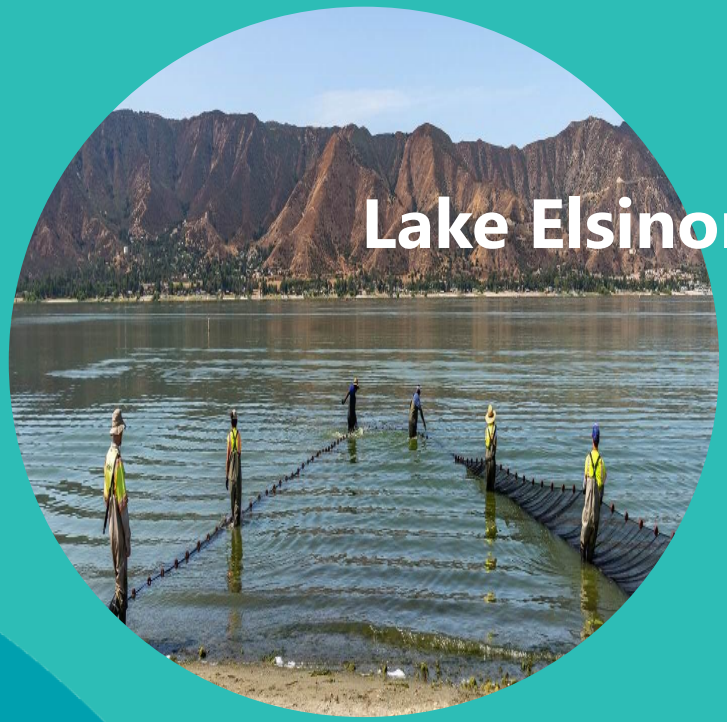
Lake Elsinore Fisheries Management Report

Study Purpose and Objectives

- Study Purpose
  - Assess the current status of the Lake Elsinore fishery and identify potential management measures to further improve the fishery and supporting aquatic habitat
- Study Objectives
  - Determine the need for additional removal of fish nuisance species impacting water quality;
  - Determine appropriate fish species for future fish stockings;
  - Develop recommendations to improve the fishery and habitat to support efforts to implement the revised nutrient TMDL; and
  - Determine potential for a 303(d) de-listing of Lake Elsinore for PCBs and DDTs.



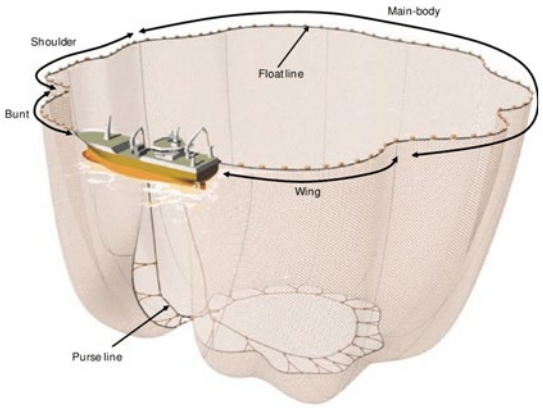
Lake Elsinore Fishery Management Report

Study Design

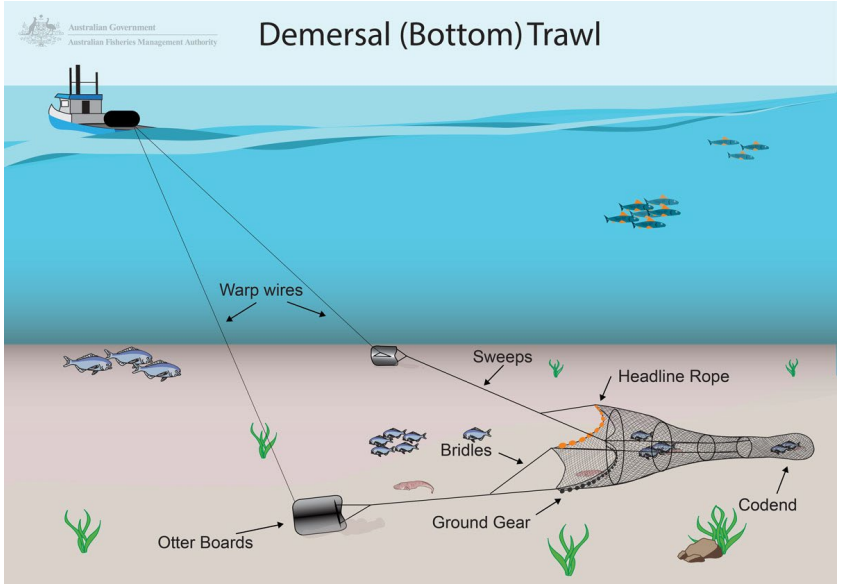
Study Design

- Fish Surveys
  - Beach seines (shallow/nearshore) – 9/4, 9/24 and 10/15, 2019
  - Purse seines (pelagic community in deeper areas) – 10/9, 2019
  - Otter trawls (deeper bottom-dwelling fish community) - 10/10, 2019
- Plankton Surveys
  - Zooplankton – July 26 and October 17, 2019; February 18, 2020
  - Phytoplankton – August 27 and October 17, 2019; February 18, 2020

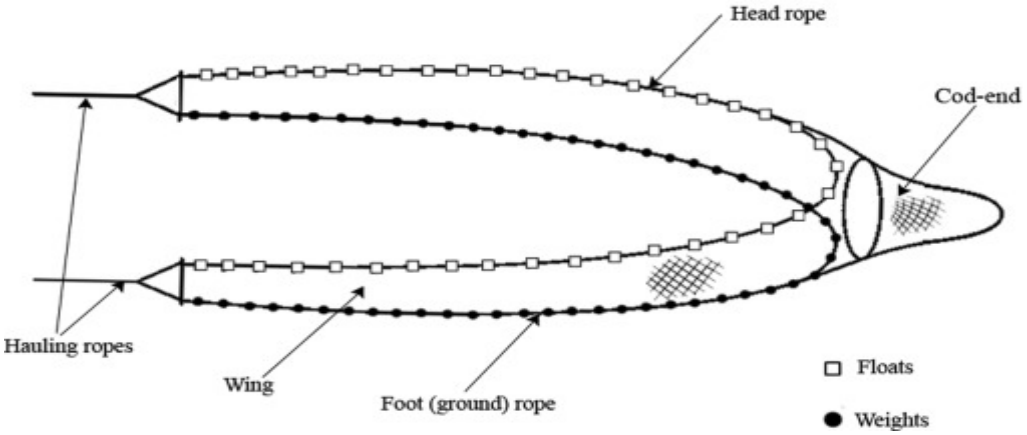
Lake Elsinore Fisheries Management: Gear Types



