

Oak Lake Field Station

National Science Foundation Planning Effort

Field Station Background



Nels H. Troelstrup, Jr., Director

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Oak Lake Field Station Background Document

National Science Foundation Planning Effort

The Northern Glaciated Plains provides a unique collection of habitats and species in the heart of the North American Continent. Historical home to a variety of plants and animals, this expanse of native prairie has largely been converted to agricultural production. Today, only small tracts of native and restored prairie remain. Like many ecosystems throughout the world, limited opportunities exist to study the ecology of prairie systems. The Oak Lake Field Station (South Dakota State University) provides a facility for research and instructional opportunities in a northern prairie environment.

Facility Description

Access and Transportation

The Oak Lake Field Station is located 23 miles northeast of the South Dakota State University campus in Brookings County, South Dakota (Fig 1). The Twin Cities International Airport is located within 200 miles with regional connecting flights to the Sioux Falls Airport which is located only 70 miles from the Oak Lake Field Station. Interstate highway (I-29) provides a route to within 15 miles while state and county highways extend to the perimeter of the 570 acre field station. Gravel roads are maintained on the field station grounds to support maintenance and programming efforts.

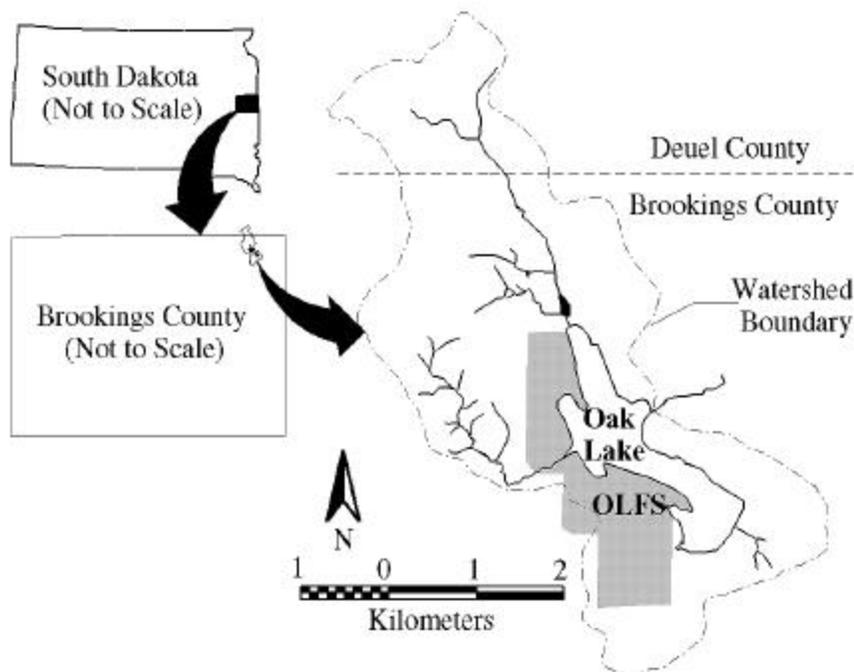


Figure 1. Relative location of Oak Lake and the Oak Lake Field Station (shaded gray) in eastern South Dakota.

Oak Lake Landscape

Oak Lake Field Station is located along the western shoreline of Oak Lake within the Northern Glaciated Plains Ecoregion (Omernik 1986). This region is naturally dominated by tallgrass prairie vegetation with bur oak woodlands along lake shorelines and drainages. The landscape is flat to rolling with well drained loamy soils. One soil group (Singsaas Series) is so intensively worked by earthworms that there is complete disruption of soil horizons. A mixture of tallgrass prairie, oak woodlands, prairie marshes and deepwater habitats occur on the field station property (Table 1). Transition zones between these major habitat types occur abruptly due to significant topographic relief on the site. Thus, groups visiting the field station witness tremendous biological diversity over short spatial distances.

The landscape of eastern South Dakota falls within the Prairie Pothole region of the upper Midwestern United States. This landscape has a mid-continental climate and was glaciated several times during the Pleistocene Epoch. Temperatures may reach -30 (C) during winter months and 30 (C) during the summer. Glacial advances and retreats left undulating topography with numerous ice-formed depressions termed potholes. These potholes vary greatly in density, size and depth. The Oak Lake basin was formed approximately 14,000 years ago as one of these potholes during the recession of the Gary Substage of the Wisconsin glaciation (Table 2). The lake sits on the eastern ridge of the Coteau des Prairie, a wedge-shaped upland area formed between two lobes of glacial ice (Flint 1955). Numerous smaller potholes are also located on the field station property. Drainages to the west of the Field Station drain into the Big Sioux River and through the Missouri River drainage to the Mississippi River. Oak Lake and drainages to the east drain into the Minnesota River and hence to the Mississippi River.

Table 1. General land cover of the Oak Lake Field Station, Brookings County, South Dakota.

Land Cover Class	Hectares	Percent
Rangeland and Pasture	152	66%
Cropland	28	12%
Forest	30	13%
Wetland Basins	18	8%
Roads and Developed Land	2	1%

Table 2. Oak Lake and drainage basin attributes, Brookings County, South Dakota.

