Conserving Mississippi's Freshwater Biodiversity

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Abstract

The southeastern United States harbors a rich diversity of freshwater species and ecosystems. In particular, Mississippi contains a spectacular diversity of aquatic plants and animals throughout its many watersheds, from coastal black water systems to lower Appalachian Tennessee River systems. Certain incompatible human uses of Mississippi's natural resources pose potential threats to this natural heritage, and many entities, including non-profit organizations, governmental agencies, local community groups and private sector companies are increasing their efforts to protect water quality, quantity and biodiversity within the State. Limited resources, however, require their efforts be carefully planned and focused to increase the probability of successful conservation and thus have a positive impact on aquatic natural resources. The Nature Conservancy (TNC) has been active in biological conservation of Mississippi's natural resources for many decades. In recent years, the Mississippi (MS) Chapter of TNC has focused resources and efforts on protecting and restoring the biodiversity of Mississippi's freshwater ecosystems. Through a process called Conservation by Design, freshwater conservation areas of biodiversity significance have been identified and prioritized and the development of plans to conserve and or protect these areas is underway. The next steps for the MS chapter of TNC will be to implement these conservation plans, measure the success of our conservation efforts and continue to revise the conservation plans as data and information become available. A major factor in the success of our conservation efforts will rely upon how well the community is engaged in the process, partnering with local, state and federal government agencies, using scientific data as the foundation of the process and obtaining adequate funding for the planning and implementation of the conservation strategies.

Key Words

freshwater conservation, freshwater biodiversity, conservation planning

Introduction

The Nature Conservancy (TNC) is a non-profit organization whose mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The conservation goal of TNC is the long-term survival of all representative types of viable native biological species and communities. The Mississippi Chapter of the Nature Conservancy was established in 1989, however the Nature Conservancy has been actively engaged in conservation in Mississippi since the 1970's, mainly through land acquisition. The Nature Conservancy also helped to establish the Mississippi Natural Heritage Program in 1976, which identifies the state's most significant natural areas through a comprehensive inventory of rare plant and animal species, exemplary natural communities, special geological features, and significant natural areas.

The importance of preserving biodiversity has been documented extensively (Wilson 1992, Norton 1988, McNeely et al. 1990, Ehrlich and Ehrlich 1981, Myers 1992 and Plotkin 1988) and includes major benefits such as: maintaining ecosystem integrity, water recycling and purification, aiding plant pollination, generating and maintaining productive soils, production of foods and medicines, providing biological pest control, offering recreation, assisting in the bioremediation of chemical pollutants and advancing biotechnology. Annual U.S. economic benefits of biodiversity are estimated at 300 billion dollars (Pimental et al. 1997). This does not take into account the many benefits that have not yet been discovered.

Historically, much of TNC's focus has been on the conservation and protection of terrestrial biodiversity. In recent years, however, TNC has committed to focusing resources and efforts to the preservation and conservation of aquatic ecosystems, both freshwater and marine.

Freshwater biodiversity in the United States is known to be rich and diverse and a large portion of the world's freshwater species occur in the U.S. (Master et al. 1998) (Table 1). Further, the southeastern United States is remarkably rich in aquatic species (Table 2).

Table 1. Global Significance of U.S. Freshwater Species

Taxonomic Group	Percentage of Known Species Worldwide Found in U.S.
Fishes	10
Crayfishes	61
Freshwater Mussels	30
Freshwater Snails	15
Stoneflies	40
Mayflies	30
Caddisflies	13
Dragonflies and Damselflies	8

Table 2. Significance of Southeastern U.S. Freshwater Species

Taxonomic Group	Percentage of U.S. Species Found in Southeast	Percentage of North American Species Found in Southeast
Fishes	62	
Crayfishes	90	
Freshwater Mussels	91	
Freshwater Snails	61	
Stoneflies		32
Mayflies		39
Caddisflies		40
Dragonflies and Damselflies		48

It has the richest fish diversity (686 species) and highest number of endemic fishes in North America north of Mexico (Warren et. al. 2000). Ninety-one percent (269 of 297) of all mussels in the United States occur in the southeast (Neves et. al. 1997). There are 313 species of freshwater snails in this region, 61% of the U.S. total. Estimates show that freshwater crustaceans, including both cave and surface dwellers, are the most diverse in the U.S. (Hobbs 1992).

This diverse assemblage of species, occurring in freshwater ecosystems of the southeastern U.S. is highly imperiled. Almost 50% of the most imperiled freshwater regions in the U. S. occur in the southeast (Master et. al. 1998). Sixty percent of mussels and 28% of fishes are in jeopardy. In the southeast, the aquatic fauna has experienced one of the highest rates of extinction in the continental U.S. (Warren et. al. 2000). This is especially true for the freshwater snails and mussels, with 38 and 36 species known to be extinct.

