



US Army Corps
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Waterways Experiment
Station

North American sturgeon: Implications for the Corps of Engineers

by K. Jack Killgore and Matthew D. Chan

Sturgeon are large, long-lived fishes that occur and spawn in most navigable rivers in the United States. Few groups of North American fishes have such an extensive range.

In North America, sturgeon represent nine taxa in two genera (*Acipenser* and *Scaphirhynchus*). Four of these taxa are listed as threatened or endangered under the Endangered Species Act.

Because sturgeon occur in main channels of rivers, they are vulnerable to the effects of flood control, navigation, and hydroelectric projects. For this reason, the U.S. Army Corps of Engineers has funded studies of sturgeon since the early 1980s. Section 7 of the Endangered Species Act directs the Corps to protect the species according to recommendations specified by the U.S. Fish and Wildlife Service. However, it is difficult to formulate management strategies with the limited life history information that is available on the species.

Protection and management of sturgeon has recently been recognized as a major environmental issue for the Corps. The issue was highlighted at the 1993 meeting of the Environmental Advisory Board in Portland, Oregon, and later at a sturgeon workshop conducted by the Corps' South Atlantic Division. A 3-year research unit to study sturgeon in the continental United States was begun in fiscal year 1995, as part of the Corps' Environmental Impact Research Program (EIRP).

This article presents life history information on the species, outlines

sturgeon issues related to Corps operations and maintenance activities, and summarizes current research priorities.

Life history and ecology

Sturgeon are primitive fishes that share a common and distinctive appearance—torpedo-shaped body; bony plates; long, hard snout; underslung mouth with barbels; and muscular upper lobe in tail (Figure 1). Some species grow to more than 4.5 meters in length and 450 kilograms in weight, and live as long as 100 years. Adults reach sexual maturity between

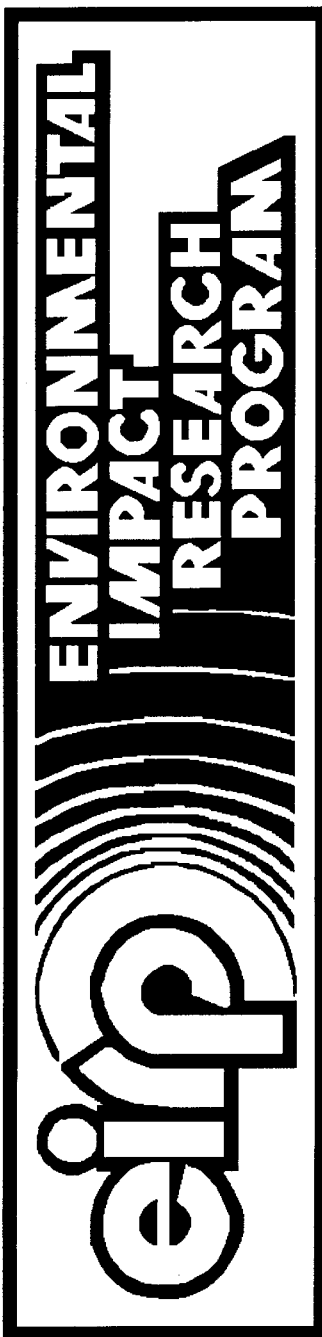
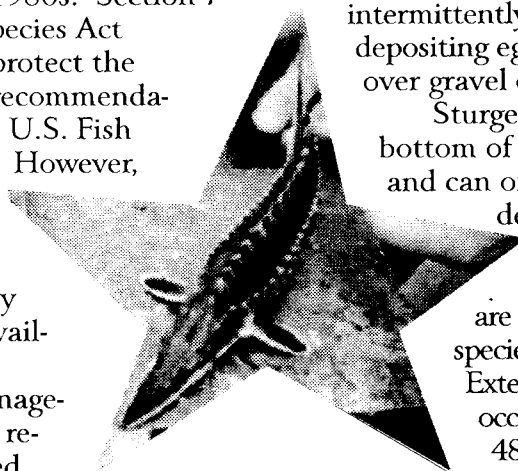
2 and 10 years of age and spawn intermittently every 2 to 5 years, depositing eggs in flowing water over gravel or rocks.

Sturgeon live on the bottom of large rivers or lakes, and can often be found in

deep holes or flowing water over sand or gravel. All species are migratory, and some species are anadromous.

Extensive migrations can occur, some exceeding 480 kilometers.

