Excerpt from the session:

Sturgeons have captivated the imagination of people over the millennia due to their large size and unique morphology. Today, they are still revered in many native cultures and by the broader public. From a scientific perspective, they have an important place in aquatic ecosystems and contribute to our understanding of evolutionary biology. However, as human populations grow, the increasing demands placed on water and land-use, and the resulting pollution, continues to pose greater challenges to conserving these fishes. In the face of these challenges, and warming climatic conditions, how are we to conserve this declining group of fishes? Our understandings of basic life history aspects, seasonal movements, physiological ecology, genetics and behavior have expanded in recent years. However, there is still much that is not known. We seek to take a balanced perspective from the latest studies examining the ecology, behavior, genetics, physiology, aquaculture, physiology and toxicology of sturgeons, to help clarify the road to sustainability.

Sturgeon Abstracts:

1. Age and growth of shovelnose sturgeon in the Missouri River

Martin Hamel[1] (presenting), Kirk Steffensen[1], Tyler Haddix[2], Ryan Wilson[3], Dane Shuman[4], Sam Stukel[5], Paul Horner[6], Wyatt Doyle[7]. [1]Nebraska Game and Parks Commission, Lincoln, Nebraska, United States, [2]Montana Fish, Wildlife, and Parks, Glasgow, Montana, United States, [3]U.S. Fish and Wildlife Service, Bismarck, North Dakota, United States, [4]U.S. Fish and Wildlife Service, Pierre, South Dakota, United States, [5]South Dakota Department of Game, Fish, and Parks, Yankton, South Dakota, United States, [6]Missouri Department of Conservation, Chillicothe, Missouri, United States, [7]U.S. Fish and Wildlife Service, Columbia, Missouri, United States

Little is known about population dynamics of shovelnose surgeon *Scaphirhynchus platorynchus* in the Missouri River. Accurate age and growth information collected over a broad spatial scale will assist researchers in making management decisions in various hydrological zones (classified as river segments). In addition, shovelnose sturgeon have been identified as a surrogate species to pallid sturgeon S. albus, a federally endangered species. Identifying age and growth differences of shovelnose sturgeon between river segments and examining factors that drive these differences may guide restoration efforts for pallid sturgeon. A total of 2,602 shovelnose sturgeon pectoral fin rays were collected over a four year period from approximately 1,600 km of the Missouri River. Fin ray cross-sections were aged by two independent readers and a consensus was formed when discrepancies occurred. Length-at-age was back calculated to account for low sample sizes of age-1 and age-2 shovelnose sturgeon (Dahl-Lee method; Carlander 1969). The mean average growth for age-1 was 190-mm; second and third year growth rates decline to 92-mm and 68-mm, respectively. Significant growth variation was observed between river segments each year for age-1-3 shovelnose sturgeon. These differences are likely related to a variety of factors such as flow modification, natural environmental events, and habitat improvement projects. Our results indicate that growth of shovelnose sturgeon was related to temporal variation within segments and suggests that variation in water releases from dams and tributary influences play a large role in sturgeon growth.

2. Wrong place at the wrong time: Incidentals take of endangered pallid sturgeon in a commercial caviar fishery

Phillip Bettoli[1] (presenting), Michelle Casto-Yerty[2], George Scholten[3]. [1]U.S. Geological Survey, Cookeville, TN, United States, [2]Tennessee Tech University, Cookeville, TN, United States, [3]Tennessee Wildlife Resources Agency, Nashville, TN, United States

We quantified the bycatch of endangered pallid sturgeon (*Scaphirhynchus albus*) in Tennessee's shovelnose sturgeon (S. platorynchus) caviar fishery by accompanying commercial fishers and monitoring their catch in April-May 2007. Fishers removed 327 live sturgeons from their gear in our presence, of which 93 were harvested; we also obtained the carcasses of 20 sturgeons that a fisher harvested out of our sight. Two of the 113 harvested sturgeons were confirmed pallid sturgeon based on microsatellite DNA analyses. Additionally, fishers gave us five, live pallid sturgeon that they removed from their gear. If the incidental take of pallid sturgeon (1.8% of all sturgeon harvested) was similar in the previous two commercial seasons, at least 169 adult pallid sturgeon were harvested by commercial fishers in the Tennessee waters of the Mississippi River in 2005 and 2006. While retrieving a gill net set the day before, a fisher we were accompanying retrieved a gillnet lost two days earlier. That ghost net caught 53 sturgeon; most of those fish were dead, including one confirmed pallid sturgeon.

3. Spawning of pallid sturgeon in the Middle Missouri River
Justin Haas[1] (presenting), Dustin Everitt[1], David Adams[1], Aaron DeLonay[2], Gerald Mestl[1]. [1]Nebraska Game and Parks Commission, Lincoln, NE, United States, [2]United States Geological Survey, Columbia, MO, United States

Aquatic habitat in the Missouri River has been extensively altered or lost. This habitat alteration has affected most native fish species including the federally endangered pallid sturgeon (*Scaphirhynchus albus*). At the time pallid sturgeon were listed, it was not known if pallid sturgeon reproduction was still occurring in the lower Missouri River. The Nebraska Game and Parks Commission and the United States Geological Survey initiated a telemetry study in 2007 to confirm the spawning of pallid sturgeon in the Missouri River and if so, where. In the spring of 2007, five pallid sturgeon in reproductive condition, two females and three males, were implanted with Lotek Wireless combined acoustic radio tags and data storage tags. After tag implantation, fish were monitored through an extensive effort (daily) for possible signs of pre-spawning movement. After the fish began to move we switched to an intensive effort where a selected fish was monitored continuously. The two female pallid sturgeons were located hourly and habitat information collected. Both intensively tracked females exhibited upstream movement with a single apex, followed by intervals of slower downstream movement. The apex of upstream movement of one female was in the Missouri National Recreational River segment and the other in the upper channelized river. After both female pallid sturgeon began moving down stream they were recaptured using trammel nets and it was determined that both had spawned.

4. Comparative examination of patterns of movement and spawning by pallid sturgeon and shovelnose sturgeon in the Lower Missouri River
Aaron DeLonay[1] (presenting), Kimberly Chojnacki[1], Sandra Clark-Kolaks[1], Emily Tracy-Smith[1], Diana Papoulias[1], Mark Wildhaber[1], Dustin Everitt[2], Gerald Mestl[2]. [1]U.S. Geological Survey, Columbia, MO, United States, [2]Nebraska Game and Parks Commission, Lincoln, NE, United States

In spring 2007 the U.S. Geological Survey with the Nebraska Game and Parks Commission studied the migration behavior and spawning of sturgeon in the Lower Missouri River in response to flow and other environmental variables. Prior to spawning, 8 pallid sturgeon (*Scaphirhynchus albus*) and 176 shovelnose sturgeon (*S. platorynchus*) were captured and implanted with a telemetry transmitter and data storage tag (DST). Implanted sturgeons were captured in two study sections within the 160-mile length of river below Gavins Point Dam. Implanted sturgeon included both reproductive and non-reproductive males and females. The reproductive status of each individual was assessed during implantation. Crews extensively tracked sturgeon from late March through August, 2007. Systematic search efforts were conducted to document direction and distance moved, and to locate potential spawning habitat. Periodic efforts were made to validate spawning behavior and timing using DIDSON imaging technology and selective recapture of individuals. Following the spawning period all fish were targeted for recapture to reassess spawning success and to collect data storage tags. Two of 8 pallid sturgeon and 104 of 176 shovelnose sturgeon were recaptured. Both species spawned in the channelized and unchannelized portions of the Lower Missouri without modified flows out of Gavins Point Dam. All implanted pallid sturgeon females and >70% of shovelnose sturgeon females spawned. Limited results suggest that movement patterns of both species may be similar. Shovelnose sturgeon used tributaries extensively, while pallid sturgeon did not. Preliminary analysis indicates that migration behavior of males and females within a species may differ.

5. Fine-scale movement of Gulf of Mexico sturgeon relative to critical habitat within Escambia, East, Pensacola, and Choctawhatchee Bays, Florida, following Hurricanes Ivan (2004) and Dennis (2005)

Michelle Duncan[1] (presenting), Lisa Hollensead[1], Lynne Carter-Gray[1], Frank Parauka[2], Stephania Bolden[3].
[1]National Marine Fisheries Service, Panama City, FL, United States, [2]United States Fish and Wildlife Service, Panama City, FL, United States, [3]National Marine Fisheries Service, St. Petersburg, FL/Southeast Regional Office, United States

Hurricanes Ivan (September 2004) and Dennis (July 2005) came ashore in northwest Florida over areas previously designated as critical habitat for Gulf sturgeon *Acipenser oxyrinchus* desotoi. Fifty-eight Gulf sturgeon were tagged with ultrasonic transmitters and released within Escambia, Yellow, Blackwater, and Choctawhatchee Rivers in June, July, September, and October 2005 to determine whether habitat patterns were similar to those observed prior to the hurricanes. Gulf sturgeon marine migration from these rivers into the Pensacola and Choctawhatchee Bay systems was monitored by underwater acoustic receivers stationed throughout each bay from October 2005 through June 2006 (study period 1) and from September 2006 through August 2007 (study period 2). During both study periods, the majority of tagged fish resided in the bays between November and April, with the exception of a few fish that were detected in near shore Gulf of Mexico. An atypical behavior was observed in one fish which was tagged in the Choctawhatchee River but remained in the upper portion of Escambia Bay for the entire summer (June - September) 2006 and returned again in June and July 2007. Several fish displayed the propensity to travel among different bays and rivers but the most notable included a fish that was tagged in the Choctawhatchee River in 2005 and migrated into the Apalachicola River in spring 2006 and then returned to the Choctawhatchee River in spring 2007. Santa Rosa Sound, the seaward arm of the Pensacola Bay system, supported 22 sturgeon for varying periods of time from November 2005 through April 2006 and 15 fish the following year (including11 fish from the previous year and 4 fish not recorded during the first study period). Several fish resided in Santa Rosa Sound for an extended period of time (up to 80 days), presumably to take advantage of the abundant food supply. Most of these habitat use patterns have been documented previously, therefore we concluded that the two hurricanes did not diminish or alter habitat use of Gulf sturgeon in the Pensacola and Choctawhatchee Bay systems.

