Cruise Report for the
Surface Waters Ambient Monitoring Program (SWAMP)
Bioaccumulation of Mercury in
Small Prey Fish in Lakes of California to
Assess Biomagnification Factors in Grebes

Sampling Dates: April 2013- September 2013

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1.0 Introduction

This report describes the second and final year sampling activities of a two year study focusing on small prey fish species in lakes of California. Because many fish-eating wildlife such as grebes, terns, cormorants, and mergansers eat fish smaller than those that were sampled previously by the Bioaccumulation Oversight Group (BOG) and since fish mercury concentrations are not always indicative of wildlife exposure to mercury, the current BOG surveys do not address whether wildlife beneficial uses may be impaired by mercury in these water bodies.

The plan is to sample birds and small prey fish over two consecutive field seasons in 2012 and 2013 in collaboration with the United States Geological Society (USGS). In 2012 USGS sampled grebes at 12 lakes immediately followed by CDFW/MPSL sampling the small prey fish. The plan for 2013 was the same as 2012. Collection took place during the breeding season when birds were particularly vulnerable to potential mercury-induced reproductive impairment. Using these data, we will relate mercury levels in breeding grebes to small prey fish and estimate a biomagnification factor for wildlife. The development of this relationship will address whether the biomagnification factor is an appropriate indicator of wildlife exposure to mercury. Also, we will address whether the biomagnification factor can be applied state-wide or do we need to incorporate the type of water body and/or geographic region. Specifically, we have three main objectives:

1) Sample grebes at 24 California lakes (over two years) to determine mercury levels in a species near the top of the food chain, and compare these data to known effects-thresholds for birds.
2) Simultaneously with grebe sampling, collect small fish (<100 mm) at these same 24 lakes to determine if mercury concentrations are above current wildlife diet objectives.
3) Use these data in Objectives 1 and 2 to calculate a bird biomagnification factor, evaluate the biomagnification factor's usefulness for estimating wildlife exposure, and assess whether the biomagnification factor differs by lake type or geographic region.

Additionally, one predator fish species at these same lakes will be collected for follow-up mercury analysis. These lakes have previously been sampled by BOG for predator fish species and mercury analysis during the 2007 and 2008 sampling seasons. Confirmation of tissue concentrations or trends can be assessed with this additional mercury data.

The State Water Quality Control Board (SWQCB) work was authorized via FY 12-13 in support of Work Order 12SWBG01.

1.0 Cruise Report

1.1 Objectives

Year Two's objectives was again to collect small (<100mm) prey fish samples within two weeks of USGS's grebe sampling in 12 California lakes. Up to five different prey species were collected in each lake to attempt to find a common or comparable species within the 12 lakes. Due to budget constraints, twenty individual fish from two prey species were analyzed for mercury at each lake. An additional, 10 predator fish were collected for individual mercury analysis at each lake. The fish tissue was analyzed as directed by BOG and SWQCB in Work Order No. 12SWBG01 (see Section 1.3 below). Sample sites were reached by boating and fish were collected by electro-shocking and by nets.

1.2 MPSL/CDFW Sampling personnel

Dylan Service	Crew Lead
Gary Ichikawa	Crew Lead
Jon Goetzl	Research Tech
Edward Parras	Research Tech

1.3 Authorization to collect samples

All sampling personnel are MPSL staff (through San Jose State University Foundation and the California Department of Fish and Wildlife) contracted through CDFW to conduct the sample collection activities listed herein. The funding and authorization to collect the samples described herein is contained in the State Water Resources Control Board (SWRCB) Work Order 12SWBG01, including the description of the number samples and species necessary to be collected at each lake.

1.4 Station reconnaissance and selection

USGS conducted the pre-sample collection reconnaissance activities by locating sufficient breeding grebes at each lake. Breeding grebe lakes were determined from local knowledge and desktop reconnaissance. BOG and SWQCB authorized all lakes for bird/fish collection and for mercury analyses as set forth in the Work Order 12SWBG01.

