Conserving the

PASCAGOULA RIVERWATERSHED

CONSERVATION ACTION PLAN

November 2005

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

SOUTHEAST AQUATIC RESOURCES PARTNERSHIP
SARP
"Saving Aquatic Resources Proactively"

Acknowledgments

The Nature Conservancy and the Southeast Aquatic Resources Partnership would like to thank numerous partners who contributed their time to the planning exercise centered on the Pascagoula River and Mississippi Sound. The individuals from the following organizations made the products of the workshops much more valuable and enjoyable. Contributing science experts included staff from the Mississippi Museum of Natural Science, Mississippi Department of Wildlife, Fisheries and Parks, U.S. Fish and Wildlife Service, Mississippi Wildlife Federation, University of Southern Mississippi, Mississippi State University, Grand Bay National Estuarine Research Reserve, Gulf Coast Research Lab, Alabama Department of Conservation and Natural Resources, Mississippi Department of Marine Resources, Alabama Marine Resources Division, USEPA Gulf of Mexico Program, National Oceanic and Atmospheric Administration, Audubon, Pat Harrison Waterway District, Mississippi Power Company, and the Mississippi Department of Marine Resources. With these outstanding partners and stakeholders active in the Pascagoula watershed, the river's and estuaries' future is much brighter. TNC staff contributing to this draft report included Becky Stowe, Nicole Vickey, Cynthia Ramseur, Mike Hanley, Steve Haase, Rick Guffey, Matthew Miller, Sally Palmer, Mary Davis and Ryan Smith.

Executive Summary

The Pascagoula River drains approximately 9,600 square miles of Gulf Coastal plain habitat in southeastern Mississippi and southwestern Alabama and is the largest undammed river in the continental United States. The surrounding watershed represents one of the finest natural areas remaining in Mississippi and along the Northern Gulf of Mexico coast and contains a long, mostly contiguous block of bottomland hardwood forest and coastal marsh. The watershed is approximately 72% forested and 21% agricultural with large areas of bottomland forest still in place along the river. The streams of the Pascagoula are appreciated for their pristine qualities and for their contribution to protecting rare and valuable plants and animals from the headwaters to the tidally influenced marsh ecosystem.

The Pascagoula River watershed is home to numerous resident and migratory bird species, including Swallow-tailed Kites and Piping Plovers. Turtle species of interest include the globally imperiled Alabama red-bellied turtle and the Yellow-blotched map turtle. The Pascagoula also provides migration and spawning habitat for several fish species including Gulf Sturgeon, Alabama Shad and Pearl Darter. Long-term protection of these animal and their complex ecological settings requires committed partnerships from various agencies and detailed watershed management plans to assure efforts to protect this watershed are effective.

Conservation planning history

Grassroots momentum for conserving the Pascagoula River began in the 1970s and in 2001, The Nature Conservancy (TNC), Audubon Society, and government agency partners including the Mississippi Departments of Wildlife and Fisheries, Environmental Quality and Marine Resources, and the U.S. Fish and Wildlife Service organized the formation of the Pascagoula River Basin Alliance. The mission of the Alliance is to promote the ecological, economic and cultural health and viability of the Pascagoula, Leaf, Chickasawhay and Escatawpa rivers and their watersheds by fostering research, communication and action. This broad-based coalition serves the watershed through the research, communication and action needed to ensure that the Pascagoula remains one of the nation's best preserved river systems. The Alliance has a 19-member steering committee and coordinator and is the major partnership group committed to conservation activities in the Pascagoula watershed.

The Nature Conservancy (TNC) has conducted conservation planning exercises with its partners in the Pascagoula River Basin Alliance since early 2000. In 2005 as part of the Southeastern Aquatic Resource Partnership (SARP) pilot rivers project, TNC led new workshops to update and refine the Conservation Action Plan to protect and restore the desirable ecological functions of this complex river. Two series of meetings were held, one to address estuarine and costal targets and one to address the freshwater and interior systems. Over 25 partners, stakeholders and organizations participated in these workshops as a team of experts, hereafter ‘experts.’

Conservation targets

The experts chose conservation targets at a coarse enough scale to encompass the diverse communities and nested species of conservation concern. This effort produced a list of four targets for the freshwater systems including: alluvial floodplain forest, diadromous fishes, resident riverine aquatic alliance and mesic longleaf matrix. The estuarine targets included tidal marshes, near-shore submerged aquatic vegetation, and live oyster reefs.

Primary threats

Several of the stresses identified for the freshwater targets include habitat fragmentation and destruction, anthropogenic changes in hydrology, altered sediment regime, and future barriers on the mainstem and tributaries. Estuarine threats were identified as incompatible dredging and trawling, residential and commercial development, urban runoff, and agricultural runoff. Further areas of investigation related to understanding threats to the Pascagoula were identified including the effects of increased turbidity on diadromous fishes, quantifying the natural ranges of variation in the hydrograph and sediment transport of the river, and the effects of invasive species on targeted species and systems.

Conservation objectives and strategies

Preliminary strategies to abate the threats to the freshwater targets include to identify and protect key areas of spawning habitat for several species; to increase the number of good water quality refugia for aquatic fauna during periods of stress; to increase the riparian buffer in the upper watershed; to protect the function of the cypress/ tupelo swamps; to increase enforcement of existing regulations for mining and stormwater control; and to decrease incidental non-game species harvest. Strategies for the estuarine system include increasing the area, quality and protection of marshes, seagrass beds and oyster reefs through education, outreach, and restoration efforts.