6. Status of gulf sturgeon in Florida waters: using age-structured population modeling techniques to reconstruct and project population trends and evaluate conservation targets

H. Jared Flowers[1] (presenting), William Pine[1], Steven Martell[2]. [1]University of Florida, Gainesville, FL, United States, [2]University of British Columbia, Vancouver, BC, Canada

Gulf sturgeon Acipenser oxyrhinchus desotoi is a US Endangered Species Act (ESA) listed "Threatened" species that was historically commercially harvested throughout its range in the northern Gulf of Mexico. Because of concerns over declines in population size due to overharvest, the fishery was closed in the mid 1980's. The Apalachicola River, Florida likely supported one of the largest Gulf sturgeon population stocks, yet this population has shown little evidence of recovery as defined by the species' recovery criteria under the ESA. To aid managers in evaluating the practicality of the current recovery criteria in terms of population size and time till recovery, we developed two age-structured population models. We first developed an SRA (stock reduction analysis) model using a time series of landings, biological information, and current population estimates for the Apalachicola River to estimate historic population biomass at the start of fishing. We then used this information to build a second model to evaluate tradeoffs of different management approaches currently being considered to expedite recovery for Gulf sturgeon in the Apalachicola River. Our findings suggest that there were about 20,000 individuals in the population prior to fishing and minimum population recovery time to this level will be in excess of 50 years from fishery closure, approximately double the currently listed target date.

7. Effects of environmental factors and parental reproductive characteristics on dispersal time of larval lake sturgeon (*Acipenser fulvescens*)

Yen Duong[1] (presenting), Kim Scribner[1], James Crossman[1], Patrick Forsythe[1], Edward Baker[2].
[1]Michigan State University, East Lansing, MI, United States, [2]Michigan Department of Natural Resources, Marquette, Michigan, United States

Rehabilitation of threatened fish species, including lake sturgeon (*Acipenser fulvescens*), is in part impeded by lack of knowledge of how environmental and genetic factors affect dispersal and survival during critical early-life history stages. Water temperatures and flow have been considered as major causes of variation in larval dispersal time. However, adult phenotype and timing and location of spawning can also influence larval dispersal. We estimated the relative importance of environmental factors (temperature and flow) and adult characteristics (body size, location and timing of spawning) on timing of larval dispersal. Biological attributes, spawning locations, and genetic samples were obtained from adult lake sturgeon spawning in the Upper Black River, Michigan during 2007. Larvae were passively captured dispersing downstream for 30 nights and were reared separately until fin clips could be taken. We employed parentage analysis using 12 microsatellite loci to assign larvae (N=1400) to adult spawners (N=203). Variation in larval dispersal time was partitioned into components attributed to environmental factors and parental reproductive characteristics. We will discuss the effects of behavioral plasticity and adaptive significance of dispersal time that is also tied to early life history traits, and discuss implications for management.

8. Genetic diversity implications of lake sturgeon stream-side rearing

Luke Roffler[1] (presenting), Brian Sloss[1], Brad Eggold[2], Tom Burzynski[2], Ron Bruch[3].
[1]Wisconsin Cooperative Fishery Research Unit, University of Wisconsin-Stevens Point, Stevens Point, WI, United States, [2]Wisconsin Department of Natural Resources, Milwaukee, WI, United States, [3]Wisconsin Department of Natural Resources, Oshkosh, WI, United States

Rehabilitation of historic Lake Michigan lake sturgeon populations using stream-side rearing facilities (SRFs) is currently underway. The Wisconsin traditional hatchery (TH) method uses eggs from one female crossed with mixed milt of five males and all subsequent progeny are reared together (mixed families). The SRF approach uses a modification of this multi-male approach where the eggs are split into roughly equal lots and fertilized by one male each, after which female families are reared separately. Our objective was to determine if the two strategies resulted in realized genetic differences by comparing genetic diversity of TH and SRF progeny. Differences were observed between approaches the two (TH and SRF). We found all broodstock populations to be representative of their source populations, based on a G-test of allele counts. However, by the end of the rearing process, all facilities had lost the representative character of the original source population. This correlates with observed paternity-related bias in survival found consistently in each cross at each facility. Such bias can cause a loss of genetic diversity through lower than expected effective numbers of breeders. This study will assist in modifying spawning and rearing strategies for the maintenance of genetic diversity in lake sturgeon propagation.

9. The St. Lawrence estuary Atlantic sturgeon (*Acipenser oxyrinchus*) fishery: managing a valuable resource towards a sustainable fishery

Guy Verreault[1] (presenting), Guy Trencia[2]. [1]Ministère des Ressources naturelles et de la Faune, Rivière-du-Loup, Qc, Canada, [2]Ministère des Ressources naturelles et de la Faune, Lévis, Qc, Canada

The Atlantic sturgeon (*Acipenser oxyrinchus*) has been exploited in the St.Lawrence estuary (Canada) for its flesh for decades. After a severe crash in late 60's, this non-regulated fishery recovered and landings peaked at record level (142 mt) in early 90's with signs of overexploitation. Lack of basic knowledge regarding population dynamics and habitat requirements have confronted managers striving to implement sustainable fishery management. Annual monitoring of the fishery and the sturgeon population was set up in 1994 in conjunction with progressive fishing restrictions. The fishery is now closely regulated with restricted seasons, individual quotas (tags), specific mesh size gillnets (20.4 cm), and maximum fork length (150 cm) for a mean annual landing of 49.2 mt (SD= 2.6). Annual size structure and CPUE were corrected for gillnet selectivity and allowed to estimate total mortality (Z= -0.12) and fishing mortality (F= -0.07). The management measures influenced fishers behaviour. Fisher selection is defined with a sigmoid function where probability for a sturgeon to be kept and tagged increases rapidly over 105 cm FL whereas gillnet selectivity decreases over the same size. Those two characteristics appear to be key components for sustaining the only remaining fishery for this species in North America.

10. Bycatch mortality of sturgeon in the Northwest Atlantic Ocean

Tim Miller[1] (presenting), Gary Shepherd[1], David Secor[2]. [1]NMFS, Northeast Fisheries Science Center, Woods Hole, MA, United States, [2]Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, Solomons, ML, United States

We performed statistical analyses to assess whether covariates (targeted species, surface water temperature, sturgeon length, and attributes of gear and its application) were correlated with mortality of sturgeon incidentally caught in gillnet and otter trawl commercial fisheries. For each gear type, we fit a suite of nested logistic regression models to data collected between 2001 and 2006 by at-sea observers in fishing fleets off of the northeastern United States. We used likelihood ratio tests of the fitted models to determine whether the covariates were significantly correlated with sturgeon mortality. For gillnet gear (135 total sturgeon bycatch mortalities out of 465 sturgeon bycatch observations), sturgeon mortality was significantly correlated with soak time, water temperature, length of the caught sturgeon and mesh size. However, these relationships were significantly different by targeted species and whether or not tie-downs were used. For trawl gear, no covariates were significantly correlated with sturgeon mortality. The inability to detect significant associations of any covariates with mortality in trawl gear could be due to low statistical power; only 48 sturgeon bycatch observations (and only 3 mortalities) were available for trawl gear.

11. A comparison of two transmitter implantation techniques in shovelnose sturgeon

Ben Neely[1] (presenting), Kirk Steffensen[1], Mark Pegg[2]. [1]Nebraska Game and Parks Commission, Lincoln, NE, United States, [2]University of Nebraska - Lincoln, Lincoln, NE, United States

Shovelnose sturgeon *Scaphirhynchus platorhynchus* are a benthic species native to the Mississippi River and Missouri River drainages. Population declines throughout their native range and their close phylogenetic relationship with the endangered pallid sturgeon S. albus have prompted researchers to observe shovelnose sturgeon behaviors and identify critical habitat types using telemetry. Telemetry transmitters are most often implanted surgically in shovelnose sturgeon with little or no documentation of alternate implantation techniques. We compared handling time and percent weight loss of shovelnose sturgeon that had transmitters implanted surgically (N=16), implanted gastrically (N=28), and not implanted (N=34). Implantation time was 35 seconds faster on average for gastric implantation versus surgical implantation ($P<0.0001$). However, there was no significant difference in percent weight loss between the three treatments ($P=0.68$). One gastric implantation mortality occurred during the 35-day observation period (day 32) and three gastric implantation mortalities occurred after the observation period ended (days 38 and 39). Two gastrically implanted tags were expelled during the 35-day observation period. Our results suggest that handling time for the transmitter implantation techniques used in this study do not affect short-term survival nor significantly influence growth.

12. Population parameters and potential management scenarios of shovelnose sturgeon in the upper Mississippi River

Jeff Koch[1] (presenting), Michael Quist[1], Clay Pierce[2], Michael Steuck[3], Kirk Hansen[3], Gene Jones[3].
[1]Iowa State University, Ames, IA, United States, [2]USGS-Iowa Cooperative Fish and Wildlife Research Unit, Ames, IA, United States, [3]Iowa Department of Natural Resources, Bellevue, IA, United States

Shovelnose sturgeon *Scaphirhynchus platorynchus* have become an increasingly important commercial species in the upper Mississippi River (UMR) due to collapsing foreign sturgeon

populations and bans on imported caviar. Data regarding shovelnose sturgeon population parameters in the UMR are currently more than thirty years old; therefore, more recent information is needed for managing these populations. We began a project in the spring of 2006, in collaboration with the Iowa Department of Natural Resources (DNR) and the Wisconsin DNR to study the impacts of commercial harvest on shovelnose sturgeon populations in the upper Mississippi River. Over 1,500 shovelnose sturgeon were collected from eight study pools (i.e. Pools 4, 7, 9, 11, 13, 14, 16 and 18). Shovelnose sturgeon from upstream pools have the highest mean lengths, weights, and ages. Mortality estimates are also lower in upstream pools (i.e. Pools 4, 7, 9, and 11) compared to downstream pools (i.e. Pools 13, 14, 16, and 18). Modeling of potential management scenarios with current population parameters from our study suggest a 24-inch minimum length limit may prevent growth overfishing, but a 27-inch minimum length limit is necessary to prevent recruitment overfishing.

13. Diet composition of juvenile shovelnose sturgeon in the Middle Mississippi River

Dawn Sechler[1] (presenting), James Garvey[1], Quinton Phelps[1]. [1]Southern Illinois University-Carbondale, Carbondale, IL/ north central division, United States

Shovelnose sturgeon populations are declining throughout their native range due to potential commercial overharvest and habitat degradation. To ensure shovelnose sturgeon populations persist in the Middle Mississippi River, a better understanding of sturgeon early life history is imperative. We quantified juvenile shovelnose sturgeon (total length (TL) range: 9-95 mm) diets from 2004-2007 to determine whether foraging behavior changed as a function of season and total length. Juvenile shovelnose sturgeons were collected from the Middle Mississippi River during the months of May-July of the above years. Each prey item was identified to genus and measured to calculate dry weight. Although, ephemeropterans, dipteran pupae, and megalopterans were consumed, chironomids comprised the majority of diet by dry biomass during all three years. For sturgeons >15 mm TL dry weight of chironomids and ephemeropterans were inversely related; smaller fish exhibited no such trend. During May-July of 2008, prey will be collected in order to quantify availability to determine whether observed foraging behavior is selective or non-selective.

