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College of William and Mary
Virginia Institute of Marine Science
School of Marine Science
Wetlands Program
Gloucester Point, Virginia 23062

Dr. Carl Hershner
Program Director

Commonwealth's Declared Policy:

"to preserve the wetlands and to prevent their despoliation and destruction. . ."

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Introduction

As the population in the coastal zone continues its rapid expansion, pressures increase to develop wetlands and other sensitive natural areas. One third of the nation's wetlands have been lost in the past 200 years, and presently more than 300,000 acres are lost annually (Hamon and McConnell 1983, Tiner 1984). While much of the loss of wetlands occurs naturally due to subsidence or erosion, the majority of the loss is caused by man's activities in channelization, flood control, agricultural land conversion, and dredging (Farnell 1981, Wakefield 1982). Even though it is generally recognized that wetlands have high ecological value and provide natural services such as water quality maintenance, development pressures continue due to economic factors. In Virginia the number of wetlands permit applications reviewed by the Wetlands Advisory Program, Virginia Institute of Marine Science (VIMS) has increased from 372 in 1980 to 935 in 1989.

During this same time period, both the regulatory and development communities have been looking for methods by which the adverse impacts of wetland development might be mitigated. One method which has seen increased use is that of compensatory mitigation. Generally this is the term used for the practice of constructing a new, similar wetland as compensation for one which is filled or otherwise disturbed by development activities. In theory the new wetland would serve to offset the losses incurred by the environment due to destruction of the natural wetland.

Although the theoretical value of wetlands compensation makes it very appealing and the practice has become increasingly common, it is generally the subject of controversy due to studies indicating less than successful implementation of the concept in application. Many of these studies are controversial in themselves due to the difficulty inherent in defining what constitutes a "successful" created wetland. Habitat creation is predicated on the theory that man-made systems can function on a par with natural systems. Major difficulties are encountered in determining when created wetlands reach ecological parity with the natural systems they theoretically replace. How does one measure and then compare the function and value of systems which at best are only poorly understood to begin with? Man-made wetlands are particularly poorly understood because the concept is relatively new and very little scientific information is available at present (Shisler and

(continued)

Charette 1984, Race 1985). Many plant species are slow colonizers and may take very long periods of time to attain natural densities and rates of production. In addition, the substrate changes over time as sediments and peat accumulate and different plant species invade the new wetland. During the development period, both plant production and habitat value are generally low (Thayer, *et al.* 1986). Also, many different types of wetland plant communities, many of which have no history of successful establishment, are being used as compensation with no predictable probability of long-term establishment. As a result, the validity of wetlands creation as a management tool has been questioned (Race and Christie 1982, Knutz 1987).

The appeal of compensation to developers, other landowners and the regulatory community is understandable. It can be looked upon as a form of having your cake and eating it too. If compensation works, development can occur, permits can be issued and at the same time resource loss is prevented. Some states have adopted mandatory compensation for all wetlands losses. Others have refused to rely on wetlands creation except in rare circumstances. With the adoption by many federal and state programs of the "no net loss" goal for wetlands resources, pressures will very likely increase to employ compensation as one method of achieving the objective. The overall question remains, however, as to how well created marshes restore the functional values of the resources they theoretically replace and how well the compensation concept is implemented on a day-to-day basis.

The study described herein has as its primary purpose an examination of how compensatory mitigation has worked as a wetlands management tool to date in Virginia (i.e., how well theory has been put into practice). Our approach was to look at the overall use of compensation in coastal Virginia based on regulatory records and to examine as many existing created wetlands as possible within the tidal area of the state to determine how closely these projects have come, both singly and collectively, to fulfilling the compensatory goal of wetland replacement.