Planning and implementation challenges

In late summer 2005 during the development of this conservation plan for the Pascagoula, catastrophic hurricanes Katrina and Rita leveled communities along the Louisiana, Mississippi, and Alabama Gulf Coasts. These events delayed the full completion of the updated Pascagoula plan, and the full extent of the ecological damage caused by these hurricanes was not captured in this phase of the plan. As communities rebuild and partners are able, gaps in the planning effort will need to be filled and will include re-assessments of the biological targets and status of threats to the Pascagoula watershed.

Table of Contents

List of Tables

List of Figures

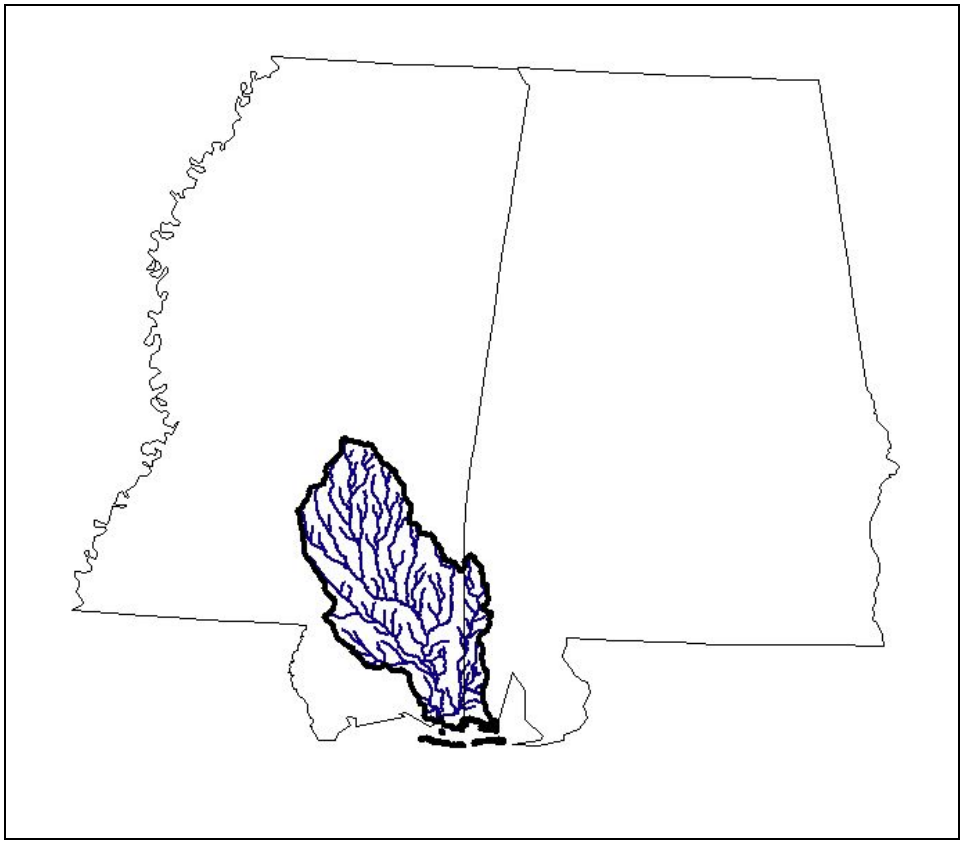

Figure 1. The Pascagoula River Watershed of southern Mississippi and Alabama.

Watershed characteristics

The Pascagoula River watershed drains approximately 9,600 square miles of Gulf Coastal Plain habitat in southeastern Mississippi and southwestern Alabama. The Pascagoula River is formed by the confluence of the Chickasawhay and the Leaf Rivers in Mississippi and is eventually joined by the Escatawpa River from Alabama near the Gulf of Mexico (Figure 1). To the east of this watershed in Alabama is the lower Mobile River and Bay and to the west in Mississippi are several other Gulf drainages including the Jourdan, Wolf, Biloxi and Tchoutacabouffa Rivers. The watershed land cover is approximately 72% forested and 21% agricultural with large areas of bottomland forest in place along the river. Urban land use covers approximately 2% of the entire watershed. The few urban areas are concentrated along the Gulf coast and along the Leaf River with the largest cities as Hattiesburg, Laurel, Meridian, and Pascagoula in Mississippi and western Mobile in Alabama (Figure 2).

The Pascagoula River Basin is heavily forested throughout the entire river basin. The central portion of the basin consists mostly of pine forests with scattered hardwoods. Near the Gulf Coast, drainage areas are low-lying flatlands, forested wetlands, and marshlands. Farther inland, the basin consists primarily of gently rolling hills and broad, flat floodplains. The majority of the streams are clear, deep to moderately deep fast flowing perennial streams. A few streams and tributaries are considered blackwater streams with their natural, tannic acid stained qualities. As the Pascagoula nears the Gulf it takes on brackish water characteristics and has a tidally influenced marsh ecosystem. The coastal plain streams of the Pascagoula watershed are generally well supplied by abundant rainfall and groundwater mostly characterized as a low gradient, clear water system with a few blackwater tributaries. Oxbow lakes are common along bottomlands of the larger, winding streams while a few higher gradient streams in the headwaters have more upland stream characteristics (MDEQ 2001).

Long, free-flowing streams are now a rarity in the continental United States. Having no major obstructions on its mainstem makes the Pascagoula the largest free-flowing river in the lower 48 states. The Pascagoula River and its watershed have extremely rich biological, historical, and aesthetic attributes. As an example of the ecologically richness, the streams and their floodplains and forests serve as habitat nearly 150 fish and over 325 bird species. The diversity of plants and animals is primarily due to the high quality, diverse habitats found throughout this large basin including the coastal marshes and estuaries. The Pascagoula River Basin supplies a large portion of the fresh water entering the Mississippi Sound and estuary. Its waters replenish nutrients and sediments that play a critical role in maintaining the productivity of the coastal waters and protective bays which are important habitats for seagrass, oysters, finfish and shellfish. Because of the abundant wildlife populations, this basin provides great bird watching, hunting and fishing, recreational activities as well as a viable commercial seafood industry along the coast.

