IMPACTS OF SECTION 404 PERMITTING REQUIRING COMPENSATORY MITIGATION ON WETLANDS IN CALIFORNIA

by

Cindy C. Holland

Research Report

Submitted To

Marine Resource Management Program
College of Oceanography
Oregon State University
Corvallis, Oregon 97331

1991

in partial fulfillment of
the requirements for the
degree of

Master of Science

ManTech Environmental Technology, Inc.
U.S. Environmental Protection Agency,
Environmental Research Laboratory
200 SW 35th Street
Corvallis, Oregon 97333

This report was funded by ManTech Environmental Technology, Inc.

ABSTRACT

Data from Section 404 permits, which were issued in California from January 1971 through November 1987 and required compensatory mitigation, were compiled and analyzed to determine patterns and trends in permitting activity and to document the cumulative effects of the associated management decisions. Information was gathered on the project permitted, wetland impacted, mitigation project, key contacts, and reports. The 324 permits requiring compensatory mitigation document that 387 compensatory wetlands (1255.9 ha) mitigated for impacts to 368 wetlands (1176.3 ha). The utility of the data on wetland area is limited, however, since approximately 40% of the impacted and compensatory wetlands lacked acreage data. The wetland type most frequently impacted (37.8% of the impacted wetlands) and used in compensation (38.2% of the compensatory wetlands) was palustrine forested wetlands. Estuarine intertidal emergent wetlands had the most area impacted (52.3%) and compensated (62.5%). The majority of the wetlands were small (less than or equal to 4.0 ha in size). Wildlife habitat was the most frequently listed function of the impacted wetlands (90.7% of the permits) and objective of the compensatory wetlands (83.3%). Endangered species were listed as affected in 20.4% of the impacted and 21.0% of the compensatory projects. Less than half (31.5%) of the projects were monitored by at least one site visit. The number of permits issued and the number of impacted and compensatory wetlands increased from 1971 to 1986.

INTRODUCTION

Concern about wetland loss and management has prompted numerous studies quantifying wetland loss on national, regional, and state levels. For example, Tiner (1984) reported that over half the 87 million hectares of wetlands present in presettlement times in the contiguous United States have been lost. Furthermore, the U.S. Fish and Wildlife Service (FWS) (1977) reported that in 1850, when California became a state, there were approximately two million hectares of permanent, seasonal, and tidal wetlands. Over 90% of this original area has been lost, with only approximately 182 thousand hectares remaining.

The major Federal statute that has been used to protect wetlands is Section 404 of the Clean Water Act (CWA). Requests for Section 404 permits are processed through the U.S. Army Corps of Engineers (COE) pursuant to its permitting authority under the CWA. Often the details of the final permit agreement are either not documented or not readily accessible. Decisions typically are made on a case-by-case basis without benefit of quantitative information on how previously granted permits relate to the current proposal, or how they have impacted the status of wetlands in the region. Consequently, the U.S. Environmental Protection Agency's (EPA) Wetlands Research Program initiated an effort to compile portions of the 404 permit record in different regions of the country and describe patterns and trends in permitting activity. Section 404 databases have been analyzed for Oregon, Washington, Texas, Arkansas, Louisiana, Mississippi, Alabama, and California. Reports summarizing permitting trends in the first seven states are in various stages of completion. This report examines the

cumulative effects of Section 404 permitting in California.

Evaluation of the effects of Section 404 of the CWA on California wetlands is important for several reasons. As previously mentioned, more than 90% of the original wetland area in California has been lost. Furthermore, California is one of five states in which estuarine wetland losses have been greatest, e.g., San Francisco Bay has been one of the most altered and most urbanized wetland areas in the United States (Tiner 1984, Mitsch and Gosselink 1986). Today, wetlands occupy less than one half of one percent of the land area in California, therefore an assessment of how Section 404 affects the status of the wetland resource in California is valuable in the effort to preserve and protect the remaining resource.

The legislative history of the Clean Water Act with respect to Federal wetlands protection is one of continuing reform. When amended in 1972, the Federal Water Pollution Control Act (FWPCA), the most comprehensive and expansive environmental legislation to date, established a national system of regulation of pollutant discharges into U.S. waters. Section 404 of the Act gave authority to the COE to regulate the discharge of dredged and fill materials into "waters of the United States". At first, the COE interpreted Section 404 narrowly to apply only to traditionally navigable waters. This definition was contested on June 23, 1975 by Natural Resources Defense Council v. Callaway (392 F. Supp. 685 (D.D.C. 1975)), in which the court held that 404 applied to all waters including wetlands. This decision marked the beginning of Federal wetland regulation under Section 404. New regulations controlling activities in coastal and inland wetlands were adopted by the COE, and revised regulations for the 404 program were

issued (Kusler 1983, U.S. Congress 1987). Permits were initially required for activities in commercially navigable waters; after July 25, 1975, adjacent wetlands also were regulated. Primary tributaries, their adjacent wetlands, and natural lakes greater than two hectares in area were included after September 1, 1976. After July 1, 1977 all waters and wetlands of the United States were regulated under Section 404 (Kusler 1983). Section 404 of the 1977 amendments, which renamed the FWPCA the CWA, provided the primary legislative authority behind Federal efforts to regulate the discharge of fill and other materials in wetlands. While the COE administers this program, EPA has oversight responsibilities and statutory authority to designate wetlands subject to permitting, and FWS, National Marine Fisheries Service, and the states have review responsibilities for permit applications (U.S. Congress 1987).

METHODS

Data from Section 404 permits, which were issued in California from January 1971 through November 1987 and required compensatory mitigation, were compiled and analyzed to determine patterns and trends in permitting activity and to document the cumulative effects of the associated management decisions. Permits issued prior to the passage of the CWA in 1977 were included in the database, since Section 404 permits were required for dredging and filling in wetlands in 1975 pursuant to the Natural Resources Defense Council v. Callaway decision. Prior to 1975 activities in navigable waters were regulated under Section 404 of the CWA.

The primary sources of information were the records from the 324 permits

requiring compensatory mitigation obtained from the three COE District Offices in California, i.e., 142 permits from the Los Angeles District, 116 from the San Francisco District, and 66 from the Sacramento District. The amount of information in the COE records ranged from files with detailed environmental impact reports and mitigation plans to those with only the COE public notice, environmental assessment, and permit issuance letter. All files included correspondence from private parties and from agencies such as the FWS and California Department of Fish and Game (CDFG). Information was compiled from the permit records by the Laguna Niguel Field Office of the FWS and included: project types, wetland functions impacted and involved in mitigation, and dates that the impacts to the wetlands occurred and the mitigation projects were completed; wetland types and areas impacted and involved in mitigation; monitoring information; contacts; and report citations (Table 1).

