E4268

BIOTIC SURVEY OF ROSS LAKE BASIN

Report for

July 1, 1974 -- September 30, 1975

Conducted by the Center for Ecosystems Research, College of Forest Resources, University of Washington, Seattle -- in cooperation with the City of Seattle, Department of Lighting, and the State of Washington, Department of Game -- under contract with the City of Seattle, Department of Lighting.

Dean, College of Forest Resources:	James S. Bethel
Director, Center for Ecosystem Research	Dale W. Cole
Principal Investigator:	Richard D. Taber, Professor, College of Forest Resources
Collaborating Investigators:	David R. M. Scott, Professor; Leo J. Fritschen, Professor; Charles H. Driver, Professor; and David A. Manuwal, Assistant Professor.
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INTRODUCTION

This report covers the fourth field period in the investigation of the general topic of determining what effects the raising Ross Lake level would have on the Basin biota, and how undesireable effects could be avoided or compensated for.

Earlier reports have described the various species of vertebrate animals found in the Ross Lake Basin, the plant communities within which they live, and the general effects to be expected if the lake level is raised.

In the course of this earlier work, evidence has been obtained which suggests that the water in the lake has an effect on the local microclimate, one consequence of which is that precipitation on and close around the lake tends to fall as rain rather than snow. The effect of this is to create a shallow-snow or snow-free zone around the lake shore. The so-called "warm bowl" effect is important to understand more completely, to increase the accuracy of any prediction concerning the microclimatological effects of raising the lake upon the snow regime of the shore.

We have followed two lines of investigation in our efforts to learn more about the "warm bowl" effect. One is to make direct instrumental measurements of temperature and precipitation, and snow depth, along a transect perpendicular to the shore. The other is to record the seasonal phenology (annual cycle of growth) of representative plant species along a transect perpendicular to the shore. In previous years we have obtained some data of both of these sorts. This year we concentrated on this type of work again, in an effort to strengthen our understanding of the supposed "warm bowl" effect. In a year of reduced budgets, we considered that this would be one of the most significant studies that we could carry on.

At the same time, we were able to add to our direct knowledge of the winter food habits of the deer on the various major winter ranges around the lake, through analysis of pellets gathered at winter's end. The technique of pellet analysis has recently been developed, and it has been only in the last year that we have develpped the capability of making such analyses.

In addition our field crews recorded any wildlife observations that were made in the course of their work.

Our results are presented under: Microclimatology, Plant Phenology, Deer Food Habits, and Snow and Winter Deer Movement.

Microclimatology:

Snow stakes, which were marked off for easy reading at a distance, were established at 23 locations, mostly in five transects perpendicular to the lake shore, one in Canada 9 miles north of the border (upper Skagit), one in the cleared belt marking the border (which is about at the head of Ross Lake), one on the south face of Desolation Mountain [illegible] Creek, and one at Ruby Point. One purpose of these snow stakes was to quantify the variations in snow-pack at the same distance above the lake, but at different locations with respect to the rain-shadow caused by the high mountains lying west of the Ross Lake Basin. The readings of snow depth for January 21, March 4, and April 30, 1975, are shown in the following table:

Elevation	Upper Skagit	Border	Desolation	Lightning	Ruby
			January		
3000'	1.5'	2.0'	2.0'	2.0'	3.0'
2500'	1.5'	1.5'	1.0'	1.0'	2.0'
2000'	no stake	1.0'	patches	patches	1.0'
			March		
3000'	1.5'	2.0'	2.0'	2.0'	2.5'
2500'	1.5'	1.5'	1.5'	1.5'	1.5'
2000'	no stake	1.0'	patches	patches	1.0'
			April		
3000'	clear	1.0'	patches	clear	patches
2500'	clear	clear	clear	clear	clear
2000'	no stake	clear	clear	clear	clear

If we compare snow-accumulation at the 3000' level, we find a pattern of deeper snow at Ruby becoming progressively less northward. This supports the theory that a rainshadow exists northward from Ross Dam. If this is true, the precipitation at a long-term weather station on the Canadian Skagit should be substantially below that at Ross Dam.

Further comparisons of precipitation are possible between Ross Dam station and our own station on Desolation Mountain; at 2360'

Period		Ross Dam	Desolation Mtn.
12/3 - 1/2/75		13"	7"
1/2 - 1/22/76		7.5"	2"
2/22 - 3/12/76		1.2"	0.8"
3/12 - 3/27/76		3"	2"
3/27 - 4/23/76		1"	0.5"
4/23 - 5/14/76		1.5"	1.5"
5/14 - 6/5/76		1"	0.7"
	Total	28.2"	14.5"

The fact that precipitation on Desolation Mountain is only about half of that at Ross Dam further illustrates the presence of a stronger rainshadow effect over the northern part of Ross Lake than at the Dam.

