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**Biophysical Surveys of Aquatic Habitats in Gwaii Haanas**

**1993: Upper Victoria Lake, Lower Victoria Lake, Escarpment Lake  
and 14 Selected Streams**

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## 2.2.2 LOWER VICTORIA LAKE

### General description, morphometry and bathymetry

This is the second largest lake in Gwaii Haanas, situated immediately south of the Upper Victoria Lake watershed. The low mountains surrounding the lake are forested (Figure 13) and are within the syntectonic plutons. There are fourteen streams that drain into the lake; the major stream flows into the northeast corner (Figure 14). The single outlet stream draining from the west end of the lake has a variable gradient (average 5%) over the 600 m distance to the ocean. Presence of several narrow rock fissures and vertical water falls currently excludes anadromous fish from access to the lake. Where the stream enters the ocean, there is a narrow boulder bay bordered by wave-sculptured cliffs (Figure 13).

Morphometric data are summarized in Table 6. The lake is slightly less than 3 km in length, 800 m in width with a maximum depth of 43 m. Lake surface area is 8% of the total watershed area. Shoreline development index is low (1.68) and there is only a single small islet on the southwest side of the lake which is connected to the shore by a shallow channel. Site localities for biophysical data are shown in Figure 15.

**Figure 13 (opposite).** Lower Victoria Lake. Upper left - looking east from south shore. Lower left - looking east past rocky islets on west end of lake. Right - looking southwest from where outlet stream enters marine waters.

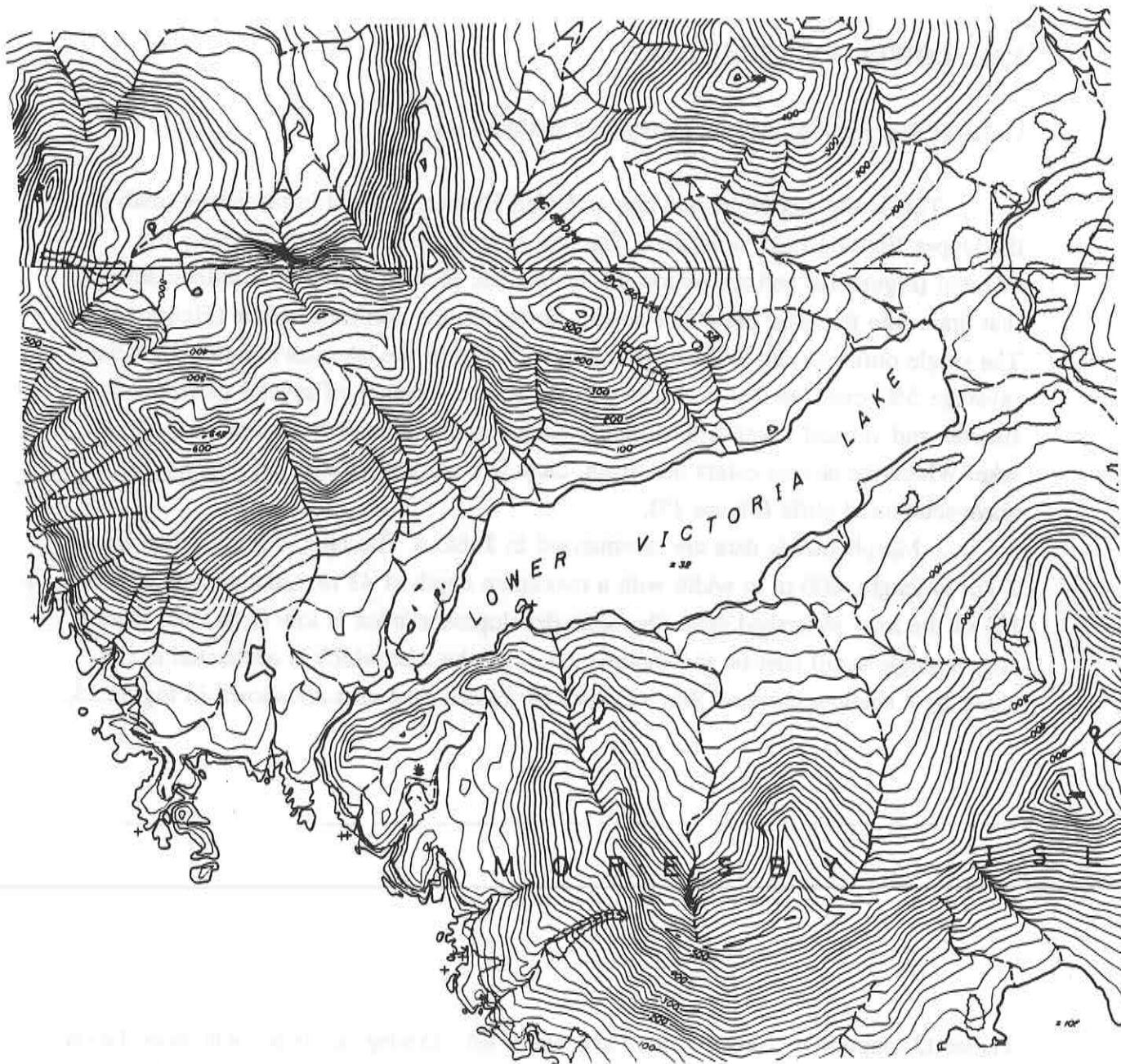
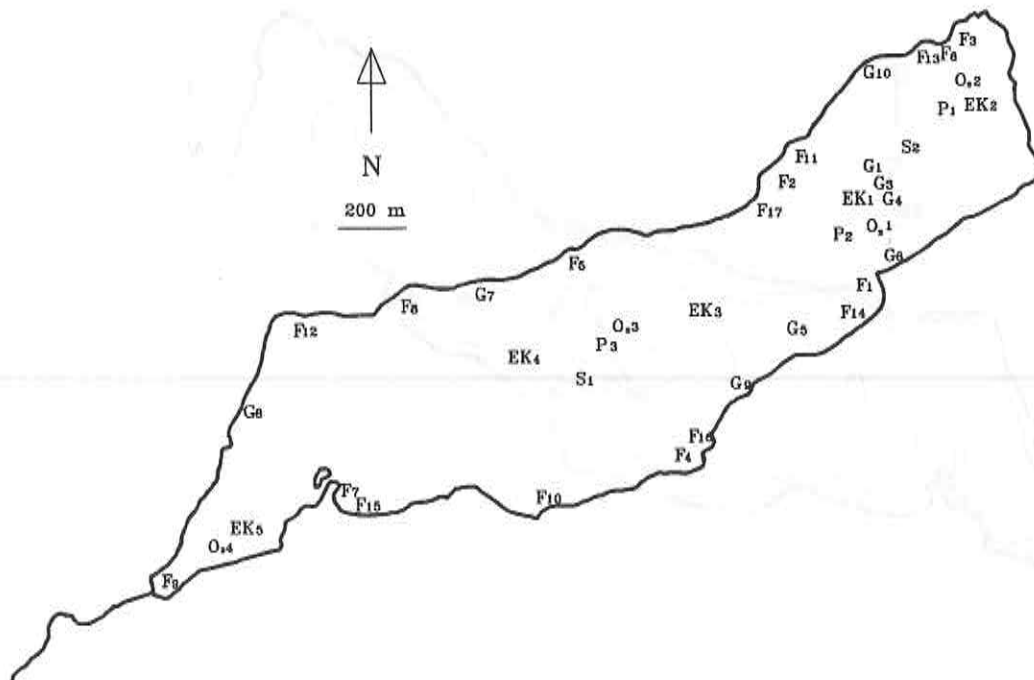


