UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Edwin B. Forsythe National Wildlife Refuge
Brigantine Division
PO Box 72
Oceanville, New Jersey 08231

Dear Reviewer

In accordance with the provisions of Section 102(2)(c) of the National Environmental Policy Act of 1969, we are enclosing for your review, the Draft Environmental Assessment on "Open Marsh Water Management for Mosquito Control on the Edwin B. Forsythe National Wildlife Refuge."

Any written comments you wish to make should be directed to:

Refuge Manager
Edwin B. Forsythe National Wildlife Refuge
PO Box 72
Oceanville, NJ 08231

by February 20, 1987.

The comment period has been extended from an earlier announced February 7, 1987, due to printing and weather delays.

Sincerely

David L. Beall
Refuge Manager

Enclosure

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Edwin B. Forsythe National Wildlife Refuge
Brigantine Division
PO Box 72
Oceanville, New Jersey 08231

For Immediate Release

Contact: David L. Beall, Refuge Manager
609/652-1665

OPEN MARSH WATER MANAGEMENT PROPOSED FOR MOSQUITO CONTROL AT REFUGE

Refuge Manager David Beall announced the availability of a draft environmental assessment on mosquito control at the Edwin B. Forsythe National Wildlife Refuge. The proposed action would permit Atlantic, Burlington, and Ocean Counties' Mosquito Control Commissions to implement open marsh water management (OMWM) on some of the refuge's saltmarshes. The purpose of OMWM is to perform mechanical marsh alterations which create a variety of water regimes, reducing the need for pesticides by providing a more lasting and effective measure of mosquito control. At the same time, the creation of ponds and the restoration of the marsh vegetation associated with OMWM returns much of the habitat degraded by parallel ditches to its pre-ditched value for wildlife.

Currently, mosquito control relies almost totally on chemical control. Pesticides used in recent years include Flit MLO, Abate 4E, Abate 2G and 5G, Teknar HPO (BTI), and Altosid for mosquito larva; and Scourge and Malathion for adult mosquitos. Though all of these pesticides are EPA registered for mosquito control, there are no data on their long-term effects on the environment. The drawbacks of insecticide use in general are well known: potential negative impacts on non-target species, disruption of the natural food chain, potential development of insecticide resistance, offers only temporary pest control, and potential health hazards to applicators.

Copies of the draft environmental assessment may be obtained from the refuge office at the address below. Those interested in commenting are encouraged to submit written comments by February 7, 1987, to the Edwin B. Forsythe National Wildlife Refuge, PO Box 72, Great Creek Road, Oceanville, NJ 08231.

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DRAFT

ENVIRONMENTAL ASSESSMENT

JANUARY 1987

OPEN MARSH WATER MANAGEMENT FOR MOSQUITO CONTROL ON THE EDWIN B. FORSYTHE NATIONAL WILDLIFE REFUGE

The proposed action would permit Atlantic, Burlington, and Ocean Counties' Mosquito Control Commissions to implement open marsh water management (OMWM) on the refuge. OMWM reduces the need for pesticide use by providing a lasting and effective mosquito control means.

U.S. FISH AND WILDLIFE SERVICE
EDWIN B. FORSYTHE NATIONAL WILDLIFE REFUGE

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I. Purpose and Need for Action

A. Purpose and Need/Background

The Edwin B. Forsythe National Wildlife Refuge (NWR) was created in 1984 by combining the former Brigantine (established 1939) and Barnegat (established 1967) NWR's and rededicating the refuge in honor of the late U.S. Congressman from New Jersey. The Migratory Bird Conservation Commission, under the authority of the Migratory Bird Conservation Act, has approved a refuge boundary of approximately 35,750 acres, of which over 31,000 acres have been acquired. Habitat types on the refuge include tidal saltmarsh, bottomland hardwoods, open bays, tidal creeks, other wetlands, upland mixed pine/oak forest, sandy beaches, and grasslands.

Refuge objectives are: 1. to preserve and manage the wetlands environment for waterfowl, shorebirds, and other wildlife as production, migration, and wintering habitat; 2. to perpetuate existing habitat that is found to benefit rare or endangered species; 3. to provide environmental education and wildlife-oriented recreation programs and facilities to the public; 4. to encourage scientific study and research by qualified organizations and individuals.

The refuge was initially established as nesting, wintering, and migration (resting and feeding) habitat for American black ducks and Atlantic brant. About 30% of the Atlantic Flyway's wintering brant population utilizes the refuge and immediate vicinity. Significant numbers of black ducks nest on the refuge, and up to 25% of the Flyway population winters on the refuge. The refuge is also a major stopover for greater snow geese, with fall peak populations of over 30,000 birds. Many other species of wildlife also derive benefits from the refuge.

Large areas of saltmarsh on the refuge which have been previously altered by man are documented breeding habitats for the saltmarsh mosquitos Aedes sollicitans, Aedes cantator, and Culux salinarius. The mosquitos originating from these refuge areas affect residents of the surrounding upland communities, including southern Ocean County, southeastern Burlington County, and eastern Atlantic County, New Jersey. Chemical pesticides have repeatedly been applied to these refuge areas and the surrounding upland to control these mosquitos because of their nuisance, negative economic impact and their disease vector potential. Former marsh alterations have been detrimental to wildlife populations by destroying feeding, resting, and breeding habitat. The application of mosquito pesticides to these areas does

nothing to restore that habitat and is possibly harmful to wildlife.

The purpose of Open Marsh Water Management (OMWM) is to perform mechanical marsh alterations which create a variety of water management regimes, reducing the need for pesticide use by providing a more lasting and effective measure of mosquito control. At the same time, the creation of ponds and the restoration of marsh vegetation associated with OMWM returns much of the degraded habitat to its former value for wildlife, and may even exceed it.

Beginning as early as the 1920's, large areas of coastal saltmarsh were ditched in a parallel grid system in an effort to drain standing surface water from shallow ponds and pools and reduce potential breeding sites for mosquitos. Often, the grid pattern was followed regardless of need, unnecessarily draining permanent ponds that never produced mosquitos but served as important habitat for migratory birds. While many of these parallel ditches were effective for a time, the mouths eventually become occluded and they fill in with silt and vegetation, causing water to remain just long enough in some situations to produce a brood of mosquitos, but not long enough to support mosquito-predaceous fish. Other man-made disturbances to the marsh, such as dredge spoil deposition and tire ruts from tractors in conjunction with extensive salt hay farming and off-road vehicles, also altered drainage patterns and created mosquito breeding areas.

