Resource Brief

National Park Service
U.S. Department of the Interior

Klamath I&M Network
Natural Resource Stewardship and Science

Vital Sign Update: 2019 Results for Mountain Ponds and Lakes Monitoring at Lassen Volcanic National Park

Importance

Ponds and lakes support varied aquatic life and are vital watering holes for Lassen Volcanic National Park's terrestrial wildlife. Snow and rain feed these ponds and lakes but can also introduce atmospheric pollutants. Exotic plant and animal species are also a threat. Since 2013, we've been monitoring ponds and lakes as a vital sign of the park's health to inform managers about current conditions and any concerning changes. This brief describes how we determine the *trophic state* and *biological diversity* of lake fauna from monitoring done in 2019.

What is trophic state?

Trophic state describes a lake's productivity – the amount of biomass (all living organisms) produced in a given time period. The higher the biomass, the more productive the pond or lake is. Productivity is affected by many factors, including geology and the shape of the lake basin. However, land use and climate (temperature and precipitation) are especially important factors for management. For example, a steep rise in lake productivity due to fertilizer or other human impacts, called "eutrophication," is a problem. We measure biomass and trophic state by sampling algal production, specifically the concentration of Chlorophyll a in the water. Chlorophyll comes from phytoplankton: generally green algae, cyanobacteria, or diatoms. A lake's trophic state can be **oligotrophic** (low production), **mesotrophic** (medium production), **eutrophic** (high production), and **hypereutrophic** (very high production).

What are zooplankton?

Zooplankton are microscopic animals that float or swim passively in lake or pond water. They eat phytoplankton (microscopic plants) in the pond or lake, or other zooplankton, and they become food for fish and amphibians. Though still small, some can be seen with the naked eye. Zooplankton are generally crustaceans (like *Daphnia*, the "water flea"), rotifers, some insect larvae, and aquatic mites. We track zooplankton as a vital part of a lake or pond's biodiversity, and also because they respond to nutrient enrichment (like fertilizer).

Collecting water quality and phytoplankton at Ink Lake in 2013. The lake is oligotrophic, and it is covered in duckweed (*Lemna* sp.)

What is the littoral zone and why count macroinvertebrates?

The littoral zone is generally the shallow zone around the edge of a lake where enough light penetrates so that aquatic plants can grow. In a shallow pond, the littoral zone may include the entire pond. We sample the edge of lakes and ponds for aquatic macroinvertebrates that inhabit this zone: insects, mites, leeches, snails, and worms. Important to biodiversity, they eat algae, plants, zooplankton, and each other. They are eaten by amphibians, fish, spiders, birds, and bats. Aquatic insects that emerge from the water as flying adults also provide energy to the surrounding landscape.

About amphibians

Amphibians need water to breed. They are some of the world's most imperiled animals because they are extremely sensitive to pollution, pathogens, and changes in water chemistry. As such, they are an early warning system for park managers. We count the overall density of amphibians in a pond or lake, regardless of species, as few species naturally occur in the park's waters.

Results and Future Monitoring

In July, August, and September of 2019, we sampled 30 mountain ponds and lakes of Lassen Volcanic National Park. View the map and table on the following pages for detailed results. We'll sample the park again in 2023.