Figure 14. Topographic map of Lower Victoria Lake watershed. Scale: 1 cm = 300 m. Contours in 20 m intervals.

**Table 6.** General morphometric data for Lower Victoria Lake.

Elevation	32 m
Watershed area	1990 ha
Lake area	167.1 ha
Volume	30,455,724 m <sup>3</sup>
Maximum length	2989 m
Maximum width	797 m
Mean width	559 m
Maximum depth	43 m
Mean depth	18.2 m
Relative depth	2.97 %
Shoreline	7708 m
Shoreline development	1.68



**Figure 15.** Site localities for biophysical surveys in Lower Victoria Lake. EK - Ekman dredge, F - Fyke net, G - gillnet, O<sub>2</sub> - oxygen and temperature, P - plankton, S - Secchi.

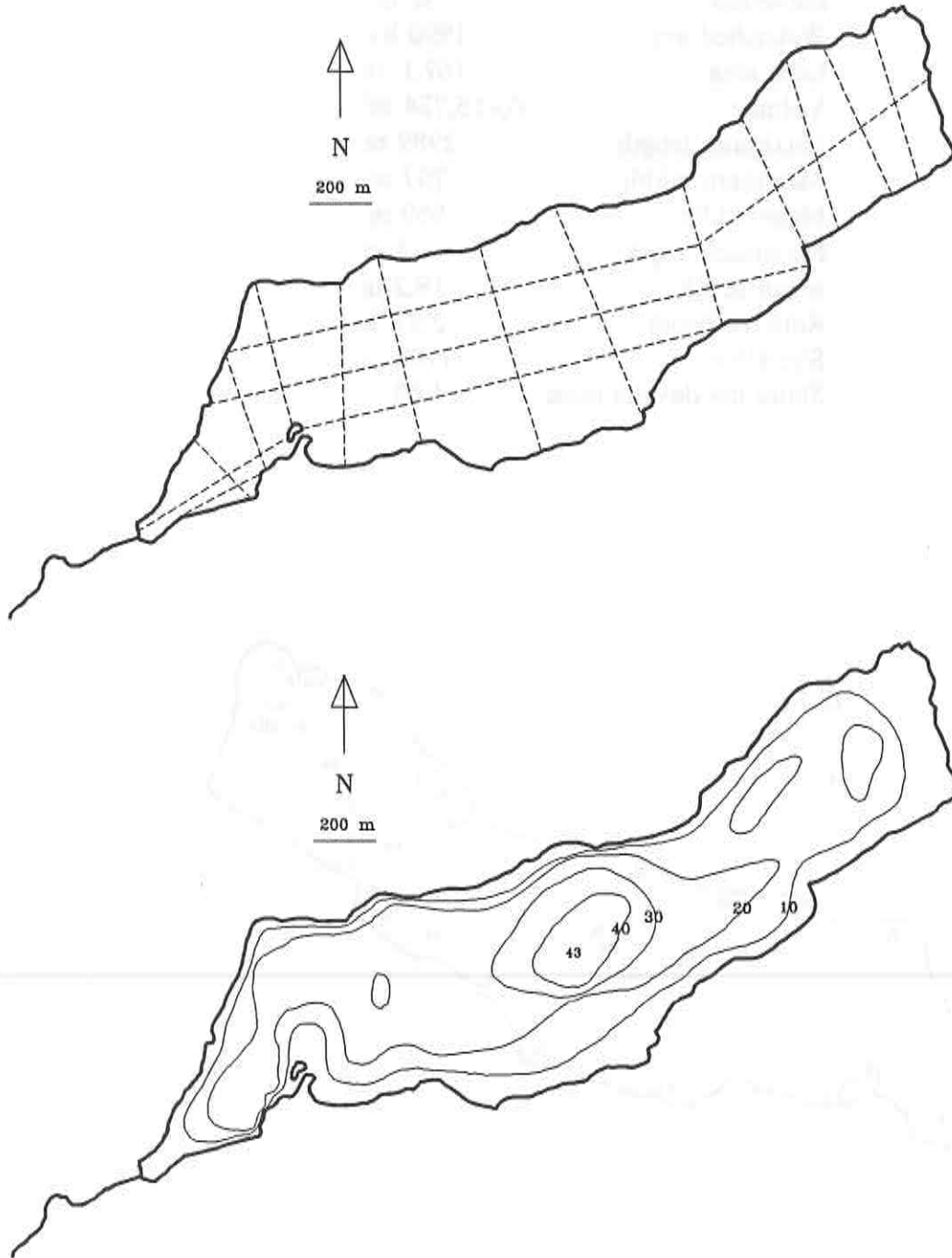


Figure 16. Bathymetry data for Lower Victoria Lake. Upper photo - boat transect positions, Lower - depth contours (m) and maximum depth records for selected areas.

A bathymetry curve (Figure 16) demonstrates a steep profile around much of the lake with the most gentle gradient on the east side. While there is a single major depression in the centre of the lake, there are also several secondary depressions. Hypsographic curve (Figure 17) shows the shallow water zone (<10m) comprises about 26% of the lake surface.

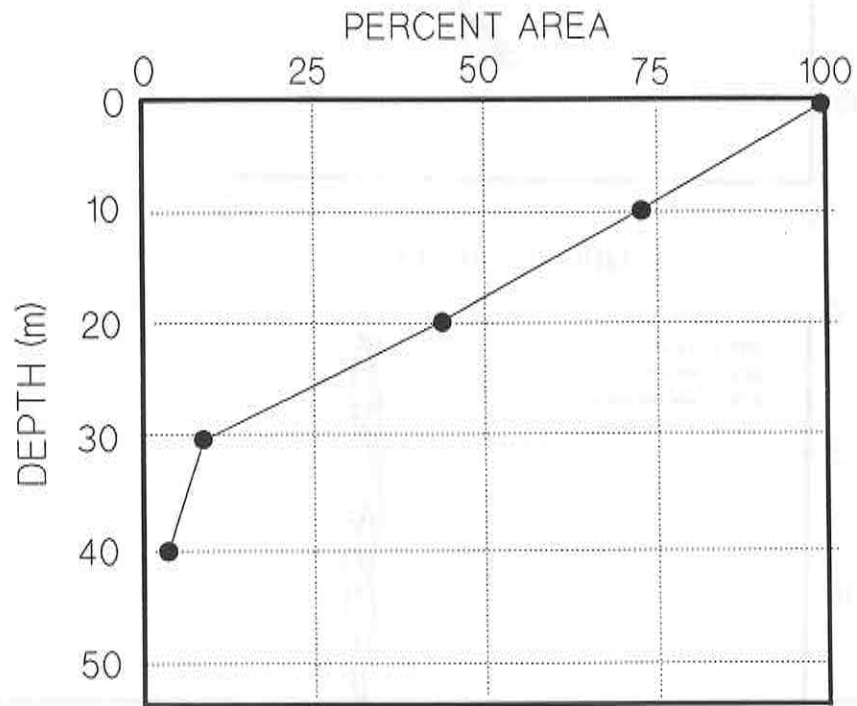


Figure 17. Hypsographic curve for Lower Victoria Lake.

