Grand Canyon Long-term Fish Monitoring: Diamond Creek to Pearce Ferry

2004 Annual Report

Submitted to

Grand Canyon Monitoring and Research Center

Submitted by

Hualapai Department of Natural Resources

and

SWCA Environmental Consultants

April 2006

Grand Canyon Long-term Fish Monitoring: Diamond Creek to Pearce Ferry

2004 Annual Report

Submitted to

Dr. Barbara Ralston
Grand Canyon Monitoring and Research Center
2255 N. Gemini Dr.
Flagstaff, Arizona 86001

Cooperative Agreement # 04WRAG0011

Submitted by

Hualapai Department of Natural Resources

and

SWCA Environmental Consultants

Prepared by

Matt Lauretta, Kara Hilwig, and Bill Leibfried, SWCA Environmental Consultants
Roland S. Rogers and Joe E. Slaughter IV, Arizona Game and Fish Department
Kerry Christensen, Hualapai Department of Natural Resources

April 25, 2006

1.0 INTRODUCTION

Fish monitoring in the Colorado River in Grand Canyon between Diamond Creek and Pearce Ferry was conducted in the mid-1990s and was last performed in 1996 by the Hualapai Tribe and SWCA Environmental Consultants (SWCA). Data collected during those efforts represent a historical baseline of the fish community in that reach of river between 1994 and 1996. Continued monitoring in the lower reaches of Grand Canyon is important in understanding patterns of upstream movement of nonnative fish species from Lake Mead into Grand Canyon, monitoring changes in native and nonnative fish abundance and distribution, and for understanding the role of downstream tributaries in the reproductive biology of native fish. Furthermore, sampling in this reach of river is essential for evaluating the effects of Glen Canyon Dam flow releases on the reproduction and survival of native fish, and will be important in the future for evaluating the effects of the proposed Temperature Control Device (TCD) on nonnative fish distribution and movement.

The objectives of the current Colorado River Fish Monitoring Program from Diamond Creek to Pearce Ferry (Diamond Down Monitoring) are as follows:

- Evaluate methodologies for quantifying the abundance and distribution of native and nonnative fishes from Diamond Creek to Pearce Ferry.
- Establish a fish abundance and distribution database that can be used as a basis for comparing past and future data.
- Evaluate downstream tributaries such as Spencer Creek as refugia for native fish.
- Mark nonnative fish so that movement data from future monitoring efforts may be obtained.
- Collect fish relative abundance, distribution, and movement data that can be used in the future to formulate hypotheses regarding the effects of implementing the TCD on native and nonnative fish in the Colorado River Ecosystem.

2.0 METHODS

Personnel and Logistics

Fish biologists from the Arizona Game and Fish Department (AGFD), SWCA, the U.S. Fish and Wildlife Service (USFWS), and the Grand Canyon Monitoring and Research Center (GCMRC) who are involved in the fish monitoring program in upper Grand Canyon participated in the initial Diamond Down Monitoring trip in October 2004 (Trip GC20041005), and were assisted by personnel from the Hualapai Department of Natural Resources (HDNR). GCMRC provided logistical support and equipment, and Humphrey Summit and Support, Inc (HSS) provided boatmen for the trip. Two 22-ft snout boats and four sport boats were provided by GCMRC; however, the amount of space the sampling gear occupied had been underestimated, and HDNR provided an extra snout boat for a total of three. Crewmembers, sampling duties, and associated agencies are listed in Table 1.

Reach Designations

Electrofishing and netting sections were stratified into four reaches according to geomorphology and logistic constraints. Unequal effort (i.e., number of sites and number of nights spent in each section) was applied in each reach depending on reach length and fish densities from prior surveys (W. Leibfried, SWCA, personal communication). Each reach was divided into two sections to allow electrofishing and netting sampling efforts to occur simultaneously without overlap (Table 2).

Electrofishing Effort

AGFD biologists electrofished seven randomly selected sections of the Colorado River between river mile (RM) 226 and RM 280. One section was electrofished per night from October 5 to11, 2004. Approximately 350–425 volts and 15–17 amps were applied to a 35-cm stainless steel anode, while one or two crewmembers (per boat) netted stunned fish from the front of the boat. Each site was sampled by single pass electrofishing along the shoreline for 500 seconds with an Achilles inflatable boat equipped with Coffelt CPS output regulators. Each boat sampled opposite sides of the river.