Typical seasonal movements include spring migrations of adults upstream to spawning grounds (from March to May); summer migration of juveniles and adults downstream to feeding and resting areas, where fish remain relatively inactive (June to September); fall migrations (September to November) of adults either downstream to overwinter, or upstream for fish that anticipate spawning the following spring. During migration, anadromous species may linger in reaches with salinities that facilitate osmoregulation.



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Figure 1. Sturgeon and paddlefish are closely related and have skeletons composed mostly of cartilage. Fossils of these fish date to the Cretaceous Period (100 to 150 million years ago)

These reaches are termed “staging areas.”

Sturgeon feed on a wide variety of aquatic animals. Juveniles consume small aquatic insects and crustaceans, particularly scuds, fly larvae, and mayfly nymphs. Subadults and adults feed on molluscs, fish, and crayfish.

Taxonomy and status

The genus *Scaphirhynchus*, which is native to North America, includes three sturgeon species—shovelnose, pallid, and Alabama. The shovelnose sturgeon (*S. plathynchus*) occurs in fresh waters of the Mississippi River basin from western Pennsylvania to

Montana and south to Louisiana. Distribution of the pallid sturgeon (*S. albus*) overlaps that of the shovelnose. The Alabama sturgeon (*S. suttkusi*) is endemic to the Mobile Bay drainage of Alabama and Mississippi.

In the genus *Acipenser*, the Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) and the shortnose sturgeon (*A. brevirostrum*) are limited to Atlantic coastal drainages. The Gulf sturgeon (*A. oxyrinchus desotoi*) ranges from the Louisiana coast to central Florida. On the West Coast, two species of sturgeon occur: the white sturgeon (*A. transmontanus*) and the green sturgeon (*A. medirostris*). White sturgeon occur in coastal

rivers from Alaska south to Mexico, and landlocked populations exist in the upper Columbia River drainage, Montana, and possibly in Lake Shasta, California. Green sturgeon are usually found around the mouths of estuaries, ranging from the Gulf of Alaska southward to Mexico. Lake sturgeon (*A. fulvescens*) occur in fresh water, ranging from the Great Lakes and Hudson-James Bay to the Mississippi River basin.

Sturgeon were commercially important in the 19th and early 20th centuries for caviar, oil, and food. Indiscriminate harvesting led to rapid declines in their numbers. Their ability to recover from overharvesting was hampered by their slow growth and a long period of sexual immaturity. Additional factors were the impacts from habitat alteration and the construction of dams, which prevented migration to spawning areas. Channel modifications associated with flood control, hydroelectric, and navigation projects may also have impacted bottom riverine habitats used by sturgeon. The result is that most sturgeon are now uncommon throughout their ranges.



The distribution range of sturgeon includes most navigable rivers in the United States, and large portions of several Corps divisions (Figure 2). Federally threatened or endangered sturgeon species (Figure 3) are present in 10 Corps divisions. Two sturgeon species (shortnose and

