

# The work of wetland credit markets: two cases in entrepreneurial wetland banking

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**Abstract** Wetland banking has been discussed in the policy literature mainly at a high level of abstraction, using economic models or generic examples to illustrate the concepts and tensions within wetland banking. This article illustrates two cases of wetland bank creation in-depth using the methodology of the extended case study, following the process from the initiation of interest in forming a bank through to the approval of credits for sale. The close attention to actual cases serves to move discussion beyond the goodness of models or the supposed rationality of economic actors, towards a consideration of actual market participants in complex situations. Successful wetland credit producers must negotiate a number of different economic, political, interpersonal, and ecological forces which impact their project from a number of different scales. While no optimal solution to this complexity is likely to be reached that is generalizable, the use of entrepreneurial wetland banking as a market-based policy may expand where skillful bankers and regulators together arrive at adequate solutions that are matched to the specificity of their contexts.

**Keywords** Wetland banking · Wetland mitigation · Compensation · Ecosystem services · Market-based environmental policy · Clean Water Act

“However beautiful the strategy, you should occasionally look at the results.”

—Winston Churchill

Wetland mitigation banking is now largely an entrepreneurial activity: 77% of the 454 approved or proposed banks identified in a 2006 report by the US Army Corps of Engineers (Corps 2006) involve the private third-party production of wetland credits for sale (see also ELI 2006). Since the first permit for an entrepreneurial bank was submitted in August of 1991, entrepreneurial banking has grown into a multimillion dollar annual market, becoming the first major environmental credit market to sell commodities certified using metrics of ecological function. It has done so while resolving persistent problems with compensatory wetland mitigation under of the §404 Clean Water Act (NRC 2001; SWS 2005).

Understanding success and failure in wetland banking is therefore crucial, and must be discussed in concrete terms (Gardner and Pulley Radwan 2005). It is the actual coming together of regulator and entrepreneur to make a bank, and the coming together of buyer and seller to exchange wetland credits, that lies at the heart of the market-based policy goal to secure the benefits of wetlands conservation. These processes are commonly described in the economically-oriented

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literature as engagements between rational rule-following market participants, and most regulatory action is described as interference with market forces (cf. Brumbaugh and Reppert 1992; Shabman et al. 1994; Shabman and Scodari 2004). Fernandez and Karp, for example, employ “optimal stopping theory” to understand an individual’s behavior in the wetland banking market, formally assuming that “the dynamic aspect of the investment decision for wetlands restoration is closely related to the problem of determining the strategy for exercising an option on a share of common stock,” (1998, p. 325). Shabman and Scodari allow that “difficulty in predicting ... future demand for credits—is always present. However, greater sources of demand uncertainty are embedded in the regulatory program itself” (2004, p. 12). A small but growing community of economic and policy researchers have reported on the subject of banking (Shabman et al. 1994; Fernandez and Karp 1998; Salzman and Ruhl 2000; Ruhl and Juge Gregg 2001; Boyd and Wainger 2002; Bonds and Pompe 2003; Gardner and Pulley Radwan 2005; Ruhl and Salzman 2006). Of these, however, very few (e.g. Ruhl and Salzman 2006) conduct site-based research, and none conduct interview-based research. Most site-based work that evaluates wetland banking is strictly ecological in nature, and stays well away from social and economic questions (cf. Mack and Micacchion 2006; Spieles et al. 2006, but see BenDor and Brozovic 2007). I argue that to understand wetland banking as it unfolds in particular places, through the actions of particular people, one must take seriously the incompatibilities and muddling-through that takes place when economic, ecological and regulatory agendas must be aligned. In establishing banks, we must *ask*, rather than *assume*, how bankers, regulators and ecologists conduct the difficult and daily task of negotiating potential conflicts which cannot be wished away or reduced to a matter of economics (cf. Robertson 2007). Failure to appreciate these incompatibilities leads to the following kinds of statements in economic theory:

Claims about that evidence inconsistent with our traditional model of human behavior can be neglected because the evidence derives from observations of people insufficiently motivated to behave themselves according to economic

assumptions, or because it fails to bear sufficiently great burdens of proof, or because the implied behavior is unlikely to matter in the types of (market) settings that economists care about. (Rabin 1998, p. 41)

These theoretical precepts appear in environmental policy in several forms: as an absence recognizable people with diverse agendas whose identities exceed the economic; as the prevalence of passive grammatical constructions (e.g., “equilibrium price is reached,”); as the performance of concrete verbs by abstract nouns:

... it is the interaction of supply and demand within each region that establishes credit prices and the number of credits needing to be supplied. (Shabman et al. 1994)

I will to go beyond the rather obvious statement, however, that economic theory makes certain assumptions that are not borne out in practice. The examination of actual cases of banking suggests not only that non-economic forces are unavoidable, but that engaging with them is a positive and essential moment in constituting the wetland banking market. It is by studying success and failure in dealing with non-economic forces in carrying out actual banking projects that we will be led to understand how the trade in wetland commodities comes to be fully-realized.

The material in this paper was gathered through interviews with the principal actors around two separate entrepreneurial wetland banks in a major US metropolitan area in 2003.<sup>1</sup> To consider the process of creating a bank from start to finish, which can take 4 years or more, it was necessary to observe two banks: one in the earliest stages of project planning, and another that had received initial approval and had just begun physical site modifications. Considered together, they touch on all important stages of bank development; considered against each other, they throw into relief the different experiences that banking entrepreneurs have faced in the task of bringing credits to market.

<sup>1</sup> The case studies below have been anonymized using pseudonyms for places, people and organizations, per the requirements of the Institutional Research Board governing this research.

My use of two case studies is not meant to achieve the kind of statistical rigor appropriate only to parametric statistical studies. Instead, I turn to the methodology of the “extended case study” (Burawoy 1991, 2000), a method of achieving rigor in the qualitative social sciences. Sociologists, anthropologists and geographers have used this method to explore a single case at length and to link the case to the broader forces and trends such as those discussed in the introduction and conclusion of this paper. These include: the general tendency of the economics literature to overlook non-economic behavior in actors, the tendency of environmental regulation to occur at several scales, the need to align non-economic timetables in fostering an ecosystem credit market, and the need for participation by individuals who can successfully translate between economic, regulatory and scientific logics. As a general methodological matter, there is broad agreement among the social sciences outside of economics that it is not appropriate to approach these questions with the tools of parametric statistics. The data and narratives presented here are meant to illustrate the processes by which actors in these cases—acting within different positional logics and different institutional settings—create and negotiate rules and institutions that allow wetland credits to be traded. As the extended case method dictates, the characteristics of these cases should not be taken as paradigmatic, but can usefully (if conditionally) provide themes by which we can understand the larger project of developing environmental credit markets.