The snow-stake data may also be examined to see whether the presence of the supposed "warm bowl" of the lake has any discernable effect. Such an effect would be strongest at lowest elevations. Perhaps our best comparison is between Ruby (which is subject to lake influence) and Border (which is north of winter lake influence). Ruby shows 50 per cent more snow at 3000' in January than Border does, which presumably means that Ruby has a greater precipitation. However, at lower elevations the difference fades away, being 25 per cent at 2500' and zero at 2000'. Consistently similar patterns are found in March and

April. One reasonable explanation is that although Ruby has greater precipitation, it also has a greater rate of snow melt (3000') or a lesser percentage of precipitation falling as snow (2500' and 2000). Both of these would be consistent with the idea that the lake water exerts a warming effect on precipitation and snow-pack.

The relation between air temperatures on a gradient perpendicular to the lake shore, and the putative "warm bowl effect" is now being investigated, using the November - June temperatures at five stations ranging between 1850' and 2980'.

Plant Phenology

Plant phenology was studied along the same transect mentioned above, though the plant phenology extended both below and above the line of weather stations, from 1650' to 4250'. A parallel, though shorter transect, was established east of Lightning Creek -- i.e. behind Desolation Mountain and so well removed from any influence of the lake on microclimate.

Vine maple development was compared on the two transects, which we can call the nearlake and farlake transects respectively.

On the lowest stations (1650-2100') nearlake bud burst was April 23. Farlake bud burst was two weeks later.

At 2500-2600' nearlake bud burst was May 7. Farlake bud burst was about ten days later.

Parallel data for pipsissewa, or princess pine (*Chimaphila umbellata*) show an even greater difference, namely two weeks and almost three weeks.

It appears that a slope far from the lake has a spring season two weeks later than a slope near the lake. This finding tends to support the idea that nearlake areas enjoy an earlier spring than farlake areas. At the same time, however, we must note that our nearlake transect had less shading than our farlake transect, by virtue of facing a wider valley.

We sought to gain further insight into the workings of the "warm bowl effect" by taking detailed phenological records on the long nearlake transect. We were particularly interested, in this case, in the variation between altitudes. The results are presented in Figures 1-6. For each of the species shown, there tends to be a delay in development with increase in altitude. This is expected, since the temperature tends to decline with increase in altitude. However, we are particularly interested in variations from station to station, or one section of the transect compared to another. Some reflection of this can be seen from our pooled data in the following table

Days of Delay in Plant Development with Increase in Altitude.

	1650' 1850'	1850' 2050'	2050' 2250'	2250' 2450'	2450' 2050'	2650' 2850'	2850' 3050'	3050' 3250'	3250' 3450'	3450' 3650'	3650' 3850'	3850' 4050'	4050' 4250'
Days Delay	0.8	0.8	1.5	2.2	4.2	14.2	19.2	26.2	27.8	30.9	31.6		33.8
Percent change	=	0	.9	.5	.9	24.4	.4	.3	.1	.1	0		.1 .1

It would appear from this that there is a sharp change between 2500' and 3000', with the season being 10-14 days earlier below. This finding supports our earlier observations.

Reverting to our snow depth data, it will be recalled that for the Desolation Mtn. snow transect, which paralleled the phenology transect, we found the following snow depths by altitude.

	January 21	March 4	April 30
3000'	2.0'	2.0'	patches
2500'	1.0'	1.5'	clear
2000'	patches	patches	clear

Snow depths at 2500' were actually greater in March than in January. At 2000' snow was only patchy through March. About the third week in April shrubs such as serviceberry and bitter cherry begin growth (bud-burst). The delay in this development around 2500' - 3000' correlates with the late lying snow at 2500' and above.

A comparison of our limited data for Lightning Creek (Figures 5 and 6) with that for Desolation Mountain (Figures 1-6) shows that the slope of delay with altitude is the same for each.

