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Overview and Summary of Recommendations

On November 14-15, 2007, a Biological Review was conducted at Banks Lake National Wildlife Refuge (NWR) by a team of managers, biologists, foresters and other resource professionals representing state, federal, private, and academic interests. The overall purpose of the Biological Review was to examine the appropriate roles the refuge should play regarding wildlife and ecosystem conservation and management as viewed from local, community, system, and other spatial scales. Based on this examination, a series of recommendations were then made with the intent of articulating management and conservation actions that refuge staff should consider undertaking in order to fulfill the refuge's conservation roles.

The Biological Review proper involved on-site visits to view and discuss relevant conservation and management issues on Banks Lake NWR, examination and discussion of material prepared by refuge staff as part of a Biological Review handbook, and numerous presentations and discussions involving key resource professionals representing entities with expertise and vested interest in Banks Lake NWR. In general, discussions and resulting recommendations were to consider the ecological roles of the refuge under ideal circumstances, but participants recognized the need to temper discussions through a realistic consideration of obvious management, staffing, and funding constraints. Still, some recommendations are more “within reach” than others, and so the recommendations herein are not meant to be prescriptive or otherwise binding. They are merely presented with the hope of aiding future management as resources become available that assist Banks Lake NWR in fulfilling the full extent of its conservation roles in the landscape. Further background regarding the purpose and approach of the Biological Review can be found in the main body of this report.

Critical Needs & Recommendations

Critical Needs are identified as those that were felt to be most immediate to the fulfillment of basic roles of the refuge, and that by addressing, may allow the fulfillment of many other needs and recommendations over time. See the body of the report for the justification and rationale supporting these needs, as well as strategies for meeting them.

1. Staffing and Budget – Lack of staff and an operating budget for Banks Lake NWR severely impedes the ability of the refuge to contribute to the mission of the NWRS and fulfill its potential ecological role on the landscape. As a satellite refuge under Okefenokee NWR, the capacity for any proactive conservation at Banks Lake NWR is largely dictated by staff, budgets, and workloads at Okefenokee. In addition to administrative demands and general management needs of Banks Lake NWR, there are a host of hydrologic and fisheries issues that need specific technical attention.
Banks Lake NWR needs one dedicated staff position at minimum for the long term. This position could be an Asst. Refuge Manager (GS0485-9/11) stationed at Okefenokee NWR with responsibilities for Banks Lake NWR, or a Refuge Operations Specialist (GS0485-7/9/11) similarly dedicated to Banks Lake NWR. To address the hydrologic and fisheries needs, a cost-effective solution would be to develop and fill a shared position with responsibilities for refuge needs across north Florida, Georgia and the Carolinas:

Asst. Refuge Mgr./Refuge Operations Specialist (GS 0485 9/11)
Fisheries Biologist (GS 0482 9/11)
OR Biological Science Technician (Fisheries) (GS-0404 05/07/09)

2. Boundary Delineation – Lack of accurate boundary delineation of Banks Lake NWR is problematic for a variety of legal, administrative, and management related reasons. Based on county landowner records, past court decisions and recent title searches, the boundary of the refuge follows the 1925 high watermark in many areas. Management on the refuge will focus on the lands and waters where Service is confident that we have jurisdiction. Additional title work, a complete survey of the boundary, and possibly additional litigation, will be required to settle this issued. This project is estimated to cost around $50,000-250,000.

3. Modeling/Predicting Hydrology and Water Levels – Biologists do not accurately understand hydrologic dynamics at Banks Lake NWR and cannot accurately relate gauge readings to lake water levels, extent of inundation, etc. The basin and catchment of Banks Lake also is not well delineated. Any future management and conservation actions on the refuge will hinge upon the collection and development of data, models (e.g., Digital Elevation Models) or other tools that enable management objectives to explicitly consider water levels, areal extent of inundation, and other hydrologic factors influencing Banks Lake and vicinity. Development of these models and tools will require specific hydrologic data and/or surveying that will take time and resources to collect, assess or conduct. Contractual services or temporary or term employment represent viable and affordable options for accomplishing this work. Resources made available to Okefenokee or Banks Lake NWR for this specific purpose will fulfill a fundamental need that influences all aspects of the refuge’s operations.
High Priority Needs & Recommendations

Next to the Critical Needs and Recommendations listed above, many other recommendations are made in this report. Those deemed to have the most significance or highest relative priority in relation to helping the refuge fulfill its roles are listed here. See the body of the report for the justification and rationale supporting these needs, as well as strategies for meeting them.

1. Water Quality Monitoring – There is a history of water quality issues and concerns at Banks Lake associated with nutrient inflows, raw sewage discharge, and organochlorine runoff. It is difficult for the refuge to actively address these concerns without adequate water quality monitoring. Basic monitoring would involve regular grab samples. More involved scenarios would involve establishing automated stations at strategic points. Costs of analyzing samples for various nutrients, contaminants, etc would have to factor into whatever sampling scheme is put into place, but the fact remains that even basic water quality information is unavailable for the refuge.

2. Mitigating Bird-Aircraft Strike Hazards – Banks Lake NWR adjoins Moody Air Force Base, which is an active training base for air force operations. There is a critical need to understand the daily and seasonal movements of bird species using the refuge that pose the greatest strike hazards. This knowledge would serve as the basis for mitigating potential strike risk. Of particular interest are resident Sandhill Cranes which occur in the area and are also a species of management interest for the refuge. Knowledge of resident crane feeding habits and movements can help the refuge continue to support conservation of cranes in the context of aviation safety. An informal monitoring or observation scheme would likely suffice in providing information on crane habitats and use patterns, as well as numbers in the area. This data would also be helpful as a basis for any future management efforts targeting cranes. Currently the refuge has no staff to conduct such surveys. Moody Air Force Base might be willing to help support costs associated with monitoring.

3. Smoke Management – Fire is an important management tool in the coastal plain, even at Banks Lake NWR, where it can play a role in managing aquatic vegetation and shrubs during lake drawdowns, or restoring upland pine habitats. Managing smoke is a critical concern with Moody Air Force Base as a neighbor. All refuge management activities requiring use of prescribed fire need cooperation and buy-in from Moody officials, and will often require coordination of Air Force activities. This represents an additional complexity in attempting to properly manage habitats at Banks Lake NWR. A recommendation was made for cyclic lake drawdowns every 5-7 years, with a 2-3 month burn window in late fall/early winter. With this infrequent fire return interval, it is anticipated that smoke management issues will not be a regular concern. Still, burn cycles should be planned as far in advance as possible, with adequate room for alteration if necessary. Burning on upland habitats may need to occur more frequently, and be more complex in terms of carrying out the prescription. Burning in upland habitats will require additional discussion and coordination with Moody officials to gain acceptance and support.
4. Improve Public Use Opportunities in a Compatible Manner – Through increased public use can come increased public awareness and support regarding the need for additional resources to properly and fully administrate conservation and management programs on Banks Lake NWR. Opportunities to increase fishing, canoeing, wildlife observation, and conservation education should be explored, and efforts to improve refuge access (e.g. canoe trails, etc) should continue to be pursued. Such improvements need to be approached from the standpoint of compatibility with the refuge's wildlife conservation mission, but there appear to be several means of expanding public use in such a manner. Recreational fishing opportunities represent the single greatest opportunity to educate the public about conservation and management issues associated with Banks Lake and the GBBL system. The upcoming Comprehensive Conservation Planning process for Banks Lake NWR may provide the proper forum for addressing compatibility, environmental compliance, and other matters relevant to expanding public use.