There are many stresses and sources of stress, together called "threats", affecting aquatic communities and species in the southeast. In most freshwater ecosystems, there are several stresses acting on the community simultaneously, resulting in degradation of the ecological integrity and ultimately the extinction of species. Of the many stresses that exist, TNC has identified three major stresses:

- In-stream habitat and hydrologic alteration
- Water quality pollutants (mainly sedimentation, organic enrichment and nutrification)
- Predation and competition from invasive species

In light of these circumstances, the MS Chapter of TNC has developed and initiated a freshwater conservation program focused on meeting the mission and conservation goal of TNC.

The Nature Conservancy's Conservation Approach

In order to meet its ambitious mission, TNC has developed a strategic, science-based planning process, called *Conservation by Design* (CBD), which helps identify the highest-priority places that, if conserved, promise to ensure biodiversity over the long term. In other words, CBD provides a framework for achieving meaningful, lasting conservation results. The MS Chapter f TNC utilizes the process of CBD in its conservation efforts, including freshwater conservation. Conservation by Design involves four main steps (Figure 1):

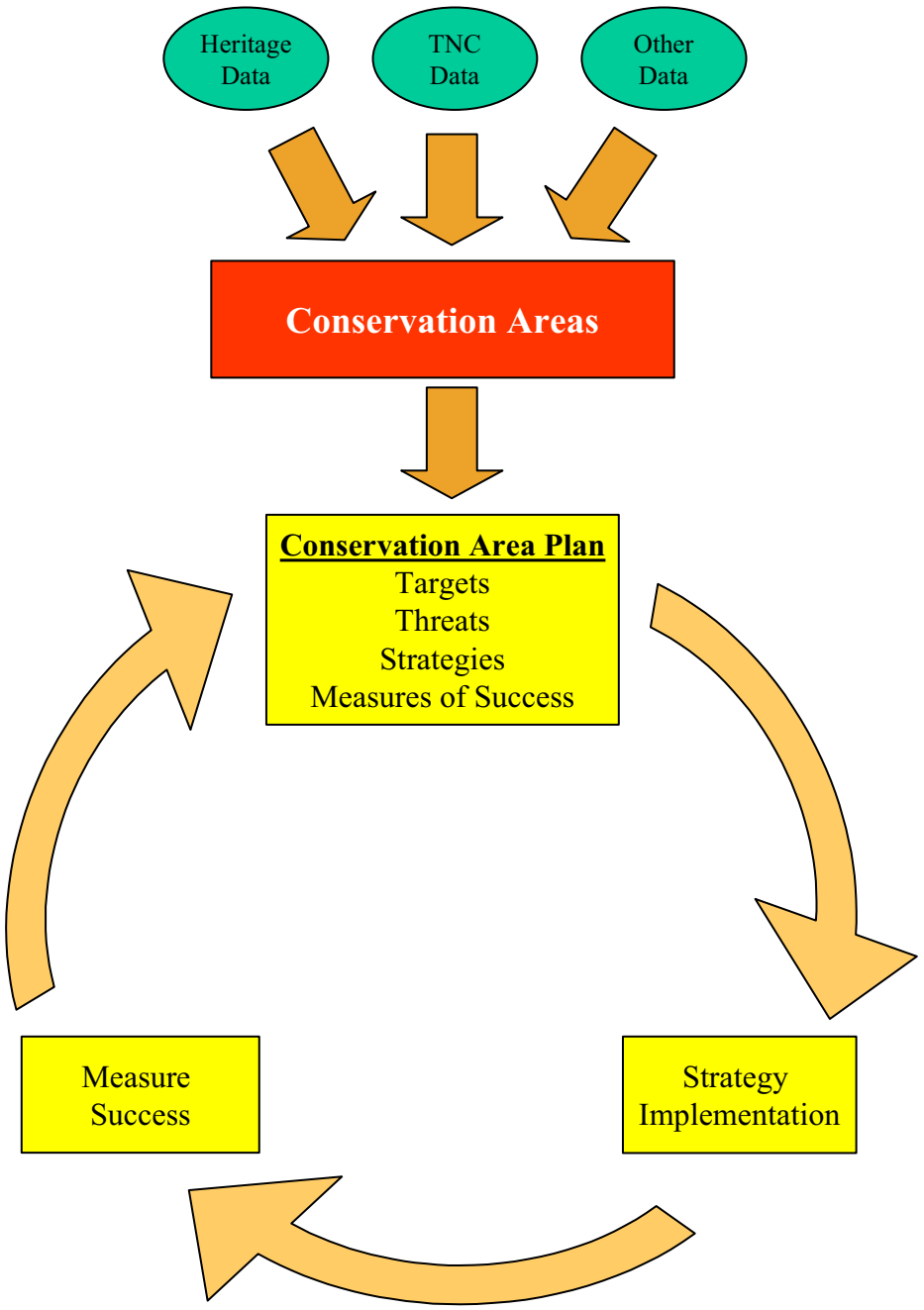

Figure 1. Conservation by Design

- Step 1. Identify and Prioritize Conservation Areas
- Step 2. Develop a Conservation Area Plan for each Conservation Area
- Step 3. Implement the Conservation Area Plan
- Step 4. Perform Measures of Success to evaluate the progress of implementation

Step 1. Identify and Prioritize Conservation Areas

The first step in CBD involves the identification and prioritization of areas of biodiversity significance. Areas of biodiversity significance are those that if protected or restored the mission and conservation goals of TNC will be met. Specifically, these biodiversity significant areas contain rare, endemic or imperiled species, represent a wide range of natural and unique biological communities, and/or are good examples of ecologically significant ecosystems.