### The economist in the wetland

Entrepreneurial wetland bankers have worked tirelessly to overturn the popular notion that reaping profit necessarily involves environmental villainy. Advocates for market-based wetland policy are nothing if not enthusiastic, and they have every reason to be. As one banker recently protested to gathered staff and management from the US Environmental Protection Agency and the US Army Corps of Engineers, “We’re the angels!”<sup>2</sup> As the architecture of top-down, command-and-control federal environmental regulation began to be dismantled in the early Reagan

Administration, plans and policies were already being laid to roll out new forms of wetland protection that promised to avoid the pitfalls that had characterized environmental regulation in the 1970s (see Hough and Robertson, this issue). The new model was built around the power of market forces to give voice to citizens’ individual desires (“utility” to economists) regarding the environment. The two fundamental theorems of mainstream economics<sup>3</sup> were referenced to insist that markets in which prices accurately reflect consumers’ utility in a commodity or resource (e.g., bread or wetlands) will produce a distribution of those resources that is “socially optimal,” and at the lowest cost. That is, the market will—without any inefficient bureaucratic interference—lead to a situation in which no person’s situation can be improved without disproportionately worsening another person’s situation (a condition referred to as “Pareto-optimality” by economists).

This was, and remains, an immensely powerful idea. In a political atmosphere that has become antagonistic to government regulation, the notion that the market can allow people to govern themselves has motivated the formation of policy from education to medicine to the environment since the early 1980s. As a result, we are no longer patients, we are health care consumers. We are not students, but rather consumers of education. And in going about our daily business of respiration and metabolism, we are now consumers of ecosystem services (MEA 2005).

However, because of the rather grand and clean-lined nature of the economic models employed in prescribing market-based environmental policy, the complexities of implementation are often overlooked in favor of iterative model-tweaking (cf. Fernandez and Karp 1998; King and Price 2006). The simpler versions of this economic paradigm (which are perforce the ones applied in environmental policy debates, cf. LI 2005) assume that markets resemble auctions where clearly defined commodities are produced, lined up on display, and sold at a price set through negotiation. This approach assumes that people act in rational, individualistic, and self-interested ways

<sup>2</sup> Personal observation, January 19, 2006, Washington, DC.

<sup>3</sup> The two theorems—first articulated by economist Leon Walras in 1874 and mathematized as the Arrow-Debreu proof in 1953—state that: (1) markets in competitive equilibrium produce optimal social welfare (i.e., Pareto-optimality), and (2) any initial allocation of resources to private owners can lead to equilibrium (Mirowski 2001).

at all times, that people respond automatically to price information, and that the social and institutional context which produce legible price, supply and demand are already in place. While these may seem like problematic assumptions, the leading lights of mainstream economics have discouraged empirical verification of economic models for nearly 60 years (Rosenberg 1992; Mirowski 2001), instead insisting that the internal consistency of models is sufficient<sup>4</sup> and provides its own rewards (Mäki 2000).

Thus, it is important to realize that even presenting this case study of the development of two wetland banks runs quite counter to the theoretical underpinnings of market-based policies in the first place. But policymakers rightly insist that environmental policy must be informed by actual outcomes that are never as clean-lined as the theory which informs the policy. This is not to argue for or against wetland banking as a policy; rather it is to argue that policy must attend to, rather than ignore, contingency, complexity and unpredictability in the application of market-based policy principles. If this seems to be a simple argument, it is nonetheless one that economists repeatedly ignore in modeling human behavior in wetland banking. In the case studies below, the task of producing wetland credits for a market looks remarkably little like a strictly economic activity and more like an exercise in the alignment of economic, regulatory and ecological forces and interests. If this is a departure from the economic models that inform wetland banking policy, we must question the ability of these models to help us develop wetland credit markets that achieve the promised goals of market-based environmental policy.

### Case 1: Pierce Lakes Bank

How hard is it to sell credits? What is the market? Can anyone else besides Vince Parker sell credits successfully?

—Rushford Open Space Committee notes<sup>5</sup>

<sup>4</sup> This stance regarding methodology became known as the “F-twist,” after its famous proponent economist Milton Friedman, widely regarded as the greatest free-market economist of the twentieth century.

<sup>5</sup> Rushford Township Open Space Committee, Rushford Twp., undated.

Rushford Township blankets 36 square miles lying directly in the path of expanding urban development at the edge of a major US city. The front of urbanization reached the Township in the late nineties, and it was not long before the eruption of tract houses set off a response of conservationism and land-preservationism among longer-term Rushford residents. As a slow-growth slate of Township Board members was swept into office in April 2001, a referendum passed by healthy margin allowing the Township to spend at least \$20 million in bonds to keep significant areas of the Township undeveloped.

As the new Township administration settled in, an Open Space Committee (OSC) was formed to create and pursue a land acquisition strategy. In this task, the OSC considered creating wetland mitigation banks as a profitable way to fulfill its directive. The first private bank in the region lay just outside the Township’s borders, and another had recently been chartered in association with one of the new developments in the northeastern part of the Township. Members of the Township Board, several of whom were engineers by profession, were personally acquainted with wetland bankers and with several Federal wetlands regulatory officials that lived within a few miles of the Township. As a result, the concept of advancing the Township’s Open Space agenda through wetland banking seemed both appealing and realistic to the OSC: the Board proposed to establish a partnership with a private banker to develop wetland credits by restoring wetlands at Pierce Lakes, a parcel of farmland recently acquired as open space by the Township. The Board, aware of the limits of its own expertise, prioritized banker experience in choosing a firm that could lead them through the unfamiliar process.

The OSC sent letters to all Corps-approved bankers in October 2002, announcing that the project was open for bidding. Two bids were eventually submitted. One was from Vince Parker, an established banker running a small firm with strong connections to engineering and other consulting firms. The other applicant was Corivol, Inc., a large and diversified engineering firm which employed a former Corps of Engineers wetland regulatory official in its environmental division. This former Corps official was excited about banking, and had convinced his more traditionally-minded colleagues in the firm’s accounting and civil engineering divisions

that the firm would prosper by being able to offer in-house wetland banking services. It would be the first firm in the metropolitan area to do so.

Both firms were somewhat surprised to find out that Rushford was by turns adversarial and accommodating. To the bidders, banking was a clear win–win solution for the Township even if the Township took *no* share in the profits: within 5 years the Township would have a high quality wetland site suitable for low-impact recreation, at no risk and no cost.

[Our firm] assumes many large risks on any wetland bank. We are prepared to commit hundreds of thousands of dollars to restore the Township's property. The only way of recouping those funds is through the sale of wetland credits. We have the expertise and experience to handle a large endeavor, but we know by experience that laws can change. ... [We] will be restoring the property into a wetland and prairie complex that the Township has identified as their goal. Since the Township shares none of these risks, we believe that the [proposed profit] split is appropriate. (Text of Proposal submitted to Board October 2002)<sup>6</sup>

However, the Township expected an even split of the profit, and also requested the application of very rigorous environmental quality criteria. Both bankers asked: what could possibly motivate the OSC to make demands which would impede the progress of the banking agreement? The bankers blamed a combination of greed and poor appreciation of market principles. Both bankers attempted to educate the OSC on the basic principles of rational market behavior:

... what they were asking for were two things: one, how to put more money faster into the Township's pockets; and secondly, how to add additional requirements over and above what the Corps had, which would add additional costs, so asking me to absorb additional costs and at the same time... make more payments to them. ... What I expressed was that typically those who spend the money and take the risks, if there's a profit they should be the first in line

for that. The Township ... was in a no-risk situation. (Parker)<sup>7</sup>

I don't think they understand the risk of building wetland mitigation. Which is what we're willing to take as a banker, because we're confident that we can make it work. And it is a good site. And the big unknown is how fast can you sell credits. (Corivol)<sup>8</sup>

The OSC, however, is not a rational economic agent seeking utility-maximization. It is a bureaucracy with a governmental agenda set through democratic representation, and banking was not necessarily the only way to achieve their goal of securing high quality open space. If the public were to suffer entrepreneurs to make a living off of public land, the OSC held that the public had better get a piece of the action. The members of the OSC were enthusiastic about banking, but were also suspicious of the motives and methods of private entrepreneurial bankers; ecologists on the OSC were also aware of the ecological difficulties of wetland restoration. All of this caused the OSC to oscillate unpredictably between regulation-centered, ecology-centered, and market-centered justifications in choosing between the two bids, as well as in negotiating the contract with the eventual awardee. A letter to both prospective bankers in January of 2003 from the Township Board requested modifications to the bankers' original proposals establishing far higher fiscal and ecological standards than those required by the Corps of Engineers (who would be certifying the cite and monitoring compliance). In making these requests, OSC's identity exceeded the economic: it played the roles of both client and local environmental regulatory agency.