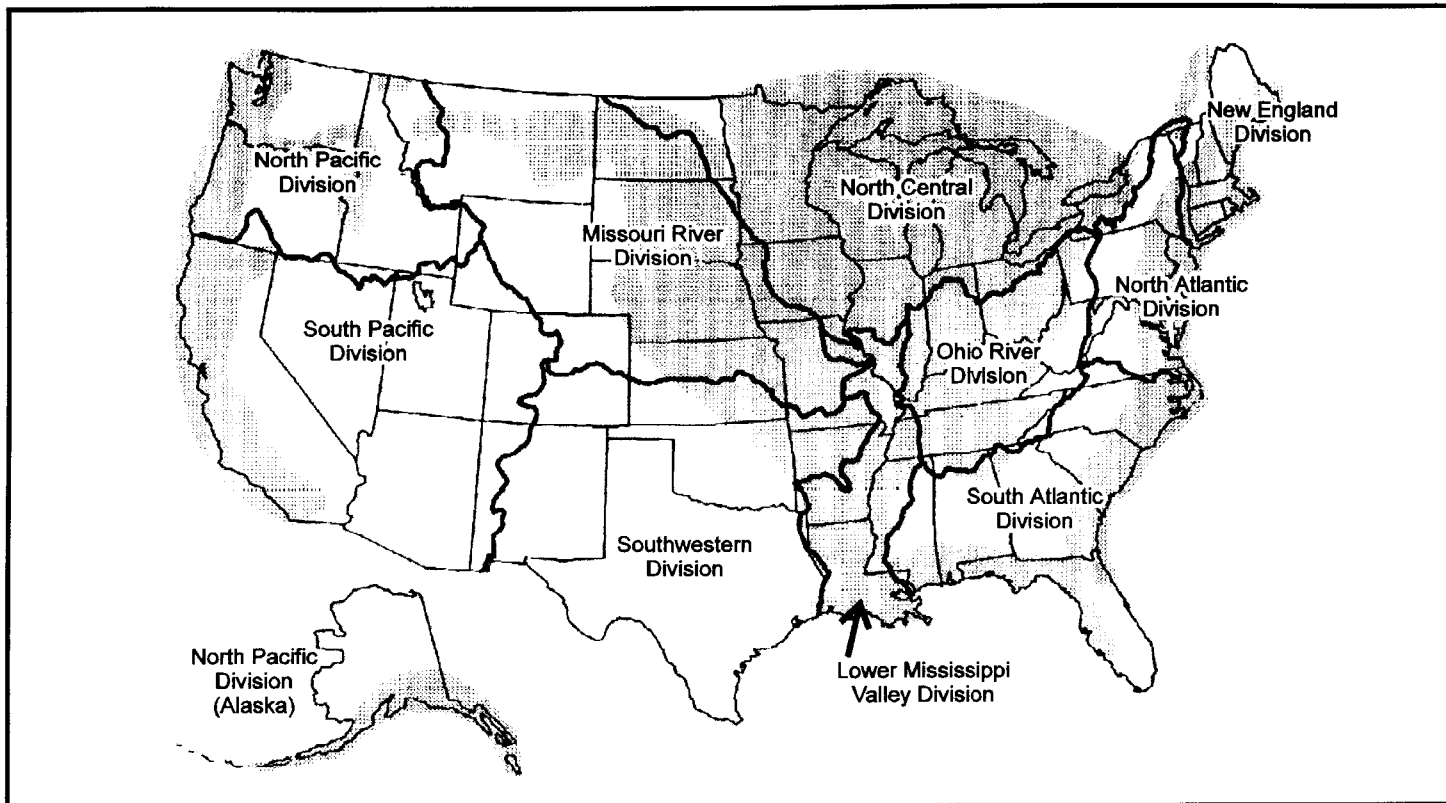


Figure 2. Distribution of sturgeon in Corps divisions

pallid) and one white sturgeon population (Kootenai River below Libby Dam, Montana) have been listed as endangered (Table 1). One subspecies (the Gulf sturgeon) has been Federally listed as threatened, and one species (Alabama sturgeon) is a species of special concern. All Federally listed sturgeon are also listed as endangered or threatened by at least two states, and some sturgeon are listed by all states within their respective ranges (Table 1).

Corps of Engineers issues

At least two navigation projects (Connecticut and West Pearl rivers) have been temporarily delayed due to litigation because not enough is known about the life history of these fishes. To identify significant sturgeon issues, EIRP researchers contacted Corps division and district offices. A total of 36 individuals in 21 districts (representing 12 divisions)

were asked to provide information on sturgeon species of interest, projects affected, expenditures, and related issues.

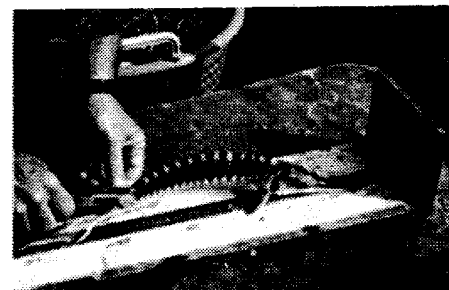
Because sturgeon have extensive ranges, the related issues cover large geographic areas and usually encompass several species with different ecological requirements. Lake, pallid, Gulf, white, shortnose, and green sturgeon were identified as species of concern. Sturgeon issues exist for most large navigable rivers in the United States.

The Corps' North Central, South Atlantic, Lower Mississippi Valley, New England, North Atlantic, Missouri River, and North Pacific divisions operate projects that are affected by the presence of threatened or endangered sturgeon. It is possible that the South Pacific Division might have problems in the future with green sturgeon.

A concern that was voiced by most districts was insufficient

information on spawning and rearing. Other project operational concerns included dredge entrainment, long-term habitat alteration by water control structures and dredging, barriers to migration caused by structures, and short-term habitat alteration from construction and maintenance. Entrainment and disturbance by barge traffic was identified as a future concern. With regard to planning projects, similar issues were noted, with barriers to migration most often cited.

