INTERNAL REPORT 25

FINDLEY LAKE WATERSHED
A TERRESTRIAL-LAKE INTERFACE PROGRAM

R. R. Olson, J. G. Bockheim, F. C. Ugolini, R. Del Moral, M. Tsukada, E. B. Welch
University of Washington

One of the major objectives of the Western Coniferous Biome is to understand the relation between terrestrial ecosystems and the chemical and biological properties of drainage waters. The first year of study on such a program has been completed and has primarily entailed a year of descriptive studies.

The Findley Lake drainage basin consists of 155.4 ha. Three lakes cover 10.5 ha. One is 9 ha, and the other two, one moderately deep and one shallow, are smaller.

In the winter of 1970-71, an unusually heavy snow accumulated in the Cascade Mountains of Washington. Findley Lake area was no exception, and by mid-June, the lake was still blocked by a large plug of snow estimated to be at least 8 feet deep. The outlet was just starting to open, and the lake was finally clear of snow by early July. The accumulation of snow persisted within the forest cover so that by August 10 some snowbanks still remained. They were minimal.

The late departure of snow from the area greatly delayed the mapping of soils, parent materials, and subordinate vegetation. It also delayed the construction of a trail to the area. The trail was finally completed by mid-August by a crew from the forestry division of the Cedar River Watershed, City of Seattle Water Department.

Facilities at the lake during the summer of 1971 were very modest. A shelter was provided by a tent, a privy was established, and a two-man rubber raft provided access to the lake.

The mapping of soils and parent materials was completed September 1971 by Bockheim and Ugolini. Widespread areas of talus occur along the east and west slopes, which range from lake-level elevation at 1,130 m to 1,350 m. The slope range is from 30 to 40 percent.

Soils of mixed materials are highly variable in morphology and parent materials. These occur on the lower and middle slopes and on all aspects except ridgetops. Forested soils of mixed materials covered mainly by Tsuga heterophylla and Abies amabilis represent the largest mapping unit and are further subdivided on the basis of slope. The soils are deeply developed podzols with thick organic layers, a light grey A2 horizon developed in volcanic ashes, and orterde B horizons indurated and weakly cemented by organic matter and iron sesquioxides.

Four major avalanche tracks occur on the south and east slopes of the Findley basin. The soils of the avalanche tracks are poorly podzolized. These soils generally contain thick sola with an abundance of gravel, cobbles, and boulders. Considerable snow damage to trees is evident, particularly at lower elevations.

A few poorly drained meadows occur around the margin of Findley Lake. And at higher elevations, at the base of avalanche tracks, are well-drained meadows. These soils contain a complete stratigraphic record since the last major glaciation. Forest openings are grazed extensively by elk and bear, and considerable disturbance results from elk activity in the poorly drained soils.

The ridges about the Findley basin are mantled with residual soils. Where the ridges are forested, a thick organic layer exists. Where unforested, however, they contain a dark brown, cobbly A1 horizon over a thin, gravelly B2 horizon.

The vegetation survey was conducted by Del Moral in August 1971. Twenty-seven 0.1 ha plots were sampled intensively for species composition, density, cover, and frequency. Seven types have been provisionally designated, and their distribution plotted on a map. A more detailed analysis of the data is in progress. The vegetation is composed principally of a fairly homogeneous old-growth forest of Abies amabilis. Several portions of this area are proposed for designation as biomass or nutrient budget reference stands.

During September, six 1-meter cores were obtained by Tsukada from the deepest portion of Findley Lake. These cores are being extracted for paleoecology study by division into 5-mm increments. These cores will be analyzed for diatoms, pollen, cladocerans, and organic and inorganic (including lead) content, as well as carbon dating.

A qualitative survey of the macroscopic, benthic invertebrates was conducted by Paulson this summer. Collections were made from all habitats of the three lakes in the Findley system as well as the streams between them. These collections will be sorted and identified during 1972. One species of mayfly and several species of caddisflies are the dominant shallow-water consumers. In addition, the principal amphibians were Taricha granulosa, Bufo boreas, and Rana cascadae, with Ambystoma gracile and Hyla regilla less common. Breeding of the amphibians was observed within the first 6 weeks after the lake cleared of snow.

Limnological studies by Welch were made about monthly and were difficult to accomplish because of lack of a boat. Chemical analysis of these samples were performed by Spiridakis. Mean values for pertinent variables were as follows: total phosphorus 5 µg/l, ortho phosphorus 1 µg/l, nitrate nitrogen 3 µg/l, silica 76 µg/l, calcium 1 mg/l, magnesium 0.6 mg/l, sodium 1 mg/l, potassium 25 µg/l, chlorophyll a 0.3 µg/l, and primary productivity of 370 mg $C/m^2/day$. Findley Lake was extremely clear with visibility extending to 15 meters deep. Because the lake is deep (30 meters) and unproductive, the hypolimnion remained well oxygenated. Maximum water temperature noted at the lake during the infrequent visits was 18 C. The dominant organism in zooplankton samples were Diaptomus shoshone and Holopedium gibberum. The conditions in the lake definitely indicate a lack of human activity and will serve as an excellent base from which to define the causes for productivity control within the lake series.