The identification process involves gathering data and information, identifying potential conservation target species, communities and systems, assessing the viability of the targets, and developing portfolios of conservation areas using these data. Sources of data and information for identifying portfolio conservation areas include TNC Ecoregional Planning Process, Natural Heritage Programs, TNC's Freshwater Initiative Program, government agencies, remote sensing data warehouses, and regional expert workshops.

The prioritization process involves consideration of several priority factors, scoring these factors for each portfolio area and ranking the areas according to their scores. The factors used to prioritize portfolio areas are:

- Conservation value
- Viability of targets
- Severity and scope of threats
- Feasibility of implementation of strategies

The Mississippi Chapter of TNC has completed the identification of freshwater conservation areas to be included in the MS Chapter's portfolio of all conservation areas, both terrestrial and aquatic (Table 3, Figure 2). In addition, these sites have been prioritized and the highest priority areas for immediate focus are shown in Figure 3. It is important to note that the list of portfolio sites is iterative and new sites may be added, current sites may be dropped and/or the priority of sites may change as new data and information become available.

Step 2. Develop a Conservation Area Plan for each High Priority Conservation Area

Once conservation areas have been identified and prioritized, a plan for how to conserve or protect the highest priority areas is developed. This plan is called a Conservation Area Plan (CAP). The CAP is developed in partnership with other technical experts with knowledge of the conservation area. The utilization of other experts in the development of the CAP is critical to developing a sound and meaningful plan. The first step in developing a CAP for areas of high priority is to gather and compile existing information and data specific to the area. Much of these data will have been gathered during the identification of conservation areas, however, this process will involve a much more comprehensive and detailed data search. Data to be gathered include but are not limited to physical, chemical, biological, remotely sensed, location of point and non-point sources of pollution, land use characteristics, and landowner information.

Table 3. Freshwater Conservation Areas Identified for Mississippi

Conservation Area Name	Conservation Program	Priority
Amite River	Central Mississippi	High
Bayou Pierre	Central Mississippi	High
Rodney Lake	Central Mississippi	High
Strong River	Central Mississippi	High
St. Catherine Creek	Central Mississippi	Medium
Bayou Sara	Central Mississippi	Low
Big Black River	Central Mississippi	Low
Clark Creek	Central Mississippi	Low
Lower Buffalo River	Central Mississippi	Low
Tallahaga/Noxapater Creeks	Central Mississippi	Low
Tangipohoa River	Central Mississippi	Low
Thompson Creek	Central Mississippi	Low
Upper Yockanookany	Central Mississippi	Low
Buttahatchee River	Northeast Mississippi	High
Hatchie River	Northeast Mississippi	High
Luxapalila/Yellow Creeks	Northeast Mississippi	High
Bull Mountain Creek	Northeast Mississippi	Medium
Noxubee River	Northeast Mississippi	Medium
Sucarnoochee River	Northeast Mississippi	Medium
Upper Wolf River	Northeast Mississippi	Medium
East Fork Tombigbee River	Northeast Mississippi	Low
Pickwick Lake	Northeast Mississippi	Low
Bay St. Louis	South Mississippi	High
Lower Pearl River	South Mississippi	High
Pascagoula River	South Mississippi	High
Tchoutacabouffa River	South Mississippi	Medium
Big Sunflower River	Yazoo Basin	High
Lower Yazoo River	Yazoo Basin	High
Indian Bayou	Yazoo Basin	Medium
Chewalla Creek	Yazoo Basin	Low
Hurricane Creek	Yazoo Basin	Low
Jenkin's Lake	Yazoo Basin	Low
Little Tallahatchie River	Yazoo Basin	Low
Otoucalofa Creek	Yazoo Basin	Low
Piney Creek	Yazoo Basin	Low
Puskus Creek	Yazoo Basin	Low
Taylor Creek	Yazoo Basin	Low
Toby Tubby Creek	Yazoo Basin	Low
Upper Yalobusha River/Shutispear	Yazoo Basin	Low

