Public Access and Wildlife Compatibility

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SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

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CONTENTS

FIGURES

TABLES

APPENDICIES

FOREWORD

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The staff of the San Francisco Bay Conservation and Development Commission (BCDC) would like to thank all those who contributed to the Public Access and Wildlife Compatibility Project. Specifically, thank you to the Citizens Advisory Committee for their review and subsequent endorsement of this report.

BCDC staff especially recognizes and extends great appreciation to the Policy Advisory Committee for their expertise, the effort they devoted to analyzing extensive amounts of information over the course of over one year, and their dedicated participation and commitment to working together to reach agreement on how to provide for both public access and wildlife protection.

PROJECT CONCLUSIONS

The following conclusions are based on the background information and research results, and supplement the conclusions that are in the existing *San Francisco Bay Plan* (Bay Plan) public access findings and policies. These conclusions were agreed upon by the Policy Advisory Committee and serve as the basis for the revisions to the Bay Plan public access findings and policies.

1. San Francisco Bay provides a variety of habitats for diverse populations of plants, fish and wildlife. The Bay presently sustains nearly 500 species of fish, invertebrates, birds, mammals, insects and amphibians. Out of the nearly 500 species of wildlife and aquatic life associated with the Estuary, 30 are listed as threatened or endangered under the state and federal Endangered Species Act. The Bay provides habitat for over one million shorebirds and is the winter home for over 50 percent of the diving ducks along the Pacific Flyway.
2. The San Francisco Bay allows the public to discover, experience and appreciate the Bay's natural resources and can foster public support for Bay resource protection including habitat acquisition and restoration. Public access can provide for recreational activities, educational and interpretive opportunities, and means for alternative transportation. There is an increasing demand for diverse kinds of public access experiences.
3. There is a need for more, well-designed, scientific studies of effects of human activities on wildlife, both on a local scale in the San Francisco Bay Area, and on a national scale in similar habitats with similar recreational uses. Specifically:

   a. There is much to learn on the relationship of recreational frequency and spatial scale to wildlife impacts;

   b. The potential ability for certain species to become adapted to some degree of human interaction is a poorly understood though important factor;

   c. Baseline data are needed both for comparison purposes and to help isolate disturbance factors (i.e., recreation caused disturbance versus other factors such as poor water quality or natural variability), and;

   d. There is a need for scientific data regarding the effectiveness of specific design and management strategies to avoid or reduce impacts of human activities on wildlife.

4. There is evidence that public access may have adverse effects on wildlife. Adverse effects on wildlife from human activities may be both direct (such as harassment or harvest) and indirect (such as habitat modification), and effects can be both immediate and long term. Immediate effects may include: nest abandonment (which may increase risk of predation of eggs or young), flushing, increased stress, which can lead to reduced feeding or site abandonment. Long-term effects may include decreased reproductive success, decreased population within species, or decreased number of total species. If improperly sited, public access may fragment habitats and serve as predator access routes to wildlife areas.

5. Over time, wildlife may adapt to the predictable actions of humans. However, not all individuals in a population adapt equally well. Furthermore, adaptation to human activity may leave wildlife more vulnerable to harmful human interactions (such as hunting).

6. Different kinds of disturbances have different effects on different species – effects are context dependent. For example, the type and severity of impacts on wildlife will depend on the type of human activity, and the predictability, frequency, magnitude, timing, season, and location of the activity. Impacts will also depend on the particular species, group size, age, sex, and whether the species is a resident or migratory.

7. Potential adverse effects from public access can be addressed through the employment of siting, design and management strategies to avoid or minimize adverse effects, including such strategies as use restrictions, buffers, periodic closures or the prohibition of public access in specific areas. Siting, design and management strategies can be effective in avoiding or reducing adverse effects on wildlife.

8. If the public is provided with rewarding and fulfilling formalized access, people will be less inclined to create their own ad hoc informal pathways. Informal pathways can increase habitat fragmentation and interaction between humans and wildlife, may result in less predictability of human use for wildlife, may create predator access routes to wildlife habitat, and may result in vegetation trampling and erosion.

9. The relative advantages and disadvantages of specific design and management strategies vary from site to site. Appropriate strategies depend on a variety of factors such as type of habitat, species present, adjacent land uses, types and frequency of users, planned future use of area, management objectives, public input, available funding, etc.

10. Detailed information on the advantages and disadvantages of specific siting, design and management strategies are most appropriately provided as guidelines for public access development, rather than policies. The existing advisory Public Access Design Guidelines, adopted by the Commission in 1985, are in need of revision and provide an appropriate format for information on siting, design and management strategies to avoid or minimize adverse effects on wildlife.

ADOPTED PUBLIC ACCESS FINDINGS AND POLICIES

The following revised *San Francisco Bay Plan* public access findings and policies were adopted by the San Francisco Bay Conservation and Development Commission on March 15, 2001.

Findings and Policies Concerning Public Access to the Bay

Findings

a. San Francisco Bay is a dominant feature of the nine-county Bay Area and affords a variety of habitats for many diverse plant and wildlife populations. It provides an environment for numerous forms of public enjoyment including viewing, photography, wildlife observation, nature study, fishing, wading, walking, bicycling, jogging, or just sitting beside the water. As an outstanding visual resource, the Bay is an important focal point for the entire region that serves to orient people to its various parts.

b. Access to the Bay allows the public to discover, experience and appreciate the Bay's natural resources and can foster public support for Bay resource protection, including habitat acquisition and restoration. Public access can provide for recreational activities, educational and interpretive opportunities, and means for alternative transportation.

c. Public access required by the Commission is an integral component of development and usually consists of pedestrian and other non-motorized access to and along the shoreline of San Francisco Bay. It may include certain improvements, such as paving, landscaping, and street furniture; and it may allow for additional uses, such as bicycling, fishing, picnicking, nature education, etc. Visual access to the Bay is a critical part of public access. In projects that cannot provide on-site public access due to safety or use conflicts, including significant adverse effects on wildlife, in lieu public access may be appropriate.

d. The Commission has adopted advisory "Public Access Design Guidelines" to assist in the siting and design of public access to San Francisco Bay. The Design Review Board was formed in 1970 of professional designers to advise the Commission on the adequacy of public access of proposed projects in accordance with the Bay Plan.

e. Although public access to the approximately 1,000-mile Bay shoreline has increased significantly since the adoption of the Bay Plan in 1968, demand for additional public access to the Bay continues due to a growing Bay Area population and the desirability of shoreline access areas. Diverse public access experiences are in great demand, both along urban waterfronts and in more natural areas. The full potential for access to the Bay has by no means yet been reached.

f. Public agencies have contributed to improved Bay access by providing a substantial number of parks and recreation areas. In addition, many agencies and communities continue to examine the waterfronts in their jurisdictions and have proposed new points of public access to the Bay. However, other demands for

governmental services will necessarily limit funds for the provision of shoreline access by these agencies. Clearly, additional public access to the Bay is needed, and this can be provided, in part at least, by private capital in a wide variety of shoreline developments.

g. Although opportunities for views of the Bay from public access areas have increased since the Bay Plan was adopted in 1968, there are still a significant number of shoreline areas where there exists little or no visual access to the Bay.

h. Public access areas obtained through the permit process are most utilized if they provide physical access, provide connections to public rights-of-way, are related to adjacent uses, are designed, improved and maintained clearly to indicate their public character, and provide visual access to the Bay.

i. In some cases, certain uses may unduly conflict with accompanying public access. For example, unmanaged or inappropriately located public access may adversely affect wildlife or some port or water-related industrial activities may pose a substantial hazard to public access users.

j. Insufficient knowledge on the specific type and severity of effects of human activities on wildlife creates a need for more scientific studies, both in the San Francisco Bay Area and elsewhere in similar habitats with similar human activities. More baseline data are needed for comparison purposes and to help isolate disturbance factors (e.g., disturbances caused by human activities versus other factors such as poor water quality or natural variability).

k. Studies indicate that public access may have immediate effects on wildlife (including flushing, increased stress, interrupted foraging, or nest abandonment) and may result in adverse long-term population and species effects. Although some wildlife may adapt to human presence, not all species or individuals may adapt equally, and adaptation may leave some wildlife more vulnerable to harmful human interactions such as harassment or poaching. The type and severity of effects, if any, on wildlife depend on many factors, including physical site configuration, species present, and the nature of the human activity. Accurate characterization of site, habitat and wildlife conditions, and of likely human activities, would provide information critical to understanding potential effects on wildlife.

l. Potential adverse effects on wildlife from public access may be avoided or minimized by siting, designing and managing public access to reduce or prevent adverse human and wildlife interactions. Managing human use of the area may include adequately maintaining improvements, periodic closure of access areas, pet restrictions such as leash requirements, and prohibition of public access in areas where other strategies are insufficient to avoid adverse effects. Properly sited and/or designed public access can avoid habitat fragmentation and limit predator access routes to wildlife areas. In some cases, public access adjacent to sensitive wildlife areas may be set back from the shoreline a greater

distance because buffers may be needed to avoid or minimize human disturbance of wildlife. Appropriate siting, design and management strategies depend on the

environmental characteristics of the site and the likely human uses of the site.

m. Providing diverse and satisfying public access opportunities can reduce the creation of informal access routes to decrease interaction between humans and wildlife, habitat fragmentation, and vegetation trampling and erosion. Formal public access also provides for more predictable human actions, which may increase the ability of wildlife to adjust to human use.

Policies

1. A proposed fill project should increase public access to the Bay to the maximum extent feasible, in accordance with the policies for Public Access to the Bay.
2. In addition to the public access to the Bay provided by waterfront parks, beaches, marinas, and fishing piers, maximum feasible access to and along the waterfront and on any permitted fills should be provided in and through every new development in the Bay or on the shoreline, whether it be for housing, industry, port, airport, public facility, wildlife area, or other use, except in cases where public access would be clearly inconsistent with the project because of public safety considerations or significant use conflicts, including unavoidable, significant adverse effects on Bay natural resources. In these cases, in lieu access at another location preferably near the project should be provided.

3. Public access to some natural areas should be provided to permit study and enjoyment of these areas. However, some wildlife are sensitive to human intrusion. For this reason, projects in such areas should be carefully evaluated in consultation with appropriate agencies to determine the appropriate location and type of access to be provided.

4. Public access should be sited, designed and managed to prevent significant adverse effects on wildlife. To the extent necessary to understand the potential effects of public access on wildlife, information on the species and habitats of a proposed project site should be provided, and the likely human use of the access area analyzed. In determining the potential for significant adverse effects (such as impacts on endangered species, impacts on breeding and foraging areas, or fragmentation of wildlife corridors), site specific information provided by the project applicant, the best available scientific evidence, and expert advice should be used. In addition, the determination of significant adverse effects may also be considered within a regional context. Siting, design and management strategies should be employed to avoid or minimize adverse effects on wildlife, informed by the advisory principles in the Public Access Design Guidelines. If significant adverse effects cannot be avoided or reduced to a level below significance through siting, design and management strategies, then in lieu public access should be provided, consistent with the project and providing public access benefits equivalent to those that would have been achieved from on-site access. Where appropriate, effects of public access on wildlife should be monitored over time to determine whether revisions of management strategies are needed.

5. Whenever public access to the Bay is provided as a condition of development, on fill or on the shoreline, the access should be permanently guaranteed. This should be done wherever appropriate by requiring dedication of fee title or

easements at no cost to the public, in the same manner that streets, park sites, and school sites are dedicated to the public as part of the subdivision process in cities and counties.

6. Public access improvements provided as a condition of any approval should be consistent with the project and the physical environment**,** including protection of Bay natural resources, such as aquatic life, wildlife and plant communities, and provide for the public's safety and convenience. The improvements should be designed and built to encourage diverse Bay-related activities and movement to and along the shoreline, should permit barrier free access for the physically handicapped to the maximum feasible extent, should include an ongoing maintenance program, and should be identified with appropriate signs.

7. In some areas, a small amount of fill may be allowed if the fill is necessary and is the minimum absolutely required to develop the project in accordance with the Commission's public access requirements.

8. Access to and along the waterfront should be provided by walkways, trails, or other appropriate means and connect to the nearest public thoroughfare where convenient parking or public transportation may be available. Diverse and interesting public access experiences should be provided which would encourage users to remain in the designated access areas to avoid or minimize potential adverse effects on wildlife and their habitat.

9. Roads near the edge of the water should be designed as scenic parkways for slow-moving, principally recreational traffic. The road-way and right-of-way design should maintain and enhance visual access for the traveler, discourage through traffic, and provide for safe, separated, and improved physical access to and along the shore. Public transit use and connections to the shoreline should be encouraged where appropriate.

10. Federal, state, regional, and local jurisdictions, special districts, and the Commission should cooperate to provide appropriately sited, designed and managed public access, especially to link the entire series of shoreline parks, regional trail systems (such as the San Francisco Bay Trail) and existing public access areas to the extent feasible without additional Bay filling and without significant adverse effects on Bay natural resources. State, regional, and local agencies that approve projects should assure that provisions for public access to and along the shoreline are included as conditions of approval and that the access is consistent with the Commission's requirements and guidelines.

11. The Public Access Design Guidelines should be used as a guide to siting and designing public access consistent with a proposed project. The Design Review Board should advise the Commission regarding the adequacy of the public access proposed.

12. Public access should be integrated early in the planning and design of Bay habitat restoration projects to maximize public access opportunities and to avoid significant adverse effects on wildlife.

13. The Commission should continue to support and encourage expansion of scientific information on the effects of public access on wildlife and the potential of siting, design and management to avoid

or minimize impacts. Furthermore, the Commission should, in cooperation with other appropriate agencies and organizations, determine the location of sensitive habitats in San Francisco Bay and use this information in the siting, design and management of public access along the shoreline of San Francisco Bay.

INTRODUCTION

The San Francisco Bay Conservation and Development Commission (BCDC) is charged under its law, the McAteer-Petris Act (California Government Code Section 66600-66682), with both protecting the Bay and its wildlife resources, and providing for maximum feasible public access consistent with a project to and along the Bay. Over the last 30 years, BCDC's policies on public access have evolved from the fundamental goal of public access creation and expansion, to more complex policies that recognize the necessity of balancing development of public access with parallel goals of wildlife and habitat protection and enhancement. However, available information on the effects of public access on wildlife has increased over time and concern over this issue has grown. Increased human demand for outdoor water-oriented experiences, expanding shoreline development, and shrinking wildlife habitat, have clearly elevated the potential for interaction between public and wildlife use of many shoreline areas.[1]

Consequently, as part of the Commission's work plan for updating the Bay Plan, BCDC staff initiated a study of the complex issue of compatibility of public access with wildlife. Through the Public Access and Wildlife Compatibility Project, BCDC endeavored to further revise its policies to better address the complex issue of public access and wildlife compatibility.

The Public Access and Wildlife Compatibility Project was initiated in partnership with the Association of Bay Area Government's Bay Trail Project (Bay Trail Project). The Bay Trail Project, with BCDC assistance, took the lead in facilitating original field research to measure public access impacts on avian species that inhabit San Francisco Bay. BCDC, with Bay Trail Project assistance, concentrated on improving its knowledge of siting, design and management strategies to avoid or reduce impacts by undertaking a comprehensive assembly and analysis of available information, collecting further observational and anecdotal information through a survey of land managers, and establishing an advisory committee to help generate policy recommendations.

A Policy Advisory Committee (PAC) was formed to function as a forum for public input and debate and to help facilitate a consensus among regional public agencies and non-profit organizations on the development of policy recommendations. The PAC was comprised of individuals representing a wide range of professional fields, geographic areas and public interests including biologists (consultant, academic and agency), resource managers, regional park district employees, environmental planners, landscape architects, and non-governmental organization activists, including both recreation and wildlife protection advocates (see Appendix F for a list of PAC members). The PAC was instrumental in reviewing and analyzing information as it became available, and reached consensus on conclusions and proposed policy directions. The resulting conclusions of the study and policy concepts agreed upon by the PAC were further refined by BCDC staff as proposed revisions to the *San Francisco Bay Plan* (Bay Plan) public access findings and policies. A public hearing was held on the proposed revisions, and

[1] Appendix A provides more information on the Bay's resources and Appendix B provides more information on the current status of public access in the Bay Area. This background information provides an important contextual basis for understanding the challenge of balancing protection and enhancement of Bay resources with public access to and along the Bay.

on March 15, 2000, the Commission unanimously voted to adopt the proposed revisions the Bay Plan public access findings and policies.

This report provides the background information and research results, on which the revisions to the *San Francisco Bay Plan* public access findings and polices are based. Chapter 1 describes in detail the history of BCDC policy development in regards to public access and wildlife compatibility issues. Chapter 2 describes what is known about the biological effects of public access on wildlife and Chapter 3 provides information on siting, design and management strategies to avoid or minimize adverse effects of public access on wildlife. The conclusions of the study and adopted revisions to Bay Plan public access findings and policies precede this introduction.

CHAPTER 1

BCDC POLICY HISTORY: BALANCING PUBLIC ACCESS AND WILDLIFE PROTECTION

In the 1969 amendments to the McAteer-Petris Act, the Legislature declared that:

> the public has an interest in San Francisco Bay…and that the Bay operates as a delicate physical mechanism in which changes that affect one part of the Bay may affect all other parts.[2]

and that:

> existing public access to the shoreline and waters of San Francisco Bay is inadequate and that maximum feasible public access, consistent with a proposed project, should be provided.[3]

The Legislature recognized the importance of the Bay as an ecological mechanism, but made no specific reference to balancing public access and wildlife and habitat protection and preservation goals. Instead, the public access policies in the McAteer-Petris Act focused initially on expanding public access.

BCDC was also charged with preparing the *San Francisco Bay Plan* (Bay Plan) for the long-term use of the Bay. BCDC's inquiry into the potential impacts of public access on wildlife and measures to address these impacts began with the preparation of the Bay Plan 35 years ago and continues to this day.

Bay Plan Background Reports. To develop the Bay Plan, BCDC prepared a series of background reports on various Bay issues. The following quotes from the Bay Plan background report on recreation, *Recreation On and Around the San Francisco Bay*, articulates the thought that helped form BCDC's public access policies:

> In addition to the waterfront access that can be provided in public parks, marinas, and fishing piers, openings to the Bay should be provided wherever feasible in all waterfront developments. The goal should be making as much of the shoreline as possible accessible to the public; access to the Bay should thus be included in residential and industrial sites, and in port and airport areas to the extent that it can be safely provided.[4]

This background report also noted the increasing importance of public access to wildlife areas for study and enjoyment:

> it is estimated that natural wildlife areas provided 370,000 user-days of varied recreational experiences, including bird watching, nature study, and photography. This "non-consumptive" use of wildlife is estimated to approach 522,400 user-days by 1980; and 860,400 in 2020. These are conservative estimates, because they presume access to the Bay remains as limited as at the present.[5]

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[2] California Government Code Section 66600.
[3] California Government Code Section 66602.
[4] San Francisco Bay Conservation and Development Commission. 1968. *Recreation On and Around the San Francisco Bay.*
[5] BCDC. *Recreation On and Around the San Francisco Bay*. pg. 62.

And also:

> Marshes and mudflats that are preserved in their natural state should have access provided by catwalks to the extent possible without disturbing the plants and animals to be studied. Similarly, access ways could be provided over some of the salt ponds to natural areas among or outboard of the ponds.
>
> Strong encouragement should be offered to "nature exploring," because this recreational use of the Bay shore is generally the least expensive, thereby being available to a large portion of the population. Furthermore, it does not reduce the stock of wildlife (as hunting and fishing do) and it is a desirable means of providing public education about the natural environment.[6]

During BCDC's early years, it endeavored to expand public access at every opportunity. Access in habitat areas was seen as desirable, in part because the amount and types of habitat lost to pre-1965 filling and diking and shoreline development were not known at that time, and it was not as clear as it is today just how important the remaining habitats are to endemic and migrating species.

Bay Plan Policies. The Bay Plan public access policies were adopted in 1969 and updated in 1979 (Figure 1 shows a selection of public access findings and policies that address the issue of wildlife protection). At that time, the Commission found that "in some rare cases, certain uses may unduly conflict with accompanying public access. For example, uncontrolled public access may detract from the quality of sensitive wildlife areas…."[7] BCDC amended its Bay Plan public access policy number 1 to require that:

> maximum feasible public access to and along the waterfront and on any permitted fills should be provided in and through every new development in the Bay or on the shoreline…except in cases where public access is clearly inconsistent with the project because of…significant use conflicts.[8]

And policy number 2 to require that:

> Public access to some natural areas should be provided, (e.g., by boardwalks or piers in or adjacent to some sloughs or marshes). However, some wildlife may be sensitive to human intrusion. For this reason, projects in such areas should be carefully evaluated in consultation with appropriate agencies to determine the appropriate location and type of access to be provided.[9]

The recreation policies in the 1969 Bay Plan did provide that "Where open areas include ecological reserves, access via catwalk or other means should be provided for nature study to the extent that such access does not excessively disturb the natural habitat."[10] However, this policy was directed at shoreline parks that were designated as ecological preserves (the National Wildlife Refuge system in the Bay did not exist at this time), and did not provide guidance to BCDC on its permit-related public access decisions.

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[6] BCDC. *Recreation On and Around San Francisco Bay*. Pg. 63
[7] BCDC. *San Francisco Bay Plan.* Pg. 36
[8] BCDC. *San Francisco Bay Plan.* Pg. 36
[9] BCDC. San Francisco Bay Plan. Pg. 36
[10] BCDC. San Francisco Bay Plan. Pg. 34

Although policies in the Bay Plan acknowledged the importance of protecting habitat areas, little was known or understood about the potential impacts of access on wildlife and the issue seldom arose in the discussion of permitted projects. BCDC's development, in partnership with the Department of Fish and Game, and 1976 adoption of the Suisun Marsh Protection Plan and the 1979 amendments to the Bay Plan public access policies pursuant to the preparation of the Public Access Supplement were the Commission's first efforts to address this issue.

Figure 1

San Francisco Bay Plan
Findings and Policies on Public Access and Wildlife Compatibility

Recreation: Findings and Policies Concerning Recreation On and Around the Bay

Policy 5 (a). In shoreside parks… (3) Where shoreline open space includes areas used for hunting waterbirds, public areas for launching rowboats should be provided so long as they do not result in overuse of the hunting area... (5) Where open areas include ecological reserves, access via catwalk or other means should be provided for nature study to the extent that such access does not excessively disturb the natural habitat.

Public Access: Findings and Policies Concerning Public Access to the Bay

Finding g. In some cases, certain uses may unduly conflict with accompanying public access. For example, uncontrolled public access may adversely impact sensitive wildlife areas….

Policy 4. Public access improvements provided as a condition of any approval should be consistent with the project and the physical environment, including protection of natural resources….

Policy 8. Federal, state, regional, and local jurisdictions, special districts, and the Commission should cooperate to provide new public access, especially to link the entire series of shoreline parks and existing public access areas to the extent feasible without additional Bay filling or adversely affecting natural resources….

Suisun Marsh Protection Plan. BCDC adopted the *Suisun Marsh Protection Plan* in 1976, establishing a more detailed management program for the Marsh than is provided for in the McAteer-Petris Act and the *San Francisco Bay Plan*. The relevant policies in the recreation and access section of the *Suisun Marsh Protection Plan*, in part, state that

> Land should…be purchased for public recreation and access to the Marsh for such uses as fishing, boat launching, and nature study. These areas should be located on the outer portions of the Marsh near population centers and easily accessible from existing roads. Improvements for public use should be consistent with protection of wildlife resources.[11]

The policies also state in part, that:

> public access and recreational use should provide for a balance of recreational needs by expanding and diversifying opportunities for activities such as bird watching, picnicking, hiking, and nature study.[12]

[11] BCDC. 1976. *Suisun Marsh Protection Plan*. Pg. 23
[12] BCDC. 1976. *Suisun Marsh Protection Plan*. Pg. 23

And also:

> Recreational activities that could result in adverse impacts on the environmental or aesthetic qualities of the Suisun Marsh should not be permitted. Levels of use should also be monitored to insure that their intensity is compatible with other recreation activities and with protection of the Marsh environment.[13]

Public access policies in the *Suisun Marsh Protection Plan* were the first attempt by BCDC to balance the sometimes competing goals of expanding public access and habitat and wildlife protection.

Public Access Supplement. In 1979, with funding provided by the National Oceanic and Atmospheric Association's Office of Coastal Zone Management, the Commission completed the Public Access Supplement to the Bay Plan that developed several public access policy recommendations for BCDC to consider. The supplement included policy recommendations that were intended to address the potential conflict between public access and sensitive wildlife. BCDC modified its policies to address these potential impacts and stated in the Bay Plan that "the Public Access Supplement… should be used as a guide" for evaluating public access proposals along the San Francisco Bay shoreline. The portions of the Public Access Supplement that address the compatibility of public access and wildlife are included in Figure 2.

Assembly Bill No. 954 (Aroner). Efforts to address the complex issue of public access and wildlife compatibility are ongoing, as witnessed by the recent Assembly Bill No. 954 (Aroner). AB 954 was signed by the Governor in September, 2000 and became effective January 1, 2001. AB 954 revises the McAteer-Petris Act (Section 66632.4 of the Government Code) to add that in areas of sensitive habitat, the Commission, when considering whether a proposed project provides maximum feasible public access consistent with the project:

> shall, after consultation with the Department of Fish and Game, and using the best available scientific evidence, determine whether the access is compatible with wildlife protection in the bay.[14]

Summary. Over the last 30 years, BCDC's policies on public access have evolved from the fundamental goal of public access creation and expansion, to more complex policies that recognize the necessity of balancing development of public access with parallel goals of wildlife and habitat protection and enhancement. BCDC's permitting process has reflected the increasing attempt to balance public access opportunities with wildlife needs (see Appendix C for a review of BCDC permits addressing this issue). Public access is an integral component of development along the shoreline of San Francisco Bay, and may be appropriately planned as part of any project to reflect and conform to the characteristics of a site. In addition, public access can foster important support for protection and enhancement of Bay resources. In the many years since the Bay Plan policies were created, however, available information on the effects of public access on wildlife has increased, concern over this issue has grown, and there is a clear need for more clarification and guidance on the public access and wildlife compatibility issue within BCDC's policies.