	Attribute	Value	Units^d
Oak Lake	Surface Elevation	549.25 ^b	masl
	Area	162.8 ² (160.3) ^a	ha
	Perimeter	9.8 ^b	km
	Volume	1.801x10 ^{6a}	m ³
	Ave Depth	1.12 ^a	m
	Max Depth	2	m
	Relative Depth	0.14	%
	Basin Length	3,081 ^b	m
	Basin Width	988 ^b	m
	Shoreline Development	2.17 ^b	
	% Basin 0 to 1.52m	72.8% ^a	
% Basin >1.52m	27.2% ^a		
Note! Oak Lake basin was recorded as dry during the period 1933 through 1937.			
Watershed	Area	1,681.8 ^b	ha
	Perimeter	23.3 ^b	km
	Drainage Density	1.9 ^b	km/km ²
Field Station	Area	231.8 ^b	ha
	Perimeter	10.9 ^b	km
Drainages	Major Drainage	Mississippi River	
	Minor Drainage	Minnesota River	
	Drainage Count	99 ^b	km
	Total Length	31.7 ^b	km
	Average Length	0.3 ^b	km
	Minimum	<0.1 ^b	km
Maximum	1.9 ^b	km	
Wetlands	Number	122 ^c	
	Total Area	267.1 ^c	ha
	Average Area	2.2 ^c	ha
	Minimum Area	<0.1 ^c	ha
	Maximum Area	163.1 ^c (Oak Lake)	ha

^aSouth Dakota Department of Game, Fish and Parks. 1965. *Diagram of planimetric measurements of the Oak Lake Basin, Brookings County. Based upon Aerial Photography taken in 1956, water stage 1.5' below normal.*

^bUnited States Geological Survey. 1970. *Astoria, South Dakota Quadrangle Map. 7.5', 1:24,000 Quadrangle Map based upon aerial photography taken in 1969.* Map digitized to create the Oak Lake Field Station Geographic Information System.

^c United States Department of the Interior, United States Fish and Wildlife Service, National Wetlands Inventory. 1990. *Wetlands delineations for the USGS Astoria, South Dakota Quadrangle Map. 7.5', 1:24,000 Quadrangle Map based upon aerial photography taken in 1986 (CIR).* Digital wetlands coverage obtained from the National Wetlands Inventory and integrated within the Oak Lake Field Station Geographic Information System.

^dAll units converted to metric equivalents from original sources.

Site History

The Oak Lake area was inhabited by Native Americans of the Dakota Sioux Tribe. European settlers first arrived from Minnesota and Scandinavia during the early 1870's (Olson 1974). A number of owners have claimed the five main land parcels over the last 100 years (Fig 2; Appendix I). Several of these parcels were divided and distributed as wood lots for firewood and building materials. Land was developed and privately managed for agricultural production until 1962 when The Girl Scouts of America purchased 570 acres along the western shoreline of Oak Lake (Appendix I). Outdoor instruction buildings, bunkhouses, administration building and dining hall were built during the period 1968-1972. The State of South Dakota acquired Oak Lake Field Station from The Girl Scouts of America through a land trade in 1988. South Dakota State University was given a 50 year lease from the South Dakota Department of Schools and Public Lands. Minor renovations have been made to the facility which is now managed as a multiple-use field station (Northern Plains Biological Field Station Committee 1989).



Figure 2. The Rue family homesteaded on the South Farm Unit in 1900. A descendant of John Rue (pictured standing) participates on the Oak Lake Community Advisory Group (with permission, Art Graslie, White, SD).

Facilities and Equipment

Twelve building structures are maintained at Oak Lake Field Station. These include a dining hall, administration building, two farm houses, two barns, repair shed, two bunkhouses, canoe house and outdoor classroom (Fig 3). Facilities and equipment are available at Oak Lake Field Station to support a wide range of instructional and research efforts. Field and laboratory equipment to support basic studies in field ecology are available at the field station or through the main SDSU campus. A resource room is equipped with library, tables, counter top space, whiteboard and telephone line (Internet connection) to support small class meetings. A field laboratory, canoes and small research boat provide basic facilities to conduct limnological investigations on Oak Lake. Additional equipment is distributed among the different facilities present at the field station (Table 3; Appendix II). Limited cold storage space is available on

site. Analytical laboratories are available on the main campus of South Dakota State University, only 30 minutes travel from the field station.

Table 3. Facilities and equipment available to support programs at the Oak Lake Field Station.

Activity Area	Facilities and Equipment
Dining Hall 3 Bedrooms 2 Bathrooms Kitchen Dining Area	Dishes and utensils Beds Telephone Tables and benches Projection screen and overhead projector
Administration Building Administrative Office Field Laboratory Resource Room	Desks, telephones, computer Countertops/Sink Lab Glassware, Balance, Microscopes Field Meters Quadrats, Field Tapes Corers, Nets, Traps Field Station Library
South Farm Unit Caretaker's Home Large Bunkhouse Small Bunkhouse Barn Shop	Weather Monitoring Equipment Bunk Beds Refrigeration, Microwave, Tables Wood Burning Stoves Tools Pick-up Truck Tractor with Loader
North Farm Unit Pioneer House Barn	Wood burning stove, Furniture Storage space
Canoe House and Outdoor Classroom	Storage and Work Space 8 Canoes 12' Research Boat Storage

* see Appendix II for listing of additional available equipment.



Figure 3. Field station administration building (left) and dining hall (right) receive the greatest demands for use.

Communications

The administration building, dining hall and caretaker's home have been connected with telephone service. No ethernet connections are available at this time. However, modem connection to e-mail and the Internet is possible over existing telephone lines.

An Internet Home Page has been developed for the Oak Lake Field Station under the Department of Biology and Microbiology's home page (<http://www.abs.sdstate.edu/bio/Oaklake/index.htm>). Field Station programs and reservations are announced via Internet, local television, radio, written brochures and newsletters.

