Navajo Agricultural Products Industry (NAPI)
Razorback Sucker Rearing Ponds
2010
Annual Report

Submitted By:

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To:

The San Juan River Basin Recovery Implementation Program

EXECUTIVE SUMMARY

- 10,500 fish received from Dexter National Fish Hatchery and stocked into NAPI ponds
    - 8, 205 fish harvested – 78.1% overall return rate
        - East Avocet – 3,500 fish stocked – 3,135 fish harvested – 89.6% return
        - West Avocet – 3,500 fish stocked – 2,630 fish harvested – 75.1% return
        - Hidden – 3,500 fish stocked – 2,439 fish harvested – 69.7% return
- NAPI stocking met 72% of the program goal for stocking 11,400 annually in the San Juan River
- 2,031 fish passively harvested
- 6,174 actively harvested
- Grow-out from April through November
    - Target growth (≥ 300mm) reached by August 15
- Navajo Nation Native Fish Biologist hired in June to manage NN-SJRRIP obligations

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INTRODUCTION

Justification/Relationship to SJRIP

The San Juan River, located in the upper portion of the Colorado River basin (Colorado, New Mexico, Utah) harbors a native fish community which is severely threatened by both human induced and natural, biotic and abiotic influences. The razorback sucker, *Xyrauchen texanus*, is one of eight historically occurring native species, accompanied by 21 established populations of non-native fish species, and is considered a priority toward recovery efforts (Holden 2000, SJRRIP 2006). The razorback sucker was listed as endangered under the Endangered Species Act in 1991 as a result of severe declines in population numbers and lack of recruitment across its native range, and is currently protected by federal, state, and tribal agencies (USFWS 1991, Furr 2009). The decline in historical abundances of San Juan River native and endangered fishes is thought to be a function of altered flow regime, loss of physical habitat through water development, and negative interspecific species interactions attributed largely to the introduction of non-native fish populations (Platania 1990, Brooks et al. 2000, SJRRIP 2010a).

Protection and recovery efforts of two endangered fish species (razorback sucker, and Colorado Pikeminnow, *Ptychocheilus lucius*) were initiated in 1992 under the formation and direction of the San Juan River Basin Recovery Implementation Program (SJRRIP). Principal to the program are two over-arching goals (SRRJIP 2010a);

1. To conserve populations of Colorado pikeminnow and razorback sucker in the Basin consistent with the recovery goals established under the Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531 *et seq.* (ESA).
2. To proceed with water development in the Basin in compliance with federal and state laws, interstate compacts, U.S. Supreme Court decisions, and federal trust responsibilities to the Southern Ute Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation.

The Navajo Nation did not initially participate in the program under the cooperative agreement developed with other tribal, state, and federal agencies in 1992. However, through consultation with the Navajo Nation tribal government and the SJRRIP program coordinator, the Navajo

Nation agreed to become an active participant in 1996 (SJRRIP 2010b). This cooperative agreement, which was extended through 2023 in 1996, commits the Navajo Nation to represent tribal interests in flow releases from Navajo Dam as it relates to endangered fish recovery (SJRRIP 2010b). The Nation has also committed to operating the Navajo Agricultural Products Industry (NAPI) razorback sucker rearing ponds managed toward razorback sucker augmentation and recovery efforts, through the Navajo Department of Fish and Wildlife (NNDFW). Under the broader goals and actions developed by the SJRRIP and outlined in the Long Range Plan, the Navajo Nation's obligation is specifically characterized under task 1.2.2.2 as "RBS will be stocked annually into three NAPI grow-out ponds with 3,000-3,500 (> 200 mm TL) hatchery-reared RBS produced at Dexter NFH (expectation to harvest 40-60%) using a single cohort strategy; pit tag and stock 300 mm fish in 12 months. Eight-year time period, 2003-2011" (SJRIP 2010a).

Razorback Augmentation/NAPI Ponds

Experimental stocking of razorback sucker occurred between 1994 and 1996 which led to a five year augmentation plan that called for the stocking of 73,482 razorback suckers in the San Juan River (Furr 2009). After shortfalls of stocking during the 5-year plan, a revised augmentation plan was drafted in 2002 that called for the stocking of 11,400 age 2 ($\geq$ 300 mm total length, TL) razorback sucker annually for a period of eight years (Ryden 2003). These fish would be produced and stocked by Uvalde National Fish Hatchery (Uvalde NFH) and the NAPI grow-out ponds. Augmentation efforts in 2008 were complicated due to problems with moving fish off station at Uvalde NFH and only one of the three NAPI grow-out ponds utilized for production (Furr 2009).

