

The US Clean Water Act and Habitat Replacement: Evaluation of Mitigation Sites in Orange County, California, USA

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ABSTRACT / Both permit requirements and ecological assessments have been used to evaluate mitigation success. This analysis combines these two approaches to evaluate mitigation required under Section 404 of the United States Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act, which allow developers to provide compensatory mitigation for unavoidable impacts to wetlands. This study reviewed permit files and conducted field assessments of mitigation

sites to evaluate the effectiveness of mitigation required by the US Army Corps of Engineers for all permits issued in Orange County, California from 1979 through 1993. The 535 permit actions approved during this period allowed 157 ha of impacts. Mitigation was required on 70 of these actions, with 152 ha of enhanced, restored, and created habitat required for 136 ha of impacts. In 15 permit actions, no mitigation project was constructed, but in only two cases was the originally permitted project built; the two cases resulted in an unmitigated loss of 1.6 ha. Of the remaining 55 sites, 55% were successful at meeting the permit conditions while 11% failed to do so. Based on a qualitative assessment of habitat quality, only 16% of the sites could be considered successful and 26% were considered failures. Thus, of the 126 ha of habitat lost due to the 55 projects, only 26 ha of mitigation was considered successful. The low success rate was not due to poor enforcement, although nearly half of the projects did not comply with all permit conditions. Mitigation success could best be improved by requiring mitigation plans to have performance standards based on habitat functions.

As a result of extensive wetland losses, there has been increased attention paid to wetland management and restoration worldwide. The United States has a long history of wetland management regulations and policies, principally based on the concept of mitigation. Mitigation policy, established as a way to allow necessary development projects while minimizing environmental impacts, was formalized in the National Environmental Policy Act (NEPA) of 1969 and subsequent agency policies and memoranda of agreement (Berry and Dennison 1993). NEPA recognizes several different types of mitigation, but compensatory mitigation, which allows resource losses to be compensated by the provision of replacement resources, has drawn the most attention; hereafter, "mitigation" is used to mean compensatory mitigation.

KEY WORDS: Clean Water Act Section 404; Compensatory mitigation; Ecological assessment; Habitat creation; Mitigation success; Restoration; Riparian habitat; Wetlands; Orange County, California

Section 404 of the US Clean Water Act (CWA) includes mitigation as part of its regulation of impacts to wetlands (Kruczynski 1990, Ambrose 2000). Creation and restoration of wetland habitat as mitigation has received little support in the scientific literature (Race 1985, Zentner 1988, Kentula and others 1992, Holland and Kentula 1992, DeWeese and Gould 1994, Miller 1995, Zedler 1996, Gilman 1998, Breaux and Serefiddin 1999, Brown and Veneman 2001). Recent criticisms of mitigation projects include a lack of information on wetland functions (Mitsch and Wilson 1996), insufficient understanding of the complexity of ecosystems, neglect of landscape-level interactions (Zedler 1996, Kelly 2001), and inadequate compliance efforts by regulatory agencies. In spite of these problems, the use of mitigation continues because it remains part of the CWA regulations. Many of these deficiencies are beginning to be identified and studied in the science of restoration ecology (Mitsch and Wilson 1996), but final solutions remain elusive (Ambrose 2000).

The US Army Corps of Engineers (Corps) regulates activities within wetlands in the United States under Section 404 of the CWA (all "waters of the United