Angling Effort

AGFD also employed a series of experimental angling surveys to test the efficacy of angling for use in monitoring fish species less susceptible to conventional electrofishing or netting gears (i.e., channel catfish, striped bass, etc.). These angling surveys were intended to be used for comparison of experimental electrofishing methods, but high turbidity precluded electrofishing experimentation. Terminal tackle, line weight, bait type, bait application, and angler effort were all standardized to minimize bias. Randomly selected eddies and/or pools, as well as each campsite encountered were fished each day, and four anglers sampled most sites for 20 minutes per site (two sites received only two anglers per 20 minutes). On two occasions the same site was fished for three consecutive 20-minute periods to make depletion estimates; otherwise, each site was only fished for one 20-minute period. At each site, species, total length (TL), angler effort, and GPS waypoints were recorded.

Netting Effort

SWCA and USFWS biologists sampled with trammel and hoop nets in a stratified random distribution, allocated within defined sampling reaches (Table 2). Two 16-ft Achilles inflatable boats were used to set and pull nets, with one boatman and two biologists on each boat.

Trammel netting was conducted in suitable habitats with 75' × 6' × 1.5" × 12" (length × width × mesh × panel) and 50' × 6' × 1" × 12" trammel nets. Two netting boats set five trammel nets each per night for a total of 10 samples per night. Each trammel net was set between 1340 and 1700 hours each night and fished for three or four sets of ~2 hours, totaling ~6–8 hours. Trammel nets were typically set at current separation points where eddy current and main current diverge, also known as eddy fences.

Hoop nets were set in the afternoon in areas characterized by low velocity along the shoreline and set at depths of 3 m or less. Two netting boats set 15 hoop nets each per day for a total of 30 samples

per night. Hoop nets were placed in pods of three in suitable low velocity locations and set overnight.

Seining efforts were focused on shoreline habitats and backwaters. Seining was conducted in suitable habitats with a 15' × 6' × 1/8" (width × depth × mesh) seine. Seine haul length, width, and depths (3 measurements) were recorded.

Fish Handling

The standard fish handling protocol outlined jointly between GCMRC and the cooperating agencies (Ward 2002) was followed, with the exceptions that carp were tagged to the left of the dorsal insertion with Floy tags instead of PIT tags, and flannelmouth suckers were tagged at sizes greater than 130 mm TL rather than 150 mm TL.

Water Quality

Water quality measurements were taken daily, including temperature, specific conductivity, and salinity using a Eureka Amphibian® unit. Turbidity measurements were taken each night.

3.0 RESULTS

Electrofishing

A total of 273 sites were electrofished during the trip (Table 3). Red shiner was the dominant species captured, followed by flannelmouth sucker and common carp (Table 3, Figure 1). These species were relatively evenly distributed among reaches. Others species captured during electrofishing included rainbow trout, channel catfish, and speckled dace, all of which were rare.

Angling

A total of 16 sites were angled over the course of four days, and yielded a mean catch rate of 2.34 channel catfish/hour plus or minus 1.35 catfish/hour (95% confidence interval). Depletion sampling was completed on two of the 16 sites with three depletion efforts per site, and yielded estimates of 8 and 10 channel catfish per site (no measure of variability is given since both depletions ended with zero fish in the last 20-minute effort). Table 4 gives a summary of angling effort for each day of sampling.

Netting

Trammel net captures consisted entirely of channel catfish, carp, and flannelmouth sucker that were larger than 190 mm TL (Table 5, Figure 2). The majority of fish were captured in the upper two reaches (between RM 238 and RM 248); however, individuals of all three species were also captured in the farthest downstream reach (between RM 277 and RM 281, Table 5). Carp was the most common species captured in trammel nets, although channel catfish were just slightly less common (Figure 1). A total of 12 carp, 12 catfish, and three flannelmouth suckers were captured in trammel nets throughout the trip.

Hoop net captures consisted of few individuals of channel catfish, carp, flannelmouth sucker, red shiner, and speckled dace (Table 6). Channel catfish was the least common species captured in hoop nets (Figure 1) with a total of three individuals captured between RM 258 and RM 268. Carp was the second least frequent species captured in hoop nets with a total of four individuals captured between RM 245 and RM 278. Flannelmouth suckers were captured in the farthest downstream sampling reaches (between RM 269 and RM 280) with four individuals captured. A total of five red shiner were captured in the upper two reaches between RM 238 and RM 248. Speckled dace was the most common species captured in hoop nets with six individuals captured throughout the sampling area.

Fish captured with seines included bluehead sucker, channel catfish, common carp, fathead minnow, mosquitofish, red shiner, and speckled dace (Table 7). Fathead minnow, flannelmouth sucker, and speckled dace were captured in backwaters. Mosquitofish had the highest catch rate after eighty individuals were caught in a single seine haul at RM 263.5; no mosquitofish were caught in other gears. Speckled dace had the second highest catch rate of species captured, followed by flannelmouth sucker, fathead minnow, and red shiner (Figure 1). Only one channel catfish, one carp, and three bluehead suckers were captured in seines throughout the trip.

