

River Crossings

Volume 15

March/April 2006

Number 2

Daughterless Carp

Imagine - rivers and lakes without Asian carp, snakeheads and other invasive species. That's the vision of Ron Thresher and his team, a group of scientists conducting "daughterless carp" research at Australia's *Commonwealth Scientific & Industrial Research Organization* (CSIRO) in Hobart as part of the *Australian Invasive Animal Cooperative Research Center* (CRC). Australia faces a major threat to the health of its rivers and lakes from an introduced carp much like we do here in the U.S. And we have been intrigued by Thresher's work on daughterless carp over the past few months, and so have dedicated the first three articles of this issue of *River Crossings* to describe his and other fish genetics work.

In the past we have expressed concerns about genetic manipulation of biotic organisms, but these concerns have centered on the exchange of genetic material between different species and the possible creation of the so called "frankenfish". But in the case of daughterless carp technology this seems unlikely because the genetic work uses the carp's own genes to "shut off" a gene so that females of the species are not produced. And if this technology can be used to reduce the numbers of female carp produced in the wild, it then follows that over the long term carp populations

could be reduced or even eliminated from our rivers and lakes.

Biologists have long known that female fish are developed only when an enzyme called aromatase transforms androgen into estrogen. And in the past it had been possible to chemically block aromatase to produce only males, but Thresher and his colleagues have advanced the science by figuring out a way to make the trait an inheritable characteristic of future generations.



By blocking the hormone aromatase all carp become males, so over the long term reproduction is reduced and carp population numbers fall.

They first tested the technique on zebra fish, a cousin of the carp, by locating the gene that produces aromatase. They then sequenced that gene in reverse — creating a blocker that binds to and neutralizes the aromatase gene. An animation of the process can be viewed on-line at: <http://www.pestanimal.crc.org.au/research/>

[carpbiootech.htm](#), and is graphically displayed on page 3 of this newsletter.

Thresher and his group then tested the new gene by injecting it into zebra fish eggs and 80% of the brood turned out to be male — a striking success given that some of the daughterless genes are inevitably destroyed during the injection process. Then in 2003 Australia's *Murray-Darling Basin Commission* (MDBC) enlisted Thresher and his team to begin developing the daughterless carp project that now forms part of MDBC's 50-year *Native Fish Strategy*.

The next phase of the project involved creation of a daughterless line using a small, fast-breeding fish which becomes sexually mature in months rather than years, allowing scientists to evaluate how (and if) the daughterless gene spreads through the population, generation after generation. These trials gave Thresher's group the chance to work out some of the kinks before beginning work on larger fish such as carp, which take two years to reach reproductive age.

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Those kinks include answering the questions:

- How many daughterless genes should the carp carry?
- Just how many doomsday carp — and how long — will it take to eliminate a wild population?; and
- Will the daughterless genes “jump” to other species?

Thresher and his team have now designed, built, and are testing a number of potential daughterless genetic constructs (i.e. gene manipulations) using Japanese medaka or ricefish (*Oryzias latipes*) as the test species. Medaka is much smaller than carp, has a shorter life span or generation time, and is much easier to work with under laboratory conditions. To date, neomales (XX males) have been successfully produced in medaka using two different constructs, and these fish are now being used for breeding to determine if the inserted gene has been inherited and if the desired characteristics are being passed on to the offspring.

Currently, the CSIRO team is slowly working through the genetics of each neomale brood line, and it appears that the constructs are being inherited in at least some lines. This suggests that the construct has integrated into the chromosomes, and that some inheritance of the “neomale” condition is occurring. Offspring from the different variants of the construct are being compared for fitness to see (1) which is the most efficient at causing the neomale condition, and (2) which causes the fewest side effects, etc. Once these determinations are made, the “best” fish will be bred and the new data used to design the next generation of constructs.

Pond trials using large indoor, biosecure aquaria have not yet begun with any of the medaka constructs, but Thresher hopes to do so within the next six months. Timing of these trials will depend on when the team is happy with the construct proposed for testing and when they have sufficient numbers of the desired daughterless carriers in hand to begin an experimental stocking program.

Meanwhile, they are modeling, in considerable detail, the likely efficacy and constraints on the use of daughterless and other genetic approaches to managing pest fish populations. This work has recently been submitted for publication in

the journal, *Ecological Applications*. In that paper they assess the performance of six different genetic approaches (daughterless, male-specific and female-specific lethal, sterile constructs, Trojan Genes, etc.) on a modeled carp population in the light of possible effects of different levels of (1) environmental variability, (2) demographic factors (e.g. density dependent population regulation, complementary harvesting efforts, etc.) and (3) genetic factors (e.g. fitness effects of the construct, gene silencing, etc.).

The results of all of their efforts to date show that daughterless technology is a very effective means of population control under a wide range of conditions. Interestingly, the models also show that under similar conditions, female-specific lethal and sterility constructs can be as efficient as daughterless technology itself. Thresher says that this is perhaps not surprising in retrospect, as both, in a sense, are just different means of producing a daughterless outcome (i.e. heavily skewed population sex ratios). For

example, in some species it might be genetically easier to produce a construct that sterilizes females rather than one that converts them to fully functional males. In fact, Thresher and his team have taken a few small steps to explore this option with medaka.

Once Thresher and his team have optimized and fully tested the medaka constructs, they will move on to the more drawn out and logistically more difficult larger fish (i.e. carp). Thresher feels that they are about a year away from producing a carp construct that they are happy with for testing. And he feels that daughterless technology will almost certainly be species specific, though he plans to test this directly. He also feels that the carp will not revert back to females in later life as the gene will be inserted into several chromosome locations. Even if one copy fails, it is highly unlikely that all copies will simultaneously fall down.

Also, he notes that the daughterless carp will not be a “frankenfish”. “When we

River Crossings

Published by

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(MICRA)
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Bettendorf, IA 52722-0774

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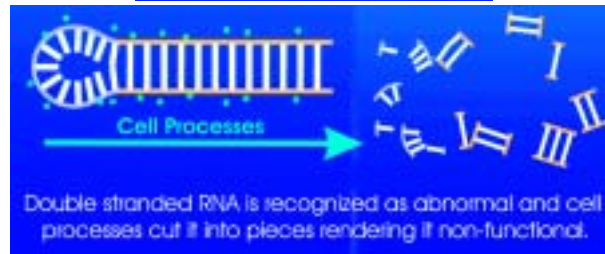
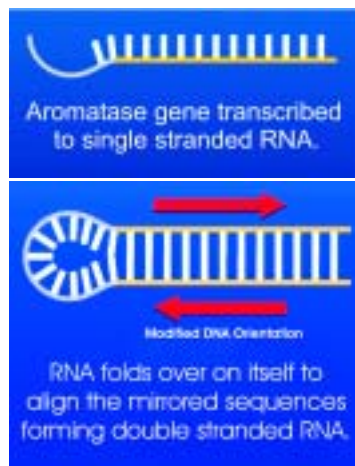
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build this for carp, it will be from 100 percent carp genes. We'll just be rearranging them to achieve what we want," he said. And anticipating the next question: "Omigod, what if someone sneaks one of these carp to Europe? Are you going to endanger the species globally?" The short answer is no. If someone snuck a thousand of these things to Europe and released them into the Danube, it really wouldn't make a significant impact," he says. This is because a full-scale daughterless carp management program would require a long-term stocking program with significant numbers of fish. A one-time stocking of a thousand fish wouldn't be large enough to significantly (or even detectably) affect a wild population.

But if stocked in larger numbers over a longer period of time, and because daughterless carp can have equivalent reproductive success to wild-type fish, Thresher predicts that the daughterless gene will escape natural selection, and rapidly spread through the wild population. A simple population genetics model which evaluates the frequency of daughterless phenotypes within a population and the impact of potential selection against daughterless carriers suggests that extinction is inevitable if daughterless carriers are as fit as wild-type fish (i.e. they exhibit similar mating success, recruitment success and survival to maturity).

But Anne Kapuscinski, a University of Minnesota geneticist and a leading expert on transgenic fish, cautions that the complex dynamics of fish populations and genetics may resist a daughterless carp assault. Nature could conspire to give the carp a higher survival rate or simply turn off the daughterless gene she says.

Thresher certainly accepts this possibility, but notes that some of these issues can be tested prior to release, and that others are likely to be overwhelmed given a reasonable stocking rate. He figures that to eliminate carp from a river, you need to introduce daughterless carp at a rate equal to between 0.5 percent and 1 percent of the total population each year for 20 years. So a lake with 100,000 wild carp would need to be stocked with 500 to 1,000 daughterless carp annually. Presumably, you could speed up the process by introducing additional modified carp. "If



A normal RNA strand (top) produces the aromatase necessary for carp to become female. Under daughterless technology, the RNA strand folds over on itself forming a double stranded RNA (middle). Double stranded RNA is recognized as abnormal and is cut into pieces by cell processes making it nonfunctional.

three years into the exercise we suddenly find the thing has jumped to Australian bass, we can stop stocking it. And the gene will eventually be overwhelmed by the wild type," he says. "There is plenty of time to launch a counter-gene." It would thus take two decades to wipe out a carp population — or maybe longer. The keys there are the maximum age of the fish (obviously the longer the wild type fish live, the longer it takes to eradicate them) and stocking rates relative to natural recruitment.

Thresher and his team have also begun the process of developing a robust risk assessment framework for daughterless carp and similar technologies as applied to controlling pest populations. To that end, they held an international workshop on the problem last year, and they intend to follow that up with a more detailed workshop next year, after they have more detail on the specifics of the constructs that they will be using.

They have also completed a great deal of public consultation on the use of the technologies in Australia, making numerous presentations to various public forums including farming groups, aquarium societies, and the media. The

CRC also commissioned a formal survey two years ago, which assessed public attitude toward the strengths and weakness of daughterless technology. Overall, the results have been very positive with people showing skeptical enthusiasm, but clearly wanting more information. The Australian public also wanted assurances that the technology would be species-specific, and that the public would be extensively consulted well before any GM fish are released into the nation's river systems. A final decision on the release of carp carrying the 'daughterless' gene into Australian rivers will not be made until 2009.

If successful, daughterless carp technology could be applied to numerous invasive species. And Thresher is optimistic about the future as he rattles off a list of other possible candidates: snails, cane toads, and maybe birds and foxes. "In theory, it could work on mammals, although you would have to use different genes. Sexual development in mammals is much, much, much more complicated than in fish," he said.

Almost all of Thresher's work on daughterless carp technology remains unpublished. It is very much a work in progress, which he wanted us to be sure to point that out for this article. He says that the main factor constraining the rate of progress on his daughterless carp work is resourcing. He said, "We know what we need to do, but lack the hands to do it quickly. In that regard, there could well be opportunities for joint efforts that could speed up the process."

So U.S. based groups concerned about the spread of Asian carp in this country should certainly consider partnering with the CRC and CSIRO on this potentially important project. It seems promising and could provide an important tool in the aquatic nuisance species control tool box.

Sources: *Personal Communication*, Ron Thresher, CSIRO, 4/4/06; *Pest Animal Control CRC Web Site*, <http://www.pestanimal.crc.org.au/research/carpbiotech.htm>; Todd Woody, *Wired News*, Issue 10.10, October 2002; and *Carp Management in the Murray Darling Basin: Daughterless Carp Technology*, CSIRO Marine Research and Murray-Darling Basin Commission, 5/14/02

FAQs About Daughterless Carp Technology?

Frequently asked questions about daughterless carp technology include the following:

What is the daughterless carp project all about? - Daughterless carp technology was developed by Australia's, *Commonwealth Scientific & Industrial Research Organization* (CSIRO) and aims to control carp through biasing sex ratios towards males. With fewer females in the population, it is predicted that this genetic technology could sharply reduce carp numbers within 20 to 30 years of release. While the program is an area of relatively high-risk research, the possible benefits warrant further development.

How does daughterless carp technology work? - Daughterless Carp technology works using gene silencing technology. When fish develop, all embryos start life as males (in humans they start as females). During its brief period of activation, the daughterless gene inhibits production of the key enzyme (aromatase) required for the fish to develop as a female — as a result the fish defaults to a male. The genetic sequence used to produce daughterless carp is found naturally in the carp itself. Aromatase (produced in the brain and reproductive organs) is the protein responsible for stimulating female development in carp and other fish at the embryo stage. By silencing the production of aromatase, scientists can bias sex ratios toward male development through to adult. The daughterless carriers have normal reproductive capacity and the gene is heritable, so daughterless males can pass on the daughterless gene to wild type carp. This type of development is typical for other fish and amphibians, so the technology could be applied to other pests as well.