More Information

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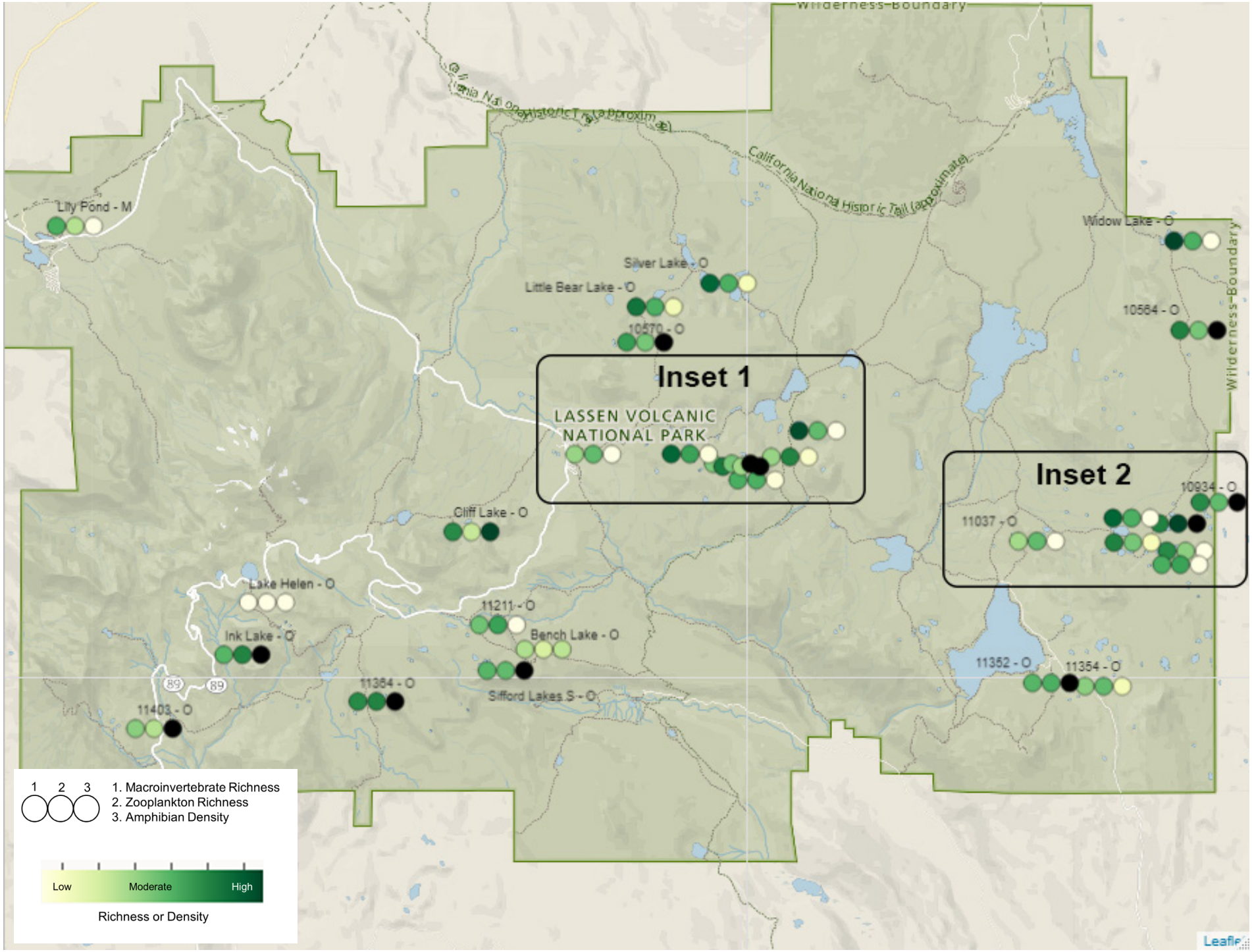
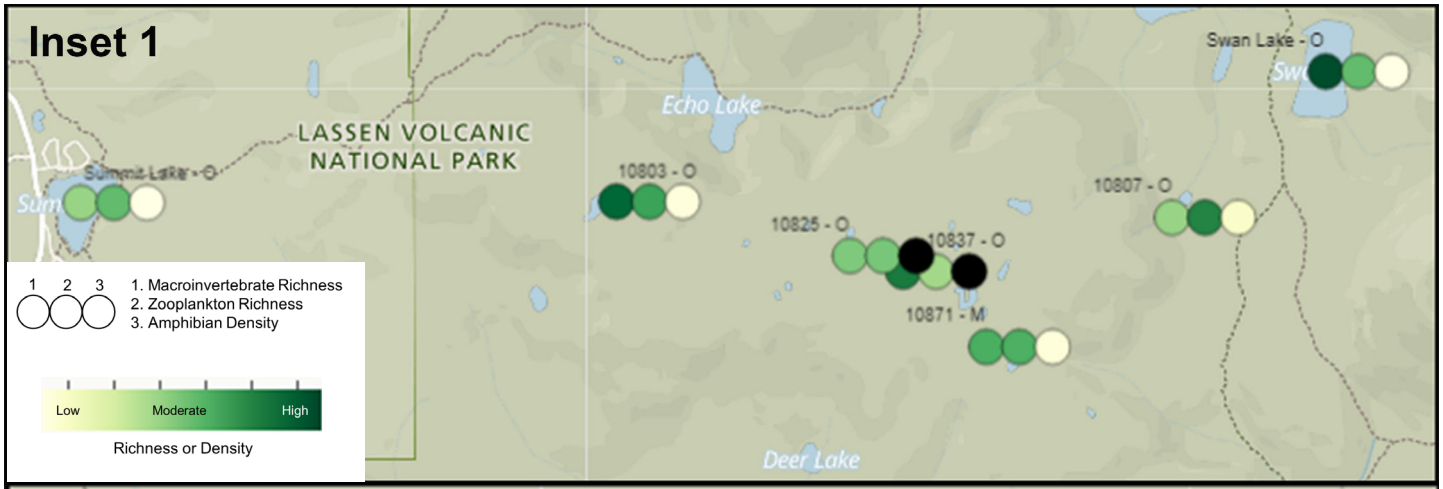