5. Basic Inventories for Plant and Animal Occurrence – Little is known about the occurrence, distribution or relative abundance of a number of potentially occurring rare, threatened, or endangered plants on Banks Lake NWR proper. A more thorough general inventory of fish, herpetiles, and mammals is needed also. Most information available is for the general locality of the GBBL complex or vicinity, and/or is based on fairly limited sampling over a few-day window. Determining species' presence will help ensure that their needs are fully considered in the development of any refuge habitat management plans and activities, or otherwise identify and justify the need for specific management attention. Refuge staff should continue to work cooperatively with the state Natural Heritage program, The Nature Conservancy, and local colleges and universities to compile existing presence and distribution data and to design appropriate inventories.
Potential Contributions to National, Regional & Ecosystem Goals

Principal management considerations and potential roles of Banks Lake NWR in support of various planning initiatives follow. Many of these require active and effective coordination with Georgia Department of Natural Resources, Georgia Department of Transportation, Department of Defense, Atlantic Coast Joint Venture, and other partners.

North American Waterfowl Management Plan

- Promote breeding and brood rearing habitat for wood ducks.
- Provide spatial/temporal sanctuary to wintering waterfowl.

Partners in Flight

- Provide, manage, and restore where possible forested wetland and pine-hardwood upland habitats in support of priority breeding and wintering landbirds identified by Partners In Flight.

North American Waterbird Conservation Plan

- Protect and enhance habitat availability for migratory and resident Sandhill Cranes.
- Identify and manage problems with contaminants or nutrient runoff so to protect water quality
- Promote appropriate foraging habitats and minimize disturbance to foraging waterbirds.

Threatened, Endangered and Listed Species Conservation

- Ensure observance of appropriate disturbance buffers (e.g., Bald Eagle Management Guidelines) around bald eagle nests that may occur on the refuge.
- Participate in annual Bald Eagle monitoring.
- Minimize disturbance around areas frequented by post-breeding Wood Storks.
- Conduct inventories for rare plants and animals and promote protection, management and restoration of habitats that support them.

Conservation of Ecosystems and Special Habitats

- Contribute to region-wide goals for longleaf pine community restoration through consideration and implementation of activities for improving/restoring pine and pine-hardwood uplands.
- Develop fire management plan for improving upland habitat and restoring to more representative conditions.
- Actively participate in watershed management issues that establish appropriate hydrologic regimes, and water quality to ensure the integrity of wetland communities.
- Participate in off-refuge activities that protect and benefit the watershed – thru Grand Bay/Banks Lake partnership, cooperating with local municipalities, etc.
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I. Introduction

On November 14-15, 2007, a refuge Biological Review was conducted at Banks Lake National Wildlife Refuge (NWR) by a team of managers, biologists, foresters and other resource professionals representing State, Federal, private, and academic interests. The overall purpose of the Biological Review was to examine the appropriate roles the refuge should play regarding wildlife and ecosystem conservation and management as viewed from local, community, system, and other spatial scales. Based on this examination, a series of recommendations were then made with the intent of articulating fairly specific management and conservation actions that refuge staff should consider undertaking in order to fulfill the refuge's conservation roles.

Biological Reviews are being conducted for all southeastern refuges, largely as a response to the National Wildlife Refuge System (NWRS) Improvement Act of 1997 that requires each refuge to prepare a Comprehensive Conservation Plan (CCP). Development of CCPs is to be guided by attention to several key considerations: original purpose(s) of each refuge, mission of the NWRS as a whole, maintenance of biological integrity and ecosystem health, management and conservation of wildlife, and promoting compatible public use.

Biological Reviews are planned and conducted in time to inform the development of the CCP for a given refuge. The resulting recommendations from the Biological Review are meant to help shape the CCP by providing the biological and ecological basis for the refuge's conservation roles at a variety of local and landscape scales. Just as refuge Public Use Reviews help outline aspects of the CCP that must have a basis in appropriate and compatible public use, Biological Reviews help outline aspects of the CCP that must have a basis in biological integrity and wildlife conservation. Thus, while Biological Reviews represent a time for interesting discussion and consideration of a refuge's conservation roles in the context of its enabling legislation and the mission of the NWRS, they are only as useful as the extent to which key recommendations and needs are either integrated into the final CCP or independently utilized by refuge staff as a foundation for future management decisions.

The Biological Review on Banks Lake NWR involved on-site visits to view and discuss relevant conservation and management issues on refuge lands, examination and discussion of material prepared by refuge staff as part of a Biological Review handbook, and numerous presentations and discussions involving key resource professionals representing entities with expertise and vested interest in Banks Lake NWR. Participants were asked to assist in the preparation of written material and recommendations that would aid in identifying:

- An overall vision of the desired ecological role(s) of Banks Lake NWR
- The most appropriate contributions that Banks Lake NWR can make to the needs of wildlife at various spatial scales
- Population and/or habitat goals and objectives that will be a basis for future management decisions
• Strategies or field level actions that will articulate how Banks Lake NWR would meet stated population or habitat objectives

• Inventory, monitoring, evaluation and research/adaptive management considerations

• Personnel and equipment needs that must be met in order to accomplish priority recommendations

In general, discussions and resulting recommendations were to consider the ecological roles of the refuge under ideal circumstances, but participants recognized the need to temper discussions through a realistic consideration of obvious management, staffing, and funding constraints. Still, discussions proceeded under the premise that the current constraints would be addressed over time, and that the ecologically appropriate roles of the refuge should be considered first, then reconciled if necessary against any obvious limitations in meeting them. The resulting recommendations are just that, and are not meant to be prescriptive or otherwise binding. It is hoped that this report will provide a useful biological basis for development of the Banks Lake CCP, and ultimately help in shaping future management effort such that Banks Lake NWR can fulfill the full extent of its conservation roles on the landscape.
II. Overview of Banks Lake NWR

The Biological Review handbook prepared by refuge staff contains additional, more detailed treatment regarding general conditions, habitats, wildlife, etc., on Banks Lake NWR. A copy of the review handbook will be maintained at Okefenokee NWR headquarters.

