

Caddo Lake

Helping Local People to Use Their Educational Infrastructure for Ecological Stewardship of Ramsar Wetlands

A case study in response to Brisbane 1996 Rec. 6.3 (Ramsar COP6)

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April, 1999

Abstract. At Caddo Lake, as in much of the developed world, few indigenous peoples subsist on the products of local wetlands. Most U.S. wetland communities are occupied by people who pursue other livelihoods. The task in developed countries is to identify strategies to reintroduce local people to their wetlands and to encourage their informed participation in sustainable management and stewardship. The Caddo Lake Institute's programs seek to do this by improving the wetland science and surveillance skills of local people and their educational infrastructure. The Ramsar Convention provides a world-class framework for this effort. "Twinning" projects with partners in less developed countries suggest that any community with an educational capacity can adapt and use this approach. This paper discusses the organizational history, "marginal cost" strategies and functions of the "Caddo Lake Institute Model" for a local "ecosystem stewardship institute."

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Overview

The Caddo Lake Ramsar wetlands are part of a large, shallow wetland complex that sprawls across the Texas-Louisiana border in the south central region of the United States. Caddo Lake lies at the bottom of the Cypress Bayou Basin. The multi-state basin drains an area of approximately 6,000 square miles in 11 Texas counties and 1 Louisiana Parish. The Texas portion of the catchment is 2,828 square miles in area. Located in the Mississippi flyway, Caddo Lake’s wetlands provide important habitat for wintering migratory waterfowl and neotropical birds which winter in Central and South America and the Caribbean. These wetlands are recognized as a unique assemblage of moss-dominated cypress swamp communities. They contain a rich bio-diversity of plants and animals, including species that are rare, endangered or of special concern to state and federal governments and the conservation community generally.

Like much of the developed world, original indigenous populations have been extirpated or relocated, and no longer occupy ancestral niches at Caddo Lake. Today, few local people rely on these wetlands for their subsistence. Most local people are employed in urban, industrial or agricultural activities. Significant populations are employed by or otherwise engaged with local educational institutions, or are retired. Therefore, surprisingly few local people have a need or opportunity to use these wetlands or to become familiar with their ecological values and functions -- except for the relatively small numbers who are involved in boating, hunting and fishing, or the government agencies which manage these activities.

The Texas-Louisiana border region is rural in nature, interspersed with small cities and settlements. It has good public and private infrastructure, but the region is considered underdeveloped by some of its residents and community leaders. The communities in and around the wetlands use the ecosystem for sports fishing, hunting, tourism, forestry and agriculture. The regional economy is dominated by oil, gas, coal and timber production, industrial-style agriculture (agri-business) such as chicken growing and processing. Tourism levels are respectable and important. Income levels tend to be below those of urban areas. The region is racially diverse, with White Caucasian populations constituting the majority and Black populations comprising a substantial minority. For example, the populations of the Caddo Lake’s two principal Texas counties, Marion and Harrison, are composed of approximately 68-70% Caucasian, 28-31% Black and very small percentages of Hispanic, Asian and Native Americans (1996-1997 Texas Almanac).

The ecosystem, while generally healthy, evidences symptoms of stress attributed to impacts of present land use patterns and modest human populations. Caddo Lake is located 180 km. east of the Dallas/Ft. Worth, Texas metropolis, a rapidly growing population center which already exceeds 4 million people. Regulations which restrict private or commercial “property rights” are culturally and politically resisted. Hence, state and local zoning and other restrictions of owners’ uses of private property are limited or non-existent. Individual “stewardship” is encouraged by some local religious denominations and community organizations.

I. The Ecological Context

Climate. The climate is subtropical, characterized by hot humid summers and mild winters, with an average summer temperature of 81 ° F and an average winter temperature of 46 ° F. Sunshine prevails 75 percent of the time during the summer and 55 percent during the winter. Total annual precipitation in Harrison County, Texas averages 46.9 inches. Of this, about 50 percent (23.5 inches) usually occurs in April-September, which spans the growing season for most crops. In two years out of ten, rainfall in the period is less than 19 inches. (U.S. Bureau of Reclamation. 1995.)

Vegetation. Historically, the region was covered by pine and hardwood forests. However, intensive forest harvesting for timber mill sale and clearing for agriculture and grazing has produced a mosaic of remnant forest and cleared land. (U.S. BOR, 1995)

Inventories of bottomland hardwood forests in East Texas indicate that they support at least 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 other herbaceous plants. The State of Texas considers 73 of these species to be of special concern. Forty-eight species are found in or are restricted to bottomland hardwood forests and associated wetlands. (U.S. BOR, 1995.)

The Caddo Lake wetlands contain many ecologically functional plant and animal “community” assemblages which existed before European settlement altered the landscape of this bio-region. These old-growth remnants include island-like baldcypress “breaks” located within the lake and along its shoreline and cypress-tupelo swamp and bottomland hardwood forest remnants located within palustrine and riverine regimes. One investigator (*Burkett, personal communication. 1994*) characterized the large forest assemblage of the Longhorn Army Ammunition Plant on the south shore of the lake, as “the best of what’s left.”

The aquatic plant which dominates the vistas of Caddo Lake is the southern baldcypress (*Taxodium distichum*). This large, broad-based (buttressed) coniferous tree is characterized as an ecological pioneer of southern wetlands. It has demanding regeneration requirements, which are dependent upon appropriate flooding and drying patterns in areas which are free from competitive tree species. Baldcypress trees are slow growing, but once they establish themselves in monocultural stands of even-aged cohorts, they are able to occupy permanently flooded areas over long lives. Trees of 250 to 350 years of age are not uncommon in the Caddo Lake ecosystem. Reported longevity elsewhere of this species can exceed a thousand years. (*Burkett, 1994.*)

Invasive species controversies. Several aquatic macrophytes are considered “nuisance plants,” or invasive species at Caddo Lake. Reasons include obstruction of navigation, contribution to high nutrient loading, low dissolved oxygen levels and accelerated eutrophication of the lake, all of which are perceived to jeopardize its water quality and valuable sports fisheries habitat. These nuisance macrophytes include Duckweeds (*Lemna sp., and Spirodela polyrhiza*), Hydrilla (*Hydrilla verticillata*), Water Hyacinth (*Eichornia crassipes*), and waterlilies (*Nymphae odorata and Nuphar luteum*), among others. (Caddo Lake Institute, 1995.)

Management of invasive species is usually controversial. One current example is a debate concerning the use of the herbicide 2,4,-D by The Texas Parks and Wildlife Department to control aquatic plants such as hydrilla and water hyacinth. This herbicide is commonly used for such purposes and has been historically regarded as ecologically benign when applied in approved ways. Control by this method often requires repeated herbicide applications as re-infestation occurs. In addition to being costly, the build up of this persistent compound is suspected in some quarters to be a source of “endocrine disruption” in humans and wildlife . This health concern arises from emerging scientific questions about damage to animal and human offspring when such persistent organic compounds build up in the food chain. At very low levels these compounds may be capable of mimicking or disrupting normal animal and human endocrine processes. These phenomena are suspected causes of developmental defects which are believed to occur during embryonic, fetal, and other early development stages of wildlife and humans. (Colborn, Dumanoski and Myers. 1996.) Recent literature notes the identification of 2,4,-D as an endocrine disrupting compound specifically implicated as a potential source of higher rates of urinary-tract and genital defects in children in agricultural areas studied by the University of Minnesota (Dumanoski, 1997.)

One proposal to “control” aquatic weeds includes upstream management that would alter water levels by manipulating inflows from the upstream dam at Lake O’ the Pines. Another proposal would modify Caddo Lake’s dam structure, to raise the permanent pool level, and to permit periodic drawdowns to kill invasive macrophytes.

Others suggest biological control of aquatic plants through the introduction of exotic insects or grass carp. Biological control by exotic insects presents special issues of unintended consequences and is still in its infancy. The literature suggests that insect control is slow and probably does not lead to widespread eradication of target species, because plant and insect populations tend to regulate each other. (Cooke, et. al. 1993.) Grass carp, or white amur (*Ctenopharyngodon idella* (Val.)) a native of China and Siberia, is a voracious, long-lived, wide-ranging fish which consumes nearly all available vegetation. Scientific literature notes, as to grass carp introduction, that “major changes in sports fishing have been reported” and that their “effects on fish are not well understood and many questions remain.” (Cooke, et. al. 1993)

Fishermen and fishing guides increasingly oppose widespread poisoning of macrophytes and the introduction of grass carp because of claimed reductions in game fish populations and the fish habitat which these aquatic plants support.

Some local skepticism exists as to government interventions by manipulation of water levels, introduced species and chemicals. In part, this arises from anecdotal histories of intentional species extirpation or questionable introduction of exotic species by private interests or government agencies, followed by regret and restoration attempts when the underlying management assumptions are superseded by new agency strategies. (Government-sponsored extirpation, several decades ago, of the large alligator gar fish is now regretted. Nutria, an aquatic rodent with ecological impacts similar to beaver and muskrat, was an exotic species allegedly introduced in the southeastern US to control aquatic plants. Nutria did not make significant inroads on nuisance vegetation but may be contributing to low cypress regeneration; rapidly expanding populations of nutria have risen to damaging levels throughout the region.) For these reasons, single-purpose agency interventions of the types proposed are highly suspect by some local populations.

Careful scientific study is needed to identify, pre-test and predict the intended and unintended consequences of the whole range of remedial options. (Cooke, et. al. 1993)

Or, as some local residents (Caddo Lake News, 1997-1998.) ask, “Should we just leave it alone and be thankful that it is here?”

Wildlife. The floristic and structural diversity found in the Caddo Lake watershed supports a rich assemblage of migratory and resident wildlife. Forested wetlands, which represent the majority of the habitat at Caddo Lake, support approximately 216 species of birds, 47 mammal species, and approximately 90 reptiles and amphibians. (U.S. BOR, 1995.)

- **Birds.** High bird habitat values for migratory and resident waterfowl and other birdlife are supported by mature mast-bearing hardwoods, dense canopy cover, diversity of under story vegetation, and the abundance of snags, cavities, and nesting and refuge sites. (U.S. BOR, 1995.) Mature hardwoods provide critical nesting and foraging habitat and are especially important for the survival and productivity of neotropical migratory birds. Many neotropical migratory bird species are habitat-specific and require large, relatively undisturbed tracts of forests for optimum habitat conditions. (U.S. BOR, 1995.) The wetland ecosystem supports one of the few colonies of chimney swifts that still nest in natural cavities, may support the only nesting ruddy ducks in Texas and also serves as a haven for over 50 percent of all neotropical migrant songbirds listed by the U.S. Fish and Wildlife Service as occurring in North America. (Chapman, Jim and Texas Parks and Wildlife Department. 1993.)

- **Mammals, Reptiles and Amphibians.** In addition to their importance to birds, the sloughs and backwaters of Caddo Lake provide important habitat values for a rich assemblage of mammals, including some of the highest densities of furbearing animals in Texas. (U.S. BOR, 1995.) Of an estimated 156 mammalian species known to be in Texas, the Caddo Lake wetlands shelter more than 50. (Caddo Lake Institute. 1995.) The high quality and large expanse of baldcypress swamps, bottomland hardwoods, emergent wetlands, and shallow vegetated flats at Caddo Lake constitute

excellent habitat for restricted wetland species such as the American alligator, mink, and river otter. These habitats provide cover for abundant prey species such as fish, crayfish, turtles, birds, small mammals, amphibians, reptiles and invertebrates. River otter populations at Caddo Lake may be the densest in Texas. (U.S. BOR, 1995.) Populations of American Beaver (*Castor canadensis*) and an introduced species of Nutria (*Myocastor copus*) are unconstrained by effective predation and are regarded as “nuisance animals” and potential risks to healthy generation and regeneration of old-growth and baldcypress forest remnants. (Caddo Lake Institute, 1995.)

-Fish and Mussels. Surveys of Caddo Lake indicate that it supports Texas’ most diverse fish fauna, with 69 species collected in one study. (Gray, 1955.) Darville and Brock recorded references to 71 species (*within classes Agnatha and Osteichthyes*). (Darville, Roy G. and Greg Brock. 1994b.) In addition to the important gamefish species, Caddo Lake supports a variety of less common and specialized fish species such as paddlefish, American eel, bowfin, southern brook lamprey, chain pickerel, flier and bantam sunfish. Species like the American eel have been particularly affected by habitat alteration elsewhere, since they breed and spawn in the sea and their upstream migrations have been blocked by dams and pollution sources. (U.S. BOR. 1995) Twenty-one species of mussels plus the Asian Clam (*Corbicula fluminea*) were identified in a U.S. Army Corps of Engineers (USACE) 1992 study of 22 sites in the western reaches of the Caddo Lake wetlands and the lower Cypress Basin catchment. Pre-historic and historic use of mussels included the Caddo Indians’ use for jewelry (before and during early European occupation of the area) and a short-lived, but valuable, freshwater pearl industry (1909-1912). USACE investigators found mussel communities to be small and scattered with *Plectomerus dobreyanus* (one of three freshwater pearl mussels) being the most common, followed by *Corbicula fluminea* and *Lampsilis teres*. (USACE, 1994b.)

-Insects. The ecological interaction of insects represents a huge gap in scientific research. Little rigorous study has occurred with respect to their impacts upon the ecosystem and vice-versa. Anecdotal reports suggest that fire ant immigrations from South America over the past century have radically altered historic communities of ground-dwelling fauna, but research is lacking. (Ingold, James L. And Laurence M. Hardy. 1996.) The ecological importance of dragon flies and beetles is admitted, but little understood. Recent avocational research into the ants of Caddo Lake earned its authors an award from the Institute because of their description of several new species and their suggestion that the permanently flooded cypress breaks may indeed be isolated, unique micro-habitats worth more intensive study. (Turner and Cook, 1997.)