Data Management

Data to summarize station use, budget, facilities maintenance, climate and water quality monitoring are maintained in digital files. These files have been developed using standard spreadsheet software (QUATTRO PRO) to facilitate use by a variety of public school, agency and campus groups. Basic database structure and maintenance were designed following the guidelines provided in Goenter (1992). All data are maintained in the laboratory of the station director and the Department of Biology and Microbiology. Data requests are managed through a central IBM compatible minicomputer. Data can also be downloaded as Macintosh text and spreadsheet files.

Automated Data Acquisition Systems

A Geographic Information System and Informational Database have been developed for Oak Lake Field Station to support instruction and research efforts (Appendix III). The spatial scope of the GIS is based upon the surficial watershed boundaries of the Oak Lake Basin and includes the field station property. This design is intended to provide a biophysical framework to support research and instructional activities. Development of the Oak Lake GIS has been supported by SDSU Central Administration, Department of Geography and South Dakota Agricultural

Experiment Station. Computer hardware (IBM microcomputer, color plotter, digitizing table) and PC ARC/INFO (GIS) software were purchased in 1992 and have been used to develop this system.

In addition to GIS capability, the Oak Lake Field Station has implemented a climatic and water resources monitoring effort. Daily temperature and precipitation data are recorded using National Weather Service equipment. These data are maintained in a computer database on campus and are provided to instructors and researchers upon request (Appendix IV). Water quality monitoring data for Oak Lake are collected biweekly during the ice-free months. These data are also provided upon request to instructors and researchers interested in projects at the station.

Site Administration

Oak Lake Field Station is administered by an academic committee appointed by the President of South Dakota State University (Table 4). The Oak Lake Committee meets three times during the academic year to make policy decisions, approve an annual budget and develop programming and planning activities. Standing subcommittees have been defined for funding, programming, research and membership program. The station director serves as chair of the Oak Lake Committee and coordinates day to day operations. Station maintenance, cleaning and repair activities are the responsibility of an on-site caretaker.

A community advisory group was established in 1995 to (1) serve as liaison between the general public and Oak Lake Committee and (2) provide recommendations regarding station finances, programming and policies. This committee meets quarterly and is chaired by an elected member of the community. Advisory Group composition includes bankers, retired politicians, farmers, housewives and business persons from the communities surrounding the field station.

Oak Lake Field Station is presently maintained and managed by two part-time staff (caretaker (33%) and director (20%)). The caretaker has been employed with the field station since 1988 while the director has served five years. Additional, part-time seasonal employees are hired during the summer to assist with grounds maintenance and programming. Secretarial support is provided through the Department of Biology and Microbiology on the SDSU campus.

Table 4. Current composition of Oak Lake Field Station Committee, Spring 1998.

Name	Affiliation	Years on Committee
Dr. Nels H. Troelstrup, Jr., Chair	Biology & Microbiology	5
Dr. Charles McMullen	Biology & Microbiology	10
Dr. Gary Larson	Biology & Microbiology	10
Ms. Linda Sandness*	Health, Physical Education and Recreation	>10
Dr. Pat Johnson	Animal & Range Sciences	5
Dr. Janet Gritzner	Geography	5
Dr. Donna Hess	Rural Sociology	5
Mr. Dick Waldner	Physical Plant	10
Dr. Tim Steele	Art	6
Mr. Tim Nichols	College of Ag/Bio	2
Mr. Jim Welch	Instructional Technologies	2
Dr. Jim Doolittle	Plant Science	< 1
Dr. Anne Marie Bahr	Philosophy & Religion	6

* Ms. Sandness experience with Oak Lake Field Station includes previous appointment as Camp Director with Girl Scouts of America.

Missions of the Oak Lake Field Station

Projects and programs fall within missions defined in the Oak Lake Management Plan (Northern Plains Biological Field Station Committee 1989).

Missions of the Oak Lake Field Station
<i>Provide educational opportunities for citizens and students in professional fields represented by South Dakota State University,</i>
<i>Provide facilities and environment for interdisciplinary research to enhance the quality of life in the Northern Great Plains region through the beneficial use of human and natural resources,</i>
<i>Provide the facilities and environment for colloquia, symposia, conclaves, conventions, seminars and gatherings related to the community and university,</i>
<i>Conserve the property in an environmentally sensitive way so as to enhance and protect the unique and valuable natural resources of the area.</i>

Field Station Use

The Oak Lake Field Station is a multiple-use facility managed by South Dakota State University. Overall use of the facility has increased dramatically since acquisition in 1988 (Fig 4). The number of groups using the field station annually has increased from less than 10 to nearly 85 while number of user-days has increased to nearly 3,700 per year.

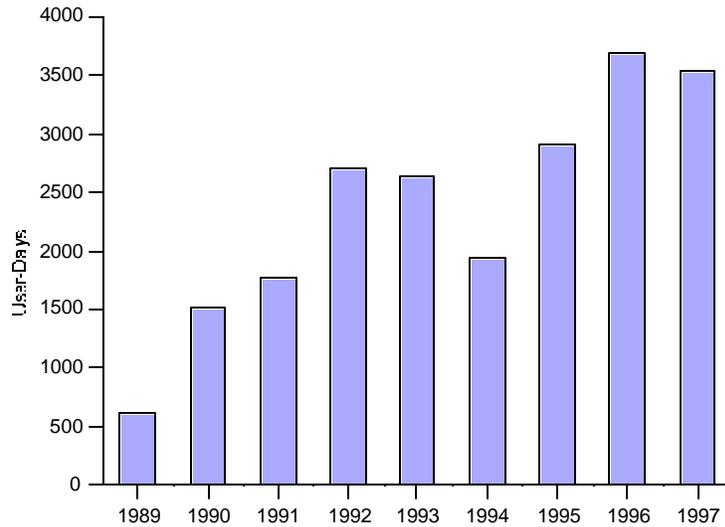


Figure 4. Changing use patterns for the Oak Lake Field Station (1989-1997).