A. Refuge Establishment & General Description

Banks Lake NWR is located in Lanier and Lowndes Counties near the city of Lakeland, Georgia. Banks Lake proper is a natural Carolina bay of ancient geologic origin, and is part of an approximately 100,000 acre blackwater wetland and upland system referred to as the Grand Bay/Banks Lake (GBBL) wetlands complex. The GBBL complex comprises the second largest freshwater wetland system in Georgia, a substantial portion of which is publicly owned and managed or otherwise retained in a largely undeveloped condition. Grand Bay Wildlife Management Area, Moody Air Force Base, and The Nature Conservancy represent three "public" land managers in the region that work collaboratively with the US Fish and Wildlife Service to promote conservation and ecological integrity within the GBBL complex. Habitats and vegetative communities of the GBBL complex include forested wetlands, mixed hardwood-pine ridges and uplands, cypress-tupelo swamps, emergent and submergent freshwater wetlands, and shallow open water areas. Hardwood conversion, cypress stumping, wetland drainage, urbanization and second home development, homeowner encroachment, and a suite of associated water quality and hydrologic issues all constitute ongoing threats to Banks Lake NWR and the GBBL complex as a whole.

Banks Lake NWR was established in 1985 under the authority of the Fish and Wildlife Act of 1956 (16 USC §742 f), as amended. This act establishes the overarching purpose for Banks Lake NWR by providing for the acquisition of land by the U.S Fish and Wildlife Service for the development, advancement, management, conservation, and protection of fish and wildlife resources; the conservation of wetlands to maintain public benefits; and the conservation of wetlands to help fulfill international obligations of various migratory bird treaties and conventions.

Within this context, the following general "strawman" objectives were proposed for Banks Lake NWR in 2004 by refuge staff:

a) provide optimum habitat for a wide diversity of native flora and fauna;

b) provide optimum habitat and protection for endangered and threatened species;

c) provide opportunities for fish- and wildlife-oriented recreation, interpretation, and environmental education;

d) provide a showcase outdoor recreational opportunity for the physically challenged; and

e) provide quality (trophy) fishing opportunities through a naturally sustaining sport fishery.
These general objectives reflect the overall mission of the US Fish and Wildlife Service to conserve, protect, and enhance fish and wildlife and their habitats, as well as the specific mission of the National Wildlife Refuge System (NWRS) to administer a national network of lands and waters for the conservation, management, and restoration of fish, wildlife, and plant resources and their habitats (NWRS Administration Act, 16 USC § 668 dd and amendments). The NWRS Administration Act, and the amending NWRS Improvement Act of 1997 together establish that wildlife conservation is the first and foremost component of the mission of the NWRS. Further, they establish the following goals for the NWRS, which provide a broader context for the conservation role of Banks Lake NWR:

a) fulfill statutory duty to achieve refuge purpose(s) and further the NWRS mission;
b) conserve, restore, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered;
c) perpetuate migratory bird, inter-jurisdictional fish, and marine mammal populations;
d) conserve the diversity of fish, wildlife, and plants;
e) conserve and restore representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems; and
f) foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing safe, high-quality, and compatible wildlife-dependent public use.

Banks Lake NWR protects and conserves the ecological integrity of approximately 3500 acres of the GBBL system. The refuge comprises Banks Lake proper and the adjoining uplands and wetlands, and consists of approximately 1500 acres of cypress swamp, 1200 acres of emergent and submergent freshwater marsh, and 1000 acres of shallow open water. Lands that established the refuge were sold to the US Fish and Wildlife Service by The Nature Conservancy, who originally purchased the area without a property line survey. This created ambiguity as to the actual boundary delineation for the refuge. In 2000, a court ruling established the refuge boundary at an historic mean water line that is several feet below present-day mean high water lines. This has created problems with respect to managing Banks Lake at full pool because of encroachment by adjacent homeowners on the north shore of the lake. Ambiguity in boundary delineation also complicates attempts to enforce or otherwise address encroachment, incompatible land use, sewage discharge, and other activities occurring adjacent to (or on?) refuge lands. Finally, explicit boundary delineation is essential for addressing a variety of other legal, policy, public use, and ecological concerns.

The hydrology of the Banks Lake area has been significantly altered. In the 1800s, Banks Lake was created through damming of the natural outlet of the ancient Carolina bay. Wetland drainage was a common practice in the region, even up to the present, with the interest of "improving" the land for agricultural uses, gaining access for logging and silviculture, or otherwise facilitating human settlement. In addition to above ground
hydologic alterations, subsurface water flows and water availability through the surficial aquifer are decreasing due to heightened demand for agricultural and public water uses. This problem is only exacerbated through loss and conversion of native vegetation in the area which have led to a reduced capacity of wetland systems to naturally conserve and recharge water supplies.

Water quality of the Banks Lake catchment is also a concern. Adjacent landowners have been documented discharging septic waste into the lake and adjacent wetlands, which represents human health concerns as well as concerns for water quality and wildlife. Nutrient influxes have also been documented, presumably as a result of non-point runoff from adjacent agricultural and residential applications of fertilizers and other organic material, as well as point source septic discharges. Runoff containing pesticides, herbicides and other environmental contaminants is also a concern, particularly as residential and suburban areas encroach on the GBBL landscape. Still, water quality monitoring remains opportunistic at best, and expanded monitoring capacity is warranted given the ecological significance of the GBBL wetland system, previously documented water quality concerns, and the need for baseline water quality data as a foundation for guiding future management.

Despite damming, Banks Lake remains a relatively shallow water body (mean = 5ft). Recreational fishing (largely "panfish") is vibrant on Banks Lake, with an average of over 20,000 recreational fishing visits per year. In addition, Banks Lake NWR grants requests for numerous fishing tournaments each year. The shallow lake environment supports presumably abundant populations of many popular game fish, including Bluegill (Lepomis macrochirus), Largemouth bass (Micropterus salmoides), Black Crappie (Pomoxis nigromaculatus), and Chain Pickerel (Esox niger). However, this same lake environment promotes rapid growth of both native and non-native (e.g. Water Hyacinth, Eichhornia crassipes) submergent and emergent aquatic vegetation, requiring periodic management (e.g., drawdowns, burning, spraying) to control and maintain vegetation at acceptable levels (i.e. < 40% surface coverage). Nutrient inflows (e.g., nitrogen fertilizers) from the adjoining watershed hasten the re-establishment of undesirably dense concentrations of aquatic vegetation.