Razorback suckers provided by Dexter National Fish Hatchery and Technology Center (Dexter NFHTC) were stocked into three ponds on NAPI lands beginning in 1998, and in 2001 an additional six ponds were constructed for rearing razorback sucker. Young-of-year (YOY) razorback sucker were stocked in the spring and harvested in late summer/fall. Due to recommendations in size of fish stocked into the San Juan River, fish < 300 mm TL were left in ponds for one more year of growth. Overwintering fish, stocking YOY in the spring, and some limited in-pond reproduction, created multiple cohorts in the ponds (Furr 2009). Beginning in

2007, the SJRRIP adjusted the multiple cohort strategy in favor of a single cohort strategy to limit problems associated with harvesting multiple cohorts. Due to difficulties in harvesting the "six-pack" ponds constructed in 2001, in the fall of 2007 the SJRRIP Biology Committee requested that beginning in 2008, the six-pack ponds be taken out of production and efforts focused on the three NAPI grow-out ponds; East Avocet, West Avocet, and Hidden Ponds (Furr 2009).

Dexter NFHTC provides approximately 10,500 150–250mm age-1 razorback suckers annually to be stocked into the three NAPI grow-out ponds. A total of 3,500 fish per pond is stocked in East Avocet, West Avocet, and Hidden Ponds with an expectation of a 40-60% return and stocked in the San Juan River annually (SJRRIP 2010a). Fish produced and stocked into the San Juan River from the NAPI ponds each fall will be in addition to fish stocked from Uvalde NFH.

METHODS

Management of the NAPI razorback sucker grow-out ponds is the responsibility of the NNDFW aided by U.S. Fish and Wildlife Service, Region 2 (hereafter known as the service), under direction and guidance from the SJRRIP. Fish are spawned and reared at Dexter NFHTC prior to rearing efforts at the NAPI facility, and the remaining grow-out period to target size is achieved through active management of daily monitoring, monthly population sampling, and ultimately harvest and stocking into the San Juan River. Grow-out period typically spans from mid-April through the first week of November.

Pond Preparation/Receiving Fish

Prior to receiving fish, each pond is evaluated post-harvest over the de-watered period for structural integrity that consists of examining bank erosion, bed slope, invasive vegetation, and graveled slopes. If modifications or repairs are needed, consultation with SJRIP is conducted and typically work is implemented through NAPI or Keller-Bliesner Engineering. Also examined for structural soundness are the irrigation lines that feed water to the ponds from the NAPI distribution units (DU), the draining siphons, pond kettles, and associated valves. If repairs or replacement parts are needed, NAPI typically provides parts and labor, if NNDFW is unable to implement the repairs.

Water becomes available through the NAPI irrigation network for pond filling by early to mid March, and NNDFW coordinates with the NAPI control center to pressurize the DU's associated with each pond and commence filling. Hidden pond fills in approximately 7 days, while Avocet East and West fill in approximately 9 days. The Avocet ponds are pressurized by the same DU, but achieve simultaneous filling through a split irrigation line. Once filling is completed, each pond's siphon is tested to ensure adequate drainage. Water quality (dissolved oxygen, pH, and temperature) is monitored each day to ensure an optimal environment before fish are released into the ponds. Typically, water quality monitoring is conducted no less than two weeks prior to receiving fish to establish there are no widely fluctuating metrics that may have negative effects on fish; however, the availability of the fish and the need to distribute fish from DNFH often will dictate the amount of time available for pre-stocking water quality monitoring.

Razorback sucker stocking into NAPI ponds is coordinated through the service, DNHF, and NNDFW. Fish are received in early to mid April at approximately 3,500 fish per pond, with an average total length that ranges yearly from 150-250mm.

