STREAM AND RESERVOIR SAMPLING ON THE NAVAJO NATION AUGUST 2004 AND 2005

A healthy hold-over rainbow trout from the Navajo Nation

Submitted to:

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EXECUTIVE SUMMARY

In August of 2004 and 2005, the Navajo Department of Fish and Wildlife (NDFW), with the assistance of the U.S. Fish and Wildlife Service, Arizona Fishery Resources Office (AZFRO) Flagstaff, completed fisheries surveys of several lakes and streams in the northeastern part of the Navajo Nation. This year's effort and data continue our ongoing effort to assist the Navajo Nation with the development of a long-term fishery management plan for these lakes and streams, an effort that began with *Stream and Reservoir Sampling on the Navajo Nation August 2002,* (Sponholtz et al. 2002). Reservoirs sampled in 2004 include Asaayi, Tsaile, and Ganado lakes and Asaayi, Tsaile, Wheatfields, and Ganado lakes in 2005. Backpack electrofishing surveys were completed on sections of Tsaile and Wheatfields creeks in 2004 and Asaayi, Crystal, Bear Canyon, and Nazlini creeks in 2005.

Catch rates of cutthroat trout increased in Asaayi Lake in 2004 and 2005, while rainbow trout catch rates remained unchanged in 2004 when compared to 2003 but increased in 2005. *Wr* values also increased in rainbow trout signifying a possible increase in primary production and food availability, and a decrease in competition for food resources, due to increased water levels in the lake. In 2005 two bluehead suckers were also caught within Asaayi Lake.

Catch rates of goldfish and green sunfish in Tsaile Lake increased dramatically in 2004 and 2005, while catch rates of channel catfish, rainbow trout, and cutthroat trout increased in 2004 when compared to 2003 but decreased in 2005. With the increase in populations of gold fish and green sunfish it is likely that competition for food resources was high enough to decrease populations of other sport fish within Tsaile Lake.

Catch rate and *Wr* values of both rainbow and cutthroat trout in Wheatfields Lake increased in 2005 compared to 2003. With the dam construction complete and water levels increasing we expect primary production and food resources to increase in this lake within the next few years, which should benefit growth rates of stocked fish.

Catch rates of largemouth bass increased in Ganado Lake between 2004 and 2005 and channel catfish were captured for the first time in 2005. Boat access in this lake is very difficult and we recommend pursuing Arizona Game and Fish Department *Heritage Grants* or other funding sources to install boat ramps to increase angler access.

In 2004 speckled dace, bluehead suckers, and rainbow trout were captured in Tsaile Creek and native fish seem to be actively recruiting despite the presence of non-native fish. In 2004 Wheatfields Creek was dominated by speckled dace. Bluehead suckers, rainbow trout and possible rainbow/cutthroat trout hybrids

were also captured. Despite the presence of non-native fish in Wheatfields Creek, speckled dace appear to be actively recruiting.

In 2005, sites sampled in Asaayi Creek just upstream of Asaayi Lake contained both rainbow trout and speckled dace. Speckled dace appear to be actively recruiting despite the presence of rainbow trout in the stream. We did not capture any bluehead suckers at sites sampled in 2005 despite their presence within the lake itself and upstream sites sampled in previous years.

In 2005, sites sampled in Crystal Creek contained only native fish (speckled dace and bluehead suckers) and thus, this and other creeks (see below) may be ideal candidates for native fish protection.

In 2005, Bear Canyon Creek (Kinlichi Creek) was spot checked to determine whether AZFRO and NDFW biologist could identify Zuni bluehead suckers via external physical features. The only species captured was bluehead suckers; however, biologist could not determine whether they differed from other species of bluehead suckers on the Navajo Nation through external physical features. Bear Canyon Creek does lie within the subspecies' historical range and therefore, we recommend following up on genetic analysis for these fish.

In 2005, Nazlini Creek was spot checked but very little water in the stream made sampling difficult; no fish were captured during this survey. We recommend exploring sampling sites further upstream where perennial flows may exist.

INTRODUCTION

In August 2004 and 2005, the Navajo Department of Fish and Wildlife (NDFW) with the assistance of the U.S. Fish and Wildlife Service, Arizona Fishery Resources Office (AZFRO) Flagstaff completed fisheries surveys of several lakes and streams in the northeastern part of the Navajo Nation. The U.S. Fish and Wildlife Service's Native American Policy (Secretarial Order #3206) clarifies the trust responsibility and treaty obligation that the U.S. Government has towards Indian Tribes and tribal members. AZFRO, in their role as trustee, shall provide technical assistance and information for the development of tribal conservation and management plans to promote the maintenance, restoration, and enhancement of the ecosystems on which sensitive species (including candidate, proposed, and listed species) depend. In addition, AZFRO has a responsibility to assist NDFW in promoting healthy ecosystems and identifying site specific and watershed level recommendations to achieve tribal land management goals, including helping NDFW balance sport-fish management with the needs of native species.

This year's effort and data continue our ongoing effort to assist the NDFW with the development of a long-term fishery management plan for these lakes and streams, an effort that began with *Stream and Reservoir Sampling on the Navajo Nation August 2002*, (Sponholtz et al. 2002). Our objectives for the 2004 and 2005 reservoir survey were to collect trend data to use in a comparison to data collected in 2003 and to refine recommendations for future management efforts made in 2003. This report will focus on the data collected in 2003 and how it compares to the data collected in 2002. However, any differences in collection techniques or sampling methods will be noted.

2004 SAMPLING

SITE DESCRIPTION

In 2004 AZFRO and NDFW sampled Asaayi (Bowl Canyon), Tsaile, and Ganado lakes. Tsaile, Wheatfields, and Asaayi creeks were also sample in 2004. These creeks are high elevation (> 7,500 ft) mountain streams with alternating riffle/pool habitats, and receive moderate to high levels of domestic livestock use. No active stocking or long-term management of these creeks is in place or planned by NDFW.

METHODS

We sampled three lakes and two streams on the Navajo Nation from August 30 – September 1, 2004 with both AZFRO and NDFW personnel (**Table 1**). To conform to standardized sampling protocol currently under development by AZFRO, we followed the naming convention of using the first two letters of the species and genus names, which are provided at the end of each graph and table.

Table 1. Participants in lake and stream fishery sampling on the Navajo Nation, August 30 – September 1, 2004.

Name	Affiliation
Earl Chicharello	NDFW
Albert Laphie	NDFW
Shaun Grimes	Arizona Fishery Resource Office Volunteer
Ferlin Begay	NDFW
Joshua David	Arizona Fishery Resources Office-Flagstaff
Dennis Stone	Arizona Fishery Resources Office-Flagstaff
Dewey Wesley	Arizona Fishery Resources Office-San Carlos

In 2004 we obtained water quality depth profiles in the deepest section of Asaayi, Tsaile and Ganado lakes using a Surveyor 4 Hydrolab at an arbitrary station. We measured pH, conductivity (μS), temperature (ºC), and dissolved oxygen (mg/L). We did not measure water quality on any streams in 2004 due to the logistics of carrying the Hydrolab 4 over rough terrain to the stream sampling sites.

During lake surveys, we used boat electrofishing and minnow traps to sample fish (we did not use gill nets during the 2004 sampling effort due to concern of incidental mortality of trout captured in nets). We used a Smith-Root (Vancouver, WA) DC electrofishing boat with power output that ranged from 7.0 to 12.5 Amps and from 30 to 60 pulses/second. In 2004 we conducted electrofishing on nearly the entire shoreline of Asaayi, Tsaile, and Ganado lakes. In an effort to keep data as comparable as possible between years, and to address possible problems with blockage of the electrofishing boat intake hoses from algae, we completed electrofishing surveys primarily during daylight hours. In addition, low water levels in all lakes presented significant boating hazards that precluded night surveys. In addition, we set 10 baited minnow traps along shorelines between 1-4 hours to capture smaller fish (i.e., additional species and/or smaller life history stages) during daylight hours.

We completed stream surveys using a Smith-Root backpack electrofishing unit. Pulse rate varied from 0.12 to 0.17 Amps and volts ranged from 200-300 pulses/second. We sampled 100 meter sections separating specific habitats discretely by pool and riffle/run and counted fish within each habitat type.

For lake surveys, fish captured were identified to species, weighed (g), measured in total length (TL, mm), and released near the point of capture. During stream surveys, all fish captured were identified to species (when possible), weighed (g), measured for total length (TL, mm), and released near the point of capture.

We determined catch-per-unit-effort (CPUE) for electrofishing data by lake, species, and site. We calculated mean CPUE and standard error by lake and species. Each electrofishing sample was 900 seconds to standardize effort among samples. We calculated minnow trap CPUE as the number of a given species collected per hour of trapping. We calculated stream CPUE as the number of fish divided by the number of seconds shocked within each discrete habitat type (pools, riffles, runs). For this report, we report stream CPUE as the mean number of fish per hour within each habitat type.

We calculated relative condition factor (Kn) as:

$$Kn = (W/W')$$

Where W is the weight of the individual and W' is the length specific mean weight for a fish in the population of study as predicted by a length-weight equation calculated for that population. The length-weight equation is provided below.

$$Log_{10}(W) = a' + b\,(Log_{10}\,(L))$$

Where W is weight, L is length, a' is the y-axis intercept ($Log_{10}a'$) and b is the slope of the equation.

We calculated relative weight (*Wr*) for specific length groups as described by Anderson and Neuman (1996). Relative weight is an index that compares the actual weight of a species with a standard weight (W_S) at the same length and is expressed as:

$$Wr = \frac{W\text{ (Weight of a fish)}}{W_S\text{ (Standard Weight of a fish)}} \times 100$$

We calculated Proportional Stock Density (PSD) as follows:

$$PSD = \frac{\text{Number of fish} \geq \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

We only completed PSD estimates on rainbow trout, cutthroat trout, green sunfish, largemouth bass and channel catfish, as they represented the primary species in each of the lakes. We separated PSD estimates by lake and by gear type. We did not determine PSD values for salmonids captured during stream surveys because most fish were less than stock length required for the above equation.

For further explanation of CPUE, Kn, *Wr*, PSD, and their use in fisheries management on the Navajo Nation, see the methods section of Sponholtz et al. (2002).

RESULTS

Asaayi Lake

In 2004, we measured water quality on Asaayi Lake and dissolved oxygen levels were sufficient in the upper portion of the lake, but became less optimal for trout at greater depths (target dissolved oxygen levels for trout are generally >6mg/L (**Table 2**). Temperatures were within tolerance limits for trout (generally <21˚C or 70˚F) in Asaayi Lake.

Table 2. Water quality parameters from Tsaile, Asaayi, and Ganado lakes sampled by AZFRO and NDFW, August 30 – September 1, 2004 using a Surveyor 4 Hydrolab. Sampling site for each lake was at the deepest section of the lake.

Lake	Depth (meters)	Oxygen (mg/L)	pH	Temperature (°C)	Conductivity (µS)
Ganado Station #1	Surface	8.69	9.89	20.21	354
Time taken: 09:31	1m	7.33	9.77	19.88	352
	2m	2.76	9.07	18.05	396
	3m	1.25	7.48	17.95	641
Asaayi Station #1	Surface	9.27	9.46	16.45	165
Time taken: 09:08	1m	8.41	9.52	16.00	164
	2m	8.37	9.49	15.90	165
	3m	7.56	9.40	15.76	168
	4m	3.30	9.13	15.40	180
	5m	2.59	8.82	15.15	186
	6m	1.81	8.60	15.00	194
Tsaile Station #1	Surface	6.82	8.67	18.6	185
Time taken: 18:14	1m	6.94	8.68	18.61	185
	2m	6.87	8.65	18.44	185
	3m	6.22	8.58	17.31	187
	4m	5.65	8.50	17.07	186
	5m	5.17	8.44	16.92	187

During lake electrofishing surveys in 2004, the most abundant species captured in Asaayi Lake was fathead minnow *Pimephales promelas,* (n=186) followed by rainbow trout *Oncorhynchus mykiss,* (n=26), comprising 87% and 13% of the total catch, respectively. In Asaayi Lake, rainbow trout decreased from 51% (2003) to 13% (2004) of the total catch while fathead minnows increased from 49% (2003) to 87% (2004).