14. Development and application of a spatially explicit habitat model for juvenile pallid sturgeon

Bryan Spindler[1] (presenting), Steven Chipps[1], Robert Klumb[2]. [1]USGS South Dakota Cooperative Fish and Wildlife Research Unit, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, SD, United States, [2]US Fish and Wildlife Service, Great Plains Fish and Wildlife Management Office, Pierre, SD, United States

The pallid sturgeon *Scaphirhynchus albus*, is an endangered species native to the Missouri, and Lower Mississippi River. As part of a large-scale recover effort, juvenile pallid sturgeon are stocked into the Missouri River and monitored using standardized sampling protocols. Understanding the distribution and habitat requirements of juvenile pallid sturgeon represents an important part of the monitoring and assessment program. In this study, we developed a habitat assessment tool for pallid sturgeon that integrated information from known capture locations with physical habitat and prey availability parameters. We used discriminant function analysis to assess habitat differences between capture (n=25) and non-capture (n=49) locations from 2003-2006 in the Fort Randall reach of the Missouri River. Six variables successfully discriminated capture from non-capture locations and included 1) water depth >2 m, 2) water velocities < 120 cm , 3) variation in water velocity direction, 4) sandy substrates, 5) dipteran abundance and 6) ephemeropteran abundance. Classification functions were then used to predict pallid sturgeon occurrence in eight 3.2 km river segments. Percent of predicted habitat area ranged from 0.5 to

23%, indicating that habitat availability for juvenile pallid sturgeon is variable in the Fort Randal reach. The model developed here could be used to evaluate pallid sturgeon habitat in other areas of the Missouri River basin and help guide future pallid sturgeon stocking and habitat restoration efforts.

15. Efforts to document spawning of shortnose sturgeon in the Penobscot River System, ME

Phillip Dionne[1] (presenting), Gayle Zydlewski[1], Michael Kinnison[1], James Wilson[1]. [1]University of Maine, Orono, Maine, United States

During the summer of 2006 the first confirmed endangered shortnose sturgeon captured in the Penobscot River in over a quarter century was netted by researchers from the University of Maine. Since then monitoring has led to efforts to develop population estimates and identify critical habitat within the system. These efforts involve the capture and tagging of sturgeon and have yielded over one hundred tagged individuals. A subset of these were also tagged with acoustic and/or radio transmitters allowing researchers to track the fish. It is currently unknown if sturgeon spawn in the Penobscot River. In the coming year, in addition to refining population estimates and distinguishing critical habitat, we will work to identify spawning habitat. Due to the delicate nature of dealing with endangered species, netting for spawning individuals is not permitted; instead efforts to document spawning will take place by tracking previously tagged sturgeon to spawning areas, or in the absence of such information, sampling when water temperatures approach those documented for spawning of the same species in adjacent river systems. Sampling will involve deploying an array of artificial substrates to capture spawned eggs that will adhere to the artificial substrates. These sampling techniques and preliminary results will be discussed and explained in relation to the challenges of this particular project. Additionally, the consequences of researching an endangered species and how the collection of data is regulated under the ESA will be considered.

16. Assessing the spatial distribution of pallid and shovelnose sturgeon capture sites in the Lower Missouri river using geospatially enabled relational data

Kimberly Chojnacki[1], Sandra Clark-Kolaks[1], Emily Tracy-Smith[1], Aaron DeLonay[1] (presenting). [1]U.S. Geological Survey, Columbia, MO, United States

Multidisciplinary research is being conducted to investigate reproductive physiology, movement and spawning habitat use of Lower Missouri River sturgeon. Pallid (*Scaphirhynchus albus*) and shovelnose sturgeon (*S. platorynchus*) central to this effort were initially collected in two segments of the Missouri River from March 8, 2007 to April 19, 2007. The upper segment was located between river mile 756 and 727. The lower segment was located between river mile 685 and 648 (Blair, NE). A total of 86 pallid sturgeon and 2286 shovelnose sturgeon were collected using 544 gear deployments, 79 3.5-inch mesh gill nets, 238 2.5-inch mesh gill nets, 70 2-inch trammel nets, and 157 trotlines baited with worms. Using a relational database framework, data were recorded about each gear deployment, including habitat type, water quality, latitude and longitude. A related table was created to maintain data on all fish captured in each deployment. Using the database framework, fishing efforts, and number of pallid and shovelnose sturgeon captured were summarized by river mile. A geographic information system was then used to map the summary of pallid and shovelnose capture locations, normalized by fishing effort. This work provides visual representation of the spatial distribution of pallid and shovelnose sturgeon capture locations, which could be used in the future to focus field sampling efforts.

17. Genetic assessment of population fragmentation of lake sturgeon (A*cipenser fulvescens*) in the Ottawa River

Kristyne Wozney[3] (presenting), Chris Wilson[1], Tim Haxton[1], Shawna Kjartanson[2]. [1]Ministry of Natural Resources, Peterborough, Ontario, Canada, [2]University Of Toronto, Toronto, Ontario, Canada, [3]Trent University, Peterborough, Ontario, Canada

Lake sturgeon (*Acipenser fulvescens*) are of conservation concern throughout their range. Lake sturgeon are a fluvial dependant species, which have been increasingly impacted and fragmented by human development. Although lake sturgeon were historically abundant in the Ottawa River and its tributaries, commercial harvest caused severe decline in lake sturgeon populations. Other anthropogenic factors such as logging, agriculture, and water quality decline have continued to suppress lake sturgeon numbers. In addition, river fragmentation by hydroelectric and water control dams may be increasing isolation among habitat patches and local rates of decline, raising concerns for persistence of local populations. We used fourteen microsatellite DNA markers to assess population structure and diversity of lake sturgeon in the Ottawa River, and analyzed samples from 10 sites that cumulatively represent more than 500 kilometers of riverine habitat. To test for evidence of anthropogenic fragmentation, patterns of genetic diversity and connectivity (dispersal and gene flow) within and among river segments we tested for concordance with geographic location (upper vs. lower reaches), separation by distance and obstacles to migration, considering both natural and unnatural barriers as well as barrier (dam) age. The results of this study will have implications as to the proper conservation and management of this species throughout this river system.

18. Genetic evaluation of lake sturgeon (*Acipenser fulvescens*) designatable units in Canada

Shawna Kjartanson[1] (presenting), Chris Wilson[2], Nathan Lovejoy[1]. [1]University of Toronto, Scarborough, Ontario, Canada, [2]Ontario Ministry of Natural Resources, Peterborough, Ontario, Canada

Canada's largest landlocked fish, the lake sturgeon (*Acipenser fulvescens*), is a heritage species with considerable social and economic value. Unfortunately, over-exploitation and habitat alteration has led to the collapse of lake sturgeon fisheries across North America. In light of the assessment of lake sturgeon by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), there will be a demand for tailored management strategies for this threatened species. As COSEWIC recommends species status changes, it recognizes designatable units (DUs) if necessary. These are defined as irreplaceable units based on significant ecologic, geographic, or genetic differences. The hierarchical system of differentiation, in order of priority, includes 1) taxonomic distinctiveness, 2) genetic evidence, 3) range disjunction, and 4) biogeographic distinction. Based on the available (yet scarce) information, COSEWIC identified eight DUs in its most recent lake sturgeon status report. Lake sturgeon populations are initially divided into four units, largely re(presenting) the "National Freshwater Ecozones" (Western Hudson Bay, Saskatchewan-Nelson Rivers, Southern Hudson Bay and the Great Lakes-St.Lawrence). Only the Saskatchewan-Nelson ecozone can be divided further into five, based on unpublished data from three microsatellite loci. Without sufficient evidence for further sub-structuring, the remaining ecozones are left intact as distinct DUs. In this study, eleven microsatellite loci are used to characterize 50 populations across the range of lake sturgeon in Canada. The robustness of the current designations are tested and discussed.

19. Hydropower facilities & sustainable sturgeon: a conservation genetic approach

Amy Welsh[1] (presenting), Melinda Baerwald[2], Mike Friday[3], Bernie May[2]. [1]State University of New York -Oswego, Oswego, NY, United States, [2]University of California - Davis, Davis, CA, United States, [3]Ontario Ministry of Natural Resources, Thunder Bay, ON, Canada

Hydropower facilities have been a barrier to lake sturgeon recovery in the Great Lakes. Dams have prevented lake sturgeon from reaching their historic spawning grounds. The water being released from the dams has affected spawning success and larval and juvenile survival. On the Kaministiquia River in Lake Superior, a remnant lake sturgeon population may be impeded or restricted from accessing their historical spawning site due to dewatering from upstream dam operations. The operation of this dam provides flows for power production and scenic flows for Kakabeka Falls Provincial Park. Water flows on the river are dependent on the operation of several dams throughout the watershed. Lake sturgeon continue to spawn on the Kaministiquia River but uncertainty remains about the number of individuals that successfully reproduce. Genetic data can provide information on the number of full-sibling families represented in a cohort and on the number of adults breeding during that spawning season. During two spawning seasons (2005 and 2006), lake sturgeon adults moving up the river to spawn were captured and genetic samples were taken. Following the spawning events, larval samples were collected. All samples were analyzed at 14 microsatellite loci. Using genetic data from the captured adults, full-sibling families were simulated. Relatedness values were calculated for the simulated data set and the actual data set. A UPGMA tree was constructed and the simulated data were used to determine the threshold for full-sibling family determination. Genetic samples from known full- and half-sib families were also analyzed to verify the analytical methods used. Results indicate that not all of the potential parents were sampled. Additionally, not all of the adults that were sampled successfully reproduced. The information on the number of families will have important implications on the operation of the hydropower facilities. With a low number of families, flows being released from the dam may need to be adjusted in order to maintain a sustainable lake sturgeon population on the Kaministiquia River.