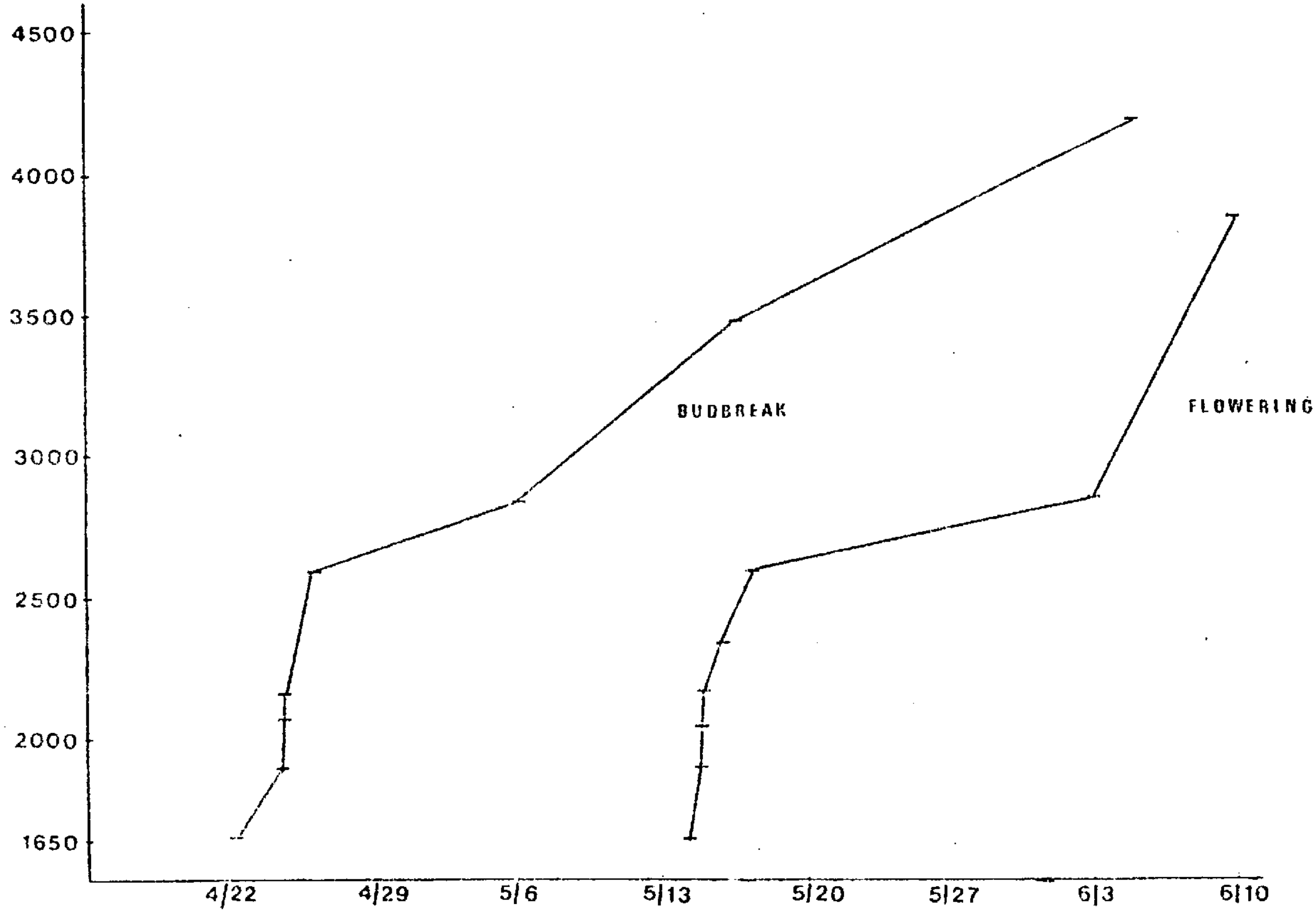

Fig. 1 Occurance of bud break and flowering in Western Serviceberry (*Amelanchier alnifolia*) along Desolation Mt. trail.