In 1998, Banks Lake NWR became an official partner in the GBBL Ecosystem Site Conservation Plan whereby the US Fish and Wildlife Service (represented by Okefenokee NWR staff and staff from the Division of Ecological Services) would participate in the development and implementation of a cooperative stewardship plan for the GBBL wetland complex. In demonstration of its commitment to this process, Banks Lake/Okefenokee NWR entered into a Cooperative Stewardship Agreement with other private and public partners, including the Georgia Department of Natural Resources, Moody Air Force Base, and The Nature Conservancy. Banks Lake/Okefenokee NWR staff work collaboratively with these and other organizations on a variety of projects that promote conservation and ecological integrity within the GBBL complex. In addition, the US Fish and Wildlife Service entered into a cooperative agreement with the Bass Anglers Sportsman Society to promote water quality, fisheries management, and recreational fishing opportunities at Banks Lake.
Figure 1. Map of Banks Lake NWR.
B. Administration

As originally intended, Banks Lake NWR was to be staffed and operated as an independent refuge. However, since its inception, lack of an operational budget led to its being administered under Okefenokee NWR, with offices located approximately 75 miles to the east in Folkston, Georgia. The distance from Okefenokee headquarters and facilities makes on-site work logistically more difficult and time consuming. The refuge has no full-time dedicated staff and no annual budget. All activities, including law enforcement, are conducted opportunistically by Okefenokee NWR staff as workloads and priorities permit.

Facilities at Banks Lake NWR include a concession operation with restrooms, canoe and kayak rentals, boat ramp, short walking trail, boardwalk and platform, and a fishing dock.

In FY07, basic refuge funding for Okefenokee NWR was $1,424,800. This does not include the fire program ($885,300) or deferred maintenance projects. Salary and benefits accounted for $1,170,299 of the base budget in FY07, leaving approximately 17.8% of the base funding for operations at both Okefenokee and Banks Lake NWRs.

Without an independent budget, the ability to conduct work at Banks Lake NWR hinges on sufficient staffing at Okefenokee NWR. As of January 2008, Okefenokee NWR staff comprised the following:

- Refuge Manager GS-0485-14
- Deputy Refuge Manager GS-0485-13
- Supervisory Refuge Ranger GS-0025-12
- Refuge Ranger GS-0025-11 (Workforce Planning)
- Refuge Ranger GS-0025-07
- Refuge Ranger GS-0025-07 (Workforce Planning)
- Refuge Ranger GS-0025-09
- Maintenance Worker WG-2805-08
- Tractor Operator WG-5705-06
- Wildlife Biologist GS-0486-12
- Wildlife Biologist GS-0486-11
- Biological Science Technician GS-0404-4
- Administrative Officer GS-0341-09
- Office Assistant GS-0303-05 (Workforce Planning)
- Office Assistant GS-03003-06
- Refuge Ranger (LE) GS-0025-09
- Forester (FMO) GS-0460-12
- Assistant FMO GS-0460-11
- Fire Program Assistant GS-0303-05
- Forestry Tech GS-0462-08
- Forestry Tech GS-0462-07
- Lead Forestry Tech GS-0462-06
- Forestry Tech GS-0462-05
- Forestry Tech GS-0462-05
- Forestry Tech GS-0462-05
- Forestry Tech GS-0462-05
- Forestry Tech GS-0462-05
- Forestry Tech GS-0462-05
- Supervisory Eng. Equipment Operator WG-5716-10
- Eng. Equipment Operator WG-5713-08
Four of these positions have been identified in the Southeast Region Refuge Work Force Plan to be abolished on or before September 2009. No new positions are expected in the next 5 years and additional cuts may occur.

Staff at Okefenokee NWR will be increasingly stretched to provide effective administrative, management, monitoring, law enforcement, and public use oversight for both refuges. This will be particularly true during years when wildfires place additional constraints on available resources. Though Okefenokee NWR staff have concern for the proper administration and management of the unique natural resources at Banks Lake NWR, fiscal and public accountability require that staff time and budget resources be directed first to priorities on Okefenokee NWR. Accomplishing any conservation oriented work at Banks Lake NWR is also hindered by absence of a basic habitat management plan, though a fire management plan does exist. These and other needs are clear manifestations of the need for permanent funding and full-time staff dedicated to advancing appropriate stewardship at Banks Lake NWR. In the interim, resource conservation and public use efforts will remain possible on Banks Lake on only a limited and opportunistic basis.
C. Habitats & Management

The heart of the refuge is Banks Lake proper. Collectively, open water and marshy habitats associated with the lake total approximately 2000 acres. Banks Lake is part of a "basin" that drains to the Alapaha River to the northeast, while adjoining portions of the wetland complex (e.g., Grand Bay Wildlife Management Area, Moody Air Force Base) drain to Grand Bay Creek to the southeast. A natural low sill running through Banks Lake complicates attempts to evenly manipulate water levels throughout the lake basin.

Much of the former natural "bay" that comprises Banks Lake was logged, most recently in the early 1900s. Stands of bald cypress (Taxodium distichum) still occur within the lake basin, though it is all "second growth" and largely mid-successional in stature. Logging occurred during low water periods, or was facilitated by drawing lake levels down or draining adjacent areas. At the lake fringes, cypress stands give way to hardwood forested wetlands and shrubby areas, eventually transitioning into pine-hardwood flatwoods and uplands. Longleaf pine flatwoods were once extensive in the region, but are now significantly reduced or only occur in a "degraded" condition (e.g., fire suppressed, encroaching hardwoods).

Fire is considered to be a natural component in the ecology and maintenance of Carolina bay systems. It is unknown what the natural fire frequency was likely to have been at Banks Lake, but it was undoubtedly variable, as was fire intensity. Low-intensity fires were obviously more frequent, perhaps occurring an average of every 25-40 years in the bay interior, and every 7-20 years in the adjoining savannas. Peat fires are the most intense and require a specific set of circumstances (very low lake levels, very low moisture levels) that likely only occurred perhaps every 100 years.

The bottom line is that fire served a very important role in setting back vegetative succession within the lake basin, controlling hardwoods in the adjoining uplands, and promoting open water areas that could be colonized by submergent or emergent aquatic vegetation. Fires were likely more typical in growing season given the presumed reliance on lightning ignition, and the necessity for drier fuels and ambient conditions to carry fires into the basins. Any attempts to manage or restore portions of Banks Lake and the GBBL system need to consider the role of fire ... frequency, intensity, seasonality, desired effects, etc. Members of the GBBL Ecosystem Stewardship Partnership have elaborated on the need and role of fire in the GBBL landscape and have attempted to articulate this in terms of desired future ecological conditions. This discussion, including objectives, needs, and constraints relative to the use of prescribed fire in managing the GBBL complex, is included in the Biological Review Handbook (Habits tab).