Methodology and Limitations

This study is a survey of wetland compensation sites created through requirements of the permit process in Virginia. Wetlands are regulated in Virginia by a cadre of 31 local wetlands boards whose activities are overseen by the Virginia Marine Resources Commission, a state agency. The Corps of Engineers manages these same wetlands from the federal perspective. Because there is no centralized listing of marsh creation sites or agency which tracks projects as they are permitted in Virginia, each regulatory body in the state was petitioned and a list of compensation projects was generated from the responses of the 31 extant wetlands boards, the staff of the Virginia Marine Resources Commission (VMRC), personnel of the Regulatory Functions Branch of the Norfolk District of the Army Corps of Engineers (COE), and the staff of the Wetlands Advisory Program of the Virginia Institute of Marine Science, College of William and Mary.

The resulting list of potential compensation survey sites has 51 entries (Figure 1). This in-

Figure 1. Distribution of Permitted Tidal Wetland Compensation Sites in the Coastal Plain of Virginia in 1989.

clusive list was examined to determine which of the potential sites were suitable to be surveyed as part of this study. Sites eliminated were those which were too recently permitted or had had less than two years of growth. Also eliminated from sampling due to time constraints and their minimal size were 11 sites under 1,000 square feet in total area. Logistic problems, the inability to locate the site or gain access, removed 5 sites from the list. Because there is no agency tracking of compensation projects, many problems were encountered in trying to evaluate project objectives versus the outcome based on permit file data. Evaluation of a number of projects had to be eliminated or cut short for these reasons. The result was 32 sites visited.

Percent cover estimates were made at each of the compensation sites and where possible at adjacent natural sites. In highly developed areas, the compensation sites were often isolated and lacked any contiguous natural wetlands. A few sites were adjacent to natural wetlands of totally different vegetative community character. In these cases, no cover estimate was determined for a natural site. Qualitative observations were made at each site where such factors as bird use, invasion by the opportunist (*Phragmites australis*), faunal associations, etc. supplemented the cover survey information.

Results and Discussion

A total of 51 compensatory mitigation projects were identified as a result of this survey. The earliest permitted wetland compensation projects identified in our survey were two which were authorized in 1981. Although somewhat variable, the number of permits issued involving wetland compensation increased generally on an annual basis between 1981 and 1989 (Figure 2). It is not possible, given the data available, to determine whether the increase in compensation projects reflects an increase in popularity of the practice among the regulatory community or whether it is accounted for simply by the increase in the total volume of permits which also climbed steadily during the same time frame. Ten compensation permits were issued in 1988, the most for any year in our survey. The permit data for 1989, the year of the survey, were incomplete. The average number of compensation projects permitted annually since 1981 was 6.3.