Who is involved with the program? - The project is a partnership program in Australia being supported by a variety of state and federal agencies and private partners. Cash contributions are also being provided by New Zealand and the State of Minnesota in the U.S.

How long will it take for the daughterless carp technology to work? - The Daughterless Carp Project is a long-term approach with components looking at communications, risk management, integrated pest management and genetics.

It will be at least 2009 before the daughterless carp are ready to be released into Australian rivers after strict and rigorous field trials. It will then take 20-30 years for the impact to be felt and for carp populations to start to fall. The time taken for the heritable daughterless gene to pass through a population of carp depends on the size of the population and how long the target species lives.

Does the daughterless carp technology only work on carp? - In this project, the daughterless carp engineered genetic constructs are taken directly from carp and modified. This means that they are specific to carp and cannot be functional in any other fish or animal species. If we were to apply the technology to other pest fish, specific constructs would need to be engineered for them. However, because carp have a similar sex determining and developmental pathway to other fish and amphibians, the same principles behind the daughterless carp technology can potentially be adapted to other pest fish or pest amphibians.

Can the technology transfer by accident into native fish species? - This is a species-specific technology because the 'blocker' has to be customized to a particular gene sequence that is different for each fish species. Native fish will not be affected by the technology for this reason. Note, however, that this is a key issue for the technology, and the CSIRO will test it thoroughly as part of its risk assessment process.

Are daughterless carp genetically modified? - Daughterless carp will be classified as a genetically modified organism (GMO) based on definitions in Australian legislation. However, only their own genes have been modified and they contain no DNA from other species.

Will the gene mutate or malfunction so that the fish revert back to female later in life? - The gene will be inserted into several chromosome locations in the fish, so even if one copy fails, it is highly unlikely that all copies will simultaneously fall down. Inserting a number of copies into the fish will ensure that the technology is robust as well as speeding up the process of incorporating this gene into the carp population.

If I caught a daughterless carp, could I eat it? - It is perfectly safe to eat a daughterless carp. The daughterless

gene is only carp specific and there is no way humans or their pets could be affected.

Is daughterless carp technology the solution to all carp control? - The ultimate answer to controlling carp will lie with an integrated approach, which might include targeted fishing; rehabilitating the environment, especially through environmental flows, chemicals, or manipulating water levels; and daughterless carp technology.

Will carp fishing and exporting be affected by the technology? - Obviously, the intention is to reduce carp populations over 20-30 years and this will progressively limit the resource for current and future catch. Predicting impacts for the carp fishing and pet food industry will be part of the consultation and assessment process.

Sources: *Pest Animal Control CRC Web Site*, <http://www.pestanimal.crc.org.au/research/carpbiotech.htm>; *Carp Management in the Murray Darling Basin: Daughterless Carp Technology*, CSIRO Marine Research and Murray-Darling Basin Commission, 5/14/02; Ross Monash, *Daughterless Carp - Technology's answer to rid Australia's Waters of European Carp*, In Depth, Second Quarter 2002; and *Personal Communication*, Ron Thresher, CSIRO, 4/4/06

Existing Genetic Methods for Biological Control of Non-Native Fish

Anne Kapuscinski (cited in our *Daughterless Carp* article above) and T. J. Patronski recently completed a project entitled: *Genetic methods for biological control of non-native fish in the Gila River Basin* under contract to the U.S. Fish and Wildlife Service. The genetic methodologies summarized for that report have applicability to the Mississippi River Basin, so we thought it would be appropriate to provide excerpts from that summary below.

It is possible to sterilize fish via two genetic methodologies: chromosome set manipulations for *triploid sterilization* and recombinant DNA methods for *transgenic sterilization*.

Triploid sterilization in fish - Traditional induction of sterility via ploidy manipulations in fish involves application of a hydrostatic pressure, temperature or chemical shock at the appropriate number of minutes after sperm fertilization of an egg, in order to disrupt the egg's normal extrusion of a polar body containing a haploid set of maternal chromosomes. The resulting retention of the polar body leads to an embryo bearing two haploid chromosome sets from the female (instead of the normal one haploid set) and a third set from the male. The presence of the odd set of chromosomes presumably causes mechanical problems involving pairing of homologous chromosomes during each cell division and this disrupts the normal development of gametes to some extent. The resulting triploid condition differs from the normal diploid number of chromosomes. Tetraploid fish, containing four sets of chromosomes, are sometimes crossed with diploid fish to yield 100% triploid offspring.

Transgenic sterilization in fish - New transgenic methods theoretically could be used to induce sterility in fish. The most relevant research to date has involved a repressible sterility technique using interference RNA (RNAi) methods. The *Commonwealth Scientific and Industrial Research Organization* (CSIRO) in Australia is a world leader in developing RNAi techniques to produce inducible sterile fish (also called 'sterile ferals'). This approach involves inserting a transgene designed to block expression of an endogenous gene essential for development of viable gametes or embryos. The transgene includes a sequence for a blocker molecule (such as RNAi) that prevents expression or at least causes mis-expression of the targeted endogenous gene. Expression of the blocker is under control of an inducible promoter, ideally inducible by the presence or absence of a compound that can be added to the food of captive animals. Other parts of the construct can be designed to allow reversible activation/repression of the inducible promoter and hence of expression of the blocker.

Released sterile fish will enable biological control only if they still enter into courtship behavior with relatives in the target population. And there are huge information gaps regarding this issue. For triploid sterilization, little research has investigated the extent to which triploid adults of different species retain normal reproduc-

tive behavior. In one of the few field tests of the behavior of triploid fish released into the natural environment, triploid adult Atlantic salmon migrated back from the ocean to natal freshwaters at a much lower rate than control salmon, thus reducing the numbers that could try to mate with wild fish of the opposite sex. Some evidence indicates that sterilized triploid males, which retain functional gonadal steroidogenic tissue, still exhibit normal reproductive behavior. It is important to note that reproductive behavior differences between diploids and triploids will likely vary among species and methods of chromosome manipulation. For transgenic sterilization, development of such transgenic fish lines is at too early a stage to include empirical tests of courtship behavior.

Strengths of triploid sterilization include:

- zero risk of spread of the "sterility condition" to non-target populations and thus no risk of associated possible genetic harm;
- relatively low cost of applying the technology;
- relatively short time period required for research, development, and implementation; and
- ecological risks are limited to just the competition and predation posed by the triploid individuals themselves.

Weaknesses include:

- difficulty of achieving 100% sterility in mass applications, thus requiring screening to cull fish that are still fertile;
- costs associated with multiple stockings of sterilized males; and
- current uncertainties regarding the level and nature of reproductive behavior exhibited by sterilized adults.

The release of tetraploid females may hold promise for biological control purposes because they could mate with diploid males leading to the hatching of 100% triploid offspring; however, tetraploid fish often have low survival rates and poor performance, which would reduce the efficacy of this method.

Strengths of transgenic sterilization of fish include:

- the potential for repressible on-off sterility expression;
- the potential for building in sterility redundancy by "stacking" sterility-inducing genes; and

- if the transgenes do not disrupt steroidogenesis or other physiological processes that affect reproductive behavior, then the transgenic-sterile fish should be capable of normal courtship behavior, a plus for biological control.

Weaknesses include:

- the preliminary status of the technology,
- higher costs and long-term commitment associated with research, development, and implementation,
- costs associated with multiple stockings, and concerns about the stability of transgene integration into the fish genome; and
- the reliability of transgene expression.

Note, however, that the sterile feral technology, patented by the CSIRO of Australia, is sufficiently developed that other parties are negotiating licenses from CSIRO to use it.

Several other different strategies involving transgenes for disrupting a given essential genes exist. Some of these strategies (described below) are still being developed conceptually, while others are being tested experimentally on insects and fish.

Sex ratio distortion involves spreading a transgene designed to alter the target population's sex ratio. For example, researchers at CSIRO are developing a "daughterless gene" construct which consists of a promoter that activates the daughterless gene to express only in females. Activated during early development, the gene inhibits production of aromatase, the key enzyme necessary for female development, and the fish defaults to a male. The daughterless gene encodes a piece of interference RNA (RNAi) that binds to the fish's native gene for aromatase, consequentially blocking synthesis of this enzyme. Releases of transgenic fish possessing a daughterless gene in appropriate quantities over time could drastically reduce a population's size or possibly eliminate it altogether.

Engineered underdominance involves release of transgenic fish carrying two mutually suppressive transgenic constructs (each construct contains a unique lethal gene and a suppressor gene that prevents expression of the lethal gene on the other construct). After mating with targeted pest fish, 50% of the offspring

die because they inherit only 1 transgenic construct and its lethal gene is now expressed. Another 25% of the offspring are also transgenic but survive because they inherit the 2 transgenic constructs. The deletion of 50% of offspring from such matings continues in every generation in which transgenic fish possessing both alleles mate with wild-type individuals. Depending on environmental conditions, the proper level of transgene integration could be maintained in a population via periodic release of transgenic fish at 3% of the native population size.

Conditional lethality involves designing transgenes that are lethal only when transgenic individuals are exposed to specific environmental conditions. For example, the 'inducible fatality gene' concept involves the spread of a gene designed to induce death once a particular compound is released into the environment or fed to the fish. Only those fish possessing the deleterious transgene die, without harm to fish not carrying the transgene. It could be difficult, however to make this strategy work in a natural environment.

Engineered female-specific lethal involves interrupting an aspect of development leading to death of female offspring. It could be accomplished by targeting or silencing an important female-specific developmental pathway or it could involve expression of a toxin such as ricin in female offspring. Males, which carry, but are unaffected by the lethal construct, pass it on as they mate with wild-type females. The release of males with multiple copies of the lethal construct may be more effective than a release of similar size with a single copy or a similar-sized release of sterile males.

Engineered fitness disadvantage can be achieved via at least two theoretical strategies:

- use of selfish genes and
- use of intentional Trojan genes.

Selfish genes are genes which naturally gain a transmission advantage relative to other components of an individual's genome. One type of selfish genetic element, homing endonuclease genes (HEGs), codes for sequence-specific endonuclease, a protein which cleaves DNA. The catalytic activity of genes such as HEGs has been characterized as

super-Mendelian and has potentially played an important role in eukaryotic evolution and extinction. The power of site-specific selfish genes to copy themselves into a defined target DNA sequence may be able to be engineered and harnessed to eradicate a target population.

Use of intentional Trojan genes involves insertion of a novel gene construct which simultaneously confers one advantage, such as a mating advantage, that drives the transgene into the target population and one disadvantage, such as reduced offspring viability, that triggers decline in number of fish. This approach may need to use a transgenic construct that will ensure: 1) the proper balance between advantage and disadvantage; and 2) the stability of the Trojan gene effect over enough generations of fish reproduction to achieve the desired level of biocontrol.

All transgenic strategies for genetic biocontrol face a set of obstacles to getting transgenes stably integrated into the fish genome. Major methods for integrating transgenes include various types of microinjection and can be facilitated by use of retroviral vectors and transposons. Gene transfer to fertilized eggs can also be achieved by immersing eggs in a buffer solution containing foreign DNA and applying electric pulses. This technique, called electroporation, is being used with increasing success and has advantages over injection techniques because its feasibility is not limited by egg size or quantity. While microinjection and electroporation of newly-fertilized eggs have been used and refined since the 1980s, it remains difficult to use these methods for inserting transgenes into the genomes of live-bearing fish species due to their lack of externally released eggs.

Several lines of ongoing research are trying to develop other reliable ways of getting transgenes into fish genomes. Key examples include:

- genetic engineering of embryonic stem (ES) cell lines as a pathway to integrate novel DNA into the genome of a fish embryo;
- in vitro genetic engineering of sperm followed by fertilizing eggs with the transgenic sperm; and
- the generation of live transgenic fry from transplantation of transgenic primordial germ cells into the peritoneum of parental fish.

Any of these approaches could eventually facilitate development of a transgenic fish for biological control and might lead to more stable transgene integration. But all of these lines of research will likely need 5-10 years of further research to reach practical application.

Source: Kapuscinski, A. R. and T. J. Patronski. 2005. *Genetic methods for biological control of non-native fish in the Gila River Basin*. Cont. Rept. to the U.S. Fish and Wildlife Service. Univ. of Minn., Inst. for Social, Economic and Ecological Sustainability, St. Paul, MN. Minnesota Sea Grant Publication F 20

Asian Carp Bill Advances in Congress

The House Judiciary Committee in late March approved a measure that would make it illegal to import or transfer Asian carp (bighead, silver and black carp) across state lines. The bill passed unanimously with no opposition according to its author U.S. Rep. Mark Green (R/WI). "We're very hopeful we can move it to (the House) floor quickly," he said. "This needed to happen years ago," said Jennifer Nalbome of the conservation group *Great Lakes United*.