Species of Concern. Ingold and Hardy’s 1996 studies of Caddo Lake’s indigenous species identified those which are ‘endangered, threatened or of special concern’ to some responsible agency. These included 6 mammals, 18 birds, 4 reptiles, 1 amphibian, 8 fishes, 1 insect, 8 mussels and 7 plants. (Ingold and Hardy, 1996.)

Federal listed species include: the bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*), Arctic peregrine falcon (*Falco peregrinus tundrius*), piping plover (*Charadrius melodis*), interior least tern (*Sterna antillarum athalassos*), and Louisiana black bear (*Ursus americanus*). The rough-stemmed aster (*Aster puniceus elliottii* var. *Scabrimaculis*) is not currently a federally listed species, but is recognized as a Category I candidate species by the U.S. Fish and Wildlife Service. Candidate species have no legal protection under the Endangered Species Act, but are species for which the Service has substantial information to support their listing.

Texas State listed species include: Southeastern myotis (*Myotis austroriparius*), eastern big-eared bat (*Plecotus rafinesquii*), black bear (*Ursus americanus*), Bachman’s sparrow (*Aimophila aestivalis*), American swallow-tailed kite (*Elanoides forficatus*), wood stork (*Myceteria americana*), white-faced ibis (*Plegadis chihi*), northern scarlet snake (*Cemophora coccinea copei*), canebrake rattlesnake (*Crotalus horridus atricaudatus*), alligator snapping turtle (*Macrolemys temminckii*), Texas horned lizard (*Phrynosoma cornutum*), and Louisiana pine snake (*Pituophis melanoleucus ruthveni*).

The giant alligator snapping turtle (*Macrolemys temminckii*) is of special interest. This turtle has been proposed for federal listing but it was declined. Its range is vast, as it covers those parts of the central and southern United States which drain into the Gulf of Mexico. (Pritchard, 1989) Sightings of this turtle are not uncommon in the Caddo Lake region. Reliable sightings have occurred with regularity in the Harrison Bayou and other Longhorn Army Ammunition Plant (LHAAP) habitat. (Caddo Lake Institute, 1995.) This suggests an opportunity to support the recovery of one of the world's many stressed or endangered giant turtle species -- well before federal listing causes costly regulation and recovery or becomes a source of potential consternation to private land owners throughout this vast historic range.

Surface Water Quality. While this wetland ecosystem enjoys many healthy attributes, it is subject to special and generic threats to its integrity. Sources of threats include changes in local land uses as well as regional and even global atmospheric conditions, air borne and water borne contaminants and nutrients, or other phenomena which need to be analyzed. (Cornier, 1995)

-Cypress Basin. Segments of several of the principal streams which flow into Caddo Lake from the upper Cypress Basin are listed by Texas because of water quality concerns which have caused them to be classified as "medium priority" or "threatened" status. Stream segments 0403, 0404 and 0409 (above Caddo Lake) achieved this status for reasons such as high fecal coliform levels which were inconsistent with contact recreation, or levels of heavy metals (such as selenium, zinc or cadmium and lead) which were inconsistent with the 'high aquatic life use' classifications of some segments. (Office of Water Resource Management. 1997) Low dissolved oxygen and elevated levels of nutrients are noted as concerns in these, and other segments.

These streams, while experiencing significant rainfall surges, are shallow and sluggish during much of the year. (Crowe, Art. 1998.) Suspected contaminant sources include natural and 'non-point' runoff from agricultural and urban areas, as well as treated wastewater discharges by agriculture, industry and municipalities. (Texas Natural Resources Conservation Commission. 1996.) For example, 'long term environmental problems' are suggested causes of an observed absence of mussels and Asian clams from some segments of Big Cypress Bayou upstream of Lake O' the Pines, although these species are present elsewhere in the basin. (Howells, Robert G. 1996. This study suggests critical examination of 'point sources,' e.g. as to whether these extirpations may be the result of a poultry plant which discharges its effluent into a tributary stream in the area. On the other hand, Anon-point source runoff of chicken litter is noted in other studies as a suspected cause of degraded water quality in the same segment. (Northeast Texas Municipal Water District. 1997.) This last study reports statements by Dr. Mary Barrett (of Centenary College, Shreveport Louisiana) to the effect that this area produces 21% of Texas broiler chicken production, and her belief that there is strong circumstantial evidence that the non-point source runoff of chicken litter constituents is causing nutrient enrichment as well as elevated levels of metal and fecal coliforms.

-Caddo Lake. As noted, Caddo Lake receives its water from all of the stream segments in the Cypress Basin. Its ecological and water qualities are matters of ongoing review by state agencies. As to Caddo Lake itself, the Texas Water Development Board (TWDB) officially noted that it is a future drinking water source for withdrawals by the City of Shreveport, Louisiana. TWDB noted however that "the Board's forecasts suggest that environmental impacts from potential significant lowering of Caddo Lake levels through expanded water supply use . . . should preclude it from being a viable site of future water supplies." (Texas Water Development Board. 1997)

TNRCC's Clean Rivers Program assessments found that the lake was 'significant in terms of water supply, recreation and ecological benefits.' TNRCC's Clean Rivers Program Report listed Caddo Lake's waters as having elevated levels of cadmium, copper, lead and zinc. It listed other concerns as including elevated nutrient levels, low dissolved oxygen and pH. Suspected causes included agricultural, industrial and municipal wastewater discharges and non point sources. Finally, this Clean Rivers Report noted the Texas Department of Health had issued a 'fish consumption advisory' due to

mercury levels found in tissue of some game fish species. (TNRCC, 1996.) As noted in a recent Health Assessment by the Texas Department of Health:

“The mercury is believed to originate from atmospheric deposition of non-point source emissions. This lake provides optimal conditions for the methylation of mercury and is subsequent biomagnification up the food chain into fish.” (TDH, 1999)

At the May, 1993 Caddo Lake Scholars Program Awards Ceremony, Dr. Jack McCullough (Professor of Aquatic Biology, Stephen F. Austin University) compared a 1993 limnological study by one of his graduate students with a similar study done by other students in 1981. This showed that eutrophication was “progressively increasing,” primarily due to “significant increases” in concentrations of nitrogen, phosphorous and potassium, in the (Texas) headwaters region of the lake resulting in a significant increase in phytoplankton. Levels of zinc, lead and manganese were somewhat elevated in bottom samples and some elevated levels of organic constituents were also noted. PCB levels, crude oil and brine contamination, probable byproducts of oil drilling in the lake, were elevated on the Louisiana side of the lake. (McCullough, 1993)

“In summary, I might say again, it is a fragile ecosystem. It is under stress. Efforts to alter the ecosystem through new construction projects -- such as channelization, plans to raise the water depth or alter the hydraulic retention time -- or any additional efforts to greatly increase development around the lake, or building a traditional industry around the lake, should be controlled carefully, so we don’t push this fragile system to the breaking point.”

II. The Sociological Context.

Human Population Dynamics. While local populations experience modest rates of growth, regional and state population dynamics may pose a subtle threat to the integrity of this ecosystem if its attractiveness results in inappropriate recreational or second home development. The 483 acre Caddo Lake State Park is located on the shores of Caddo Lake and Big Cypress Bayou. The attractiveness of the recreational amenities of the lake is reflected by the fact that the park, in spite of its rustic accommodations, served approximately 250,000 visitors in 1992. In a 1987 study, Texas Parks and Wildlife Department (TPWD) estimated that the direct economic impact of the park to the local economy was nearly \$1.4 million (based on a 1987 visitor total of 201,634). (U.S. BOR, 1995.)

-Lake Communities. About 1300 people reside in the unincorporated lake communities of Uncertain, Karnack, Pine Island Point, Mossey Acres, Cypress Village and Longpoint, in Harrison County, Texas. This resident population is expected to increase by 8-10 percent every 10 years -- assuming no extraordinary stimulus to accelerated in-migration. With these assumptions, the population of this portion of Harrison County will reach about 1,400 by year 2000, and about 1,700 by 2020. Based on the number of water hookups in the area, the population inflates to about 1,900 during the summer recreational months. Using the same county projections, the summer population would increase to 2,400 by year 2020. (U.S. BOR, 1995.)

-Cypress Basin Commercial Activities. As previously noted, the total drainage area of the Cypress Basin in Texas is 2,800 square miles. The primary commercial activities of the basin are manufacturing, retail and wholesale trade, mineral and petroleum production, agriculture and agribusiness. The population increased from 118,192 in 1980 to 124,177 in 1990. Population in the basin is projected to increase to 147,000 by the year 2050. Major population centers (and their latest population estimates according of the Texas Water Development Board) are Marshall (24,064), Mount Pleasant (13,466), Atlanta (6,180), Gilmer (5,313), Pittsburg (4,369), Winnsboro (3,180), Daingerfield (2,628), Linden (2,368), Hughes Springs (2,087) and Waskom (1,850). (Texas Water Development Board. 1997.)

However, population trends which are occurring well beyond these lake communities suggest that Caddo Lake could soon be seen as a recreational/second home development opportunity for burgeoning urban populations of the region and the world.

-Dallas/Ft. Worth Metroplex. For example, the Dallas Fort Worth metroplex (which had a 1993 combined population of 4.1 million) is approximately two and a half hours away by auto, and an hour away by plane. The Dallas/Ft. Worth Council of Governments region experienced a 6.10 percent 1990-1993 growth rate.

-Texas and the World. Texas is the second most populous state in the United States, with a 1994 population of 18.4 million. From 1990 to 1994, 58 percent of Texas growth was from natural increase, while the 42 percent balance was from national and international in-migration. The growth of Texas population is projected to continue at nearly twice the rate as that for the nation and will lead to a population that is more mature and ethnically diverse than at any time in Texas history. (Murdoch, 1997) The future impact of these population trends on the growth of the Caddo Lake communities remains uncertain.

Cultural impediments & opportunities as to long-term ecological conservation. Cultural impediments to long term conservation of this ecosystem arise mainly from the frontier roots which Texans share with other populations of the rural southern and western US. These lands were settled, and their resources aggressively exploited, on the once-valid assumption of a seemingly limitless ability of nature to restore any insult and replace any resource. The peoples who originally settled these areas often were intentionally leaving behind the social and legal constraints of their communities of origin. The ethics of self-reliance, “being left alone,” and “not being told what to do” - by neighbors and government - are still regarded as cultural and legal “rights” in the rural areas of Texas and the western US. This makes many people reluctant to restrain or openly criticize the questionable environmental actions of other people and businesses, and creates the expectation that this restraint will be reciprocated. Anxiety about imposing restraints on the activities of landowners and commercial interests is reinforced by painful historical economic realities. These anxieties arise from remote and recent history of agrarian and rural poverty (during early settlement, the Great Depression of the 1930’s and the collapse of the oil and gas industry in the 1980’s). These hardships were only mitigated through jobs or wealth realized through aggressive manipulation of natural resources -whether extractive (petroleum, timber, mining), by polluting discharges to the air, soil and water for manufacturing or development, or by government public works investments in vast hydrological alterations for navigation, flood control or agriculture purposes.

-Land ownership, commercial and political determinants. Most of the land around Caddo Lake is privately owned, in hundreds of small and large parcels. A strong “private property rights” culture in Texas resists both state and federal land use restraints. Commercial interests which resist governmental regulation are well represented at state and local government levels.

Large public ownerships do exist. More than 15,000 acres of public and private lands at Caddo Lake have been designated or nominated for Ramsar status. However, this is a small portion of what is potentially available for development, and Ramsar designation would not have the legal effect of zoning nor would it necessarily compel better private, ecological management. Even so, the Ramsar Convention, and IUCN’s “Caring for the Earth,” have formed principle unifying themes for the “ecological stewardship” of the Caddo Lake ecosystem, as is discussed later.

More aggressive conservation regulation may ultimately be imposed by expanding urban majorities; especially if provoked by growing environmental impacts of commercial interests -- which currently inflict significant damage to the environment of Texas, and the world. (According to the Houston Advanced Research Center, Texas discharges more toxins to the air, water and soil than any other state, and more greenhouse gases than most nations. Louisiana runs a close second in toxic discharges.) These commercial and industrial interests now mobilize traditional anti-regulatory rhetoric to continue regulatory patterns in Texas and Louisiana. These are frequently indifferent to

strict environmental protection, are unduly considerate of commercial interests, and place undue reliance on agency provision of technical support for “voluntary” regulation. The US government, especially the Environmental Protection Agency (US EPA), may eventually force more effective environmental regulation through the powerful leverage available through direct enforcement, withdrawal of federal funding, or oversight of environmental and development permitting authority exercised by these states.

-Individual, ethical and spiritual determinants. Many Texans profess concern about conservation of environmental amenities for a variety of reasons, ranging from pragmatic, to ethical and spiritual. Many residents engage in hunting and fishing, or are engaged in tourism related businesses. While down from previous years, more than 60% of Texans polled in 1996 continue to support stronger government regulation to control industrial pollution, or specific conservation measures --such as restricting housing in wetlands. (Klineberg, 1996.)

This highly individualistic culture also includes large numbers of evangelical religious denominations common to the “Bible Belt.” Over 60 percent of the residents of Harrison and Marion County, Texas, are affiliated with local churches. A majority of these residents belong to the Southern Baptist Convention (Dallas Morning News, 1996-1997 Texas Almanac). The Southern Baptist Convention has recognized strong commitments to “spiritual stewardship” for the divinely “created order” (Southern Baptist Convention, 1990) The same is true for many sister evangelical denominations, which are also heavily represented in the region. (Dewitt, 1993.)

Whether or not needed regulatory reforms occur, the wisest strategy may be to embrace and inform existing cultural ethics with the scientifically-based “ecological economics” of conservation and sustainable development. This is the rationale for the Institute’s Pathfinder Projects, especially its participation in community-based catchment management programs such as the Texas Clean Rivers Program. These efforts are designed to provide support for expanded ‘ecological literacy’ of local stakeholders, opinion makers and constituents. Such ecological literacy permits them to create and monitor successful collaborative conservation activities, which they can defend as being in the economic self interests of ecologically literate local constituencies.