Figure 2

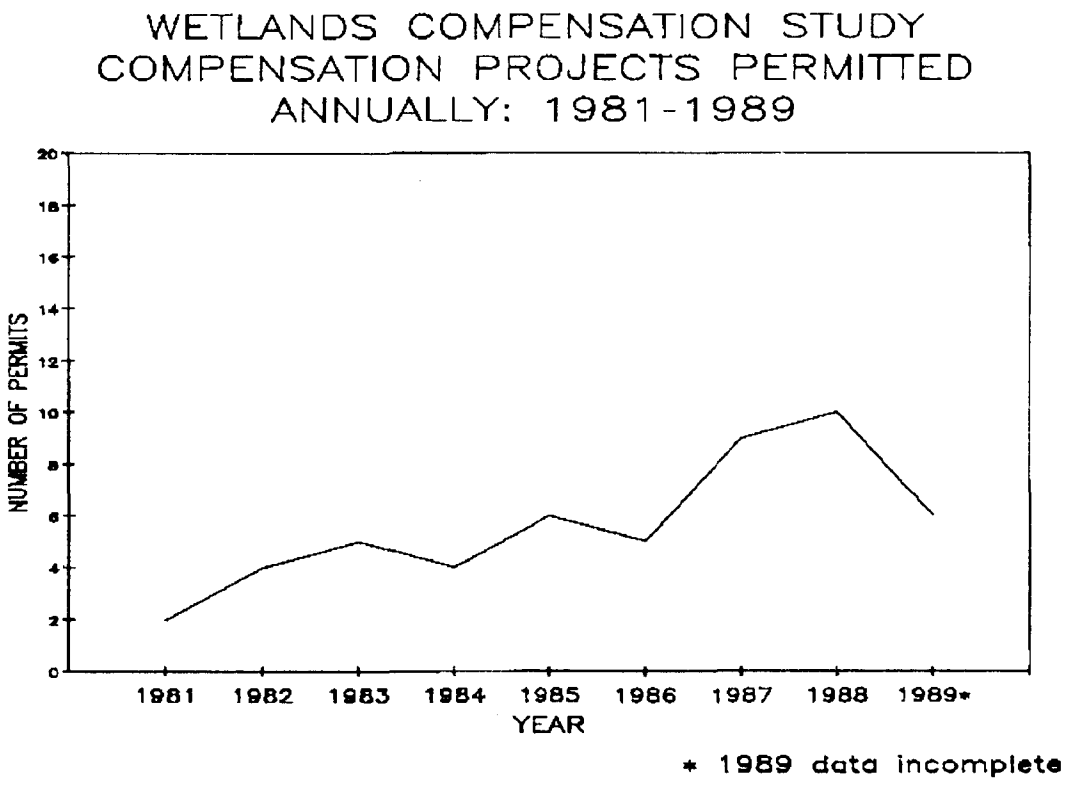
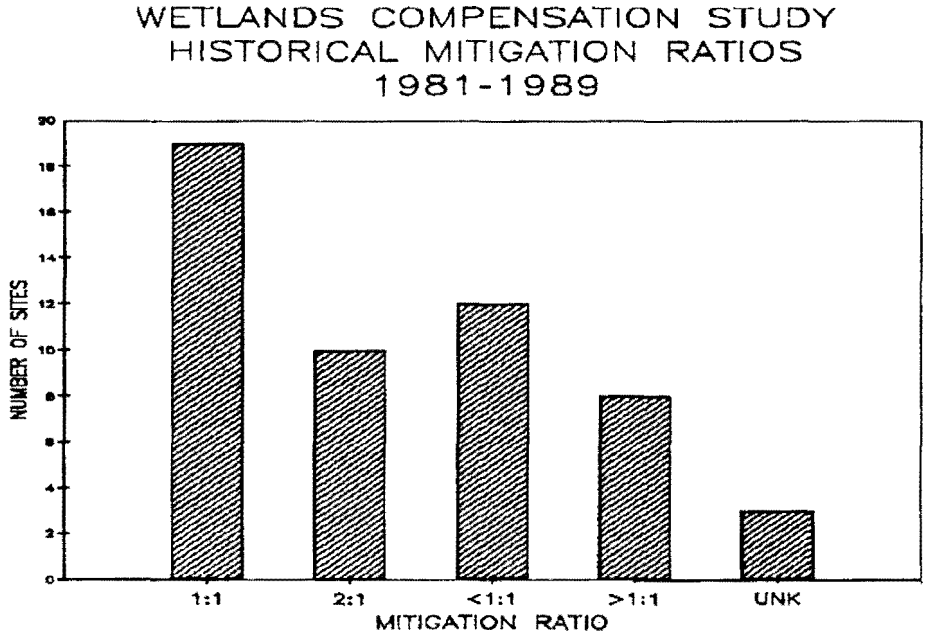


Figure 3



Since wetland compensation was first permitted for use in Virginia in 1981, a total of 32.3 acres of man-made wetlands has been ordered as compensation for projects impacting a total of 31.3 acres of aquatic habitat. The average size mitigation area permitted was 0.68 acres. If, however, the seven projects over one acre in size are deleted, the average man-made wetlands is 0.12 acres. The latter average is more indicative of the size projects generally constructed in Virginia since a total of 43 compensation projects are below one acre in size and 9 are below 1,000 square feet. The seven large projects mentioned above account for 79% of the 32.3 acre wetland compensation total.