The wetland types listed in the permit records were classified according to the FWS's wetland classification scheme (Cowardin et al. 1979). Each wetland type listed in a permit was treated as a separate wetland in the analysis because the information in the records was often too vague to consistently distinguish between complexes of more than one type of wetland and separate wetlands. For example, a palustrine forested wetland and a palustrine emergent wetland on a site were counted as two wetlands, as were two, individual palustrine forested wetlands. In addition, all types of compensatory mitigation--wetland creation, restoration, and preservation were analyzed collectively, and are referred to as "compensatory" or "compensation" in this report. Although it would have been important to distinguish between complexes of more than

one wetland type and sites with only one wetland type, and to evaluate trends by each of the three types of compensatory mitigation, the quality of the information in the permit record did not allow for such analyses.

The FWS used a data management system (DMS), developed by EPA's Wetlands Research Program, to compile and organize the data from the permit records. Several error checks were performed to verify the information in the database files. A search for missing information, typographical errors, unused fields, and irrelevant information was performed. Correspondence between files was checked, and errors were corrected and documented. As a second check, the contents of each category in the corrected database were listed, then outliers and inconsistencies between entries were identified, corrected, and documented. The DMS also was used by EPA's Wetlands Research Program to analyze the 404 databases.

RESULTS

This report summarizes the major findings on the cumulative impacts of individual Section 404 permitting decisions on wetlands in California. The results were compiled from information contained in the permit records, therefore inferences cannot be made concerning compliance with permit specifications or the success of the mitigation project.

Wetland trends

From January 1971 through November 1987, 324 Section 404 permits requiring

compensatory mitigation were issued in California. One of the permits preceded enactment of the 1972 provisions of the CWA. The permits analyzed documented that 387 compensatory wetlands (1255.9 ha) mitigated for impacts to 368 wetlands (1176.3 ha). Permitting affected 25 wetland types; 24 types were impacted, and 23 types were involved in compensatory mitigation (Table 2). The wetland type most frequently impacted (37.8%) and used in compensation (38.2%) was palustrine forested wetland (PFO), followed by estuarine intertidal emergent wetland (E2EM), and palustrine emergent wetland (PEM). However, E2EM had the most area impacted (52.3%) and compensated (62.5%), followed by PFO, and palustrine scrub-shrub (PSS) (Table 2). The utility of the data on wetland area, however, is limited. Data on wetland area were missing for 38.0% of the impacted and 41.6% of the compensatory wetlands. Therefore, the information on wetland area presented here reports what was found in the permit record, but does not represent all that was involved in the permits compiled.

The compensatory wetland types and areas often differed from those impacted. A net gain of nine PFOs was the largest increase in wetland numbers for any wetland type; the largest loss (four wetlands) was for marine intertidal unconsolidated shore (M2US) (Table 2). The largest gain in wetland area (169.5 ha) occurred in E2EM. Although the largest net gain in wetland numbers occurred in PFOs, they suffered the largest loss in area (-143.8 ha) (Table 2). One permit impacted 222.6 ha, but no area was specified for the mitigation project; this permit accounted for 57.0% of the total area of PFO impacted. Without this permit, a net gain of 78.8 ha of PFO and an overall net gain of 302.2 ha of wetland area would have resulted.

Individual permits primarily involved one wetland less than or equal to 4.0 ha in size (Figure 1). Of the wetlands with acreage information, 79.8% of the impacted and 73.9% of the compensatory wetlands were less than or equal to 4.0 ha in size. The larger impacted and compensatory wetlands tended to be E2EMs, whereas most of the smaller projects were PFOs. The largest impacted wetland was 222.6 ha; the largest compensatory wetland was 80.9 ha.

Most of the permits (78.1%) required in-kind compensation, i.e., compensatory mitigation involving a wetland type the same as that impacted. Only 9.6% of the permits required out-of-kind compensation, i.e., mitigation involving a wetland type different from that impacted. Both in-kind and out-of-kind compensation were specified in 11.7% of the permits. Those permits requiring in-kind compensation resulted in a net loss of 246.9 ha, whereas a net gain of 326.0 ha occurred when compensation was out-of-kind. The large loss in area with in-kind compensation was largely due to the one permit which impacted 222.6 ha of PFO, but specified no area for the mitigation project. Without this permit, there was a net loss of 24.4 ha with in-kind compensation.

Project trends

Creation of wildlife habitat was the most frequently listed objective for the mitigation projects (83.3% of the permits), followed by functional replacement (60.8%) and fisheries habitat (31.2%) (Table 3). The most frequently listed functions impacted were: wildlife habitat (90.7% of the permits), fisheries habitat (31.2%), and endangered species habitat (20.1%) (Table 3). Shoreline stabilization (22.2%), highway and road

construction (17.9%), and stream modification (15.4%) were the most common project types. Only 11.4% of the impacted and 2.2% of the compensatory projects had completion dates. Since there can be more than one objective, function, and project per permit, the percentages listed for those items sum to greater than 100 percent.

Only 31.5% of the permits were monitored by at least one site visit. Vegetated cover (87.2% of the permits monitored), plant diversity (50.0%), and animal use (11.8%) were the parameters most frequently listed as monitored. The parameters listed as monitored least frequently were: animal diversity (6.9%), endangered species (6.9%), primary productivity (2.0%), and water quality (2.0%). The percentages for the items monitored also sum to greater than 100 percent, since up to three parameters per permit can be listed as monitored.

Of the three types of compensatory mitigation: wetland creation, restoration, and preservation, wetland restoration was required by 65.4% of the permits. Wetland creation was specified in 29.9% of the permits and preservation in 24.1%. Mitigation banks were used in 6.5% of the permits. Since there can be more than one type of compensation per permit, the percentages listed above sum to greater than 100 percent.

Locational trends

Permitting activity occurred in 42 of the 58 (72.4%) counties in California (Figure 2). The counties with the most impacted and compensatory wetlands, in descending order, were: San Diego, Marin, and Orange. Ventura, Marin, and Napa had the most

area impacted. One permit, however, accounted for 93.3% of the impacted area in Ventura county. The top counties in terms of area compensated were: Marin, Alameda, and San Diego. The counties with the most permits issued, San Diego, Marin, and Orange, are coastal. The counties with the most area involved are also coastal. All of the compensatory wetlands were located in the same county as the impacted wetlands, and for 95.4% of the permits, the compensatory and impacted wetlands occurred in the same river or waterbody.

