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Seasonal variations in environmental conditions of fresh-water ostracode habitats, San Francisco Peninsula, California

by

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ABSTRACT

Fresh-water ostracodes from eight sites on the San Francisco Peninsula were sampled periodically between October, 1989 and October, 1990. Collection site data included pH, conductivity, and temperature of the water. Observed seasonal variations in the relative abundances of ostracode species are interpreted as due mainly to changes in water temperature, with only minor, largely undetectable, influence from the changes in pH and conductivity.

INTRODUCTION

Ostracodes are bivalved crustaceans with calcite carapaces, which are common in the fossil record. They live in most aquatic environments and are excellent indicators of past and modern environmental conditions. This study extends a previous one (Carter, 1991) by including pH and conductivity data for the waters in which the ostracodes live, as well as providing additional analyses of seasonal variations in ostracode populations.

ACKNOWLEDGEMENTS

My thanks to Rick Forester for so generously sharing his ostracode expertise, and to Nona Chiariello and Stanford University for giving me free access to the Jasper Ridge Biological Preserve.

METHODS

This study focuses on fresh-water ostracodes found at eight sites in the vicinity of Menlo Park, California. These sites (Fig. 1) were sampled every two weeks from October, 1989 through October, 1990. The sites include two sublocalities on Searsville Lake, Arastradero Lake, Boronda Lake, Coast Casey Forebay, two sublocalities on Los Gatos Creek, and one of the Los Gatos percolation ponds.

During every site visit, the temperatures of the water surface, the sediment, and the sediment/water interface were measured with a digital thermometer. Conductivity and pH were measured with small, hand-held meters that were calibrated against standards at the start of each collecting trip. Ostracodes were collected with a bola or a turkey baster and processed with baking soda and Calgon (for details, see Carter, 1991, p. 4).

All adult ostracodes were picked onto micropaleontological

slides, except for samples in which one species was overwhelmingly abundant (more than 100 individuals). In those cases, an estimate of its numbers relative to the rest of the fauna was made and only the less numerous species were actually picked and counted. These counts were converted to percentages of the total population and are shown graphically on Figures 2 through 11.

COLLECTING SITES

The collecting sites are described in detail in Carter (1991). Searsville Lake is a small lake (about 730 m long, 240 m wide, 7 m deep) located in the Jasper Ridge Biological Preserve (closed to the general public) belonging to Stanford University. Arastradero Lake is a pond about 120 meters in diameter and 5 meters deep, located in the City of Palo Alto's Arastradero Preserve. Boronda Lake is a small, shallow (about 3 m deep), lake about the same size as Searsville, located in the City of Palo Alto's Foothill Park. Coast Casey Forebay is a diked-off section of salt marsh near the southern end of San Francisco Bay with a small, fresh-water stream flowing through it. Los Gatos Creek is a small stream flowing northward through Los Gatos Creek County Park and is part of the ground-water-recharge system of Santa Clara County. It runs between a number of percolation ponds, one of which was included in this study.

OSTRACODE POPULATIONS

Graphs of the ostracode populations of each site (Figs. 2-11) illustrate fluctuations in the constituent species as a percentage of the total population over time. It should be noted that 1) only adult or nearly adult specimens were counted; juveniles of all or most of the resident species are present in nearly all collections; 2) ostracodes can be quite active and their movements may have an effect on sampling; 3) some variations in sample size and exact location of collection sites were unavoidable. Therefore, the population numbers were converted to percentages, and terms such as "numerous" and "abundant" are meant only relative to the percentage base, and not in any absolute sense.

Searsville Lake, Sublocality 1

The constituent species of the ostracode population of Searsville Lake at sublocality 1 are shown in Figure 2 as percentages of the total adult population. The minor constituent species are shown in more detail in Figure 3. The population is dominated by two species, *Physocypria pustulosa* (Sharpe) and *Cypria opthalmica* (Jurine). *P. pustulosa* comprises more than 70% of the population from October through mid-January and more than 50% from mid-February through mid-

August. *C. opthalmica* dominates the population from mid-January to mid-February and from mid-August to the end of the study period in October, 1990. *Herpetocypris brevicaudata* Kaufmann dominated the fauna on June 26, 1990, but did not alter the seasonal trend between *opthalmica* and *pustulosa*. Among the minor constituents (Fig. 3), *Cypridopsis vidua* (Mueller) was the most abundant species from April to August, while *Candona* sp. B was most abundant in November. During the study period, the pH at the collecting site (Fig. 12) ranged from a low of 7.21 on Oct. 23, 1990 to a high of 8.18 on Nov. 7, 1989, showing limited variability. The conductivity (Fig. 13) ranged from a low of 630 microsiemens on Oct. 9, 1989 to a high of 783 microsiemens, showing only limited seasonal variability. Temperature, by contrast, (Fig. 14) shows the expected seasonal pattern (Carter, 1991) and seems more likely to be related to changes in the ostracode species populations. The population of *C. opthalmica* expands following the coldest water temperatures in November and December and it expands again in September and October of 1990. *C. opthalmica* is known to grow and reproduce in cold water, being most prolific at temperatures below 20 degrees Celsius (R.M. Forester, oral commun., 1990), and indeed, it occurs only at sites in this study where the sediment temperature falls below eight degrees Celsius in the winter. Therefore, the winter population increase is expected. The increase in the *C. opthalmica* population during September and October of 1990 also occurs at the onset of falling temperature. However, not all drops in temperature result in a *C. opthalmica* population increase, because it did not happen during 1989. Perhaps additional factors are at play. Among the minor population constituents, *C. vidua* and *H. brevicaudata* appear to be responding to the warmer water of the spring and summer months.

Searsville Lake, Sublocality 2

Here *C. opthalmica* exhibits population increases in three pulses: December through February and the months of May and November (Fig. 4). At all other times during the study period *P. pustulosa* is the most abundant species. The pH (Fig. 15) was nearly constant, ranging from a low of 7.3 in May to a high of 7.95 in October, 1990. The conductivity (Fig. 16) exhibits a prominent increase late in 1989, but then remains nearly constant from May onward. The temperature plot for sublocality 2 is shown in Figure 17. The relative abundances of *C. opthalmica* in December, January, and February are similar to those at sublocality 1, and are probably related to the cold water temperatures of that time period. Again, pH and conductivity fluctuations do not have any discernible effect on the ostracodes. A second increase in the *opthalmica* population occurs in May, a time of

warm water temperatures, and a third (smaller) increase occurs in late November. Perhaps this is a case of second and third generations, the descendants of the first (cold-water) generation, hatching and coming to maturity when conditions might not be optimal for the species, but are at least "tolerable". It is possible that these three population pulses are rough indicators of the length of *C. opthalmica*'s life cycle: optimal conditions (cold water) produce the December-February pulse, then three months later (May), the offspring of the winter adults mature. But warm water is not conducive to their growth, so that the offspring of the May adults require about six months to mature (until November), and they are relatively less abundant.

Arastradero Lake

The ostracode population of Arastradero Lake is characterized by one major component species, *P. pustulosa*, and numerous minor component species, graphed in Figures 5 and 6. The species diversity was lowest from April through early October, 1990, when the population sonsisted mostly of *P. pustulosa* and when temperatures were highest (Fig. 18) and conductivity declined (Fig. 19). Among the less abundant species, *C. vidua* was the most common and numerically dominated them in December through March and June through October. The plot of pH (Fig. 20) shows that it remained relatively constant with a small upward deviation in September. Conductivity (Fig. 19) shows modest seasonal variability and is the highest value among the fully continental sites. As before, the seasonal pH and conductivity profiles show no visual correlation with the changes in seasonal abundance of the species in the ostracode community. Most of the species found however, reach adulthood during the cooler period of the year.