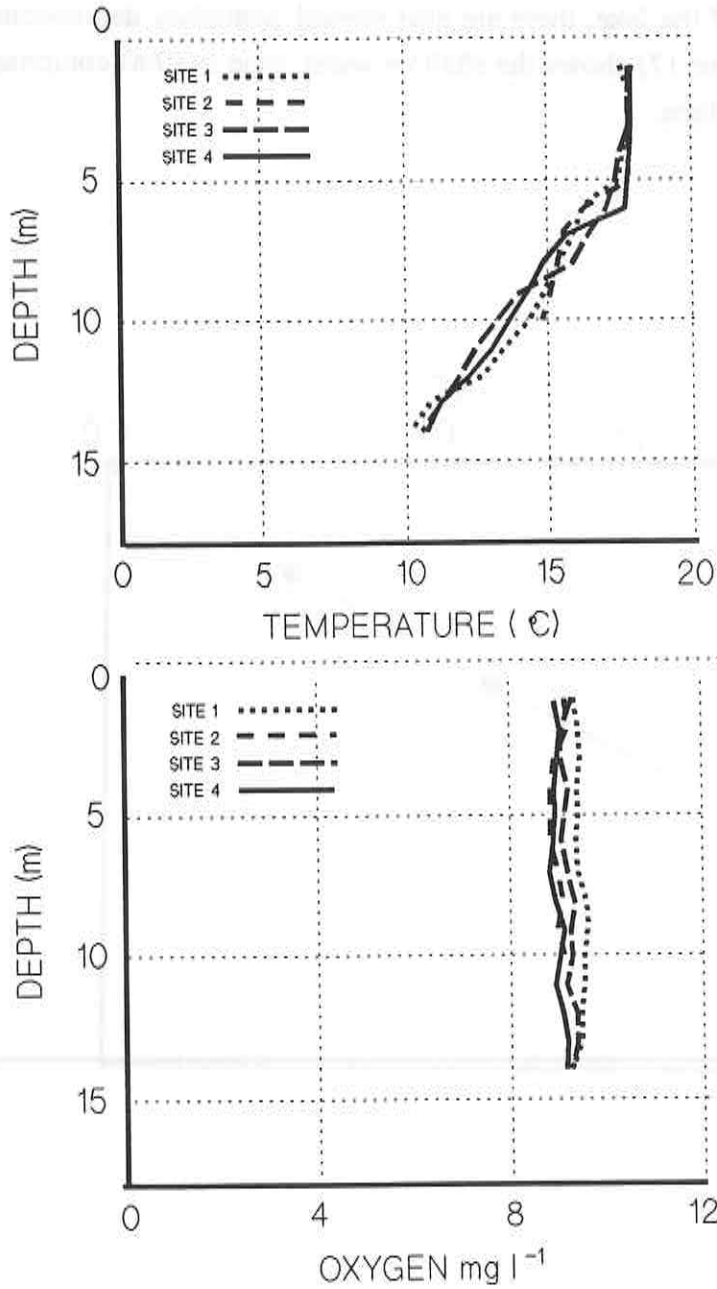


Figure 18. Temperature and oxygen profiles for Lower Victoria Lake.



## Chemical and spectral analyses

Conductivity and pH of the lake was 40  $\mu\text{mhos cm}^{-1}$  and 6.95 respectively at two geographically distinct localities in the lake. Chemical analyses (Table 7), indicates low levels of all elements with sodium and calcium relatively higher than others.

Light penetration was 5.6 m at the two open water sampling sites. Spectrophotometric data was 94.8% transmission at 400 nm, slightly higher than Upper Victoria Lake.

**Table 7.** Water chemical analyses for Lower Victoria Lake. All results in ppm. Blank values (-) are below detectable limits.

<b>P</b>	<b>S</b>	<b>Mg</b>	<b>As</b>	<b>Na</b>	<b>Al</b>	<b>Zn</b>	<b>Cu</b>
0.010	0.559	0.711	0.013	4.676	0.066	0.017	0.011
<b>Pb</b>	<b>Ti</b>	<b>Ni</b>	<b>K</b>	<b>Mn</b>	<b>Fe</b>	<b>Ca</b>	
0.005	-	0.021	0.714	0.004	-	1.404	

## Temperature and oxygen

Lake temperature was 18°C at the surface and 10°C at a depth of 15 m. The temperature profile (Figure 18a) shows an epilimnion thickness of about 6m followed by a relatively uniform temperature drop of 1°C per m down to a depth of 15 m. Site 4, on the west end of the lake, had the thickest epilimnion (6 m).