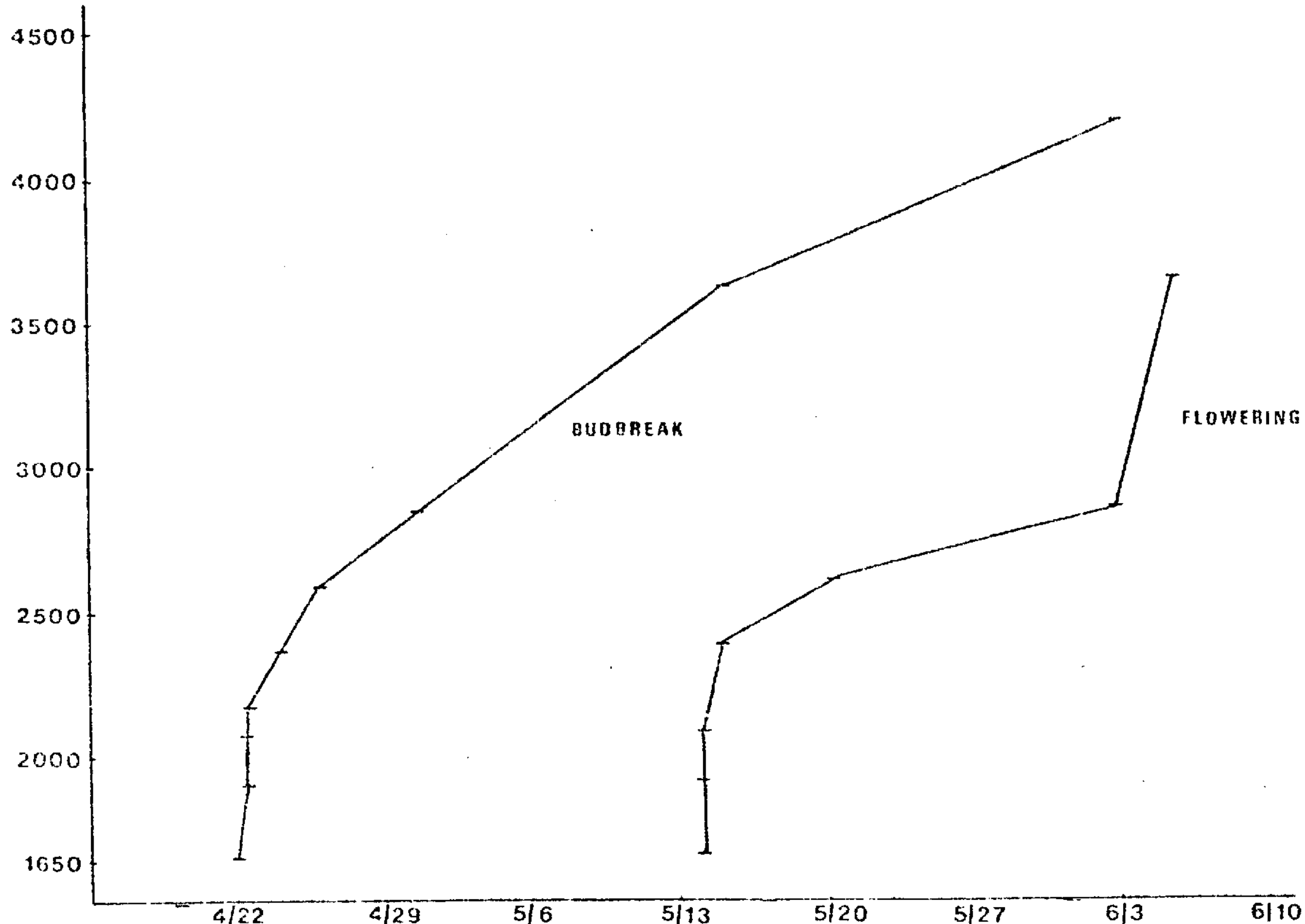

Fig. 2 Occurance of bud break and flowering in Bitter Cherry (*Prunus emarginata*) along Desolation Mt. trail.

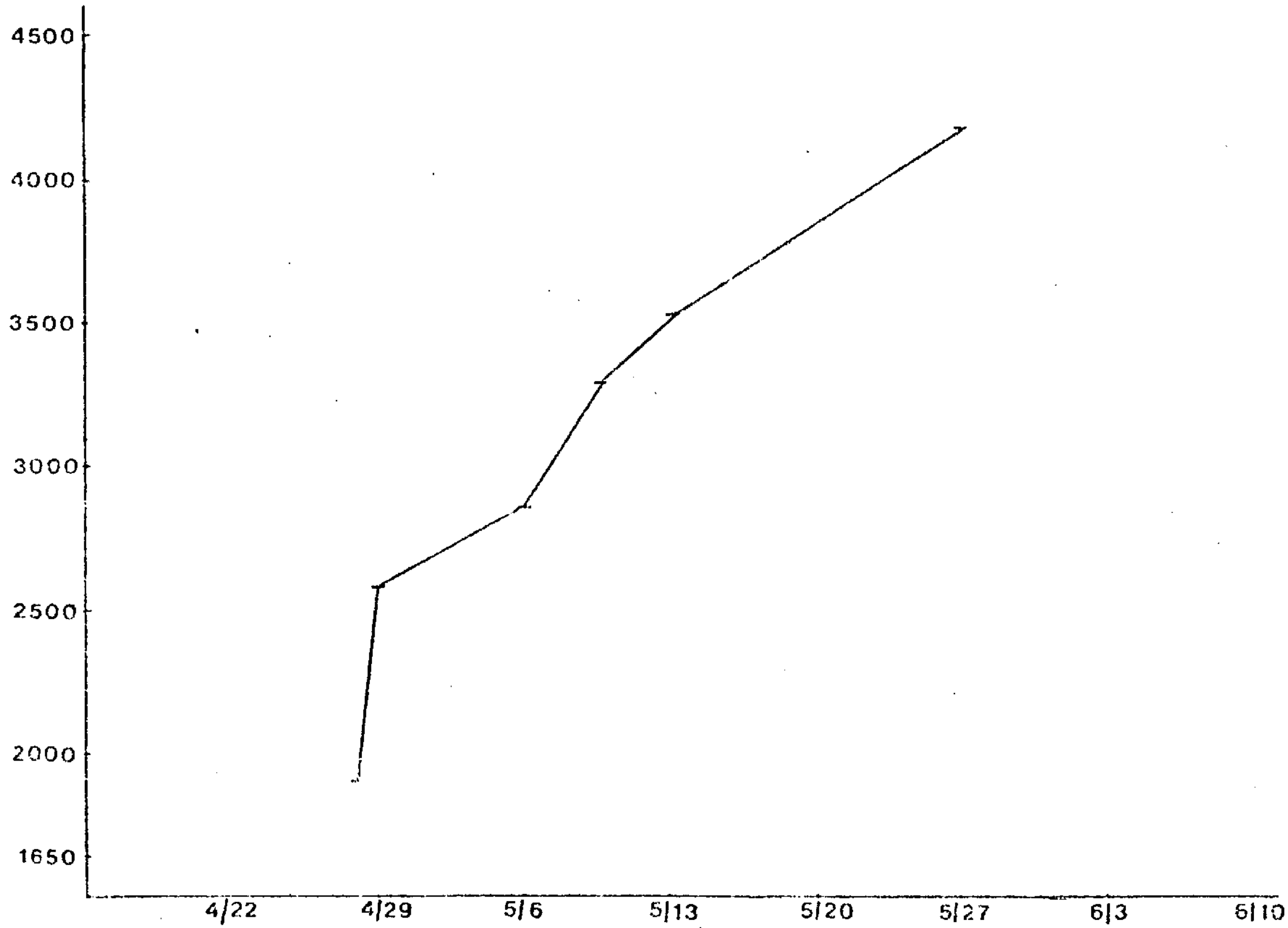

Fig. 3 Occurance of bud break in Mountain Maple (*Acer glabrum*) along Desolation Mt. trail.

