Trends and Patterns in Section 404 Permitting Requiring Compensatory Mitigation in Oregon and Washington, USA

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ABSTRACT / The effects of permitting decisions made under Section 404 of the Clean Water Act for which compensatory mitigation was required were examined. Information was compiled on permits issued in Oregon (January 1977–January 1987) and Washington (1980–1986). Data on the type of project permitted, wetland impacted, and mitigation project were collected and analyzed. The records of the Portland and Seattle District Offices of the US Army Corps of Engineers and of Environmental Protection Agency Region X were the primary sources of information.

The 58 permits issued during the years of concern in Oregon document impacts to 82 wetlands and the creation of 80. The total area of wetland impacted was 74 ha while 42 ha were created, resulting in a net loss of 32 ha or 43%. The 35 permits issued in Washington document impacts to 72 wetlands and the creation of 52. The total area of wetland impacted was 61 ha while 45 ha were created, resulting in a net loss of 16 ha or 26%. In both states, the number of permits requiring compensation increased with time. The area of the impacted and created wetlands tended to be ≤0.40 ha. Permitted activity occurred primarily west of the Cascade Mountains and in the vicinity of urban centers. Estuarine and palustrine wetlands were impacted and created most frequently. The wetland types created most often were not always the same as those impacted; therefore, local gains and losses of certain types occurred. In both states the greatest net loss in area was in freshwater marshes.

This study illustrates how Section 404 permit data might be used in managing a regional wetland resource. However, because the data readily available were either incomplete or of poor quality, the process of gathering information was very labor intensive. Since similar analyses would be useful to resource managers and scientists from other areas, development of an up-to-date standardized data base is recommended.

Thousands of requests for permits to dredge or fill in wetlands are processed each year by the US Army Corps of Engineers (COE) pursuant to its permitting authority under Section 404 of the Clean Water Act. The US Environmental Protection Agency (EPA) reviews these requests as part of its oversight responsibilities. Much time and effort is expended by the COE, EPA, and other federal and state agencies in deciding whether or not to permit proposed projects. Often the details of the final permit decision are either not clearly documented, readily accessible, or incorporated into the permit conditions. Decisions are typically made on a case-by-case basis without benefit of quantitative information on how previously granted permits relate to the current proposal.

Efforts to compile information on the status of the wetland resources within the United States have been

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initiated as concern about wetland destruction has grown (e.g., Office of Technology Assessment 1984, Frayer and others 1983, Tiner 1984, Feierabend and Zelazny 1987). All report that over half the wetland area present in presettlement times in the conterminous United States has been lost.

Section 404 of the Clean Water Act is the major regulatory statute for federal protection of wetlands. Because of the current concern about wetland loss, it is important to document how the 404 permitting process is affecting the status of the resource. In 1980, the National Marine Fisheries Service (NMFS) began such an effort by documenting how their recommendations influenced the permitting process and, ultimately, contributed to the protection of fisheries habitat (Lindall and Thayer 1982). After examining a sample of the permit record from its southeast region for October 1981–1985 and again for 1987, NMFS concluded it had been only partially effective in getting its conservation recommendations included in permits (Mager and Thayer 1986, Mager and Ruebsamen 1988). Moreover, they noted that the cumulative acreage associated with numerous small projects was considerable and that more information was needed on the kinds of habitat involved so that trends in alteration by habitat type could be tracked.

A study by Stockton and Richardson (1987) analyzed trends in wetland conversion on the coast of North Carolina from 1970 to 1984 authorized under Section 404, and the State's Coastal Area Management Act and Dredge and Fill Law. They showed that about 2% of the area of salt marsh wetlands was altered under these programs. However, since normal, ongoing agricultural and forestry practices are exempt under these laws, their impact on wetlands were not included in the information compiled.

Additional studies are needed to completely characterize how the 404 program is affecting the status of wetlands. Consequently, EPA initiated an effort to compile the 404 permit record in different regions of the country and to describe the patterns and trends in permitting activity. This report is the first in a series that examine the permit record. It focuses on permits requiring compensatory mitigation, i.e., creation, restoration, or enhancement, as restitution for wetland fill projects. Gains and losses in the numbers and area of wetland types are reported. How these permit decisions affected the wetland resource in the region is discussed.

Methods

Information was compiled on 404 permits issued for wetland alteration in Oregon (January 1977 through January 1987) and Washington (1980–1986) where compensation was required. These permits represented about 3% of the entire permit record in both states. Data on the type of project permitted, wetland impacted, and mitigation project were collected and analyzed. Wetlands were classified according to the US Fish and Wildlife Service's (FWS) Wetland Classification System (Cowardin and others 1979). However, for the purposes of this report, the names have been shortened (Table 1).