The Corps offices were also asked to identify areas of research necessary to developing adequate protection and management plans.



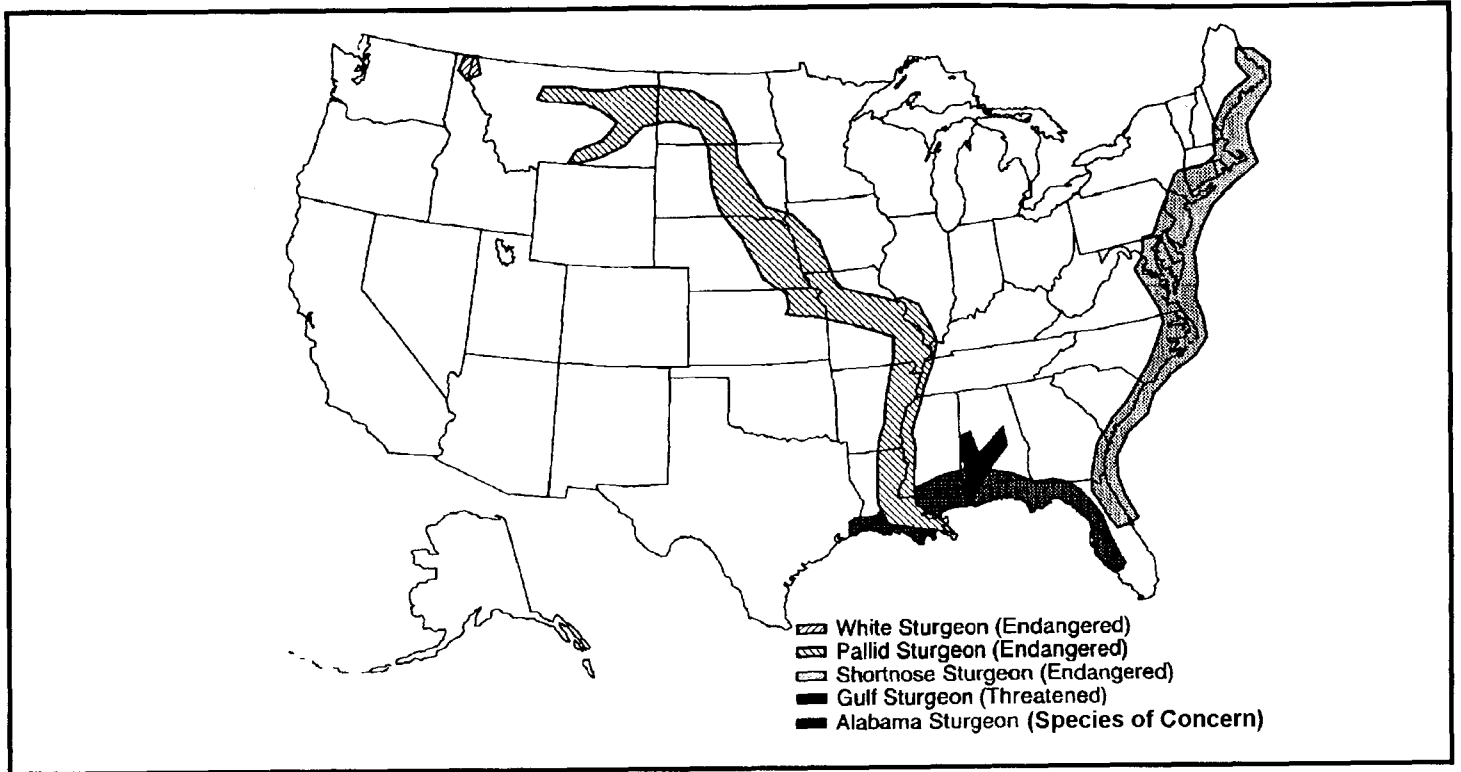


Figure 3. Distribution of Federally listed sturgeon in the United States

Table 1. Status of North American Sturgeon

Common Name (Scientific Name)	Federal Listing	State Listings
Shortnose sturgeon (<i>Acipenser brevirostrum</i>)	Endangered	Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Virginia
Lake sturgeon (<i>A. fulvescens</i>)	None	Illinois, Indiana, Iowa, Michigan, Missouri, Nebraska, New York, Ohio, Pennsylvania, Tennessee, Vermont
Gulf sturgeon (<i>A. oxyrinchus desotoi</i>)	Threatened	Florida, Louisiana, Mississippi
Atlantic sturgeon (<i>A. oxyrinchus oxyrinchus</i>)	None	Connecticut, Massachusetts, Pennsylvania
Green sturgeon (<i>A. medirostris</i>)	None	None
White sturgeon (<i>A. transmontanus</i> Kootenai River)	Endangered	Idaho, Montana
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	Endangered	Arkansas, Illinois, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, South Dakota, Tennessee
Shovelnose sturgeon (<i>S. platyrhynchus</i>)	None	Texas
Alabama sturgeon (<i>S. suttkusi</i>)	Species of Concern	Mississippi

These topics included distribution and movement, spawning habitat, swimming performance, and feeding habits of sturgeon.

