MALACOLOGY DATA NET

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ANNOUNCEMENT

Malacology Data Net embodies a new concept in biological publication. It is an information-exchange network for research workers whose discoveries cannot wait a year to see the light of day. It is an inexpensive and democratic system where each author is his own editor and publisher. It is a permanent record of birth and development of ideas and a vehicle for initiating redistribution by sale of un-needed scientific literature. But most of all it may be a service to malacology and a promoter of greater efficiency in our chosen field.

Good research builds on the results of work by others, but if research results are to be made available only through established scientific journals which take a year to publish, or through science news journals which are able to accept only a minority of the good papers submitted, our goal of understanding the enormous diversity of life on earth will never be approached. This communication bottleneck has been solved by nuclear physicists and space technologists who converse daily through a continental computer network. Some biologists in a few major institutions may soon have the same priviledge. But as Albert Einstein once said: "perfection of means and confusion of goals seems to characterize our age". Malacologists don't need to communicate research results by computer network, but some genuine and dramatic improvement in our glacial progress is clearly essential.

The tools for such an improvement are available to us all. We need only our own energy, a copying machine or offset printer, and the mails. Freedom of the press is a right guaranteed by the Constitution and available to each of us.

The ECOSEARCH series of Malacology Data Net was engendered by a need to supply urgent information without which two species of spiny mussels, *Canthyria collina* (Conrad) and *C. steinstansana* (Johnson and Clarke), might quickly become extinct. It will continue to be published at irregular intervals. Malacology Data Net is an open-ended system and its name is freely available to other workers who produce their own autonomous series but who also wish to facilitate library storage and retreival. The only guidance one needs are the famous words of Theodore Roosevelt: "Be sure you are right, and then go ahead!"

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Competitive Exclusion of *Canthyria* (Unionidae) by *Corbicula fluminea* (Müller)

by Arthur H. Clarke

SUMMARY: The James River endemic unionid *Canthyria collina* has lost roughly 95% of its distributional range and of its numbers since about 1970. Evidence indicates that this is almost entirely attributable to competition from *Corbicula fluminea*. The rare Tar River endemic *Canthyria steinstansana* is probably close to the point of extinction from the same menace. Mechanisms which account for these conditions are proposed and an immediate rescue operation for *C. steinstansana* is urgently called for.

INTRODUCTION

From 1982 through 1984 ECOSEARCH, Inc. carried out detailed status surveys of the Tar River Spiny Mussel *Canthyria steinstansana* (Johnson and Clarke, 1983) in North Carolina and the James River Spiny Mussel *C. collina* (Conrad, 1836) in Virginia for the U.S. Department of the Interior, Fish and Wildlife Service (FWS). Complete reports on the general results of that and previous work (Clarke, 1983, 1984) are on file at the FWS so only a brief account is given here. Principally as a result of that work *C. steinstansana* has now been classed as "endangered" on the federal "List of Endangered and Threatened Species" and *C. collina* has been proposed for "threatened" status on that list.

Although placement of a troubled species on the federal list is an important conservation achievement, that does not guarantee that the species can be effectively protected. That issue and other considerations will be addressed in this report.

Acknowledgements: - For valuable assistance I wish to thank my wife Judith and several other friends and colleagues, viz. Mr. R.G. Biggins, Mr. Andrew Gerberich, Dr. M.J. Imlay, Ms. Helen A. Kitchell, Mr. Steven Moyer, Dr. R.J. Neves, and Mr. Michael Zeto.

MATERIALS AND METHODS

A total of 91 site investigations were carried out in the Tar River System from 1977 to 1983. Collections were made at bridge access points and by river runs of 5 to 10 miles using a canoe. Each site was searched for about 0.8-1.5 hours by 2 to 4 collectors and some were searched several times. Gear included wet suits, snorkels and masks, and veiwing boxes; quantitative collections using quadrats were made; and comparable data on species occurences and ecological parameters were determined at each site and entered on standard data sheets.

Seventy-three site investigations were carried out in the James River System in 1984. Collections were made from numerous road access points in the tributaries and in the James River itself, where access was much more limited, collections were made by means of river runs with a canoe. The same gear and procedures were employed as in the Tar River study.

RESULTS AND DISCUSSION

Canthyria collina and the James River System.

The distribution of *C. collina* prior to 1970 included the entire James River above Richmond, VA. and several of its tributaries, i.e. the Rivanna River, the Calfpasture River-North River System, the Johns Creek-Craig Creek System, the Bull Pasture-Cow Pasture River System, Jackson River, and the Potts Creek System. Our survey showed that in 1984 it existed in only two headwater tributary systems, the Johns Creek-Craig Creek System and the Potts Creek System. Although C. collina still numbered about 25,000 to 50,000 individuals, between 1970 and 1984 its populations size and its area of distribution had been reduced by about 95%.

According to Diaz (1974) Corbicula fluminea first appeared in the James River (near Richmond) in the early 1970's. Our 1984 survey showed that except for a few polluted areas not inhabited by any bivalve mollusks (lower North River, lower Jackson River and Tye River), Corbicula had spread throughout nearly the whole of the James River System and that the distributions of Corbicula and of Canthyria there were mutually exclusive. To put it in another way, except for a few polluted areas where no bivalves occurred, in 1984 the only areas where Canthyria still survived were the areas into which Corbicula had not yet penetrated.