But the measure might find some fierce opposition on the House floor from Southern state representatives, whose constituents raise and market the carp commercially. Ted McNulty, aquaculture coordinator for the state of Arkansas, said he was aware the bill had been introduced, but he didn't think anyone would take seriously a law that could level such a crippling blow to the fish farming industry. "At first, we just kind of ignored it," McNulty said. "I think they have some momentum behind it, so I guess we are going to have to pay some attention to it."

McNulty said the measure would block fish farmers from getting their crops to market, but it won't stop the fish from swimming into the Great Lakes on their own. "All it does is shut down an industry," he said. "It does nothing to stop all those that are there now going into the Great Lakes." Green says he knows his measure won't magically stop the spread of the carp, but it could slow the infestation and perhaps keep them from colonizing the Great Lakes. "This is obviously not a guarantee that we won't have invasive species in the Great Lakes,

or the Asian carp in the Great Lakes,” he said. “But this step . . . is a huge step in the right direction. “What it will do is make it illegal to import or transfer Asian carp across state lines, and that certainly will slow down the problems that have led to where we are.”

Most importantly, the bill would help to stop the spread of Asian carp into uninfested watersheds. By themselves the fish can only find their way into new locations by swimming between connected waterways. But with the help of the fish farmer’s livehaul trucks, the carp can be carried overland to anywhere in the nation where a vehicular accident or an unscrupulous person can release them into any waterway. In fact, in one reported incident in Virginia, passers-by were helping to toss live Asian carp spilled from a roadway accident into a nearby stream thinking it important that the fish be saved. This sort of thing could happen anywhere, and the carp’s ecological requirements can be satisfied in just about any of the nation’s larger rivers, lakes and waterways. So as long as live carp are hauled overland, the rivers and lakes of locations through which the carp are hauled to market are at risk.

It is widely believed that Asian carp (bighead and silver) escaped from the fish farms and fish culture operations of Southern states (primarily Arkansas and Mississippi) in the 1970’s and 80’s, and ever since they have been spreading up the connected waterways of the Mississippi River Basin. The filter feeding bighead and silver carp, which can grow up to 100 pounds and consume 40 pounds of plankton per day, have spread to within less than 50 miles of Lake Michigan which is connected to the Mississippi River Basin via the Chicago Sanitary and Ship Canal (CSSC). The only thing preventing the carp from reaching Lake Michigan and the entire Great Lakes ecosystem — the

world’s largest freshwater system — is an electrified barrier located in the CSSC.

The fish, particularly bighead and silver carp, have overwhelmed stretches of the Mississippi and Illinois rivers (see photo below). Silver carp are also a problem for recreational boaters. They become agitated by the noise of boat motors and launch themselves out of the water like log-sized missiles. The problem is so bad that one town along the Illinois River has begun hosting “redneck fishing tournaments.” Contestants don’t use fishing poles; they just drive around in their boats and wait for the fish to jump in.

Meanwhile also in Illinois, state Sen. Mike Jacobs (D/Moline) is proposing a \$750,000 state subsidy for *Schafer’s Fisheries* of Thomson, IL, to buy the equipment necessary to process the large, bony fish into breaded patties for institutional sales. Jacobs said the subsidy would help *Schafer’s Fisheries* retool so it can process, press, bread and sell the fish.

Schafer’s already sells the heads of the fish in Asian-American communities, where it is a delicacy. But the company’s hope is to create a mainstream market for processed Asian carp meat — a market that not only could be profitable, but would have the added benefit of thinning the carp’s population in the Illinois and Mississippi rivers. Proponents say the subsidy is necessary because the carp are worthless if there isn’t a market for it. “It takes time and money to develop a market,” said Mike Schafer, owner of the company. He said he hopes to increase his current annual take of 2 million pounds of the fish up to 10 million, which could have a noticeable impact on the river population.

But others suggested that the limited interest in carp as a food dish might make such a plentiful fish hard to profit from. “I don’t care for the taste, and they have a fair amount of bone,” said Ed Kram, owner of *Kram Fish Co.* near downtown St. Louis. He said fishermen who supply his company throw the Asian carp back when they

inadvertently catch them. “I don’t know what the market would be. Who wants them?”

But Jacobs said the subsidy idea is to “take this problem and turn it into a solution.” Among the first customers, he suggested, could be the Illinois Department of Corrections. Being fed Asian carp patties everyday could thus give the concept of being in prison a whole new meaning!

Source: Dan Egan, *Milwaukee Journal Sentinel*, 3/29/06; Kevin McDermott, *St. Louis Post-Dispatch*, 3/29/06; and *Greenwire*, 3/30/06

Greenbelt Defense

Levees just about always result in the destruction of marshes and wetlands, so one is rarely considered complimentary to the other. But in the case of Hurricane Katrina it was marshes and wetlands that actually saved some of the levees according to Hassan Mashriqui, a Louisiana State University (LSU) researcher. Mashriqui calls this the “greenbelt defense”.

On soils like we have in Louisiana, he says, marsh and trees — even small amounts — can better armor the levees than concrete and steel, because they don’t sink and don’t have to be rebuilt. “Katrina has proven these are things we must start considering,” he said. From the Mississippi River Gulf Outlet (MR-GO) to eastern New Orleans, levees with a buffer of wetlands had a much higher survival rate than those that stood naked against Katrina’s assault. Reestablishing or building even narrow buffer zones could dramatically increase storm protection, Mashriqui said. “If you travel the area and look at what survived and what didn’t, it becomes obvious,” he said. “And this is not news. Other countries have been using natural barriers to protect against storms for many years.”

In fact, in the late 1960s, the U.S. Army, Corps of Engineers (Corps) produced a report that has become gospel for coastal wetlands advocates — 2.7 miles of coastal marsh reduces storm surge by 1 foot. And while many storm researchers today consider that report to have been widely misinterpreted, there is no disagreement that wetlands can reduce the worst effects of a hurricane — wind and rising water.



Jumping Asian carp below the navigation dam at Peoria, IL.

The problem is that many of the wetlands that once stood between New Orleans' levees and the Gulf of Mexico have been destroyed by man-made developments. And while environmentalists for years fought a lonely battle against wetlands abuse, Katrina provided a deadly demonstration of their importance in storm protection — not just in huge swaths many miles wide, but even in narrow borders adjacent to the levees, Mashriqui contends.

Marsh and wooded wetlands reduce the impact of hurricanes in different but essential ways. Friction from marsh grass reduces the speed, or current, of a storm surge, but not as most people would imagine. The common concept of a storm surge is a wind-driven wall of water rolling across the landscape. Actually, a storm surge is a dome of water that rises over hours and days as a hurricane nears the coast. The direction and speed of the surge is determined by the path and speed of the storm — not the winds.

For example, during Katrina, northeast winds drove huge waves against the southwest shoreline of Lake Borgne and the MR-GO levees. But below the surface the surge was actually flowing in a northwest direction. It's a critical distinction, because moving water will erode a levee the way a rushing river cuts into its banks. The faster a storm surge current brushes the surface of a levee, the more dangerous it is. So reducing the speed of that surge is important.

Mashriqui said data collected by the state showed the speed of the surge in the open water of the MR-GO approached 7 feet per second as it flowed over the shoulders of the levee at the Bayou Bienvenue floodgates. But in the marshes across the channel, friction from grasses and shrubs reduced that speed to 3 feet per second. "If you can reduce the surge speed by half, this is very important to protecting levees," he said. "Had there been marshes in front of the MR-GO levee instead of the (2,000-foot) wide canal, they would have had a much better chance."

In addition to being a speed bump to storm surge, large expanses of marshes also provide a de-facto rise in ground elevation, Mashriqui said. "If the top of the marsh grasses is 3 feet, then in effect you have raised the land elevation by 3 feet," he said. "To build waves, the surge must first flood that marsh with 3 feet of

water, then add water to the top of that. And the marsh grasses are so thick, if they stand 3 feet tall, the surge must be 3 feet higher to gain momentum, force and speed. "So, for all practical purposes, you are gaining elevation for your levees and your communities with marshes."

Wooded wetlands, such as the cypress swamps that once ringed New Orleans, are even more effective at lessening storm surge, researchers said, because their height and size act as natural breakers for wind as well as water. A study done by Japanese scientists showed that an area about the size of a football field with a tree density equal to what is found in most Louisiana swamps would reduce the wave energy in a storm by 90%, LSU researchers said.

"If you had a border of even small trees like willows, you can significantly reduce wave energy," LSU researcher Paul Kemp said. "The waves are breaking against trees instead of against levees. That's really important in our areas, because the levees are not armored. "Natural systems are very effective at protecting levees and other storm defenses, and they have the added benefit of offering other environmental benefits, such as helping fisheries," However, quantifying the storm-dampening effects of wetlands is tricky business, experts said. Much depends on the size of a storm as well as its speed. "You'll get a lot more benefit from wetlands during a fast-moving storm, because the surge has less time to build," Kemp said. "But in a slow-moving storm — something that just sits over the area for days — then you'll eventually just be overwhelmed."

The types of wetlands in a storm's path also are important. For example, that 1960s study by the Corps was based on storms that had come ashore in southwestern Louisiana, which has many miles of healthy freshwater marshes crossed by natural ridges forested with oak trees. Southeastern Louisiana's coastal marshes are built on young river deltas and are much thinner and more fragile, with few ridges. "Even before the amount of erosion that has taken place in southeastern Louisiana, you probably wouldn't see that level of surge reduction as they did in that study," said Joe Suhayda, a retired LSU professor. "So the type or quality of the wetlands is very important. "The reduction in surge will depend on the

characteristics of each storm and the wetlands it crosses."

By comparing actual storm surges against predictions, LSU researchers can provide an estimate of what wetlands could have meant to the New Orleans area during Katrina. Their sophisticated storm-surge models, while accurate for areas that are not protected by wetlands, consistently overpredicted surge heights in areas that were protected by wetlands. For example, the surge prediction for St. Charles Parish adjacent to the Bayou Labranche wetlands was 2-3 feet higher than what actually happened, Mashriqui said. "You have this very large area of wetlands that have been rebuilt over the last 10 years or so that really knocked down the surge," he said. "Also, during Hurricane Rita, our models predicted a storm surge 2-3 feet higher for Lake Charles than they actually got. And once again, it's a city with miles of wetlands out in front of it."

An LSU study of Hurricane Andrew showed that that storm's surge, estimated at between 10-12 feet when it came ashore at Pointe au Fer on the central coast, was only 8 feet when it reached Morgan City, 25 miles inland. The only thing standing between Morgan City and the eye of the storm was the flooded forests of cypress and tupelo in Atchafalaya Basin and its delta of freshwater marshes.

"So it's easy to deduce that (New Orleans) could get that same kind of reduction in surge if it had the wetlands that existed many years ago," Mashriqui said. Hurricane planners should seek solutions that aren't built of concrete and steel, he said. "They have to do what many parts of the world are already doing with success. They must consider restoring and building natural defenses."

Source: Bob Marshall, *New Orleans Times-Picayune*, 3/23/06

Iowa and Ohio Pollution Problems

Iowa has some of the most polluted water in the country, while Ohio factories and sewage plants violate more federal clean water laws than any other state, according to two assessments released in late March.

A new analysis by *The Des Moines Register* shows that Iowa ranks among the nation's highest in fecal bacteria,

nitrogen and phosphorus pollution. Concentrations of nitrogen and phosphorus — fertilizer ingredients that speed the natural death of rivers and lakes — in Iowa streams are among the highest in the world, according to an Iowa State University study. The health-threatening compounds caused, in part, by crop fertilizers register in some Iowa streams at levels 50% higher than in the rest of the Corn Belt, and 18 times the U.S. median.

Iowa and its corn-growing sister, Illinois, account for up to 35% of the nitrogen washing down the Mississippi River watershed, which covers 41 percent of the lower 48 states. That fertilizer feeds huge algae blooms in the Gulf of Mexico. When the algae dies it decomposes and creates the area of the Gulf known as the “dead zone”, where organisms unable to relocate to other waters die.