Table 1. Correspondence between US Fish and Wildlife Service's (FWS) Wetland Classification System (Cowardin and others 1979) and the wetland names used in this report[a]

FWS classification	Names used in this report
Estuarine intertidal aquatic bed	Intertidal seagrass bed
Estuarine intertidal emergent wetland	Salt marsh
Estuarine intertidal reef	Intertidal reef
Estuarine intertidal rocky shore	Intertidal rocky shore
Estuarine intertidal unconsolidated shore	Intertidal flat
Estuarine subtidal aquatic bed	Subtidal seagrass bed
Estuarine subtidal reef	Subtidal reef
Estuarine subtidal unconsolidated bottom	Subtidal flat
Lacustrine littoral aquatic bed	Lacustrine aquatic bed
Lacustrine littoral emergent wetland	Lacustrine marsh
Lacustrine littoral rocky shore	Lacustrine rocky shore
Lacustrine littoral unconsolidated bottom	Lacustrine bottom
Lacustrine littoral unconsolidated shore	Lacustrine shore
Palustrine aquatic bed	Palustrine aquatic bed
Palustrine emergent wetland	Freshwater marsh
Palustrine forested wetland	Forested wetland
Palustrine scrub–shrub	Shrub wetland
Palustrine unconsolidated bottom	Pond
Riverine intermittent streambed	Intermittent streambed
Riverine lower perennial emergent wetland	Lower riverine marsh
Riverine lower perennial unconsolidated bottom	Lower riverine bottom
Riverine lower perennial unconsolidated shore	Lower riverine shore
Riverine tidal aquatic bed	Tidal riverine aquatic bed
Riverine tidal emergent wetland	Tidal freshwater marsh
Riverine tidal unconsolidated bottom	Tidal riverine bottom
Riverine tidal unconsolidated shore	Tidal riverine shore
Riverine upper perennial aquatic bed	Upper riverine aquatic bed
Riverine upper perennial unconsolidated bottom	Upper riverine bottom

[a]Three estuarine deepwater habitats classified under the same system are also included.

The primary sources of information were the files of

Table 2. Examples of questions that can be answered by querying the 404 permit data base

What is the frequency of occurrence of:
- impacts to and creations of specific wetland type(s)?
- impacted and created wetlands in specific locations?
- the type(s) of projects permitted?
- the wetland functions impacted?
- impacts to specific functions by wetland type?
- specific objectives required for the wetland creation?
- impacts and creations by size and location?
- impacts and creations by size and wetland type?

What are the trends in time in the:
- number of permits issued?
- types of wetlands impacted and created?
- location of permit activity?
- types of projects being permitted?
- objective(s) set for the wetland creation?
- size of impacts permitted?
- size of the mitigation projects required?

Other questions include:
- What percent of the compensation was in kind?
- How do the functions impacted compare with the goals set for the created wetland(s)?
- What percent of the created wetlands are found in the same location (e.g., county, river basin) as the wetland destroyed?
- What percent of the created wetlands were monitored?

the Portland and Seattle district offices of the COE and of EPA Region X. Included in these files were copies of federal permit applications, site maps, extracts from reports and environmental assessments, and resource agency comments. Records at the Oregon Division of State Lands, the agency that is a counterpart to the federal system, were also examined and cross-referenced to COE's records. The official record, however, was insufficient to provide the data desired. Therefore, information in agency files was supplemented with interviews with state and federal agency staff involved with each project, applicants or their attorneys or consultants, and actual visits to the sites.

A computerized data base was created using a data management system developed to store and retrieve information gathered for this study. After data were entered and verified, the data base was queried using the data management system. Table 2 lists examples of questions that can be answered by this process.

Several error checks were performed to identify missing information, typographical errors, outliers, correspondence between files, unused fields, and irrelevant information. Emphasis was placed on the files and fields to be used for querying. If any questions remained after the error checks, the original data forms were consulted.

Each wetland type and each discrete area of the same wetland type that occurred at a site was treated as an individual wetland in the analysis. For example, a freshwater marsh and a palustrine aquatic bed both found on a site were counted as two wetlands, as were two individual freshwater marshes. This was necessary since wetland complexes were seldom identified in the permit record. Therefore, the definition of what constitutes an individual wetland used in this paper is an artifact of the information available.

The analysis used the information contained in the permit record. There was no judgement made as to whether there was compliance with the terms of the permit or whether the created wetland replaced the ecological functions of the wetland destroyed. Neither can be determined from the permit record—they can only be evaluated using field data.

Results

The analysis of the Oregon and Washington data bases was designed to describe how 404 permit decisions affect the wetland resource. It focused on documenting the location of permit-related activity; the types, sizes, and numbers of wetlands impacted and created; the types of projects being permitted; and the wetland functions impacted. Trends over time were characterized. Finally, patterns and trends were examined to identify any compromises made (e.g., trades in wetland types, differences in wetland area impacted and created).

Oregon

The Oregon data base contained information on 58 permits issued from January 1977 through January 1987 that required compensatory mitigation. Impacts to 82 wetlands and the creation of 80 were documented. Only 47% of the mitigation projects were checked (i.e., had at least one site visit recorded in the permit record).

Most permitted activity (96%) was located west of the Cascade Mountains (Figure 1). Ninety percent of the impacted and created wetlands were associated with the coast, an estuary, or a navigable waterway. Fifty-six percent were within 5 km of an urban area with a population greater than 10,000 primarily Portland and Coos Bay. All the created wetlands were located in the same county, river basin, or waterbody as the associated impacted wetlands.