Trends involving endangered species

Endangered species were frequently mentioned in the permits. They were listed as being impacted in 20.4% of the permits and compensated for in 21.0%. Twenty-two endangered species were involved in permitting activity. Of the 22 endangered species listed, most were birds (40.9%), then plants (22.7%), fish (13.6%), and mammals (13.6%). Habitats for Sterna antillarum browni, California least tern (27.3% of the permits listing endangered species), Reithrodontomys raviventris, salt marsh harvest mouse (18.2%), and Vireo bellii pusillus, least Bell's vireo (16.7%) were listed most frequently as being impacted. Habitats for V. bellii pusillus and S. antillarum browni (22.0% each), R. raviventris (19.1%), and Rallus longirostris obsoletus, California clapper rail (16.2%) were compensated for most frequently (Table 4). Overall, there was a net loss of 94.5 ha of endangered species habitat (Table 4).

Trends in time

The number of permits requiring compensation and the number of impacted and compensatory wetlands increased from 1971-1986 (Table 5 and Figure 3). The number of wetland types involved in permitting has also increased from 1971-1986 (Table 5). In general, it appears that the rate of change for both the number of permits issued and the number of impacted and compensatory wetlands has increased since 1980 (Figure 3). The area impacted and compensated has fluctuated over time but has increased overall. The data suggest a trend to smaller (less than or equal to 4.0 ha) impacts to wetlands and mitigation projects. Most of the impacts to wetlands (75.0%) and mitigation projects (83.3%) greater than 40.0 ha occurred in or before 1982. Moreover, the proportion of the total number of wetlands involved in permits requiring compensatory mitigation that were less than or equal to 4.0 ha in size has increased over time (Figure 4). The percent of permits with in-kind compensation has increased over time, while the percent of permits with out-of-kind compensation has decreased over time.

DISCUSSION

Interpretation of results

Specific requirements for the size of the compensatory wetland were often omitted from 404 permit specifications. This can lead to inaccurate conclusions about the effectiveness of 404 in protecting the wetland resource. For example, the greatest net loss in area for a wetland type occurred in PFO. However, this was largely due to

the one permit that impacted 222.6 ha of PFO, but no area for the compensatory wetland was specified. Furthermore, the data show that 404 permitting resulted in a net loss in area of endangered species habitat. This would suggest that the compensatory wetlands involving endangered species habitat were smaller in area than the impacted wetlands involving endangered species habitat. However, the utility of the data on wetland area is limited. Both of the examples show that although compensatory mitigation is occurring, an evaluation of its potential effect on the wetland resource cannot be made, because data on the size of the impacts and mitigation projects are lacking. Furthermore, an assessment of the COE's implementation of the 404 program reported that permits often do not record wetland area that will be impacted by a proposed project (U.S. General Accounting Office 1988). Obviously, determination of compensatory wetland area is impossible without documentation of the impacted area.

Most of the impacted and compensatory wetlands were small, less than or equal to 4.0 ha in size, and a trend of increasing numbers of small wetlands being impacted and used in compensation was evident. The utility of creating many small wetlands is questionable. One of the design principles recommended for successful mitigation is to create large wetland areas with a diversity of habitats (Sorensen 1982). Furthermore, in a study of wetland projects of the California State Coastal Conservancy, Zentner (1988) found that successful enhancements correlated relatively well with project size. The average size of unsuccessful projects was just over 2.0 ha, while the average for successful projects was 18.2 ha (Zentner 1988). Not only were the compensatory

wetlands small, but the size of the wetlands impacted also decreased over time. The positive implications of this are that fewer permits affecting large wetlands are getting through the 404 permitting process. However, the cumulative effects of incremental wetland loss by numerous small projects must be investigated.

Wildlife and fisheries habitats, in particular those of endangered species, were the major functions of the wetlands impacted and primary objectives for the mitigation projects. Although California wetlands provide unique habitat for fish and wildlife, the stress placed on these wetland functions seems to have resulted from a bias of agency biologists and individuals associated with compiling the 404 data. For the most part, wetland functions were not identified in the original 404 files. The FWS and the CDFG often mentioned the value of fish and wildlife habitat in their review of permit applications. Otherwise, the functions commonly ascribed to a wetland type were assigned by FWS during their compilation of the 404 data. Fish and wildlife concerns were emphasized over such functions as sediment trapping and shoreline stabilization during the process of data compilation. Two reasons were given for the emphasis of fish and wildlife habitat. First, the other functions, e.g., food chain support and shoreline stabilization, were cited as attributes which make wetlands important habitat for fish and wildlife. Second, fish and wildlife were specified as the more easily identifiable functions listed in the database. Therefore, other functions might be equally important, but did not show up in the analysis due to the emphasis on fish and wildlife habitat (J. Griffith, pers. comm. 1989).

The most intense permitting activity occurred in coastal counties. Historically,

coastal wetlands have been drastically altered for farming, mining, and urban development. Between 1945 and 1975, California's population tripled to more than 20 million with 85% of the 1975 population living within 30 miles of the coast (California Coastal Zone Conservation Commission 1975). Today California's population is close to 30 million, with approximately the same proportion of the population living near the coast. With demand for waterfront property far exceeding supply, coastal wetland areas are under intense development pressures. (Argent 1989). Since there is a finite amount of coastline, with its associated salt marsh and intertidal flat, several wetland types are in increasing jeopardy as the development pressures along the coast of California escalate.

Several factors may have contributed to increase the rate of change in the number of permits requiring mitigation around 1980 (Figure 3). First, there probably were delays in establishing and implementing the new regulations associated with the 1977 amendments to the CWA, which strengthened regulations governing dredge and fill activities in wetlands. Intense development pressure in the late 1970s and early 1980s is another factor, possibly contributing to an increased demand to fill wetlands in the early 1980s. Both of these events could have caused an increase in the total number of Section 404 permits issued, and consequently the number of 404 permits requiring mitigation. It is likely, however, that in 1980 the number of 404 permits requiring mitigation increased relative to the total number of 404 permits issued. Another factor to consider is the issuance of the FWS Mitigation Policy (46 FR 7644-7655), the first published National mitigation policy, proposed in September 1980 and

finalized in January 1981. The FWS policy outlined the agency's mitigation guidelines and established final guidance for FWS personnel in making recommendations to protect and conserve fish and wildlife habitat. Since the COE is required by the Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.) to consider the FWS's recommendations in the 404 permit review process, the FWS Mitigation Policy probably contributed to the increase in permits requiring mitigation that occurred after 1980.