Marked and Recaptured Fishes

A total of 11 flannelmouth suckers between 132 and 337 mm TL were tagged with PIT tags, and a total of 11 carp between 175 and 545 mm TL were tagged with Floy tags (Table 8). One flannelmouth sucker was recaptured with a 132-megahertz tag on 9/11/2003 during an electrofishing survey; however, no river mile was recorded in the database for the tag. Additionally, this fish was previously tagged with a 400-megahertz tag (Tag ID 51160E273A), although no other records exist with information on the original tag date and location.

Water Quality

River temperature ranged between 17 and 18ºC, conductivity ranged between 800 and 840 mS/cm, and salinity measurements were between 2000 and 2250 PPS (Table 9). Turbidity was initially measured at approximately 13,000 NTUs on 10/5/04 and steadily decreased throughout the trip to just less than 2,000 NTUs on 10/11/04 (Figure 3).

4.0 DISCUSSION

Electrofishing

High turbidity during the entire trip likely impacted electrofishing catch rates. Previous surveys have yielded greatly reduced catch rates of all species of fish upriver of Diamond Creek while sampling in water with turbidity at or above 700 NTUs. Turbidity measurements of less than 1,800 NTUs were not recorded during the trip (Figure 3), and most likely resulted in low catchability for all species. To produce valuable indices for long-term population trend monitoring it is critical that catchability remains fairly constant. While these data are useful for presence and absence of species within reaches, it is likely that the catch rate or density index data for the trip are artificially low due to high turbidity and decreased catchability.

Angling

The use of angling as a method of monitoring catfish populations could be beneficial but future experimentation and analyses are necessary. Angling efforts produced the greatest number of channel catfish of any gear type with a total of 59 individuals captured over a total of approximately 25.3 hours of sampling. No species other than channel catfish were captured during angling efforts. It is unknown whether or not turbidity has an impact on angling catch rates of channel catfish. This issue may be better evaluated following 2005 sampling if turbidity levels are considerably lower.

Netting

Similar to electrofishing, high turbidity levels likely impacted netting catch rates, particularly hoop net catches. Turbidity has been shown to decrease hoop net catch rates in the Little Colorado River (USFWS humpback chub monitoring data), and it is assumed that a similar effect is observed in the Colorado River. Furthermore, hoop nets have been shown to be one of the most effective gear types for capturing native species in the Colorado River within Grand Canyon (Johnstone *et al*. 2003, Johnstone and Lauretta 2004). Hoop netting efforts produced relatively few fish (22 total captures); however, it is possible that turbid conditions impacted the effectiveness of the gear to capture native fish species.

It is unknown whether or not high turbidity impacts trammel net and seining catch rates, although the number of channel catfish captured in trammel nets was greatest during the first night of sampling when turbidity levels were highest. This may also be due to higher catfish abundance in that reach. Only three flannelmouth suckers were captured in trammel nets during the trip, and little may be inferred about the impact of turbidity on catch rates of this species. Catch rate statistics from this sampling trip may not accurately represent the relative abundance of fish or the ability to detect changes in populations based on catch rate trends. A comparison may be made following the 2005 sampling effort to address the potential impact of turbidity on trammel and hoop netting catch rates of various species.

Hoop and trammel netting was logistically difficult in the lower reaches because of high cutbanks, shallow sloping river margins, rapid water velocities, and debris and sand banks calving into the river. These factors may have an effect on the catch rates of these gear types in the lower reaches.

Seining occurred along sandy shorelines, with the exception of one backwater sample. Seining efforts produced mostly young-of-the-year native fish, including bluehead sucker, flannelmouth sucker, and speckled dace. Small-bodied nonnative species were present in lower numbers, including fathead minnow, red shiner, and mosquitofish. Native species were captured more frequently in the lower reaches. This increase was likely a result of the greater availability of low velocity, nearshore habitats.

Electrofishing and netting combined captured a wide range of size classes of channel catfish, carp, and flannelmouth sucker (Figure 2), although too few of each species were captured to observe age cohorts. Only two flannelmouth suckers greater than 300 mm TL were captured, and these fish represent the only adult native fish captured during sampling.

The data obtained during this years sampling effort may not accurately represent fish relative abundance, distribution, and population age structure due to low captures and turbidity impact on catch rates. Therefore, the data may not be useful for evaluating the effectiveness of gear types to capture native and nonnative species, or to build a baseline of information for measuring the effects of implementing the TCD to fish populations. Furthermore, backpack shocking in tributaries was not conducted; therefore, the importance of downstream tributaries as native fish refugia was not addressed by this trip. These objectives may be addressed following completion of the 2005 sampling effort provided more suitable sampling conditions exist.

5.0 RECOMMENDATIONS

Logistics: Despite this trip being relatively short in distance and duration, three snout boats are needed to haul the required equipment and personnel. One 33-foot S rig and one snout boat would also be adequate. An 8-day trip is required to sample all reaches and habitats adequately.