Daily Operations

Active management is achieved through daily water quality monitoring, feeding, and invasive aquatic vegetation removal. Water quality parameters include dissolved oxygen concentrations, pH, water temperature, and conductivity. Measurements are conducted twice a day, morning and afternoon, at three locations of each pond (middle, east side, and west side). At each location measurements are taken at the surface and one foot above the bottom. This monitoring schedule allows evaluating the effects of changes in abiotic conditions over nocturnal and diurnal periods (i.e., temperature, sunlight, etc). It also allows evaluations of subtle changes that may be trending toward lower water quality standards and provides time to implement measures to reverse the trends.

Optimum D.O. concentrations range from 7 – 10 mg/L and pH from 7-9. No large fluctuations of pH outside of optimum range has been observed; however, liming would be implemented if extended periods of acidic conditions occurred. Protocol for liming will be developed and included in a NAPI pond management plan, currently being drafted. D.O. concentrations become a stressor for fish when levels drop to or below 5 Mg/L for extended periods. If these levels are observed for greater than 24 hours, pond flushing is initiated and will last until a desired increase in D.O. is observed (usually 24-48 hours).

Fish are fed each morning (if needed) based upon growth rate calculations from monthly sampling efforts (elaborated further under "Monthly Operations"). If aquatic vegetation is relatively dense, feeding is reduced, as razorback sucker will also feed on the vegetation. This helps minimize the potential of having too many nutrients in the system which can rapidly increase vegetation densities, thus decreasing oxygen availability as it decomposes, as well as adding excessive nitrogen. Both place unintentional stress upon the fish by limiting oxygen and limiting their ability to regulate nitrogen concentrations. Feed is distributed evenly throughout the pond aided by boat and manual hand feeding.

Aquatic vegetation poses problems with each pond through rapid growth of pond weed, *Potamogeton spp*., often growing in densities above the recommended management target level of less than 30% surface area (Lamarra 2005). Some vegetation is welcome, as it helps produce oxygen and contributes to suspended solids, limiting light penetration, which in turn aids in limiting further vegetative growth. However, high densities of aquatic vegetation can dramatically reduce DO levels as it decomposes, a condition typically occurring in the hottest and longest days of the summer. Manual removal occurs when vegetation becomes too extensive. Utilizing an 8'x 1" diameter cable towed behind a boat at approximately twenty feet, vegetation can effectively be removed to manageable levels if implemented on a daily basis. We estimated that approximately 100-200 pounds of vegetation can be removed per week to maintain optimal water quality when vegetation is extensive.

Monthly Operations

Once each month (generally the 15th of each month), standardized sampling is conducted in each pond to track growth rates, calculate feeding rates, and evaluate the general condition of the fish. Three fyke nets are set in each pond the afternoon prior to sampling and left overnight with an effort of approximately 14 hours per net. A minimum of 30 fish must be captured for adequate representation and if there are greater than 30 individuals, all fish in the net are sampled to avoid biasing the sample. If there are less than 30 individuals, those fish are processed, as well as all the fish in the next net, and so on until a sufficient representation is met. Length (mm) and weight (g) are recorded, as well as the general condition of the fish. As fish approach the target San Juan River stocking size (300mm), the ponds may be sampled more frequently to ensure target size is reached before harvesting fish.

Feeding rates are calculated on a monthly basis according to growth rates. The calculation is based upon water temperature and average weight of the sampled individuals extrapolated to the total number of fish per pond (Table 1).

Table 1. Razorback sucker feeding rates for NAPI ponds.

Water Temperature	% Body Weight to Feed	Feeding Schedule (Days)
≥ 80° F	3%	Mon, Wed, Fri
Between 60°F and 80°F	2%	Mon - Fri
≤ 60° F	1.5%	Mon - Thurs

Harvesting and Stocking

Active and passive methods of harvest are implemented for removing fish from the pond. Fyke nets are used for passive harvest and active harvest consists of draining the ponds and capturing fish using a seine. By reducing the total number of fish requiring immediate capture, passive harvest reduces the stress that occurs when the ponds are drained. It also allows a more logistically feasible method for capturing a large number of individuals with limited personnel. Passive harvest begins when at least 80% of the population has reached or surpassed the target stocking size of 300mm. This usually occurs after approximately 4 ½ to 5 months of grow-out after receiving the fish from Dexter NFHTC. During passive harvest, nine fyke nets of the same size (two throated, 3’x4’ rectangle front entrance, twelve feet long) are set overnight, for a total of approximately 126 fyke net hours. Captured fish are held in an aerated tank located on the boat and each fish is measured for TL (mm), SL (mm), and weight (g). Fish captured which do not meet target size are returned to the pond for further growing. Each individual harvested receives a 134.2 kHz Passive Integrated Transponder (PIT) tag and placed into a hauling tank with aeration and supplemental oxygen.