One of the most alarming findings in the analysis is that significantly less than half of the permits issued were monitored by at least one site visit. The information contained in the 404 permit records, therefore, cannot be verified, nor can compliance with the conditions of the permit or the success of the compensation. In a study of wetland enhancements in California, Zentner (1988) reported that one of the common elements of unsuccessful projects was a lack of monitoring. Josselyn and Buchholz (1982) also found that monitoring was given low priority in an assessment of wetland restoration projects in California. Without adequate monitoring, there is no way of learning from project successes or failures. Site visits are needed during construction to assure compliance with permit specifications and post-construction to evaluate project success.

Problems with data quality

The quality of the data ranged from some categories with complete information, e.g., location of impacted and compensatory wetlands by county and wetland types, to others with inadequate information, e.g., dates projects were completed and areas

of the impacted and compensatory wetlands. This mix of complete and incomplete data limits the ability to reach defensible conclusions. Several of the data quality problems deserve particular attention. Approximately 40% of the impacted and compensatory wetlands lacked acreage data, because area information was either unknown, not applicable, or unavailable. Moreover, information on areas by wetland type is misleading. For example, the area of a PFO with patches of PEM was usually listed as all PFO, and an area of 0.0 ha was assigned to the second wetland type. Furthermore, the impacted area was often to be determined after project completion. Since post-construction checks were seldom made, many of the wetland areas impacted were never recorded.

Interpretations of the net result of compensatory mitigation on wetland area in California is further complicated by the type of compensation required. Approximately 65% of the mitigation projects were restorations, and for the purposes of mitigation, restoration acreage generally is not equivalent to creation acreage (Kruczynski 1990). Unfortunately, the information in the permit record was insufficient to analyze area trends by each of the three types of compensatory mitigation. Therefore, strict comparisons of area impacted with area compensated cannot be easily interpreted.

Effectiveness of 404 in protecting the wetland resource

The effectiveness of Section 404 permitting in protecting wetlands in California is difficult to assess, since record keeping was inadequate and less than half of the projects were monitored. In addition, only those permits requiring mitigation were

analyzed; comparative information on 404 permits not requiring mitigation was unavailable. Furthermore, Section 404 permitting represents only a fraction of the wetland conversion or loss activities occurring in wetlands nationwide. In California, the three greatest pressures on wetlands are from: conversion of inland wetlands to intensive agriculture and changes in crop practices; urban, industrial, and port development along the coast; and channelization and maintenance of flood control channels (Frayer et al. 1989). Agricultural practices, the largest factor contributing to wetland loss in California, may be exempted from regulation under Section 404.

Section 404, a case-by-case permitting system, allows for cumulative destruction of the wetland ecosystem. Oversight of the additive effects of permitting on wetlands is lost when decisions are made on an incremental basis (Argent 1989). Although the size of the impacted and compensatory wetlands has decreased over time, the cumulative effects of these small projects should be evaluated to better assess permit-related wetland mitigation.

It is important to recognize that trends presented in this paper reflect information contained in the permit record. In reality, however, the completed mitigation project may bear little resemblance to the conditions outlined on paper. For example, in a recent study of compliance with the conditions of Section 404 permits involving freshwater palustrine emergent wetlands in Oregon, it was found that of the eleven created wetlands in the study, none were constructed as either planned or permitted (Gwin and Kentula 1990).

CONCLUSIONS

Information on patterns and trends in Section 404 permitting can be useful in wetland management. Areas of high permitting activity can be identified, as well as changes in local wetland populations due to the numbers, types, and areas of impacted and compensatory wetlands. Such information can help resource managers anticipate increased demands on wetlands and do a better job of managing the resource.

Improved documentation of the impacted wetlands and mitigation projects is needed. For the most part, information on the permitted projects was lacking or of poor quality. For example, impacted and compensatory wetland types were rarely recorded in the permit records. This information had to be determined by the FWS in the process of compiling the data. In addition, approximately 40% of the impacted and compensatory wetlands lacked acreage data in California. This is corroborated by a U.S. General Accounting Office (1988) study on the COE's implementation of the 404 program that found that permit files often do not record the impacted wetland area. A better assessment of the effects of Section 404 permitting on wetlands would be possible if record keeping was improved and standardized nationwide.

Regular reporting on patterns and trends in Section 404 permitting is recommended to determine effects on the wetland resource on a periodic basis. With routine reporting, trends, such as a loss in area of endangered species habitat, can be identified, and subsequent actions can be taken to avoid potential losses in wetland numbers, types, and areas.

Finally, increased monitoring is recommended. Only 31.5% of the 404 permits issued in California were checked at least once. Furthermore, a study of restoration projects in California found that a lack of monitoring was a common element of unsuccessful projects (Zentner 1988). Monitoring is needed during project construction to assess compliance with permit specifications and after construction to evaluate project success. With improved documentation, regular reporting, and increased monitoring, better evaluations of the outcomes of wetland mitigation will be possible.

ACKNOWLEDGEMENTS

The research described in this article has been funded by the U.S. Environmental Protection Agency (EPA) and conducted at EPA's Research Laboratory in Corvallis, Oregon, through Contract #68-C8-0006 to NSI Technology Services, Corp., and Interagency Agreement #DW14932030 to U.S. Fish and Wildlife Service (FWS), Laguna Niguel Field Office. It has been subjected to the Agency's peer and administrative review and was approved for publication.

LITERATURE CITED

Argent, G. 1989. Wetlands: Private Property or Public Resource? Western Water, Nov/Dec, Water Education Foundation, p. 4-11.

California Coastal Zone Conservation Commission. 1975. California Coastal Plan. State Printing Office, Sacramento, CA.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS - 79/31. U.S. Fish and Wildl. Serv., Washington, DC. 103 pp.

Frayer, W.E., D.D. Peters, and H.R. Pywell. 1989. Wetlands of the California Central Valley: Status and Trends, 1939 to mid-1980s. U.S. Fish and Wildl. Serv., Portland, OR. 28 pp.

Gwin, S.E. and M.E. Kentula. 1990. Evaluating Design and Verifying Compliance of Wetlands Created Under Section 404 of the Clean Water Act in Oregon. EPA/600/3-90/061. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 122 pp.

Josselyn, M. and J. Buchholz. 1982. Summary of Past Wetland Restoration Projects in California. In: Josselyn, M. (ed), Wetland Restoration and Enhancement in California, pp. 1-10. California Sea Grant College Program Report No. T-CSGCP-007, La Jolla, CA.

Kruczynski, W.L. 1990. Options to be Considered in Preparation and Evaluation of Mitigation Plans. In: Kusler, J.A. and M.E. Kentula (eds), Wetland Creation and Restoration: The Status of the Science, Part 2: Perspectives, pp. 143-158. Island Press, Washington, DC.

Kusler, J.A. 1983. Our National Wetland Heritage. A Protection Guidebook. Environmental Law Institute, Washington, DC.