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[13] BCDC. 1976. *Suisun Marsh Protection Plan*. Pg. 23

[14] Assembly Bill No. 954. Chapter 498. *An act to amend Section 66632.4 of the Government Code, relating to public resources.*

Figure 2

BCDC Public Access Supplement
Excerpts Regarding Public Access and Wildlife Compatibility

1. "The abundant natural resources of the Bay both enhance and constrain public access to and along the shoreline. The occurrence of resources such as stands of native trees, rock outcrops, or flocks of shorebirds enhance the public access experience. However, some natural areas, particularly wildlife habitats, are fragile, in some cases too fragile to withstand human intrusion. Also, natural factors such as steep slopes or high cliffs can pose a serious safety hazard to the public (page 6)."
2. "Public access to natural areas around the Bay is highly desirable, but should be subject to the following special considerations, especially in rural and undeveloped areas:
    a. Because of potential conflicts with wildlife uses, public access to tidal marshes, managed wetlands, and sensitive habitat areas should` be provided only where the access can be controlled and managed, preferably by an appropriate public agency or non-profit organization. To assist in this management, additional in-depth studies are needed to evaluate the impact of public access on these areas. Until such studies are complete, access should only be provided where it can be shown in advance, through an environmental assessment or environmental impact report, that the habitat will not be adversely affected.
    b. In order to provide for appropriate public access to tidal marshes, managed wetlands, and other sensitive habitat areas, all agencies involved with the acquisition or management of these areas for public use should allocate sufficient funding for the construction and continuing maintenance of adequate public-use facilities that would safeguard the natural character of the area and are consistent with the protection and maintenance of the natural resources of the area.
    c. Any access to the margins of marshes and managed wetlands, particularly in isolated areas, should generally be restricted to 'point' rather than 'continuous' access, e.g., access to a point or points on the shoreline rather than continuous access along it, in order to mitigate the adverse impact of human intrusion on wildlife resources, especially the more timid species. Shoreline in this case means the marsh-upland interface, not the marsh-Bay (open water) edge. In some cases, such as for educational purposes or to avoid solid fill in a marsh, a boardwalk over a portion of a marsh may be appropriate.
    d. Some habitats (such as harbor seal hauling grounds, and certain nesting sites and hunting areas) may only be suitable for access seasonally when not being used by wildlife or hunters (page 7-8)."
3. "In some cases, project uses, environmental constraints, or uses on adjacent areas may conflict with the goal of providing maximum feasible public access. Examples include sensitive wildlife areas where uncontrolled public intrusion may significantly decrease the wildlife values...(page 62)."
4. "The Bay Plan Policies on Public Access should be amended to provide for those rare situations where public access at the location of a specific project may be difficult or impossible to achieve because of possible jeopardy to wildlife values or to the safety of public access users (page 63)."
5. "Uses in or Adjacent to Marshes, Mudflats, Salt Ponds, Agricultural Areas, Wildlife Areas or Wetlands in Typically Non-Urban Areas:
    a. Develop or provide public access in these areas, if appropriate, only in a way that respects and enhances the natural values.
    b. Provide point access (e.g. spur trails) or view areas rather than continuous shoreline paths. Provide controls to protect wildlife resources or other features from any access into these areas.
    c. Provide minimal improvements such as trash containers and signs which identify the area and interpret the resources.
    d. Encourage supervised interpretive use of sensitive resource areas (page 66)."
6. "Provide for observation and interpretation of wildlife where appropriate (page 70)."
7. "Locate and design public access so as to be consistent with the protection of fish and wildlife habitat (page 70)."

CHAPTER 2

BIOLOGICAL EFFECTS OF PUBLIC ACCESS ON WILDLIFE

The following chapter provides information on what is currently known regarding the potential biological effects of public access on wildlife. Prior to a review of published scientific field studies, a conceptual framework for understanding potential interactions between humans and wildlife is provided. In addition, a complete bibliography for this chapter is provided in Appendix D.

Conceptual Framework. Human activities in areas of wildlife habitat can be generally grouped into two categories: consumptive and non-consumptive. Consumptive activities are those that directly remove wildlife such as hunting and fishing. Non-consumptive activities, such as observing and photographing wildlife, or recreating near wildlife, do not. Although adverse effects from non-consumptive activities have traditionally been considered harmless to wildlife, this point of view has been changing.[15] Boyle and Samson[16] reviewed 166 articles on the effects of non-consumptive recreational uses on wildlife and found that the majority of the articles reported negative effects on wildlife from non-consumptive recreational uses. For example, a significant adverse effect on wildlife may occur in "non-consumptive" recreation activities when recreationists unintentionally or intentionally produce stressful situations for wildlife. These situations may last for an extended period of time if instigator is taking pictures or observing the wildlife.[17]

The relevant literature distinguishes between short-term and long-term effects on wildlife. Most studies in the past have focused on immediate reactions of wildlife to human activities such as nest abandonment or alarm calling, and have tended not to look at long-term effects, such as decreased reproduction or changes in species compositions.[18] A second distinction has been made between direct effects (such as harassment or harvest) and indirect effects. Indirect effects includes habitat modification such as vegetation trampling, destruction of nesting areas, introduction of exotic plant species, habitat fragmentation, and creation of access for non-indigenous predators. Both direct and indirect adverse effects can lead to alteration of behavior, displacement and a change in the reproduction level of a species.[19] Consequently, species composition and structure among wildlife populations may be altered.[20] Figure 3 shows one example

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[15] Flather, C. H. and H.K. Cordell. 1995. Outdoor Recreation: Historical and Anticipated Trends. In R. Knight and k. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence through Management and Research*. Island Press, Washington, D.C.

[16] Boyle, S. A. and F.B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: A review. *Wildl. Soc. Bull.* 13:110-116.

[17] Cole, David N, and Richard L. Knight. 1991. Wildlife Preservation and Recreational Use: Conflicting Goals of Wildland Management. *Transactions of the 56th North American Wildlife and Natural Resources Conference*; and Vaske, Jerry J., Alan R. Graefe and Fred R. Kuss. 1987. Recreation Impacts: A Synthesis of Ecological and Social Research. *Transactions of the 48th North American Wildlife Conference*.

[18] Knight, R. L. and D. N. Cole. 1995. Factors that Influence Wildlife Responses to Recreationists. In R. Knight and K. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence through Management and Research*. Island Press, Washington, D.C..

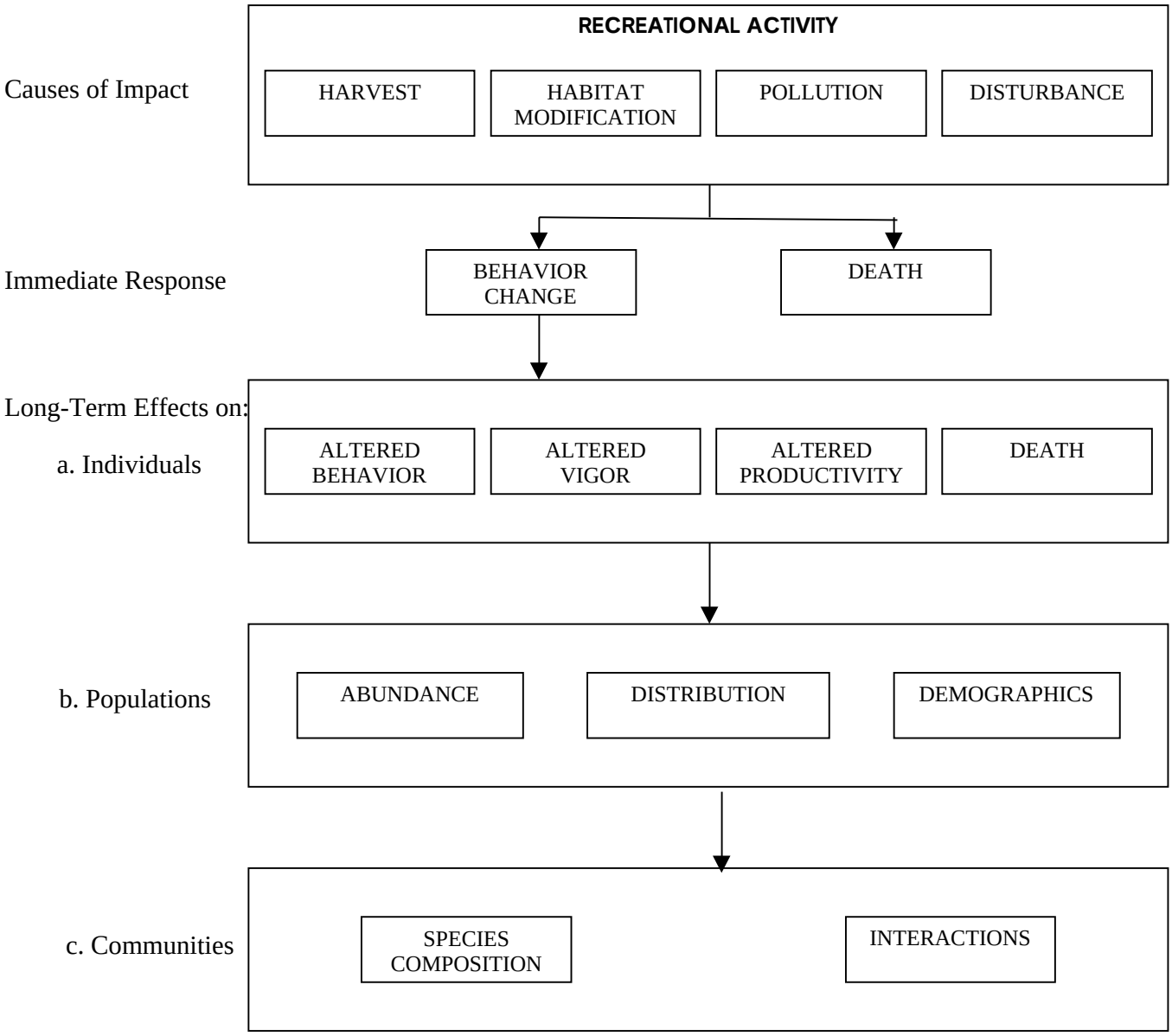
[19] Hammitt, William E. and David N. Cole. 1998. *Wildland and Recreation: Ecology and Management.* John Wiley and Sons, Inc. New York, NY.

[20] Anderson, Stanley H.. 1995. Recreational Disturbance and Wildlife Populations. In R. Knight and K. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press,Washington, D.C.

from the literature of a conceptual framework for potential adverse effects of recreation on wildlife. Figure 3 shows only the potential *adverse* effects of the human and wildlife interaction, though there may be other neutral or even positive effects of recreation that are not indicated.

Figure 3

A Conceptual Framework for Potential Adverse Effects of Recreation on Wildlife[21]



[21] Adapted from Cole and Knight, 1991.

Different disturbances have different effects on different species, which means effects are "context dependent."[22] The characteristics of the disturbance can be broken down into six categories: type of activity, recreationists' behavior, predictability, frequency and magnitude, timing, and location. Furthermore, the characteristics of wildlife can be grouped into three categories: type of animal, group size, and age and sex.[23]

There are also varying responses of wildlife when exposed to regular disturbance, and categorization of types responses may help determine the type of effect a disturbance may result in. Knight and Temple,[24] for example, grouped responses of wildlife to human interaction into three categories: attraction, avoidance, and habituation.

Attraction behavior is associated with interactions with humans that result in rewards (i.e., food). Attraction of wildlife to humans can be harmful for both humans and wildlife (e.g., bear / human interactions that may result in injury or death to both humans and bears). Furthermore, wildlife dependence upon humans for the reward (food) may result in a dependence upon humans and in the absence of humans, may affect survival.

Avoidance behavior is associated with interactions with humans that result in pain or penalty for the wildlife (e.g., hunting). Avoidance behavior also includes panic-type avoidance responses as a result of abrupt, fearful or unexpected intrusion. Avoidance behavior can result in altered resting, foraging and nesting patterns.

Habituation behavior is described as a decline in the reaction of wildlife to human activity that is not associated with either punishment or reward. There is evidence that wildlife may adapt to predictable nonthreatening actions of humans.[25] However, not all species or individuals in a population adapt equally well.[26] Furthermore, adaptation may increase the vulnerability of wildlife to harmful human activities and may result in mortality (vehicle collisions, poaching, etc.).

Historically, there have been difficulties with the research and data collected on the effect of human activities on wildlife. Identifying human effects on wildlife is challenging for many reasons including: 1) baseline data for comparison are often missing; 2) there may be delays in time between activities and effects, as well as separations in space between activities and effects; 3) it is difficult to distinguish between natural variability and human-induced variability (or difficult to isolate individual factors that may be causing adverse effects – many studies simply report observations of an increase in human visitation and a potentially coincident change in productivity or population size

[22] Gutzwiller, Kevin J. 1995. Recreational Disturbance and Wildlife Communities. In R. Knight and K. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press,Washington, D.C.
[23] Knight and Cole, 1995; Hammitt and Cole, 1998.
[24] Knight, Richard L., and Stanley Temple. 1995. Origin of Wildlife Responses to Recreationists. In R. Knight and K. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C.
[25] Knight and Temple, 1995.
[26] Olliff, T.K. Legg, and B. Kaeding, editors. 1999. *Effects of winter recreation on wildlife of the Greater Yellowstone Area: A literature review and assessment*. Report to the Greater Yellowstone Coordinating Committee. Yellowstone National Park, Wyoming.

or distribution of wildlife[27]); and 4) the potential ability of wildlife to adapt to human disturbance is poorly understood.[28]

Over the years, however, there have been several field studies completed on the effects of human activities on wildlife.

Bay Trail Project Literature Review. In 1996 independent scientific consultants to the Bay Trail Project undertook an extensive literature search for material that addressed public trail-related impacts on wildlife, in preparation for a scientific field study.[29]

Out of hundreds of abstracts that were reviewed by consultants to the Bay Trail Project, only 25 were found that specifically addressed the topic of human disturbance impacts on wildlife. Moreover, only 8 of those 25 were field studies that directly assessed impacts of trails on wildlife.

The conclusions drawn from these studies were varied, though the 8 field studies all showed some adverse impact on wildlife from trail activity. The most common responses reported were animals moving away in response to human activity, and changes in species diversity and abundance near trails. Figure 4 shows a summary of the results of the eight studies specific to trails (Appendix D contains a complete list of references for this chapter). Six of the studies reported immediate effects on animal behavior, such as moving away from the trail when users approached the study site. For example, two studies[30] noted that photographers had the most negative effect on birds near trails, compared to walkers, joggers and vehicles. Another study[31] reported that shorebirds were disturbed by direct approaches on the beach and joggers on a path next to the beach, though there was no disturbance reported by walkers on the path and horseback riders on the beach. Several other studies found reproductive and long-term responses. One study[32] observed that people walking through colonies of nesting brown pelicans caused nest abandonment, chick mortality, and reduced reproductive success. In addition, another study[33] found lower nest densities and changes in bird species composition at sites near trails versus far from trails. One long term study on wood turtles[34] found that the turtle population in a public area declined to extinction in nine years. Only one study was done in the San Francisco Bay Area.[35] The study looked at the amount of human disturbance at four wetland sites and found that as human

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[27] Carney, K. M. and W.J. Sydeman. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds. 1999. 22(1): 68-79.

[28] Cole and Knight, 1991; Knight and Cole, 1995; and Vaske, et al. 1987.

[29] Sokale, Jana and Lynne Trulio. 1996. *San Francisco Bay Trail Project Wildlife and Public Access Study Site Selection Report.* Prepared for the San Francisco Bay Trail Project.

[30] Burger, J. and M. Gochfeld. 1993. Tourism and short-term behavioral responses of nesting masked, red-footed and blue-footed boobies in the Galapagos. Environmental Conservation 20:255-259; Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildl. Soc. Bull. 21:31-39.

[31] Burger, J. 1981. The effect of human activity on birds at a coastal bay. Biological Conservation 21:231-241.

[32] Anderson, D. and J. Keith. 1980. The human influence on seabird nesting success: conservation implications. Biological Conservation 18:65-80.

[33] Burger and Gochfeld, 1993.

[34] Garber, S. and J. Burger. 1995. A 20-year study documenting the relationship between turtle decline and human recreation. Ecological Applications 5:1151-1162.

[35] Josselyn, M., M. Martindale, and J. Duffield. 1989. Public Access and Wetlands: Impacts of Recreational Use. Technical Report #9. Romberg Tiburon Center, Center for Environmental Studies, San Francisco State University, Tiburon, California.

disturbance at a site increased the number of birds decreased. The study did not compare the study sites to control sites.

Figure 4.

Specific Impacts of Trails on Wildlife from the Selected Bibliography[36]

Study	Species	Disturbance	Effects on Species
Anderson and Keith, 1980	Brown pelicans, Hermann's gulls	Passive and active	· Flight · Nest abandonment · Increased chick mortality · Reduction in breeding birds
Burger, 1981	Shorebird, Waterfowl, and Water bird spp.	Passive, active jogging, horseback	· Always disturbed by any approach on beach and joggers on paths · No disturbance by walkers on paths or horseback riders on beach · Species, distance, type of impact affected response
Burger and Gochfeld, 1993	Booby spp.	Passive and active	· Move or fly away · Lower nest density near trails · Biggest impacts from noise and photos
Garber and Burger, 1995	North American wood turtle	Passive and active	· Extirpation of the population in 9 years
Hickman, 1990	Forest bird spp.	Passive and active	· Change in species composition near trail
Josselyn, et al., 1989	Shorebird, Waterfowl, and Water bird spp.	Passive and active	· Change in species composition near trail
Klein, 1993	Shorebird, Waterfowl, and Water bird spp.	Passive, active and vehicles	· Move/fly away; increased alarm calling · On-foot approach more disruptive than vehicles; photographers the most disruptive
Mainini, et al., 1993	Alpine marmots	Passive, active and dogs	· Run away · Biggest impact from dogs

Additional Field Studies on the Effects of Human Disturbance on Birds. In a further search of peer-reviewed scientific journals, several additional applicable studies, not cited in the literature review conducted by consultants to the Bay Trail, were identified. The additional studies cover the more general topic of human disturbance on wildlife (not limited specifically to trail related effects). However, given the focus on protecting avian species in the San Francisco Bay Area, the additional identified field studies are limited to the effects of human disturbance on birds, particularly in shoreline environments.[37]

[36] Sokale and Trulio. 1996.

[37] For a more general bibliography of studies on the effects of recreational activities on wildlife (including effects from off-highway vehicles, snowmobiles, and inland hiking activities) there is the extensive Trails and Wildlife Bibliography, available from Colorado State Parks, 1313 Sherman Street, Room 618, Denver, CO 80203.

The following provides an annotated bibliography of the additional identified field studies.

- Anderson, D.W. 1988. Dose-response relationship between human disturbance and Brown Pelican breeding success. Wildl. Soc. Bull. 16:339-345.

  In a pelican colony on islands in Mexico, both a threshold value and a direct relationship between nest abandonment and nearness to human activities were observed. In an undisturbed colony, pelican productivity averaged 2.5 times higher than at the disturbed colony site. Brown Pelicans were disturbed by human intrusion at about 600 meters.

- Burger, J. 1994. The effect of human disturbance, behavior, and habitat use in piping plover. Estuaries 17(3):695-701.

  In a study of habitat use and foraging behavior at three coastal locations in New Jersey, the plovers selected sites that contain fewer people. The time devoted to vigilance rather than foraging was directly related to the number of people near them, and to the overall human use of that habitat. In habitats with few people, the plovers can spend 90% of their foraging time actively searching for prey and feeding, whereas on beaches with many people they may spend less than 50% of their foraging time in direct feeding behaviors. A diversity of habitats allows the birds to move between habitats to minimize interactions with people and thus maximize the time devoted to foraging.

- Burger, J., M. Gochfeld and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: contrasting responses of birds, tourists, and managers. Environmental Conservation 22:56-65.

  Several case studies were conducted in coastal New Jersey and New York on the effects of ecotourists on birds. Least Tern colonies undergoing visits from many ecotourists generally had lower nesting rates and lower reproductive success than colonies with other types of disturbance (e.g. swimmers and industrial activity) or than those with no human disturbance. As the number of people increased, foraging Piping Plovers spent more time devoted to vigilance rather than foraging. Migrant gulls and shorebirds responded to people by moving farther from paths when there are people present, thereby losing access to certain foraging areas. Shorebirds responded to people by flying from their approach, and ultimately abandoning beaches where they had been repeatedly disturbed. Migrant hawks avoided areas of high human use. Careful management of human use provided suitable foraging area for the hawks while still allowing for bird watching.

- Erwin, M.R. 1980. Breeding habitat use by colonially nesting waterbirds in two mid-atlantic U.S. regions under different regimes of human disturbance. Biological Conservation 18:39-57.

  A comparison of habitat use of beach-nesting seabirds in an urbanized area of coastal New Jersey with a more pristine area of coastal Virginia. Seabirds almost exclusively nested on the barrier islands (supporting virtually no recreational use) of Virginia, but where the barrier islands support high levels of recreational

activity (including vehicle access) in New Jersey, the majority of seabirds nested instead on dredge deposition sites or natural marsh islands.

- Hand, J.L. 1980. Human disturbance in Western Gull colonies and possible amplification by intraspecific predation. Biological Conservation 18:59-63.

  The study of various colonies of beach-nesting western gull in the Gulf of California concluded that human disturbance (walking, camping) caused nesting gulls to temporarily abandon nest sites, leaving eggs or chicks vulnerable to potentially lethal sun exposure. Breeding adult gulls that lose their eggs or chicks (due to nest abandonment or from direct egg collection by humans) may increase rates of predation on eggs or chicks of other breeding adult gulls, thus potentially increasing effects of human intrusions.

- Holmes, Tamara L., Richard Knight, Libby Stegall, and Gerald Craig. 1993. Responses of wintering grassland raptors to human disturbance. Wildl. Soc. Bull. 21:461-468.

  Recorded flushing responses and flush distances of wintering grassland raptors disturbed by pedestrians or vehicles in Colorado. Walking disturbances resulted in more flushes than vehicle disturbances for all species studied except prairie falcons. For walking disturbances, a linear relationship existed between flight distance and body mass, with lighter species flushing at shorter distances. However this trend did not hold for vehicle disturbances.

- Klein, M. L., S.R. Humphrey and H.F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9:1454-1465.

  Study of displacement of 38 species of waterbirds by specific human activities on a wildlife drive (with both pedestrian and vehicle use) at a wildlife refuge in Florida. Human visitors disturbed about half of the 38 species, and avoided foraging areas near the wildlife drive. Resident species were less sensitive to disturbance than migrant species. Migrant ducks were more sensitive to disturbance when they first arrived at the site than later in the season. Herons, egrets, Brown Pelicans, and Anhingas were the least sensitive to human disturbance, and did not generally avoid the roadway. Shorebirds were displaced at varying distance and visitation levels. Although pedestrians were more disruptive than vehicles, the *volume* of pedestrian or vehicle traffic was the most important variable. The displacement of waterbirds from human activities resulted in an absence of birds from large areas of the refuge. Managing the levels, times and types of visitor use, and public education were suggested management measures.

- Kury, C.R. and M. Gochfield. 1975. Human interference and gull predation in comorant colonies. Biological Conservation 8:23-34.

  Interactions between gulls and comorants were studied in the United States (Maine) and Argentina (Chubut). Although comorants appear to generally avoid predation by gulls in the absence of human disturbance, with human intrusion into breeding colonies of comorants and resulting temporary nest abandonment, gull predation of cormorant eggs and nestlings greatly increased. Management of human access was suggested to prevent comorant nest abandonment.

- Levenson, Howard and James R. Koplin. 1984. Effects of human activity on productivity of nesting ospreys. Journal of Wildlife Management 48(4):1374-1377.

  Study on the effects of human activity on the productivity of nesting ospreys in northwestern California. After ospreys began nesting, a substantial increase in human activity (e.g. logging) after incubation begins had a significant adverse effect upon productivity (due to decreased egg hatching success and nest abandonment). Productivity did not differ significantly between nests where there was no or minimal disturbance (occasional hiking) during the study, and nests where there was relatively constant disturbance (hiking, picnicking, nonmotorized recreation) during the study. Results indicated ospreys nesting near human habituation, or initiating nesting while human activity is ongoing may be more tolerant of human activity.

- Miller, Scott G., Richard L. Knight, and Clinton K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8(1):162-169.

  Investigated the effect of trails on breeding bird communities in forest and mixed-grass prairie ecosystems in Colorado. Bird species composition was altered adjacent to trails in both ecosystems. Generalist species were more abundant near trails, whereas specialist species were less common. Within the grassland ecosystem, birds were less likely to nest near trails. Within both ecosystems, nest predation was greater near trails.

- Riffell, S.K., K.J. Gutzwiller, and S.H. Anderson. 1996. Does repeated human intrusion cause cumulative declines in avian richness and abundance? Ecological Applications 6(2):492-505.

  Study on whether or not cumulative impacts occurred in Wyoming bird communities as a result of repeated intrusion by solitary hikers. Relative richness and abundance for the set of common species were the only metrices to exhibit significant declines between years during the 5-year period. The declines in the variables, however, were not cumulative. The study suggested the yearly effects detected for some richness and abundance variables may not have led to cumulative declines because individuals displaced one year may have been replaced in subsequent years, and some individuals each year may have habituated to or learned to tolerate the intrusions.

- Robert, H.C. and C.J. Ralph. 1975. Effects of human disturbance on the breeding success of gulls. Condor 77:495-499.

  Study of the effects of human disturbance (walking) on a colony of gulls on Southeast Farrallon Island, California found a correlation between hatching failure and level of human disturbance. In addition, young gulls that were more frequently disturbed were more habituated to human disturbance whereas young gulls that were less frequently disturbed reacted to human disturbance by running into other gull territories where they were sometimes attacked by adult gulls. However, overall mortality was greater for the more disturbed colonies.

- Rodgers, J.A. and H.T. Smith. 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. Conservation Biology 9:89-99.

  Nesting colonial waterbirds in Florida were studied to determine recommended set-back distances for protecting mixed-species assemblages of birds from various types of human disturbances. Flushing distance variation both within and between species was observed for the same type of human disturbance. Great Blue Herons and Great Egrets were more sensitive to disturbance than Brown Pelicans and Wood Storks. In general, flushing distances were greater for a walking approach as compared to a motor boat approach. Both increased tolerance to disturbance (Cattle Egrets, Laughing Gulls) and increased sensitivity to disturbance (Black Skimmers) were observed. A general buffer of 100 meters for wading bird colonies and 180 meters for mixed tern / skimmer colonies was recommended.

- Steidl, R.J., and R.G. Anthony. 2000. Experimental effects of human activities on breeding bald eagles. Ecological Applications 10(1):258-268.

  Study on the effects of human activity on breeding behavior of bald eagles in interior Alaska. Activity budgets of breeding eagles changed considerably when humans were camped for 24 hours at a distance of 100 meters from nests compared to when they were camped 500 meters from nests. Within humans near nests, adult eagles decreased the time they preened, slept, maintained nests, and fed themselves and their nestlings, and increased the time they brooded nestlings. Further, overall activity (total number of behaviors performed by adults at nests per day) decreased with humans near nests, as did the amount of prey adults consumed and fed to nestlings. In contrast, nest attendance did not change with humans near nests; however, the time adults were absent from the nest area increased with humans near nests. Throughout the 24 hour observation period, eagle responses to nearby humans diminished, suggesting that eagles habituated to the disturbance. During the last 4 hours, however, adults still vocalized twice as frequently as controls, indicating continued agitation.

- Yalden, D. W. 1992. The influence of recreational disturbance on common sandpipers Actitus hypoleucos breeding by an upland reservoir, in England. Biological Conservation 61:41-49.