Boronda Lake

Population dominance changed seasonally from *C. vidua* in October through January to *P. pustulosa* in February through October (Fig. 7). A few adults of other species were found from May to August. The seasonal pH profile (Fig. 21) shows more variability especially compared to the other sites; it ranged from a low of 8.0 on October 23, 1990 to a high of 9.89 on May 8. Conductivity (Fig. 22) also varied seasonally, ranging from relatively low values to values more typical of the other sites. It ranged from 260 microsiemens on several dates up to 412 microsiemens at the end of the study. The temperature plot (Fig. 23) shows a visual correlation between rising water temperature and an increase in the population of *P. pustulosa*, whereas the abundance of *C. vidua* increased with falling water

temperature. No obvious visual correlation exists between pH or conductivity and the ostracode population.

Coast Casey Forebay

The ostracodes at this site were collected from a stream that runs through Coast Casey Forebay. The fauna is primarily composed of two species, *Heterocypris salina* (Brady) and *H. carolinensis* (Ferguson) (Fig. 8). *Cyprideis beaconensis* (LeRoy) was rare and may have been transported by vectors such as birds or wind from the adjacent salt marshes. *H. salina* was predominant during the entire study period, although *H. carolinensis* had a population increase in June through August as well as in October and November of 1989 and February to March, 1990. The pH plot (Fig. 24) shows minimal seasonal variability, with a range from 7.57 (June 5) to 8.03 (May 1). Conductivity (Fig. 25) was variable, especially in July through October, and ranged from a low of 4.48 millisiemens on May 15 to a high of 16.1 millisiemens on July 31. The high conductivity reflects the partial connection to the ocean. No visual correlation is apparent between the seasonal ostracode population dynamics and any of the measured parameters, even water temperature (Fig. 26).

Los Gatos Creek, Sublocality 1

The ostracode populations were generally sparse and only show some visual correlation with temperature. Unlike the other sites, pH in Los Gatos Creek shows moderate seasonal variability (Fig. 27). It ranged from 7.39 on October 30, 1990 to 9.06 on April 3. The conductivity (Fig. 28) was also extremely variable; in two months (Sept. 4 to Oct. 30, 1990) it registered its greatest fluctuation of the study period, rising from its lowest (427 microsiemens) to its highest (663 microsiemens) recorded values. This environment, with its greater variability, may explain the sparse fauna (Fig. 9). *Candona* sp. C was common, but it and other species may have been introduced by birds and other vectors. The pH and conductivity were probably so variable because of the large amounts of imported water added to the creek to recharge the ground water supply of the Santa Clara Valley. Temperature (Fig. 29) may also have influenced the ostracode population because most of the adults found were collected from March through May when the water was warming up.

Los Gatos Creek, Sublocality 3

This site is upstream from sublocality 1 and also upstream from the point where the imported water is added to the creek. The pH here (Fig. 30) is fairly constant with a very slight upward trend through the study period. It ranges from a low of 7.80 in June to a

high of 8.43 on August 18. Likewise, the conductivity (Fig. 31) is much more stable here than downstream, ranging from 516 microsiemens on February 20 to 678 microsiemens on October 30, 1990. Dominance of the ostracode populations shifts seasonally between four different species: *Limnocythere itasca* Cole, *Isocypris* sp., *Ilyocypris gibba* (Ramdohr), and *H. brevicaudata* (Fig. 10). *L. itasca* reaches adulthood and population dominance when the water temperature (Fig. 32) decreases but not when it is coldest, in January and February.

Los Gatos Percolation Pond

The pH of the water in the percolation pond (Fig. 33) is relatively high but fairly constant, ranging from 8.69 on August 14 to 9.69 on April 17. The conductivity (Fig. 34) fluctuated widely from a low of 447 microsiemens on September 18 to a high of 672 on June 17. From July 2 to September 18 it dropped from 656 to 447 microsiemens and then six weeks later rebounded back up to 572 microsiemens. The temperature plot for the percolation pond is shown in Figure 35. The fauna (Fig. 11) was always rather sparse except for January and February. Limnocytherids were most numerous from October, 1989 to the end of April, 1990, and *Potamocypris* sp. was dominant for most of the time from May to the end of the study period. However, the small number of adult valves (eight adults or less) from June onward would not be sufficient to establish statistical validity.

CONCLUSIONS

No regular seasonal fluctuations in pH or conductivity were detected in the waters of the study sites. The fluctuations that were recorded seem to have had a pronounced effect on the resident ostracodes in only one case: the artificially manipulated flows of Los Gatos Creek at sublocality 1. Apparently, water temperature is the main influence on seasonal fluctuations in these ostracode populations.

REFERENCES CITED

Carter, Claire, 1991, Seasonal occurrences of ostracodes in lakes and streams of the San Francisco Peninsula, California: U.S. Geological Survey, Open File Report 91-118, 64 p.

APPENDIX

The following tables contain data on temperature, pH, and conductivity recorded for each visit to each site, as well as the component species of the ostracode population as percentages of the total population. The last column in each table records the total number of adult specimens counted. Temperatures are given in degrees Celsius. Conductivity figures are are given in microsiemens for all sites with the exception of Coast Casey Forebay.

LOCALITY DATA FOR SEARSVILLE LAKE, JASPER RIDGE PRESERVE, CALIFORNIA
OCTOBER 10, 1989 to OCTOBER 23, 1990 SUBLOCALITY 1

DATE	TIME	AIR TEM	WATER TEM	SED/WAT	SED	pH	CONDUCTIVIT	COLL.NO.	P. pust	C. opth	H. brevi	C. vidua	Candona	I. gibba	Candona A	TOTAL
10/09/89	9:00 AM	15	15	15	13.1	7.96	630	CC-89-CA-60	80	4	4	6	4	3		21
11/07/89	9:30 AM	16.7	13.4	13.4	12.1	8.18	676	CC-89-CA-70	80				20			2
11/21/89	8:35 AM	9.5	8.3		7.8	8.11	673	CC-89-CA-85	80	5	2		13			12
12/05/89	8:30 AM	8	7.4		7.5	7.92	646	CC-89-CA-96	80	17			3			6
01/08/90	8:30 AM	11.1	9.2		9.6	7.65	728	CC-90-CA-1	77	18	2	2		2		57
01/31/90	8:30 AM	3.5	7.7	7.5		7.92	724	CC-90-CA-11	20	69	2	6		2		49
02/13/90	8:45 AM	8.3	8.6	6.6		7.75	758	CC-90-CA-21	49	49		2				43
02/27/90	8:45 AM	10	10.9	11		8	677	CC-90-CA-33	65	35						est.
03/13/90	8:15 AM	10.2	10.7	10.3		7.95	692	CC-90-CA-42	83	13		2			2	86
03/27/90	8:30 AM	16.3	15.5	14		7.74	759	CC-90-CA-51	89	8					3	107
04/10/90	8:30 AM	14.4	15.8		15.1	7.92	757	CC-90-CA-59	80	4		16				6
04/24/90	8:35 AM	15.5	17.2		16.4	8.08	745	CC-90-CA-68	80	4	4	8	4			5
05/08/90	8:35 AM	19.5	20.1		16.4	8.08	753	CC-90-CA-77	80		12	8				5
05/22/90	8:50 AM	17	18.2		17.4	7.94	737	CC-90-CA-85	83	8	3	6				118
06/12/90	8:15 AM	16	21	20.6		7.72	733	CC-90-CA-95	90	1		7	1		1	71
06/26/90	8:25 AM	19	21.8		20.1	7.64	713	CC-90-CA-104	33	5	47	15				40
07/24/90	8:30 AM	19	22.6	21.7		7.75	697	CC-90-CA-112	82	2	2	14				45
08/07/90	8:15 AM	20.5	23.9		23.1	7.37	725	CC-90-CA-120	59	24	3	13		1		125
08/21/90	8:20 AM	17	21		21.1	7.61	720	CC-90-CA-128	47	53						72
09/11/90	8:35 AM	17	17.7		15.5	7.84	743	CC-90-CA-136	38	60			2			66
09/25/90	8:30 AM	15	15.4		16.7	7.36	745	CC-90-CA-144	22	73	2	3				64
10/09/90	8:30 AM	12	11.3		12.7	7.26	783	CC-90-CA-152	22	72		6				46
10/23/90	8:45 AM	9	9.5		13.8	7.21	779	CC-90-CA-160	23	75		2				94