Minnow traps were also set along the shoreline in Asaayi Lake in 2004. Fathead minnows and crayfish were the only species captured in minnow traps; 2004 fathead minnow catches (n=6) were consistent with those in 2003 (n=5).

Mean total CPUE during electrofishing surveys on Asaayi Lake was 69.10±53.71 fish/900 sec. Fathead minnows had the highest mean CPUE of all species collected at 60.7±54.5 fish/900 sec, followed by rainbow trout at 8.4±1.2 fish/900 sec (**Figure 1**). In general, catch rates of rainbow trout in Asaayi Lake in 2004 were consistent with catch rates in 2003 (**Figure 2**).

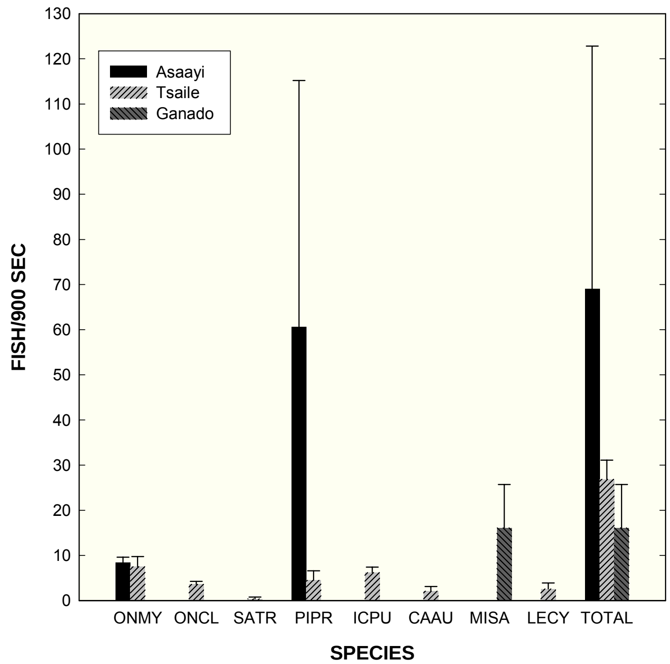

Figure 1. Mean catch per unit effort among lakes for fish captured via electrofishing during surveys on the Navajo Nation, August 30 – September 1, 2004 by AZFRO and NDFW. Note: ONMY = rainbow trout (*Oncorhynchus mykiss*); SATR = brown trout (*Salmo trutta*); ONCL cutthroat trout = (*Oncorhynchus clarkii*); ICPU = channel catfish (*Ictalurus punctatus*); LECY = green sunfish (*Lepomis cyanellus*); PIPR = fathead minnow (*Pimephales promelas*); CAAU = goldfish *(Carassius auratus)* MISA = largemouth bass (*Micropterus salmoides*).

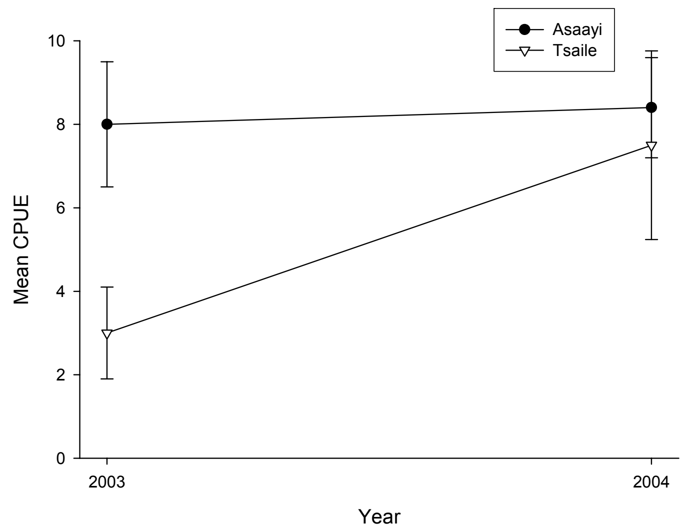

Figure 2. Mean catch-per-unit-effort on Asaayi and Tsaile lakes for rainbow trout captured via electroshocking surveys in 2003 and 2004 on the Navajo Nation by AZFRO and NDFW. Error bars represent ± 1 standard error.

PSD values for rainbow trout in Asaayi Lake were higher in 2004 (14.3) than 2003 (13.3). These values are below the guidelines (20-70) for a balanced rainbow trout population, indicating that stocked fish are being harvested or experience mortality before they reach quality size. Length frequencies for rainbow trout support current PSD values with over 94% of the rainbow trout captured being less than 400 mm TL (**Figure 3**).

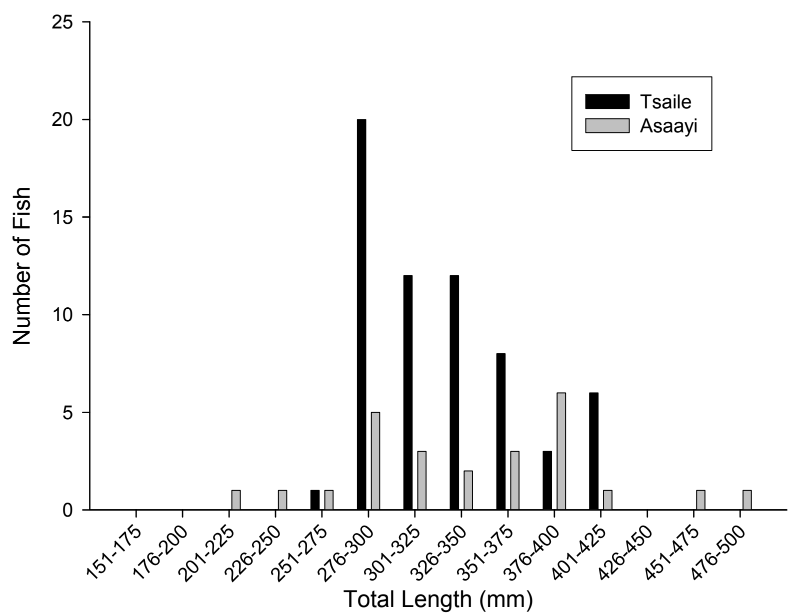

Figure 3. Length frequency of rainbow trout collected at Asaayi and Tsaile lakes, Navajo Nation, by electrofishing in 2004.

In 2004, mean *Wr* of rainbow trout in Asaayi Lake was 94.02±4.8, which represents an increase from 2003 (89.4±2.4). Mean *Kn* of rainbow trout in Asaayi Lake was 1.02±0.03. Overall, rainbow trout in Asaayi Lake appear to be in “good” condition.

Tsaile Lake

In 2004 we measured water quality on Tsaile Lake and dissolved oxygen levels were sufficient in the upper portion of the lake, but became less optimal for trout at greater depths (target dissolved oxygen levels for trout are generally >6mg/L (**Table 2**). Temperatures were within tolerance limits for trout (generally <21˚C or 70˚F) in Tsaile Lake.

In Tsaile Lake the most abundant species captured was channel catfish *Ictalurus punctatus* (n=53, 25%) followed by rainbow trout (n=44, 21%), fathead minnows, (n=36, 18%), cutthroat trout *Oncorhynchus clarkii* (n=31, 14%) green sunfish *Lepomis cyanellus* (n=26, 12%), goldfish *Carassius auratus* (n=18, 8%) and brown trout *Salmo trutta* (n=3, 2%). In Tsaile Lake, rainbow trout decreased from 31% (2003) to 21% (2004) of the total catch, fathead minnows decreased from 25% (2003) to 18% (2004) of the total catch, channel catfish decreased from 31% (2003) to 25% (2004) of the total catch and goldfish decreased from 9.9% (2003) to 8% (2004) of the total catch. Green sunfish in Tsaile Lake increased from 2.9% (2003) to 12% (2004) of the total catch and brown trout increased from 0.9% (2003) to 2% (2004).

Fathead minnow catch rates in minnow traps were much lower in Tsaile Lake (n=16) in 2004 than 2003 (n=276), and green sunfish were captured for the first time in minnow traps in Tsaile Lake (n=16).

Mean total catch rate during electrofishing surveys on Tsaile Lake was 26.85±4.2 fish/900 sec. In Tsaile Lake, rainbow trout had the highest mean CPUE (7.5±2.26 fish/900 sec) followed by channel catfish (6.2±1.2 fish/900 sec), fathead minnows (4.5±2.1 fish/900 sec), cutthroat trout (3.6±.0.66 fish/900 sec), green sunfish (2.6±1.3 fish/900 sec), goldfish (2.1±1 fish/900 sec) and brown trout (0.4±0.4 fish/900 sec). Catch rates in Tsaile Lake increased from 3±1.1 fish/900 sec in 2003 to 7.5±2.26 fish/900 sec in 2004 (**Figure 2**).

PSD for rainbow trout in Tsaile Lake in 2004 was 6.56, down from values in 2003 (12.12). Channel catfish in Tsaile Lake had the highest PSD value at 48 indicating a more balanced population; however, despite sampling channel catfish of several size classes, smaller life history stages were absent (**Figure 4**) or were undetected by our sampling methods.

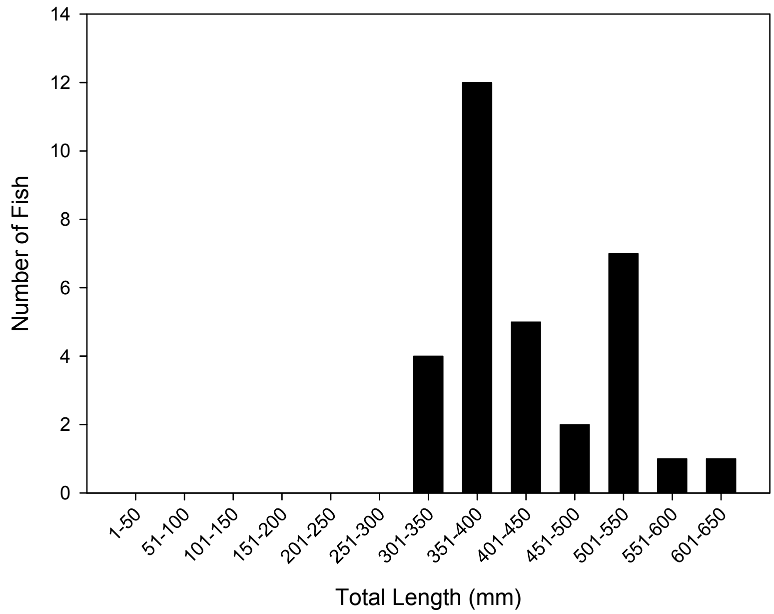

Figure 4. Length frequency of channel catfish from Tsaile Lake, Navajo Nation sampled via electrofishing by AZFRO and NDFW, 2004.

In 2004 mean *Wr* of rainbow trout in Tsaile Lake was 94.2±6.9. Mean *Wr* and mean Kn values of the other species collected in Tsaile Lake are presented in **Table 3**. All mean condition values for all species captured in Tsaile Lake indicate that fish are in "good" condition.

Table 3. Mean relative weight (*Wr*) and relative condition factor (Kn) for fish sampled in Asaayi, Tsaile, and Ganado lakes via boat electrofishing, August 30 –September 1, 2004 by AZFRO and NDFW.

			Wr		Kn	
Lake	Species	Count	Mean	Standard Error of Mean	Mean	Standard Error of Mean
ASAAYI	ONMY	26	94.02	4.8	1.02	0.03
TSAILE	ICPU	53	103.2	1.0	1.00	0.01
	LECY	26	111.1	12.1	1.01	0.06
	ONMY	44	94.2	6.9	1.05	0.03
	ONCL	31	104.2	4.8	1.0	0.02
	SATR	3	104	10.7	1.00	0.04
GANADO	MISA	46	105.0	7.2	1.03	0.04

Ganado Lake

Water quality conditions for Ganado Lake in 2004 were as to be expected for a warm-water fishery, with dissolved oxygen levels diminishing towards the bottom of the lake. In Ganado Lake largemouth bass *Micropterus salmoides,* was the only species captured in 2004 (n=46), with a mean CPUE of 16.1±9.6 fish/900 sec. Ganado Lake was not sampled with baited minnow traps in 2004.

PSD values for largemouth bass in Ganado Lake were low (14) but may be indicative of small sample size; length frequencies indicate that there is a natural recruiting population (**Figure 5**).