  Study on common sandpipers in England. Results indicated that as long as there was adequate free space for the birds to fly to and feed, recreational disturbance was not a serious problem. However, the study suggested sandpipers may avoid setting up territories in heavily disturbed areas that provide inadequate space for retreat, resulting in smaller populations with more space for the survivors.

San Francisco Bay Trail Project: Wildlife and Public Access Study. The San Francisco Bay Trail Project is currently conducting a scientific investigation of the potential effects of non-motorized, recreational trails on shorebirds and waterfowl that use mudflat foraging habitat adjacent to the San Francisco Bay Trail. The specific objectives of the study are to assess the potential effects of human trail use on the diversity, abundance and behavior of shorebirds and waterfowl in the San Francisco Bay. Principal investigators Jana Sokale and Lynne Trulio summarized some of the preliminary, unpublished results of the first year of the Public Access and Wildlife Study in presentations to the

Bay Conservation and Development Commission Policy Advisory Committee and to the National Trails Conference in September 2000. Findings based on very early analyses indicate:

1. The study is functioning as designed and will allow for complete analyses of the research questions.
2. These preliminary results showed no general relationship between human use of trails and bird abundance or diversity in foraging habitats at the three locations studied in the San Francisco Bay Area.
3. The lack of pattern exemplified by the trail versus control findings suggests that habitat quality may be a more important determinant of bird use than human trail use.

A number of caveats must be considered when interpreting the preliminary results of this study. To date, the conclusions apply only to overall species abundance and diversity as compiled over 48 days of 4-hour observation periods. Many other measures of abundance and diversity exist and will be used in future comparisons. Relationships relative to species-specific effects, daily effects or seasonal effects have not yet been explored in the data set. The study examines impacts to birds in their foraging habitat. Potential effects of trail use on species abundance and diversity adjacent to breeding habitat are not a part of the study.

In addition, it should be noted that these results were collected under specific conditions and may apply only to sites with similar conditions. For example, trails were within 30 feet of the mudflat and motorized vehicles were not allowed at these sites. Changes in these conditions could produce different results. It is also important to realize that both the trail and the control sites in this study were adjacent to levees and all of these sites have been altered in other ways from their natural condition. All three locations exist in the highly developed and urbanized San Francisco Bay Area. As a result, the species composition and, very likely the behavior, of birds has changed since Europeans arrived. The goal of the study is to determine whether, under existing conditions, trails are having a significant impact on bird abundance, diversity and behavior.

Many more analyses are needed to evaluate a variety of relationships that may exist between human trail use, bird use, bird behavior, seasonal variations and daily variations. Statistical and qualitative analyses are needed to consider potential effects of trail use on particular species of birds and / or classes of birds (such as migratory versus resident species). Based on the interest in the study, data collection for the Public Access and Wildlife Study has been extended for a second year. The second year of the study began on October 1, 2000 and will continue through September 30, 2001. The same study design and protocols are employed for the second year of data collection. The locations of the control quads have been changed to provide additional data that will add significantly to the statistical power and confidence of the results. The second year of data will also allow for the analysis of more subtle factors affecting bird use.

Summary. There are clearly many unknowns surrounding the possible effects of public access on wildlife. Relatively few field studies exist specific to the topic, and the only two studies that have been undertaken in the San Francisco Bay area have initially produced differing results (though the studies are different in their design). Josselyn

and Martindale's study[38] found that among their four study sites, the wetlands with the highest degree of human use had the least amount of bird use. The initial analyses on the first year of the Bay Trail sponsored Wildlife and Public Access Study show no significant relationship between human use of trails and bird abundance or diversity when their three study sites were compared to control sites.

The continuation of the Bay Trail sponsored research will help increase the current state of knowledge, but there is still a need for more, well-designed, scientific studies of effects of human activities on wildlife, both on a local scale in the San Francisco Bay Area, and on a national scale in similar habitats with similar recreational uses. Specifically:

- There is much to learn on the relationship between disturbance frequency and intensity, and wildlife impacts;
- The potential ability for certain species to become adapted to some degree of human interaction is a poorly understood though important factor;
- Baseline data are needed both for comparison purposes and to help isolate disturbance factors (i.e., recreation caused disturbance versus other factors such as poor water quality or natural variability)[39], and;
- There is a need for scientific data regarding the effectiveness of specific design and management strategies to avoid or reduce adverse effects of human activities on wildlife.

Furthermore, although progress has been made over the years in understanding the effects of human disturbance on wildlife, some have expressed the concern that there may be a tendency of scientists and journals to publish only studies that find significant adverse effects from human interactions with wildlife, and that there may be unpublished studies that find no effect.[40]

Based on the studies available, however, there is clearly evidence that public access may have adverse effects on wildlife. Adverse effects on wildlife from human activities may include both direct (such as harassment or harvest) and indirect (such as habitat modification), and effects can be both immediate and long term. Immediate effects may include nest abandonment (which may increase risk of predation of eggs or young), flushing and increased stress, which can lead to reduced feeding or site abandonment. Long-term effects may include decreased reproductive success, decreased population size within species, or decreased number of total species. As more scientific data are produced, managers can continue to expand and refine management strategies to avoid or minimize potential adverse effects of public access.

[38] Josselyn, et al. 1989.
[39] For example, no studies at all were found that compare an area before allowing public access with that same area after allowing public access.
[40] Carney and Sydeman, 1999.

CHAPTER 3

DESIGN AND MANAGEMENT STRATEGIES TO AVOID OR REDUCE ADVERSE EFFECTS OF PUBLIC ACCESS ON WILDLIFE

It is clear that there are gaps in our scientific knowledge on specific effects of public access on wildlife. However, the potential for adverse effects is apparent, and as more scientific information is generated, many managers will choose to use precaution and design and manage public access to avoid or minimize potential adverse effects to wildlife.

Furthermore, though better science is obviously needed in order to make better informed decisions about management of public access, science alone will not dictate the existence or design of public access. Rather, science is part of a larger framework that also includes public values and benefits, laws and regulations, and overall management objectives of specific areas. Within this larger public policy framework, some sites may be managed to preclude or severely limit public access, while at other sites a variety of uses may be allowed and actively managed to find a balance between resource preservation, education, recreation, and low-impact transportation use. It is within this larger management framework that managers are striving to find the optimal balance between use and protection, and where specific design and management strategies can be employed to avoid or minimize potential impact.

History and Trends. The issue of how to balance protection and use has historically been discussed in the field of park and wilderness management. The United States National Park System, for example, has the dual management objectives of preserving natural resources while providing for high quality recreational and public access opportunities. As visitation to the U.S. National Park system greatly increased, so did concern over how to manage these potentially conflicting goals. The National Park System initially focused its management efforts on the theory of "carrying capacity," a concept adopted from the field of ecology which refers to the number of individuals of any one species that a particular habitat can support. This concept was applied by the Park System in the 1960s as a way of formulating management objectives based on the number of visitors a particular park could support in a given time frame (per day, per season, etc.), in terms of the impacts on park resources.[41] Over the years, the concept of carrying capacity has broadened to include the social aspects of the visitor experience (i.e., how user numbers affect the personal experience of visitors in terms of overcrowding). More recently, the concept is expanding from that of a visitor *numbers* only to include *type* of visitor use. Carrying capacity is now defined by the National Parks as "the type and level of visitor use that can be accommodated while sustaining acceptable resource and social conditions that complement the purpose of a park."[42]

The concept of carrying capacity as applied to park management has led to another management construct, called "limits of acceptable change" or LAC. The notion behind LAC is that despite the attempt to establish carrying capacities for individual areas, given the demand for public use of parks some degree of impact or change is inevitable,

[41] U.S. Department of the Interior. 1997. The Visitor Experience and Resource Protection (VERP) Framework: A Handbook for Planners and Managers. National Park Service. Denver Service Center.
[42] U.S. Department of the Interior, 1997.

and furthermore, that limiting use is just one management tool of many to address impact and may not even be the most effective.[43] The question of how much change is too much is determined by inherently subjective standards (informed by science) and is addressed by establishing limits of acceptable change. The limits are based on a description of the desired future condition, and contain the identification of indicators of quality, the formulation of monitoring techniques, and the development of specific management actions to ensure the limit of acceptable change is not exceeded.[44]

On a smaller, more local, scale, there is a burgeoning body of literature on public access siting and design that addresses or identifies ways to minimize human use effects on wildlife. Again, the majority of this work focuses on strategies for inland, forested habitats, but some information can be adapted to the coastal environment. For example, the State of Colorado has undertaken considerable work on trail siting and design and has prepared an extensive bibliography,[45] as well as a unique and extremely useful handbook for public access managers.[46] The Waterfront Regeneration Trust in Canada has produced a similar, though less extensive, publication generated from their personal experience with the Waterfront Trail located on the north shore of Lake Ontario.[47]

For coastal states, the public access and wildlife compatibility topic is fast becoming a very important management issue as the states work to actively encourage public access to their shorelines while also protecting natural resources. In a recent assessment by the National Oceanic and Atmospheric Administration, "State Enhancement Grant Assessments and Strategies: Public Access,"[48] eight coastal states (including California) cited wildlife and public access compatibility issues as an area of concern. Oregon, for example, has developed a Rocky Shores Management Strategy which, in part, addresses the impact of public access on rocky shore habitat.

In the Chesapeake Bay region, several initiatives to address public access and wildlife compatibility issues are underway. For example, the Virginia Ecotourism Association offers a voluntary eco-tour certification program for Virginia's coastal areas that aims to protect natural resources while encouraging the growth of Virginia's tourism industry.[49] In addition, the Hampton Roads Planning District Commission in Virginia, in partnership with several local, state and federal agencies, and other interested parties, is developing a memorandum of agreement to address conflicts between watercraft and impacts generated by watercraft (including impacts on sensitive wildlife). The intention of the MOA is to generate a voluntary water-zoning system that would

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[43] Hammitt and Cole, 1998.
[44] U.S. Department of the Interior, 1997.
[45] Colorado State Parks. 1999. *Trails and Wildlife Bibliography*. Denver, Colorado.
[46] Colorado State Parks and Hellman Associates. 1998. *Planning Trails with Wildlife in Mind: A Handbook for Trail Planners*. Denver, Colorado.
[47] Reid, Ron. 1997. *The Waterfront Trail and Wildlife Habitat Protection.* Prepared for the Waterfront Regeneration Trust, Toronto, Canada.
[48] National Oceanic and Atmospheric Administration. 1999. *State Enhancement Grant Assessments and Strategies: Public Access.* Office of Ocean and Coastal Resource Management, Coastal Programs Division. NOS/OCRM/CDP 99-04.
[49] Virginia Department of Environmental Quality. Ecotourism Certification page. Online. Available: <http://www.deq.state.va.us/coastal/ecotour.html>. 10 October 1999.

identify certain areas for certain types of craft (e.g., non-motorized craft use only in smaller, narrower tributaries).[50]

The Maryland Department of Natural Resources has created design guidelines for trails in specific areas that meet the Critical Area Act, which encourages public access to the shoreline while protecting sensitive habitats. The design guidelines provide recommendations to local officials, planners, consultants, and contractors on how public walkways in the Critical Area can most effectively meet the goals and requirements of the State and local programs. A 100-foot buffer is designated for sensitive areas in Maryland. Public walkways are encouraged to be designed outside of the buffer (or in "Buffer Exemption Areas") where possible; access within the buffer areas is permitted "at intervals" to "provide opportunities for education and access to the water." Mitigation for public walkways in buffer areas is encouraged even in Buffer Exemption Areas, at a 2:1 or 3:1 ratio depending on the location of the walkway.[51]

It is expected that more initiatives addressing the issue of public access and wildlife compatibility will continue to emerge from various resource and regulatory agencies, as well as non-profit organizations and private parties. The sharing of knowledge and personal experiences among those faced with this issue will continue to play an important role as the demands for both public access and resource protection continue to increase in both inland and coastal environments.

Public Access and Wildlife Compatibility Survey. Though the scientific literature on this issue is relatively sparse and provides little, if any, conclusive guidance, managers all over the world are employing various siting, design and management strategies in an effort to avoid or minimize potential adverse effects of public access on wildlife. In an effort to gain more knowledge on the use of design and management strategies, BCDC staff (with assistance from the Policy Advisory Committee) conducted a survey of land managers from coastal and Great Lake states nationwide. The goals of the survey were to gather further observational information on recreational effects on wildlife, and to document on-site experiences with specific design and management strategies and how those strategies have or have not been an effective tool in avoiding or reducing adverse effects on wildlife from human activities.

The survey was mailed to 362 land managers from coastal and Great Lake states around the country. The selected participants manage local, state and federal reserves, parks, refuges, open spaces, recreation areas, and wildlife management areas. The sites managed by survey participants contain sensitive habitat areas, such as wetlands or sandy beach, and allow public access for recreational activities.

Significant interest in this topic nationwide and a vigorous follow up effort resulted in 157 surveys returned, for an excellent response rate of 43 percent. Responses to the survey were tabulated, where possible. Many of the survey questions were open-ended and generated a variety of qualitative responses. Responses to open-ended questions were reviewed, categorized, and summarized to the greatest extent possible. Answers have not been correlated or queried for causal relationships. Not all respondents answered all questions. Please refer to Appendix E for the full report of the survey results.

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[50] Eric Walberg, Hampton Roads Planning District Commission, personal communication 1999.
[51] Maryland Department of Natural Resources. Critical Area Commission Page. Online. Available: <http://www.dnr.state.md.us/critical area/>. 10 October 1999.

The survey documented on-site experiences with specific design and management strategies and how those strategies have or have not been an effective tool in avoiding or reducing impact on wildlife from human activities.

An extremely high response rate to the survey, wide national distribution of respondents, and the large number of respondents with a high level of responsibility indicates a strong nationwide interest and high degree of importance assigned to the access and wildlife compatibility topic. Varied size and make up of sites contributed to a wide distribution of data on access and wildlife compatibility. Respondents had varying backgrounds (scientific, managerial, etc.), employed a wide variety of observational techniques (formal and informal) and were responding for a wide variety of local, state, and federal sites of various sizes and with various missions and management strategies.

Observed or documented short-term and long-term effects of human activities on wildlife at specific sites were varied (respondents were not asked to correlate observed or documented effects on wildlife with other factors such as degree of use of site or effectiveness of design and management strategies to avoid or reduce impacts on specific sites).

- The most commonly reported immediate effect on wildlife was from unleashed dogs, followed by walking/jogging.
- The most commonly reported observed or documented long-term effect on wildlife was from humans feeding wildlife, followed by fishing.
- The activity types most commonly reported as having no observed or documented effects on wildlife were photography, followed by birdwatching.

All of the survey respondents employed one or more design or management strategy(ies) (such as trail types, separation features, prohibition of trail development, area closures, visitor number limits, activity type restrictions, user behavior restrictions, education and outreach programs, and wildlife management/monitoring) on their sites. The vast majority of all respondents felt that their design and management strategies were at least somewhat effective in avoiding or reducing recreational impacts on wildlife.

The most commonly employed strategy was education and outreach programs. The second most commonly employed strategies were activity type restrictions and user behavior restrictions, followed closely by area closures and separation features. Limits on visitor numbers was the least frequently employed strategy.

Vegetative buffers were the most common type of separation feature employed. Vegetative buffers were also reported as the most effective type of separation feature for avoiding or reducing impacts on wildlife from human activities, followed by bridges/boardwalks and viewing platforms/overlooks, then fencing.

Loop trails were the most common type of trail present and were reported as the most effective trail type for avoiding or reducing impacts on wildlife from human activities.

Overnight and seasonal closures were the most common type of area closures employed.

The most common type of activity restrictions employed were boat restrictions (including jet skis), motorized vehicle restrictions (including ATVs/ORVs), and bicycle restrictions. The most common type of behavior restrictions employed were pet restrictions.

The most common type of enforcement mechanisms employed were signs, followed by staff patrols.

The most common type of education and outreach mechanisms employed were written materials (pamphlets, brochures, etc.), followed by interpretive signs/self-guided trails.

Respondents reported that combinations of strategies were very effective and that the success of design and management strategies depends greatly on available funding and staff to employ, monitor and enforce strategies.

Public Access Siting, Design and Management Strategies. Based on information gathered from published literature, the Internet, personal communications, the Public Access and Wildlife Compatibility Survey, and public input, a Siting, Design and Management Strategies Matrix (Table A) and accompanying discussion was developed to provide an extensive synthesis and discussion of specific design and management strategies that may be used as guidelines to avoid or minimize adverse effects of public access on wildlife (please refer to Appendix C for a history of BCDC permit actions on this issue and Appendix G for pictorial examples of siting, design and management strategies from the San Francisco Bay Area).

In the Siting, Design and Management Strategy Matrix (Table A), techniques that address potential public access effects on wildlife are categorized into one of three variables that characterize the user/wildlife interaction. These three management categories are: 1) siting and design; 2) use management; and 3) wildlife management. Each of the three elements (the access route itself, the public access users, and the wildlife in the public access area) can be managed independently or, more likely in combination, to avoid or minimize adverse effects. Obviously, manipulation of one variable will affect the others, and the distinction between the three variables may not always be precise (i.e., seasonal closure of a trail may be considered a manipulation of the visitor, as well as a manipulation of the trail itself). However, categorizing management techniques into these three variables provides a useful means of organization for discussion and planning purposes.

1. **Trail Siting and Design**. The initial planning and design of the public access site is the first means by which to avoid or minimize adverse effects on wildlife. Recognizing that public access features will change the landscape in some way and recognizing that the public access site will have an effect on the surrounding area (which may extend for quite some distance), an initial site analysis of the area is important.[52] With a thorough understanding of the area and the species which inhabit it currently (or are projected to inhabit the area in the future such as with seasonal use areas or planned habitat restoration sites) and an analysis of the projected human use of the area, an evaluation of

[52] Colorado State Parks and Hellman Associates. 1998.

access siting and design alternatives can be undertaken to help avoid or minimize potential adverse effects on wildlife.[53]

Planning an access area with a regional view of the environment can help balance the needs of wildlife and the public across a larger perspective. For example, knowledge of adjacent land uses can help determine the siting, design and management of public access. Some strategies to employ with a regional perspective in mind include: avoiding disturbance of smaller, isolated habitat patches; aligning access along the edge, rather than bisecting undisturbed areas, avoiding wildlife breeding areas, and aligning a trail along an already disturbed area (which may also facilitate restoration of the area as part of the trail development).[54] Furthermore, an analysis of the site may determine that public access is not appropriate at all.

Siting and design of public access can incorporate many types of buffers (or access controls) that constrain public access to a defined area, such as fencing, vegetation, boardwalks, and viewing areas. Buffers or transition areas between public access and wildlife habitat can provide a physical barrier to keep users out of sensitive areas, may allow for enough physical space for wildlife to avoid public, and may contribute additional habitat. Different types of buffers may be appropriate in different public access areas.

Many strategies employed during siting and design address the issue of "visitor satisfaction." When weighing the potential impacts of public access on wildlife versus the potential benefits, how gratifying the experience is for the user will be a factor in the degree of potential wildlife impact associated with trail use.[55] For example, access routes that do not provide some sort of access to desirable areas such as the shoreline or a wildlife area may inadvertently encourage the creation of numerous alternative informal pathways created by users. Informal pathways can increase adverse effects on an area from physical trampling of vegetation, by creating access to sensitive areas, by dispersing use within a sensitive area, and by lessening the degree of predictability of users to wildlife. Similarly, a hidden habitat or viewshed may frustrate users, and may induce users to find it on their own (i.e., a shoreline obstructed by a high levee may lead to the periodic trampling of levee vegetation as users attempt to achieve the visual access). Lastly, strategies that limit access by concentrating use (such as boardwalks and viewing platforms) may lead (depending on use levels) to negative social outcomes of user overcrowding, which again may lead to creation of informal pathways as users attempt to avoid crowds.

2. **Use Management.** Use management strategies consist of restrictions on the amount, type and behavior of visitor use as well as educational / behavior modification approaches. As discussed previously, the concepts of carrying capacity and limits of acceptable change as applied to public access areas may assist managers in deciding whether to employ use management strategies that limit the amount of visitors in an area, but limits on numbers of users is just one possible management strategy.

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[53] Colorado State Parks and Hellman Associates, 1998; and Palmisano, Terry. 1999. *Wildlife 101: So You Want to Build a Trail.* California Department of Fish and Game. Presentation at California State Trails Conference. April 17, 1999.

[54] Colorado State Parks and Hellman Associates. 1998; San Francisco Bay Conservation and Development Commission. 1985. *Public Access Design Guidelines*. San Francisco, California; and Reid, 1997.

[55] Vaske et al, 1987.

Furthermore, it has been shown in some cases that the greatest degree of impact may occur at a fairly low level of use, while increasing numbers of users does not notably increase the degree of impact.[56]

Instead, managers may allow the amount of use to go unregulated and instead work to reduce the amount of impact each user causes by managing the impact of the individual users, such as limiting the type of use at a particular site (i.e., pedestrian only trails) and the behavior of the users (i.e., leash requirements, seasonal restrictions, guided trails). Use management may also consist of periodic closures of public access routes based on the use of the site by wildlife (such as during breeding seasons or at high tide when species are forced upland).

An important aspect of these types of use management is control over the predictability of user locations and activities. Managing use to facilitate predictability of human actions may increase the potential for certain species of wildlife to adapt to those actions.[57] Some obvious challenges for planners and managers in employing many of these use management strategies include the need for a great deal of site-specific knowledge and the potential for high personnel costs.

Finally, increasing the knowledge of users regarding the habitats and species at a site, the implications of users' actions, and the reasons behind user restrictions is an often cited management tool that can help facilitate an interesting and meaningful user experience as well as reduce potential adverse effects to the site.[58] Educational materials, guided tours, and interpretive panels are all examples of ways to increase the knowledge of users.

3. **Wildlife Management/Monitoring.** Management of the wildlife itself at a site may help to avoid or minimize adverse effects of public access on specific species. Monitoring of wildlife at a site can provide for extremely useful information on which the success of efforts to protect wildlife can be based. Habitat modification, restoration, enhancement, and creation are strategies that may provide benefits for both wildlife and public access goals, including diversifying available habitat for wildlife to provide alternative areas for foraging, nesting and resting.

The use of some wildlife management techniques, such as creation of alternative nesting habitats to encourage wildlife to nest in areas away from public access routes, must be weighed against the creation of a less "natural" environment. Wildlife management techniques may also be opposed by the public. For example, there has been negative public reaction to the elimination of predators, though predator elimination techniques can be an effective (though potentially costly) management tool to combat the secondary impacts of public access (i.e., the creation of predator access to wildlife along trails).[59]

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[56] Hammitt and Cole, 1998.
[57] Hammit and Cole, 1998.
[58] Colorado State Parks and Hellman Associates. 1998; Hammit and Cole, 1998; National Park Service, 1997; and Reid, 1997.
[59] United States Fish and Wildlife Service. 1997. *Biological opinion of the proposed San Mateo County Bay Trail Route Access Improvement Project.* Sent to David Densmore, Federal Highway Administration, from the Acting Regional Director, Portland Oregon.

Summary. Siting, design and management strategies may be used to avoid or minimize adverse effects of public access on wildlife. The relative success of specific siting, design and management strategies will vary from site to site. Appropriate strategies depend on the habitat, species present, present and future species use of habitat, adjacent land uses, types and frequency of users, specific management objectives of the site, public input, available funding, etc.

Because the relative advantages and disadvantages of many strategies will vary, they are most appropriately provided as guidelines for public access development, rather than policies. The existing advisory *Public Access Design Guidelines* were based on the *San Francisco Bay Plan* policies and also reflect past permit decisions of the Commission and recommendations of the Commission's advisory Design Review Board on individual project designs. The Guidelines, adopted by the Commission in 1985, are in need of revision and provide an appropriate format for information on siting, design and management strategies that avoid or minimize adverse effects on wildlife.

TABLE A.

Public Access and Wildlife Compatibility
Siting, Design And Management Strategies Matrix

STRATEGY	ADVANTAGES	CHALLENGES
SITING AND DESIGN		
Site Analysis	· Inventory and analysis of site prior to public access design and construction can generate useful information on potential recreational and educational uses, and on species and habitats that can be used to better design public access features to avoid or minimize adverse effects.	· Thorough site data gathering and analysis requires time and staff and funds
Construction Materials	· A durable pathway will reduce impact to adjacent habitat (via erosion, for example) · A durable pathway will help limit creation of alternative access routes by users trying to avoid muddy or unsafe pathways	· The more durable the pathway, the less natural the area becomes (need to weigh trail durability with overall management objectives for site)
Varied and Interesting Access Experience	· Providing users with a fulfilling varied and interesting public access experience will keep users in designated areas and limit the creation of informal routes	· Access route must be designed to limit impacts on resources
Perimeter/Loop Pathway	· Provides user with visual access to interesting habitat, yet preserves an enclosed, undisturbed interior habitat · May reduce overall use (public passes only once) · May require fewer parking/staging areas · Provides predictability of human use for wildlife	· Design may not adequately discourage social trails · Continuous perimeter access may have a greater impact on resources than point access.
Spur Trails/Point Access	· Limits physical access to sensitive areas while providing users with some access · Spur trails tend to have lower volumes of users · Provides predictability of human use for wildlife	· Public may be enticed to wander past end of the trail, creating social trails and potentially impacting sensitive habitat/species · Pathway must be designed to limit impacts

TABLE A, Cont.

STRATEGY	ADVANTAGES	CHALLENGES
SITING AND DESIGN, cont.		
Locate Parking/Staging Areas Away From Sensitive Habitat	· May limit number of users visiting sensitive areas, because access is more difficult (use levels are often reduced beyond 1/4 to 1/2 mile from parking/staging area)	· May limit utility of site as an educational tool or recreational resource · May limit wildlife viewing opportunities
Buffers/Access Control: Vegetation	· Can provide physical barrier to keep users out of sensitive areas · Provides a "natural" barrier (can restore native plant communities to area) · Can visually screen wildlife from trail users · Can provide sound buffer for wildlife · Can control erosion · Can serve as wildlife habitat/wildlife cover	· May obstruct visual access · May be difficult to maintain based on plants used · May provide habitat for predators · May not keep out dogs or children
Buffers/Access Control: Open Space	· Can limit impact and provide for good visual access without physical barriers · Potential for large distance between wildlife and public which may allow for wildlife avoidance of public or for wildlife escape routes	· Users may still access sensitive areas away designated access areas
Buffers/Access Control: Fencing	· Can allow some visual access while preventing physical access by both people and dogs · Can temporarily protect restoration sites	· May obstruct visual access · May provide perches for predators · May be expensive and difficult to maintain
Buffers/Access Control: Moats/Wetlands	· Creates physical barrier (often unpassable) while still providing for good visual access	· May not prevent predator access (i.e., red fox may swim across moat) · Moat or wetland may contain sensitive species · Access at edge of wetland habitat may block wetland species from accessing upland dry areas at high tide periods
Buffers/Access Control: Levees	· Can provide physical barrier to keep users out of sensitive areas	· Depending on placement of access features, may obstruct visual access and encourage creation of informal trails · May provide access corridors for predators

TABLE A, Cont.

