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Sustainable Approaches to Managing Small-Scale Ecosystems: A Case Study of Vernal Pool Protection in the Commonwealth of Massachusetts, United States of America

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Abstract

This paper reviews the current management scheme used by Massachusetts to protect vernal pools, which represent small-scale ecosystems, and analyzes the scheme's relative strengths and weaknesses from an overall sustainability standpoint by looking at the frameworks developed for management. The frameworks are analyzed to determine if the objectives of vernal pool protection are being met. The initial impression is the outcomes are not meeting the objective of overall vernal pool protection, because there are failures in the drivers (mainly the *certification* requirement), which limits the number of vernal pools actually protected. An expansion of the current Massachusetts program is suggested to allow for proper consideration of *all* vernal pool resources regardless of their physical location, proximity to *priority habitat*, or their legal status at the time of review. Such an expansion would allow for the quantifiable ecosystem services provided by vernal pools to be more readily protected. However, such an expansion also raises important legal questions regarding the extent to which private property can be regulated in the United States. Although this question is not analyzed within the context of this paper, it may limit the application of certain proposed solutions.

Keywords: Sustainability, Ecosystem-Based Management, Vernal Pools, Policy, Law

1. Introduction

Massachusetts was one of the first states in the United States to actively protect vernal pools (Note 1). While definitions vary slightly within the Massachusetts regulatory regime, "vernal pools" generally apply to ephemeral, isolated, small bodies of water that support amphibian lifecycles, while not supporting fish lifecycles (Brooks & Hayashi, 2002). Because vernal pools support a unique diversity of organisms, some of which rely solely on vernal pool habitat, they have become a focus of ecosystem-based management in recent years.

Due to legal limitations at the national level on isolated, non-navigable water bodies (which defines most vernal pools), state management of these resources is the primary mechanism of protection in many areas (Note 2). The Massachusetts model, focusing on regulatory oversight, can be viewed as an example of primarily state management. While the overall policy goal favors vernal pool protection, a close examination of the regulatory framework shows failures in both the identification and classification of vernal pool habitat. Therefore, the ultimate success of the regulatory program (to protect vernal pool habitat) is called into question.

With development being the main threat to vernal pool habitat in Massachusetts, it is unclear whether the current legislative and regulatory mechanisms are capable of protecting remaining vernal pool resources within the Commonwealth. Thus, it is questionable whether protections afforded vernal pools under current Massachusetts' law are sufficient to protect ecosystem values in a way that promotes long-term sustainable outcomes. To remedy this, it is suggested current Massachusetts' law change to allow for a fuller protection of vernal pools. Some suggestions for improvement are outlined below at the end of the paper. While not analyzed in this paper, there is some concern over how the suggested changes would impact legally protected property rights. This concern highlights the importance of balancing property rights with the need to adequately protect critical environmental resources. Since vernal pools represent microcosms or larger scale ecological values (biodiversity, etc.), the exploration of ways in which to fully protect vernal pools is a good exercise in how we might translate such protections to larger spatial units.

2. The Importance of Vernal Pools as Ecological Units

Vernal pools can be defined as ecological units because they are unique (spatially and temporally), and they support a diverse number of species that rely wholly, or in part, on the resources located in vernal pool habitat (Boyce & Haney, 1997). A number of species that rely on vernal pool habitat have been listed as endangered, threatened, and species of special concern by the Massachusetts Endangered Species Act (MESA) (Homan, Windmiller, & Reed, 2004) (Note 3). Some of these species have also been identified as endangered or threatened under the federal Endangered Species Act (ESA) (Note 4). Examples of species that rely on vernal pools, and are further listed for protection under MESA include:

The Jefferson Salamander (*Ambystoma jeffersonianum*);

Blue-Spotted Salamander (*Ambystoma laterale*);

Marbled Salamander (*Ambystoma opacum*);

Eastern Spadefoot (*Scaphioupus holibrookii*);

Eastern Box Turtle (*Terrapene Carolina*);

Bog Turtle (*Glyptemys muhlenbergii*);

Wood Frog (*Rana sylvatica*);

Intricate Fairy Shrimp (*Eubranchipus intricatus*); and

Wood Turtle (*Glyptemys insculpta*) (Note 5).