Oxygen levels ranged from 8.8 mg l<sup>-1</sup> to 9.2 mg l<sup>-1</sup> or approximately 90-93% saturation and were similar over the 15 m depth range (Figure 18b).

## Littoral substrate

Because of the relative steep profile around much of the lake, the shoreline is generally narrow (3 - 6 m) and rocky (Figure 13). Dominant substrates for each sector are summarized in Figure 19 while more detailed descriptions for shallow and deep littoral zones is shown in Table 8. The eastern region is composed primarily of coarse gravels and cobbles while the west is predominantly bedrock. Clay is present at greater depths. Submerged wood debris was common in several sectors (4, 12). Approximately 100 m from shore on the northwest and south side of the lake (near sectors 2, 12, 13, 14), tree spires protrude up to 5 m above the lake surface. They are anchored to the bottom in depths of up to 25 m and have resulted from major slides on adjacent mountain slopes.

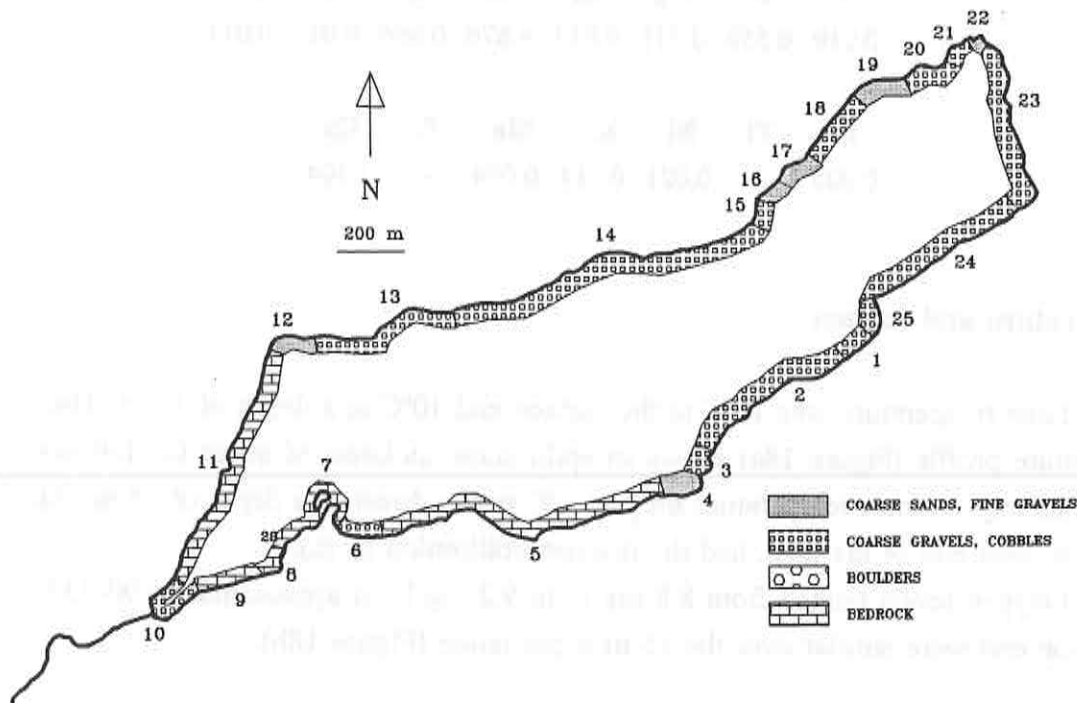


Figure 19. Dominant substrates in littoral zone for Lower Victoria Lake. Sectors show linear areas of similar substrate surveyed for macrophytes.

## Vegetation

### Aquatic

Aquatic plants were usually uncommon throughout the lake and were generally absent from bedrock shorelines found on the south and west regions (Table 8). Bays contained the more diverse assemblages. Six species of vascular aquatic plants as well as macroscopic algae and liverworts were recorded. Eight of the 25 sites (about 25% of the shoreline) had no macroscopic vegetation.

Isoetes echinospora, Juncus oreganus, Nuphar lutea, Chara and a leafy liverwort were widely distributed in the available sites, associated with the predominant substrate of coarse gravel. Within sites, Nuphar grew in small patches, while the other species were more randomly distributed. No site had a diversity of greater than 5 species. The major inlet stream had largely stagnant waters and was frequently covered in a brown scum (possibly iron bacteria).

### Terrestrial

The east and south shorelines (sectors 1-6) were dominated by lodgepole pine although yellow cedar, western hemlock and sitka alder were locally common (sector 7). The steep north facing slopes at the southwest corner of the lake contained western hemlock and sitka alder. Lodgepole pine and yellow cedar occur over most of the north shore of the lake apart from a dense stand of large sitka spruce and yellow cedar on an old slide (sector 13). Yew (Taxus brevifolia) and yellow cedar (extensively browsed) were common along the major inlet stream at the northeast corner of the lake. Menyanthes trifoliata occurred in small ponds adjacent to this stream.