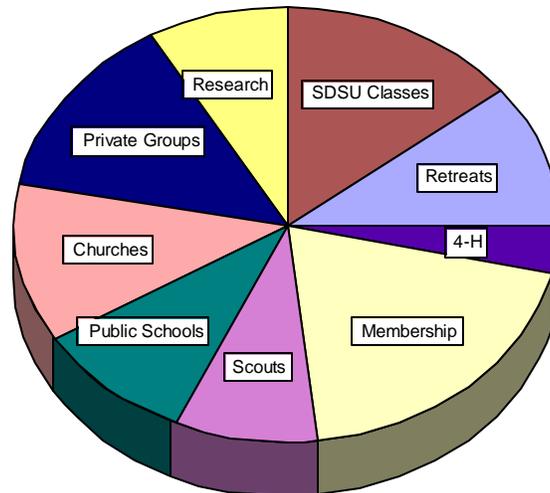


Figure 5. Oak Lake Field Station user composition, 1997.

Field station users represent a diverse group of interests (Fig 5). Approximately one-third of field station use is directed toward instructional and research activities from the university community. Research efforts have increased from 0 user-days in 1989 (first year managed by SDSU) to 309 user-days of activity in 1997. Five-year management goals have been established to triple research activity by the year 1999. Realization of this goal would be facilitated through improved facilities and collaborative ties with other field stations (Lohr et al. 1995).

Instructional activity has also increased tremendously over the past seven years. University instruction, field courses provided through public schools, continuing education and outreach programs all utilize facilities at the field station. Instructional use by these groups has increased from 50 user-days in 1990 to 1645 user-days of instructional activity in 1997. Continuing education programs in environmental science are presently linked with funded research to investigate post-instructional retention of environmental science concepts. In addition, Oak Lake Membership activities include Saturday instructional programs on prairie vegetation, bird life and cultural history of the northern plains region to civic organizations and the general public.

Research at the Oak Lake Field Station

Research efforts at Oak Lake Field Station are focused in the area of prairie ecology (Appendix V). Over its brief ten year history, Oak Lake Field Station has provided facilities and equipment to support five different post-graduate theses and a number of faculty research projects. Research topics have included studies on physiological ecology of purple coneflower (*Echinacea angustifolia*), foraging activities of blue jays (*Cyanocitta cristata*), habitat utilization of white-tailed deer (*Odocoileus virginianus*), influence of littoral zone disturbance on invertebrate, bird and mammal communities, studies of ornamental traits in prairie wetland invertebrates, extended limnological studies (>20yrs) of prairie pothole lakes, influence of fire on prairie vegetation and assessment of environmental education programs.

Active research efforts focus on ecological pattern and process on the Northern Plains. Long-term studies (> 20 yrs) of factors influencing the dynamics of phytoplankton in prairie lakes are being examined at Oak Lake and other nearby prairie pothole basins (Haertel and Jongsma 1982; Haertel and Tucker 1993). Physiological ecology of native prairie plants (i.e., purple coneflower, *Echinacea angustifolia*) is the focus of both undergraduate and graduate research in the Department of Biology and Microbiology (Feghahati 1995; Feghahati and Reese 1994; Viles and Reese 1996). Foraging behavior of blue jays (Dixon 1994) and habitat utilization by white-tailed deer (Oehler et al. 1994) have been topics of recent undergraduate and graduate research projects through the Department of Wildlife and Fisheries at South Dakota State University. Recently funded projects focus on community responses to disturbance within the land-water interface of prairie lakes. These efforts integrate the utilization of GIS technology and manipulative field experiments to investigate response/recovery patterns of littoral zone communities in prairie pothole environments. Other newly funded efforts focus on development and assessment of hands-on, inquiry based environmental education materials for public school systems.

Representative Research Products

Bakker, K. and N.H. Troelstrup, Jr. 1998. Patterns in avian community structure and non-point source disturbance potential along the land-water interface of a prairie pothole lake. *Proceedings of the South Dakota Academy of Science* 77: 221-230.

Bakker, K. 1996. *Bird community attributes in critical and non-critical areas within the land-water interface of a prairie lake*. MS Thesis, Department of Biology and Microbiology, South Dakota State University, Brookings, SD. 134p.

Dixon, M.D. 1994. *Acorn caching and consumption of weevil-infested nuts: Possible means of tannin circumvention for the Blue Jay*. MS Thesis, Department of Wildlife and Fisheries, South Dakota State University, Brookings, SD. 98p.

Feghahati S.M.J. and R. N. Reese. 1994. Ethylene, light and prechill enhanced germination of *Echinacea angustifolia* seeds. *Journal of the American Horticultural Society* 119: 853-858.

Haertel, L. and N.H. Troelstrup, Jr. 1998. Transport of nutrients and phytoplankton into two glacial prairie lakes. *Proceedings of the South Dakota Academy of Science* 77: 13-25.

Haertel, L. and W.L. Tucker. 1993. Long-term changes in prairie lake water clarity and plankton composition as an indicator of stress to prairie lake ecosystems. Pages 96-101, in Nels H. Granholm (ed.). *Biostress*. Proceedings of the Stress Mechanisms Symposium, South Dakota State University, Brookings, SD.

Kraft, C.K. 1996. *Mammals inhabiting the land-water interface of Oak Lake as indicators of disturbance*. MS Thesis, Department of Biology and Microbiology, South Dakota State University, Brookings, SD. 181p.