The theoretical acreage figures for man-made vs. natural marsh, presented in the foregoing paragraph, demonstrate an overall mitigation ratio of slightly greater than 1:1. The actual numbers from permit files are shown in Figures 3 and 4. These data demonstrate that ratios of 1:1 or less than 1:1 were the rule and were permitted 60 percent of the time. If all projects were constructed successfully, these figures would indicate a slight gain in wetland acreage.

Smooth cordgrass, *Spartina alterniflora*, was the vegetation planted or seeded in 83 per cent of the projects permitted (Figure 5). Areas were permitted to naturally revegetate in only 6 percent of the permits. Since this survey only covers tidal areas and in general smooth cordgrass has the highest historical planting success rate, these figures are not surprising. The use of smooth cordgrass would also be expected since it is a vigorous plant that spreads rapidly via rhizome growth. It can be established via plugging or seeding.

Figure 4

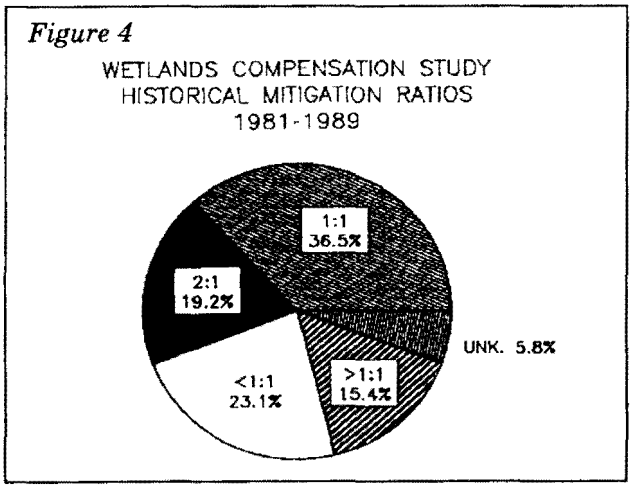
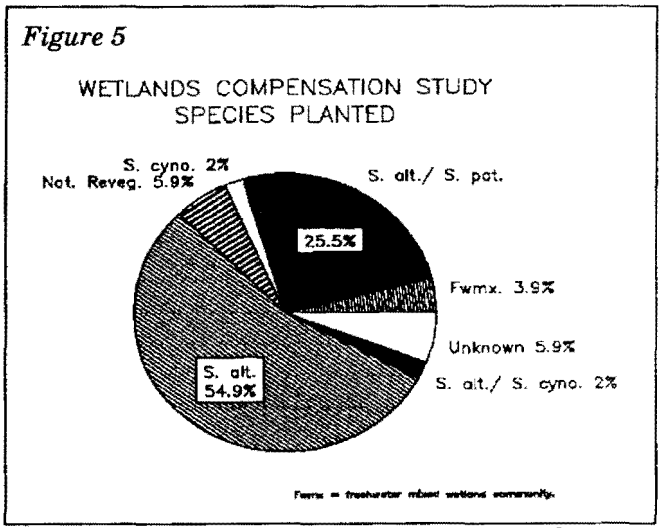
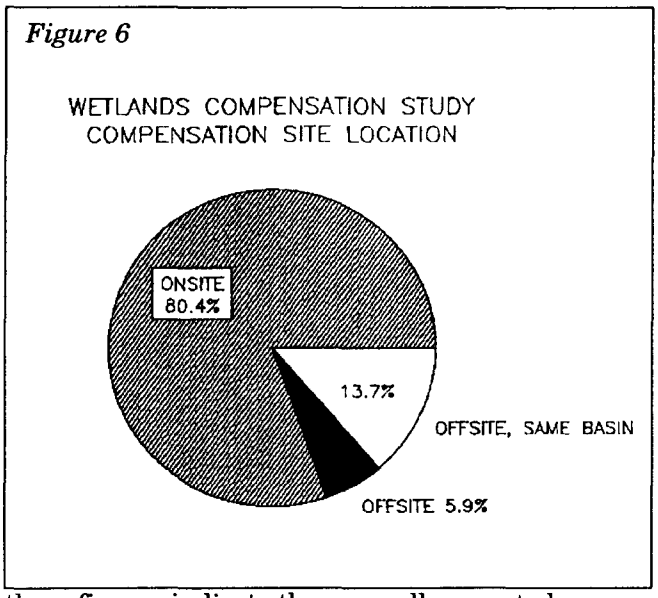