Purse Seine: Deep Water Upper Column

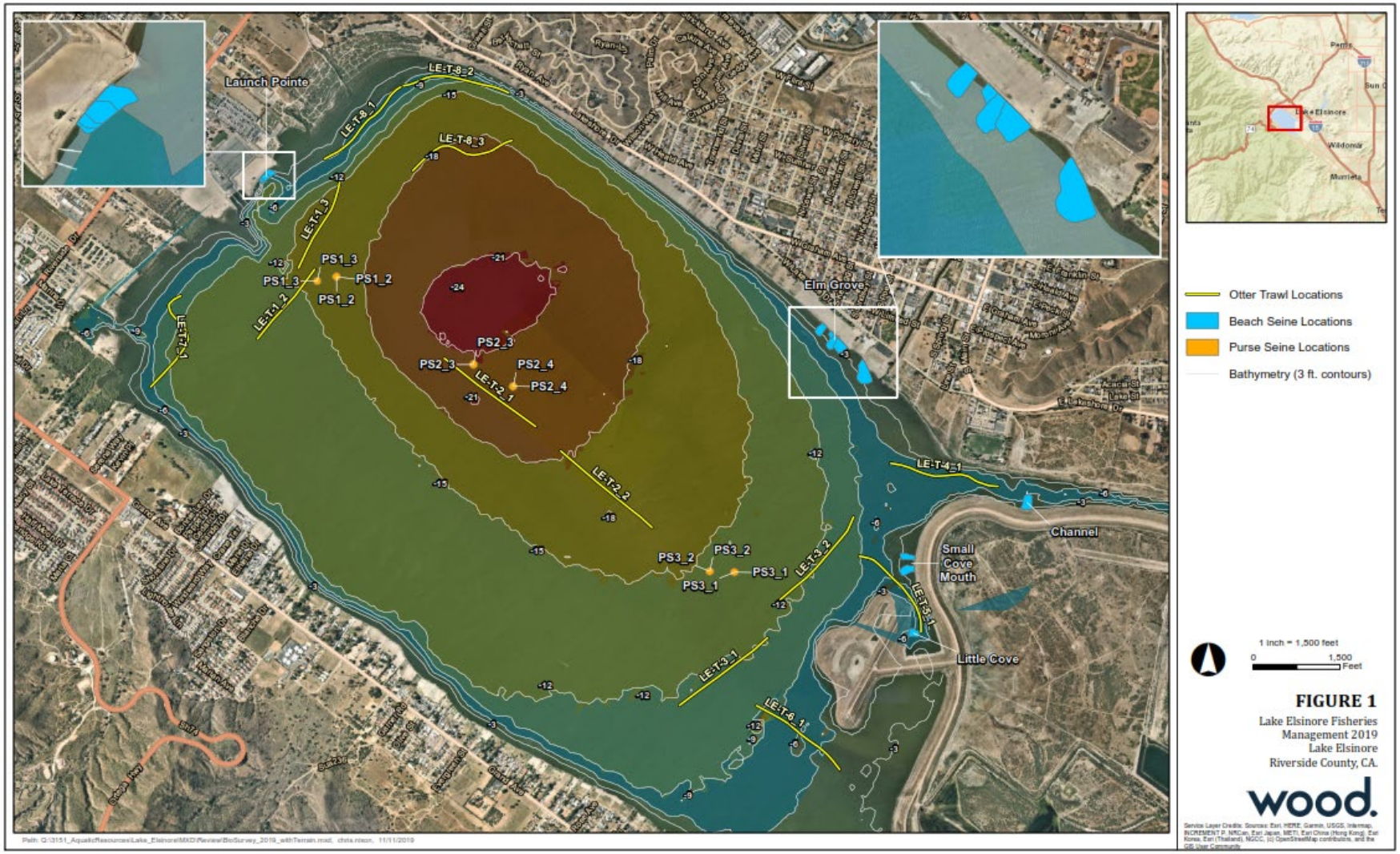


Otter Trawl: Deep Water Bottom



Beach Seine: Top to Bottom Shallow Water

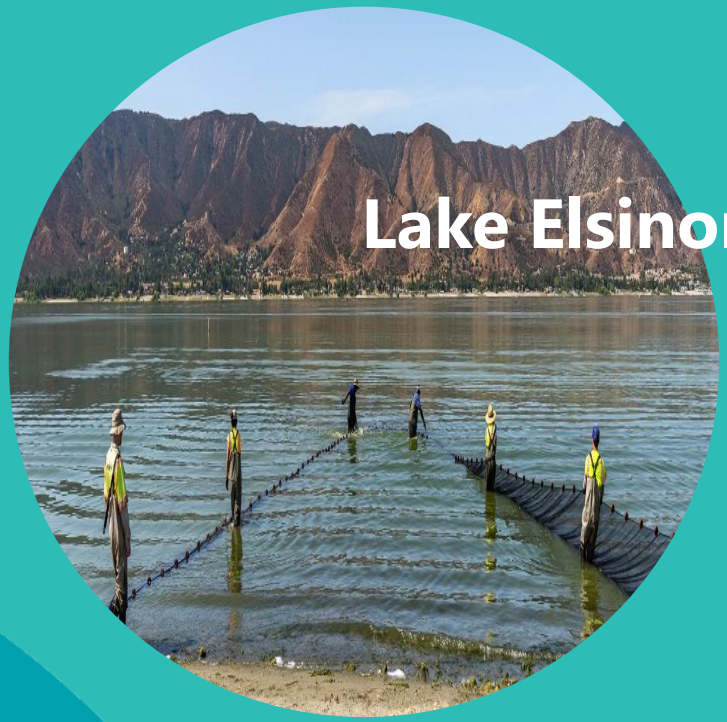
Lake Elsinore – Survey Locations



Lake Elsinore – Survey Locations

Area Surveyed in Lake Elsinore

Survey Method/Area (acres)		Depth Strata (feet)			Total
		0 – 8	8.1 – 16	> 16	
Lake Area Surveyed	Beach Seine	9.7	--	--	9.7
	Purse Seine	--	0.2	0.3	0.5
	Otter Trawl	2.8	4.2	2.3	9.3
	Total Area Surveyed (all methods)	12.5	4.4	2.6	19.5
Total Lake Acreage	Total Area in Lake Elsinore (Acres)	679	1,480	797	2,956
	Portion of Lake Elsinore within Depth Strata (%)	23%	50%	27%	100%



Lake Elsinore Fishery Management Report

Fish Survey Observations

Fish Survey Results – Species Captured

Bluegill

Black Crappie

Channel Catfish

Largemouth Bass

Green Sunfish

Common Carp

Mosquitofish

Threadfin Shad

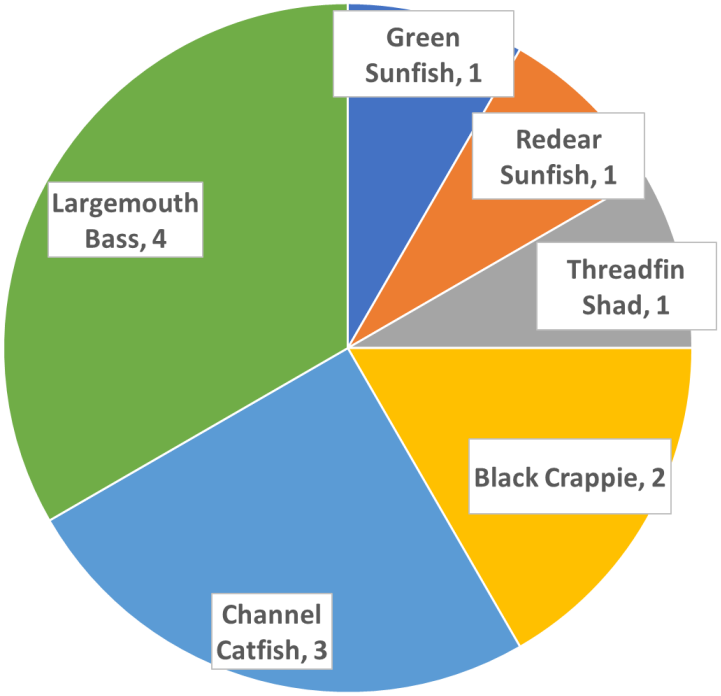
Red Ear Sunfish

Silverside Minnow

Fish Survey Results by Method and Depth (feet)

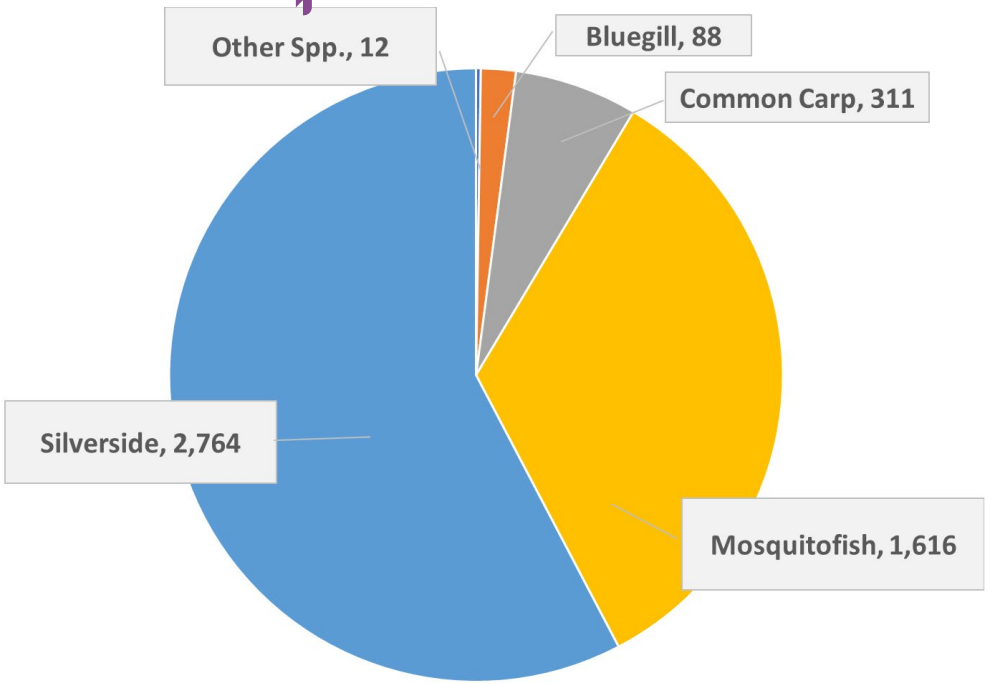
Fish Species	Beach Seine	Purse Seine		Otter Trawl			All Methods & Depths
	0 – 8	8.1 - 16	> 16	0 - 8	8.1 - 16	> 16	
Black Crappie	0	1	1	0	0	0	2
Bluegill	62	0	0	11	15	0	88
Channel Catfish	2	0	0	1	0	0	3
Common Carp	289	2	2	8	8	2	311
Green Sunfish	1	0	0	0	0	0	1
Silverside Minnow	2,350	340	74	0	0	0	2,764
Largemouth Bass	4	0	0	0	0	0	4
Mosquitofish	1,567	36	13	0	0	0	1,616
Redear Sunfish	1	0	0	0	0	0	1
Threadfin Shad	1	0	0	0	0	0	1
Grand Total	4,277	379	90	20	23	2	4,791