Permitting affected 15 wetland types; 12 types were impacted and 13 were created (Table 3). Freshwater marshes were impacted and created most often. They also experienced the greatest net loss in numbers and area of wetlands. At the other extreme, ponds accounted for 23% of the number of wetlands created

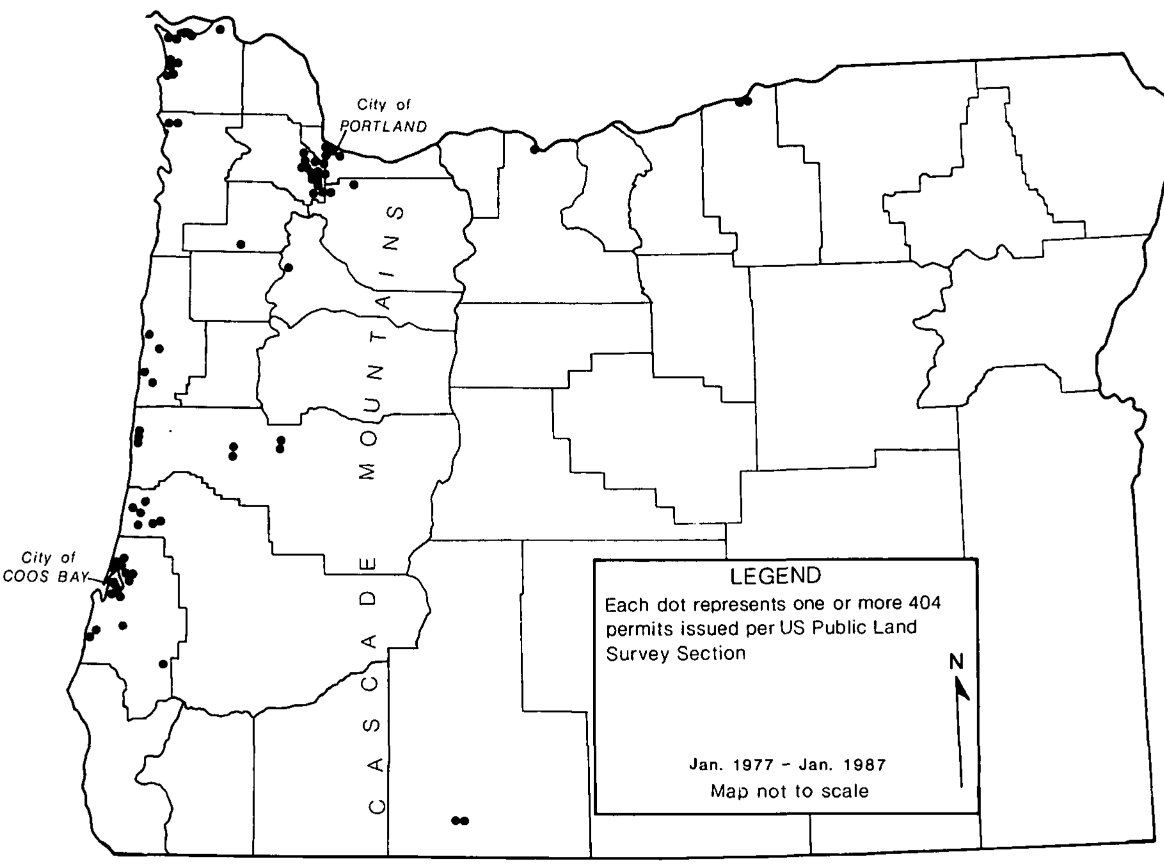

Figure 1. Locations of Section 404 permit activity requiring compensatory mitigation in Oregon, January 1977–January 1987.

and 19% of the area created, but none were impacted. The largest net gain of wetland area was also in ponds. For estuarine wetlands, the largest loss in numbers and area of wetland was in subtidal flat, while the largest gain was in salt marsh.

The majority of the permitted activity involved small numbers and areas of wetlands (Figure 2). Sixty-six percent of the wetland areas impacted and 68% of the areas created were ≤0.40 ha. The area of wetland impacted was 73.90 ha while 41.81 ha were created, resulting in a net loss of 32.09 ha or 43% (Table 3). Wetland alteration allowed by five permits accounted for most of the loss. These permits collectively impacted 38.12 ha, but created only 6.23 ha. In the remaining 53 permits, the areas involved were smaller and permits where more area was created than impacted helped to offset the net loss.

Permits requiring wetland creation most often involved road and highway construction (33%). Nonmarine commercial projects (e.g., shopping center, parking lots) were second (19%). Moreover, road and highway construction was involved in projects that impacted nine of the 11 wetland types destroyed and occurred in ten of the 14 counties having permitted activity.

The wetland functions most often cited as being impacted were, in descending frequency of occurrence, wildlife and fisheries habitat, flood storage, food-chain support, sediment trapping, and nutrient retention and removal. Functional replacement was required in 66% of the permits. Moreover, at least 50% of the permits issued each year listed functional replacement as the goal for the mitigation project. Other objectives frequently mentioned were wildlife and fishery habitat and food-chain support.

The number of permits issued that required mitigation in the form of wetland creation or restoration increased from one in 1977 to 18 in 1987 (Table 4). Most were issued since 1983, with 1983, 1985, and 1986 accounting for 76% of the permits. The area impacted each year was greater than or equal to the area created from 1977 to 1984, but less than the area created in 1985 and 1986 (Table 4). Larger impacts and creations occurred in the early years, while a trend to increased numbers of smaller projects began in 1983.