Thus, vernal pool habitat is important because it provides a unique geospatial location that is in constant change, and used in the lifecycle of numerous organisms (DeMeester et al., 2005). In addition, due to the high diversity between individual pool systems, it has been shown that vernal pools make significant contributions to local biodiversity (Oertli et al., 2002; Calhoun et al., 2003; Williams et al., 2004). As such, vernal pools offer an opportunity to study the potential impacts of human activities on various ecosystem services. From a regulatory standpoint, they offer the opportunity to study the effectiveness of policies aimed at protecting ecosystem services. For example, if regulatory protections afford the opportunity for vernal pool habitats to flourish, then we can potentially scale-up the policy lessons to larger ecosystems. Thus, vernal pools serve as both important ecological units for localized biodiversity, and as important test sites for the viability of policies aimed at protecting ecosystem values.

3. The Massachusetts System

Massachusetts has one of the longest histories of any U.S. state in protecting small water bodies like vernal pools, based in large part on the recognition of the important ecosystem services provided by vernal pools. However, as will now be discussed, the Massachusetts system of protection is largely ineffective at holistically protecting vernal pool resources. This is largely due to the ways in which Massachusetts' law defines vernal pools, as well as the fragmented policy of providing protection to vernal pools under various legal instruments. The ultimate lesson learned from this case study may be the importance of rigorously defining, and then defending, these invaluable ecosystem services, even when they are provided in small-scale ecosystems. To begin, we review the Massachusetts system to highlight definitional and fragmentation issues. Suggestions for improvement then follow.

Vernal pools are spatially defined as ephemeral depressions that are wet in the early spring, and then dry in the winter (Zedler, 2003). However, vernal pools also have a functional definition. They can be defined by the wildlife value provided to species such as those mentioned above, as well as the water quality value provided individually, or as part of a larger wetland resource (Forman & Deblinger, 2000; Shiravasta, 2007). It is these multiple definitions that give rise to problems in enforcement, and therefore protection, of the ecological resource? Or, is it the habitat itself that is of value, or only when the habitat is shown to be an active hotspot for biodiversity, and therefore support a wilderness value?

There is no single definition of "vernal pools" to be found in the Massachusetts regulatory framework for the protection of vernal pool habitat. Rather, there are multiple definitions based on the general purpose of the law in which vernal pools are identified. For example, the Massachusetts Wetlands Protection Act might define a vernal pool by its overall size and proximity to other water resources (like a river or stream). Meanwhile, the Massachusetts Endangered Species Act might define a vernal pool for protection purposes based on the types of species that are identified as inhabiting a particular pools. The effect of this fragmented definition of vernal pools creates inconsistency in the application of vernal pools protections. Two examples will highlight this inconsistency.

Under the Massachusetts Endangered Species Act (MESA), vernal pools are identified based on their proximity to *priority habitat*, which are areas determined to be used by endangered, threatened, or species of special concern. In order to be considered for protection under MESA, a vernal pool must fall within the geographic range of priority habitat. If it does not, then it does not receive protection. This spatial requirement that only those vernal pools existing within identified priority habitat areas are potentially capable of being protected is, from a scientific standpoint, arbitrary. Most fundamentally, this particular Massachusetts law is making the ecological value of the vernal pool dependent on its proximity to known habitat that supports separate ecological values (say the value of a particular endangered species). This leaves potentially thousands of vernal pools at risk simply because they do not exist in areas predetermined to be priority habitat.