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States”) as well as Section 10 of the Rivers and Harbors Act (navigable waterways). The Corps regulates the discharge of dredged or fill material into wetlands and waters of the United States. Placement of fill and drainage of wetlands has the greatest potential for direct and permanent loss of habitat. Corps permits in 1994 allowed 6964 ha of impacts while requiring 15,385 ha of habitat creation or restoration as mitigation for project-related impacts. Similarly, in 1993, 4696 ha of habitat were impacted with 6154 ha of mitigation required (Studt 1994). Both of these analyses imply that more wetlands are being restored or created than are being impacted as a result of Corps-issued permits, implying a good degree of protection for wetland resources. However, more detailed reviews of permit files for a number of states have shown that mitigation requirements generally do not completely compensate for the losses allowed through Section 404 permitting (Holland and Kentula 1992, Kentula and others 1992, Sifneos and others 1992a,b Kelly 2001). Moreover, official Corps wetland numbers (Studt 1994) reflect only hectares of impacts and required mitigation, not the functions or values of those hectares. Corps statistics represent the best possible case because they do not consider whether the mitigation is less than successful or is not completed.

In one of the earliest studies evaluating the success of mitigation projects, Race (1985) identified problems with all of the eleven sites she evaluated in San Francisco Bay, although Harvey and Josselyn (1986) argued that the problems were not as severe as Race indicated. A review of 18 wetland sites associated with San Francisco Bay Conservation and Development Commission (BCDC) permits judged 33% of the projects to be successful (Demgen, 1988). A summary of work completed before 1989 (Josselyn and others 1990) found mixed results, with only one survey (Zentner 1988) indicating a success rate of at least 50%. More recently, DeWeese and Gould (1994) found 50% of the projects evaluated achieving at least 75% compliance with stated permit conditions. Similar results were found in a recent study of mitigation sites in Southern California (Allen and Feddema 1996), which identified a success rate of 67%, again for compliance with permit conditions. Several studies have suggested that increased enforcement of mitigation permits would improve compliance with permit conditions (Zedler and Weller 1990, Holland and Kentula 1992, Sifneos and others 1992a, DeWeese and Gould 1994).

In this study, the effectiveness of the Corps program allowing mitigation as replacement for lost habitat is evaluated by examining one region in detail. All permits issued by the Los Angeles District Corps of Engi-

neers for work within wetlands and waters of the United States in Orange County, California, were assessed. The assessment combined the two approaches, evaluation of permit requirements and evaluation of ecological conditions, commonly used to evaluate mitigation success. All permit files were examined to determine the extent of permitted impacts and planned mitigation, as in other studies (Holland and Kentula 1992, Kentula and others 1992, Sifneos and others 1992a,1992b, Breaux and Serefiddin 1999, Kelly 2001). Next, field investigations determined: (1) If the project had been constructed, and (2) the success of the mitigation site based on (a) a determination of compliance with specific permit conditions and (b) a qualitative assessment of habitat constructed. Comparing permit compliance with habitat quality recognizes the distinction between compliance success—how well the projects met their permit requirements—and ecological success—how well they replace the functions of natural wetlands (Quammen 1986).

Materials and Methods

Database and File Survey

Official files for permits issued in Orange County by the Regulatory Branch of the Army Corps of Engineers were screened to determine hectares of impacts and mitigation using methods similar to those of Holland and Kentula (1992) and Sifneos and others (1992a,b). Official permit files are kept in the Los Angeles District for every permit action processed by the Corps since the early 1900s. Each permit file includes project information, all incoming and outgoing correspondence, and pertinent maps, charts or photographs. A summary of the information in these files is maintained on an automated database that enables project managers to track past permit actions, conduct database searches using key words or phrases, and provide data on permit processing statistics as required by the Office of the Chief of Engineers. Permits issued, denied, or withdrawn in Orange County were identified using the automated database. Our search identified 840 files associated with regulatory actions in Orange County from January 1978 (date of the oldest permit with mitigation requirements) to May 1993 (date of the initial database query). The official record for each permit was examined individually in the district office, although records on projects issued before 1980 had been archived and could not be found. Official records were screened to confirm that the permit action occurred in the county, that mitigation was included as a special condition of the permit, and to obtain informa-

Table 1. Criteria for determining success of mitigation sites^a

Category	Permit conditions	Qualitative estimate
Success	Meets or exceeds all of the special conditions associated with the Section 404 permit.	Habitat has similar spatial and species diversity as minimally disturbed habitat.
Partial success	Meets at least one of the special conditions associated with the Section 404 permit.	There is wetland or riparian vegetation on site, not an upland site.
Failure	Meets none of the special conditions associated with the Section 404 permit.	1. Majority of vegetation consists of upland species. 2. Less than 10% cover, all vegetation.
No attempt	Project completed, no mitigation found.	
No project	Project not initiated, no mitigation needed.	