STRATEGY	ADVANTAGES	CHALLENGES
SITING AND DESIGN, cont.		
Buffers/Access Control: Bridges/ Boardwalks	· Can provide physical access to sensitive areas (such as wetlands) while limiting direct impact to habitat (restricts and confines human use) · Provides predictability of human use for wildlife, which may increase ability of wildlife to adapt to human activity	· May cause indirect effects (i.e., shading) · Potential impact from potential for close physical contact with wildlife/habitat areas · Based on use levels, potential negative social reaction to concentrated use in small area – may lead to social trails to avoid crowds · May be expensive and difficult to maintain · Adaptation ability of species highly variable
Buffers/Access Control: Viewing Platforms/ Overlooks	· Restricts and confines use while providing desired visual access (may prevent creation of social trails) · Limits contact with wildlife · Provides predictability of human use for wildlife, which may increase ability of wildlife to adapt to human activity	· May provide perch for predators · Based on use levels, potential negative social reaction to concentrated use in small area – may lead to social trails to avoid crowds · May be expensive and difficult to maintain · Adaptation ability of species highly variable
Prohibition of Public Access Pathway Development/No Public Access	· Adverse effects on wildlife from public access can be avoided · Avoids habitat fragmentation	· If access is needed or desired, alternative route may be difficult to locate/design · Some public objectives may be lost · Uncontrolled dispersed access may lead to greater impacts than controlled access (impact on a larger area, lack of human predictability for wildlife) · May require signage/enforcement · May be expensive/difficult to maintain
Maintenance Provisions	· Maintains public safety · Maintains public satisfaction with access opportunities and decreases creation of informal access due to blocked views, etc.	· May require long term staff and funding needs

TABLE A, Cont.

STRATEGY	ADVANTAGES	CHALLENGES
USE MANAGEMENT		
Closures	· Periodic closures based on time of day, season or tidal regime may avoid/minimize impact use on certain wildlife species during sensitive periods (i.e., during breeding seasons or at high tide when species are forced upland) · Periodic closures may allow for habitat recovery	· Requires site-specific knowledge of species · Management strategy for site must allow periodic closure (may not be desirable or feasible for multi-use public accessways) · Some public objectives may be lost · Requires staff management/enforcement
Limits on Number of Users	· Reducing numbers of users may reduce adverse effects on habitat and wildlife · May increase visitor satisfaction	· Requires ability to monitor/manage visitor numbers (staffed entrance, permitting, etc.) · May be difficult to define appropriate visitor number level · Use may also be limited with lack of signage (limit ability to find/follow trail) or low maintenance (psychological deterrent), but techniques may not be practical or desirable for multi-use public access · May not substantially reduce impact
Visitor Activity Restrictions	· Limiting to specific types of uses may lessen wildlife impact (i.e., pedestrian only pathways, vehicle tour trails, etc.) · Certain types of activities may be limited by trail width, surface and amenities (which may also limit number of users)	· Requires site specific knowledge of species reactions to specific uses (e.g., tolerance of vehicles v. people, etc.) · Enforcement of regulations desirable for maximum compliance · Education on rationale behind restrictions increases compliance · Requires adequate staff resources
Visitor Behavior Restrictions	· Direct and easily implemented management tool to limit potentially destructive user behaviors (e.g., leash requirements, prohibitions on pets, no feeding wildlife, etc.) · Restricting behavior types may lower overall number of users	· Requires site specific knowledge of species reactions to specific behaviors · Enforcement of regulations desirable for maximum compliance · Education on rationale behind restrictions increases compliance · Requires adequate staff resources

TABLE A, Cont.

STRATEGY	ADVANTAGES	CHALLENGES
USE MANAGEMENT, Cont.		
Guided Trails, Docents, Rangers	· Increased educational experience for some members of public · Better control over undesirable user behavior · Personal contact with users can be particularly effective for education and compliance · Educated users may educate others	· Requires adequate staff resources · Some public objectives (e.g., solitary access experience) may be lost
Educational/ Interpretive Materials	· Increasing knowledge of users (regarding wildlife and the implications of users actions) decreases damaging user behavior · Explanation of reasons behind trail policies (i.e., leash requirements, closures, etc.) increases compliance with regulations · May foster public support for site · Educated users may educate others	· Requires much time and effort to research, plan, design, and construct/distribute effective materials · Requires commitment and consistency · May be expensive and difficult to maintain · More effective in areas with high number of local/habitual users · Casual park users may not be interested in passive educational programs
WILDLIFE MONITORING/MANAGEMENT		
Wildlife Monitoring	· Establishes baseline data and enables staff to track efforts to protect wildlife · Can assist in mapping critical habitat for specific species that can then be avoided	· Requires adequate staff resources over an extended period of time
Creation of Alternative Nesting Habitats	· Alternative nesting habitats can be created away from trail site	· Requires intensive management · Lack of knowledge on success of technique
Habitat Modification/ Restoration/ Enhancement/ Creation	· Potentially provides benefits for both habitat and access goals · Can enhance critical habitat for specific species · Can retain/increase habitat diversity to help alleviate competition with human use of an area	· Requires extensive site specific knowledge · May reduce wildlife viewing opportunities · Potentially controversial · May be expensive and difficult to maintain

TABLE A, Cont.

STRATEGY	ADVANTAGES	CHALLENGES
WILDLIFE MONITORING/MANAGEMENT, Cont.		
Species Re-Introductions	· Can be used as a secondary management technique to mitigate for species loss from an area	· Lack of knowledge on success of technique · Requires intensive management of area to prevent need for additional re-introductions · Potentially controversial
Predator Control	· Can be used as a secondary management technique to help ameliorate problem of pathways providing predator access routes	· Hazardous to place traps in areas frequented by people and pets · Potential for vandalism of traps · Potential negative public perception · Success depends on surrounding land uses (i.e., feral cats from adjacent urban areas)

APPENDIX A

HABITAT CHARACTERISTICS OF THE SAN FRANCISCO BAY

The San Francisco Bay system is made up of three different Bays: Suisun Bay, San Pablo Bay and San Francisco Bay. These three Bays make up a large body of water with numerous types of waterways and baylands (defined as shallow water habitat between low and high tide levels) throughout their expanse. These baylands and waterways provide important habitat to numerous plant, fish and wildlife populations. The Bay presently sustains nearly 500 species of fish, invertebrates, birds, mammals, insects and amphibians[60].

The baylands provide habitat for more than one million shorebirds and are the winter home for nearly half of the waterfowl and shorebirds migrating along the Pacific Flyway.[61] As a whole, the bay supports 31 different shorebird species including the western sandpiper, red knot and federally listed threatened snowy plover. The bay also supports 30 species of waterfowl including dabbling ducks such as the northern pintail and the mallard as well as diving ducks including the canvasback and ruddy duck. Furthermore, over 180 other bird species make use of the baylands of the San Francisco Bay. These birds include gulls, raptors, rails, including the state and federally listed endangered California clapper rail and the state listed threatened black rail, as well as grebes and terns such as the state and federally listed endangered California least tern[62].

Extensive habitat loss and fragmentation have reduced the number of species residing in the bay, as well as the population numbers existing within each species. For example, tidal flat habitat has decreased from about 50,000 acres to about 30,000 acres. A seventy-nine percent loss in tidal marsh habitat has occurred over the past 200 years, resulting in a decline of acreage from 190,000 to about 40,000[63]. Habitat loss and degradation have played key roles in the population decline of many species. Out of the 500 species of wildlife and aquatic life associated with the Estuary, 30 are listed as threatened or endangered under the state and federal Endangered Species Act, including one amphibian, two reptiles, nine birds, and two mammals.

Current Conditions. The San Francisco Bay is a diverse ecosystem with many habitat types. A brief description of the habitats that make up the different regions of the Bay will help visualize the Bay as a whole and why it is an important wildlife area.[64]

The furthest upstream, in the Northeastern corner of the region within Solano and Contra Costa counties, the Suisun Bay represents an area of unique aquatic and wildlife habitats. The Suisun Bay shoreline is composed mainly of managed diked wetlands that provide habitat for waterfowl. Some tidal marsh occurs on the edges and in many of the sloughs in Suisun Bay area. Further inland are small patches of grasslands and vernal pools. This is an extremely important region as its 75,000 acres of baylands contain the largest portion of remaining wetlands in the Bay and comprise ten percent of the

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[60] San Francisco Estuary Project. 1992. *Status and Trends Report on Wildlife of the San Francisco Estuary*. San Francisco Estuary Project, Oakland, CA.

[61] San Francisco Estuary Project. 1999. *Wetlands*. Online.
<www.abag.ca.gov/bayarea/sfep/reports/fact/wetlands.html>. 20 August 2000.

[62] Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, CA/S.F. Bay Regional Water Quality Control Board, Oakland, CA.

[63] Ibid.

[64] Most of the information in the following sections (except where otherwise noted) comes from the Baylands Ecosystem Habitat Goals (Goals Project).

remaining wetlands in California[65]. Most of the wetlands in this area are privately owned and managed for waterfowl.

Soft bird's-beak, Suisun thistle, Mason's lilaeopsis, and Delta tule pea are just a few of the plants that inhabit this region. Animals that inhabit this area include Delta smelt, Striped bass, Chinook salmon and steelhead, black rails, Suisun song sparrows, and both canvasback and redheaded diving ducks. Furthermore, the state and federally listed endangered salt marsh harvest mouse and California clapper rail inhabit this region as well as a myriad of other migratory and shorebirds, amphibians and mammals.

Moving west into the San Pablo Bay brings a wider variety of baylands. The majority of this area, consisting of Napa, Sonoma and Marin counties and often referred to as the North Bay, is diked agricultural bayland. Again, however, smaller areas of tidal marshes, diked wetlands, grasslands & vernal pools, tidal flats, salt ponds, lagoons, rivers, creeks, sloughs, and developed and undeveloped bay fill can be found. Approximately one-half of the baylands in this region are privately-owned and farmed for agricultural purposes, primarily oat hay. On the south share in Contra Costa County, there exists both developed urban shoreline and marshlands.

Salmon, steelhead, starry flounder and Dungeness crab use this region as a breeding ground. The salt marsh harvest mouse, California clapper rail, black rail, and diving ducks can also be found in this area along with many other birds, mammals, amphibians and rare plants.

The Central Bay shoreline, which includes Richardson Bay, Oakland Estuary, and San Leandro Bay, consists almost entirely of developed bay fill. The area which includes the cities of Richmond, Oakland, San Francisco and San Mateo, sustains much larger human populations than San Pablo and Suisun Bays and has a mostly urban shoreline. There do exist in this area, however, a few relatively small areas of diked wetlands, seasonal wetlands, tidal marshes, tidal flats, and freshwater marshes. Shallow subtidal areas support some eelgrass beds, and pockets of shell and sand beaches can also be found in the Central Bay.

Harbor seals, steelhead, salt marsh harvest mice, garter snakes, red-legged frogs, black rails, double-crested cormorants, California clapper rails and California least terns represent a portion of the wildlife in the area.

Stretching from Hayward down to the southern tip of the bay and northwest to Redwood City, the South Bay is comprised mostly of both developed urban shoreline and extensive salt ponds converted from tidal marshes. Large areas of tidal flats also exist in the South Bay, as do fragments of tidal marshes. Large channels and associated slough systems are also found in this area. Cargill Salt Division and other public and private landowners control most of the South Bay baylands.

The California clapper rail and salt marsh harvest mouse are also found in this region. Along with them one can find harbor seals, snowy plovers, least terns, herons, egrets, tadpole shrimp, steelhead, and California tiger salamanders.

Future Conditions. The Bay area is experiencing and will continue to experience increased concentrated development along the shoreline. At the same time, restoration of wetland habitat is a high priority at the local, state and federal levels and there is an ongoing concerted effort around the Bay to undertake large-scale restoration of wetland habitat, including areas previously diked from the Bay.

[65] BCDC. 1982. Suisun Marsh Protection Plan.

APPENDIX B

PUBLIC ACCESS IN THE SAN FRANCISCO BAY AREA

In the 35 years since BCDC was created, public access to the shoreline expanded significantly from approximately 4 miles in 1965 to over 200 miles today, with more public access being added each year. Demand for public access continues due to an increasing Bay Area population and the desirability of shoreline access experiences. Furthermore, there is a demand for a diversity of access experiences, including both along urban waterfronts and in more natural areas.

The character of shoreline public access areas is determined largely by the nature and intensity of surrounding land uses. For example in the intensively developed areas of the most populous cities of San Francisco and Oakland, the shoreline edge is typically a hard edge with fairly intensive development at the shoreline and access areas provided primarily for active and passive recreation and periodic large civic events and celebrations. In some of the smaller towns and cities around the Bay, smaller intensively developed shoreline areas provide similar recreational areas as larger cities, while in many towns, lower intensity residential and commercial uses may front on the shoreline with a softer sometimes natural shoreline edge improved for primarily passive recreation. This variety creates a rich mosaic of shoreline open spaces that accommodate widely varying types and intensities of use, ranging from thousands of visitors at some locations on a given day, to few to none per day at other sites.

Federal, state, county and local agencies, a regional park district, as well as private landowners and land trusts, are the primary providers of publicly accessible shoreline open spaces around San Francisco Bay. The different missions and goals of the open space providers determine the size, character, uses and level of improvement for each of the types of public access. Through its permit program, the Commission ensures that these shoreline open space areas maximize public access to the Bay shoreline, consistent with its mandate to preserve and protect wildlife.

The federal government has preserved several thousand acres of Bayfront lands as park, recreation, and natural areas for varying purposes. The Golden Gate National Recreation Area under the management of the National Park Service provides large developed and natural, open space areas that accommodate a wide variety of public recreation and provide scenic value. Utilizing closed federal facilities, including military bases and a closed island penitentiary the Park Service has created a mixture of intensively used urban open spaces for active and passive recreation such as the Presidio and Alcatraz Island, and more natural, passive recreation areas such as the Marin Headlands and Muir Woods. Other closed federal facilities may provide opportunities for public access in the future (e.g., the Point Molate naval fuel depot on the Richmond shoreline). The Department of the Interior, through the U.S. Fish and Wildlife Service (USFWS) manages the Don Edwards San Francisco Bay National Wildlife Refuge and the San Pablo Bay National Wildlife Refuge. Both refuges are working aggressively to expand by acquiring additional lands and conducting large habitat restoration projects. The refuges provide access to large, undeveloped tracts of primarily slat ponds and tidal and seasonal marsh lands and shallow open waters areas.

The State of California, through several agencies, has provided significant shoreline areas for recreation and natural resource protection throughout the Bay. The State Parks Department manages four shoreline parks, including one island park for primarily

passive and some active recreation. The Department of Fish and Game has extensive land holdings in the North Bay, Suisun Bay and San Mateo counties, managed primarily as habitat areas for improving wildlife resources and for hunting. The California Coastal Conservancy works in partnership with local governments, other public agencies, nonprofit organizations, and private landowners to purchase, protect, restore, and enhance coastal resources, and to provide access to the shore. The Coastal Conservancy improves public access to the coast and bay shores by acquiring land and easements and by building trails and stairways.

The East Bay Regional Park District operates 50 parks and 20 trails totaling more than 75,000 acres providing for a variety of passive and active recreation as well as protecting and enhancing the natural resources of its lands. The nine counties and 46 cities that front on San Francisco Bay have created several county and city parks of varying size accommodating a wide variety of recreational activities as well as for wildlife habitat protection.

Local governments provide parks and open space for public access.

Private land owners, including Commission permittees who provide public access to and along the shoreline of their lands as part of shoreline development and private wildlife organizations and land trusts also contribute significantly to the shoreline open space inventory. Wildlife organizations and land trusts own and manage lands primarily for wildlife, but also allow some passive wildlife viewing.

The Bay Trail Project. In 1987, then-state Senator Bill Lockyer authored Senate Bill 100 (SB 100) authorizing the Association of Bay Area Governments (ABAG) to "develop and adopt a plan … for a continuous recreational corridor which will extend around the perimeter of San Francisco and San Pablo Bays." SB 100 required that the plan include a specific trail route; the relationship of the route to parks and other recreational facilities; links to existing and proposed public transportation facilities; an implementation and funding program for the trail; and provisions for implementing the trail without adversely affecting the natural environment of the bay.

The San Francisco Bay Trail Project, a nonprofit organization administered by ABAG, was created in 1990 to plan, promote and advocate implementation of the Bay Trail. To carry out its mission, the Bay Trail Project makes available grant funds for trail construction and maintenance; participates in planning efforts and encourages consistency with the adopted Bay Trail Plan; educates the public decision-makers about the merits and benefits of the Bay Trail; produces maps and other materials to publicize the existence of the Bay Trail; and disseminates information about progress on its development. (However, the Bay Trail Project does not own land or construct trail segments; instead segments are built, owned, managed and maintained by cities, counties, park districts and other agencies with land-management responsibilities, often in partnership with local nonprofit organizations, citizens' groups or businesses.)

When complete, the Bay Trail will be a continuous 400-mile recreational corridor that will encircle the entire Bay Area, connecting communities to each other and to the Bay. It will link the shorelines of all nine counties in the Bay Area and 47 of its cities. To date, approximately 215 miles of the Bay Trail, or slightly more than half its ultimate length, has been developed.

APPENDIX C

BCDC PERMITS BALANCING PUBLIC ACCESS AND WILDLIFE PROTECTION

Over the past thirty years, BCDC has frequently confronted the question of how to balance the sometimes competing interests of improving public access and preserving and enhancing wildlife habitat in the Bay. The following brief project descriptions demonstrate how BCDC reconciled these issues in certain of its permit decisions.

1. BCDC Permit No. 13-83, The Ashton Company and American Savings and Loan; Strawberry Spit, Mill Valley, Marin County.

This project involved the construction of 62 single family residences on Strawberry Spit, a peninsula of made-land constructed with dredged spoils in the early 20th Century. A public access trail was provided along the Bay shoreline, along with two open spaces and public parking. Fourteen of the homes on the northern half of the peninsula were subsequently allowed to construct boat docks for recreational boats and permission to dredge a navigation channel at the perimeter of the peninsula was also granted. The northernmost tip of the peninsula was used as a haul-out area by Harbor Seals.

Measures taken to reduce disturbance: To reduce the impact of recreational boaters on the haul-out area, the northern end of the peninsula was made into an island by excavating a 165-foot-wide channel across the peninsula. The seal haul-out area was enlarged by excavating approximately 0.5 acres of the shoreline. The southern end of this new island was fenced and planted with dense vegetation to reduce visual contact with public access areas and private yards on the peninsula. Signs were placed to warn the public of the location of the seal haul-out and to prohibit human access to the island.

2. BCDC Permit No. 9-87, California Department of Transportation (Caltrans); Central Avenue / I-580 interchange.

In 1987-89, Caltrans widened and extended I-580 from the Richmond San Rafael Bridge to the Richmond-Albany city border. The Central Avenue interchange portion of the project was within BCDC jurisdiction. The Commission authorized construction of the freeway improvements and required that a public access path be provided along the Bay shoreline beside the interchange and a portion of the freeway. This is a "spine" (main) segment of the Bay Trail. At this location, the freeway lies between two high-value tidal wetlands—The Hoffman Marsh and the Albany Mudflat. Small amounts of fill were needed to accommodate the public access path adjacent to the freeway. To mitigate for the fill, Caltrans was required to construct a 10,000 square foot tidal wetland adjacent to the new trail.

Measures taken to reduce disturbance: Caltrans was required to construct a four-foot tall fence at the edge of the trail to prevent human and pet access to the Albany mudflat and to provide interpretive signage at the trailhead to inform trail users of the habitat values and to discourage behavior that would disturb wildlife. This segment of the Bay Trail along Albany Mudflat was to be retrofit consistent with the requirements of BCDC Permit 8-92, to improve the buffering between the trail and the habitat areas. Mitigation requirements in BCDC Permit 8-92 required that tidal

wetland habitat be constructed immediately adjacent to this trail, increasing the need for buffering to ensure mitigation habitat goals are achieved.

3. BCDC Permit No. 8-92, California Department of Transportation (Caltrans); Albany Mudflat.

During the early 1990's Caltrans obtained four BCDC permits to widen the existing four-lane, I-80 freeway to five lanes to add east and west-bound High Occupancy Vehicle (HOV) lanes and to make operational improvements at several interchanges in Alameda and Contra Costa Counties. BCDC Permit 8-92 authorized widening I-80 between Central Avenue in Richmond, Contra Costa County and Gilman Street in Berkeley, Alameda County, and authorized a significant reconfiguration of the I-80-I-580-Buchanan Street Interchange. BCDC required, in part, that Caltrans: (1) create approximately 3.5 acres of tidal marsh and 3.5 acres of transitional upland refugia habitat; (2) construct an approximately 1-mile segment of shoreline access as part of the project; and (3) retrofit an approximately 1/2-mile segment of existing trail (required in BCDC Permit No. 9-87).

Measures taken to reduce disturbance: Caltrans was required to: (1) establish baseline wildlife and habitat values by observing site for one year prior to construction to document use of site by wildlife; (2) construct 4-1/2- to 5-foot-tall opaque fence along entire shoreline trail to prevent wildlife disturbance; (3) provide periodic windows in the fence to allow for wildlife viewing; (4) assess existing habitat and wildlife values at the site prior to construction; (5) monitor wildlife species diversity and abundance and wildlife behavior for three years following opening of the trail and assess any impact of trail use on the habitat and wildlife resources; and (6) cooperate with BCDC and consulting resource agencies to address any impacts identified during the monitoring program.

4. BCDC Permit No. 6-94, City of Redwood City; Redwood Shores.

The project involved upgrading 15,300 linear feet (approximately 2.9 miles) of an existing levee to meet existing U.S. Army Corps of Engineers, Federal Emergency Management Agency, and City standards to maintain long-term, safe, reliable flood protection for the entire Redwood Shores peninsula. The existing exterior levee was improved between 1945 and 1962. The Bay side of the levee is generally bordered by tidal salt marsh, and a variety of native and non-native grasses or shrubs, common to the upland transitional zone of San Francisco Bay marshes. An unpaved pathway exists along the top of the entire levee. On the interior of the levee, the land uses include residential and commercial development, a sewage treatment plant, radio facilities, seasonal wetlands, open space, borrow ditches and salt pannes.

As part of a title settlement between the California State Lands Commission and Redwood Shores' predecessor, in 1974, the State Lands Commission obtained fee title or easement to the levee for the express purpose of providing public access. Though unimproved and unsigned, the levee top is currently used by walkers, joggers, and bike riders. For at least the last 20 years, the public has used the unimproved levee that was raised and strengthened by this project. However, during informal and later formal consultation with the U. S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act, the USFWS recommended eliminating access on most of the levee to protect populations of the endangered California Clapper Rail and the Salt Marsh Harvest Mouse living in the adjoining

wetlands. The public access approved in this permit is the result of discussions between BCDC staff, the USFWS, Redwood City, and Redwood Shores to provide an alternative to access on the levee that would be continuous and would provide a Bay experience. Ultimately, the Commission and the State Lands Commission determined that the alternative inland access was sufficient to justify conditional suspension of levee access.

Measures to reduce disturbance: To address the concerns of the USFWS, access over most of levee at the end of the peninsula was discontinued and an alternative access alignment provided that is continuous, that provides views of the Bay at various locations, and that generally runs along existing seasonal wetlands or proposed lagoons, thereby affording an open space experience to the degree possible. The remainder of the levee encircling Redwood Shores remains open to public access. The public access improvements at the tip of the peninsula involve relocating the access from the perimeter levee inland to a trail Point access on raised observation decks was constructed at the terminal of these trails to maximize views.

5. BCDC Permit No. M96-56, Port of Oakland; Arrowhead Marsh.

The Port of Oakland filled alleged wetlands at the Oakland International Airport as part of its on-going expansion. The Audubon Society, the Save San Francisco Bay Association and the Sierra Club sued the Port for violation of Section 404 of the Clean Water Act. The Port and the plaintiffs agreed to settle the lawsuit, and as part of the settlement, the Port agreed to construct approximately 37 acres of tidal and 28 acres of seasonal wetlands adjacent to the existing Arrowhead Marsh. The project site is located adjacent to East Bay Regional Park District's Martin Luther King, Jr. Shoreline Park and Arrowhead Marsh at the southern end of San Leandro Bay, in the City of Oakland. Located on former bay tidelands, the site was filled over a number of years. Arrowhead Marsh, a primarily cordgrass marsh just north of the site, is habitat for the endangered California Clapper Rail.

Measures to reduce disturbance: A number of public access amenities would be constructed as part of this project: (1) two on-grade viewing platforms and one viewing deck with a blind, all with benches and interpretive signs to allow visitors opportunities for wildlife viewing; (2) planting appropriate native vegetation throughout the upland portions of the restored site; and (3) installing a five to six-foot-high wire mesh fence around the entire wetland project perimeter to prevent intrusion into the restored area. The mesh fence is intended to prevent access to wildlife areas. The plantings are concentrated at the parking lot and opaque fencing was installed at the touchdown of a pedestrian bridge and at observation blinds to reduce disturbance at the most concentrated locations of human activity. Interpretive signs that discuss the habitat and resource values present and the need to avoid habitat areas and activities that may disturb wildlife were installed.

APPENDIX D

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APPENDIX E

PUBLIC ACCESS AND WILDLIFE COMPATIBILITY SURVEY

Results

August, 2000

Prepared as part of the Public Access and Wildlife Compatibility Policy Development Project

SAN FRANCISCO BAY
CONSERVATION AND
DEVELOPMENT COMMISSION

CONTENTS

FIGURES

TABLES

CHAPTER 1
Introduction

Background

The San Francisco Bay Conservation and Development Commission (BCDC) is charged with both protecting the Bay and its wildlife resources, and providing for maximum feasible public access to and along the Bay. Federal and state resource agencies and nonprofit environmental groups, such as local chapters of the National Audubon Society, the Sierra Club and Save San Francisco Bay Association, have sometimes objected to the public access provisions of projects approved by BCDC, contending that public access is incompatible with wildlife. Moreover, federal and state resource agencies, such as the U.S. Fish and Wildlife Service and the California Department of Fish and Game, also periodically object to the public access provisions required by BCDC as a condition of obtaining a BCDC permit. Often the groups conflict in their independent view of whether public access is appropriate at a particular site and the appropriate scale and intensity of the access.

Over the last 30 or so years, BCDC's policies on public access have evolved from the fundamental goal of public access creation and expansion, to more complex policies that recognize the necessity of balancing development of public access with parallel goals of wildlife and habitat protection and enhancement. BCDC's permitting process has reflected the increasing attempt to balance public access opportunities with wildlife needs. However, in the years since BCDC most recently updated its public access policies, available information on the effects of public access on wildlife has increased and concern over this issue has grown. BCDC is now endeavoring to further revise its policies to better address the complex issue of public access and wildlife compatibility.

The San Francisco Bay Public Access and Wildlife Compatibility Project

BCDC received funding from the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, to address this fundamental coastal management issue. BCDC has initiated, in partnership with the Association of Bay Area Government's Bay Trail Project (Bay Trail Project), the San Francisco Bay Public Access and Wildlife Compatibility Policy Development Project. This two-year study will generate improved information on public access impacts on wildlife and ways to address these impacts to facilitate better informed policy decisions.