The two applicants modified their proposals in response to the OSC's concerns, and formal interviews with the two firms were conducted in March of 2003. A final recommendation from the OSC to the Township Board was made in May. At the Township meeting on May 27th, the Township Board chose to begin negotiations with Corivol over the terms of partnership. It is worth looking in detail at these two proposals, for what they reveal about entrepreneurial strategy in the banking business. Parker proposed to

<sup>6</sup> Rushford Township Open Space Committee files, Rushford Twp.

<sup>7</sup> Interview January 27, 2003.

<sup>8</sup> Interview January 28, 2003.

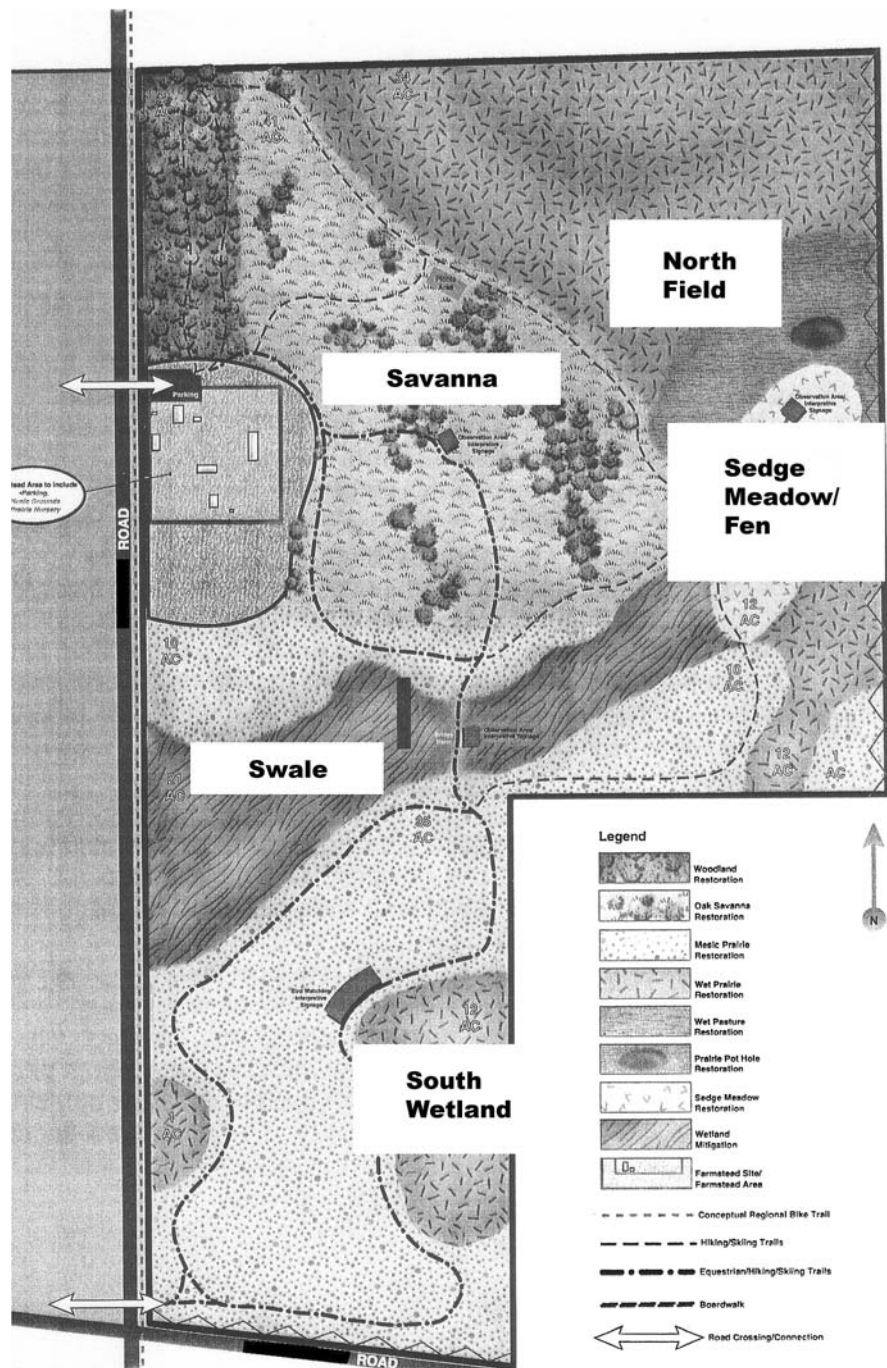


create 90.13 credits worth of new wetland on the “north field,” in the western drainageway, and in a small pocket called the “south wetland,” a small declivity with wetland soils perched on a hill (Fig. 1). Some enhancement of the existing high quality fen was proposed, as well as a modest amount of upland

buffer credit. The banker proposed a 90–10% split of the profits. His total costs are listed as \$2,204,166.25, with each credit thus costing \$24,456.77 to develop.

Corivol proposed to develop only 80 credits, forgoing what their project manager considered to be the unlikely prospect of restoring the perched

**Fig. 1** The “Open Space Master Plan” for the eventual restoration of natural communities at the Pierce Lakes property. The area marked “sedge meadow/fen” was a pre-existing moderate-quality fen, and the area marked “savanna” was planned by Corivol to provide “buffer credit.” The “north field,” “swale,” and “south wetland” were wetlands to be restored from agricultural use and deposited at as bank credits. The remainder of the site is upland. Provided by Rushton Twp Secretary, August 2, 2004



“south wetland”. They responded to the OSC’s strong desire to have the savanna be part of the restoration plan by incorporating the savanna as providing buffer credit. Furthermore, they proposed what appeared to be a much more generous profit split, close to 60–40% in favor of Corivol. The cost of the entire project was given as \$2,445,000, giving a unit production cost of \$30,562.50 per credit.

Both proposals were innovative. Parker proposed the higher acreage total, being more aggressive than Corivol in estimating where wetland hydrology would return when the drain tile system was disabled. Proposing the restoration of the perched “southern wetland” illustrates the inherent risk in using ecological (or in this case, hydrological) information in the development of a profit strategy:

I’m quite certain that [we] would make that work. Is it pretty iffy if you don’t do it right? Hell, yeah. It’s by no way a slam dunk like that northern field, you know. (Parker)<sup>9</sup>  
Oh, it’s kind of up on the hill, and it’s not a slam dunk... now, we haven’t seen the tile survey. We didn’t have enough information to say we can get ten acres of credits there. (Corivol)<sup>10</sup>

However, for all their caution regarding the successful restoration of hydrology to the southern basin, Corivol adopted an aggressive posture toward getting 25% “buffer credit” for an adjacent savanna area, which encompassed territory quite far from the proposed wetland restoration area. Parker, for his part, proposed buffer credit only for an area that lay in a more conventional narrow perimeter around the wetland restoration site. He also proposed to apply for “enhancement credit” for improving an existing fen.