P.pust = *Physocypria pustulosa* (Sharpe)
C.opth = *Cypria opthalmica* (Jurine)
H.brevi = *Herpetocypris brevicaudata* Kaufmann
CandonaA = *Candona* sp. A
C.vidua = *Cypridopsis vidua* (Mueller)
Candona = *Candona* spp.
I.gibba = *Ilyocypris gibba* (Ramdohr)

LOCALITY DATA FOR SEARSVILLE LAKE, JASPER RIDGE PRESERVE, CALIFORNIA
OCTOBER 10, 1989 to OCTOBER 23, 1990 SUBLOCALITY 2

DATE	TIME	AIR TEM	WATER TE	SED/WATER	SED TEMP	pH	CONDUCTIVIT	COLL. NO.	P. pust	C. opthal	C. vidua	CandonaB	H. brevi	TOTAL
10/09/89	9:00 AM	15	14.1	13.8	14.2	7.57	750	CC-89-CA-61	75	25				16
11/07/89	9:30 AM	16.7	10.2	7.8	8.4	7.7	723	CC-89-CA-71	80	19		1		53
11/21/89	8:35 AM	9.5	6.5	5.8		7.82	658	CC-89-CA-86	80	19	0.5	0.5		44
12/05/89	8:30 AM	8	4.9		5.4	7.91	665	CC-89-CA-97	26	72		2		125
01/08/90	8:30 AM	11.1	10	9.5	9.3	7.8	950	CC-90-CA-2	10	90				20
01/31/90	8:30 AM	3.5	8.2	8.4		7.57	790	CC-90-CA-12	4	87		6	2	47
02/13/90	8:45 AM	8.3	8.9	9.1		7.5	766	CC-90-CA-22	34	65		1		65
02/27/90	8:45 AM	10	11.4	11.5		7.57	686	CC-90-CA-34	42	57		2		53
03/13/90	8:15 AM	10.2	11.3	10.7		7.76	710	CC-90-CA-43	79	21				19
03/27/90	8:30 AM	16.3	16.6	15.5	15.4	7.56	759	CC-90-CA-52	79	21				29
04/10/90	8:30 AM	14.4	16.7	16.7		7.78	781	CC-90-CA-60	94	6				18
04/24/90	8:35 AM	15.5	17.3		16.9	7.54	784	CC-90-CA-69	83	14		3		70
05/08/90	8:35 AM	19.5	20.3	20.3		7.8	750	CC-90-CA-78	33	67				49
05/22/90	8:50 AM	17	17.5	17.1		7.7	750	CC-90-CA-89	36	61	3			208
06/12/90	8:15 AM	16	21.3	21.1		7.3	730	CC-90-CA-98	52	40	8			184
06/26/90	8:25 AM	19	22.3	22.3		7.57	731	CC-90-CA-10	74	24	2			139
07/24/90	8:30 AM	19	22.8		22.7	7.48	726	CC-90-CA-11	100					no count
08/07/90	8:15 AM	23	24.1	24.3		7.65	740	CC-90-CA-12	83	17				89
08/21/90	8:20 AM	17	20.6	21.1	21.3	7.62	747	CC-90-CA-12	67	33				358
09/11/90	8:35 AM	17	19.5	19.7	19.5	7.92	765	CC-90-CA-13	100					no count
09/25/90	8:30 AM	15	18	18.3	18.3	7.71	782	CC-90-CA-14	55	42	3			69
10/09/90	8:30 AM	12	14	13.8	13.5	7.86	792	CC-90-CA-15	60	38	1	1		172
10/23/90	8:45 AM	9	12.1	11.4		7.95	808	CC-90-CA-16	66	33	1			107

P.pust = *Physocypria pustulosa*
C.opthal = *Cypria opthalmica*
C.vidua = *Cypridopsis vidua*
CandonaB = *Candona* sp. B
H.brevi = *Herpetocypris brevicaudata*

LOCALITY DATA FOR ARASTRADERO LAKE, ARASTRADERO OPEN SPACE PRESERVE,
PALO ALTO, CALIFORNIA OCTOBER 9, 1989 to OCTOBER 23, 1990

DATE	TIME	AIR TEM	WATER TEM	SED/WATE	SED TEM	pH	CONDUCTIVI	COLL.NO.	P.pust.	C.vidua	H.brevi.	CandonaA	CandonaB	Potamo.	P.unicaud.	I.gibba	L.itasca	TOTAL
10/09/89	11:00 AM	18.4	18.4	18.5	18.6	8.6	1160	CC-89-CA-62	80	7			1	1	2		9	35
11/07/89	1:00 PM	17.3	14.8	14.4	13.7	8.3	1168	CC-89-CA-74	69	12				2		2	16	51
11/21/89	10:10 AM	11	11.9	11.8		8.25	1167	CC-89-CA-87	80	5				8	3		5	132
12/05/89	2:45 PM	19.4	12.9	10.6		8.32	1160	CC-89-CA-99	78	16				3			3	79
01/08/90	9:40 AM	19.9	8.9	8.3		8.27	1.25mS	CC-90-CA-3	88	12								25
01/31/90	10:30 AM	14.5	9.2	8.8		8.21	1105	CC-90-CA-13	86	9	1				1	1	2	99
02/13/90	10:30 AM	10.9	9.3	9.5		8.26	1113	CC-90-CA-23	80	10			7		3			6
02/27/90	10:45 AM	10.4	10.8	11		8.12	1021	CC-90-CA-35	72	22			6					36
03/13/90	9:45 AM	13.6	11.7	11.2	11.5	8.05	1012	CC-90-CA-44	80	17			2		1			26
03/27/90	9:45 AM	20	17.6	15.2		8.02	1047	CC-90-CA-53	75	19				6				36
04/10/90	1:50 PM	23.5	18.9		19.5	8.18	1026	CC-90-CA-62	80	5	5			5			5	4
04/24/90	10:00 AM	15	17.9	17.6		8.23	1030	CC-90-CA-70	93				5				2	41
05/08/90	9:55 AM	20	21.4	20.8	21	8.64	1030	CC-90-CA-79	96	2							2	42
05/22/90	10:30 AM	21	20.5	18.1	18.8	8.19	1038	CC-90-CA-87	92				8					13
06/12/90	9:35 AM	19	21.9	21.2		8.6	977	CC-90-CA-97	90	10								48
06/26/90	9:40 AM	20	23.1	22.5		8.64	941	CC-90-CA-10	100									no count
07/24/90	9:45 AM	23	24.4	24.4		8.75	967	CC-90-CA-11	99	1								85
08/07/90	9:30 AM	24	25.6	25.4		8.8	967	CC-90-CA-12	81	19								27
08/21/90	9:40 AM	17	22	22.1		8.57	1044	CC-90-CA-13	85	9	2	2		2				58
09/11/90	10:00 AM	19	21.4	21.3		9.13	1090	CC-90-CA-13	87	7		3			3			29
09/25/90	9:50 AM	18	20.2	20.4		8.95	1089	CC-90-CA-14	100									no count
10/09/90	9:45 AM	21	18.8	18.4		8.73	1152	CC-90-CA-15	97	2							1	88
10/23/90	10:00 AM	15	16.4	16.4		8.42	1200	CC-90-CA-16	67	17		3	3	7	3			29

P.pust. = *Physocypria pustulosa*
C. vidua = *Cypridopsis vidua*
H.brevi. = *Herpetocypris brevicaudata*
CandonaA = *Candona* sp. A
CandonaB = *Candona* sp. B

Potamo. = *Potamocypris* n.sp.
P.unicaud. = *Potamocypris unicaudata* Schaefer
I.gibba = *Ilyocypris gibba*
L.itasca = *Limnocythere itasca* Cole