The Iowa Department of Natural Resources plans to set new sewage limits for the state and is looking for ways to cut the runoff that accounts for 90% of the state’s stream pollution. Fertilizer runoff leaves Iowa’s waters green, fighting for oxygen and with fewer fish than they would contain naturally. That could cripple a fishing industry that accounts for \$336 million in spending per year, which already is far lower than in many other states.

Many farmers use less fertilizer than they used to, and Iowa leads the nation in the installation of grassy buffer strips. But farmers also lay miles of new drainage tiles each year. These tiles or pipes turn their fields into the equivalent of sink drains that flush pollutants toward streams before they can be soaked up by wetlands or buffer strips.

The U.S. Geological Survey in the late 1990s reported that the average phosphorus level in some Iowa streams was triple the U.S. average and 14% higher than average levels in the other corn-growing states. A U.S. Environmental Protection Agency (USEPA) report on pollution in small streams in Iowa, Kansas, Missouri and Nebraska from 1999 to 2001 showed that those in Iowa posted the top 53 of 675 nitrate readings and the top 44 nitrogen readings. Nebraska fared worse on phosphorus, with five of the top 10 readings; Iowa had two. Nitrogen and phosphorus feed algae blooms that suck oxygen from lakes and rivers.

Other runoff ingredients are big issues as well. Pesticides are found in groundwater across the state, as is the case in many agricultural areas. The levels are below federal health standards, but scientists don’t really know what happens when we drink small amounts of several pesticides — a common occurrence in Iowa. Iowa’s waters are also cloudier than in many other states, hampering fish populations and encouraging the growth of pathogens that could make people sick. Fecal bacterial levels run many times the level considered safe for human contact in some rivers. That means that waders, swimmers, fishers, kayakers, boaters, tubers and rafters all are at a bit more risk of getting diarrhea, a skin infection or worse by getting the water in their mouths or in open wounds.

Meanwhile in Ohio, factories and sewage plants violate discharge levels under federal Clean Water Act (CWA) permits more often than facilities in any other state, according to a report published by the *Ohio Public Interest Research Group* (Ohio PIRG). That report showed that 228 Ohio facilities violated their pollution permits 2,656 times between July 1, 2003, and Dec. 31, 2004. Ohio’s total of 2,656 permit violations was No. 1 in the U.S.; ahead of Texas with 2,043; New York with 2,014; Pennsylvania with 1,993; and Louisiana with 1,366.

The report, compiled from USEPA data under the Freedom of Information Act, looks at compliance data with the federal CWA. Ohio has 292 facilities with federal discharge permits. In addition, 78% of Ohio’s factories and sewage plants discharged more pollution than allowed under their federal discharge permits at least once in the 18 months of data reviewed, and many violators were way over their permit limits, Ohio PIRG said.

Ohio permit holders reported 205 instances in which they exceeded their permit levels by at least 500%, ranking Ohio No. 1 in the country again, Ohio PIRG said in *Troubled Waters: An Analysis of Clean Water Act Compliance*. “Ohio’s waterways including Lake Erie, the Cuyahoga River, the Ohio River, the Olentangy River and dozens more are being polluted with health-threatening sewage and toxic chemicals like lead and cyanide,” said Amy Gomberg of Ohio PIRG. “All Ohioans deserve clean water to drink and safe places to swim and fish, but sewage pollution and other contaminants

are jeopardizing our health and the environment,” she said in a statement.

In 2004, the Ohio EPA issued 56 orders to halt water pollution, the highest total since 1992, said spokeswoman Linda Oros. The agency that year also imposed \$11 million in water pollution fines, the highest amount since 1990, she said. Ohio PIRG called on the Bush administration to toughen the federal CWA to curb such discharges. Nationally, more than 3,700 facilities, or 62%, violated their discharge permits at least once, the report said.

Sources: Perry Beeman, *Des Moines Register*, 3/24/06; and Bob Downing, *Akron Beacon Journal*, 3/24/06; and *Greenwire*, 3/27/06

UMR Mussel Concerns

Over the past several years, Upper Mississippi River (UMR) natural resource management agencies have planned and executed water level drawdowns to increase production, extent, and diversity of aquatic vegetation, particularly, emergent plants, in order to increase fish and wildlife habitat in selected navigation pools. For example, during the summer of 1995, water surface elevations in Navigation Pool 25 near St. Louis, MO were held 1 to 2 ft. lower than normal, exposing about 3,000 acres. Similarly, during the summers of 2001 and 2002, a demonstration pool water surface elevation drawdown was done in Pool 8 when about 1,954 acres were dewatered, representing about 8.5% of the pool.

Then in 2005, Pool 5 was drawn down about 1.5 ft. between June 13 and September 26 exposing about 1,101 acres of shallow mudflats. But unlike during previous experimental drawdowns, this time extensive freshwater mussel mortalities occurred. The mean density of freshly dead mussels at sampled dewatered locations in the lower half of the pool was 0.40/m². Mussel survival was related to depth; 30.1% of mussels located in 1 ft. of water survived while 98% survived when located in 3 ft. of water. Also, mussels located at sloped sites had three times the survival rate of those at flat sites, suggesting that escape routes are important.

Members of the subfamily Ambleminae had over 1.6 times the survival rate of members of the subfamily Lampsilinae.

This may be related to the ability of these species to close their valves tightly, thus retaining a larger proportion of water. Biologists were not able to estimate the mortality of state listed species, but at least 8 representatives of these species are known to occur in the pool and were killed by the drawdown. Freshly dead population densities seemed fairly uniform throughout the pool. The possible loss of 0.4 mussels/m² over 4.5 million exposed m² is considerable. Considering the dire continental conservation status of native freshwater mussels, biologists recommend that serious consideration be given to such losses before future drawdowns occur.



Mussel mortality observed during UMR Pool 5 drawdown (WI Dept. of Natural Resources Photo).

Most mussels are long-lived and have very low reproductive rates and hence have slow recovery rates. An additional loss of one or two percent annually could, over time, reduce total numbers. Potential mortality minimization and mitigation measures that could be used during future drawdowns include:

- **Full-scale “Rescue”** - This would involve volunteers returning stranded mussels to deeper water, but due to the likelihood of large number of stranded mussels and their large spatial extent, it is unlikely that most could practically be relocated.
- **Smaller-scale “Rescue”** - This could be attempted in locations containing rarer species, high population densities or high species richness of stranded mussels.
- **Moderation of Rate of Drawdown** - Drawing the pool down at a slower rate would necessitate starting the drawdown earlier to achieve benefits to emergent vegetation. An earlier start, say as soon as flows can be re-controlled in the pool after the spring flood, may also reduce mussel colonization and re-colonization in areas dewatered in 2005.
- **Direct Compensatory Mitigation** - At least the state-listed and special concern species could be artificially propagated and released into deep waters of Pool 5.

- **Reducing the Depth of Drawdown** - It is likely there would be lower mortality rate from a drawdown of lower magnitude. Doing a 1 ft nominal drawdown instead of a 1.5 ft. nominal drawdown at the dam may reduce drawdown-induced mortality by about 30%.

Biologists feel that additional investigation is needed to verify and refine their mortality estimates as well as factors contributing to drawdown mussel mortalities. Most importantly, a more rigorous investigation is needed to determine total mortality on a pool-wide scale and its effect on pool-wide populations before UMR drawdowns become programmatic and routine.

Source: Wisconsin Dept. of Natural Resources. 2006. *Preliminary Report on the Effects of the 2005 Pool 5, Mississippi River Drawdown on Shallow-water Native Mussels*. La Crosse Service Center, 3550 Mormon Coulee Rd., La Crosse, WI 54601.

MO River Water Plan Continues as Scheduled

The U.S. Army, Corps of Engineers (Corps) announced in February that plans to manage the Missouri River to encourage the endangered pallid sturgeon’s breeding habits will continue as scheduled. Reservoirs upstream released a two-day “spring pulse” in late March to coincide with the start of the navigation season and will do so again in late May to mimic the natural rise that, before dams were built, used to come from melting mountain snow.

The Corps developed the plan under orders from the U.S. Fish and Wildlife Service (FWS) to comply with the Endangered Species Act. The final plan does not vary much from the proposed plan announced in October, and it will proceed as long as the reservoir water level is at least 36.6 million acre-feet. Current forecasts show enough storage capacity for the releases to occur, said Corps spokesman Paul Johnston in Omaha, NE. The two-day pulses are intended to encourage pallid sturgeon spawning. Environmental groups generally support the plan as the best way to protect river wildlife.

But barge companies complain that the spring rise limits upstream water available

later in the fall, when drought conditions can make the river unnavigable. And Missouri Gov. Matt Blunt has threatened legal action. He calls the science sketchy and says the pulses could flood thousands of acres of farmland along the river. Last year, the Corps cut the river’s navigation season to 48 days — the shortest season on record. And Missouri officials grew concerned in December, when the U.S. Department of Agriculture’s Risk Management Agency said farmers who experience crop damage as a result of intentional flooding by the federal government would not be eligible to make federal crop insurance claims.

“I was always taught that the mission of the Corps was to manage the United States’ navigable waters, not to reach to the whims of environmentalists and put citizens in harm’s way,” said *Missouri Farm Bureau Federation* President Charlie Kruse. Corps spokesman Johnston said he expected the river to rise about two feet at Kansas City during the May pulse, but that the pulse would be postponed if the river is already high because of rain.



Barge companies and upstream fishers said releasing water from upstream could lower already-dry lakes in Montana, North Dakota and South Dakota and also reduce river levels later in the fall. “Although they are clearly trying, this plan still gives upstream states like Montana the short end of the stick,” said Sen. Max Baucus (D/MT). “We need to share the pain more during drought years. This plan doesn’t go far enough. It still gives preference to the barge industry,” he said. Baucus has sponsored legislation requiring a 44 million acre-feet minimum before releasing water downstream, and he said he will reintroduce the bill again this year.

Meanwhile, Reps. Ike Skelton (D/MO) and Kenny Hulshof (R/MO) said they are working to find a legislative solution that would help farmers keep insurance coverage in the event of flooding. And

Missouri Attorney General Jay Nixon said he will examine the Corps' environmental assessment before considering litigation. "We want to really look at what they believe their science is," Nixon said. "That's the only way to fully assess the risk."

Then in late March, the Supreme Court declined to hear North Dakota's arguments appealing a lower court's decision that the Corps did not violate state water pollution laws in managing the Missouri River. As a result, the action essentially upholds previous decisions saying that the state cannot use antipollution laws to force the Corps to keep more cold water in reservoirs to help recreation and fishing.

A federal appeals court in August had upheld an earlier court decision in favor of the Corps plan for management of the Missouri River, rejecting a plea by environmental groups to limit barge traffic and conserve water. At issue are releases from the River's three main reservoirs — Fort Peck, MT, Lake Sakakawea, ND, and Lake Oahe, SD. All are at record lows, and lawmakers have blamed the drought conditions on the Corps' decision to release water to support scant barge traffic.

But North and South Dakota are still waiting for the Supreme Court to decide whether it will hear another case, challenging the same appeals court's decision that the federal government's efforts to maintain navigation traffic take precedence over recreation and other uses in the river's upstream reservoirs. "That's a more serious issue for us," North Dakota Attorney General Wayne Stenehjem (R) said. "I'm hopeful we'll be able to get the Supreme Court to take the case and to determine that all of the (water) uses are to be given equal consideration."

Sources: *Kansas City Star*, 2/1/06; *AP/Billings Gazette*, 2/1/06; Mary Clare Jalonick, *AP/Kansas City Star*, 3/20/06; and *Greenwire*, 2/1/ and 3/21/06

MO River Water Diversion Controversy

Canadian officials said in late February that they oppose North Dakota's plan to stave off drought by diverting Missouri River waters into drainages that feed Manitoba's Lake Winnipeg. The Canadian lake is the world's 10th largest freshwater lake and it supports a commercial fishery.

But North Dakota officials said the state faces severe drought within 50 years and needs to tap water from the Missouri River. The plan would take about 120 cubic feet of water per second out of the river, which flows at 20,000 cubic feet per second on the average.

"Our concern would be that it brings a risk of harm to Manitoba with the potential movement of harmful species," said Dwight Williamson of *Manitoba Water Stewardship*. Gaile Whelan-Enns, spokeswoman for *Sierra Club Canada*, said the latest plan...would join two water basins that have been separated for 10,000 years and could bring foreign species from the Missouri River to Lake Winnipeg and then to Hudson Bay. "The Boundary Waters Treaty between Canada and the U.S. must be upheld," she said.