Initial efforts to address the mosquito problem in the study area with Open Marsh Water Management began in 1970, when the New Jersey State Mosquito Control Commission established the Great Bay Project, a joint effort by three counties to control mosquitos within the Great Bay (Brigantine Division) area. The primary target of this project was the saltmarsh mosquito (Aedes sollicitans), an established nuisance mosquito and known vector of eastern equine encephalitis which is a potentially serious disease in humans. Physical control efforts ceased in 1973 due to the lack of appropriate equipment. Since that time, control has consisted entirely of repeated pesticide applications by the State Airspray Program, including larvicides on the saltmarsh and adulticides on the surrounding uplands. Mosquito control efforts on the Barnegat Division have been much the same, consisting mostly of chemical treatment. Ocean County Mosquito Control Commission has been permitted to maintain mosquito control impoundments and OMWM projects that were in place when the land was acquired for the refuge.

In recent years, rapid residential development in these coastal areas has resulted in an increase in mosquito nuisance complaints and an increased concern about protecting the public from encephalitis. Increased surveillance has resulted in the discovery of many new larval habitats, and pesticide needs in the study area are expected to continually rise without an alternate method of control.

Refuge managers and the public are concerned over the environmental impacts of the continued application of pesticides. Those in recent use include Flit MLO, Abate 4E, Abate 2G and 5G, Teknar HPO (BTI), and Altosid for larvae; and Scourge and Malation for adults. Though all these pesticides are EPA registered, there are no data on their long-term effects on flora and fauna or the environment. The drawbacks of insecticide use in general are well known: potential negative impacts on non-target species, disruption of the food chain, potential development of insecticide resistance, temporary pest control, accidental spills during aerial applications, and potential health hazards to applicators.

B. Authority and Policy

The National Wildlife Refuge System Administration Act (Public Law 89-669) and Title 50, Code of Federal Regulations, Part 29.3, both permit uses of refuge lands that are compatible with the primary purpose or objectives for which the area was established or is administered. The U.S. Fish and Wildlife Service is authorized to perform Open Marsh Water Management for mosquito control and wildlife habitat enhancement under these authorities.

The Department of the Interior, as the Nation's principal conservation agency, has the responsibility of assuring maximum protection of the environment. The Departmental Manual (DM) states: "It is the policy of the department:

a. To use pesticides only after full consideration of alternatives - based on competent analysis of environmental effects, safety, specificity, effectiveness, and costs. The full range of alternatives including chemical, biological, and physical methods, and no action will be considered. When it is determined that a pesticide must be used in order to meet important management goals, the least hazardous material that will meet such goals will be chosen;

b. To utilize pest management research, control, education, and assistance programs to develop, support, and adopt integrated pest management (IPM) strategies wherever practicable." (517 DM 1.2.A&B)

C. Concerns, Issues, Opportunities

In consideration of the Open Marsh Water Management proposal, there are many environmental, public health, and political issues that need to be addressed. These include:

1. The effects of mechanical marsh alterations on water levels in a tidal saltmarsh, and possible changes in plant species composition.

2. The effects of mechanical marsh alterations on animal species composition and abundance, including fish, invertebrates, waterfowl, wading birds, and shorebirds.

3. The extent to which OMWM alterations can reduce mosquito breeding and the need for chemical pesticide applications.

4. The detrimental and possible long-term environmental effects over the continued and exclusive use of pesticides for mosquito control.

This assessment provides the opportunity to critically examine the concerns outlined above, to the extent that past studies and experience in OMWM can address them. A Fish and Wildlife Service research study, to be conducted in conjunction with the County Mosquito Commissions' OMWM work, will provide additional data as the management program progresses. This assessment also offers the public an opportunity to review and comment on Service plans and activities.

II. Alternatives

A. No Action - No Mosquito Control

Under this alternative, all present spraying of larvicides and adulticides on the refuge for mosquito control would cease. No mechanical means of control would be utilized. Mosquito nuisance complaints from surrounding communities would increase, as would the health threat of eastern equine encephalitis. Documented cases of the disease in humans may increase in frequency. At the very least, the U.S. Fish and Wildlife Service would take on a bad image with the public and local governments for not addressing a

public health problem. More likely, political intervention would result in the inability to choose and stick with this alternative.

B. Retain Chemical Control of Mosquito

Under this alternative, the existing method of mosquito control, i.e. aerial and ground application of pesticides, would continue. No mechanical means of control would be used. Pesticide usage would be expected to continually increase with rising human populations and the finding of additional mosquito larval habitats.

C. Proposed Action - Initiate Integrated Pest Management for Mosquito Control

This alternative involves combining limited use of pesticides with Open Marsh Water Management. Allowed pesticide use will be based on U.S. Fish and Wildlife Service (USFWS) policy for chemical mosquito control on National Wildlife Refuges in Region 5. The OMWM work will be accomplished within the standards developed by the State and will interface with the marsh management objectives of the refuge. An amphibious rotary ditcher will be used to install ponds, pond radials, and to plug unneeded grid ditches, especially those that will restore migratory bird and fish habitat. Existing tidal ditches will be cleaned and new tidal ditches will be dug only as a last resort, when ditch plugs and internal ponds and radials will not do the job. A permit for the marsh excavation and filling associated with OMWM has already been received from the U.S. Army Corps of Engineers; all work will be performed by the County Mosquito Commissions. The need for aerial pesticides on the refuge can be expected to decrease substantially, to the extent that OMWM alterations in key larval habitats are practical and feasible.

D. Open Marsh Water Management Only - No Chemical Mosquito Control

Under this alternative, all chemical control for mosquitos would immediately cease, and OMWM would be initiated in its place. Mechnical alterations would still be restricted to previously disturbed (i.e. ditched) saltmarsh.

III. Description of the Environment

The Edwin B. Forsythe National Wildlife Refuge, Brigantine and Barnegat Divisions, is located in Ocean, Atlantic, and Burlington Counties, New Jersey. Though the local character of the refuge is still fairly rural, it lies in close proximity to several eastern metropolitan areas; the refuge

is ten miles north of Atlantic City, 60 miles east of Philadelphia, and 100 miles south of New York City. The economy of the area is based primarily on tourism. Summer population levels swell to three times or more the year-round population in local communities, and recreational pursuits include sunbathing, boating, fishing, clamming, camping, sightseeing, and gambling.