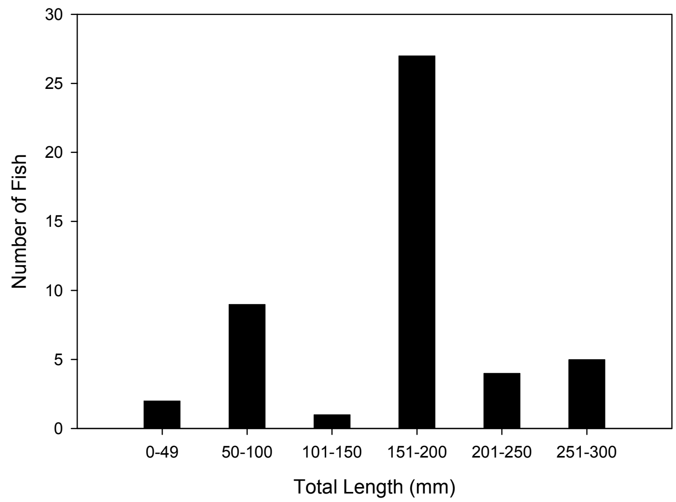

Figure 5. Length frequency of largemouth bass from Ganado Lake, 2004 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

Relative weight (105±7.2) and condition factors (1.03±0.04) of largemouth bass in Ganado Lake suggest a healthy population of largemouth bass despite low water conditions in 2004.

Wheatfields Creek

In 2004 AZFRO and NDFW sampled portions of Wheatfields Creek. The most abundant species in Wheatfields Creek was speckled dace (96%, n=185) followed by possible cutthroat/rainbow trout hybrids (2%, n=4), rainbow trout (1%, n=2) and bluehead suckers (1%, n=2).

Speckled dace CPUE in Wheatfields Creek was 640.5±390.1 fish/hr followed by a potential cutthroat/rainbow trout hybrid (28.9±16.92 fish/hr), rainbow trout (7.9±5.2 fish/hr) and bluehead suckers (2.5±2.5 fish/hr) (**Figure 6**). In 2004 CPUE was not divided into separate pool/riffle habitats due to the dominant sampling habitats being pools.

Speckled dace in Wheatfields Creek are actively recruiting and show two separate cohorts with a large spring 2004 year class being present (**Figure 7**). Wheatfields Creek also held bluehead suckers, rainbow trout, and a potential cutthroat/rainbow trout hybrid (cutthroat/rainbow trout hybrids will be referred to as cutthroat trout, ONCL within this report); however, sample sizes were not large enough to accurately determine separate cohorts through length frequency histograms.

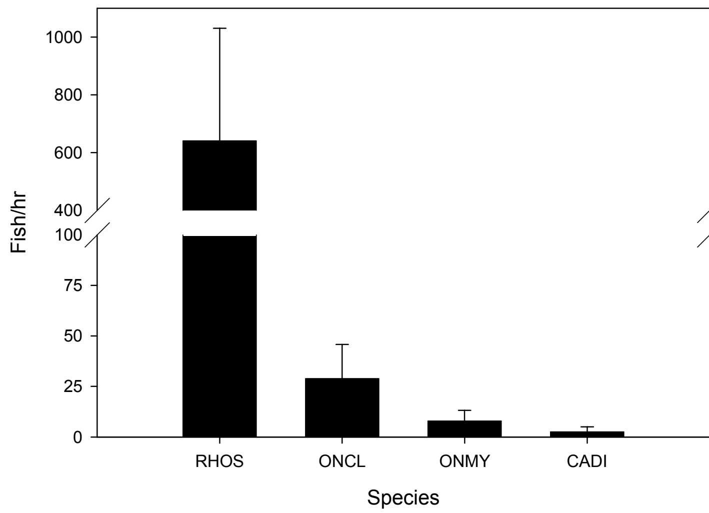

Figure 6. Catch-per-unit-effort for species captured in Wheatfields Creek, Navajo Nation, 2004 by AZFRO and NDFW. Error bars represent ±1 standard error. Note: ONMY = rainbow trout (*Oncorhynchus mykiss*); ONCL = cutthroat trout (*Oncorhynchus clarkii*); RHOS = speckled dace (*Rhinichthys osculus*); CADI (*Catostomus discobolus)*.

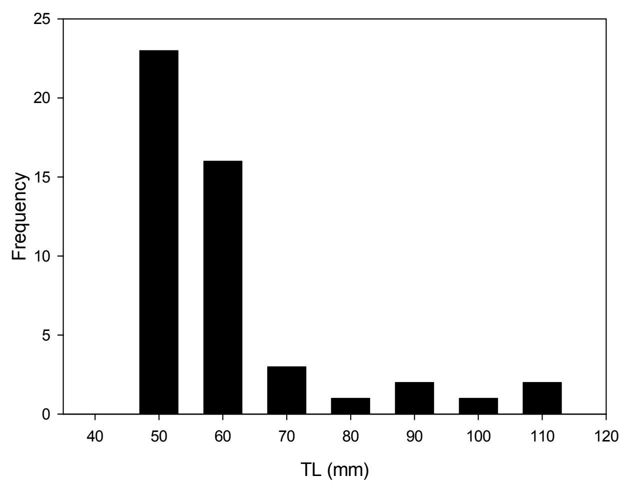

Figure 7. Length frequency of speckled dace in Wheatfields Creek, 2004 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

Relative weights of rainbow trout in Wheatfields Creek were also low (75.26) but relative condition was “good” (1.00±0.14). The contradiction between relative weights and condition factor was also apparent in 2002 and may be attributed, in part, to low sample sizes used to generate relative weight values.

Tsaile Creek

In Tsaile Creek, speckled dace was the most abundant species (85%, n=318) followed by bluehead suckers (10%, n=39) and rainbow trout (5%, n=14). In Tsaile Creek, in 2004 speckled dace was the dominant species sampled with a CPUE of 724.03±255.96 fish/hr (**Figure 8**), followed by bluehead suckers (83.32±40.5 fish/hr) and rainbow trout (40.88±2.34 fish/hr). In 2004, CPUE was not divided into separate pool/riffle habitats due to the dominant sampling habitats being pools.

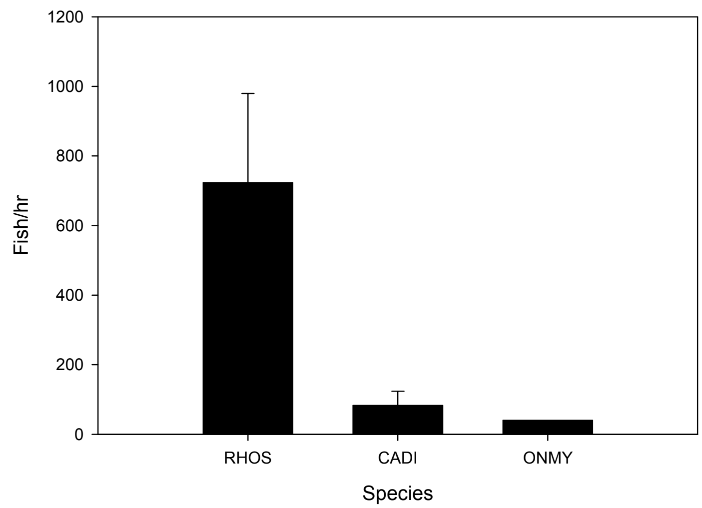

Figure 8. Catch-per-unit-effort for species captured in Tsaile Creek, Navajo Nation, 2004 by AZFRO and NDFW. Error bars represent ±1 standard error. Note: ONMY = rainbow trout (*Oncorhynchus mykiss*); RHOS = speckled dace (*Rhinichthys osculus*); CADI (*Catostomus discobolus).*

Native species in Tsaile Creek appear to successfully recruit despite the presence of rainbow trout and high sediment loads from the surrounding watershed. At least two separate cohorts of bluehead suckers can be discerned from the length frequency histograms (**Figure 9**), and the mean total length was 20% smaller than fish captured in 2003 (**Table 4**), which is to be expected due to the presence of a 2004 cohort.

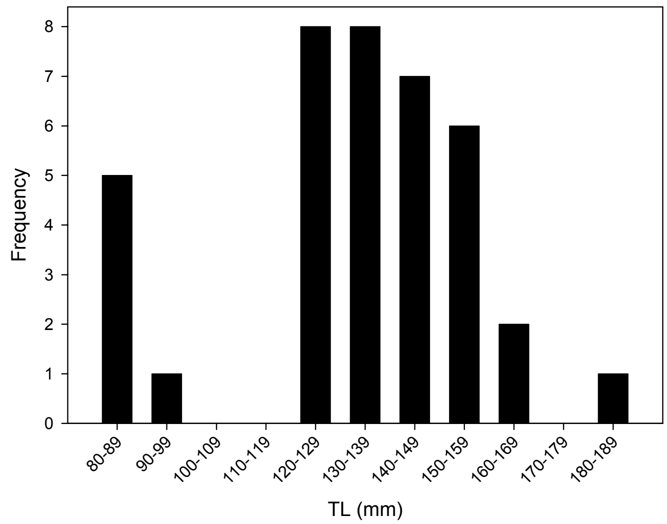

Figure 9. Length frequency of bluehead suckers in Tsaile Creek, 2004 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

Table 4. Mean length and weight for fish sampled in Tsaile and Wheatfield creeks by backpack electrofishing, 2004 by AZFRO and NDFW.

			TL (mm)		Wt (gm)	
Lake	**Species**	**Count**	**Mean**	**Standard Error of Mean**	**Mean**	**Standard Error of Mean**
TSAILE	ONMY	16	136.94	14.81	31.31	8.27
	CADI	37	129.95	3.67	17.05	1.30
	RHOS	12	90.67	2.22	6.67	0.66
WHEAT	ONCL	3	155.00	7.64	37.33	7.31
	ONMY	3	170.00	20.00	45.00	12.00
	RHOS	59	61.08	5.82	5.82	0.56

ONMY = rainbow trout (*Oncorhynchus mykiss*); ONCL = rainbow/cutthroat trout hybrid (*Oncorhynchus clarkii*); RHOS = speckled dace (*Rhinichthys osculus*); CADI = bluehead sucker (*Catostomus discobolus*).

Recruitment is also evident in rainbow trout collected in Tsaile Creek (**Figure 10**) and mean total length was 30% smaller than fish captured in 2003. Only one cohort of large adult speckled dace is apparent in the length frequency histogram, however this is possibly due to bias during measurement in which only a subset of the sample was measured (**Figure 11**). Smaller size classes were present but not actively detected due to our measurement protocols.

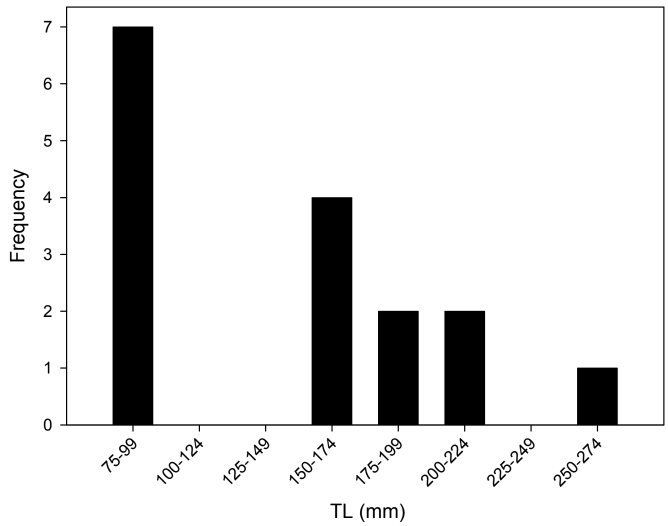

Figure 10. Length frequency of rainbow trout in Tsaile Creek, 2004 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

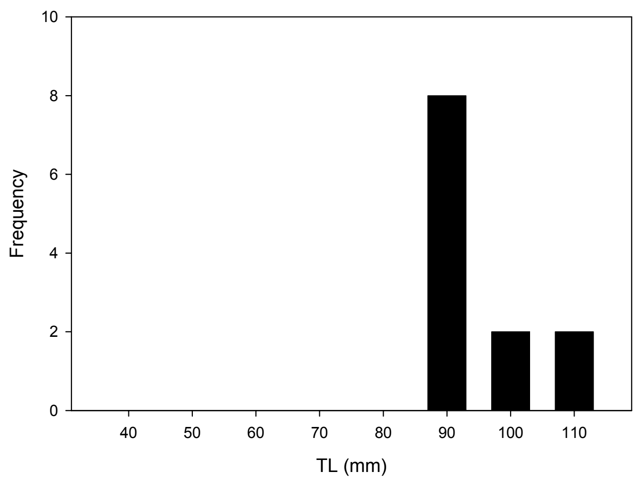

Figure 11. Length frequency of speckled dace in Tsaile Creek, 2004 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

Relative weights (*Wr*) of rainbow trout in Tsaile Creek were relatively low (60.41); however, relative condition was good (1.01±0.16) indicating food sources are sufficient within the creek. Low *Wr* values are likely due to low sample size.