Formation of the Policy Advisory Committee

BCDC formed a Policy Advisory Committee (PAC) to function as a forum for public input and debate and to help facilitate a consensus among regional public agencies and non-profit organizations on the development of revisions to existing public access policies. The PAC is comprised of fourteen individuals representing a wide range of professional fields, geographic areas and public interests to assist BCDC in developing achievable, effective consensus-based policies that may be implemented throughout the region. The represented disciplines include biologists (consultant, academic and agency), resource managers, regional park district employees, environmental planners, landscape architects, and non-governmental agency activists (including both recreation and wildlife protection advocates).

Distribution of National Survey

With assistance from the PAC, BCDC conducted a survey of land managers from coastal and Great Lake states nationwide. The goals of the survey are to gather further observational information on recreational impacts on wildlife, and to document on-site experiences with specific design and management strategies and how those strategies have or have not been an effective tool in avoiding or reducing impact on wildlife from human activities. Results from the survey will be incorporated with other information on human impacts on wildlife and design and management tools to avoid or minimize impacts. The cumulative analysis of all available information will be presented in a BCDC staff background report, which will include preliminary findings and recommended policies that will be presented for Commission consideration.

CHAPTER 2
Methodology

The Public Access and Wildlife Compatibility Survey was developed over several months by BCDC staff and the Policy Advisory Committee. Additional survey development assistance was provided by statisticians from the California Department of Fish and Game and the social science department of the National Park Service. The survey was pretested with representatives from local, state, and federal sites.

The survey was mailed to 362 land managers from coastal and Great Lake states around the country. The selected participants manage local, state and federal reserves, parks, refuges, open spaces, recreation areas, and wildlife management areas. The sites managed by survey participants contain sensitive habitat areas, such as wetlands or sandy beach, and allow public access for recreational activities.

Significant interest in this topic nationwide and a vigorous follow up effort resulted in164 surveys returned, for an excellent response rate of 45 percent. However, seven of those surveys were returned too late for inclusion in the analysis. This report is therefor an analysis of 157 surveys.

Responses to the survey were tabulated, where possible. Many of the survey questions were open-ended and generated a variety of qualitative responses. Responses to open-ended questions were reviewed, categorized, and summarized to the greatest extent possible. Answers have not been correlated or queried for causal relationships. Not all respondents answered all questions.

CHAPTER 3

Survey Results

Background

Survey respondents provided background information on themselves and the sites they managed. A total of 157 surveys were returned from coastal and Great Lake states (Table A). The returned surveys represent a wide national distribution, with 62 responses from the Eastern Seaboard, 27 from Gulf Coast States, 61 from West Coast states, and 8 from the Great Lakes.

Table A. Breakdown of Survey Responses by State

STATE	# Sent	# Received		STATE	# Sent	# Received
Alabama	6	4		Mississippi	6	3
Alaska	18	9		New Hampshire	2	0
Arkansas	5	3		New Jersey	2	1
California	42	23		New York	2	0
Delaware	9	1		North Carolina	11	6
Florida	46	18		Ohio	1	0
Georgia	7	5		Oregon	29	10
Hawaii	4	0		Puerto Rico	2	1
Louisiana	11	6		Rhode Island	0	0
Maine	17	8		South Carolina	8	2
Maryland	25	19		Texas	6	1
Massachusetts	20	7		Virginia	13	4
Michigan	1	1		Washington	55	18
Minnesota	11	5		Wisconsin	2	2

The returned surveys also represent a wide distribution among various types of federal, state and local managed areas (Table B).

Table B. Breakdown of Respondents by Site Type

FEDERAL			
National Wildlife Refuge	National Estuarine Research Reserve	National Seashore (NPS)	Wetland Management District (USFWS)
60	10	5	2
STATE			
Park	Recreation Area	Wildlife Management Area	Preserve/Reserve
47	5	4	5
Natural Resource Management Area	Wildlife Park	Wildlife Sanctuary	
1	1	3	
REGIONAL			
Park	Preserve	Marine Reserve (park)	
6	2	1	
COUNTY			
Park	Wetlands Sanctuary (park)	Marine Reserve (park)	
2	1	1	
CITY			
Refuge			
1			

The majority of the respondents answering for the sites were the Managers, Assistant Managers, Directors, or Supervisors of the site. Figures 1 and 2 show the respondents' titles and the respondents' training/background, if provided.

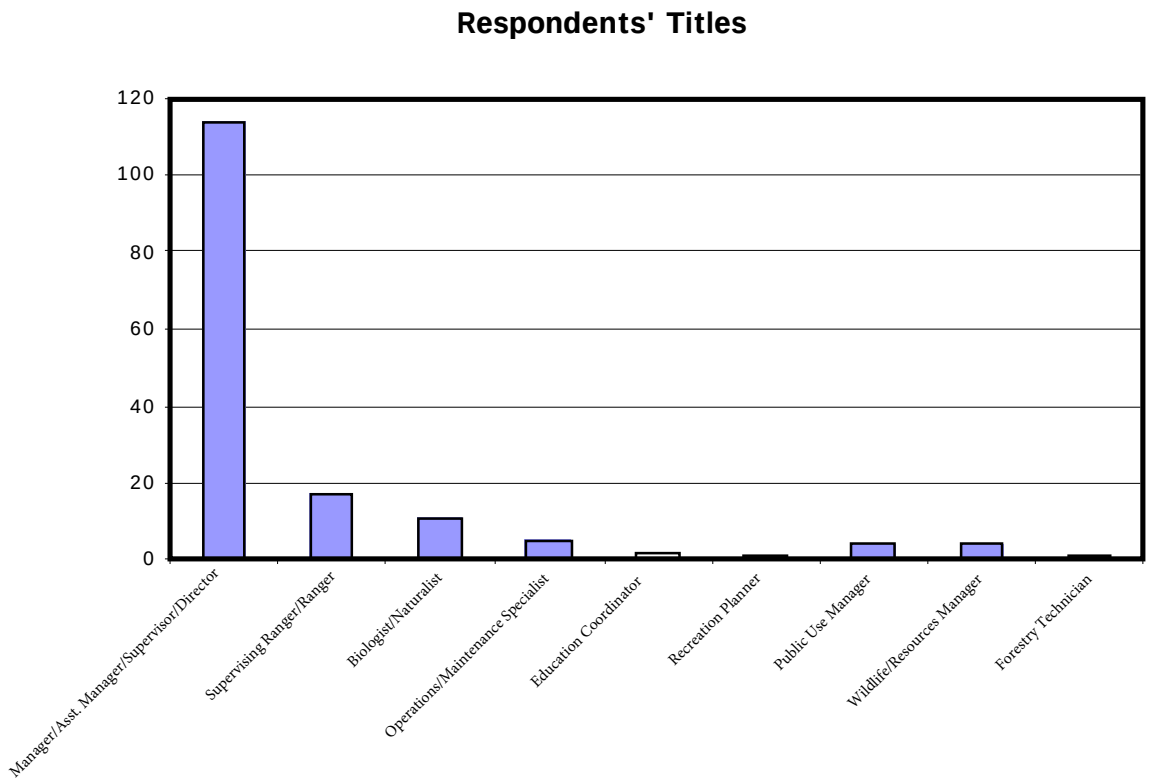

Figure 1. Titles of Respondents

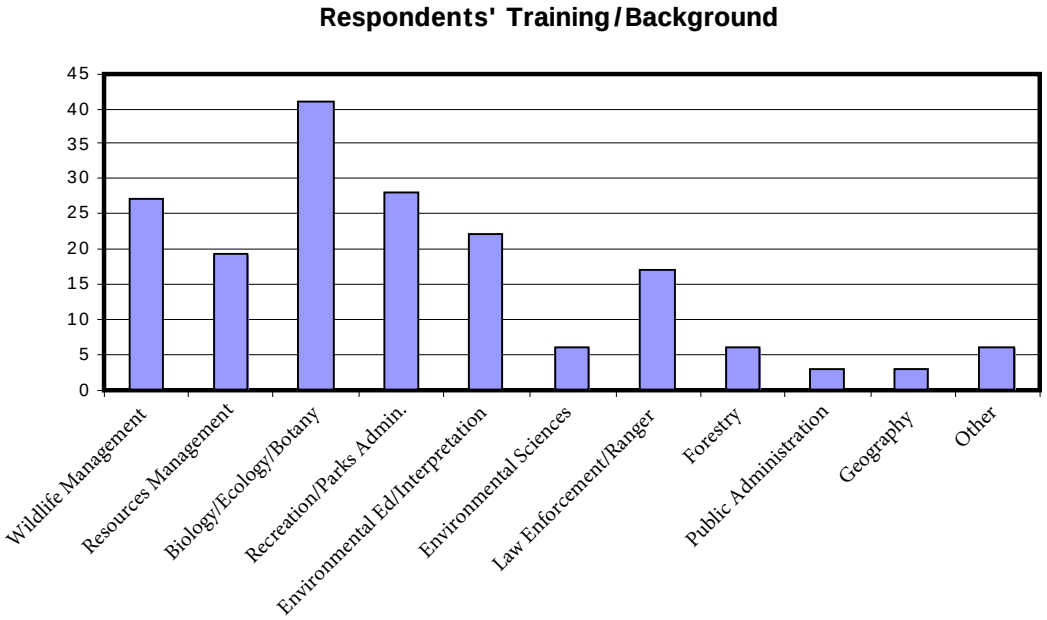

Figure 2. Background/Training of Respondents

Figure 3 shows the varying lengths of time the sites have been open to the public, and Figure 4 shows the varying lengths of time the respondents' have been involved with the sites they provided information for. Most sites had been open at least ten years and most respondents had been associated with the site for five or more years.

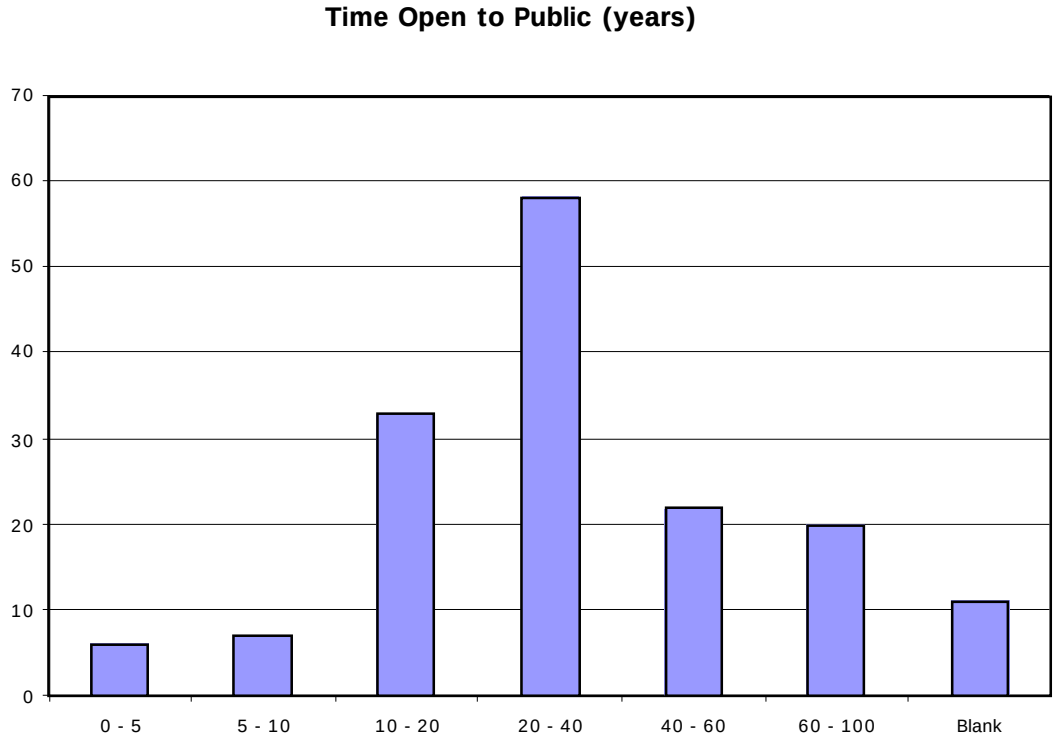

Figure 3. Length of Time Responding Sites Open to Public (in years)

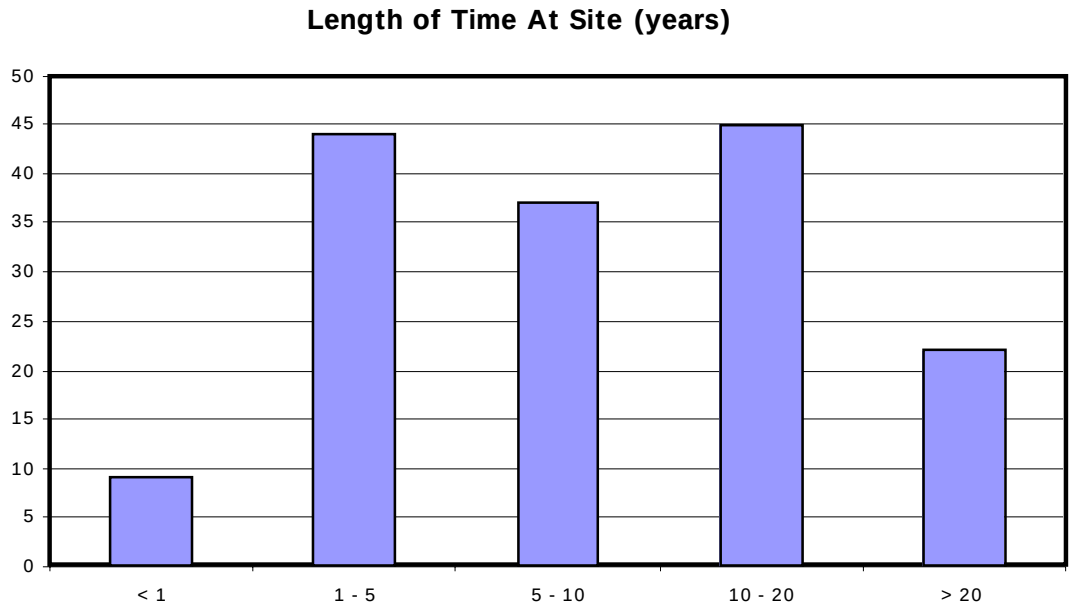

Figure 4. Length of Time Respondents' Involved with Site (in years)

Site Characterization

Respondents were asked a series of background questions regarding the sites they were providing information for. The responding sites were of various sizes as shown in Figure 5, with 33% of the sites 1000 acres or less in size.

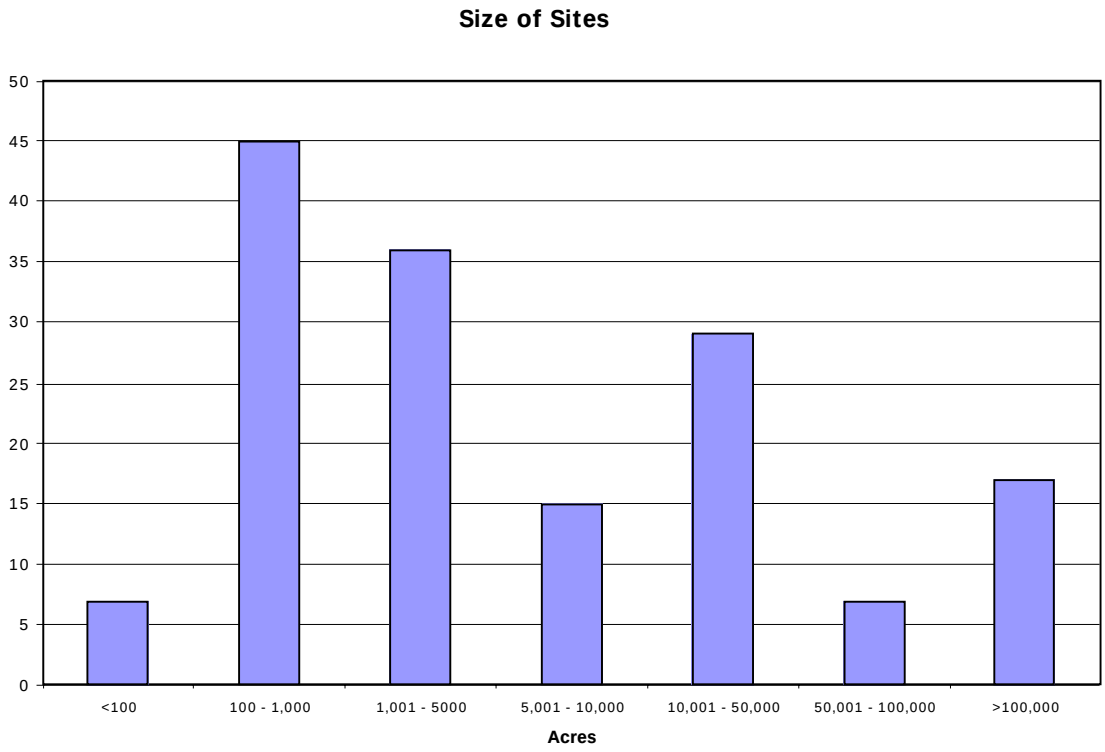

Figure 5. Size of Responding Sites

The sites contained a variety of habitat types, as shown in Figure 6. Types of land uses identified under "other" included agriculture (the most commonly identified other habitat type) tundra, glaciers, levees, agriculture, beach, rocky shore, coastal scrub, oak scrub, rock outcrop, pasture, mangroves, peat bog, and willow shrub.

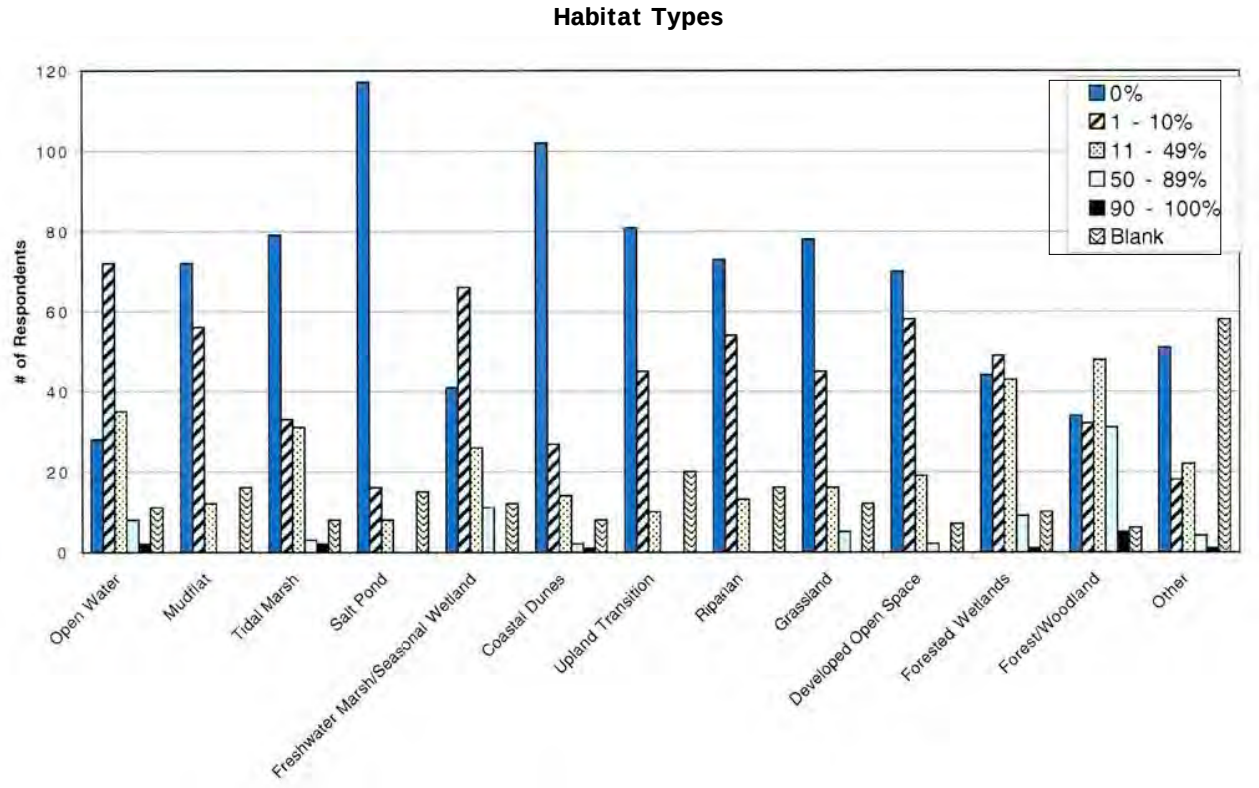

Figure 6. Percentage of Habitat Types at Responding Sites

Respondents were asked to indicate, to the best of their ability, the types of wildlife present at their sites (Figure 7a and 7b).

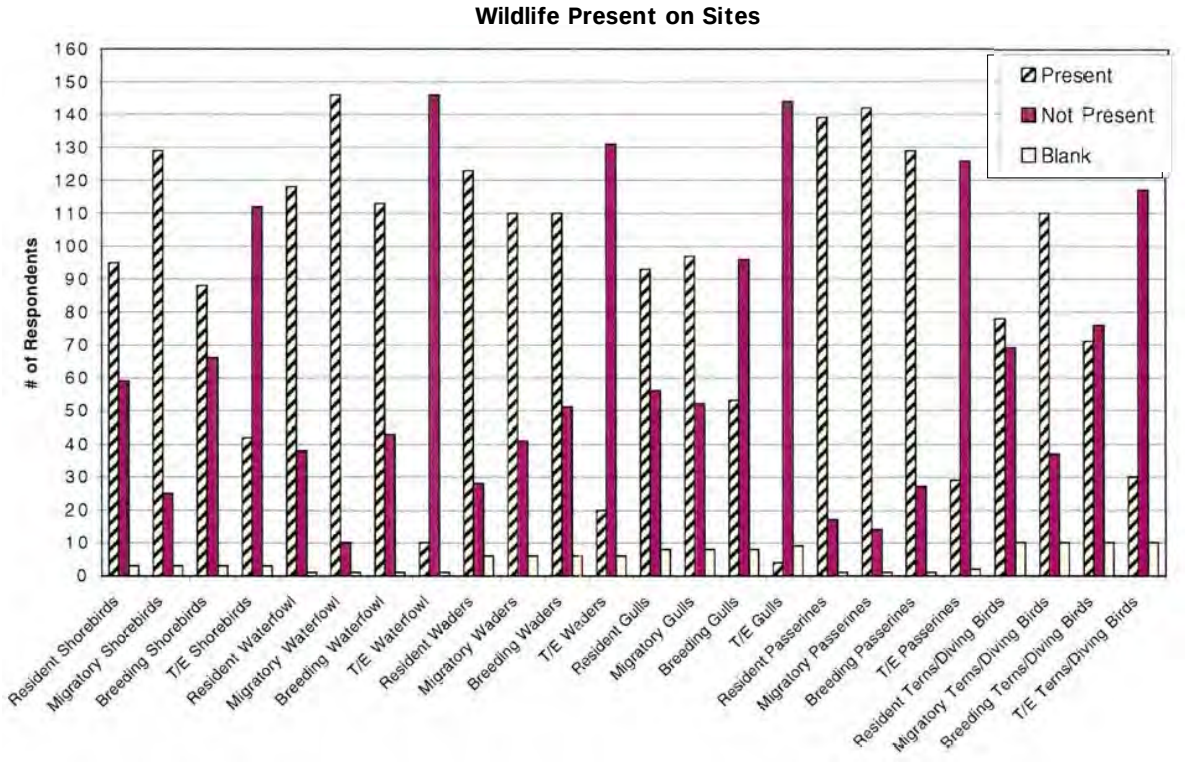

Figure 7a. Types of Wildlife at Responding Sites

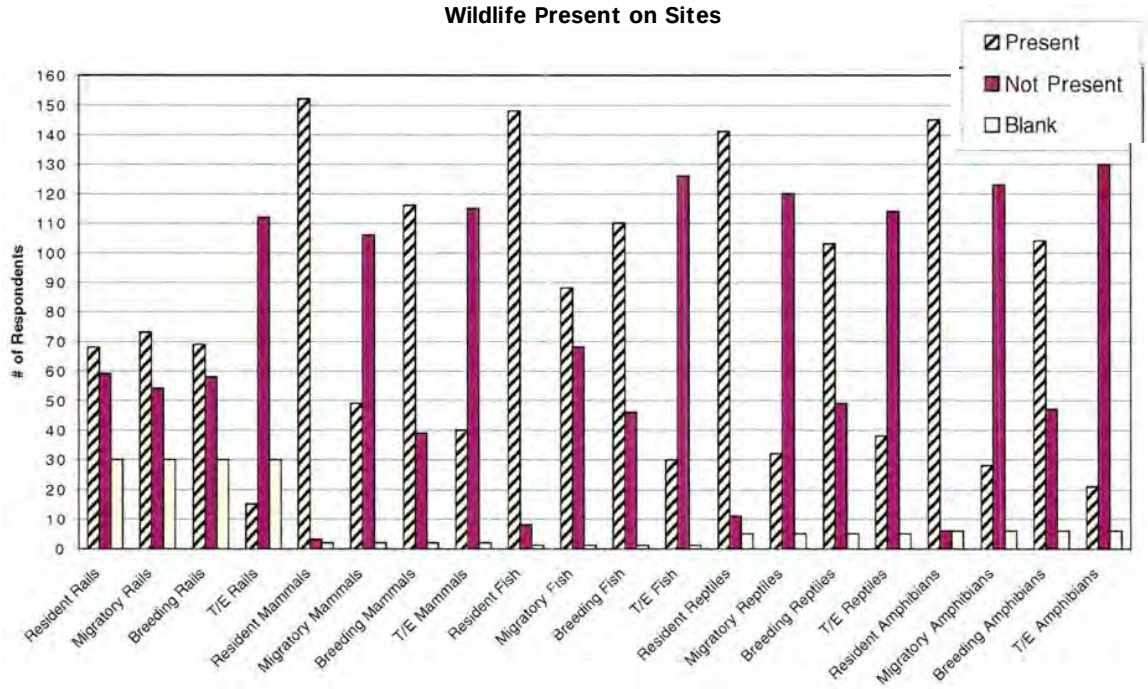

Figure 7b. Types of Wildlife at Responding Sites, Cont.

Respondents were then asked to identify the most common wildlife type(s) at their sites (Figure 8). The most common wildlife type identified were waterfowl, followed by passerines, then mammals.

