



Dakota Chapter 2000 Set For Spearfish

The 36th Annual Meeting of the AFS Dakota Chapter is scheduled for February 28 – March 1, 2000 at the Holiday Inn in Spearfish, SD. A wide range of events and technical sessions are being planned. The meeting will begin on Monday afternoon with a Continuing Education Program followed by a social. The arrangement committee is exploring some new and exciting options for the conference.

With the meeting beginning on Monday please consider coming to Spearfish for the weekend, as the Black Hills can offer a wonderful opportunity for a winter vacation. Skiing and snowmobiling can be excellent in late winter. If you have any suggestions for speakers or format please contact Jack Erickson at: 605-394-1759 or E-mail at: erickson@gfrc1.state.sd.us

American Fisheries Society

Dakota Chapter News

Issue 14

July, 1999

President's Message

By Steve Kelsch

Stress: what's in it for fish?

Stress is a puzzling response. It must be adaptive or we wouldn't expect its prevalence among vertebrates. Yet, why does stress result in such maladaptive consequences as reduced growth, reduced reproductive potential, and reduced disease resistance? It is even more difficult to understand why fish would be stressed by such benign stimuli as mild handling, transport, and feeding (at least for newly-captured wild fish). Given these consequences of stress, wouldn't individuals with a reduced stress response better tolerate the rigors of hatchery conditions?

The answer is probably yes. In fact, there has been some effort to develop stocks with reduced stress responses through selective breeding. The hope is that such stocks will show better growth, higher reproductive success, and improved disease resistance under hatchery conditions. Even in the absence of purposeful selection there may be an inadvertent selection for a reduced stress response. This would tend to occur over successive generations if those that are most stressed have reduced fecundity or survival.

It appears that a primary function of the stress response is in the maintenance of homeostasis. When a fish is stressed, a number of metabolic mechanisms kick in that aid the individual in resisting and adapting to tolerate the stressor. There is evidence that exposure to a stressor can lead to greater tolerance of that stressor. This clearly is an adaptive response, but it does not explain why fish would be stressed having detected a stressor only through the senses; for example when newly-captured wild fish are stressed by the approach of someone coming to feed them.

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President's Message (Con't.)

I have proposed that this latter aspect of the stress response is an adaptation to avoid the risk associated with unknown stimuli. Unknown stimuli, such as an approaching hatchery worker, may be dangerous, non-dangerous, or even beneficial, as in the case of the feeder. The stress response prompts a fish to avoid the stress-inducing stimulus by moving to a greater distance until it has learned that the stressor is non-dangerous. It doesn't take long for wild fish to learn to respond positively to the approach of someone coming to feed them. Thus the stress response enables an individual to avoid risk from unknown stimuli while gaining time to learn not to flee from non-dangerous stimuli.

If this is the way that the stress response functions, then there are a number of implications for fisheries professionals. For example, it would not be beneficial to either intentionally or unintentionally select fish with a reduced stress response if their progeny are destined for stocking in the wild. While these individuals may perform better in the hatchery, they would not be as adept at avoiding unknown and potentially risky stimuli in the wild.

Also, if the degree that an individual is stressed can be modified through previous experience with the stressor, we must be aware that practices leading to inadvertent injury or mortality may result in greater stress on subsequent exposure. It is also possible to take advantage of this learning capability. Some studies have found that hatchery fish trained with a predator were better able to avoid predation than novice individuals. Another found that fish had reduced mortality from handling, transport and stocking if they were trained in advance under a regimen of handling followed by feeding. It makes sense that under the latter scenario, individuals had learned that handling was not dangerous and were less stressed by it, thus increasing survival.

When working with fish, we should be aware that confinement has the effect of blocking the escape response, thereby subjecting fish to chronic stress, which leads to reduced growth, survival, and disease resistance. However, if the stress response works in the way that I have described, it may be possible to develop innovative methods that condition fish to tolerate the stresses of handling while leaving untouched the genetic capability and magnitude of the stress response, and the likelihood of survival in the wild.

Fish Species Trading Cards

Dave Lucchesi

The Fish Species Trading Card project is progressing, although slowly. A draft of the narratives and range maps for 25 fish species were sent to Maggie Hachmeister, SDGFP Education Services Coordinator, for review. Underwater images of fish are being provided by the Nebraska Information and Education Department, the Oregon Department of Fish and Wildlife and the Missouri Department of Conservation. Hopefully, the designing and printing of the cards will begin soon. If things go smoothly from here, I hope to have a product ready for Dakota Chapter 2000.

