State of California
The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE

Lake Davis Pike Eradication
2013-2015 Post-Project Monitoring

Amber Mouser
Environmental Scientist

September 17, 2015

TABLE OF CONTENTS

ACRONYMS

North Lake Davis

MS	Mosquito Slough (1)*
MSS	South Mosquito (1)
MSSS	South of South Mosquito (1)
FC	Freeman Cove area (2)

West Lake Davis

CC	Cow Cove area (2)
HH	Honey Hole Cove area (2)
FG	Fugarui Cove area (2)
WP	Willow Point area (3)
JC	Jenkins Cove area (3)
NC5	North Camp Five area (3)
SC5	South Camp Five area (4)
DB	Dan Blough Cove area (4)
EP	Eagle Point (4)
OC	Osprey Cove area (4)

East Lake Davis

FV	Fairview area (1)
BC	Bluff Cove area (1)
LT	Lightning Tree Cove area (1)
FTP	Five Tree Point area (6)
JP	Juniper Point area (6)
MC	Mallard Cove area (6)
CB	Coot Bay area (5)
HC	Honker Cove area (5)
GH	Grasshopper Cove area (5)

South Lake Davis

DM	Dam area (5)
CF	Catfish Cove area (5)

Islands

NI	North Island
SI	South Island

Lake Davis Tributaries

GCKL	Lower Big Grizzly Creek; below dam
GCKU	Upper Big Grizzly Creek; above dam
FCK	Freeman Creek
CCK	Cow Creek
OCK	Oldhouse Creek
DBCK	Dan Blough Creek

Methods of Capture

EB	Boat electrofisher
EP	Backpack electrofisher

Fish Species

BB	Brown bullhead *Ameiurus nebulosus*
GSH	Golden shiner *Notemigonus crysoleucas*
LMB	Largemouth bass *Micropterus salmoides*
PSD	Pumpkinseed *Lepomis gibbosus*
RT	Rainbow trout *Oncorhynchus mykiss*

* Numbers in parentheses denote study areas used in previous Lake Davis work, and are provided here to enable cross-reference.

I. INTRODUCTION

Northern pike, *Esox lucius*, are a non-native, invasive, predatory fish species illegally introduced to California. They have the potential to seriously impact California's aquatic ecosystems. Northern pike were first discovered in California at Frenchman Reservoir, Plumas County, in 1989. Due to the potential harmful impacts to statewide water management, aquatic ecosystems, and recreational fisheries both in Frenchman Reservoir and throughout the waters of the state, California Department of Fish and Game (DFG) determined it was necessary to eradicate northern pike from Frenchman Reservoir. After the required legal and environmental review, in June 1991 DFG successfully eradicated northern pike from Frenchman Reservoir using a commercial formulation of the piscicide rotenone (DFG 2007).

Northern pike were discovered in Lake Davis, Plumas County, in 1994. Lake Davis is approximately 26 kilometers (km) west of Frenchman Reservoir. Similar to Frenchman Reservoir, Lake Davis is a dammed reservoir located 8 km above the Middle Fork Feather River. Grizzly Valley Dam precludes fish passage from the Middle Fork Feather River into Lake Davis therefore northern pike were presumably introduced illegally. In October 1997, after completion of the California Environmental Quality Act (CEQA) process, much public debate, and several court challenges, DFG applied the commercial piscicides Nusyn-noxfish® and powdered rotenone to Lake Davis and its tributaries to eliminate northern pike.

In May 1999, a northern pike was caught in Lake Davis by an angler. Subsequent sampling confirmed the presence of northern pike in Lake Davis (DFG 2007). The origin of these northern pike is unknown. Genetic studies indicate that northern pike collected in 1999 were genetically indistinguishable from fish collected prior to the 1997 treatment (Aguilar et. al. 2005). It is unknown whether these fish 1) survived the 1997 treatment, 2) were removed from Lake Davis prior to the treatment and then later reintroduced, or 3) were a second introduction of pike from the original, unidentified source.

In September 2007, again after considerable public involvement and the completion of the CEQA process, DFG conducted a second chemical treatment of all waters within the Lake Davis watershed upstream of Grizzly Valley Dam. This included the lake, its tributary streams, and associated standing water. Immediately following the treatment in 2007 DFG conducted extensive post-treatment monitoring of fish populations in Lake Davis and its tributaries to determine if the chemical treatment had successfully removed northern pike from the watershed. Monitoring of Lake Davis and its tributaries, the Middle Fork Feather River, and other waters of Plumas County occurred in 2008. In 2009, 2011, and 2012 monitoring included Lake Davis and its tributaries. In 2010, 2013, and 2015 monitoring was limited to the lake only.

This report summarizes the results of the 2013 and 2015 monitoring in Lake Davis and its tributaries. The results of the 2007 post-project monitoring of Lake Davis and its tributaries (Stephens and Paulsen 2007; Roberts 2008), 2008 monitoring of Lake Davis, its tributaries, and the Middle Fork Feather River (LaCoss and Rossi 2011a), 2008 monitoring of other waters of Plumas County (LaCoss and Rossi 2011b), 2009 monitoring of Lake Davis and its tributaries (LaCoss and Rossi 2011c) and Lake Davis Pike Eradication 2010-2012 Post-Project Monitoring (Rossi 2013) are summarized in previous reports.