The *Boundary Waters Treaty of 1909* mandates that cross-border water disputes be settled by the International Joint Commission (IJC), which ruled in 1977 against diverting water from the Missouri unless both countries could agree that risks would be eliminated. Just last year, North Dakota rejected Canada's request for an IJC review of its plan to drain Devil's Lake into the Sheyenne River, which eventually flows into Lake Winnipeg. North Dakota then got Canada to agree by promising to add more rocks and gravel to the drain as filters for invasive species.

This time, a treatment plant would prevent the transfer of invasive species, said Merri Mooridian of North Dakota's Garrison Diversion Conservancy District. Canada wants North Dakota to use water sources within the Red River Basin in Minnesota and North Dakota, but Mooridian said there will not be enough water available during the expected drought.

The Garrison Diversion is due to issue its final environmental impact statement by December, after which the U.S. Interior Secretary will make a final ruling. Congressional approval will be required before construction can begin. Construction costs, estimated at \$500 million to \$660 million, would probably not start before 2009 and the system would be operational by 2012 at the earliest.

Sources: Marcy Nicholson, *Reuters*, 11/23/06; and *Greenwire*, 2/24/06

Texas Environmental Water Rights

Texas judge, Suzanne Covington, in early February ruled that environmental groups have just as much right to purchase water rights for preservation as companies do for commercial rights. The decision will require the Texas Commission on Environmental Quality (TCEQ) to give equal consideration to applications from environmental groups for state water rights to preserve waterways.

Judge Covington had been considering arguments made in her court by the *San Marcos River Foundation* (SMRF), the *Matagorda Bay Foundation* and other environmental groups that filed applications seeking state-issued water rights for the explicit purpose of retaining flows in Texas rivers. Historically, most water rights have been granted for the purpose of taking water out of the state's rivers for use by cities, industry and agriculture.

The SMRF application to secure 1.3 million acre-feet of water a year for the Guadalupe and San Marcos rivers was rejected in March 2003, prompting Texas Lt. Gov. David Dewhurst (R) to write the TCEQ saying it should delay decisions on applications submitted by environmental groups until it could be determined if the state could dispense such right by law. The other applications, which were filed in 2002, were aimed at conserving water for Galveston Bay; the Trinity, Colorado and Lavaca rivers; and Caddo Lake. Together, the proposals sought more than 12 million acre-feet per year.

In her February ruling, Judge Covington said the state law does allow the granting of water rights for environmental preservation. Dianne Wassenich (SMRF) said "There will most likely be appeals, but we are celebrating today". The TCEQ said that it is considering an appeal.

Sources: Dina Cappiello, *Houston Chronicle*, 2/7/06; *Victoria Advocate*, 2/8/06; and *Greenwire*, 2/8/06

Climate Change Update

In a recent issue of the journal *Science*, researchers said that temperature records dating back to 800 suggest that the climate shift of the 20th century has been the greatest in the last 1,200 years. Researchers at the University of East Anglia in the United Kingdom made this

determination by analyzing tree rings, fossil shells, ice cores and measurements dating back to the time of the Vikings.

“The key conclusion was that the 20th century stands out as having unusually widespread warmth, compared to all of the natural warming and cooling episodes during the past 1,200 years,” said Timothy Osborn, co-author of the report. While the last century’s unusual warming was “probably related” to global warming, the study also acknowledged other unusual warm and cold periods in the last 1,200 years: the *Little Ice Age* from about 1580 to 1850 and the *Medieval Warm Period* from 890 to 1170, which many scientists have attributed to colonization of Greenland and Iceland by Nordic Vikings during that same time period.

In the U.S. this was the fifth warmest winter on record, according to the National Oceanic and Atmospheric Administration (NOAA) *National Climatic Data Center*. And temperatures in Canada through February) were 7 °F above normal, the warmest winter since records began in 1948, according to Environment Canada. In fact, the past decade has seen six of Canada’s 10 warmest winters. This winter topping the previous warmest, in 1986-87, by 1.6 degrees resulted in several islands off Nova Scotia being inundated by thousands of pregnant seals forced to give birth on shore by unusually mild weather that prevented the Gulf of St. Lawrence from freezing.

Also because of warm Canadian winters, the mountain pine beetle has destroyed \$5.14 billion worth of timber Canadian timber industry officials said. The beetle has always lived in high areas from Arizona to northern British Columbia, but cold winters (i.e. with 20 below zero cold snaps) have controlled outbreaks until now. It has been 15 years since temperatures were low enough for long enough to kill off the beetles, so they are now in nearly 40% of the province’s lodge pole pines, British Columbia chief forester Jim Snetsinger estimated. By 2013, he said, “80% of susceptible pine will have been affected.” British Columbia’s \$15.2 billion timber industry produces 7% of the world’s pine. The beetle “takes out approximately 480 billion cubic meters [of wood] a year, three times Canada’s annual harvest,” said *Forest Products*

Association of Canada President Avrim Lazar.

Permafrost melting in Alaska, Canada and Siberia is also releasing partially decayed organic matter that can turn into methane and carbon. Arctic soils contain 200 to 800 gigatons of carbon, according to David Lawrence of the *National Center for Atmospheric Research*. Annual human carbon output is 7 gigatons per year, and the concentration of carbon dioxide (CO₂) in Earth’s atmosphere is now 381 ppm, according to 2005 NOAA data. That level is 100 ppm above the preindustrial average, and 2.6 ppm above 2004 levels. Pieter Tans, NOAA’s chief CO₂ analyst, said the rate of increase has doubled in recent years. “We don’t see any sign of a decrease; in fact, we’re seeing the opposite, the rate of increase is accelerating.” Britain’s chief scientific adviser, David King, said it was evidence of climate change. “Today we’re over 380 ppm,” he said. “That’s higher than we’ve been for over a million years, possibly 30 million years. Mankind is changing the climate”.

Research published in late March in the journal *Science* suggests that temperatures in the Arctic are likely to hit their highest point in 130,000 years by 2100, with the resulting glacial runoff raising sea levels by 1 to 3 feet over the next 100 to 150 years. “Basically, every glacier on Earth has gotten smaller in the last 100 years,” said Richard Alley, a glaciologist at Pennsylvania State University (PSU). “Even in the places where there’s more snow, there’s more (glacial) shrinkage.” The bottom line, Alley said, is that the melting observed now is rapid and widespread.

In March Montana Gov. Brian Schweitzer (D) took a helicopter tour of Glacier National Park, where he announced that the park was down to “a couple dozen” glaciers, from over a hundred previously. “By 2025, 2035 at the rate that they’ve been declining, there will be no glaciers in Glacier National Park,” he said.

In Switzerland, the Aletsch glacier, the longest in Europe at 14 miles, shrank by 72 yards last year because of global warming, *Swiss Academy of Sciences* researchers said in early February. A study of the 91 largest of Switzerland’s 1,800 glaciers confirmed earlier findings that the ice formations are shrinking because of climate change. Eighty-four

of the 91 had lost mass since last year, scientists said. One glacier, the 3-mile Trift, lost 236 yards, in part because it is surrounded by a lake. Researcher Andreas Bauder said the results reflected low levels of snowfall last year. The academy also monitored three Alps ice caps and found that they shrank by between 27 and 66 inches last year.

From Patagonia to Tibet to the Antarctic, the world’s glaciers are in crisis, according to experts who attended the annual meeting of the *American Association for the Advancement of Science* held in St. Louis in February. The growing flow of freshwater into the oceans could result in potentially catastrophic rises in sea level and changes in currents that drive world weather patterns, they said. “Freshwater storage on Earth is out of balance for the first time in history” because of glaciers’ increasingly rapid melting, said Mark Dyurgerov, a glaci-



View of the Muir Glacier, Glacier Bay, Alaska 1941 (top) and 2004 (bottom) (USGS Photo).

ologist at the University of Colorado-Boulder, who noted that 77% of the Earth’s freshwater is bound up in ice. “There is no question that sea levels will rise,” said Gabriel Filipelli, a geologist at the University of California-Santa Cruz. Current estimates are about 40 centimeters, or 16 inches, by 2100, he said, adding: “That’s pretty rapid.” And while coastal communities are at risk, some island nations could disappear completely. “In some cases,” Filipelli said, “we’re talking about whole cultures and communities.”

Though scientists have tracked the world’s glaciers for several decades, the pace of melting in the last five years has been a major surprise, many said.

"Fifteen years ago, we thought Greenland (glaciers) were not doing anything," said Eric Rignot of NASA's *Jet Propulsion Laboratory*. Now, ice sheets below an elevation of 2 kilometers show "major melting," he said. "We're going over the edge." Rignot is co-author of another new study, published in the journal *Science*, that documented the quickening pace of Greenland's glaciers slide toward the Atlantic Ocean. "I don't think any of us in the scientific community expected such drastic changes in Greenland," Rignot said.

Similar problems are seen around the globe, in the mountains of South America to Central Asia. The latter is second only to the Arctic and Antarctica in its amount of glacial ice, which provides water for about 2.5 billion people. "Mountain glaciers are the water tower for the 21st century," Dyrugerov said. "And they're disappearing." "Mount Kilimanjaro has had an ice cap for thousands and thousands of years," said Filipelli. "In about 10 years, it'll be gone completely."

Still, the situation may be worst in Antarctica, which contains enough glacial ice to raise sea levels by 60 meters. Temperatures along the continent's peninsula are rising six times faster than the global average, and thinning is evident in most coastal areas. Melting is particularly severe in areas where glaciers are grounded below sea level. "Clearly, the ocean is representing the biggest threat for these glaciers," Rignot said. He cited as a bellwether event the collapse of Antarctica's Larsen B ice sheet in 2002 and urged action to curb greenhouse gas (GHG) emissions to combat climate change. "After 10,000 years of relatively stable existence, Larsen B disappeared in three weeks in 2002," he said. "It's clear, nature is having a little experiment on us."

The Antarctic ice sheet is losing as much as 36 cubic miles of ice per year according to another new paper that provides the first evidence that the sheet's total mass is shrinking significantly. The new findings, also published in an early March issue of the journal *Science*, using data from two NASA satellites called the *Gravity Recovery and Climate Experiment* (GRACE), found that the amount of

water pouring annually from the ice sheet into the ocean — equivalent to the amount of water the United States uses in three months — is causing global sea level to rise by 0.4 millimeters a year.

The continent holds 90% of the world's ice, and the disappearance of even its smaller West Antarctic ice sheet could raise worldwide sea levels by an estimated 20 feet. "The ice sheet is losing mass at a significant rate," said Isabella Velicogna, the study's lead author and a research scientist at Colorado University at Boulder's *Cooperative Institute for Research in Environmental Sciences*. PSU's Richard Alley who has also studied the Antarctic ice sheet but was not involved in this new research, called the study significant and "a bit surprising" because a major international scientific panel predicted five years ago that the Antarctic ice sheet would gain mass this century as higher temperatures led to increased snowfall. "It looks like the ice sheets are ahead of schedule" in terms of melting, Alley said. "That's a wake-up call. We better figure out what's going on."

Meanwhile, marine biologists said in late March that warming waters and disease are killing off coral reefs around the globe at an unprecedented rate over the last several months. National Park Service fisheries biologist Jeff Miller, who checked 40 coral sites in the Virgin Islands, said most of the coral dying off can never be replaced because it grows so slowly, in some cases no more than a dime's width per year. "These are corals that are the foundation of the reef. ... We're talking colonies that were here when Columbus came by have died in the past three to four months."

But Caribbean coral reefs have fared better than those in the Indian Ocean, which have seen mortality rates as high as 90%. Warming waters appear to be the chief assailant of the reefs, with sea surface temperature data from NOAA showing temperatures in the Caribbean from last summer and fall the highest by far in the 21 years of satellite monitoring. "The big problem for coral is the question of whether they can adapt sufficiently quickly to cope with climate change," said biochemistry professor M. James Crabbe of the University of Luton near London. "I think the evidence we have at the moment is: No, they can't."

Starting next year, more than 50,000 participants from more than 60 countries will begin the *International Polar Year* (IPY), a yearlong intensive period of research meant to sustain a legacy of polar research for the next 50 years. The new initiative, organized by the *International Council for Science* and the *World Meteorological Organization*, models a similar effort from the 1950s. The *International Geophysical Year* effort in 1957-58 provided the foundation for much of the polar science knowledge used today. "If you want to understand the global carbon cycle, the global water cycle, the global weather cycle, or global economics, it requires an understanding of polar regions," said David Carlson, IPY's program director. "It's a polar science, but it has a global impact."