1.5 Summary of types of samples authorized to be collected

Up to five species of prey fish were collected to attempt to find a common prey species at all the lakes. For better biomagnification estimates, the prey fish collections were attempted within two

weeks of the grebe collections. Additionally, one predator fish species were collected for follow-up mercury analysis.
Physical parameters were collected for each individual prey fish, which included: weight, total length, fork length, standard length and presence of any abnormalities. Each fish was placed in an individually labeled zipper-closure bag and stored on dry ice for the duration of the trip. At the MPSL/CDFW lab, samples were stored in a freezer until they were processed for authorized analysis, per appropriate SOP's. Analysis authorization dictates tissue analysis (QA/QC requirements-preservatives, dissecting, cooling, etc.). For more detailed information reference section “E 1.” of the BOG Grebe Study QAPP.

1.6 Discussion

The absence of grebes, bad weather, equipment malfunctions and scheduling difficulties were problems encountered during fish sampling. Several reconnaissance trips were required prior to the sampling of the 12 lakes. A total of 12 lakes for biomagnification estimates and predator trend analyses were completed.

1.7 Results

Prey and predator fish samples were collected for the twelve lakes authorized.

1.8 Description of Sample Collection Stations

Multiple CDFW/MPSL teams sampled the twelve authorized lakes. Descriptions and maps of sample collection for all lakes and species sampled are linked to Table 1.8.1 below.

1.8.1 Table of Contents for Prey/Predator Fish Lakes

Lake Name	Page Number
Perris Reservoir (802PPR203)	5
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Lake Casitas (402PLC055)	11
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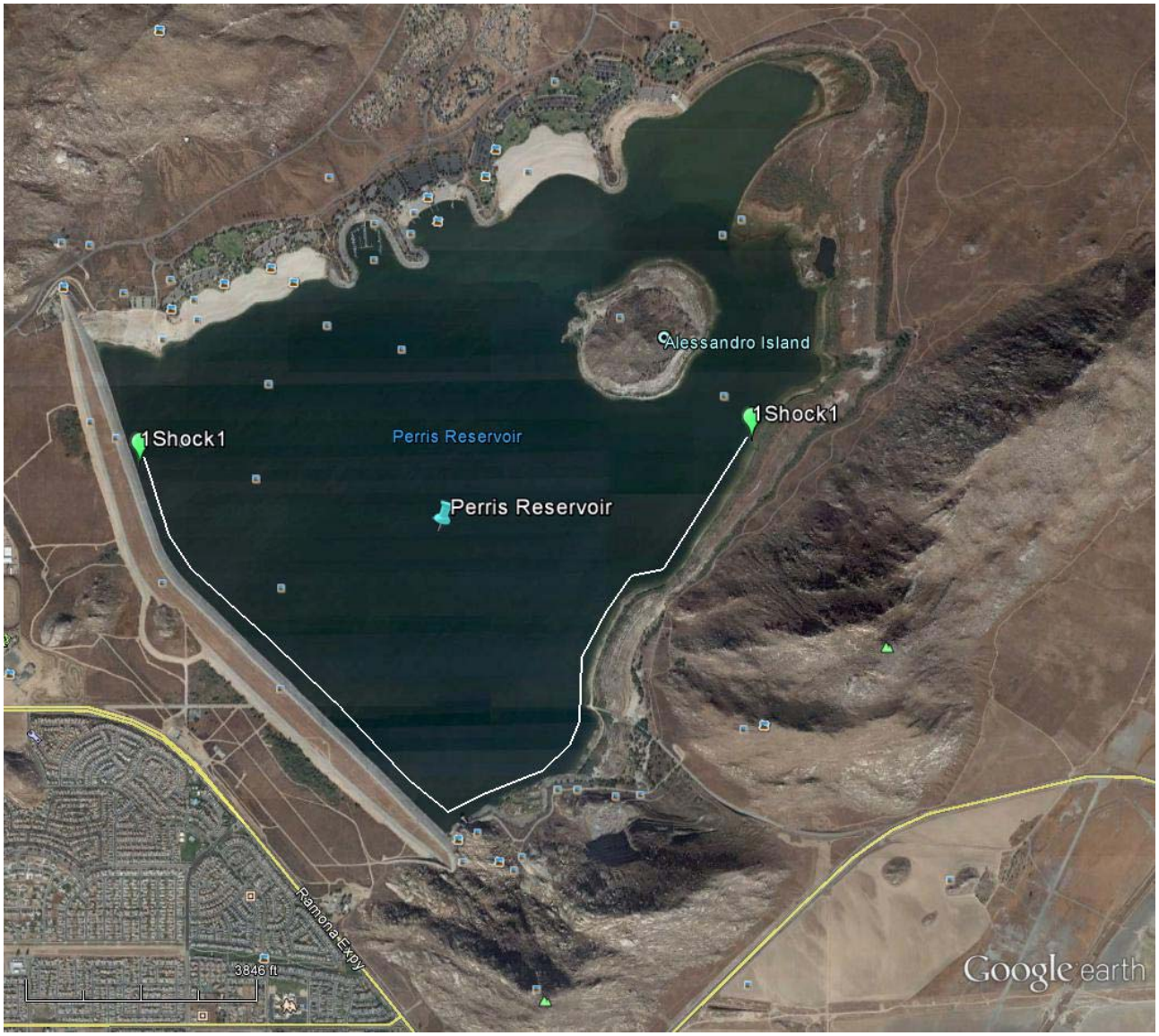
Antelope Lake (518PAL175)	27

