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MID-TERM REPORT

TO

THE U.S. FISH AND WILDLIFE SERVICE
ASHEVILLE AREA OFFICE
50 SOUTH FRENCH BROAD AVENUE
ASHEVILLE, N.C. 28801

FROM

ECOSEARCH, Inc.
7 HAWTHORNE STREET
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TITLE

STATUS SURVEY OF THE TAR RIVER SPINY MUSSEL

PREPARED BY

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December 21, 1982
Date

CONTENTS

INTRODUCTION

On May 14, 1982, a contract was awarded to ECOSEARCH, Inc. for a status survey of the Tar River Spiny Mussel in the Tar River System of North Carolina. The primary objective of the study is to assist the SERVICE to determine if this species (here referred to the Genus Canthyria Swainson) should be proposed for the Endangered Species Act Protection. Secondarily, the study is to provide information on potential recovery and management measures for the species. In meeting these objectives, a status survey of the Tar River and its tributaries was to be conducted throughout their entire lengths beginning at a point where the streams have acquired a width of about six meters. The following work elements were specified:

"a. Review and compile presently available information on range, occurrence, and life history of the species.

b. Conduct field surveys using glass bottom buckets and snorkling of known and suspected habitats to determine the species entire distribution and an indication of its population density. Quantitative mussel samples will be taken where dense mussel population are encountered and where the Tar River spiny mussel is found to occur. This will be accomplished using a $\frac{1}{4}$ meter square sampler which will be randomly placed to cover approximately one percent of the mussel bed area.

c. Characterize habitat requirements for the mussel.

d. Review and summarize existing information concerning the reasons for any decline in the species and its habitat.

e. Identify current and foreseeable threats to the continued existence of the species and its habitat.

f. Evaluate possible management, conservation, and recovery actions.

g. Clarify any taxonomic question involving the species.

h. Prepare a final report summarizing the results of the above information.

i. Be available to present technical information at any public meetings or hearings that are necessitated by the listing of the species by the SERVICE as endangered or threatened, as well as any required meetings for the designation of Critical Habitat for these species."

A mid-term report is to be delivered to the Project Officer by January 1, 1983, providing a summary of work accomplished. The present document constitutes that report. A final, more detailed, report is to be submitted by May 31, 1983. That will be done in accordance with the provisions of the contract.

The following pages describe in general terms the work which was carried out in 1982 and the most important results which were obtained. A manuscript describing the results of a comprehensive mussel survey carried out by the writer and his wife in 1977 is

already on file with the Service. The final report for the 1982 contract will discuss the results of our 1982 work in detail and will include pertinent information from the 1977 survey and from other collections and observations made in 1978 and 1979.

MATERIALS AND METHODS

On May 30, 1982, the ECOSEARCH team consisting of A.H. Clarke and J.M. Clarke, with vehicles, canoe, and other field equipment, travelled from Massachusetts to Washington preparatory to surveying the Tar River. Although rain had been reported to have been light for at least a week, we learned that water levels were still too high. Mussels can only be efficiently collected during periods of low water; at other times many specimens are missed and results are incomplete and misleading. Long periods of heavy rain also occured in North Carolina during this period so we were forced to return to Massachusetts.

On June 27, as soon as previously high water levels in the Tar River appeared to be at reasonably levels (as reported by the U.S. Geological Survey in Raleigh, N.C.) we travelled to the area of the Tar River in which water levels were lowest, i.e. the upper part of the river, and began work. Nine river sites (stations 1905-1913), mostly in Granville County, were carefully searched. On July 5 heavy rain again fell and water levels which had been moderate in the upper river rose dramatically. Since continuing wet weather was forecasted, we left the area.

