

Corps/Service Cooperate To Protect Endangered Mussels

One evening in early August, Jim Engel found a message awaiting him at home to call Sam Fuller at once, no matter how late the hour. Engel, the U.S. Fish and Wildlife Service's Region 1 endangered species specialist based in Minneapolis-St. Paul, imagined that the call was about before he picked up the telephone. There had been other urgent calls like this one from Fuller—all concerning new finds of endangered mussel specimens in the upper Mississippi River system. A malacologist with the Academy of Natural Sciences of Philadelphia (ANSP), Fuller has been surveying portions of the river's navigational channel scheduled for dredging by the U.S. Army Corps of Engineers. Under a unique contingency plan agreed to by the Corps and the Service, Fuller has instructions to call Engel and Corps officials as soon as endangered mussels are located, so that measures can be taken to protect them from the dredges.

On this occasion, Fuller informed Engel that he had found five Endangered Higgins' eye pearly mussels (*Lampsilis higginsii*) in the St. Croix river near the Hudson (Wisconsin) railroad bridge (about 25 miles upstream from where the St. Croix joins the Mississippi). The five specimens had been taken from a pool not far from where Fuller's crew discovered two other Higgins' eyes in 1977.

Under the contingency plan, dredging scheduled for this site would be temporarily stayed to prevent the imminent destruction of protected mussels while permitting an evaluation of the effects of dredging and the consideration of available alternatives.

In Effect Since 1977

Essentially, the agreement is an interim approach to promoting Corps compliance with Section 7 of the Endangered Species Act of 1973—a provision that requires all Federal agencies to insure that their actions do not jeopardize Endangered or Threatened species or destroy or modify habitats considered to be critical to the species' continued existence.

In effect since the culmination of the survey in June 1977, the contingency plan is representative of the Corps' comprehensive effort to study Endangered mussels of the upper Mississippi to insure that channel maintenance will not have an adverse impact on any listed species or subspecies.

Jack Hemphill, former Twin Cities regional director for the Service, considers the actions of the Corps' St. Paul District since initiating consultation in January 1977 as exemplary: "In view of the potential ramifications this particular consultation presented, and the results accruing from the cooperative effort, I believe this consultation should serve as a model of how section 7 of the act should be administered."

The Corps of Engineers has been dredging the upper Mississippi to maintain a 9-foot navigational channel for over 50 years. Estimates put last year's river traffic in commercial cargo in the district at nearly 20 million tons, both up- and down-bound. During its 220-day navigational season, the Corps dredges an average of 6 percent of the 284 river miles in its St. Paul District. Some 20 sites must be dredged either annually or every other year to clear a path for the continuous flow of such commodities as coal and grain, commonly shipped by barge.

Source of Controversy

In 1976, a few months after the Higgins' eye and fat pocketbook (*Proptera capax*) pearly mussels were listed by the Service as Endangered (F.R. 6/14/76), a private citizen complained that the Corps' dredges had killed a Higgins' eye in the Mississippi River's east

channel at Prairie du Chien, Wisconsin. She charged the agency with violating section 7.

Prior to the complaint, and even prior to the final listing of the species, the Corps had met with the Service, local government officials, and concerned citizens to notify them of its intent to dredge the channel and to discuss possible impacts. The Great River Environmental Action Team (GREAT), an interagency group of Federal and state representatives (see accompanying story), consulted commercial clambers to determine locations of clam beds and, in July 1976, visited the sites. This resulted in a modification of the dredging design to reduce the possibility of damage to known or suspected clam beds.

Following its review of the proposed operations, the Service determined that reasonable precautions were being taken by the Corps to insure that endangered mussels would not be jeopardized.

Study Launched

But the incident showed that knowledge of the status and distribution of the Higgins' eye was very limited, as was information on the abundance, distribution, and ecological requirements of the other 48 mussel species and subspecies known in the upper Mississippi. Accordingly, in keeping