Meanwhile, the U.S. Fish and Wildlife Service (FWS) announced in early February that it has begun a review process to see if the Alaskan polar bear warrants protection under the Endangered Species Act. FWS spokesman Bruce Woods said the petition filed last year by three environmental groups to protect the polar bear "contains sufficient information to convince us that we need to do a more thorough analysis of the polar bear population worldwide". The *Center for Biological Diversity*, the *Natural Resources Defense Council* and *Greenpeace* filed the lawsuit last December citing studies that showed the Arctic Circle ice is melting at an unprecedented rate. The bears spend days traveling along the ice caps, but when the ice shrinks, they have trouble making it back to land, oftentimes drowning during the journey.

"A lot of the stories you read make it sound like there's uncertainty (about global warming)," said Jonathan Overpeck, a professor of geosciences at the University of Arizona. "There's not uncertainty." The questions scientists continue to address, he said after his presentation at the *Alaska Forum on the Environment*, are how much of the warming is caused by humans and how drastic the long-term effects will be. Overpeck reviewed NASA studies showing how Arctic ice has shrunk in size and depth. Climate models 25 years ago predicted a shrinking ice pack, but "What we didn't predict is that it would be so dramatic," Overpeck said.

Scientists predict the summertime Arctic could be ice-free before the end of the century, opening up northern sea routes but threatening the existence of polar bears. If warming trends continue, Overpeck said, the globe eventually will get a nasty message from the Arctic – a rise in sea levels. Higher oceans will flow into low-lying parts of the world such as New Orleans, making recovery in that hurricane-ravaged city moot. “It’s hard to imagine why we’re wanting to rebuild if we’re going to allow global warming,” Overpeck said.

A recent public opinion poll by *Time* magazine, *ABC* and Stanford University, showed that 85% of Americans now believe global warming is occurring, but 64% think scientists are in disagreement about it. Eighty-eight percent think global warming threatens future generations, and just over half say weather patterns in their area of the country have grown more unstable in the past three years, while 70% perceive global weather patterns as having become more unstable. Faced with these statistics, as well as observations of their own made on a recent trip to Antarctica, Australia and New Zealand, some politicians are changing their stance on global warming. A House delegation coming back from their recent trip to the region now have a more open mind. “Of the 10 of us, only three were believers,” said Rep. Sherwood Boehlert (R/NY). “Every one of the others said this opened their eyes.”

Others who may be opening their eyes include the new Chief Executive Officer of *Exxon Mobil Corp.*, Rex Tillerson, who took over from Lee Raymond three months ago. Tillerson said in late March that “greenhouse gas emissions are one of the factors affecting climate change,” a dramatic departure from his predecessor’s public stance on that issue. Raymond had dismissed fears of global warming and called environmental activists “extremists.” And as recent as last spring Tillerson’s said he shared Raymond’s skepticism. Environmentalists and others have taken issue with *Exxon’s* record \$36.1 billion net income last year, the highest for any U.S. company ever.

Meanwhile, leaders of the *National Association of Evangelicals* (NAE) said in early February that they would not take a position on steps to address

global warming due to a lack of consensus among their constituents. The move comes after top evangelical leaders sent a letter to NAE President Ted Haggard asking him to refrain from officially commenting on proposals to limit GHG emissions. Among the authors of the letter were *Focus on the Family* Chairman James Dobson and *Oral Roberts University* President Richard Roberts. “While there is lots of debate about the causes and hazards of climate change and how best to respond to it, there is no debate about the Bible’s priority on helping the world’s poor to improve their lot,” said E. Calvin Beisner, a professor of social ethics at *Knox Theological Seminary* who signed the appeal letter. “By declining to embrace anti-warming policies that would delay economic development and access to clean air, clean water and reliable food and energy supplies in poor countries, we and the NAE together are putting the needs of the poor at the forefront.” NAE represents 30 million evangelical Christians across the U.S.

But a week or so later a coalition of 86 evangelical Christian leaders kicked off an opposing campaign to position action on global warming as a moral imperative to help the world’s poor. “Those who will be affected primarily by climate change, and most egregiously, are the ones who have the smallest margins for error,” said Duane Litfin, president of *Wheaton College*. Calling itself the “*Evangelical Climate Initiative*”, the group issued a statement calling on the federal government to limit CO₂ emissions. Signers include 19 heads of religious organizations, 10 bishops and “mega-church” pastors and 40 college and seminary pastors. “For most of us, until recently this has not been treated as a pressing issue or major priority,” the statement reads. “Indeed, many of us have required considerable convincing before becoming persuaded that climate change is a real problem and that it ought to matter to us as Christians. But now we have seen and heard enough to offer the following moral argument related to the matter of human-induced climate change.”

Leaders of the new climate push acknowledged dissent on the issue within the evangelical Christian community. Jim Ball, executive director of the *Evangelical Environmental Network*, said the new initiative, which

he supports, is a starting point to unify the evangelical base around climate issues. “This statement is groundbreaking,” he said. “It lays a foundation for consensus in our community.” Ball also noted that the NAE was never formally asked to sign on to the new statement, although 22 members of the organization’s board are counted among the signatories. Litfin argued that the campaign is part of a larger trend. “A whole world of evangelicals are rising not only to climate change issues but to environmental issues as a whole,” he said. Rep. Jay Inslee (D/WA) called the announcement “a dam breaker” on the climate change issue. “The power of faith is going to touch people’s hearts to listen to the science,” he said. “From a pragmatic political perspective,” the support of these groups could get certain members of Congress to pay closer attention to the science, Inslee added. While there have had no conversations with the White House about the campaign, “It’s a mistake to say this has not registered with the president and Republicans,” Litfin said. “This is a bipartisan, nonpartisan effort. We don’t have any desire or will to make this political.”

Meanwhile, a coalition of states, cities and environmental groups asked the Supreme Court in early March to overrule a key Bush administration decision on global warming. Massachusetts Attorney General Tom Reilly (D) led the petition for *writ of certiorari*, arguing that further delay in regulating GHG emissions from U.S. motor vehicles could hamper the country’s ability to address climate change. “EPA has squandered nearly a decade,” Reilly wrote. “This delay, itself, has the effect of compounding the problem by narrowing our ability to mitigate it.” The plaintiffs argue that the Clean Air Act requires EPA to regulate air pollutants from motor vehicles based on a determination if the emissions are a threat to public health or welfare. In this case, the states say EPA and a federal appeals court have ignored the law. Joining Massachusetts in the Supreme Court petition are California, Connecticut, Illinois, Maine, New Mexico, New Jersey, New York, Oregon, Rhode Island, Washington and Vermont. Attorneys for American Samoa, Baltimore, New York City and Washington, D.C., also joined the case.

Environmental plaintiffs include *ICTA*, *Greenpeace*, *Natural Resources Defense Council* and the *Sierra Club*.

In California the Public Utilities Commission (CPUC) voted in mid February to impose a strict cap of carbon emissions based on 1990 levels, despite objections by utilities. The CPUC acted in order to “do our part in meeting the ... greenhouse gas reduction goals articulated” last year by Gov. Arnold Schwarzenegger (R), said CPUC President Mike Peevey. But regulators must be “very, very careful to have a full understanding of the costs involved,” urged CPUC member John Bohn. The vote sets in motion the process of establishing a specific cap, with the details expected to come about from subsequent discussions with environmentalists and the California’s three investor-owned utilities. Based on the CPUC vote, California may adopt a cap-and-trade system similar to the program established by seven Northeastern states called the *Regional Greenhouse Gas Initiative*, or RGGI. “What you’re considering in California is much broader than anything being discussed in other states — it’s very significant,” said Ned Helme, president of the *Center for Clean Air Policy*.

In Arizona and New Mexico, Govs. Janet Napolitano (D/AZ) and Bill Richardson (D/NM) have pledged to work together to slash GHG emissions and tackle the climate change issue for the Southwest region. Under the *Southwest Climate Change Initiative* signed at the *National Governors Association* annual conference in Washington, the two states will develop ways to measure, forecast and report GHG levels and identify options for reducing emissions. The initiative calls for the states to promote energy efficient technology and renewable energy sources as well as advocate for regional and national climate policies that reflect the needs of the Southwest. “Southwestern states have particular concerns about the impacts of climate change and climate variability on residents, businesses and the environment, including the potential for prolonged drought, severe forest fires, warmer temperatures, increased snowmelt, reduced snowpack and other effects,” the governors said.

In mid February New Mexico became the first state to enroll in the Chicago

Climate Exchange (CCX), the only U.S. market for trading carbon emissions credits. Several cities have joined the exchange — including Chicago, Oakland and Boulder — but New Mexico is the first state. Companies in the CCX include *IBM*, *DuPont* and *Ford Motor Co*. Under CCX trading, emission credits are traded daily over the Internet. “We have a huge drought, and data indicates that pollution has an impact on the quality of life that our economy depends upon,” said Gov. Richardson. The exchange functions by having companies and entities enter legally binding agreements to cut their emissions by a certain amount and date. If they beat expectations, they generate extra credits that they can sell or bank. If they fall behind, they must purchase credits through the exchange.

The CO₂ emissions trading market is booming and is one of the world’s fastest-growing markets, experts said in February, marking the one-year anniversary of the Kyoto Protocol. We’ve seen tremendous growth this year,” said Henrik Hasselknippe, senior analyst at *Point Carbon*. “Carbon is now being used as a commodity on the same lines as other energy commodities.” According to *Point Carbon’s* estimates, CO₂ trading will be a \$40 billion annual industry by the end of this decade. A metric ton was recently changing hands at more than \$31 dollars, while a year ago, it sold for about \$8.

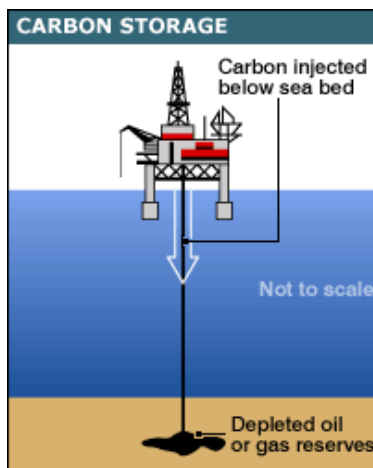
Meanwhile, in Europe, the Norway-based *Statoil* is projecting that all of Europe’s CO₂ emissions could be stored in an undersea aquifer beneath its Sleipner platforms in the North Sea. “There are calculations that say it could handle all of Europe’s CO₂ emissions for

several hundreds of years,” said *Statoil’s* Senior Vice President for the Environment Tor Fraeren. “It could all be handled by this reservoir. I hope that during these hundreds of years we could solve the CO₂ problem in a more efficient way, but we have the potential here to store it,” said Fraeren.

Sequestering CO₂ deep below the ground could cut global emissions by 20-40% between now and 2050, according to a U.N. commissioned report. The U.N. *Intergovernmental Panel on Climate Change* (IPCC) — the world scientific authority on global warming — commissioned the report in 2003. The report found that between 220 and 2,200 billion metric tons of CO₂ could be economically stored underground in geological structures such as empty oil and gas fields and also in deep oceans between now and 2100. The process could cost anywhere from \$15-75 per metric ton of CO₂, the IPCC estimated.

The *World Wildlife Fund* in early March urged Northern European power stations to drastically slash their GHG emissions in order to avoid predicted severe winter storms. “A dangerous wind of change is blowing across Europe,” said Jennifer Morgan, director of WWF international’s global climate change program. “We have to take this threat seriously and stop climate pollution in order to protect people and their properties from devastating storms.” In a report analyzing recent weather patterns in seven European countries and research on global warming, the WWF concluded that the north Atlantic Ocean and North Sea were becoming more stormy. The United Kingdom will suffer the biggest increase in storms by the end of the century out of the European countries analyzed — namely Poland, Germany, Netherlands, Spain, Italy and France. Ten additional severe storms could hit Britain over the next 30 years if carbon emissions continue to rise unchecked, the report warns.

Meanwhile, the March/April issue of the *Green Guide* ranked U.S. cities according to their “greenness” (i.e. kindness to the environment and to human health). Criteria included: good water- and air-quality, efficient use of resources, renewable energy leadership, accessible and reliable public



BBC News Diagram

transportation, green building practices, parks and greenbelts, access to locally-grown fresh food through farmers' markets and community supported agriculture groups, and affordability. The top ten, listed alphabetically, include the following, four of which are in the Mississippi River Basin: Austin, TX, Boulder, CO, Chicago, IL, Honolulu, HI, Madison, WI, Minneapolis, MN, Oakland, CA, Portland, OR, San Francisco, CA, and Seattle.