Personnel: A crew of twelve people was able to effectively sample and run a camp. A crew of fewer than twelve people would likely result in less efficient sampling.

Sampling Methods: Electrofishing, hoop netting, and trammel netting efforts should continue to be conducted to develop long-term monitoring information. Seining efforts should be more evenly distributed among the reaches, as habitat availability permits, so that results are more comparable. Sampling in tributaries should be conducted, especially in the spring to determine the seasonal use by native fishes.

Timing of Survey: A spring (May/June) effort would provide additional data during the native fish reproductive season. Movement of lentic species has historically been observed in the spring; therefore, sampling in spring may provide a better characterization of nonnative fish abundance and distribution in the Lower Colorado River Gorge.

Monitoring Program Objectives: The program objectives should be readdressed following the 2005 sampling effort to compare catch rates under less turbid conditions, including evaluation of sampling methodologies, establishment of a species abundance and distribution database, evaluating the importance of tributaries for native fish refugia, and building a baseline of information to measure impacts of the TCD.

6.0 REFERENCES

Johnstone, H.C., and M.V. Lauretta. 2004. Native Fish Monitoring Activities in the Colorado River within Grand Canyon during 2003. Annual Report to Grand Canyon Monitoring and Research Center. SWCA Environmental Consultants, Flagstaff, Arizona.

Johnstone, H.C., M.V. Lauretta, and M.A. Trammel. 2002. Native Fish Monitoring Activities in the Colorado River within Grand Canyon during 2002. Annual Report to Grand Canyon Monitoring and Research Center. SWCA Environmental Consultants, Flagstaff, Arizona.

Ward, D.M. 2002. Standardized Methods for Handling Fish in Grand Canyon Research. Draft Report to Grand Canyon Monitoring and Research Center and Cooperators, Flagstaff, Arizona. Arizona Game and Fish Department, Phoenix.

TABLES

Table 1. Personnel for the 2004 Diamond Down Monitoring Trip

Crew Member	Sampling Duties	Agency
Scott Rogers	Electrofishing biologist	Arizona Game and Fish Department/Research
Joey Slaughter	Electrofishing biologist	Arizona Game and Fish Department/Research
Steve Jones	Electrofishing boat operator	Humphrey Summit
Dennis Harris	Electrofishing boat operator	Humphrey Summit
Barbara Ralston	Biologist	Grand Canyon Monitoring and Research Center
William Leibfried	Netting biologist	SWCA Environmental Consultants
Kara Hilwig	Netting biologist	SWCA Environmental Consultants
Randy Van Haverbeke	Netting biologist	U.S. Fish and Wildlife Service
Emily Dale	Netting boat operator	Humphrey Summit
Lynn Roder	Netting boat operator	Humphrey Summit
Scott Crozier	Netting assistant	Hualapai Department of Natural Resources
Duane Parker	Netting assistant	Hualapai Department of Natural Resources

Table 2. Sampling Schedule for the 2004 Diamond Down Monitoring Trip

Date	Logistic Reach	Start RM	End RM	Reach Length	Camp Mile	Sampling Separation Mile	Netting Reach	Electrofishing Reach
10/05/2004	1	225.8	235.0	9.2	229.1	229.0	below	above
10/06/2004	2	235.1	246.0	10.9	239.6	240.2	above	below
10/07/2004	3	246.1	259.0	12.9	246.4	249.1	above	below
10/08/2004	3	246.1	259.0	12.9	260.2	255.8	below	above
10/09/2004	4	259.1	265.0	5.9	260.2	262.8	above	below
10/10/2004	5	265.1	274.0	8.9	268.5	268.2	below	above
10/11/2004	6	274.1	280.0	5.9	277.0	277.5	above	below
10/12/2004	Takeout at South Cove							

Table 3. Summary of Electrofishing Samples, Start Mile, Effort, and Fish Captured by Each Boat

Date	Boat	# Runs	Start RM	Total Effort (sec.)	Mean Effort (sec.)	CCF	CRP	FMS	RBT	RSH	SPD
10/05/2004	A	12	231.1	4,260	355	0	0	0	0	0	0
10/05/2004	B	7	230.3	2,108	301	0	0	1	0	0	0
10/06/2004	A	21	241.1	8,558	408	0	3	0	0	11	0
10/06/2004	B	23	242.9	7,067	307	0	0	1	0	0	0
10/07/2004	A	23	262.2	9,130	397	0	1	0	0	7	0
10/07/2004	B	26	252.85	7,940	305	0	2	0	0	1	0
10/08/2004	A	24	264.3	8,827	368	0	0	2	1	14	2
10/08/2004	B	16	264.3	4,867	304	0	0	0	0	0	0
10/09/2004	A	26	258.1	8,789	338	0	2	7	0	7	0
10/09/2004	B	15	258.0	4,659	311	1	3	1	0	0	0
10/10/2004	A	26	267.2	8,345	321	0	2	7	0	13	0
10/10/2004	B	14	266.8	4,214	301	0	1	2	0	0	0
10/11/2004	A	24	274.5	7,840	327	0	2	0	0	9	1
10/11/2004	B	16	274.5	4,917	307	0	0	1	0	3	1
Total		**273**		**91,521**		**1**	**16**	**22**	**1**	**65**	**4**