The second example is the Massachusetts Wetlands Protection Act (WPA), which is the primary law focused on the protection of vernal pools in Massachusetts. Rather than directly protect vernal pools, the WPA protects vernal pools that are determined to be part of *wetland resource areas*. Wetland resource areas are determined

based on one of eight categorical functions deemed important under the WPA. (Note 6) If vernal pools are not identified with one of these eight functions, then there is no protection afforded under the WPA. This does not mean vernal pools cannot be protected under the Act, but rather, there must be some connection made between the pool and a categorical function in order to identify the pool as a resource area. The most immediate way of doing this is through the certification process.

Certification is a process whereby the wilderness value of the vernal pool is proven by documentation of one of three methods developed by the Commonwealth's Natural Heritage & Endangered Species Program. (Note 7) In essence, certification requires evidence of biological criteria, fishlessness, and physical criteria in varying degrees depending on the quality of evidence presented. Finally, a means of identifying the geo-spatial location (mapping of the area) is required.

Certification indicates there is a physical location that represents the traditional definition of vernal pool habitat. Also, it identifies the wilderness value that is required for WPA protection. However, this does not ensure protection. Under the WPA, unless the certified vernal pool lies within a resource area, there is no protection. Thus, vernal pools that lie within, or themselves constitute a resource area are the only types of pools that may be protected under the WPA. This leaves a large percentage of potentially important vernal pool habitat unprotected under the WPA.

In the two examples above, we can see how two Massachusetts laws identifying the goal of protecting vernal pool ecosystems place substantial conditions in order for this protection to actually take place. One can argue these conditions place an affirmative duty to prove the ecological value of the vernal pool as a condition or protection. The alternative policy would be to presume the ecological value of the vernal pool resource, and then require an affirmative showing the pool lacks the ecological value as a condition of altering the vernal pool. The science certainly seems to suggest most, if not all, vernal pools are likely to contain important ecological functions, and therefore the presumption in favor of ecological value is likely justified (Leibowitz, 2003; Calhoun, Miller, & Klemens, 2005; Gibbs, 1993).

4. Summary of Failures of the Current Regulatory Scheme

As outlined above, the current regulatory program for the protection of vernal pools in Massachusetts is not comprehensive. There are at least four separate statutes that incorporate some level of protection for vernal pools, and each makes protection conditioned upon an affirmative showing of ecological value, rather than presuming that value exists, and shifting the burden-of-proof to those who wish to alter vernal pool habitat.

Further, the regulatory schemes for protection seem counter-intuitive. For example, the Massachusetts Endangered Species Act requires vernal pools to be identified within priority habitat. Priority habitat is that habitat that is determined necessary for sustaining threatened and/or endangered species. Thus, vernal pools protection becomes tied to the plight of both obligatory and non-obligatory species. If a species recovers and is no longer threatened, than potentially vernal pools once located in priority habitat may find themselves no longer protected. The major concern here is the ecological value of the vernal pool is being tied to some other ecological value. In this example, if a non-obligatory species of animal get delisted, then its priority habitat is no longer a "priority." Thus, vernal pools located in the range of this animal potentially loose protection under this regulatory framework. In this way, we cannot see MESA as a valid regulatory framework to directly protect the ecological values associated with vernal pools. As such, it must be seen as a regulatory failure.

The Massachusetts Wetlands Protection Act fails in adequately protecting vernal pools for many of the same reasons as MESA. Similar to MESA, as one example, the WPA conditions vernal pool protection on the occurrence of some other event. In the case of the WPA, the "event" is identifying a "wetland resource area" from which the vernal pool must be located. If it is located outside such an area, then it is left unprotected.

5. Suggestions for Improvement

Currently, there are approximately 4571 certified vernal pool habitats that have been identified in the Commonwealth as of September 2009 (see Figure 1). This compares with an estimated 26 637 potential sites that are assumed capable of housing the wilderness value identified under the WPA. As stated above, one major problem of the current program is the need to have certification prior to protections being implemented. This results in vernal pools with potentially important wilderness values being destroyed simply because an analysis of the wilderness value was not completed prior to the proposal for development, or because the vernal pool did not exist in an identified resource area.