Sources: *Agence France-Presse*, 2/8, 2/12, 2/13, 3/2, 3/16 and 3/20/06; *Swissinfo*, 2/8/06; Dan Joling, *AP/San Francisco Chronicle online*, 2/8/06; Dan Joling, *AP/Anchorage Daily News*, 2/7/06; Mike Toner, *Atlanta Journal-Constitution*, 2/10/06; Steve Connor, *London Independent*, 2/10/06; Martin Mittelstaedt, *Toronto Globe and Mail*, 2/10/06; Jo Chandler, *Sydney Morning Herald*, 2/13/06; Juliet Eilperin, *Washington Post*, 2/11/06; Jemilah Magnusson, *The Green Guide*, March/April 2005 #107; Rick Jurgens, *Contra Costa Times*, 2/17/06; Mark Martin, *San Francisco Chronicle*, 2/17/06; *BBC News*, 2/16/06; Susan Dieneshouse, *Chicago Tribune*, 2/23/06; Doug Struck, *Washington Post*, 3/1/06; *AP/Albuquerque Tribune*, 3/1/06; Juliet Eilperin, *Washington Post*, 3/3/06; Robert Lee Hotz, *Los Angeles Times*, 3/3/06; Andrew Revkin, *New York Times*, 3/3/06; David Shukman, *BBC News online*, 3/14/06; *AP/Los Angeles Times*, 3/14/06; Rebecca Morelle, *BBC News online*, 3/15/06; *E&E Daily*, 2/27/06; Jad Mouawad, *New York Times*, 3/30/06; *Time*, 3/26/06; Jeffrey Kluger, *Time*, 4/3/06; ; Seth Borenstein, *AP/San Francisco Chronicle online*, 3/30/06; *ABC News*, 3/27/06; Lauren Morello, *Greenwire*, 2/1, 2/8, 2/21 and 3/28/06; Darren Samuelsohn, *Greenwire*, 3/3/06; and *Greenwire*, 2/8, 2/10, 1/13, 2/17, 2/21, 2/23, 3/1, 3/2, 3/3, 3/14, 3/16/06, 3/22, 3/27, 3/30 and 3/31/06

New River Coordinators

Interstate river coordinator jobs don't turn over very often, so it's unusual when two of them turn over in one year.

Last fall the U.S. Fish and Wildlife Service (FWS) announced that Mr. Wayne Nelson-Stastny would be taking over the responsibilities of the Missouri River Natural Resources Committee (MRNRC)

Coordinator position, formerly held by Mike LeValley of the U.S. Fish and Wildlife Service (FWS) at DeSoto National Wildlife Refuge in Missouri Valley, IA. The South Dakota Game, Fish and Parks is graciously providing Mr. Nelson-Stastny to the FWS through an Interagency Personnel Agreement.



Wayne Nelson-Stastny

Wayne will be coordinating key Missouri River natural resource issues among the MRNRC member States (Montana, North Dakota, South Dakota, Nebraska, Iowa, Kansas and Missouri) in addition to facilitating communications with the FWS, Corps of Engineers, other Federal agencies, Tribes, universities, organizations, and other stakeholders.

Wayne brings a wealth of skills and experience to the position. He grew up in southeastern South Dakota and was fortunate to spend much of his childhood on the Missouri River above and below Fort Randall Dam. His education at the University of South Dakota under Dr. J. C. Schmulbach brought him even closer to the river as he obtained his B.S. and M.A. studying paddlefish in the Missouri River. Following graduate school, he left the Missouri to work at the Columbia River Research Center in Cook, WA. There he studied Chinook salmon smolt migration on both the Columbia and Snake Rivers from 1993-1995. Wayne returned to South Dakota in the spring of 1995, working as a Fisheries Biologist for the South Dakota Department of Game, Fish and Parks on the Missouri River and its reservoirs. His work on Missouri River water management issues led to his appointment as the Missouri River Coordinator for the State of South Dakota in 2005

Wayne is working out of the FWS South Dakota Ecological Services Field Office in Pierre. He can be reached at: 420 South Garfield Avenue, Suite 400, Pierre, SD 57501, (605) 224-8693 x 29, Wayne_NelsonStastny@fws.gov.

The FWS then announced in February that Scott Yess, biologist at the FWS's La Crosse Fisheries Resources Office (FRO) in Onalaska, WI would be taking over as Coordinator of the Upper Mississippi River Conservation Committee (UMRCC) in mid-March. This position was formerly held by Jon Duyvejonck at the Rock Island, IL FWS Ecological Services Field Office. The appointment of Scott will also include a move of the UMRCC office from its current location to the FRO in Onalaska.

Scott will be coordinating key Upper Mississippi River (UMR) natural resource issues among the five UMRCC States (Minnesota, Wisconsin, Iowa, Illinois and Missouri) in addition to facilitating communications with the FWS, Corps of Engineers, other Federal agencies, Tribes, universities, organizations, and other stakeholders.



Scott Yess

Scott also brings a wealth of experience to his position. He began his fisheries work at Vermillion Community College in Ely, MN where he received an AA degree in 1979. He then transferred to the University of Wisconsin at Stevens Point where he received a B.S. in Fisheries with a chemistry minor in 1981. After graduation he spent two years with the Peace Corps working as a Fish Culture Extension Agent from 1981-83 in Zaire, Africa. His Peace Corps duties included working with 20-30 farmers on tilapia culture techniques. He joined the FWS in 1984 as a fish hatchery biologist at Willow Beach National Fish Hatchery in Arizona where he worked with rainbow trout as well as bonytail chub and razorback suckers. This led to the Project Leader position at Parker Fishery Assis-

tance Office where he working the on the Lower Colorado River from 1985-90. Since 1990 he has served as Assistant Project Leader for the LaCrosse FRO. In that position he worked on federal and tribal waters in four states – Minnesota, Wisconsin, Iowa and Illinois, primarily working in Minnesota with lake sturgeon restoration, fish passage and invasive species. He has also worked with the UMR Environmental Management

Program, monitoring habitat rehabilitation projects; served as project coordinator for the Pool 12 Dredge Material Placement Project; served on the FWS Region 3 dive team working with mussel recovery projects; and served on the Topeka Shiner Recovery Team.

Scott can be reached at: UMRCC, 555 Lester Avenue, Onalaska, WI 54650, (608) 783-8432, scott_yess@fws.gov.

We welcome both Wayne and Scott to their new positions. The sub-basin committees that operate on the Upper Mississippi, Lower Mississippi, Missouri, Ohio, Tennessee, and Arkansas-Red rivers are extremely important to MICRA's success. A representative from each of these sub basins sit on our Executive Board and play key roles in shaping our basinwide programs.

Meetings of Interest

May 7-11: Fifth National Monitoring Conference: Monitoring Networks: Connecting for Clean Water, San Jose, CA. Contact: NWQMC2006@tetrataeach-ffx.com, (410) 356-8993.

May 13-14: Moving Fisheries Science and Policy Towards Ecosystem-Based Management, St. Pete Beach, FL, See <http://imars.marine.usf.edu/~cwall/FAMEast/home.htm>.

May 14-19: 14th International Conference on Aquatic Invasive Species, Key Biscayne, FL. Contact: Elizabeth Muckle-Jeffs, Conference Administrator, 1027 Pembroke Street East, Suite 200 Pembroke ON K8A 3M4, Canada, N. Am. phone: (800) 868-8776, International phone: (613) 732-7068, Fax (613) 732-3386, profedge@renc.igs.net, Web Site: www.icaiss.org

Jun 3-8: 12th International Symposium on Society and Resource Management: Social Sciences in Resource Management: Global Challenges—Local Responses, Vancouver, British Columbia. See: www.issrm2006.rem.sfu.ca.

Jun 4-9: American Society of Limnology and Oceanography Summer Meeting: Global Challenges Facing Oceanography and Limnology, Victoria, B.C., Canada. See: <http://aslo.org/meetings/victoria2006/> Contact: Helen Lemay, business@aslo.org, (254) 399-9635.

Jun 12-16: Symposium on the Ecology of Stream Fish: State of the Art and Future Prospects II, Leon, Spain. Contact: Fred Utter, fmutter@u.washington.edu.

Jun 14-21: 24th Session of the European Inland Fisheries Advisory Commission and Symposium on Hydropower, Flood control and Water Abstraction: Implications for Fish and Fisheries,

Mondsee, Australia. See: www.fao.org/fi/body/eifac/eifac.asp.

Jun 25-28: International Conference on Rivers and Civilization: Multi-disciplinary Perspectives on Major River Basins, La Crosse, WI. Contact: Jim Wiener, University of Wisconsin-La Crosse, (608) 785-6454, wieners.jame@uwlax.edu

Jul 10-14: Fish Population Structure: Implications to Conservation, Aberdeen, UK. See: www.fsb2006.org.uk.

Jul 12-17: American Society of Ichthyologists and Herpetologist Annual Conference, New Orleans, LA. See: www.asih.org/meetings/meetings. Contact: Mark Pyron, mpyron@bsu.edu.

Jul 18-22: Seventh International Congress on the Biology of Fish, St. John's, Newfoundland, Canada. See: www.mun.ca/biology/icbf7. Contact: Kurt Gamperl, kgamperl@mun.ca, (709) 737-2692.

Aug 6-11: 8th International Conference on Mercury as a Global Pollutant, Madison WI. See: www.mercury2006.org. Contact: James Wiener, wieners.jame@uwlax.edu, (608) 785-6454.

Aug 22-23: The Invasive Asian Carps in North America: A Forum to Understand the Biology and Manage the Problem, Peoria, IL. See: <http://www.waux.cerc.cr.usgs.gov/MICRA/Asian%20Carp%20Symposium.htm>. Contact: Duane Chapman, dchapman@usgs.gov

Sep 10-14: American Fisheries Society 136th Annual Meeting, Lake Placid, NY. Contact: Betsy Fritz, bfritz@fisheries.org, (301) 897-8616, ext. 212.

Oct 10-13: Managing Agricultural Landscapes for Environmental Quality - Strengthening the Science Base. Soil and

Water Conservation Society, Westin Crown Center Hotel, Kansas City, MO. See: www.swcs.org/en/swcs_international_conferences/managing_agricultural_landscapes

Nov 5-8: 60th Annual Southeastern Association of Fish and Wildlife Agencies Conference: Wildlife Management in the Next New World, Norfolk, VA. See: <http://seafwa2006.org>. Contact: Tom Wilcox, tom.wilcox@dgif.virginia.gov, 804/367-6892.

Nov 8-10: North American Lake Management Society's 26th Annual International Symposium: Making Connections—People, Lakes, Watersheds, Indianapolis, IN. See: www.nalms.org. Contact: Carol Winge, winge@nalms.org, 608/233-2836.

Dec 9-13: Restore America's Estuaries, Third National Conference and Expo on Coastal and Estuarine Habitat Restoration: Forging the National Imperative, New Orleans, LA. See: www.estuaries.org/conference.

Feb 18-23, 2007: Sixth International Symposium on Ecohydraulics, Christchurch, New Zealand. See: www.conference.co.nz/echohydraulics2007. Contact: Rachel Cook, rachel@conference.co.nz.

Jun 6-9, 2007: Fourth International Reservoir Symposium: Balancing Fisheries Management and Water Uses for Impounded River Systems, Atlanta, GA. Sponsored by the Southern Division AFS Reservoir Committee. Contact: Mike Colvin, Mike.Colvin@mdc.co.gov.

Sep 2-6, 2007: American Fisheries Society, 137th Annual Meeting, San Francisco, CA. Contact: Betsy Fritz, bfritz@fisheries.org, 301/897-8616, ext. 212

Congressional Action Pertinent to the Mississippi River Basin

Climate Change

S. J. RES. 5. Feinstein (D/CA) and 13 Co-Sponsors. Expresses the sense of Congress that the U.S. should act to reduce greenhouse gas emissions.

S. 245. Collins (R/ME) and 5 Co-Sponsors. Provides for the development and coordination of a comprehensive and integrated U.S. research program that assists in understanding, assessing, and predicting human-induced and natural processes of abrupt climate change.

S. 342. McCain (R/AZ) and 12 Co-Sponsors and **H. R. 759.** Gilchrest (R/MD) and 25 Co-Sponsors. Provides for scientific research on abrupt climate change, to accelerate the reduction of greenhouse gas (GHG) emissions in the U.S. by establishing a market-driven system of GHG tradeable allowances, to limit GHG emissions in the U.S. and reduce dependence upon foreign oil, and ensure benefits to consumers from the trading in such allowances.

