

Count It by Acre or Function—Mitigation Adds Up to Net Loss of Wetlands

The recent report by the National Research Council's Committee on Mitigating Wetland Losses found that compensatory mitigation has failed to achieve the national policy of no net loss of wetlands. Three committee members now go beyond the study to explain some of those failings.

by R. Eugene Turner, Ann M. Redmond, and Joy B. Zedler

The national policy of no net loss of wetlands recognizes the important role that wetlands play in the landscape. The no net loss goal was endorsed by the first Bush Administration more than a decade ago, and it has been supported by every successive administration through today. This goal underlies federal agencies' efforts to develop permitting guidelines under section 404 of the Clean Water Act that will result in compensation for permitted wetland losses, as codified by the 1990 U.S. Army Corps of Engineers and Environmental Protection Agency memorandum of agreement on mitigation.¹ But have the agencies' efforts paid off? Are the nation's stock of wetlands and their function being replaced by compensatory mitigation?

We undertook a detailed analysis of peer-reviewed and "gray" literature on the performance of wetland mitigation under the section 404 permitting program to determine the nation's progress in meeting the no-net-loss goal. We asked if mitigation projects performed under the section 404 program have resulted in a net gain or loss of wetland functions. While we recognize the controversy over whether the regulatory program places undue emphasis on compensation for permitted wetland losses, we do not argue for or against the legitimacy of mitigation itself. Rather, we devote our analysis to whether current practices are meeting their stated policy goals.

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Mitigation Implementation and Compliance in Area

According to the Corps' national database on permits granted for wetland alteration or destruction, the area of wetland mitigation required through permits issued under section 404 averaged 17,100 hectares (1 hectare = 2.47 acres) annually from 1993 to 2000. These hectares were requirements to offset permitted annual wetland losses of 9,600 hectares, and they should have yielded a net wetland gain of 7,600 hectares annually. The amount permitted for mitigation and the amount lost has been fairly constant over the last eight years, with an average of 1.78 hectares of mitigation required for every hectare permitted for loss.

Issuance of a permit with mitigation requirements does not guarantee, however, that the required mitigation is achieved—or even attempted. We reviewed eight studies (covering seven states) of mitigation projects in which a permit requirement did not necessarily result in on-the-ground activity. In fact over these eight studies, the proportion of mitigation efforts initiated range anywhere from 28 to 100 percent of the total amount permitted.² Only one of the eight studies indicates that all required compensatory activities were initiated.³ Some unfinished mitigation projects may have concerned impacts that were not realized, but we cannot determine the occurrence or frequency of this situation from the literature.

Even when the mitigation is attempted, permit conditions may not be met. For example, a review of 80 permits issued between 1985 and 1993 in Orange County, California, indicates that 30 permits met the permit conditions, 19 met some of the permit requirements, six met none of the requirements, 13 were never completed, and two were never attempted.⁴ The Orange County permit compliance scenario typifies 19 other studies of mitigation project implementation we examined. While 10 of the studies found a majority of projects to be in compliance with their permit conditions, nine studies found only 4 to 49 percent of the sites to be in compliance.

We also examined five state permitting programs—eight studies evaluated whether the area of mitigation achieved exceeded the area

Table of completed mitigation projects and their degree of compliance. Results are based on field inspection or monitoring reports. Unverified projects are considered non-compliant. NA = not available.

Location	Number of permits	Percent in Compliance	Source
California			
Orange County	57	13	Sudol 1996
Southern California	75	42 ^a	Allen & Feddema 1996
Sacramento and San Francisco	30	50 ^b	DeWeese 1994
Northeast Florida	29	79	Lowe et al. 1989
Northeast Florida	201	86	Miracle et al. 1998 ^c
South Florida	42	10	Erwin 1991
Florida Water Management Districts			OPPAGA 2000
SW Fla. WMD, 1988-89	33	33	
SW Fla. WMD, since 1995 ^d	254	82	
St. Johns River WMD, 1999	NA	78	
Suwannee River WMD	NA	100	
Florida Department of Environmental Protection			OPPAGA 2000
SE District (no date)	NA	67	
NE District (no date)	NA	87	
Illinois	NA	4	Gallihugh 1998
Massachusetts DEP	84	49	Brown & Veneman 1998
Ohio	14	100	Fennessy & Roehr 1997
Ohio	5	80	Wilson & Mitsch 1996
Virginia	32	NA	Mason & Slocum 1987
with permit conditions		86	
w/o permit conditions		44	
with time limits		100	
w/o time limits		50	
Washington	17	53	Storm & Stellini 1994
Washington	43	35	Johnson et al. 2000
Washington	29	21	Mockler et al. 1998

^aCompliance reflects 100 percent compliance.

