F1-D99

I. EXECUTIVE SUMMARY

San Francisco Bay and the delta of the Sacramento and San Joaquin Rivers form one of the largest estuaries in the world (Conomos 1979, Sudman 1981). Two-thirds of the remaining salt marsh ecosystems and tidal flat habitats on the Pacific Coast are located in the San Francisco Estuary (SFE) (Josselyn 1983). However, 95% of wetlands in the SFE have been lost to filling and dredging for urban development or agricultural purposes (Nichols et al. 1986). Despite extensive habitat loss and degradation, the estuary is a critical ecosystem for Pacific Flyway migratory birds and many rare endemic species. The population of shorebirds in the SFE is estimated to be 1 million birds (Stenzel and Page 1988), and the SFE supports nearly 700,000 waterfowl in the Pacific Flyway during winter (USFWS, midwinter surveys, unpubl. data). Several animal species of the SFE are currently listed as federal or state threatened or endangered, under consideration for listing, or of state special concern (Harvey *et al.* 1992). These species include the California least tern (*Sterna antillarun browni*), western snowy plover (*Charadruis alexandrinus nivosa*), California black rail (*Lateralus jamaicensis corturniculus*), long-billed curlew (*Numenius americanus*), San Pablo song sparrow (*Melospiza melodia samuelis*), saltmarsh common yellowthroat (*Geothlypis tirchas sinuosa*), American peregrine falcon (*Falco peregrinus anatum*), San Pablo vole (*Microtus californicus sanpabloensis*), salt marsh wandering shrew (*Sorex vagrans halicoetes*), Suisun ornate shrew (*S. ornatus sinuosus*), salt marsh harvest mouse (*Reithrodontomys raviventris*), and California clapper rail (*Rallus longirostris obsoletus*).

Many of these species would benefit from an increase in availability of salt marsh ecosystems with their characteristic *Spartina* and *Salicornia* plant communities. This is especially true for the endangered salt marsh harvest mouse and the California clapper rail which are only found in the SFE salt marsh ecosystem (Josselyn 1983). The North Bay area comprises the largest remaining expanse of undeveloped land on the Bay edge. San Pablo Bay National Wildlife Refuge (SPBNWR) will manage most of these new land acquisitions and will need to have an approach for restoration of previously converted agricultural land. One of the first projects to be considered under the North Bay Initiative is the Fish and Wildlife Service acquisition formerly known as the Cullinan Ranch. This 606 ha area was acquired for wetland restoration at a cost of $7.5 million and transferred to the SPBNWR in 1990 as the Napa Marsh Unit (Cullinan Ranch). Located between San Pablo Bay to the south and salt evaporation ponds to the north (Fig. 1), this historic salt marsh of the Napa River Delta was diked and drained for agriculture (hay and oats) in the late 1800s (Mozejko 1989). Drainage and farming has caused the surface elevation to subside more than 2 m below sea level, but contaminants used in farming have not caused widespread contamination (USFWS 1990). The marsh soil has been significantly altered by drainage and alteration, and oxidation of marsh sulfides has created an acidic, saline condition (Bates 1977).

The goal of this project is to use the Cullinan Ranch as a model for converting a diked, farmed wetland to a tidal marsh and creating habitats suitable for target species such as the California clapper rail and the salt marsh harvest mouse. We propose to participate in this project by developing a restoration plan for the Cullinan Ranch, designing a monitoring plan for the restoration work, and examining source and sink dispersal patterns of animal and plant communities in salt marsh ecosystems.

Cullinan Ranch Tidal Marsh Restoration. Part II: Evaluation and Monitoring of Biological Resources

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Type of Organization: Federal Government

RFP Project Group 3

III. PROJECT DESCRIPTION

A. Project Description and Approach

The goal of this project is to use the Cullinan Ranch as a model for converting a diked, farmed wetland to a tidal marsh and creating habitats suitable for target species such as the California clapper rail and the salt marsh harvest mouse. We propose to participate in this project by developing a restoration plan for the Cullinan Ranch, designing a monitoring plan for the restoration work, and examining source and sink dispersal patterns of animal and plant communities in salt marsh ecosystems.