Fish Survey: Few Species Dominate Community



Other Species

All Fish



Lake Elsinore Fish Density, Abundance and Biomass

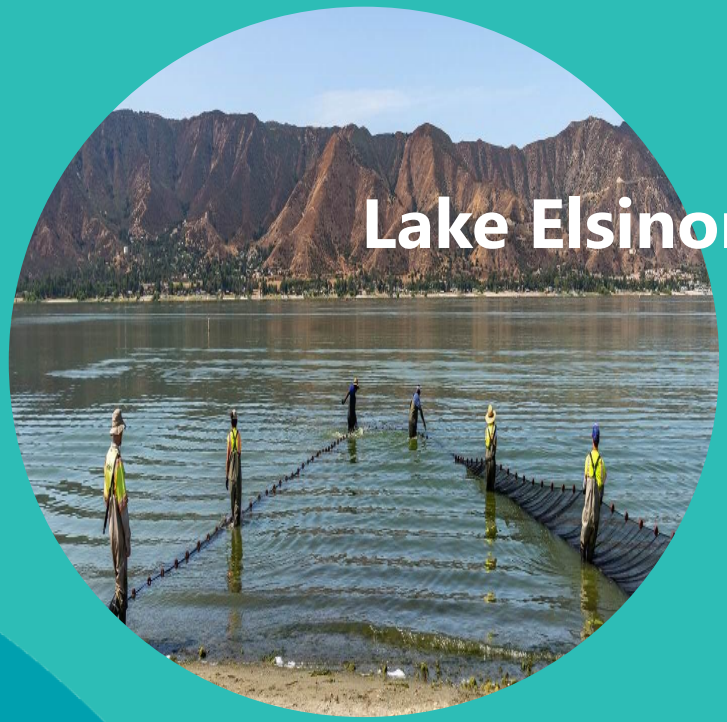
Fish Species	Density/Abundance			Biomass		
	Density (Fish/ Acre)	Abundance (No. of Fish)	Abundance (%)	Biomass (lbs)	Biomass (%)	Biomass Density (lbs/acre)
Black Crappie	1.5	11,020	0.3	12	0.0	0.002
Bluegill	2.3	12,266	0.3	1,113	1.2	0.18
Channel Catfish	0.1	383	0.01	269	0.3	0.07
Common Carp	8.9	47,789	1.3	83,280	88.5	15.58
Green Sunfish	0.02	70	0.002	< 0.001	< 0.001	< 0.001
Silverside	409	3,290,057	86.2	8,950	9.5	1.20
Largemouth Bass	0.1	281	0.01	55	0.1	0.01
Mosquitofish	68.6	453,076	11.9	441	0.5	0.08
Redear Sunfish	0.02	70	0.002	2	0.002	0.001
Threadfin Shad	0.02	70	0.002	5	0.006	0.001
Total	491	3,815,082	--	94,127	--	17.13

Long-term Fish Community Trends Challenging Due to Variation in Survey Methods

Year	Method	Depth	Whole Lake Population Analysis
2002	Gill Net	Unknown	Abundance (%)
2002	Electrofish	Shoreline	Abundance (%)
2003-2008	Beach Seine (Mark-recapture)	Shoreline	Carp Biomass/Biomass Density
2008	Electrofish	Shoreline	Abundance (%)
2008	Hydroacoustic	Whole Water Column	Abundance (%), Density
2009	Electrofish	Shoreline	Abundance (%)
2010	Electrofish	Shoreline	Abundance (%)
2014	Electrofish	3 - 7 ft	None
2014	Gill Net	8 - 20 ft	None
2014	Minnow Traps	2 - 7 ft	None
2015	Hydroacoustic	Whole Water Column	Abundance (%), Density
2019	Beach Seine, Purse Seine & Otter Trawl	Shoreline, Demersal, Pelagic	Abundance (%), Density, Biomass/Biomass Density

Dominant Species (% Abundance) Has Shifted

- 2002 – Dominated (% abundance) by four species: Common Carp (34%), Threadfin Shad (23%), Channel Catfish (22%) and Largemouth Bass (10%)
- 2003 – Dominated (% abundance) by Common Carp (88%); Channel Catfish second most common (8.7%)
- 2008-2009 – Dominated (% abundance) by Common Carp and Bluegill (~80%); Threadfin Shad common in 2008; not observed in 2009
- 2015 – Threadfin Shad dominate (~96% of abundance) (based on hydroacoustic survey that assumed small fish were Shad, but could also have included silverside minnows or Mosquitofish)
- 2019 – Dominated by silverside minnows and Mosquitofish comprising (~ combined more than 90% of fish abundance); Carp third most common species (~7%)