New Well For McNenny

Dennis Unkenholz

Sediment problems have prompted SD Game, Fish and Parks staff to develop a plan to replace one of the wells at McNenny State Fish Hatchery. Engineering plans and requests for proposals have been completed. The well is scheduled to be finished by late fall or early winter of 1999. Ironically the old well has been functioning with very few sedimentation problems for nearly the past year. The replacement well will give a small amount of water supply redundancy which will provide security to the all gravity flow system.

D. C. Booth Day and National Fish Culture Hall of Fame Induction Ceremonies

Steve Brimm

On Sunday, May 16, 1999, ceremonies honoring new members into the National Fish Culture Hall of Fame were held in Spearfish, South Dakota, at the D. C. Booth Historic Fish Hatchery. This year's inductees included James Kahrs, Dr. Otto Tiemeier and Ralph Tritt. Charles Suppes, Department of Conservation in Sweet Springs, MO, Sponsored James Kahrs and Dr. Tiemeier. Ralph Tritt was sponsored by Roger Schulz, US Fish and Wildlife Service, Atlanta, GA. Deborah Burger represented her father, Ralph Tritt, during the ceremonies. Dr. Pat Mazik, American Fisheries Society representative, presented the inductees and their representatives with honorary plaques.

The Booth Society, Inc. hosted a reception in the famous 1905 Booth House on Saturday evening, May 15. James Kahrs established the internationally known Osage Catfisheries, Inc. in 1953. He operated and guided its growth until retirement in 1996. His family continues the operation. Since its beginning, Osage Catfisheries has branched into specialty fish such as paddlefish and sturgeon and many other species. His innovative skills enabled Osage Catfisheries to incorporate and develop worldwide markets. At least ten other nations have received fish from Osage Catfisheries. Jim provided fish products and vast technical and practical fish culture knowledge to help both established and developing nations. Jim was instrumental in organizing the Missouri Aquaculture Association and has been a leader in the Catfish Farmers of America and the National Aquaculture Association. Not only commercial but state, federal and university fishery workers admire, respect and have counted on Jim's advice, counsel and help during their careers. He has had a positive influence on National and World Aquaculture. His foreign activities have fostered and developed a positive international image of the United States.

Dr. Otto Tiemeier's teaching and research career spanned almost 30 years at Kansas State University. He was an excellent teacher and a practical research professor. He began to study stunted catfish problems and supplemental feeding and this led to a strong interest in fish nutrition. Eventually, he obtained construction and operation funds for the Tuttle Creek Research Laboratory. The Lab was operated cooperatively with the University system, Conservation Commission, Bureau of Sport Fisheries and Wildlife and commercial fisheries. The laboratory provided some of the earliest data about nutrition, digestion, metabolism, genetic selection and behavior of channel catfish. The lab was a training facility for students of fisheries, feed milling, endocrinology and zoology. He also published many useful articles about culture and nutrition of catfish. He received numerous awards during his career and trained many graduate and undergraduate students who have achieved recognition in their careers due to his training.

Missouri River Meeting

The Missouri River Natural Resources Committee Annual Meeting will be held in Pierre, SD on August 10 – 12, 1999. The meeting will be held at the Ramkota Inn Rivercenter (605-224-6877) in the Lake Sharpe Room. The MRNRC will finalize their recommended Master Manual Alternative to the Corps of Engineers at this meeting. Contact Jim Riis at 605-773-5535 for more info.

Aquatic Invertebrate/Plants Workshop Postponed

John Lott

The aquatic invertebrate/plants workshop sponsored by the AFS Dakota Chapter, for this summer, has been postponed until the summer of 2000. We were unable to line up a qualified aquatic plant instructor for the course this summer. Dr. Gary Larson of SDSU agreed to teach the aquatic plant portion of the workshop but Dr. Larson was forced to cancel because of hip replacement surgery. Because we want to provide chapter members with a quality workshop, it was decided to postpone the workshop rather than ask another botanist that may not have the expertise with aquatic plants possessed by Dr. Larson.

Workshop arrangements for the summer of 2000 will be made prior to Dakota Chapter 2000 in Spearfish in February of 2000.

Fish Culture HOF (Con't.)