^bCompliance reflects 8, 9, or 10 on a scale of 10.

^cAfter 5 years, some projects still in monitoring stage (and compliant).

^dIncludes projects that achieved success and those "trending toward" success.

of wetland lost through permitting.⁵ Two of the studies found that the area of mitigation achieved equaled or exceeded the area of wetland lost. Six of the studies found the opposite—mitigation area achieved was less than wetlands lost, due to non-compliance. Nine studies (representing four state programs) involved ground-truthing to determine if the actual area implemented equaled that required by the permit. These studies found fewer hectares of mitigation than required by permits. The average area of mitigation implemented was 0.69 hectares for every hectare lost. The data do not clarify whether the reduced area is due to undersizing the implemented mitigation area or to a failure of the entire implemented area to become a jurisdictional wetland.

Delving Deeper into Functional Equivalency

Although the mitigation studies paint a bleak picture of compensatory mitigation falling far short of mitigated area requirements,

wetland area only represents part of the equation. The policy of no net loss policy calls for no net loss of wetland functions and values. Simple ratios of area do not indicate the equivalent replacement of wetland functions for two reasons: different types of mitigation (creation, restoration, enhancement, or preservation) yield different types and degrees of wetland function, and the wetland functions expressed by each impact site vary greatly.

Initiation of a mitigation project—and even compliance with permit conditions—does not guarantee full replacement of wetland functions. Studies of compensatory mitigation projects suggest that functions are not being fully replaced. In fact, of the studies we followed, we found that only 21 percent of the mitigation sites met various tests of ecological equivalency to the functions lost. These replacement wetlands ranged from 0 to 67 percent functionality. The compliance rate for these same studies ranged from 6 to 100 percent.

Some studies used vegetation as the main criterion for a short-term evaluation, because herbaceous vegetation is easily monitored and establishes itself quickly in a wet environment.⁶ Other studies caution against examination of vegetation alone, finding that while vegetation is easy to measure, it is a poor indicator of ecological function.⁷ Nonetheless, vegetation is the most common indicator used for measuring wetland function. For example, vegetation (type or cover) was the most frequently measured parameter for 110 compensatory wetland projects in California permitted from 1988 to 1995.⁸ Two common functions of wetlands—flood storage and water quality improvement—were required to be replaced by fewer than 10 percent of the California permits.

An examination of 70 mitigation permits in Massachusetts told different stories, depending on whether one looked only at vegetation or at a more robust array of environmental parameters.⁹ Field visits were made to 68 of the sites, seven of which were "variance" sites (sites that received a higher degree of scrutiny due to the relatively large area of permitted impacts). Parameters were measured in the mitigation wetlands and reference sites. The field visits revealed that although plant cover and other indicators of plant community health were similar between mitigation and reference wetlands, the species composition differed. The differences in plant species may explain why use by amphibians, mammals, and birds (but not reptiles) was lower in mitigation sites than in their reference sites. Furthermore, as compared to the reference sites, all the replacement wetlands contained fewer species, while the number of species at variance sites did not differ. The increased level of regulatory scrutiny for the variance sites had resulted in mitigation with higher levels of ecological functioning.

In an example on the Pacific Coast, a salt marsh restoration attempt in southern California for the endangered light-footed clapper rail demonstrates that multiple evaluation criteria provide a

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including our own, have had their land certified “organic.” The task of producing, processing, packaging, and marketing a packaged, organically certified meat product has proven to be very challenging, but we still keep plugging away, and hope to be marketing a finished product by the end of 2002.

The conservation easement aspects of the Rock Creek Heritage Project has made much progress to date, although we still have a long way to go. Thus far, approximately 1,320 acres have been placed under conservation easement—by sale and donation. Another 1,200 acres are currently in the easement process and should be completed before the end of 2002. A request for funding an additional 1,600-acre parcel has been submitted, and if approved, should also be completed by the end of 2002. Further, 1,800 acres are under an option to purchase a conservation easement with American Farmland Trust, pending the availability of funds. A 760-acre parcel, which was owned by one of the landowners who indicated uncertainty in the initial postcard response, has just been sold outright to the land trust, to be placed under easement with Ducks Unlimited and then resold to an agricultural operator. The 3,033 acres of our ranch are among those parcels in the works and under option. More than 500 acres have been sold to the Fish and Wildlife Service and incorporated into the Monte Vista National Wildlife Refuge.

