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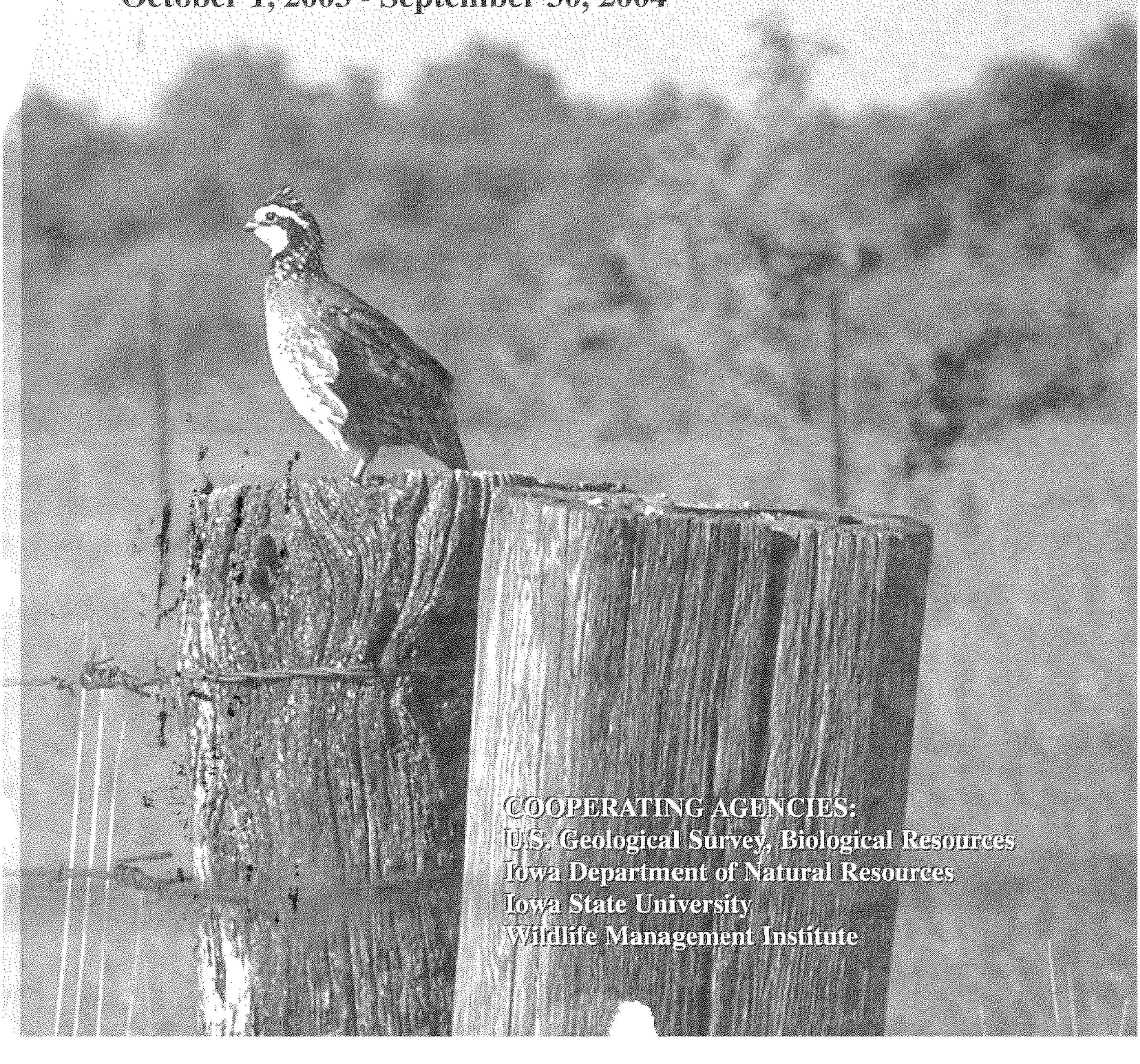

COOPERATING AGENCIES:
U.S. Geological Survey, Biological Resources
Iowa Department of Natural Resources
Iowa State University
Wildlife Management Institute

Genetic variability and geographic structure of *Lampsilis higginsii* mussels in the upper Mississippi River and tributaries

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Duration: September 2001 to September 2004
Funding Source(s): U.S. Army Corps of Engineers

Goals and Objectives:

- Assess the genetic variability and geographic structure within and among five populations of *Lampsilis higginsii* in the Upper Mississippi, St. Croix, and Wisconsin Rivers using three segments of the mitochondrial DNA genome from 30 animals per population.
- Make management recommendations regarding relocations of individuals among populations, specif ically with regard to (a) numbers of animals to be relocated and (b) appropriate geographical sites for relocations.
- Assess the level of genetic variability (number of alleles and percent heterozygosity) of microsatellites in a sample of *Lampsilis higginsii.*
- Provide recommendations on utility of microsatellites for identification of individual females and determination of multiple paternity in *L. higginsii.*

Progress:

The Higgins' Eye Pearlymussel, *Lampsilis higginsii*, is a Federally endangered species, which is in jeopardy of extinction throughout its range, the Upper Mississippi River (UMR) and several associated tributaries. Plans for recovery of this species include a Relocation Plan submitted by the St. Paul District (MVP), Army Corps of Engineers (COE), to augment and/or create *L. higginsii* populations throughout its range. The Relocation Plan includes relocation of adult individuals and a propagation program. Information on the genetic characteristics of *L. higginsii* populations was obtained to make scientifically sound decisions regarding the numbers, localities, and logistical concerns of proposed relocations. The current project focused on surveying genetic variation at three mtDNA genes (1027 nucleotides) of *cytochrome-b*, *cytochrome c oxidase I,* and *16S rRNA*) from an extensive sample of individuals (130) that are distributed throughout the range of the species. We also surveyed nuclear DNA microsatellite variation in 41 individuals, using the genetic primers developed by Eackles and King for the congener *Lampsilis abrupta*. Both the mtDNA and microsatellite analyses were completed in 2004.

Conclusions and Recommendations:

We found a surprisingly high level of genetic variation within populations of *L. higginsii*, using both mtDNA and microsatellite DNA markers. Using mtDNA, we detected 24 genetic forms (haplotypes), which clustered into four groups (clades). Statistical analyses of the mtDNA survey indicate that *Lampsilis higginsii* does not contain genetically distinct populations in the portio ns of the St. Croix and Mississippi Rivers that we studied. The level of genetic variation is high in *L. higginsii*, compared with other endangered species. We found that a small number of individuals sampled contained the mtDNA form typically found in *Lampsilis siliquoidea*, a common and widespread congener that occurs in the Midwest. Similar observations have been made in other animal groups. Additional research is required to determine the cause of this finding and the implications it has for conservati on of *L. higginsii*. Our survey of nuclear DNA using microsatellites included DNA of 41 individuals from several localities and from individuals that have been used in the captive propagation project. We detected between 6 and 25 alleles per locus. This high level of genetic variation at nuclear loci is consistent with the mtDNA findings. A significant deficiency of heterozygotes at most microsatellite loci appears to be due to null alleles, which would limit the utility of these microsatellite primers for studies of paternity and maternity in *L. higginsii.*

The high level of genetic variation that we detected in *L. higginsii* represents a valuable genetic resource that should be preserved in this endangered species. We recommend that when relocations occu r, a large number of individuals should be used in order to preserve as much genetic variation as possible and that more than 100 females should be used in the propagation program. Even though we did not find evidence of differentiation among populations, we recommend that animals used for relocations to new populations should come from nearby sources.

Best Management Practices for Channel Catfish Culture in Plastic-Lined Ponds

Principal Investigator: Joseph E. Morris
Student Investigator: Len Kring (M.S.)
Duration: July 2003 to June 2006
Funding Source(s): Iowa Department of Natural Resources

Goals and Objectives:

- To identify best management practices for culturing channel catfish in plastic-lined ponds.
- To model the nitrogenous and phosphorus outputs derived from culturing channel catfish in plastic-lined ponds.

Progress:

In 2000, the Iowa Department of Natural Resources began using 10 0.4-ha and six 0.04-ha plastic-lined ponds at the Rathbun Fish Hatchery and Research Facility (Moravia, Iowa) to culture game fish that are subsequently stocked into public waters. During the first 3 years of use, inconsistent growth and survival of channel catfish (*Ictalurus punctatus*) were evident. Two separate studies were composed to better understand the culture of channel catfish in these ponds. The effects of stocking density was investigated in the 0.4-ha production ponds. In 2003, stocking densities were 75,000 and 112,000 fish/ha. No significant differences were seen in catfish production; although fish in the lower treatment were slightly larger. The only significant difference with regard to water quality was that the ponds stocked with 112,000 fish/ha had higher concentrations of total phosphorus. In 2004, the same ponds were stocked at rates of 38,000 and 75,000 fish/ha. The fish in the lower treatment exhibited significantly higher specific growth and normalized biomass. These fish were also significantly longer and heavier at harvest. Ponds stocked at a rate of 75,000 fish/ha had significantly higher concentrations of on ammonia, total phosphorus and chlorophyll a. In 2004, the six 0.04-ha plastic-lined ponds were used in conjunction with six 0.08-ha earthen ponds located at the Iowa State University Horticulture Station (Ames, Iowa), to assess the effects of dietary protein percent on the production of channel catfish. Plastic-lined ponds that received the 28% protein feed exhibited significantly higher levels of total phosphorus and turbidity. Earthen ponds that received the 36% protein feed displayed significantly higher concentrations of ammonia and chlorophyll a. Fish fed the 36% protein diet in the plastic-lined ponds had significantly higher relative weights (W_r) then fish fed the 28% protein diet. There was a significant difference in harvest lengths and weights in the earthen, with the fish fed the 36% protein feed being longer. A stocking density between 38,000 and 75,000 fish/ha should be used to culture channel catfish fingerlings in plastic-lined ponds in Iowa, with fish being fed a feed that contains over 28% protein.

Future Plans:

At the completion of fish harvests in October 2005, the effect of feeding rates will be assessed related to the water quality parameters measured during the culture period. Future studies will investigate the use of diets with both lower protein as well as phosphorus for culture of channel catfish fingerlings in plastic-lined ponds.