These variations showcase the diverse strategies employed by entrepreneurs to create the wetland credit product. Both proposed larger amounts of buffer credit than is typically approved. Both bankers utilized sophisticated understandings of wetland ecological and hydrological processes to arrive at thoroughly different proposals, and both anticipated on some lenience and flexibility on the part of the Federal agencies during the approval process.

Standing federal banking guidance and cost estimates were only a starting point.

Corivol’s strategy was to emphasize its flexibility as a large and diversified firm, able to serve Rushford Township in whatever capacity was needed. The Township, in fact, initially considered the notion of being the bank sponsor themselves rather than being merely a landowning partner, and hiring Corivol or Parker only as site architects and engineers. Corivol’s letters and presentations stressed their in-house ecological expertise, the reasoned optimism of their proposals, and the capacity of this large firm to direct its *own* development clients towards the wetland credits available in the bank. When the OSC sent each applicant a set of questions and proposed revisions in January 2003, Corivol responded with a thorough revision that responded to nearly all of the Township’s requests, whereas Parker’s proposal changed very little. Requests that Corivol could not accommodate were given a firmly financial explanation, and elements of uncertainty within their proposals were discussed frankly:

We realize that our original proposed upland buffer credit is somewhat aggressive and that we cannot guarantee Corps approval of these credits. ... Because the [Corps District’s banking regulatory guidance] does not give a maximum percentage for uplands, we feel that there is some flexibility and a determination of credits will consider the significant functional values provided by the proposed buffers, especially for the savanna.<sup>11</sup>

Parker’s proposal, on the other hand, stressed a different kind of flexibility. As a small firm, he instead proudly proclaimed that “banking is all we do.”<sup>12</sup> His flexibility consisted of strong relationships with many independent subcontractors and engineering firms throughout the region. Parker could legitimately claim to seek the lowest-cost provider of needed services, and avoid accruing large numbers of billable in-house hours. This, he explained, was the essence of his advantage as a banker:

<sup>9</sup> Interview June 13, 2003.

<sup>10</sup> Interview June 13, 2003.

<sup>11</sup> Letter from Corivol staff to Rushford Twp Chair, January 28, 2003. Rushford Township Open Space Committee files, Rushford Twp.

<sup>12</sup> Interview June 13, 2003.

I have 200 engineers ... [and] I could get any one of them, or as many of them to work on banks whenever I need them. ...why have all of this overhead that has to be absorbed into your costs weighing you down? I have to run lean and mean. Get as many people as I need when I need them, and get rid of them when I don't.<sup>13</sup>

Parker pointed out that, while Corivol might be able to direct its own clients towards a future Pierce Lakes Bank, other large engineering firms might be unwilling to send their clients to purchase wetland credits directly from a competing engineering firm. Whereas Corivol stressed in-house expertise and horizontal integration, Parker stressed his thorough integration into both horizontal and vertical networks of acquaintance and expertise; his long and positive relationship with the federal regulatory personnel was perhaps his strongest selling point.

Both presentations were innovative at the margins while retaining much of the boilerplate developed for previous bank proposals in the region; Parker created the proposed banking instrument (the document legally chartering the bank) using a template from his earlier banks, changing only details. In the OSC's evaluation of the proposals, however, staff members attempted to negotiate issues that both bankers considered to be relatively fixed features of the banking industry: profit-sharing that favored the banker, the amount of insurance bonding, the lack of any sunset on the banker's ability to sell credits, and the lack of a commercial marketing strategy. It had never occurred to the bankers, for example, that the OSC would spend so much time worrying about marketing. Because wetland credit sales transactions are usually coordinated by either the Corps or by longstanding clientelistic business relationships in the environmental consulting industry, commercial advertising has rarely been a concern for bankers, and both applicants struggled to express this to their prospective banking partner. OSC members eventually admitted to me that they were poorly-equipped to understand or evaluate the strategies proposed by the applicants to navigate the regulatory challenges unique to banking. As these complex regulatory challenges dawned on the OSC over the winter of 2002–2003, Rushford moved gradually towards an

interest in other, non-bank methods of fulfilling their open-space preservation mandate. In this environment, the "all we do is banking" approach of Parker became something of a liability, and Corivol's ability to play any one of a number of different consulting roles led eventually to their proposal being chosen.

Note the absence of any active federal regulatory role whatsoever in the story so far. While it has usually been to the advantage of a banker to bring regulatory personnel into the process as early as possible, to avoid unpleasant surprises after sunk costs have been made, it is also generally true that bankers prefer to have some kind of coherent proposal in hand when they first contact regulatory personnel for a "pre-application consultation." Neither applicant wanted the pessimistic realism of the federal agencies to intrude on the entrepreneurial optimism of their proposals to Rushford Township. This is a rather fine line to walk, and it demands great familiarity and some bravado on the part of the banker to lay out a realistic project in great detail, as both bankers did, in a complete vacuum of consultation from the relevant regulatory officials.

Corivol contacted the Corps of Engineers in September 2003 to arrange for a pre-application site visit by federal agency staff. However, at this point the state Department of Natural Resources (DNR) issued a letter stating their unequivocal rejection of all banks which might operate on land purchased with state money—and the Pierce Lakes site had been acquired in part with DNR grant funding. While such a decision might be challenged, bankers are not usually interested in becoming adversarial with an important state resource agency.

Thus when federal staff convened at the Pierce Lakes site on October 28, 2003 it was more as a post-mortem than as a true site assessment. Representatives from the Corps, the US Environmental Protection Agency and the US Fish and Wildlife Service spent an hour walking the site with staff from the OSC and Corivol. It immediately became apparent that, DNR objections aside, the site presented serious obstacles from the regulatory perspectives of the federal agencies. The prospect of allowing the bank to claim the entire savanna area as buffer for the existing and restored wetland violated the ecological sensibilities of most federal staff members. "Buffer against what?" one asked pointedly, noting the already-protected state forest land on the other side

<sup>13</sup> Interview *ibid*.



of the proposed buffer. For the federal agencies, employing ecological and regulatory logic rather than economic logic, there was no compelling argument for allowing the bank to claim credit from the buffer. For similar reasons, the agencies expressed reluctance to assign much credit for enhancement activities in what was already considered a high-quality remnant fen. Corivol's reluctance to coordinate "too early" with the federal agencies, perhaps combined with their lack of experience in the bank permitting process, resulted in blindness to these obstacles.