Task 1: Develop an environmental assessment and comprehensive restoration plan for the Napa Marsh Unit

1. DIGITAL MAP A digital base map (1 inch=40 feet) including elevational contours (1 foot), soil types, and existing structures will be generated from orthophotography and existing data. A geographic information system (GIS) will be used to display the base map and data layers in ARC/INFO format.
2. HYDROGRAPHIC MODEL A physical wetland restoration plan will be developed from a hydrographic model estimating effects of tidal flows (Cheng and Gartner 1984), water movement, water control structures, and sediment deposition on marsh development (M. Johnson et al., Univ. Calif. at Davis, Civil and Environ. Engr., unpubl. rep.). Returning surface elevations to sea level on the area will involve facilitating natural sedimentation or adding dredge material to the Cullinan Ranch. Six scenarios will be discussed from the model to examine different combinations of water (3) and sedimentation (2) sources. An additional alternative will consider development of seasonal wetlands rather than tidal wetlands. The SPBNWR management will select the final scenario for the actual restoration.
3. BIOPHYSICAL VARIABLES Ecological characterization of existing salt marshes will be used to develop goals for the restoration project. Information will be gathered for several variables including water quality, invertebrates, plants, and target wildlife species from existing literature or with field surveys. Several different survey techniques will be tested within a plot-based sampling scheme (see Obj. 2, below). All sample locations will be georeferenced to the nearest meter in a horizontal plane with a global positioning system (GPS) and all data will be entered into ARC/INFO.

Objective 2: Design a monitoring program to document ecological characteristics of existing and restored tidal wetland habitats

1. BASELINE DATA: Each refuge unit will be stratified into marsh plain and slough channel habitat types because the less available slough channels may be used heavily by wildlife species. The units also will be divided into 3 polygonal sections of equal size based on distance from San Pablo Bay to examine effects of channel size, decreased waterflow, and decreased salinity. Section boundaries will be mapped prior to sampling with a GPS and recorded in the ARC/INFO database prior to locating

sample plots. A representative sample (random start, uniform grid) of 10 circular plots (0.25 ha) will be used to monitor changes for each unit (3) x type (2) x section (3) combination (up to 180 total plots). Three-way multivariate (MANOVA) (Johnson and Wichern 1988) or univariate analysis of variance (ANOVA) tests (SAS 1985, Zar 1984) will be used to compare most biophysical variables by unit, type, and section.

Several biophysical variables will be measured and are listed below. Most measurements will be taken simultaneously with single visits to plots (see Dedon and Barrett 1982) unless specified below. Many samples will be collected a set distance from plot centers to limit observer effects on the plots.

A. SEDIMENTS Dredge material provided by the Army Corp of Engineers may be used to increase the rate of sedimentation for the restoration, but this alternative will require careful contaminant monitoring.

B. WATER QUALITY: Total hardness, temperature, pH, turbidity, salinity, and dissolved oxygen will be determined on site from 3 integrated water column samples taken at each plot in the slough channel type. These samples will be taken at high tide in conjunction with other monitoring samples on each plot during winter (October - March) and summer (April - September). Three-way analysis of variance tests will be used to characterize water quality of each site and examine differences by unit, section, and season.

C. PLANTS: An east-west (roughly parallel to the Bay edge) transect of 18 m will be established from the center of each marsh plain plot to determine the composition (percent occurrence) of plant species. A 0.5 m^2 grid will be examined at 3 m intervals on the transects (6 grids/transect) to estimate mean stem density, height, and percent cover of plants. Transects in the slough channel type will parallel the slough channels. Six 0.5 m^2 grid squares also will be sampled on slough channel sites, but these will be selected at random locations near the transects in channel (2), levee (2), and tidal flat (2) areas. Differences in the plant community by unit, type, and section will be examined in 3-way MANOVA tests with percent occurrence as the response variable, although transformation of percentages may be required.

D. INVERTEBRATES: A core sample (10 cm diameter, 10 cm depth) will be taken to enumerate benthic invertebrates at each sampling plot. Samples will be screened (0.5 mm) and frozen prior to sorting. The invertebrates will be identified to family or genus, counted, dried, and weighed to the nearest 0.1 mg. MANOVA tests will be conducted on total weight and percent occurrence by invertebrate family to examine unit, type, and section differences.