CCF Channel Catfish
CRP Common Carp
FMS Flannelmouth Sucker
RBT Rainbow Trout
RSH Red Shiner
SPD Speckled Dace

Table 4. Summary of Angling Samples, River Mile, Effort, and Capture of Channel Catfish

Date	# Samples	Total Effort (min.)	Mean Effort (min.)	CCF
10/8/2004	24	480	20	15
10/9/2004	28	560	20	24
10/10/2004	12	240	20	17
10/11/2004	12	240	20	3
Total	**76**	**1,520**		**59**

CCF Channel Catfish

Table 5. Summary of Trammel Net Samples, Miles Sampled, Effort, and Species Captured by Each Boat

Date	Boat	# Samples	RM Sampled	Total Effort (hrs.)	Mean Effort (hrs.)	CCF	CRP	FMS
10/06/2004	A	5	238.1–239.4	35.4	7.09	7	0	0
10/06/2004	B	5	238.0–239.3	35.4	7.07	0	2	0
10/07/2004	A	5	244.8–248.5	26.6	5.32	0	6	1
10/07/2004	B	7	245.6–247.7	29.8	4.25	3	0	1
10/08/2004	A	5	258.0–258.8	29.7	5.93	1	1	0
10/08/2004	B	6	259.0–260.8	30.1	5.02	0	1	0
10/09/2004	A	5	259.5–260.7	28.4	5.68	0	1	0
10/09/2004	B	5	260.5–262.0	28.3	5.66	0	0	0
10/10/2004	A	5	269.0–273.0	23.1	4.62	0	0	0
10/10/2004	B	5	267.0–269.0	25.7	5.15	0	0	0
10/11/2004	A	5	277.0–279.5	20.2	4.05	0	0	0
10/11/2004	B	5	277.7–281.3	19.1	3.82	1	1	1
Total		**63**		**331.8**		**12**	**12**	**3**

CCF Channel Catfish
CRP Common Carp
FMS Flannelmouth Sucker

Table 6. Summary of Hoop Net Samples, Miles Sampled, Effort, and Species Captured by Each Boat

Date	Boat	# Samples	RM Sampled	Total Effort (hrs.)	Mean Effort (hrs.)	CCF	CRP	FMS	RSH	SPD
10/06/2004	A	15	238.1–239.8	280.7	18.7	0	0	0	0	0
10/06/2004	B	15	238.7–239.4	261.9	17.5	0	0	0	2	0
10/07/2004	A	15	245.9–248.4	280.7	18.7	0	1	0	3	1
10/07/2004	B	15	245.8–246.3	274.1	18.3	0	0	0	0	0
10/08/2004	A	15	258.0–259.0	297.7	19.8	1	0	0	0	0
10/08/2004	B	15	257.4–260.1	278.3	18.6	0	0	0	0	1
10/09/2004	A	15	258.3–259.1	329.2	21.9	0	2	0	0	1
10/09/2004	B	15	260.2–260.9	280.7	18.7	1	0	0	0	0
10/10/2004	A	15	269.2–273.6	278.6	18.6	0	0	1	0	0
10/10/2004	B	15	267.0–268.5	264.5	17.6	1	0	0	0	0
10/11/2004	A	15	274.5–278.1	262.0	17.5	0	1	0	0	3
10/11/2004	B	15	277.9–280.4	265.4	17.7	0	0	3	0	0
Total		**180**		**3,353.8**		**3**	**4**	**4**	**5**	**6**

CCF Channel Catfish
CRP Common Carp
FMS Flannelmouth Sucker
RSH Red Shiner
SPD Speckled Dace

Table 7. Summary of Seining Samples, Effort, and Species Captured

Habitat Type	# Samples	Total Effort (m^2)	Mean Effort (m^2)	BHS	CCF	CRP	FHM	FMS	MOS	RSH	SPD
Backwater	7	333.2	47.6	0	0	0	1	6	0	0	18
Shoreline	21	1,088.5	51.8	3	1	1	14	47	80	17	90
Total	**28**	**1,421.7**		**3**	**1**	**1**	**15**	**53**	**80**	**17**	**108**

