

**Aquatic Plant Surveys in Donner Lake State Park, California:
2017**

Report to California State Parks

Final Draft

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Introduction

Aquatic plants have long been part of the benthic community of Donner Lake, California (Iwatsubo et. al 1972, Dong 1975, Allen, personal communication). Native plant species provide habitat for native fish (Lahontan redbreast shiner, (*Richardsonius egregius*) and Lahontan speckled dace, (*Rhinichthys osculus*)) over soft silt sediments where little cover would otherwise be afforded. Additionally these plants provide nursery grounds for young fish, stabilize substrates prone to resuspension and add to the dissolved oxygen content of the water. A lake's native aquatic plant community is an integral part of the underwater ecosystem.

However, when nonnative plant species become established they can have a range of impacts from a benign presence to disruption of the limnological and biological character of the water body. More commonly, invasive plants interfere with human recreation (boating, swimming, fishing) leading to the determination that certain invasive plant species are nuisance weeds.

Recently invasive weed species including Eurasian water milfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*) have become a nuisance in marinas, embayments, and shallow protected waters of nearby Lake Tahoe as well as the Truckee River. These species are difficult to eradicate once established due to their rapid growth and ability to proliferate through various biological means. The most effective method of preventing widespread outbreaks of aquatic invasive plants is to prevent their introduction. Even with a strict boat inspection program in place, preventing transport is very difficult in water bodies with multiple recreational interests and a close connection to established nuisance weed populations. Therefore, an early detection program designed to identify and treat invasive plant populations immediately after their discovery is an important line of defense against potential nuisance weed growth.

There have been previous studies that looked at the Donner Lake's plant community but they have been sporadic and lacked continuity as a result of disparate funding sources. A study of invasive species and limnology was conducted by the University of Nevada, Reno and the California Department of Fish and Wildlife in Donner Lake for three consecutive years (2010 - 2012), (Caldwell and Chandra 2012). The study included a whole lake shore zone survey for non-native plants both from a boat and from shore. The surveys were conducted above water with plant collections taking place for verification. During the 3-year effort no nonnative plant species were found.

In order to better characterize Donner Lake's plant community long term, California State Parks contracted with the UC Davis, Tahoe Environmental Research Center (TERC) to establish repeatable underwater surveys in the nearshore zone off Donner Memorial State Park and the outlet channel above the dam. This report details the establishment of the survey locations, methods of evaluation, and findings from the first round of surveys.

Study Area

Donner Memorial State Park covers the east and south shorelines of Donner Lake for a distance of 3 miles. The outflow from Donner Lake, Donner Creek, meanders through the state park after passing through a sixteen-foot high dam. The dam enhances Donner Lake's maximum water elevation by 14.4 feet providing 11,580 acre-feet of reservoir capacity. The dam is managed by the Truckee Meadows Water Authority for flood control and irrigation with minimum elevations maintained from late fall through early spring. Lake levels are allowed to rise to the maximum legal elevation (5935.8 ft AMSL) in late spring (depending upon available water from winter precipitation). Allowing for required releases, Donner Lake's surface elevation is held relatively constant through the summer.

There are few areas of the Donner Lake nearshore capable of supporting plant growth. Of the 6.1 miles of shoreline, only the area associated with Donner Memorial State Park and the far west end provide suitable shallow water habitat (figure 1). This is due to Donner Lake's steep sloping bathymetry and limited light transparency as measured by Secchi disk (5 - 12m Dong 1973; 4 - 14m Vineyard 1997). Additionally, the annual fluctuation in surface elevation of 14 feet prevents the establishment of perennial aquatic vegetation. Any plants able to root in this zone during the summer are subjected to desiccation and freezing during the winter months when the lake level is drawn down.

The area of the lake between the dam and main body of the lake will be referred to as the outlet channel. This section is unique in that it holds ponded water during the summer months when the lake is full but becomes part of Donner Creek as the lake elevation is lowered. Swift currents travel down the channel during dewatering leaving higher elevation regions dry. This is an important area for plant surveys as any species established in the area has a high likelihood of being transported downstream into the Truckee River.