The topography of the refuge is typical of the coastal marshes of New Jersey, where uplands taper gradually to a wide band of saltmarsh, terminating in open shallow bays. The change from upland to marsh is more abrupt on the Brigantine Division, whereas on the Barnegat Division hardwood swamps form the transition zone. The bays are separated from the ocean by barrier islands and beaches, which protect the marsh from direct wave action. The elevation of the refuge ranges from six feet below mean sea level in some of the bays to 50 feet above mean sea level in the woodlands. Normal tidal amplitude is from 2 to 4 feet.

The major vegetation types on the refuge are saltmarsh hay, Spartina patens, and saltmarsh cordgrass, Spartina alterniflora. These are supported by firm, deep, clay-like muck and nourished from tidal nutrients and rainfall. The refuge supports a variety of animal life, including about 289 species of birds, 33 species of mammals, 18 species of reptiles and amphibians, and numerous species of fish, shellfish, and other invertebrates. Species protected under the Federal Endangered Species Act which utilize the refuge include the peregrine falcon, a resident and recent nester; the piping plover, a beach nesting species; and the southern bald eagle, a winter migrant. State-endangered species which nest on the refuge include the osprey, black skimmer, and least tern.

Averaqe annual precipitation is 42 inches, including 14 inches of snowfall. Average annual temperature is 54°F, with a January average of 36°F, and July-August averages of 73°F. Average annual evaporation is 33 inches. The area is subject to periodic "nor'easters", especially in early spring with heavy rains, high winds, and flood tides.

IV. Environmental Consequences of the Proposed Action and Alternatives

A. No Mosquito Control (No Action)

If this alternative were enacted, there would be no mosquito control on the Edwin B. Forsythe National Wildlife Refuge. The environmental consequences associated with this action would be as follows:

The refuge environment would no longer be subjected to chemical mosquito insecticides.

Existing mosquito ditches would receive no maintenance and continue to fill in, creating new mosquito larval habitats. The diversity of the marsh ecosystem and the wildlife fod base would increase. Carrying capacity of the marsh would increase for waterfowl, shorebirds, and other migratory birds such as flycatchers, gnat-catchers, and purple martins. Bats would also benefit from the increased food supply. Aquatic productivity may also increase.

Populations of adult saltmarsh mosquitos in the immediate vicinity would increase dramatically. The effects of these increased populations could be realized for great distances.

Public nuisance complaints from the local communities regarding mosquitos would increase. There are documented cases of eastern equine encephalitis in the local area and the oocurrence of this disease could probably also increase.

The relationship between the U.S. Fish and Wildlife Service and the local communities would suffer. The refuge would be pressured by citizen's groups, businessmen, local government heads, Congressmen, and others to take action for the public well-being.

B. Retain Chemical Control of Mosquitos

Under this alternative, the current mosquito control program on the refuge would remain unchanged. The County Mosquito Commissions, under the authority of U.S. Fish and Wildlife Service Special Use Permits, would continue to spray pesticides on the refuge as directed by the New Jersey State Mosquito Commission. Needed applications are determined by dip counts and landing counts, and are made in accordance with USFWS Regional policy.

In 1985, over 5,ØØØ acres were treated with pesticides an average of four times on the Brigantine Division alone. Habitats treated were the upland edge, ditched saltmarsh, the barrier island edge (Wilderness Area), and the most heavily treated pristine saltmarsh (also a Wilderness Area).

There is a definite environmental concern over the continued applicationn of pesticides which are used for mosquito control. Labels on adulticides and larvicides in current use (including Malathion ULV, Scourge, Abate 4E, Abate 5G, and Abate 2G) warn that the products are toxic to fish, shrimp, crabs, and/or birds. No data exists on the toxic effects of these insecticides on refuge wildlife, but less obvious negative impacts on the environment have been documented. For example, the

chemical temephos (active ingredient in Abate), applied at recommended rates, has been shown to retard growth in fish, modify behavior in fiddler crabs, and inhibit photosynthesis in algae.

Other mosquito control products are promoted as being species specific and therefore environmentally safer, such as bacteria (e.g. BTI) and growth inhibiting hormones (e.g. Altosid). However, these are presently being used on an experimental basis only, as they are more expensive, more complicated to apply, and somewhat inconsistent in their results.

It seems likely that, under this alternative, pesticide applications will increase in the future as human populations grow and larval mosquito habitats continue to be created and discovered. Chemical control costs would continue to rise as the Service restricts chemicals to the safest available. Political pressures to maintain or increase mosquito control activities will be ever-present.

C. Proposed Action - Initiate Integrated Pest Management for Mosquito Control

The proposed alternative is to initiate an IPM approach to mosquito control on Forsythe NWR. This includes a limited use of chemicals, and Open Marsh Water Management wherever feasible and practical. The County Mosquito Commissions will perform the pesticide applications and mechanical alterations under stringent guidelines and Service policy, and under the constraints of time and budget.

Specific refuge areas proposed for OMWM alterations within the next five to ten years include the Mott's Creek/Oyster Creek tract of the Brigantine Division (about 1,500 acres) and approximately 2,000 acres on the Barnegat Division (see attached maps). All areas to be worked have been previously ditched; no pristine saltmarsh will be disturbed by OMWM. The non-OMWM areas which produce an abundance of mosquitos may be treated with pesticides, with a move to exclusive use of those chemicals which have been proven environmentally safe.

The techniques of OMWM involve changing water regimes to benefit wildlife while eliminating mosquitos. As a last resort, some existing ditches would be cleaned, eliminating surface water. Existing semi-permanent and permanent ponds would be maintained. Temporary ponds that are mosquito producers would have deep reservoirs installed in them to maintain a population of mosquito-predaceous fish (e.g. Fundulus leteroclitus). In some cases, drainage ditches would be plugged to deepen

those seasonal ponds. The drainage ditches would then function as minnow sumps and travel lanes. In areas where there are high concentrations of mosquito larval habitats, permanent ponds would be installed, also containing deep fish reservoirs. In some situations, consideration will be given to allowing tidal circulation in permanent water with sill (semi-tidal) ditches, and connecting small breeding areas to permanent water with pond radials (closed ditches). Alterations will be made to look more "natural" with ponds and ditches of irregular size and shape and ditches that meander when feasible.

Specific environmental consequences of these actions would be as follows:

Some invertebrate fauna (including mosquito larvae) and algae will be eliminated by opening small pools to tidal fluctuations and/or providing access and refuge for minnows.

Some marginal areas of Spartina alterniflora near old tidal ditches will eventually be replaced by Spartina patens. Saltmarsh fleabane, Pluchea purpurascens, is expected to invade spoil areas soon after deposition, but should be replaced by the original vegetation after several growing seasons.