CCF Channel Catfish
CRP Common Carp
FHM Fathead Minnow
FMS Flannelmouth Sucker
MOS Mosquitofish
RSH Red Shiner
SPD Speckled Dace

Table 8. Summary of Fish Tagged or Recaptured during the 2004 Diamond Down Monitoring Trip

Date	River Mile	Species	TL (mm)	Recap	Tag Type	Tag ID
10/06/2004	239.3	CRP	355	N	Floy	USGS 07305
10/07/2004	246.2	FMS	500	Y	PIT	3D9.1BF198F49C
10/07/2004	247.5	CRP	425	N	Floy	USGS 07730
10/07/2004	247.5	CRP	501	N	Floy	USGS 07731
10/07/2004	247.5	CRP	545	N	Floy	USGS 07732
10/07/2004	247.5	CRP	252	N	Floy	USGS 07733
10/07/2004	247.5	CRP	262	N	Floy	USGS 07734
10/07/2004	247.5	FMS	337	N	PIT	3D9.1BF1CD843A
10/08/2004	258.3	CRP	444	N	Floy	USGS 07747
10/08/2004	260.3	CRP	493	N	Floy	USGS 07308
10/09/2004	260.3	CRP	465	N	Floy	USGS 07746
10/09/2004	259.4	FMS	150	N	PIT	3D9.1BF1CD62AF
10/09/2004	259.4	FMS	152	N	PIT	3D9.1BF1D88A0F
10/10/2004	261.7	FMS	145	N	PIT	3D9.1BF1D87DA9
10/11/2004	277.7	CRP	545	N	Floy	USGS 07308
10/11/2004	281.0	FMS	248	N	PIT	3D9.1BF1D86791
10/11/2004	273.0	FMS	132	N	PIT	3D9.1BF1CD67FD
10/11/2004	273.0	FMS	143	N	PIT	3D9.1BF1E92F1A
10/11/2004	273.0	FMS	168	N	PIT	3D9.1BF1A0391F
10/11/2004	273.0	FMS	137	N	PIT	3D9.1BF1D8B5B7
10/12/2004	274.5	CRP	175	N	Floy	USGS 07745
10/12/2004	277.9	FMS	167	N	PIT	3D9.1BF1CD37BA
10/12/2004	278.3	FMS	284	N	PIT	3D9.1BF1CD49F9

CCF Channel Catfish
FMS Flannelmouth Sucker

Table 9. Water Quality Measurements Taken during the 2004 Diamond Down Monitoring Trip

River Mile	Date	Time	Temp (C)	Sp.Cond (mS/cm)	Salinity (PSS)
231.0	10/06/2004	9:55	17.1	817	2102
231.0	10/06/2004	10:23	17.1	804	2030
238.0	10/06/2004	16:32	17.4	811	2064
238.0	10/07/2004	8:47	17.5	838	2219
246.0	10/07/2004	19:55	17.5	838	2222
246.0	10/08/2004	8:44	17.4	837	2215
260.0	10/09/2004	13:41	18.2	835	2202
260.0	10/10/2004	8:34	17.4	831	2180
269.0	10/10/2004	18:33	18.0	841	2240
269.0	10/11/2004	7:29	17.0	837	2214