Figure 5



Eighty percent of the permits issued requiring wetland compensation were issued for construction "onsite". "Offsite, same basin" and "offsite" accounted for the remaining twenty percent (Figure 6). If implemented as permitted,

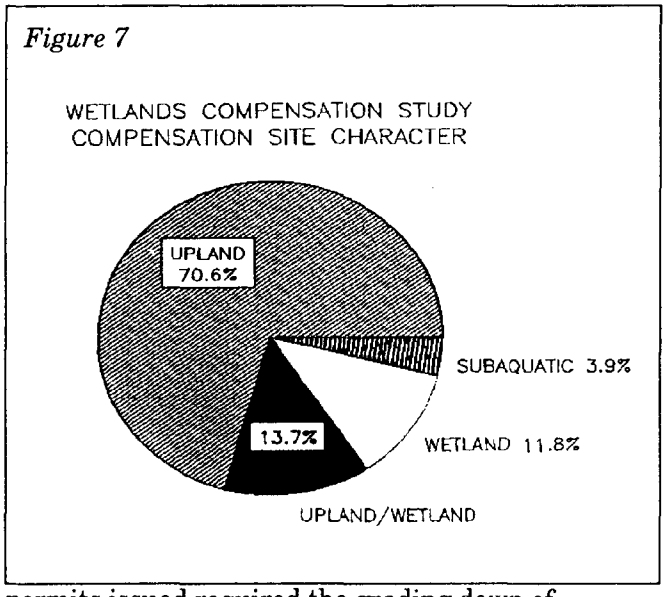
Figure 6



these figures indicate the generally accepted prioritization for these three choices of location are being followed in the tidal areas of Virginia.

Data on the general site character of areas permitted to be used for compensation are presented in Figure 7. Seventy percent of the

Figure 7



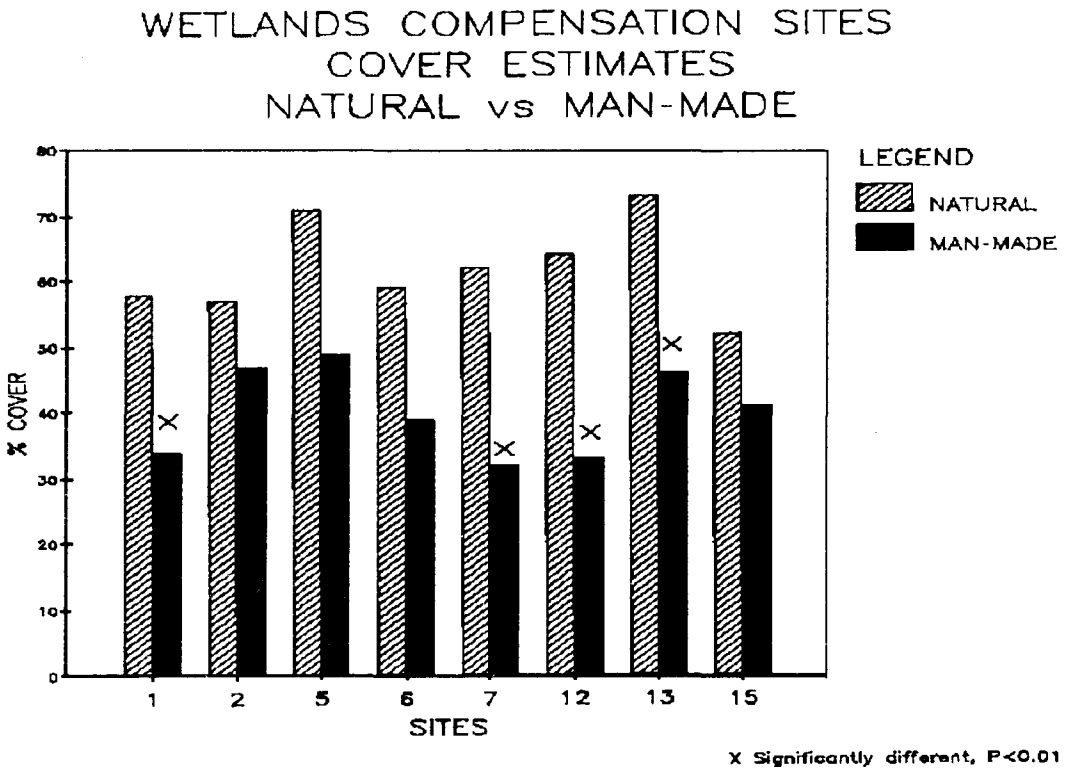
permits issued required the grading down of uplands, while thirty percent involved the use of both upland and wetland, wetland only or the use of subaquatic habitat. These data indicate that if all projects are constructed as proposed, something less than thirty percent of the projects will involve the construction of wetlands on some type of existing marine habitat. To the extent that this occurs, it negates the compensatory aspects of these projects. The permit record data regarding site characteristics were often quite incomplete. Some of the permit files seemed to indicate that projects may have involved restoration of disturbed areas in some cases rather than purely wetland for wetland. In other cases it was clear that one marine habitat such as subaquatic bottom or higher elevation marsh was used to create a different marsh community for compensatory mitigation purposes.