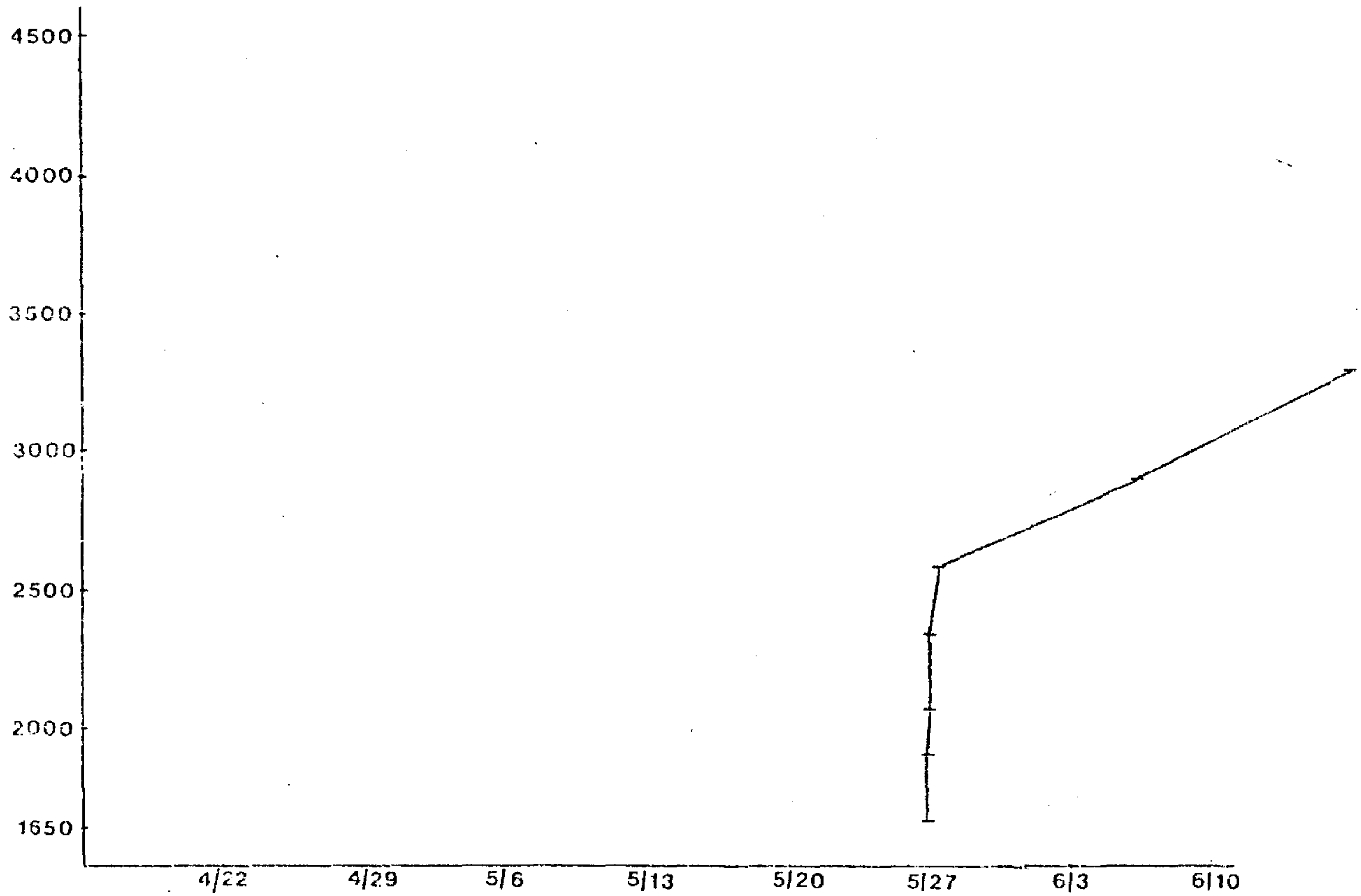

Fig. 4 Occurance of bud break in Douglas Fir (*Pseudotsuga menziesii*) along Desolation Mt. trail.