E. MAMMALS: Small mammal work will be conducted from a random sample of 3 plots in each unit x type x section combination (54 total plots). A rectangular capture grid with traps separated by 10 m will be placed at a random point 30 m from each plot center with Sherman live traps (48). Traps will be baited each evening within 3 hours of sunset and checked during 3 consecutive mornings within 3 hours of sunrise (144 trap-nights/plot) once during summer and winter seasons. Six pitfall traps and short barrier fences also will be used to sample shrews. At least 3 grids will be sampled simultaneously, requiring a maximum of 54 days to complete sampling during each season.

Species will be identified and individuals will labeled with nonpermanent markers (codes will be shaved in their fur with a moustache trimmer) to record recaptures. Mark-recapture analyses (White et al. 1982: Program CAPTURE) will be used to estimate small mammal densities or an index of catch per trap night will be reported. Traps will be provided with extra food and cotton insulation, and individuals which are inadvertently injured during trapping will be euthanized with humane methods of carbon dioxide asphyxiation (Custer and Franson 1988) or cervical dislocation. Trapping permits to capture small mammals in the salt marsh will be coordinated with the SPBNWR.

F. BIRDS: Variable circular plots (DeSante 1981) will be used to sample birds in summer and winter at the center of each sample plot. The plots will be sampled from 0.5 - 3.0 h after sunrise with a settling period of 2 minutes followed by a survey period of 8 minutes. Species and distance from the plot center will be recorded. Variable line transect statistics (Burnham et al. 1980) adjusted for circular plot areas (Roeder et al. 1987) will be calculated from program DISTANCE to estimate seasonal densities of common species. If numbers of certain species are inadequate to produce density estimates, an index of average number of birds per plot will be reported. Playback recordings will be tested on a subsample of plots to augment surveys and improve counts of secretive rail species (Evens et al. 1991, Marion et al. 1981, Repking and Ohmart 1977). Mistnetting also will be tested as a method to sample subspecies of local songbird populations, especially the San Pablo song sparrow which must be identified in the hand. Nets will be monitored hourly and birds will be extracted as quickly as possible, but injured birds will be euthanized with approved cervical dislocation techniques. Counts and location of larger species (waterfowl, shorebirds) will be completed during a single census of each site in each season (6 surveys), supplemented by an aerial survey if needed.

2. RESTORATION MONITORING DATA: As the restoration project progresses, data will be collected to monitor characteristics of marsh development for the first 3 years. The methods will follow those listed in Obj. 2.1 above. A monitoring design will be developed for the Cullinan Ranch and East San Pablo Bay Unit with a practical number and arrangement of plots on the basis of data collected in baseline surveys. Comparisons will be made to examine changes in variables through time from analysis of variance procedures with time as a repeated measure (Hand and Taylor 1987).

   A. CONTAMINANTS: Initial samples (Obj. 2.1.A) will be used to design a continued contaminant monitoring program if dredge material is used in the project. These samples will provide a database showing contaminant levels prior to the restoration in the ESPBU, and in both units at 1-year after project initiation with resampling at annual intervals through the development of the marsh.

   B. WATER QUALITY: Water samples will be taken and analyzed for water quality (Obj. 2.1.B) each year during the first 3 years of the restoration project and every 3 years thereafter. Samples will be collected during both winter and summer seasons at each study plot in the slough channels.

   C. PLANTS: Plant sampling will be conducted on an annual basis. The procedure will follow Obj. 2.1.C, but the total area of slough channels and upland types will change as the project proceeds. Plots may be added to sample the slough channels as they develop during restoration. The extent of the vegetation types will be mapped to the GIS system from low-level aerial photographs taken annually.

D. INVERTEBRATES: Invertebrate sampling will follow the initial study design (Obj. 2.1.D) on a semiannual basis for the first 3 years followed by sampling every 3 years. If dredge material is used in the restoration project, collected invertebrates also will be analyzed for contaminants (see Obj. 2.1.A).

E. MAMMALS: Mammal trapping will follow Obj. 1.3.E on a semiannual basis. If initial samples provide inadequate numbers to estimate densities, the number of capture grids or traps at a location will be increased.

F. BIRDS: Surveys will be conducted semiannually to examine changes in bird abundance and species diversity. Intensive airboat or call count surveys will be added to examine *Rallidae* populations as the restoration proceeds.