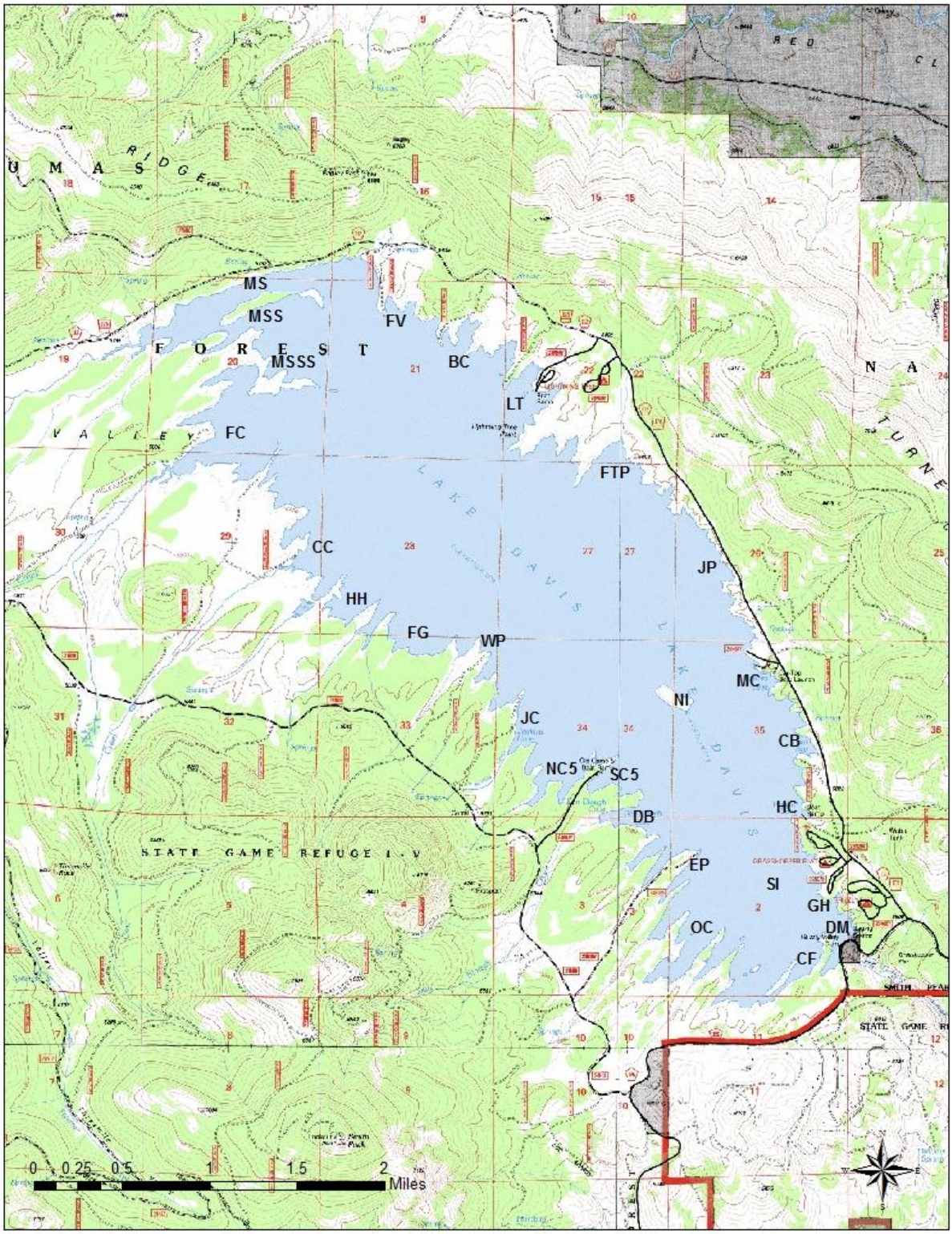
II. METHODS

Monitoring was conducted by sampling the lake for fish using methods appropriate for the respective habitat types, and that have been demonstrated to be effective at capturing northern pike (DFG 2000). Sampling methods included boat electrofishing. A minimum of 30 fish captured during each sampling event of each species were randomly sub-sampled and measured (total length (TL); millimeters (mm)) and weighed (grams (g)). Sampling events were defined as one monitoring period using a given area electrofished. If more than thirty fish per event were captured they were tallied by species. Capture rates for each method and species were calculated as catch per unit effort (CPUE), by dividing the number of fish captured by the hours sampled.

Boat Electrofisher

Smith-Root electrofishing boats (SR-18) were used during daylight hours between August and October to sample the shallow water and weedy areas, the preferred habitat of northern pike, around the perimeter of Lake Davis (Figure 1). Based on prior experience, electrofishing during daylight produced comparable capture rates to night sampling (DFG 2000). Boat output was generally set between 60%-80% DC Low at 120 volts producing between 6 to 8 amperes output.

Figure 1. Lake Davis sampling sites. Refer to list of acronyms for site names.