Because of a lack of ecological and biological information on North American sturgeon, the most significant effects on Corps projects were increased expense and workload toward preparing environmental documents, conducting coordination activities, and monitoring field studies.

In response, the Corps districts have provided support, on a project-by-project basis, for collecting relevant information on sturgeon ecology and life history. In fiscal year 1994, approximately \$778,000 was spent on data gathering. Cumulative expenditures have totaled more than \$1.8 million.

Measures that have been implemented to avoid impacts to sturgeon during dredging include limiting the duration, using screens, and requiring observers on dredges to monitor potential impacts.

Research priorities

Despite the sturgeon research that has been conducted over the past 30 years, much information is lacking. Migration patterns, seasonal habitat requirements, feeding strategies, and most importantly, spawning and rearing behavior are still poorly documented for most species.

Generalizations about spawning habitat can be inferred from the few references that intensively addressed a certain species, but the timing and exact locations are speculative for most river systems. Larvae are rarely collected, so the habitat requirements of

this early life history stage are unknown. Staging areas during adult migrations have not been identified in most rivers, and there is no information on habitat use by juvenile pallid, shovelnose, green, and Alabama sturgeon.

Telemetry can be an effective monitoring technique, but it cannot substantiate spawning. Sexes cannot be differentiated externally, and since adult sturgeon spawn intermittently, they may occur at spawning sites without releasing gametes. Furthermore, collecting fish and locating seasonal habitats in large river systems is difficult because



sampling efficiency declines in deep, fast-flowing, turbid environments. Acquisition of telemetry signals is hampered for the same reasons and in areas of high salinity.

As a result, protection and management of sturgeon continues to be addressed with inadequate data. Speculation leads to restrictions, delays, and inflated costs to Corps projects.

The national scope of this problem requires a coordinated effort among the concerned

agencies to develop effective assessment and management techniques. Limited funding requires that managers prioritize the species based on the current effort (funding and number of individuals studying a species), status (Federal or state listing as threatened and endangered species), and geographic range.

For the Federally listed sturgeon species, the recommended priority for research is:

1. **Pallid sturgeon.** Although this species ranges throughout the Mississippi River drainage, few researchers are conducting field studies of it. Sampling efficiency is particularly difficult in the Mississippi River. Shovelnose sturgeon are closely related and relatively common in the Mississippi River. For experimental studies or habitat modeling, they could serve as surrogates for rare pallid sturgeon.
2. **Gulf sturgeon.** This species occurs in the Gulf coastal drainage from the Mississippi River to Florida. However, only a few rivers have been studied. Adults are infrequently collected, which suggests inadequate sampling or low recruitment.
3. **Shortnose and white sturgeons.** Numerous studies have been conducted on shortnose sturgeon, and this species continues to receive attention from universities and conservation groups. Only the Kootenai River population of white sturgeon was listed, representing a very limited range compared to other Federally listed species.

Current efforts under the EIRP work unit include field studies on Gulf sturgeon movement and habitat preference in the Pearl River and Lake

Ponchartrain systems in Mississippi and Louisiana. Morphometric data are being collected on pallid and shovelnose sturgeon in the lower Mississippi River to improve field identification of these species and to evaluate possible hybridization. This work complements a previous study in the Missouri River. Commercial fishermen have assisted in these studies by collecting fish and identifying preferred habitats.

The behavioral ecology and swimming performance of recently spawned fish (obtained from hatcheries) are being evaluated in laboratory flumes. The results will help predict habitat preferences in rivers and the sturgeon's susceptibility to entrainment or barriers.

Research will also be conducted on techniques for collecting eggs and larvae, estimating population size from mark-recapture, determining age and growth using fin rays or other suitable tissues, and developing innovative approaches for identifying the presence of sturgeon in deep, fast-flowing habitats.