The positive interaction between culture and conservation is yet to be well understood or effectively mobilized. This is not likely to occur without active involvement of insightful local people such as guides and interpreters. Local land ownership and regulatory patterns in the Caddo Lake region would support unconstrained development of the type that could over stress the ecosystem.

A local ecosystem stewardship institute is uniquely suited to mobilize cultural values which blend the “faith” that conservation is good with the ‘proof’ that good stewardship pays real economic dividends.

III. Involvement of Stakeholders

Institute projects do not yet directly involve all the significant stakeholders affected by ecological stewardship issues in the Caddo Lake wetlands. The following list describes the interests of some of the more important stakeholders and their interests:

Governmental Stakeholders. “Fragmented” is the word which best describes the management of the Caddo Lake wetlands and their catchment basin. Due to its location in two states and its status as a navigable water body of the United States, Caddo Lake’s management falls within the authorities of three general governments -- the US federal government and the state governments of Texas and Louisiana. Each of these three governments exercises a confusing number of limited-purpose management roles -- which are divided among several agencies of each government.

-Red River Interstate Compact. An Interstate Compact, known as the “Red River Compact” broadly allocates gross water volume and uses between the states of Texas, Louisiana and Arkansas, and other signatory states. The Compact apportions Cypress Basin’s waters in terms of a percentages

of flows and specified volumes of storage contained in existing reservoirs and reaches. The Cypress Basin is a part of 'Reach III' of the larger Red River watershed. In this Reach, Texas is apportioned 60% of the runoff, and has unrestricted rights to all water above Marshall, Texas as well as 50% of the storage capacity of "any future enlargement of Caddo Lake." Texas may construct reservoir storage if it does not adversely affect delivery of water apportioned to another signatory of the Compact. (Texas Water Development Board. 1997.)

-Federal Agencies. As will be seen, the U.S. government is often a distant and passive observer. Even so, it has a history of intermittent but profound interventions which have caused significant alterations of this ecosystem.

The US Army Corps of Engineers (USACE) is the federal agency with primary wetland conservation duties. USACE "delineates" wetlands which come under the US regulatory control, by virtue of its authority to grant or withhold federal permits for any activities which result in the dredging and filling of wetlands. These powers are exercised under oversight from the United States Environmental Protection Agency. US EPA has plenary regulatory authority over wetlands, as well as water quality, toxic and contaminant discharges to the wetlands, the lake and the watersheds of both states.

USACE has been the principle cause of the most profound hydrological changes in the ecosystem. USACE's historic involvement has included massive alteration of lake ecology. That occurred, as may again happen, when the US Congress provided water development funding at the insistence of political constituencies for commercial objectives that may have been at odds with careful conservation of local ecological resources. In the 1800's the Corps' predecessor agencies removed the original natural dams (known as the Great Raft, a massive century-old log jam) which created a much larger complex of lakes than presently exists. This early engineering project caused the original lake complex to shrink as water levels became quite shallow. The intended or unintended effect of this alteration was to relocate the western terminus of steamboats from Jefferson, Texas to Shreveport, Louisiana, 30 miles to the east.

After more than a century, at the demand of oil and gas interests, the USACE installed the present dam and spill way, which raised the lake level sufficiently to permit drilling barges access to construct and operate the world's first primitive "offshore drilling platforms." USACE is responsible for Caddo Lake's present dam, which has no outflow manipulation mechanisms. Since the 1960's, inflow hydrology has been significantly altered by other Corps flood control reservoir projects upstream in the Cypress Basin. The management of these dams controls the water level fluctuations of the lake itself. Present gradients of plant and animal communities were created and depend upon the relatively limited range of water fluctuation of the present hydrologic regime which resulted from these USACE interventions at Caddo Lake.

Between 1980 and 1993 there was an attempt by commercial interests to obtain US Congressional funding to permit USACE to construct an ecologically damaging barge canal through Caddo Lake's wetlands. This project was suspended after much expense and controversy. However, USACE, at the urging of other regional constituencies, usually has some proposal under consideration which has the potential to significantly alter the hydrological and ecological regime. The most recent proposal of this type is to raise the dam level and to add outflow control mechanisms to allow manipulation of water levels. This would permit upstream and Caddo Lake dams to be managed so as to allegedly "simulate and restore" scouring flood surges (which were removed by other upstream USACE flood control projects). Raising of the dam would create commercially valuable additional water supply storage.

The US Fish and Wildlife Service (USFWS) and other federal agencies have limited program-based interests in the wetland habitats and flyways of Caddo Lake.

Under federal legislation, USFWS must be consulted for advisory opinions whenever federal land disposals or federally-financed water development projects are proposed. The USFWS has classified

Caddo Lake as a Resource Category One wetland. This assures that future water development projects will be carefully evaluated, and that their significant mitigation costs will be calculated, as occurred during the proposed USACE barge canal project. USFWS is also the agency which passively monitors compliance of the Caddo Lake Ramsar wetlands with the Ramsar Convention.

As a navigable waterway of the United States, Caddo Lake's navigation is subject to the US Coast Guard's inland waterway regulations. However, there is no recent sighting of Coast Guard regulatory personnel at Caddo Lake.

-State and Local Agencies. The lake and several of its principle tributaries converge in the lower basin which includes portions of Caddo parish, Louisiana and Harrison and Marion counties, Texas. Local navigation improvements consist of narrow dredged "boat roads" and channel markers, which are maintained by a Texas special-purpose local government entity called the Cypress Valley Navigation District. Its board is made up of elected officials or citizen members appointed from the two Texas Counties. Neither the navigation district nor the county governments or other local governments perform ecosystem management or conservation activities. Local zoning or land use regulations do not exist, except for basic codes regulating wastewater treatment and construction.

The agencies which have the most consistent engagement with the lake and its wetlands are the state agencies of Texas and Louisiana. However, the stewardship roles of these agencies are constrained by their limited missions, e.g., management of wildlife, environmental protection, water development, or natural resource extraction. Wildlife agencies include the Texas Parks and Wildlife Department and the Louisiana Department of Wildlife and Fisheries. Both have personnel assigned to the lake, such as game wardens and wildlife and habitat management biologists. Water quality protection services are provided by the Texas Natural Resource Conservation Commission and the Louisiana Department of Environmental Quality. The Texas Water Development Board, the Texas Railroad Commission, the Texas General Land Office, and their Louisiana counterparts, manage some environmental risks, minerals extraction, or state-owned lands within their respective state boundaries. State agency resource management, while the most frequent, is nevertheless limited and fragmented, due to their limited missions and the remoteness of the lake from the state capitols and principal regional administrative centers.

NGO Stakeholders. Several non-governmental organizations(NGO's) have roles which may impact the Caddo Lake wetlands.

-Local Economic Development NGOs. Harrison County, Texas, has several economic development entities charged with the creation of conventional economic development generally. These NGOs periodically review the opportunities for economic development at Caddo Lake. However, the remoteness of the settlements there, and the lack of urban-capacity wastewater collection and treatment facilities (US BOR, 1996) are impediments to high density residential, or large-scale commercial development of the types which these NGOs would most likely sponsor. Marion County, Texas has an NGO called the Cypress Valley Alliance. CVA is located in the historic town of Jefferson. Its mission is to create and support sustainable economic development. CVA has undertaken several initiatives to enhance Marion county's vocational and secondary educational infrastructure, with an emphasis on environmental education. These initiatives are intended to support expanded career opportunities for local people and as a complement to high-quality cultural tourism which occurs in the ante-bellum town of Jefferson, Texas. The Caddo Lake Institute coordinates its educational activities with CVA on request.

-The Texas Nature Conservancy. This world-renowned NGO continues to be instrumental in the conservation of Caddo Lake's wetlands. Its land man Shawn Hamilton developed and executed with TWPD a brilliant assembly of options and several million dollars in federal grant funds. This strategy resulted in TPWD's acquisition of the initial 6500 acre Wildlife Management Area that was designated in 1993 as the initial Caddo Lake Ramsar site. Dick Bartlett, former chairman of TNCs

board, owns a home near the Caddo lake State Park. TNC and its field biologists continue to provide a TNC presence in conservation initiatives at Caddo Lake.

-Stephen F. Austin State University. Stephen F. Austin State University (SFA) is located at Nacogdoches, Texas, about 80 miles south of the lake. Its scientists and students conduct significant research in and around Caddo Lake. (McCullough, 1993; Crowley, 1993, Beasley, 1997) The Institute recognizes and supports SFA's active participation as a an important wetland science stakeholder and partner.

-Greater Caddo Lake Association. One of Caddo Lake's oldest and most vocal non-governmental organizations is the Greater Caddo Lake Association, Inc. (GCLA). It purports to represent approximately 1,000 members from the Caddo Lake region of Texas and Louisiana. GCLA publishes a newsletter called the Caddo Lake News, which is widely read by inhabitants of the lake's several small settlements. Its views are not necessarily shared by broader commercial or government interests. GCLA has been a consistent, and sometimes abrasive, force in opposing state and federal project or management initiatives which might change the status quo, be they hydrological or other so-called governmental "improvements." GCLA advances a simple and clear response to such proposals, which is that, "The lake is doing all right as it is, in spite of whatever today's problems may be. The least change is the best for the lake" (Caddo Lake News, 1997/1998. GCLA, 1998) GCLA is the only organized voice for that point of view. GCLA was instrumental in mobilizing broadly effective opposition to the USACE barge canal proposal, which was discontinued because of negative cost/benefits related to environmental damage the project would have caused.

-The Caddo Lake Institute. The Caddo Lake Institute is the newest NGO devoted to conservation of Caddo Lake's ecological and cultural values. The Institute's status as a "stakeholder" arises from its self-declared role as "an eco-system stewardship institute." Its stated mission is to "protect and enhance the biological and cultural resources of the Caddo Lake eco-region of Texas and Louisiana." The Institute is a private charitable, non-governmental organization founded in 1993. Although it has successfully attracted public appropriations and foundation grants for many of its projects, the Institute's general and administrative expenses are mostly underwritten by contributions from Don Henley. Henley, a noted American musician and environmentalist who grew up in the Caddo Lake region, provided the funding and concern which launched the Institute's Caddo Lake Scholars Program in 1993.

The Institute has a full time staff of 2 people. Its President, Dwight Shellman, directs the local Caddo Lake Scholars Program elements from his residence at Caddo Lake, in the village of Uncertain, Texas; he also directs the Institute's corporate, financial, business, national and international activities, from his former law offices at Aspen, Colorado, where he practiced law full time prior to starting the Institute with Mr. Henley. Pending relocation of corporate, administrative and business functions to the Caddo Lake region, these functions are supported by two to three part-time Aspen-based clerical personnel. The Institute's full time staff is rounded out by Vice President Sara Kneipp, of Marshall, Texas. Mrs. Kneipp oversees general coordination and support of local participants and institutions in the Caddo Lake region; she also delivers the Institute's extensive local educational outreach and educator-training programs, regionally and throughout the state of Texas.

The Institute's primary workforce is not this full-time staff, but its cadre of "part-time scholar-employees." At any given time, this fluctuating group of scholar-employees may be composed of 5 to 10 academic scientists (called "Core Mentors", or "Master Wetland Educators") and student "Wetland Interns." This part-time staff acts as project leaders and maintains much of the Institute's broad array of ecosystem stewardship projects (called "Pathfinder Projects) which are discussed elsewhere. The Institute pays for the extra-mural services of these part-time staff members through a "marginal cost" compensation strategy which is also discussed in the Results section of this study.

The following listing shows the power of the Institute's fundamental strategy of supporting existing local academic scientists through marginal cost strategies. It shows the impressive range of scientific

capabilities which, although unsupported within a single entity, have joined together to lead the Institute's ecosystem stewardship projects. It shows that powerful capabilities may already exist, even in the relatively small educational institutions typically found in so-called rural or undeveloped areas.

These following academic colleagues are the Institute's principle "Core Mentors" and "Master Teachers" for its pathfinder projects: Roy Darville, Ph.D. Limnology (East Texas Baptist University, Marshall, Texas); Alexandrine Randriamahefa, Ph.D. Microbiology (Wiley College, Marshall, Texas); James Ingold, Ph.D. Ornithology (Louisiana State University, Shreveport Louisiana), Rebecca Gullette, MS Biology and Darrell Hudson, MS Botany (Panola College, Carthage Texas); Mike Buttram, Ph.D. Chemistry (Texarkana College of Texarkana, Texas), Mary Hearron, Ph.D. Environmental Education (Northeast Texas Community College, Mt Pleasant, Texas) and Ray Darville, Ph.D. Sociology (Stephen F. Austin State University, Nacogdoches, Texas). Public school science teachers who are the most active as leaders of Institute projects include Peggy Byasee (Marshall, Texas High School), Kenneth Winn (Karnack, Texas High School) and Patricia Furgeson, MS Microbiology (Mt Pleasant, Texas High School). Other public school educators participate from nearby school districts in Waskom, Hallsville, and Harlton, Texas.

These academic leaders, and academicians and teachers from other regional educational institutions, participate in specialized training which permits them to execute wetland science "campus plans" at their respective institutions. These plans usually include maintaining a part of the Institute's water monitoring network which has been sampled monthly for over two years. Other educational elements include specialized teacher training programs and curricula for grade levels K-12 in eight local school districts, as well as advanced natural science curricula in four local colleges and universities.

IV. Results

"Results" and their relationships to Constituencies, Themes and Tactics. To evaluate "results" it is necessary to know how predefined strategic missions were advanced by specific tactical programs. Except for in-house research, an institution most often pursues its strategic missions by assisting stakeholder groups, or "constituencies" to achieve the tactical goals through locally appropriate work --hence the term "working constituencies."