Ralph Tritt's accomplishments included instilling a spirit and ethic in other people, especially young fishery biologists and culturists. He was a self-motivated, practical and dedicated individual. He treated his co-workers, family, job, the fishery resource, his hatchery, agency and the public fishery consumer with the highest respect and dignity. His example was a vital and positive growing experience for the many young people who trained under or worked with him in his 32-year career at the Chattahoochee National Fish Hatchery. Early on he recognized the most important asset of fish culture were the young biologists of who the future depended. Ralph made it his lifetime responsibility to do his utmost to share with fellow fish culturists and promising young biologists everything he knew about fish and fish culture. He had a reputation of being calm, steady, reassuring and having practical advice to resolve a serious problem. Ralph dedicated 32 years of his life to improving fish culture in the United States. He taught others the science and art of fish culture. His tireless efforts produced a cadre of talented fish culturists whose leadership and contributions continue to benefit fish culture. Ralph was instrumental in training his daughter, Deborah Burger. Deborah followed in her father's footsteps as manager of Chattahoochee National Fish Hatchery.

Clean Water Act Amendment

An amendment titled "Fishable Waters Act" will be, if not already, introduced in this session of Congress to revise the Clean Water Act. The act, as it is, has been successful in improving water quality around the country. The bottom line is that there are waters that still do not support fisheries or where the fisheries are threatened. The new amendment will allow work to be done on waters that contain fisheries to protect and/or enhance them. If this bill passes it will mean more funds will be available for fisheries work on a watershed basis. The bill requires that the state fish and wildlife agency be the administering agency to oversee work done through the amendment. This will be a big challenge for states like the Dakotas.

From the Editor

Will Sayler

I would like to take this opportunity to express my thanks to those of you who have submitted items for the newsletter over the past year. The newsletter takes a little time to put out but it is really an enjoyable task when there is enough material. It speaks very highly of our membership that they want to share information with their peers.

Workshop (con't)

The specifics of the workshop will be announced then. The list of people expressing an interest in the workshop will be kept on file and those individuals will be notified once the workshop is rescheduled. If you have any questions please contact John Lott at 605-773-4158.

SD Fisheries Personnel Changes

Mike Whitcher, a long time resource biologist for the SD Department of Game, Fish and Parks in Rapid City recently resigned to go into private business. We wish Mike great success.

Mike's position was filled when Greg Simpson transferred from Operations to the Technical Services position and will be working with Jack Erickson and Ron Koth on Black Hills fisheries management and research.

Eric Unkenholz was hired to fill the position vacated by Greg Simpson. Eric will be working with Lee Vanderbush and Ron Sieg in Region I fisheries management in Rapid City. Eric returns to South Dakota from Florida where he was working with bass.

Small Dam Evaluation Matrix

An effort to evaluate fisheries potential for small dam has been led by Ron Koth of the South Dakota Department of Game, Fish and Parks. The matrix provides an objective process to view all aspects of a small dam in terms of criteria important to fisheries. Criteria such as access, facilities, angler use, population, location to similar waters, management objective, erosion potential in the watershed, shoreline vegetation, shoreline development, basin morphometry, submergent vegetation, watershed/lake area ratio and area are used to calculate a relative ranking of small dams. This process along with similar matrices for other values such as: wildlife, structural, conservation and recreation will be used to develop a composite ranking. This will help planners, engineers, fish and wildlife managers and agency administrator determine where best to spend operation and maintenance money on small dams across the state. As we are all aware many of the W.P.A. dams are old and beyond their useful life expectancy. This process will give objective assistance during the decision making.

Walleye Production at Blue Dog Lake SFH

Jerry Broughton

Blue Dog Lake State Fish Hatchery, SD Department of Game, Fish and Parks staff completed harvest of small walleye fingerlings in June. The return of over 3 million fingerlings was substantially higher than in either 1997 or 1998. All rearing ponds were stocked at a rate of 125,000 fry per acre in 1999, whereas in past year some ponds were stocked at reduced rates (40,000 – 62,500 fry per acre). Ponds were fry stocked at high densities in an attempt to offset egg and fry shortages experienced in South Dakota this spring. Excess small fingerlings were used to supplement or replace fry stockings needs that were not met.

High-density fry stocking rates do present some drawbacks. Low stocking rate ponds typically maintain about double the zooplankton densities for a longer duration, and fish at harvest are nearly twice as large. Zooplankton populations in high-density fry stocked ponds historically crash at the 30-day mark and the "mad rush" harvest occurs in an attempt to get the fish out before they become emaciated or starve.