2013 BOG, Perris Reservoir (802PPR203)



Latitude: 33.85565
Longitude: -117.19376
Collection Method: Electrofisher boat
Date (s) of Collection: May 13, 2013
Samplers: Dylan Service and Jon Goetzl

Prey Fish caught: Location 1: Bluegill Sunfish											
TL (mm)	64	81	93	89	96	63	81	83	90	95	

Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	33	26	26	26	24	22	28	26	23	25	

Prey Fish caught: Location1: Inland Silverside											
TL (mm)	86	72	84	75	69	72	80	87	72	79	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	370	332	346	420	470	362	370	350	315	430	

Comments: The sampling vessel was launched from the main reservoir ramp. Three samples of prey fish were collected in addition to a predator species, largemouth bass, using the electrofisher boat.

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2013 BOG, Lower Otay Reservoir (910PLO182)

Latitude: 32.61738
Longitude: -116.93243
Collection Method: Electrofisher boat
Date (s) of Collection: May 14, 2013
Samplers: Dylan Service and Jon Goetzl

Prey Fish caught: Location 1: Bluegill Sunfish											
TL (mm)	96	90	68	65	75	82	60	50	48	63	
Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	93	98	98	85	75	99	97	90	92	83	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	375	376	370	390	318	345	385	368	391	345	

Comments: The sampling vessel was launched from the main reservoir ramp. Two samples of prey fish were collected in addition to a predator species, largemouth bass, using the electrofisher boat at one location.

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2013 BOG, Lake Hodges (905PLH070)

Latitude: 33.06626
Longitude: -117.11166
Collection Method: Electrofisher boat
Date (s) of Collection: May 15, 2013
Samplers: Dylan Service and Jon Goetzl

Prey Fish caught: Location 1: Bluegill Sunfish											
TL (mm)	75	95	75	97	75	83	95	80	88	65	
Prey Fish caught: Location 1: Threadfin Shad											
TL (mm)	90	85	87	85	95	88	92	82	90	85	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	360	385	362	410	410	415	420	418	478	485	

Comments: The sampling vessel was launched from the main lake ram. Two samples of prey fish were collected in addition to a predator species using the electrofisher boat. Shiner perch were also seen.

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2013 BOG, Lake Casitas (402PLC055)

Latitude: 34.37000
Longitude: -119.33925
Collection Method: Electrofisher boat
Date (s) of Collection: June 10, 2013
Samplers: Gary Ichikawa and Edward Parras

Prey Fish caught: Location 1: Bluegill Sunfish											
TL (mm)	99	77	77	90	78	81	72	75	66	71	
Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	49	45	55	54	41	50	44	48	47	49	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	371	410	370	435	491	400	443	455	342	395	
Predator Fish caught: Location 1: Prickly Sculpin											
TL (mm)	33	39	85	55	46	46	59	43	70	53	
Prey Fish caught: Location 2: Threadfin Shad											
TL (mm)	74	60	66	65	58	69	73	68	54	74	

Comments: The sampling vessel was launched from the main ramp near the marina. Four samples of prey fish were collected in addition to a predator species using the electrofisher boat. Sculpins and carp were the only other fish seen.