Increased tidal circulation is obtained in conjunction with an increase in permanent water areas, allowing tidal food web enhancement and more feeding and resting areas for waterfowl and wading birds. Construction of islands in OMWM ponds may provide additional nesting areas for waterfowl.

No impacts on endangered species are expected, except an increase in potential feeding areas.

Pesticide needs on the refuge will decrease as mosquito larval habitats are either flooded, drained and tidally flushed; or made more inhabitable for mosquito-predaceous fish. A few shallow and isolated pools may be filled with spoil and allowed to revegetate. Local nuisance complaints and the health hazard of eastern equine encephalitis will not increase. After OMWM alterations are completed, pesticide use will generally be limited to non-OMWM areas with large mosquito populations. An area successfully treated with OMWM will be effective in controlling mosquitos for several years (maybe decades) before mechanical rehabilitation is necessary.

D. Open Marsh Water Management Only - No Chemical Mosquito Control

The environmental consequences of OMWM have been mentioned in the previous alternative. The control effects of OMWM would not be felt immediately, because the total elimination of pesticides would dramatically increase local mosquito populations. It would probably take many years for OMWM alterations to make a substantial dent in mosquito breeding habitats and OMWM will never eliminate nuisance mosquitos due to the restrictions on where mechanical alterations may take place. Nuisance complaints and fears of disease outbreaks can be expected to put pressure on local governments, and therefore the USFWS, to take more effective action against mosquitos.

V. Consultation and Coordination

Information for this Environmental Assessment was obtained from OMWM results and future proposals provided by Delaware Department of Natural Resources and Environmental Control Section, and the New Jersey County Mosquito Commissions. Research literature produced by Rutgers University was consulted on the effects of marsh alterations and chemical pesticides on wildlife and the environment.

OMWM work will be monitored by the New Jersey State Mosquito Commission, the Rutgers University Office of Mosquito Research and Control, the U.S. Fish and Wildlife Service Patuxent Wildlife Research Center, and refuge staff biologists. Follow-up work to monitor effectiveness and environmental responses will continue by the County Mosquito Commissions and the U.S. Fish and Wildlife Service.

This assessment will be available for review by interested parties. Availability will be announced via news releases, and copies will be obtainable on request.

DRAFT

ENVIRONMENTAL ASSESSMENT

PUBLIC DEER HUNTING

at

Edwin B. Forsythe National Wildlife Refuge

Atlantic, Burlington, and Ocean County, New Jersey

Prepared by:

U.S. Department of the Interior
Fish and Wildlife Service
Edwin B. Forsythe National Wildlife Refuge
P. O. Box 72, Great Creek Road
Oceanville, New Jersey 08231

I. PURPOSE AND NEED FOR ACTION

The U.S. Fish and Wildlife Service proposes to initiate public hunting for big game on portions of the Edwin B. Forsythe National Wildlife Refuge.

The purpose of the big-game hunt is to maintain the refuge deer herd within the carrying capacity of the habitat and provide additional wildlife-oriented recreational opportunity for sport hunters to harvest a surplus renewable resource. Controlling deer populations by an annual deer harvest will alleviate the management concerns of:

1) maintaining the deer population on the refuge at a level compatible with the habitat

2) reducing the possibility of habitat destruction caused by an overpopulation of deer and the attendant negative effects on other refuge wildlife

3) reducing the threat of Lyme disease.