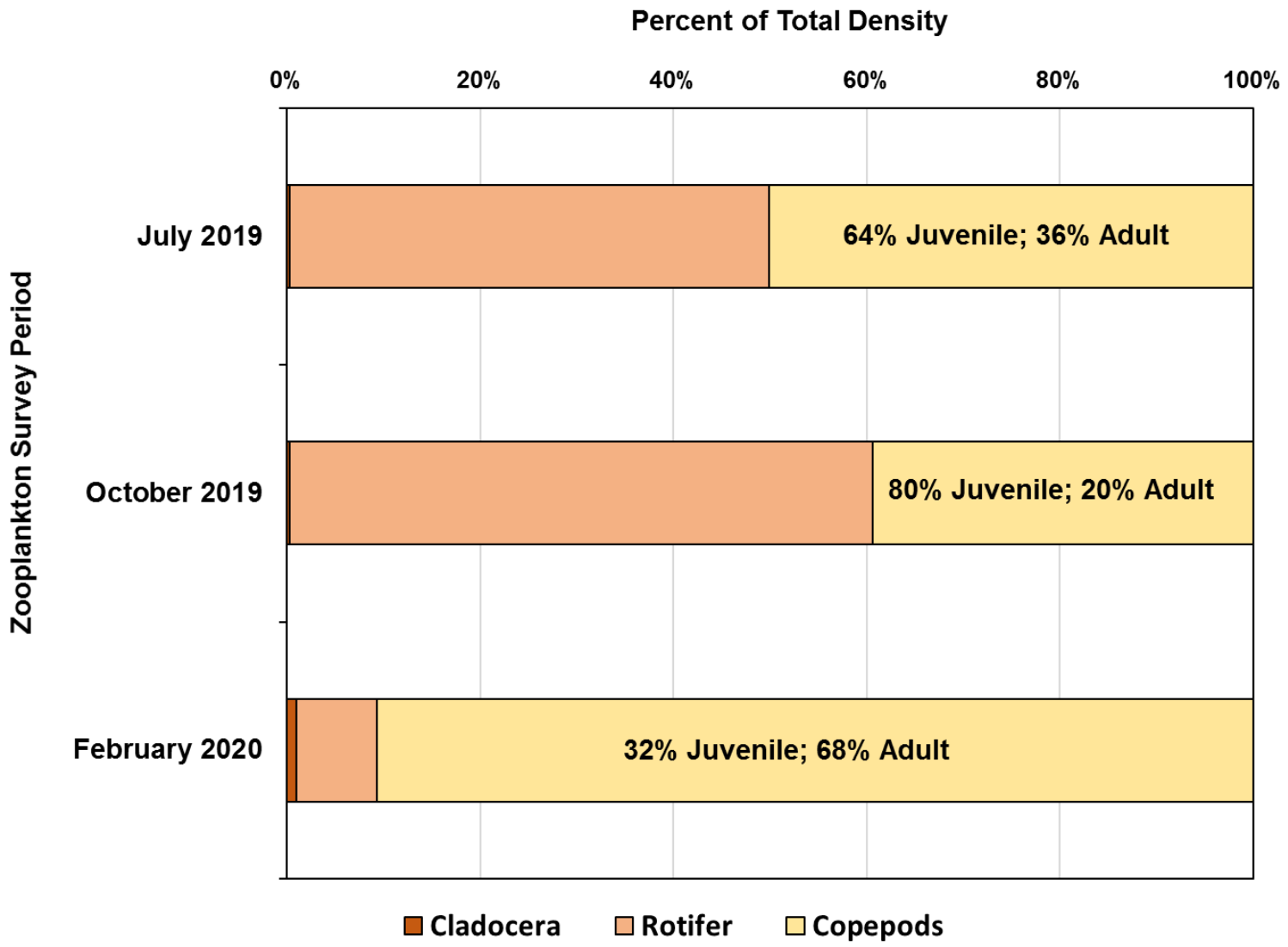
Lake Elsinore Fishery Management Report

Zooplankton Observations

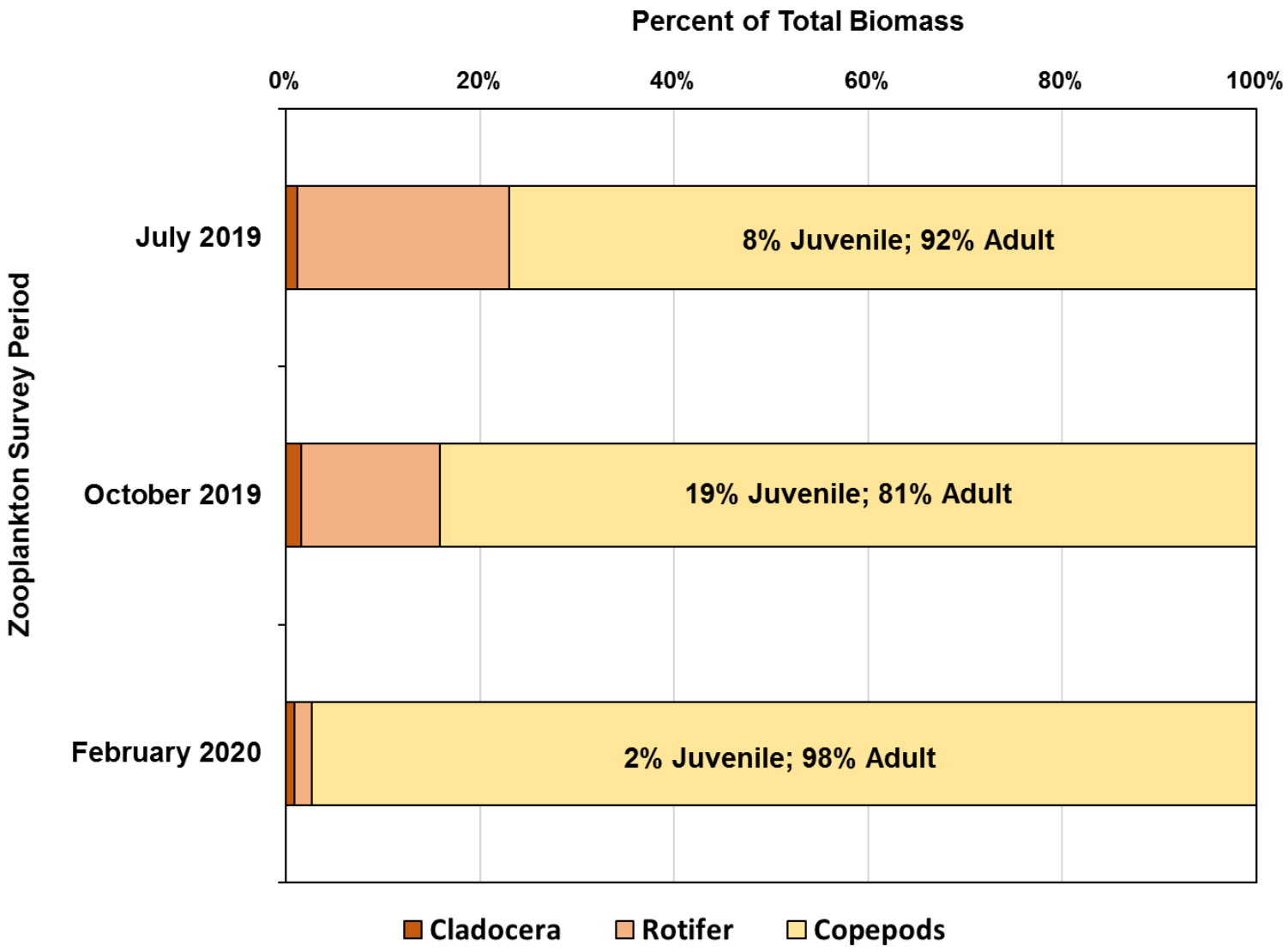
Zooplankton Community

Zooplankton Group	Unique Taxon
Cladocera 	*Daphnia rosea*
	Daphnia sp.
	Diaphanosoma sp.
Copepoda 	*Acanthocyclops robustus*
	Calanoida - copepodites
	Cyclopoida - copepodites
	Leptodiaptomus siciloides
	Copepoda - nauplii (juvenile)
Rotifera 	*Brachionus angularis*
	Brachionus caudatus
	Brachionus plicatilis
	Filinia longiseta
	Filinia terminalis
	Keratella valga

Zooplankton Density

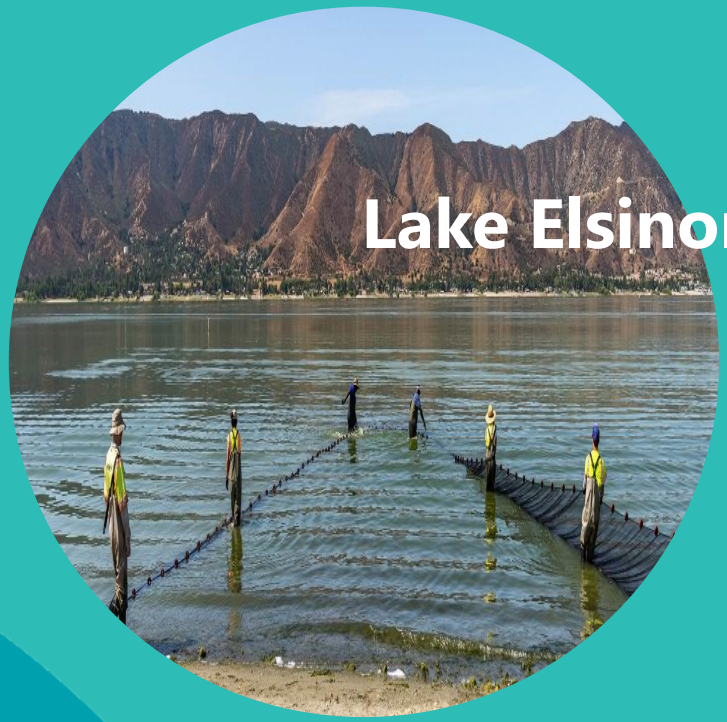


Zooplankton Biomass



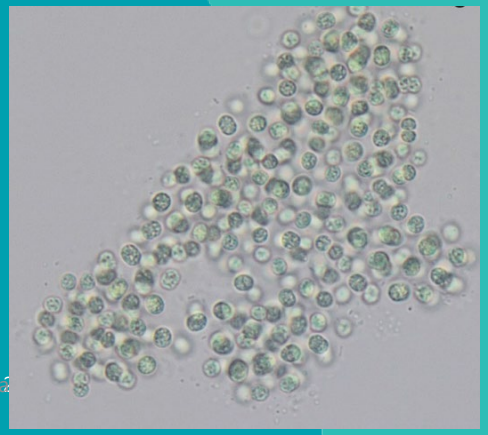
Zooplankton: Long-term Observations

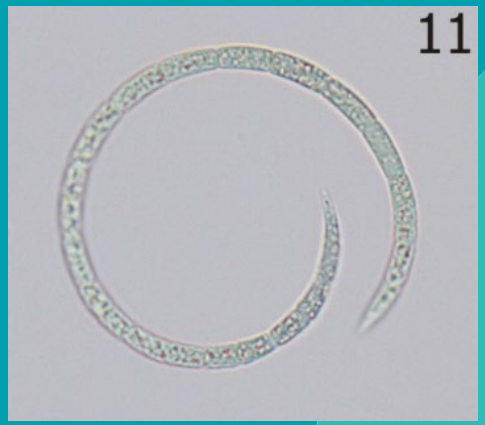
- Two previous surveys to compare to: 2003/2004 and 2009/2010 (however, some apparent differences may be result of variations in collection methodology, i.e., net mesh size
- 2019-2020 density much higher than 2009/2010 survey but generally lower than 2003/2004 survey:
  - Cladocera continue to have very low density/abundance
  - Copepods are typically most common in the winter; rotifers tend to dominate in the summer
- Seasonal variation observed; highest numbers typically observed in the summer/fall
- Taxa Richness - ranged from ~3 to 10 since 2003; 2019/2020 survey had a range of 7 to 9 taxa/event
- Diversity - ranged from 0.13 to 0.78 since 2003; highest diversity observed in October 2019 and February 2020 surveys.

