation.

Previous empirical work supported by DUC has indicated that decisions about upland composition are a function of expected crop prices, expected crop yields, input prices, soil quality and a number of regional factors (Rashford 2009). Similarly, decisions about wetland drainage are functions of expected crop yields, expected input costs, expected crop prices, 'nuisance' costs, costs of maintaining existing drainage infrastructure, farm size, and policy incentives (Cortus et al. 2010). In addition to physiographic characteristics of the farm, current land use, soil quality, wetland characteristics, and proximity to an existing water conveyance also affect decisions about wetland drainage (Howerter and Boychuk, unpublished). Each of these explanatory variables is directly related to the profitability of the farming enterprise. Thus, strategic gains will be realized by better understanding how these factors vary spatially. Further, we recognize that (1) current information about factors affecting profitability is imperfect, and (2) that other considerations influence land use decisions (e.g., social norms, personal recreation/enjoyment; Gowdy et al. 2010). Clearer understanding of factors affecting land use decisions will position DUC to achieve its habitat goals.

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