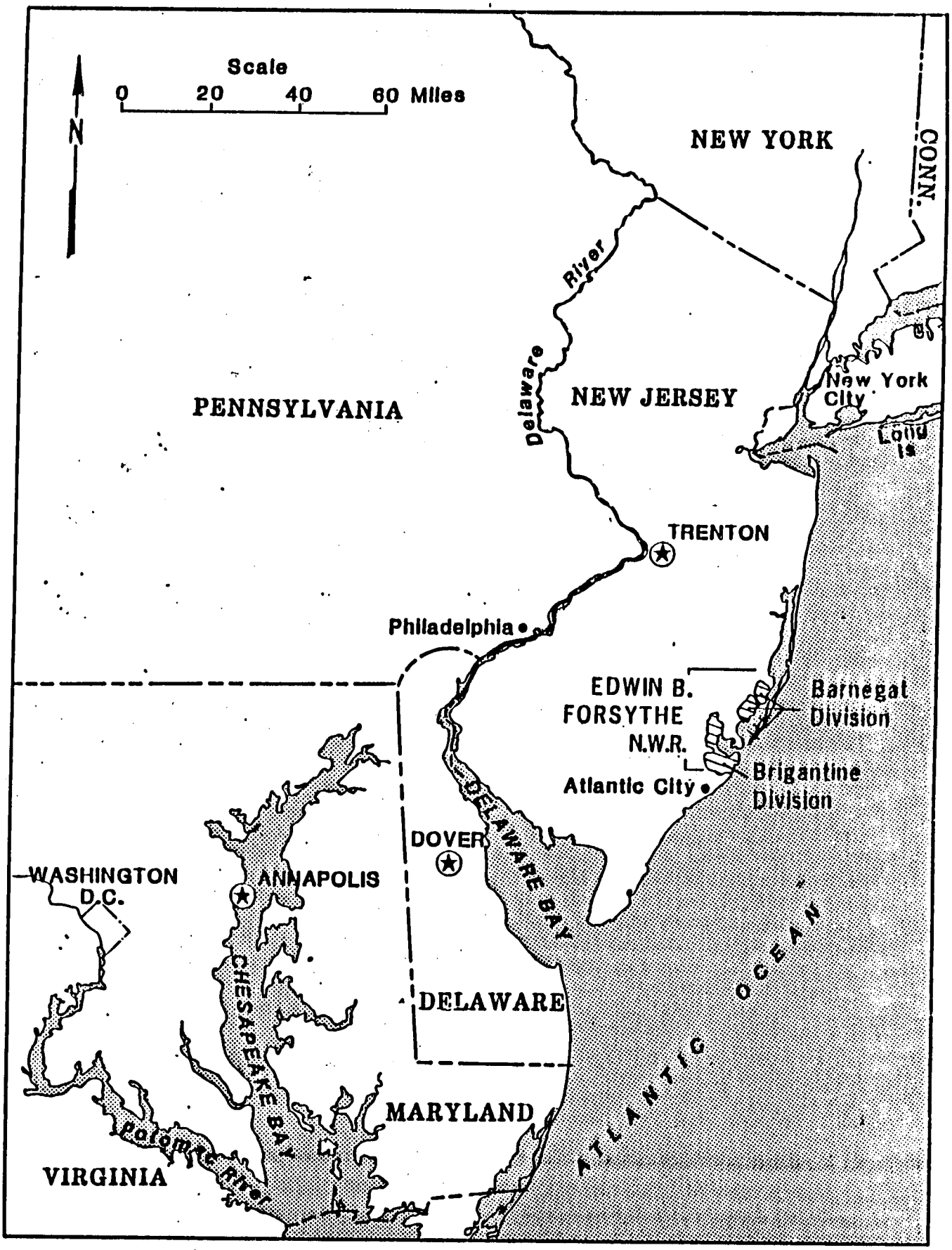
Background

Edwin B. Forsythe NWR was created in 1984 by combining the former Brigantine (established 1939) and Barnegat (established 1967) NWRs and rededicating the refuge in honor of the late U.S. Congressman from New Jersey. There are approximately 45,580 acres within the current approved refuge boundary approved for acquisition. These lands are located in Atlantic, Burlington, and Ocean Counties. Approximately seventy percent of lands within the acquisition boundary have been acquired.

Figure 1 shows Edwin B. Forsythe NWR within the State of New Jersey and its proximity to several eastern metropolitan areas. The refuge is ten miles north of Atlantic City, sixty miles east of Philadelphia, and seventy miles south of New York City.

The proximity of the area to New York City and Philadelphia and the revitalized economy of Atlantic County have increased development of year-round and summer housing. The residences for these human inhabitants are situated in a patchwork pattern because of wetlands protection laws, Pinelands laws, and local lot size zoning requirements. Parcels remaining between houses or developments are large enough to support an increasing herd of deer but small enough to preclude safe hunting. Huntable land and recreational opportunity for hunting decreases. With less local hunting, the short-term effect will be a reduction of the mortality rate for deer. The herd will be reduced then by accidents, disease, and/or starvation. The long-term effect,

EDWIN B. FORSYTHE
NATIONAL WILDLIFE REFUGE
LOCATION MAP



will be habitat destruction caused by deer exceeding the biological carrying capacity. This will come at the expense of other wildlife species dependent on the same habitat.

The refuge occupies a large proportion of the land along this coastal development area. Habitat on refuge upland is similar to undeveloped parcels off the refuge. There is free interchange of deer and other wildlife between refuge and off-refuge habitat. As the deer herd increases, it will affect the habitat of the refuge as well as the undeveloped land off-refuge. Habitat destruction by an overpopulated deer herd would be counter-productive to several management objectives of the refuge.

Deer populations have the potential for rapid growth. Under normal circumstances, adult does produce twins annually, while yearlings typically produce single fawns. In the absence of predation and hunting, this kind of reproduction can result in rapid deer herd growth. This was clearly illustrated on the 1,146-acre George Reserve in southern Michigan when the deer herd grew from 10 to 212 individuals in 5 years (McCullough, 1984).

There are natural limits to the number of deer that a given parcel of habitat can support. These limits are typically a function of the quantity and quality of deer forage. The maximum number of deer that a given parcel can support in good physical condition over an extended period of time is referred to as "Biological Carrying Capacity" (BCC). Deer productivity causes populations to overshoot BCC, unless productivity is balanced by mortality. When BCC is exceeded, habitat quality decreases and herd physical condition declines.

When BCC is exceeded, competition for limited food resources results in overbrowsing. Overbrowsing may result in reduced plant species richness (a diverse group of edible plant species is replaced by a select few inedible ones) and reduced understory structural diversity (due to the inability of seedlings to establish themselves). This in turn may have a deleterious impact on local animal communities, which depend on shrub-layer vegetation for food and cover. In time, overbrowsing results in reduced habitat quality and a long-term reduction in BCC. Coincident with overbrowsing is a decline in herd health. This decline is manifest in decreased body weights, lowered reproductive rates, lowered winter survival, increased parasitism, and increased disease prevalence. In the absence of a marked herd reduction, neither herd health nor habitat quality will improve, as each constrains the other. Such circumstances enhance the likelihood of die-offs due to disease and starvation.

The refuge has exhibited several indications of a significant deer population and the effect of the deer population on refuge habitat (Downing, 1980, 264-267). In addition to direct ground and aerial observations of deer on the refuge, indicators include:

1. Total loss of Atlantic white cedar regeneration to deer browsing.

2. Prominent browse line on Eastern red cedar on and adjacent to the refuge.

3. Browse surveys indicate significant deer browsing on key vegetation species.

4. Pellet group counts indicate deer frequent all upland areas of the refuge.

5. Deer kill by automobile collisions on roads surrounding the refuge increased from 31 in 1985 to 42 in 1986.

6. Land owner depredation complaints to the New Jersey Division of Fish, Game and Wildlife have increased in recent years.

7. The number of deer observed during winter counts around the wildlife drive frequently exceed thirty and have reached a maximum of 85 animals.

The BBC of the refuge habitat is finite. A winter carrying capacity for the entire refuge provided by the DEERCAMP (Moen, Severinghaus, and Moen, 1986) is estimated at approximately 180 deer. Based on New Jersey Division of Fish, Game and Wildlife estimated carrying capacity for deer management zones 22 and 42, which overlay the refuge, an estimated carrying capacity for the refuge is 150 deer.

II. ALTERNATIVES

To accomplish the refuge habitat management and deer population objectives four alternatives were closely examined. Five other alternatives were considered and dismissed as being contrary to Service policy, impractable, or technically unfeasible. These five alternatives are briefly discussed below. A more complete discussion of these dismissed alternatives and deer management in general is presented by Ellingwood (1987).

1. Live Trapping/Relocating - This alternative was dismissed because it is expensive, has a high mortality rate, and most other deer habitat in New Jersey is well populated.

2. Introduce Predators - This alternative is unlikely to succeed because suitable deer predators including mountain lions and timber wolves would not find suitable habitat in the suburban environment of the refuge. The eastern coyote is not an effective predator on healthy, adult white-tails. A population of coyotes large enough to affect even moderate annual deer herd reduction would likely adapt to suburban foraging and become a nuisance.

3. Artificial Feeding - This strategy would permit more deer to survive, thus compounding the problem. It is not consistent with the current Service policy of using the least intensive management effort required to attain objectives (ref. USFWS, Refuge Manual, 6 RM 1.3 and exhibit 1, May, 1986).

4. Reproductive Inhibitors - Population control of free-ranging deer with anti-fertility agents is impractical and cost prohibitive. It would be ecologically irresponsible due to risks to target and non-target species.