Recognizing the ecological and economic benefits of protecting the Pascagoula, over 1,000,000 acres of the watershed are currently protected or have conservation management. Key protected areas include DeSoto National Forest, Bienville National Forest, Nature Conservancy preserves and easements, the Coastal Preserve System managed by the Mississippi Department Marine Resources, seven Wildlife Management Areas managed by the Mississippi Department of Wildlife Fisheries and Parks, the Mississippi Sandhill Crane National Wildlife Refuge managed by the U.S. Fish and Wildlife Service, Grand Bay National Estuarine Research Reserve (NERR), and other State Parks and wilderness areas.

Conservation planning approach

In the Spring and Summer 2005, the Nature Conservancy held several workshops to develop Conservation Action Plans for the Pascagoula to help identify where conservation and restoration work should be focused in this watershed and estuary. Two series of meetings were held, one to address estuarine and coastal targets across the Mississippi Sound, including the Pascagoula and one to address the freshwater and interior systems particular to the Pascagoula. Through these workshops, TNC invited area conservation partners and researchers to help define needed conservation and restoration work in these landscapes, using an internal process known as *Conservation By Design*.

Conservation By Design is the process by which TNC sets its priorities, develops strategies, takes conservation action and figures out how to measure the success of such actions. The goal that drives *Conservation by Design* is the long-term survival of all viable native species and communities. The workshop objectives were as folllows:

- identify "conservation targets" (the species, systems and natural communities that we are concerned with protecting);
- assess the viability of these targets, including the identification of key ecological attributes; and
- identify and rank critical threats to these conservation targets.

As stated in *Conservation by Design*, The Nature Conservancy's conservation goal is "the long term survival of all viable native species and community types" within portfolios of sites by ecoregion. In order to accomplish the ambitious goal of conserving all native biodiversity, the Conservancy has developed many tools for conservation planning at the ecoregional and site-based scale. The Pascagoula drainage is one of the finest natural areas remaining in Mississippi and together with the pristine reaches of the Escatawpa in Alabama makes this area one of the highest conservation concerns for The Nature Conservancy and others. TNC has been working in the basin since its first acquisition there in the early 1970s based on its riverine forests, freshwater resources, rare species and critical ecological linkage to its estuary and the Gulf of Mexico. The rivers, estuary and much of the terrestrial landscape found within the project have been identified as significant sites through the East Gulf Coastal Plain and Northern Gulf of Mexico ecoregional planning process.

To address conservation strategies at the site scale for the Pascagoula River Watershed, the Conservancy's conservation staff in Mississippi, Alabama and the Southeast Region led a series of workshops. The goal of these workshops was to apply The Nature Conservancy's site conservation "5-S Framework" to the Pascagoula River Watershed project area, thereby developing a conservation blueprint for action and a baseline from which to measure its success over time. The 5-S's are defined below:

- **Systems**: the conservation targets occurring at a site, and the natural processes that maintain them, that will be the focus of site-based planning.

- **Stresses**: the types of degradation and impairment afflicting the system(s) at a site.

- **Sources**: the agents generating the stresses.

- **Strategies**: the types of conservation activities deployed to abate sources of stress (threat abatement) and persistent stresses (restoration).

- **Success**: measures of biodiversity health and threat abatement at a site.

Through the guidance of workshops and input from experts and stakeholders, the conservation planning team selected conservation targets (systems), analyzed and ranked stresses and sources of stress for each target, and identified conservation strategies to abate threats. A comprehensive conservation plan and strategy for implementation is being developed and will updated through iterations to focus and direct the TNC-Mississippi and Alabama chapter's conservation efforts for the next 5 to 10 years as well as serve as a useful tool for other agencies and partners to utilized in their management and conservation efforts. This report presents the conservation action plan that resulted from the most recent workshops and meetings.

Over 25 partners, stakeholders and organizations participated in these workshops. Contributing science experts included staff from: Mississippi Museum of Natural Science, Mississippi Department of Wildlife, Fisheries and Parks, U.S. Fish and Wildlife Service, Mississippi Wildlife Federation, University of Southern Mississippi, Mississippi State University, Grand Bay National Estuarine Research Reserve, Gulf Coast Research Lab, Alabama Department of Conservation and Natural Resources, Mississippi Department of Marine Resources, Alabama Marine Resources Division, USEPA Gulf of Mexico Program, National Oceanic and Atmospheric Administration, Audubon, Pat Harrison Waterway District, Mississippi Power Company, Mississippi Department of Marine Resources and the Nature Conservancy. Additional Planning efforts are underway by the Mississippi Department of Environmental Quality (MDEQ) who are developing a watershed management plan to complement their 2001 Pascagoula River Basin Status Report. This plan should be available in 2006 from MDEQ.

Identification of conservation targets and key ecological attributes

During the Conservation Planning process participants selected targets at a coarse enough scale to represent the biodiversity of the Pascagoula, and encompass the diverse communities and numerous species of conservation concern. Brainstorming and discussions consolidated numerous individual species and ecological communities into a manageable number of targets. Groupings within targets were based on common habitat requirements and individual species with specialized or complex life history traits were identified and "nested" in one of the broader conservation targets. This effort produced a list of four targets for the freshwater systems including: alluvial floodplain forest, diadromous fishes, resident riverine aquatic alliance and mesic longleaf matrix. The estuarine targets included tidal marshes, nearshore submerged aquatic vegetation, and live oyster reefs. A list of individual species of conservation need in the Pascagoula watershed of Alabama and/or Mississippi is listed in the Apppendix.