As a simple case study, this entire narrative could be considered irrelevant to most economic accounts of how wetland banking markets operate in the aggregate—akin to asking why and how a roulette ball fell on number 12. But it is clear that the group meeting in the field at Pierce Lakes decided on the particular translations between the divergent imperatives of ecology (in the matter of buffers), commerce (in the matter of cost estimates), and law (in the matter of regional Corps guidance) that seemed personally palatable to those who happened to be present, rather than settling on a solution required by economic logic. It is, in other words, manifestly *not* the laws of supply and demand that determine the availability of credits in this case. Given a different group of people, or the same group at a different time,

a different translation among logics might have occurred. For example, the Corps role on the interagency team was being temporarily filled by an inexperienced young staffer who tended to defer to the more ecologically-grounded concerns of the FWS and EPA representatives. The dynamic of informal consensus that typifies such meetings, which occur strolling across corn stubble or hunched over a map spread on the hood of an SUV (Fig. 2), discourages the dogmatic adherence to the concerns of any one agency or industrial imperative and encourages negotiated accommodation between the concerns of the people present.

The second item on the federal interagency team agenda that day provided a revealing coda to the Pierce Lakes experience. Rushford Township had recently purchased another property, consisting entirely of row-cropped fields, which they hoped to turn into a park and natural area. As the group arrived at this property, with the OSC and Corivol representatives still somewhat sobered from the Pierce Lakes judgment, the federal team members began to remark immediately on what an ideal bank site the new property would make. It was, in short, a blank slate: no existing ecological community was present to complicate the assessment of potential credit production, and it appeared that the federal staff were more comfortable with redeveloping such a site as a

**Fig. 2** Federal review team members and project staffers from traverse a prospective bank site, October 2003. Photo: Morgan Robertson



wetland bank. On February 10, 2004, Corivol and Rushford Township signed an agreement to create a mitigation bank at the new site.

## Case 2: Clearwater Bank

I've never seen so much ragweed in one place.  
—Clearwater banker Gil DeLoos<sup>14</sup>

The Pierce Lakes case examined the process of initiating a new bank from inception through to the first federal agency appraisal. I now turn to a bank in the second phase of the approval process. The Clearwater Bank, unlike Pierce Lakes, was the product of a partnership between two very experienced bankers, and it progressed rapidly through the initial planning and approval stages with the very little objection or concern. However, after its approval by the Corps, the subsequent tasks of site construction, seeding, and maintenance presented their own complex set of challenges.

The establishment of the Clearwater Bank was the indirect result of the Supreme Court decision in *Solid Waste Agency of Northern Cook County v. US Army Corps of Engineers (SWANCC)* (531 US 159) which eliminated Clean Water Act jurisdiction and protection over an entire class of isolated wetlands. In response to the new vulnerability of their wetlands, rapidly-urbanizing Hartshorne County passed an ordinance that established a county-based permit program to protect wetlands left unprotected by *SWANCC*. Two competing bankers, George Gamben and Gil DeLoos, noticed that while the market for wetland credits might shrink following *SWANCC*, this trend might be reversed in Hartshorne County when the stormwater ordinance was signed. They agreed to establish a joint venture that would sell credits only within Hartshorne County. They would continue to compete outside of Hartshorne County, but since the county ordinance required all wetland impacts to be mitigated in-county, it created a bounded spatial market within which their competition elsewhere would not affect their cooperation. The stormwater ordinance in Hartshorne County was rapidly approved: the *SWANCC* decision was handed

down on January 9th, 2001; Hartshorne County began discussing amendments to its stormwater ordinance in March of 2001; and the two bankers submitted their full bank application to the Corps on September 15, 2001, only a month after the county had passed the ordinance re-establishing a permitting program that regulated isolated wetlands.

The conjoining of their expertises seemed natural and the strengths of DeLoos (a former environmental regulator and ecologist) and Gamben (a former earthmoving contractor) seemed complementary:

Well, [DeLoos] is very cognizant on cost. And one of the reasons why he likes to find sites that he can eliminate the earthmoving; two reasons, one is cost, and secondly, his background isn't in that type of work. I mean, he's not as aware of some of the things that you need to watch for in grading a site as I am. My background in grading, it doesn't scare me a bit. So if it needs to be done, I do it. ... we both worked on the permitting, he handles the planting and the maintenance and monitoring, that sort of thing. And I handle the construction... the physical stuff. Plus I handle the sales. (Gamben)<sup>15</sup>

Gamben's close working relationships with developers balanced DeLoos's regulatory background, creating a "good cop, bad cop" dynamic that could be employed effectively in convincing developers to resolve their trouble with complex wetland permitting regulations by purchasing bank credits. "I'm the guy who's gonna do something for them," said Gamben, "he's the guy who's telling them what to do."<sup>16</sup>

The Corps project manager who handled the application remembered it as a model of efficiency and professionalism. The Clearwater Bank was not only efficiently conceived, it is marked by innovative site design that, as with Pierce Lakes, tests the flexibility of the parameters laid out in the Corps District's banking guidance. However it is considerably more complex a proposal than Pierce Lakes, consisting of six separate parcels of land, each proposed as a different phase (A through F), and involving four different landowners, with each of

<sup>14</sup> Interview June 20, 2003.

<sup>15</sup> Interview January 27, 2003.

<sup>16</sup> Interview *ibid*.

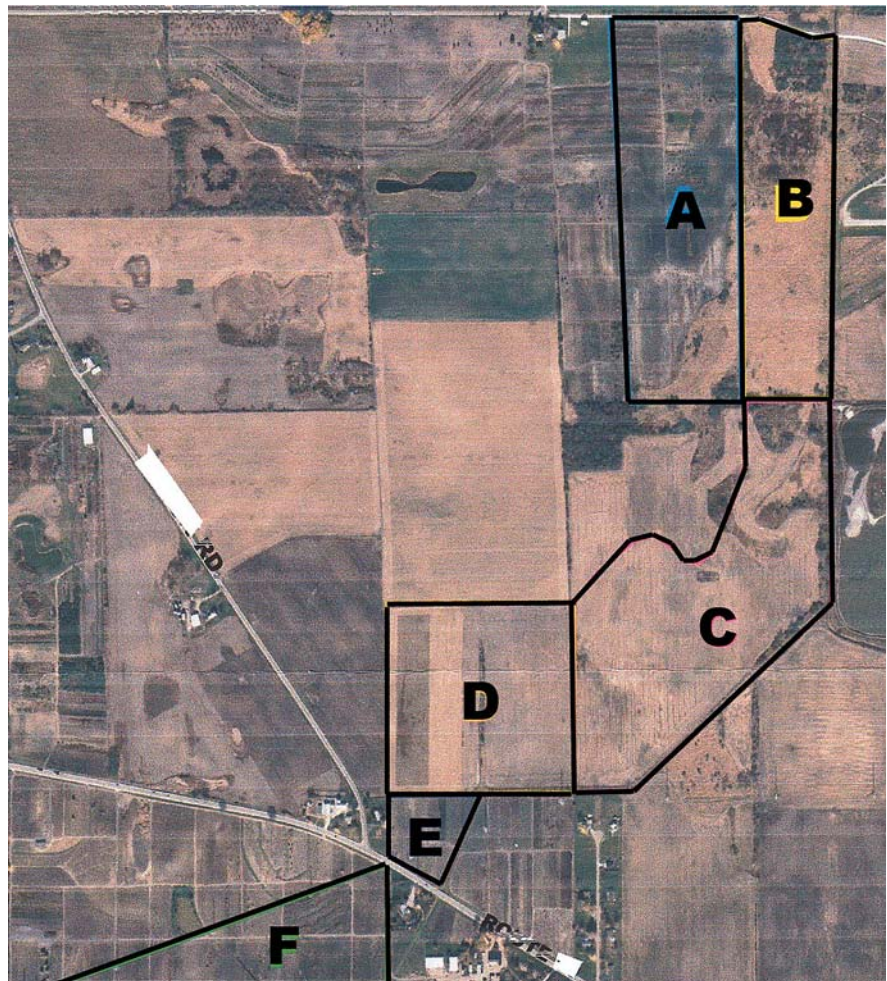
whom the bankers have made separate agreements to develop wetland credits as profit-sharing partners (Fig. 3).