A more comprehensive management scheme might include the need to assess all vernal pools, whether or not they exist in a resource area or have been certified prior to proposed development for the site. This could easily be done under the existing framework for development in and around resource areas. Local Conservation Commissions are given primary responsibility for protecting resource areas. When a proposal for development occurs within a resource area, Commission review is automatically triggered. The Commission could establish a procedure whereby developers must complete a wetlands analysis, to include identification of potential vernal pool habitat. Policing usually includes a "site inspection" by Commission representatives prior to the public

hearing on the application. If a vernal pool is identified at this time, then a certification procedure could be established as part of the Order of Conditions, i.e., the certification procedure would be triggered prior to considering approval of the permit. If the vernal pool was shown to contain wilderness value, then the special performance standards under the WPA are triggered. While this will not ensure protection of all vernal pool habitats that could contain wilderness value now or in the future, it allows for a more comprehensive scheme of protection that comes closer to the intent of protecting wilderness value in general.

The suggestion of identifying the presence, or absence, of ecological value in a vernal pool habitat prior to issuing a permit is similar to the permitting scheme employed by the Army Corps of Engineers (COE) under the Federal Clean Water Act. The COE permitting process employs a "no filling" unless a permit is issued philosophy. This seems the proper balance, where the burden is shifted onto the applicant to show the presumed value of the wetland resource will be maintained. Although this does not always ensure a wetland area will be completely protected, it allows for a full consideration of the value of the wetland (to include wilderness value in the case of the WPA) before action is taken. The current WPA scheme creates a "race/notice" scenario where the burden is shifted to the permitting authority to justify the ecological value of the vernal pool before enhanced performance standards can be enacted to protect that specific value. Since the value is proven through a certification process, and Conservation Commissions are not mandated to determine certification, it is unlikely vernal pools are receiving appropriate attention for their explicit value in numerous circumstances. For this alone, the vernal pool certification program under the WPA cannot be seen as a holistic success for the protection of species reliant on vernal pool habitat.

For vernal pools outside resource areas (beyond Conservation Commission jurisdiction), a similar condition (identify vernal pools on property) can be part of the building permit process. Again, policing would be the main issue. Local authorities may increase permit fees to offset the added cost of enforcement, but the Conservation Agent may be the person to make a site visit prior to building approval to confirm the non-existence of vernal pool habitat. Also, access to remote sensing data will aid in the process of mapping potential vernal pool habitat within jurisdictional boundaries.

The point in these suggestions is to improve the identification of sites with ecological value by reviewing all vernal pools for certification prior to activity. This should occur regardless of the vernal pool's proximity to resource areas, and should be based on affirmative obligations of public agencies, where the burden is placed on the applicant by conditions placed into the permitting process. The State should carry this burden since the values being protected contain significant public benefits.

6. Conclusion

The management of vernal pools is a complicated process in Massachusetts. For one thing, there are issues of competing jurisdiction at the federal level. For vernal pools existing in federal jurisdiction, there are water quality standards to protect vernal pool habitat. In addition, there are Massachusetts performance standards for vernal pool habitat that lies within resource areas under the WPA. However, these all focus on the water quality issues, i.e., values associated with the water as a resource itself. The stated "wilderness value" that the WPA seeks to protect in vernal pools is less clear, and of importance for the unique biodiversity represented by species that use vernal pool habitat as an integral part of their lifecycle.

If a vernal pool becomes certified under the WPA, then the vernal pool is protected specifically for that wilderness value. Similarly, regulatory programs such as the ESA and MESA will protect wilderness values attached to vernal pools for listed species. Protection under MESA includes the identification of priority habitat, which can extend beyond the immediate area of the vernal pool itself. For those species that are not listed under MESA, the Massachusetts program offers limited protections. Essentially, the vernal pool must exist within a resource area (with narrow exceptions), and the extent of protection is generally limited to the geographic extent of the vernal pool itself. Important upland habitat is left unprotected. Also, if the vernal pool has not been certified, the pool has no specific protections for wilderness value (although other enumerated values may offer some protection). For vernal pools located outside resource areas, there is essentially no protection offered, even if the pool receives certification. This leaves a large void in the protections for vernal pools in general, and the stated wilderness value in particular.