Six other species of unionids also occurred in the James River System: Elliptio complanata, E. lanceolata, Fusconaia masoni, Alasmidonta undulata, Strophitus undulatus, and Villosa constricta. In 1984 all of these still occurred in areas where Corbicula thrived as well as in areas still unaffected by Corbicula. But in the James River only E. complanata was abundant and all other unionids were rare whereas in headwater areas where Corbicula was absent S. undulatus, A. undulata, and V. constricta were common, E. lanceolata was occasionally found, and E. complanata was rare or absent. Other studies (e.g. Boss and Clench, 1967) have shown that before 1970 all of these species were common and occurred together in the James River. The evidence therefore indicates that C. collina is entirely unable to withstand competition from dense populations of Corbicula, that the abundance of F. masoni, A. undulata, and S. undulatus may be seriously reduced by Corbicula, and that E. complanata may be unaffected.

Canthyria steinstansana and the Tar River System.

The historical distribution of C. steinstansana in the Tar River is known to have included four sites, viz an area about 2 miles west of Spring Hope, Nash Co. (in 1967-1968); Tarboro and Old Sparta, Edgecombe Co.; and 1.4 miles east of Falkland, Pitt Co. (all in 1966). The 1982-1983 survey revealed that C. steinstansana then lived only within a 12-mile reach of the Tar River in the vicinity of Tarboro. (Its absence from the Nash Co. site is believed to have been caused by highway and bridge construction which, while it was underway, had obstructed river flow; C. steinstansana lives only in free-flowing habitats with sandy substrates). The population in 1983 was estimated to contain only 100 to 500 individuals, making it perhaps the rarest unionid species in North America.

The Tar River and James River cases show alarming parallels. Prior to 1980 Corbicula was absent from the Tar River System. In the summer of 1980 it was still absent above Old Sparta, Edgecombe Co., but it may have been present below that point. By the summer of 1982 it was abundant (up to 1000 per square meter) in the whole river reach below Old Sparta, and it also occurred rarely upstream as far as a point 2 1/2 miles below N.C. Highway 44 (north of Tarboro, Edgecombe Co.). By the summer of 1983 it had spread farther: about

10 miles up Fishing Creek and up the Tar River to U.S. Highway 64 Alt. near Spring Hope, Nash Co., but it was not yet abundant in those areas. *Corbicula* is now common to abundant throughout the entire 12-mile reach where *Canthyria steinstansana* still occurred in 1982 and 1983.

Preliminary searches in 1985 by FWS staff in that 12-mile reach did not reveal any living specimens of *C. steinstansana*. Nevertheless present recovery plans for *C. steinstansana* do not make any provision for rescuing any surviving individuals (if any can be found) from the *Corbicula*-infested area. Apparently most biologists do not yet believe that *Corbicula* may exert a harmful impact on any mussel populations.

CONCLUSIONS

I believe that concerned malacologists should now revise their opinion (e.g. see Fuller & Imlay, 1976 and Kraemer, 1979) that *Corbicula* becomes abundant only in disturbed areas which are losing any unionid populations they may have had anyway, and that proliferation of *Corbicula* therefore does not harm native unionid populations. In some parts of the United States *Corbicula* clearly does become abundant in undisturbed areas, and in some regions where that occurs some sensitive unionid species surely do suffer.

In general, because of the great abundance of predaceous insect larvae and other invertebrates the epibenthic zone of rivers and lakes must be an exceedingly hazardous environment for tiny juvenile mollusks. Unionids have evolved devices for protecting newly excysted juveniles from epibenthic predators. I propose that these include (a) excystment in an area perhaps already depleted of arthropods by the host fish, (b) development of shell-reinforcing ridges (beak sculpturing), and (c) burrowing far below the epibenthic zone. Corbiculids lack these devices and depend on mass production of young. Densities of benthic insect larvae and other predators are variable in time and space, however, because of variations in many physical, chemical, and biological attributes. In areas where and at times when predator pressure is very high one can confidently predict that only a small proportion of newly-settled Corbicula juveniles will survive, whereas in regions where for any of several reasons predation is low, a large proportion of juvenile Corbicula will survive. After Corbicula are introduced streams of relatively low productivity, such as those in much of the South Atlantic Drainage Area, may be hosts to quite a different scenario of events than streams of high productivity, such as those of the Ohio-Mississippi Drainage Area.

In addition to this we know that adult Corbicula filter from 300 to 800 ml of water per hour (Buttner and Heidinger, 1981). At that rate even a Corbicula population of 200 per square meter, in water 1 M deep under turbulent flow, can theoretically reduce a standing crop of phytoplankton by more than 99% in 24 hours. Although that level of efficiency cannot be achieved in nature it is overwhelmingly likely that in low productivity streams, Corbicula populations of 1000 per square meter must have a devastating effect on a small or moderate crop of phytoplankton which is available as food for native unionids.

Only 3 species of Canthyria (Swainson) exist, C. collina in the James River System of Virginia, C. steinstansana in the Tar River System of North Carolina, and C. spinosa (Lea) in the Altamaha River System of Georgia. The unusual, disjunct, locally-endemic distribution of the three species indicates that Canthyria may not be able to withstand vigorous biological competition. Gardner et al (1976) have already shown that C. spinosa starves in the presence of abundant Corbicula. In this paper we have provided evidence that C. collina also cannot withstand competition from Corbicula. These facts, together with recent observations in the Tar River, indicate that the already rare species C. steinstansana is probably in imminent danger of extinction from the same menace.

Malacologists and government officials are urged to abandon the theory that competition from Corbicula cannot and does not have any deleterious effect on any Unionidae anywhere. That viewpoint is dangerous and is a detriment to unionid conservation efforts in North America. If any C. steinstansana still survive they must be moved from the Tar River within the next 2 or 3 months or the species will almost certainly become extinct in 1986.

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