20. Identifying the fundamental unit of management in U.S. Atlantic coast sturgeons: A genetic-based approach

Tim King[1] (presenting), Barbara Lubinski[1], Anne Henderson[1], Doug Peterson[2]. [1]USGS_Leetown Science Center, Kearneysville, WV, United States, [2]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, Georgia, United States

Sturgeons are remnants of the once flourishing chondrosteans, dominant fishes of the Permian period. The continued existence of these “fossil” fishes is in jeopardy throughout North America, Europe, and Asia and they require conservation efforts to identify and sustain ecological processes and evolutionary lineages. However, sturgeons present significant challenges for investigating the evolutionary processes shaping the nuclear genomes of extant species due to the presence of autopolyploidy ranging in a series from 4N-8N-12N-16N times the haploid number. Microsatellite DNA markers have become the tool of choice for investigating genetic variation and determining the fundamental unit of management in species of conservation concern. We will present the results of range-wide surveys of microsatellite DNA variation for two at-risk species exhibiting different ploidy levels: Atlantic sturgeon (Acipenser oxyrinchus; 4N) and shortnose sturgeon (*Acipenser brevirostrum*; 12N-16N). In addition to the delineation of population structure throughout the range of *A. oxyrinchus*, microsatellite variation at 12 loci allowed the confirmation of the presence of a reproducing population within the Chesapeake Bay (James River). Polysomic microsatellite markers (N=11) have allowed delineation of population structure and a re-defining of the number of distinct population segments among A. brevirostrum

collections. Comparisons will be made with patterns observed by other researchers using mitochondrial DNA sequence variation.

21. Drift dynamics and abundance of larval lake sturgeon in the Peshtigo River, Wisconsin, USA

David Caroffino[1] (presenting), Trent Sutton[1], Dan Daugherty[2]. [1]University of Alaska Fairbanks, Fairbanks, Alaska, United States, [2]Texas Parks and Wildlife Department, Ingram, Texas, United States

Drift-net catches of larval lake sturgeon *Acipenser fulvescens* have been used to determine spawning success, drift duration, and relative year-class strength. However, little or incomplete information is available regarding absolute abundance and vertical distribution of drifting larvae. This lack of information and past assumptions of benthic or uniform drift confound estimates of spawning success, year-class strength, and abundance. The objective of this research was to estimate abundance and determine the vertical distribution of drifting larval lake sturgeon in the Peshtigo River, Wisconsin. Catches from four D-frame drift nets, equally spaced across the channel and 100 m below lake sturgeon spawning habitat, were used to determine abundance during 2006 and 2007. Two sets of stacked, rectangular-frame drift nets were used in 2007 to assess the vertical distribution of larvae. An estimated 3,260 (95% CI: 829 – 6,776) larvae were produced from the 2006 year class. While lake sturgeon larvae were captured drifting in all parts of the water column in 2007, their distribution was not equal: 36% were captured near the surface, 77% drifted in the upper half of the water column, and only 5% were captured in the 0.2 m section adjacent to the bottom. If the 2006 abundance estimate were modified to incorporate this unequal drift, it would increase to 6,208 (95% CI: 2,357 – 13,037) larvae. In 2007, after correcting for the unequal distribution, abundance was estimated to be 13,207 (95% CI: 628 – 32,474) larvae. These results suggest that the vertical distribution of larvae is neither benthic nor uniform and confirm the necessity of assessing the vertical distribution of drifting lake sturgeon larvae before estimating abundance.

22. Tracking temporal trends in female effective population size for white sturgeon in the lower Columbia River

Andrea Drauch[1] (presenting), Tucker Jones[2], Colin Chapman[2], Bernie May[1]. [1]University of California Davis, Davis, CA, United States, [2]Oregon Department of Fish and Wildlife, Salem, OR, United States

Anthropogenic pressures such as habitat destruction have disturbed recruitment in many white sturgeon populations, although a direct relationship between spawner abundance and habitat disturbance has not yet been quantified. In highly fecund species such as white sturgeon, the number of female spawners surviving to contribute offspring each year can be used as an indicator of population viability. We examined trends in white sturgeon female effective population size and genetic diversity in samples collected pre- and post-impoundment of the Lower Columbia River system. We genotyped white sturgeon spawned in 1937-1941 (directly after impoundment), 1982-1987, and 2001-2005 at fifteen microsatellite loci and calculated pairwise relatedness values to determine kinship between white sturgeon juveniles from each time period. Archived data from known full-sibling white sturgeon families were used to determine a relatedness threshold value distinguishing between full-sibling and unrelated juveniles. This threshold relatedness value was applied to estimate the minimum number of female spawners contributing to the Lower Columbia River white sturgeon collection by identifying the number of full-sibling and unrelated groups in each time period. Recognition of declines in genetic diversity

and/or reductions in the minimum number of female spawners since impoundment would provide evidence that this particular habitat modification may be contributing to recruitment declines in this white sturgeon population.

23. Effect of rearing temperature on the onset and duration of dispersal of early life stages of shortnose sturgeon

Erika Parker[1] (presenting), Boyd Kynard[2]. [1]USGS, Conte Anadromous Fish Research Center, Turners Falls, MA, United States, [2]BK-Riverfish, LLC. Amherst, MA, United States

Shortnose sturgeon undergo a downstream dispersal during the larval life stage. The objective of this study was to determine the effect of three temperature regimes on the timing and pattern of downstream dispersal of Connecticut River (MA, USA) shortnose sturgeon larvae. Tests were conducted in artificial stream tanks with three replicates at each of three temperatures, 10°, 15°, and 20°C. Fish were introduced to experimental tanks immediately upon hatching, and their movements were monitored day and night with video cameras. Rearing fish at 10°C caused development to slow and delayed the onset of dispersal. Fish in the 10°C group had a single peak of dispersal lasting 8 days. Increasing the temperature (15 and 20°C) caused fish to begin dispersing at a younger age (in days after hatch), but also produced a dispersal with multiple peaks. Fish were all at or close to the beginning of the larval life stage (i.e. beginning exogenous feeding) and were all morphologically similar when they began dispersing, regardless of temperature. Fish in the 15 and 20°C treatments required a similar number of degree-days to become larvae, but fish in the 15°C group took more degree-days to begin dispersal than fish in the 20°C group. Fish in the 10°C group took many more degree-days both to become larvae and to initiate dispersal than fish in the other two groups. These results show development and dispersal of shortnose sturgeon early life stages can be influenced by river temperature, and anthropogenic impacts that alter river temperature regimes have the potential to affect sturgeon dispersal patterns.

24. Dispersal and behaviour of early life stages of Kootenai white sturgeon: a laboratory study

Boyd Kynard[1] (presenting), Erika Parker[2], Brian Kynard[2], Timothy Parker[2]. [1]BK-Riverfish, LLC, Amherst, MA, United States, [2]Conte Anadromous Fish Research Center, Turners Falls, MA, United States

For 3 years, we used artificial stream tanks to observe the dispersal and behavior of free embryos and larvae produced by different Kootenai white sturgeon *Acipenser transmontanus* parents. Most photonegative free embryos remained hidden in cover, but some left and moved weakly downstream, a move that would not likely carry them a far distance. However, when free embryos developed into feeding larvae, all initiated a strong day and night dispersal that lasted for many days. This dispersal is greatly affected by velocity, with larvae in artificial streams with fast velocity (mean, 23.4 cm/s) initiating dispersal earlier, with greater intensity, and moving more days (14 d) than larvae in slower velocities. Substrate size may also affect dispersal with more downstream movement of larvae in tanks with gravel compared to fish in tanks with cobble. During dispersal, larvae mainly used channel flow, and those entering the low velocity in a side eddy, quickly left, suggesting wild larvae do not use side eddies, but instead have a strong preference for fast velocity in order to remain in the main flow and move a far distance. The strong long dispersal style of larvae is likely an adaptation to move fish a far distance from the egg deposition reach to the rearing reach for larvae and early juveniles.

25. Spatial distribution and movement of juvenile lake sturgeon in an impounded reach of the Winnipeg River

Cameron Barth[1] (presenting), Stephan Peake[2], Mark Abrahams[1], W. Gary Anderson[1]. [1]University of Manitoba, Department of Biological Sciences, Winnipeg, Manitoba, Canada, [2]Canadian Rivers Institute, University of New Brunswick, Fredriction, New Brunswick, Canada

Many studies have focused on relatively large juvenile lake sturgeon (i.e. > 500 mm fork length) in small rivers and tributaries of the Great Lakes, but little is known regarding juvenile habitat utilization in large, northern rivers. To address this lack of information, we tagged 64 juvenile lake sturgeon (16 > 500 mm and 48 < 500 mm) with acoustic transmitters in a 35 km long impounded reach of the Winnipeg River, Manitoba. During the open water season of 2007, fish implanted with acoustic transmitters were monitored using: a) a VRAP telemetry system (VEMCO, Halifax, NS Canada) to monitor fine scale movements and micro-habitat preferences; and b) an array of 74 VR2 receivers (VEMCO) to monitor coarse scale, long distance movements. In addition, recapture information from over 300 juvenile lake sturgeon marked with Floy-tags during 2006 and 2007 have been collected. Information from the Floy-tag recaptures, indicates that lake sturgeon exhibit high site fidelity and suggests that juvenile lake sturgeon may avoid moving either upstream or downstream through areas of high water velocity. Data from the VRAP system indicates that juvenile lake sturgeon prefer deep water areas with sand or sand/gravel substrates, and may move for extended periods of time (i.e. weeks) in relatively narrow areas of the river in a pattern parallel to water flow. Results from the VR2 receiver array, including movements of 6 larger juveniles, and 13 smaller juveniles that were relocated, will also be presented.

26. Juvenile Gulf sturgeon winter habitat use patterns in the Suwannee River estuary and in Apalachicola Bay as defined by automated acoustic listening post telemetry

Kenneth Sulak[1] (presenting), Michael Randall[1], April Norem[1], J Travis Smith[1], Kirsten Luke[1], William Harden[1]. [1]U.S. Geological Survey, Gainesville, FL, United States

Pilot telemetry studies were conducted in winter 2005-06 in the Suwannee River estuary and nearhore Gulf of Mexico, and in winter 2006-07 in estuarine Apalachicola Bay. Studies were undertaken using a set of 14 automated acoustic listening posts and acoustically-tagged Gulf sturgeon to document patterns of movement and trophic habitat use by juvenile and adult sturgeons on the winter feeding grounds in estuarine waters. In the Suwannee estuary, individual juveniles displayed a characteristic pattern of frequent and substantial movement, with extensive forays out of a core river-mouth feeding area into the open Gulf of Mexico. In Apalachicola Bay, both juveniles and adults remained within a very restricted area of the river-mouth throughout the winter, with limited movements close to shore in shallow water, and with little evidence of offshore forays (except for the largest adults). It is hypothesized that anthropomorphic food sources (seafood processing facilities discharging wastes into the Apalachicola river-mouth) may influence the winter habitat use pattern of sturgeons in the Apalachicola population, keeping the population concentrated within a limited activity area. In contrast, the Suwannee population, with food resources uninfluenced by human activities, depends upon naturally-occurring benthic prey species with patchy distributions. Individual movement patterns displayed in Suwannee Gulf sturgeon juveniles are interpreted as evidencing searching/foraging behavior. A much more robust (52 acoustic listening posts deployed in a systematic grid pattern)0 follow-up study was conducted for the Suwannee population in winter 2007-08, with data to be downloaded in May and reported at this symposium, as well.