Mitsch, W.J. and J.G. Gosselink. 1986. Wetlands. Van Nostrand Reinhold, New York, NY.

Sorensen, J. 1982. Towards an Overall Strategy in Designing Wetland Restorations. In: Josselyn, M. (ed), Wetland Restoration and Enhancement in California, pp. 85-91. California Sea Grant College Program Report No. T-CSGCP-007, La Jolla, CA.

Tiner, R.W., Jr. 1984. Wetlands of the United States: Current Status and Recent Trends. U.S. Fish and Wildl. Serv., National Wetlands Inventory, Washington, DC. 55 pp.

U.S. Congress, Office of Technology Assessment. 1987. Wastes in Marine Environments. OTA-O-334, U.S. Government Printing Office, Washington, DC.

U.S. Fish and Wildlife Service. 1977. Concept Plan for Waterfowl Wintering Habitat Preservation. Central Valley California. Region 1, Portland, Oregon. 116 pp. + appendices.

U.S. General Accounting Office. 1988. Wetlands. The Corps of Engineers' Administration of the Section 404 Program. GAO/RCED-88-110. Washington, DC. 119 pp.

Zentner, J. 1988. Wetland projects of the California State Coastal Conservancy: An assessment. Coastal Management, 16: 47-67.

Table 1. Organization of information compiled on 404 permits requiring mitigation in California, January 1971-November 1987. The categories correspond to the files in the 404 permit data management system used in this study.

CATEGORY	TYPE OF INFORMATION
Project	Types of projects permitted
	Impacted and compensatory wetland functions
	Dates impacts occurred and mitigation projects completed
	Techniques used in the wetland mitigation
Location	Sites of the impacts and the mitigation projects including state, county, water body or river basin, and map coordinates
	Area of impacted and compensatory wetlands
	Types of impacted and compensatory wetlands
Monitoring Program	Frequency and duration of monitoring activities
	Items monitored
Contacts	Names, addresses and phone numbers of individuals key to the project
Reports	Citations of any reports

Table 2. Numbers and areas by wetland type of impacted (IMP) and compensatory (CO) wetlands in 404 permits requiring compensatory mitigation in California, January 1971-November 1987. The original areas were expressed in acres, which were converted to hectares by multiplying by 0.4047. Information on wetland type was missing for one impacted and two compensatory wetlands. In addition, data on area were missing for 38.0% of the impacted and 41.6% of the compensatory wetlands. unconsol. = unconsolidated.

WETLAND TYPE	# WETLANDS IMP	# WETLANDS CO	AREA (ha) IMP	AREA (ha) CO	NET CHANGE IN AREA (ha)
Estuarine subtidal					
aquatic bed	16	18	9.9	18.6	+8.7
unconsol. bottom	3	6	5.0	11.4	+6.4
Estuarine intertidal					
emergent wetland	94	96	615.0	784.5	+169.5
streambed	2	9	0.8	0.5	-0.3
unconsol. shore	22	22	33.9	49.1	+15.2
Lacustrine littoral					
emergent wetland	11	11	5.5	0.7	-4.8
rock bottom	1	2	0.0	0.0	0.0
unconsol. bottom	2	1	0.5	0.4	-0.1
Marine subtidal					
rock bottom	1	1	1.7	2.1	+0.4
unconsol. bottom	2	0	0.8	0.0	-0.8
Marine intertidal					
aquatic bed	3	7	0.0	1.8	+1.8
rocky shore	1	1	0.0	0.0	0.0
unconsol. shore	6	2	29.1	4.0	-25.1
Palustrine					
aquatic bed	2	2	0.0	0.1	+0.1
emergent wetland	30	27	35.5	54.6	+19.1
forested wetland	139	148	390.8	247.0	-143.8
rock bottom	0	1	0.0	0.0	0.0
scrub-shrub	14	18	36.2	68.0	+31.8
unconsol. shore	2	2	7.9	1.6	-6.3
Riverine tidal					
emergent wetland	3	3	1.7	10.2	+8.5
Riverine lower perennial					
emergent wetland	4	4	1.2	1.2	0.0
unconsol. bottom	2	1	0.2	0.1	-0.1
unconsol. shore	1	0	0.6	0.0	-0.6
Riverine upper perennial					
rock bottom	4	2	0.0	0.0	0.0
Riverine intermittent					
streambed	2	1	0.0	0.0	0.0
TOTAL	367	385	1,176.3	1,255.9	+79.6

Table 3. The functions of wetlands impacted and the objectives of the mitigation projects expressed as the percent of the total number of 404 permits issued in California, January 1971 - November 1987, which required compensatory mitigation. Up to five functions and three objectives can be listed per permit, therefore percents sum to greater than 100.

FUNCTION IMPACTED	% OF PERMITS
Wildlife habitat	90.7
Fisheries habitat	31.2
Endangered species	20.1
Food chain support	8.6
Passive recreation	2.8
Shoreline stabilization	2.2
Sediment trapping	1.8
Active recreation	0.9
Nutrient retention & removal	0.9

OBJECTIVE OF MITIGATION PROJECT	% OF PERMITS
Wildlife habitat	83.3
Functional replacement	60.8
Fisheries habitat	31.2
Endangered species	17.0
Passive recreation	8.6
Shoreline stabilization	8.0
Food chain support	5.9
Sediment trapping	4.0
Flood storage & desynchronization	1.2
Nutrient retention & removal	1.2
Research	0.6
Active recreation	0.3
Mosquito abatement	0.3
Nursery for mitigation plants	0.3

Table 4. Numbers and area of impacted (IMP) and compensatory (CO) wetlands involving endangered species in 404 permits which required compensatory mitigation in California, January 1971 - November 1987. The original areas were expressed in acres, which were converted to hectares by multiplying by 0.4047. Amer. = American, Calif. = California.