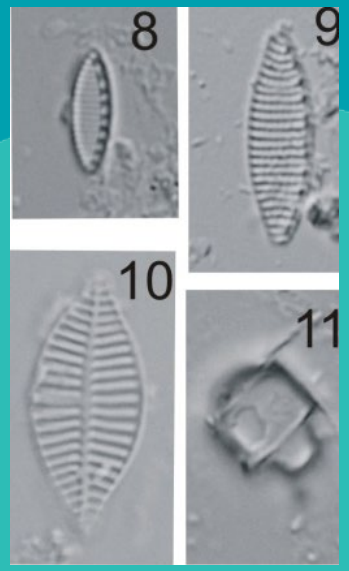


Lake Elsinore Fishery Management Report

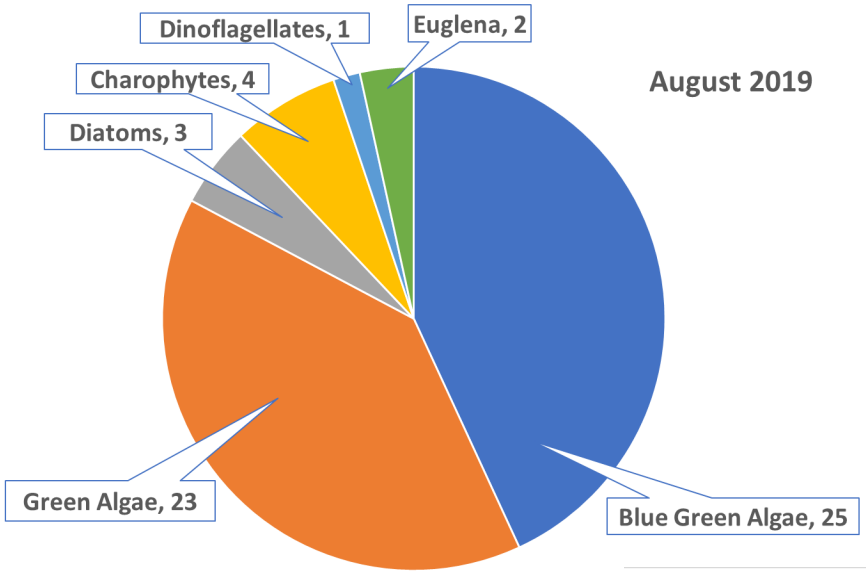
Phytoplankton Observations

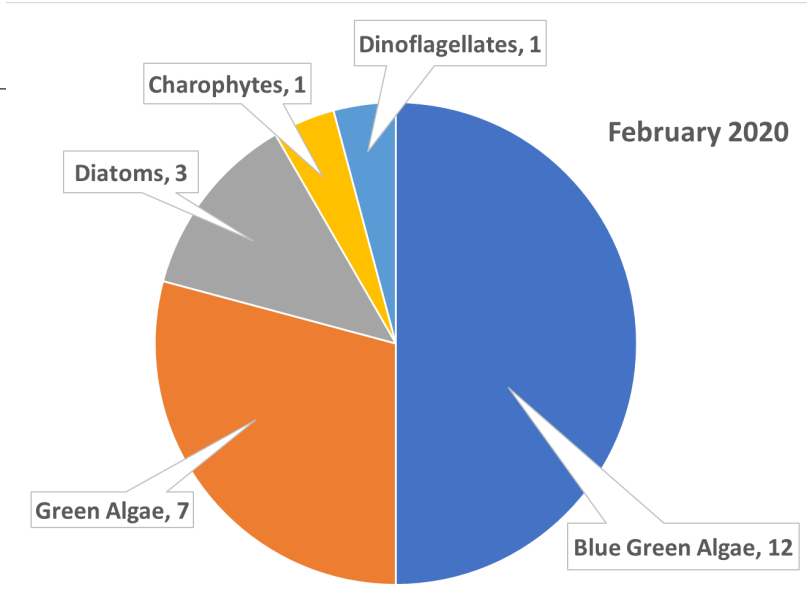


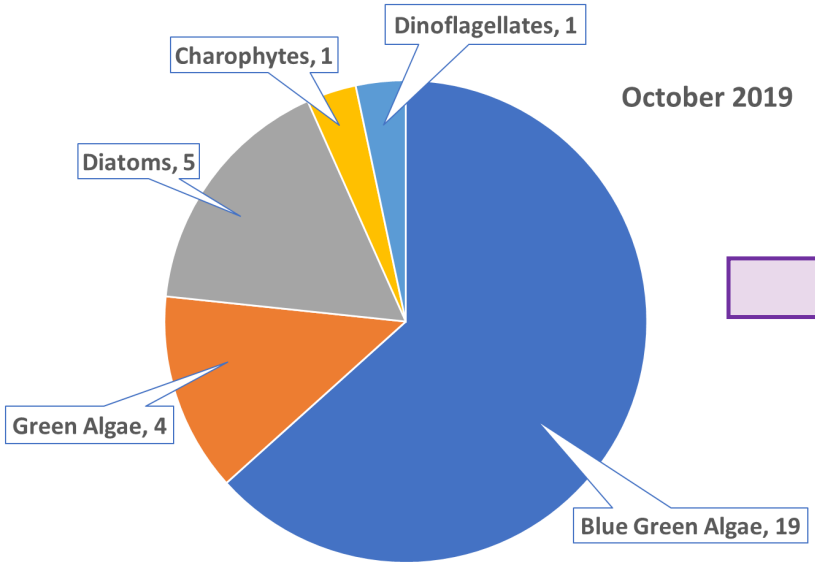




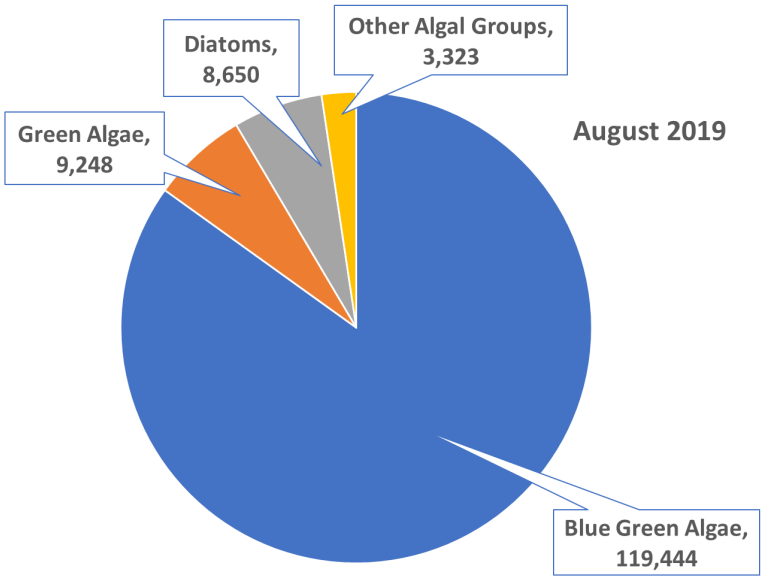
Phytoplankton Richness

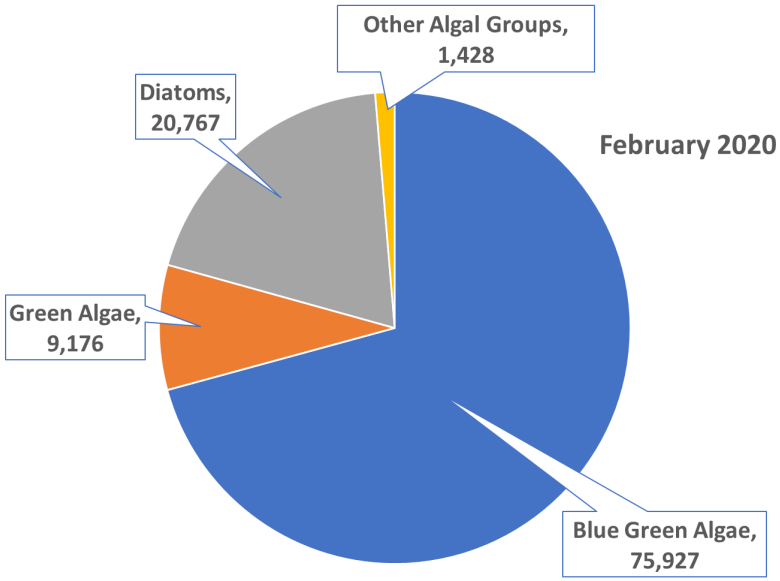


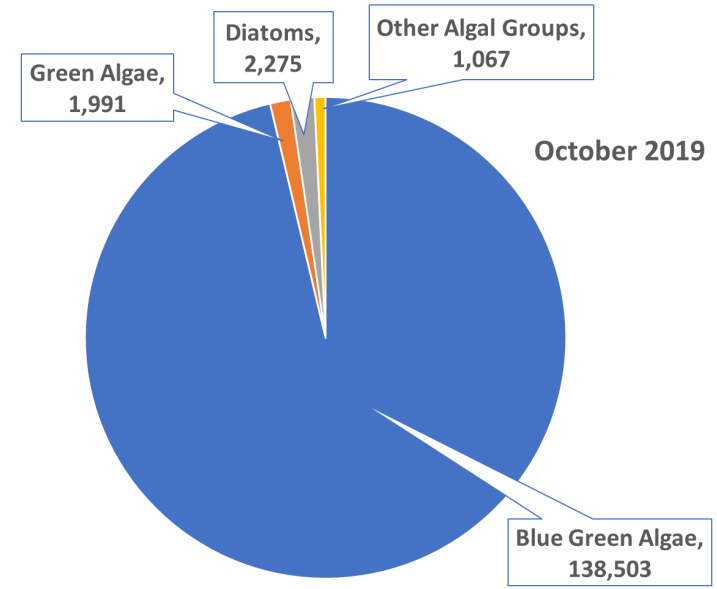




Phytoplankton Density



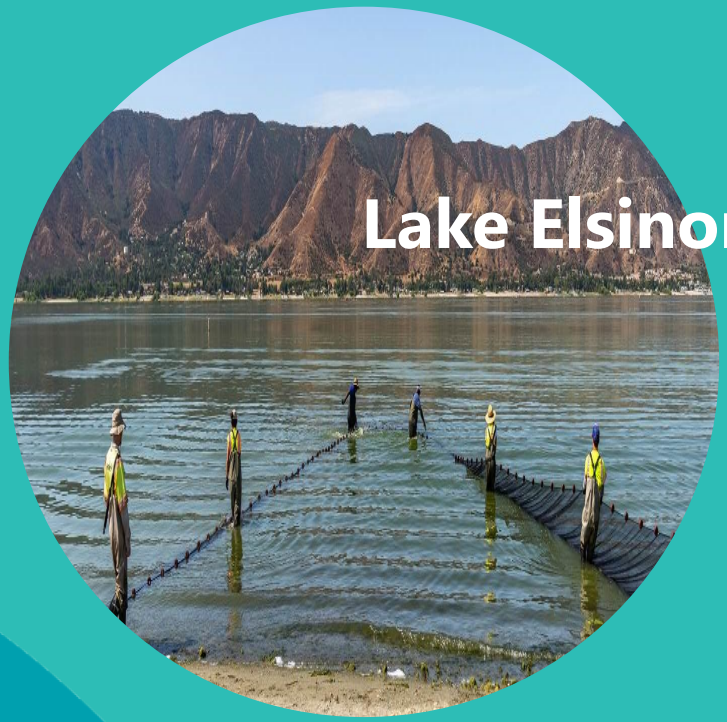




Phytoplankton: Long-term Observations

- Highest algal densities were observed in August and October, during the period of warmer water temperatures
- Blue-green algae were dominant during all sample events in 2019-2020, consistent with previous surveys
- Several blue-green algae taxa observed in the 2019 survey have the potential to produce harmful cyanotoxins; however, many other blue-green algae relatively abundant during 2019-2020 survey are not known to be harmful.

- Seasonal succession pattern observed in previous surveys (dominance of diatoms in the winter/spring shifts to dominance of blue-green algae in the summer/fall), was not observed in the 2019-2020 surveys