Table 8. Dominant littoral substrates and macrophytes for Lower Victoria Lake. Values show percentage occurrence. Wood debris S - bark and twigs, L - large branches and trees. Macrophyte codes A - abundant, C - common, R - rare. See Figure 19 for lake sectors.

DEPTH SUBSTRATE	LAKE SECTOR														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<1m Gravel (<2mm)			20	80								20	10	10	
Gr(2-16mm)	10	10	10	20		20				20		60	10	10	30
Gr(16-64mm)	70	70	50			80				80		20	80	40	60
Gr(64-128mm)															10
Gr(128-256mm)					10										
Gr(>256mm)	20	20	20		90		10	9	50		10			40	
Bedrock							90	95	50		90				
Wood debris				L									L		
>1m Gravel (<2mm)										90		95	20		20
Gr(2-16mm)										10		5			
Gr(16-64mm)	10	10													
Gr(64-128mm)	10	10											80		
Gr(128-256mm)	75	75			30										80
Gr(>256mm)	5	5			70		10	5	5		10				
Bedrock							90	95	95		90				
Wood debris				L									L		
Isoetes	R	R	R								C				R
Sparganium	R		C								A				
Potamogeton															
Carex															
Juncus	C	R	C												R
Eleocharis															
Nuphar				C						A	C	C	R	C	
Ranunculus		C		C						C					
Callitriche															
Lilaeopsis															
Utricularia															
Algae	C														
Chara				C											R
Liverwort	C	R	C											R	C
Sponge															

Table 8 cont.

		LAKE SECTOR									
DEPTH	SUBSTRATE	16	17	18	19	20	21	22	23	24	25
<1m	Gravel(<2mm)							10			20
	Gr(2-16mm)	80	80	10	80	10	10	60			30
	Gr(16-64mm)	20	10	80	10	20	20	30	50	30	50
	Gr(64-128mm)		10	10	10	70	70		50	40	
	Gr(128-256mm)									20	
	Gr(>256mm)									10	
	Bedrock										
	Wood debris	S									
>1m	Gravel(<2mm)		90	10	90	20	20				
	Gr(2-16mm)		10		10						
	Gr(16-64mm)			20							
	Gr(64-128mm)			70						20	80
	Gr(128-256mm)					80	80			80	20
	Gr(>256mm)										
	Bedrock										
	Wood debris										
	Isoetes	C		R		R	C		C		
	Sparganium						A				
	Potamogeton										
	Carex										
	Juncus		C	R	C	R	R				
	Eleocharis	C									
	Nuphar	C		R		C					
	Ranunculus	C	C		C				C		
	Callitriche										
	Lilaeopsis										
	Utricularia										
	Algae										
	Chara	C	A	R	A	R	C		R		
	Liverwort		C	C	C						
	Sponge										

## Zooplankton

Zooplankton (copepods and cladocerans) were uncommon with an average density of 425 individuals per cubic meter (range 91-1209, Table 9). The greatest density occurred in the sample taken during darkness. A random sample shows the majority (92%) are cyclopoid copepods with small numbers of cladocerans. Settled volume was 0.25 ml.

Table 14. Zooplankton counts for Lower Victoria Lake. See Figure 15 for site position in lake. Plankton includes total counts for cladocerans and copepods.

SITE	TIME	DEPTH(m)	PLANKTON	NUMBER m <sup>3</sup>
P1	NOON	18.3	91	440
P1	MIDNIGHT	18.3	99	479
P2	NOON	24.4	25	91
P2	MIDNIGHT	18.3	250	1209
P3	NOON	39.0	101	229
P3	MIDNIGHT	19.2	22	101
<b>AVERAGE</b>				<b>425</b>

## Fish

Three species of fish were found in the lake (Dolly Varden, rainbow trout, threespine stickleback). Each species was present in most of the littoral sites sampled (Table 10). The outlet bay (sector 10, Figure 19) had the greatest abundance of threespine stickleback and also had high numbers of Dolly Varden and rainbow trout. Gillnets set in open water had low capture success both at the surface and bottom habitats. However, in littoral gillnets, Dolly Varden were common, consistent with the data on littoral Fyke nets. This suggests limited use of open water habitats. Stickleback were common in minnow traps from shoreline to depths of 5 m.

Length frequency distribution of Dolly Varden (N = 317) shows a modal size of 14 cm and a range from 5 to 22.5 cm (Figure 20). A scatterplot of length/weight data for Dolly Varden (Figure 21) shows an exponential association similar to that observed at Upper Victoria Lake. Rainbow trout (N = 107) had a SL mode near 16 cm (Figure 22) with a range from 7.5 to 29 cm. Threespine stickleback (N = 718) averaged 4.8 cm.