Conservation target descriptions

- Alluvial floodplain forest
  Mixed hardwood forests periodically flooded and utilized by aquatic fauna as well as Swallow-tailed kites and Neo-tropical migratory birds

- Diadromous fishes
  Migratory fishes that utilized both freshwater and marine environments to complete their life cycle, including: Gulf Sturgeon, Alabama shad, Striped Bass, and American eel

- Resident riverine aquatic alliance
  Aquatic community utilizing streams for their entire life cycle including freshwater fishes, mollusks, crayfish, reptiles and amphibians. Figure 2 presents the various freshwater tributaries in the Pascagoula.

- Mesic longleaf matrix
  Terrestrial community situated upland of the floodplain and host to a variety of grassland communities, bogs, pitcher plant flats, evergreen bayheads and utilized by grassland birds, crayfish, gopher tortoise etc.

- Tidal marshes
  Tidally-influenced marshes and the organisms they support, particularly juvenile fish and migratory birds, and reptiles

- Nearshore submerged aquatic vegetation
  Rooted vascular plants and the organisms they support, particularly juvenile fish and waterfowl

- Live Oyster reefs
  Oysters. *Crassostrea virginica* and the suite of shellfish, finfish, invertebrates, that this habitat supports

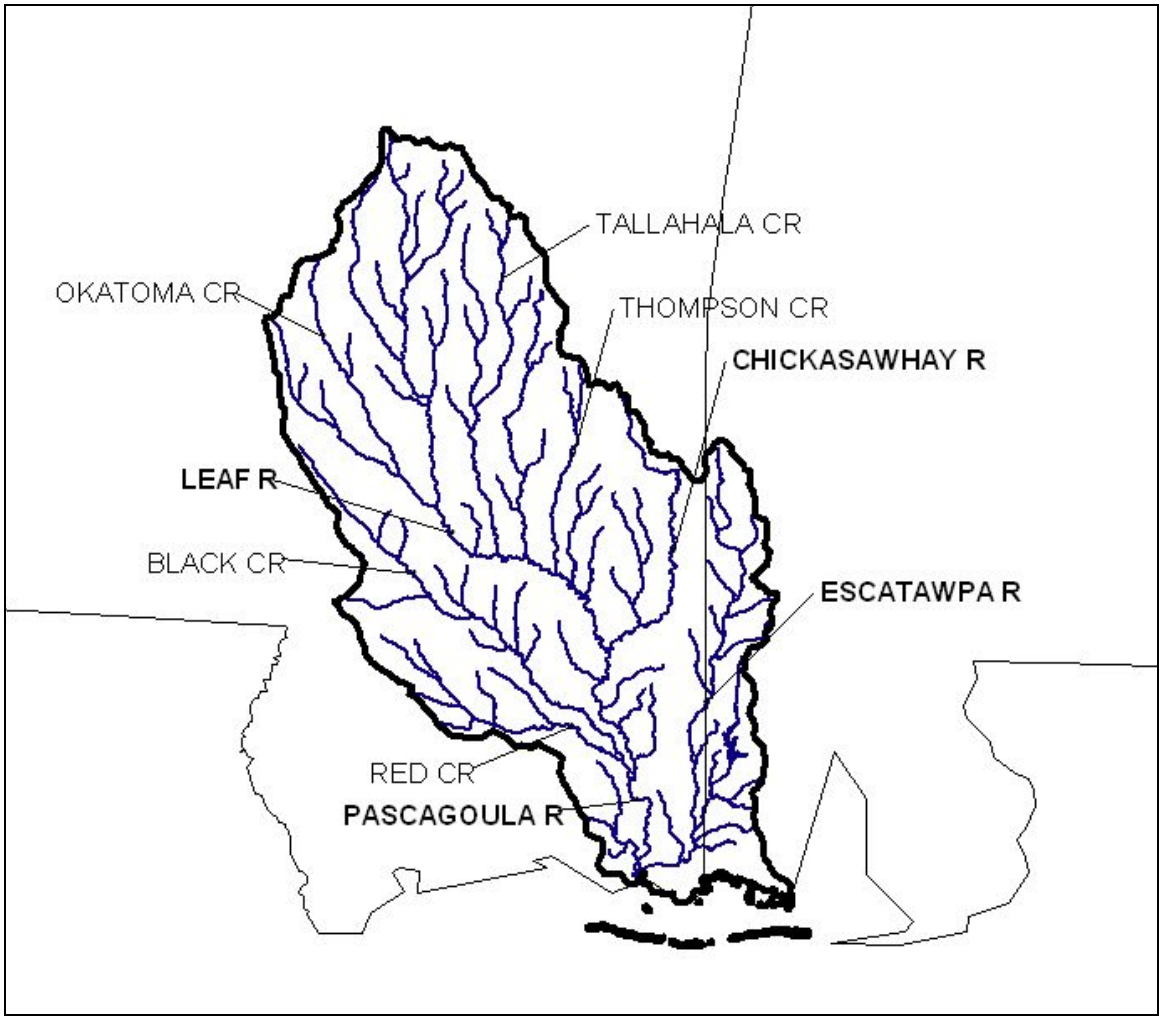

Figure 2. Pascagoula River watershed with major tributaries.

Key ecological attributes of conservation targets

Ecological attributes which were considered key to maintaining the viability and integrity of were developed for the four freshwater-associated targets were identified during the conservation planning meetings and are listed in Tables 1-4 the experts' opinion on a descriptive indicator and current status, if known. The indicator status and ranking should be consider as drafts only that require subsequent review and improvement.