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2013 BOG, Lake Success (555PSL174)

Latitude: 36.06190
Longitude: -118.92122
Collection Method: Electrofisher boat
Date (s) of Collection: June 11, 2013
Samplers: Gary Ichikawa and Edward Parras

Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	36	53	60	49	45	51	60	65	60	52	
Prey Fish caught: Location 1: Bluegill											

TL (mm)	59	65	64	60	81	81	82	86	75	89	
Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	358	350	375	320	419	491	455	500	435	374	

Prey Fish caught: Location 2: Threadfin Shad											
TL (mm)	38	47	42	42	39	52	52	35	52	40	

Comments: The sampling vessel was launched from the main ramp off Success Valley Drive. Three samples of prey fish were collected in addition to one predator species using the electrofisher boat. Carp, crappie, catfish warmouth, and green sunfish were other fish were seen.

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2013 BOG, Topaz Lake (631PTL196)

Latitude: 38.693042
Longitude: -119.51997
Collection Method: Electrofisher boat
Date (s) of Collection: July, 8, 2013
Samplers: Dylan Service and Edward Parras

Prey Fish caught: Location 1: Sacramento Sucker											
TL (mm)	88	75	61	60	76	72	90	80	72	70	
Prey Fish caught: Location 1: Smallmouth bass											

TL (mm)	40	35	38	44	41	40	41	80	81	88	

Predator Fish caught: Location 1: Smallmouth Bass											
TL (mm)	380	420									
Predator Fish caught: Location 1: Brown Trout											
TL (mm)	178	209									

Comments: The sampling vessel was launched from the Topaz Lake Park boat ramp. We sampled the entire lake. The lake water level was very low. Two samples of prey fish were collected in addition to only two fish for two predator species collected using the electrofisher boat.