Analyses of Dolly Varden stomachs (N = 8, SL 12 - 13.2 cm) showed diptera pupae (Chironomidae, 4 stomachs), trichoptera larvae (2 stomachs) and threespine stickleback (2 stomachs). Rainbow trout stomachs (N=6, SL 10-20 cm) contained odonate naiads (Libellula, Aeshna, 2 stomachs), diptera pupae (Chironomidae, 2 stomachs), trichoptera larvae (1 stomach) and threespine stickleback (1 stomach).

For population estimates, a total of 280 Dolly Varden were marked and released at each capture site around the lake. A single recapture was obtained. This allows a crude estimate of 7500 individuals. Rainbow trout (N = 99) were marked and released and one individual was recaptured. This yields a population estimate of 4253 individuals. Both of these estimates lack rigour as reducing the number of recaptures by only one would produce an estimate of an infinite population size.

**Table 10.** Summarized data on fish collections in Fyke nets from Lower Victoria Lake. See Figure 15 for Fyke net positions. SITE - L (littoral), OWB (open water benthic), OWS (open water surface).

DATE	METHOD-SITE	DOLLY VARDEN	RAINBOW TROUT	STICKLE BACK
11/07/93	Fyke1 L	35	9	0
12/07/93	Fyke2 L	6	12	43
	Fyke3 L	0	0	0
12/07/93	Fyke4 L	43	24	88
	Fyke5 L	20	7	20
	Fyke6 L	3	0	8
13/07/93	Fyke7 L	18	7	80
	Fyke8 L	26	10	8
14/07/93	Fyke9 L	31	15	203
	Fyke10 L	2	0	0
	Fyke11 L	2	4	54
15/07/93	Fyke12 L	23	6	55
	Fyke13 L	11	2	40
	Fyke14 L	10	1	33
16/07/93	Fyke15 L	10	1	30
	Fyke16 L	12	1	0
	Fyke17 L	6	1	50
11/07/93	GN1 OWB(1-10cm)	6	1	0
12/07/93	GN2 OWB(1-10cm)	0	0	0
13/07/93	GN3 OWS(1-10cm)	1	0	0
14/07/93	GN4 OWB(1-10cm)	0	0	0
15/07/93	GN5 OWB(1-10cm)	0	0	0
	GN6 L (2.5cm)	12	1	0
16/07/93	GN7 OWB (1cm)	3	1	6
	GN8 L (2.5cm)	1	1	0
	GN9 L (2cm)	13	1	0
	GN10 L (5cm)	3	2	0
	<b>TOTALS</b>	<b>317</b>	<b>107</b>	<b>718</b>



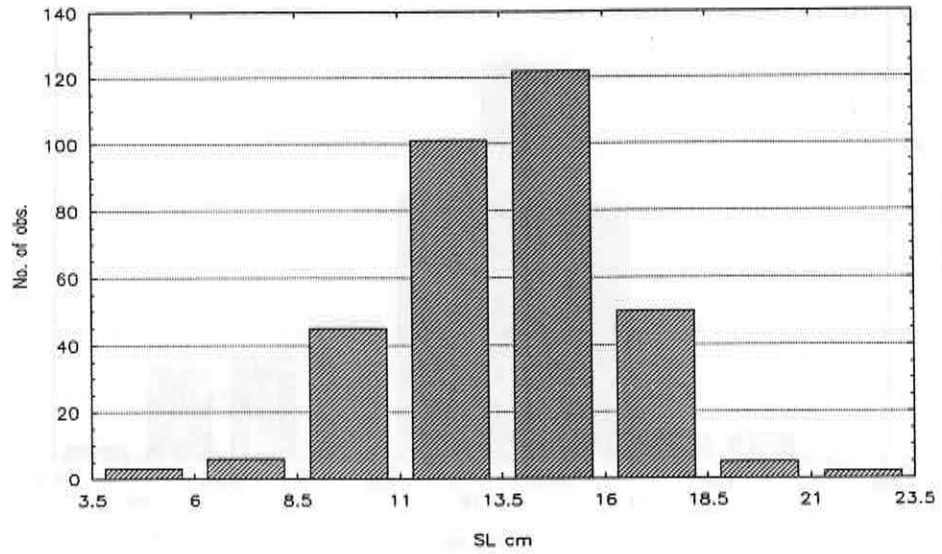


Figure 20. Frequency histogram of body length (SL) for Dolly Varden at Lower Victoria Lake.