S. 387. Hagel (R/NE) and 3 Co-Sponsors. Amends the Internal Revenue Code of 1986 to provide tax incentives for the investment in GHG intensity reduction projects, and for other purposes.

S. 388. Hagel (R/NE) and 3 Co-Sponsors. Amends the Energy Policy Act of 1992 to direct the Secretary of Energy to carry out activities that promote the adoption of technologies that reduce GHG intensity and provides credit-based financial assistance and investment protection for projects that employ advanced climate technologies or systems, provides for the establishment of a national GHG registry, and for other purposes.

S. 887. Hagel (R/NE) and 6 Co-Sponsors. Amends the Energy Policy Act of 1992 to direct the Secretary of Energy to carry out activities that promote the adoption of technologies that reduce GHG intensity and to provide credit-based financial assistance and investment protection for projects that employ advanced climate technologies or systems, and for other purposes.

S. 1151. McCain (R/AZ) and Lieberman (D/CT). Provides for a program to

accelerate the reduction of GHG emissions in the U.S. by establishing a market-driven system of GHG tradeable allowances.

H. R. 955. Olver (D/MA) and Gilchrest (R/MD). Amends the Clean Air Act to establish an inventory, registry, and information system of U.S. GHG emissions, and for other purposes.

H. R. 2828. Inslee (D/WA) and 14 Co-Sponsors. Ensures that the U.S. leads the world in developing and manufacturing next generation energy technologies, to grow the economy, create new highly trained, highly skilled American jobs, eliminate American overdependence on foreign oil, and address the threat of global warming.

Conservation

S. 260. Inhofe (R/OK) and **H. R. 2018.** Sullivan (R/OK). Authorizes the Secretary of the Interior to provide technical and financial assistance to private landowners to restore, enhance, and manage private land to improve fish and wildlife habitats through the Partners for Fish and Wildlife Program.

S. 339. Reid (D/NV) and 4 Co-Sponsors and **H. R. 731.** Udall (D/CO) and Otter (R/ID). Reaffirms the authority of States to regulate certain hunting and fishing activities.

S. 421. Lott (R/MS) and Kohl (D/WI). Reauthorizes programs relating to sport fishing and recreational boating safety, and for other purposes.

S. 964. Alexander (R/TN) and 3 Co-Sponsors. The "American Outdoors Act of 2005" provides a conservation royalty from Outer Continental Shelf revenues to establish the Coastal Impact Assistance Program, to provide assistance to States under the Land and Water Conservation Fund Act of 1965, to ensure adequate funding for conserving and restoring wildlife, to assist local governments in improving local park and recreation systems, and for other purposes.

H. R. 524. Berkley (D/NV). Amends the Internal Revenue Code of 1986 to provide incentives for the conservation of water.

Endangered Species Act (ESA)

S. 2110. Crapo (R/ID) and 3 Co-Sponsors. Amends the ESA to enhance the role of States in the recovery of endangered and threatened species, to implement a species conservation recovery system, to establish certain recovery programs, to provide Federal financial assistance and a system of incentives to promote the recovery of species, and for other purposes.

H. R. 93. Gilchrest (R/MD). Assists in the conservation of flagship species throughout the world.

H. R. 1299. Cardoza (D/CA) and 16 Co-Sponsors. Amends the ESA to reform the process for designating critical habitat under that Act.

H. R. 1837. Flake (R/AZ) and 4 Co-Sponsors. Amends the ESA to establish limitations on the designation of critical habitat, and for other purposes.

H. R. 2779. Herger (R/CA). Amends the ESA to enable Federal agencies responsible for the preservation of threatened and endangered species to rescue and relocate members of any of those species that would be taken in the course of certain reconstruction, maintenance, or repair of Federal or non-Federal man-made flood control levees.

H. R. 3300. Graves (R/MO) and 2 Co-Sponsors. Amends the ESA to authorize species recovery agreements under which the Federal Government is obligated to make annual payments or provide other compensation for activities that improve the recovery of one or more species listed under that Act, and for other purposes.

H. R. 3824. Pombo (R/CA) and 13 Co-Sponsors. Amends and reauthorize the ESA to provide greater results in conserving and recovering listed species, and for other purposes.

H. R. 4857. McMorris (R/WA) and 5 Co-Sponsors. Better inform consumers regarding costs associated with compliance for protecting endangered and threatened species under the ESA

Energy

S. 1860. Domenici (R/NM) and 5 Co-sponsors. Amends the Energy Policy Act of 2005 to improve energy production and reduce energy demand through improved use of reclaimed waters, and for other purposes.

H. R. 140. McHugh (R/NY). Promotes use of anaerobic digesters by agricultural producers and rural small businesses to produce renewable energy and improve environmental quality.

H. R. 174. Millender-McDonald (D/CA). Encourages greater use of geothermal energy resources.

H. R. 2064. Udall (D/CO). Assures that development of certain Federal oil and gas resources will occur in ways that protect water resources and respect the rights of the surface owners, and for other purposes.

Federal Water Pollution Control Act (FWPCA) Amendments:

S. 912. Feingold (D/WI) and 8 Co-Sponsors and **H.R. 1356.** Oberstar (D/MN) and 125 Co-Sponsors. Amends the FWPCA to clarify the jurisdiction of the U.S. over waters of the U.S.

S. 1400. Chafee (R/RI) and 3 Co-Sponsors. Amends the FWPCA and the Safe Drinking Water Act to improve water and wastewater infrastructure in the U.S. .

H. R. 74. Davis (R/VA). Amends the FWPCA to impose limitations on wetlands mitigation activities carried out through the condemnation of private property.

Invasive Species

S. 363. Inouye (D/HI) and 3 Co-Sponsors. Amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 to establish vessel ballast water management requirements, and for other purposes.

S. 507. De Wine (R/OH) and 4 Co-Sponsors and **H. R. 1593.** Ehlers (R/MI). Establishes the National Invasive Species Council, and for other purposes.

S. 770. Levin (D/MI) and 12 Co-Sponsors and **H.R. 1591.** Gilchrest (R/MD) and 4 Co-Sponsors. Amends the

Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 to reauthorize and improve that Act.

S. 1402. DeWine (R/OH) and 7 Co-Sponsors and **H. R. 3049.** Green (R/WI). *Asian Carp Prevention and Control Act* amends the Lacey Act, to add certain species of carp to the federal list of injurious species that are prohibited from being imported or shipped.

S. 1541. Akaka (D/HI) and 3 Co-Sponsors. Protects, conserves, and restores public land administered by the Department of the Interior or the Forest Service and adjacent land through cooperative cost-shared grants to control and mitigates the spread of invasive species, and for other purposes.



H. R. 489. Pearce (R/NM). Provides for an assessment of the extent of the invasion of Salt Cedar and Russian Olive on lands in the Western U.S. and efforts to date to control such invasion on public and private lands, including tribal lands, to establish a demonstration program to address the invasion of Salt Cedar and Russian Olive, and for other purposes.

H. R. 1592. Ehlers (R/MI) and 5 Co-Sponsors. Establishes marine and freshwater research, development, and demonstration programs to support efforts to prevent, control, and eradicate invasive species, as well as to educate citizens and stakeholders and restore ecosystems.

Mining

S. RES. 64. Jeffords (I/VT) and 7 Co-Sponsors. Expresses the sense of the Senate that the U.S. should prepare a comprehensive strategy for advancing and entering into international negotiations on a binding agreement that would swiftly reduce global mercury use and pollution to levels sufficient to protect public health and the environment.

S. 961. Rockefeller (D/WV) and **H. R. 1600.** Cubin (R/WY) and 4 Co-Sponsors. Amends the Surface Mining Control and Reclamation Act of 1977 to reauthorize and reform the Abandoned Mine Reclamation Program, and for other purposes.

S. 1701. Thomas (R/WY) and Enzi (R/WY). Amends the Surface Mining Control and Reclamation Act of 1977 to improve the reclamation of abandoned mines.

H. R. 905. Cubin (R/WY). Amends the Mineral Leasing Act to provide for the development of Federal coal resources.

H. R. 1165. Kanjorski (D/PA) and 6 Co-Sponsors. Amends the Internal Revenue Code of 1986 to allow a credit against income tax to holders of bonds issued to finance land and water reclamation of abandoned mine land areas.

H. R. 1265. Udall (D/CO). Provides a source of funding for the reclamation of abandoned hardrock mines, and for other purposes.

H. R. 1266. Udall (D/CO) and Salazar (D/CO). Facilitates the reclamation of abandoned hardrock mines, and for other purposes.

H. R. 2721. Peterson (R/PA) and 16 Co-Sponsors. Amends the Surface Mining Control and Reclamation Act of 1977 to reauthorize collection of reclamation fees, revise the abandoned mine reclamation program and for other purposes.

Public Lands

S. 1897. Corzine (D/NJ) and Dodd (D/CT). Amends the Forest and Rangeland Renewable Resources Planning Act of 1974 and related laws to strengthen the protection of native biodiversity and ban clearcutting on Federal land, and for other purposes.

H. R. 599. Udall (D/CO) and Tancredo (R/CO). Provides a source of funds to carry out restoration activities on Federal lands under the jurisdiction of the Secretary of the Interior or the Secretary of Agriculture, and for other purposes.

H. R. 975. Tancredo (R/CO) and 5 Co-Sponsors. Provides consistent enforcement authority to BLM, NPS, FWS, and FS to respond to violations of regulations

regarding the management, use, and protection of public lands under the jurisdiction of these agencies, and for other purposes.

H. R. 3166. Grijalva (D/AZ). Provides compensation to livestock operators who voluntarily relinquish a grazing permit or lease on Federal lands where conflicts with other multiple uses render livestock grazing impractical, and for other purposes.

Water Resources

S. 232. Smith (R/OR). Authorizes the Secretary of the Interior, acting through the Bureau of Reclamation, to assist in the implementation of fish passage and screening facilities at non-Federal water projects, and for other purposes.

S. 353. Conrad (D/ND) and Dorgan (D/ND). Amends the Water Resources Development Act of 1999 to direct the Secretary of the Army to provide assistance to design and construct a project to provide a continued safe and reliable municipal water supply system for Devils Lake, ND.

S. 728. Bond (R/MO) and 17 Co-Sponsors and **H.R. 2864** (Passed by the House). Provides for the consideration and development of water and related resources, to authorize the Secretary of the Army to construct various projects

for improvements to rivers and harbors of the U.S., and for other purposes.

S. 753. Feingold (D/WI) and McCain (R/AZ). Provides for modernization and improvement of the Corps of Engineers, and for other purposes.

S. 802. Domenici (R/NM) and 10 Co-Sponsors and **H. R. 1386.** Hastings (D/FL) and 24 Co-Sponsors. Establishes a National Drought Council within the Department of Agriculture, to improve national drought preparedness, mitigation, and response efforts, and for other purposes.

S. 1017. Chaffee (R/RI) and 10 Co-Sponsors. Reauthorizes grants for the water resources research and technology institutes established under the Water Resources Research Act of 1984.

S. 2288. Feingold (D/WI) and McCain (R/AZ). Modernizes water resources planning, and for other purposes.

H. CON. RES. 120. Schakowsky (D/IL) and 23 Co-Sponsors. Expresses the sense of Congress with regard to the world's freshwater resources.

H. R. 109. Herseth (D/SD). Provides compensation to the Lower Brule and Crow Creek Sioux Tribes of South Dakota for damage to tribal land caused by Pick-Sloan Projects along the Missouri River.

H. R. 135. Linder (R/GA) and 8 Co-Sponsors. Establishes the "Twenty-First Century Water Commission" to study and develop recommendations for a comprehensive water strategy to address future water needs.

H. R. 391. Leach (R/IA). Directs the Secretary of the Army to convey the remaining water supply storage allocation in Rathbun Lake, IA, to the Rathbun Regional Water Association.

H. R. 487. Pearce (R/NM). Imposes limitations on the authority of the Secretary of the Interior to claim title or other rights to water absent specific direction of law or to abrogate, injure, or otherwise impair any right to the use of any quantity of water.

H. R. 1368. Burgess (R/TX) and 2 Co-Sponsors. Provides the Secretary of the Army with additional and enhanced authority with respect to water resources projects, and for other purposes.

H. R. 4588. Doolittle (R/CA). Reauthorizes grants for and requires applied water supply research regarding the water resources research and technology institutes established under the Water Resources Research Act of 1984.

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