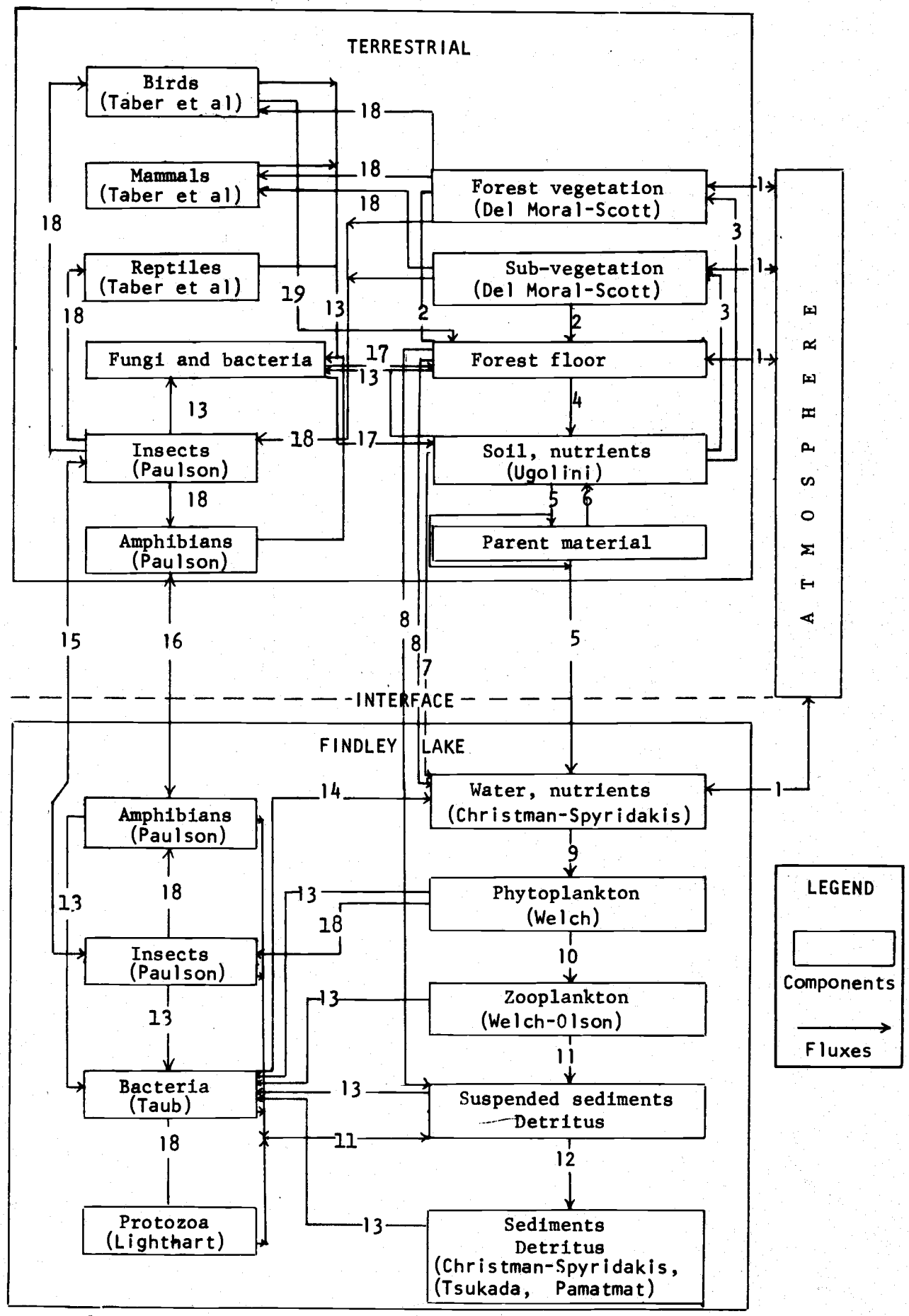

FIGURE 1 TERRESTRIAL - LAKE INTERFACE PROGRAM: FINDLEY LAKE WATERSHED

Transfer functions in Figure 1

1. Gas exchange with atmosphere (Fritschen)
2. Return to forest floor (Cole)
3. Uptake by vegetation (Scott)
4. Leaching into and through soil (Cole, Ugolini)
5. Deep leaching (Wooldridge)
6. Release to soil from parent material (Ugolini)
7. Soil leaching shallow (Cole, Wooldridge)
8. Surface flow (Wooldridge)
9. Phytoplankton assimilation (Welch)
10. Zooplankton consumption (Welch, Olson)
11. Death
12. Sedimentation (Pamatmat)
13. Decomposition (Lighthart), detritus (Taub), sediments (Matches, Pamatmat), water column (Packard)
14. Return from bacterial decomposition (Taub, Lighthart)
15. Movement of insects across interface (Paulson)
16. Movement of amphibians across interface (Paulson)
17. Return to soil and forest floor by bacteria and fungi
18. Consumption, terrestrial (Taber et al), aquatic (Paulson)
19. Return to forest floor by consumers