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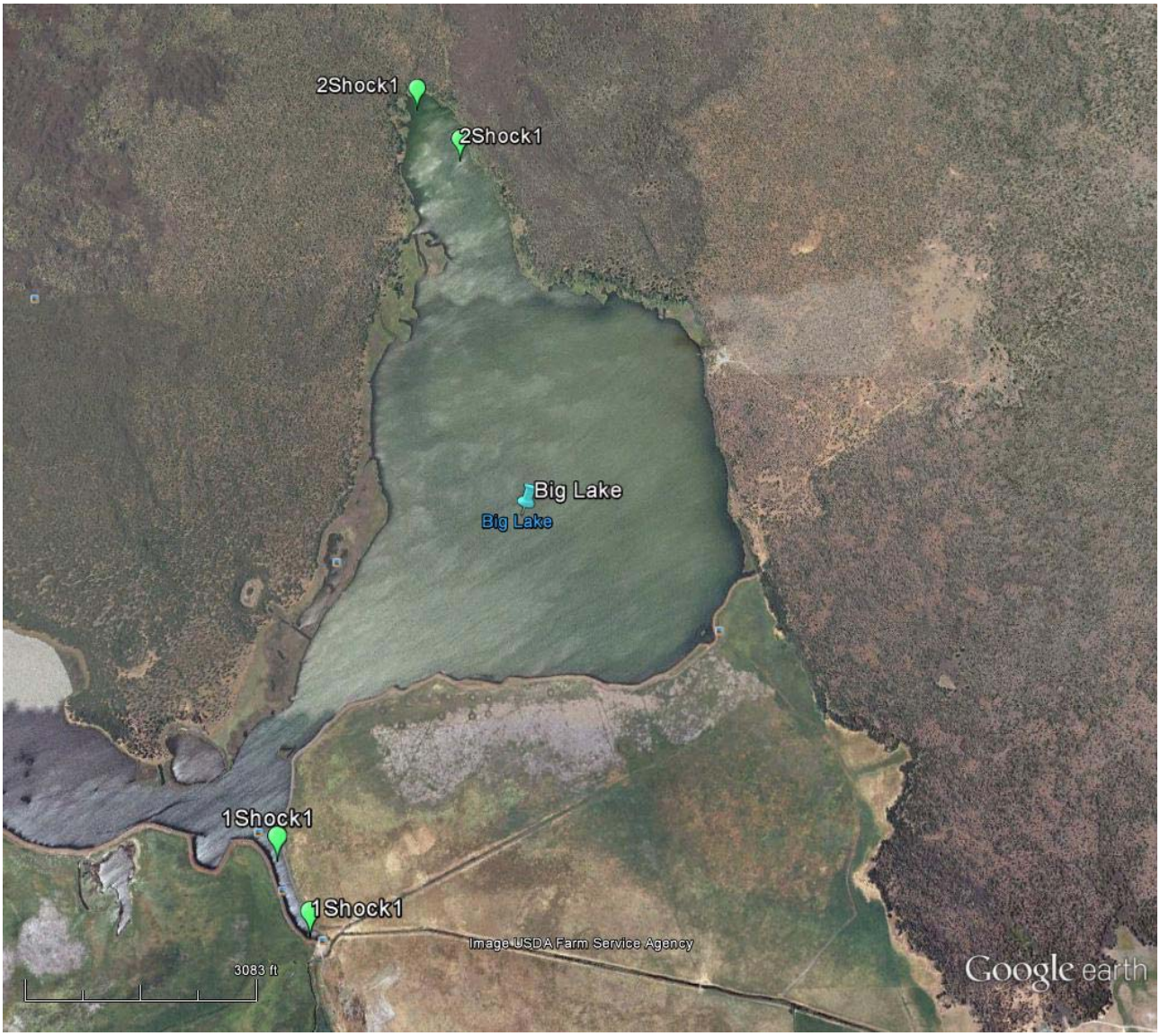
2013 BOG, Big Lake (526PBL034)



Latitude: 41.10027
Longitude: -121.41260
Collection Method: Electrofisher boat
Date (s) of Collection: July 23, 2013
Samplers: Gary Ichikawa and Edward Parras

Prey Fish caught: Location 1: Bluegill											
TL (mm)	31	32	75	71	90	75	85	94	94	99	
Prey Fish caught: Location 1: Hitch											

TL (mm)	48	45	50	71	76	49	55	66	70	83	
Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	47	71	73	77	80	68	72	75	75	80	

Predator Fish caught: Location 2: Rainbow Trout											
TL (mm)	550	471	489	505	490	468	319	391	380	402	

Comments: The sampling vessel was launched from Ahjumawi Lava Springs State Park dirt boat ramp. Three samples of prey fish were collected in addition to one predator species using the electrofisher boat.

The lake had a very dense green algal bloom.

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2013 BOG, Lake Mendocino (114PLM149)

Latitude: 39.20456
Longitude: -123.18262
Collection Method: Electrofisher boat
Date (s) of Collection: July 30, 2013
Samplers: Gary Ichikawa and Dylan Service

Prey Fish caught: Location 1: Bluegill											
TL (mm)	72	78	80	66	62	94	84	98	94	95	
Prey Fish caught: Location 1: Largemouth Bass											

TL (mm)	54	52	56	56	47	46	51	59	56	59	
Prey Fish caught: Location 1: Island Silverside											
TL (mm)	59	54	54	52	43	42	54	46	48	50	
Prey Fish caught: Location 1: Threadfin Shad											
TL (mm)	82	83	71	64	57	59	59	59	59	54	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	324	309	311	427	401	384	385	367	362	485	

Comments: The sampling vessel was launched from off the main public launch ramp near the dam. Four samples of prey fish were collected in addition to one predator species using the electrofisher boat.