McCart, C.D. 1996. *Effectiveness of an environmental education workshop for secondary science and agricultural teachers in eastern South Dakota*. MS Thesis, Department of Biology and Microbiology, South Dakota State University, Brookings, SD. 79p.

Oehler, M.W., Sr., J.A. Jenks, R.T. Bowyer. 1994. Antler rubs by white-tailed deer: the importance of trees in a prairie environment. *Canadian Journal of Zoology* 73: 1383-1386.

Troelstrup, N.H., Jr. and G.A. Myers. 1994. K-16 outdoor classroom at the Oak Lake Field Station. *Principally Speaking* 6: 18-21.

Viles A.L. and R.N. Reese. 1996. Allelopathic potential of *Echinacea angustifolia* D.C. *Environ Exper Bot* (In Press).

Instructional Activities at the Oak Lake Field Station

Instructional activities at the Oak Lake Field Station include field courses presented by public school groups and university faculty. In addition, continuing education and outreach programs in the area of environmental science have been conducted at Oak Lake Field Station for several years. These have included Woodrow Wilson Science Institutes for Science Teachers, Project Learning Tree, Project SAVE and Project WILD training workshops for science teachers and a Summer Science Camp for middle school children. Newly funded efforts link instruction using hands-on, inquiry based environmental education activities with research on student understanding and retention of environmental concepts.

In addition, field components of several university classes have been offered at Oak Lake Field Station (Appendix V). Classes utilizing the station have included General Biology, Vertebrate Zoology, Introduction to Range Management, Disturbance Ecology, Biomonitoring and Assessment, Big Game Management, Mammology, Natural Resource Measurements, Integrated Natural Resources Management, Camping Skills and Canoeing Basics.

Hosted Special Activities

The Oak Lake Field Station has hosted several special workshops and society functions. These include a 1993 Special GIS Training Workshop, the 1994 Meeting of the Great Plains Limnological Conference and banquet for the 1995 Meeting of the North Central Division of the American Phytopathological Society. Oak Lake Field Station also hosts an annual Native American Writers Colloquia. Authors of Native American short stories meet each fall to share ideas and discuss Native American writing styles.

New Opportunities

Oak Lake Field Station has initiated prairie reclamation and fire management projects to restore and/or improve tall grass prairie stands. Two small crop fields were recently re-seeded to native prairie grasses. In addition, fire has been reintroduced as a management tool to manage invasion of woody vegetation and exotic grasses. Reclamation burns were conducted in 1996 and 1997 in three different patches with excellent results. These management efforts provide research opportunities for university faculty and students. For example, Dr. Pat Johnson (Animal and Range Sciences) has initiated an experimental study to examine the influence of prairie fire on dominant grass species. Her project was initiated as a result of our management burns.

Existing and Future Support

Oak Lake Field Station is presently supported through a combination of funding sources (administrative, endowment, self-generated). The annual operating budget of the field station is currently \$12,000. Administrative support accounts for 50-70% while remaining revenues are self-generated through user-fees, crop land sales and station programs.

Administrative support of the field station has increased over the last several years. Operating and maintenance allocations for 1997 and 1998 were \$7,820 and \$8,660, respectively. SDSU Administration has provided support to establish the Oak Lake Geographic Information System, implement over \$42,000 of renovations to the facilities over the past 4 years and fund faculty research projects in disturbance ecology.

The Oak Lake Capital Campaign has set a goal to generate \$2.5 million for an endowment to support operations and programming at the field station. Efforts to establish endowment funds have so far generated \$100,000. These funds will provide continued support for maintenance, renovations and programming support into the foreseeable future.

Statements of Support

The Oak Lake Field Station provides a facility to meet research and instructional needs of a variety of user groups in the Northern Plains. Past and current efforts have included participation by university faculty and students from institutions throughout the region. In addition, our facility addresses current research and instructional needs of natural resource agencies and local civic organizations. The statements provided below attest to the value of the facility and demonstrate the scope of user-groups served by our facility.

President Robert Wagner (South Dakota State University)

South Dakota State University is committed to the development of facilities and programs at the Oak Lake Field Station to support research and instructional activities within the Northern Plains Region. The field station presently serves research, instructional and service needs of several colleges within our university system. In addition, participation in field station programs by outside institutions and agencies demonstrates efforts by South Dakota State University to take a leadership role in sciences within the region. Existing research efforts in prairie ecology and environmental science are strongly linked to classroom instruction on the South Dakota State University campus and the public school system. We anticipate future strengthening and broadening of these programs through collaboration with other field stations and institutions. Support for this facility and its programs will continue to be a priority of this institution as we move into a new era of opportunities in the Northern Plains.

Dr. James A. Perry (University of Minnesota)

Thank you for the information about your NSF proposal for the Oak Lake Field Station. I am quite familiar with the programs at Oak Lake and have participated in some of those programs. I see great opportunity for further collaboration and for both research and graduate education at the Station. The combinations of lake and wetland environments, lab and residential facilities, agricultural and "less intensively managed landscapes" all provide excellent opportunities for growth. I would strongly support your request to NSF for planning funds to better understand how the Station can play a central role in your research and education program within the Upper Midwest. If I can be of further assistance as your planning proceeds, please contact me.

Dr. Patricia Johnson (South Dakota State University)

Opportunities to study and conduct ecological experiments in tallgrass prairie ecosystems in this area are very limited. This is one important reason that the Oak Lake Field Station is an invaluable asset to the region. The station encompasses a wide variety of ecosystem types, including wetlands, tallgrass prairie and oak woodlands. These natural attributes and the proximity of the station to regional campuses provide incentives for researchers and instructors to utilize the facility.