The majority of the funding to date for these conservation easements has come from the Colorado Wetlands Initiative and the Landscape Legacy Program, supported by the Great Outdoors Colorado Trust Fund—the state organization charged with distributing Colorado State Lottery proceeds, which are allocated to fund open space and wildlife habitat protection projects. These programs benefit from partnership arrangements with conservation organizations and federal agencies, including Ducks Unlimited, The Nature Conservancy, U.S. Fish and Wildlife Service, and Colorado Division of Wildlife.

The Rock Creek Heritage Project has evolved in just a few short years from scattered phone inquiries by cautious landowners to an established landowner initiative in watershed conservation involving many institutions. We now count among the coalition numerous landowners, the American Farmland Trust, Ducks Unlimited, The Nature Conservancy, Trust for Public Land, and Colorado Cattlemen’s Agricultural Land Trust, as well as a number of government agencies such as the U.S. Fish and Wildlife Service, the Natural Resource Conservation Service, and the Colorado Division of Wildlife. We are very thankful and appreciative to the many organizations and agencies that have helped us take a dream and begin to turn it into a reality. Because of the efforts of so many organizations and individuals, we all have tremendous hope for the continued viability and sustainability of our agricultural community and landscape for future generations. ■

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more complete picture of restoration progress than simply exploring plant cover and also the potential peril of using vegetation as the sole evaluation criteria. The salt marsh restoration involved construction of islands planted with salt marsh vegetation. At the end of the five-year study period, 11 parameters were compared with those of a nearby natural site. Three parameters of plant health showed 42 to 84 percent of all levels in the reference marsh (“equivalency”), two benthic invertebrate parameters indicated 36 and 78 percent equivalency, and four soil parameters ranged from 17 to 110 percent equivalency (one parameter was 10 percent greater in the constructed site than in the reference site, yielding 110 percent “equivalency”). A recent update, compiling the 10-year data set, indicates that this site would likely not comply with permit conditions.¹⁰ Plant cover data alone would not have revealed the inadequacy of the site for clapper rail nesting now or in the future. It was the combination of soil, nutrient, and vegetation trajectories, in conjunction with bird nesting habitat requirements, that allowed researchers to predict insufficient capacity to support nesting by the target species.

Perhaps a better measure of wetland function would be an assessment of hydrologic conditions. One study used hydrogeomorphic (HGM) classification to assess 40 projects covering 97 hectares of impacts and 104 hectares of proposed mitigation in Orange County, California.¹¹ Fifteen habitat functions were compared between mitigation sites and seven reference sites. While 42 percent of the compensatory mitigation wetland area met the permit requirements, no project entirely complied. Fourteen projects partially complied. The study concludes that the fundamental reason for insufficient ecological performance was the inability to restore or create the necessary hydrological conditions.

Although some mitigation sites might improve over time, we conclude that compensatory mitigation projects that meet all permit conditions are slow to attain functional equivalency with their reference sites or with the sites they replace—if they ever do attain equivalency. Indeed, wetland restoration trajectories do not suggest that most sites will reach equivalency within the commonly used five-year monitoring period. The few studies of ecological trajectories at wetland mitigation sites suggest that an equilibrium for many functions may take up to 20 years—and they still may not equal the reference conditions.

Mitigation Has Failed, Regardless of the Measure

For every permit issued, the national average of wetland area that is *intended* to be restored, created, enhanced, or preserved was estimated by the Corps to be 178 hectares for every 100 hectare of impacted wetland.¹² (For the purposes of estimating wetland loss or gain, enhanced and preserved mitigation wetlands are not differentiated from created or restored mitigation wetlands in the Corps’ database.) Comprehensive data are not available to determine how much permitted mitigation area should result in net changes in wetland function versus area. Therefore, the 178 hectares is

overestimated by an unknown, but probably significant, amount.

Setting aside function for the moment, if we apply the Corps' estimate to the on-the-ground results we reviewed, we can assume that the required 178 hectares of mitigation result in about 134 hectares or 75 percent of the permits being implemented, and those hectares in turn result in 77 to 104 hectares or 58 to 78 percent of the implemented mitigation projects complying with permit requirements. If we then estimate the area of functionally equivalent wetlands at each site, we can assume that only about 16 to 19 hectares or around 20 percent of wetland functions are compensated. Replacement of only about 16 to 19 hectares of the required 178 hectares represents about 10 percent of the required amount. Because the average replacement ratio was nearly two hectares lost for every hectare replaced, the actual

Mitigation area required and the actual area achieved, based on post-construction evaluation. Results shown are based on the assumption of complete compliance with all other permit conditions. Ha = hectares.