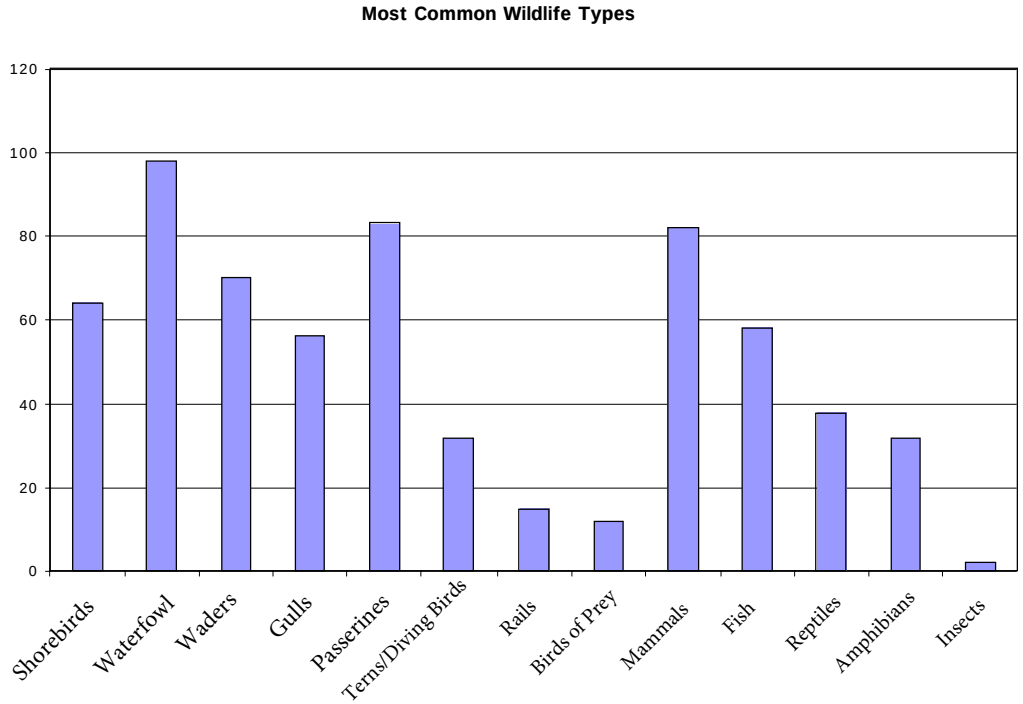

Figure 8. Most Common Wildlife Types Identified at Responding Sites

The responding sites also contained various amounts of trails open to the public, as shown in Figure 9, with the majority of sites containing between 1 and 10 miles of trails open to the public.

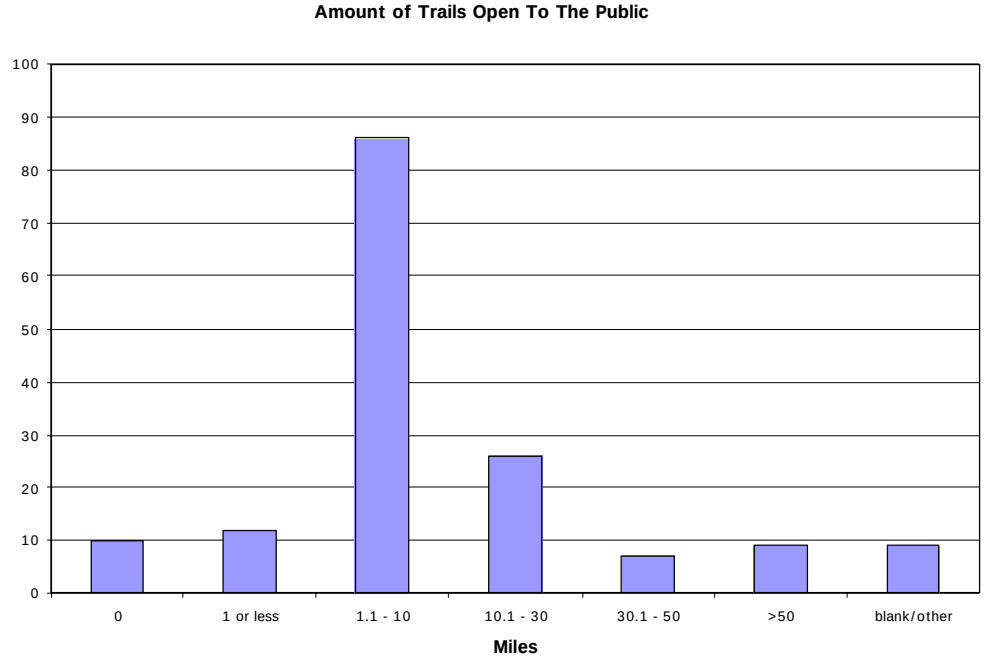

Figure 9. Amount of Trails Open to Public at Responding Sites

Finally, the responding sites had various types of adjacent land uses as shown in Figure 10. The most common types of adjacent land uses were open space, residential rural, and agricultural. Types of adjacent land uses identified under "other" included mining, timber harvest, hunt clubs, native villages, golf course, roads, open water, dump site/landfill, silviculture, government/military, oil/gas, and residential suburban.

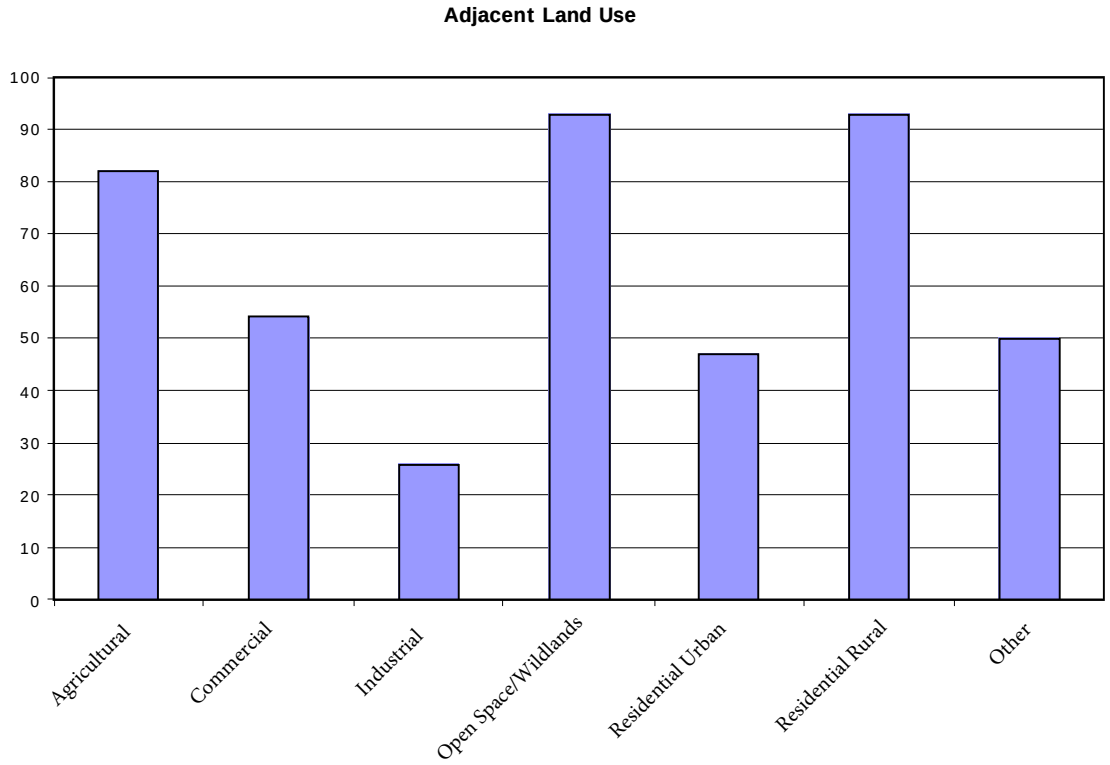

Figure 10. Types of Land Use Adjacent to Responding Sites

Human Interaction with Wildlife

Respondents were asked a series of questions regarding human interaction with wildlife at their sites.

The number of visitors at the sites ranged from 100 to five million (Figure 11). Most of the sites had a high degree of visitor use, between 100,000 and 1 million visitors in the last calendar year.

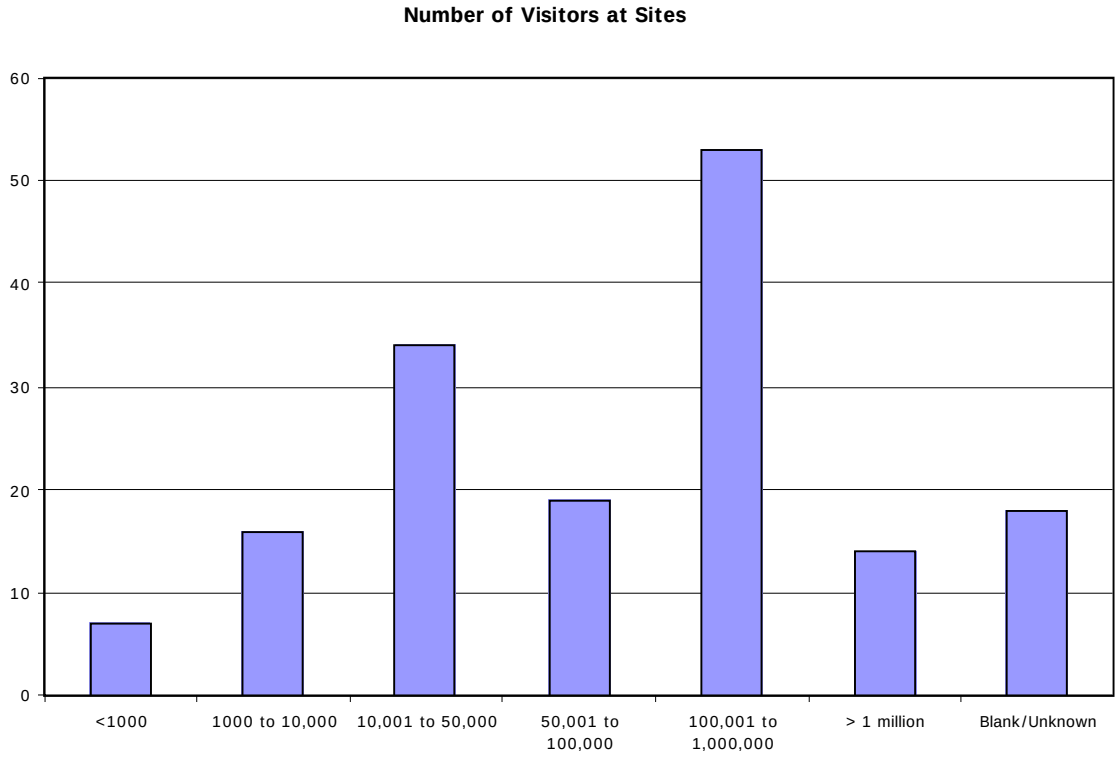

Figure 11. Number of Visitors to Responding Sites During Last Calendar Year

Respondents were asked how, if at all, they monitor impacts on wildlife from recreational activities at their sites (Figure 12). The vast majority of the respondents indicated they had informal, anecdotal, or observational monitoring and/or some degree of formal monitoring or surveys at their site (often species specific). The blank/other category includes answers that were unclear as well as blank answers.

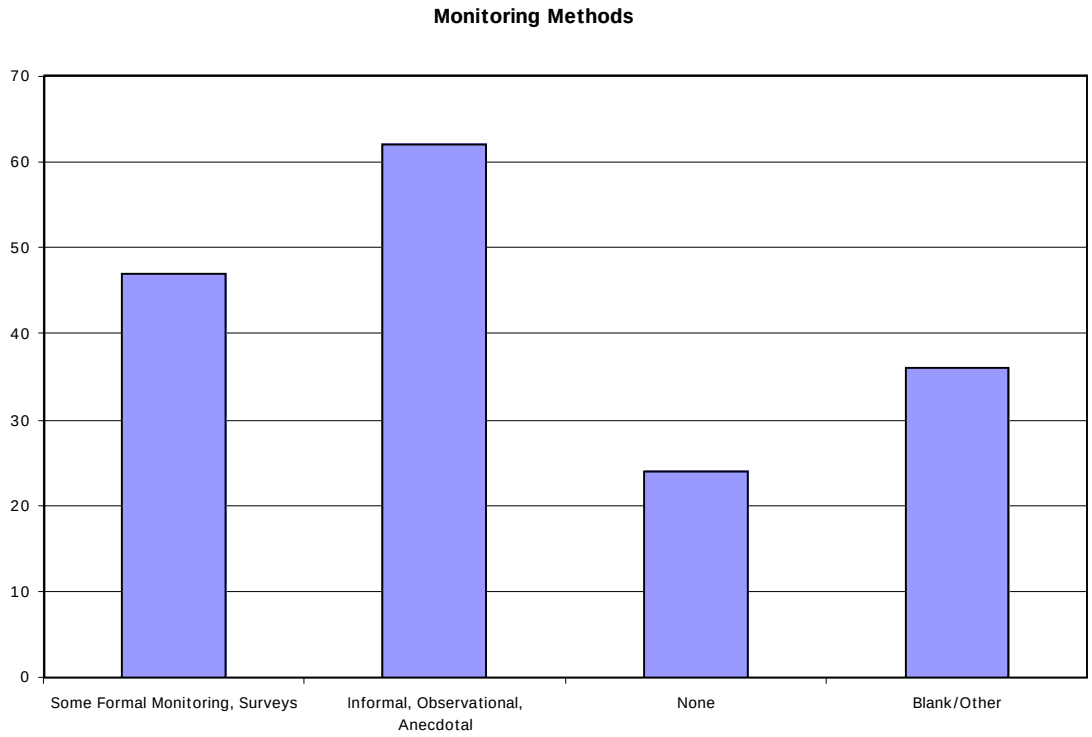

Figure 12. Methods of Monitoring Impacts on Wildlife From Recreational Activities on Responding Sites

Respondents were asked to identify all observed or documented effects on wildlife by activity type. Respondents were asked to identify both immediate effects (such as alarm calling, nest abandonment, flushing, reduced feeding due to increased vigilance, site abandonment, or fatality) and long-term effects (such as decreased reproductive success, site abandonment, decreased population within species, or decreased number of total species). Respondents were not asked to specify whether observed or documented effects were positive or negative. Figures 13a and 13b show results for those activities present ("activity not present" or blank answers are not included in results).

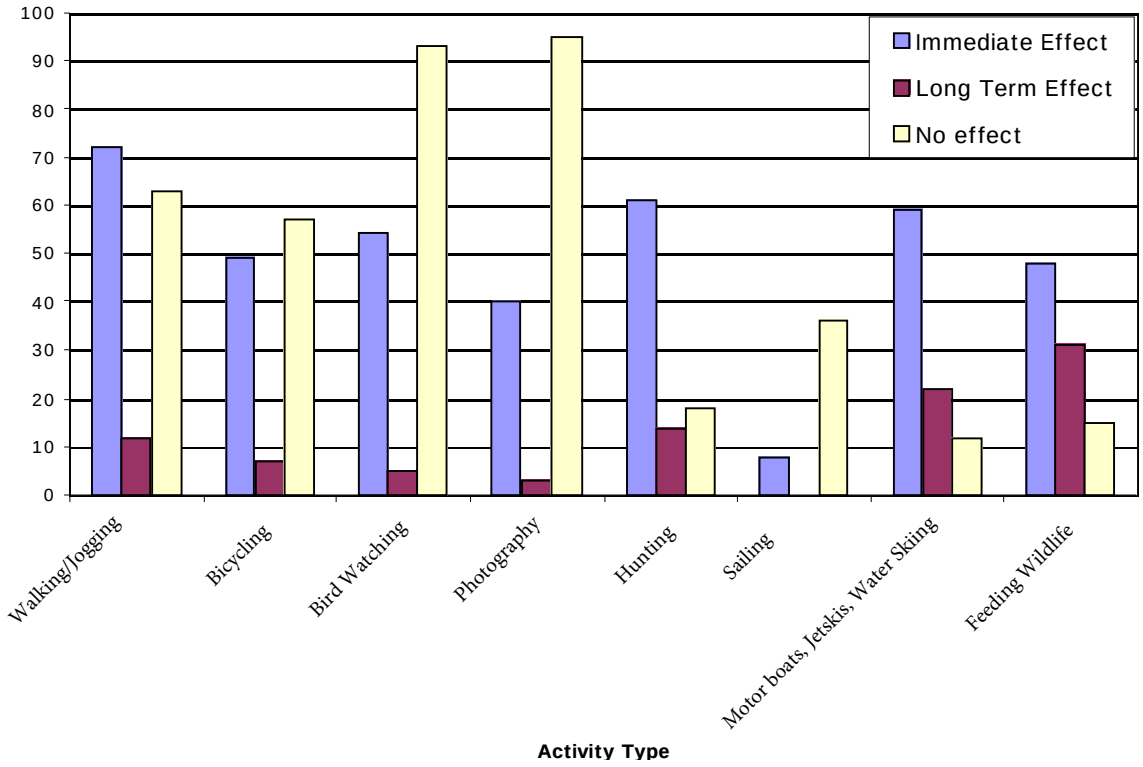

Figure 13a. Reported Observed or Documented Effects on Wildlife at Respondents' Sites

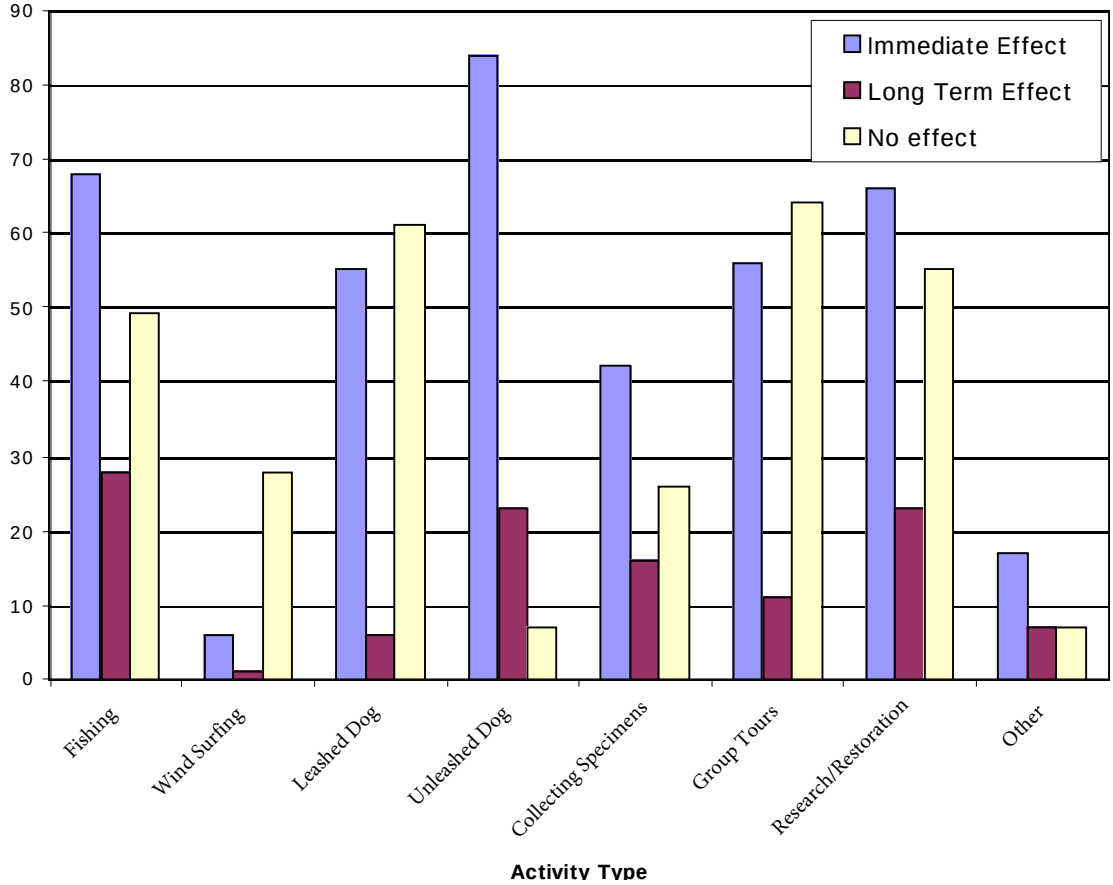

Figure 13b. Reported Observed or Documented Effects on Wildlife at Respondents' Sites, Cont.

It is important to note that respondents were not asked to correlate observed or documented effects on their sites with any other factors such as intensity of human use or management and design strategies employed at the sites. For example, seven respondents specified very low visitation at their sites (1000 or less visitors in the last calendar year) which may have affected their answers about observed or documented effects (i.e., no effect due to low intensity of human use). Similarly, the perceived effectiveness of various management strategies may have also affected responses regarding observed or documented effects of human activities (i.e., effects may have been avoided or minimized due to specific design and/or management strategies).

Finally, respondents were asked to provide any additional information that may help understand the effects of human activities on wildlife at their site. As expected, responses to this open-ended question varied, with 89 respondents answering. Many respondents mentioned specific conflict areas on their sites (i.e., Bear/people interactions, poaching, foot traffic on dunes, effects of light on sea turtles, vehicle/wildlife conflicts, photography, illegal uses, etc.).

Two respondents stated that effects were species specific. Three respondents indicated generally that shorebirds are easily disturbed by human activities, and one respondent cited observed movement of shorebirds away from trails. One respondent stated they had observed birds temporarily flushing at the site from every activity. Two respondents indicated location, seasonal modifications, and/or environmental factors as important modifiers of degree of impact of recreational

use. Two respondents indicated wildlife habituation as a reason for low/no impact at their site. One respondent observed that pedestrian traffic appeared to cause more disturbance to wildlife than vehicular traffic and one respondent observed no apparent conflicts between resting bald eagles and park visitors.

Many respondents discussed degree of use on their site. Fifteen respondents mentioned low human use of their site. Nine respondents mentioned use restrictions or discussed how access is controlled or limited at the site to limit impact. Two respondents felt that a high concentration of people negatively impacted wildlife at their site. One respondent stated it would be "misleading" to claim that any human activity has no effect. Four respondents discussed educational programs at their site. One respondent specified no observed impacts with multiple users on site. One respondent felt that activities on site resulted in a mostly "incidental" disturbance to wildlife.

Design And Management Strategies

Respondents were asked a series of questions regarding siting, design and management strategies on their sites. All of the respondents employed one or more strategy(ies). Figure 14 shows the number of respondents who employed each type of design and management strategy. The vast majority of all respondents felt that their design and management strategies were at least somewhat effective in avoiding or reducing impacts on wildlife from human activities.

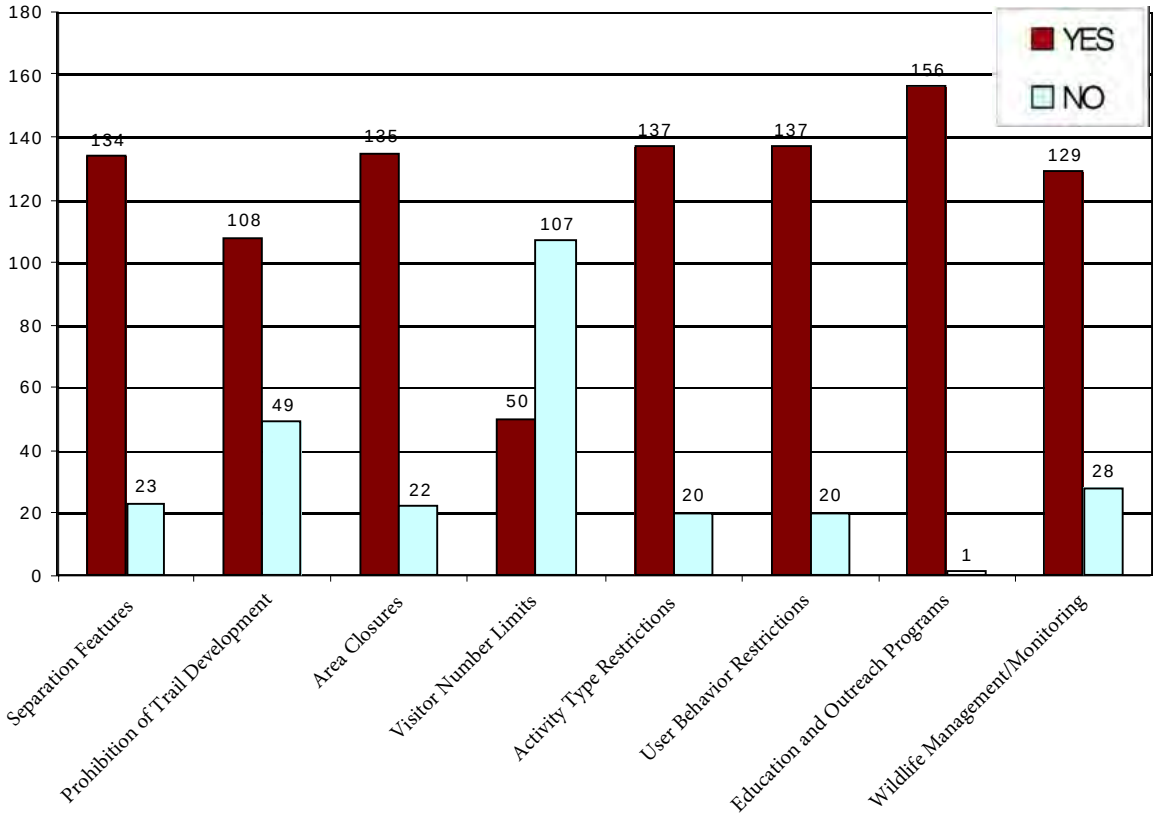

Figure 14. Design and Management Strategies Employed at Responding Sites

The following sections describe responses to design and management questions in more detail.

1. Trail Siting and Buffer Design

Trail Types and Separation Features. Respondents were asked to identify what trail types and features are present on their sites and of those trail types and features, which they felt are effective at avoiding or reducing recreational impacts on wildlife and why.

Loop trails were the most common trail type present at the sites (Figure 15), and vegetative buffers were the most common separation feature at the sites (Figure 16).