5. Control Deer Numbers with Sharpshooters - This could be either contracted or by Service personnel. This alternative is prohibitively expensive as pointed out by Ellingwood (1987). Income to local economies would be less than with sport hunting. This option would be extremely controversial and against policy because it would deny sportsmen access to a renewable natural resource.

The four alternatives closely examined are the following:

A. No Action

This action would result in no addition of recreational activity for big-game hunters. Actually, since big-game hunting is not legal on refuge lands, it would reduce recreational opportunity as lands within the approved refuge boundary, but not yet Service owned, are acquired by the refuge. Many of these lands are now hunted and hunting would cease with refuge acquisition.

This alternative is contrary to Service policy of managing wildlife resources and permitting public use activities which do not conflict with the purposes for which the refuge was established.

B. Short Intensive Deer Hunt-Refuge Wide

Under this alternative, portions of the refuge would be open to permit either sex/any age deer hunting for two to ten days annually. This would likely require closing the entire refuge to all other public uses during the hunt for safety reasons.

Hunter numbers would be limited by permits, based on the harvest quotas, length of harvest, expected harvest rate and number of days open to hunting. Based on current huntable refuge acreage of 3,000 acres, and a hunter density of one hunter/25 acres, 120 hunters/day or a maximum of 720 use-days of hunting recreation could accrue.

Hunting would be permitted on future acquisitions of refuge uplands.

C. Refuge Deer Hunt Concurrent with all State Seasons

This alternative would open portions of the refuge concurrent with all New Jersey deer hunting seasons for deer management zones 22 and 42. A potential 91 days of deer hunting would be available, based on the 1987-88 State seasons in these Deer Management Zones. Future acquisitions of refuge uplands would be open to deer hunting.

It is not possible to estimate additional recreational use-days accurately under this alternative. It is likely that it would be higher than under any other alternative, especially for the first few years.

D. Zone Controlled Public Deer Hunt - Proposed Action

This action would open portions of the refuge to big-game hunting. The refuge would be divided into three deer management zones to facilitate hunt administration: north of the Mullica River; between the Mullica River and Stoney Hill Road; and south of Stoney Hill Road. These deer management zones would be incorporated into the State's permitting and harvest date collection process to aid refuge hunt administration. This would accommodate varying hunting intensities for deer population management while minimizing impacts on other public uses.

Under this alternative, a potential of 91 days of deer hunting could be opened, based on the 1987-88 State seasons for these Deer Management Zones. Hunter permits would be allocated annually based on huntable refuge acreage available in that year. This would be planned to control hunter density at an approximate ratio of one hunter per 25 acres during the gun season.

This restriction would not apply to archery seasons, however, a comparable density is anticipated and is used to estimate recreation use. Current huntable refuge acreage is 3,000 acres. Therefore, the number of hunters on the refuge at any one time would be 120 under this alternative. These conditions would allow approximately 10,920 use-days of recreational activity. Actual recreational use-days would vary according to season lengths, number of permits applied for, no-shows during the seasons, hunter success, etc. Almost no hunters hunt during the entire bow season of 36 days. It is estimated that 5,000 to 6,000 use-days would actually accrue in an average year. These estimates may increase up to thirty percent higher as additional huntable lands within the refuge acquisition boundary are acquired.

III. AFFECTED ENVIRONMENT

The Edwin B. Forsythe National Wildlife Refuge currently contains over 33,500 acres of habitat representing a cross-section of habitat types ranging from beaches and dunes, through open bays and salt or brackish marshes, through forested wetland, to upland mixed pine and oak forest.

A. Refuge Objectives

1. Preserve and manage the wetlands environment for waterfowl, shorebirds, and other wildlife as production, migration, and wintering habitat.

2. Perpetuate existing habitat that is found to benefit rare or endangered species.

3. Provide environmental education and wildlife oriented recreation programs and facilities to the public.

4. Encourage scientific study and research by qualified organizations and individuals.

B. Physical Features

1. Climate - In general, the climate of the refuge is temperate. Temperatures range from an average daily maximum of 82°F in summer to an average daily minimum of 26°F in winter. Precipitation averages 42 inches annually and is distributed rather evenly throughout the year. Average wind speed is 10 miles per hour. Coastal storms occur more than once a year in the form of hurricanes or northeasters.

2. Topography and soils - The refuge lies entirely within the Atlantic Coastal Plain. Elevations range from sea level to approximately 50 feet above mean sea level. There is very little physical change in topography--the upland tends to rise rather abruptly at the saltmarsh edge in those areas with higher relief.

   Soils on the refuge consist of unconsolidated quartz gravel, sand, silt, and clay of Cretaceous and Tertiary age overlaid by a veneer of fluvial sand, gravel, silt, and clay of Quaternary and Recent age. Soils over most of the refuge are nearly level, poorly to very poorly drained, with mineral and organic soils on tidal flats, organic and sandy soils on lowlands, and sandy soils on the higher ground.

3. Hydrology - Edwin B. Forsythe is a coastal refuge. A large portion of the refuge is open bays and estuaries. The saltmarsh is characterized by meandering tidal creeks, scattered salt pannes, and tidal ponds. Old parallel mosquito ditches occur extensively throughout the marsh. Several more recent shallow mosquito control impoundments can also be found. All these waters are tidal, with normal amplitude ranging from 6 inches in Barnegat Bay up to 4.5 feet along the ocean. High tides during storms can reach eight feet above mean sea level, which totally inundates the saltmarsh, and backs water into the forested wetlands. Two man-made impoundments totalling 1,600 acres are located near the Brigantine headquarters.

   Most forested wetlands occur in the Ocean County portion of the refuge. Here the water table is at or near the surface even during dry periods of the year. During the wet period of spring and early summer, areas with up to 12 to 18 inches of standing water may occur. Numerous artesian streams flow west to east through the forested wetlands into the saltmarsh.

C. Biological Resources

1. Vegetation - Vegetation of estuarine saltmarsh is dominated by saltmarsh cordgrass (Spartina alterniflora) and saltmeadow cordgrass (S. patens). Other grasses found on the saltmarsh include; glasswort (Salicornia spp.), saltgrass (Distichlis spicata), black grass (Juncus gerardi), big cordgrass (Spartina cynosuroides), and Olney threesquare (Scirpus olneyi). Marsh elder (Iva frutescens) and groundsel bush

(Baccharis halimifolia) occupy higher sites, especially spoil piles along mosquito ditches, which several dredge spoil areas support pure stands of common reed (Phragmites australis).