The ability to precisely manipulate water levels of Banks Lake is an essential capacity in the management of the refuge. More importantly, in order to achieve desired management objectives, managers need to be able to relate water levels (whether manipulated or not) to the extent and depth of flooding across the lake basin. Presently, only a fairly cursory understanding exists with regard to how lake levels (e.g., as measured by gauge readings at the dam) relate to inundation and depth of inundation across the refuge. This understanding could be improved though the development of digital elevation models. Development of these models would require gauge readings and water measurements taken throughout the refuge and related to topographic or survey information. Alternatively, aerial photography could be used to relate extent and location of water to...
various gauge readings. Longer term, installation of gauges and water level recorders would permit improved real time tracking of water levels and inundation.

Periodic drawdowns of the lake are a desirable management tool for the purposes of controlling aquatic vegetation and shrub succession, and re-invigorating the fishery. Presently, these drawdowns occur roughly once every 10 years, but this frequency is not deemed to be sufficient. Nutrient loading and the favorable natural conditions of Banks Lake lead to rapid establishment of dense beds of aquatic vegetation, including native species (e.g., Coontail, *Cabomba* spp.) and introduced exotics (e.g., Water Hyacinth). More frequent drawdowns, accompanied by controlled burns and/or mechanical/chemical treatment are necessary to keep aquatic vegetation and open water in appropriate proportions.

Drawdowns expose a fairly deep peat layer (perhaps 5 feet in some areas). It is not generally desirable for fires to burn into this layer too deeply because of prolonged smoldering and associated smoke problems for Moody Air Force Base. Patchy burns into the peat layer do help maintain a greater extent of open water and can retard re-establishment of dense aquatic vegetation. Over time, the increasing difficulty in managing water levels and introducing fire during drawdown periods is beginning to lead the dominance of shrub-stature communities within parts of the lake basin. These habitats are unique and potentially important for wildlife (e.g., possible roosting areas or wading bird rookeries), but also reduce the area of accessible open water (e.g. for recreational fishing) and open aquatic vegetative communities.

As mentioned, water quality throughout the refuge is a concern primarily due to three inputs: septic waste, nutrient enrichment (nitrates and fertilizers), and organochlorines. Refuge staff have worked closely with Georgia Department of Natural Resources in attempting to document/monitor water quality in the GBBL system, but this has primarily focused on mercury contamination. It is suspected that organochlorine residue from pesticides and herbicides could be a problem, however testing for presence and persistence of these chemicals has been cost prohibitive. The main concern with organochlorine contamination are effects on fish and other aquatic animals. Raw sewage has been discharged directly into the lake from residences that fringe the shoreline. This can cause nutrient enrichment and the possibility for such serious health concerns as fecal coliform bacteria. These residences are not linked to city sewage, and there is a growing need to rally the local community to recognize the concerns here and generate the political and financial support necessary to properly address residential sewage issues. There is also some concern about petroleum contamination in the lake from outboard motors used by recreational fisherman. Given the potential seriousness of water quality issues in and adjacent to Banks Lake NWR, the potential for accumulation in the lake catchment, and the dominance of typically sensitive aquatic communities on the refuge, a critical need exists to develop baseline hydrologic and water quality studies as a basis for future management decisions.

General habitats of the refuge include:

- Open Water
- Floating/Emergent and Submerged Aquatic Vegetation
- Scrub Wetland
- Hardwood and Cypress Swamps
- Pine Flatwoods and associated Pine-Hardwood "Uplands"
A few vegetation inventories or surveys of Banks Lake NWR and vicinity have been conducted (see Biological Review Handbook, Habitats tab), but these were neither systematic nor comprehensive. Still, this information along with general observations allows the dominant habitat composition to be described.

In hardwood swamps, principle overstory species on the refuge include water tupelo (*Nyssa aquatica*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), elm (*Ulmus spp.*), ash (*Fraxinus spp.*), hickory (*Carya spp.*), and water and willow oaks (*Quercus nigra* and *Q. phellos*). As hardwood forests grade into "swamps", tree species diversity decreases and forests tend towards dominance by water tupelo and bald cypress.

Forested wetland habitats are not extensive at Banks Lake NWR, and primarily fringe the lake boundary before transitioning into either remnant pine flatwoods or pine-hardwood uplands. Where they do occur, they can be characterized as mostly closed canopied and relatively mature (though not characteristic of "old growth"). As is true throughout southeastern forests, mature bald cypress is undoubtedly less common on the refuge today due to persistent harvest pressure over the years. Certainly, past practices of removing the most valuable mature timber have affected (i.e. reduced) average age and stature of forested wetland and cypress stands on Banks Lake NWR, and have shifted overstory composition to some degree.

Common mid- and understory species in hardwood swamps on Banks Lake NWR include poison ivy (*Toxicodendron radicans*), titi (*Cyrilla recemiflora*), lyonia (*Lyonia spp*), flowering dogwood (*Cornus florida*), privet (*Ligustrum spp.*), and others. Giant cane (*Arundinaria gigantea*) is present sporadically in very small patches.

Flatwood and upland systems at Banks Lake NWR can broadly be classified as oak-hickory-pine. Chief overstory species include hickories, sweetgum, white oak (*Q. alba*), persimmon (*Diospyros virginiana*), tulip poplar (*Liriodendron tulipifera*), and loblolly, slash, and longleaf pines (*Pinus taeda*, *P. elliottii*, and *P. palustris*). Mixed forest types on the refuge are typically hardwood dominated. The fire tolerant/dependent pines now comprise only a minor component of upland stands, presumably due to the exclusion and suppression of fire, and resultant hardwood encroachment. Hardwoods can shade and suppress existing pine trees, and preclude the establishment of future pine cohorts through shading and competition for space and nutrients.

The ecological potential for coastal plain flatwood and upland sites such as those on Banks Lake NWR and vicinity is likely to favor development of pine-dominated systems. Thus, more open stands of mixed pine-hardwood or pine dominated stands could be promoted through reintroduction of prescribed fire, or mechanical means where fire is problematic. A limiting factor here is of course the need to manage prescribed fire in the context of military readiness activities at Moody Air Force Base. Use of prescribed fire to promote more open, pine dominated stands at the refuge would require the surmounting of logistical and resource constraints that are not insignificant. Smoke management is a primary concern, with local communities and private landowners, not just Moody Air Force Base. In addition, accumulation of natural fuels presents inherent risk, and requires special attention to minimize this risk and return fire safely to the landscape. Coordination with Moody Air Force Base, as well as adjacent landowners and communities is essential if fire is going to be reintroduced as a regular occurring feature in the flatwood and upland systems of Banks Lake and the GBBL complex.
Other habitats on the refuge include scrub wetlands, and floating/emergent aquatic communities and associated "open" water (often with submerged aquatic vegetation). Scrub wetlands are beginning to encroach into areas of Banks Lake that were formerly kept more open thru more regular drawdowns, fires, etc. These communities provide a natural transition between more open aquatic habitats and adjacent forested fringes of the lake, but are beginning to extend ever further into the lake basin. Shrub communities are a desirable habitat feature, and should not be viewed as problematic in that sense. However, increasing succession of areas of the lake into shrubbier conditions means a loss of perhaps a more natural balance between these habitats and floating/emergent aquatic habitats and open water. Shrub communities should be maintained, but not to the extent they begin to dominate or otherwise continue to encroach further into areas of the lake that were formerly more open. Appropriate use of prescribed fire during drawdowns can help retard shrub succession.