Table 1. Alluvial floodplain forest key ecological attributes.

KEY ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	VERY GOOD	CURRENT STATUS	CURRENT RATING	DESIRED RATIING
Functional Forest	Acreage	<20,000	20,000-100,000	100,000	>100,000	Good	100,000	>100,000
Species Composition	Dominant species	Willow/ cottonwood dominance	Sweet gum/ blackberry dominance	Secondary growth hard mast dominance	Old growth dominance	good	Secondary growth hard mast dominance	Secondary growth hard mast dominance
Growing Season Flooding	Frequency, duration, amplitude	5 years	2-4 years	Every other year	Every year	Very good	Every year	Every year
Stand Structure	Tree size	Even age monoculture	Cut last 30 years	Pre 1960s second growth, few old	Super emergent old/young	good	Pre 1960s secondary growth, few old	Super emergent old/young
Biotic interaction swallow-tailed kites	# breeding age	>150	150-300	300-500	>500	fair	150-300	300-500
Natural creation of oxbows and meanders	Percentage creation	None	10%	15%	Common 20%	Very good	Common 20%	Common 20%
Forested lands instead of urban	Percentage	30%	40%	50%	>60%	good	50%	50%

Table 2. Diadromous fish key ecological attributes.

KEY ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	VERY GOOD	CURRENT STATUS	CURRENT RATING	DESIRED RATING
Connectivity, barriers blocking migration	# on mainstem	1	--	--	0	Very good	0	0
Primary and secondary streams disconnected by empoundments	Percentage of streams	>30%	20-30%	10-20%	<10%	??	??	<10%
Cool water (<25 degrees) refugia	# to support 50 striped bass	<5	5-25	25-100	>100	Poor	<5	>100??
Reproductive success	#young of year Alabama Shad	0	0-10	10-20	>20	Poor	??	>20
Flow with high coefficient variation	# of days with this flow	--	--	--	--	??	??	??

Table 3. Resident riverine aquatic alliance key ecological attributes.

KEY ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	VERY GOOD	CURRENT STATUS	CURRENT RATING	DESIRED RATING
Habitat quality	% undisturbed channel evolution	<50%	50-75%	75-90%	>90%	Good	75-90%	>90%
Watershed meeting WQ standards	% of watershed meeting standards	<25%	--	--	>90%	Good	--	>90%
Reproductive success yellow-blotched map turtle	# of age classes	1	2	3	4	Good	3	4
Reproductive success native mussel species	# of age classes	1	2-3	3-5	>5	Very good	>5	>5

Table 4. Mesic longleaf matrix key ecological attributes.

KEY ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	VERY GOOD	CURRENT STATUS	CURRENT RATING	DESIRED RATING
Hydrology	% Vertical sheetflow	0-50%	50-75%	75-100%	100%	unknown	unknown	100%
Fire frequency	Years between fires	>10	5-10	3-5	2-3	unknown	unknown	2-3 years
Growing season fires	% of fires during growing season	0-25%	25-50%	50-75%	75-100%	unknown	unknown	75-100%
RCW recovery plan	Acreage included	0-200K	200-400K	400-500K	>500K	unknown	unknown	>500K
Species composition	# native herbacious (psm)	<10	10-30	30-40	40-50	unknown	unknown	40-50
Open Structure	%canopy closure	>70%	50-70%	30-50%	0-30%	unknown	unknown	0-30%

Threats were identified by experts at the meetings for each of the freshwater and estuarine targets. Key threats that were identified as affecting more than one target or those with the potential to destroy or eliminate a given target are summarized below. Figure 3 illustrates the major urban areas within the Pascagoula River watershed.

Freshwater

- Anthropogenic changes in hydrology
- Altered sediment regime – increased sedimentation
- Physical barriers on mainstem and tributaries
- Channel incision/alteration
- Loss of floodplain function
- Habitat fragmentation/destruction/alteration

Estuarine

- Incompatible dredging and trawling
- Residential and commercial development
- Urban runoff
- Agricultural runoff

For each of the four freshwater-related targets, threats were identified and then subjectively ranked based on their severity (slightly impaired, moderately degrade, seriously degrade, or destroy) and the scope at which the given stress acts on the target (very localized, localized, widespread, or very widespread). Experts provided the lists of key sources of stress. Tables 5-8 summarize the information for these four targets.