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2013 BOG, Tule Lake (105TT0361)

Latitude: 41.90735
Longitude: -121.5646
Collection Method: Fyke net
Date (s) of Collection: July 31, 2013
Samplers: US Fish and Wildlife staff, Josh Rasmussen and Nolan Banish

Prey Fish caught: Location 1: Tui Chub											
TL (mm)	76	94	99	94	99	94	97	92			
Prey Fish caught: Location 1: Blue Chub											

TL (mm)	89	82	83	81	82	87	80	86	83	89	

Prey Fish caught: Location 1: Sacramento Perch											
TL (mm)	41	40	34	31	42	44	39				

Comments: Staff from the Klamath Falls Office for US Fish and Wildlife collected fish for us. Fyke nets were set and retrieved at the dirt boat launch ramp. No sport fishing is allowed at Tule Lake, therefore, none were collected.

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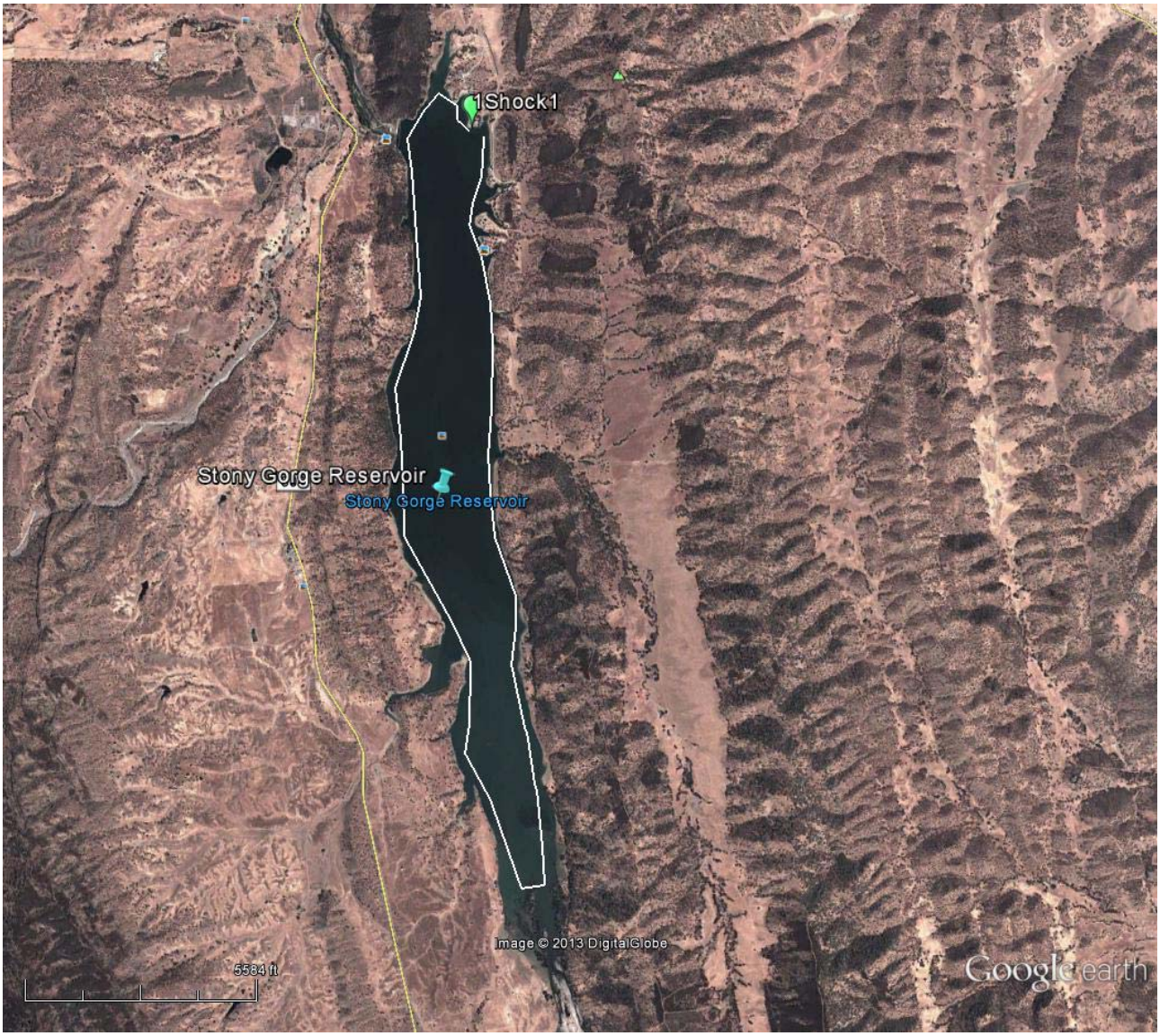
2013 BOG, Stony Gorge Reservoir (522PSG041)