Submerged aquatic vegetation found in shallow bays, tidal pools, and creeks includes eel grass (Zostera marina), widgeon grass (Ruppia maritima), smartweeds (Polygonum spp.), and pondweeds (Potamogeton spp.).

The marsh ecotone varies in width and is composed of marsh elder, groundsel bush, bayberry (Myrica pensylvanica, and highbush blueberry (Vaccinium corymbosum).

Forested wetlands are vegetated primarily with red maple (Acer rubrum), oaks (Quercus spp.), black gum (Nyssa sylvatica), and sweetgum (Liquidambar styraciflua). Small pure stands of Atlantic white cedar (Chamaecyparis thyoides) are found locally throughout the wet forested areas. Important understory plants include sweet pepperbush (Clethra alnifolia), American holly (Ilex opaca), highbush blueberry (Vaccinium corymbosum), and greenbrier (Smilax spp.).

Fields in the early successional stages are covered with various forbs and grasses interspersed with sassafras (Sassafras albidum), eastern red cedar (Juniperus virginiana), and winged sumac (Rhus copallina).

Uplands are dominated by pitch pine (Pinus rigida), various oaks, red maple, and black cherry (Prunus serotina). The understory is composed of various blueberries, greenbrier, and several other species.

2. Wildlife - The refuge is primarily a waterfowl refuge, providing valuable nesting, resting, and wintering habitat for migratory waterfowl, marsh, and shorebirds.

Peak waterfowl concentrations occur in the fall migration, with a much smaller spring peak. Important waterfowl species include American black ducks (Anas rubripes), Atlantic brant (Branta bernicla), greater snow geese (Chen caerulescens), Canada geese (Branta canadensis), mallards (A. platyrhynchos), pintails (A. acuta), blue-winged teal (A. discors), green-winged teal (A. crecca), gadwall (A. strepera), American widgeon (A. americana), northern shoveler (A. clypeata), bufflehead (Bucephala albeola), greater scaup

(Aythya marila), canvasbacks (Aythya valisineria), hooded merganser (Lophodytes cucullatus), common merganser (Mergus merganser), red-breasted merganser (Mergus serrator), oldsquaw (Clangula hyemalis), and tundra swans (Cygnus columbianus). Smaller numbers of many other species use the refuge during some part of the year. Waterfowl production is significant with over 1200 ducks, including over 700 black ducks and 400 mallards, and over 100 Canada geese produced in 1987.

Federally designated endangered species found within the refuge are the bald eagle and peregrine falcon. The piping plover, listed as threatened, is a summer resident and nester. Peregrines have nested annually since 1980 and prey heavily on species found within the surrounding saltmarsh. Impoundments and saltmarsh habitat are regularly used by wintering and migrating bald eagles for short durations.

The refuge is also a home for a variety of resident wildlife species. Typical species include bobwhite quail (Colinus virginianus), white-tailed deer, eastern cottontails (Sylvilagus floridanus), gray squirrel (Sciurus carolinensis), red and gray fox (Vulpes vulpes and Uroncyon cinereoargenteus), raccoon (Procyon lotor), and muskrat (Odotra zibethicus).

Generally, the refuge wildlife populations are diverse with 289 species of birds, 33 species of mammals, and 18 species of reptiles and amphibians occurring within the area.

D. Public Use

Public uses within the exterior boundaries of the refuge cover a broad spectrum of activities from commercial shellfishing to birdwatching. The majority of the public use occurs in the vicinity of the Wildlife Drive at Brigantine Division in Atlantic County. Most of the refuge uplands are currently closed to public use.

Recreation activities which are planned and for which facilities are developed include nature observation and study, photography, environmental education, hiking, cross-country skiing, snowshoeing, shell collecting, fishing including crabbing and clamming, waterfowl hunting, and fur trapping. Annual visitation for these permitted activities exceeds 250,000. Other public use activities such as sunbathing, swimming, surfing, and boating also occur, mostly on riparian lands within the refuge boundary.

IV. ENVIRONMENTAL CONSEQUENCES

A. No Action

This alternative would result in no changes in public use patterns. No public users currently using the refuge would be disturbed. No activity hours of non-consumptive use would be lost. Actually activity hours of hunting would be lost as the refuge acquires land that is currently hunted.

Upland wildlife would not be subjected to any increased disturbance. No loss of individual deer by legal hunting on refuge would occur.

With no deer hunting on the refuge and continually decreasing mortality off-refuge, caused by decrease of huntable area, the local deer population would continue to expand. Moen, Severinghaus, and Moen (1986, p. 69) demonstrated, with the DEERCAMP population dynamics model, that deer populations exhibit exponential growth even with a reduced birth rate caused by reduced biological carrying capacity.

Population growth of this type would eventually result in severe habitat degradation. Many similar examples are documented in the literature, beginning with the Kaibab Plateau in Arizona (Allen, 1962, pp. 234-235) through one of the most recent problems areas at Crane Memorial Reservation and Wildlife Refuge in Massachusetts (Moen, 1984). Habitat degradation would negatively affect not only the deer herd, but many other species of upland wildlife and songbirds. A few species, requiring more open, parklike habitat may be favored.

In addition to habitat degradation of refuge and off-refuge woodlands, increased damage to shrubs and ornamental plantings will occur. Complaints of deer depredations to local vegetable gardens, both back-yard and commercial, will increase.

As deer densities increase, numbers of automobile collisions will increase. This will increase property damage to automobiles. It likely will cause more personal injuries and may result in some traffic fatalities.

B. Short Intensive Deer Hunt-Refuge Wide

This alternative would result in a sufficient deer harvest to maintain a stable deer population and achieve refuge habitat objectives, but would require a significant increase in staff time and administrative

costs, reduced deer hunting opportunities, and diminished hunt quality. To assure a sufficent harvest a special shotgun season may have to vary in length from two to ten days and a permitted harvest may have to be as high as one deer per hunter per day. This alternative may require a higher hunter density than alternatives C or D, reducing the quality of hunt and hunter safety.

For safety reasons, all non-consumptive uses on the refuge would be closed during this hunt. Depending on the timing of the hunt, it could conflict with a minimum of 450 visitors per day mid-week in late December, to over 1,000 visitors per day on a nice weekend day in November.

Some disturbance to refuge wildlife would occur during the open season. This effect would be relatively short term, but could be intense during that period.