Ms. Maggie Hachmeister (South Dakota Game, Fish & Parks)

As the Education Services Coordinator of the Division of Wildlife, SD Department of Game, Fish & Parks, I am closely involved with all those in the state who work in environmental education. The Oak Lake Field Station provides an exceptional facility for teacher continuing education and K-12 school field experiences. Each instructional activity is unique because of the wide array of outdoor, research-based activities that can be conducted on the site. Our agency has utilized the facility to conduct environmental education workshops and is presently planning a research effort to investigate environmental education programs within the state.

Description of Planning Effort

During 1993, the Oak Lake Committee conducted a review of field station programs and use. Both long-term and 5-year programming goals were established to guide management of the field station (Troelstrup 1995). This review led to a proposed planning effort funded through the National Science Foundation. The objectives of our NSF planning effort are to (1) define the research and instructional science agenda for the Oak Lake Field Station, (2) identify facility and equipment needs of the Oak Lake Field Station, (3) establish collaborative working relationships for research and instructional programs with other biological field stations, (4) establish communication with other field stations for the exchange of long-term monitoring data and instructional materials and (5) develop a physical plan and cost estimates for proposed changes in the facility to be used in subsequent funding requests (Lohr et al. 1995). These objectives will be addressed through a combination of interactive workshops and intensive planning efforts over a two year period.

Establishing a Science Agenda

Oak Lake Field Station is a member of the Organization of Biological Field Stations (OBFS). This proposed effort will utilize the experience of field station directors from several OBFS facilities to help guide planning and design efforts for the Oak Lake Field Station. The first step of this planning process is to define the science agenda for the Oak Lake Field Station. By definition, an agenda is a list of tasks to be accomplished. In strategic planning, this list might correspond to specific strategies undertaken to accomplish particular goals and objectives. Our science agenda has both instruction and research components.

Education Mission: Provide educational opportunities for citizens and students in professional fields represented by the University,

Research Mission: Provide facilities and environment for colloquia, symposia, conclaves, conventions, seminars and gatherings related to the community and university.

Instruction Goal: Strengthen science education opportunities for public school, undergraduate, graduate and post-graduate citizens of the Northern Plains.

Objective #1. Provide facilities and environment for public school and university classes.

Strategy #1: Develop an indoor classroom facility for use by public schools and university courses by the year 2000.

Strategy #2: Winterize dining hall and administration building by the year 2010.

Strategy #3: Improve housing facilities to support visiting instructors and students by the year 2010.

Strategy #4: Develop Internet and multimedia capabilities for use by instructors by the year 2000.

Strategy #5: Develop on-site library to support studies of Northern Prairie environments by the year 2000.

Strategy #6: Develop collaborative distance education offerings in natural resources and environmental science by the year 2005.

Objective #2. Develop a natural resources monitoring program.

Strategy #1: Work with the National Weather Service to develop a climate monitoring data base by the year 1995 [Monitoring Underway].

Strategy #2: Design and implement a water quality monitoring program for the Oak Lake Basin by the year 1994 [Monitoring Underway].

Strategy #3: Inventory Oak Lake flora and fauna by the year 2005.

Objective #3. Develop and maintain data related to natural and human resources of the Oak Lake Field Station.

Strategy #1: Construct a geographic information system for Oak Lake Field Station by the year 1995. Basic GIS coverages should be developed on a 1:24,000 base map and include soils, land cover, drainages, basins, building structures and transportation corridors [Functional GIS Constructed].

Strategy #2: Develop spreadsheet data sets of monitoring and inventory information. Such data sets should be constructed to allow easy access to

public schools and university students/faculty [Database Files Established].

Strategy #3: Define land and cultural history of Oak Lake parcels by the year 1998 [Land Ownership Research Complete].

Objective #4. Provide incentives and marketing to improve instructional use of Oak Lake Field Station.

Strategy #1: Establish a visiting scholars program to enhance summer course offerings at Oak Lake Field Station by the year 2005.

Strategy #2: Establish collaborative linkages with state agency and tribal education programs to provide funding to support environmental education courses by the year 1996 [Current Funding Available for Environmental Education Programs].

Strategy #3: Develop and offer weekend education programs on natural resources by the year 1996 [Oak Lake Membership Programs Developed].

Strategy #4: Develop an Internet home page to advertise station programs and facilities by the year 1998 [Internet Home Page Constructed].

Strategy #5: Utilize newsletters, press releases and brochures to advertise educational offerings at Oak Lake Field Station.

Objective #5. Improve instructional funding to support instructional programs and facilities at Oak Lake Field Station.

Strategy #1: Identify instructional facility, equipment and programming needs to support our instructional science agenda by the year 1999.

Strategy #2: Utilize university new instructional ideas fund to support acquisition of equipment and small building renovations in support of our instructional science agenda by the year 1999.

Strategy #3: Submit funding requests to the National Science Foundation (Division of Marine Laboratories and Field Stations) in support of large building renovations by the year 2000.

Research Goal: Enhance scientific understanding of Northern Plains ecosystems through collaborative, interdisciplinary research and scientific interaction.

Objective #1. Improve field station facilities and equipment available for prairie research.

Strategy #1: Identify research facility and equipment needs to support collaborative, interdisciplinary research efforts by the year 1999.

Strategy #2: Improve housing facilities to support visiting research scientists and students by the year 2005.

Strategy #3: Expand field laboratory space to support visiting research scientists and faculty by the year 2005.

Strategy #4: Develop library reference collection focusing on prairie environments by the year 2000.

Strategy #5: Purchase two dedicated IBM compatible workstations to support research efforts at Oak Lake Field Station by the year 2000.