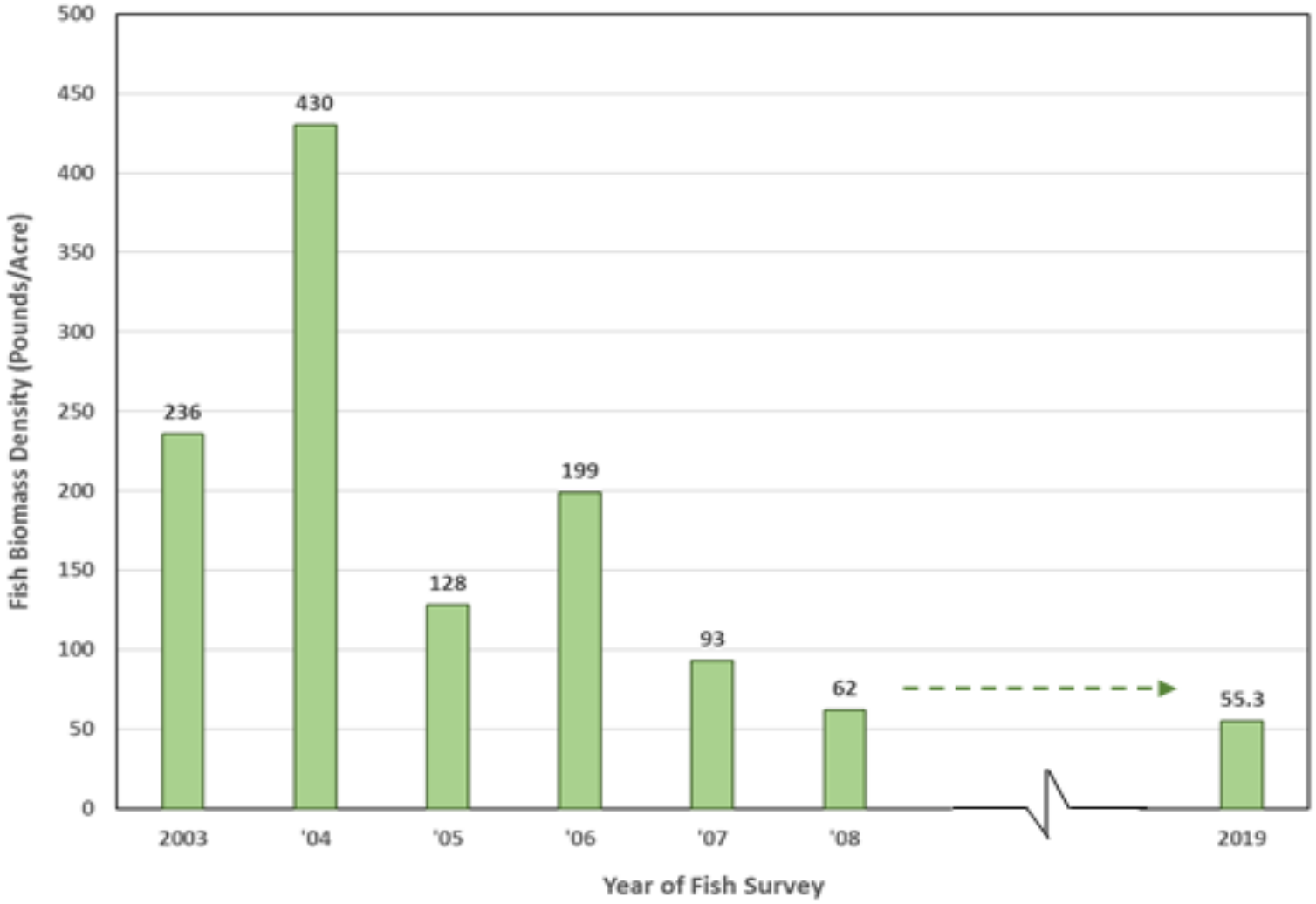


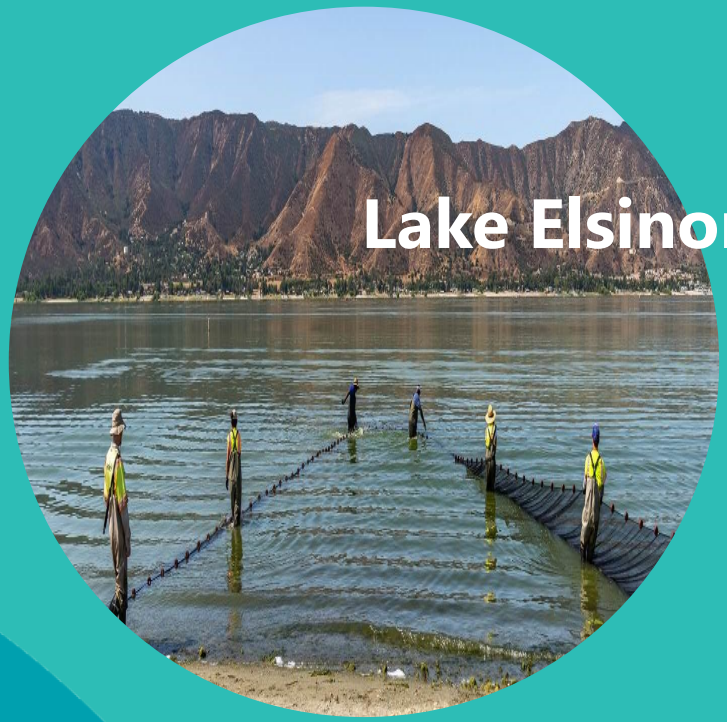
Lake Elsinore Fishery Management Report

Study Objective: Determine Need for Additional Removal of Fish Nuisance Species

Common Carp Population Remains Stable

- Survey findings show no need to implement a carp removal program at this time; conduct periodic surveys to re-evaluate





Lake Elsinore Fishery Management Report

Study Objective: Determine Appropriate Fish Species for Future Fish Stockings

Objective: Determine Appropriate Fish Species for Future Fish Stockings

- Recommendation No. 1: Stock Striped/White Bass hybrids ("Hybrid Bass") (aka "Wipers") of size > 100-125 mm in length
  - Species will provide top-down biomanipulation, e.g.,
    - Less impact on zooplankton if larger fish stocked
    - Sufficient forage fish (silverside/Mosquitofish) to support
    - Can support Carp management by feeding on juvenile Carp
  - Suitable life history for Lake Elsinore, e.g., more tolerant of Lake Elsinore water quality than other gamefish
  - Successfully stocked previously
  - Readily fished by anglers (typical size is 2-5 lbs; 10-15 lb fish not uncommon

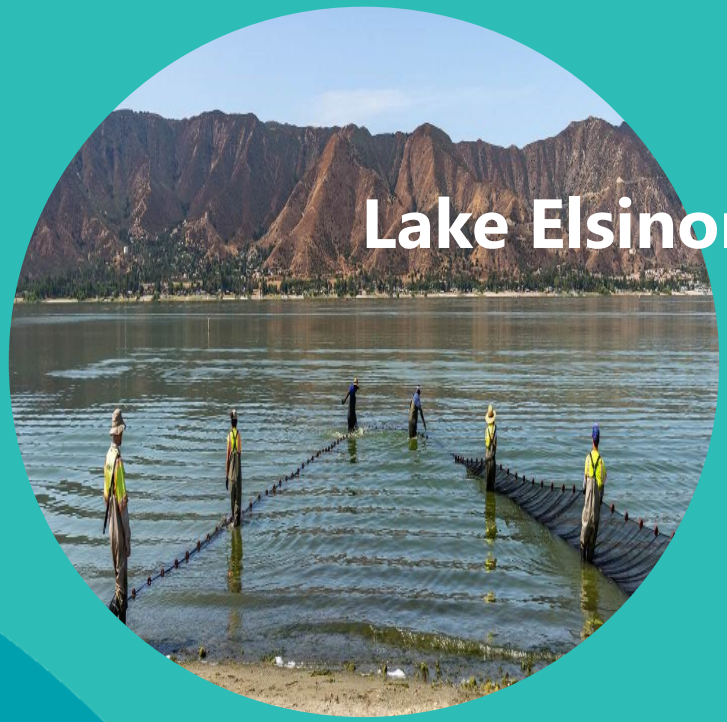
Objective: Determine Appropriate Fish Species for Future Fish Stockings

- Recommendation No. 2:
  - Discontinue stocking Channel Catfish, Largemouth Bass, and Redear Sunfish; 2019 data suggest survival of these stocked species has been very poor.
- Recommendation No. 3:
  - Continue stocking Black Crappie and Bluegill (> 150 mm in length to avoid Hybrid Bass predation) as survival of these stocked species appears to have been good
- Recommendation No. 4:
  - Do not stock baitfish; silverside and Mosquitofish are present in high numbers and appear to be reproducing and maintaining a viable population

Objective: Determine Appropriate Fish Species for Future Fish Stockings

- Recommendation No. 5: Conduct periodic fish surveys to evaluate success of ongoing fish stocking activities, potential to modify the species stocked and evaluate populations of other species:
  - Periodic re-stocking of Hybrid Bass is necessary as species is unlikely to reproduce. Periodic surveys provide information on the status of the Hybrid Bass population in the lake.
  - When water quality has improved, other game fish species may be stocked, e.g., Black Crappie/Bluegill (which appear to have good survival) and Largemouth Bass given they are generally more preferred by anglers than Hybrid Bass.

  - Regular surveys provide the opportunity evaluate Carp population and the availability of baitfish in the lake.



Lake Elsinore Fishery Management Report

Study Objective: Develop Recommendations to Improve the Fishery and Habitat to Support Efforts to Implement Revised Nutrient TMDL

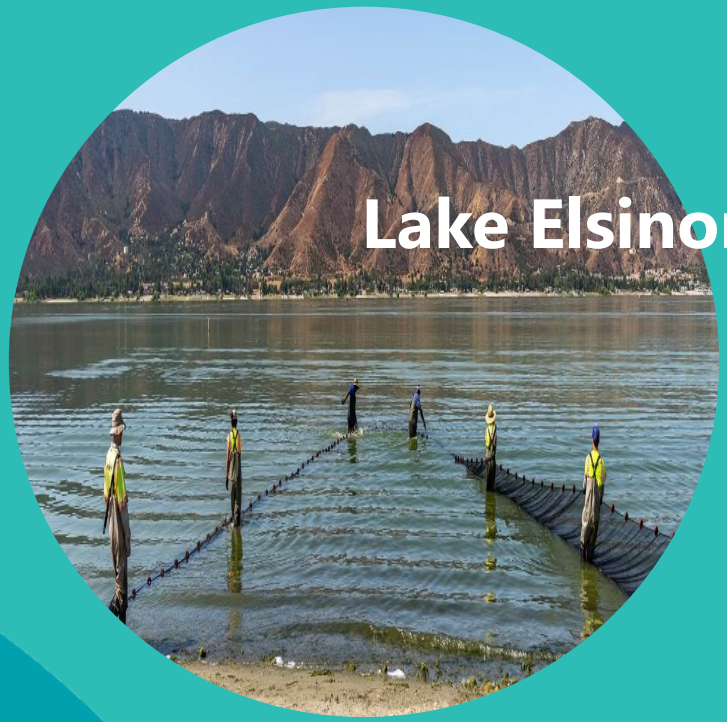
Objective: Recommendations to Improve Fishery and Habitat to Support TMDL Implementation

- Recommendation No. 1: Plant rooted aquatic and emergent vegetation (as originally recommended in 2005).
  - Increased vegetation would provide:
    - Spawning habitat for many fish species;
    - Habitat for small fish;
    - Ambush habitat for large fish;
    - Shelter for zooplankton; and
    - Nesting habitat and food for waterfowl.
  - Aquatic plants uptake nutrients otherwise used by algae and reduce resuspension of sediments due to wind and wave action.
  - Recommended plants include: sago pondweed (native to the lake); cattail and tule/bulrush (which currently exists in small pockets around the lake)
  - Plants may need enclosures or restrictions to protect them from Common Carp, birds, wave action, and human activity while they are becoming established.