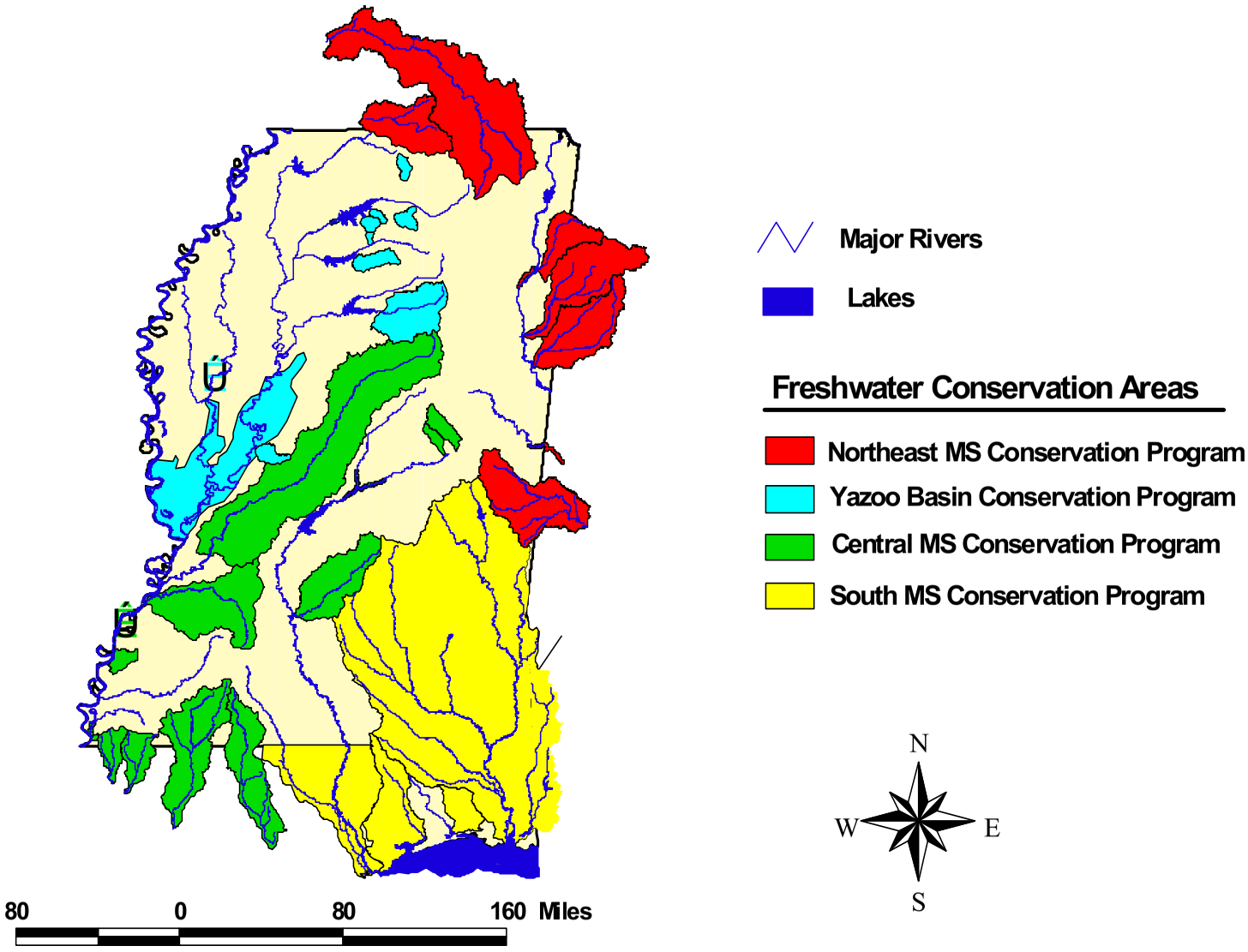

Figure 2. Map of Freshwater Conservation Areas Identified for Mississippi

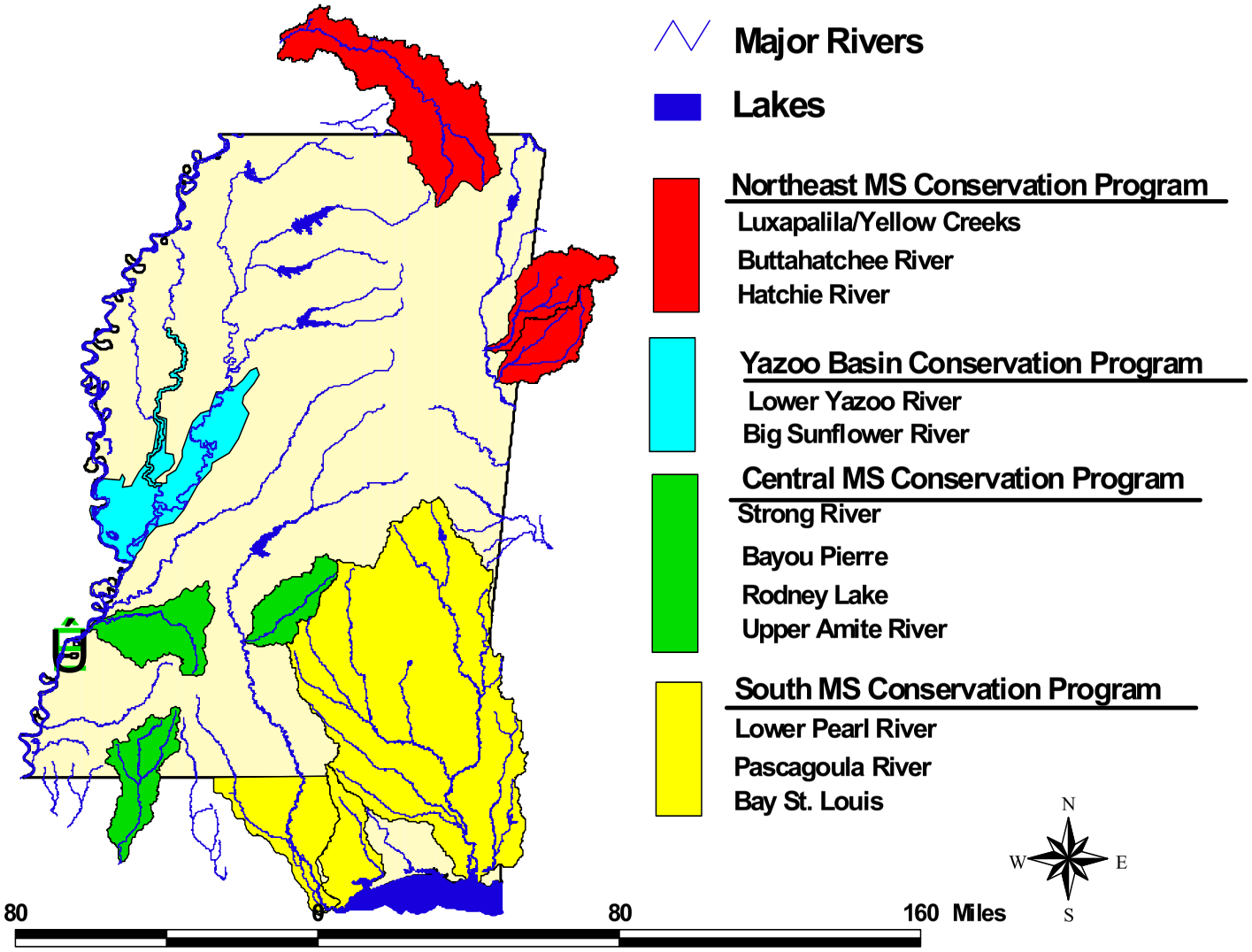

Figure 3. Map of High Priority Freshwater Conservation Areas Identified for Mississippi

The second step in the CAP process is to evaluate the compiled data and information to identify *conservation targets,* and *threats* to those targets, with *threats* being defined as *stresses* and *sources of stress* to the targets. *Conservation targets* include species that are imperiled, endangered or of special concern, biological communities that are groupings of co-occurring significant species, and ecological systems that are assemblages of communities occurring together on the landscape and are linked by common environmental processes, regimes, or gradients. *Stresses* are factors that may potentially degrade or negatively impact the targets within the next ten years. Stresses may be those factors that directly impact the target or those that indirectly impact the target by affecting important ecological processes that influence the target. Examples of stresses include habitat disturbance, sedimentation, reduction of connectivity, organic enrichment and nutrient enrichment. *Sources of stress* are anthropogenic practices that are incompatible and result in the stress to the targets. Sources of stress include active sources as well as historical sources. Examples of sources of stress include: incompatible urban development, incompatible grazing practices, incompatible forestry practices, alteration of channel morphology and/or hydrologic regime, and point source pollution discharges.

The third step in the CAP process is to develop strategies to abate the threats to the conservation targets and to develop measures to evaluate the success of the conservation strategies. Strategies that are identified are also ranked according to their benefits, feasibility and cost of implementation. Following are some examples of strategies that have been used by TNC:

- Land Acquisition