The stated mission of the Caddo Lake Institute is to conserve and assist in the careful sustainable use of the Caddo Lake ecosystem. In a political world, this requires the selection of "compatible working constituencies," out of the hundreds of individual and commercial interests which are actively engaged in the region. (Most business interests in the region give rhetorical support for the preservation of the Caddo Lake ecosystem; many propose development and uses --of the Lake, its shoreline or its catchment-- in ways that suggest stewardship is not their primary objective, or that they are indifferent to the potentially incompatible consequences.)

Thus, three primary compatible "working" constituencies were identified. They were selected because Institute stewardship programs could not only improve their own abilities to defend their conservative views about local sustainable development, but they could enhance their credibility with competing constituencies and the public at large.

The criteria for identifying these primary working constituencies was the existence of a real appreciation for the complexity and fragility of the ecosystem --through close personal experience, or advanced education, or both. Thus, the three primary working constituencies that were identified as most important to the Institute are:

--Lake community residents and business owners. Large numbers of local residents of the Lake communities act out a "leave it as it is" attitude when responding to recurring efforts by outsiders to impose their agendas on the lake. As typified by the Greater Caddo Lake Association, these residents are armed with a healthy skepticism about those who would inject inappropriate industrial or government activities around the lake, or encourage mass tourist invasions of the lake

which they call “loving it to death.” This population includes a large number of resident business people whose concept of “sustainable development” is a modest increase of like-minded visitors, who will also use existing under-utilized visitor capacity. Their financial and emotional interests are compatible with the continuation of present levels of hunting, fishing, boating --and continuation of resident businesses-- without developmental conflict. These interests can be reinforced by the increased stewardship that will result from modest growth of “natural science tourists” and field researchers, which the Institute’s Ramsar-based projects seek to develop. Many of these business people know that mass tourism and associated land development will not only overburden the ecosystem, but in all likelihood will destroy their businesses through the in-migration of chains and the corporate hospitality industry. In a very real sense, “sustainable development” is not a fuzzy term, but a tool for survival of their personal lifestyles and businesses.

- The interests of this Lake community constituency –because of its recognition that sustainable wetland development must be ecologically sensitive -- lies at the foundation for the Institute’s “Ramsar themes” which are described below.
- Locally-appropriate “sustainable” economic development is the strategic goal of the Institute’s academic and scientific programs to increase work in the ecosystem by area academic scientists and educators. Expanded natural science tourism and stewardship will also result from the Institute’s fulfillment of its Brisbane 1996 pledge to the Ramsar nations: to establish a Caddo Lake Ramsar wetland center, an academy of wetland science education at Longhorn Army ammunition Plant.

--Environmentally concerned area residents and educators. Many area residents may not live at the Lake, but share the motivations of Lake residents, because of formal education or common stewardship concerns. This constituency was found to include a large number of educators, - primary, secondary and university level. Educators, especially, have a special interest in improving their own skills and improving the education of their students through the field opportunities of Caddo Lake’s Ramsar Wetlands. The motivations of environmentally concerned area residents and educators are the justification for significant Institute investments in creating opportunities for this constituency’s advanced training through the Ramsar and “Action Research” themes.

- This investment maximize this constituency’s opportunity to learn and teach world-class stewardship skills through “Applied Scientific and Technical Stewardship Projects” described later.

--Non-resident academicians, scientists and highly educated conservation practitioners. The third constituency is but an extension of the first two. While composed of non-residents, it shares the same motivations because of local ecological appreciation and an informed world view. The members of this constituency tend to be highly-educated academic, non-profit and agency personnel. Their status and advanced training in the natural sciences gives them special skills to support the stewardship of the two local constituencies.

- Members of this non-resident constituency often have special capabilities and relationships which they can use to connect local constituencies to federal and international resources.
- The special capabilities of this non-resident constituency is the rationale for the Institute’s aggressive program to integrate into its projects for each constituency many opportunities for partnerships and joint ventures with natural science agencies, universities and conservation NGOs.
- The proposal to take Longhorn into the National Refuge system presents a potential opportunity for all three constituencies to form a Longhorn Re-users Consortium to participate in the Brisbane Pledge and other satellite facilities

Ramsar Stewardship Themes. The Institute operates an array of community-based scientific and technical projects which provide support for the wise, sustainable use of the Caddo Lake ecosystem and its Cypress Basin catchment, in furtherance of the treaty principles of the “Ramsar Convention.”

--Monitoring Guidance. An effective monitoring program is a prerequisite for assessing whether a wetland has undergone a change in its ecological character.

The Ramsar Convention's guidance calls for monitoring of Ramsar wetlands to detect ecological change. Brisbane Resolution VI.1, of March, 1996, calls on contracting parties to support the development of early warning systems for detecting and initiating action in response to or change in ecological character of Ramsar wetlands. The resolution goes on to require that change in the ecological character of a listed site should be assessed against the baseline status presented in the Information Sheet on Ramsar Wetlands. This assessment should be linked to the Ramsar criteria fulfilled by the site at the time of Ramsar designation. Additional monitoring guidance is found in Ramsar Kushiro 1993 Resolution 5.6

A monitoring program that is designed to detect ecological change can be used to suggest that a wetland be placed on the Montreux Record of the Ramsar Convention. The Montreux Record, adopted in 1990 at the Fourth Conference of the Contracting Parties held in Montreux, Switzerland, is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference. The purpose of the list is to identify Ramsar sites that are in need of corrective action.

At the Sixth Conference of the Contracting Parties at Brisbane, Australia, Resolution VI.19 was adopted. This Resolution supports the need for and enlargement of wetland education and public awareness. The resolution affirms that education and public awareness are essential instruments for successful and sustainable wetland management.

International recognition of the Institute's programs occurred first at the 6th Conference of the Ramsar Convention's Contracting Parties (CoP6) at Brisbane, Australia, in March, 1996. There, Institute technical presentations were made on the Caddo Lake Institute model for local participation in wetland management. (Shellman, 1996.)

The Institute's president participated as one (of two) official NGO members of the U.S. Official Government Delegation. The Institute was appointed, by Recommendation 6.3 of the Ramsar Contracting Parties, to be one (of four) international NGOs tasked to complete a worldwide study of models and guidelines by which the Ramsar Nations could encourage participation by local and indigenous peoples in wetland conservation and management. The other NGO partners are IUCN, WWF and the Kushiro (Japan) International Wetland Center. This study plan has been developed. Draft guidelines have been considered at international conferences in Kushiro (in March, 1998) and at the U. S. National Wetlands Conference in Alexandria, Virginia (April, 1998).

--U.S. Brisbane >96 Pledge; the Caddo Lake Regional Ramsar Center. By joint pledge to the Ramsar nations at the Brisbane >96 conference, the U.S. Government and the Institute agreed to undertake what is now known as the "Mollie Beattie Regional Ramsar Wetland Center" project.

This project began with the Institute's pledge of \$100,000 in private funding to initiate the establishment of such a center on the Longhorn Army Ammunition Plant at Caddo Lake. This Pledge was invited by the U.S. Government and was included as a part of its Brisbane '96 Pledge to the Ramsar Nations to provide supplemental support for advancement of the Ramsar Treaty.

To implement this pledge, the Institute entered into a 30 year lease (for a gross rental of \$300,000) of 1400 acres of old growth bottom land forest at Longhorn. This leased area, together with another 10,000 acres of wetlands, have been nominated by the Institute and wetland owner entities for addition to the original 1993 Caddo Lake Ramsar site.

Action Research Themes. The Institute's applied scientific projects extend into, and well beyond, the educational realm. As will be seen, the educational program emphasizes Ramsar orientation coupled with stewardship field projects. Beyond academia, local academic scientists moved into the design

and maintenance of a wide variety of participation in rigorous “Scientific and Technical Stewardship Projects” (discussed below) at Caddo lake and in the Cypress Basin. These illuminate the “action research” theme. This term denotes an emerging realization that true environmental literacy occurs through the personal use of applied science methods to define and solve local environmental problems. (Stapp, Arjen, Wals and Stankorb. 1996.) Action Research may include methods of single or multiple academic disciplines, social sciences, physical sciences or philosophical inquiry. Technical tools may include the analytical, field tools and methods of conservation professionals, such as the “ground truthing” and use of remote satellite sensing (landsat) or aerial imagery –to show land cover and land uses, to serve as a backdrop for baseline monitoring of water and biological indicators-- the conduct of species inventories, development of data archival and retrieval systems, and publication and broadcast of scientific and technical literature relating to the ecosystem.

Project Partnerships Among Working Constituencies. One of the most significant, and unnoticed, outcomes of the Institute model is its agency partnerships, which supplement the Institute’s educational and applied scientific projects with agency resources. The most effective agency partnerships have been those with the U.S. Geological Survey’s National Wetland Research Center, Lafayette, Louisiana (NWRC); the U.S. Fish and Wildlife Service (USFWS), the Texas Parks and Wildlife Department (TPWD), Austin, Texas; the Texas General Land Office (TGLO), Austin Texas, the Louisiana Department of Environmental Quality (LADEQ), Baton Rouge, Louisiana among others.

The Caddo Lake Institute, after many years of work, is successfully supporting the Department of Interior in taking over the Longhorn Army Ammunition Plant on Caddo Lake as a possible addition to the National Refuge System. This has provided a very significant strategic opportunity for the Institute to assist the Department of Interior in resolving outstanding questions or obstacles to such a transfer and use, and also to initiate a long- delayed program to establish at this site the first U.S. Regional Ramsar Center (pursuant to a joint U.S./CLI pledge in 1996). As part of this initiative, the Institute will seek to organize a consortium of colleges, universities and other scientific institutions to establish at Caddo Lake the first U.S. Academy of Wetland Science Education, satellite scientific and biological research and monitoring facilities and programs by regional and state universities. Among the universities currently engaged in initial discussions at the Institute are Texas A&M, Texarkana College, Steven F. Austin State University, Prairie View A&M, Wiley College, East Texas Baptist University, and Louisiana State University, among others. The Texas Nature Conservancy, the National Wetland Research Center, and Texas Parks and Wildlife Department are among the agencies which may join the consortium.

The Institute’s marginal-cost approach to community-based stewardship. The listing of academic scientists (in the Stakeholders section, above) shows the power of the Institute’s fundamental marginal-cost organizing strategy, which is discussed in more detail next.

Subtle implications of the Institute’s part-time academic “staff” strategy represent important innovations which merit further examination. This approach not only minimizes institutional overhead, but also multiplies benefits to all participants and the eco-system. As such, the Caddo Lake Institute Model may provide guidance as to how modest incentives might be targeted to recruit the unused talents of local people, and their institutions, to expand community-based ecosystem stewardship activities. It should be examined for possible use or adaptation in other communities.

-Political benefits. Politically, the independent status and understood mission of the Institute enable it to take responsibility for research and monitoring results. This can minimize risk of criticism, or even financial or job insecurity, of the part-time staff members and their primary institutions. Educators as a class, and educational institutions of all kinds, are vulnerable to criticism by powerful public or private interests. Faculty depend on the esteem of their institutional administrators, and rarely enjoy real employment security if they attract controversy. Their primary institutional employers depend greatly on private endowments or governmental appropriations. Both are vulnerable to criticism for advocacy, or engaging in activities which are “controversial.” Under

the part-time staff arrangement, the Institute is responsible for the quality, disclosure and use of the research and findings, rather than the part-time staff members or their primary employers.

-Risk management benefits. Financial risk management accrues to the Institute and the primary institutions, from the part-time staff strategy. For example, injury liability exposure concerns frequently inhibit the management of primary institutions from using faculty and students for apparently “extra-mural” stewardship activities --those which do not fall within regular curricula, or occur off-campus or outside of regular instructional times. The Institute’s “part-time staff” innovation permits the Institute, at marginal payroll cost increases, to cover the liability risk of these “extra-mural” activities under Workmen’s Compensation coverage. In most states of the United States, state-mandated “Worker’s Compensation” insurance is underwritten by modest premiums which are based upon gross payroll amounts. Worker’s Compensation legislation usually limits the employer’s uncontrollable liability exposure in exchange for assuring the employee of payment of scheduled levels of basic medical and disability income reimbursement, if they are injured “in the course of” such part-time employment. No such injury has yet occurred to part-time staff, for several reasons. Part-time staff who are faculty are well acquainted with managing such risks. Student interns are not so engaged until their performance during advanced training shows them to be mature and safe practitioners. Even then, they ordinarily work under the direct supervision of part-time faculty, who impose the same safety regimes applied in academia.

-NGO benefits. Benefits to the Institute accrue from this staffing approach. First, the part-time staffing pattern limits the number of full-time salaried personnel, and the management and budget growth, which would be required to have readily available an equally broad-based, interdisciplinary staff, and/or qualified consultants. Secondly, the part-time engagement of local residents who are already employed, or enrolled, in local educational institutions avoids significant recruitment costs frequently overlooked, such as the costs of attracting, screening, hiring, relocating, orienting and retaining scientific employees from elsewhere, as well as the loss of these investments through later attrition, when some of these employees find themselves unsatisfied by local pay rates, or local scientific and cultural contexts, or are attracted by better opportunities elsewhere.

-Benefits to educators. Individual part-time staff members realize both direct and indirect benefits from this approach. They are the direct recipients of honoraria, stipends, hourly pay, grants and research contracts. They also receive reimbursements for professional enrichments, such as travel, room, board and tuition for conference attendance and advanced training elsewhere in the US and the world. Although modest, part-time income and benefits can be important to individual academic scientists and educators. Notoriously low institutional pay rates are common for science educators, academic scientists and students interns in many small communities. Opportunities to further ecosystem expertise do not necessarily result from performance of their regular full-time teaching responsibilities. Rather, these roles are more directly driven by the institutional needs of their primary employers. Their performance of part-time services in their chosen disciplines is often consistent with their personal goals as well as the professional advancement policies of their full-time employers. The income supplement, and other benefits, earned by part-time staff sends to faculty peers the right ecosystem stewardship message to fellow academicians. Instead of being yet another uncompensated job, this “stewardship pays” real monetary and professional benefits.