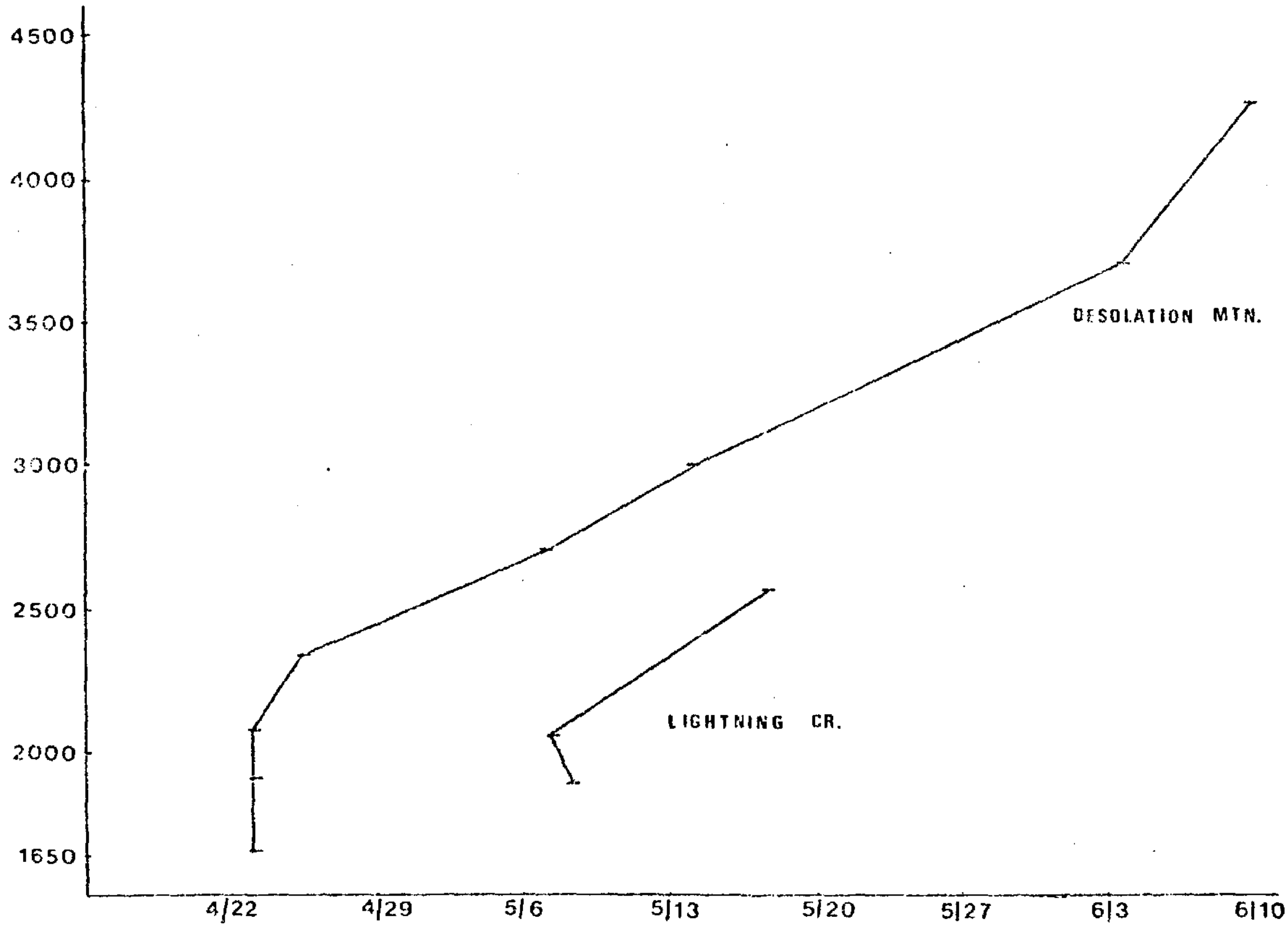

Fig. 5 Occurance of bud break in Vine Maple (Acer circinatum) along Desolation Mt. trail and Lightning creek.