D. Wildlife and Fisheries Resources

The various habitats on Banks Lake NWR sustain a diversity of fish and wildlife. Wood storks (*Mycteria americana*), migrant and resident sandhill cranes (*Grus canadensis*), and other water and marshbirds forage regularly throughout the shallowly flooded aquatic and grassy habitats. Wood storks are federally classified as endangered in Georgia, Florida and the Carolinas, though it is increasingly recognized that widespread post-breeding dispersal confounds the origins of storks occurring in late summer as far east as Georgia. A resident population of Florida sandhill cranes (*G. c. pratensis*) was introduced into the GBBL area by Georgia Department of Natural Resources.

Waterfowl, including migrating and wintering ringecked ducks (*Aythya collaris*), mallards (*Anas platyrhynchos*) and blue-winged teal (*A. discors*) are common. Forested wetland fringes and cypress swamps provide outstanding wood duck (*Aix sponsa*) habitat, with many remaining year round to breed. Scrub wetlands and adjacent forested wetlands provide potential roosting and rookery sites for herons, egrets, ibis, and anhingas (*Anhinga anhinga*), although it unknown to what extent these species may indeed breed on refuge owned land.

The hardwood forests of the refuge are an important habitat supporting the conservation of dozens of species of resident and migratory landbirds, many of which are designated as priorities due to continued concern over declining populations, habitat threats, and other factors. Priority neotropical migrants found breeding on Banks Lake NWR include prothonotary warbler (*Protonotaria citrea*) and yellow-billed cuckoo (*Coccyzus americanus*). Bald eagles (*Haliaetus leucocephalus*) utilize the refuge for foraging although none are presently known to breed on the refuge. Other occurring bird species include woodpeckers, kingfishers, hawks, owls, vireos, warblers, and Caprimulgids. The refuge and surrounding lands and waters form one of the largest freshwater wetland systems in Georgia, and their preservation is critical to the many species of landbirds and waterbirds that require large, relatively uninterrupted systems to provide appropriate foraging and/or breeding habitats.

Numerous mammalian species inhabit the refuge, and other more diminutive species (e.g., shrews, rodents, bats) are also likely to occur based on existing habitat conditions. White-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis*
virginiana), and gray fox (Urocyon cinereoargenteus) occur commonly. Coyotes (Canis latrans) and beaver (Castor canadensis) also occur.

The temperate climate and largely aquatic conditions at Banks Lake NWR create potentially suitable conditions for a variety of reptile and amphibian species, however, presence of most species can only be inferred because no rigorous surveys have been conducted on the refuge. Federally threatened American alligator (Alligator mississippiensis) are documented on the refuge. Dry, pine dominated uplands could possibly support eastern indigo snake (Drymarchon couperi) and gopher tortoise (Gopherus polyphemus). A number of additional lizards, snakes, frogs, toads and other herpetiles are to be expected on Banks Lake NWR, and these are discussed in a report by J. G. Palis in the Wildlife tab of the Biological Review Handbook. Additional surveys focusing on Banks Lake NWR are warranted to document the presence and relative abundance of these and other species.

Banks Lake is an important recreational fishery, primarily for largemouth bass and panfish. Ichtyofaunal surveys have been conducted on Banks Lake, and periodic electrofishing samples have helped characterize the fish fauna on the refuge. The fishery is largely a closed system, needing periodic management (e.g. drawdowns) to enhance. Nonetheless, there is a diversity of warmwater species including largemouth bass, bowfin (Amia calva), redfin pickerel (Esox americanus), sunfish (Lepomis and Enneacanthus spp.), and black crappie. A summary of documented and potential fish species for Banks Lake is provided in the Wildlife tab of the Biological Review Handbook.

E. Public Use

The NWRS Improvement Act of 1997 and Executive Order 12996 emphasize the importance of providing compatible wildlife dependent educational and recreational opportunities on NWRs. Public use opportunities on Banks Lake NWR have been limited, primarily because Okefenokee NWR cannot devote the staff and resources necessary to safely and effectively support them, beyond facilitating boat access through operation of a public boat launch. There is ready access to the refuge by well maintained roads and highways that lead to the public boat ramp near the lake outlet.

Recreational fishing use averaged approximately 20,000 visitors annually, as well as several fishing tournaments held each year. Fishing is permitted within the framework of state regulations and licensing requirements. The refuge is committed to enhancing fishing opportunities and the overall quality of the fishing experience here. To a large degree, this requires vigilance regarding water quality, aquatic vegetation communities, and population dynamics of popular sport fish. The increasingly urbanized landscape around the cities of Valdosta and Lakeland, Georgia represents a significant and growing potential user base, and the refuge will need to carefully assess how public use might impact other refuge management objectives. Other public use mainly consists of canoeing, photography, and birdwatching. There is presently no hunting on the refuge.
F. Current Threats and Issues

Following is a summary of relevant threats and issues for Banks Lake NWR as introduced in preceding sections:

- Budget and Staff – no operating budget, no staff, and lack of a nearby office severely limit the capacity for any work on the refuge.

- Boundary Delineation – need to explicitly define refuge owned lands and waters.

- Hydrology – fundamental need to understand present surface and groundwater hydrology of the Banks Lake and its relationship to hydrology in the greater GBBL system.

- Water Management – need additional water gauges and/or data that contribute to an understanding of how water depth and extent of inundation across the basin relate to gauge readings, elevational gradients, etc. Based on this information, need to develop and link water management objectives (e.g., frequency, duration and extent of drawdowns) to objectives for fisheries and habitat management.

- Water Quality – documented inputs of contaminants and nutrients. Need additional investment in water quality monitoring to identify and proactively address issues associated with septic waste, nitrogen and fertilizers, organochlorines, and other possible contaminants.

- Encroachment – lack of boundary definition has led to private encroachment on what is ostensibly refuge property.

- Aquatic Vegetation – submerged and floating/emergent aquatic vegetation is proliferating and needs to be controlled to 40% or less coverage. Water hyacinth is a problem exotic species.

- Prescribed Fire – the role of fire as a management tool in the restoration and perpetuation of desired flatwood and upland forest conditions needs critical consideration. Continued use of fire is also needed in the lake basin during drawdowns or low water to help manage aquatic vegetation. Because of smoke management and liability concerns, coordination with Moody Air Force Base, private landowners, and other conservation partners is essential.

- Fisheries Management – need for increased capacity to monitor populations of important sport fish and ensure recreational fishing opportunities are promoted. Manage water levels and drawdown regimes accordingly.