Latitude: 39.5868
Longitude: -122.52562
Collection Method: Electrofisher boat
Date (s) of Collection: August 18, 2013
Samplers: Gary Ichikawa and Jon Goetzl

Prey Fish caught: Location 1: Bluegill											
TL (mm)	69	73	85	78	90	92	95	94	98	99	
Prey Fish caught: Location 1: Green Sunfish											

TL (mm)	62	68	69	60	92	77	72	75	89	84	
Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	55	61	60	62	60	62	58	51	89	89	
Prey Fish caught: Location 1: Threadfin Shad											
TL (mm)	67	67	67	65	63	72	65	70	72	70	

Predator Fish caught: Location1: Largemouth Bass											
TL (mm)	250	229	270	270	432	392	448	259			

Comments: The water level was very low and the regular boat launch was exposed and unusable. The sampling vessel was launched from the bank off the north end of the lake. The entire lake was sampled. The banks were very steep and there was very little bass habitat. Four samples of prey fish were collected in addition to one predator species using the electrofisher boat. Very few sizable largemouth bass were seen. Suckers, pike minnow and catfish were also seen.

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2013 BOG, Lake Hennessey (206LHENSY)

Latitude: 38.48433
Longitude: -122.35770
Collection Method: Electrofisher boat
Date (s) of Collection: August 29, 2013
Samplers: Gary Ichikawa and Dylan Service

Prey Fish caught: Location 1: Bluegill											
TL (mm)	69	78	61	62	59	81	89	82	85	94	
Prey Fish caught: Location 1: Inland Silverside											

TL (mm)	62	60	68	50	59	69	65	67	60	60	
Prey Fish caught: Location 1: Largemouth Bass											
TL (mm)	62	59	62	69	75	78	85	93	92	99	
Prey Fish caught: Location 1: Green Sunfish											
TL (mm)	70	78	76	62	66	77	75	79	67	85	
Prey Fish caught: Location 1: Threadfin Shad											
TL (mm)	82	87	89	89	83	94	80	95	92	90	

Predator Fish caught: Location 1: Largemouth Bass											
TL (mm)	305	320	343	396	352	361	384	392	379	402	

Comments: The sampling vessel was launched from the public launch ramp off Highway 128. Five samples of prey fish were collected in addition to one predator species using the electrofisher boat. No other fish were seen.