LOCALITY DATA FOR BORONDA LAKE, FOOTHILLS PARK, PALO ALTO, CALIFORNIA
OCTOBER 9, 1989 to OCTOBER 23, 1990

DATE	TIME	AIR TEM	WATER TEM	SED/WATE	pH	CONDUCTIVIT	COLL. NO.	P.pust.	C.vidua	L.itasca	Potamo.sp.	H.brevi.	TOTAL
10/09/89	11:45 AM	22.9	20.4	19.4	8.5	260	CC-89-CA-63	40	60				10
11/07/89	11:00 AM	16.7	14.7	14.2	8.49	269	CC-89-CA-72	12	88				17
11/21/89	11:10 AM	12.5	13.6	13	8.85	270	CC-89-CA-88	50	50				6
12/05/89	1:40 PM	19.1	11.5	10.9	8.91	265	CC-89-CA-98		100				1
01/08/90	10:40 AM	17.8	10	9.7	8.86	283	CC-90-CA-4		100				5
01/31/90	11:30 AM	11	9.5	8.9	8.5	284	CC-90-CA-14		100				1
02/13/90	11:30 AM	9.3	9.9	9.8	8.23	302	CC-90-CA-24	75	25				16
02/27/90	11:50 AM	12.8	11.9	11.9	8.87	300	CC-90-CA-36	67	33				3
03/13/90	10:30 AM	13.6	11.7	11.8	8.64	300	CC-90-CA-45	92		8			13
03/27/90	11:00 AM	22	17.5	16.7	8.97	302	CC-90-CA-54	100					no count
04/10/90	9:20 AM	19.3	17	16.9	9.17	295	CC-90-CA-61	100					no count
04/24/90	11:00 AM	21	16.9	16.2	9.52	275	CC-90-CA-72	100					10
05/08/90	10:50 AM	21	22.6	22.3	9.89	260	CC-90-CA-80	85	11		4		27
05/22/90	12:05 PM	23	18.3	17.1	9.15	265	CC-90-CA-89	89	11				9
06/12/90	10:25 AM	19	22.4	21.9	9.18	260	CC-90-CA-98	72	22	6			18
06/26/90	10:45 AM	22	25	24.3	8.95	276	CC-90-CA-107	88	11	1			77
07/24/90	10:45 AM	19	24.5	23.1	8.14	349	CC-90-CA-115	94	4			2	114
08/07/90	10:20 AM	26	26.5	25.2	8.21	363	CC-90-CA-123	69	19	3	9		32
08/21/90	10:35 AM	18.5	21.7	20.6	8.58	369	CC-90-CA-131	94	6				18
09/11/90	10:45 AM	20	23.3	21.6	9.01	358	CC-90-CA-139	80	20				10
09/25/90	10:40 AM	19	20.6	20	8.77	373	CC-90-CA-147	100					no count
10/09/90	10:35 AM	23	20.2	17.8	8.62	376	CC-90-CA-155	94	6				16
10/23/90	10:45 AM	18	18.4	16.8	8	412	CC-90-CA-163	84	16				19

P.pust. = *Physocypria pustulosa*
C.vidua = *Cypridopsis vidua*
L.itasca = *Limnocythere itasca*
Potamo.sp. = *Potamocypris* sp.
H.brevi. = *Herpetocypris brevicaudata*

LOCALITY DATA FOR COAST CASEY FOREBAY, MOUNTAIN VIEW, CALIFORNIA
OCTOBER 10, 1989 to OCTOBER 30, 1990

DATE	TIME	AIR TEM	WATER TEM	SED/WATE	SED TEM	pH	CONDUCTIVIT	COLL NO.	H.salina	H.carolinensis	C.beaconensis	TOTAL
10/10/89	8:50 AM	16.6	17.2		17.5	7.76	7.71mS	CC-89-CA-67	78	17	4	23
11/14/89	8:35 AM	13.3	14	14.4	14	7.8	7.45mS	CC-90-CA-80	92	8		13
11/28/89	8:45 AM	6.9	10.4		10.5	7.96	5.94mS	CC-89-CA-90	86	14		7
12/12/89	10:00 AM	10.4	11		10	7.96	6.38mS	CC-89-CA-101	100			5
01/23/90	9:20 AM	8.3	9.8		9.4	7.87	5.58mS	CC-90-CA-6	100			3
02/07/90	9:40 AM	8.2	9.6	9.2		7.74	5.92mS	CC-90-CA-17	58	33	8	12
02/20/90	10:00 AM	9.6	10.5		9.8	7.76	5.33mS	CC-90-CA-28	87	4	9	23
03/06/90	9:10 AM	17.4	12.7		12.1	7.8	5.15mS	CC-90-CA-38	71	29		14
03/20/90	9:00 AM	20.8	15.3		14	7.9	4.66mS	CC-90-CA-47	100			9
04/03/90	9:00 AM	18.4	14.3		13.8	7.84	5.00mS	CC-90-CA-55	100			4
04/17/90	8:30 AM	14.7	15.8	15.7		7.86	5.03mS	CC-90-CA-64	100			5
05/01/90	8:45 AM	20	15.9		15.1	8.03	5.40mS	CC-90-CA-73	100			10
05/15/90	8:40 AM	15	15.3		15.1	7.93	4.48mS	CC-90-CA-81	86	14		7
06/05/90	9:05 AM	20	18.1		17	7.57	6.08mS	CC-90-CA-90	67		33	3
06/19/90	8:45 AM	19.5	18.3		17.6	7.67	5.79mS	CC-90-CA-100	50	50		30
07/02/90	8:20 AM	18.5	17.6	17.7		7.64	5.96mS	CC-90-CA-108	91	9		23
07/31/90	8:20 AM	18	19		20.3	7.89	16.10mS	CC-90-CA-116	86	14		7
08/14/90	8:30 AM	17	18.5		18.9	7.64	8.82mS	CC-90-CA-124	83	17		6
09/04/90	8:30 AM	20	18		18.2	7.69	11.02mS	CC-90-CA-132	94	6		145
09/18/90	9:00 AM	21	17.8		17.8	7.81	10.93mS	CC-90-CA-140	100			no count
10/02/90	8:30 AM	17.5	16.3		17.2	7.79	11.81mS	CC-90-CA-148	96		4	27
10/16/90	9:20 AM	17	16.5		16.5	7.94	11.03mS	CC-90-CA-156	92	4	4	24
10/30/90	8:20 AM	19	15.7		16	7.92	7.21mS	CC-90-CA-164	100			23

H.salina = *Heterocypris salina* (Brady)
H.carolinensis = *Heterocypris carolinensis* (Ferguson)
C.beaconensis = *Cyprideis beaconensis* (LeRoy)