Active harvest generally occurs during the first week in November (approximately 7 months of growing) when pond temperatures and river temperatures are relatively similar, target size has been met for all individuals, and the service is available to aid with the effort. Each pond is drained separately for harvesting to avoid de-watering and stranding fish. Each pond drains in roughly 30 to 36 hours. As a pond drains, fish are funneled toward a kettle (a low lying channel) where the siphon is located. The fish are then captured in a seine and hauled to portable aerated tanks where the fish are processed correspondingly to passive harvest. Total length, standard length, and weight are recorded for a sample of the first 100 to 200 individuals, and total length is the only metric recorded for the remaining fish. All fish receive a PIT tag and are placed into an aerated, oxygenated hauling tank.

San Juan River stocking of NAPI fish occurs at river mile 166.6, also known as the Power Company of New Mexico (PNM) fish weir. Hauling distance is approximately 10 miles from the NAPI ponds. Before releasing, water temperatures of the tank and river are measured and the fish are acclimated according to the temperature differential one hour for every three degrees Celsius (Manuel Ulibarri, personal communication).

Contingency Planning

There are currently few protocols in place for managing the NAPI ponds during emergency periods of unforeseen water quality problems, fish health issues, and complications with physical aspects of the ponds (i.e., structure, irrigation, etc). The existing nature of management during problems with water quality (most commonly associated with low D.O. levels) is to flush the ponds, resetting water quality parameters. If issues occur regarding water quality or fish health that the NNDFW cannot attribute the cause to, personal communication with Manual Ulibarri (Dexter NFHTC) and various personnel within the SJRRIP (e.g., Jason Davis and Weston Furr – the service), is conducted and management actions are implemented upon expert recommendations. Matters regarding pond structural and irrigation repair are typically implemented through NAPI personnel or through consultation with the SJRRIP and a recommended action is taken. A comprehensive contingency plan will be incorporated into a detailed NAPI pond management plan which is currently being drafted and targeted to be completed by the end of the 2011 calendar year.

RESULTS

Harvest

We received 10,500 razorback suckers from DNFH on April 8, 2010. Approximately 3,500 fish were stocked into each of the three ponds (Hidden, Avocet East, and Avocet West). The grow-out period lasted between 141 and 212 days (depending on whether harvested through early passive harvest or the later active harvest).

Passive harvest occurred between August 26, 2010 and October 27th (Table 2). A total of 2,031 fish were passively harvested (~25% of total fish harvested) and all were at or above the target size of 300mm (Table 2.). All fish were acclimated to river temperatures and stocked at river mile 166.6 (PNM weir).

Active harvest occurred during the first week of November. Each pond was drained for approximately 24-36 hours of de-watering with the subsequent harvest lasting one day. A total of 6,173 fish were actively harvested (~75% of total fish harvested) and all were at or above target size (Table 2). All fish were acclimated to river temperatures and stocked at river mile 166.6 (PNM weir).

Table 2. 2010 Passive and Active Harvest Dates, Effort, Average Size, Number, and Percent Return.

Pond	Date	Effort (net nights)	Avg Size (mm)	Number	% Return
Passive					
Avocet East	Aug 26 – Oct 8	88	337	831	23.7
Avocet West	Sept 22 – Oct 27	88	367	1000	28.9
Hidden	Oct 4 – Oct 22	80	362	200	5.9
Active					
Avocet East	Nov 4	--	359	2,304	65.8
Avocet West	Nov 5	--	382	1,630	46.9
Hidden	Nov 3	--	373	2,239	64.0
Total					
Avocet East				3,135	89.6
Avocet West				2,630	76.0
Hidden				2,439	70.0