- Benefits to full-time institutional employers. Primary institutional employers also receive direct and indirect benefits from the Institute’s part-time employment of their faculty and students. The Institute’s programs typically support improved educational course offerings and opportunities for ordinary students who may take the course work, but do not participate in the Institute projects. This results in better science education, through improved and locally-relevant curriculum enrichments, the increased use of locally observable natural phenomena, better field-training opportunities and improved familiarity with commonalities and differences raised by local ecosystem stewardship issues. Institutional jobs or assistance opportunities for students can be advertized, such as paid internship positions to students whose training has qualified them to participate in the mentorship and applied science projects of the Institute’s part-time scientific staff. In cases where the

part-time staff member must perform jointly beneficial services during regular business hours of his or her primary employer, the Institute has made “release time” payments directly to the primary institution. Finally, it can be argued that the Institute’s supplemental income to individual part-time staff participants may act as an indirect subsidy to the primary employer, whenever it encourages continued full- time employment at that primary institution.

-Benefits to the ecosystem. Ecosystem services or benefits can be increased by this approach, although they are subtle and indirect. One of these ecosystem benefits is the increased use of the underutilized equipment, laboratory and meeting space which are available at the primary institutional employers of the part-time staff members. Another is increased opportunity for cross-utilization by staffers of expertise of other participants, who are not employed within the primary institution. In other cases, a specific investment by the Institute, which might not be justified by any primary institution, may expand the capacity of all of the primary institutions. One example is the Institute’s purchase of a specialized research boat and automated monitoring equipment. This enabled all to improve the rigor and scope of ecosystem monitoring. Another example is the Institute’s active support for a large grant for Wiley College from a third party foundation. This significantly increased compensation and expense reimbursements to several Institute part-time scientists, and permitted Wiley College to expand its monitoring activities in the basin. This permitted the Institute to capture additional baseline data, without incurring costs of collection. In practice, our participants capitalize on such opportunities and access the Institute’s, and each other’s, skills, equipment and facilities in the course of the Institute’s many collaborative ecosystem projects.

-Effects on agency partnerships. The most subtle, but significant, benefit to the ecosystem has been the evolution of faculty and agency partnerships and concentration of additional research funds in the Cypress Basin. Increased attention to the Caddo Lake ecosystem now occurs naturally -- as a result of collaborative relationships between our part-time staff and their counterparts in our agency partnerships. Before the inception of the Caddo Lake Scholars Program, any of the present participants could have conducted similar ecosystem research or monitoring. However, little of this was done. Impediments to this sort of effort arise from several institutional sources: isolation and lack of channels for disseminating or coordinating ecosystem research needs, or existing research findings, and the difficulty of identifying what work of this type might be the most useful and those who have done similar work. By contrast, the Institute’s research partnerships with federal and state conservation agencies have developed broad collegial relationships between part-time staff and scientists of these agencies. Thus, since the inception of the Caddo Lake Scholars program, there has been a measurable increase in the amount of agency resources invested in local ecosystem research and monitoring .

While some of this agency research productivity may have been driven by an internal agenda, much of this good agency attention has occurred as a result of this understandable dynamic:

Where funds for agencies’ elective research are limited, they are more likely to be invested in ecosystems populated by local colleagues and communities which are most likely to participate in, appreciate and use the resulting research products.

Tactics for Empowering Educational Constituencies The Institute’s Wetland Educator programs provided wetland science training to four overlapping educational populations: (1) local minorities and women, (2) local university credit curricula on Ramsar and Action Research (3) local recruitment and advanced training of Master Wetland Educators and Interns as monitors and Action Researchers (4) educator workshops on use of improved curricula about wetland ecology and ecosystem monitoring, locally and statewide.

--Minorities and Women. Direct investments by the Institute supported expanded expertise of minority faculty and students at Wiley College.¹ and other schools participating in the Caddo lake

¹ Wiley College is the oldest historically Black College or University (HBCU) west of the Mississippi. It was

Scholars Program (CLSP). At Wiley College, especially, it became evident that the Institute's past and current wetland science innovations were not only attracting more faculty and students, but also that third-party grantors had become interested in helping Wiley to expand our model. These phenomena significantly enhanced Wiley College's ecological and cultural stewardship accomplishments in the Cypress Basin and elsewhere.

These outcomes kept faith with our original charge from the late Mollie Beattie --to place special emphasis on the training of minority and female faculty and students in 'applied' natural science skills. The largest number of faculty and students in the Institute's FY 1998 programs were non-Caucasian. Females made up about half of the most active faculty and student intern cohorts. An unprecedented number of Wiley College female students completed our program and went on to graduate school. Native American participation, by Caddo Tribal government representatives, was an innovation of the FY 1998 program.

The principal faculty leader at Wiley College was Biology Professor Alexandrine Ramdriamahefa Ph.D. Since 1995, she has been a Master Wetland Educator of the Caddo Lake Institute (Described in (2) below). President Julius Scott of Wiley College provided visionary and forceful leadership which reinforced Dr. Randriamahefa's program development; these were major determinants of the Institute's FY 1998 'Public Stewardship Programming' (discussed in C. below). Together, they greatly enhanced the Institute's ability to achieve tight integration of Marshall Museum's Public Lecture Series (Part C.) with annual Institute training courses, through initiation of the new Wiley ISEE Course², as a preview of what Dr. Scott called 'the potentialities' of Wiley College's new institutional 'niche' of environmental stewardship education.

Dr. Randriamahefa, and her student and faculty teams, led an aggressive water quality monitoring program in the Caddo Lake's catchment, the Cypress Basin of Texas. Through long-term and short-term intensive field exercises, these teams examined water chemistry and nutrient loading in the upper stream segments of the basin. Dr. Rand's connection with our program enabled her to attract, and become the principal investigator, under supplemental grant funding from the United Negro College Fund and the Houston Endowment. For the UNCF project she recruited student Wetland Interns previously trained by the Institute, and affiliated as a principal consultant the Institute's water monitoring network coordinator, Dr. Mike Buttram of Texarkana College. This coordinated initiative had the effect of extending the Institute's traditional monitoring activities within the basin, as well as local urban stream monitoring and out-of-basin monitoring by student/faculty teams from three other collaborating HBCUs.

As these program expansions occurred, Dr. Randriamahefa's participants assumed greater responsibilities for many of the Institute's support functions. These additional functions included added UNCF water monitoring data to the Institute's Cypress Basin GIS data bases.

Wiley College was also the venue for much of the Institute's FY 1998 Winter/Spring Public Lecture Series (discussed in "Public Stewardship Programming"). These lectures supplemented regular courses offered annually by Institute academic initiatives.

Minority and women students participated from schools other than Wiley College e.g. Marshall High School Karnack High School, Waskom High School and Mt Pleasant High School. However, Wiley College became a focal point of all of the FY 1998 Institute programs and themes.

one of the three initial higher education institutions which joined the Institute's Caddo Lake Scholars program in 1993.

² ISEE is an acronym for AInterdisciplinary Studies in Ecology & Environment@ a special Wiley College/ Institute training course.

Most gratifying was the fact that, in FY 1998, Dr. Randriamahefa's academic leadership resulted in greatly increased application and enrollment of her students in graduate schools and prized summer internship positions with notable scientists elsewhere.

--Curricular Enrichments at Other Local Universities in Ramsar and the Natural Sciences.

The Institute has sponsored university-level credit curricular enrichments focused on its stewardship themes. These included East Texas Baptist University's Biology 4100: 'Caring for the Earth,' January 1998 (Prof. Darville) and a GREEN workshop at Wiley College in 'Action Research' (science-based protocols and field activities for defining and investigating community environmental issues).

Institute themes were included in Wiley College courses, such as Ecology, Environmental Chemistry, Botany and Microbiology. Wiley College students participated in Institute-sponsored courses available at Wiley College's new Environmental Studies major program and at East Texas Baptist University's offerings in General Ecology, Wetland Ecology and Global Sustainability courses (Darville, 1996), which are attended annually by CLSP participants generally.

A 1998 innovation was an Interdisciplinary Stewardship course co-sponsored by the Institute and Wiley College. Special college credit was offered to Wiley College students who attended a Public Lecture series sponsored by the Marshall Museum with the Institute. (This series is discussed later under Public Stewardship Programming). The lectures served as integral classroom elements of a course in Interdisciplinary Stewardship of Ecology and Environment (ISEE) through Action Research on lecture topics. The purpose of this course was to provide field training and research presentation experience to faculty/student teams from the departments of science, history and sociology. Speakers' themes included a wide range of cultural and ecological topics, ranging from the spiritual roots and modern expressions of stewardship to technical orientations for prescribed stewardship Action Research projects.

ISEE course participants also attended an Action Research training program at Wiley College, conducted by Institute academicians, and then applied this approach to a selected lecture topic.

- One ISEE history team's Action Research Project was a joint archaeological dig -- with Caddo Indian Tribal representatives-- at Longhorn Army Ammunition Plant (discussed later).
- Another ISEE team, composed of faculty and students from Wiley's Sociology Department as well as Karnack High School; conducted an Action Research a door-to-door opinion survey of wells, contaminant and clean water concerns of neighbors of the Longhorn Plant, a contaminated 'superfund' site.
- Other ISEE teams participated in ornithology lectures and field work. All course participants and members of the public attended an annual Institute lecture entitled 'Caddo Lake and the Ramsar Treaty.'

Since public outreach was a course requirement, these teams, and Caddo Indian Tribal participants, made poster presentations of their field products at the Community Day in May 1998 which concluded the Institute-sponsored Oil Spill 'Desk Top Drill' (described in Scientific and Technical Stewardship sections later).

Institute-trained faculty and students from Wiley College have organized and supported an Environmental Club and an Ecology Team for Wiley College students. Members from these clubs sponsored Earth Day 1998 at Wiley College. Many of the speakers and team interviews were the subjects of local radio broadcasts from Wiley College's campus radio station, as part of the Public Stewardship Programming, described later.

The Institute's Vice-president Sara Kneipp, Wiley's Dr. Randriamahefa and other Wiley College Biology Department faculty jointly created and taught a one credit hour course in the Wiley College Education Department. This course oriented student teachers in Project WET teaching plans, which

the Institute uses for its teacher training. These curriculum enrichments have been supported by improved texts, training, interns, equipment and facility repairs and greenhouse renovations which were underwritten by the Institute. Other Wiley College support by the Institute included computers, software, texts, botanical reference literature, plant propagation materials, botanical greenhouse improvements, and a new campus wetland addition to the Wiley Woods natural area and nature trail.

--Training Master Wetland Educators & Interns at All Levels The Institute's most effective educational participants are science faculties of small local universities, colleges and public schools systems in the Caddo Lake catchment. Candidates for the Institute's designations of Master Wetland Educator and Wetland Intern undertake a year-long course of special training. Since 1995 Five Master Educator teams which have been trained, and other candidate for these designations are in various stages of exposure to Institute training and orientation. They function as primary points of contact on their respective campuses, as well as off-campus trainers and field investigators in field stewardship initiatives. Master Wetland Educators, or advanced candidates, are now in place in five regional colleges and five regional high schools. There they guide their own Campus Action Plans and provide expert direction of many other Institute projects. Master Wetland Educators facilitate and design formal wetland science curricula. They conduct course work and field training for their own faculties and students. They act as mentors for candidate Master Wetland Educators and Wetland Interns, who are recruited at other campuses. They conduct personal applied science research projects, such as those managed by Dr. Randriamahefa, Dr. Darville and Dr. Buttram..

Mrs. Peggy Byassee, Marshall High School science teacher, is an excellent example of how a Master Wetland Educator and her Campus Plan advanced several Institute stewardship goals. During FY 1998, Mrs. Byassee's wetland science curriculum was approved by appropriate state educational authorities. She offered the curriculum as part of an Honors/College Advanced Placement program called 'Biology/Environmental Systems.' This program attracts large numbers of high school Honors students who are interested in field science. As a result, many of these students aspire to Institute Wetland Intern status, and therefore also participate in the Institute's college level ecology and global sustainability courses offered at East Texas Baptist University.

Off-campus, the Marshall High School teams have maintained (since 1995) several of the Institute's monthly monitoring stations in the Caddo Lake vicinity, and report their data to Dr. Buttram for inclusion in the Institute's Cypress Basin data base as Wiley College. Mrs. Byassee also serves as a GREEN or WET facilitator or trainer at other venues.

At Marshall High School, Mrs. Byassee's students track vegetative succession of their own campus wetland (which the Institute helped to construct in 1996); they use GIS mapping programs to capture resulting biological and spatial data. They also conduct urban stream monitoring (in collaboration with their Wiley College upstream colleagues) to assess the aquatic and chemical health of Turtle Creek, an urban drainage body which runs through both campuses and discharges into the Sabine watershed.

This Marshall High School urban monitoring investigation disclosed a serious potential sewage spill risk, due to flood induced undermining of supports for a stream-crossing structure for a large main sewerage pipeline. This risk was documented by an engineer's report, paid for by the Institute, and delivered to a member of the City Commission of Marshall Texas, which owned the sewer main. The engineer's report also documented that prompt identification and correction of this risk probably saved the City of Marshall about \$200,000 in spill response costs and up to 1\$ Million in environmental cleanup costs and fines. Thus, small investments by an Institute Master Educator and her Wetland Interns paid a huge environmental and economic "dividend."

--Wetland Science Curriculum Training for Educators Generally. Many educators do not or are unable to seek Master Wetland Educator designation. However, many educators desire to teach recognized environmental curricula or to receive state-sanctioned environmental education

certificates. To continue to meet the needs of this broader population, 1998 saw the investment of federal and private resources to provide a large number of one and two-day curriculum workshops for educators. These addressed the use of well-recognized wetland or aquatic science curriculum plans, which had been tested and endorsed by the Institute.³ Populations included college and public school educators and students. These workshops were delivered primarily by the Institute's Vice-president Sara Kneipp. In addition, Dr. Mike Buttram (Texarkana College, Texas) is the Institute's coordinator of its state -sponsored Texas Watch monitoring network. In this capacity he continued ongoing training of Texas Watch Facilitators and Water monitors as well as two Texas Watch water monitor trainings and semi-annual workshops for Texas Watch QAQC procedures and certifications. He conducted two monitor/facilitator workshops which resulted in state sanctioned certificates to 20 Texas Watch Water monitors certificates. The following Table II shows the educator populations served by Mrs. Kneipp⁴ and Dr. Buttram and their Institute Master Wetland Educator colleagues during FY 98, and cumulative numbers since 1996.