With the Hartshorne County ordinance safely on the books and the wetland mitigation market rebounding from the post-SWANCC slump, the bankers were eager to devote their financial resources to the restoration of Phase D, a square 40-acre field with a drainage ditch running down the middle (Fig. 4). Conventional restoration practice would call for the herbiciding of extant weeds, followed by plowing and seeding, tasks which must occur *after* the recession of spring floods and *before* the onset of summer's full heat (which would kill new sprouts). The site has to be wet enough to encourage wetland plants to sprout, yet dry enough to allow the use of heavy machinery; thus, a particularly wet or dry spring can be problematic. The necessary control over the site's hydrology is

often achieved by waiting to disable the tile system until after planting is accomplished. Restoration should thus be a straightforward process of waiting until a dry moment to conduct a seeding, and then "wetting-up" the site by disabling the drainage system, in that order. DeLoos is an expert at this process, and arguably the best ecologist among the regional bankers. And yet 2003 proved to be an extraordinarily frustrating year at Clearwater.

The failing drain-tile system had in recent years fostered the massive growth of giant ragweed (*Ambrosia trifida* L.) on Phase D, and because of the site's wetness, the farmer had apparently conducted only minimal weed control activities on the site for several years. The seed bank, therefore, was rich with ragweed, and as the spring floods receded a 10-foot tall forest of ragweed emerged to dominate the entire site. DeLoos's strategy was to mow the site,

**Fig. 3** The six phases (A–F) proposed for the Clearwater Bank; analysis below focuses on the development of Phase D. The pictures in Figs. 4 and 5 were taken standing at the southwest corner of Phase D. Map provided by George Gamben





**Fig. 4** A view from southwest to northeast; Clearwater Phase D lies to the right, and the Hill Valley Townhomes development site lies to the far left and in the background. June 16, 2003. Photo: Morgan Robertson



and then spray with glyphosate, a common herbicide. This was done in April, and soon after this spraying the site was covered with a thick thatch of dead and decaying ragweed stems. But the approved mix of wetland plant seed could not be planted through this thatch; it would have to be removed before the heavy seeding machinery could be used on the site, and the cheapest and best way of removing the debris would be to burn it. However, because of the site's location in a major metropolitan area, where the air quality is regulated by the Clean Air Act, the partners had to apply for a burn permit from the EPA. This permit was so long delayed that a new crop of ragweed had appeared by the time the permit was granted in late May. By this time, moreover, the building season in the region was hitting its spring peak, and the subcontractors that had initially been lined up to do the seeding work were no longer available.

At this point, a question of site design was raised that caused the bankers to delay further management action until the site visit by the interagency review team, scheduled for June 17th. In their initial permit application, the bankers had proposed to place a water control structure where the small internal ditch in Phase D emptied into Clear Creek. It occurred to them, however, that it might be preferable to use the unexpected delay to actually fill in the entire ditch.

This would avoid the engineering costs of a water control structure, add perhaps another two acres of bankable credits, and eliminate a potential corridor of invasion by the noxious weed reed canary grass (*Phalaris arundinacea* L.) from the *Phalaris*-dominated creek. Such a change would produce considerable cost savings while remaining a "minor modification" of their Corps permit which would not trigger a new round of public comment. On the other hand, it produced a further inconvenience: such disruptive earthwork would have to be done *before* seeding, and in filling the ditch (thus disabling the tiles draining into the ditch) the bankers would give up their ability to control hydrology on the site. They would be thoroughly dependent on precipitation patterns to produce conditions dry enough for seeding, followed by conditions wet enough for germination. This is a risky proposition even in the springtime, but the bankers were now contemplating a midsummer planting, and thus taking a considerable risk of losing thousands of dollars worth of seedstock if July and August proved rainless.

During the regulatory site visit, the two bankers strongly urged the interagency review team members to approve the proposed ditch-fill, mainly emphasizing that their plan would prevent invasion by *Phalaris* and restore the site to a more natural-looking (ditchless) condition. Strategically, they posed their request



narrowly as a simple modification of their Corps permit rather than a structural change to the site design, which they hoped would cause the other review team members to defer to the Corps representative.

The modified permit was issued within 5 days, and immediately the growth of ragweed was sprayed once again. This prepared the site for the tile breaking and ditch-filling, which occurred in early July, and the thatch was burned soon after (Fig. 5). Although the bankers finally had a site ready for seeding, July is typically a very dry month; subcontracted at \$2,000 an acre, the seeding of Phase D would cost \$80,000, and the bankers could not afford a failed planting. Furthermore, they had created a baresoil situation which, since they no longer controlled the site hydrology, would strand any heavy seeding equipment in mud if the rain *did* occur.

July, however was sufficiently wet, and the bankers hesitated in seeding only because late summer seedings rarely thrive: the perennials would have a scant few months to establish a root system before the fall frosts. In their hesitation, the seed bank proved itself again, responding to the rains with another vigorous crop of ragweed. The bankers sprayed and mowed again, and then, badly needing credits for sale during the fall permitting season, defiantly seeded as much of the site as was accessible to the machinery and free of standing water. Without great hope, they then applied to the Corps for the partial release of credits based on the partial completion of planting and the establishment of wetland hydrology at Phase D.

This was granted on September 30. As water receded in the late fall, they dormant-seeded the western edge of the site that had been inaccessible to the seeding machinery over the summer, and applied for the release of the remaining seeding- and hydrology-based credits. This release was approved in January, 2004.

Thus, within a year of beginning physical work on Phase D, the Clearwater bankers were able to turn 28 fresh wetland credits out onto the market for sale. Within 3 years of the SWANCC decision, an entrepreneurial team representing a high degree of banking industry expertise had proposed a massive, 132-credit site, navigated the regulatory pathways as efficiently as possible and sold more than seven credits from other phases of Clearwater Bank, grossing perhaps between \$350,000 and \$400,000. This is both an impressive accomplishment and a sobering commentary on the nature of the obstacles to development in the banking industry. Clearwater might represent the best-case scenario regarding the knowledge and economic acumen of the principle players, but is still heavily dependent upon a daunting array of the interests of other businesses and a startling variety of non-economic factors: subcontracted earthmovers and seeders, the EPA air quality attainment permit system, the adjacent housing developers, the owners of the land title, the interagency review team, and the Hartshorne County Stormwater Management Commission to name just a few. Furthermore, the cycles of season and precipitation have dramatic effects on the viability of banker plans, and the plans of these other

**Fig. 5** The black line of fresh earth shows the rapid filling of the central ditch, less than a week after permission was granted by the Corps. Photo looks east from the southwest corner of Phase D. July 2, 2003. Photo: Morgan Robertson



interests. In this respect, wetland banking may resemble agricultural production more than traditional commodity production, but without the stabilizing influence of systems of farm credit and government subsidy.<sup>17</sup> The differences between regulatory markets and traditional commodity markets become starkly clear: producers of traditional commodities do not usually face the task of coordinating their production finances and schedules with the interests and timelines of such a large number of non-economic people, institutions and ecological forces. But the creation of new markets must be achieved by people on the ground with specific flexibilities and skills, and if we fail to understand this then we fail to understand the potential rewards and risks of market-based environmental policy. The quality of the bankers' savvy is not in their ability to behave like a self-interested rational economic agent, but rather in their ability to depart from such behavior in order to successfully accommodate non-economic factors such as ecological and regulatory forces. The bankers achieved the alignment of disparate forces through their own flexibility while not expecting these other interests and climatic forces to conform to a strictly economic calculus. Less well-networked and experienced entrepreneurs juggling the timing of rainfall, subcontracting, and permit-approval are likely to have dropped at least one crucial ball.