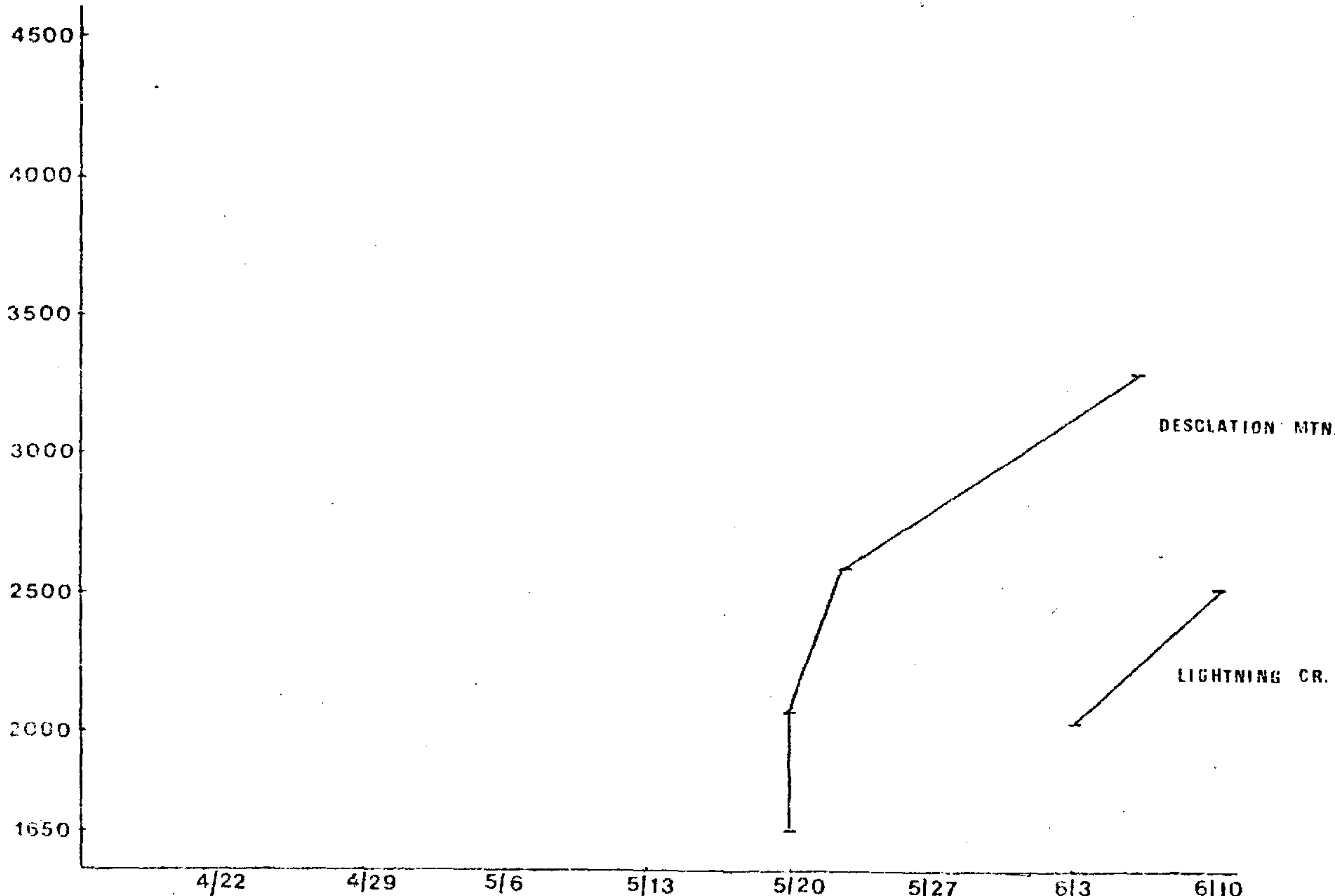

Fig. 6 Occurance of bud break in Pipsissewa (Chimaphila umbellata) along Desolation Mt. trail and Lightning creek.

Spring plant development is of course correlated with the warming of the environment at that season. Within that general framework we are especially interested in the role of the lake in the controlling processes. Therefore our analysis of microclimate data and its relation to plant phenology will continue.

Deer Food Habits

Recently we have attained expertise in the identification of food fragments in deer pellets. This allows us to make quantitative reconstructions of deer winter diets. This, in turn, permits a more accurate evaluation of the relative importance of the various plant species as winter deer forage.

Tables I and II summarize winter food habits on eight individual winter ranges around the lake. Oregon grape (*Berberis repens*) is important everywhere, as is serviceberry (*Amelanchier alnifolia*) to a lesser extent. Other species which are locally important, depending on availability, are cedar, Douglas-fir, pine, and ceanothus.

Table I. Winter Deer Diets, 1974-5, southern Ross Lake Basin

	Ruby Arm		Roland Bay	Pumpkin Mtn.		10-Mile Isl.	Skymo
Forage Plants	Jan.	Winter	Winter	Feb.	Winter	Winter	Winter
Berberis sp.	77	48	16	2	70	52	59
Pinus sp.	3	6	4	44	10	16	0
Amelanchier alnifolia	4	3	18	11	3	10	22
Ceanothus sp.	0	0	tr	0	0	4	6
Unknown forb	trace	0	1	0	1	tr	0
Salix sp.	0	0	0	0	0	0	0
Shepherdia canadensis	0	0	0	1	tr	tr	0
Unknown grass	tr	2	1	tr	tr	0	0
Holodiscus discolor	tr	0	0	tr	tr	tr	0
Rosa sp.	tr	0	tr	tr	tr	7	6
Acer sp.	0	0	1	0	0	0	1
Thuja plicata	7	21	46	26	4	0	4
Pseudotsuga menziesii	8	13	5	2	1	3	0
Rubus sp.	tr	3	tr	0	5	5	2
Polypodiaceae fern	tr	2	5	12	3	0	0
Equisetum sp.	0	0	0	0	0	0	0
Achillea sp.	0	0	tr	0	0	0	0
Carex	0	2	tr	tr	tr	0	0
Stanleya sp.	0	0	0	0	0	0	0
Compositae	0	0	0	0	tr	0	0
Lichen	tr	0	tr	tr	0	0	0
Tsuga sp.	0	0	0	0	0	0	0