^aCriteria were applied during field visits to each mitigation site.

tion on hectares of impacts, hectares of mitigation (if applicable), and Corps regulatory authority (Section 10 or 404). Initial screening of the official records showed that 305 permits actions were erroneously identified as occurring in Orange County and actually occurred in other counties. The remaining 535 actions were completed in Orange County between 1979 and 1993, and 70 of these permits had mitigation requirements written as special conditions. Most permits concerned riparian habitat that was jurisdictional “waters of the United States” under Corps regulations, although they may not have been “three-parameter” jurisdictional wetlands. In this paper, we consider riparian habitat as a wetland habitat in the broad sense, even though it may not meet the Corps regulatory requirements for a wetland.

The specific type of mitigation was also determined from the official record and verified during site inspections. These categories were defined as in Lewis (1990), with an additional category (passive revegetation) added to remove possible ambiguities. The categories are: (1) restoration: return to a preexisting condition; (2) creation: conversion of a persistent nonwetland (or riparian) habitat into wetland (or riparian) habitat (two subdivisions are recognized: artificial (irrigation required) or self-sustaining); (3) enhancement: increase in one or more functions due to intentional activities (i.e., plantings); (4) passive revegetation: allow a disturbed area to naturally revegetate without plantings. In addition, if the site was planned to be constructed on upland habitat and maintained through the application of artificial irrigation (sprinklers or drip systems), this was noted and confirmed in the field.

Site Visits

We located the mitigation sites (important because Corps staff had never visited many of the sites), recorded general site-specific information, and estimated the success of the mitigation project using two sets of

criteria (Table 1). The first set is based on compliance with the success criteria established by the permit. Success criteria are written as special conditions of the permit or included in the applicant’s proposed mitigation plan and could be readily evaluated in the field. Typical success criteria included percent survival of transplanted plants, percent vegetation cover (all species), and/or the average height of vegetation after a specific period. Generally, the success criteria were proposed by the permit applicant’s consultant and approved by the Corps on a case-by-case basis. Thus, success criteria were different for nearly every mitigation project. The specific conditions identified in each permit were evaluated in the field to rate each site.

The second set of criteria concerns habitat quality, including the density of the vegetation, plant species diversity, presence of invasive plant species, and average tree height as compared to “native” habitat (defined as an area that is subject to normal regional hydrologic conditions that has not been directly impacted by human activities). This approach, “best professional judgment,” is used frequently by resource agencies to assess habitat quality in permit decisions. Such qualitative assessments have been the subject of much debate and criticism (Harvey and Josselyn 1987). However, our main purpose is to provide a rough estimate of ecological condition, so that the evaluation of mitigation success was not based solely on permit conditions.

Field visits were conducted from January 1994 to January 1995. If no mitigation was found, then the original project site was visited to learn if the project was ever built. If no project was built, the mitigation was classified as “no project.” If the project was built, another attempt was made to locate the mitigation site. If the mitigation site could not be found, the owner or consultant was contacted in an attempt to determine if mitigation was attempted. If the consultant/applicant could not be contacted, the site was classified as “no attempt.”