Objective 3: Home range, movements, and colonization of representative animal species in salt marsh ecosystems

The Cullinan Ranch restoration project provides a unique opportunity to examine home range, movements, and colonization of representative salt marsh species. Home ranges of black rails and San Pablo voles will be examined at the 2 existing salt marsh units for 2 years. Comparable studies will be undertaken after the tidal plain becomes established in the restoration unit to examine movements and colonization of a new area. These studies will be described in a separate work unit.

1. Samples: Ten black rails will be captured in existing salt marsh units annually. Each bird will be banded, weighed, measured, and radio-marked following procedures successfully used on California clapper rails (J. Albertson, SFBNWR, pers. comm.). Thirty San Pablo voles will be captured annually in Sherman live traps, weighed and measured. They will be marked with small radio transmitters (size:<1 g, lifespan:30 days, range:2 km, attachment:glue). Radio-marked individuals will be tracked daily by observers with handheld antennas on the ground or from small tower telemetry systems. Data will be entered daily into a laptop computer after locations are determined (Dodge and Steiner 1986, Dodge et al. 1986).
2. Home Range and Movements: Radio telemetry will be used to examine movements of rails and voles. Locations will be recorded at high and low tides, each day for 30 days. A regression analysis (Zar 1984) will be used to compare distances moved by individuals between locations with relation to their distance from slough channels.

   Home range areas (Samuel and Garton 1985) and core areas (Samuel and Green 1988) of the radio-marked animals will be documented. Well-developed slough channel systems have been suggested as critical components of natural or restored salt marsh habitats. We will use ANOVA tests to determine if home range sizes of individuals in slough channel areas are smaller and probable source areas compared with individuals in marsh plain areas.

B. Location and/or Geographic Boundaries

Primary Site: Three refuge areas will be examined in this study plan. The primary restoration site is the newly acquired 606 ha Cullinan Ranch, located 6 km west of Vallejo, California on the northern edge San Pablo Bay north of Highway 37 (Fig. 1). The Cullinan Ranch has been cultivated for oat and hay production since the late 1800s, but farming operations on the Cullinan Ranch were discontinued in 1992. Preliminary surveys will be conducted on the Cullinan Ranch site prior to the restoration to document existing conditions, and a monitoring program will be designed to evaluate the success of the restoration.
Reference sites: Two refuge units with existing salt marsh habitats will be surveyed to gather comparable baseline information. Surveys will be conducted on the East San Pablo Bay Unit (ESPBU) located adjacent to the Cullinan Ranch, south of Highway 37 and bordered by the Cargill salt pond intake channel to the west and Mare Island Naval Station to the east (Fig. 1). East San Pablo Bay Unit is nearly the same size as the Cullinan Ranch (ca. 600 ha), but sedimentation has increased the elevation of this marsh above sea level. The East San Pablo Bay Unit likely will be altered by channel construction to restore the Cullinan Ranch, and assessment of changes on the East San Pablo Bay Unit will be included in the monitoring plan. In addition, the 361 ha Tubbs Island Unit (TIU), 8 km west of the Cullinan Ranch and bordered by the Petaluma River and Tolay Creek levee, will be surveyed as a reference site. The East San Pablo Bay Unit is a separate area from the Cullinan Ranch and will not be affected by the restoration project, but it will be used as a reference site.

C. Expected Benefits

Although many wetland restorations have been initiated, few have been proven to support the target endangered species shortly after restoration. These data will confirm whether restoration of diked farmland to tidal salt marsh is achieving the desired goal of supporting endangered species. It will also produce a model for restoration monitoring and planning in the northern reach of the estuary.

D. Background and Biological/Technical Justification

San Francisco Bay and the delta of the Sacramento and San Joaquin Rivers form one of the largest estuaries in the world (Conomos 1979, Sudman 1981). Two-thirds of the remaining salt marsh ecosystems and tidal flat habitats on the Pacific Coast are located in the San Francisco Estuary (SFE) (Josselyn 1983). However, 95% of wetlands in the SFE have been lost to filling and dredging for urban development or agricultural purposes (Nichols et al. 1986). The quality of remaining wetlands is endangered by accumulation of toxins from agricultural and urban runoff, introduction of contaminants from industrial and municipal discharge, accidental spills from petroleum and chemical transport, and freshwater diversions.