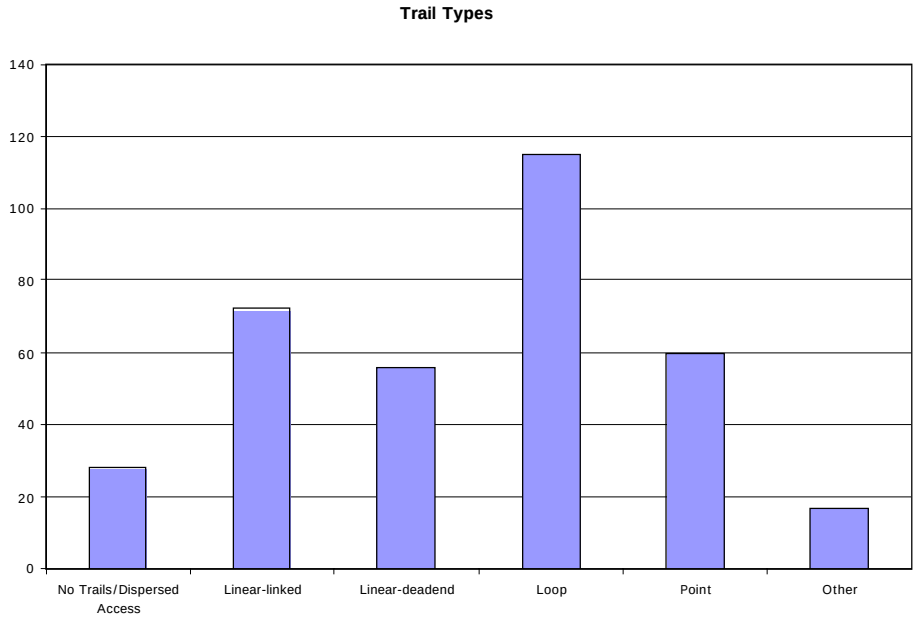

Figure 15. Types of Trails Present at Responding Sites

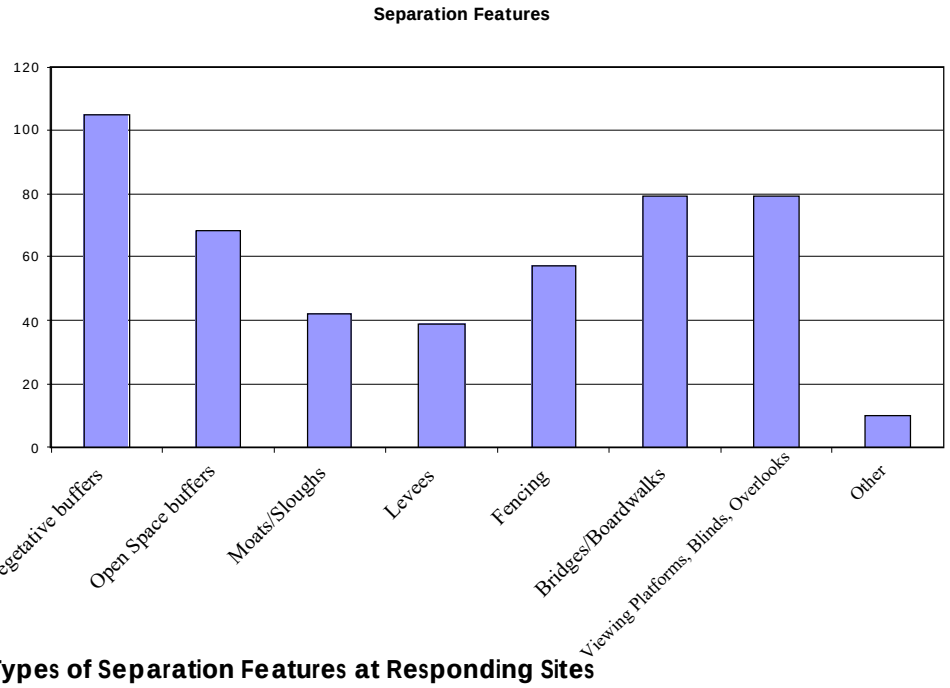

Figure 16. Types of Separation Features at Responding Sites

Vegetative buffers were the feature most often cited by respondents as effective at avoiding or reducing recreational impacts (43)(though it should be noted that vegetative buffers were also the most commonly present feature as shown in Figure 15). Reasons commonly cited for effectiveness included the benefits of vegetation for wildlife shelter and habitat (7), for visual screening (8), and for noise reduction (4). Vegetative buffers that discourage access (i.e., with thorns, etc.) were indicated several times as being particularly effective. One respondent also mentioned the erosion control benefits of vegetative buffers, and one respondent cited the "naturalness" of using a vegetative buffer as a benefit. The cost-effectiveness of vegetative buffers was also cited as a benefit (as compared to other features). Potential problems cited by respondents with vegetative buffers include that they don't always keep out dogs and that they may not allow for desired visual access.

After vegetative buffers, both bridges/boardwalks and viewing platforms/overlooks were the features most often cited as being effective (30 each). Bridges/boardwalks and viewing platforms/overlooks were also tied as the second most commonly present feature at the sites. By far the most common benefit cited for both bridges/boardwalks, and viewing platforms/overlooks was that the features restrict/confine/structure access. Both features were also cited as providing predictability of human use for wildlife, and in preventing the creation of alternative "social" or "renegade" trails (guard rails on boardwalks were specifically mentioned). Viewing platforms were cited as effective due to the ability to view wildlife at a distance (thus avoiding contact), and by providing an interesting destination for public (increased visitor satisfaction). Boardwalks were cited as being particularly good for protection of certain types of habitat (wetlands, sand dunes, salt flats) and species (i.e., protection of seabird nesting burrows). A problem cited for both viewing platforms and boardwalks was cost (for both construction and maintenance).

Fencing was the third most cited effective feature, followed by open space buffers. Fencing was cited as effective at preventing access into sensitive areas by both people and dogs. Fencing allows some visual access while preventing physical access, and can protect restored areas (i.e., allowing vegetation to grow). Fencing was also cited by one respondent as the preferred method to protect bluff slope habitat from public access impacts. Potential problems cited with fencing were unattractiveness and cost. A commonly indicated benefit of open space was potential large distance between public and wildlife, which creates room for wildlife to see and react to public (may allow for wildlife avoidance of public, or wildlife escape routes).

Moats, sloughs, and levees were cited as most effective about five times each. The cited benefits of moats, sloughs, and levees include the creation of physical separations (often unpassable) and distance and the confinement/restriction of public access.

In terms of trail types, perimeter/loop trails were most often cited as the most effective trail type (loop trails were also cited as the most common type of trail present). Cited benefits of loop trails included reduction of traffic (public passes only once, generally one direction), looped trails provide a focused use that helps prevent renegade trails, and they require only one trailhead/parking area. Linear dead end trails were cited as potentially encouraging renegade trails as public are enticed to wander past the end of the trail. There were several comments on the benefits of trails in general including providing the "path of least resistance" for public which

prevents renegade trails and helps provide for public safety/confines public use. Another benefit of trails and separation features in general that was cited several times was predictability. Paved trails were mentioned as having positive noise reduction values and limiting cuts in ground. Several respondents cited the benefits of having interesting destinations and routes in general.

Prohibition of Trail Development. 107 respondents indicated there are areas within their sites where trail development is prohibited. 42 sites do not have areas prohibited from trail development. Eight respondents did not answer the question.

The most common reason indicated by respondents for prohibiting trail development was for habitat/species protection (91). The 91 references to habitat/species protection included:

- 28 general references to habitat or species protection
- 20 specific references to wetlands/marshes/bogs
- 6 specific references to dunes
- 12 specific references to threatened/endangered species
- 5 specific references to waterfowl and 3 references to birds in general
- 10 specific references to nesting species/areas
- 2 specific references to breeding species (marine mammals and birds)
- 1 each specific reference to riparian habitat, monarch butterflys, mammals, shoreline protection, and agriculture protection

The second most common reason indicated for prohibiting trail development was due to designated wilderness area, research area, or site regulations (32). Eight respondents indicated protection of cultural/archeological/historic resources, and ten respondents indicated inhospitable terrain/safety. Five respondents indicated that trails were prohibited to provide a buffer for adjacent property or for privacy, two respondents indicated erosion control, and two respondents indicated deterrence of access in general as reasons for prohibiting trail development. Additional reasons indicated included money/staff (2), lack of space (2), to prohibit dumping, to protect hunting area, to prevent predator access, to prevent native species displacement, and lack of public demand.

Respondents were asked to explain if they felt prohibition of trail development has or has not been an effective management technique for avoiding or reducing the recreation impacts on wildlife at their sites.

The majority of respondents indicated prohibition of trail development has been an effective management technique (75). Four respondents mentioned that trail prohibition is effective, but only if alternative adequate trails are provided (one respondent said observation platforms are sufficient as alternatives to trails). Four respondents cited limiting of people as the reason for trail prohibition effectiveness. Two respondents indicated prevention of habitat destruction and disturbance. Two respondents indicated that the prohibited areas must be properly controlled and signed and one respondent cited the need for species specific prohibitions. Other reasons for effectiveness included distribution of people over a broader area and distribution of people to perimeter of the area.

Seven respondents felt that prohibition of trail development has not been an effective management technique for avoiding or reducing the recreation impacts on wildlife at their sites. Four respondents indicated the lack of public abiding by rules as the reason for ineffectiveness.

One respondent felt that forcing dispersed access had a negative effect, and one respondent indicated the resulting lack of visitor predictability resulting from prohibition of trail development.

Eight respondents did not know if prohibition of trail development has or has not been an effective management technique. Three respondents indicated the need for more science, before being able to judge effectiveness, and two respondents indicated the impacts to wildlife from trails were less than impacts from commercial and residential development.

Respondents were asked for any additional information that may help in understanding the trail siting and buffer design at their sites. Respondents' comments included several specific trail siting and design strategies at their site, such as trails built on levees, trails built on existing roads, the use of trial and error trail siting, species-specific needs resulting in trail design on a case-by-case basis, trails built for cost-effectiveness, recreational and educational goals as guides for trail development, respect for site as guide for trail development, and avoidance of wildlife contact as guide for trail development.

2. Public-Use Management and Stewardship

Area Closures. Respondents were asked to identify which types, if any, of area closures they employ at their site (Figure 17).

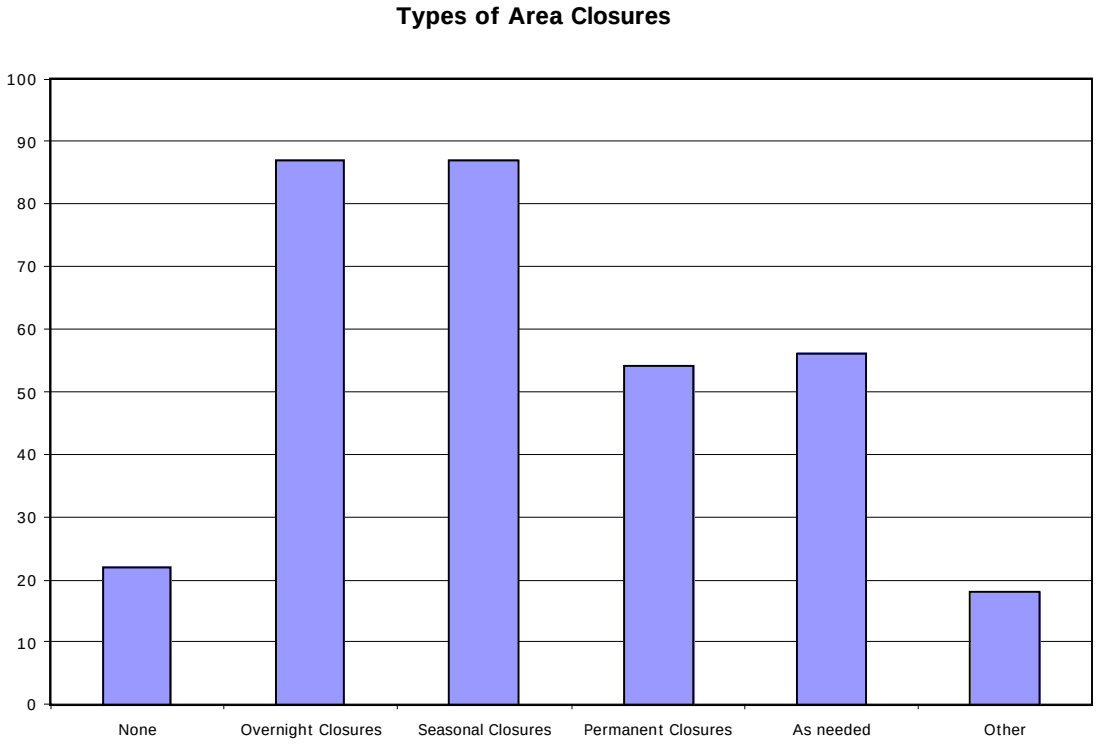

Figure 17. Types of Area Closures Employed by Respondents

The most common types of area closures employed by respondents are overnight and seasonal. Many respondents also employ area closures on an "as-needed" basis. Many of these respondents indicated that the reasons for "as-needed" closures were based on seasonal species-specific needs, so could have been grouped with seasonal closures (nineteen respondents total). Specifically, respondents indicated closures on an "as-needed" basis for bald eagle nesting sites, colonial nesting shorebirds, nesting animals in general, breeding bird colonies, heron rookeries, alligator nesting, wood duck nesting, and shellfish harvesting. Additional "as-needed" reasons for closures included flood conditions, drought conditions, storm damage, or general repair needs (21), high public use (3), public safety (2), specific management needs (2), and for research. Six respondents who marked "as-needed" did not specify a reason. Closures indicated under the "other" category included the limiting of access *type*, construction closures, closures of dune areas only, closure of banding areas, and closure of fields irrigated with sewage.

Respondents were asked to explain why they feel closing certain areas of their site has or has not been an effective management technique for avoiding or reducing the impacts of human activities on wildlife.

The following provides a summary of respondent comments and are grouped, to the degree possible, by closure type. General overall responses and additional specific responses are also summarized.

General Comments. The overwhelming majority of the respondents felt area closures have been an effective management technique. Several respondents, however, cited compliance issues as a challenge for effectiveness of area closures. Specifically, three respondents indicated that closures are effective only if enforced and maintained on a constant basis. Two respondents cited low compliance with closures at their site and one added that though law enforcement responses can be effective, they come with high costs and negative public relations. Another respondent indicated that due to many points of entry and limited staff, encroachment on a closed area could occur. Similarly one respondent indicated that closures are effective on inland sites, but not effective along the shoreline. One respondent indicated the importance of involving the public in area closings and openings in an effort to get public "buy in" and to increase compliance. Finally, one respondent cited the practice of not marking trails in an effort to decrease access without employing official area closures.

Several respondents indicated that area closures are driven by safety and maintenance needs not wildlife protection, though one respondent cited the indirect benefits for wildlife of closures for personal safety. Additionally, one respondent cited the safety benefits and visitor satisfaction from closures that separate uses.

Overnight Closures. The most common reason given for why overnight closures have been an effective management technique for avoiding or reducing the impacts of human activities on wildlife can be grouped under the general category of wildlife/habitat protection/recovery (26). More specific wildlife protection benefits mentioned included several references to protection of nesting sea turtles (5), waterfowl (3), nesting shorebirds (3), and nocturnal/crepuscular foraging animals (2). Also mentioned was protection of the Northeastern Beach Tiger Beetle, migratory nesting species, protection of bear feeding areas, and generally providing higher quality nesting and feeding habitat. Finally, two respondents mentioned better security as the reason why overnight closures have been effective.

Reasons indicated for possible ineffectiveness of overnight closures included lack of visitor compliance with closure (3). One respondent couldn't speak to effectiveness due to lack of data, and one respondent stated no impact "either way" was noticed.

Seasonal Closures. Like overnight closures, the most common reason cited for effectiveness of seasonal closures can be grouped under the general category of wildlife/habitat protection/recovery (28). Specific wildlife protection benefits cited included protection for nesting birds (11), waterfowl (8), nesting turtles (2), and eagle nests (2). Additional comments included the provision of higher quality nesting and feeding habitat, protection of mouse burrows, alligator nests, shorebirds, waders, breeding harbor seals, Canada geese, Piping plover nesting and migratory nesting, as well as shellfish regeneration and intertidal species recovery. Two respondents mentioned the potential cost savings of seasonal closures when visitation is low.

One respondent indicated compliance issues as a potential reason why seasonal closures may not be effective, and one respondent cited lack of data available to evaluate effectiveness.

Permanent Closures. The majority (16) of the respondents who employ permanent closures at their sites indicated general wildlife/habitat protection/recovery as why the closures have been effective. Specific wildlife protection benefits cited by respondents included protection for waterfowl (4) and waders (2), provision of higher quality nesting and feeding habitat (2),

reduction of nest abandonment, protection for migratory nesting, increase of shellfish population, and protection for endangered plant species. One respondent indicated that upon permanently closing a two-mile trail, bald eagles have successfully bred every year where previously they failed to produce any young.

One respondent stated that the significance of no access in terms of effect on wildlife is highly debated.

Visitor Number Limitations. 105 respondents indicated they do limit the number of visitors on their site. 48 respondents do not limit the number of visitors, and 4 respondents did not answer.

The most frequently given reason for limiting the number of visitors was due to the carrying capacity of the habitat or the facility (41), followed by the desire to decrease impact on wildlife/habitat (20). Other reasons for limiting numbers of visitors included increasing visitor satisfaction (7), staff limitations or logistics (4), visitor safety (4), legislation or regulations (2), and to limit impacts to research (1).

Respondents were asked to explain why they feel that visitor limits have or have not been an effective management technique for avoiding or reducing the impacts of human activities on wildlife.

The vast majority of respondents indicated they felt visitor limits have been an effective management technique for avoiding or reducing impacts. The most frequently given reason for why limits have been effective was the reduction of impacts on wildlife and/or habitat (22), followed by reduction of impacts on habitat. Four respondents indicated increase in visitor satisfaction as to why limits have been effective. Other reasons for effectiveness included safety, regulation of harvest/overuse of resources, and provision for short term protection for wildlife. One respondent indicated that visitor limits are especially effective when combined with education. Two respondents mentioned the need to define levels of acceptable change, select indicators, and set carrying capacity.

Two respondents indicated that visitor limits have not been an effective management technique for avoiding or reducing impacts on wildlife. One respondent indicated that limits do enhance the visitor experience, however, and one respondent indicated that parking has no effect on wildlife in a day use area.

Five respondents indicated that they did not know if visitor limits have or have not been an effective management technique. Three respondents indicated a lack of data, and one respondent pointed to a lack of staff and funds for monitoring.

Visitor Activity Restrictions. 137 respondents restrict certain activities on their sites. 17 respondents do not restrict activities, and three respondents did not answer the question.

Respondents were asked to specify what activity types they restrict and why, and to explain why they feel that restricting certain activities has or has not been an effective management technique for avoiding or reducing recreational impacts on wildlife at their site.

Respondents' answers to what types of activities are restricted can be classified into eighteen general categories (Figure 18). The following provides a summary of respondent comments and are grouped, to the degree possible, by type of restricted activity. General overall responses and additional specific responses are also summarized.

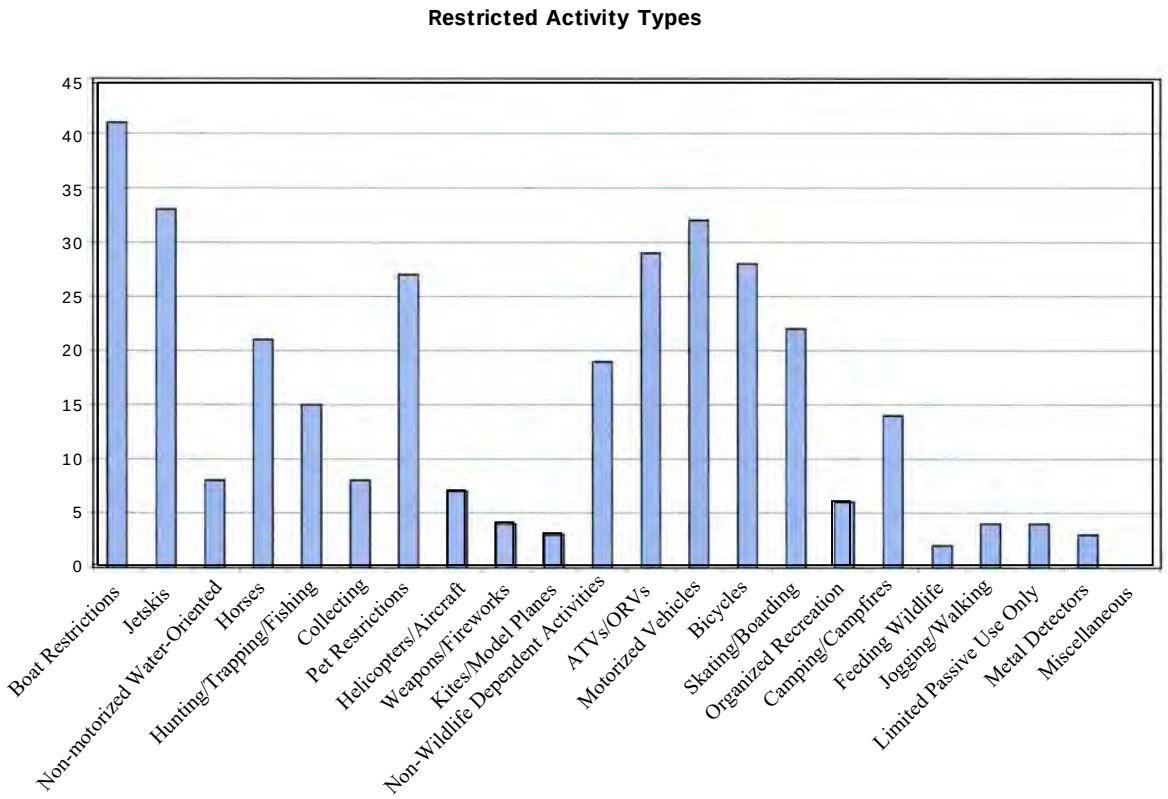

Figure 18. Types of User Activity Restrictions Employed by Respondents

General Comments. The vast majority of the respondents felt restrictions on activity types were an effective technique to reduce impact on wildlife, though two respondents in general comments indicated restrictions are only effective if enforced. One respondent indicated in a general comment that activity type restrictions had not been effective because most impacts came from permitted uses such as hiking and camping. Five respondents specifically said they did not know if activity type restrictions were effective due to lack of data, lack of enforcement, or because the restrictions were not specifically for wildlife.

Boat Restrictions. Thirty respondents employ some sort of boat restrictions including restrictions on type, size, speed, and accessible area. All respondents who employ restrictions on boats felt the restrictions were effective. The most frequently cited reason for boat restrictions was to prevent or reduce disturbance to wildlife, especially nesting shorebirds and waterfowl. Additional reasons for effectiveness indicated by respondents included; reduction of noise pollution, reduction of impacts from wakes, reduction of hydrocarbons in water, reduction of exotic invasive species (by restricting gas engines), reduction of propeller scarring of seagrass beds.

One respondent indicated insufficient staff to regulate restrictions as a potential challenge to effectiveness.

Jetskis. Although jetski restrictions could fall under the general heading of boat restrictions, they are discussed under a separate category due to the high volume of respondents who specifically mentioned jetski restrictions.

All respondents who imposed jetski restrictions at their sites felt the restrictions were effective in reducing disturbance to wildlife from noise, pollution, harassment, and habitat impacts. One respondent specifically noted that minimization of jetskis has encouraged birds to use the area for feeding.

Non-motorized Water-Oriented Uses. Restricted uses under this category include windsurfing and swimming. Respondents gave no specific comments on reasons for limitations. One respondent indicated that insufficient staff limited efforts to regulate windsurfing restrictions. No other specific comments on effectiveness were given.

Horses. Respondents felt limitation of horses was an effective technique because horses increase the environmental impact of trails, horses can cover much area and so increase access to outlying areas, and because horses directly disturb wildlife. One respondent indicated, however, that though horses on their site are restricted to trails, the riders do stray from the trails.

Hunting/Trapping/Fishing. The only specific comment related to hunting/fishing/trapping restrictions was that hunting restrictions are difficult to enforce.

Collecting. One respondent indicated that restrictions on collecting have helped educate the public about the resource. One respondent indicated that restrictions on collecting are difficult to enforce.

Pet Restrictions. Within the category of pet restrictions, eight respondents specifically mentioned restrictions on unleashed dogs.

Most respondents felt that pet restrictions were an effective technique to avoid or reduce impacts on wildlife because pet restrictions benefit sea turtle and shorebird nesting success, beach mice, waterfowl and shorebirds. One respondent indicated that pet restrictions have not been effective due to political pressure to allow fox hounds on the site, and one respondent mentioned the difficulty of enforcing leash restrictions.

Please note that pet restrictions are also discussed under restrictions on user behavior.

Kites/Model Planes. One respondent indicated that kites may resemble birds of prey.

Non-Wildlife Dependent Activities. National Wildlife Refuges by law only allow specified wildlife dependent activities. Respondents indicated that restricting non-wildlife dependent activities is an effective technique because: wildlife dependent activities have less impact, are less destructive and are less disturbing to wildlife; sanctuaries for wildlife are provided; restricting activities reduces the total number of visits and, therefore, minimizes adverse effects on wildlife, allows managers time to determine impacts and adjust accordingly, provides for greater visitor satisfaction, and the associated cost savings of restricting uses can be used to enhance management programs or wildlife oriented recreational opportunities.

ATVs/ORVs. The vast majority of the respondents felt restricting ATVs/ORVs was an effective management technique. The most common benefits of restrictions indicated by respondents were: protection of ground nests; reduced impact to vegetation and soil; reduced wildlife

mortality; protection of wildlife habitat; limitation of new areas opened up for predator travel; wetland protection from rutting, trail hardening, and channelization of water sheet flow; protection of dune habitat; decrease in noise pollution; decrease of human incursion into isolated habitat areas.

One respondent mentioned the difficulty of enforcing ATV/ORV restrictions.

Motorized Vehicles (including cars, motorbikes, snowmobiles) . All the comments on restrictions of motorized vehicles felt the restrictions are an effective technique. Specific benefits of restrictions indicated by respondents include: protection of dune habitat; reduction of noise; reduction of erosion; reduction of wildlife mortality; protection of vegetation from severing, trampling, and compaction; limitation of overall access to site; reduction of impacts to shorebirds, beach mice, and seals.

Bicycles. The majority of respondents felt restrictions on bicycles were an effective technique. Specific benefits of bicycle restrictions indicated by respondents included: protection of ground nests, reduction of soil compaction and erosion, protection of vegetation, decrease in user conflicts, reduction of environmental impact of trails, limitation of overall access to site, reduction of wildlife disturbance.

One respondent indicated that since bicycles do not have a large negative impact on wildlife, restrictions on bicycle use is not an effective technique to reduce impacts.

Skateboarding/Skating/Sandboarding. One respondent indicated that rollerblades increase environmental impact of trails.

Active Organized Recreation. Activities under this category include frisbee, golf, ball-playing, and horseshoes. No specific comments were provided for this category.

Camping/Campfires. One respondent indicated that limiting camping to designated areas reduces damage to natural resources.

Jogging/Walking. One respondent indicated that night walking on beach impacts sea turtles. One respondent indicated jogging is more disturbing to wildlife and detracts from wildlife oriented recreation.

All but Limited Passive Use . One respondent indicated that restricting uses to all but limited passive use allows area to support unique ecological features. Respondents also indicated that foot traffic only on trails increases visitor satisfaction, eliminates noise disturbance of wildlife, reduces trail erosion, and limits costs associated with maintenance.

Miscellaneous. This category includes all other restricted activities indicated by respondents including metal detectors, sunbathing, chainsaws, generators, and dumping.

Restrictions on User Behavior. 137 respondents restrict user behavior at their sites. 13 respondents do not restrict user behavior and seven respondents did not answer.

Respondents were asked to specify which user behaviors are restricted, the reason for the restrictions, and why they feel user behavior restrictions have or have not been an effective management technique for avoiding or reducing recreational impacts at their site.