Objective: Recommendations to Improve Fishery and Habitat to Support TMDL Implementation

- Recommendation No. 2:
  - Until appropriate water levels can be maintained, a temporary alternative to planting shoreline vegetation is to consider installation of anchored floating vegetation mats. These mats:
    - Rise and fall with water levels
    - Offer many of the same benefits as shoreline/submerged vegetation
    - Are not as aesthetically pleasing as other habitat options

- Recommendation No. 3:
  - Create physical, non-plant structures to serve as fish habitat (originally proposed 2005), e.g., addition of gravel patches, rock piles, large woody materials, brush piles, or other fish attractors.

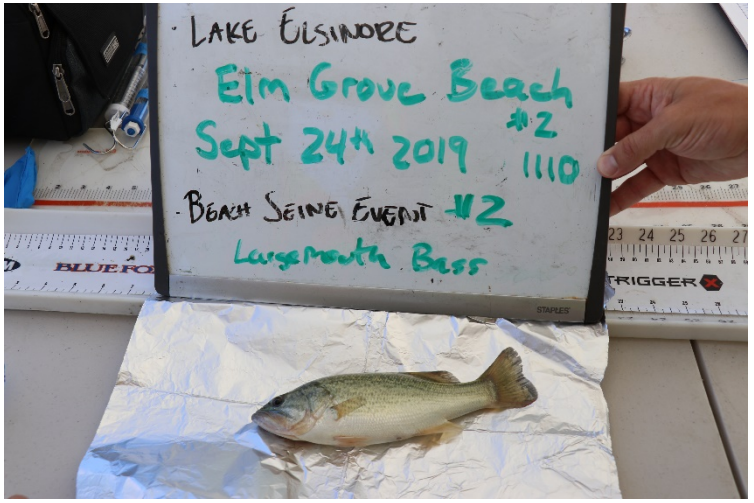


Lake Elsinore Fishery Management Report

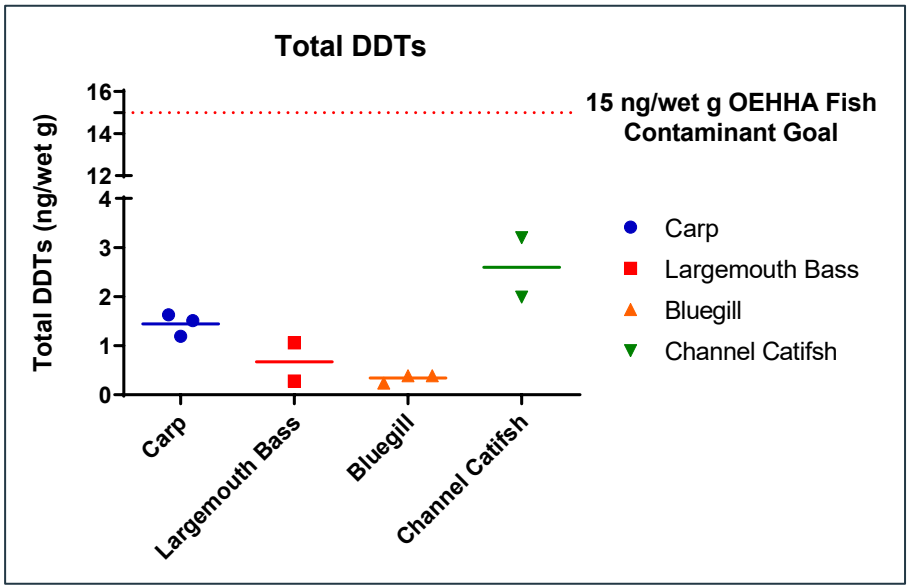
Study Objective: Determine Potential for a 303(d) Delisting of Lake Elsinore for PCBs and DDTs.

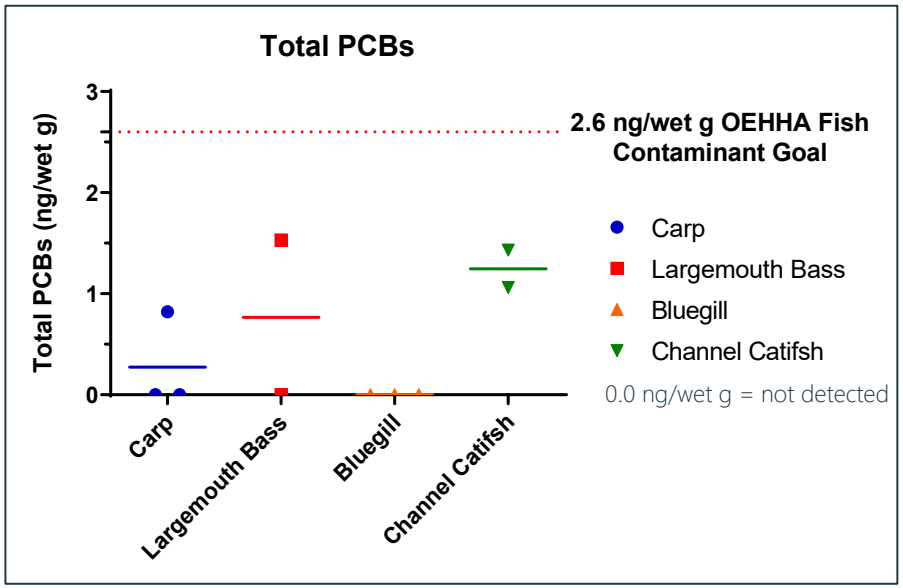
Fish Tissue Collection Methods and QAQC

- Collected fish are measured and weighed
- All fish handled with gloved hands
- Placed on acetone rinsed aluminum foil, sealed in double Ziplock bag, placed on ice
- Frozen immediately at end of day
- Tissue samples prepared in laboratory clean-room environment with non-contaminating techniques
- 75% rule – all fish in a composite within 75% the length of each other
- Lake Elsinore considered Medium sized lake (SWAMP 2015 SAP) - minimum 2 samples
- Fish composites grouped by size and location collected



Summary of DDT and PCB Concentrations for 2019 Fish Tissue Collections





Summary of DDT and PCB Concentrations for 2019 Fish Tissue Collections

Analyte	Carp Rep 1	Carp Rep 2	Carp Rep 3	LMB Small Fish	LMB Large Fish	Bluegill Rep 1	Bluegill Rep 2	Bluegill Rep 3	Catfish Small Fish	Catfish Large Fish
# Fish in Composite	5	5	5	2	1	5	4	2	2	1
Total DDTs (ng/wet g)	1.51	1.19	1.63	0.28	1.06	0.39	0.39	0.24	1.99	3.20
Total PCBs (ng/wet g)	ND	ND	0.82	ND	1.53	ND	ND	ND	1.06	1.43
Aroclor 1248 (ng/wet g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254 (ng/wet g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260 (ng/wet g)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Nitrogen (% wet wt)	5.3	5.3	5.3	5.8	6.0	5.8	5.9	5.7	5.2	5.2
Total Phosphorus (µg/wet g)	10710	10610	13730	15360	16310	11700	15770	16760	11080	10730
Lipids (%)	1.12	0.75	1.29	0.38	1.3	0.78	0.42	0.49	3.21	1.68
Solids (%)	19.5	20.7	20.1	19.5	22.2	20.3	19.3	20.6	21.5	21.0

Summary of DDT and PCB Concentrations for 2019 Fish Tissue Collections

Analyte	Carp Rep 1	Carp Rep 2	Carp Rep 3	LMB Small Fish	LMB Large Fish	Bluegill Rep 1	Bluegill Rep 2	Bluegill Rep 3	Catfish Small Fish	Catfish Large Fish
# Fish in Composite	5	5	5	2	1	5	4	2	2	1
Total DDTs (ng/wet g)	1.51	1.19	1.63	0.28	1.06	0.39	0.39	0.24	1.99	3.20
Total PCBs (ng/wet g)	ND	ND	0.82	ND	1.53	ND	ND	ND	1.06	1.43
Aroclor 1248 (ng/wet g)	ND	ND							ND	ND
Aroclor 1254 (ng/wet g)	ND	ND							ND	ND
Aroclor 1260 (ng/wet g)	ND	ND							ND	ND
Total Nitrogen (% wet wt)	5.3	5.3	5.3	5.8	6.0	5.8	5.9	5.7	5.2	5.2
Total Phosphorus (µg/wet g)	10710	10610	13730	15360	16310	11700	15770	16760	11080	10730
Lipids (%)	1.12	0.75	1.29	0.38	1.3	0.78	0.42	0.49	3.21	1.68
Solids (%)	19.5	20.7	20.1	19.5	22.2	20.3	19.3	20.6	21.5	21.0

OEHHA Fish Contaminant Goal (June 2008)
Total DDT 15 ng/wet g
Total PCB 2.6 ng/wet g

Questions