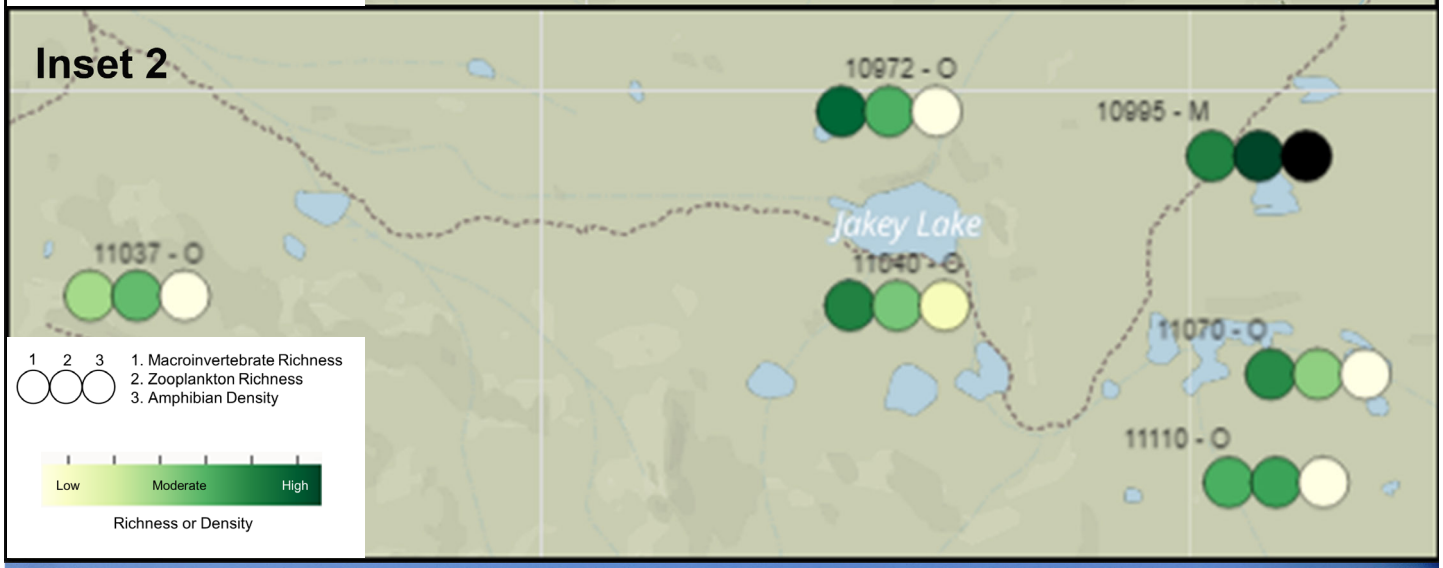
Project overview, reports, and protocol:
https://www.nps.gov/im/klmn/lakes.htm