III. RESULTS

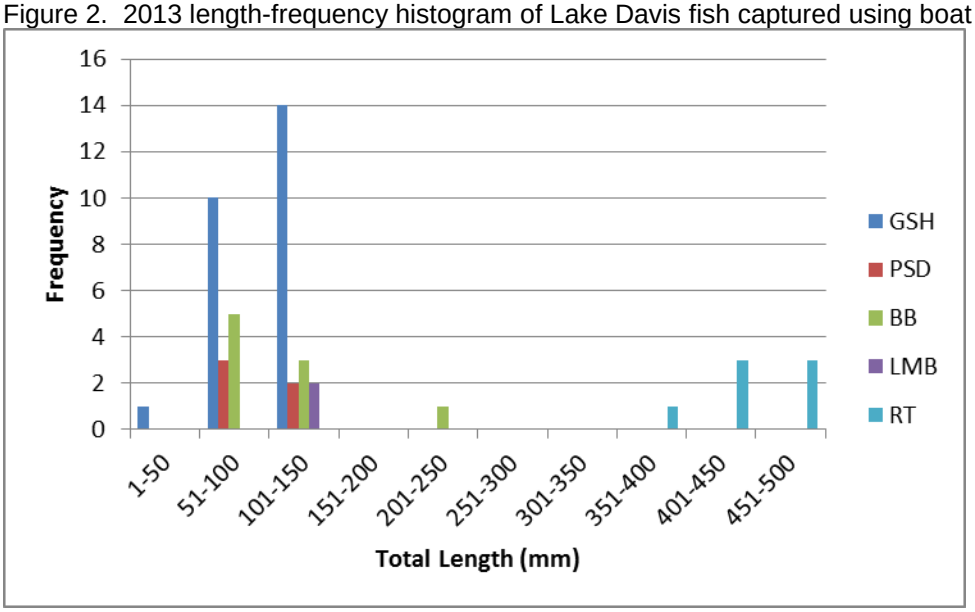
Lake Davis 2013

Lake Davis was sampled by boat electrofisher with a total of 1 sampling event (Appendix A). A total of 0.59 hours of electrofishing occurred during this event, resulting in the capture of a total of 48 fish, of which all were measured. Five species of fish were captured: pumpkinseed (*Lepomis gibbosus*; 70-126 mm; mean TL = 98 mm), rainbow trout (*Oncorhynchus mykiss*; 370-472 mm; mean TL = 436 mm), brown bullhead (*Ameiurus nebulosus*; 53-202 mm; mean TL = 96 mm), golden shiner (*Notemigonus crysoleucas*; 47-137 mm; mean TL = 98 mm); and largemouth bass (*Micropterus salmoides*; 112-127 mm; mean TL = 120 mm) (Table 1). Individual length and weight data for fish measured during electrofishing events is provided in Appendix B, and in a length frequency histogram in Figure 2.

Table 1. 2013 summary of fish captured in Lake Davis using boat electrofishing.

Species	Number Captured	Number Measured	Species Composition (%)	CPUE (fish per hour)
Pumpkinseed	5	5	10%	8
Rainbow trout	7	7	15%	12
Brown bullhead	9	9	19%	15
Golden shiner	25	25	52%	42
Largemouth bass	2	2	4%	3
Total	**48**	**48**	**100%**	**81**

Figure 2. 2013 length-frequency histogram of Lake Davis fish captured using boat electrofishing.



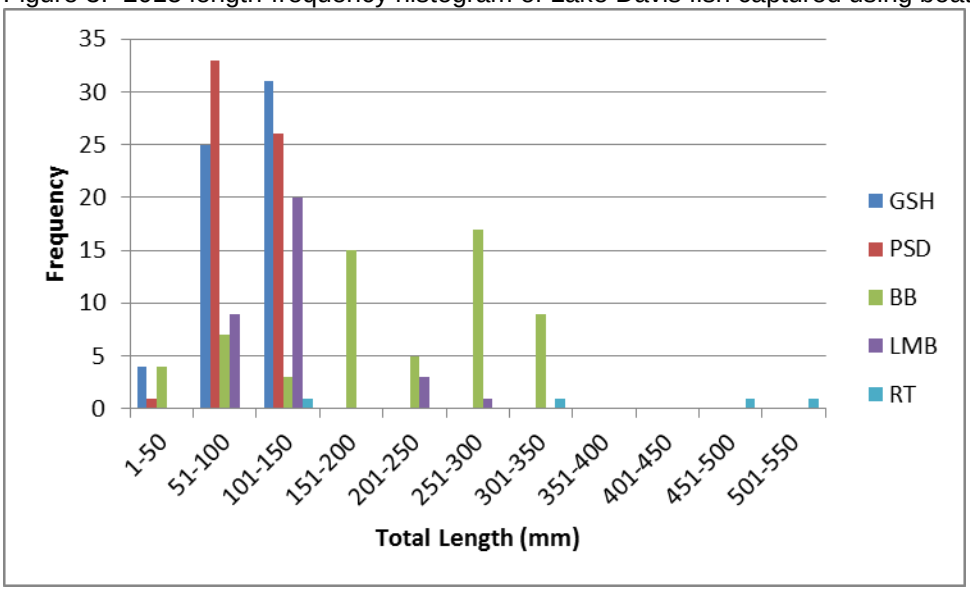
Lake Davis 2015

Lake Davis was sampled by boat electrofisher with a total of 2 sampling events (Appendix A). A total of 2.13 hours of electrofishing occurred during these events, resulting in the capture of a total of 454 fish, of which 217 were measured. Five species of fish were captured: pumpkinseed (40-142 mm; mean TL = 99 mm), rainbow trout (126-536 mm; mean TL = 367 mm), brown bullhead (45-336 mm; mean TL = 205 mm), golden shiner (35-130 mm; mean TL = 96 mm); and largemouth bass (56-265 mm; mean TL = 121 mm) (Table 2). Individual length and weight data for fish measured during electrofishing events is provided in Appendix B, and in a length frequency histogram in Figure 3.

Table 2. 2015 summary of fish captured in Lake Davis using boat electrofishing.