Cover estimates were made at eighteen of the compensation marshes visited. The investigators were able to sample similar adjacent marshes at eight of these sites. A total of four of the eight compensation marshes sampled had significantly lower cover than their respective adjacent natural systems (Figure 8). Slope runoff and perhaps tidal communication appeared to be the problem at two of the sites. Tidal communication and substrate elevation appeared to have adversely affected vegetation at the two other sites.

The cover data for all eighteen sites were also pooled to examine the overall differences between the man-made and natural wetlands. A significant difference was found at the 99 percent confidence level for the pooled data. The mean cover for all man-made marshes was 41 percent and that for the natural systems was 63 percent. The cover estimates noted above are an important indicator of how successful a marsh is at that particular point in time. This one parameter, however, is one indicator and not conclusive evidence of success or lack thereof. In order to say any more about the success of wetland community establishment in the man-made versus the natural marshes of this survey, destructive sampling techniques such as peak standing crop, stem density and below-ground biomass are necessary. This approach was not considered feasible for a survey of this type, dealing with many small, privately-owned marshes.

In order to further examine wetland compensation in Virginia, the authors looked at the acreages proposed to be constructed and that which was found at the sites. Two of the large compensation sites could not be accurately measured and so are not included in these numbers. For the sites visited in this survey, 709,358 sq. ft. of wetland was to be constructed. Our observations indicate that 68,792 sq. ft. either was never constructed or was generally devoid of marsh vegetation at the time of our site review. This amounts to approximately 10 percent of the total extent of the compensation

Figure 8



sites examined. If this ratio holds for all compensation within Virginia, it would mean that approximately 3.1 acres of compensation marsh is non-functional or non-existent. In addition to this factor, our survey indicates that although the exact acreages are not known, approximately 12 percent of the mitigation sites permitted in Virginia to date were on sites which were already wetlands. The compensatory value of these "wetland to wetland" areas would have to be in question.

A number of other factors were observed to be affecting the quality of some of the compensation sites examined in this survey. Several marshes were being adversely affected by sedimentation which came from unstabilized, adjacent land. Several were adversely affected by the activities which were occurring in their immediate vicinity and from which they were not buffered. In addition, 65 percent of the "new" marshes were already being invaded by the less desirable opportunist, *Phragmites australis*. The quality of the marsh as compensation for that lost to development may be diminished to the extent that this species is able to displace the wetlands species planted. This is not a measurable factor at present, however.