- Mitigating Aircraft Strike Hazards – to the extent potential for bird-aircraft collisions remains a concern for Moody Air Force Base, movements and habitat use of strike-prone bird species needs to be understood and relayed to Air Force authorities.

- Inventory – as a basis for future management and conservation activities, there exists a critical need for basic wildlife and habitat inventory data.
• Research – the refuge provides one of the best examples in the region of a relatively undisturbed Carolina bay system. Management would benefit from on-site research that contributes to local as well as landscape scale understanding of ecology and conservation of such systems.

• Public Use – need to balance high recreational fishing use in a compatible manner with refuge conservation and management objectives. Law enforcement capacity is very limited.

III. Recommendations

Following are a series of needs and recommendations for addressing the various administrative, management and conservation issues discussed above as well as outlined further in many instances in the Biological Review Handbook.

A. Hydrology and Water Quality

<<Recommendations associated with this list of issues could be fleshed out as in subsections D thru F>>

hydrologic study
water quality monitoring, stations, delineation, DEM's
Septic discharge issues
Nutrient influxes
Mercury
Organochlorines

B. Aquatic Resources & Habitats

<<Recommendations associated with this list of issues could be fleshed out as in subsections D thru F>>

Aquatic Vegetation
maintain at 40 or less.
burn, burn, burn
burn plan
drawdown
herbicides where necessary
see Aquatic veg mgt EIS, management plan
Wetland Shrub Communities

encroachment problem

Fisheries

inventories, monitoring?
lake drawdowns – how frequently needed, do they really help promote productive sport fisheries?
Control vegetation to promote fisheries.
Mercury contamination monitoring
monitor organochlorines

C. Flatwood and Upland Habitats

<<Recommendations associated with this list of issues could be fleshed out as in subsections D thru F>>

assess potential for restoration of flatwood and upland habitats
check for longleaf pine
develop fire management/habitat management plan
prescribed fire
desired future conditions
coordinate burns with Moody, GA DOT, adjacent private landowners.
Do burns on more than refuge property if possible
outreach material on need, issues regarding burns?
Promote burning with Moody officials, try to plan burns well in advance
burn plan?

D. Administrative Issues

Budget & Staffing

RECOMMENDATION 1. Fund dedicated staff to address conservation and management issues at Banks Lake NWR:

- Elevate need to Regional Refuge Chief and Area Supervisor for at least 1 full time staff position dedicated to Banks Lake, and 1 shared position to address fisheries issues at Refuges across several coastal plain states
  - Establish an Assistant Refuge Manager or Refuge Operations Specialist position (GS 0485 09/11) stationed at Okefenokee NWR dedicated to addressing issues at Banks Lake NWR
  - Consider funding or co-funding (with Ecological Services) a Fisheries Biologist (GS 0482 0/11) or Biological Science Technician (Fisheries) (GS
0404 05/07/09) to provide fisheries technical assistance at Refuges in north Florida, Georgia, and the Carolinas

- Possible duty stations might include Brunswick or Athens, Georgia, or Jacksonville, Florida

- In lieu of funding new positions, abstain from abolishing one or more positions at Okefenokee NWR as identified in the Southeast Region Refuge Work Force Plan
  - Identify an appropriate position currently slated to be cut and "re-instate" this position with identified responsibilities for addressing administration and management at Banks Lake NWR.

Boundary Delineation

RECOMMENDATION 1. Establish an unequivocal boundary delineation for Banks Lake NWR:

- Conduct a complete survey of the court decreed boundary (e.g., 1925 high water line) and complete additional title work to clarify lands owned in fee title by the NWRS
  - Estimate costs of survey and title work
  - Coordinate with the Southeast Region Division of Realty
  - Address the possible need for additional litigation to clarify ownership.
    - Determine aspects of refuge delineation likely to require litigation
    - Determine how to fund anticipated litigation expenses (consult with Area Supervisor, Division of Realty)

RECOMMENDATION 2. Appropriately post refuge lands

- Where refuge boundaries are explicitly known, post refuge with appropriate signage
- Ensure continued posting of refuge boundaries as ambiguities are resolved

Encroachment

RECOMMENDATION 1. As boundary issues are resolved, or where refuge boundaries are explicitly known, begin addressing encroachment issues:

- Identify known, likely or suspected instances of encroachment and prioritize according to potential impacts to refuge resources and potential to resolve
Consider boat docks, buildings, infrastructure (e.g., sewage drains), resource modification (e.g., tree cutting or habitat manipulation), and chemical use/contaminants.

Develop a "plan" to sequentially address high priority occurrences.

Document occurrences through photography, written statements, law enforcement documentation, testimony of others, and other evidence (e.g., delineation of encroachment against known refuge boundaries, sick or incapacitated fish and wildlife [e.g., in the instance of poisoning, pesticides], etc).

Coordinate with Division of Law Enforcement, and local authorities where necessary.

- Actively engage local communities regarding awareness, real or potential impacts to public trust resources, health and safety concerns, and support for addressing encroachment issues in a proactive and positive manner.
  
  - Work collaboratively with City of Lakeland, Georgia regarding the efficacy, costs, policy and legal implications of extending city sewer services to communities adjoining refuge and lake boundaries.
  - Identify sympathetic landowners willing to serve as examples or spokespersons to other private residents and landowners who might otherwise remain suspicious, skeptical, or irreverent towards government interests.
  - Emphasize non-confrontational approaches.
  - Be open about legal and enforcement aspects.

**Partnership Coordination**

RECOMMENDATION 1. Maintain active coordination with conservation and public use partners vested in Banks Lake and the GBBL system:

- Continue to promote advancement of the GBBL Ecosystem Site Conservation Plan.
  
  - Encourage principals with Georgia Dept. of Natural Resources, Moody Air Force Base, The Nature Conservancy, and others to actively implement the GBBL Cooperative Stewardship Agreement and develop the site conservation plan.
    
    - Establish an activity "plan" to make explicit progress over a 1-3 year period.
    - Identify the need for physical meetings, teleconferences or informal networking to successfully meet objectives for progress.
    - Consult discussions and outcomes from desired future ecological conditions workshop.
  