Species	Number Captured	Number Measured	Species Composition (%)	CPUE (fish per hour)
Pumpkinseed	210	60	46%	99
Rainbow trout	4	4	1%	2
Brown bullhead	97	60	21%	46
Golden shiner	109	60	24%	51
Largemouth bass	34	33	8%	16
Total	**454**	**217**	**100%**	**213**

Figure 3. 2015 length-frequency histogram of Lake Davis fish captured using boat electrofishing.



IV. DISCUSSION

Lake Davis boat electrofishing indicated a spike in the pumpkinseed and brown bullhead populations in 2010, followed by a decline in 2011(Figures 4 and 5). The population spikes may have been related to the lack of predators or competition. Following 2010, both the golden shiner and the largemouth bass populations appeared to take off (Figures 6 and 7). 2012 indicated an increase in pumpkinseed, brown bullhead, golden shiner and largemouth bass. 2013 showed a decline in pumpkinseed, brown bullhead, and golden shiner. However, this may

have been the result of poor sampling conditions or an inadequate sample size in 2013, rather than an actual population decline. 2015 indicated healthy quantities of all four species previously mentioned. These comparisons were made by using the annual CPUE (fish per hour of electrofishing) per species (Figures 4 through 7). The average length of catchable sized rainbow trout captured by boat electrofishing in the lake has also shown a gradual increase over the past six years (Figure 8). Only rainbow trout over 254mm (fish in a catchable size class) were used for comparison for consistency across the years. The average length increase may be the result of a decrease in the number of recently stocked catchable sized trout adding to the average (Figure 9) and an increased forage base. The annual average Fulton Condition Factor (K factor) ranged between 1.00 to 1.18 (Figure 10). Since the K factor formula specifies fork length, a rainbow trout conversion factor of 1.025 was used to convert total length measurements to fork length.

Given the nature of sampling, definitively proving the absence of anything, including northern pike, is impossible. Sampling, by definition, attempts to characterize an entire population based on only a fraction of that population. However, confidence in samples accurately representing a population, and in this case the absence of northern pike, can be increased by collecting large samples, optimizing sampling efficiency, and non-randomly sampling habitat where northern pike are most likely to be found. With 2.72 hours of electrofishing, 2013 and 2015 post-project sampling of Lake Davis did not result in the observation or capture of any northern pike.

Figure 4. Annual CPUE results for pumpkinseed captured during boat electrofishing 2008-2015.

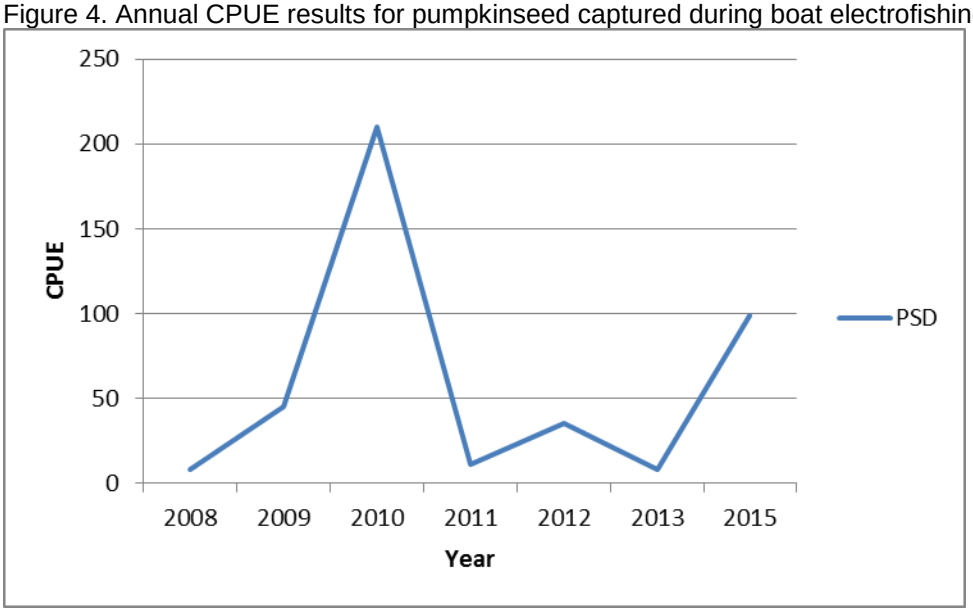


Figure 5. Annual CPUE results for brown bullhead captured during boat electrofishing 2008-2015.

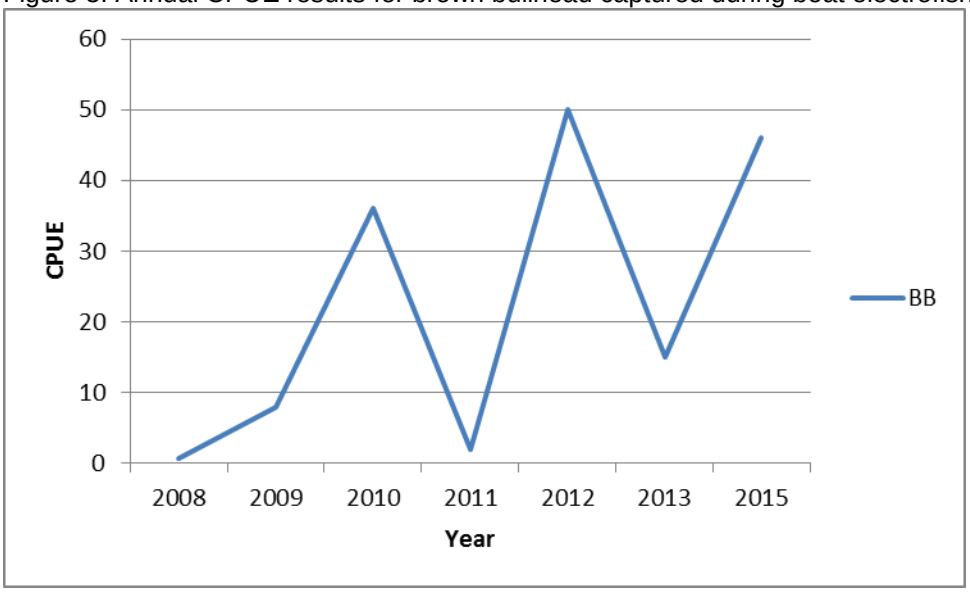


Figure 6. Annual CPUE results for golden shiner captured during boat electrofishing 2008-2015.