Conclusions and Recommendations

In overview, our survey results support the continued use of wetland compensation by the regulatory community, but only on a highly limited basis (i.e., generally as a last resort). The study documents problems with implementation of the concept in both wetland establishment success and regulatory decision-making. Our cover data and historical decision characterization indicate that adverse impacts (i.e., the net loss of wetland habitat) are probable on a local scale. If wetland compensation continues to see increasing use, these relatively small local effects could have cumulative significance. Increased planning, monitoring and research are recommended in order to effectively deal with such an eventuality. The pressures of growth in the coastal zone, and the adoption of "No Net Loss" policies almost ensure more pressure for compensatory mitigation in the future. These recommendations along with the newly promulgated "Wetland Compensation Guidelines" should address the concerns brought out by this study.

Wetland compensation has had a relatively limited role in tidal Virginia to date. Based on

the results of our survey, 32.3 acres of tidal wetlands have been proposed for creation since 1981 (the earliest application year identified). This eight-year acreage total is dwarfed by the 215,000 acre total for tidal wetlands in Virginia and is a relatively small proportion of permitted wetland losses of approximately twenty acres annually (VIMS' Wetlands Advisory Program, unpublished data). Our data indicate a slowly increasing use of compensation as a management tool. In terms of project numbers, wetland compensation in Virginia is dominated by small projects. In terms of wetland acreage, however, seven projects over one acre in size compose 79 percent of the 32.3 acre wetland compensation total.

Our research indicates that 10 percent of this total was not constructed or has been adversely affected by other external factors to the point that it is not viable wetland. Additionally, the man-made compensation marshes exhibited significantly lower vegetative cover than the natural wetlands sampled. These results indicate that even though the planned overall mitigation ratio within Virginia is slightly greater than 1:1, the effective ratio in terms of successful marsh establishment may be significantly less than that envisioned by the permitting agencies. If in practice anthropogenic wetlands are significantly less productive and in some cases never establish as planned, we may be in a sense mortgaging our wetland future.

Our study indicates that, in general, state regulators are using compensation on a conservative basis. Record keeping is highly variable and much of the permit information available is maintained at different locations within the regulatory community. There is much information that is apparently not available due to the fact that there are no standard record-keeping practices for compensation projects. In addition, there is some indication that monitoring and follow-up are being employed on a limited basis, although this effort appears to have little consistency. Most of the follow-up which does occur appears to be at the behest of the federal regulatory authority.

If wetland compensation continues to be used as a management tool or sees increasing use, as our survey indicates is happening, steps should be taken to ensure that the compensation wetlands are constructed in a manner which will ensure that they mature, in both structural and functional aspects, into wetlands similar to existing natural systems. Based on our survey of permit records, our ten years of field experience, and the field surveys conducted as part of this study, we offer the following recommendations:

- Record-keeping for compensatory mitigation projects should be improved through consolidation and standardization. A centralized record repository is needed.

- All projects should have post-construction inspections and selected projects should be monitored for viability and ecological function. The monitoring should include similar, adjacent natural systems where possible.

- Regulatory agencies should give greater consideration to the siting and buffering of wetland compensation areas during permit review. The aim should be to minimize the impacts to the wetland from adjacent physical features (i.e., sediment erosion and deposition), and from adjacent activities such as farming and development.

- More attention should also be directed to other planning aspects such as tidal hydrology and substrate elevation. Slow-spreading species such as *Spartina cynosuroides* should generally not be planted or should be mixed with faster growing species such as *Scirpus robustus* and *Spartina alterniflora*.

- *Phragmites australis* should be studied to determine its impact on created marshes and how best to naturally control it if this is deemed necessary.

- Wetland compensation should take into consideration regional wetland management needs through the use of comprehensive shoreline inventories or other information systems.

- Basic research aimed at increasing our knowledge of the values, structure and function of both anthropogenic and natural wetland systems should be continued.

- Long-term monitoring of man-made wetlands should be initiated in order to establish what the realistic time tables are for these systems to reach ecological parity with similar natural communities. These efforts should involve multi-

parameter investigations as well as structurally diverse wetland types.

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