Table 2. Success of mitigation projects based on permit compliance and habitat conditions^a

Category	Permit compliance			Habitat conditions		
	<i>N</i>	Impacts (ha)	Mitigation (ha)	<i>N</i>	Impacts (ha)	Mitigation (ha)
Total permits	70	136	152	70	136	152
No project	13	8	13	13	8	13
No attempt	2	1.6	1.6	2	1.6	1.6
Projects evaluated	55	126	138	55	126	138
Success	30	91	72	9	42	26
Partial	19	24	45	32	63	78
Failures	6	11	21	14	21	34

^aSuccess criteria given in Table 1. Success was evaluated for the 55 mitigation projects actually initiated out of the 70 permits requiring mitigation.

Results

The Corps issued 535 permits for work within Orange County from 1979 to 1993. Total impacts from these permits were 157 ha with 152 ha of mitigation required, indicating a net loss of wetland habitat in Orange County during this period. Only 70 of the 535 permits issued had requirements for mitigation; these 70 permits accounted for 87% (136 ha) of the area impacted. The remaining 465 permits accounted for 21 ha of impacts, the result of many small projects authorized by the Corps that did not require mitigation. Most of these 465 permits were issued under Section 10 for work within the bays and harbors of Orange County that was considered to have minimal impacts on the aquatic environment.

The 70 permits requiring mitigation consisted of 65 permits associated with Section 404 and five permits associated with Section 10. Project-related wetland impacts and mitigation associated with the Section 404 permits in the county were divided into seasonally flooded, intermittent riverine (riparian habitats), and isolated lacustrine systems (terminology after Cowardin and others 1979). The impacts associated with Section 10 permits involved intertidal estuarine habitats. Mitigation associated with three of the five Section 10 permits involved monetary contributions to the Newport Back Bay Ecological Preserve; only two Section 10 permits involved direct habitat restoration of estuarine habitat.

Field evaluations verified that 15 mitigation projects had not been constructed (Table 2). These 15 sites illustrate inaccuracies in estimates gleaned solely from permit files. Thirteen sites were classified as no project and two sites were classified as no attempt. The thirteen no-project sites would have had 8.1 ha of impacts and 13 ha of mitigation. Removal of these sites from the acreage totals resulted in a reduction in total impacts from 136 to 128 ha and reduction in mitigation from

152 to 139 ha. Projects associated with the two no-attempt sites were built, 1.6 ha of habitat was lost with no mitigation being constructed.

Evaluation of the remaining 55 mitigations found that the majority of the sites were either successful or partially successful (Table 2). Using the project-specific permit conditions, 55% of the mitigation sites were considered successful; in terms of acreage, 52% were successful. Nineteen sites fulfilled at least one of the special conditions and thus were judged partially successful (35% of the sites, 32% of the acreage). Six sites were determined to be failures (11% of the sites, 15% of the acreage). Using the criteria in the permits, the 55 projects resulted in the loss of 126 ha of habitat with only 72 ha of mitigation considered successful.

Qualitative evaluation of the mitigation sites considered fewer successful (16% or nine sites); in terms of acreage, 19% were successful. Thirty-two sites were considered partially successful (58% of the sites, 57% of the acreage). Fourteen sites were considered failures (26% of the sites, 25% of the acreage). The 55 projects resulted in the loss of 126 ha of habitat with only 26 ha of mitigation considered successful. Thus, the evaluation of success based on habitat yielded a lower success rate than the evaluation based on permit conditions.

Creation of habitat accounted for over two thirds of the wetland mitigation acreage (87 ha of planned mitigation) associated with projects in Orange County (Table 3). The success of these mitigation projects as evaluated by the permit compliance showed that 80% (44 of the 55; 88% by acreage) were either successful or partially successful. However, the qualitative evaluation indicates that approximately 20% (11 sites, 11 ha) of these wetland mitigation projects were classified as failures. Except for passive revegetation projects, mitigation projects were judged 8%–13% less successful by the qualitative habitat evaluation compared to permit compliance. Much of the success of the creation

Table 3. Summary of mitigation success by mitigation type

	Mitigation type				Total (ha)
	Creation (ha)	Restoration (ha)	Enhancement (ha)	Passive revegetation (ha)	
Permitted impacts	86	22	6.5	11	126
Planned mitigation	87	28	9.7	13	138
Successful or partially successful by permit conditions	77	20	9.3	11	117
Successful or partially successful by qualitative evaluation	68	17	8.5	11	104
Successful or partially successful by qualitative evaluation and without artificial irrigation	32	17	8.5	11	67

projects was due to irrigation. When creation sites requiring irrigation to maintain the habitat are removed from the analysis, the success rate declines to 14.5% success (8 projects, 32% by acreage). There were no restoration, enhancement, or passive revegetation sites requiring artificial irrigation.