Figure 1, Table: Curriculum Workshops & Participants Trained

CURRICULUM PLAN WORKSHOP TOPICS & PARTICIPANTS TRAINED	FY 1998 total particip.	FY 96-98 Cumulative Total Partic.
GREEN* Action Research/empowerment workshops	46	46
GREEN facilitator trainers certificate workshop participants	2	7
GREEN Teachers certificate workshop participants	16	50
WET* Facilitator certificate workshop participants	108	300
WET Teacher certificate workshop participants	117	417
'Discovery days' and small group demonstrations of above curricula for Educators, Parents & children	241	440
Texas Watch Facilitator/Monitor Certificate Training participants	20	78
WORKSHOP CERTIFICATE PARTICIPANT TOTALS	550	1338

Applied Scientific and Technical stewardship Projects. Local decision-making is usually improved by early local participation in scientific-fact gathering and interpretation, well before decision-makers or their constituencies become invested in poorer choices. Early monitoring and interpretation are not as dramatic as 11th hour public or private confrontations over shortcomings in data or opinions. However, the former is frequently a lot more effective. Academic scientists in small communities are rarely tasked, and therefore often do not have the experience to establish their credentials or to provide expert advice which could positively influence local wetland stewardship decisions. Thus, data collection and analysis of any kind by local academics expands expertise within the community. That is why the Institute's projects went beyond classical classroom-bound education -- to include a

³ These include highly regarded curriculum plans of Global Rivers Environmental Education Network (GREEN) and Wetland Education Teachers (WET)program, among others.

⁴ During FY 1998, Mrs. Kneipp also presented workshops to many hundreds of attendees at public at educational conferences, which are not tabulated.

wide range of applied 'action research' projects to enhance local scientific expertise and critical analysis skills.

In FY 1998 the Institute's projects provided direct executive support services as well as payments of federal and private funds for qualified local wetland scientists and wetland interns, when they conducted applied research using basic or advanced scientific protocols supported by the Institute. A number of these FY 1998 scientific stewardship initiatives are summarized next.

--Designations and Delineations as Stewardship Strategies. The first significant designation and delineation activities occurred in 1993. The value of this approach became apparent with the U.S. Fish & Wildlife Service's designation of Caddo Lake itself as a Resource Category 1 Habitat. This is a little-known administrative classification which imposes rigorous mitigation burdens upon disruptive activities that are federally funded, such as navigation and water development projects. RC-1 designation provided partial justification for the 1993 Ramsar designation, when the Institute initiated requests to the Texas and Federal governments for Ramsar status for 6,500 acres of Texas-owned natural areas at Caddo Lake.

(a) Caddo Lake Ramsar site enlargement. During 1998 the Institute completed and submitted to USFWS all of the mapping and other Ramsar nomination paperwork to support the 'First Enlargement' of the Caddo Lake Ramsar Site. This enlargement will add over 10,000 additional acres of surface and submerged acreage which are owned or managed by the Army, two Texas agencies, the Institute and private owners.

(b) Important Bird Area, American Bird Conservancy. During FY 1998 the Institute and participating academic and agency scientists completed a first draft of the Site Nomination Form for designating Caddo Lake environs as a United States Important Bird Area under the procedures of the American Bird Conservancy. This activity was coordinated with the ornithology portion of the ISEE/Speakers program. The current draft is now undergoing peer review, and will be completed and submitted during FY99.

(c) Archeological and Cultural Delineation Projects. Pending archeological and cultural research may identify Caddo Indian and other historic heritage areas which may enjoy special protection. These included a successful archeological reconnaissance of the centuries-old permanent habitation site of ancient Caddo Indians, as well as a post-European historic site. These digs were initiated under the Institute's Army ARPA permit and occurred on the Institute's 1400 Harrison Bayou/Starr Ranch (Ramsar) lease tract located within the Longhorn Army Ammunition Plant. by Institute Teams of professional archaeologists as well as faculty and student ISEE teams from Wiley College, Louisiana State University Shreveport (LSUS) and the Caddo Lake Institute executive personnel.

The interim report on the finding of these excavations concluded that the Caddoan site was much more extensive than earlier thought, had apparently been occupied for several centuries, probably contained Native American graves and would qualify for listing on the National Register of Historic Places along with several other sites surveyed during the same FY 1998 Field Reconnaissance project (Perttula, 1998).

--Longhorn Superfund Technical Review Committee. Institute representatives and academic scientists sit on and participate actively in the Longhorn Superfund Technical Advisory Committee (TAC). Research design discussions are underway for sampling of Longhorn animal tissue for DNA breakage which may reflect contaminant damage to significant biological receptors. As a result of concerns expressed by local residents and information considered by the TAC, the Institute and its local participants are initiating literature and field studies to determine whether there have been migrations of Superfund contaminants into wells and wetlands beyond Longhorn's boundaries. Institute Doctrine and the Institute's local stewardship goals recognize that Longhorn's contamination represents a classroom which should be used to produce local jobs and training opportunities -- by

involving local people in environmental risk assessment, remediation and restoration. Practitioners of such arts are highly compensated (Henley, 1996). During the summer of 1998, the Institute underwrote continuation of a Stephen F. Austin State University graduate student research project on the western mud snake distribution within the Harrison Bayou area of Longhorn Army Ammunition Plant (Martin, 1998).

--**Spill Contingency Planning.** Beginning in the Fall of 1997 and concluding in May of 1998 the Caddo Lake Institute facilitated the planning and demonstration of an improved HAZMAT/oil spill response plan for Caddo Lake. Underwriters and response entities included 30 local, state, federal and private sector entities. Lead agencies were the U.S. EPA, Texas Parks & Wildlife Department, the US Fish & Wildlife Service, Texas General Land Office, the Louisiana Governor's Oil Spill Coordination Office, and the National Wetlands Research Center's Spatial Analysis Branch. EPA oversight and financial support advanced current agency directives to refine the Area Contingency Plan in Region 8 to include community-based response elements and to conduct a PREP (tabletop) drill of one such local plan in 1999.

The consensus objective of this group was to use Caddo Lake as the ideal venue to develop a Core Document for Community-based Response to HAZMAT/Oil spills, which could serve as a model for the country. The resulting model emphasized participation by local community members and agencies. Currently, there is no other such community-based plan of this type for inland water spill response. The need for such planning was proven when a substantial oil spill was observed to be in progress on the Louisiana side of the lake when some members of the planning group made a helicopter orientation flight. This project produced localized GIS spill response maps which reflected shore side response capabilities and the most sensitive wetlands, cultural and biological areas to be avoided or given special treatment by responders. These maps were produced by the Texas General Land Office and the National Wetlands Research Center based upon consensus findings of special sensitivity between agencies, academic scientists, local lake users, residents and guides. Spill Response trainings were conducted with local oil producers and emergency preparedness organizations.

All participants then engaged in a simulated response ('Table Top Drill') to test these capabilities and responder relationships on April 29-30 1998. This was followed by a Community Outreach Day on May 1, 1998, where the public observed the presentations of response organizations and agencies, as well booth and poster presentations by the Wiley Collage/Institute ISEE and Caddo Tribal participants.

The Institute's goals for facilitating this event were fully realized. Significant positive relationships and response experience were forged among potential responders. Of equal importance was the creation of response maps of the most significant biologically and culturally sensitive areas. (See Part D.9 below). These will have permanent value not only for responders, but also for researchers and as future vehicles for the production of lodging and amenity maps for the development of a natural science eco-tourism industry. A large intangible outcome was to bring to the attention of responsible agency officials, and the public at large, the chronic problem of recurring small spills and the importance of better managing spill risks to these biologically and culturally sensitive wetlands, and the recreational tourism which they support.

--**Academic Wetland Monitoring Networks.** The Ramsar Convention supports collection of good baseline ecological data for wetlands to identify ecological change. Local monitoring of a Ramsar wetland is therefore a globally significant activity. During FY 1998 the Institute's participating campuses expanded the Institute's Cypress Basin monitoring network. The network now includes about 20 shoreline sampling sites. Teams from participating campuses obtained water quality and coliform samples monthly and collected quarterly benthic samples. These data were analyzed for water chemistry (using the Texas Watch Protocol), bio-monitoring of organisms in sediments (using Izaak Walton League benthic protocols), and fecal coliform monitoring (using EPA protocols). Project GREEN protocols also provide excellent critical analytical frameworks, which permit trained people to classify water quality. Data were collected and archived in GIS format at Wiley College for

subsequent pattern and trend analysis. This academic monitoring network is expanding upstream into the rest of the 3,000 square mile Cypress Basin.

It would be a mistake to assume that academic water monitoring is not useful applied science. The tools we use may not afford the finest measurement. But they do provide good quality assurance practices, important gross measurement tools (which are often quite adequate), and provide recognized analytical frameworks. Presumptive sampling results of interest are consistently being confirmed when rechecked under more rigorous protocols. Educational monitoring thus provides entry-level presumptive data and analysis tools. Their use also creates appreciation by participants of the benefits and limitations of scientific tools. This academic science often operates as a hothouse to develop local skills and responds to the Ramsar call for early warning mechanisms, by detecting anomalies which may require further examination.

--Caddo Lake Institute Protocols/Random Intensive Bio-monitoring. Collegiate master faculty, NWRC and other agency personnel are augmenting academic monitoring with new, rigorous protocols called the Caddo Lake Institute Protocols for Random Intensive Bio-monitoring (CLIP/RIB). (Darville and Shellman, 1997). These are adapted from U.S. EPA sources. These protocols will be used to monitor biota and chemistry, metals, nutrients and other contaminants of concern of the entire water column and sediments at 90 on-water locations at Caddo Lake. When perfected, the stations will be extended throughout the rest of the Cypress Basin. Rigorous field work, to agency and enforcement standards, also occurred when the Institute's academic scientist took an active role in the Texas Clean Rivers monitoring program, discussed next.

--Cypress Basin Clean Rivers Program. In 1998 the Institute became a member of the Steering Committee of the Cypress Basin Clean Rivers Program (CRP), a Texas state-sponsored water quality assessment and pollution control program. Institute personnel facilitated development of a consensus among polluters for a Quality Assurance Project Plan (QAPP) for the entire Cypress Basin. These QAPP procedures and resulting data meet the most rigorous sampling standards. The Institute also assumed direct monitoring of significant numbers of state water sampling stations with teams of academic scientist and student interns. Institute participation cut a year and substantial costs from initial program estimates, which assumed that sampling would be performed only by agency and consultant professionals. CRP data-gathering is 'applied science' in the truest sense. It will be used to grant or deny state water discharge permits, including eventually establishment of EPA-required Total Maximum Daily Load (TMDL) that will allocate among all polluters the cumulative discharges permitted into the waters of the Cypress Basin. This data gathering represents the best type of direct local participation in official basin management. This procedure not only acquaints the participants with the baseline information, but it also shows them how aquatic resources are protected --or degraded-- through governmental processes.

--Northeast Texas Air Care Technical Advisory Committee (NETAC). The Institute is an active member of the regional technical advisory committee for the East Texas Council of Governments (ETCOG). This committee includes representatives from local governments, private polluter industries and NGOs. It reviews and provides technical advice on air quality compliance concerns to the governments in the five counties which make up ETCOG. Current stated priorities are to identify and correct exceedences of previous and new EPA air pollution standards for ground level Ozone. Institute personnel and representatives from other NGOs are conducting research into apparent correlations between air emissions pollutants and their occurrence in water, sediments and biota. These may include possible contributions to increased nitrogen loading, reduced acid buffering capacities (from SO₂ NO_x acidification) as well as excessive levels of mercury, cadmium, lead and other heavy metals which are vaporized by coal-burning power plants, and other, point source emissions in East Texas and Northwest Louisiana. These correlations will be the subject of ongoing research design and public information elements of future years' programs.

--Archive and 'Gray Literature' Web Page Initiative. During FY 1998 the Institute's World Wide Web pages⁵ have continued to reflect enlargement of its archive of locally-relevant

⁵ See www.caddolakeinstitute.org and www.clidata.org specifically e.g./clip and /spill

scientific and technical research papers and GIS map products. Much of this is 'gray literature.' This term refers to scientific and technical literature which is not published in recognized scientific journals, but which often contains useful data or analysis which is either specific to the local ecosystem or which address questions or processes which occur therein. These products typically result from academic and agency science research projects. Sources of gray literature may include work products of undergraduate, masters and doctoral students, or faculty research, as well as agency scientific studies. If not preserved, these often become practically unavailable because institutional or individual awareness erodes as to their existence. Other gray literature is produced by Institute projects or third-party grants which support scientific research into important knowledge gaps. Gray literature is attracted into the public domain by Institute technical seminars and workgroup meetings, such as those with members of the Stephen F. Austin State University College of Forestry. These meetings disclosed extensive graduate and faculty research into the hydrology, herpetofauna, plant communities, and resulting GIS mapping products, of the Army's Longhorn Plant, as well as research into plant communities of the larger ecosystem. This material is now available on the Institute's web page.

--GIS (Geographic Information Systems) Product Creation and Archiving. Prior projects with National Wetland Research Center have resulted in creation and interpretation of extensive remotely sensed (and locally ground truthed) landscape mapping of exceptional quality. These are used to archive and retrieve (by reference to collection point coordinates) data obtained from many sources, including gray literature and water quality, habitat and other monitoring activities.