- Conservation Easements
- Develop/Promote Watershed Management Plans
- Provide Land Management Assistance
- Influence Public Policy/Planning
- Establish Water Management Agreements
- Support/Promote Compatible Development
- Support/Promote Sustainable Forestry
- Provide Wetland/Stream Mitigation
- Develop Regional Conservation Alliances
- Support/Promote and Implement Best Management Practices

The fourth step in the CAP process is to identify measures of success. Measuring the success of conservation strategies can be difficult and expensive, and may involve establishing monitoring programs. Ultimate success may take many years; therefore, surrogate measures of intermediate success or milestones are also used. To evaluate the success of conservation strategies, one may measure the condition of the conservation target, the persistence of the threats, or the progress of the strategy. In addition, one may employ the use of surrogate measures of overall ecological integrity of the system of which the target is a part. Following are examples of measures of success that have been used by TNC:

- Target specific measures: population status and trends, species surveys
- Ecological System measures: using Indices of Biological Integrity as indicators of community health, geomorphic status indicators, and habitat quality indicators
- Threat abatement measures: BMPs, miles of riparian buffer, sediment loads

Step 3. Implement the Conservation Area Plan

This is the natural next step upon completion of the CAP. Strategy implementation occurs based on the ranking of strategies, as outlined in the CAP, and available funding and resources. Strategy implementation is enhanced by the use of partnerships with other agencies and groups committed to the same mission and goals. In addition, TNC's experience indicates that long-term ecosystem conservation will succeed only with strong support from the people who live and work in these places. Therefore, TNC strives to build strong community support during the implementation phase of the process.