On August 8, Tar River water levels had dropped to a moderate level and we travelled again to the research area. Between August 10 and 17, several more survey sites were searched and one day was spent (with R.G. Biggins) carring out a float survey from U.S. Rt. 1 to Franklin County road 1003. On August 18, present rain

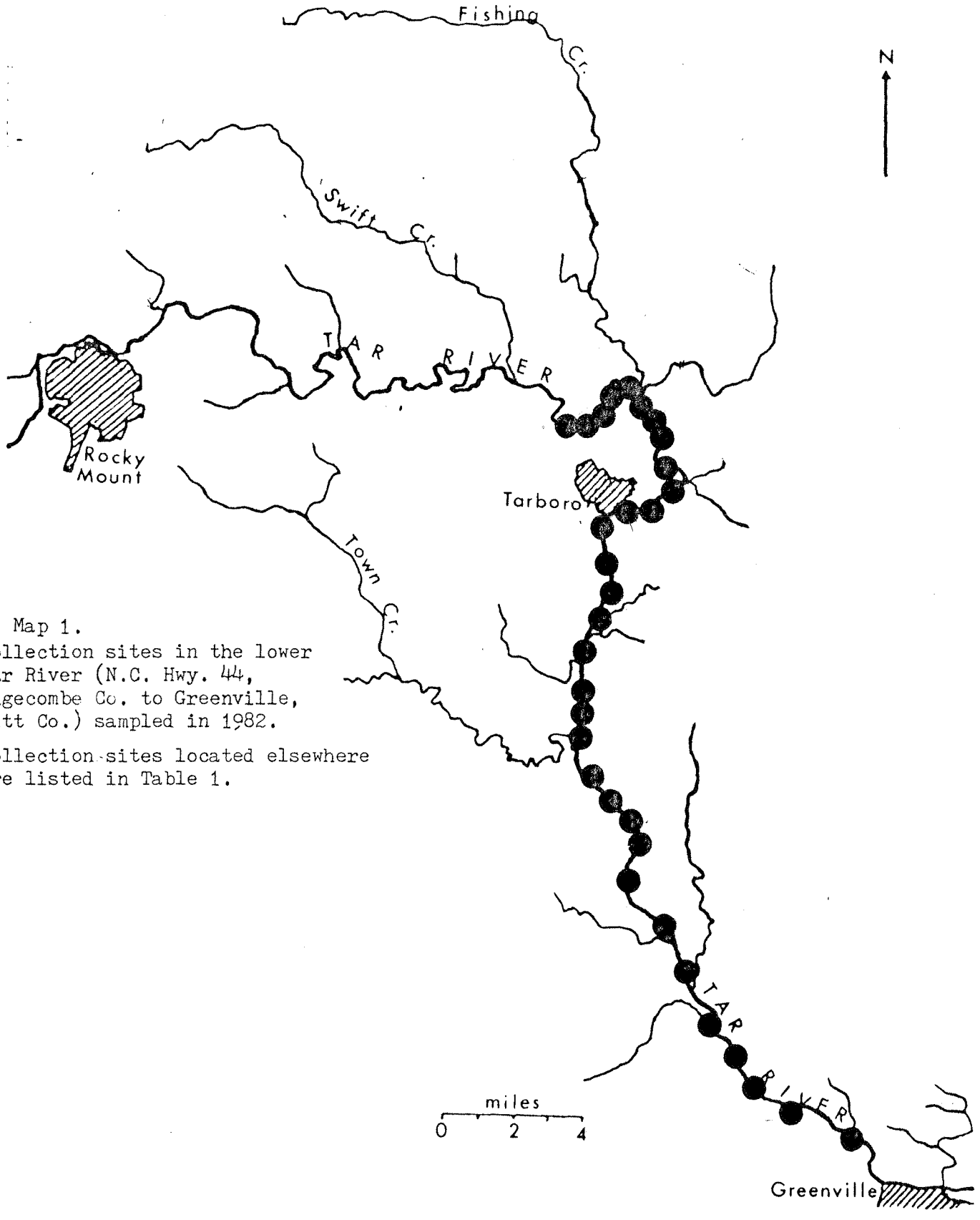
and the forecast of more rain again forced our departure from the area.