Pond culture plans at Blue Dog for 2000 will no doubt hinge on the walleye egg take and the number and size of fingerlings that South Dakota fisheries managers request.

AFS Introduced Fish Section Seeks New Members

The AFS Introduced Fish Section (IFS) provides members with an array of information on many aspects of introduced fish. Information is provided through the Section's newsletter, organization and sponsorship of symposia and special publications. The section presents \$150 to the student having the best poster or presentation on introduced aquatic species at the AFS annual meeting. As an incentive for membership recruitment, IFS president Don Baltz will offer \$50 worth of AFS raffle tickets to the AFS member recruiting the most new members to IFS. Membership in IFS is \$5 and should be sent to Charles Brown, IFS Secretary/Treasurer, U.S. Dept of Agriculture, APHIS, 4700 River Rd., Unit 149, Riverside MD 20737-1238

Upcoming Meetings

129th Annual Meeting of the AFS Aug. 29 – Sept. 2, 1999
Charlotte, NC

Iowa – Nebraska Joint Annual Meeting Jan. 25 – 27, 2000
Nebraska City, NE

Dakota Chapter 2000
36th Annual Meeting of the Dakota Chapter of the AFS Feb. 28 – Mar. 1, 2000 Spearfish, SD

Long Time South Dakota Hatchery Worker Passes

In late April, Carl Gibson who had worked 39 ½ years for the South Dakota Department of Game, Fish and Parks passed away. Carl began his career in 1957 with the game division. After a short stint in the Army, he worked in the forestry division before transferring to Cleghorn Springs State Fish Hatchery in 1962. Carl finished his career at Cleghorn when he retired last year after 35 years as a hatchery worker. Carl saw many changes at Cleghorn Springs Hatchery from the 1972 Rapid City Flood and the rebuilding of the hatchery to feeding ground meat to trout to commercial diets. Carl enjoyed brook trout fishing in the isolated streams and ponds of the Black Hills. His wife and children survive Carl.

New AFS executive Director

Dick McWilliams – Iowa Chapter President

The new AFS executive director is Ghassan (“Gus”) Rassam. Dr. Rassam trained in the geosciences, earning a master's degree at Miami University (Ohio) and a Ph.D at the University of Minnesota. He has been a Fulbright scholar and did graduate study at the Sorbonne University in Paris. He has considerable expertise in a variety of areas. He has shared his communication and scientific expertise with numerous government and professional entities. He chaired the Commission on Geological Sciences and served on the executive board of the International Council for Scientific and Technical Information. He was also president of the Association of Earth Science Editors and was a member of the governing board and executive committee of the American Institute of Physics.

Garrison Dam NFH Happenings

Rob Holm

Production at Garrison Dam NFH has been about normal this year. Northern pike production exceeded past year, relative to size produced and we were easily able to meet our requests with 1.4 million fingerlings. A decrease in walleye egg production from Lake Oahe put added pressure on the harvest from Lake Sakakawea. South Dakota Game, Fish and Parks crews assisted the North Dakota Game and Fish crews to collect extra eggs. The weather was exceptionally uncooperative and egg collection fell short of goals. A total of 252 quarts of eggs were kept at Garrison Dam NFH to meet requests for North Dakota, Wyoming, Idaho, Washington and Arizona. The remaining 219 quarts were sent to Blue Dog Lake SFH to help South Dakota meet its walleye egg goals. A total of 3.9 million walleye fingerlings were produced as well as 2.35 million fry to fill out of state requests. This year all walleye fry leaving the hatchery were oxytetracycline marked to aid in the assessment of hatchery produced

Salmonid Committee

Jack Erickson

The Salmonid Technical Committee held its annual summer meeting July 13-14th, 1999 in Lacrosse, Wisconsin.

Approximately 30 fisheries professionals from the Midwest were in attendance. A member from each local AFS Chapter gave an update on their Chapter as well as an update on issues each of their respective State agencies was working on. James Dexter from the Michigan DNR and Pat Rivers from the Minnesota DNR gave updates on current trout regulation proposals in their states as well as histories of past special management regulations. Discussion focused on how to implement biologically sound regulations, the realities of external publics having the ability to lobby for “social” regulations and how can fish and wildlife agencies provide quality fishing opportunities for a large variety of anglers.