Despite extensive habitat loss and degradation, the SFE is a critical ecosystem for Pacific Flyway migratory birds and many rare endemic species. The population of shorebirds in the SFE is estimated to be 1 million birds (Stenzel and Page 1988), and the SFE supports nearly 700,000 waterfowl in the Pacific Flyway during winter (USFWS, midwinter surveys, unpubl. data). Several animal species of the SFE are currently listed as federal or state threatened or endangered, under consideration for listing, or of state special concern (Harvey *et al.* 1992). These species include the California least tern (*Sterna antillarun browni*), western snowy plover (*Charadruis alexandrinus nivosa*), California black rail (*Lateralus jamaicensis corturniculus*), long-billed curlew (*Numenius americanus*), San Pablo song sparrow (*Melospiza melodia samuelis*), saltmarsh common yellowthroat (*Geothlypis tirchas sinuosa*), American peregrine falcon (*Falco peregrinus anatum*), San Pablo vole (*Microtus californicus sanpabloensis*), salt marsh wandering shrew (*Sorex vagrans halicoetes*), Suisun ornate shrew (*S. ornatus sinuosus*), salt marsh harvest mouse (*Reithrodontomys raviventris*), and California clapper rail (*Rallus longirostris obsoletus*).

Many of these species would benefit from an increase in availability of salt marsh ecosystems with their characteristic *Spartina* and *Salicornia* plant communities. This is especially true for the endangered salt marsh harvest mouse and the California clapper rail which are only found in the SFE salt marsh ecosystem (Josselyn 1983). The Environmental Protection Agency has recently organized local, state, and federal agencies in a "North Bay Initiative" to protect and restore wetlands in the San Pablo Bay (T. Yocum, EPA, San Francisco Estuary Project, pers. comm.), because the area comprises the largest remaining expanse of undeveloped land on the Bay edge. San Francisco Bay National Wildlife Refuge (SFBNWR) will manage most of these new land acquisitions and will need to have an approach for restoration of previously converted agricultural land.

One of the first projects to be considered under the North Bay Initiative is the Fish and Wildlife Service acquisition formerly known as the Cullinan Ranch. This 606 ha area was acquired for wetland restoration at a cost of $7.5 million and transferred to the SFBNWR complex in 1990 as the Napa Marsh Unit (Cullinan Ranch) of the San Pablo Bay NWR. Located between San Pablo Bay to the south and salt evaporation ponds to the north (Fig. 1), this historic salt marsh of the Napa River Delta was diked and drained for agriculture (hay and oats) in the late 1800s (Mozejko 1989). Drainage and farming has caused the surface elevation to subside more than 2 m below sea level. However, contaminants used in farming have not caused widespread contamination of the site (USFWS 1990). The marsh soil has been significantly altered by drainage and alteration, and oxidation of marsh sulfides has created an acidic, saline condition (Bates 1977).

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E. Proposed Scope of Work

FY 98 Prepare Draft Environmental Assessment for restoration from existing data. Develop biological monitoring program.

FY 99 Continue biological monitoring program studies.

Initiate studies of site colonization.

FY 00 Continue biological montoring program studies. Continue studies of site colonization.

FY 01 Data analysis and report preparation.

F. Monitoring and Data Evaluation

Data will be evaluated and analyzed using standard parametric and nonparametric techniques as appropriate. An interim report will be submitted at the end of the second year of the study. The final results will be submitted to a peer reviewed journal for publication, and the final report will be prepared in the format of the target journal.

G. Implementability

The project is fully implementable with permits obtained through the U. S. Fish and Wildlife Service and California Department of Fish and Game held by the Biological Resources Division of the U.S. Geological Survey.

H. References

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IV. COSTS AND SCHEDULE TO IMPLEMENT PROPOSED PROJECT

A. Budget Costs

The specific costs and funding source for each project task are provided in Table 1. CalFed funding is currently the only source of funding available to carry out this project. Incremental funding is potentially feasible.

Table 1. Project Cost Summary by Task.

Project Phase and Task	**Direct Labor Hours**	**Direct Salary and Benefits**	**Overhead Labor (General, Admin and fee)**	**Service Contracts**	**Material and Acquisition Contracts**	**Miscel-laneous and other Direct Costs**	**Total Cost**
Task 1 CalFed; no O&M	3,150	50,400	10,412	3,600	4,420	25,200	97,182
Task 2 CalFed; no O&M	5,513	88,200	17,898	3,600	7,735	44,100	167,046
Task 3 CalFed; no O&M	7,088	113,400	22,888	3,600	9,945	56,700	213,621

B. Schedule of Milestones

FY 98 Prepare Draft Environmental Assessment for restoration from existing data. Develop biological monitoring program.