On September 2, a fourth trip was made to the Tar River. Water levels were low. The ECOSEARCH team carried out three float surveys of long sections of the Tar River in Edgecombe and Pitt counties, a fourth survey in Edgecombe County was done by A.H. Clarke and R.G. Biggins and a fifth in Pitt County was done by R.G. Biggins and D. Lenat. These float surveys completely covered about 35 miles of river (see map 1) beginning at North Carolina Rt. 44 (northwest of Tarboro) and ending at Greenville. As demonstrated below this is the most important portion of the Tar River with respect to occurrence of the Tar River Spiny Mussel. An additional float survey was also done by A.H. Clarke and D. Lenat in the vicinity of Spring Hope in Nash County and several individual stations were also searched by the ECOSEARCH team.

On September 12 we were forced to leave the area to take up other contract obligations for the Fish and Wildlife Service in the Kanawha River West Virginia.

The total number of collections made in 1982 was 51 and the total number of collections which are available for data for the final report is about 80.

The stations which were searched in 1982 are listed on Table 1. A few specimens of non-endangered species were collected for later examination and ecological data were gathered at each station. At each station where Canthyria occured, photographs and sedement



Map 1.
Collection sites in the lower Tar River (N.C. Hwy. 44, Edgecombe Co. to Greenville, Pitt Co.) sampled in 1982.

Collection sites located elsewhere are listed in Table 1.

samples were taken, depth transects were measured, and the location of each mollusk specimen found within a 10 M square (with Canthyria in the center) was mapped. All of these observations, including lists of species and tabulation of numbers of specimens, will be reproduced in the final report.

TABLE 1

Tar River North Carolina Survey

Field Stations - 1982

Sta. No.	Date	Collectors	Locality (1)
1905	June 30	AHC	8 mi. S of Oxford, Granville Co.
1906	June 30	AHC & JMC	6 mi. SSW of Oxford, Granville Co.
1907	July 1	AHC	1.0 mi. N and 3.5 mi. W of Oxford, in Person Co.
1908	July 1-2	AHC	2.5 mi. W of Berea, Granville Co.
1909	July 3	AHC	4.5 mi. NE of Stem, Granville Co.
1910	July 3	AHC	4.5 mi. NE by ENE of Stem, Granville Co.
1911	July 3	AHC	0.4 mi. NNE of Wilton, Granville Co.
1912	July 4	AHC	4.5 mi. SW of Kittrell, Vance Co.
1913	July 4	AHC	5.0 mi. SSE of Spring Hope, Nash Co.
1925	Aug. 10	AHC & JMC	Old Sparta, Edgecombe Co.
1926	Aug. 11	AHC	Chilcod Creek, 2.1 mi. W of Grimesland, Pitt Co.
1927	Aug. 16	AHC	0.3 mi. E of US Rt. 1, 5 mi. N of Franklinton, Franklin Co.
1928	Aug. 17	AHC & RGB	0.2 mi. downstream from Sta. 1927
1929	Aug. 17	AHC & RGB	ca. 2.5 mi. downstream from Sta. 1927
1930	Aug. 17	AHC & RGB	ca. 3.7 mi. downstream from Sta. 1927
1931	Aug. 17	AHC & RGB	ca. 4.2 mi. downstream from Sta. 1927
1932	Aug. 17	AHC & RGB	ca. 4.7 mi. downstream from Sta. 1927
1933	Aug. 17	AHC & RGB	ca. 5.2 mi. downstream from Sta. 1927
1934	Aug. 17	AHC & RGB	near Franklin Co. rd. 1003, ca. 5.7 mi. downstream from 1927
1934A	Aug. 18	RGB	100 yds. above River Front Pk., Tarboro, Edgecombe Co.

(1) All localities are in the Tar River unless otherwise noted.