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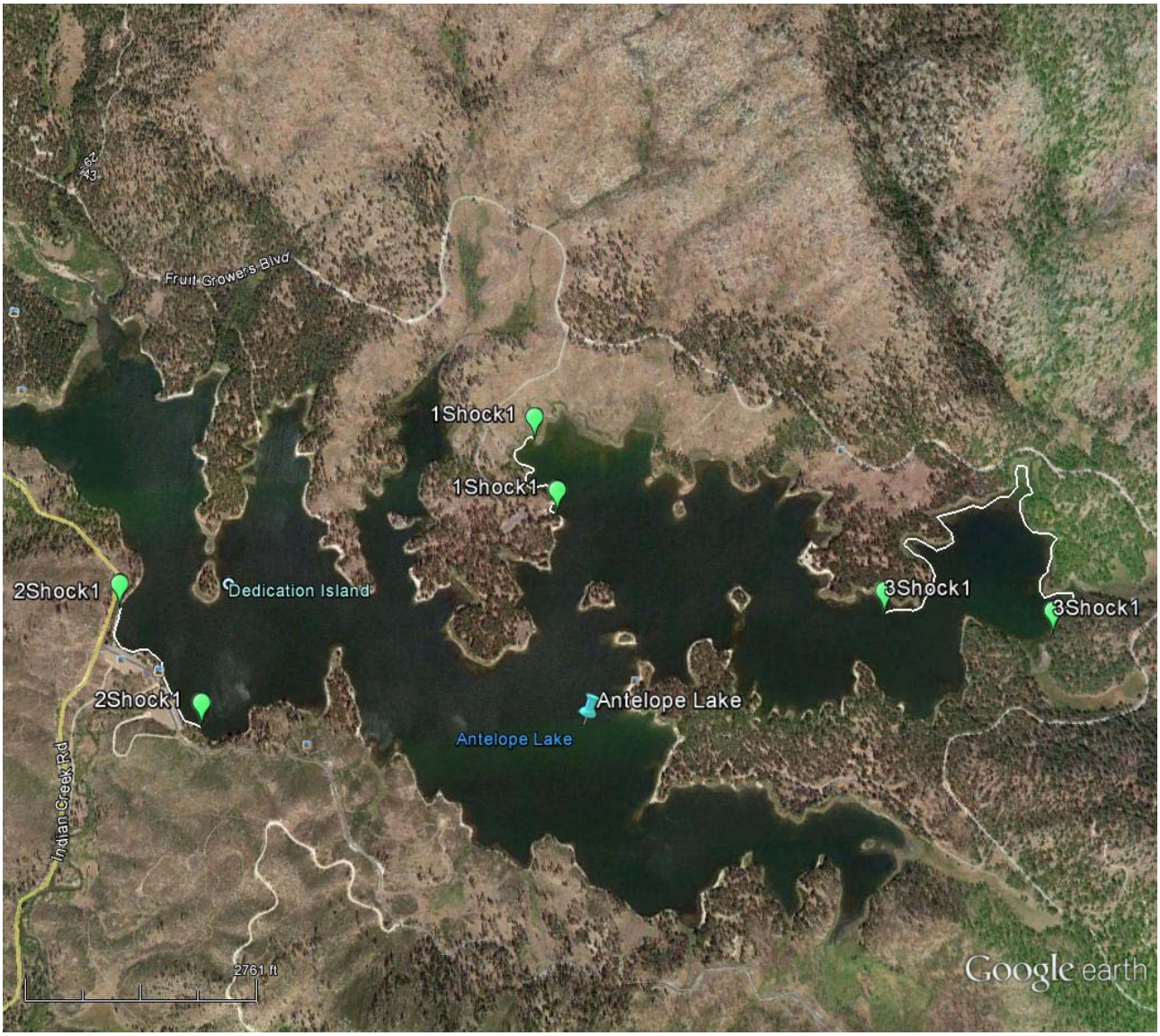
2013 BOG, Antelope Lake (518PAL175)



Latitude: 40.1862
Longitude: -120.59092
Collection Method: Electrofisher boat
Date (s) of Collection: September 4, 2013
Samplers: Gary Ichikawa and Dylan Service

Prey Fish caught: Shock Location 1: Golden Shiner											
TL (mm)	76	80	67	74	66	70	71	71	66	65	
Prey Fish caught: Shock Location 1: Largemouth Bass											

TL (mm)	59	74	85	66	70	66	74	75	82	87	
Prey Fish caught: Shock Location 2: Redear Sunfish											
TL (mm)	90	96	99	84	87	96	93	92	42	42	

Prey Fish caught: Shock Location 2: Black Crappie											
TL (mm)	67	61	56	57	55	59	57	57	59	52	
Predator Fish caught: Shock Location 3: Largemouth Bass											
TL (mm)	381	319	399	306	350	307	431	376	324	346	

Comments: The sampling vessel was launched from the main boat ramp. Four samples of prey fish were collected in addition to one predator species using the electrofisher boat.

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References

Bonnema, A. 2012. Quality Assurance Project Plan:
INCORPORATING WILDLIFE METHYLMERCURY EXPOSURE AND RISK ESTIMATES USING BIOMAGNIFICATION FACTORS INTO CALIFORNIA LAKE MONITORING. Moss Landing Marine Labs. Prepared for SWAMP BOG, 40 pages plus appendices and attachments.