LOCALITY DATA FOR LOS GATOS CREEK, LOS GATOS, CALIFORNIA
OCTOBER 9, 1989 to OCTOBER 30, 1990 SUBLOCALITY 1

DATE	TIME	AIR TEM	WATER TE	SED/WATE	pH	CONDUCTIVIT	COLL. NO.	Candona C	L.itasca	C.vidua	Isocypris	I.gibba	TOTAL
10/09/89	2:10 PM	25.1	21.5	20.8	8.01	470	CC-89-CA-64						no adults
11/14/89	10:00 AM	16.6	14.7	14.6	7.53	570	CC-89-CA-81						no adults
11/28/89	10:40 AM	9.6	11.4	11.3	7.92	581	CC-89-CA-92		100				1
12/12/89	11:15 AM	11.4	10.8	10.3	8.25	607	CC-89-CA-102						no adults
01/23/90	10:30 AM	14	9.7	9.2	7.86	650	CC-90-CA-7						none
02/07/90	12:50 PM	12.3	9.4	9.2	8.12	560	CC-90-CA-20						none
02/20/90	11:30 AM	12.4	8.1	8	7.96	516	CC-90-CA-32						none
03/06/90	10:35 AM	21.8	14.7	14	8.41	511	CC-90-CA-41						no adults
03/20/90	10:30 AM	25	17.6	16.9	8.35	505	CC-90-CA-50	40	40			20	5
04/03/90	10:30 AM	23.5	19.8	18.9	9.06	527	CC-90-CA-58	67	22	11			9
04/17/90	10:00 AM	19	17.5	17.2	8.73	645	CC-90-CA-67	71	29				7
05/01/90	10:15 AM	24.5	19.8	19.8	9.05	641	CC-90-CA-76	75			25		4
05/15/90	10:05 AM	18	21.7	20.9	8.3	631	CC-90-CA-84	57	29		14		7
06/05/90	10:20 AM	21	22.7	21.1	8.7	644	CC-90-CA-94						no adults
06/19/90	9:45 AM	20.5	18.8	18.9	7.53	626	CC-90-CA-101						no adults
07/02/90	9:25 AM	20.5	20.1	20.1	7.59	602	CC-90-CA-109		100				2
07/31/90	9:30 AM	21	23.3	23.2	7.57	470	CC-90-CA-117						no adults
08/14/90	9:35 AM	18	22.6	22.7	7.4	515	CC-90-CA-125						no adults
09/04/90	9:45 AM	19.5	22	20.9	8.09	427	CC-90-CA-133						no adults
09/18/90	9:55 AM	19	19.6	19.5	7.66	476	CC-90-CA-141						no adults
10/02/90	9:40 AM	17	20.6	20.6	7.75	505	CC-90-CA-149						no adults
10/16/90	10:25 AM	18.5	19.5	19.3	7.47	620	CC-90-CA-157						no adults
10/30/90	9:30 AM	18	17.9	17.7	7.39	663	CC-90-CA-165						no adults

Candona C = *Candona* sp. C
L.itasca = *Limnocythere itasca*
C.vidua = *Cypridopsis vidua*
Isocypris = *Isocypris* sp.
I.gibba = *Ilyocypris gibba*

LOCALITY DATA FOR LOS GATOS CREEK, LOS GATOS, CALIFORNIA
OCTOBER 9, 1989 to OCTOBER 30, 1990 SUBLOCALITY 3

DATE	TIME	AIR TEM	WATER TE	SED/WATE	pH	CONDUCTIVIT	COLL. NO.	H.brevicaud.	L.itasca	Isocypris	I.gibba	C.vidua	Potamocyp.	TOTAL
10/09/89	2:10 PM	25.1	19.6	19.6			CC-89-CA-66		100					2
11/14/89	10:00 AM	16.6	13.5	13.8	8.12	615	CC-90-CA-83		100					2
11/28/89	10:40 AM	9.6	12	12	8.11	590	CC-89-CA-93							no adults
12/12/89	11:15 AM	11.4	9	8.9	8.12	609	CC-89-CA-104		60	40				5
01/23/90	10:30 AM	14	9	8.8	7.88	576	CC-90-CA-10	14	14	57	14			7
02/07/90	12:50 PM	12.3	9.4	9.2	8.12	560	CC-90-CA-18				100			5
02/20/90	11:30 AM	12.4	8.1	8	7.96	516	CC-90-CA-29		67	17		17		6
03/06/90	10:35 AM	21.8	11.7	11.2	7.96	525	CC-90-CA-39		56			33	11	9
03/20/90	10:30 AM	25	14.7	14.5	8.09	548	CC-90-CA-48	76		5	19			21
04/03/90	10:30 AM	23.5	16.3	16.2	8.16	590	CC-90-CA-56	56	5	39				18
04/17/90	10:00 AM	19	16.7	16.6	8.12	603	CC-90-CA-65	58	13	23	6			64
05/01/90	10:15 AM	24.5	18	17.3	8.07	610	CC-90-CA-74	29	57		14			7
05/15/90	10:05 AM	17	17.5	17.3	8.17	621	CC-90-CA-82	19	6	69	6			16
06/05/90	10:20 AM	21	19.2	18.8	7.8	608	CC-90-CA-91							no adults
06/19/90	9:45 AM	20.5	21.3	20.2	7.8	608	CC-90-CA-102							no adults
07/02/90	9:25 AM	22.5	23.4	23.1	8.27	616	CC-90-CA-111							no adults
07/31/90	9:30 AM	24	23.7	23.4	8.37	576	CC-90-CA-119							no adults
08/14/90	11:00 AM	24	22.7	22.4	8.06	601	CC-90-CA-127							no adults
09/04/90	9:45 AM	19.5	21.4	21	8.18	584	CC-90-CA-135		100					6
09/18/90	9:55 AM	19	20.1	19.9	8.43	604	CC-90-CA-143		100					1
10/02/90	10:45 AM	21	19.5	19.3	8.32	617	CC-90-CA-151							no adults
10/16/90	10:25 AM	18.5	18.9	19	8.39	642	CC-90-CA-158							no adults
10/30/90	9:30 AM	20.5	15.4	15.4	8.42	678	CC-90-CA-166	7	43	29	7	14		14

H.brevicaud. = *Herpetocypris brevicaudata*
L.itasca = *Limnocythere itasca*
Isocypris = *Isocypris* sp.
I.gibba = *Ilyocypris gibba*
C.vidua = *Cypridopsis vidua*
Potamocyp. = *Potamocypris* sp.

LOCALITY DATA FOR LOS GATOS PERCOLATION POND, LOS GATOS, CALIFORNIA
NOVEMBER 14, 1989 to OCTOBER 30, 1990 SUBLOCALITY 4

DATE	TIME	AIR TEM	WATER TEM	SED/WATE	pH	CONDUCTIVIT	COLL. NO.	L.inopinata	Potamocyp.	L.itasca	Pelocypris	others	I.gibba	TOTAL
11/14/89	10:00 AM	16.6	16	15	9.3	508	CC-89-CA-84	75	25					4
12/12/89	11:15 AM	11.4	10.8	9.9	9.38	583	CC-89-CA-105			75	25			8
01/23/90	12:00 PM	20.8	9.4	9.1	9.58	638	CC-90-CA-8		7	81		7	4	27
02/07/90	12:50 PM	12.3	11.8	11	9.2	611	CC-90-CA-19	55		42			3	31
02/20/90	12:40 PM	12.4	9.8	9.2	9.55	620	CC-90-CA-30	50	12	35			4	26
03/06/90	10:35 AM	21.8	16.1	13.1	9.06	604	CC-90-CA-40	11		78	11			9
03/20/90	10:30 AM	25	18.1	17.1	9.58	550	CC-90-CA-49	23		69			8	13
04/03/90	10:30 AM	23.5	19.8	18.5	9.59	528	CC-90-CA-57							no adults
04/17/90	10:00 AM	19	18.3	17.9	9.69	561	CC-90-CA-66	100						1
05/01/90	10:15 AM	24.5	20.2	19.5	9.4	628	CC-90-CA-75	17	67	17				6
05/15/90	10:05 AM	17	20.6	19.7	9.34	658	CC-90-CA-83	9	64	18		9		11
06/05/90	10:20 AM	21	23.3	22.9	9	665	CC-90-CA-93		33	67				3
06/19/90	9:45 AM	20.5	24.9	23.7	9.1	672	CC-90-CA-103		100					1
07/02/90	9:25 AM	20.5	23.8	23.6	9.11	656	CC-90-CA-110	20	20	60				5
07/31/90	9:30 AM	21	24.5	24.4	8.74	526	CC-90-CA-118		67	33				3
06/14/90	9:35 AM	18	25.2	25.4	8.69	510	CC-90-CA-126		100					2
09/04/90	9:45 AM	19.5	22.9	22.8	8.73	466	CC-90-CA-134							no adults
09/18/90	9:55 AM	19	21.3	21.5	9.24	447	CC-90-CA-142		100					2
10/02/90	9:40 AM	17	21.7	21.9	9.18	466	CC-90-CA-150		100					2
10/16/90	10:45 AM	18.5	20.8	19.7	9.19	505	CC-90-CA-159	25	25	50				4
10/30/90	9:30 AM	20.5	18.5	17.8	9.35	572	CC-90-CA-167		88	12				8