During the winter of 2017-18 a dredging project will remove accumulated sediment in the outlet channel between the lake and the dam. This will dramatically change the bathymetry of this area and is likely to alter aquatic plant distribution for some time after the project is completed. It is recommended that the placement of the snorkel survey established during this study be reevaluated following the dredging project, and that a bathymetric survey of the region be undertaken in order to establish the new baseline.

Objectives

There were two objectives of this project, 1) establish repeatable underwater transects that could be used for both snorkel and scuba surveys, and 2) conduct surveys along the established transects to evaluate the spatial coverage of plant growth and identify the species present. The 2017 survey serves as a baseline to determine changes in the aquatic plant community both in scope and species diversity.

Methods

Establishment of Transects

On 7 September 2017 the Truckee Meadows Water Authority began decreasing the reservoir storage capacity of Donner Lake. Between 2 and 4 October, TERC staff established five aquatic plant survey transects in Donner Lake. During this time the lake surface elevation was 5929.1 feet above mean sea level (AMSL), 6.7 feet below full lake conditions, leaving a reservoir with a volume of 3966 acre feet (USGS-10338400, provisional data from National Water Information System). For the purposes of this report all depth measurements will be based on maximum lake surface elevation (5935.8 ft AMSL, i.e. 6.7 feet added to measurements taken in the field) as this represents the most common condition during the usual times of aquatic plant growth and abundance.

A total of 7 survey transects were established along the perimeter of Donner Memorial State Park in the main body of the lake with one transect being established along the thalweg of the outlet channel (figure 2). These survey areas were divided into snorkel surveys (5) designed to evaluate areal plant distribution and general species composition and scuba transects (2) which employed point intercept methods to identify plant species within a 0.25m plot.

Snorkel Surveys (see appendix 1 for detailed description)

Snorkel surveys were designed to be conducted by four people swimming abreast while noting plant coverage and general species composition. Due to staffing limitations, only two snorkelers were available for these surveys. To ensure broad coverage of the designated area, each snorkeler transited the area twice covering new bathymetry with each pass. During the October surveys, water quality conditions allowed snorkelers visible observation of the bottom 20 feet below the surface.

Snorkel survey 1 (281m)

The survey area was located in the outlet channel between the main body of the lake and the dam. Due to the low lake elevation during the establishment of the surveys, this survey followed the wetted channel as the remaining area was above the water line. The water depth was less than 2 feet throughout this survey area making it impractical to employ snorkel techniques. Instead, a wading survey was conducted. Due to the unique circumstances in this area, measurements of the wetted channel width were taken at five points to better characterize the survey location and how it may change with the current dredging project (table 1).

Snorkel Survey 2 (228m)

This snorkel survey transited a north-south direction and covered the area along the east side of Donner Lake. Due to the low lake level, aquatic plants began near the water's edge in an area that would normally be 7 feet underwater. The outer edge of the

survey was limited by visibility (20 feet). The water line represented a substrate transition zone from soft sediments underwater to hard packed sand and gravel above.

Snorkel Survey 3 (218m)

The area surveyed traversed an east-west zone from the western edge of the sandy beach west of the outlet channel to the State Park boat rental. The width of the survey area was determined by the shallowest edge of plant growth and the greatest depth of visibility. The substrate consisted of soft silt throughout the area.

Snorkel Survey 4 (360m)

The survey area covered an east-west section of shoreline over relatively shallow lake bottom. Unlike survey areas 2 and 3, the substrate in this zone was comprised of gravel, cobble, and boulder. Soft silt was only found on the deeper side of the survey area.

Snorkel Survey 5 (211m)

This survey area covered the region on the western edge of the state park. It traversed a north-south direction through China Cove, including the designated swimming area, to the shallow-water-warning buoy at the northern point. The lake bottom dropped off quickly compressing the width of the survey area due to visibility. The substrate varied with depth. The deeper area was comprised of large boulders separated by areas of soft silt while the shallow region was made up of sand, gravel, and cobble.

Scuba Transects (see appendix 1 for detailed description)

The scuba transects were designed to be a repeatable method of quantifying the species of aquatic plants within a known area (0.25m²). The intention was to establish a permanent underwater marker upon which a measured line would be attached. Divers attempted to secure rebar stakes at one end of each transect. Due to the depth of the soft sediment and its unconsolidated nature, the rebar disappeared into the bottom before becoming secure. Additionally the height and density of the aquatic plants present would have prevented future discovery of other marker types placed on the bottom. As an alternative method, detailed descriptions of each transect start location, heading, and depth were noted.