Discussion

The evaluation of mitigation is often based on raw acreage of wetland habitat created, restored, or enhanced as mitigation for projects negatively impacting aquatic or riverine habitat. For example, a survey of wetland loss and mitigation by Tolman (1996), which included official information from the US Fish and Wildlife Service, National Resources Conservation Service, and the US Department of Agriculture, concluded that the US is gaining wetlands through construction of new habitat as mitigation. The Corps has published statistics showing more area of mitigation being required than impacts allowed, again indicating a net gain of wetlands (US Army Corps of Engineers 1995). This apparent gain in wetland acreage has been used to support the policy of accepting mitigation for unavoidable impacts. However, these statistics do not consider the quality of the habitat created, restored, or enhanced as mitigation (Wilén 1995, Heimlich and Melanson 1995) or even whether the proposed mitigation is actually completed.

This study examined all permits issued within one county in Southern California over a 15-year period to characterize the success of past mitigation activities and assess the validity of statistics based on evaluation of permit requirements. Field investigations of Orange County mitigation sites found that there was a net loss of wetland habitat, in spite of the fact that many mitigation sites did meet the success criteria included in the Corps permits. There were 126 ha of impacts from 55 permits with only 72 ha of successful and 45 ha of partially successful mitigation, as evaluated by the suc-

cess criteria in each permit. Even fewer of these sites were judged successful based on a qualitative assessment of the habitat quality, further reducing the acreage of effective mitigation. Even these estimates overstate the long-term success of the mitigation projects. In most cases, once a site meets the permit criteria, further maintenance or monitoring is not required, potentially leading to additional losses as these sites decline due to loss of irrigation or invasion by nonwetland or nonriparian species.

The field assessment methods used in this study were simple yet effective for evaluating important aspects of mitigation projects. Determining compliance success (i.e., the degree to which mitigation projects meet the conditions of their permits) requires no special methodology but provides important insights beyond the information gleaned from an office review of permit files. In this study, we found substantially less mitigation being provided than suggested from the permit files alone. The qualitative assessment of ecological success, while no replacement for a detailed ecological assessment, was simple to perform and demonstrated that many mitigation projects judged successful in terms of permit conditions were still resulting in resource losses. Routine application of simple field assessment methods, such as employed in this study (see also Ainslie 1994, Stein and Ambrose 1998, Yoder and Rankin 1998), would provide a more accurate assessment of the success of Section 404 mitigation than simple permit-derived summaries of acreage.

Previous studies have called for increased compliance efforts by the Corps as a means to improve mitigation success (Zedler and Weller 1990, Holland and Kentula 1992, Sifneos and others 1992a, DeWeese and Gould 1994). Better enforcement could certainly have prevented the losses associated with the two permits in which no mitigation was attempted, but this was a minor contribution (1.6 ha) to the overall wetland losses identified in this study. Enforcement might also have improved the success of the 11% of the projects judged

failures and the 35% judged partially successful. However, 54% of projects studied met all of their permit conditions. If a site meets the conditions for success in its permit, the Corps approves the mitigation project and can take no further action. In Orange County, the Corps could not seek changes to more than half of the mitigation sites because the permit conditions were met.