L.inopinata = *Limnocythere inopinata* (Baird)
Potamocyp. = *Potamocypris* sp.
L.itasca = *Limnocythere itasca*
Pelocypris = *Pelocypris* sp.
I.gibba = *Ilyocypris gibba*
others = non-resident species

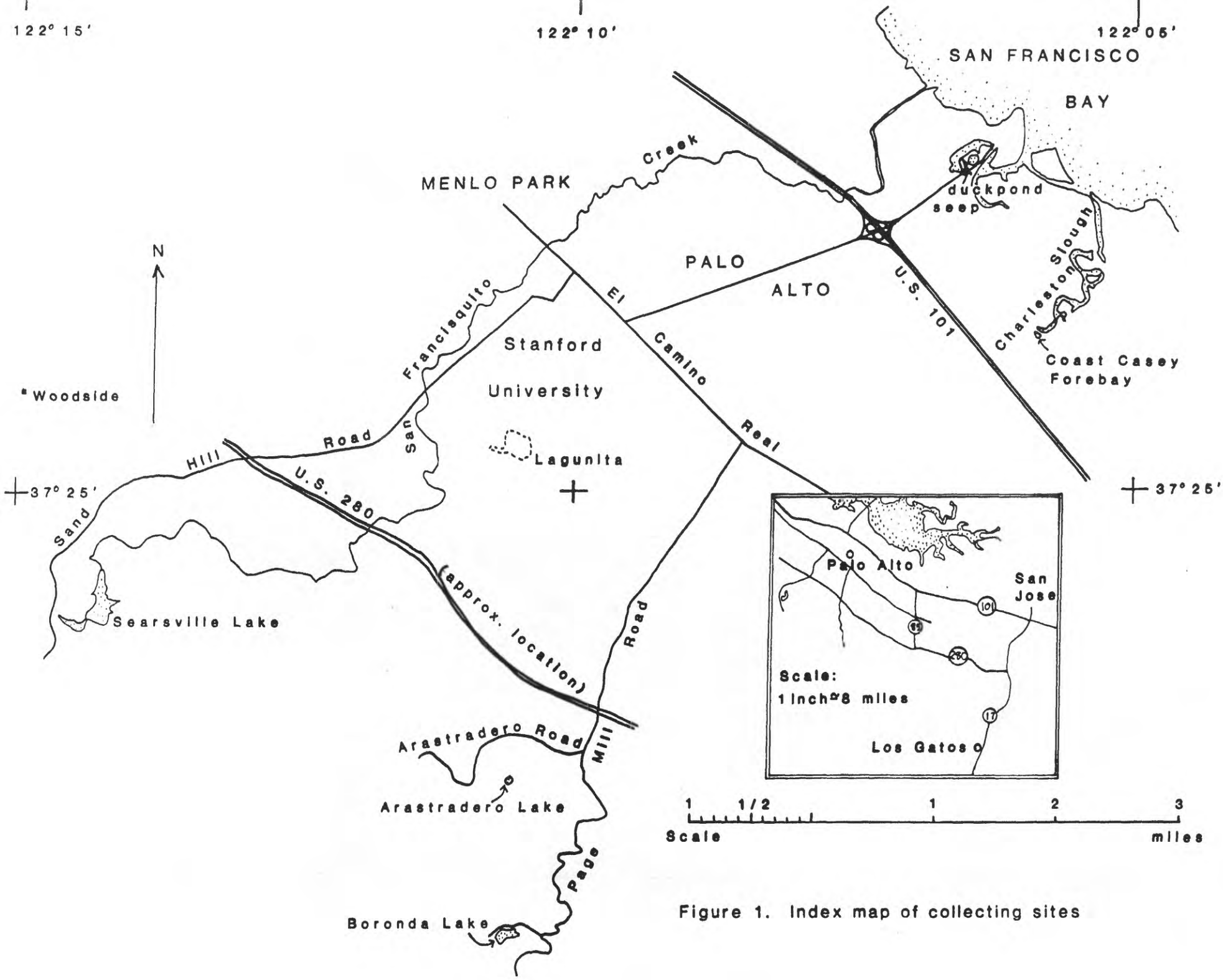

Figure 1. Index map of collecting sites

Figure 2. Searsville Lake, Subloc. 1: Constituent species of population