Water Quality

Water quality was evaluated on a daily basis, however, inconsistency with data entry, new management, and lost data due to meter malfunction led to a lack of data available for a robust synthesis of water quality data. In general, over the course of the grow-out period, water quality parameters remained adequate for optimum growth, with exception of three periods where D.O. became limiting due to aquatic vegetation growth and a miscalculation of feeding rates in May. During the low D.O. events, each pond underwent intensive vegetation removal along with pond flushing, resulting in a return to optimum water quality conditions. As a result of a feed rate miscalculation which led to over-feeding, a fish kill of approximately 100 individuals occurred in Hidden pond. The cause of the kill was likely a function of the fish's inability to regulate a higher than normal nitrogen concentration in the pond. Pond flushing commenced at the time the kill was observed, and little mortality was observed in the days following the kill.

During active harvest in early November, fish in Avocet East were infected with a parasitic protozoan, *Ichthyophthirius multifilis*, otherwise known as "Ich". The disease was not observed two weeks earlier during the monthly sample count; however, because of low water temperatures only three fish were captured. During the harvesting process, these fish tended to become stressed at a much faster rate than normal, resulting in a large number of mortalities (which was not quantified, but approximated at 200-300 fish). Under consultation with the service and Dexter NFHTC, a decision was made to treat each fish with a 3% salt bath for 5 minutes, prior to processing and stocking. Mortalities after stocking were likely to occur at an unknown rate; however, the salt treatment likely limited any mortalities which would certainly have occurred without treatment.

Monthly Growth Rates/Feed Calculations

Monthly sample counts are typically conducted on the 15th of each month; however, inconsistency in data entry precluded synthesis of growth rates and feeding calculations over all months. Feeding calculations and growth rates were determined at the time of the sampling which ensured adequate feeding and tracking growth to target harvesting size. Growth could be tracked as an average from the time fish were received from Dexter NFHTC to the time of harvesting, however, the averages received from the service do not seem to coincide with actual size observed. For instance, the service reports average size of 230 to 245mm (depending on pond) when fish were received in April; however, our earliest sampling data recorded in late May (approximately 2 months after receiving fish) showed averages among the three ponds of 219 to 230mm, suggesting a much smaller size at pond stocking than reported. This discrepancy is perhaps a result of miscommunication or a data mix up of standard and total length.

DISCUSSION

Though there were hurdles to overcome with adjusting to new management and new field techniques, the overall results of the NAPI grow-out ponds were more than encouraging. The return rates were the highest observed since initial implementation of the grow-out ponds, techniques for daily and monthly assessments of the fish and water quality have been adapted for a more effective and accurate assessment, and future management will continue to strive to improve all aspects of NAPI pond management with hopes of maintaining high return rates.

Several aspects of 2010 NAPI management seemed to contribute significantly to the overall successful return rates. The ability to passively harvest a large number of fish by dramatically increasing catch effort greatly reduced the stress placed upon the remaining fish during active harvest, as there were less fish congregated together in the de-watered pond and less time required for processing. It also allowed a large number of fish to be harvested from Avocet East before becoming infected with “Ich”. Active management of the ponds through increased effort and adjusted water quality monitoring also allowed a much faster response to poor water quality events and the ability to better predict the likelihood of poor water quality under certain conditions. We were able to preemptively flush ponds to regain adequate water quality before any major problems occurred.

The importance of subsequent monitoring efforts in the river must remain high in effort to evaluate post-stocking survival, which in turn will aid our ability to understand and manage the ponds in the most productive manner. Considering the deficiencies and successes in 2010, there are several aspects which the Navajo Nation will improve upon and consider under SJRRIP direction and consultation for 2011 and future management;

1) All data (water quality, monthly sampling, and harvest) will be digitally updated and backed up every week to minimize the potential for lost data. This will ensure having the necessary data to conduct a full analysis for future reporting and assessment of trends over the grow-out period.
2) Feeding rates will be calculated and recorded consistently according to recommendations outlined in the methods section to avoid over-feeding.
3) We will experiment with alternative passive harvest techniques that would allow an increased catch (i.e., larger fyke netting effort, large beach seining, etc).
4) We will begin passive harvest at an earlier date (as soon as target size is reached) to increase the amount of time available for passive harvest efforts.
5) Multiple stocking locations will be considered under SJRIP guidance.
6) We will complete development of a long-term management/contingency plan for NAPI pond management (in progress).

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