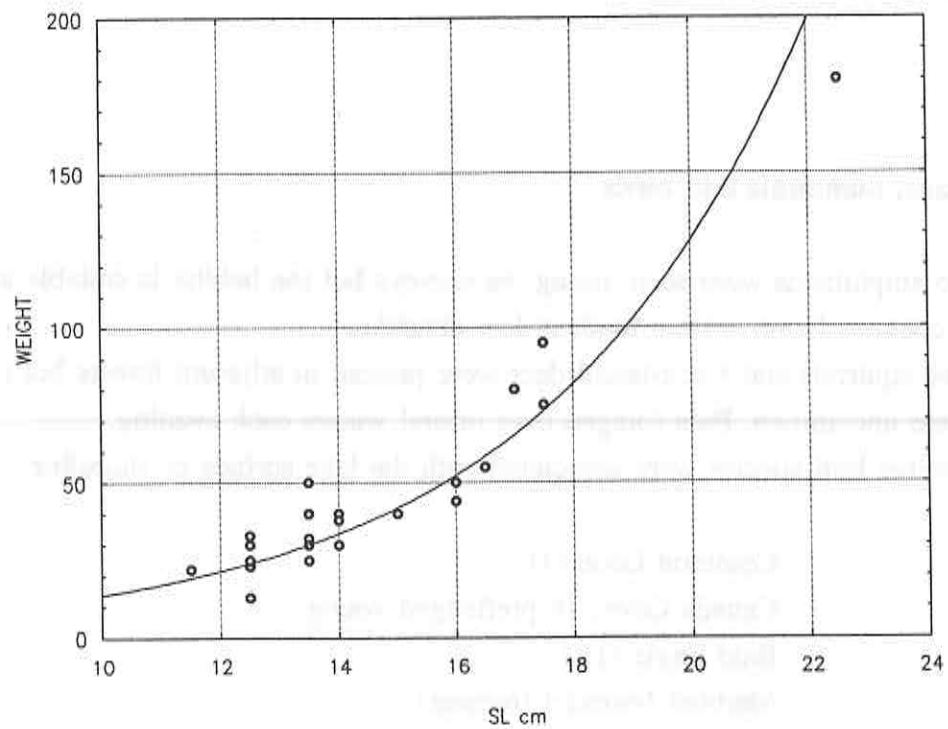


Figure 21. Length/weight relationship for Dolly Varden at Lower Victoria Lake.

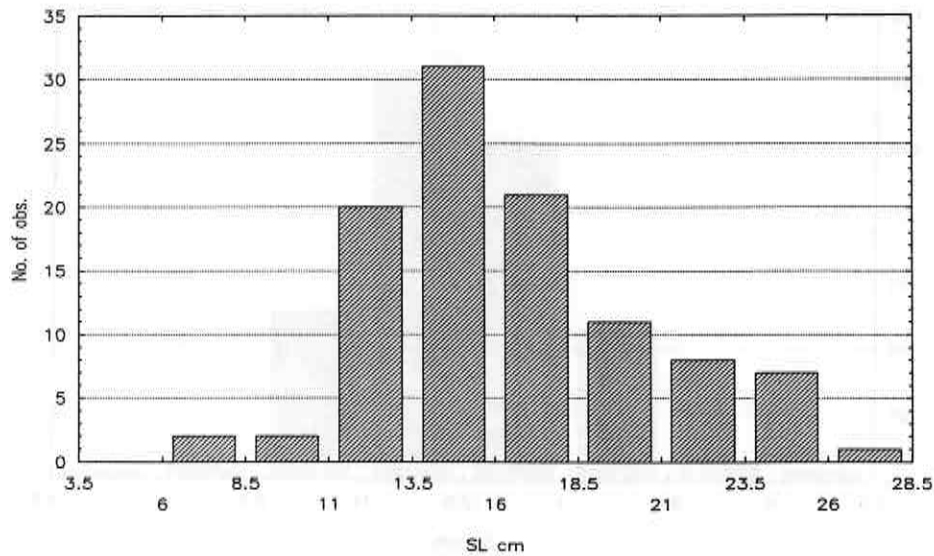


Figure 22. Frequency histogram of body length (SL) for rainbow trout at Lower Victoria Lake.

### Amphibians, mammals and birds

No amphibians were seen during the surveys but the habitat is suitable and probably contains Northwestern toads at low densities.

Red squirrels and black-tailed deer were present in adjacent forests but the former were uncommon. Bats foraged over littoral waters each evening.

Twelve bird species were associated with the lake surface or shoreline:

- Common Loon (1)
- Canada Goose (6 prefledged young)
- Bald Eagle (1)
- Marbled Murrelet (present)
- Glaucous-winged Gull (3)
- Belted Kingfisher (1)

Red-shafted Flicker  
Winter Wren (common)  
Hermit Thrush  
Western Flycatcher (with young, common)  
Townsend's Warbler (occasional)  
Chestnut-backed Chickadee (locally common)

Marbled Murrelets (up to 15 calls in the evening) were heard primarily from a small region of old growth forest on the north-western shore (sector 13). Pre-fledged Canada Goose were observed on the Sphagnum bog adjacent to the outlet stream while adult geese were observed foraging on the north shore of the lake. A Belted Kingfisher foraged at the inlet stream.