Objective #2. Provide incentives to increase research productivity at Oak Lake Field Station.

Strategy #1: Develop a mechanism to generate "seed money" to support a competitive research fund for on-site projects by the year 2000.

Strategy #2: Increase collaborative research efforts with tribal colleges, public universities and state/federal agencies by the year 2000.

Strategy #3: Develop natural resources data base and geographic information system in support of research efforts by the year 1999 [GIS and Structure Defined].

Strategy #4: Provide opportunities for on-line publishing of student research results on Oak Lake home page by year 1999.

Strategy #5: Develop research opportunities profiles for societal bulletins and OBFS newsletter by the year 1999.

Objective #3. Increase visibility of Oak Lake facilities and research opportunities.

Strategy #1: Publish and distribute summary articles describing research efforts in field station newsletter and home page [Newsletter and Home Page Developed].

Strategy #2: Encourage student and faculty publication of research results.

Strategy #3: Require published and presented research deliverables from field station funded research efforts.

Anticipated Benefits of Planning Effort

Information developed from this planning effort will be used to refine and guide station management and fund raising efforts for the next 5-10 years. Current efforts to generate funds for station programs and facilities will be enhanced through the development of detailed planning information for the Oak Lake Field Station. Requests for facility and equipment needs will be viewed with greater confidence based upon the collective recommendations of established field station directors representing a number of institutions.

In addition to facilities planning, this project will serve to enhance instruction and research programs at the Oak Lake Field Station through greater collaborative ties with other field stations. New student exchange programs and interactive media (video and Internet) will provide means for interbiome projects and learning experiences for students and faculty. Faculty at other institutions will become aware of facilities and opportunities at Oak Lake Field Station. This increased awareness will enhance our ability to serve a broader group of scientists and students interested in prairie environments.

References Cited

Flint, R.F. 1955. *Pleistocene geology of eastern South Dakota*. U.S. Geological Survey Professional Paper 262, Washington, D.C.

Gorentz, J.B. (ed) 1992. *Data management at biological field stations and coastal marine laboratories*. Report of an Invitational Workshop, W.K. Kellogg Biological Station, Michigan State University, East Lansing, MI. 110p.

Lohr, S.A., P.G. Connors, J.A. Stanford, J.S. Clegg. 1995. *A new horizon for biological field stations and marine laboratories*. Miscellaneous Publication No. 3, Rocky Mountain Biological Laboratory, Crested Butte, CO. 36p.

Northern Plains Biological Field Station Committee. 1989. *Management plan. Northern Plains Biological Field Station*. Planning Document Produced for the Oak Lake Field Station, South Dakota State University, Brookings, SD.

Olson, L.M. 1974. *Oak Lake girl scout camp history*. Minn-Ia-Kota Girl Scout Council, Sioux Falls, SD. 10p.

Omernik, J.M. 1986. *Ecoregions of the United States*. Environmental Research Laboratory, U.S. Environmental Protection Agency, Corvallis, OR. map

Troelstrup, N.H., Jr. 1995. *The Oak Lake Prairie Learning Center. A concept for the future*. Planning Document, Oak Lake Field Station, South Dakota State University, Brookings, SD.

Appendix I. Oak Lake Field Station History of Ownership

	North Farm Lots 1-4	South Farm E1/2 of NW1/4	South Farm SE1/4	South Farm NE1/4	Peninsula Lot 6 of NW1/4
Legal Description	T112N 48WS12	T112N R48WS13	T112N R48WS13	T112N R48WS13	T112N R47WS18
First Homesteaded	July 19, 1886	September 27, 1881	September 27, 1881	September 27, 1881	February 20, 1897
First Owner	Ms. Kristin Lunde	Winona & St. Peter Railroad Company	Winona & St. Peter Railroad Company	Winona & St. Peter Railroad Company	Mr. Ole Bogen
Number of Owners	28	20	20	34	23
Girl Scout Purchase	June 6, 1963	September 21, 1965	January 11, 1973	January 11, 1973	July 16, 1966
SDSU Acquisition	December 8, 1988	December 8, 1988	December 8, 1988	December 8, 1988	December 8, 1988

Complete listings of land ownership for each parcel have been transferred to the Oak Lake database. File entries include dates of transactions and names of individuals to whom land was transferred. Land use history is currently under investigation by the history subcommittee of the Oak Lake Advisory Group.

Appendix II. Laboratory and Classroom Equipment Inventory

Location	Equipment List
Field Laboratory	<p style="text-align: center;"> IBM Pentium Microcomputer with 28.8/33 Mhz Fax/Modem (1) IBM Pentium II Microcomputer (1) Gateway Colorbook II Microcomputer (1) Laboratory Glassware Measuring Tapes Top Loading Balance (1) Max/Min Thermometers (2) Clinometer and Compass (1) Field Filtration Apparatus (1) Compound Microscope (2) Zoom Dissecting Microscope (1) Hach DREL 2010 Field Spectrophotometer (1) Orion pH Wand (1) Speedtech Depth Sounder (1) Magellan Field Pro V Global Positioning System (1) Magellan Pro Mark XCP Global Positioning System (1) Marsh-McBirney Current Meter (1) LICOR Quantum Sensor and Data Logger (1) YSI Model 54 Dissolved Oxygen Meter (1) YSI Model 33 Salinity, Conductivity and Temperature Meter (1) Secchi Disks (2) Clarke-Bumpus Plankton Sampler (1) Wisconsin Plankton Net Benthic Sediment Corer (1) Van Dorn Bottle (1) Wetland Activity Traps (17) Kicknets (3) Seines (2) Benthic Sampling Sled Assorted Sieves Plant Presses (2) Vegetation Sampling Quadrats (4) Vegetation Density Board Refrigerators (2) Cabin Tent Screen Tent </p>
Resource Room	<p style="text-align: center;"> Field Sampling Bottles, Dishes and Trays Miscellaneous Small Mammal Traps Folding Field Tables (2) Student Van Dorn Bottle (1) Student Invertebrate Samplers Decomposition Activity Kit (1) Soil Studies Teaching Kit (1) Soybean Teaching Kit (1) LaMotte Water Testing Kit (1) Enviroscope Modules (4) A/O Dissecting Microscopes (19) A/O Compound Microscopes (21) TV/VCR/Scope Camera Unit Multimedia Projector Assorted Writing, Drawing & Craft Supplies </p>