DISCUSSION

Asaayi Lake

Water quality conditions for Asaayi Lake were marginal in 2004 with pH levels exceeding the minimum standards (<9) for stocking trout. Dissolved oxygen levels remained sufficient in the top half of the water column but dropped significantly below 3m.

Length frequencies of rainbow trout found in Asaayi Lake provide evidence that the fish sampled in 2004 are representative of stocked rainbow trout. In support of a put-grow-take fishery, Asaayi Lake was stocked in the spring with 8" catchable rainbow trout and fall with 6" sub-catchable rainbow trout. In Asaayi Lake, only 1 rainbow trout was captured under 250 mm with the majority (99%) being between 250 – 425 mm TL.

Low rainbow trout PSD values indicate that the sampled fish represent a population that is dominated by individuals less than "quality" size (≥400 mm). Since this lake is managed as a put-and-take fishery, the PSD values likely represent the stocking and management regime rather than an imbalance within the lake. That is, the fish are a specific size when stocked rather than representative of a naturally recruiting population and harvest is encouraged over trophy angling. Trophy angling could be encouraged by establishing slot limits encouraging in lake growth and natural recruitment. *Wr* values exceeded 100 for all species sampled indicate that food availability was not a contributing factor to low PSD values. This is encouraging despite reduced water levels and less than optimal water quality because we would expect a decrease in overall lake productivity associated with a reduction in wetted perimeter.

Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. Until the dam can be fixed and water levels raised and stabilized, ongoing stocking efforts should continue at current levels. In addition, while a third year of data adds to our understanding of how this lake functions with respect to fish population dynamics, additional surveys are required before trends can be generated and interpreted.

In general, we reiterate our management recommendations from 2003 and emphasize the importance of specific management objectives followed by the collection and interpretation of angler creel data. A fishery management plan would identify goals, objectives, and strategies for management of lakes within the Navajo Nation. Creel data for these lakes are critical to understand harvest and stocking rates, and angler satisfaction, thus providing a mechanism to evaluate management objectives.

Tsaile Lake

Tsaile Lake water quality was sufficiently within guidelines for stocking trout with pH levels below 9 and sufficient dissolved oxygen levels throughout.

Length frequencies of rainbow trout found in Tsaile Lake provide evidence that the fish sampled in 2004 are representative of the stocked rainbow trout and cutthroat trout. In support of a put-grow-take fishery, Tsaile Lake is stocked in the spring with 8" catchable rainbow trout and fall with 6" sub-catchable rainbow trout. In Tsaile Lake only 1 cutthroat and 1 rainbow trout were captured under

250 mm with 99% of both cutthroat and rainbow trout captured distributed between the size ranges of 250 - 425 mm. For the third year in a row brown trout were identified in Tsaile Lake (one was captured in 2002 and one in 2003). Brown trout were last stocked in Tsaile Lake in 1992. While there may be remnant individuals from this initial stocking still present in the lake, it is possible that during favorable fall conditions, brown trout may use inflow streams to spawn and recruit in small numbers. However, a lack of smaller size classes in samples collected over the last three years indicates no recent recruitment.

Low PSD values indicate that the sampled fish represent a population that is dominated by individuals less than "quality" size (≥400 mm). Since this lake is managed as a put and take fishery, the PSD values likely represent the stocking and management regime rather than an imbalance within the lake. That is, the fish are a specific size when stocked rather than representative of a naturally recruiting population and harvest is encouraged over trophy angling. Trophy angling could be encouraged by establishing slot limits to encourage in lake growth and natural recruitment. *Wr* values exceeded 100% for all species sampled indicated that food availability was not a contributing factor to low PSD values. This is encouraging despite reduced water levels and less than optimal water quality because we would expect a decrease in overall lake productivity associated with a reduction in wetted perimeter.

Goldfish were first discovered in Tsaile Lake in 2003 and were captured again in 2004. Catch rate increased since 2003 (1±0.6 fish/900 sec) to 2.1±0.97 fish/900 sec in 2004. Based on length frequency distribution and size range sampled (120 – 550 mm) and based on similar length frequencies in 2003 we are now certain that goldfish are established and reproducing effectively. Their impact on the Tsaile fishery is not yet known and goldfish populations should be monitored in the future for population expansion into adjacent fisheries and within the lake itself. We recommend that the Tribe take advantage of low water levels to control goldfish populations through chemical renovations or by water level manipulations; eggs could be dried out after spring spawning events.

Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. Until the dam can be fixed and water levels raised and stabilized, ongoing stocking efforts should continue at current levels. In addition, while a third year of data adds to our understanding of how this lake functions with respect to fish population dynamics, additional surveys are required before trends can be generated and interpreted.

In general, we reiterate our management recommendations from 2003 and emphasize the importance of specific management objectives followed by the collection and interpretation of angler creel data. A fishery management plan would identify goals, objectives, and strategies for management of lakes within the Navajo Nation. Creel data for these lakes are critical to understand harvest and stocking rates, and angler satisfaction, thus providing a mechanism to evaluate management objectives.

Ganado Lake

Ganado Lake was a new addition to our sampling efforts in 2004. Largemouth bass were the only species identified within the lake and due to vast amounts of aquatic weed beds the area immediately adjacent to the dam was the only area sampled. The weed cover also limits angler use to areas immediately near and around the dam. If angler use and satisfaction at Ganado Lake are important to the Tribe we recommend the use of aquatic weed cutting equipment to open up areas within the lake. However it is important to note that these methods are not a cure all and will need to be completed annually. Boat access is also difficult at Ganado Lake. To increase angler use, the Tribe may want to pursue Heritage Grants through the Arizona Game and Fish Department to install boat ramps and docks.

Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. Until water levels can be raised and stabilized, and in lake aquatic vegetation removed, ongoing stocking efforts should continue at current levels. In addition, several more years of data will be needed to contribute to our understanding of how this lake functions with respect to fish population dynamics, additional surveys are required before trends can be generated and interpreted.

In general, we reiterate our management recommendations from 2003 and emphasize the importance of specific management objectives followed by the collection and interpretation of angler creel data. A fishery management plan would identify goals, objectives, and strategies for management of lakes within the Navajo Nation. Creel data for these lakes are critical to understand harvest and stocking rates, and angler satisfaction, thus providing a mechanism to evaluate management objectives.

Streams

A possible cutthroat / rainbow trout hybrid was first detected by sampling in 2003 in Asaayi and Tsaile creeks. In 2004 additional possible hybrids were captured in Tsaile and Wheatfields creeks. Our first inclination was that these may be hybrids from a source population of native cutthroat trout. However given historical stocking records of cutthroat trout through out these watersheds it is apparent and more likely that these hybrids originate from stocked cutthroat trout. AZFRO is still pursuing funding to analyze fin clips from these fish to determine first of all whether the fish is a hybrid and second to determine if the cutthroat strain is from a native source population.

As in 2002 and 2003, it appears that Tsaile and Wheatfields creeks still retain healthy native fish populations. Despite heavy sedimentation in Tsaile Creek, the native species are recruiting and persisting in detectable numbers. However, increased fine sediment loads may negatively affect more sensitive, nonnative species like trout. It is likely that the low number of trout in Tsaile and Wheatfields creeks is related to the heavy sediment loads and the negative effects on spawning redds and gravel embeddeness. Controlling sediment through better watershed management could improve fish habitat conditions in the creeks and improve downstream, reservoir fisheries.

2005 SAMPLING

SITE DESCRIPTION

In 2005 AZFRO and NDFW sampled Asaayi, Tsaile, Wheatfields, and Ganado lakes. We also sampled Asaayi, Crystal, Bear Canyon (Kinlichi), and Nazlini creeks. These creeks, with the exception of Crystal and Nazlini, are high elevation mountain streams with alternating riffle/pool habitats and receive moderate to high levels of domestic livestock use. The exception is some sections of Asaayi Creek that have been fenced to limit livestock access into the riparian area. No active stocking of long-term management of these creeks is in place or planned by NDFW.

METHODS

We sampled four lakes and four streams from August 8-12, 2005 with both AZFRO and NDFW personnel (**Table 5**). To conform to standardized sampling protocol under development by AZFRO, we followed the naming convention of using the first two letters of the species and genus names and are provided at the end of each graph and table.

Table 5. Participants in lake and stream fishery sampling on the Navajo Nation, August 8-12 2005.

Name	Affiliation
Viola Willeto	NDFW
Dondi Begay	NDFW
David Mikesic	NDFW
Josh David	Arizona Fishery Resources Office-Flagstaff
Dennis Stone	Arizona Fishery Resources Office-Flagstaff
Dewey Wesley	Arizona Fishery Resources Office-San Carlos
Tom Ensman	Arizona Fishery Resources Office-Pinetop
Morgan Thompson	Arizona Fishery Resources Office-Volunteer

Due to equipment failures water quality measurements were not taken in 2005, these practices will be reinitiated in future sampling efforts.

During lake surveys, we used boat electrofishing and minnow traps to sample fish (we did not use gill nets during the 2005 sampling effort due to concern of incidental mortality of trout captured in nets). We used a Smith-Root (Vancouver, WA) DC electrofishing boat with power output that ranged from 7.0 to 12.5 Amps and from 30 to 60 pulses/second. In 2005 surveys were conducted on Wheatfields, Asaayi, and Ganado lakes. In an effort to keep data as comparable as possible between years, and to address possible problems with blockage of the electrofishing boat intake hoses from algae, we completed electrofishing surveys primarily during daylight hours. In addition, low water levels in all lakes presented significant boating hazards that precluded night surveys. In addition, we set 10 baited minnow traps along shorelines between 1-4 hours to capture smaller fish (i.e., additional species and/or smaller life history stages) during daylight hours.

We completed stream surveys using a Smith-Root backpack electrofishing unit. Pulse rate varied from 0.12 to 0.17 Amps and volts ranged from 200-300 pulses/second. We sampled 100 meter sections separating specific habitats discretely by pool and riffle/run and counted fish within each habitat type.

For lake surveys, fish captured were identified to species, weighed (g), measured in total length (TL, mm), and released near the point of capture. During stream surveys, all fish captured were identified to species (when possible) weighed (g), measured for total length (TL, mm) and released near the point of capture.

We determined catch-per-unit-effort (CPUE) for electrofishing data by lake, species, and site. We calculated mean CPUE and standard error by lake and species. Each electrofishing sample was 900 seconds to standardize effort among samples. We calculated minnow trap CPUE as the number of a given species collected per hour of trapping. We calculated stream CPUE as the number of fish divided by the number of seconds shocked within each discrete habitat type (pools, riffles, runs). For this report, we report stream CPUE as the mean number of fish per hour within each habitat type.

We calculated relative condition factor (Kn) as:

$$Kn = (W/W')$$

Where W is the weight of the individual and W' is the length specific mean weight for a fish in the population of study as predicted by a length-weight equation calculated for that population. The length-weight equation is provided below.

$$\mathrm{Log}_{10}(W) = a' + b\,(\mathrm{Log}_{10}\,(L))$$

Where W is weight, L is length, a' is the y-axis intercept ($\mathrm{Log}_{10}a'$) and b is the slope of the equation.