A better management scheme would include the assessment of potential ecological value for all identified vernal pools, regardless of their location, or proximity to defined resource areas. This can be done through small augmentations to the current permitting schemes for alterations to land within and outside resource areas. For applications within resource areas, local Conservation Commissions can require the identification and assessment of vernal pool habitat as a condition to issuing a compliance permit for development in the area. Other permitting authorities can require a similar condition for locations outside identified resource areas. If a vernal pool is identified in such areas, Conservation Commission expertise can then be sought to review the *wilderness value* assessment. The additional policing expenses could be funded by increases in permitting application fees. There would be no substantial changes to the current municipal infrastructure.

The Massachusetts vernal pool example of identifying an ecosystem-based management regime has brought forth the immense difficulty in fully understanding the extent of existing frameworks for the protection of particular values, and how they achieve, or fail, to offer a comprehensive scheme for the protection of the stated values. Aside from consideration of the federal role, the Massachusetts program offers an incomplete scheme for the protection of biodiversity identified in the vernal pool setting. Specifically, the program places too much focus on a certification process to identify a specific value, which is ephemeral, rather than protecting a spatial value, which is somewhat constant. A solution within the current framework is to shift the burden of proving value by requiring an assessment of every identified vernal pool as a condition of receiving a building permit. I would also recommend extending this beyond resource areas to all identifiable vernal pool habitats in the Commonwealth. Such a measure would come closer to providing holistic protection for the species dependant on the unique habitat provided by vernal pools. Feasibility questions remain, including the legal implications of expanding restrictions on private property development to encompass life-cycle habitat of vernal pool species. A thorough analysis should be conducted to determine potential legal limitations to such expanded protections, as well as possible solutions to such limitations.

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Notes

Note 1. See Massachusetts General Laws, Chapter 131, Section 40. Available: http://www.mass.gov/legis/laws/mgl/131-40.htm (January 26, 2010).

Note 2. See generally, *Solid Waste Agency of Northern Cook County v. United States*, 531 U.S. 159, 121 S.Ct. 675 (2001) (Discussing the limitations of federal jurisdiction over wholly intra-state water bodies); *Rapanos v. United States,* 547 U.S 715, 126 S.Ct. 2208 (2006) (Discussing federal limitations over certain intra-state water bodies, and the need to establish a connection between such bodies and larger, navigable waters).

Note 3. See Massachusetts General Laws, Chapter 131A; Code of Massachusetts Regulations Title 321, Chapter 10.03.

Note 4. See, Title 16, United States Code, Section 1513 *et seq*.

Note 5. A current list of Endangered, Threatened, and Special Concern Species can be found at the following link: http://www.mass.gov/dfwele/dfw/nhesp/species_info/mesa_list/mesa_list.htm (Last Visited: January 26, 2010).

Note 6. The eight *interests* protected by the WPA are as follows: (1) protection of public an private water supply; (2) protection of ground water supply; (3) flood control; (4) storm damage prevention; (5) prevention of pollution; (6) protection of land containing shellfish; (7) protection of fisheries; and (8) protection of wildlife habitat.

Note 7. The acceptable methods include an *Obligate Species Method*, whereby a breeding or adult obligate invertebrate is documented at the vernal pool; a *Facultative Species Method*, where two or more of certain amphibians, reptiles, or invertebrates are identified; and the *Dry Pool Method*, where evidence of certain amphibians, reptiles, or invertebrates (shells, larvae, etc.) are identified. In addition, all three methods require a showing of the physical characteristics of a vernal pool, i.e., evidence of a confined basin depression with no permanently flowing outlet and evidence there is no established, reproducing fish population.

Figure 1. Certified Vernal Pools in Massachusetts as of September 2009