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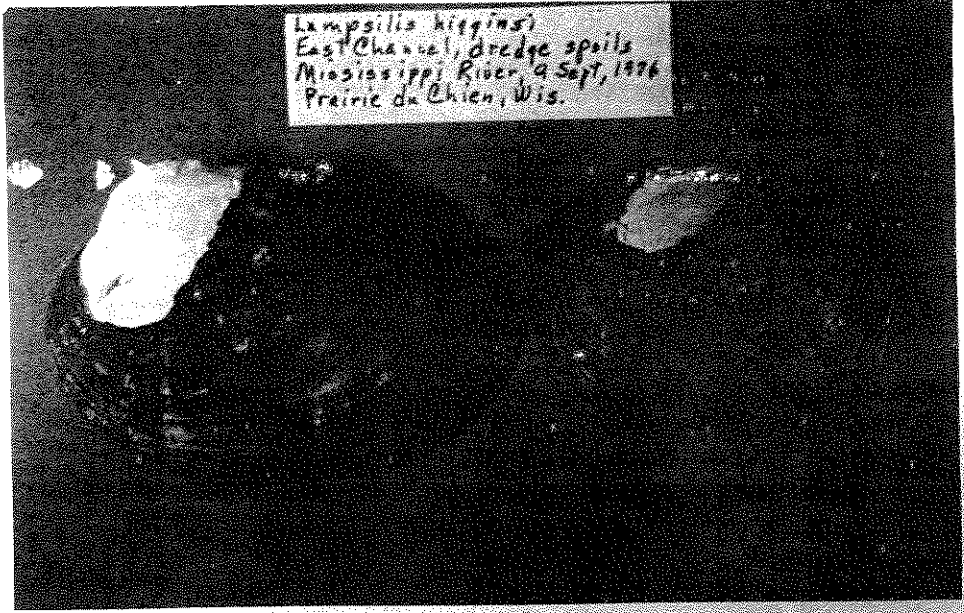


Photo by Joseph F. Havlik
 These Higgins' eye specimens—chipped from a dredge pipe in the Mississippi River's east channel near Prairie du Chien—prompted Marian Havlik to charge the Corps of Engineers with a Section 7 violation

with its section 7 responsibilities—and as a key member of the GREAT seeking to restore the river's multiple wildlife and recreational resources—the Corps decided to undertake a comprehensive study of freshwater mussel ecology to determine the effects of dredging and channel maintenance.

The need for the study was further

underscored by a threshold examination conducted in February 1977 by the Service (following the initiation of formal consultation by the Corps), which concluded that:

- Maintenance dredging may jeopardize the continued existence of the species and/or adversely modify the habitat that may be determined critical to the species.

- Sufficient information did not exist

at the time to determine Critical Habitat for the species.

- To make a biological judgment as to whether or not maintenance dredging would modify the Critical Habitat, it would be necessary to determine the location and extent of existing clam beds. Further, to determine whether maintenance dredging has jeopardized the continued existence of a species, it would be necessary to understand the effects of siltation on mollusks.

Great River Studies Striving To Conserve Fish and Wildlife

Preservation of endangered freshwater mussels is one of many concerns of the Great River Environmental Action Team (GREAT)—a Federal/state interagency body that is performing intensive studies of the upper Mississippi River.

GREAT was created in 1974 under the auspices of the Upper Mississippi River Basin Commission to investigate environmental concerns arising out of the dredging and maintenance of the 9-foot navigational channel by the U.S. Army Corps of Engineers from New Orleans to Minneapolis-St. Paul. Approximately 1 million cubic yards of sediment are removed from the river system annually and deposited in shallow backwater areas, on natural islands, or on spoil banks along the river.

Numerous wing dams have been constructed by the Corps at right angles to the river to control water flow. There also has been a considerable amount of construction and dredging by private interests.

These manmade changes have greatly altered the character of the river since 1924, when Congress proclaimed "navigation" as the river's primary purpose. That same year, Congress also established the Upper Mississippi River Wild Life and Fish Refuge, near Wabasha, Minnesota, but stipulated that operation of the 195,000-acre refuge was not to interfere with the operation of the 9-foot navigational channel.

Over the years, however, conservation organizations, officials of states adjoining the river, biologists, and interested individuals have become increasingly concerned about the river's alteration. Their campaign to give equal attention to such other aspects as fish and wildlife, recreation, wilderness areas, water quality, and flood plain management has led to the formation of GREAT.

The interagency team is made up of appointed representatives from the States of Wisconsin, Minnesota,

Illinois, Missouri, and Iowa. The five Federal agency members are the Fish and Wildlife Service, the Corps of Engineers, the Department of Agriculture's Soil Conservation Service, the Environmental Protection Agency, and the U.S. Coast Guard.