Contacts with Russian scientists, who have been studying sturgeon for over a century, have been established. The information obtained through these contacts is expected to be useful in designing monitoring studies.

Information sources

WES scientists reviewed the literature of the last 30 years on sturgeon biology, ecology, and management. A technical report summarizing this information, derived from more than 170 published studies, is scheduled for completion by September 1996 (Chan and Killgore, in preparation).

Several other sources of information on sturgeon are available. The "Second Summary of Sturgeon and Paddlefish Researchers and Managers" (Carmody 1994) identifies 273 researchers and managers interested in this topic. Interest for a particular sturgeon species was related to the area of



its range, relative abundance, and sport or commercial value. Consequently, lake sturgeon received the most interest, followed by shortnose, Atlantic, pallid, white, shovelnose, and Gulf sturgeon. The Alabama and green sturgeon had the least interest.

The Department of the Interior, the Department of Commerce (National Oceanic and Atmospheric Administration), and utility companies have been the principal funding sources for sturgeon studies.

The *Sturgeon Quarterly*, published by the Sturgeon Society,¹ includes studies from other countries. *Sturgeon Notes*, which focus on the shortnose and Atlantic sturgeon, are published by Cornell University² under the sponsorship of the Hudson River Foundation.

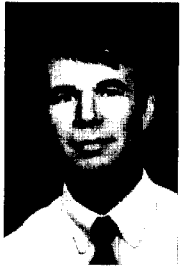
Further information concerning the WES sturgeon studies is available from Dr. K. Jack Killgore, telephone (601) 634-3397, fax (601) 634-2398, or e-mail killgok@wes.army.mil.

References

- Carmody, G. (1994). "Second summary of sturgeon and paddlefish researchers and managers," U.S. Fish and Wildlife Service, Panama City, FL.
- Chan, M. D., and Killgore, K. J. "North American sturgeon: Review of ecological literature and identification of research priorities," Technical Report (in preparation), U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

1 Available from The Sturgeon Society, 331 West 57th Street, Suite 159, New York, NY 10019.

2 Available from Department of Natural Resources, Fernow Hall, Cornell University, Ithaca, NY 14853-3001.



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Environmental Impact Research Program—Overview

The Corps of Engineers' Environmental Impact Research Program (EIRP) is structured and managed to provide the Corps with a unique opportunity to investigate emerging problems in environmental areas as they relate to three research thrust areas. These areas focus on documenting and quantifying environmental effects associated with Corps activities; developing and demonstrating practical engineering and resource management strategies to minimize adverse effects of Corps activities and to protect and manage important natural and cultural resources; and developing, verifying, and demonstrating user-oriented impact prediction and assessment techniques.

Traditionally, the strategy of the EIRP has been to provide rapid response to unexpected environmental research needs. It is the vehicle by which the Corps can initiate research in a wide variety of areas that are not covered by one of the specific R&D programs.

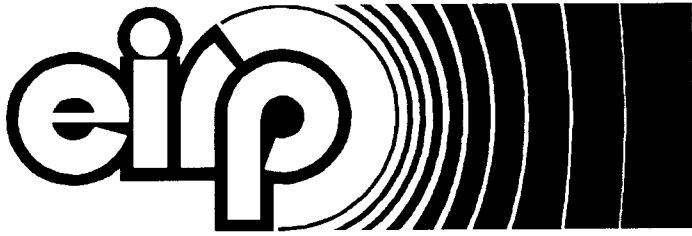
EIRP research has resulted in a number of practical and widely recognized products. Among these are the Corps' Wildlife Management Manual, the Site Restoration Manual, the Visual Assessment Manual, the Benthic

Resource Assessment Technique, and the Archeological Site Preservation Manual. Work on the Chesapeake Bay Model was initiated by the EIRP. In addition, the EIRP has supported verification and testing of the Habitat Evaluation Procedure and years of cooperative effort with the U.S. Fish and Wildlife Service. Practical field guidance has been developed on protection of endangered molluscs and the sturgeon, ecological effects of coastal structures and activities, and low-

cost biotechnical erosion control techniques for shorelines and streambanks.

EIRP activities are conducted under the direction of Civil Works R&D and Program Monitors at Headquarters, U.S. Army Corps of Engineers, with program management assigned to the U.S. Army Engineer Waterways Experiment Station. Continuous support and much-needed feedback is provided by the Field Review Group. A listing of key personnel is provided below.

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ENVIRONMENTAL IMPACT RESEARCH PROGRAM

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