Step 4. Perform Measures of Success to evaluate the progress of implementation

The Nature Conservancy has defined conservation success as making substantial progress towards the long-term abatement of critical threats and the sustained maintenance or enhancement of biodiversity health at conservation areas. The two core measures of success involve measuring biodiversity health and threat status and abatement. There is often a lag-time between implementation of threat abatement strategies and abatement of the threat, and an even longer lag-time between strategy implementation and showing changes in biodiversity health. Therefore, TNC has developed a set of short-term indicators that reflect our capacity to implement effective strategies and enhance or maintain the conservation targets.

Status of Conservation Efforts at Mississippi's Highest Priority Freshwater Conservation Areas

The MS Chapter of TNC has been actively engaged in conservation efforts in the Pascagoula watershed long before a state chapter even existed. Subsequently, we have been most successful through Conservation by Design in this conservation area. To date we have completed the first iteration of the CAP for the Pascagoula watershed and are actively engaged in strategy implementation. We are also continuing to refine the conservation targets, threats and strategies.

With the recent addition of a Program Director for the Northeast Mississippi Conservation Program, we have initiated freshwater conservation efforts in the Luxapalila and Buttahatchee River conservation areas. For these areas and the other high priority conservation areas, we are in the beginning stages of data and information gathering, CAP development and strategy implementation.

Example of Conservation Efforts in the Pascagoula Watershed

The Pascagoula River is the largest river with an unimpeded main stem channel in the lower 48 states and represents one of the finest natural areas remaining in Mississippi (Figure 4). It contains a long, mostly contiguous block of bottomland hardwood forest and coastal marsh. The Pascagoula River and the Ward Bayou Wildlife Management Areas (over 50,000 acres of conservation land) include about fifty miles of frontage along the Pascagoula River that consists

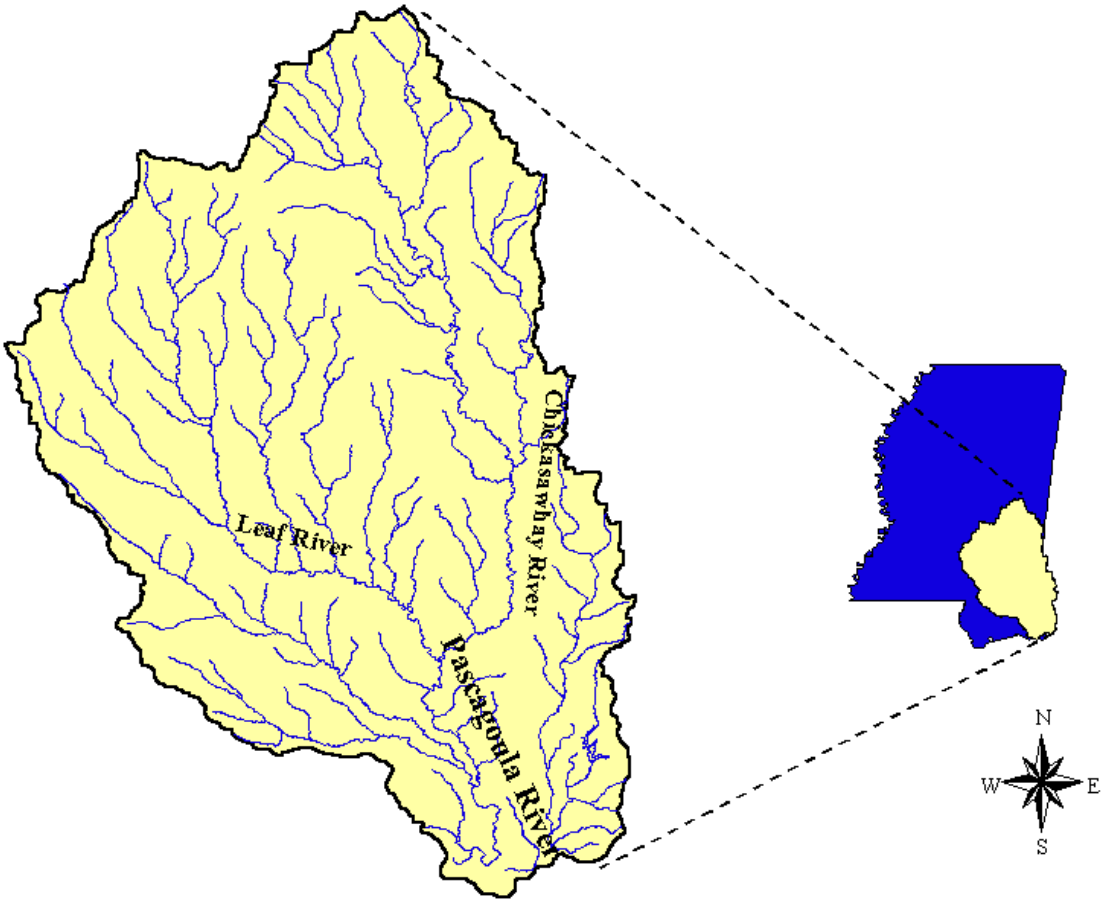

Figure 4. Pascagoula River Watershed

of sandbars, low ridges, high flats, low flats and over fifty oxbow lakes. The Coastal Preserve System includes over 11,000 acres in the Pascagoula and Escatawpa marshes, of which TNC has bought or protected 4,500 acres. The Nature Conservancy has been actively engaged with conservation on the Pascagoula beginning with the original state acquisitions in the early 1970s. In 1999 a 3300-acre preserve at the confluence of the Leaf and Chickasawhay Rivers was purchased and dedicated in honor of Charles Deaton. In 2002, a 1700-acre preserve adjacent to the Deaton preserve was purchased and dedicated in honor of Herman Murrah.