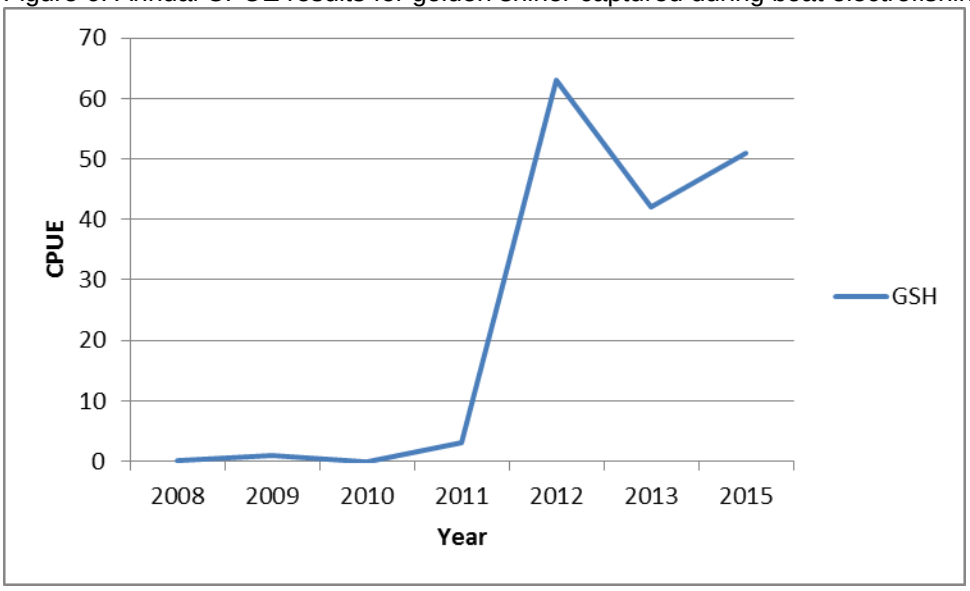


Figure 7. Annual CPUE results for largemouth bass captured during boat electrofishing 2008-2015.

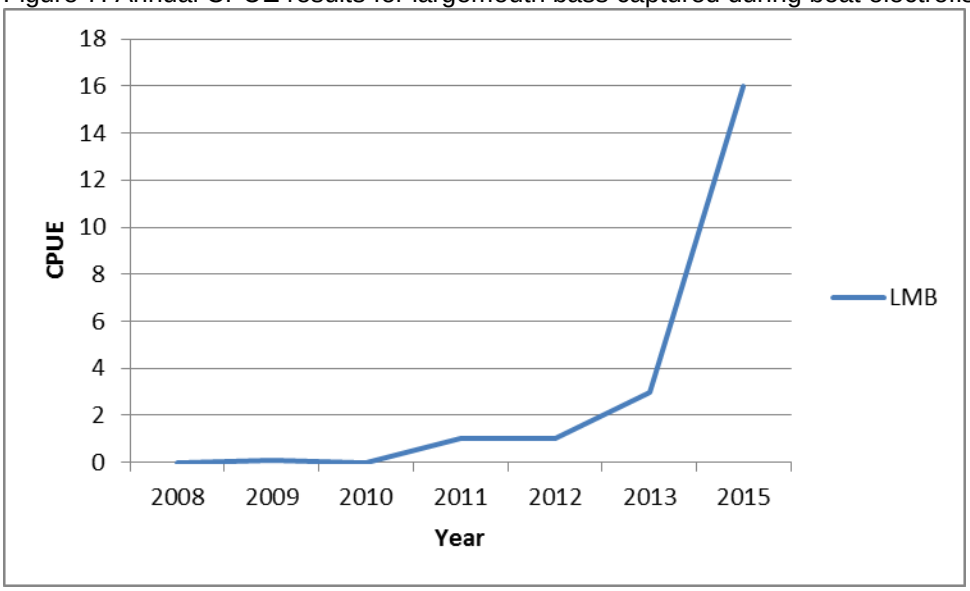


Figure 8. Annual average rainbow trout lengths. Figures based on catchable sized (greater than 254mm) fish captured during boat electrofishing.