FIGURES

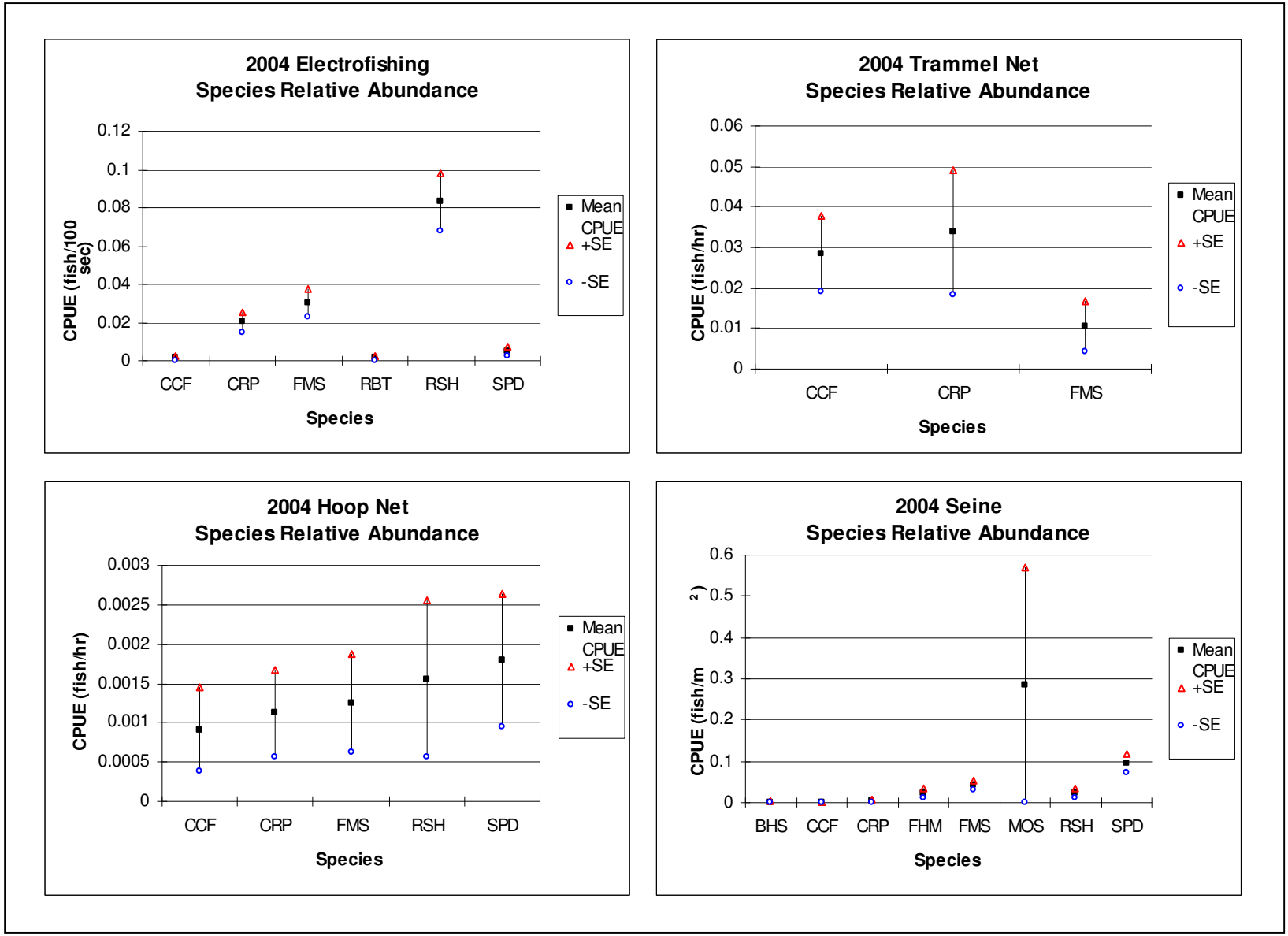

Figure 1. Relative abundance of species captured by each gear type.