Through the development of the first iteration of a CAP for the Pascagoula River the following conservation targets have been identified:

- Resident Riverine Aquatic Alliance
- Anadromous Fish
- Emergent Marsh Complex
- Seagrass Beds
- Bottomland Hardwood Forest Complex
- Swallow tailed Kite
- Longleaf Sandhill Matrix

While about fifty miles of the river corridor is already protected by the State or by The Nature

Conservancy, several high threats to conservation targets exist and require immediate action. The following threats have been identified for the Pascagoula River during the development of the CAP:

- Sedimentation
- Alteration to Hydrologic Regime
- Land Conversion and Forest Fragmentation
- Point Source Pollution
- Exotic Invasive Species
- Alteration of Fire Regimes

The MS Chapter of TNC has identified and engaged in several strategies to abate critical threats facing the Pascagoula River Watershed. Some of the higher priority strategies include:

- Collaborate with MDEQ's Basin Management Approach
- Establish and Support a Pascagoula River Basin Alliance
- Acquire Lands Along the Pascagoula River and its Major Tributaries
- Form a South MS Prescribed Fire Council
- Further the Scientific Knowledge and Understanding of the Pascagoula Watershed

Water withdrawal projects and proposed reservoirs require The Nature Conservancy to engage with community-based strategies and to acquire hydrologic expertise in order to abate these threats. In addition, there is a need to work with industry, particularly the shipbuilding industry, to diminish toxins in the river. Education and compatible economic development are community-based strategies that can affect best practices by industry.

One issue of important concern, that will require a creative strategy is the increase in the amount of sediment entering streams and rivers in the Pascagoula, as well as the issue of in-stream sedimentation caused by scouring of the bed and bank erosion. The building of roads at an unprecedented rate creates sedimentation concerns as well as interrupting hydrologic flow. Incompatible silviculture practices are also a major source of sedimentation. Gravel mining, sedimentation and alterations to hydrologic regime are major threats to the migration and spawning habits of Gulf Sturgeon, Pearl Darter and Alabama Shad.

By following through with implementation of identified strategies, the MS Chapter of TNC is involved in several projects in the Pascagoula Watershed.

A Coastal Impact Assistance Program (CIAP) funded collaboration between TNC, MDEQ, Jackson County and George County has led to the Upper Pascagoula Connector Project. In addition, the MS Chapter of TNC has initiated a Lower Pascagoula Connector Project. The goal of these projects is to connect the eastern riverfront side of the Upper Pascagoula with the Deaton Preserve, to connect the western side of the Upper Pascagoula protected lands with the Desoto National Forest and to connect the lower portion of the Pascagoula Protected Lands with the Coastal Preserves (Figure 5).