Table 3. Numbers and area by wetland type of wetlands impacted (IMP) and created (CR) in Oregon in 404 permits requiring wetland creation[a]

Wetland type	No. of wetlands		Area		Gain or loss in area
	IMP	CR	IMP	CR	
Salt marsh	5	11	3.68	9.87	+6.19
Intertidal reef	0	1	0.00	0.08	+0.08
Intertidal flat	13	11	5.54	3.40	−2.14
Subtidal flat	5	1	10.97	0.08	−10.89
Freshwater marsh	37	28	29.26	14.29	−14.97
Forested wetland	5	2	8.13	2.67	−5.46
Shrub wetland	5	1	6.96	0.24	−6.72
Pond	0	18	0.00	8.09	+8.09
Intermittent streambed	0	1	0.00	0.32	+0.32
Lower riverine marsh	1	0	0.08	0.00	−0.08
Lower riverine bottom	4	1	8.46	0.12	−8.34
Lower riverine shore	1	1	0.40	2.23	+1.82
Tidal freshwater marsh	3	3	0.20	0.28	+0.08
Tidal riverine shore	1	0	0.04	0.00	−0.04
Upper riverine bottom	2	1	0.16	0.12	−0.04
Totals	82	80	73.90	41.81	−32.09

[a]Area is expressed as hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047.

The wetland area impacted tended to equal the area created when the compensation required was in-kind (i.e., the wetland created was the same type as impacted) (Table 5). Of the 82 wetlands impacted, 50 (61%) were compensated with the creation of the same wetland type and resulted in a net gain of 0.61 ha. In the case of freshwater marshes (the wetland type experiencing the largest losses) when compensation was in-kind, there was a gain of 0.45 ha. When compensation was out-of-kind, there was a loss of 15.42 ha. Similar results were obtained when the pattern was examined by permit. Twenty-five permits (43%) required in-kind compensation and resulted in a net gain of 0.53 ha. Thirteen permits (22%) involved out-of-kind compensation, and resulted in a net loss of 10.60 ha. Twenty permits (34%) involved both in-kind and out-of-kind compensation and resulted in a net loss of 8.82 ha.

Washington

The Washington data base contained information on 35 permits issued from 1980–1986 that required compensatory mitigation. Impacts to 72 wetlands and the creation of 52 were documented. Fifty-one percent of the mitigation projects were inspected at least once.

Most of the permitted activity (96%) was located west of the Cascade Mountains (Figure 3). Eighty-seven percent of the impacted and created wetlands were associated with the coast, an estuary or a waterway, primarily in Puget Sound. Sixty-six percent occurred within 5 km of an urban area with a population greater than 5000. The majority were in the vicinity of the Seattle/Tacoma metropolitan area. All but one of the created wetlands were located in the same county, waterbody, or river basin as the associated impacted wetlands.

Permitted activity involved small numbers and areas of wetlands (Figure 4). The median number of wetlands impacted per permit was two; created per permit, one. The areas of 65% of the impacted wetlands and 59% of the created wetlands were ≤0.40 ha. For all but two of the size classes used in the analysis, the number of created wetlands was less than or equal to the number of impacted wetlands. This suggests that the area of the compensation tends to be less than or equal to the area of the impact, as was the case for 78% of the permits.

Permit decisions that required compensatory mitigation resulted in a net loss of 15.95 ha (Table 6). Eight of these permits accounted for a loss of 15.05 ha, while two permits accounted for a gain of 4.33 ha. Therefore, the largest gains and losses of area were due to ten permits (29%), while the remainder of the permits resulted in a net loss of 5.22 ha.

Permitting affected 24 wetland types, 22 types were impacted and 16 were created (Table 6). Estuarine and palustrine wetlands were impacted and created most frequently, accounting for 69% of the impacted and 76% of the created wetlands. In terms of numbers of wetlands, intertidal flats were impacted and created most often. They were altered in seven out of 11 counties with permit activity but were created in only four, indicating localized losses. Considering only inland freshwater systems, the greatest loss in numbers was in forested wetlands. Permit decisions resulted in a net gain of 9.71 ha of salt marsh. The largest wetlands destroyed were freshwater marshes, and they also experienced a net loss of 11.57 ha.

Construction of marinas, boat basins and docks, and channel maintenance activities were responsible for the majority of the permits requiring mitigation. These types of projects impacted more wetland types and occurred in more counties than any other types. After these activities, projects involving road and highway construction were permitted most often.

Functional replacement was listed most often as the objective for the created wetlands. It was mentioned in 71% of the permits, followed by fish and wildlife habitat and food-chain support.

Increased numbers of permits requiring compensation were issued over time (Table 7). The largest area of wetland was impacted and created in 1984. In following