COMMON NAME	# WETLANDS			AREA (ha)		
	IMP	CO	CHANGE	IMP	CO	CHANGE
Aleutian Canada goose	1	1	0	0.0	0.0	0.0
Amer. peregrine falcon	4	3	-1	123.8	15.4	-108.4
Armagosa speckled dace	1	1	0	0.0	0.0	0.0
Armagosa vole	1	1	0	0.0	0.0	0.0
Bald eagle	5	5	0	2.6	3.2	+0.6
Brown pelican	2	1	-1	20.2	0.0	-20.2
Calif. clapper rail	10	11	+1	199.3	132.9	-66.4
Calif. freshwater shrimp	1	1	0	0.0	0.0	0.0
Calif. least tern	18	15	-3	12.6	30.2	+17.6
Least Bell's vireo	11	15	+4	26.9	56.4	+29.5
Light-footed clapper rail	6	6	0	0.2	2.9	+2.7
Pedate checker-mallow	1	1	0	0.0	0.0	0.0
Salt marsh bird's beak	2	3	+1	0.2	1.9	+1.7
Salt marsh harvest mouse	12	13	+1	230.7	199.4	-31.3
San Diego button celery	1	1	0	0.4	14.2	+13.8
San Diego mesa mint	1	1	0	0.4	14.2	+13.8
Slender-petaled mustard	1	1	0	0.0	0.0	0.0
Southern sea otter	1	1	0	0.0	0.0	0.0
Thicktail chub	1	1	0	0.0	0.0	0.0
Unarmored threespine stickleback	5	5	0	6.1	12.1	+6.0
Valley elderberry longhorn beetle	5	5	0	10.5	59.3	+48.8
Yuma clapper rail	2	2	0	2.7	0.0	-2.7
TOTAL	92	94	+2	636.6	542.1	-94.5

Table 5. Numbers of permits, types of wetlands, and numbers and area of impacted (IMP) and compensatory (CO) wetlands, January 1971-December 1986. The original areas were expressed as acres, which were converted to hectares by multiplying by 0.4047. Information on the dates permits were issued was missing for two permits, corresponding to three impacted and four compensatory wetlands and 4.1 ha of impacted and 6.2 ha of compensatory wetland. A complete year of data was not available for 1987, therefore 1987 was not included.

YEAR	# OF PERMITS	# TYPES		# WETLANDS		AREA (ha)	
		IMP	CO	IMP	CO	IMP	CO
1971	1	1	1	1	1	11.4	24.7
1974	4	2	3	4	5	35.4	55.6
1976	3	2	2	3	3	0.6	0.6
1977	10	6	4	11	10	44.8	94.0
1978	12	5	6	12	14	9.3	19.1
1979	14	4	6	14	16	112.7	119.7
1980	11	5	5	12	11	102.1	135.3
1981	15	6	6	17	18	25.1	28.1
1982	33	6	8	37	40	164.9	130.6
1983	42	11	11	48	53	149.3	192.7
1984	43	11	9	46	48	104.9	138.2
1985	55	15	15	69	73	326.8	155.1
1986	58	16	13	69	69	27.4	33.5
TOTAL	322	95	95	365	383	1,172.2	1,249.7

FIGURE CAPTIONS

Figure 1. Comparison of the sizes of impacted and compensatory wetlands involved in 404 permitting which required compensatory mitigation in California, January 1971-November 1987. The original areas were expressed in acres, which were converted to hectares by multiplying by 0.4047.

Figure 2. Comparison by county of the numbers of impacted and compensatory wetlands involved in 404 permitting which required compensatory mitigation in California, January 1971-November 1987.

Figure 3. Comparison by year of the number of permits issued and the number of impacted and compensatory wetlands involved in 404 permitting which required compensatory mitigation in California, January 1971-December 1986. A complete year of data was not available for 1987, therefore 1987 was not included.

Figure 4. Comparison by year of the percent of the total number of impacted and compensatory wetlands that were less than or equal to 4.0 ha in size that were involved in 404 permitting which required compensatory mitigation in California, January 1979-December 1986. The original areas were expressed in acres, which were converted to hectares by multiplying by 0.4047.

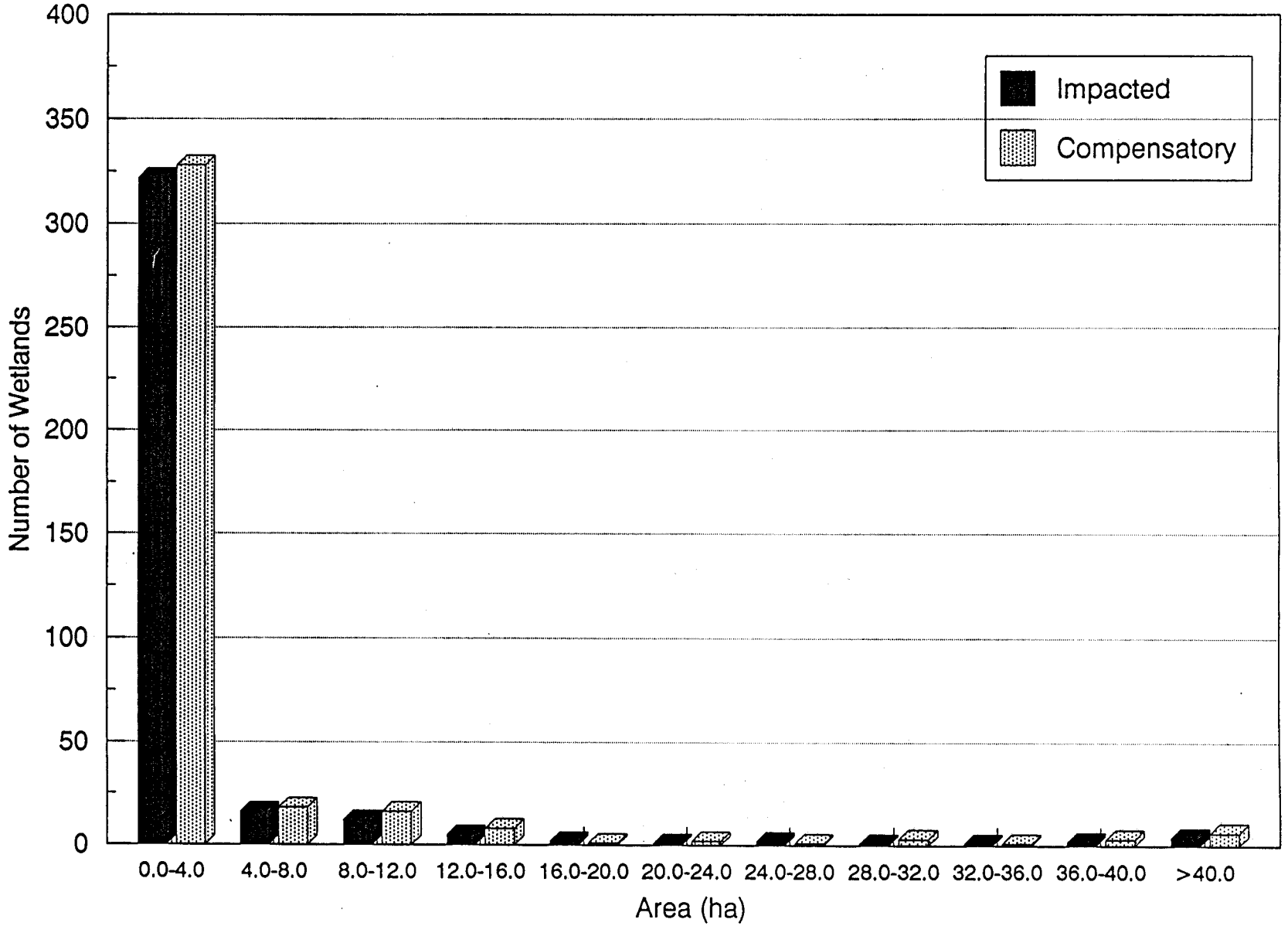
400
350
300
250
200
150
100
50
0
Number of Wetlands
Impacted
Compensatory
0.0-4.0
4.0-8.0
8.0-12.0
12.0-16.0
16.0-20.0
20.0-24.0
24.0-28.0
28.0-32.0
32.0-36.0
36.0-40.0
>40.0
Area (ha)

Figure 1.