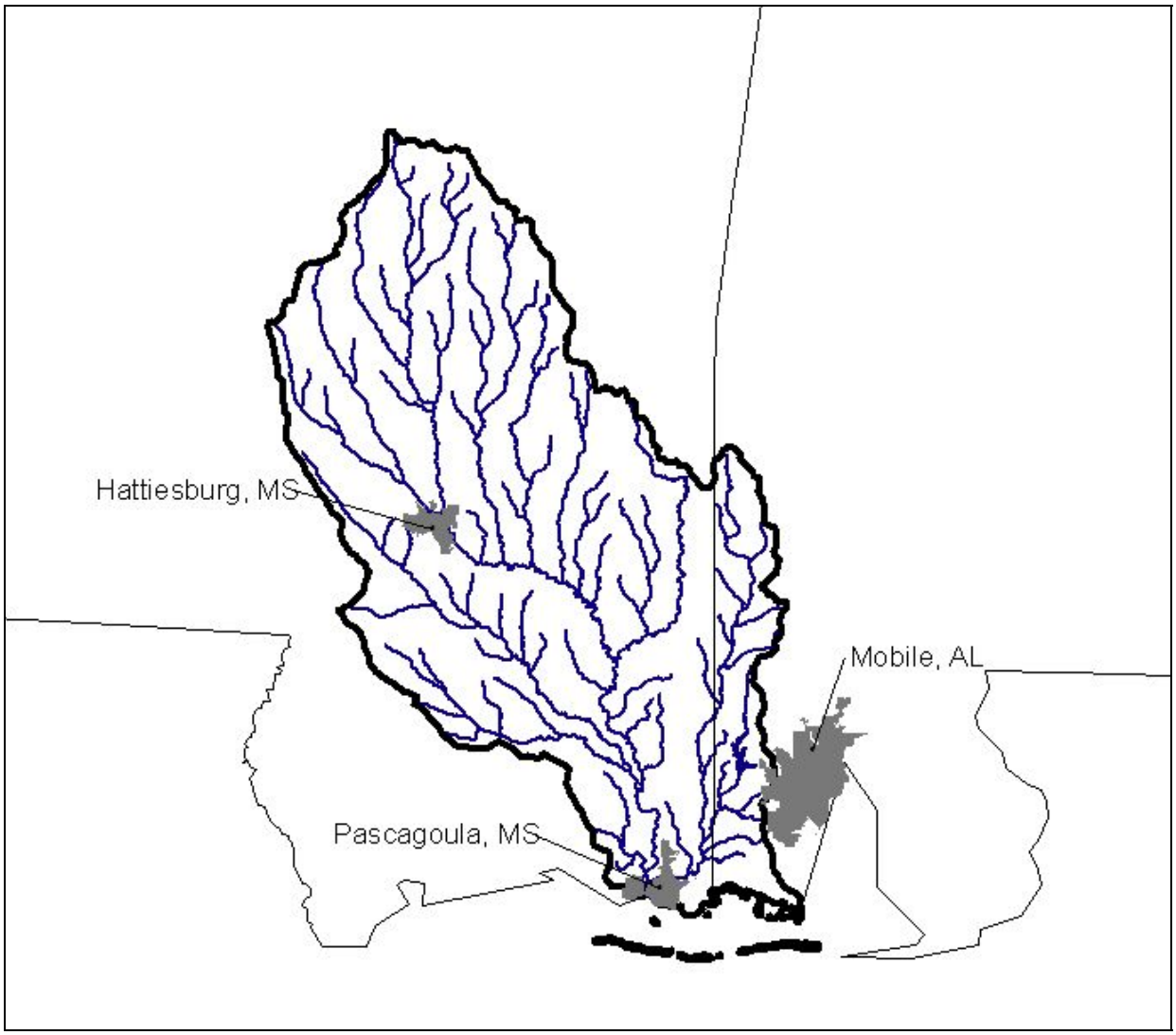

Figure 3. Pascagoula River watershed with major urban areas.

Table 5. Threats to alluvial floodplain forests.

STRESS	SEVERITY	SCOPE	SOURCES
Habitat Fragmentation	Seriously degrade	Very widespread	incompatible, unsustainable forestry urbanization Agriculture, utilities/highway ROWs, sand and gravel mining, oil and gas industry
Altered hydrograph	Destroy	Very widespread	change in land cover, urban development – new homes, channel incision, water withdrawal during low water period, routine dredging, climate change
Altered species composition	Seriously degrade	Very widespread	forestry roads – mortality, other disturbances, incompatible silviculture - bedding
Even-aged management	Seriously degrade	Very widespread	silviculture
Channel incision	Seriously degrade	Very widespread	--

Table 6. Threats to diadromous fishes.

DIADROMOUS FISHES TARGET THREATS			
STRESS	**SEVERITY**	**SCOPE**	**SOURCES**
Poaching/By-catch	Slightly impaired	Very widespread	recreational, dredging, commercial fishing
Warm summer temperature	Destroy	widespread	change in land cover , forestry (shorter rotations/ bmps), agriculture urban development, gravel mining
Altered Hydrograph	Seriously degrade	Very widespread	change in land cover, urban development (new homes), channel incision, water withdrawals during low water period, climate change, routine dredging, bank armament
Extant Physical Barrier	Slightly impaired	localized	farm ponds, NRCS flood control, road bed deposit -
Altered sediment regime – increased sedimentation	Destroy	Very widespread	construction runoff (new roads, etc.), entrenching/head cuts, forestry (bmps/short rotations), agriculture (cattle), sand and gravel mines, recreational (atvs, horses), bank armament

Future physical barrier on mainstem	Destroy	Very widespread	recreational lakes, economic lakes, reservoir water supply
Future physical barrier on tributaries	Destroy	Very localized	recreational lakes, economic lakes, reservoir water supply
Water toxicity (dioxin, organics, pesticides, pharmaceuticals)	Moderately degrade	Very widespread	golf courses, parking lots, septic, wastewater – municipal, pharmaceuticals, oil & gas fields and storage, industrial point sources, paper mills

Table 7. Threats to resident riverine aquatic species.