Artificial irrigation has become a point of contention within several Corps districts. Applicants frequently propose artificial irrigation of upland sites as mitigation for impacts to wetlands and riparian habitat. In the Los Angeles District, these projects have historically been accepted because of the difficulty of finding suitable areas for mitigation. The Corps, in the analysis of less-damaging project alternatives, cannot require an applicant to construct mitigation that is considered prohibitively expensive or not practical using current technology. Consequently, the Corps cannot require an applicant to purchase property for mitigation if the cost of that land makes the entire project significantly more expensive. As a result, mitigation is usually performed on areas already owned by the applicant (or on public lands) that lack wetland hydrology and do not support wetland vegetation. Applicants propose various plans to provide water to the site under the assumption that the addition of water will support the planting and establishment of wetland or riparian vegetation.

Twelve of the 22 habitat creation sites in Orange County were upland areas that had been cleared and graded, with trees and shrubs planted in rows to facilitate installation and maintenance of the artificial irrigation system. These sites obviously do not resemble or function like natural riparian habitats; rather, they were designed to achieve the performance criteria established in their permits, which include tree survival rates, tree height, and percent of canopy cover. Not surprisingly, the permit conditions have driven the design of these sites. Permittees desire a mitigation project that will meet the Corps' mitigation requirements at reasonable cost, and a field of regularly spaced and irrigated trees satisfies these needs. Unfortunately, without natural hydrologic processes, which are essential for natural recruitment and the maintenance of species diversity (Warner and Hendrix 1985, Faber and others 1989), these sites will never be able to support a self-sustaining riparian community. In addition, continued artificial irrigation is not included as a specific permit condition in many cases, so the water can be turned off once the success criteria are met. In these cases, the vegetation will almost certainly revert back to an upland community. Because 36 ha of the mitigation projects were irrigated, it is clear that the policy of allowing

irrigation of upland areas has, by itself, ensured that the goal of no net loss of wetland habitat was not met. While this practice has been curtailed in some districts, the practice of relying on vegetation parameters as the primary criteria for success continues (Breaux and Serefiddin 1999).

Another practice recently questioned by resource agencies is the appropriateness of allowing enhancement of riverine wetland habitat (rather than creation or restoration) as mitigation. This type of mitigation does not provide new replacement habitat. Riverine habitat in Southern California is in a constant state of flux due to the influence of the annual winter rains and associated flooding (Warner and Hendrix 1985, Faber and others 1989). Riverine zones are areas of natural scour and recolonization by specific plant communities; enhancement of an area under the influence of natural processes may alter the timing of succession but does not provide a net gain of habitat. If the goal of the enhancement is to increase the suitability of an area for an endangered species, then it might be considered suitable mitigation, but there were no such mitigation plans in Orange County. Allowing the enhancement of wetlands as mitigation results in a net loss of habitat area, although the mitigation area may be protected from future development through the use of deed restrictions or conservation easements.

The results of this study support previous findings (GAO 1988, Kentula and others 1992, Race and Fonseca 1996) that a net loss of wetlands in the United States is continuing under current regulations. If the national success rate is similar to that of Orange County's, then thousands of hectares of wetlands are lost annually because of inadequate mitigation. In this study, enforcement could have prevented some mitigation failures, although more than half of the projects met all of their performance standards. More importantly, improved mitigation and monitoring plans would rectify problems with inadequate mitigation plans and inappropriate mitigation success criteria. More recent plans contain more clearly defined mitigation objectives. Vague goals and objectives hindered earlier evaluations of mitigation success (DeWeese and Gould 1994), whereas the projects we reviewed had permit conditions that could be used to assess compliance. However, our results demonstrate that meeting regulatory requirements is not sufficient to protect wetland resources. Because permit conditions generally did not focus on replacing the functions lost when natural riparian habitats were impacted, even "successful" projects (i.e., those meeting all permit conditions) could result in resource losses. Without permit conditions that better reflect ecological functions, mitigation

efforts will allow the continued loss of wetland habitat and the ecosystem services they provide.

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