We calculated relative weight (Wr) for specific length groups as described by Anderson and Neuman (1996). Relative weight is an index that compares the actual weight of a species with a standard weight (W_S) at the same length and is expressed as:

$$Wr = \frac{W \text{ (Weight of a fish)}}{W_S \text{ (Standard Weight of a fish)}} \times 100$$

We calculated Proportional Stock Density (PSD) as follows:

$$PSD = \frac{\text{Number of fish} \geq \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

We only completed PSD estimates on rainbow trout, cutthroat trout, green sunfish, largemouth bass and channel catfish as they represented the primary species in each of the lakes. We separated PSD estimates by lake and by gear type. We did not determine PSD values for salmonids captured during stream surveys because most fish were less than stock length required for the above equation.

For further explanation of CPUE, Kn, *Wr*, PSD, and their use in fisheries management on the Navajo Nation, see the methods section of Sponholtz et al. (2002).

RESULTS

Aaayi Lake

During lake electrofishing surveys in 2005, the most abundant species captured in Asaayi Lake was cutthroat trout, (n=77) followed by rainbow trout (n=42) comprising 63% and 34% of the catch respectively. Also captured were two bluehead suckers *Castostomus discobulus,* and three fathead minnows. Species composition changed dramatically in Asaayi Lake in 2005. In 2004 rainbow trout were the only salmonid species captured. In 2005 there was a shift from stocking rainbow trout to rainbow and cutthroat trout. Cutthroat trout comprised 63% of our total catch in 2005 (**Figure 12**).

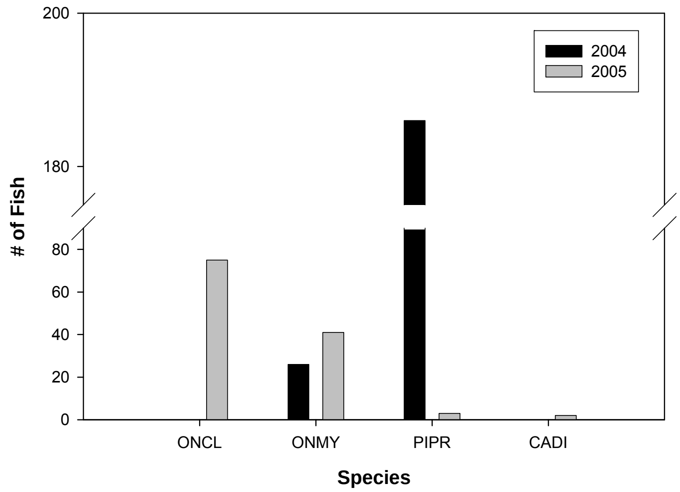

Figure 12. Species composition in Asaayi Lake 2004 and 2005, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**
Note: ONCL = cutthroat trout; ONMY = rainbow trout; PIPR = fathead minnow; CADI = bluehead sucker**.**

Fathead minnow catch rates in minnow traps increased in Asaayi Lake between 2004 (1.2±0.8 fish/hour) and 2005 (2.6±0.8 fish/hour).

Mean total catch rate during electrofishing surveys on Asaayi Lake was 40±25 fish/900 sec (**Figure 13**). On a species level, cutthroat trout had the highest mean CPUE (25±19 fish/900 sec) followed by rainbow trout (14±6.1 fish/900 sec). In Asaayi Lake rainbow trout CPUE increased from 8.4±1.2 in 2004 to 14±6.1 fish/900 sec in 2005 (**Figure 14**).

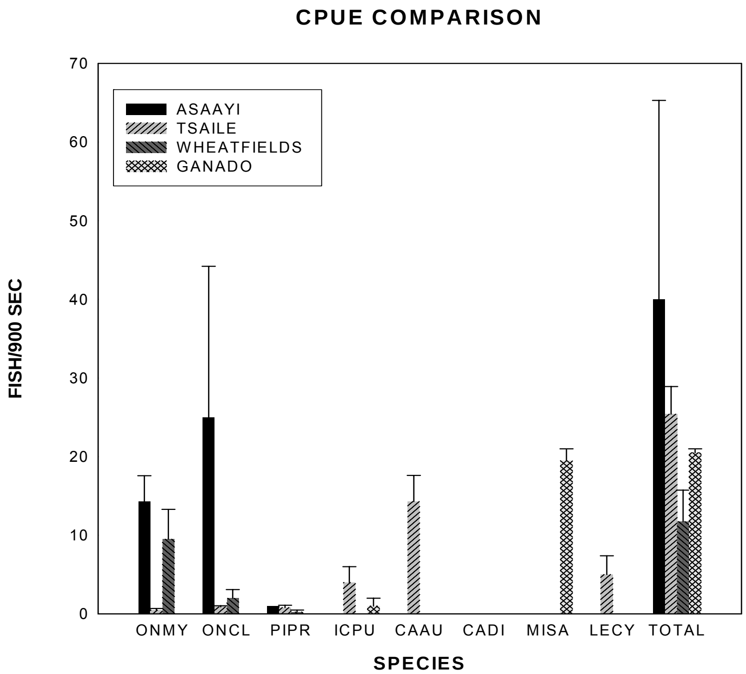

Figure 13. Mean catch per unit effort among lakes for fish captured via electrofishing during surveys on the Navajo Nation, August 8 - 12, 2005 by AZFRO and NDFW. Note: ONMY = rainbow trout (*Oncorhynchus mykiss*); ONCL cutthroat trout = (*Oncorhynchus clarkii*); ICPU = channel catfish (*Ictalurus punctatus*); LECY = green sunfish (*Lepomis cyanellus*); PIPR = fathead minnow (*Pimephales promelas*); CAAU = goldfish *(Carassius auratus)* MISA = largemouth bass (*Micropterus salmoides*).

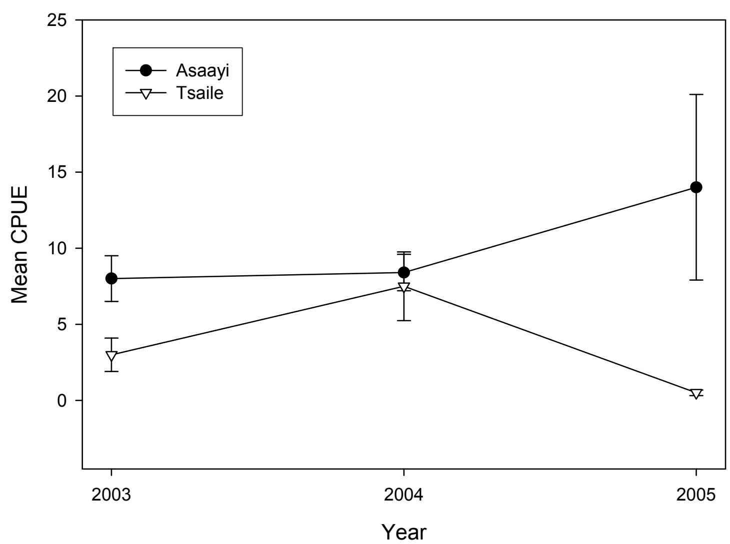

Figure 14. Mean catch-per-unit-effort on Asaayi and Tsaile lakes for rainbow trout captured via electroshocking surveys in 2003 - 2005 on the Navajo Nation by AZFRO and NDFW. Error bars represent ± 1 standard error.

In 2005 according to proportional stock density calculations (PSD) for both rainbow and cutthroat trout in Asaayi Lake (PSD = 3.03 & 0 respectively) PSD values fall well below guidelines (between 20-100) for a balanced populations, which is a decrease in PSD in rainbow trout in 2004 (PSD = 14). These values indicate that fish are being harvested or experience mortality before they reach quality size. Length frequencies for rainbow trout and cutthroat trout in Asaayi Lake support these values (**Figures 15 & 16**) in which 99% of fish captured were less than 400mm (the minimum "quality" length).

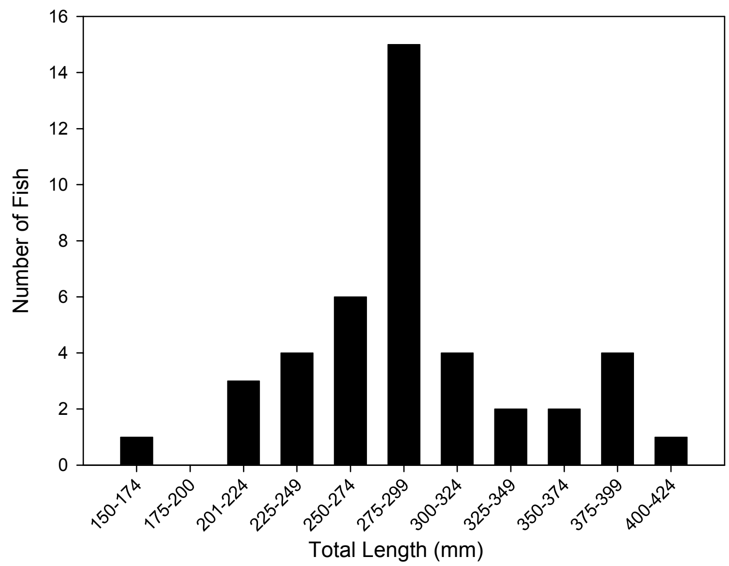

Figure 15. Length frequency of rainbow trout from Asaayi Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

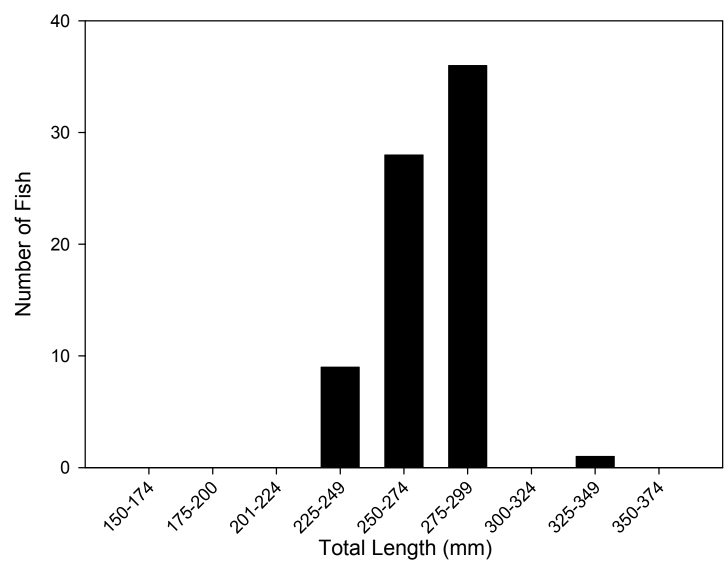

Figure 16. Length frequency of cutthroat trout from Asaayi Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

In 2005 mean relative weight *(Wr)* of rainbow trout in Asaayi Lake was 106.14±6.3 an increase from 2004 values (94.02±4.8). Mean relative condition (Kn) of rainbow trout in Asaayi Lake was 1.04±0.06. Overall, rainbow trout in Asaayi Lake appear to be in “good” condition. Mean relative weight of cutthroat trout in Asaayi Lake in 2005 was 99.07±1.6 and mean relative condition factor was 1.01±.06. These values indicate that rainbow and cutthroat trout are approaching or exceed the standard weight expectation and may reflect optimal ecological and physiological conditions.

Tsaile Lake

In 2005 goldfish was the most abundant species captured in Tsaile Lake (n=91, 52%), other species included green sunfish (n=38, 22%), channel catfish (n=32, 18%), fathead minnows (n=6, 3%), rainbow trout (n=4, 2%) and cutthroat trout (n=1, 1%).

Species composition has changed dramatically in Tsaile Lake since 2004. In 2003, goldfish were discovered, however, abundance was relatively low. In 2004 overall abundance increased (n=18, 8% Figure 17) and in 2005 increased again comprising 52% of our total catch (n=115). In 2005 green sunfish abundance also increased 10%. While goldfish and green sunfish abundance increased, channel catfish abundance decreased from 25% (2004) to 18% (2005), rainbow trout abundance decreased from 21% (2004) to 2% (2005), cutthroat trout decreased from 14% (2004) to 1% (2005), and fathead minnow abundance decreased from 18% (2004) to 3% (2005) of our total catch.