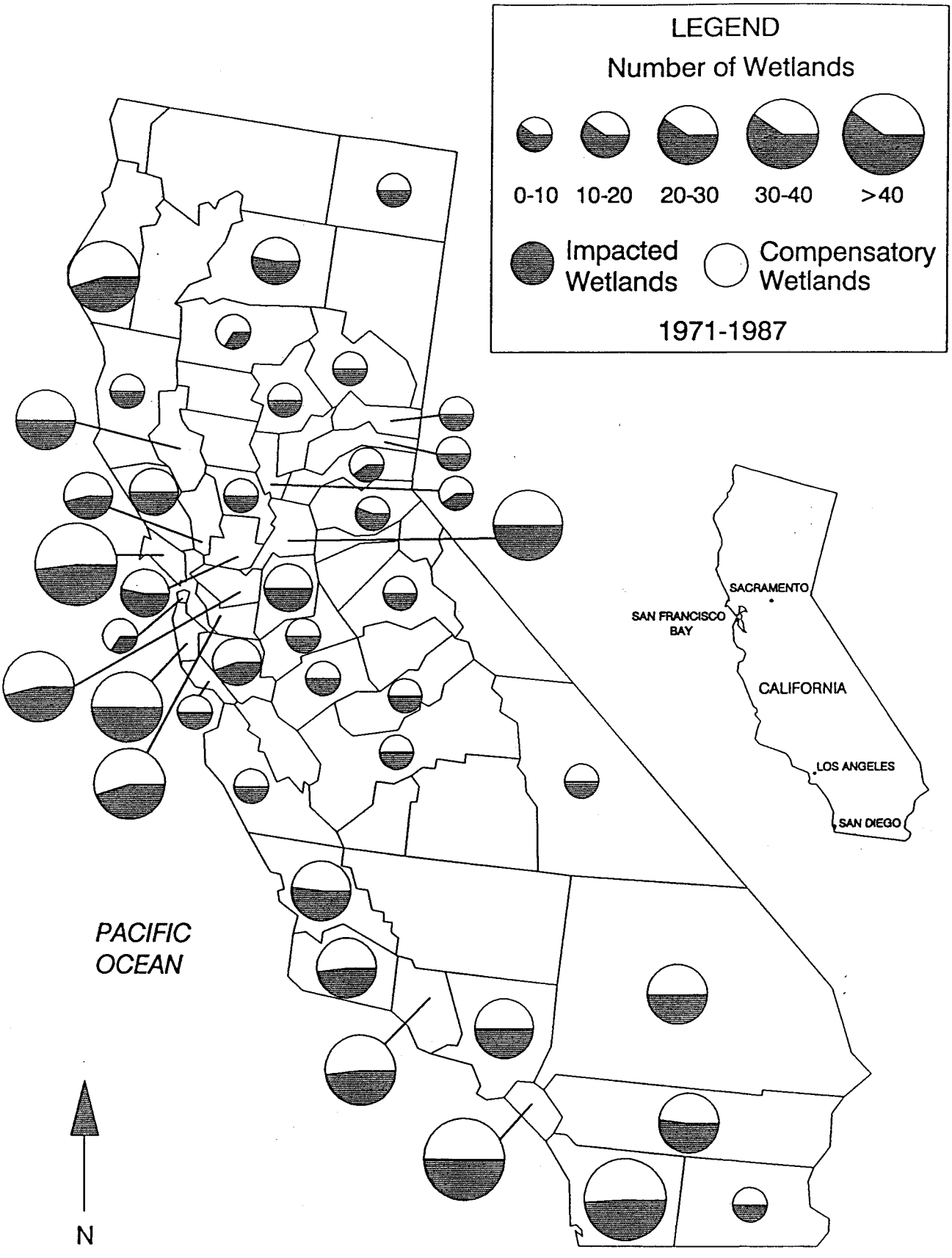
LEGEND
Number of Wetlands
0-10
10-20
20-30
30-40
>40
Impacted Wetlands
Compensatory Wetlands
1971-1987
SACRAMENTO
SAN FRANCISCO BAY
CALIFORNIA
LOS ANGELES
SAN DIEGO
PACIFIC OCEAN
N

Figure 2.