SUPPLEMENTAL REPORT 25-A

FINDLEY LAKE VEGETATION SURVEY PROJECT

R. Del Moral

University of Washington

During August 1971, I, with two assistants, surveyed the vegetation of the Findley Lake Basin. Twenty-seven 0.1-ha plots were sampled intensively for species composition, density, cover, and frequency. Trees were cored for aging, and all diameters recorded. Photographs were made, and extensive notes concerning rare species, microsites, soil, exposure, slope, elevation, location, and evidence of disturbance were recorded at each site. A preliminary report tabulated density (or frequency), cover, and importance values for each species in each stand. Seven types were provisionally designated, and the distribution of these types plotted on a map made from an aerial photograph.

A more detailed analysis of the data is in progress. A program to ordinate the stands is being refined, and stands will be reanalyzed with this similarity ordination. Stand dynamics and various synthetic attributes of the vegetation are being determined.

The vegetation is composed principally of a fairly homogeneous old-growth forest of Abies amabilis. Several portions of this area are suitable for designation as reference stands for biomass or nutrient budget studies.

The complete report will be a regular scientific report, submitted to a journal of regional interest such as Syesis or Northwest Science. This is primarily because of its highly descriptive nature and little theoretical interest.

The vegetation survey begun here should be extended to the entire drainage.

SUPPLEMENTAL REPORT 25-B

PALEOECOLOGY OF FINDLEY LAKE

M. Tsukada

University of Washington

During the week of September 13, six 1-meter cores were taken below about 20 m of water from Findley Lake. These samples could not be obtained earlier, because of the ice and snow cover; the lack of the trail way prevented the operation. The cores are being extracted and divided at 5-mm intervals. Diatom, pollen, and other analyses have started, and the diatom and pollen analyses should be completed by late November.

The uses of the cores are for: lead analysis, carbon dating, diatom and pollen analyses, organic analyses, inorganic analysis, and cladoceran analysis.

Before taking the samples from Findley Lake, the methods to be employed were tested and perfected on cores from Angle Lake (47°26' N, 122°17' W) near the Sea-Tac Airport. The data in Table 1 aided in the interpretation of the work on Findley Lake.

Table 1. Angle Lake data.

Depth	*Asterionella formosa* (diatom)	LOI	Chlorophyll derivatives
Cm	*Percent*	*Percent*	*OD/100 mg sed*
0.0	49.2	37.4	0.406
0.5	50.7	29.6	0.515
1.0	51.9	22.4	0.361
1.5	52.7	18.0	0.538
2.0	55.9	22.4	0.321
2.5	59.3	25.3	0.322
3.0	63.0	26.6	0.232
3.5	54.8	27.2	0.268
4.0	57.4	28.4	0.307
4.5	56.1	31.2	0.303
5.0	51.3	33.2	0.278
5.5	43.6	36.4	0.302
6.0	37.6	39.2	0.428
6.5	39.0	38.8	0.421
7.0	40.7	39.0	0.495
7.5	28.2	40.2	0.448
8.0	22.0	48.2	0.428
8.5	17.0	40.9	0.448
9.0	9.1	42.8	0.380
9.5	8.1	42.5	0.331
10.0	7.0	43.9	0.343

SUPPLEMENTAL REPORT 25-C

LIMNOLOGICAL ASPECTS OF FINDLEY LAKE

E. B. Welch

University of Washington

Three water-sampling field trips were conducted to Findley Lake in the late summer of 1971. The lake was not accessible before this time because of snow cover. As predicted, Findley was the most oligotrophic in the four-lake series under investigation. Mean values for pertinent variables were as follows: total phosphorous 5 µg/liter, orthophosphorous 1 µg/liter, nitrate-nitrogen 3 µg/liter, silica 76 µg/liter, chlorophyll *a* 0.3 µg/liter, and primary productivity 370 $mgC/m^2/day$. Findley Lake was extremely clear, with visibility extending to 15 meters deep. As the lake is deep (30 meters) and unproductive, the hypolimnion remained well oxygenated. The conditions in the lake definitely indicate a lack of human activity and will serve as an excellent base from which to define the causes for productivity control within the lake series.