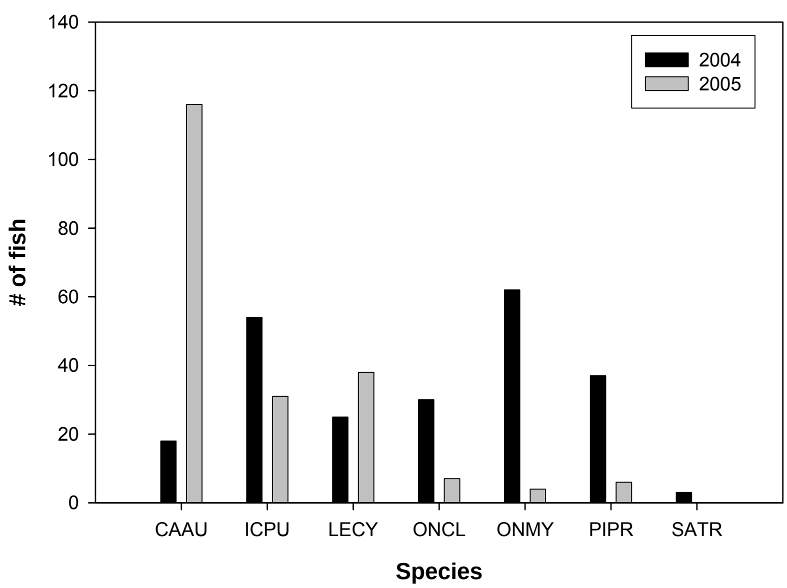

Figure 17. Species composition in Tsaile Lake 2004 and 2005, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**
Note: CAAU = goldfish; ICPU = channel catfish; LECY = green sunfish; ONCL = cutthroat trout; ONMY = rainbow trout; PIPR = fathead minnow; SATR = brown trout.

Catch rates of green sunfish (17.8±4.6 fish/hour) in minnow traps in Tsaile Lake were substantial and comprised 86% of the catch, this is a drastic increase from 2004 (0.53±0.4 fish/hour).

Mean CPUE in Tsaile Lake in 2005 was 25±25.4fish/900 sec. On a species level in Tsaile Lake, goldfish had the highest mean CPUE at 14±3.2 fish/900 sec followed by channel catfish at 4±1.9 fish/900 sec, cutthroat trout 0.9±0.14 fish/900 sec, and rainbow trout 0.5±0.18 fish/900 sec. Rainbow trout CPUE decreased from7.5±2.26 in 2004 to 0.5±0.18 fish/900 sec in 2005 (**Figure 19**). In 2003 goldfish were discovered in Tsaile Lake, however catch rates were low (CPUE=1±0.6 fish/900 sec, (Figure 18). In 2004 catch rates of goldfish increased (CPUE=2.1±0.97 fish/900 sec) and in 2005 catch rates increased seven fold (CPUE=14.3±3.3 fish/900 sec) from 2004. It is important to note that while catch rates for goldfish and green sunfish increased in Tsaile Lake, all other species CPUE decreased (**Figure 19**).

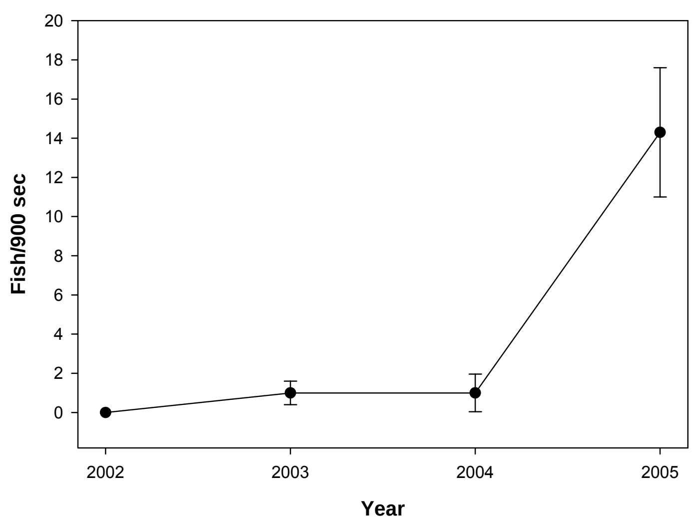

Figure 18. Goldfish CPUE comparison from 2002-2005 in Tsaile Lake, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, 2002 - 2005.

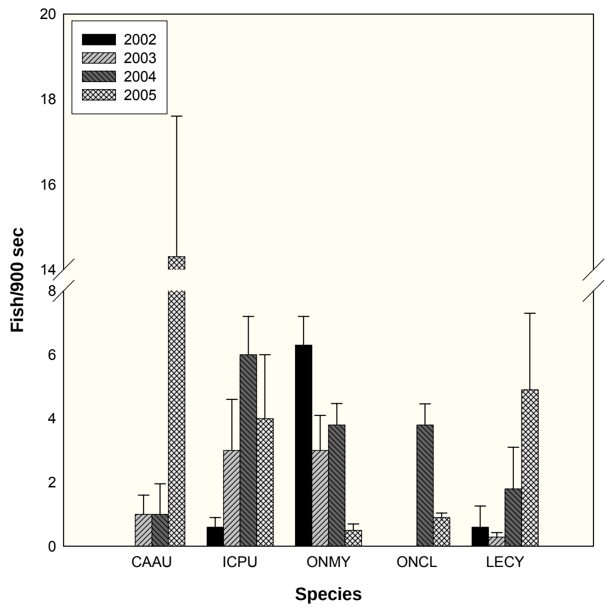

Figure 19. CPUE comparisons from 2002-2005 in Tsaile Lake, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**
Note: CAAU = goldfish; ICPU = channel catfish; ONMY = rainbow trout; ONCL = cutthroat trout; LECY = green sunfish.

PSD values for cutthroat trout in Tsaile Lake fall within guidelines (PSD = 42.9), however due to low sample size (n=6) this may not be indicative of a balanced population, the rainbow trout sample size in Tsaile Lake was too small to accurately measure PSD values. Although catch rates declined for channel catfish in Tsaile Lake, PSD values (47) indicate a balanced population and length frequencies further support these values (**Figure 20**).

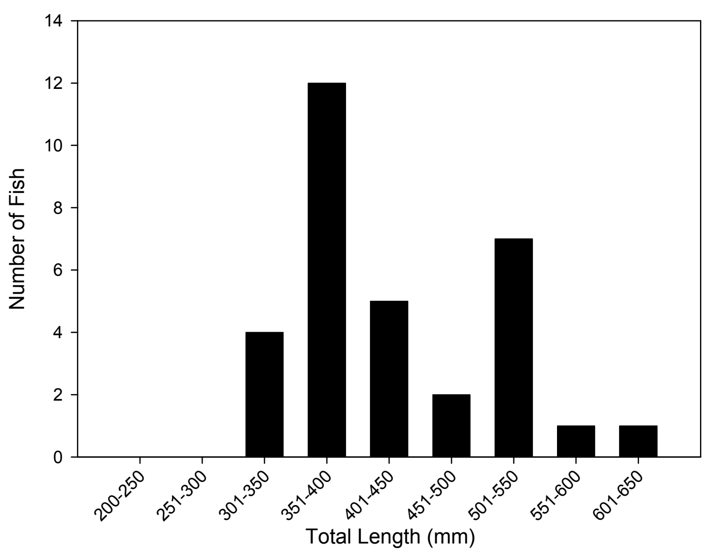

Figure 20. Length frequency of channel catfish from Tsaile Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

In 2005 mean relative weight of rainbow trout in Tsaile Lake was 94.4±6.9. Mean relative weight and mean relative condition values of other species in Tsaile Lake are presented in **Table 5**. All mean condition values for all species captured in Tsaile Lake indicate that fish are in “good” condition.

Table 5. Mean relative weight (*Wr*) and relative condition factor (Kn) for fish sampled in Asaayi, Tsaile, Wheatfields and Ganado lakes via boat electrofishing, August 8-12, 2005 by AZFRO and NDFW. NV indicates no value.

			Wr		Kn	
		Count	Mean	Standard Error of Mean	Mean	Standard Error of Mean
ASAAYI	ONMY	42	106.14	6.3	1.04	0.02
	ONCL	77	99.07	1.6	1.01	0.06
TSAILE	ICPU	32	99.7	1.5	1.00	0.01
	LECY	38	118.3	5.9	1.06	0.06
	ONMY	4	94.4	6.9	1.05	0.03
	ONCL	6	100.6	5.1	0.83	0.05
WHEAT	ONCL	8	112.5	5.6	1.0	0.04
	ONMY	38	104.8	3.8	1.01	0.03
GANADO	MISA	39	112.0	6.5	1.07	.07

Wheatfields Lake

At Wheatfields Lake, rainbow trout was the most abundant species (n=38, 82%) followed by cutthroat trout (n=8, 81%); one fathead minnow was also collected during the sampling.

Baited minnow trap catch rates increased in Wheatfields Lake from 2003 (2003 =17±7.2 fish/hour, 2005= 82.2±41.7 fish/hour). More than half of the catch in Wheatfields Lake was located within a closed section of the lake in which an embankment separates a standing pool of water near the dam. When lake levels rise these fish will join populations of the main lake again.

In 2005 mean CPUE for Wheatfields Lake was 12±3.96 fish/900 sec. On a species level in Wheatfields Lake, rainbow trout comprised the highest mean CPUE (9.5±3.7 fish/900 sec), followed by cutthroat trout (2±1 fish/900 sec), and fathead minnows (0.25±0.25 fish/ 900 sec).

Cutthroat trout in Wheatfields Lake had the highest PSD value at 62.5, although sample size was low (n=9). Length frequencies support these values and it appears these fish may be representative of stockings that occurred before dam repair (**Figure 21**). Rainbow trout PSD in Wheatfields Lake was zero indicating that none of the fish sampled were greater than or equal to minimum quality length (**Figure 22**).

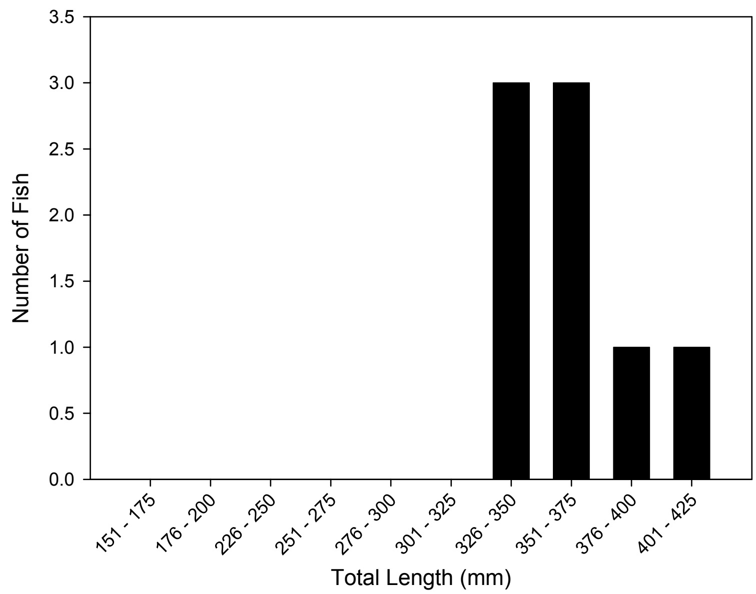

Figure 21. Length frequency of cutthroat trout from Wheatfields Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

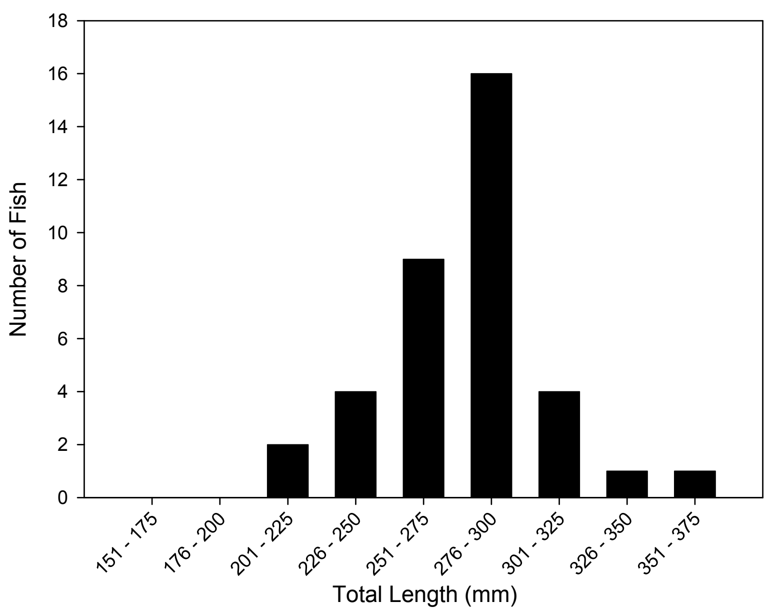

Figure 22. Length frequency of rainbow trout from Wheatfields Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

In 2005 mean relative weight of rainbow trout and cutthroat trout in Wheatfields Lake was 112.5±5.6 and 104.8±3.8, respectively. Mean relative condition values of rainbow and cutthroat trout were both above 1.0 indicating that fish captured in Wheatfields Lake are in “good” condition.