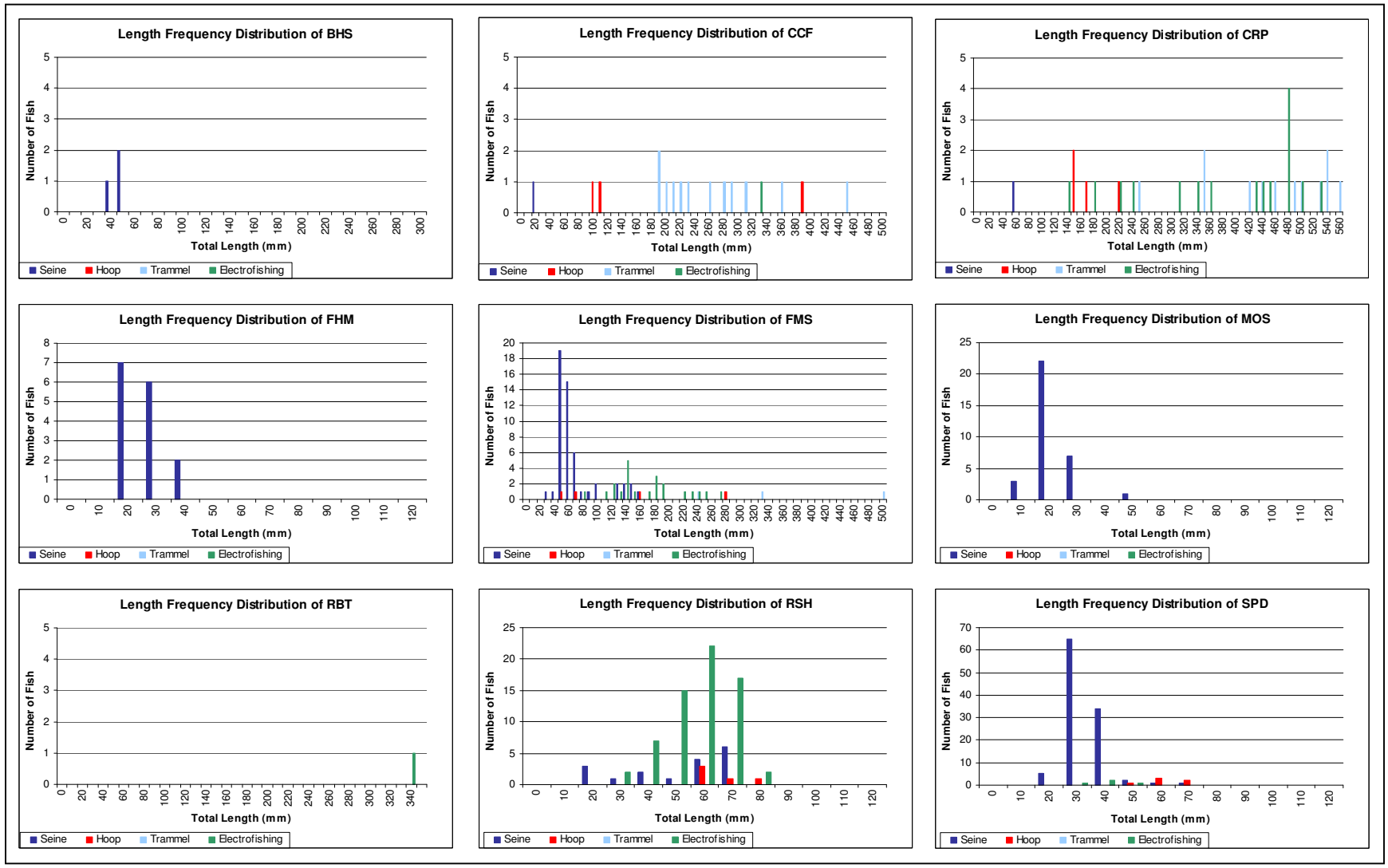

Figure 2. Length frequency distributions of all species captured by each gear type.

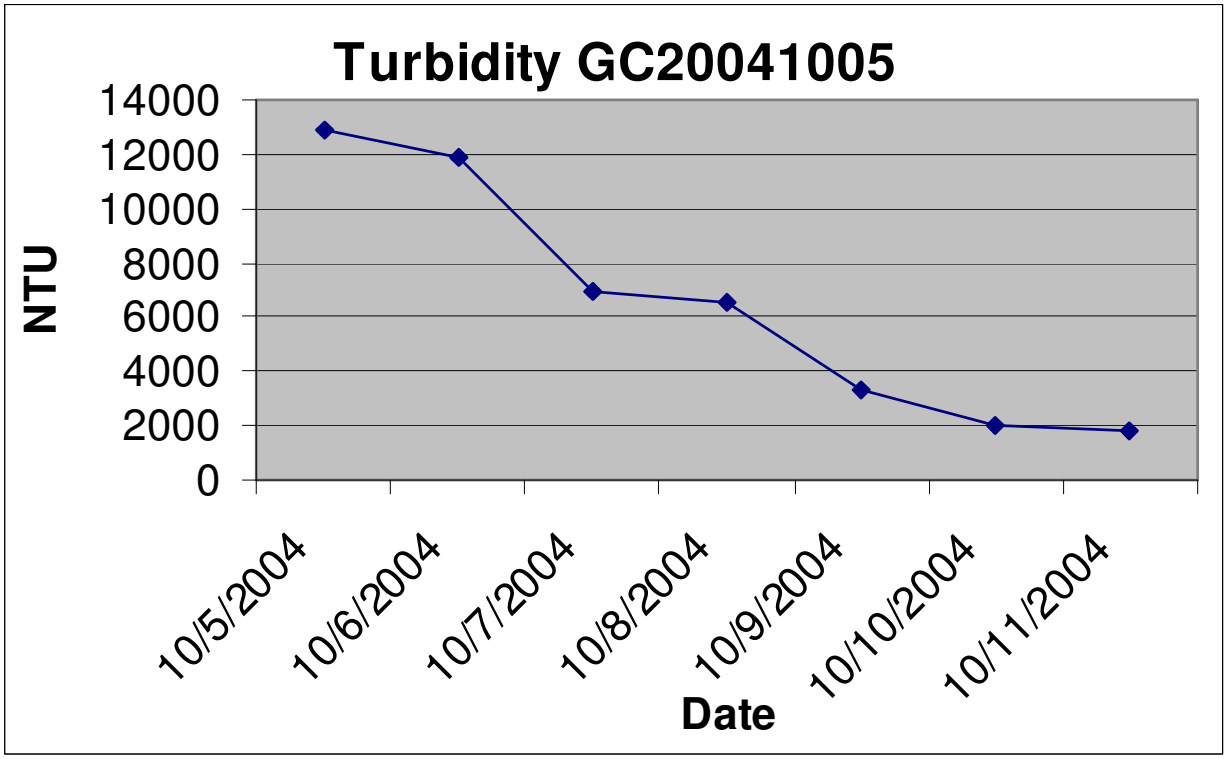

Figure 3. Nightly turbidity measurements taken during the 2004 Diamond Down Monitoring trip.