Datasets and all related publications:
https://irma.nps.gov/DataStore/Reference/Profile/2171801


Wilderness Boundary
California National Historic Trail (approximate)
Lily Pond - M
Silver Lake - O
Little Bear Lake - O
10570 - O
Widow Lake - O
10564 - O
Wilderness Boundary
Inset 1
LASSEN VOLCANIC
NATIONAL PARK
Inset 2
10934 - O
11037 - O
Cliff Lake - O
Lake Helen - O
11211 - O
Bench Lake - O
Ink Lake - O
89
89
11364 - O
Sifford Lakes S - O
11403 - O
11352 - O
11354 - O
1 2 3
1. Macroinvertebrate Richness
2. Zooplankton Richness
3. Amphibian Density
Low
Moderate
High
Richness or Density
Leaflet


Inset 1
LASSEN VOLCANIC NATIONAL PARK
Echo Lake
Summit Lake - O
10803 - O
10825 - O
10837 - O
10807 - O
Swan Lake - O
10871 - M
Deer Lake
1 2 3
1. Macroinvertebrate Richness
2. Zooplankton Richness
3. Amphibian Density
Low
Moderate
High
Richness or Density


Inset 2
10972 - O
10995 - M
Jakey Lake
11037 - O
11040 - O
11070 - O
11110 - O
1 2 3
1. Macroinvertebrate Richness
2. Zooplankton Richness
3. Amphibian Density
Low
Moderate
High
Richness or Density

Site	Date Sampled	Zooplankton Taxa Richness	Macroinvertebrate Taxa Richness	Total Number of Amphibians	Chlorophyll µg/L	Trophic State
Lily Pond	7/16/2019	8	28	2	4.04	Mesotrophic
Summit Lake	7/17/2019	12	22	2	0.49	Oligotrophic
11211	7/18/2019	14	25	1	0.29	Oligotrophic
11403	7/19/2019	8	23	0	0.01	Oligotrophic
11037	7/20/2019	12	21	20	1.48	Oligotrophic
Ink Lake	7/21/2019	16	27	0	1.07	Oligotrophic
11364	7/22/2019	16	32	0	0.69	Oligotrophic
11352	7/29/2019	13	27	0	0.66	Oligotrophic
11354	7/30/2019	12	23	400	0.45	Oligotrophic
10825	7/31/2019	11	24	0	0.41	Oligotrophic
10837	7/31/2019	9	34	0	0.92	Oligotrophic
Sifford Lakes S	8/1/2019	12	27	0	0.38	Oligotrophic
Cliff Lake	8/5/2019	7	32	2869	0.27	Oligotrophic
10803	8/6/2019	14	37	73	0.89	Oligotrophic
Swan Lake	8/7/2019	12	40	13	0.25	Oligotrophic
Lake Helen	8/8/2019	1	8	6	0.09	Oligotrophic
10570	8/9/2019	11	30	0	0.97	Oligotrophic
10564	8/11/2019	11	33	0	0.58	Oligotrophic
Bench Lake	8/12/2019	6	20	945	1.21	Oligotrophic
10934	8/19/2019	12	32	0	0.84	Oligotrophic
Little Bear Lake	8/20/2019	13	35	406	0.70	Oligotrophic
Widow Lake	8/21/2019	13	41	20	0.68	Oligotrophic
10807	8/22/2019	16	22	229	0.84	Oligotrophic
10871	8/22/2019	13	28	96	2.14	Mesotrophic
10972	8/23/2019	13	37	20	0.68	Oligotrophic
11040	8/24/2019	11	33	350	0.35	Oligotrophic
Silver Lake	8/25/2019	13	37	366	0.18	Oligotrophic
10995	9/3/2019	21	33	0	3.29	Mesotrophic
11070	9/4/2019	10	32	12	0.67	Oligotrophic
11110	9/4/2019	14	28	26	1.28	Oligotrophic