C. Refuge Deer Hunt Concurrent with all State Seasons

This alternative would result in deer hunting on the refuge, with the exception of the immediate headquarters area, strictly based on the State regulations for Deer Management Zones 22 and 42. It is the most liberal of all the alternatives considered. This alternative offers the potential for maximum recreational activity.

The deer harvest under this alternative would be directly correlated with hunter numbers, ie. the more hunters the higher the harvest. Since the entire population would be hunted, herd control would be assured. Proper herd control would result in achievement of refuge habitat objectives.

Since the refuge has been closed to deer hunting for years, it is likely that the demand could be high, leading to overcrowding and safety problems for other hunters or visitors and the perception of quality may be decreased for a few hunters.

A limited amount of public use data could be collected under this alternative, since only those hunting during a season requiring a state permit (special archery, muzzle-loader, and either sex firearm) could be contacted. Contact during the regular firearm and archery seasons would require additional staff time for personal contact, or rough estimates based on the number of vehicles parked adjacent to hunted areas.

Likewise, communication directed towards hunter education would be limited. Mailings may be possible to special permit holders. Otherwise, personal contact would be necessary to convey information.

Refuge specific data to evaluate the effectiveness of the hunt on the refuge herd would not be readily available. Data would be lumped with Deer Management Zones 22 and 42. Even the most rudimentary data, the actual refuge harvest, could be of questionable accuracy because of potential confusion of refuge hunting area overlaying state zones 22 and 42 resulting in erroneous reports by hunters.

As with any hunt on the refuge, some disturbance to wildlife is anticipated. This disturbance would be temporary and limited to the time hunters are actually using the area. Under this alternative, the maximum amount of disturbance is possible. Since hunter numbers would not be directly controlled, there would be little that could be done to limit disturbance on various areas of the refuge.

An additional benefit of deer herd reduction or stabilization is that it would reduce the number of hosts available for adult deer ticks. These ticks are often carriers of Lyme disease and an infected tick can transmit the disease to humans. White-tailed deer serve as a reservoir for the bacteria Bonelia burgdorferi. In 1986, a Service employee was diagnosed as having Lyme disease caused by being bitten by a tick likely contacted on the refuge, thus demonstrating a local disease pool. Control of deer numbers, which would result from hunting, would reduce the risk of exposure to the disease for Service employees and the visiting public.

D. Zone Controlled Public Deer Hunt - Proposed Action

Selection of this alternative would result in a potential 10,920 additional use days of wildlife oriented recreation. It would allow some hunters currently hunting on future refuge lands to continue to hunt there. It would provide a place to hunt for hunters displaced from huntable lands by development and previous closure of refuge lands.

Approximately 450 visitors per day could be excluded from using public use facilities located south of Stoney Hill Road for an estimated one to three days

annually. This alternative would permit that condition to exist for only the Permit Shotgun season, which is expected to be one to three days in duration. No non-consumptive public use is permitted north of Stoney Hill Road. Thus, the expected 1350 visits would be affected.

Under this alternative, there would be an annual reduction of the deer herd. While individual deer would be harvested, the overall long-term benefit to the habitat resulting from herd reduction would be beneficial to all wildlife using the habitat.

The use of the State permitting and harvest data collection system will significantly facilitate the administration of the hunt. This will reduce the cost of administrating the hunt and provide refuge specific deer population data for management decisions.

Implementation of a big-game hunt would result in some temporary disturbance to upland wildlife using the refuge during the fall and winter. Most disturbance would occur as hunters enter and leave the hunting area. The greatest short-term disturbance would probably occur during the six-day firearms season, when many hunters would be present. During other seasons, most hunters would be present on opening days, Saturdays, and holidays. Hunting activities on other days are expected to be light. Hunter density may also be affected by the deer population and weather. When the deer population is high, the opportunity for success would be greater and more hunters would hunt. When the deer population decreases, the opposite will occur.

Bald eagles and peregrine falcons may make limited occasional use of the area being considered. This hunt could cause some minor temporary disturbance of these birds. Any long-term disturbance or more serious consequences are unlikely. Waterfowl hunting has been permitted on other sections of the refuge primarily used by these birds for several years. No accidental or deliberate shooting has occurred. Disturbances have not resulted in behavioral or territorial alteration.

As with the Unrestricted Deer Hunt alternative, deer herd reduction or stabilization by this alternative would reduce the risk of Lyme disease.

The major environmental consequence of this action is the fact that deer on the refuge would be managed to be at or below the biological carrying capacity of refuge habitat. This would likely require annual reduction,

thus offering recreational hunting. Maintaining the herd at this level would be most beneficial to the habitat and other wildlife using it. Properly protected and managed habitat, supporting a diverse population of wildlife, would be most attractive and educational for all refuge visitors.

V. CONSULTATION AND COORDINATION WITH OTHERS

Consultation and coordination with the New Jersey Division of Fish, Game, and Wildlife has been conducted. The Division has long encouraged the consideration of a deer hunt on the Edwin B. Forsythe NWR to assist in their management of deer by the Deer Management Zone concept.

A news release concerning the development of the hunt plan and availability of the Environmental Assessment will be issued to the public in November 1987. Information about the hunt will be published in the annual New Jersey Deer Guide. Public comments for this Environmental Assessment will be accepted for 30 days commencing November 23, 1987. A summary of public comments will be prepared and attached, along with the comments themselves, as appendices in the final Environmental Assessment.

All comments received by December 22, 1987 will receive due consideration; the final EA may be modified to incorporate these comments.

LITERATURE CITED

Allen, Durward L. 1962. Our Wildlife Legacy. 422 pages. Funk and Wagnalls. New York, NY.

Downing, Robert L. 1980. Vital Statistics of animal populations. Pages 247-267 in Sanford D. Schemnitz, ed. Wildlife Management Techniques Manual, 4th ed., revised. The Wildlife Society, Inc. Washington, DC.

Ellingwood, Mark. 1987. White-tailed Deer Management in the Northeast. Joint publication of the Wildlife Society and Northeast Deer Study Group (in press).

McCullough, D.E. 1984. Lessons from the George Reserve, Michigan. Pages 211-242 in L.K. Halls, ed. White-tailed Deer Ecology and Management. A Wildlife Management Institute book. Stackpole Books. Harrisburg, PA.

Moen, Aaron N., C. W. Severinghaus, and Ronald A. Moen. 1986. DEERCAMP. Corner Brook Press. Lansing, NY.

Moen, Aaron, N. 1984. Deer Management at the Crane Memorial Reservation and Wildlife Refuge. 90 pages. Corner Brook Press. Lansing, NY.