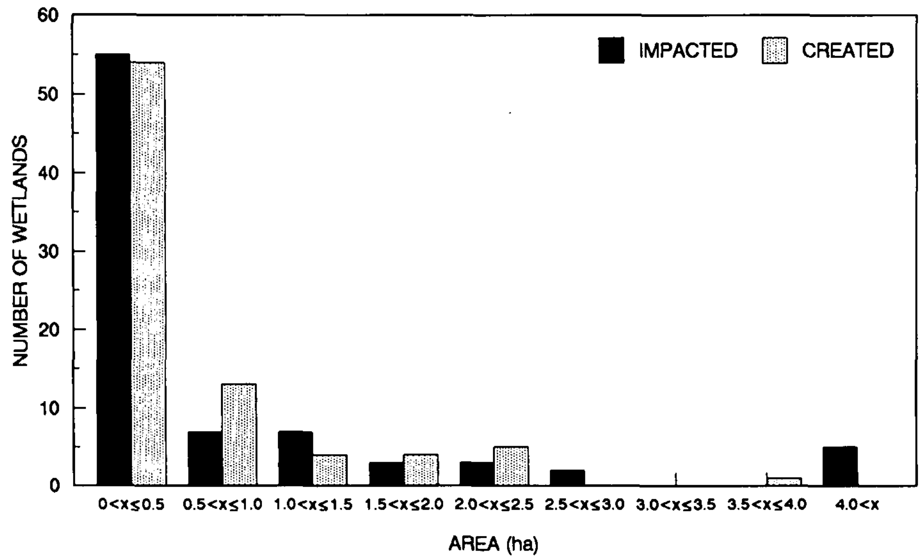

Figure 2. Comparison of the sizes of wetlands impacted and created due to Section 404 permits requiring compensatory mitigation issued in Oregon, January 1977–January 1987.

Table 4. Numbers and area of wetlands impacted (IMP) and created (CR) and numbers of wetland types involved in 404 permits requiring wetland creation in Oregon, 1977–1986[a]

Year	No. of permits	Impacted		Created		Area	
		No. of types	No. of wetlands	No. of types	No. of wetlands	IMP	CR
1977	1	2	2	1	1	10.52	1.21
1978	0	0	0	0	0	0.00	0.00
1979	0	0	0	0	0	0.00	0.00
1980	2	2	4	4	5	10.77	1.54
1981	0	0	0	0	0	0.00	0.00
1982	4	3	5	4	4	7.69	3.89
1983	9	6	15	4	13	14.37	6.84
1984	6	4	8	4	6	3.93	3.24
1985	17	8	21	7	24	6.23	6.48
1986	18	8	25	6	25	14.81	15.82
Totals	57	12	80	13	78	68.31	39.01

[a]Area is expressed as hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047.

years there was an increase in the number of projects less than or equal to 2.0 ha permitted.

Examination of the 32 permits with complete information on area indicates that, whether compensation was in-kind or out-of-kind, the result was a net loss in wetland area (Table 8). In-kind compensation was required in 11 permits (34%), resulting in a net loss of 4.01 ha. Out-of-kind compensation was required in five permits (16%), resulting in a net loss of 8.82 ha. A combination of in-kind and out-of-kind compensation was required in 16 permits (50%), resulting in a net loss of 8.82 ha. The largest loss with in-kind compensation was 11.01 ha of freshwater marsh; the largest gain was 8.30 ha of salt marsh. The largest loss with out-of-kind compensation was 4.49 ha of subtidal flat; the largest gain was 1.42 ha of salt marsh.

Indications of Compliance in Both States

Compensatory mitigation required in both states tended to be completed within two years after the permit was issued. Of the permits where the work was not yet completed, 17 of 23 in Oregon and seven of 12 in Washington were issued in 1985 or 1986, the final two years covered by this study. If the pattern holds, most of these wetlands should have been created in 1987 and 1988. These results do not imply that the wetlands were constructed or are functioning as planned or permitted, merely that they exist.

Table 5. Comparison by wetland type of wetland area impacted (IMP) and created (CR) when compensation was in-kind (in-kind comp) and out-of-kind (out-of-kind comp) in Oregon[a]

	In-kind comp			Out-of-kind comp		
Wetland type	IMP	CR	Gain/loss	IMP	CR	Gain/loss
Salt marsh	3.68	3.89	+0.20	0.00	5.99	+5.99
Intertidal reef	—	—	—	0.00	0.08	+0.08
Intertidal flat	3.68	1.90	−1.78	1.86	1.50	−0.36
Subtidal flat	0.08	0.08	0.00	10.89	0.00	−10.89
Freshwater marsh	13.80	14.25	+0.45	15.46	0.04	−15.42
Forested wetland	2.67	2.51	−0.16	5.46	0.16	−5.30
Shrub wetland	—	—	—	6.96	0.24	−6.72
Pond	—	—	—	0.00	8.09	+8.09
Intermittent streambed	—	—	—	0.00	0.32	+0.32
Lower riverine marsh	—	—	—	0.08	0.00	−0.08
Lower riverine bottom	0.12	0.12	0.00	8.34	0.00	−8.34
Lower riverine shore	0.40	2.23	+1.82	—	—	—
Tidal freshwater marsh	0.20	0.28	+0.08	—	—	—
Tidal riverine shore	—	—	—	0.04	0.00	−0.04
Upper riverine bottom	0.12	0.12	0.00	0.04	0.00	−0.04
Totals	24.77	25.37	+0.61	49.13	16.43	−32.70

[a]Area is expressed in hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047. Dashes indicate no data.