GIS mapping has also been created for CLSP campus wetlands, campus habitat data and interpretive sites. Such maps have been used and demonstrated during public discovery days and the training phases of local Campus Action Plans for individual campuses. As already noted, the May 1998 spill maps are platforms for spill responders, researchers and for eco-tourism and Refuge visitor information products to be developed in future year programs. Many of these map products are already available on the Institute's web page, and provide iconography for quick visual interpretation of complex monitoring data.

Empowerment of Lake Communities & Economic Development Partnership by Brisbane Pledge Fulfillment. As noted elsewhere, the Institute's Brisbane 1996 Pledge was to establish at Longhorn the first US Regional Ramsar Center and Academy of Wetland Science Education. To implement this pledge, in 1996 the Institute entered into a 30 year lease (for a gross rental of \$300,000) of 1400 acres of old growth bottom land forest at Longhorn. This leased area, together with another 10,000 acres of wetlands, was then nominated by the Institute and wetland owner entities as the First Enlargement to the original 1993 Caddo Lake Ramsar site. Future Brisbane Pledge fulfillment of this US/Institute Pledge will require collaborative planning and land acquisition activities by both Pledgors during 1999. This should delineate appropriate funding roles for the Caddo Lake Regional Ramsar Center itself, as well as complimentary activities by federal, state, educational and private sector partners.

The possibilities for mutually reinforcing partnerships between the Institute, the Army, USFWS and Texas Parks & Wildlife Department, and others, experienced significant stimulation when USFWS Region 2 notified the U. S. General Services Administration of its desire to take Longhorn into the national wildlife refuge system.

This decision also prompted an Institute-sponsored fact-finding team reconnaissance trip to the Bosque del Apache Refuge in Socorro New Mexico during its Fall 1999 Crane Festival. The fact-finding team was composed of 20 business and residential occupants of the Lake communities as well as interested agency, academic and NGO representatives.

Upon their return to East Texas, local residents formed the "Longhorn Refuge Neighbors Association" (LRNA). Their stated purpose was to support local participation in the Longhorn refuge program and the Ramsar Center's Natural Science Re-users campus. This served as an effective means to assure not only good decontamination of the facility, but also subsequent sustainable levels of Ramsar-based eco-tourism, science visitations and programs that would enhance economic re-use

of Longhorn, as well as ecological stewardship for the ecosystem and the communities which call it home.

Public Outreach through Public Stewardship Programming. A successful innovation in the FY 1998 program design was the use of Public Lecture events as integral elements of the Institute's broader training joint ventures. Public Lecture/Training Course integration occurred through partnerships with the Marshall Texas Museum's Public Lecture Series and Wiley College's ISEE program. The result was that the Institute-sponsored speakers in the Museum's Public Lecture Series typically addressed topics that were a part of the Wiley/Institute ISEE course, and also satisfied the scope and sequence of the Institute's annual training program for non-Wiley Master Teacher and Student Intern candidates.

Thus, public lectures were used, in addition to informing public audiences, to introduce CLSP participants to specific local field training topics for ISEE credit. Public Lecture course supplementation included: the religious sources of 'Spiritual Stewardship' (Rev. Vincent Harris, Wiley College Chaplain, Winter 1998) and 'Caddo Lake and the Ramsar Treaty' (Shellman, Public Lecture Series, Marshall Civic Center, March 1998).

Several other lecture topics were introductions to a lecturer-led field event, e.g. 'Caddoan Archaeology' (Dr. Perttula and Caddo Tribal members followed by Winter 1998 digs at Longhorn), 'Longhorn Contamination' (Wilma Subra, Superfund expert, followed by Wiley Sociology/Karnack High School joint canvass of Longhorn neighbors concerning local attitudes about water quality, future Longhorn re-uses and contamination, in Spring of 1988), 'Caddo Lake Ornithology' (Ingold lecture and bird identification field program leader in April 1998). ISEE field products were presented for public viewing, when they were the subject of poster presentations at the Institute-sponsored 'Oil Spills' Response/Community Demonstrations in April-May 1998. Thus completing the trainee demonstration and public information cycle.

An additional Public Stewardship initiative involved multi-media capacity building, to present ISEE information to the public at large. Audio and video taping of ISEE events, or ISEE team interviews, permitted re-broadcasting of Core Curriculum and Public Lecture topics in FY 1998. The objective of this initiative was to begin to build the capacity for archiving, academic reuse and public dissemination of the substantive productivity of CLSP programs. The Wiley radio station manager received special professional tutoring in video acquisition and post-production skills, producing her report in the form of a descriptive 'how to' video tape for re-teaching these skills to other Wiley and Institute participants.

Thus, this initial Public Stewardship Programming resulted in initial public media capacity-building as well as actual radio re-broadcasts, by the Wiley College radio station, of Wiley/Institute ISEE speakers and taped interviews of ISEE field demonstration teams.

Broader public recognition of the Institute's world-class stewardship model has also occurred at state and national levels. The Institute's projects have attracted national and state press attention since 1993. (Gold, Sue. 1993. In 1997, the Texas agency-supervised Texas Watch Program recognized the Institute as its "Leading Partner" organization. It also recognized two Caddo Lake Scholars Program schools (Karnack and Marshall High Schools) as "Outstanding Texas Watch Participants." The Texas League of Woman Voters recognized the Institute's work for its 1997 Excellence in Environmental Awareness in the Organization Category. The Institute's Caddo Lake Scholars Program has received grant recognition and funding from the U.S. Fish and Wildlife Service (1994, 1998), the National Biological Service (1995, 1996), the National Fish and Wildlife Foundation (1995-96) the U.S. Bureau of Reclamation (1997) and, among others. The Institute's officers and leading faculty and student participants regularly present the Caddo Lake Institute model to domestic and international conferences, as a part of their own professional training and to discharge their "ecological mentorship" responsibilities. (Shellman, 1996.)

Conclusion: The Caddo Lake Case Study & Recommendation 6.3.

The Institute's "other" initiative at the sixth Conference of the Parties to the Ramsar Convention (CoP6) has seen significant progress. As a result of its exemplary community-based wetland science model, the Institute was appointed in Recommendation 6.3 of the Ramsar Contracting Parties, to be one (of four⁶) NGO members of an international working group. This working group was tasked to complete a worldwide study of models and guidelines by which the Ramsar Nations could encourage participation by local and indigenous peoples in wetland conservation and management. This study plan has been developed with significant Institute participation and support, during international wetland conferences at Kushiro in March, 1998, and the U.S. National Wetland Conference in Washington, DC, in April, 1998. The Final Report of this working group will be presented at CoP7 of the Ramsar nations in May of 1999 in San Jose Costa Rica.

The Caddo Lake Institute submits this report as one of the Rec. 6.3 Case Studies. We hope that this and other case studies will embolden other local institutions to adapt our results, strategies and tactical programs to their own local situations and cultures. In the final analysis it remains for the local peoples of the world to transform Ramsar Policy rhetoric into living programs that not only transform the wise use of their wetlands, but enrich their local science and educational capacities to perform the necessary stewardship services themselves. The lessons of the Caddo Lake Case Study orbit around the attraction of the Institute's primary insight. That insight is this:

- Even remote rural regions have, within their various local institutions, a basic science education infrastructure, and enough dedicated academicians and bureaucrats, to transform themselves and their institutions into credible "experts" and stewards of their own ecosystems.
- The task is to forge a consensus among local constituencies for commonly supported strategies, themes and tactics which redefine the missions and redirect these community resources to world-class skills and knowledge that is needed to assure broadly supported stewardship of local Ramsar wetlands.
- The guidance of the Ramsar Convention, including Rec 6.3, can provide powerful yet flexible themes for assuring wise use of wetlands and the sustainable development and educational enrichment of wetland communities and their institutions. In doing so, they can prove the adage that local people can act globally by acting locally.

⁶ The other NGO parties are IUCN, WWF and the Kushiro (Japan) International Wetland Center.

APPENDICES:
Appendix I: 6.3 Recommendation Responses
Appendix II: 6.3 Summary Table

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Appendix I: 6.3 Recommendation Responses

The following recommendations respond to the questions included in part III.4 of the 6.3 Case Study Guidelines:

Question 1. WHAT CRITERIA IDENTIFIES THE CASES IN WHICH ACTIVE INVOLVEMENT OF LOCAL INDIGENOUS COMMUNITIES IS CRUCIAL TO THE SUCCESS OF MANAGEMENT?

Answer: Crucial criteria include the following:

- a. Resident, business and educational constituencies with an experience-based skepticism for ecological manipulation by powerful governmental and commercial interests, and identifiable local economic or personal interests in maintaining the integrity of those processes.
- b. The existence of local constituencies, including educational elites, which either have basic science education capabilities or personal or economic motivations to learn about the workings of their ecosystem through the acquisition of conservation assessment and management skills.

Question 2. WHAT CONDITIONS AND FORMS SUPPORT RESIDENT COMMUNITIES BECOMING INVOLVED IN PROTECTION OF THEIR LOCAL ECOSYSTEM?

Answer: In addition to the answer to Question 1, conditions and forms of the "Caddo Lake Institute Model" (discussed in the Results section) are as follows:

- a. Actual commitment by management of agencies and private owners to the long term, sustainable "stewardship" of ecosystem resources, as defined by Ramsar (or equivalent) guidance, policies or regulations.
- b. Official policy acknowledgment that local participation could provide personnel and technical services needed to accomplish these stewardship outcomes, or that such outcomes could be positively advanced with involvement by local people and institutions they influence.
- c. Existence of local individuals or institutions desiring to provide personnel and/or data collection, surveillance or other services, in exchange for skill acquisition and training and reimbursement of marginal costs incurred.
- d. Willingness on the part of agency leadership to adjust resources and attitudes to support the mobilization, training and support of such local persons or institutions.
- e. Willingness of management of agencies and local entities to work through "partnerships" that provide marginal costs, reimbursements and training to qualify local people to participate as co-participants rather than as employees.

Evolution of the Institute's "marginal cost" community-based organizing model listing of academic scientists (in the Educational Stakeholders section) shows the power of the Institute's marginal cost organizing strategy, which can be summarized as follows:

1. Effective participation by local people in wetland management is not possible unless they have the capability to comprehend the technical and scientific strengths, and limitations, of management proposals for local wetlands, and the ability to monitor whether adopted proposals are working properly.

2. Members of local communities who might wish to support wetland stewardship are reticent to do so because they are not on an equal financial or technical footing with government or commercial advocates of specific management proposals.

3. In most cases there will not be sponsors (like those who underwrote the Caddo Lake Institute's programs) who are willing to underwrite the hiring or training of scientific and technical support services for local people.

4. However, the Caddo Lake Institute "model" does demonstrate that such capabilities can be created and the need to raise significant funding may be significantly minimized by specific organizational strategies which capitalize on mobilization of a community science education infrastructure which already exists .

5. This model suggests that an effective and sustainable strategy is one which, at the least cost, mobilizes existing investments in local scientific and technical expertise, equipment and facilities. This can be accomplished by the following refocusing of existing local technical and scientific capabilities:

A. In the case of the Caddo Lake Institute, the evolution of these capabilities occurred over time in the course of a "cycle of meetings" which were used to identify tasks and resources, and to create a "feedback ecology" between participants. These meetings included periodic

1. "Scoping briefings" with agency, academic and community personnel who were invited because they shared possible interests in locally-supported ecological conservation science activities. Scoping meetings used briefing materials to facilitate free-flowing discussions were recorded as they were made, for later reference. Initial themes and scholarship awards and categories were derived from these. (The first reference to the Ramsar Convention occurred, as an aside, by a federal agency executive at the first such scoping meeting which ultimately became the Caddo Lake Institute's Scholars Program.)

2. Subsequent conferences may include:

a. Recognition events, usually at the end of a school term, for those who followed through on any stewardship activities.

b. "Evaluation round tables," at the end of group directed "pilot projects." Project participants and others assess the efficacy of "pilot projects," discard unsuccessful activities, recommend useful strategy and project modifications, identify misunderstandings and adjust mission objectives and tasking definitions.

c. Annual announcement and recruitment conference, for educators and students, usually after commencement of the regular school year.

d. Special advanced training courses during the regular school year for educators and students who agree to prepare for part-time staff status, as master teachers or wetland interns. This may be a part of regular curricular offerings or specialized extra mural workshops.

e. Summer field work, course work and workshops in a desired knowledge or skill, as well as specialized agency internships for advanced educators and student interns.

Such a process can be repeated annually.

B. Each local (or regional) university, college and public school system can be a source of one or more of the features needed, such as courses, scientific and technical talent, equipment and facilities.

C. The ecosystem stewardship capabilities in each local educational institution can be enhanced by using the local ecosystem to learn field-based scientific assessment skills and orientation in world-class legal and analytical frameworks.

D. Institutional programs should demonstrate how ecological literacy can be supported by access to existing public investments, such as the use of existing governmental expertise, equipment and facilities. This is most often accomplished by cultivating mutually supportive and beneficial relationships and partnerships with agencies, through coordinated field projects and data sharing.

E. Where practicable, regular intra-mural staff and curricular activities should be expected to create useful scientific and technical work products which benefit the local ecosystem.

F. All of the above enhancements can be justified by improved performance of the educational and professional missions which existing institutional investments were tasked and funded to perform in the first place.

G. Where use of existing investments is impracticable, because of legal, liability or institutional limitations, faculty and students should be encouraged and given support for performing such stewardship activities through other entities, on an *extra-mural* basis.

6. A local ecosystem stewardship institute (like the Caddo Lake Institute) can be an appropriate *extra-mural* entity, for such purposes as :

A. Coordinating, and seeking grant or agency support for, academic eco-system stewardship activities by participating institutions and individuals, whether *intra-mural*, *inter-mural* or *extra-mural*.

B. Discharging responsibilities arising from extra-mural, or other, part-time field activities, such as providing injury and liability coverage, payroll charges, withholding and other record keeping functions for part-time employees which are not covered by part-time participant's primary academic institution.