A 100 m measured line was attached to a temporary stake pressed into the bottom. Every 10m a quarter square meter quadrant was placed on the bottom. The species of aquatic plants within the quadrant were noted (table 2).

Scuba Transect 1

The scuba transect was located within the plant bed encompassed by Snorkel Survey area 2. It traversed depths between 14 and 18 feet deep over soft silt sediment. The survey line followed a magnetic heading of 0 degrees (-13.5 degrees of declination in Truckee, CA).

Scuba Transect 2

Similar to Scuba transect 1 this transect was located in a plant bed within the area of Snorkel Survey 3. It started at a depth of 12 feet and transitioned to a depth of 13 feet over fine silt sediment. The transect followed a magnetic heading of 260 degrees.

Findings

Snorkel Surveys

Snorkel surveys at the east end of Donner Lake and the outlet channel (surveys 1 - 3) were characterized by a thick growth of native aquatic plants. The plants were limited to soft silt substrates which were present below the lowest lake stand during winter drawdown. The only exceptions to this were shallow depressions outside of the main flow of the outlet channel where silt had accumulated. A wading survey of the depressions found the same plant species as in the outflow channel. This area is currently being dredged so future surveys may not present conditions suitable for aquatic plant growth.

Snorkel survey 1, located in the outlet channel, found three species of native plants. The species observed in order of abundance were (1) Richardsons pondweed (*Potamogeton richardsonii*), (2) elodea (*Elodea canadensis*), and (3) Robins pondweed (*Potamogeton robbinsii*) (figures 3-5). These species have previously been identified in Donner Lake.

Surveys 2 and 3 within the lake revealed nearly complete coverage of Richardson's pondweed exhibiting stem heights up to 10 feet (3m). With surveys being conducted late in the season, it is expected that plant growth had ceased in both height and propagation. Some plants were observed to be in the early stages of seasonal decay. For this reason it is believed that the maximum areal growth was observed but peak plant height had likely happened during late summer.

Along the shallow margin of the plant beds, patches of elodea were observed covering up to 1 m². Being a low growing species, it is possible that elodea is restricted to the margins of suitable habitat due to shading by the taller growing Richardson's pondweed.

The deep margin of plant growth appeared to be limited by bathymetry and light availability. Thick stands of Richardson's pondweed ended abruptly where the slope rapidly increased despite the continuation of soft silt substrate. The depth of change varied between snorkel survey 2 (20 ft) and survey 3 (17 ft).

Snorkel survey 4 exhibited a transition in substrate type from soft silt to predominantly sand, gravel, and cobble. The soft substrate was on the outer margin of the survey area (lake side) while the hard substrates dominated the shallow nearshore and western end. The hard substrates appear unable to support growth of the native aquatic plant species observed at the east end of the lake and are associated with the portion of the littoral zone that is exposed during reservoir drawdown.

Within the area of snorkel survey 4, two distinct plant beds were found. Both were comprised exclusively of Richardson's pondweed. The larger patch was estimated to be 30m long and 10m wide ranging in depth from 11 - 15 feet. A smaller plant bed was observed in 13 feet of water and again contained only Richardson's pondweed. A large area of gently sloping soft sediment existed along the lakeside edge of these plant beds allowing for their potential expansion. It is unlikely these plant beds could expand shoreward as the substrate is comprised of hard sediments (gravel, cobble, boulder).

No aquatic plants were found along snorkel survey 5. This is likely due to the substrate transitioning from sand, gravel, and cobble to silt at the same point where the bathymetry quickly increases in depth. While soft sediments typically conducive to plant growth exist along the outer edge of the survey area, the depth appears to be too deep for plant growth (20 ft) based on observations in the other survey areas.