27. Habitat selection of early juvenile Atlantic sturgeon in the St. Lawrence estuarine transition zone

Daniel Hatin[1] (presenting), Jean Munro[1], François Caron[1], Rachel Simons[1]. [1]Ministère des Ressources naturelles et de la Faune, Longueuil, Quebec, Canada, [2]Fisheries and Oceans Canada, Mont-Joli, Quebec, Canada, [3]Ministère des Ressources naturelles et de la Faune, Jonquière, Quebec, Canada, [4]Stanford University, Stanford, CA, United States

Habitat selection of early juvenile Atlantic sturgeon *Acipenser oxyrinchus* have been little studied and remain largely unknown throughout the species' range. A recent multidisciplinary project on the ecological impacts of dredged sediment disposal operations in the St. Lawrence estuary presented us with an opportunity to examine some aspects of Atlantic sturgeon ecology. In 2000–2002, survey trawling, ultrasonic telemetry, benthos sampling, and hydrodynamic modeling were used to determine habitat use and selection of early juvenile Atlantic sturgeon in the St. Lawrence estuarine transition zone. Fish were located mostly in freshwater relatively close to the salt wedge boundary and far from the shore, intertidal zones, and islands. They mostly used the 6–10 m depth range relatively close to a channel, in areas with low bottom current velocities, and over silt–clay substrates. Salinity and distance from the salt wedge were the two most important variables explaining their habitat selection. Young-of-the-year Atlantic sturgeon used similar depth ranges, bottom salinities, and current velocities, but occupied mainly sandy substrate. Management implications of these results are discussed in relation to the impact of dredging and sediment disposal operations in the St. Lawrence estuary.

28. Evidence of behavioural habitat selection in juvenile Atlantic and shortnose sturgeons

Edwin Niklitschek[1] (presenting), David Secor[1]. [1]Universidad Austral de Chile, Centro Trapananda, Coyhaique, Aysen, Chile, [2]University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, MD, United States

Laboratory-derived bioenergetics models have been used to predict habitat suitability for endangered and depleted species such as Atlantic and shortnose sturgeons. Implicit in the application of these models is the assumption that the distribution of sturgeons is determined through the behavioural selection of suitable habitats. In a series of laboratory choice experiments, we evaluated behavioural responses of 57 juvenile Atlantic and 49 juvenile shortnose sturgeons (individual mass ~ 25 g), divided and acclimated into three temperature, two oxygen saturation and three salinity levels. Behaviour experiments were conducted using a binomial choice chamber composed of two converging raceways supplied with a constant water flow where temperature, dissolved oxygen saturation (DO) and salinity were controlled to meet experiment specifications. Nine binary combinations of salinity, temperature and DO (choices) were randomly allocated to each chamber arm and tested on each fish, following a random sequence of treatments. We observed that both species were similarly capable to discriminate of selecting the highest offered DO-level (incidence=65% ± 7.0 (SE)), with stronger selection when the lowest prescribed DO saturation (40%) was applied. Behavioural responses to temperature were significantly different between species. Juvenile Atlantic sturgeon chose the lowest provided temperature option at 76% ± 5.7 (SE) incidence, regardless of treatment and acclimation temperature. Juvenile shortnose sturgeon, on the other hand did not show a significant preference among any of the offered temperature choices. No significant preferences were observed among salinity choices involving 1, 8 and 15, with the exception of juvenile Atlantic sturgeon acclimated to 15, which showed selection for this salinity over any of the other choices in 75% ± 8.9 (SE) of the trials. Behavioural responses to dissolved oxygen were the strongest and matched expectations from bioenergetics and survival models. Habitat choice for temperature and salinity

did not match model predictions as consistently.

29. Circadian or diel depth changes in shortnose (*Acipenser brevirostrum*) and Atlantic sturgeon (*A. oxyrinchus*) in Connecticut waters

Tom Savoy[1] (presenting), Jacqueline Benway[1], Kevin Friedland[1]. [1]CT Dep. Environmenatl Protection, Old Lyme, CT, United States

Circadian rhythms are apparent in all phyla, yet little understood in fish. We present evidence of apparent diel patterns in movement of two species of sturgeon in Connecticut waters from acoustic telemetry. Depth-sensing ultrasonic transmitters were implanted into shortnose sturgeon (20 in 2002, 19 in 2003) and Atlantic sturgeon (18 in 2006, 22 in 2007). Over 1.4 million observations of shortnose sturgeon and over 200,000 observations of Atlantic sturgeon were recorded from acoustic receivers deployed throughout Connecticut waters. Numbers of observations per individual ranged from 853 to 120,896. Shortnose and Atlantic sturgeon utilized deeper water during daylight hours. Shortnose sturgeon were active throughout all months of the year with similar movement patterns. Atlantic sturgeon are not present in Connecticut during the winter and thus receivers were only deployed seasonally and information available from May thru November. Individuals of both species move to greater depths during daylight hours. and continued this behavior even when moving into deep water (>15.0 m for shortnose, and >30.0m for Atlantics), despite the likelihood of few visual cues from light attenuation in turbid waters. All sturgeon with ultrasonic transmitters did not display precise diel patterns, some fish display unique movement patterns to confound analyses.

30. Growth variation among juvenile lake sturgeon: a consequence of competitive interactions or an adaptive strategy?

Cheryl Klassen[1] (presenting), Mark Abrahams[2], Steve Peake[3]. [1]University of Manitoba, Winnipeg, Manitoba, Canada, [2]Memorial University of Newfoundland, St. John's, Newfoundland, Canada, [3]University of New Brunswick, Fredericton, New Brunswick, Canada

Size variability within cohorts, generated by inter-individual differences in growth rates, has been observed across plant and animal populations. It is particularly interesting that these deviations can emerge within cohorts reared together with adequate resources under controlled conditions. Social interactions (e.g. dominance hierarchies) are most often attributed to growth variations; however, trade-offs between increased growth and mortality for some species (e.g. reduced antipredatory responses, immune function and resistance to physiological stressors) suggest an adaptive quality to slow growth rates and an explanation for its persistence in some populations. Growth variability within lake sturgeon (*Acipenser fulvescens*) cohorts has been observed under culture conditions but the processes involved that influence this phenomenon have received limited exploration. Progeny from wild lake sturgeon collected in the spring of 2008 will be reared under two treatments (isolation and groups) in an attempt to determine whether growth rate is an inherent trait or the product of competitive asymmetries. Experiments will be conducted on offspring produced from a single cross (i.e. one male and female) to control for genetic differences. If variable growth rates are due to inherent differences, we would expect variance among growth rates to be similar between treatments. Conversely, if variable growth rates are due to competitive interactions, the growth rates of fish reared in groups should be more variable than those individuals reared in isolation. Results may suggest that the lake sturgeon's life-history strategy is to produce phenotypically diverse offspring to maximize fitness (i.e. form of bet hedging). Alternatively, results may suggest that lake sturgeon populations consist of competitively dominant and inferior individuals. Both outcomes present interesting insights into the potential structure of lake sturgeon populations.

31. A GIS-based niche model for mapping and monitoring white sturgeon habitat in the lower Columbia River, USA

James Hatten[1], Michael Parsley[1] (presenting). [1]U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, WA, United States

We developed a GIS-based niche model that characterizes in a spatially explicit manner white sturgeon *Acipenser transmontanus* habitat in the lower Columbia River, USA. The niche model was developed using riverbed slope and roughness, water depth, fish positions collected in 2002, and Mahalanobis distances (D2). In the model development stage, we compared a full-rank model based upon dissimilarity to an optimum configuration to two reduced-rank models that focused upon a minimum set of basic habitat requirements. We calibrated the models by identifying a D2 threshold under which 70% of white sturgeon relocations occurred in 2002. Our project goal was the identification of the most appropriate model for characterizing sturgeon habitat and assessing changes in potential habitat within the project area. Model selection involved comparing the accuracy and specificity of each model to an independent dataset that was collected in 2003. We selected the full-rank model to meet our project goal because it had higher accuracy and specificity than the reduced-rank models. Our analysis revealed that white sturgeon prefer moderate to high water depths and riverbed slopes, and moderate riverbed roughness. Using these criteria, as represented by a D2 threshold ≤ 3.19 (i.e. high-potential habitat), the model was 81.2% accurate in 2003. The eigenvectors indicated that riverbed slope and roughness were more important than water depth, but all 3 variables were important. We assessed the sensitivity of the full-rank model to channel modifications by synthetically filling a deep-water pool to different depths and calculating the change in D2. Synthetic pool-filling revealed that high-potential habitat declined ≤ 2.1% when up to ~9 m of fill was added, declined 15.1% when ~12 m was added, and declined 42.7% when the pool was completely filled (~15 m of fill added). Future research should consider water velocity as a variable as well as model applicability to other areas in the Columbia River.

32. Evidence of fall spawning in Gulf of Mexico sturgeon, *Acipenser oxyrinchus* desotoi, in the Suwannee River, FL

Michael Randall[1] (presenting), Kenneth Sulak[1]. [1]US Gological Survey, Florida Integrated Science Center, Gainesville, FL, United States

Gulf of Mexico sturgeon, *Acipenser oxyrinchus* desotoi, spawn in March and April following immigration into rivers. However, probable fall spawning has been indicated in the Suwannee River, FL, from captures of sturgeon that were ripe or exhibited just-spawned characteristics in the fall. The capture of a 93 mm TL young-of-the-year Gulf sturgeon on 29 November, 2000, which would have been spawned in late September, 2000, is conclusive evidence that fall spawning occurs in the Suwannee River. Analysis of age-at-length data indicates that approximately 20% of the Suwannee River Gulf sturgeon population may be attributable to fall spawning. The option to spawn in either spring or fall may represent an elegant solution to the hazards of climatic change, in that Gulf sturgeon have spawning alternatives to counter environmental variables such as drought.