RESIDENT RIVERINE AQUATIC TARGET THREATS			
STRESSES	**SEVERITY**	**SCOPE**	**SOURCES**
Altered hydrograph	Seriously degrade	Very widespread	change in land cover, urban development (new homes), channel incision, water withdrawals during low water period, climate change, routine dredging, bank armament
Loss of floodplain function	Destroy	Widespread	
Exotics/invasive species	Seriously degrade	Widespread	
Altered sediment regime	Destroy	Very widespread	construction runoff (new roads, etc.), entrenching/head cuts, forestry (bmps/short rotations), agriculture (cattle), sand and gravel mines, recreational (atvs, horses), bank armament
Loss of off-channel aquatic habitat	Destroy	Widespread	Excessive sedimentation from agriculture, urbanization and forestry
Water toxicity	Moderately degrade	Very widespread	golf courses, parking lots, septic, wastewater – municipal, pharmaceuticals, oil & gas fields and storage, industrial point sources, paper mills
Physical barrier on Mainstem	Destroy	Very widespread	recreational lakes, economic lakes, reservoir water supply
Physical barrier on tributaries	Destroy	Very localized	recreational lakes, economic lakes, reservoir water supply
Channel incision/alteration	Destroy	Very widespread	

Bycatch/poaching	Moderately degrade	Very localized	recreational, dredging, commercial fishing
Recreation and sandbars incompatibility (yellow-blotched map turtle)	Seriously degrade	Very localized	

Table 8. Threats to the mesic longleaf pine matrix.

MESIC LONGLEAF MATRIX			
STRESSES	**SEVERITY**	**SCOPE**	**SOURCES**
Altered fire regime	Destroy	Very widespread	Liability, lack of resources (funding & personnel), public education , fire suppression, regulations – smoke, air quality, lack of planning
Habitat fragmentation/destruction/alteration	Destroy	Very widespread	incompatible, unsustainable forestry, urbanization, agriculture, utilities/highway ROWs, sand and gravel mining, oil and gas industry
Exotics/invasives	Seriously degrade	Very widespread	
Altered species composition	Moderately degrade/seriously degrade	Very widespread	forestry roads – mortality, other disturbances, incompatible sivilculture - bedding
Channel incision	Moderately degrade/seriously degrade	Very widespread	
Altered hydrology	Moderately degrade/seriously degrade	Very widespread	

A considerable amount of research is needed further the identification and monitor indicators related to key ecological attributes. Some of the research needs identified by experts included are as follows:

- What is the cause of loss of springs in the river system?
- How does turbidity affect life history needs of diadromous fishes?
- What is natural range of variability in the river system (hydrograph, organic load, sediment load)?
- What is the effect of low head dams on gravel transport?
- How do invasive species affect diadromous fishes and other targets?
- What are effects of bulkheading on targets?
- What is the importance of "off channel' environments?
- Need to gather and analyze bycatch/poaching/incidentals take and harvest data.
- Do human disturbances such as dumps stress alluvial floodplain forests?
- What are consequences of channel maintenance/dredging on targets?

Several research areas regarding the characterization of threats to the Pascagoula River were also identified and are listed below:

- Effect of increased turbidity on diadromous fishes
- Quantifying the natural ranges of variation in the hydrograph
- Quantifying the natural ranges of sediment transport
- Invasive species effects on target species and systems

Draft strategies and objectives to abate the threats to the conservation targets were discussed by experts and were summarized into freshwater and estuarine categories. Table 9 summarizes the draft strategies identified for the 4 freshwater-related targets. Table 10 summarizes specific objectives and strategies for estuarine and near-shore targets.

Freshwater

- Identifying and protecting key areas of spawning habitat for target fish species including the restoration of altered or degraded habitat
- Increase the number of good water quality refugia areas during periods of stress including improving and restoring hydrologic and geomorphic integrity,
- Increase the riparian buffer in the upper watershed by improving land use practices adjacent to streams and wetland habitat, or acquisition or expansion of preserves or conservation managed lands
- Protecting the function of the cypress/ tupelo swamps through sustainable harvest management or preservation.
- Increase enforcement of existing regulations for mining, stormwater, and nongame species harvest

Estuarine

- Increase the area, quality and protection of estuarine marshes through education, outreach, restoration, and enforcement of existing best management practices and regulations.
- Increase the area, quality and protection of sea grass beds through education, compatible recreational activities, protection of water quality and restoration.
- Increase the area, quality and protection of oyster reef, through the protection of water quality, restoration, and encouragement of sustainable harvest guidelines.

Table 9. Draft strategies for reducing threats to freshwater-related targets.

ALLUVIAL FLOODPLAIN FOREST • Protect cypress/tupelo swamps • Connect management areas to national forest • Increase stand diversity
DIADROMOUS FISHES • Protect Cedar Creek Refuge – regulations on fishing, restore deep, cool pools, increase the number of refugia • Map areas of appropriate substrate for spawning • Increase recruitment by 10% • Implement current bmps
RESIDENT RIVERINE AQUATIC ALLIANCE • increase riparian buffer width in upper basin • revise criteria for gravel mine sites • enforce existing mining regulations • enforce non-game regulations • education about non-game harvest • limit/prevent new impoundments • develop bmps • enforce stormwater regulations
MESIC LONGLEAF MATRIX • address institutional impediments to fire – warm season • develop cost-share and resource program for fire • expand fire co-op • education about invasive management • encourage funding for cost-share invasive management • support Longleaf Alliance • encourage fire ant suppression

Table 10. Draft objectives and strategies for reducing threats to estuarine and near-shore targets.