Ganado Lake

The most abundant species in Ganado Lake was largemouth bass (n=38) comprising 95% of the total catch, 2 channel catfish were also collected. Ganado Lake was not sampled with baited minnow traps in 2005.

Mean CPUE for Ganado Lake was 20±0.5 fish/900 sec. On a species level, largemouth bass had the highest CPUE at 19.5±1.5, followed by channel catfish at 1±1 fish/900 sec. Sampling Ganado Lake was challenging this year due to equipment failures and road conditions. Only two sites were sampled comprising areas near the dam and an island adjacent to the dam. Weed beds within the lake were substantial and choked most of the lake except in areas of extremely deep water. Despite the difficulties in sampling, largemouth bass catch rates increased but did not differ significantly between 2004 (16.1±9.6 fish/900 sec Figure 23.) and 2005 (19.5±1.5 fish/900 sec). Additionally two channel catfish (tl = 580 & 524 mm) were captured this year.

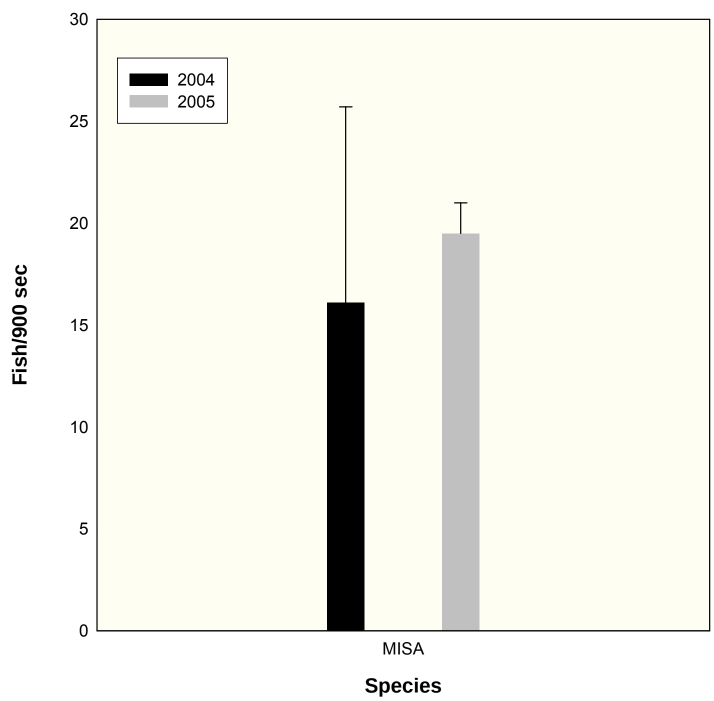

Figure 23. CPUE comparisons from 2004 and 2005 in Ganado Lake, Navajo Nation, sampled via electrofishing by AZFRO and NDFW.
Note: MISA = largemouth bass

PSD values for largemouth bass in Ganado Lake were within guidelines for a balanced population (26.3) and length frequencies support these values; 40% of largemouth bass were between 200-400mm (**Figure 24**).

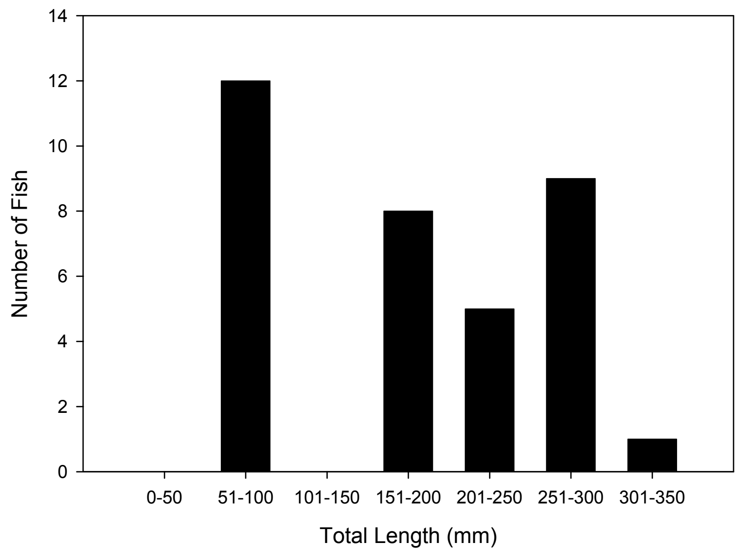

Figure 24. Length frequency of largemouth bass from Ganado Lake, 2005 Navajo Nation, sampled via electrofishing by AZFRO and NDFW.

In 2005 mean relative weight of largemouth bass was 112.5±6.5. Mean relative condition value of largemouth bass was 1.07±.07 indicating that fish captured in Ganado Lake are in “good” condition.

Asaayi Creek

In 2005 AZFRO and NDFW sampled portions of Asaayi Creek. In sections of Asaayi Creek approximately 1.5 miles upstream of Asaayi Lake, catch rates were dominated in both pools and riffles by rainbow trout (pool = 5550.8±147.6 fish/hr sec riffle = 1416.6±226.8 fish/hr) followed by speckled dace (pool = 102.6±39.6 fish/hr riffle = 345.6±133.2 fish/hr (**Figure 25**). No bluehead suckers or possible cutthroat/rainbow trout hybrids were captured this year in the portions of Asaayi Creek sampled. This is most likely due to the close proximity of our sample sites to Asaayi Lake and the abundance of rainbow trout in the system.

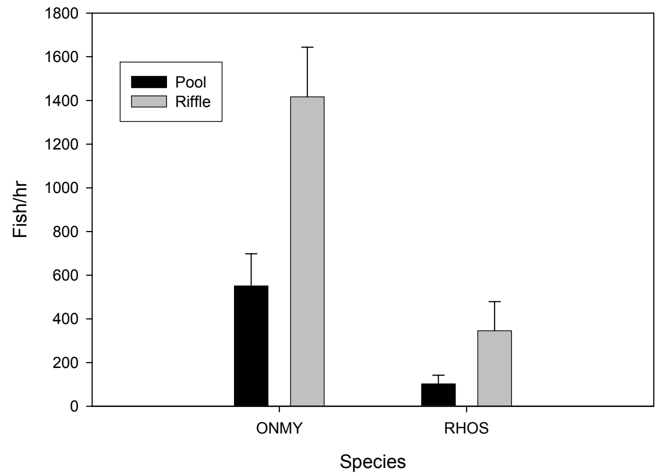

Figure 25. CPUE comparisons between pool and riffle in Asaayi Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.** **Note:** ONMY = rainbow trout, RHOS = speckled dace.

Length frequencies histograms of rainbow trout and speckled dace in Asaayi Creek indicate that both are actively recruiting (**Figures 26 & 27**). PSD values were relatively low for rainbow trout in Asaayi Creek (4) as was relative weight (87.14±1.42); however, condition factors were normal at 1.00±.01. These values are not surprising given the small size of the stream and heavy substrate loads that dominate this lower portion of Asaayi Creek.

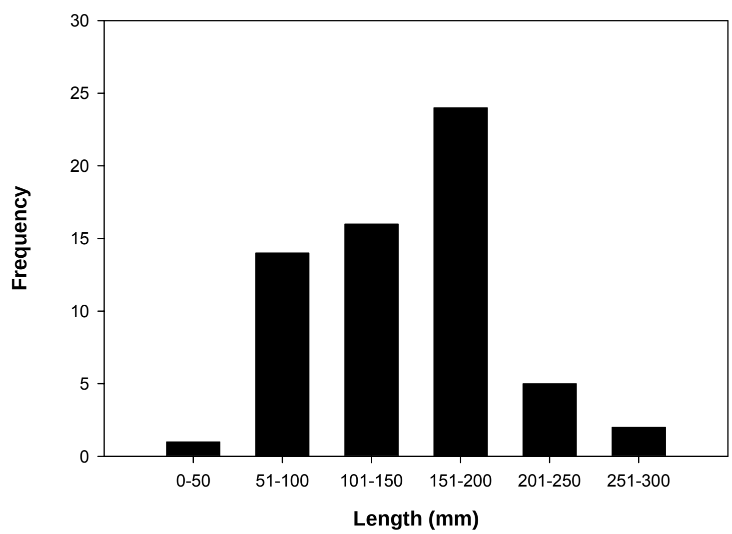

Figure 26. Length frequency of rainbow trout from Asaayi Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**

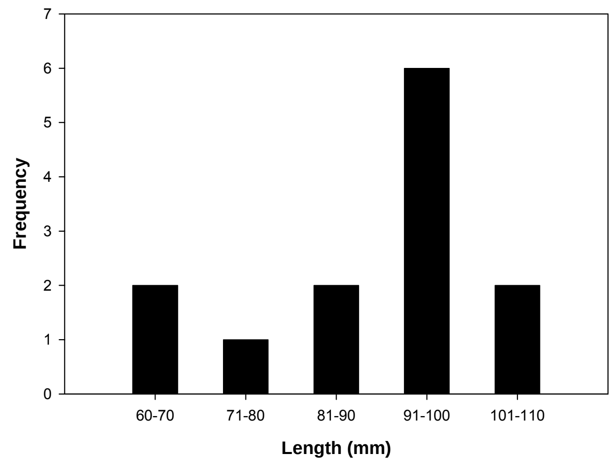

Figure 27. Length frequency of speckled dace from Asaayi Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**

Crystal Creek

The portions of Crystal Creek surveyed this year were dominated solely by native fish including bluehead suckers and speckled dace. Catch rates were highest for speckled dace (pool = 136.8±77.4 fish/hr riffle = 250.2±118.8 fish/hr) (**Figure 28**) followed by bluehead suckers (pool = 32.4±21.6 fish/hr riffle = 18±18 fish/hr).

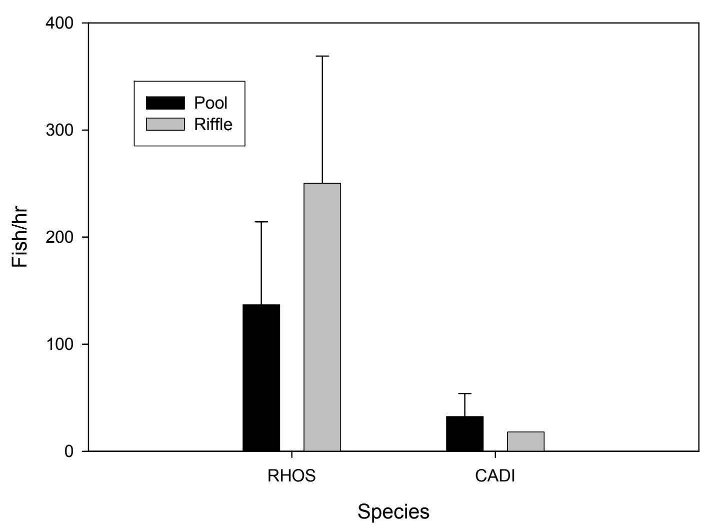

Figure 28. CPUE comparisons between pool and riffle in Crystal Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**
Note: CADI = bluehead sucker, RHOS = speckled dace.

Length frequencies of both bluehead suckers and speckled dace indicate that these populations are actively recruiting within Crystal Creek (**Figures 29 & 30**) and show several separate size classes.