33. Use of pop-up satellite archival tags and GIS to estimate movements, habitat use, and threats for adult Atlantic sturgeon in the ocean

Daniel Erickson[1] (presenting), Andy Kahnle[2], Michael Millard[3], Gosia Bryja[4], Amanda Higgs[2], Jerre Mohler[3], John Sweka[3], Gregg Kenney[2], Mark Dufour[2], Ellen Pikitch[1]. [1]University of Miami, Pew Institute for Ocean Science, New York, New York, United States, [2]New York State Department of Environmental Conservation, New Paltz, New York, United States, [3] U.S. Fish and Wildlife Service, Northeast Fishery Center, Lamar, Pennsylvania, [4]United States Wildlife Conservation Society, Bronx, New York, United States

Oceanic migratory patterns and habitat use by Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are largely unknown. Although mark-recapture studies have been conducted to describe these patterns for juvenile Atlantic sturgeon, results are incomplete because sample sizes are small (i.e. rare recapture events) and data are biased since they are fishery-dependent. Virtually nothing is known about oceanic-migratory patterns for adult Atlantic sturgeon. We used pop-up satellite archival tags (PSATs) to describe movements, habitat use, and concentration sites for adult Atlantic sturgeon while in the open ocean. These tags record date, time, light, depth, and water temperature while attached to fish. At a programmed date, the tags release, float to the surface, and transmit summarized data to satellites. Twenty three adult Atlantic sturgeon were tagged with PSATs in the Hudson River during June and July of 2006 and 2007. These fish entered the river to spawn, and returned to the ocean between July and October of the tagging season. Although we encountered some problems (e.g. a number of tags were lost before the programmed pop-up date), we found that these tags produced numerous position estimates using light levels (day length and time at mid-day or mid-night). The precision of these light-based position estimates was improved using depth and temperature information. Our PSAT data have produced hundreds of reliable position estimates as well as preferred depths and water temperatures for adult Atlantic sturgeon in the ocean - independent of fishing operations. Using these data, we describe the migratory corridors and concentration sites for adult Atlantic sturgeon from the Hudson River while in the ocean. Potential threats to this stock of Atlantic sturgeon are described by combining these results with other data sources (e.g. fishing).

34. Movement patterns and habitat use of adult lake sturgeon in an impounded river system

Holly Labadie[1] (presenting), Steve Peake[1]. [1]University of New Brunswick, Fredericton, NB, Canada

Lake sturgeon are endemic to the large lakes and rivers of the Hudson Bay, Great Lakes and Mississippi drainages. These fish are endangered or threatened throughout most of their natural range because of habitat destruction and over fishing. The purpose of this study was to determine seasonal adult lake sturgeon movement patterns and habitat use in the Winnipeg River, Manitoba, Canada. Adult lake sturgeon were caught using large mesh gill nets in the Winnipeg River between two generating stations in the spring and fall of 2007. Twenty eight fish were tagged with acoustic transmitters and released, and 74 Vemco VR2 hydrophone dataloggers were deployed such that the entire stretch of river (approximately 34 km) was covered. Substrate samples were also taken, and water quality parameters were measured along several transects passing through various sections of the river (i.e.: rapids, narrow areas and lakes). Movement data as recorded from the VR2 array (collected in 2008) will be presented in context with measured habitat variables.

35. Using telemetry to evaluate modification in the spatial distribution of the Eastmain River lake sturgeon (*Acipenser fulvescens*) after dam construction and reservoir impoundment in James Bay territory (Québec)

Frederic Burton[1] (presenting), Marc Gendron[1], Michel Simoneau[1], Jean-Jacques Fournier[2]. [1]Environnement Illimite inc, Montreal (Quebec), Canada, [2]Hydro-Quebec, Montreal (Quebec), Canada

After impoundment of the Eastmain 1 reservoir, during winter 2005-2006, 76 adults lake sturgeon were marked with internal or external radio transmitters and tracked down below the dam and the power plant. Tracking was conducted four months/year, from May to July to identify the modification in the spawning and feeding habitat, and in February to locate the wintering habitats. Those localizations are compared with pre-construction localizations. We find out a significant difference in habitat utilization after reservoir impoundment as re-localization of spawning and wintering habitats. In the reservoir Eastmain 1, a program of lake sturgeon implantation is going on since 2005 where the objective is to introduce 30 lake sturgeons per year until 2014. At the present time, 80 of those planted sturgeons have been marked with radio transmitter. We wanted to see how lake sturgeon will colonize a newly impounded reservoir. Since the beginning of the introduction program, we observe that lake sturgeon mainly stay in lotic environment in the upper part of the reservoir.

36. Fine-scale movement patterns of adult lake sturgeon during spawning

Stephan Peake[1] (presenting). [1]University of New Brunswick, Fredericton, NB, Canada

Lake sturgeon are spring spawners, and may undertake extensive migrations to reach the spawning grounds, which are often located downstream of migratory barriers such as rapids or hydroelectric installations. However, detailed information on behaviour and micro-habitat use, relative to available habitat and hydropower operations, is scarce because it is difficult to track spawning fish into turbulent and acoustically noisy environments. We used various methods (netting, telemetry, egg traps, etc.) in an attempt to provide this information for a population inhabiting the Winnipeg River, Manitoba, Canada. Data in 2007 suggested that adults spawned near the tailrace of a large hydro dam, where water flows were highest (water levels in spring were low and spillways were not in operation). Substrate in the area was relatively poor in quality (primarily bedrock). High flows are expected in 2008 and, based on 2007 results which suggest fish select habitat based primarily on hydraulic variables, we expect behaviour and habitat use during a high water season to be markedly different.

37. Balancing mineral resource extraction and protection of a lake sturgeon population in a northern Ontario River

Rob Mellow[1] (presenting), Chris Pullen[1], John Seyler[1], Dana Schmidt[1]. [1]Golder Associates Ltd, Sudbury, ON, Canada, [2]Golder Associates Ltd, Ottawa, ON, Canada, [3]Golder Associates Ltd, Sudbury, ON, Canada, [4]Golder Associates Ltd, Castlegar, BC, Canada

The extraction of mineral resources can, if not well planned, significantly impact the surrounding natural environment where that activity is occurring. The operation of a nickel/cooper mine associated with a known lake sturgeon spawning area within the Upper Groundhog River, part of the James Bay watershed, represents an example of how a balanced approach can be taken to managing mineral extraction while at the same time providing for the protection of an important species of concern. This paper will review the development of a monitoring program and comment on the challenges and benefits derived from an adaptive management approach. Treated mine water effluent from the Montcalm Mine, located near Timmins, Ontario, is discharged to the

Upper Groundhog River via a buried pipeline and in-river diffuser system. As a result of permitting requirements stipulated by the province of Ontario, the mine has undertaken an annual monitoring program since 2004 to evaluate the potential impacts of mine water effluent on the spawning population within the area known as Six Mile Rapids. The monitoring program focuses on the lake sturgeon spawning period to determine if the release of treated mine water effluent is impacting the spawning population. Initially the challenge was designing a program that included measurable monitoring end points to determine if impacts were occurring in the context of a long lived species with a protracted life history. The result was the design of a program which was divided into a series of study components with the overall objective of assessing the potential pathways, or linkages, between the discharge of treated mine effluent and lake sturgeon in the Groundhog River. Study elements include monitoring spawning habitat utilization, evaluating egg/larval survival and development; and collecting population characteristic (i.e. length, weight, age, tag returns, genetic structure) data. Results from the annual monitoring programs have been used by both the mine operator and regulator as an adaptive management tool and have resolved some of the operational concerns originally associated with the mine. Lessons learned from this program may prove helpful to other industries and regulators faced with the challenge of managing development in the presence of lake sturgeon.

38. Understanding lake sturgeon spawning demographics in a northern Ontario river

Chris Pullen[1] (presenting), Robert Mellow[1], John Seyler[1], Dana Shmidt[1]. [1]Golder Associates, Ottawa, Ontario, Canada

Lake sturgeon spawning activity has been monitored since 2003 within the James Bay watershed at two locations on the Groundhog River. Population data has been collected as part of a monitoring program that has specific objectives that must be met on an annual basis as specified in mine authorizations from the provincial government. While the monitoring program is not designed to test a hypothesis in the traditional sense, the data collected on lake sturgeon is valuable in understanding lake sturgeon population structure and dynamics from a population that has not been subject to intensive study. This paper summarizes the data that has been collected to date and compares and contrasts it with data from other spawning populations in North America. The population characteristics data set collected spans the period from 2003 to 2007. Data collected include length, weight, age, sex, tag returns and spawning habitat characteristics. An analysis of the data indicates that the Groundhog River's annual spawning cohorts display demographic structure, meristic characteristics and age ranges similar to other populations monitored in more southern locations.

39. Combining new technologies with traditional mark-recapture methods to estimate the number of green sturgeon that spawn in the Rogue River, Oregon

Daniel Erickson[1] (presenting), Steven Lindley[2], Ethan Mora[2], John Weber[3], Todd Confer[3], Blair Krohn[3], Phaedra Doukakis[1]. [1]University of Miami, Pew Institute for Ocean Science, New York, New York, United States, [2]National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA, United States,[3]Oregon Department of Fish and Wildlife, Gold Beach, OR, United States

Green sturgeon are anadromous and range from the Bering Sea to Ensenada, Mexico. Two distinct population segments (DPS) have been described for this species, with the Eel River demarcating the boundary between the Southern and Northern DPS. Spawning populations are known to exist only in the Sacramento River system (Southern DPS) and the Klamath and Rogue River systems (Northern DPS). The Southern DPS is listed as threatened under the US

Endangered Species Act, whereas the Northern DPS is listed as a Species of Concern. Even though this species is known to spawn in only three river systems, little has been done to estimate or monitor the abundance of spawning adults. In this paper, we provide abundance estimates and confidence intervals for adult green sturgeon that spawn in the Rogue River, Oregon, using traditional mark-recapture methods. More than 300 adult green sturgeon were caught and marked (PIT tags and scute removal) in the river between 2000 and 2005. In 2007, 85 adults were caught by gill net to provide our estimate of abundance. In addition to estimating absolute-abundance for green sturgeon spawning in the Rogue River, we describe steps taken to provide the most accurate estimate possible. Estimates were improved by studies to (a) understand the behavior of green sturgeon using sonic and radio telemetry (e.g. determining spawning periodicity, time of entry and departure, and summer/fall holding sites), (b) estimate the total possible number of summer/fall holding sites throughout the river based upon known-holding sites and using a GIS framework, and (c) verify the presence and positions of green sturgeon at potential holding sites using a DIDSON camera before setting gillnets in order to maximize capture rates. Because we now understand the behavior of green sturgeon, and because more than 400 adults are tagged, little effort (< 3 weeks per year) is now needed for acquiring annual abundance estimates for Rogue River green sturgeon, which will be a significant asset to management. Our methods could be used as a template to develop sturgeon-monitoring programs for important spawning rivers throughout the world.