The Committee will sponsor a Trout/Trout Angler Workshop the first week of July in 2000. The workshop will explore the current status of trout management; especially, various aspects of human dimensions research as they relate to trout fishing in the Midwest. The program committee plans to invite several plenary session speakers with backgrounds in fish research, human dimension, and sport fishing to address a topic of interest to fisheries researchers, managers and anglers.

Garrison (Con't.)

fish. To date we have harvested 232,000 smallmouth bass fingerlings, a drop from previous years. We are in the process of rebuilding our domestic broodstock and should be back in full swing in a couple of years. Crappie and bluegill are yet to be harvested.

On the coldwater side we have reduced our inventory with the spring stockings. In May 59,000 ten inch rainbow trout and 32,000 ten inch cutthroat trout were stocked across the state. Lake Sakakawea received 223,000 chinook salmon fingerlings. The salmon size at stocking was reduced to 70 – 100 fish per pound this year in an attempt to bring more 3 – 4 year old fish back to the fishery. It was suggested that by stocking the larger smolts we were encouraging the fish to mature at an earlier age.

A cutthroat trout fishery is developing in the Sakakawea tailrace with a May stocking of ten inchers and then a boost of 10,300 twelve-inch fish in July. Anglers are reporting several fish caught.

Pallid sturgeon propagation was successful again this year. We were able to get all three females to ovulate. Problems were encountered with the fry produced from one female. In only eight days post hatch all fry from that female were lost. A cause has yet to be determined. We have five other families on station and they appear to be doing well. The virus identified in the sturgeon population at Gavins Point NFH and Valley City NFH has this program on hold temporarily. The future of this fish is even more uncertain.

Priority Changes in National Fish Hatcheries

Terry Steinwand

The U.S. Fish and Wildlife Service is again reviewing national fish hatcheries across the nation. Under the label of “Positioning the National Fish Hatchery System for the 21ST Century” the Washington office of the FWS has decided that they should prioritize their efforts toward recovery and restoration of native species. Although a noble priority it begs the question, “What does it mean for the Dakotas and their respective recreational fisheries?”

In the not too recent past, the Service attempted to close some of their hatcheries but the efforts met with resistance. We’ve been relatively fortunate because we haven’t had any closures, although we’ve had to vociferously fight at times to prevent closures from occurring. It appears that this is simply another effort, under the guise of recovery and restoration, to again close some national fish hatcheries.

I’m sure some will consider my comments on this issue as being pro-stocking and not willing to address habitat issues. Habitat is certainly the key and there can be no argument with that. However, stocking is sometimes critical to maintaining a viable recreational fishery by

National Fish Hatcheries (Con't.)

supplementing natural reproduction and re-establishing populations following chemical renovation or fish kills. Although stocking is only one tool we use, it can be an extremely important one. Almost all stock for North Dakota (and some for other states) comes from the Garrison Dam and Valley City National Fish Hatcheries, both considered mitigation hatcheries. With restoration and recovery as a priority, mitigation evidently becomes a lesser priority for the USFWS.

In this age of the “user pay” philosophy it would seem reasonable to partially review hatcheries based on what they contribute to the economy. In North Dakota, recreational fisheries contribute approximately \$3.5 million in federal income tax (American Sportfishing Association). Yet the federal fish hatchery budget is only \$362,000 for FY99.

It seems to be early in the “game” but there is very little information coming from the Regional or Washington office on this issue. Although we are considered partners it appears we are relegated to being silent partners in this re-positioning of the national fish hatchery system.

The Inland Fisheries Committee of the International Association of Fish and Wildlife Agencies (IAFWA), of which Doug Hansen is the chairman, passed a motion to express IAFWS support for a formal stakeholder evaluation process to help determine the role of the national fish hatchery system. The Fisheries Administrator Section of AFS has also urged that the Inland Fisheries Committee of IAFWA to continue and increase involvement in this issue.

This issue has the potential to seriously impact how we manage our recreational fisheries in the Dakotas. The national fish hatcheries are critical partners, especially in North Dakota. Restoration and recovery of native aquatic species and providing management activities that maintain healthy aquatic habitats is important but can it be solely placed on the shoulders of the fish hatcheries and the fisheries they help to sustain and enhance.