Table II. 'nter Deer Diets northern Ross Lake Basin

Forage Plants	Lightning Creek Jan	Lightning Creek Feb	Jack Point Winter	Little Beaver Winter
Berberis sp.	37	27	57	31
Pinus sp.	3	5	0	0
Amelanchier alnifolia alnifolia	13	13	6	3
Ceanothus sp.	23	41	0	9
Unknown forb	5	tr	1	3
Salix sp.	1	0	0	2
Shepherdia canadensis	tr	tr	0	0
Unknown grass	2	tr	3	tr
Holodiscus discolor	2	tr	tr	tr
Rosa sp.	5	8	tr	tr
Acer sp.	5	tr	0	0
Thuja plicata	0	2	21	29
Pseudotsuga menziesii	tr	tr	10	14
Rubus sp.	0	0	tr	tr
Polypodiaceae fern	0	0	tr	5
Equisetum sp.	0	0	0	0
Achillea sp.	tr	0	0	0
Carex sp.	tr	0	0	tr
Stanleya sp.	2	0	tr	0
Compositae	0	0	0	tr
Lichen	0	0	tr	tr
Tsuga sp.	0	0	0	tr

In Table III we have spring diets for a single major winter range, Lightning Creek.

Table III. Spring deer diet Lightning Creek - 1975

Forage Plants	April	May	June
Berberis	32	21	0
Pinus sp.	tr	2	0
Amelanchier alnifolia	9	27	29
Ceanothus sp.	42	33	1
Unknown forb	4	2	6
Salix sp.	3	5	0
Shepherdia canadensis	tr	1	tr
Unknown grass	2	2	tr
Holodiscus discolor	0	tr	0
Rosa sp.	2	6	9
Acer sp.	5	1	2
Thuja plicata	tr	0	0
Pseudotsuga menzeisii	0	0	0
Rubus sp.	0	0	51
Polypodiaceae fern	0	0	tr
Equiseturn sp.	0	0	tr

Oregon grape was an important winter food on Lightning Creek in the winter, and continued to be important only into May. Ceanothus followed the same pattern. Servicebeery, taken in moderate amounts in winter, began to be taken much more heavily in May and June, when it was in active growth. Trailing blackberry, not taken in significant amounts in winter, suddenly made up half the diet in June. These and similar observations will be most useful in establishing scales of deer preference for various species.

During the most adverse part of the winter, on February 23, 1975, we made a survey, of forage use on the Lightning Creek winter range. We found the following: Barberis ?

Heavy Use: Serviceberry (Amelanchier alnifolia)
Evergreen ceanothus (Ceanothus velutinus)
Redstem ceanothus (C. sanguineus)

Moderate Use: Vine Maple (Acer circinatum)
Willow (Salix spp.)
Rose (Rosa sp.)

Light Use Bitter Cherry (Prunus emarginata)
Russet Buffaloberry (Shepherdia canadensis)

Comparing these observations to the findings on winter diet on Lightning creek in Table II, we see that for large woody shrubs there is a direct correspondence between amount in the diet and evidence of browsing on the shrub. But the small inconspicuous shrub which actually produced most of the food, Oregon grape (Berberis) was not described in the survey. This is presumably because the Oregon grape holds its heaves into the winter, the deer eat these leaves one by one, and there is no evidence of this feeding except the inconspicuous low stem that remains behind.

Snow and winter deer movement

During the winter investigations of our Canadian counterparts, they found the major deer concentrations during soft snow periods to be on steep south-facing slopes at around 3500 ft., where the snow burned off. Then, in periods when the snow generally had a heavy crust, the deer moved freely, presumably to feed.

As part of our interest in the various factors which influence deer winter biology, we made observations on snow donditions in relation to deer during the winter of 1974-5. The following notes are fragmentary, but we can hope to add to them in future years.

December 18: heavy snow.

January 1: One foot of snow at Ross Dam but only patchy snow at lake level, Desolation Mtn. trail.

22: Rain -- snow crusts.

Februaryy (early): Snow very hard; deer travel extensively.

(mid): Some melting.

(late): Deer sink into snow surface; little travel by deer; 1' of snow next to lake.

March 4: From air deer tracks on crusted snow noted at about 3500' on Desolation Mtn.

March (late): Snow melting below 2500'.

Discussion

We believe that it is important both to provide the information needed to help assess the environmental consequences of High Ross, and to mitigate them, and also to make generally available any significant new information obtained.

As this is being written a proposal for further work in Ross Basin in 1975-6 is being submitted. This proposal focusses more closely on the individual winter ranges, with the purpose of obtaining specific base data for the later development of local mitigation measures, and for the ultimate determination of the effects of raising the lake if this is done.

The new information obtained in this general investigation includes data on the unusual hybrid population of deer, the surveys of distribution of terrestrial vertebrates and their habitats and the possible influence of the lake water upon the terrestrial environment. We will try to prepare publishable reports on each of these. A preliminary report on hybridization in deer and deermice has been published. A brochure Mammals of the North Cascades National Park is in draft form. The other reports are just being outlined for further work during the coming year.