40. Indirect measures of reproductive state in lake sturgeon

Peter Allen[1] (presenting), W. Gary Anderson[1], Stephan Peake[2]. [1]University of Manitoba / Canadian Rivers Institute, Winnipeg, Manitoba, Canada, [2]University of New Brunswick, Fredericton / Canadian Rivers Institute, Fredericton, New Brunswick, Canada

Techniques that indirectly measure reproductive developmental state and minimally impact sampled animals are important for management purposes, and particularly for the conservation of rare species. The lake sturgeon, *Acipenser fulvescens*, is a declining or endangered species in many Canadian ecosystems. Low abundance, late reproductive maturity, slow egg development, long reproductive intervals, and a lack of external sex characteristics pose challenges for population assessment of this species. Population management and size estimates can be greatly improved with additional information on reproductive maturity. Understanding the annual size of the spawning population can benefit population status assessments and long-term population modeling for estimates of reproductive output. We sampled wild adult lake sturgeon from the Winnipeg River, Manitoba in order to determine indicators of reproductive development for use in population assessments. Adult lake sturgeon were sampled for blood indicators of sex and stage of maturity, and gonadal biopsies were collected for histological verification. Fish from both sexes and all reproductive stages were used to determine the best indicators of sex and reproductive development stage. Results will be discussed in the context of management and conservation of this species. Research supported by Manitoba Hydro and NSERC (CRDPJ 321520-05).

41. Shortnose sturgeon in the Ogeechee River, Georgia

Daniel Farrae[1] (presenting), Douglas Peterson[1]. [1]University of Georgia, Athens, GA, United States

The Ogeechee River, Georgia is thought to contain one of the smallest populations of the endangered shortnose sturgeon (*Acipenser brevirostrum*). Despite more than four decades of federal protection, recent studies suggest that the population has not recovered. The objectives of this study were to: 1) estimate current abundance, and 2) evaluate the population age structure as

an indication of potential population bottlenecks that may be limiting recovery. From June–August 2007, we used bottom-set entanglement gear to sample the population and to conduct a mark-recapture estimate of abundance. Over the 3-month sampling period, we captured 111 shortnose sturgeon, including 15 recaptures, yielding a Schnabel estimate of 368 (95% CL; 223–657) individuals. Age determinations from pectoral fin spines revealed that <2% of the fish captured were juveniles. Similar studies of shortnose sturgeon in the Altamaha river showed that juveniles comprise >50% of that population. These findings suggest that while the Ogeechee River population may have increased slightly in recent years, it remains limited by persistent recruitment failure.

42. Use of fishery independent surveys to determine abundance, habitat, distribution and age class structure of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) within the Atlantic Ocean

Keith Dunton[1] (presenting), Adrian Jordaan[1], Michael Frisk[1], David Conover[1]. [1]School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY, United States

In 1998, a 40 year moratorium was enacted to prevent the harvest of Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*. Currently there are concerns that Atlantic sturgeon recovery is being hindered by by-catch in the near-shore oceanic fishery. While little information exists on the oceanic habitats of Atlantic sturgeon, commercial fishers have frequently reported large by-catch of this species within the near-shore environment. We used the results from NJDEP, NYSBU, and NMFS fishery independent surveys to identify the relative abundance, distribution, age-class structure and habitat preferences of Atlantic sturgeon within the Northeast Atlantic Ocean. Long term data trends from NJDEP survey suggest that juvenile recruitment to the marine fishery has improved over the last four years. Observations suggests sturgeon have a strong depth preference of 10-15 m with no sturgeon captured in water deeper than 30 m. CPUE and distribution varied with each season with the highest catches occurring in NY and NJ. Results show that 42% of all sturgeon captures occurred within a small area near the mouth of the Hudson River. Limited tag recaptures suggests that the population within this area is may be quite large and warrants further protection as essential fish habitat. Sturgeon sizes within this area ranged from 66-248 cm TL with peak size distribution ranging from 90-110 cm TL. Preliminary analysis suggests that 81% of the sturgeon encountered within this area were juveniles between 5-11 years old. A total of 11% represent fish that are potentially mature adults.

43. Predicting local extinction of pallid sturgeon in the Mississippi River

James Garvey[1] (presenting), Steven Bartell[2], Thomas Keevin[3]. [1]Southern Illinois University, Carbondale, IL, United States, [2]E2 Consulting Engineers, Inc. Maryville, TN, United States, [3]US Army Corps of Engineers, St. Louis, MO, United States

The pallid sturgeon *Scaphirhynchus albus* is an US federally endangered species that resides in the drainages of the Mississippi and Missouri Rivers. Natural reproduction only occurs in a portion of its range, including the 200-km reach of the Mississippi River where harvest of its congener, the shovelnose sturgeon *S. platorynchus*, is still permitted. Incidental harvest of the pallid sturgeon occurs, even given the best efforts of the conservation enforcement community; we explored the potential impact of harvest at varying rates on population dynamics of this endangered species using empirical data plus population viability modelling. We quantified mortality, sex-specific maturation schedules, and reproduction through standardized sampling (gill nets plus trawling) across multiple years. An age-structured demographics model was constructed to assess how population density changes as a function of differing scenarios of fishing mortality. Annual mortality rate of the pallid sturgeon was similar to that of the sympatric shovelnose sturgeon. Current rates of purported fishing mortality led to extinction of the local population of pallid sturgeon in the demographics model within 15-20 years, given no other stochastic events that affect reproductive success. However, in the absence of any fishing mortality in the model, the population grew unchecked. Therefore, we need to improve our understanding of mechanisms regulating population growth in this river reach (e.g. density dependence, habitat, etc.). Given the likely vulnerability of the pallid sturgeon to incidental harvest and the difficulty in enforcing the prevention of intentional or accidental take, we recommend that regulatory agencies consider curbing harvest of the shovelnose sturgeon to allow the congener to recover.

44. Validation of true age of lake sturgeon and implications for population and harvest management

Ronald Bruch[1] (presenting), Shannon Davis-Foust[1], Michael Hansen[2], Steven Campana[3]. [1]WI Dept. of Natural Resources, Oshkosh, WI, United States, [2]University Of Wisconsin-Stevens Point, Stevens Point, WI, United States, [3]Bedford Oceanographic Institute, Dartmouth, Nova Scotia, Canada

Age data are likely the most important data collected on managed fish populations. Ages of sturgeon have been estimated by counting growth marks on a variety of bony structures but the structure of choice for the last 100 years, pectoral fin rays, have never been fully validated to verify the ages estimated from them are the true age of the fish sampled. The validity of ages estimated from growth marks on pectoral fin ray sections of lake sturgeon from the Winnebago System in east central Wisconsin was examined through mark and recapture of known age fish, and by comparing bomb radiocarbon levels in otolith cores to a reference time series of bomb radiocarbon developed for Lake Winnebago. Ages estimated from pectoral fin ray sections were found to be relatively accurate for fish up to 13-15 years of age (98-103 cm, 39-41 in), but generally underestimates of true age for fish older than 15 years of age. The power function True Age = 1.35703*(Est Age^0.9606) was used in an age error key to correct >14,000 age estimates collected during winter spearing harvests from 1954-2007. Corrected catch-age data were used in a Statistical Catch at Age model to estimate annual recruitment, instantaneous fishing mortality and abundance. The harvest predicted by the SCAA model correlated 94.9% with actual harvest. For the period 1954-2007, SCAA estimated average F at 0.0369 (S.E. 0.0044), and A at 0.0965 (S.E. 0.0038). A sensitivity analysis estimated M to be 0.065. The validation of true age of lake sturgeon shows the species grows slower and matures later than reported earlier for the Winnebago System, and verifies that maintaining annual exploitation rates below 5% will allow a lake sturgeon stock to grow at an intrinsic rate of population increase (r) of 0.0585. Lake sturgeon life history parameters used in management decision making need to be based on accurate age estimation data to prevent overharvest of this k-selected species.

45. Evaluation of recovery goals for endangeredwhite sturgeon in the Kootenai River, Idaho USA

Vaughn Paragamian[1] (presenting), Michael Hansen[2]. [1]Idaho Department of Fish and Game, Coeur d Alene, Idaho, United States, [2]University of Wisconsin Stevens Point, Stevens Point, Wisconsin, United States

Our objective was to evaluate recovery goals for endangered white sturgeon *Acipenser transmontanus* in the Kootenai River, Idaho. We used demographic statistics for white sturgeon in the Kootenai River in a stochastic density-dependent population model to estimate recruitment

rates needed for population recovery. We simulated future abundance of white sturgeon in the Kootenai River over a 25-year period and a range of hypothetical recruitment rates to estimate the level of recruitment that would lead to population recovery (7,000 fish, the number that were present before the population suffered recruitment failure). We compared simulations of future abundance at enhanced levels of recruitment to those based on the present status of the population and to the recruitment criterion in the Kootenai River White Sturgeon Recovery Plan. We found that the population would decline to only 57 individuals after 25 years and 6 individuals after 50 years if recruitment failure continued. The population reached the target carrying capacity of 7,000 individuals within 25 years only when each adult produced 0.4 age-1 recruits, a recruitment rate equivalent to reaching the target level of recruitment in the recovery plan every year. In contrast, the population grew to only 1,200 individuals if the target level of recruitment in the recovery plan was produced in only three of every ten years, as specified in the recovery plan. We recommend that recovery goals for white sturgeon in the Kootenai River be modified as follows:[1] a population goal of 7,000 sub-adults and adults;[2] population recovery within 25 years; and[3] a minimum recruitment rate of at least 20 age-1 juveniles detected from each year class in each of 10 years using a standardized monitoring protocol.

46. Stock-recruit dynamics of Atlantic sturgeon in the Altamaha River, Georgia: a baseline for evaluating species recovery

Paul Schueller[1] (presenting), Douglas Peterson[1]. [1]University of Georgia, Athens, GA, United States

Recent studies of Atlantic sturgeon spawning runs in the Altamaha River, Georgia, have documented annual run sizes of approximately 190-390 adults, however evaluating population recovery is difficult without historical (pre-exploitation) abundance data. To help assess recovery of the population, the objective of this study was to quantify recruitment of age-1 juveniles in relation to annual adult run size to better understand stock-recruit dynamics of the population. From 2004-2007, we used entanglement gear to collect adults and juveniles in the tidally influenced portion of the Altamaha River. We used Multi-strata, Robust design models to estimate demographic parameters, including juvenile and adult abundance, annual survival, and recruitment. Over the 4 years of the study we captured 370 adults, and 1127 juveniles. Annual run sizes of 324, 386, and 211, produced age-1 cohorts of 1417, 326, and 1323. Peak outmigration occurred at age-2 or 3, depending on abundance of younger cohorts. Our data suggest that small variations in annual run size (<50%) may result in large variations (up to 400%) in corresponding cohort abundance. These findings should provide a baseline for monitoring population recovery in other southern rivers; however, further studies are needed to better understand how environmental variations affect stock-recruit dynamics.