	Objectives and Strategic Actions
Objective	**By 2015 increase seagrass coverage to 10% over existing coverage within potential habitat in the Mississippi Sound**
Strategic action	Create a demarcation/delineation of passages to minimize prop-scarring
Strategic action	Identify stakeholders and develop approaches to dredging and dredging disposal that are compatible with conservation targets of the Mississippi Sound
Strategic action	Develop study to determine the critical times of seagrass growth in the Mississippi sound where excess sediment may cause negative impact
Strategic action	Develop outreach program that provides information to Gulf Island recreational users where seagrasses are located and where they can have access in the area
Strategic action	Develop education and outreach program that addresses the nutrient issue for septic systems, landscape businesses, golf clubs and general public (lawns) in the Mississippi sound
Strategic action	Prior to undertaking outreach campaigns assess the relative contribution of different sources of nutrients into Mississippi Sound
Objective	**By 2015 oyster reef areas in the Mississippi Sound are restored to 5% of historic coverage (1900).**
Strategic action	Engage the ACOE in developing at least one 206 or 1135 project to restore oyster reefs.
Strategic action	Engage the Dauphin Island Parkway project with the Mississippi-Alabama Sea Grant Consortium and Mobile Bay National Estuary Program.
Strategic action	Encourage the ACOE and State partners to develop a master plan of Oyster reef restoration for the Mississippi Sound, including restoration for both commercial and ecological benefits.
Strategic action	Identify stakeholders and develop approaches to dredging and dredging disposal that are compatible with conservation targets of the Mississippi Sound
Strategic action	Complete and evaluate existing oyster reef restoration projects
Strategic action	Develop an education and outreach program to educate the public on the ecological benefits of oyster reefs in Mississippi Sound
Objective	**By 2015 the area of tidal marshes in the Mississippi Sound is stabilized using restoration and conservation actions.**
Strategic action	Identify and map the area of Tidal Marsh that was the coverage in 1990.
Strategic action	Identify ACOE1135 or 206 projects that entail restoring tidal marsh using shoreline stabilization technology that uses live barriers (oysters)
Strategic action	Promote alternative bulkheading approaches that are more compatible with marshes and other conservation targets, in partnership with the Institute for Compatible Development-Scruggs and NERR Coastal Training program in Alabama.
Strategic action	Secure conservation ownership and management of large tracts of tidal marsh in the Mississippi Sound.

Conclusions

The workshops conducted as part of the Southeast Aquatic Resource Partnership's Pilot River Project were successful in providing a draft analysis of the conservation needs of the Pascagoula Watershed and Mississippi Sound estuary. Utilizing this pilot planning exercise to better coordinate efforts will allow the partners to maximize our capacity for tackling joint conservation priorities in the future. The hurricane events of late summer 2005 which devasted the Louisiana, Mississippi, and Alabama Gulf Coast region interfered with a more thorough planning process. As this region recovers from the devastation, this pilot plan may be revisited and expanded upon in order to advance collaborative work aimed at restoring and protecting the Pascagoula River.

Literature cited

Alabama Department of Conservation and Natural Resources. 2005. Alabama Comprehensive Wildlife Conservation Strategy, Division of Wildlife and Freshwater Fisheries., Montgomery, Alabama.

Mississippi Department of Environmental Quality. 2001. Pascagoula River Basin Status Report, Jackson, Mississippi.

Mississippi Museum of Natural Science. 2005. Mississippi's Comprehensive Wildlife Conservation Strategy. Mississippi Department of Wildlife, Fisheries and Parks, Mississippi Museum of Natural Science, Jackson, Mississippi.

Species of conservation concern in the Pascagoula River watershed

Species were selected based on their presence in the Pascagoula watershed and the State or Global Heritage rank in Alabama or Mississippi.

SCIENTIFIC NAME	COMMON NAME	Global Rank
Amphibians		
Plethodon ainsworthi	Baysprings Salamander	GH
Pseudotriton montanus	Mud Salamander	G5
Pseudotriton rubber	Red Salamander	G5
Rana heckscheri	River Frog	G5
Birds		
Elanoides forficatus	Swallow-Tailed Kite	G5
Haliaeetus leucocephalus	Bald Eagle	G4
Crayfish		
Cambarellus diminutus	Least Crayfish	G3
Cambarellus lesliei	A Crayfish	G3
Fallicambarus danielae	Speckled burrowing crayfish	G2
Fallicambarus oryktes	A Crayfish	G4
Fish		
Acipenser oxyrinchus desotoi	Gulf Sturgeon	G3
Alosa alabamae	Alabama Shad	G3
Anguiila rostrata	American Eel	G4
Atractosteus spatula	Alligator Gar	G3
Cycleptus meridionalis	Southeastern Blue Sucker	G3
Enneacanthus gloriosus	Bluespotted Sunfish	G5
Etheostoma lynceum	Brighteye darter	G5
Ichthyomyzon castaneus	Chestnut Lamprey	G5
Leptolucania ommata	Pygmy Killfish	G5
Morone saxatilis	Striped Bass	G5
Moxostoma carinatum	River Redhorse	G5
Notropis chalybaeus	Ironcolor Shiner	G4
Notropis melanostomus	Blackmouth Shiner	G2
Percina aurora	Pearl Darter	G1
Percina lenticula	Freckled Darter	G2
Polyodon spathula	Paddlefish	G4
Pteronotropis welaka	Bluenose Shiner	G3

SCIENTIFIC NAME	COMMON NAME	Global Rank
Mussels		
Anodontoides radiatus	Rayed Creekshell	G3
Elliptio arca	Alabama Spike	G3
Elliptio arctata	Delicate Spike	G4
Lasmigona complanata complanata	White Heelsplitter	G5
Obovaria jacksoniana	Southern Hickorynut	G1
Obovaria unicolor	Alabama Hickorynut	G3
Pleurobema beadleianum	Mississippi Pigtoe	G3
Uniomerus declivis	Tapered Pondhorn	G5
Reptiles		
Farancia erytrogramma	Rainbow Snake	G5
Graptemys flavimaculata	Yellow-Blotched Map Turtle	G2
Graptemys gibbonsi	Pascagoula Map Turtle	G3
Macrochelys temminckii	Alligator Snapping Turtle	G3
Pseudemys alabamensis	Alabama Redbelly Turtle	G1
Regina septemvittata	Queen Snake	G5
Sternotherus carinatus	Razor-backed musk turtle	G5