Types of restrictions on user behavior can be grouped into sixteen general categories (Figure 19). The following provides a summary of respondent comments and are grouped, to the degree possible, by type of user behavior restriction. General overall responses and additional specific responses are also summarized.

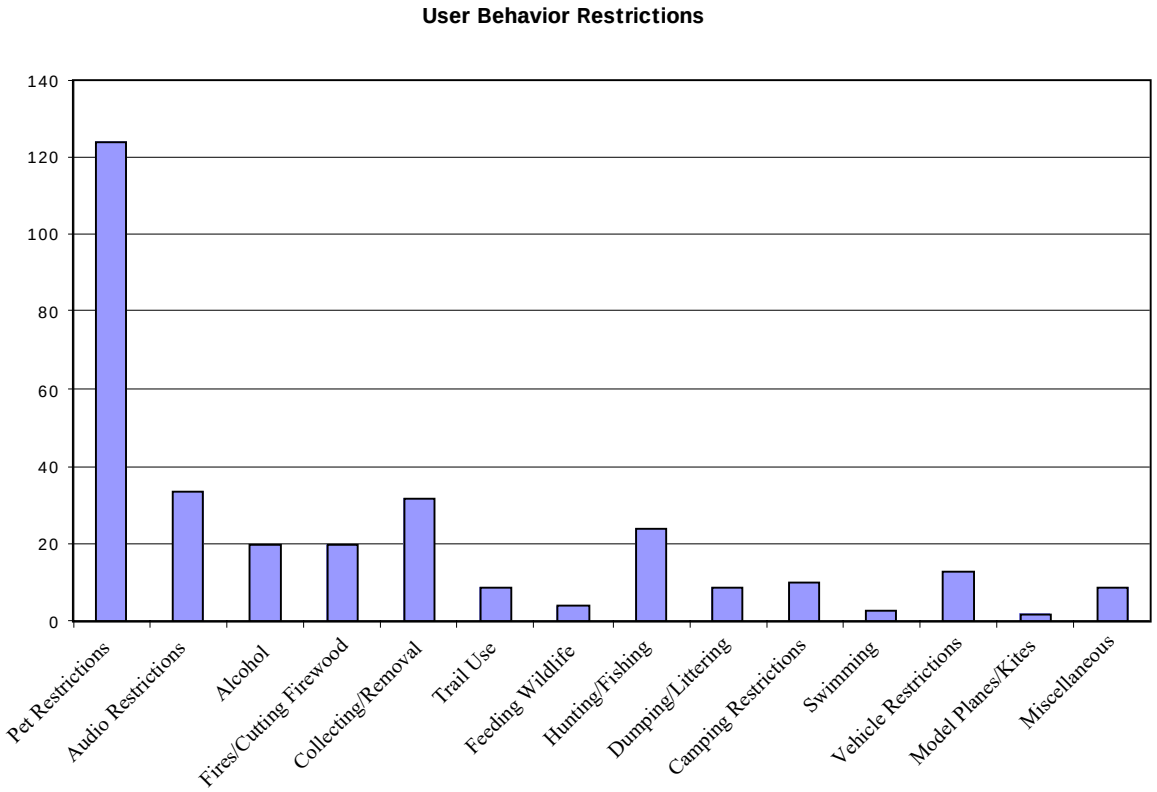

Figure 19. Types of Behavior Restrictions Employed by Respondents

General Comments. The majority of the respondents felt that restricting certain activities was an effective management technique for avoiding or reducing recreational impacts on wildlife. In general, respondents indicated that activity restrictions protect resources overall. More specifically, respondents indicated that restricting type of use restricts the overall number of potential users, keeps public use focused in developed areas, provides continuity for visitors and, if supported by the public, new users will abide by restrictions due to "peer pressure." One respondent indicated that by comparing their site to similar sites, they were able to prevent impacts by imposing proactive restrictions before a problem occurs.

Though only four respondents specifically stated that activity type restrictions have not been an effective technique, several more respondents indicated specific challenges to the success of activity type restrictions. Several respondents indicated the need for enforcement of the restrictions and for education of visitors. One respondent indicated that law enforcement staff (not park staff) lack sensitivity to wildlife needs. One respondent mentioned the specific problem of having a site that has high rate of new visitors, with a high tourist attendance and high rate of

turnover in the community. In this case, efforts to "train" new users must be ongoing and enforcement must be continuous, which is problematic. One respondent mentioned the difficulty of enforcement without being invasive.

One respondent indicated that activity type restrictions control impacts, but do not eliminate them. Finally, one respondent indicated that behavior restrictions are not needed with proper trail siting and design.

Six respondents did not know if restricting activity types was an effective technique. Several indicated lack of data.

Pet Restrictions. The most commonly restricted activity type among respondents falls under the heading of pet restrictions. 24 respondents had general pet restrictions (e.g., no pets), 9 respondents required dogs to be under voice control, 9 respondents specifically allow dogs on the beach, 2 respondents required visitors to clean up after dogs, and 80 respondents required dogs/pets to be on leashes (sometimes of various lengths and in various specific areas of the sites).

The most common reason indicated by respondents for pet restrictions was for the protection of wildlife from harassment. Many respondents indicated benefits to birds from restrictions, specifically shorebirds, waterfowl, overwintering geese, nesting terns, bald eagles, and peregrine falcons. Other wildlife mentioned specifically as benefiting from pet restrictions were sea turtles and sea turtle nests, marine mammals, and terrestrial species. One respondent indicated that pet restrictions were especially effective in avoiding or limiting wildlife impact when wildlife is confined to a small, diminishing habitat. The safety and visitor satisfaction of other visitors was also mentioned frequently as a reason for pet restrictions. One respondent mentioned the secondary benefit of leash laws is they likely encourage owners to pick up waste as well.

Several respondents indicated that the effectiveness of pet restrictions was dependent upon enforcement. One respondent stated that leash laws are commonly ignored, but that compliance increases with visitor education about the benefits of leash laws.

Site Access Restrictions. One respondent indicated that the extremely limited access at their site has increased species productivity and population levels and has allowed previously extirpated species to return to site. One respondent indicated that though access restrictions keep public to a defined area and thus leave other areas for wildlife only, the areas are so small and fragmented that this strategy only works to a small degree.

Please note that access restrictions are also discussed under area closures.

Removal/Collecting. One respondent indicated that though collecting restrictions were put in place to conserve an educational resource (tidepools) birds have also benefited from preservation of a food source.

Feeding Wildlife. One respondent indicated that feeding restrictions keep most species non-aggressive.

There were no additional comments provided for the remaining categories under user behavior restrictions.

Enforcement. Respondents were asked to explain how, if at all, they enforce public use regulations at their site, and why they feel that their public-use enforcement mechanisms have or have not been effective at avoiding or reducing the effects of human activities on wildlife.

Types of enforcement mechanisms indicated can be grouped into 11 general categories (Figure 20). The following provides a summary of respondent comments and are grouped, to the degree possible, by enforcement type. General overall responses and additional specific responses are also summarized.

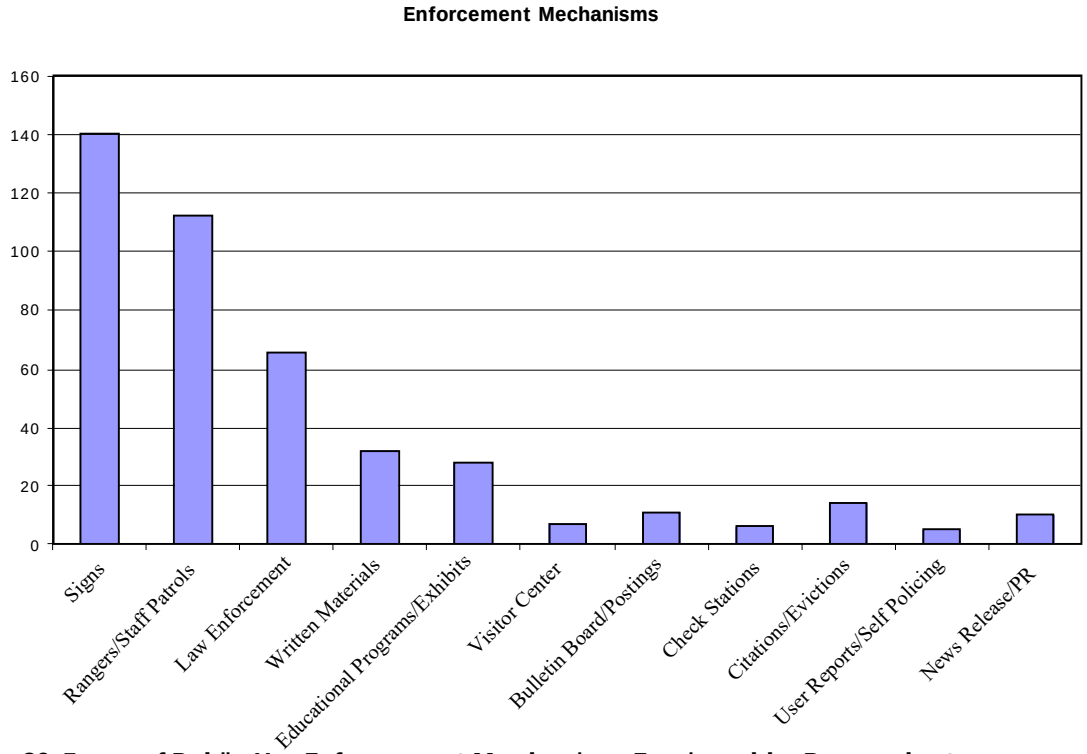

Figure 20. Types of Public Use Enforcement Mechanisms Employed by Respondents

General Comments. The majority of respondents indicated that their public-use enforcement mechanisms have been effective at avoiding or reducing the effects of human activities on wildlife. Comments included the need for various degrees of enforcement, including the comment that simply having some sort of staff presence increases effectiveness (though another respondent indicated that enforcement is only effective if staff witnesses violations), and that the public generally understands and respects environmental messages and conservation ethics and wants to do the "right thing" and that restrictions are more effective with public involvement. However, one respondent also indicated the importance of enforcement to keep public from "taking advantage" of the site and another respondent indicated noticing a resurgence of unacceptable behavior appearing during periods of lax enforcement. One respondent indicated the importance of providing alternative sites for other activities in addition to enforcing

restrictions. Several respondents indicated that enforcement mechanisms assist in educating the public. One respondent indicated that success of enforcement mechanisms was due to docents and self-policing by the public. Many respondents indicated that limited staff and funds affect success of enforcement mechanisms.

Thirteen respondents specifically indicated that enforcement mechanisms had not been effective at reducing or avoiding impacts to wildlife. Several of those respondents indicated lack of staff as a primary reason for reduction of success. Respondents specifically mentioned the difficulty of patrolling outlying areas and the lack of formal entrance and exit areas to monitor area closures. One respondent also indicated that relying on volunteers to assist with enforcement is not generally successful, as most volunteers would rather help with field research, rather than enforcement. Two respondent indicated that enforcement mechanisms are geared towards managing recreational use, not wildlife. Another respondent indicated that public use restrictions were much more effective than enforcement mechanisms in avoiding or reducing impacts to wildlife. One respondent mentioned that being part of a national system was beneficial in that many visitors are familiar with common regulations. Finally, one respondent indicated that there will always be a small percentage of people who do not follow guidelines who will therefore have an impact on wildlife.

Ten respondents did not know if enforcement mechanisms were effective. Many of those respondents required more data.

Ranger Patrols/Law Enforcement. Several respondents indicated that ranger patrols and/or law enforcement were effective enforcement mechanisms because personal contact creates an opportunity to answer questions and educate the public to reduce future violations, especially effective in areas with high repeat usage. One respondent indicated that the public recognized and appreciated the patrols. Several respondents indicated that ranger patrols were effective but that it was impossible to be "everywhere at once." One respondent indicated that seven days a week patrolling has been very effective, though another indicated that random, once a week patrols should suffice. One respondent indicated the success of aerial patrols because they are generally unseen and users know they may be under surveillance. Several respondents mentioned the importance of combining enforcement mechanisms with other techniques such as interpretive programs and signage as being particularly effective. One respondent indicated that law enforcement with strong court support is essential to avoid or reduce human impacts on wildlife. One respondent indicated that similar areas without enforcement mechanisms show escalating law enforcement problems. Two respondents cited ranger patrol/law enforcement as being particularly effective relative to hunting, poaching, and fishing restrictions.

Lack of staff/funds and too large an area to adequately patrol were the most commonly cited challenges for ranger patrol and/or law enforcement success.

Signage. Several respondents indicated that signage is effective when combined with patrolling/staff presence. Two respondents indicated that signage was effective at keeping users within certain areas. Respondents indicated that signage must be properly worded and visible, and colorful and descriptive. One respondent indicated that signage is somewhat effective, but that noncompliance can not be stopped, only deterred.

Printed Material. One respondent indicated that printed material does not work as an enforcement mechanism because the public feels they have certain rights to the site and they "do as they please."

Education. Two respondents indicated that enforcement through education is their most effective tool, though one of these indicated in addition that the education must be ongoing due to new visitors at site. Two respondents indicated a combination of education/interpretive programs with staff interaction/ranger patrols is the most effective enforcement mechanism.

Visitor Center. One respondent indicated the visitor center was a successful enforcement mechanism because all visitors must first stop in visitor center so everyone hears about the site's regulations.

Education and Outreach. Respondents were asked to specify what types, if any, of education and outreach programs they offer (Figure 21).

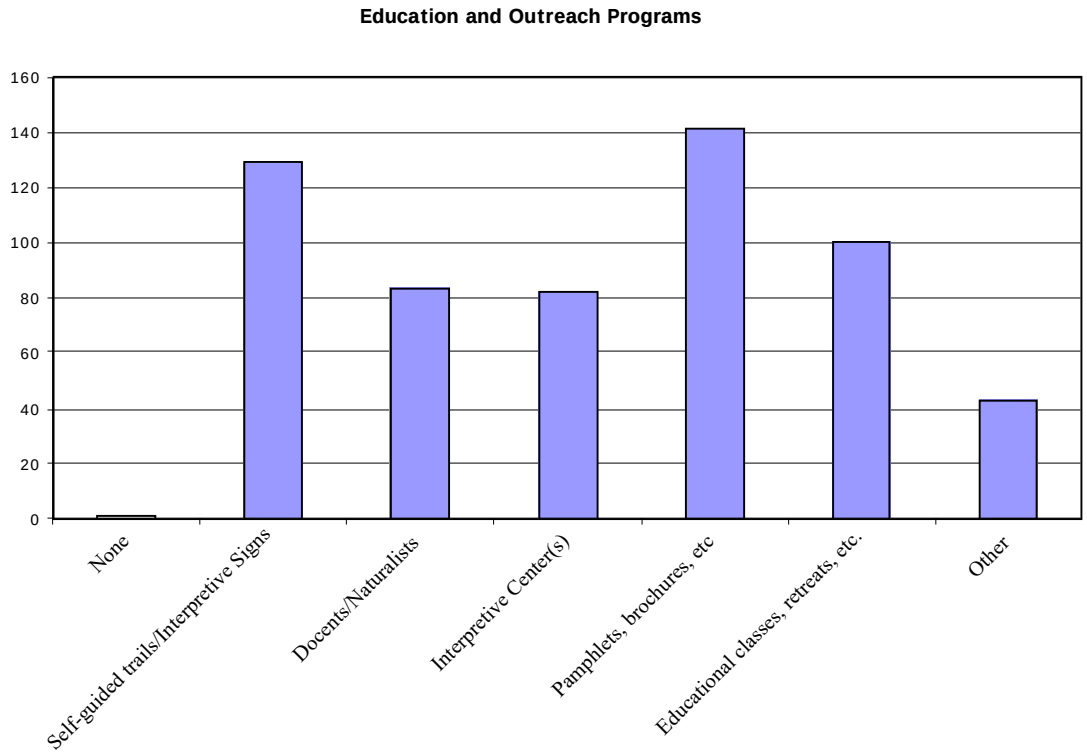

Figure 21. Education and Outreach Programs Employed by Respondents

The most common types of education and outreach programs include the use of written materials and self guided tours/interpretive signs.

Respondents were asked to explain why they feel that education and outreach programs have or have not been an effective management techniques for avoiding or reducing impacts from human activity on wildlife at their site.

The following provides a summary of respondent comments.

General Comments. The majority of respondents felt education and outreach programs have been an effective management techniques. Several respondents indicated educational efforts have resulted in a more educated, responsible and appreciative visitor thereby reducing recreational impacts on wildlife. One respondent indicated that educational efforts result in both immediate and long term behavior changes. Respondents also commented on the benefit of edu-

cation in fostering public support for the site, and a few respondents also added that an educated user may educate other users. It was noted by several respondents that education works very well where a high portion of the visiting public is local and that working with the local community and local schools is very effective. Several respondents indicated the importance and benefit of educating children, one respondent added that education of children can result in changes in parent behavior, and one respondent indicated many adults volunteer at the site after attending educational programs. One respondent indicated the connection between education, which improved local public understanding of the site, and the resulting passage of a local ordinance to protect the site. One respondent indicated that as a result of public education efforts, local landowners participated in conservation easements. Finally one respondent indicated that personal contact via docents/naturalists is a very effective technique, and another respondent indicated the value of training all staff, including volunteers, to provide consistent responses to visitor questions and actions.

Several respondents did indicate that education and outreach programs have not been an effective management technique. Many of those respondents indicated lack of staff and funds as the reason the programs were not effective. Several respondents indicated that education without enforcement was not enough, and that more staff was needed to accomplish both strategies. One respondent indicated that successful outreach takes commitment and consistency to be done correctly. Several respondents mentioned lack of participation or lack of interest from the public in educational efforts, that many casual park visitors are not interested in participating in passive educational programs, including reading interpretive signs and printed materials. However, one of the respondents did indicate that a well-paid, well-trained ranger/interpreter was a very successful tool in preventing impacts. As mentioned above, several respondents indicated a lack of success due to seasonal visitation from a broad area, the small number of visitors reached and high turnover. One respondent mentioned potentially conflicting messages from other county, state or federal programs and one respondent felt educational programs were basically unnecessary as the visitor learns from other sources such as school and television.

Five respondents indicated that they did not know if education and outreach programs were successful.

3. Wildlife Management

Respondents were asked what types, if any of wildlife management and monitoring techniques do they employ at their sites specifically to avoid or reduce impacts from human activities on wildlife (Figure 22). Wildlife monitoring was the most frequently identified technique, followed by habitat modification, restoration or enhancement.

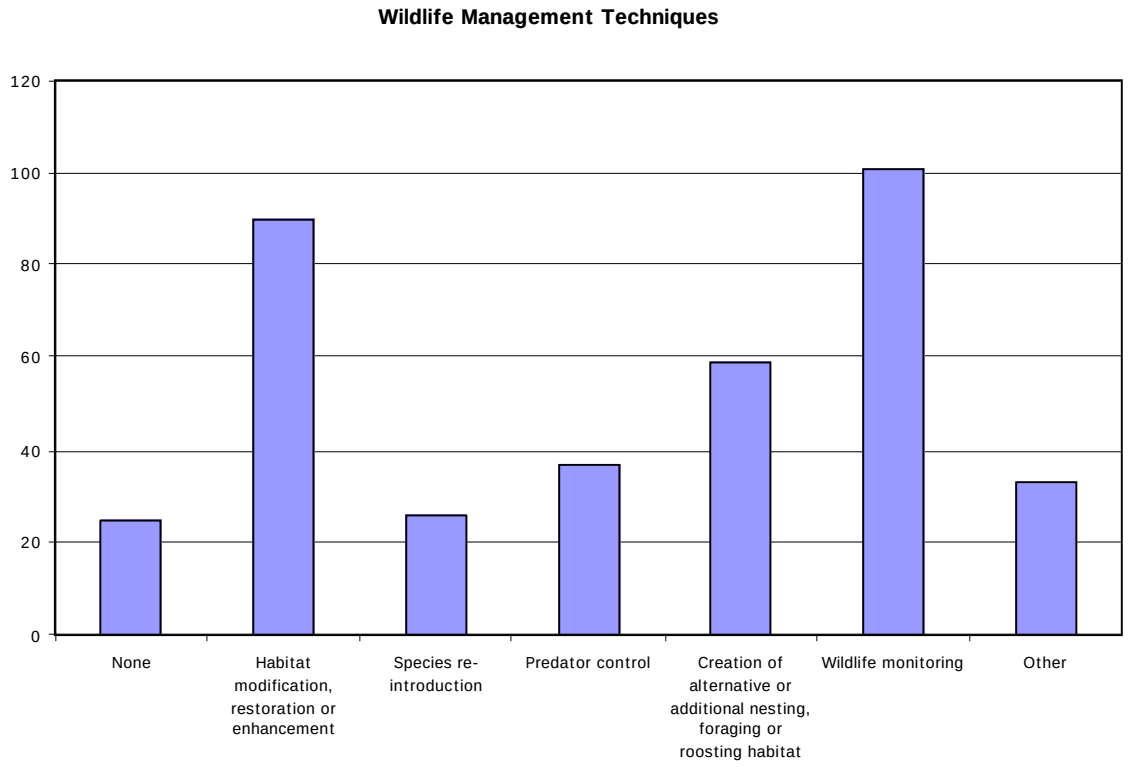

Figure 22. Wildlife Management and Monitoring Techniques to Avoid or Reduce Impacts From Human Activities on Wildlife Employed by Respondents

Respondents were asked to explain whether they feel that the wildlife management and monitoring techniques employed at their site have or have not been effective in avoiding or reducing impacts from human activities on wildlife.

The majority of respondents felt wildlife management and monitoring techniques have been effective. The following provides a summary of specific comments on wildlife management.

Wildlife Monitoring. Most respondents who commented specifically on monitoring indicated that wildlife monitoring has been effective because monitoring establishes a baseline and enables staff to track efforts to protect wildlife, and assists staff in making decisions to implement any management changes. Respondents also indicated that monitoring programs increase public involvement and sense of stewardship and can map critical habitat for specific species which can then be avoided by visitors.

Habitat Modification, Restoration, Enhancement Several respondents indicated that habitat modifications allowed provision of high quality public access that maintains reasonable wildlife use and keeps public out of critical habitat areas. Respondents also indicated that habitat restoration and enhancement can correct prior human alterations and increase wildlife numbers and biodiversity. One respondent indicated that by modifying habitat and providing additional nesting areas, they have had little or no impact on wildlife at their site.

Predator Control. Several respondents indicated that control of predators has had a positive effect on wildlife, though one respondent indicated that predator control was the least effective technique due to the highly urban environment surrounding the site.

Creation of Alternative or Additional Nesting, Foraging, or Roosting Habitat Two respondents indicated that creation of alternative nesting habitat has been successful for osprey and wood ducks. However, one respondent indicated that osprey platforms were not effective, probably because the area is too heavily used by the public.

APPENDIX F

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APPENDIX G

SITING, DESIGN AND MANAGEMENT STRATEGIES TO AVOID OR REDUCE ADVERSE EFFECTS ON WILDLIFE FROM PUBLIC ACCESS:

Examples from the San Francisco Bay Area

SITING AND DESIGN

Buffers/Access Control

Slatted fence allows through visual access in one direction only to minimize adverse effects on birds. Height of structure allows some visual access above fence.

Opaque fencing at base of high traffic bridge reduces adverse effects on wildlife in marsh restoration area. Transparent fencing along rest of pathway provides desired visual access.

Opaque slatted fence with "viewing window" provides some visual access to sensitive wildlife area.

Fencing combined with a vegetative buffer along a public pathway.

SITING AND DESIGN

Buffers/Access Control

Boardwalks and viewing platforms provide public with physical access to sensitive areas, while confining and structuring human activities.

Vegetation blocking "view window" in fence exemplifies the need to include adequate maintenance provisions when designing opportunities for visual access to sensitive wildlife areas.

SITING AND DESIGN

Providing Fulfilling Access Experience

Pathway on low side of levee doesn't provide public with viewing opportunities so many informal damaging pathways up the levee were created for public to access desired views of Bay and wildlife.

Access not provided to roadway beyond fence, so informal access was created by cutting fence.

Informal public access created to water by placing ladder on slope.

Posted signs regarding area closures and restrictions on visitor behavior help manage public use of an area to avoid or minimize adverse effects on wildlife.

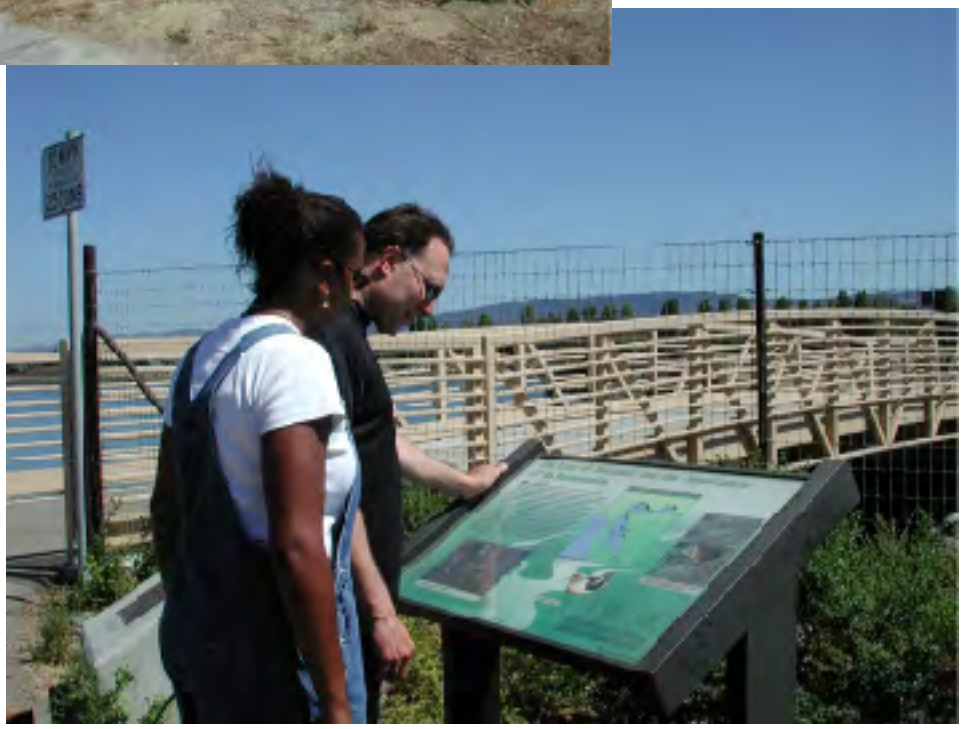
USE MANAGEMENT

Educational/Interpretive Strategies

Interpretive Centers and guided tours increase knowledge of users and increase compliance with use regulations.

USE MANAGEMENT

Educational/Interpretive Strategies



Interpretive signs increase knowledge of users and increase compliance with use regulations.

WILDLIFE MANAGEMENT

Habitat Creation/Enhancement

Habitat creation / enhancements such as this constructed bird island may help mitigate adverse effects from nearby pathway and provides bird watching opportunities for public.