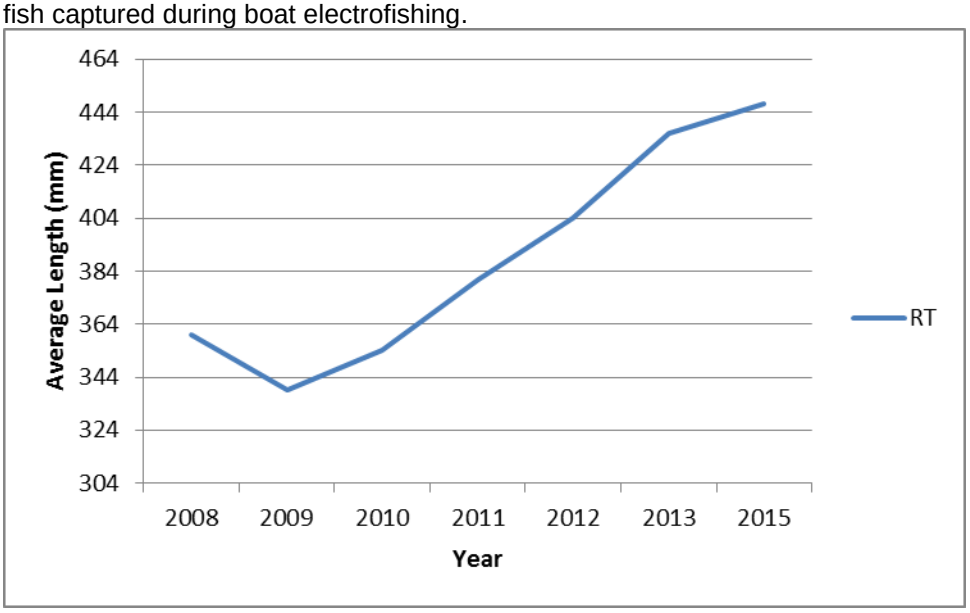


Figure 9. Post-treatment rainbow trout annual allotment.

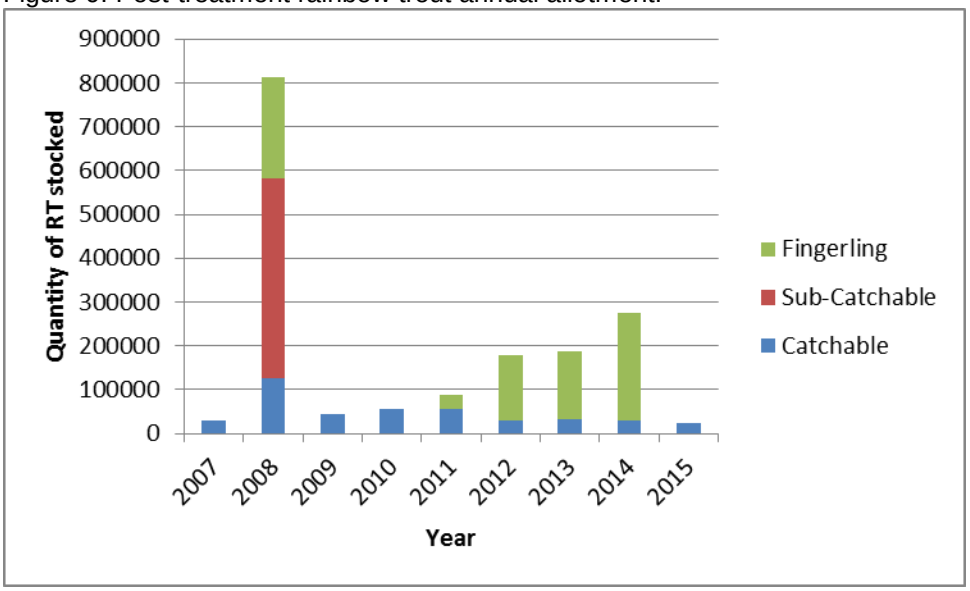
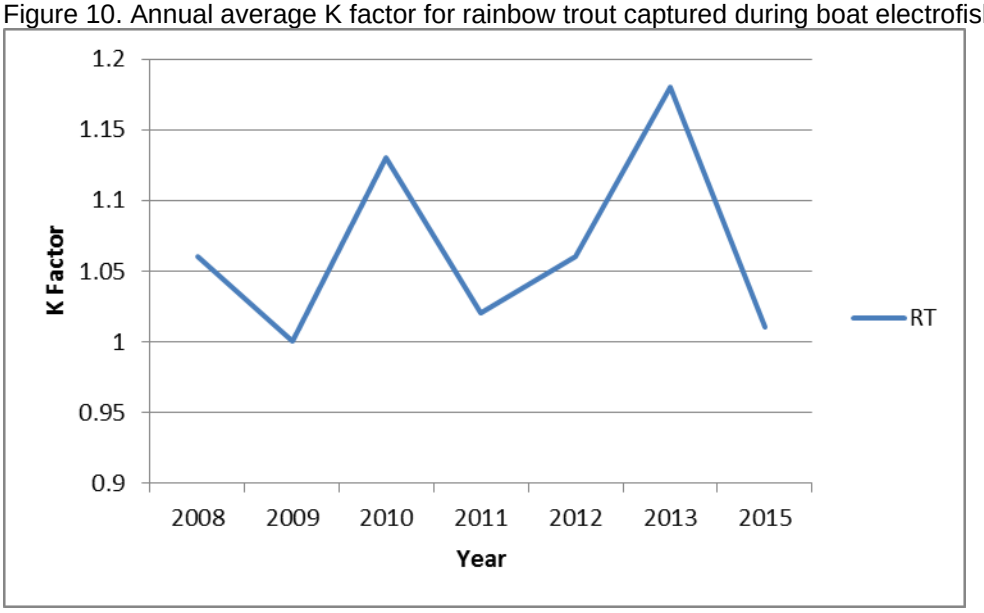


Figure 10. Annual average K factor for rainbow trout captured during boat electrofishing..