Discussion

Trends in the Pacific Northwest

The number of permits requiring compensatory mitigation in Oregon and Washington has increased with time, resulting in increased numbers of wetlands and wetland types being created. Permitted activity occurred primarily west of the Cascade Mountains and in the vicinity of urban centers. The created wetlands tended to be located in the same county, river basin, or waterbody as the associated impacted wetlands. However, because of differences in the wetland types impacted and created, local gains and losses of certain types occurred. For example, in Washington, intertidal flats were created in four of the seven counties where they were impacted; in Oregon 23% of the wetlands created were ponds, but no ponds were impacted. Examination of the National Wetland Inventory maps for the Willamette Valley, Oregon, where most of the ponds were constructed, revealed that ponds were not a wetland type typical of the region. The only ponds found were associated with the major water courses, and, therefore, were subject to yearly flooding. The created ponds were typically isolated hydrologically from the river. This local pattern of increase in ponds was reflective of the national gain in area of ponds between the mid-1950s and mid-1970s (Tiner 1984). The potential ecological effects of these exchanges cannot be evaluated with the data from this study. However, it is important for resource managers to be aware that such trades are being made so that losses of wetland function in the landscape are prevented.

More than half of the wetlands impacted and created were ≤0.40 ha in size. Information from EPA regional personnel evaluating requests for proposals suggests that this may be a nationwide pattern (Zedler and Kentula 1986). Similarly, Lindall and Thayer (1982) expressed concern over the considerable cumulative acreage associated with numerous small projects in the Southeast. The possible cumulative effects of these numerous small projects should be evaluated.

Effectiveness of 404 in Protecting the Wetland Resource

Impacts of permit decisions requiring compensatory mitigation on the wetland resource should be evaluated both in terms of the numbers and the area of wetlands created and destroyed. In the Pacific Northwest, different conclusions were reached about the consequences of permit decisions involving compensatory mitigation depending on what data were examined. In Washington, the greatest loss in numbers of wetlands was of forested wetlands; in Oregon, freshwater marshes. The region lost more area of freshwater marsh than any other type of wetland. There was also a net increase in area of salt marsh due to creation, while there was a net

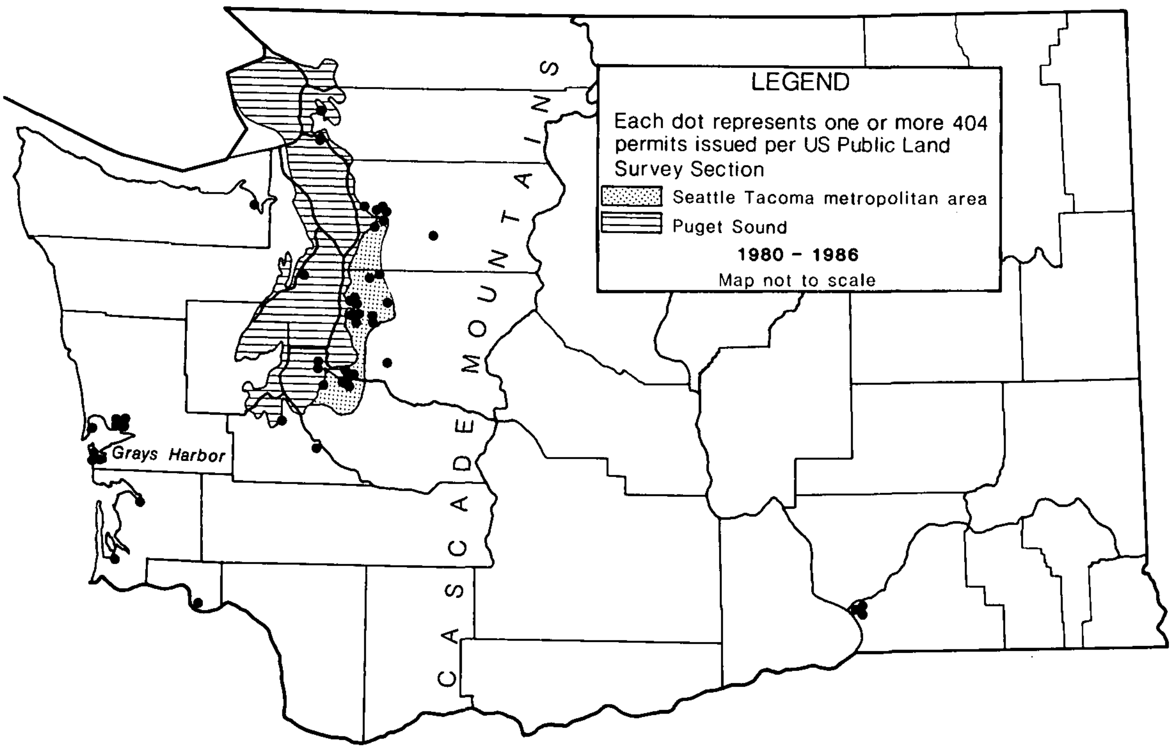

Figure 3. Locations of Section 404 permit activity requiring compensatory mitigation in Washington, 1980–1986.