Location	Ha req'd per ha lost	Actual ha on site	% Area Built	Source
California				
San Diego County	1.51	0.93	62	Fenner 1991
Southern Calif.	1.40	0.96	69	Allen & Feddema 1996
Sacramento and San Francisco	1.44	1.29	90	DeWeese 1994
Orange County	1.03	0.18	17	Sudol 1996
Indiana	2.48	1.10	44	Robb 2000
Ohio	1.50	1.26	84	Fennessy & Roehrs 1997
Ohio	1.72	0.66	38	Wilson and Mitsch 1996
Ohio	1.50	0.93	62	Sibbing 1997 ^a
Tennessee	1.00	0.87	87	Morgan & Roberts 1999

^aIncludes enhancement

The percentage of mitigation permits meeting tests of ecological functionality or viability.

Location	Number Permits	% Meeting Viability/Function	Source/Notes
California	57	0	Sudol 1996 ^a
Florida	29	45	Lowe et al. 1989 ^b
Florida, SFWMD	NA	4	Erwin 1991
Florida	63	27	FDER 1991 ^c
Freshwater	34	12	
Saltwater	29	45	
Florida, State			OPPAGA 2000
Johns WMD	(1992) NA	27	
	(1999) NA	67	
Ohio	10	0	Fennessy and Roehrs 1997
Oregon	17	18	Storm and Stellini 1994
Washington	29	3	Mockler et al. 1998

^aSites classified as a complete success and not irrigated.

^bSite variability classified as good or poor.

^cSites rated on hydrology, soils, vegetation, and fauna.

amount of wetland impacts offset is only about 20 percent, meaning that the section 404 permitting program has been fostering an 80 percent net loss of wetlands. Even if our estimate is off by a factor of two, three, or four, the mitigation program falls far short of attaining a no-net-loss of wetland functions as well as area.

While some Corps districts fulfill many of their regulatory obligations, our findings suggest that at least part of the impediments to achieving program goals can be attributed to administrative failure. Some simple but important changes are needed. First, the Corps permits should specify conditions and deadlines. Two studies point to administrative fixes that could raise the success of mitigation through changes in permit conditions, deadlines, verification, and enforcement. For example, compliance rates doubled when the permit contained specific conditions, compared with permits that contained no specific conditions. Importantly, when the permit contained a deadline, the compliance rate was 100 percent, compared with 50 percent for permits without time limits.¹³ Lack of monitoring is also a common element of failed projects.¹⁴ Compliance monitoring is commonly known to be nonexistent after five years. A higher post-implementation rate should increase permit compliance rates. Self-interest in reporting data to agencies might have an influence on the accuracy of the evaluation, and may be a reason to restrict consultants responsible for site development from being the ones also responsible for submitting the monitoring reports for their own projects.¹⁵ Other necessary changes are more extensive, such as elevating permit enforcement to a high program priority.¹⁶

Two additional changes could dramatically improve mitigation projects: (1) increased use of ecological criteria (community structure and ecosystem functioning) in setting permit requirements and (2) locating mitigation sites within the context of watershed management plans. While the specific designation of an ecological endpoint is not realistic, it is possible to require that the fundamental processes defining wetland types be established.¹⁷ To achieve that end, mitigation projects should be implemented and constructed according to established design criteria, using an adaptive management approach that is specified in the permit.¹⁸ And while most individual mitigation actions are probably not detectable at the watershed scale, their cumulative effects could be detected.¹⁹ Proper placement of mitigation sites in the landscape would yield dramatic improvements in mitigation wetland viability.²⁰ Therefore, site selection for wetland conservation and mitigation should be conducted on a watershed scale to maintain wetland diversity, connectivity, and appropriate proportions of upland and wetland systems needed to enhance the long-term stability of the wetland and riparian systems.²¹

To date, efforts to compensate fully for damages to wetlands through individually permitted projects often result in a net loss of wetland area. The record shows that mitigation is ecologically possible, that mitigation has routinely accomplished in some Corps districts, but that mitigation is not being done well in most. Of the hectares restored and created, a smaller area complies with permit requirements, and of

those, an even smaller area can be considered functionally equivalent to naturally occurring wetlands in the region. There is much to be improved in tracking both hectares and functions that are lost via the compensatory mitigation process. Indeed, there is also much to be improved in implementing projects. If watershed-management plans were accomplished in advance of permitted damages to wetlands, and

if such plans laid out a suite of promising wetland restoration sites, the selection of mitigation sites could facilitate the retention of wetland functions. Then, if mitigation requirements were based on ecological criteria (desired attributes of community structure and ecosystem functioning), the likelihood of sustaining wetland function within sites and watersheds should improve greatly. ■

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