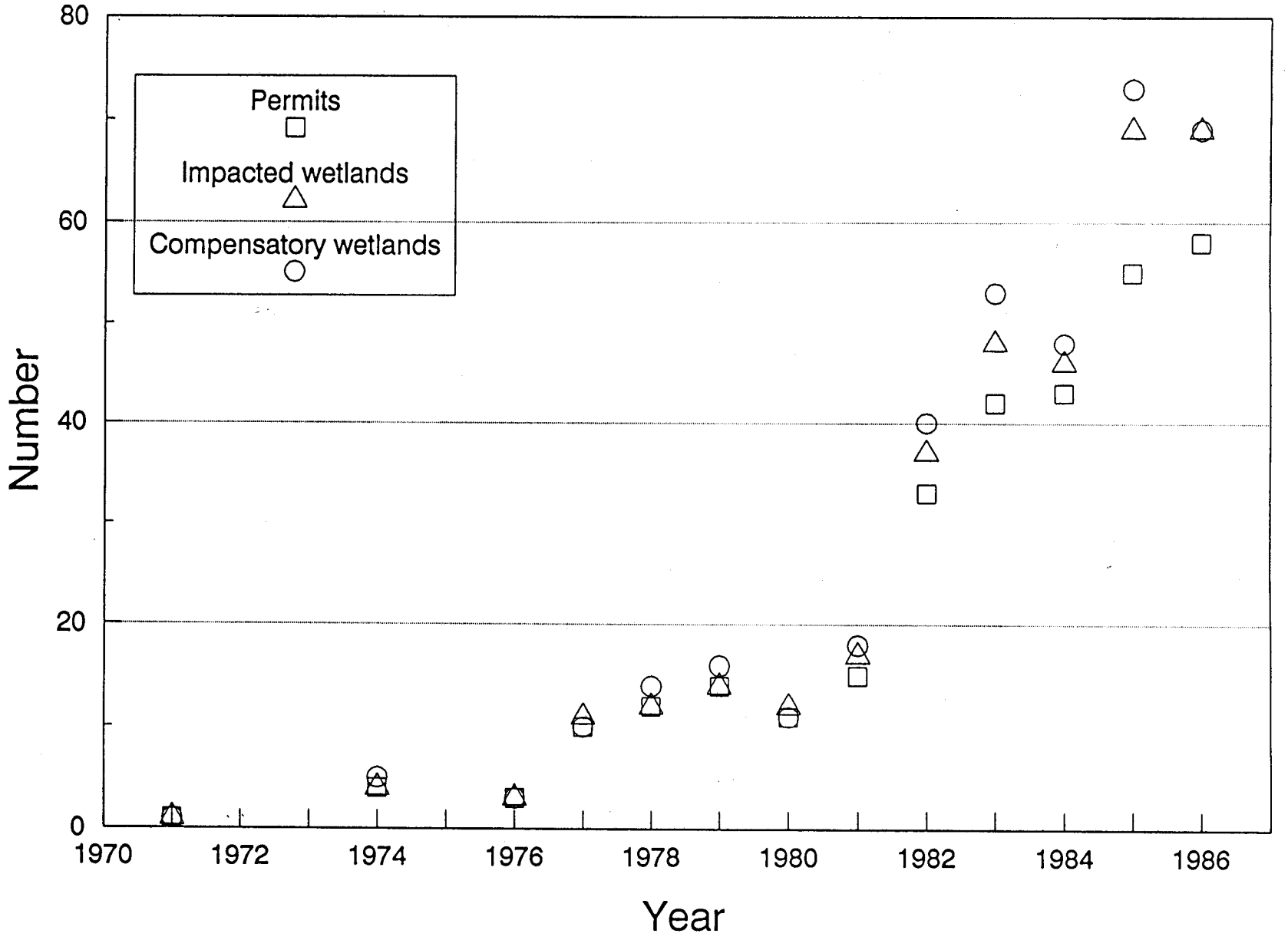
Permits
Impacted wetlands
Compensatory wetlands
Number
Year
0
20
40
60
80
1970
1972
1974
1976
1978
1980
1982
1984
1986

Figure 3.

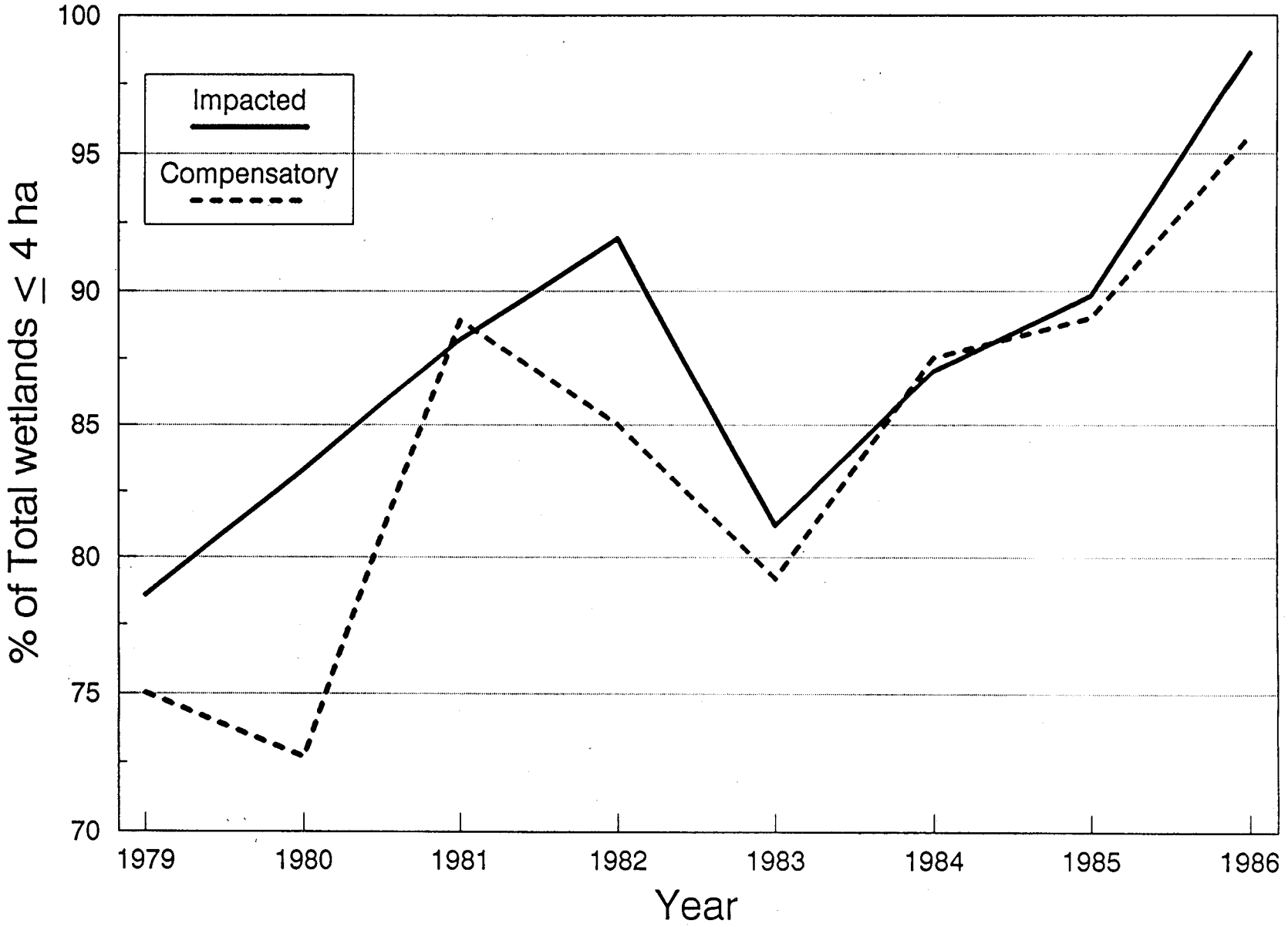
Impacted
Compensatory
% of Total wetlands ≤ 4 ha
100
95
90
85
80
75
70
1979
1980
1981
1982
1983
1984
1985
1986
Year

Figure 4.