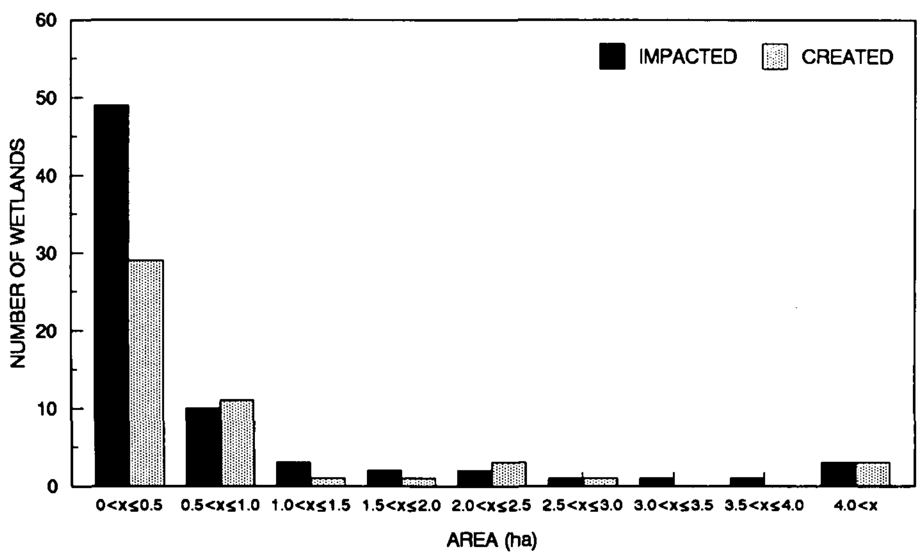

Figure 4. Comparison of the sizes of wetlands impacted and created due to Section 404 permits requiring compensatory mitigation issued in Washington, 1980–1986.

decrease in area of other estuarine types, especially intertidal and subtidal flats.

Our findings indicate that mitigation projects are being built. Both the permitted impacts and the required creations seem to be completed within two years of permit issuance. However, monitoring of the mitigation projects by agencies was minimal. About half were visited at least once. Therefore, we had no data by which to evaluate whether or not the created wetlands were constructed or functioning as planned; we merely were able to confirm that they existed.

Permits requiring compensatory mitigation only represent a fraction of the total number of permits issued. In Washington, approximately 3% of the permits issued required compensatory mitigation. The proportion in Oregon was probably similar. In both states, the

Table 6. Numbers and area by wetland type of wetlands impacted (IMP) and created (CR) in Washington in 404 permits requiring wetland creation[a]

Wetland type	No. of wetlands IMP	No. of wetlands CR	Area IMP	Area CR	Gain or loss in area
Intertidal seagrass bed	4	4	1.01	1.86	+0.85
Salt marsh	3	5	4.29	14.00	+9.71
Intertidal reef	1	1	0.12	0.28	+0.16
Intertidal rocky shore	1	4	0.04	1.17	+1.13
Intertidal flat	15	12	9.67	6.35	−3.32
Subtidal seagrass bed	2	1	0.65	0.12	−0.53
Subtidal reef	1	0	0.12	0.00	−0.12
Subtidal flat	3	1	4.53	0.04	−4.49
Lacustrine aquatic bed	2	0	0.32	0.00	−0.32
Lacustrine marsh	0	1	0.00	0.81	+0.81
Lacustrine rocky shore	0	1	0.00	0.16	+0.16
Lacustrine bottom	2	2	3.04	2.95	−0.08
Lacustrine shore	4	2	0.40	0.45	+0.04
Palustrine aquatic bed	1	0	0.08	0.00	−0.08
Freshwater marsh	9	8	23.35	11.78	−11.57
Forested wetland	5	0	2.63	0.00	−2.63
Shrub wetland	4	1	1.90	0.04	−1.86
Pond	1	0	0.08	0.00	−0.08
Tidal riverine aquatic bed	2	0	0.89	0.00	−0.89
Tidal freshwater marsh	4	2	5.71	2.23	−3.48
Tidal riverine bottom	1	0	0.24	0.00	−0.24
Tidal riverine shore	3	2	0.49	1.05	+0.57
Upper riverine aquatic bed	3	2	1.74	2.19	+0.45
Upper riverine bottom	1	0	0.12	0.00	−0.12
Totals	72	49	61.43	45.49	−15.95

[a]Area is expressed as hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047.

permits that required compensatory mitigation resulted in a net loss in numbers and area of wetlands. Consequently, the majority of all 404 permits issued resulted in a net loss of wetlands. However, to evaluate thoroughly the effect of Section 404 on the resource one would also need to consider the wetlands protected by avoidance and minimization of impacts as a result of the permitting process. This information was not available. It is also important to acknowledge that the 404 program accounts for only part of the wetland loss and creation occurring nationwide. Agricultural development was responsible for 87% of recent national wetland losses and nearly all of the 8.5×10^5 ha of ponds created (Tiner 1984). Therefore, the 404 program does not regulate the principal cause of wetland loss and is probably not the principal reason for wetland creation in the nation.

Agency personnel need information on the ecological functions of wetlands and how to assess them. Functional replacement was listed as the goal for the wetland creation in over 65% of the permits. It was often difficult to evaluate what functional replacement meant in individual cases, because the functions of the wetland to be destroyed were usually not elucidated or, when they were, the basis for their being assigned to the wetland was not documented. When documentation was provided in the permit file, functions most commonly listed were provision of habitat for fish and wildlife, while water quality and hydrologic functions were seldom listed.

Factors Influencing Permitting—An Example from Oregon

A trend in the Pacific Northwest to increased numbers of permits requiring wetland creation, especially small projects, began in 1983 (Tables 4 and 7). Several factors, inside and outside the permitting process, may have contributed. In 1982 the Oregon Legislature established a revolving fund for port development loans. Tourism, much of it water based, was also increasing steadily over the same time period. Furthermore, the population was increasing in certain areas of the state (E. Schafer, Center for Population Research, Portland State University, personal communication). Between 1983 and 1986 there was significant population growth in areas that had permit activity requiring compensatory mitigation.