Congress has appropriated nearly \$10 million for a series of studies by GREAT from fiscal year 1975 through fiscal year 1979. These studies have been broken down geographically into three phases and cover every aspect of the river system's resources and management. GREAT I extends from Minneapolis-St. Paul south to Guttenberg, Iowa; GREAT II stretches from Guttenberg to Saverton, Missouri; and GREAT III covers the system from Saverton to the mouth of the Ohio River at Cairo, Illinois.

The main stem of the Mississippi, which drains 1.5 million square miles of land covering 31 states and two Canadian provinces, is the largest environmental "corridor" in the United States sustaining abundant fish and wildlife resources. But GREAT studies are showing that the biological productivity of the upper Mississippi is being threatened in a number of ways.

Continuing sedimentation is filling lakes, marshes, and backwaters. The disposal of dredged materials in some instances has resulted in the conversion of productive fish and wildlife habitat into relatively sterile open sand areas. Some backwaters created by the construction of dams and the diking effect of spoil banks formerly provided rich habitat for mammals, fish, and waterfowl. But now many of these same areas appear to be dying for lack of fresh water and for other complex ecological reasons.

It is disturbing problems like these, along with the conservation of fish and wildlife resources in the river's mainstream, that the GREAT studies are striving to correct before it is too late.

Dredging Effects "Minor"

The independent 2-year study effort—designed with the assistance of the Service, the States of Wisconsin and Minnesota, and the ANSP—was started in mid-July 1977 by Fuller, a recognized authority on mussels, under a contract with the Corps. Working through mid-November, Fuller surveyed 46 sites that had a history of dredging or were scheduled for dredging, including 42 sites on the upper Mississippi, 3 on the Minnesota River, and 1 on the St. Croix River, with cursory examination of a dozen additional locations.

At each sampling site, observations were made on its physical and biological condition, on the nature of the mussel community, and on the possible effects of channel maintenance.

After the first year of study, investigators tentatively concluded that channel dredging and associated activities "have only a minor impact on freshwater mussels, including the legally protected species" and that with careful planning the impact could continue to be minor. For example, Fuller noted that the two Higgins' eye specimens found in the St. Croix River during the study were only a few meters from where the navigational channel had been dredged in 1970, yet both were old enough to have been there prior to that time.

Confirmed adverse effects of dredging on *Lampsilis higginsii*, the study reported, were found only at Prairie du Chien, where 21 specimens had been lost in dredging operations, and on the Mississippi at Brownsville (Minnesota), where one juvenile specimen had been located.

But the study cautioned that, unless care was exercised in the removal of materials from the channel and in its deposition on spoil banks along the river, mussels could be adversely affected. The potential impacts include direct destruction of the animals by the dredges' cutterheads and subsequent transport through pipes to a new location; the burial of mussels under dredged deposits; and, increased turbidity and pollution through the resuspension of heavy metals and other