  - Consider involvement of Georgia Department of Transportation with respect to lands owned adjacent to Banks Lake NWR.
• Identify principal contact; begin engaging
• Discuss potential conservation role of Department of Transportation lands
• Develop plans for any active management that will help meet GBBL-wide goals for restoration, management, and conservation

• Continue to engage Moody Air Force Base biological staff and base leadership to forge foundations for increased use of fire, balanced against smoke management concerns
  o Promote essential need for fire in managing the lake basin and upland pine habitats
  o Demonstrate acknowledgement of safety concerns
  o Encourage proactive scheduling of burn plans and burn windows that can be crosswalked with mission operations
  o Develop concise maps depicting locations of desired burn operations

• Continue progress on implementing cooperative agreement with the Bass Anglers Sportsman Society
  o Promote water quality, fisheries management, and recreational fishing opportunities at Banks Lake in accordance with the agreement

  • See recommendations in this report under Aquatic Resources & Habitats
  • Prioritize Aquatic Resource and Habitat needs according to potential to help meet intent and objectives of the cooperative agreement
  • Seek assistance from Bass Anglers Sportsman Society to conduct work necessary to meet priority objectives

E. Public Use & Outreach

Consult the Banks Lake NWR Comprehensive Conservation Plan and/or Public Use Review for further information on public use. These recommendations emphasize public use in the context of promoting public appreciation, political support and conservation of biological resources.

RECOMMENDATION 1. Promote community and public appreciation for Banks Lake NWR as a significant ecological asset, locally and regionally:

• Consider establishing multi-use canoe/boat "trails" into presently less accessible areas of Banks Lake (e.g., shrub-wetland communities)
  o Facilitate access for refuge staff for monitoring, maintenance, safety, prescribed burning, etc.
- Encourage public exploration and support of wetland environments and their conservation
- Ensure compatibility with other refuge conservation and management objectives
- Develop maps or brochures delineating and otherwise promoting these trails

- Ensure adequate law enforcement presence to support levels of public use
  - Emphasize safety and security
  - Emphasize high periods/seasons of use
  - Develop a "plan" to balance presence at Banks Lake with other responsibilities associated with primary responsibilities for Okefenokee NWR

- Identify and develop top outreach messages, focusing on greatest conservation issues affecting Banks Lake NWR and environs
  - Consider staff presence/participation during fishing tournaments and periods of traditionally high recreational fishing use to distribute outreach material and address public interests
  - Seek regular staff involvement in local school and other educational programs
  - Post outreach materials at boat landing and concession building
  - Consider independent public use signage and outreach station.

**RECOMMENDATION 2.** Consider installation of boat cleaning station to control aquatic weed transfer:

- Prevent hydrilla from transferring into Banks Lake
- Develop associated public outreach information on invasive exotics, effects on fishery resources, and prevention as the best management tool

**F. Miscellaneous**

**Bird-Aircraft Strike Hazards**

**RECOMMENDATION 1.** Coordinate with Moody Air Force Base biological staff on identifying and mitigating bird-aircraft strike hazards:

- Determine the relative significance of strike hazards for cranes, storks, vultures and roosting blackbirds
  - Pending assessment of strike risk for vultures and blackbirds, develop appropriate mitigative measures
 Coordinate with USDS Wildlife Services, Georgia office, for appropriate recommendations
 Coordinate with Moody Air Force Base and other adjacent public landowners to implement recommendations
 Consult with Dept. of Defense Bird Aircraft Strike Hazard (BASH) prevention program

 Pending assessment of strike risk for cranes and storks, document local and seasonal patterns of abundance, habitat use, and movements as a basis for considering mitigative measures that balance conservation and aviation safety interests

 Conduct opportunistic field observations during anticipated periods of use
 Seek to develop more rigorous surveys and studies within an undergraduate or graduate thesis project
 Consider use of Doppler radar from nearby civilian or military stations to provide data on bird movement patterns
 Document areas or habitats of highest use and relate to current/planned Moody operations
 Identify the potential for cost-sharing with Moody Air Force Base or other organizations
 Consult with BASH prevention program

 RECOMMENDATION 2. Identify, protect and promote habitat and food resources being utilized by post-breeding wood storks and sandhill cranes:

 Based on information gathered on crane and stork movements, habitat use and foraging resources, minimize disturbance/flushing

 Minimize or restrict public use, access, or activities in areas frequented by cranes and storks
 Protect cranes and storks, habitats, and foraging resources from disturbance

 General Inventory, Monitoring & Research Needs

 RECOMMENDATION 1. Improve understanding of the presence and/or likelihood of flora and fauna on the refuge:

 Consult and compile available data and information, especially for typically poorly studied groups like amphibians, fish, and herbaceous plants

 Compile bibliography or otherwise aggregate information
 Document historic or previous occurrences as a baseline
• Conduct surveys for animal or plant species where presence/abundance is not well documented
  
  o Prioritize information needs
    ♦ Emphasize species or groups of special concern (e.g., T/E species)
    ♦ Emphasize species or groups where knowledge would directly improve management decisions
  
  o Consider use of student interns (SCEP/STEP), undergraduate/graduate students at local colleges and universities, or otherwise collaborating with local experts
  
  o Encourage public involvement through "bio-blitzes" or other public hands-on activities that are meaningful in helping address inventory needs

• Develop inventory/survey protocols appropriate for identifying invasive exotic plants before they become problematic
  
  o Remain vigilant for hydrilla and other extremely invasive exotics

• Coordinate with Georgia Dept. of Natural Resources regarding bald eagle monitoring interests, and gather and provide requested information.

RECOMMENDATION 2. Improve understanding of ecology and ecological processes on the refuge and within the GBBL system:

• Identify critical information needs linked to effectively meeting refuge management objectives and fulfilling the refuge's role within the GBBL landscape
  
  o Review and compile refuge management objectives
  
  o Identify critical assumptions or information gaps associate with objectives
  
  o Prioritize information needs
    ♦ Based on ecological significance
    ♦ Based on management significance
    ♦ Based on "risks" associated with managing incorrectly if our current understanding is incorrect

• Promote the refuge as a living laboratory
  
  o Identify local and regional researchers with past or potential interest in GBBL ecology and conservation
    ♦ Consider academia, USGS, State and private conservation organizations
o Proactively approach identified researchers regarding possible research projects of mutual interest
   ♦ Periodically engage researchers to build relationships, discuss needs, ideas, etc.

o Widely publicize refuge information needs to the research community
   ♦ Post needs thru college and university "bulletin boards"
   ♦ Conduct presentations in relevant college and university courses
   ♦ Offer to assist with college and university field trips to the refuge

• Assist in developing research proposals and seeking research funding

   o Articulate research needs/objectives for use in engaging academic and management community in developing competitive funding proposals

   o Annually identify research funding opportunities
      ♦ Contact Region 4 Research Coordinator (Bill Starkel), and staff in the NWRS Branch of Planning (e.g., Chuck Hunter) for ideas and advice on possible cyclic funding opportunities, desirable aspects of competitive proposals, pooling needs with other refuges, etc.
      ♦ Consider Refuge Challenge Cost Share and FWS/USGS Quick Response as likely funding sources
      ♦ Develop an annual "plan" for submitting 2-3 competitive research proposals

   o Track important refuge investments ($$, staff time, resources) as potential match

   o Offer to provide critical review of proposals or research ideas with relevance to Banks Lake NWR information needs

<<END OF REPORT>>