FY 99 Continue biological monitoring program studies.

Initiate studies of site colonization.

FY 00 Continue biological monitoring program studies. Continue studies of site colonization.

FY 01 Data analysis and report preparation.

C. Third Party Impacts

There are no third party impacts associated with this project.

V. APPLICANT QUALIFICATIONS

A. JOHN TAKEKAWA

RELEVANT WORK EXPERIENCE:

August 1995 to present. Wildlife Biologist (Research), U. S. Department of Interior, National Biological Service, California Science Center, San Francisco Bay Estuary Field Station, Vallejo, CA.

January 1995 to August 1995. Wildlife Biologist (Research), U. S. Department of Interior, National Biological Service, California Pacific Science Center, Dixon Field Station, Dixon, CA.

October 1993 to December 1994. Wildlife Biologist (Research), U. S. Department of Interior, National Biological Survey, California Pacific Science Center, Dixon Field Station, Dixon, CA.

April 1988 to October 1993. Wildlife Biologist (Research), U. S. Department of Interior, FWS, Northern Prairie Wildlife Research Center, Pacific States Ecology Field Station, Dixon, CA.

October 1986 to April 1988. Wildlife Biologist (Research), U. S. Department of the Interior, FWS, Northern Prairie Wildlife Research Center, Pacific States Ecology Field Station, Dixon, CA.

November 1983 to September 1986. Wildlife Biologist, U. S. Department of the Interior, FWS, Northern Prairie Wildlife Research Center, Upper Mississippi River Field Station, LaCrosse, WI.

August 1982 to October 1983. Wildlife Biologist, GS-9, U. S. Department of the Interior, FWS, Northern Prairie Wildlife Research Center, Upper Mississippi River Field Station, LaCrosse, WI.

August 1983 to June 1986. Graduate Research Assistant, Iowa State University, Department of Animal Ecology, Ames, IA.

August 1983 to June 1986. Graduate Teaching Assistant, Iowa State University, Department of Animal Ecology, Ames, IA.

July 1982 to September 1982. Wildlife Technician, FWS, Migratory Bird Management Office, Big River, Saskatchewan, Canada.

June 1979 to May 1982. Graduate Research Assistant, University of Idaho, Department of Fisheries and Wildlife, Moscow, ID.

EDUCATION

B.S. 1979, University of Washington, Seattle, Washington
Wildlife Science/Forestry.

M.S. 1982, University of Idaho, Moscow, Idaho
Wildlife Resources.

Ph.D. 1987, Iowa State University, Ames, Iowa
Animal Ecology, Statistics minor.

HONORARY SOCIETIES AND PROFESSIONAL ORGANIZATIONS

The Wildlife Society
British Ornithologist's Union
American Institute of Biological Sciences

AWARDS

Star Excellence Award. U. S. Geological Survey. Davis, CA. September 1996.
Special Service Award. National Biological Service. Dixon, CA. July 1994.
Taking Wing Award: Investigations. U. S. Forest Service. Washington, D. C. March 1994.
Dennis G. Raveling Award. California Waterfowl Association. Sacramento, CA. June 1992.
Special Act Award. U. S. FWS, San Francisco Bay National Wildlife Refuges. Newark, CA. December 1991.
Special Achievement Award. U. S. Dep. Interior, FWS, Northern Prairie Wildlife Research Center. Jamestown, ND. October 1991.
Special Achievement Award. U. S. Dep. Interior, FWS, Northern Prairie Wildlife Research Center. Jamestown, ND. September 1987.
Best Ph.D. Research Presentation. Ecology and Management of Breeding Waterfowl Symposium. Winnipeg, Manitoba. August 1987.
Research Excellence Award (top 10% of graduate research). Iowa State University. Ames, IA. May 1987.
Izaac Walton League Scholarship. Izaac Walton League. Dubuque, IA. 1984.
Prestigious Award for Career Excellence. Iowa State University. Ames, IA. 1982.
Graduate with Honors Cum Laude (top 2%). University of Washington, Seattle. March 1979.
Walt Simonson Memorial Scholarship. Washington State Sportsmen's Council, Seattle. 1979.
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