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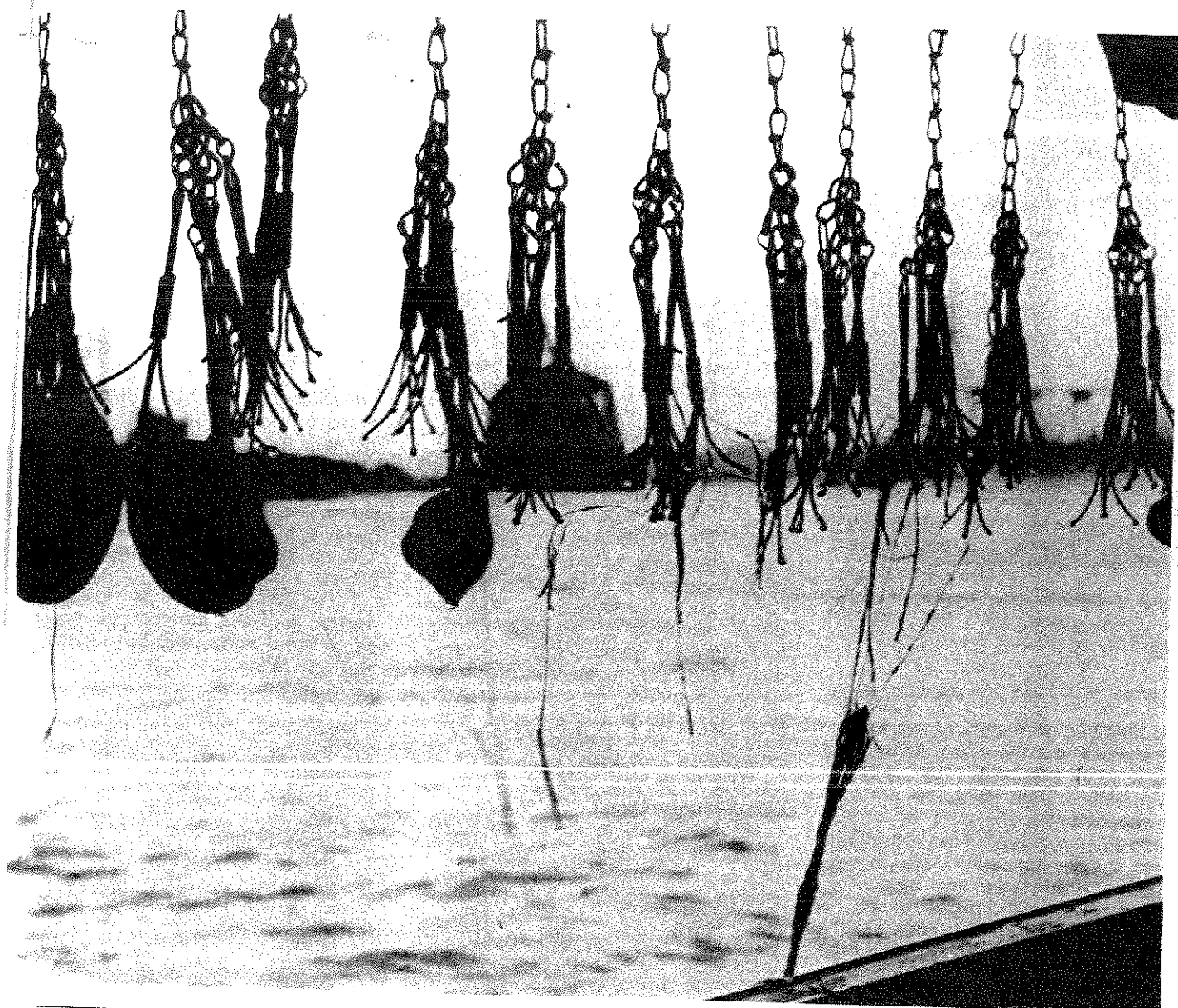


Photo by Dona Finnley

Mussels (continued from page 4)

toxic materials when the river bottom is disturbed.

Turbidity reduces light penetration, decreasing the productivity of microorganisms upon which mussels feed, according to Fuller. Associated suspension of fine particles also may interfere with the animals' feeding and respiration by clogging their gills.

(Under agreement with the Minnesota Pollution Control Agency, the Corps is now studying the effects of turbidity, in terms of duration and extent of dissipation, and is attempting to determine the degree and nature of chemical pollutants resuspended during dredging.)

Project investigators also noted that backwater areas created by spoil deposits since 1924, when Congress authorized maintenance of the navigational channel, serve as prime nursery

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This sampling of freshwater mussels was pulled from the St. Croix River by Samuel Fuller just below the Hudson (Wisconsin) railroad bridge (in background), where he previously found six Endangered Higgins' eye pearly mussels. The mussels are clinging to a device known as a brail, which Fuller's crew has used extensively in its survey of dredging sites along the upper Mississippi River navigational channel for the U.S. Army Corps of Engineers.

The brail consists of a 10-foot wooden bar equipped with a number of 10-inch chains from which are suspended bunches of hooks. The hooks are straight wire tines of different gauges (to accommodate various sizes of mussels) tipped with balls of solder. The bar is designed to float above the riverbed while towed from a small boat, allowing the hooks to graze the bottom. As a hook passes between the open valves of a mussel, the animal clamps shut on it and is pulled along by the motion of the brail and boat.

In Fuller's brailing runs, the device is towed downstream for five minutes, then lifted into the boat so that specimens can be removed. Several 5-minute runs covering about 500 feet are made at each survey site, generally about 50 feet from the shoreline.

Mussels also are retrieved in the survey by pollywogging—wading offshore and collecting by hand; by scooping them up in a wire mesh box called a Needham scraper (useful for finding juveniles too small to be caught by brailing); and by hard-hat HOOKAH diving. The latter technique permits the visual examination of suspected endangered mussel beds without disturbing them.



Photo by Dona Finnley

Daniel J. Bereza, assisting Sam Fuller in the survey project, holds two specimens believed to be Higgins' eyes

Mussels (continued from page 5)

and breeding grounds for several mussel species and their host fishes, and may need special protection.