Sta. No.	Date	Collectors	Locality
1953	Sept 10	AHC & DL	Near Rt. 64, near Spring Hope, Nash Co.
1954	Sept. 10	AHC & DL	2.5 mi. SW of Spring Hope, Nash Co.
1955	Sept. 10	AHC & DL	3.0 mi. SW of Spring Hope, Nash Co.
1956	Sept. 10	AHC & DL	2.5 mi. below Rt. 64, Nash Co.
1957	Sept. 10	AHC & DL	3 mi. below Rt. 64, Nash Co.
1957A	Sept. 11	AHC	Fishing Cr., Hwy. 97, ca. 10 mi. NNE of Tarboro

Sta. No.	Date	Collectors	Locality
1934 B	Aug. 18	RGB	below Webb's Mill, Nash Co.
1934C	Aug. 18	RGB	above Webb's Mill, Nash Co.
1934D	Aug. 18	RGB	10 mi. SW of Rocky Mount, Nash Co. (Hwy 58
1935	Sept. 5	AHC & JMC	0.5 mi. S of Tarboro, Edgecombe Co.
1936	Sept. 5	AHC & JMC	1.0 mi. S of Tarboro, Edgecombe Co.
1936A	Sept. 5	AHC & JMC	1.5-5 mi. S of Tarboro, Edgecombe Co.
1937	Sept. 5	AHC & JMC	1.5 mi. N of Old Sparta, Edgecombe Co.
1938	Sept. 7	AHC & JMC	0.5 mi. below Hwy. 44, ca. 2.5 mi. N of Tarboro, Edgecombe Co.
1939	Sept. 7	AHC & JMC	ca. 1.0 mi. below Hwy 44, Edgecombe Co.
1940	Sept. 7	AHC & JMC	ca. 2.5 mi. below Hwy 44, Edgecombe Co.
1941	Sept. 7	AHC & JMC	ca. 3.0 mi. below Hwy 44, Edgecombe Co.
1942	Sept. 7	AHC & JMC	ca. 3.5 mi. below Hwy 44, Edgecombe Co.
1943	Sept. 7	AHC & JMC	ca. 0.2 mi. below mouth of Fishing Cr., Edgecombe Co.
1944	Sept. 8	AHC & RGB	ca. 0.3 mi. below mouth of Fishing Cr., Edgecombe Co.
1945	Sept. 8	AHC & RGB	ca. 1.2 mi. below mouth of Fishing Cr., Edgecombe Co.
1946	Sept. 8	AHC & RGB	ca. 1.5 mi. below mouth of Fishing Cr., Edgecombe Co.
1947	Sept. 8	AHC & RGB	2.0 mi. ENE of center of Tarboro, Edgecomb Co.
1948	Sept. 8	AHC & RGB	1.5 mi. E of center of Tarboro, Edgecombe
1949	Sept. 8	AHC & RGB	upstream end River Front Pk., Tarboro, Edgecombe Co.
1950	Sept. 9	AHC & JMC	roadside park, Old Sparta, Edgecombe Co.
1950A	Sept. 9	AHC & JMC	sandbars between Old Sparta & Penny Hill
1951	Sept. 9	AHC & JMC	0.5 mi. S of Penny Hill, Pitt Co.
1952	Sept. 9	AHC & JMC	2.0 mi. NE of Falkland, Pitt Co.
1952A	Sept. 9	AHC & JMC	0.5 mi. N of Falkland, Pitt Co.
1952B	Sept. 9	RGB & DL	between Falkland & Greenville, Pitt Co.

GENERAL RESULTS

During the 1982 survey 10 living specimens of the Tar River Spiny Mussel,and 2 freshly dead specimens, were found. The stations which yielded Canthyria sp. are listed in Table 2 and their locations are shown on Map 2. The living specimens were each examined, measured, photographed, and (with one exception) were all quickly replaced in the substrate in a natural position close to their original locations. The single living specimen which was inadvertently retained is the adult Canthyria collected at Station 1946. It had no spines and it was not recognized as a Tar River Spiny Mussel when it was collected. This is unfortunate, but it was carefully relaxed and preserved and it will pdovide the only available anatomical material for a critical study by the writer of the taxonomy of this new and unusual unionid.