47. Lake sturgeon (*Acipenser fulvescens*) artificial fertilisation, rearing and propagation at the Eastmain-1 hydroelectric development (Québec): a conservation program in collaboration with the Cree.

Jerome Gingras[1] (presenting), Frederic Burton[1], Marc Gendron[1]. [1]Environnement Illimite inc, Montreal Quebec, Canada

The construction of the Eastmain-1 powerhouse began in 2002, impoundment of the reservoir was completed in June 2006 and the powerhouse commissioning was staggered between August and December 2006. One of this project's mitigation measures is the production and release of lake sturgeon in the Eastmain River just downstream of the dam and in the Eastmain 1 reservoir. The stocking program began 2004 and will end in 2014. Lake sturgeon larvae and YOY are produced in a field hatchery close by the river. At every step of the protocol, there is a collaboration with members of the Cree nation with the aim of technological transfert. Since 2004, a total of 89 000 larvae (2 cm), 24 747 larvae (3 to 4 cm) and 21 920 YOY (6 to 10 cm) where introduced in the Eastmain River just downstream of the dam. In the Eastmain 1 reservoir, a total of 29 000 larvae (2 cm), 21 866 YOY (6 to 10 cm) and 88 adults where introduced in the new reservoir with the objective of starting a new population.

48. Status of Stocked Lake Sturgeon in Targeted Restoration Waters of New York

Dawn Dittman[1] (presenting). [1]USGS Tunison Laboratory of Aquatic Science, Cortland NY, United States

In response to the imperiled status of the key native species, lake sturgeon (*Acipenser fulvescens*), the NYSDEC is following a recovery plan to maintain or reestablish lake sturgeon populations in at least eight separate locations. The Genesee River received 1,900 fingerlings in 2003-2004. As of October of 2007, 677 individuals have been recaptured and floy tagged. Catch rates in 07 were 20 to 35 sturgeon per night. The estimate of the number juvenile sturgeon still using the river is 900 to 1,200. The average size of 4 year old fish was 603mm & 918g. The 3 year old fish averaged 505mm and 571g. In Cayuga Lake system 3,772 fall fingerlings of 4 year classes (95, 98, 00, 04) were stocked. In 2005, 16 sturgeon were caught in the Cayuga outlet, the average length was 1.13m. In May 06, 2 sturgeon were caught. One was a ripe male, 9.29 kg and 1.21m. At 11 years old he was in the lower range of age for the start of sexual maturity in sturgeon. Netting in August resulted in 29 sturgeon, average size 1.1m and 8.1kg. In addition, to these detailed evaluations, I will discuss the status and observed habitat use of stocked sturgeon in other target restoration rivers, including the St. Regis (received 5,000 fingerlings 98-04) and the Raquette, received 800 fingerlings in 2004. Understanding the life history details and success of stocked sturgeon in the available habitat is a vital input into sturgeon management progress in New York and across the Great Lakes Region.

49. Lake sturgeon reintroduction in the Coosa River System, Georgia, United States

Justin Bezold[1] (presenting), Douglas Peterson[1]. [1]University of Georgia, Athens, Georgia, United States

Lake sturgeon *Acipenser fulvescens* were once abundant in the Coosa River of northwestern Georgia; however, habitat degradation and over-exploitation during the 1900s contributed to their extirpation. In fall 2001, the Georgia DNR initiated a new reintroduction program to restore the population. Our objectives were to evaluate the success of this reintroduction program. From fall 2004-2007, we captured juvenile lake sturgeon using bottom set entanglement gear to evaluate post-stocking growth and survival. We also used radio-telemetry to monitor seasonal movements and habitat use of age-1+ juveniles. Over 3 years of sampling, we captured 682 lake sturgeon measuring 270 – 790 mm TL, with annual cohort survival rates varying from 1 – 14%. Length at age analysis showed that although growth was slightly slower than expected, relative conditions were comparable to those reported for northern populations. Radio-telemetry data showed that lake sturgeon were most active in spring and fall and that reservoir habitats were preferred in all seasons except during late summer when dissolved oxygen declined to <3.0 mg/L. While our findings show that a juvenile lake sturgeon population has been re-established in the Coosa River System, reservoir hypoxia during the summer months may limit the ultimate success of the restoration program.

50. Lake sturgeon spawning habitat enhancement through flow manipulation

Mike Friday[1] (presenting). [1] Lakehead University, Thunder bay, Canada

The base of Kakabeka Falls on the Kaministiquia River ON is an historical spawning site for adult lake sturgeon. This site however, is often dewatered during the period of spawning for power production and scenic flows for Kakabeka Falls Provincial Park. Controlled flow conditions over the falls were provided by Ontario Power Generation to determine flows necessary for adult sturgeon to access this site and facilitate successful spawning, hatch and larval drift. We examined flows of 23 m3/sec (2004 and 2005), 17 m3/sec (2006) and "scenic flows" in 2007. Scenic flows fluctuate between 0.34 m3/sec (at night), 4.25 m3/sec (weekdays) and 8.5 m3/sec (weekends). To monitor sturgeon movements into the spawning area radio telemetry was utilized. Adult sturgeon were tagged in the lower river (with external radio transmitters) when they were known to be migrating upstream to spawn. Their movement into the spawning area and migration back downstream was monitored using an ATS data logger. Larval drift netting was carried out to document spawning success under these flow regimes. During flows of 23 m3/sec and 17 m3/sec access and successful spawning occurred. Scenic flow conditions resulted in limited access and reduced spawning success.

51. Results of a formal review of recruitment failure hypotheses for white sturgeon (*Acipenser transmontanus*) from the upper Columbia River

Gary Birch[1] (presenting), Paul Higgins[1], Robin Gregory[2], Graham Long[3]. [1]BC Hydro, Burnaby, B.C. Canada, [2]Decision Research, Galiano Island, B.C. Canada, [3]Compass Resource Management Ltd. Vancouver, B.C. Canada

The Upper Columbia River White Sturgeon Recovery Initiative was formed in 2001 and brings together over 25 U.S. and Canadian government, industrial, First Nations and public stakeholders dedicated to the recovery of the white sturgeon in the upper Columbia River basin upstream of the Grand Coulee Dam. The initiative published a recovery plan in 2002 which has since directed the efforts of the program in several areas including conservation culture, population monitoring, recovery research and public outreach. In 2006, the government of Canada listed the white sturgeon in the upper Columbia as endangered under the Species at Risk Act, which formalized the initiatives efforts under a national recovery plan umbrella. Stakeholders and governments have provided variable degrees and time periods of support, driven by different goals and objectives. This has led to effects on program direction, focus and efficiencies in delivery. During 2007-08, the program recovery group re-examined the original recovery plan as well as subsequently developed hypotheses that were being used to explain recruitment failure and develop mitigative responses. The process involved multi-stakeholder decision making which utilizes the weighted judgement of a combination of program experts and external non-aligned experts within a decision framework model. The process was designed to reach consensus among participants on priority hypotheses to be tested and future program direction. This presentation summarizes the results of the review, and demonstrates the importance of using a decision framework to refocus variable opinions within a recovery team scenario.

52. Long-term field evaluation of external and internal telemetry-tagged shortnose sturgeon

Micah Kieffer[1] (presenting), Boyd Kynard[2]. [1]USGS Conte AFRC, Turners Falls, MA, United States, [2]BK-Riverfish, Amherst, MA, United States

We monitored the affects of several tagging procedures on adult shortnose sturgeon *Acipenser brevirostrum* in the Connecticut and Merrimack rivers. Tags mounted externally on dorsal scutes detached after a mean of 95.9 d. Tags mounted through the dorsal fin base were retained a mean of 262.2 d, significantly longer than scute-mounted tags. Loss of external tags resulted from either tissue erosion or tag mount failure. Scute or dorsal fin erosion caused by external tagging healed and had no long-term effects. Tags surgically implanted into the body cavity were usually retained for the tag's operational life, and in most cases, for much longer (mean, 1,370.7 d). Poor healing of incisions was rare. Some internal-antenna (IA) tags were ejected by an unreported method: the tag moved to the posterior end of the body cavity and is forced against the thin body wall adjacent to the anal opening. This tissue ruptures, allowing the tag to exit the body cavity through the rupture in the body wall just to one side of the anal opening. Tag ejection was reduced by coating tags with an inert elastomer. Internal-antenna tags had no deleterious affects on fish and were well-suited for long-term studies. Fish carried IE tags (internal transmitter and external antenna) a mean of 1,532.3 d. The best antenna exit site was at the edge of or through a ventral scute. For IE tags, antenna chafing and tag encapsulation were minimal, and all physical damage healed causing no lasting effects. Neither spawning success of 13 wild females in an artificial spawning stream nor sperm release of 12 wild IA-tagged males observed in the field was affected by internal tagging procedures. There was no effect of tagging on growth as growth of IA and non-tagged males was similar.

53. Determining the timing of seawater migration in juvenile green sturgeon through LA-ICP-MS of pectoral fin rays

Peter Allen[1] (presenting), James Hobbs[2], Joseph Cech[3], Joel Van Eenennaam[3], Serge Doroshov[3]. [1]University of Manitoba, Canadian Rivers Institute, Winnipeg, Manitoba, Canada, [2]Bodega Marine Laboratory, Bodega Bay, California, United States, [3]University of California, Davis, Davis, California, United States

We investigated the use of laser ablation-inductively coupled plasma-mass spectrometry on green sturgeon (Acipenser medirostris) pectoral fin rays, for the examination of initial seawater entry. In control, hatchery fish (n=6), reared 1-2 years in fresh water and 1-3 years in seawater, we found a significant increase in strontium (Sr)/calcium (Ca), decrease in barium (Ba)/Ca, and increase in Sr/Ba (16.5-fold) in fresh water versus seawater calcified growth zones. In wild adults captured in the Klamath River (n=10), the combined evaluation of Sr/Ca and Ba/Ca concentrations proved to be more valuable than Sr/Ba concentrations, likely due to a more complex life history. Ba/Ca concentrations dropped significantly between growth zones 1 and 2 (0.5-1.5 years) indicating a transition into saline waters, such as the estuary. Sr/Ca concentrations increased slightly in the same location, but increased to concentrations found in control fish held in seawater between growth zones 3-4 (2.5-3.5 years). Sr/Ca, Ba/Ca, and Sr/Ba concentrations in growth zones 4-6 (4.5-6.5 years) of wild fish were similar to those found in control fish held in seawater, and corroborated with previous physiological studies and limited field data. These results demonstrate the usefulness of trace element analyses of green sturgeon pectoral fin rays, and an early age of entry into seawater.