Restrictive state laws now preclude the open water dumping or dredge spoils along the upper Mississippi. Disposal is now generally made in consultation with states and other concerned agencies and organizations. Although so-called spoil islands are the primary dump sites, spoil is often used as landfill, for sanding icy roads, or as blacktopping.

Siltation Study

Another study—performed in 1977 by the Service under contract with the Corps—indicates mussels are capable of surviving burial under dredged silt to some degree.* Researchers demonstrated this by burying fat mucket (*Lampsilis radiata luteola*) and pocketbook (*L. ventricosa*) clams in sediment from 2 to 10 inches in depth. They found that 7 inches or more of sand or silt was required to prevent the emergence of the two species, while 4 inches of silt was sufficient to kill 50 percent of the smaller pigtoe (*Fusconaia flava*) clams.

Declining Populations

The Fuller study reveals that all species of mussels have suffered a decline

* Leif L. Marking and Terry D. Bills, "Acute Effects of Silt and Sand Sedimentation on Freshwater Mussels," FWS Fish Control Laboratory at La Crosse, Wis., 1977.

in abundance in the upper Mississippi River over the past 75 years. (An exception is the mapleleaf—*Quadrula quadrula*—which has apparently managed to flourish by exploiting the impounded backwater areas.) There was no evidence of mussels in the lower Minnesota River, where they were abundant in the late 19th century.

Fuller attributes the sharp drop in numbers of several species, including the Higgins' eye, partly to excessive commercial exploitation by the pearl button industry, which used mussel shells to make buttons around 1900.

Probably all mussels have been affected by water quality degradation from municipal and industrial wastes, pesticide runoff, and increased siltation. Dredging and disposal of riverbed material by private companies was listed as another adverse factor.

Specimen Findings

Fuller's crew of 16 surveyors collected more than 8,500 living mussels during 1977, providing a cross-sectional sampling of the river's freshwater mussel fauna. From their scarcity, Fuller concluded that an "unfortunate number" of mussel species were in decline and probably facing extinction—among them the buckhorn (*Tritogonia verrucosa*), bullhead (*Plethobasus cyphus*), and elephant ear (*Elliptio crassidens*).

No trace was found of the Endangered fat pocketbook. The study said this species "may linger in the backwaters, but its presence in the Upper Mississippi River in 1977 was in question." Similarly, no specimens were located of the rare narrow papershell (*Leptodea leptodon*)—also called the scale pearly mussel—and salamander mussel (*Simpsoniconcha ambigua*). The status of the narrow papershell is under review for possible listing under the Endangered Species Act.

Another rare species, the spectacle case mussel (*Cumberlandia monodonta*), was discovered at two sites. This species apparently can live in wing dams that have been built at right angles to the shore to control the flow of the river.

Exotic Intruder

The study discovered the presence of an exotic species—the Asiatic clam (*Corbicula manilensis*)—in the St. Croix River. The species is known to dislodge mussels from the streambed, uprooting them to their eventual death. Fuller said if the Asiatic clam becomes established in the beds where the Higgins' eyes are located and elsewhere, it could pose as big a threat to the mussel population as any of the other adverse factors.

Parasitic Phase

An associated problem is the availability of the proper fish species to serve as glochidial hosts. Many species of freshwater mussels reproduce by the male shedding his sperm into the current; the sperm is then picked up downstream by the female whose eggs become fertilized as they are extruded from the oviducts. The fertilized eggs are held in the gills, where they develop into larval forms known as glochidia.

In some genera, the glochidia develop into juveniles while still in the mussel's gills. But in others, such as *Lampsilis*, the glochidia attach themselves to the gills and body of a passing fish. The larval bivalve then soon becomes covered by fish tissue, which forms a cyst or capsule. After its metamorphosis in this parasitic stage, a juvenile mussel then drops from the fish to the stream bottom, where it grows to adulthood.

Fuller believes further research is needed into the glochidiosis process as no larval hosts have been identified for three of the rare mussels.

Biological Opinion Due

Additional information gathered during this year's survey effort will be available in the form of a second report around the first of the year. These and related data will then be employed by the Service in preparing its biological opinion on the overall impacts of the Corps' channel maintenance operations, which the Service expects to issue by early spring.



Photo by Dona Finnley

Samuel L. H. Fuller, the malacologist selected by the Corps to lead its survey effort, examines a pigtoe mussel

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