Changes were also occurring in the 404 permitting process that affected the management of wetlands. During the 1980s there has been a gradual maturation of the mitigation process, beginning with the adoption of the first comprehensive mitigation policy by FWS in 1981 (Federal Register, V. 46, No. 15, at 7644). This was followed in 1985 by the adoption of mitigation policies by COE and EPA Region X.

Attention to mitigation at the state level through the Oregon Removal/Fill Law also contributed to increased use of wetland creation and restoration as a management tool (Good 1987, Quarterman 1985). Mitigation became a statutory requirement for estuarine wetland alterations in 1979; detailed implementing regulations for estuaries were adopted in 1984. This was followed in 1986 by state regulations that extended mitigation authority to all wetlands and waters of the state, not just estuaries. During the same period, local comprehensive plans that included new wetland management provisions were being adopted. Together these actions gave developers direction about where development could be located, how permits could be obtained, and what mitigation was needed.

Conclusions

Examination of trends and patterns in the 404 permit record can be useful in wetland management. Areas of high permit activity can be identified, as can changes

Table 7. Numbers and area of wetlands impacted (IMP) and created (CR) and the numbers of wetland types involved in 404 permits requiring wetland creation in Washington, 1980–1986[a]

Year	No. of permits	Impacted		Created		Area	
		No. of types	No. of wetlands	No. of types	No. of wetlands	IMP	CR
1980	1	3	3	2	2	2.43	0.20
1981	1	3	3	1	1	0.12	0.16
1982	3	7	8	2	4	5.79	2.47
1983	5	4	7	4	4	11.25	6.11
1984	9	9	15	11	18	30.76	30.07
1985	6	10	13	5	8	5.83	1.05
1986	9	14	22	7	15	5.14	5.42
Totals	34	22	71	16	52	61.31	45.49

[a]Area is expressed as hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047.

Table 8. Comparison by wetland type of wetland area impacted (IMP) and created (CR) in Washington, 1980–1986, when compensation was in-kind (in-kind comp) and out-of-kind (out-of-kind comp)[a]

Wetland type	In-kind comp			Out-of-kind comp		
	IMP	CR	Gain/loss	IMP	CR	Gain/loss
Intertidal seagrass bed	0.69	1.54	+0.85	0.32	0.32	0.00
Salt marsh	4.29	12.59	+8.30	0.00	1.42	+1.42
Intertidal reef	0.12	0.28	+0.16	—	—	—
Intertidal rocky shore	—	—	—	0.04	1.17	+1.13
Intertidal flat	5.34	4.61	−0.73	4.33	1.74	−2.59
Subtidal seagrass bed	0.16	0.12	−0.04	0.49	0.00	−0.49
Subtidal reef	—	—	—	0.12	0.00	−0.12
Subtidal flat	—	—	—	4.53	0.04	−4.49
Lacustrine aquatic bed	—	—	—	0.32	0.00	−0.32
Lacustrine marsh	—	—	—	0.00	0.81	+0.81
Lacustrine rocky shore	—	—	—	0.00	0.16	+0.16
Lacustrine bottom	3.04	2.95	−0.08	—	—	—
Lacustrine shore	0.12	0.45	+0.32	0.28	0.00	−0.28
Palustrine aquatic bed	—	—	—	0.08	0.00	−0.08
Freshwater marsh	22.46	11.45	−11.01	0.89	0.32	−0.57
Forested wetland	—	—	—	2.63	0.00	−2.63
Shrub wetland	0.28	0.04	−0.24	1.62	0.00	−1.62
Pond	—	—	—	0.08	0.00	−0.08
Tidal riverine aquatic bed	—	—	—	0.89	0.00	−0.89
Tidal freshwater marsh	5.46	2.23	−3.24	0.24	0.00	−0.24
Tidal riverine bottom	—	—	—	0.24	0.00	−0.24
Tidal riverine shore	0.32	0.12	−0.20	0.16	0.93	+0.77
Upper riverine aquatic bed	1.66	2.19	+0.53	0.08	0.00	−0.08
Upper riverine bottom	—	—	—	0.12	0.00	−0.12
Totals	43.95	38.57	−5.38	17.48	6.92	−10.56

[a]Area is expressed as hectares. The original information was expressed as acres, which was converted to hectares by multiplying by 0.4047. Dashes indicate no data.

in the local wetland population due to the types, numbers, and area of wetlands being impacted and created.

Patterns in permit activity may be related to events both inside and outside the permitting process. Factors outside the process include efforts to stimulate development and the economy and demographic trends. Within the process, increased awareness of the permitting system, definition of the use of compensatory mitigation, and clarification of land-use regulations may affect the number of permit requests. Such information can help resource managers anticipate increased demands on the resource and do a better job of protecting it.

The process of gathering the information presented in this article was very labor intensive. The readily available data were often either incomplete or of poor quality. For example, the extent of the permitted alteration was often documented as volume of dredge or fill. Such units are meaningless when trying to estimate area of wetland impacted. Fishman Environmental Services (1987) encountered similar difficulties in their evaluation of estuarine mitigation in Oregon. Since analyses of historic 404 permit information, such as the one presented here, would be useful to resource managers and scientists across the nation, development of standardized record-keeping procedures and maintenance of an up-to-date data base are recommended.

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