## Conclusions

The general goals of this paper have been to ground the enthusiasm for market-based wetland policy in real-world situations, and to combat the tendency in the economic literature on environmental credit markets to either reduce all factors to matters of economic rationality, or to lament our inability to do so. Bankers may style themselves "the angels" of wetland conservation in the United States, but their work is distinctly and mundanely earthbound. Following the extended case method, three general themes can serve to connect the specificity of these narratives to more general issues and trends in the

effort to develop wetland banking markets. First, wetland banking—and producing environmental credits for sale in any regulatory market—requires an ability to think outside of the strictly economic logic that might successfully inform the production of traditional commodities. Second, it is apparent that the banking industry is highly dependent on timetables and schedules that it does not control. Finally, influences from multiple scales of government interfere with the achievement of a stable regulatory setting in which fixed market trading rules can allow the wetland banking industry to develop. I ground the importance of these three themes in the broad and durable literature on markets and the environment from institutional and other heterodox economists (e.g., Bromley 2006; Henderson 2003; O'Connor 1994; Polanyi 1944; McAfee 1999).

## Translation

These cases suggest that the ability to think as an ecologist and as a regulator, and to anticipate—or even take advantage of—ecological and regulatory strictures that are imposed on entrepreneurial activity, is essential in successfully establishing a bank. It is obvious from these cases that not all entrepreneurs are equally well positioned to coordinate these different forces, and that not all configurations of ecological, regulatory and economic factors are equally amenable to a solution which will support the production of bank credits. This is illustrated by the experience of the Rushford Open Space Committee. Its high level of general knowledge about banking allowed it to see that a banking proposal would have to be shaped around the ecological realities of their site, but it also created a potential conflict between its own regulatory imperatives to preserve high-quality open space and the entrepreneurial goals of developing a bank. This was evident as the OSC explored alternative ways to achieve its regulatory goals for the site. As one OSC staff member said: "We don't want to confuse our primary mission, which is to get green area and keep it."<sup>18</sup> Of course it is obvious that the Rushford OSC has a dual identity as both client and government—but it is nonetheless illustrative: we may search long and hard

<sup>17</sup> See Henderson (2003) for an engaging discussion of the positive and constructive aspects of the dependence of the agricultural economy on seasonal and other non-economic factors.

<sup>18</sup> Interview January 29, 2003.

for a market participant who does not have such a dual identity that in some way interferes with strictly economic behavior. Some translation is always necessary between these identities, and there is always the potential for failure. The entrepreneurial interest in Pierce Lakes could not be accommodated with the interests of the local government in requiring very high levels of ecological quality, and the regulatory imperatives of the Clean Water Act, which would not bend to allow buffer credit to be claimed at Pierce Lakes where there was no demonstrable threat to be buffered against.

## Time

Any banking project will encounter ecological timetables, such as seasonality, the timing of rainfall, or the growth rates of desired or undesirable plant species. It will also encounter economic timetables, such as the schedules of subcontractors that interfered with the work at Clearwater, or the development timetables of housing developers which determine where and when they will need credits. Some timetables, finally, are regulatory, as with the schedules of Corps project managers which leave little time for in-depth permit review, or the schedule for credit release at a bank.<sup>19</sup> I argue that, compared to conventional commodity producers, producers in environmental credit markets like wetland banking face the integration of schedules from such widely different realms that they demand much greater agility on the part of both banker and regulator. This kind of agility was seen in the Clearwater case, where the bankers were able to quickly modify their site plan and rapidly act after approval of the permit modification. However, all the agility in the world may not suffice: no matter how dire their need, the Clearwater bankers could not achieve their goal of

getting all of their hydrology and planting credits released for sale by the fall of 2003.

The temporal sequence of events that flows from the regulatory apparatus of the Clean Water Act is not, and cannot be, completely aligned with the temporal sequence of events that flows from a banker's interest in maximizing profit on a piece of land in southern Hartshorne County. And neither of these, of course, are designed to be responsive to the schedules of plant growth or precipitation patterns. Although it is impossible to align them *perfectly*, it appears to be just possible for skilled bankers to align them *adequately*. A failure of perfect alignment should not be conceived of as a suboptimality that calls for a better model.

## Scale and stability

Over the short time span covered by this study it is clear that multiple scales of government figure prominently in the construction and propagation of the banking market. In both cases, the primary importance of Corps District banking regulations was superseded in some way by regulations either more local or more national in scope. At Pierce Lakes, the state-level DNR interceded with its own regulatory agenda, and the Township's open-space goals caused them to ask for ecological improvements not normally required of banks. At Clearwater, the rapid development of the county stormwater code spurred equally rapid development of the bank credits, a situation stimulated by a Supreme Court ruling at the national level.

I wish to make two related points concerning this phenomenon: first, the multi-scaled nature of government regulation guarantees a lack of stability; and second, even within a particular scale, "regulation" is not an abstract force but is carried out by agencies and even individuals in conflict and negotiation with each other. Therefore it may be that entrepreneurs who can navigate constant instability, rather than those who plan for stability, are given the advantage. Economic accounts of environmental credit markets frequently argue for the necessity of a stable system of market trading rules (cf. Brumbaugh and Reppert 1994). Economic modeling of banking often assumes such stability (cf. Fernandez and Karp 1998), and even work such as Shabman and Scodari's (2004) that impressively documents the pervasiveness of

<sup>19</sup> The use of a credit release schedule, which allows credits to be sold after certain administrative performance standards have been met, but before any ecological performance standards have been met, is one way of coping with the temporal unpredictability of ecological processes. The creation and negotiation of such a schedule is a vivid example of translation and negotiation between economic, ecological, and regulatory requirements. The release of credits after the site has been secured, the instrument approved, and long-term financing arranged for—but before a single shovel has been placed in the ground—is now quite common (ELI 2006).

instability simultaneously decries it and seeks to eliminate it. Such accounts often highlight the ways in which regulatory instability is inimical to markets, and they generally conceive of “government” as a unitary whole and do not contemplate different levels of government interfering in meaningful and uncoordinated ways with each other. While most economists who examine environmental credit markets acknowledge the necessity of regulation (noting that all supply and all demand in these markets is created by regulation) (Shabman et al. 1994; Scodari and Shabman 1995; King and Herbert 1997; Oates 2006), these case studies show that “regulation” is not a simple, unidirectional force. It may be a multi-scaled position with internal conflicts, as with the Rushford OSC, the Supreme Court, and the DNR. The power of a given scale of government is not neatly and hierarchically nested within regional, state, and national scales, and no one regulatory scale can guarantee the stability of particular arrangement that will provide a predictable business environment for entrepreneurs (Robertson 2006). Furthermore, the case studies make it clear that successful bankers such as Gamben and DeLoos can both exploit the disharmony between many scales of government (as with their quick action following Hartshorne County’s stormwater ordinance), and exploit the lack of unity within government (as with their focus on Corps staff when requesting permission for the ditch-fill). Less experienced bankers such as Corivol may fail to manage these same disharmonies between scales (the conflict between the Township and DNR), and within government (conflicting Township goals for the prospective bank site).