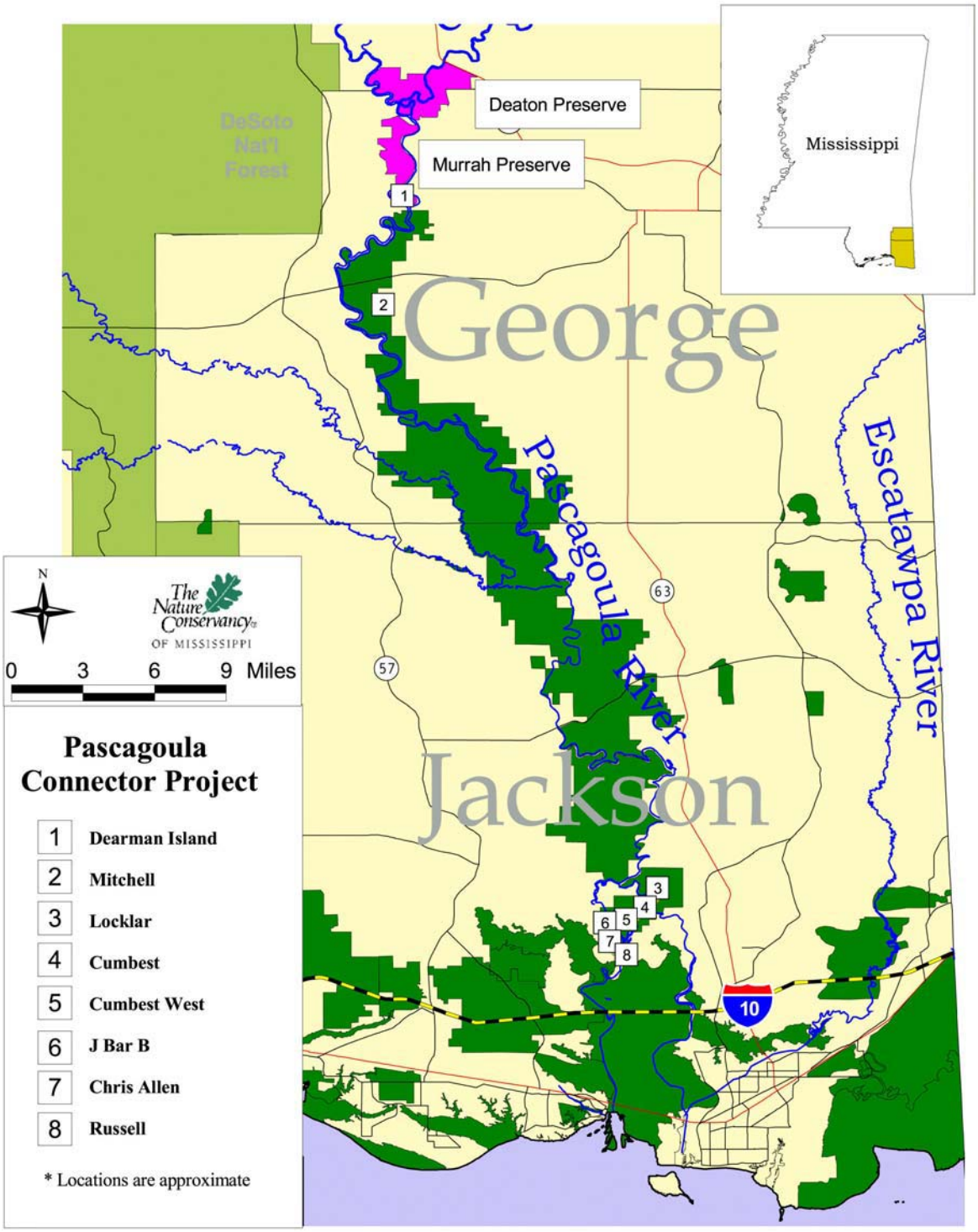

Figure 5. The Upper and Lower Pascagoula Connector Projects

Another CIAP funded collaboration between TNC, MDEQ, Jackson and George Counties, the

Coastal Preserves and Audubon MS has led to the Pascagoula River Ecotourism Study. This study will hopefully provide sound data and information to foster the utilization of ecotourism as a successful strategy that will promote environmental protection and restoration, while at the same time, provide a boost to the economy of the area.

Collaboration between TNC, George County Economic Development Foundation, the Lucedale Garden Club and Audubon MS has led to the holding of an annual Migration Discovery Day in George County, MS. This is another example of where TNC and its partners hope to build positive awareness of the ecological significance of this area by engaging the public in positive interaction with the ecosystem.

A Nature Trail and Observatory are being developed along the Escatawpa River in Jackson County, MS. The nature trail and observatory will be located in the Grand Bay Wildlife Refuge, at the Mississippi Welcome Center on Interstate 10. The objective of this project is to capitalize on the heavy traffic along this major interstate to attract visitors to view the beautiful and pristine ecosystem of this area to hopefully promote awareness of the significance of the Escatawpa River and its surrounding landscape.

Finally, TNC is partnered with the Pat Harrison Waterway District, U.S. Army Corps of Engineers and the U.S. Geological Survey to conduct a geomorphic assessment of the Pascagoula River System. Dr. Joann Mossa, from the Department of Geology at the University of Florida is conducting the study for the purposes of gaining an understanding of the current geomorphic state of the Pascagoula River and to understand the causes and effects of accelerated erosion within the watershed. The results of this study will facilitate a better understanding of the physical and hydrological characteristics of the Pascagoula River so that better and more sound assessments can be made regarding the threats to the system and appropriate strategies can be developed. In addition, these results will provide sound scientific data for decision and policy makers and will hopefully help guide decisions regarding the future uses of the resources and the management of the Pascagoula River Watershed.

Summary

The southeastern United States contains a rich diversity of freshwater species, communities and ecosystems. In particular, Mississippi contains a rich diversity of aquatic plants and animals throughout its many watersheds. Certain incompatible human uses of Mississippi's natural resources pose threats to this natural heritage, resulting in an increasing need for efforts to protect water quality, quantity and biodiversity within the State. Limited resources, however, require these efforts be carefully planned and focused to increase the probability of successful conservation and thus have a positive impact on aquatic natural resources. Through a process called Conservation by Design, freshwater conservation areas of biodiversity significance have been identified and prioritized and the development of plans to conserve and or protect these areas is underway. The next steps for MS TNC will be to implement these conservation plans, measure the success of conservation efforts and continue to revise the conservation plans as data and information become available. Key factors in the success of the conservation of Mississippi’s freshwaters are to engage the community in conservation planning and the implementation of conservation strategies, to educate the citizens and policy makers of the State as to the importance and significance of freshwater biodiversity and

conservation, to form partnerships with private, public and non-profit organizations to complement and enable resources to achieve common objectives, to use scientific data as the foundation of conservation planning and to identify and secure adequate funding for conservation activities.

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