Scuba Transects

Both scuba transects encountered a dense, tall growth of Richardson's pondweed along their respective 100m lengths. The exception to this were two point locations (40m and 80m) along transect 1 (table 2) where no plants were found. Plants of varying height were found along the transects, with some reaching 10 feet in height. During full lake conditions it is expected that some plants could reach the surface. The mono-crop of Richardson's pondweed leads to the possibility that once established, it out competes both Robbins pondweed and elodea, the two other aquatic plant species found during this study. Further evidence of habitat competition was displayed by elodea only being found on the shallow edge of Richardson's pondweed patches where it avoided shading.

The existing plant beds along the nearshore of Donner Memorial State Park provide habitat for other species. During the surveys, Lahontan redbreast shiners and Lahontan speckled dace were observed within the dense stands of Richardson's pondweed. Additionally, crayfish were found seeking shelter among the stems. Non-native brown bullhead catfish, rainbow trout, and brown trout have been observed utilizing this area as well (Allen, personal communication).

Throughout the survey areas, Asian clams were found. Both live and dead clams were located within soft sediments as well as on the surface of shallow sand and gravel. The clams became prominent in the lake about a decade ago and persist year round below the reservoir level.

Conclusions

Native plant growth in Donner Lake along the shoreline of Donner Memorial State Park appears to be healthy and stable. No non-native species of plants were found. The plant beds are associated with stable, soft, silt sediments occurring below the level of reservoir drawdown. This has the effect of separating aquatic plants from most forms of lake based recreation (boating, paddle boarding, swimming) with the exception of late summer when Richardson's pondweed is capable to reaching the surface.

Limitations to plant areal expansion appear to be the hard sediments and exposure as a result of the reservoir ring and light limitation associated with depth. While these limits appear to effect native species distribution, non-native plants may be able to exploit other habitats leading to increased regional coverage should they become established.

There does appear to be some competition effects on plant abundance as the dominant species, Richardson's pondweed, covers the vast majority of the area with limited growth of elodea and Robins pondweed occurring at the margins.

Annual monitoring of the plant beds utilizing the survey areas and scuba transects established during this study is recommended. It is likely the most efficient method of quickly identifying the establishment of non-native plants as large areas of the lake bottom can be visually assessed in a short period of time. With Donner Lake's proximity to other water bodies containing invasive plant species vigilance will be key in detecting changes in the plant community.

References

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Tables and Figures

Snorkel Survey 1	
Channel width at specific locations along the transect	
Location	Channel Width (m)
N39 19'20"; W120 14' 21"	4.5
N39 19' 20"; W120 14'19"	6.5
N39 19' 21"; W120 14' 16"	6
N39 19' 24"; W120 14' 16"	7
N39 19' 25"; W120 14' 14"	6.5

Table 1: Measured channel widths and locations along snorkel survey 1

Scuba Point Intercept Surveys					
Transect 1			Transect 2		
Location: N39 19' 27": W120 14' 26"			Location: N39 19' 25"; W120 14' 28"		
Heading: 0 degrees magnetic			Heading: 260 degrees magnetic		
Distance (m)	Plant Species		Distance (m)	Plant Species	
0	Richardson's Pondweed		0	Richardson's Pondweed	
10	Richardson's Pondweed		10	Richardson's Pondweed	
20	Richardson's Pondweed		20	Richardson's Pondweed	
30	Richardson's Pondweed		30	Richardson's Pondweed	
40	NA		40	Richardson's Pondweed	
50	Richardson's Pondweed		50	Richardson's Pondweed	
60	Richardson's Pondweed		60	Richardson's Pondweed	
70	Richardson's Pondweed		70	Richardson's Pondweed	
80	NA		80	Richardson's Pondweed	
90	Richardson's Pondweed		90	Richardson's Pondweed	

100	Richardson's Pondweed	100	Richardson's Pondweed
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Table 2: Species encountered along scuba transect 1 and 2 at specific locations