V. CONCLUSION

While no pike were observed or captured, this effort does not prove the absence of northern pike, but builds upon the monitoring results from 2007 through 2012 and supports the hypothesis that the 2007 eradication project was effective at eliminating northern pike from Lake Davis and its tributaries. If northern pike are present and sampling failed to capture any, their numbers are likely low, thus periodic sampling should continue. Sampling should also continue in the other waters of Plumas County to ensure that northern pike were not introduced elsewhere, resulting in the establishment of populations in other bodies of water.

VI. REFERENCES

Aguilar, A., J. D. Banks, K. F. Levine, and R. K. Wayne. 2005. Population genetics of northern pike (*Esox lucius*) introduced into Lake Davis, California. Canadian Journal of Fisheries and Aquatic Sciences, 62(7). pp 1589-1599.

Department of Fish and Game (DFG). 2000. Managing northern pike at Lake Davis: A plan for Y2000. California Department of Fish and Game, Rancho Cordova, CA. 20pp.

Department of Fish and Game (DFG). 2007. Final fisheries management plan for Lake Davis, Plumas County, California. California Department of Fish and Game, Rancho Cordova, CA. 15pp.

LaCoss, J. and A. Rossi. 2011a. Lake Davis pike eradication: 2008 post-project monitoring. California Department of Fish and Game, Rancho Cordova, CA. 16pp.

LaCoss, J. and A. Rossi. 2011b. Lake Davis pike eradication: 2008 post-project monitoring of other waters of Plumas County. California Department of Fish and Game, Rancho Cordova, CA. 19pp.

LaCoss, J. and A. Rossi. 2011c. Lake Davis pike eradication: 2009 post-project monitoring. California Department of Fish and Game, Rancho Cordova, CA.

Moyle, P. B. 2002. *Inland fishes of California: revised and expanded*. University of California Press, Berkeley.

Roberts, J. 2008. 2007 stream monitoring. Memo to file. California Department of Fish and Game, Rancho Cordova, CA. 2pp.

Rossi, A. 2013. Lake Davis pike eradication: 2010-2012 post-project monitoring. California Department of Fish and Game, Rancho Cordova, CA.

Stephens, S., and I. Paulsen. 2007. *Draft* Lake Davis pike eradication project treatment and post-treatment effectiveness monitoring of Lake Davis and tributary streams. California Department of Fish and Game, Rancho Cordova, CA. 12pp.

APPENDICES

Appendix A. Capture Summaries

2013 Lake Davis Boat Electrofishing

Event	Method	Water	Location	Date	Seconds	Hours Fished	No. of RT	No. of BB	No. of PSD	No. of GSH	No. of LMB
1011131	EB	Davis	DM, EP, MS	10/11/13	2116	0.59	7	9	5	25	2

2015 Lake Davis Boat Electrofishing

Event	Method	Water	Location	Date	Seconds	Hours Fished	No. of RT	No. of BB	No. of PSD	No. of GSH	No. of LMB
0826151	EB	Davis	MS => HC	08/26/2015	4313	1.20	0	57	46	34	18
0911151	EB	Davis	DM => EP	7/24/2012	3026	0.94	4	40	164	75	16

Appendix B. Length and Weight Data

Lake Davis 2013

Event	Species	Length	Weight
1011131	GSH	47	0
1011131	GSH	62	2
1011131	GSH	62	6
1011131	GSH	62	6
1011131	GSH	68	2
1011131	GSH	86	6
1011131	GSH	96	7
1011131	GSH	97	8
1011131	GSH	100	10
1011131	GSH	100	10
1011131	GSH	100	9
1011131	GSH	103	9
1011131	GSH	103	10
1011131	GSH	106	12
1011131	GSH	107	10
1011131	GSH	107	11
1011131	GSH	108	11
1011131	GSH	111	12
1011131	GSH	111	11
1011131	GSH	112	20
1011131	GSH	112	14
1011131	GSH	112	13
1011131	GSH	116	13
1011131	GSH	126	20
1011131	GSH	137	26
1011131	PSD	70	5
1011131	PSD	90	13
1011131	PSD	96	16
1011131	PSD	106	21
1011131	PSD	126	36
1011131	BB	53	2
1011131	BB	56	2
1011131	BB	60	3
1011131	BB	60	3
1011131	BB	62	3
1011131	BB	116	20
1011131	BB	125	25
1011131	BB	131	29
1011131	BB	202	103
1011131	LMB	112	19
1011131	LMB	127	25

Event	Species	Length	Weight
1011131	RT	370	756
1011131	RT	418	806
1011131	RT	420	718
1011131	RT	437	827
1011131	RT	465	1177
1011131	RT	469	980
1011131	RT	472	1042