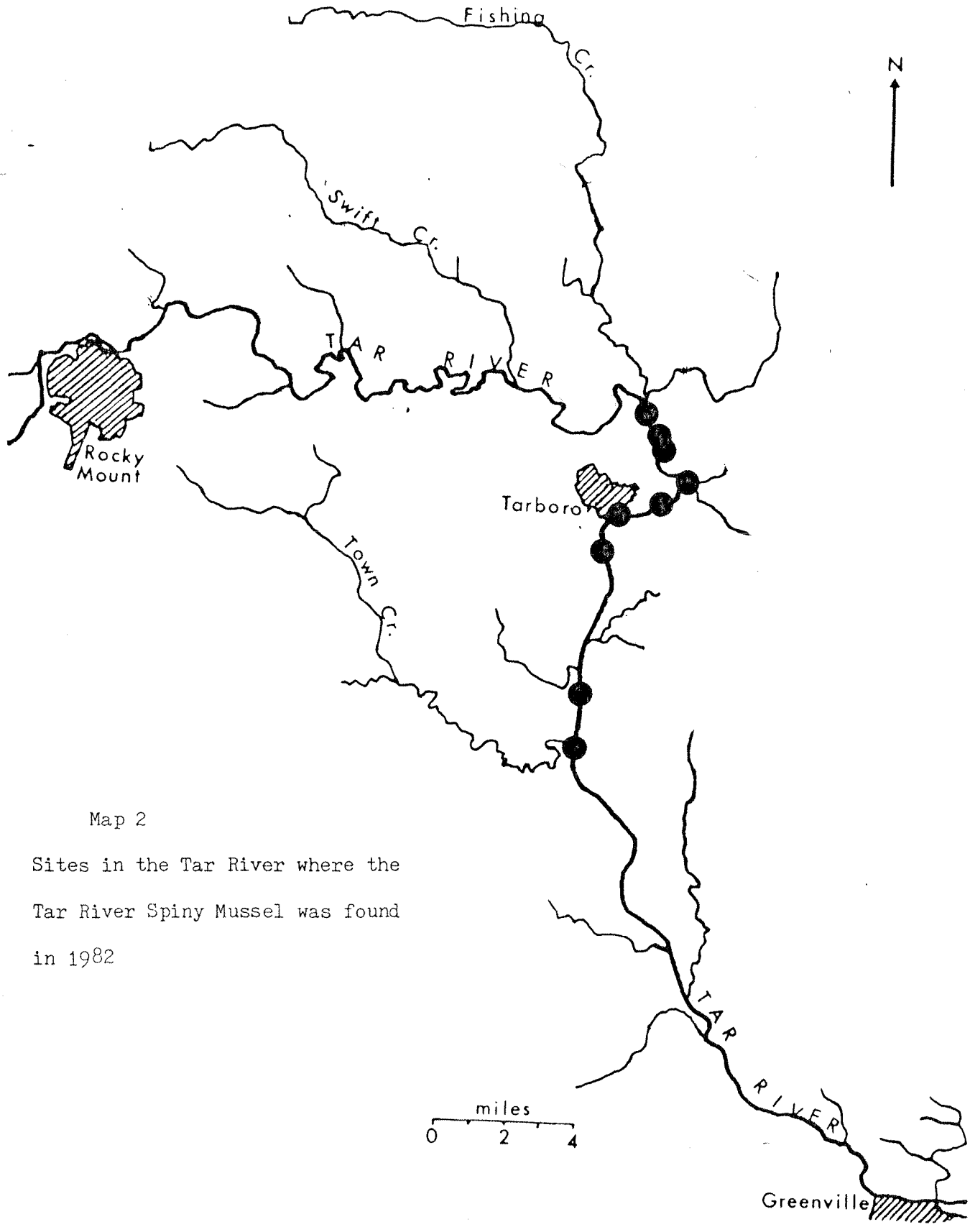
The mussel species most frequently associated with Canthyria are Elliptio complanata (Lightfoot) and a lampsiline, tentatively identified as thin-shelled specimens of Lampsilis cariosa (Say) (? = L. crocata (Lea)). It may, however, belong to the species Lampsilis (Leptodea ?) ochracea (Say). The anatomy of the lampsiline species and other critical species will be studied in an effort to resolve the taxonomic problems which exist.