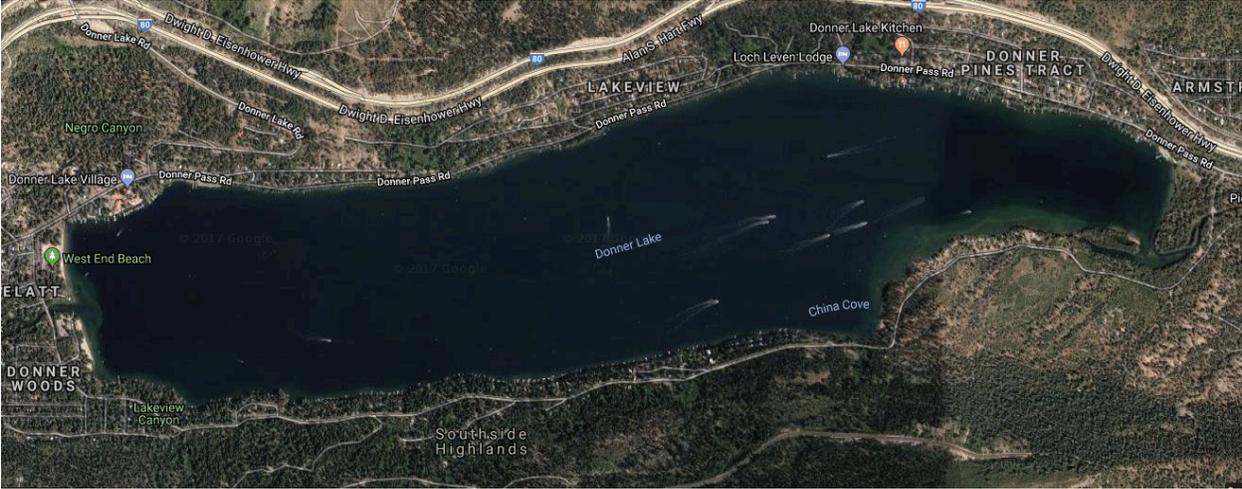


Figure 1: Google Earth image of Donner Lake displaying the limited shallow water, nearshore habitat available for aquatic plant establishment (light colored areas).



Figure 2: Google Earth image of survey areas with areal snorkel surveys indicated in grey and point intercept scuba transects delineated with a red line.



Figure 3: Richardson's pondweed (*Potamogeton richardsonii*) recovered from snorkel transect 1.



Figure 4: Elodea (*Elodea canadensis*) recovered from snorkel transect 1.



Figure 5: Robins pondweed (*Potamogeton robbinsii*) recovered from snorkel transect 1.

Appendix 1

Detailed descriptions of each snorkel and scuba transect

Snorkel Survey 1

The survey started at the concrete anchor for the “No Boats” buoy where the lake transitions into the outlet stream (N39 19’ 21”; W120 14’ 24”). Extended 281m downstream following the thalweg of the stream channel.

Snorkel Survey 2

The survey area paralleled the east end beach of Donner Lake. It extended 228m from prominent dead trees on the shoreline (N39 19’ 24”; W120 14’ 22”) at the south end to the fence delineating the boundary between Donner Memorial State Park and the Tahoe Donner Association property to the north (N39 19’ 31”; W120 14’ 19”).

The width of the snorkel survey was determined by water depth. The beach side (shallow) of the area was at a depth of 9 feet and the lake side (deep) was 20 feet deep.

Snorkel Survey 3

The area surveyed extended from the western edge of the small sand beach just west of the start of the outlet channel (N39 19’ 23”; W120 14’ 27”) to the boat rental beach covering a length of 218m.

The width of the snorkel survey was again determined by water depth. The shallow edge was 9 feet deep and the outer edge coincided with the sharp increase in bathymetric slope at a depth of 17 feet.

Snorkel Survey 4

The survey area started offshore of the largest boulder on the state park shoreline (N39 19’ 25”; W120 14’ 52”) at a depth of 9 feet. It extended in a westerly direction to the shallow water buoy at the point before China Cove (N39 19’ 20”; W120 15’ 04”). The length of the survey area was 360m with the outside edge following the break in depth contour at 17 feet.

Snorkel Survey 5

The survey area covered China Cove and north to the shallow water buoy near the point. The start point was adjacent to a large sunken log on the south side of China Cove (N39 19’ 11”; W120 15’ 09”). The end point was at the first shallow water warning buoy near the point (N 39 19’17”; W120 15’ 08”). The shallow margin of the survey area was 9 feet deep and the outer edge followed the limits of visibility at a 20 foot depth. This survey included the roped off swimming zone.