Lake Davis 2015

Event	Species	Length	Weight
0826151	BB	190	105
0826151	BB	244	205
0826151	BB	248	211
0826151	BB	250	225
0826151	BB	257	236
0826151	BB	257	245
0826151	BB	260	260
0826151	BB	264	295
0826151	BB	266	266
0826151	BB	269	294
0826151	BB	275	298
0826151	BB	276	375
0826151	BB	280	333
0826151	BB	281	336
0826151	BB	281	306
0826151	BB	284	333
0826151	BB	285	366
0826151	BB	290	374
0826151	BB	292	384
0826151	BB	296	402
0826151	BB	296	404
0826151	BB	302	432
0826151	BB	306	496
0826151	BB	311	502
0826151	BB	312	468
0826151	BB	319	509
0826151	BB	324	512
0826151	BB	326	524
0826151	BB	332	573
0826151	BB	336	622
0826151	GSH	49	1
0826151	GSH	56	2
0826151	GSH	84	5
0826151	GSH	90	10
0826151	GSH	90	8
0826151	GSH	93	8
0826151	GSH	94	10
0826151	GSH	94	6
0826151	GSH	95	9
0826151	GSH	96	6
0826151	GSH	98	11
0826151	GSH	98	12
0826151	GSH	100	9
0826151	GSH	101	10
0826151	GSH	101	10
0826151	GSH	102	11
0826151	GSH	102	7
0826151	GSH	103	11
0826151	GSH	104	13
0826151	GSH	104	13
0826151	GSH	104	11
0826151	GSH	105	14
0826151	GSH	105	12
0826151	GSH	106	12
0826151	GSH	106	7
0826151	GSH	109	12
0826151	GSH	110	13
0826151	GSH	112	10
0826151	GSH	116	15
0826151	LMB	56	4
0826151	LMB	72	5
0826151	LMB	73	3
0826151	LMB	91	11
0826151	LMB	96	10
0826151	LMB	97	11
0826151	LMB	102	13
0826151	LMB	104	16
0826151	LMB	105	15
0826151	LMB	106	16
0826151	LMB	108	13
0826151	LMB	110	16
0826151	LMB	112	17
0826151	LMB	112	18
0826151	LMB	114	19
0826151	LMB	115	21
0826151	LMB	117	21
0826151	PSD	72	7
0826151	PSD	73	9
0826151	PSD	77	8
0826151	PSD	77	10
0826151	PSD	78	11
0826151	PSD	78	7

Appendix B. Length and Weight Data

Event	Species	Length	Weight
0826151	PSD	81	10
0826151	PSD	81	11
0826151	PSD	82	10
0826151	PSD	82	8
0826151	PSD	87	15
0826151	PSD	87	9
0826151	PSD	90	10
0826151	PSD	92	15
0826151	PSD	96	10
0826151	PSD	97	15
0826151	PSD	103	22
0826151	PSD	114	31
0826151	PSD	115	30
0826151	PSD	120	32
0826151	PSD	120	35
0826151	PSD	124	37
0826151	PSD	125	43
0826151	PSD	125	32
0826151	PSD	126	44
0826151	PSD	126	41
0826151	PSD	127	38
0826151	PSD	133	37
0826151	PSD	136	56
0826151	PSD	142	61
0911151	BB	45	1
0911151	BB	47	1
0911151	BB	49	3
0911151	BB	50	4
0911151	BB	51	2
0911151	BB	51	2
0911151	BB	55	3
0911151	BB	55	2
0911151	BB	55	3
0911151	BB	55	4
0911151	BB	59	3
0911151	BB	117	18
0911151	BB	118	15
0911151	BB	130	28
0911151	BB	152	39
0911151	BB	155	46
0911151	BB	155	44
0911151	BB	158	52
0911151	BB	162	61
0911151	BB	166	59
0911151	BB	170	63
0911151	BB	175	58
0911151	BB	175	71
0911151	BB	180	75
0911151	BB	182	81
0911151	BB	185	80
0911151	BB	185	79
0911151	BB	188	85
0911151	BB	203	116
0911151	BB	235	156
0911151	GSH	35	2
0911151	GSH	44	1
0911151	GSH	45	1
0911151	GSH	59	4
0911151	GSH	68	3
0911151	GSH	69	4
0911151	GSH	72	4
0911151	GSH	78	4
0911151	GSH	92	9
0911151	GSH	95	8
0911151	GSH	95	8
0911151	GSH	95	9
0911151	GSH	95	8
0911151	GSH	100	10
0911151	GSH	100	8
0911151	GSH	105	10
0911151	GSH	105	12
0911151	GSH	109	12
0911151	GSH	110	15
0911151	GSH	110	9
0911151	GSH	111	15
0911151	GSH	112	14
0911151	GSH	112	12
0911151	GSH	115	14
0911151	GSH	115	15
0911151	GSH	116	16
0911151	GSH	117	17
0911151	GSH	125	20
0911151	GSH	128	20
0911151	GSH	130	21

Appendix B. Length and Weight Data

Event	Species	Length	Weight
0911151	LMB	65	2
0911151	LMB	81	7
0911151	LMB	97	13
0911151	LMB	110	20
0911151	LMB	115	18
0911151	LMB	117	23
0911151	LMB	119	21
0911151	LMB	119	24
0911151	LMB	125	23
0911151	LMB	125	24
0911151	LMB	129	30
0911151	LMB	130	29
0911151	LMB	226	166
0911151	LMB	240	203
0911151	LMB	245	195
0911151	LMB	265	275
0911151	PSD	40	0
0911151	PSD	75	7
0911151	PSD	76	9
0911151	PSD	79	9
0911151	PSD	79	9
0911151	PSD	80	9
0911151	PSD	80	5
0911151	PSD	80	8
0911151	PSD	86	11
0911151	PSD	87	12
0911151	PSD	90	12
0911151	PSD	90	13
0911151	PSD	90	13
0911151	PSD	90	15
0911151	PSD	91	14
0911151	PSD	92	15
0911151	PSD	92	14
0911151	PSD	94	15
0911151	PSD	101	21
0911151	PSD	105	23
0911151	PSD	105	22
0911151	PSD	106	24
0911151	PSD	108	23
0911151	PSD	114	29
0911151	PSD	118	34
0911151	PSD	119	35
0911151	PSD	120	33
0911151	PSD	120	33
0911151	PSD	126	43
0911151	PSD	129	42
0911151	RT	126	19
0911151	RT	350	421
0911151	RT	455	827
0911151	RT	536	1431