C. Establishing comprehensive programs to be accomplished in the course of coordinated, or part-time, research tasks, including quality controls.

D. Accepting institutional responsibility for the accuracy and findings of work products of part-time participants, so as to insulate the primary academic institutions where they prefer not to be associated with the work product.

E. Providing mechanisms for recruiting, assigning, supporting and coordinating groups of academic scientists and skilled students from many community institutions who elect to participate as community leaders of ecosystem stewardship projects.

F. Maintaining archives for and access to research data and literature supporting local stewardship activities.

G. Conducting public information, outreach and recognition events which assist with recruitment and enhance public appreciation of the importance of local investments and participation in wise sustainable management of local and global wetlands, including the guidance provided by law and treaties such as the Ramsar Convention.

Question 3. WHAT KEY PROCESS STEPS WOULD YOU SUGGEST BE USED ELSEWHERE?

Answer: The Caddo Lake experience (detailed in the answer to the prior question) included the following key process steps:

a. Identification of private sector underwriters for locally based stewardship programs which did not exist (Don Henley and Dwight K. Shellman).

b. Interaction with local academic institutions to enlist assistance in recruitment of institutions and academicians in developing such programs.

- c. Convocation of scoping “briefings” which permit agency personnel, academicians and local residents to “brief” each other about local ecosystem information, research and conservation needs.
- d. Careful recording and incorporation of points disclosed at briefings; use of points in local participants’ initial ecological research and scholarship projects.
- e. Recognition events which honor initial research and scholarship products and which broaden recruitment and expand local stewardship.
- f. Evaluation “round tables” at logical (annual) points in time, to create a “feedback ecology” between agency and local participants concerning achievement of briefing points. These evaluation sessions permit participants to correct misunderstandings, or to refine or enlarge tasks and missions, or to incorporate new stewardship techniques (e.g., at Caddo Lake we decided to develop new curricula that advanced research goals, to use of Ramsar themes, to give academic credit for field research and monitoring, and to pay of stipends and marginal costs of participants’ off-campus work, etc.).
- g. Development of mission statements and work plan schedules to focus efforts and to attract governmental and foundation funds and technical support.
- h. Use of a “Pilot project” approach to new initiatives. This can test and adjust important mission statement roles. These pilot projects were followed by participant evaluation round table and recognition events.
- i. Repetition and refinement of these key processes, to reinforce a partnership ecology of mutual collaboration for mutual benefits.

Question 4. WHAT SPECIFIC ADVICE WOULD YOU GIVE IN TERMS OF NEGOTIATION PROCEDURES?

Answer: This question is not clear. In the Developed world, local people do not always need official “permission” to conduct research in publicly accessible wetlands, or in private lands they own or can obtain permission to enter. Neither can they be prevented from sharing their results with officials or the public.

Question 5. WOULD YOU RECOMMEND THE DEVELOPMENT OF FORMAL OR INFORMAL WRITTEN AGREEMENTS AMONG STAKEHOLDERS?

Answer: Unless required by legal considerations, I would minimize treating “agreements” as pre-conditions to commencement of stewardship work. Formal agreements tend to distract people by the need to know exactly what they are agreeing to before they can begin. I would, instead, assure participants that there will be many opportunities to refine approaches after something is attempted, even if it is not fully defined. This should encourage individual initiatives and collaborations designed to create evolutionary working “relationships.” This approach is not always comfortable for educators who prefer to teach from a predetermined plan. However, it is more flexible and may work better than excessive preoccupation with formal writings. We intentionally designate each specific project as a “pathfinder” project to make clear that it is expected to find new pathways, rather than to follow a predetermined path. This permits changes in direction or content to accommodate experience, new learning, new participants or changing personnel needs of old participants.

Formal or informal agreements must occur when legal conditions require, e.g., when significant money or property changes hands or liabilities are created. For example, the Institute often purchases and “loans” scientific or technical equipment to participants. Since these are not ownership transfers or gifts to the recipients, we enter into written and signed “Equipment Loan Agreements.” Written definitions of employment or other relationship may be necessary to establish liability, risk definition, damage release or other legal requirements (e.g., workers compensation, tax withholding, risk assumption, insurance coverage, etc.).

A “learning letter” agreement written to Mollie Beattie by participants contained the “conceptual agreements” for in our first pilot project in February 1994. It was discussed, revised and signed by all of the educator and student participants. This provided the first test of the key concepts of the Caddo Lake Institute’s present scholars program. This included joint training of a group of educators (“Core Mentors”), and their student proteges (intern candidates) from several colleges and school systems, in the use of natural science teaching plans, monitoring curricula. It resulted in the adoption of the concept of compensated master mentors and student “wetland interns.” Mollie Beattie was late Director of the USFWS, and had promised a modest sum for

this initiative. She was greatly respected for her gesture, and her personal relationship with our participants, who she never personally met before her untimely death in 1996.

Question 6. WHAT SPECIFIC ADVICE WOULD YOU GIVE IN TERMS OF PROCEDURES TO ENFORCE SUCH AGREEMENTS?

Answer: See the previous answer. Where agreements are necessary, the enforcement procedures should be stated. Termination for cause is a typical, and non-threatening way to resolve an unexpectedly dysfunctional relationship.

Question 7. WHAT SPECIFIC ADVICE WOULD YOU GIVE IN TERMS OF MANAGEMENT INSTITUTIONS?

Answer: See the criteria discussed in the Answer to Questions 2 and 3,.

Question 8. WHAT SPECIFIC ADVICE WOULD YOU GIVE IN TERMS OF MONITORING AND EVALUATION PROCEDURES?

Answer: Technical and quality control standards are essential. Ecological monitoring and evaluation should be based upon existing well-regarded guidance. We use the sampling and analytical manuals of the state of Texas' monitoring program known as "Texas Watch," supplemented with the Izaak Walton League's benthic monitoring protocols. Because of their superior quality, and use of indices to rank sampling results qualitatively, we are using manuals of GREEN (Global Rivers Environmental Education Network), referred in the Caddo Lake Case Study. Our monitors also receive orientation in Ramsar principles, resolutions and scientific and technical panel guidance of the Ramsar program. We emphasize the "consensus" approach which the Ramsar "culture" promotes.

Activities and relationships between remote agencies and local participants need to be "monitored and evaluated." The best way to do this is with an annual or seasonal briefing and evaluation round tables discussed in Answer 3 above. This should permit each to "brief" the others on what has been, or is yet to be accomplished. Briefings should include written reports and should result in a transcript or summary of any consensus reached, refinements in approach and reports of past and proposed research projects, for later reference.

Participants, and their internal evaluation and monitoring techniques, should encourage an ecological approach to how they build, and reinforce, their relationships, based upon mutual benefits.

APPENDIX II: 6.3 SUMMARY TABLE

Wetland Information	
Site name	Caddo Lake
Province, country	Texas & Louisiana, U.S.A. (Ramsar site in Texas only)
Wetland type (please use the Ramsar category classification, attached)	Inland wetland complex of permanent freshwater lakes, swamps and swamp forests.
Author's Information	
Name(s) and address(es) of author(s)	Dwight K. Shellman, Jr., President The Caddo Lake Institute P.O. Box 2710 Aspen, CO 81612
Other people/groups who provided information for this case study	Barbara E. Ornitz, Vice President, The Caddo Lake Institute, Aspen, Colorado. Dr. Roy G. Darville, East Texas Baptist University, Marshall, Texas. See also authors for specific citation references in Caddo Lake Institute's

	case study text.
Local/Indigenous People's Involvement	
Who are the main local/indigenous stakeholders involved in management? (See your reply to Section IV.1 of the questionnaire.)	Local participants in the Caddo Lake Institute's Scholar programs include local businesses and residents of Lake communities, academic scientists and educators from local public schools, colleges and universities, their students, and other local residents and non-resident conservation stewardship entities of all kinds. The Caddo Lake Institute, a non-governmental organization, coordinates the activities of their participants.
What is/are the main role(s) of local/ indigenous communities in the management of the wetland? What are their main assumed responsibilities? (See your reply to Section IV.3.)	Local communities provide the capabilities of the personnel and facilities of existing community educational institutions, whose programs can be re-targeted to improve local education by providing new ecosystem stewardship services. (E.g., <i>the programs of local schools and colleges are improved by including field based stewardship skill training as a part of new science curricula.</i>) In the case of the Caddo Lake communities, this created the roles listed below. (1) The Institute coordinates and manages participants from multiple educational institutions pursuing research and in funding marginal costs of new curriculum development and field work; (2) maintenance of a monitoring network for the wetlands and their catchment; (3) educational monitoring of biota and water quality which produces scientific baseline data; (4) monthly and seasonal sampling data are reported to appropriate agencies and archived for local accessibility at Institute computers maintained at a local college by wetland interns; and (5) the participants build collegial relationships with local, state and federal entities whose tasks include management of the ecosystem, or specific resources within it. Other main responsibilities include (6) dissemination of Ramsar and natural science guidance through new educational curricula in local schools and colleges; (7) public outreach activities; and (8) conduct of other natural science research projects.
What are the main benefits received by local/indigenous communities? (See your reply to Section IV.4.)	Educators, wetland intern students and their primary educational institutions receive direct payments of money for services rendered, expense reimbursements, tuition and curriculum improvement. These stay in the local economy. Visitors also supplement the local economy when they come to learn about or participate in ecosystem stewardship. Local teachers and academicians realize indirect benefits in the form of travel and other expenses for conference and advanced training, elsewhere in the US and the world. They improve their local knowledge and use of scientific skills. Improved collection of scientific data and local wetland science expertise is more accessible to the community. Ramsar principles are taught by local educational systems. Public and agency recognition of expertise of local participants and the institute, may result in compensated collaborations. Institute coordination avoids management expense to local institutions, duplication of effort and provides continuity and technical support for diverse activities by participants.
What are the crucial factors contributing to a positive involvement of local/indigenous communities? (If appropriate, please list at least five factors; see your reply to Section IV.6.)	(1) The ability to obtain funds to pay marginal costs increases of re-targeting local educational components for better ecosystem stewardship, including supplemental income to local science educators and students; (2) Willingness of participants to assume additional work for career development proposed; (3) Willingness to spend off campus time to maintain monitoring networks to capture new data and to forge collegial relationships with interested agency personnel; (4) Membership in official air and water quality advisory bodies; (5) Support by a local NGO stewardship entity willing to coordinate complimentary activities by many local participants; (6) the NGO's ability to attract additional technical and financial resources for use by local people; and (7) the fact that the

	ecosystem is not yet subject to developmental pressure by populations or activities which may exceed its sustainable carrying capacity.
What are the crucial obstacles to a positive involvement of local/ indigenous communities? (See your reply to Section IV.7.)	Crucial obstacles include the following: (1) Partisan political and agency ‘control’ conflicts; (2) Cultural and commercial resistance to regulation of private activities, legal land use controls, and lack of such controls. (e.g. at Caddo Lake, there was effective political opposition to alleged ‘private property’ impacts of preserving endangered species, and ONRW classification of Caddo Lake waters so as to preclude further degradation of water quality; (3) <u>Ad hoc</u> and uncoordinated decision-making by limited purpose agencies (e.g., forest, wildlife, air and water pollution, water development,, nuisance species control and resource extraction agencies and local governments) and/or commercial interests; (4) Economically and politically powerful special interests which emphasize short-term resource exploitation or revenue production which conflicts with preservation of biodiversity, ecological services and long-term Sustainability; (5) Tendency of local residents not to be involved in conservation initiatives unless their personal interests are threatened; (6) Tendency of local education and academic scientists to avoid involvement in extra-mural policy debates that might provoke criticism o them or their institutions; (7) Lack of local scientific or technical expertise needed for informed decisions; and (8) Local abdication of decision-making to more remote government agencies and special interests.
Summary Evaluation	
Is the ecosystem well managed? (e.g., biodiversity is protected, resource use is ecologically sustainable, wetland services are maintained)	Because management is fragmented between agencies of the federal government and two states, the ecosystem is not actually managed in a unified way to prevent threats to its ecological integrity. However, the present modest pressure for growth, development, or exploitation, has allowed agencies and local constituencies to support policies which maintain biodiversity and wetland services, and which might permit remediation of existing ecological damage.
Is the livelihood of local/indigenous communities assured?	No. Those that still depend on local resources for subsistence are at risk to limited-purpose or inappropriate management, contamination of fish and game, their habitats, and degradation of community qualities or natural resources which attract residents and visitors. The income of local people which is derived from maintenance and sustainable use of ecological resources is not great when compared with high returns achievable through potentially conflicting uses, such as inappropriate development, hydrologic or biologic alteration, pollution and invasive species. The Institute’s program has sought to augment existing modest levels of ‘eco-tourism’ uses (hunting, fishing) by underwriting ‘natural science tourism’ uses, such as visits by natural science researchers and natural science educators from elsewhere. The Institute’s activities generate supplemental income to local program participants and businesses, which did not exist before.
Is the involvement of local/indigenous communities an overall success? A failure? A mix of both?	The involvement of local people in the Institute’s initial projects has been a success for its participants and their commercial and agency partnerships. While far better than what would have happened otherwise, the present success is regarded as modest and limited. It can and should be expanded as to area and number of participants. While the Institute officers do participate in official policy advisory bodies and their policy formulation activities, only a few of the academic scientists and educators have offered their opinions in public policy debates.
What are the main management benefits and problems that can be directly ascribed to the involvement of local/indigenous people? (See	<u>Benefits</u> include: career advancement and recognition, utilization and enrichment of local knowledge and stewardship skills, improved monitoring and increased public support for sustainable use. The main <u>problems</u>

your reply to questions IV.8 and IV.9.)

identified by our involvement of local people is that increased direct and marginal costs are incurred by the private and public sector underwriters to pay for the Institute's essential coordination and direction function. Since sustainable maintenance of the Institute's funding sources is not assured, its suspension may result in discontinuance of most of the local activities which it coordinates, unless those functions are fully assumed by other local institutions.