Other unionid species found in the Tar River are Elliptio lanceolatus, Uniomerus tetralasmus, Fusconaia masoni, Alasmidonta undulata, A. heterodon, Lasmigona subviridis, Anodonta cataracta, A. imbecilis, Strophitus undulatus, Lampsilis radiata radiata, and Villosa constricta. Sphaeriids include Sphaerium striatinum

TABLE 2

Stations Where Tar River Spiny Mussels Were Found

Station No.	Specimens
1925	1 living adult (without spines)
1934A	1 juvenile (freshly dead)
1936	1 living juvenile
1937	1 living juvenile
1944	1 adult (freshly dead)
1945	1 living adult
1946	2 living juveniles 1 living adult (without spines)
1947	1 living juvenile
1948	2 living adults



Map 2

Sites in the Tar River where the Tar River Spiny Mussel was found in 1982

and Musculium transversum, and the gastropods are Campeloma decisum, Lioplax subcarinatum, Gillia altilis, Goniobasis virginica, G. catinaria dislocata, Mudalia carinata, Helisoma anceps, and Physa heterostropha. Corbicula fluminea occurs from above Tarboro (about $2\frac{1}{2}$ mi. downstream from N.C. Rt. 44) to Greenville and beyond, but not yet in the middle or upper portions of the Tar River.

DISTRIBUTION OF THE TAR RIVER SPINY MUSSEL

In the Tar River, the Tar River Spiny Mussel apparently occurs only between the mouth of Fishing Creek, about 3 mi. N of the center of Tarboro, and the mouth of Town Creek at Old Sparta, all in Edgecombe County, North Carolina. This reach spans a distance of approximately 20 river miles. Canthyria is rare, however, even in this region. Details of its population density and ecology will be analysed further and will be presented in the final report. It is already clearly apparent, however, that the Tar River Spiny Mussel is rare and endangered. In my opinion it should be protected under the Endangered Species Act.

Although positive evidence is lacking, there seems to be sufficient correlation between water quality and Canthyria distribution to suggest a causal relationship. The Tar River immediately downstream from Rocky Mount has been recently polluted and does not support populations of freshwater mussels. As the river approaches Tarboro the water quality improves and scattered individual mussels occur, but it does not improve sufficiently to allow dense populations of mussels, or even of Corbicula, to flourish until the vicinity of Fishing Creek is reached. Fishing Creek, although too slow-flowing to provide the proper sandy substrate for Canthyria, apparently contributes enough water of good quality so that the Tar River downstream from Fishing Creek can support good mussel populations, including Canthyria. This

condition prevails for about 20 miles until the river reaches the mouth of Town Creek. The effect of Town Creek water is more speculative, but it appears to be significantly lower in dissolved calcium (30 ppm $CaCO_3$ on September 11, 1982) than Tar River water above Town Creek (40 ppm $CaCO_3$ on that date) and this may be enough to reduce Tar River water below the threshold of hardness required for long-term survival of Canthyria. Downstream from Town Creek the river ecology also gradually changes; the current speed lessens, sandy beaches and sandbars become scarce, and mussel populations become sparse.