Appendix III. Geographic Information System

Status

Development of the Oak Lake Field Station geographic information system was supported by South Dakota State University Administration, South Dakota Agricultural Experiment Station and the Department of Geography. Nine base coverages have been developed. Attribute tables are more developed for soils and wetland coverages. Global Positioning System technology is currently being used to support individual research efforts. Station maps are produced to facilitate planning, instruction and research efforts. Additional coverages should be developed for subsurface geology, spring locations, temporal changes in land cover and utility lines.

Platform	IBM Compatible, Windows NT Pentium II		
Type	Vector		
Software	PC ARCINFO		
Base Map	1:24,000 USGS Quad Sheets		
	Name	Type	Source
Coverages	Watershed Boundary	Polygon	USGS Quad Sheet
	Field Station Boundary	Polygon	USGS Quad Sheet
	Building Structures	Point	USGS Quad Sheet
	Roads & Trails	Line	USGS Quad Sheet
	Soils	Polygon	NRCS Mylar Overlays
	Elevation Contours	Line	USGS Quad Sheet
	Drainages	Line	USGS Quad Sheet
	Wetland Basins	Polygon	NWI Aerial Photography
	Land Cover	Polygon	BW Aerial Photography

Appendix IV. Monitoring Database for Oak Lake Field Station

Monitoring Effort	Parameter	Method	Data Density
Weather & Climate	Air Temperature	Thermistor Thermometer	Daily since 1994.
	Ambient		Daily since 1994.
	Minimum		Daily since 1994.
	Maximum		Daily since 1994.
	Daily Precipitation	NWS Rain Gauge	Daily since 1994.
Oak Lake	Water Depth	Graduated Rod	Bimonthly since 1994. ¹
	Stream Flows	0.6x Depth	Bimonthly since 1994. ¹
	Water Temperature	Thermistor	Bimonthly since 1994. ¹
	Dissolved Oxygen	YSI Model 54	Bimonthly since 1994. ¹
	Conductance	YSI Model 33	Bimonthly since 1994. ¹
	Water Transparency	Secchi Depth	Bimonthly since 1994. ¹
	Phytoplankton	1 Minute Tow	Monthly since 1994. ¹
	Zooplankton	1 Minute Tow	Monthly since 1994. ¹
	Zoobenthos	Eckman Grab & Kicknet	Monthly since 1994. ¹
		Fecal Coliforms	MPN/100ml
	Ice-up/Ice-out	Dates Recorded	Annually since 1994.

¹Samples collected during ice-free season.

Appendix V. Oak Lake Instruction and Research Summary

Course	Instructor	Term	Year(s)
Aquatic Ecology	Droge	Fall	1996
General Biology	Peterson	Summer	1991-92, 98
Mammalogy	Dieter	Fall	1995-96
Vertebrate Zoology	Haertel	Fall	1992-93
Big Game Management	Jenks	Spring	1996
Disturbance Ecology	Troelstrup	Spring	1995-97
Integrated Natural Res. Mgt.	Scalet et al.	Spring	1994
Natural Resources Measurements	Johnson	Fall	1992-96
Entomology	Johnson	Fall	1993
Introduction to Range Science	Kronberg	Fall	1995-97
Flora of the Northern Plains	Larson	Summer	1996
Geographic Information Systems	Gritzner & Troelstrup	Summer	1993
Basic Project WILD	Troelstrup	Summer	1996-98
WILD - Exotic Species	Troelstrup	Summer	1996
Project Learning Tree	Troelstrup	Summer	1997
Project SAVE	Troelstrup	Summer	1995
Project WET	Lewis	Summer	1997-98
Environmental Classroom	Troelstrup	Summer	1996-98
Woodrow Wilson Institute	McMullen, Peterson & Hein	Summer	1992, 1993 & 1994
Canoeing Basics	Sandness	Fall	1989-98
Camping Skills	Sandness	Fall	1989-98

Investigators	Department	Title
L. Haertel	Biology & Microbiology	Limnological studies of prairie lakes.
N. Troelstrup	Biology & Microbiology	Disturbance in the land-water interface.
N. Reese	Biology & Microbiology	Physiological studies of prairie cone-flowers.
J. Jenks	Wildlife & Fisheries	Habitat utilization of whitetail deer.
P. Johnson	Animal and Range Sciences	Effects of fire on native prairie grasses.
W.C. Johnson	Horticulture, Forestry, Landscape & Parks	Foraging behavior of bluejays.

Recently Funded Field Station Efforts:

Troelstrup, N.H., Jr. 1997. Enhancement of research and training facilities at the Oak Lake Field Station, South Dakota. National Science Foundation - \$13,000.

Troelstrup, N.H., Jr. 1997. Assessment of Project WILD in South Dakota: Implementation and understanding at the middle-school level. South Dakota Department of Game, Fish & Parks - \$66,216.