These cases suggest that bankers and federal resource agencies do not control, or fully understand the factors controlling, the market they have built. Perhaps because of this, the initial establishment of stable market rules—on which such stress is put by economists—may serve mainly as the point of departure for the operation of networks of personal acquaintance and contingency through which bankers and regulators negotiate a complex and rapidly-changing regulatory, ecological and economic terrain. These are necessarily qualitative factors which are not easily parameterized. These cases suggest that, in the adoption of market-based environmental policies, equal policy attention should be focused on extra-economic issues in the creation of markets in

environmental credits, and on the importance of particular actors with the necessary skills in coordinating across multiple logics, scales and temporalities.

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## References

- BenDor TK, Brozovic N (2007) Determinants of spatial and temporal patterns in compensatory wetland mitigation. *Environ Manage* 40:349–364
- Bonds MH, Pompe JJ (2003) Calculating wetland mitigation banking credits: adjusting for wetland function and location. *Nat Resour J* 43:961–978
- Boyd J, Wainger L (2002) Landscape indicators of ecosystem service benefits. *Am J Agric Econ* 84:1371–1378
- Bromley DW (2006) Sufficient reason: volitional pragmatism and the meaning of economic institutions. Princeton University Press, Princeton
- Brumbaugh RW, Reppert R (1992) Wetlands mitigation banking demonstration study: status and summary. In: Kusler JA, Lassonde C (eds) *Effective mitigation: mitigation banks and joint projects in the context of wetland management plans*. ASWM, Palm Beach Gardens, pp 12–17
- Brumbaugh RW, Reppert R (1994) National wetland mitigation banking study: first phase report. US Army Corps of Engineers Institute for Water Resources, Alexandria
- Burawoy M (1991) The extended case method. In: Burawoy M (ed) *Ethnography unbound*. University of California Press, Berkeley, pp 271–287
- Burawoy M (2000) Introduction: reaching for the global. In: Burawoy M, Blum JA, George S, Gille Z, Gowan T, Haney L, Klawiter M, Lopez SH, Riain SÓ, Thayer M (eds) *Global ethnography: forces, connections, and imaginations in a postmodern world*. University of California Press, Berkeley, pp 1–40
- Corps (US Army Corps of Engineers) (2006) Draft environmental assessment, finding of no significant impact, and regulatory analysis for proposed compensatory mitigation regulation. US Army Corps of Engineers, Washington. March 13, 2006
- Environmental Law Institute [ELI] (2005) National forum on synergies between water quality trading and wetland mitigation banking: forum report. ELI, Washington
- Environmental Law Institute [ELI] (2006) 2005 Status report on compensatory mitigation in the United States. ELI, Washington
- Fernandez L, Karp L (1998) Restoring wetlands through wetlands mitigation banks. *Environ Resour Econ* 12:323–344
- Gardner RC, Pulley Radwan TJ (2005) What happens when a wetland mitigation bank goes bankrupt? *Environ Law Rep* 35:10590–10604



- Henderson GL (2003) California and the fictions of capital. Temple University Press, Philadelphia
- King DM, Herbert LW (1997) The fungibility of wetlands. *Natl Wetlands Newsl.* September–October 1997, pp 10–13
- King DM, Price EW (2006) Developing defensible wetland mitigation ratios: standard tools for “scoring” wetland creation, restoration, enhancement, and conservation. Report prepared for National Oceanic and Atmospheric Administration, Office of Habitat Protection, Silver Spring, MD, August 15, 2006
- Mack JJ, Micacchion M (2006) An ecological assessment of Ohio mitigation banks: vegetation, amphibians, hydrology and soils. Ohio EPA Technical Report WET/2006-1. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, Ohio
- Mäki U (2000) Kinds of assumptions and their truth: shaking an untwisted F-twist. *Kyklos* 53(3):317–335
- McAfee K (1999) Selling nature to save it? Biodiversity and green developmentalism. *Environ Plan D* 17:133–154
- MEA (Millennium Ecosystem Assessment) (2005) Ecosystems and human well-being: synthesis. Island Press, Washington
- Mirowski P (2001) Machine dreams: economics becomes a cyborg science. Cambridge University Press, Cambridge
- NRC (National Research Council) (2001) Compensating for wetland losses under the Clean Water Act. National Academy Press, Washington
- Oates WE (2006) An economic perspective on environmental and resource management: an introduction. In: Oates WE (ed) *The RFF reader in environmental and resource policy*. Resources for the Future, Washington, pp xv–xx
- O'Connor M (1994) On the misadventures of capitalist nature. In: O'Connor M (ed) *Is capitalism sustainable?: political economy and the politics of ecology*. Guilford, New York, pp 125–151
- Polanyi K (1944) *The great transformation: the political and economic origins of our time*. Beacon Press, Boston
- Rabin M (1998) Psychology and economics. *J Econ Lit* 36:11–46
- Robertson M (2006) Emerging ecosystem service markets: trends in a decade of entrepreneurial wetland banking. *Front Ecol Environ Sci* 4(6):297–302
- Robertson M (2007) Discovering price in all the wrong places: the work of commodity definition and price under neoliberal environmental policy. *Antipode* 39(3):500–526
- Rosenberg A (1992) *Economics: mathematical politics or science of diminishing returns?* University of Chicago Press, Chicago
- Ruhl JB, Juge Gregg R (2001) Integrating ecosystem services into environmental law: a case study of wetlands mitigation banking. *Stanford Environ Law J* 20:365–392
- Ruhl JB, Salzman J (2006) The effects of wetland mitigation banking on people. *Natl Wetlands Newsl* 28(2):1, 9–14
- Salzman J, Ruhl JB (2000) Currencies and the commodification of environmental law. *Stanford Law Rev* 53:607–694
- Scodari P, Shabman LA (1995) National wetland mitigation banking study: commercial wetland mitigation credit markets: theory and practice. US Army Corps of Engineers Institute for Water Resources, Alexandria, Virginia
- Shabman LA, Scodari PF (2004) The past, present, and future of wetlands credit sales. Resources for the future discussion paper 04-48. Resources for the Future, Washington. <http://www.rff.org/rff/Documents/RFF-DP-04-48.pdf>
- Shabman LA, Scodari PF, King DM (1994) National wetland mitigation banking study: expanding opportunities for successful mitigation: the private credit market alternative. US Army Corps of Engineers Institute for Water Resources, Alexandria
- Spieles D, Coneybeer M, Horn J (2006) Community structure and quality after 10 years in two central Ohio mitigation bank wetlands. *Environ Manage* 38:837–852
- SWS (Society of Wetland Scientists) (2005) Wetland mitigation banking. <http://www.sws.org/wetlandconcerns/banking.html>. Accessed August 16, 2006