I believe that the region cited above is the only portion of the Tar River where Canthyria occurs. Previously it had also been reported, by another worker, as a single empty shell, from the vicinity of Spring Hope in Nash County. We have searched on several occasions in that area, and carried out a float survey of a significant part of it in 1982, and found no trace of Canthyria. The river ecology in that area differs from that in the Tarboro-Old Sparta region: the river is much narrower and is without the predominance of broad stretches of clean sand characteristic of the latter area.

We have already described the wet weather conditions which, despite the expenditure of much time and money, prevented us from completing reliable float surveys of the whole region above and below Spring Hope in 1982.

If the Service wishes to have more work done on the Tar River, however, we will do it.

PROSPECTS FOR THE FUTURE

Fortunately for Canthyria survival, the upper portion of its distribution coincides with the source of the Tarboro municipal water supply and good water quality there will no doubt be maintained. Although the reach below Tarboro is used for recreation and will also receive some protection on that account, it could be ruined as a Canthyria habitat by a single pollution event.

The Tar River is a popular fishing stream and fishing pressure is high, but according to local fishermen, all of its fish populations have been declining in recent years. Unfortunately we know nothing about the life history of this Canthyria, nor the identity of its fish host. If this trend continues it is possible that its fish host might become so reduced in numbers, even before its identity is known, that successful reproduction of the mussel might be impared.

Another threat to the survival of the Tar River Spiny Mussel, and one which is difficult to mitigate, is the introduced Asian Clam Corbicula fluminea (Müller), a pest species which is rapidly spreading throughout the country. Previous collections have shown that Corbicula did not occur in the Tar River in 1978 or earlier, and was not in the Old Sparta area even in 1980. In 1982 it was not only present in the lower Tar River (downstream from a point about $2\frac{1}{2}$ miles below N.C. Hwy. 44 in Edgecombe County) but was abundant at Old Sparta and further downstream to beyond Greenville, where it reached densities exceeding 1000 per square meter. Apparently the water pollution below Rocky Mount has imposed a barrier to the upstream spread of this invader.

It has been asserted and widely accepted, that dense Corbicula populations will only develop in disturbed habitats and that decreases in unionid populations are not caused by Corbicula invasions but ordinarily preceed them. In my opinion this is only partly true, i.e. the habitat cannot be crowded with mussels or Corbicula larvae will be consumed by unionids and mass invasions will not occur. Healthy habitats, such as the Tar River near Tarboro, may not be so full of unionids that space and food are limiting, however, and Corbicula will perhaps become dense there.

It has been observed that dense Corbicula populations effectively compete for food with indiginous unionid populations and that this produces emaciation and high mortality in the unionids. I have also suggested, but have not demonstrated, that dense Corbicula populations may also filter unionid sperm out of the water and impede unionid reproduction. Further consideration of the ecological relationships of Corbicula and unionids are out of place here but the expected spread of Corbicula in the Tar River and its tributaries may contribute evidence bearing on this problem. The huge population of Corbicula now in the Tar River is ominous in relation to future survival of the Tar River Spiny Mussel and lends urgency to the need for life history studies and for conservation and recovery of that species. Artificial culture of Canthyria, or transplants of the species , might be necessary for its survival in the face of heavy competition from Corbicula.

In conclusion, it should be mentioned that an important threat to Canthyria survival resides in the activities of malacologists and shell collectors. An enthusiastic taxonomist, for example, intent on producing a statically robust comparison between the 3

existing species of Canthyria, might collect such large population samples that the Tar River population is reduced to a dangerously sparse level. Furthermore, a surprisingly large proportion of museum scientists believe that if a species is endangered they should quickly go out and collect specimens for their museum while they are still available. And finally, shell collectors may also pose a serious problem for an unusual, localized species such as this.

All of these threats would be substantially reduced if the Tar River Spiny Mussel could be added to the federal List of Endangered Species. In my opinion the species clearly deserves such treatment and I urge the Service to formally propose it for such listing.