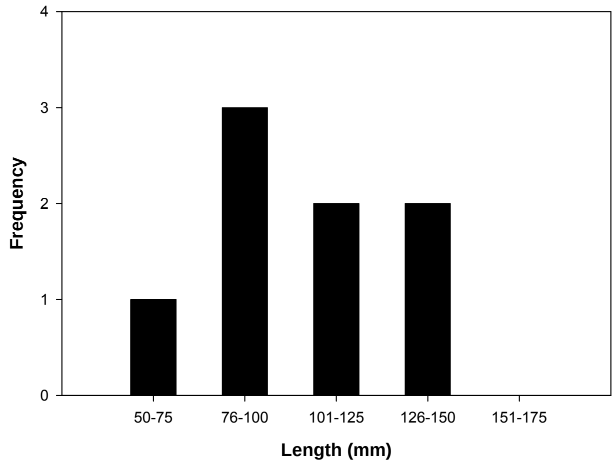

Figure 29. Length frequency of bluehead suckers from Crystal Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**

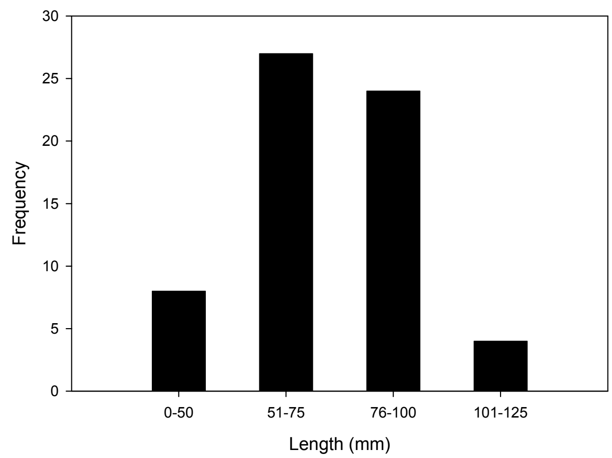

Figure 30. Length frequency of speckled dace from Crystal Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**

Bear Canyon (Kinlichi Creek)

A 100 meter section of Bear Canyon Creek was surveyed that included two distinct pool habitats. Within these pools, only bluehead suckers were captured, which had a CPUE of 25.32±7.34 fish/hr. Length frequencies suggest that bluehead suckers are actively recruiting within Bear Canyon Creek (**Figure 31**).

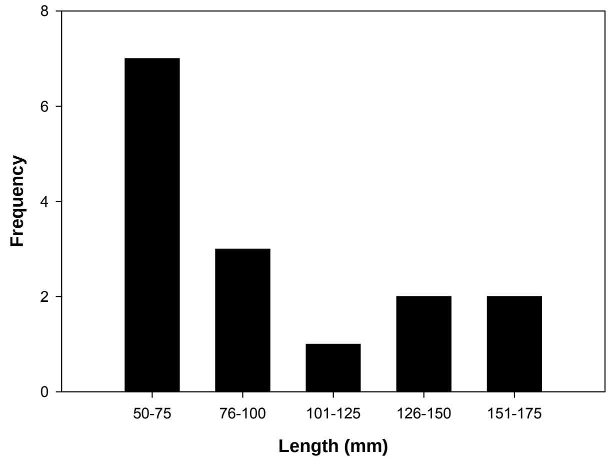

Figure 31. Length frequency of bluehead suckers from Crystal Creek, Navajo Nation, sampled via electrofishing by AZFRO and NDFW, August 8-12, 2005**.**

Nazlini Creek

Approximately 40 meters of Nazlini Creek were surveyed in 2005; miscellaneous pools and runs were fragmented by a dry creek bed. No fish were captured during this survey. We recommend surveying farther upstream to determine whether this drainage holds fish in areas with perennial flows.

DISCUSSION

Asaayi Lake

Length frequencies of rainbow and cutthroat trout in Asaayi Lake provide evidence that the sampled population in 2005 is representative of the stocked rainbow and cutthroat trout. In support of a put-grow-take fishery, Asaayi Lake is stocked in the spring with 8" catchable rainbow trout and fall with 6" subcatchable rainbow and cutthroat trout. In Asaayi Lake 93% of captured rainbow and cutthroat trout fell between the size ranges of 200 – 400 mm.

Low PSD values indicate that the sampled fish represent a population that is dominated by individuals less than "quality" size (≥400mm). Since this lake is managed as a put and take fishery, the PSD values likely represent the current stocking and management regime rather than representative of a naturally recruiting population and harvest is encouraged over trophy angling. As we saw in 2003 and 2004 some larger individuals appear to hold out through the winter despite marginal water quality and low water levels. *Wr* values for all species exceeded 100% for all species sampled indicating that food availability was not a contributing factor. These increased *Wr* values (2003 *Wr* = 89%) may be indicative of increased water levels in 2005 which increases overall lake productivity associated with an increase in wetted perimeter (Carpenter et al. 1985; Hough et al. 1991).

Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. Until dam repairs can be completed and water levels raised and stabilized, ongoing stocking efforts should continue at current levels.

Tsaile Lake

Length frequencies of rainbow and cutthroat trout in Tsaile Lake provide evidence that the sampled population in 2005 is representative of the stocked rainbow and cutthroat trout. In support of a put-grow-take fishery, Tsaile Lake is stocked in the spring with 8” catchable rainbow trout and fall with 6” subcatchable rainbow and cutthroat trout. In Tsaile Lake 99% of captured rainbow and cutthroat trout fell between the size ranges of 200 – 400 mm.

Low PSD values indicate that the sampled fish represent a population that is dominated by individuals less than “quality” size (≥400mm). Since Tsaile Lake is managed as a put and take fishery, the PSD values likely represent the current stocking and management regime rather than representative of a naturally recruiting population and harvest is encouraged over trophy angling. As we saw in 2003 and 2004 some larger individuals appear to hold out through the winter despite marginal water quality and low water levels. *Wr* values for all species exceeded 100% for all species sampled indicating that food availability was not a contributing factor. These increased *Wr* values (2003 *Wr* = 89%) may be indicative of increased water levels in 2005 which increases overall lake productivity associated with an increase in wetted perimeter (Carpenter et al. 1985; Hough et al. 1991).

Goldfish were first detected in Tsaile Lake in 2003 and again in 2004. In 2005 we saw CPUE for goldfish increase seven fold. This increase in population size is worrisome on several levels. First and most problematic is the risk of goldfish ulcer disease (GUD). GUD is a bacterial disease first isolated from a goldfish farm in Victoria, British Columbia in 1974. Since then outbreaks have occurred at warm water fish hatcheries in New South Whales and Victoria. GUD appears as open lesions on the dorsal musculature and attacks vital organs and nerve centers ending in death. The only cure is active injections in fish, and can remain dormant without a host for long periods of time. It has been found that trout species are at high risk of infection, and infection can possibly destroy entire lake populations. Second is the possibility of food resource competition. While little is known about goldfish impacts on sports fisheries, negative effects of a close relative the carp is known (Zambrano and Hinojosa 1999, Barton et al. 2000). Green sunfish catch rates in Tsaile Lake have also increased since 2004 and young-of-the-year green sunfish comprised 86% of our baited minnow trap catch (n=319). Green sunfish feed primarily on aquatic and terrestrial insects, but will also eat crayfish and small fish. These diet trends overlap with rainbow and cutthroat and are furthering food resource competition for trout species. In contrast, channel catfish catch rates did not differ greatly from 2004 and relative weights and condition factors indicate that the channel catfish population has not changed over time.

In 2005 rainbow trout and cutthroat trout catch rates in Tsaile Lake were at an all time low (CPUE = 0.5±0.2 and 0.9±0.1 respectively), without further research we can not determine that this reduction is in fact linked to goldfish and green sunfish population increases. However it is suspicious that these low capture rates coincided with increased goldfish and green sunfish abundance. In the next few years unless something is done to curb goldfish and green sunfish populations we expect numbers to increase exponentially. Our recommendations are to drain the lake during dam repairs in conjunction with chemical treatments of standing water to successfully remove goldfish and green sunfish. However consideration must be made in regards to water outflow during draining to minimize the possibility of goldfish and green sunfish spreading through the watershed. We feel that the future success of Tsaile Lake as a productive sport fishery is at risk and renovations to remove goldfish and green sunfish should become a top priority.

Wheatfields Lake

Length frequencies from Wheatfields Lake provide evidence that the sampled population in 2005 is representative of the stocked rainbow trout and cutthroat trout. In support of a put-grow-take fishery, Wheatfields Lake is stocked in the spring with 8” catchable rainbow trout and in the fall with 6” subcatchable rainbow and cutthroat trout. In Wheatfields Lake, 99% of the rainbow and cutthroat trout were between the size ranges of 250 – 400 mm.

Low PSD values indicate that the sampled fish represent a population that is dominated by individuals less than “quality” size (≥400mm). Since this lake is managed as a put and take fishery, the PSD values likely represent the current stocking and management regime rather than representative of a naturally recruiting population and harvest is encouraged over trophy angling. As we saw in 2003 and 2004 some larger individuals appear to hold out through the winter despite marginal water quality and low water levels. *Wr* values for all species exceeded 100% for all species sampled indicating that food availability was not a contributing factor. These increased *Wr* values (2003 *Wr* = 89%) may be indicative of increased water levels in 2005 contributed to post dam refill which increases overall lake productivity associated with an increase in wetted perimeter (Carpenter et al. 1985; Hough et al. 1991).

Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. Until water levels can be raised and stabilized, ongoing stocking efforts should continue at current levels. In conjunction with these repairs low water levels provide opportunities to conduct improvements such as removal of built up sediments, increasing lake depth, and conducting removal efforts for undesirable species. In the case of Wheatfields Lake where dam repairs have been completed, given increased water levels we recommend continuing with creel surveys and adjusting stocking rates if angler data reflect a need for it. Newly filled lakes or reservoirs with highly fluctuating water levels are subject to the "new reservoir" effect and can exhibit trophic upsurge and result in whole lake increases in primary productivity (Kimmel and Groeger 1986.) This trophic upsurge often provides optimal growth conditions thus supporting a very successful fishery.

Ganado Lake

Ganado Lake appears to be maintaining a healthy population of largemouth bass, however, effectively sampling this lake is difficult due to the over abundance of aquatic weed beds carpeting 80-90% of the lake. Management recommendations and changes to the existing program are limited due to current water level issues and a lack of established management objectives. It is possible that the Tribe may want to pursue aquatic vegetation removal projects and Heritage Grants (or other funding resources) to install a boat ramp to increase angler use of this lake.

Streams

In 2005 100% of captured fish in Bear Canyon, Nazlini and Crystal creeks were native fish (speckled dace and bluehead suckers). It is encouraging seeing these native fish populations actively recruiting and persisting in detectable numbers. Further, it is rare to find streams that contain solely native fish and we encourage NDFW to protect these valuable resources from non-native invasion by installing upstream fish barriers and public outreach educating the detriments of non-native species on native fish populations. We reiterate recommendations from 2003 and 2004 to consider integrating downstream reservoir and tributary stream management. In the portions of Assayi Creek sampled we found higher concentrations of rainbow trout that are most likely associated with the relative close proximity (1.5 miles) from Asaayi Lake. Low *Wr* values for rainbow trout in Asaayi Creek could possibly be contributed to by low sample size, but despite low *Wr*, length frequencies indicate that they are actively recruiting within the stream. Despite the presence of rainbow trout we also found what appears to be a healthy population of speckled dace with several size classes present. We did not capture any bluehead suckers in the sections of Asaayi Creek sampled in.

As requested by NDFW surveys were conducted on Bear Canyon (Kinlichi) Creek to try and determine whether the Zuni bluehead sucker (*Castostomus discobolus yarrowi*) a subspecies of bluehead suckers (*Castostomus discobolus discobolus*) was present. AZFRO biologists could not determine from external physiology whether they differed from other blueheads sampled throughout the Navajo Nation. Historical records show that Bear Canyon Creek was identified as a source population of Zuni Bluehead suckers. Our recommendation would be to differentiate, through genetic analysis with fin clips, previously obtained by New Mexico Game and Fish Department. It is possible that if creeks were sampled during spawning, Zuni Bluehead suckers might be identified through external physiology. During spawning season, males develop tubercles on the anal fin and ventral lobe of the caudal fin, and become intensely black dorsally with a bright-red lateral band and a white venter (Propst et al. 2001). We encourage NDFW to continue partnerships with New Mexico Game and Fish Department and US Fish and Wildlife Service to conclusively identify the presence or absence of this threatened species within drainages of the Navajo Nation.

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