Gavins Point National Fish Hatchery Activities

Herb Bollig

In addition to our culture of black crappie, white crappie, bluegill, and walleye we work with paddlefish and pallid sturgeon. Below are some brief updates on the paddlefish and sturgeon programs.

The 15 Missouri pallid sturgeon, radio-tagged and PIT tagged on March 18, 1999, were stocked at the confluence of the Platte and Elkhorn Rivers within the boundary of the Two Rivers State Recreation Area approximately 20 miles west on Omaha, NE. The exact stocking location was adjacent to the Cottonwood Campground. Dr. Ed Peters and his crew from the University of Nebraska Lincoln, NE, did the tagging and marking at our hatchery for stocking and monitoring in the Platte River.

Preserved specimens of shovelnose, hybrid and pallid sturgeon have been forwarded to Dr. Rick Mayden, (Dept. of BioSciences, Scientific Collection Facility, University of Alabama, Tuscaloosa, AL). This series of formalin-preserved specimens are part of the developmental work/genetic testing that eventually can be used to distinguish between the species during field and laboratory work. Since hybridization has been documented in the wild, the results of what Dr. Mayden discovers may help us in better distinguishing hybrids from the pure species.

Alf Haukenes and Justin Sipiorski, Dept. of Biology, USD, Vermillion, SD, sampled pallid sturgeon for our cooperative research project entitled “Time-Course Evaluation of Serotonergic Activity in Several Brain Regions of the Pallid Sturgeon. *Scaphirhynchus albus*, Following Exposure to Acute and Chronic Stressors”.

Gavins Point (Con't)

The goal of these experiments is to determine whether or not chondrosteans show increase serotonergic activity in the brain after experiencing stress.

A temporary pallid sturgeon recovery setback occurred in late April when a quarantine was placed on sturgeon being held at the Garrison NFH, Valley City NFH, Gavins Point NFH and the Bozeman FTC. An unknown virus was found in shovelnose sturgeon at Gavins Point, after some mortality had been experienced in the shovelnose sturgeon progeny from 1998. Samples were sent to the Bozeman Fish Health Center for verification and it was found that an unknown virus resembling “iridovirus” was present. There does not appear to be any indication that the fish were contaminated from an outside source. The primary reason for the quarantine was to a. take precautionary measures in order to prevent the spread of an unknown virus, b. protect the pallid sturgeon at all facilities and c. identify the unknown organism. Nonlethal and lethal tissue samples were collected by the Bozeman FHC from pallid sturgeon at all four locations and from the wild populations below Oahe Dam and in the Yellowstone River. Plans have been made to also collect samples from young-of-year sturgeon from wild population in the near future. It is suspected that the unknown virus has always been present in the wild population and can be transmitted by either vertical or horizontal modes to other sturgeon. The testing being conducted should begin to answer this question.

We are continuing our cooperative research with Dr. Paula MaBee, USD, regarding the development of bone/cartilage in paddlefish and pallid sturgeon. The work involves fixing a developmental series of each species in 10 per cent buffered formalin, clearing and staining a subset of specimens and analyzing the osteological development from the cleared and stained specimens.

Dr. Darrel Snyder, CSU, Fort Collins, CO, completed his final report for the Recovery Team entitled “Pallid and Shovelnose Sturgeon Larvae-Morphological Development and Identification” which includes a re-description of pallid sturgeon and comparison with shovelnose sturgeon (revision of the 1994 report).

Five female paddlefish were successfully spawned with us collecting approximately 732,000 eggs. All of the eggs remained at our hatchery for our use in the hatchery production program that will result in large fingerling being stocked in Lake Francis Case, SD.

We are continuing our cooperative research with Dr. Michael Conlon (Creighton University, Omaha, NE) on 2 – year-old pallid sturgeon that focuses on purifying and characterizing structurally hormonal peptides from an extract of the pancreas of the pallid sturgeon.

Dr. Bruce Barton, USD, Vermillion, SD, Continued his stress physiology research on pallid sturgeon. Alf Haukens, USD is examining the physiological responses associated with inflammation in pallid sturgeon. In earlier experiments at the university they altered rearing density and found a different response among fish held at different densities, which suggests that endocrine involvement in the immune response may be altered at different loading densities.

Three pallid sturgeon males were cross with one female on May 15, 1999, resulting in three sublots of eggs. The female was hand-stripped every two hours. Egg inventories were completed and 144,975 were collected. Egg eye-up was 86 percent and hatch was 48.3 percent.