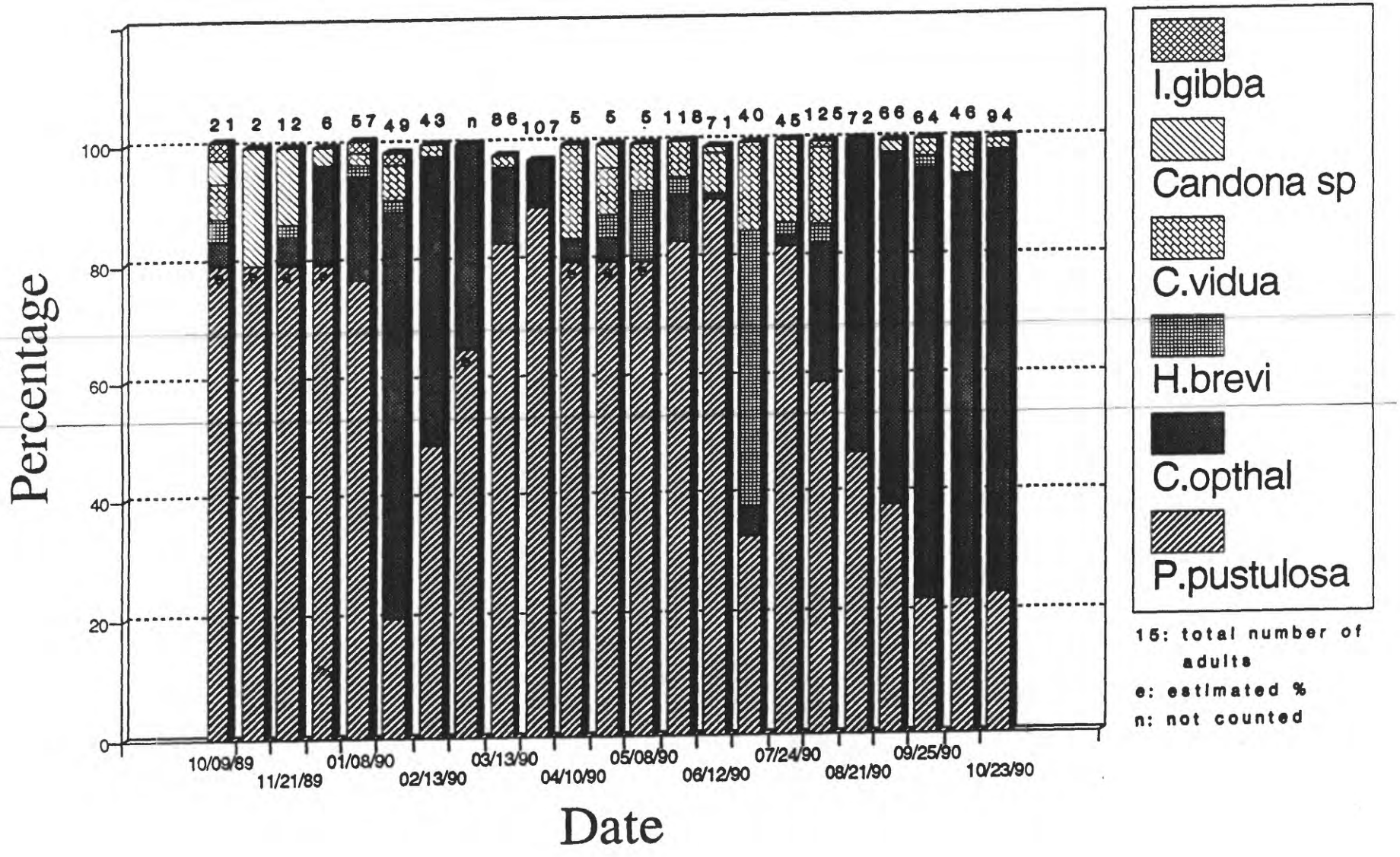

Figure 3. Searsville Lake, Subloc. 1: Minor constituent species of population

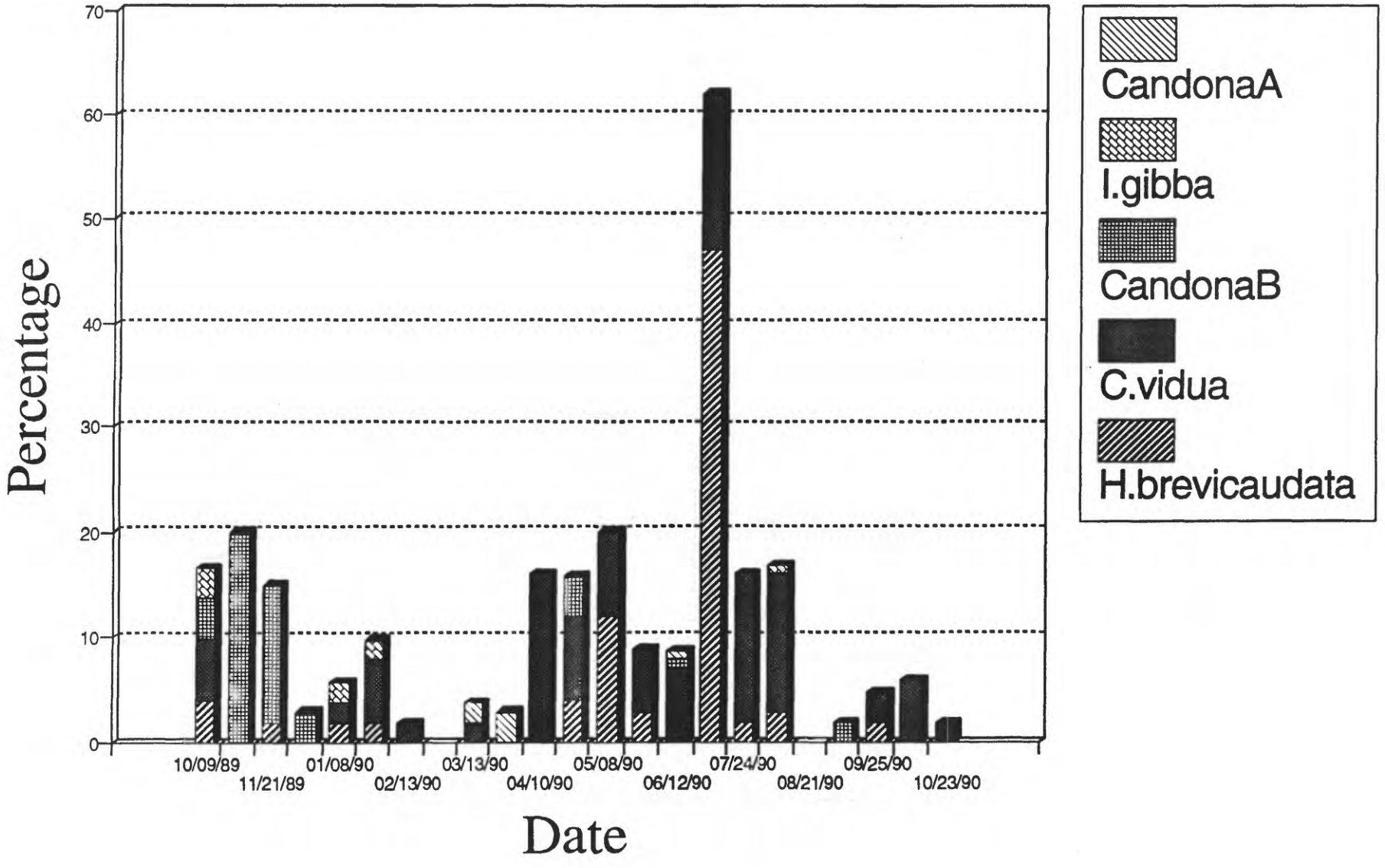

Figure 4. Searsville Lake, Subloc. 2
Constituent Species of Population

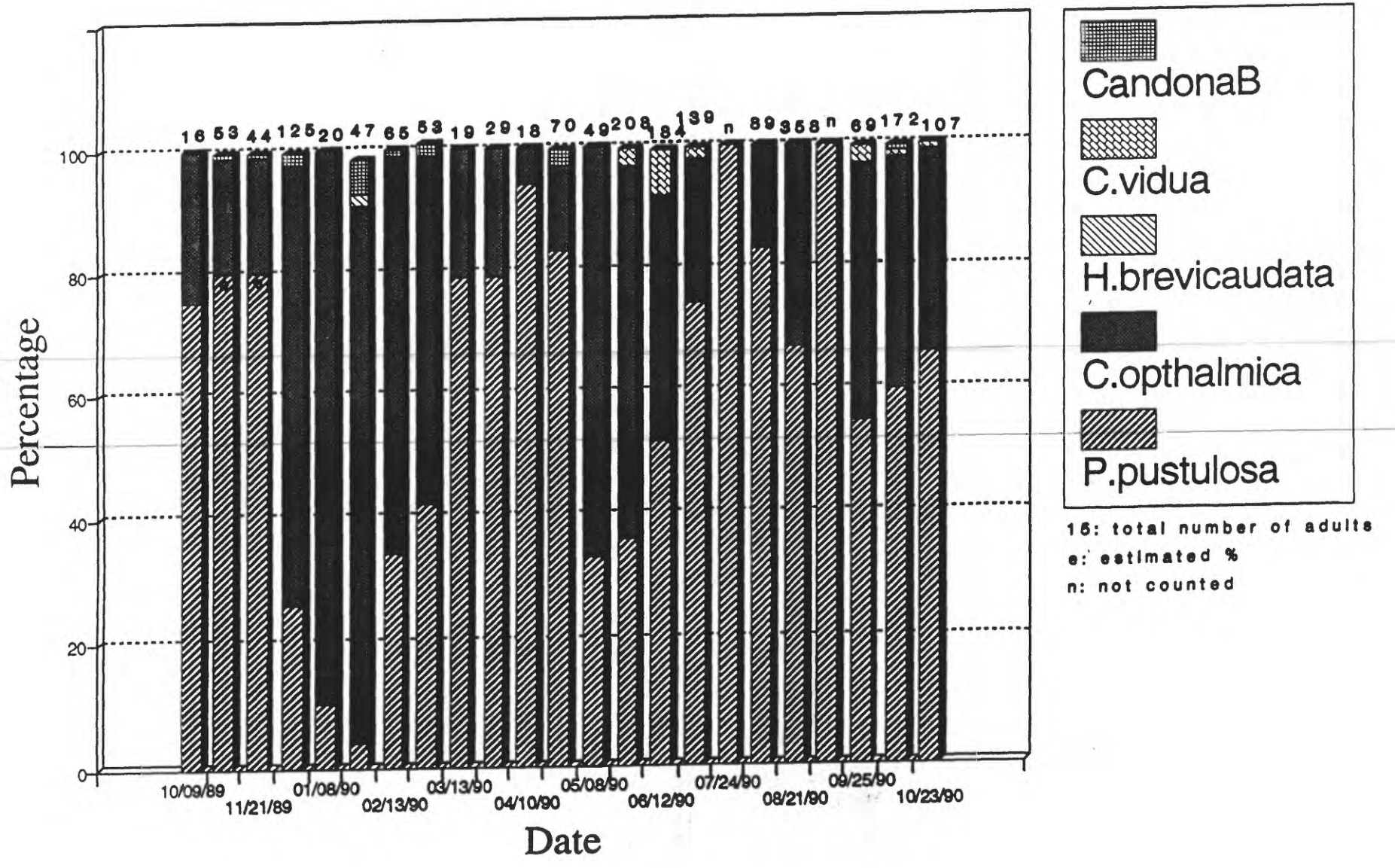

Figure 5. Arastradero Lake:

P.pustulosa as % of total population

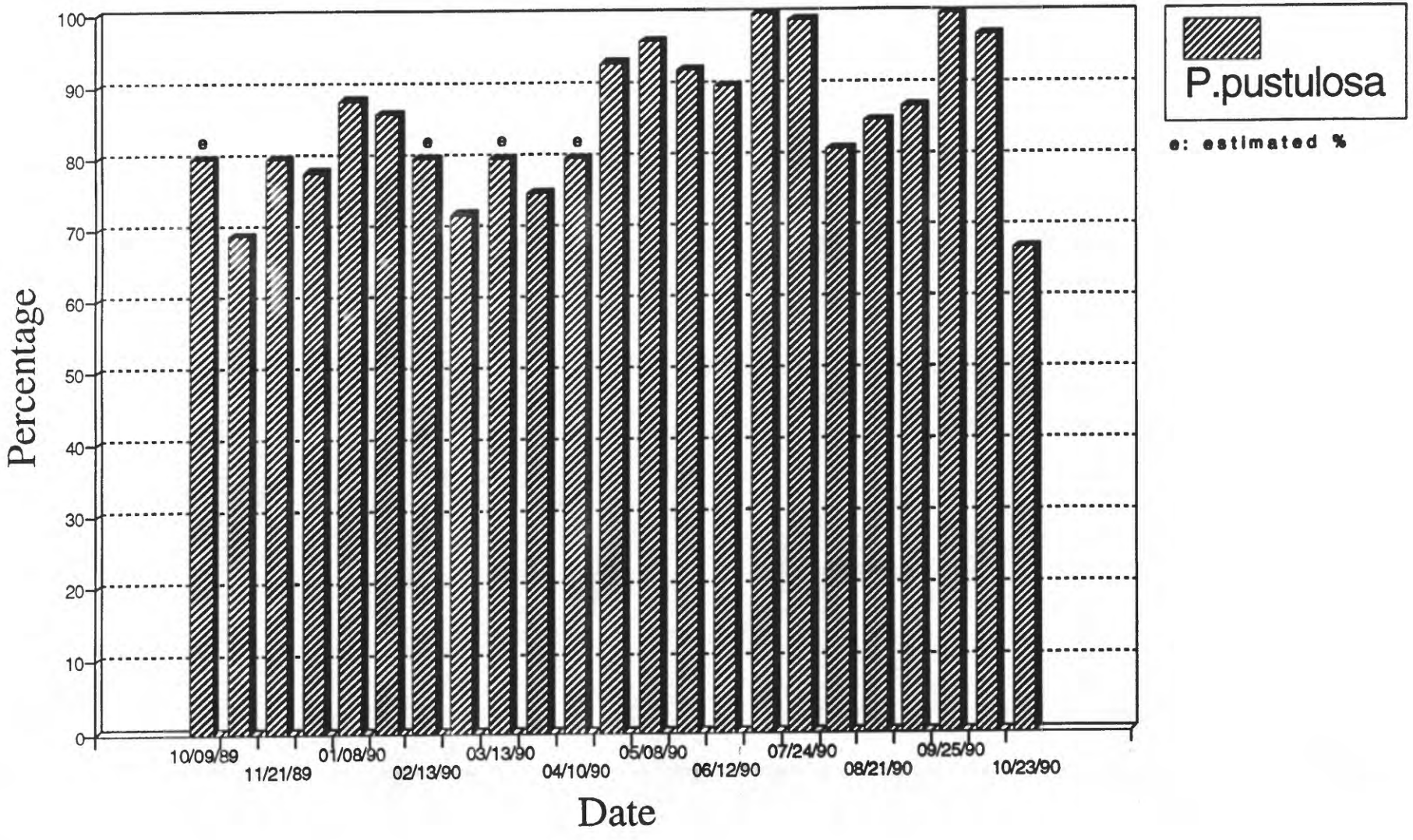

Figure 6. Arastradero Lake:
Minor constituent species of population

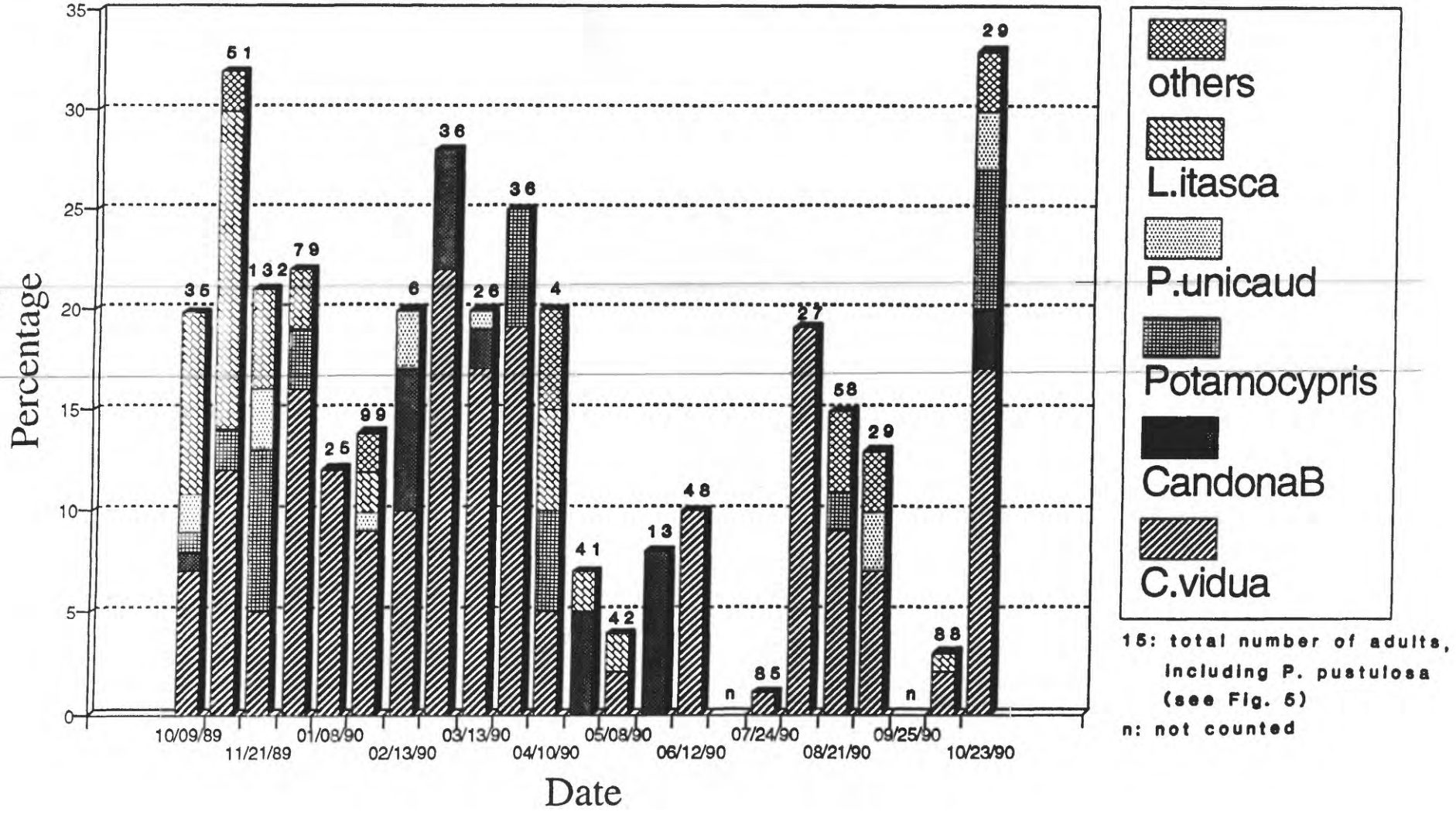

Figure 7. Boronda Lake:
Constituent Species of Population

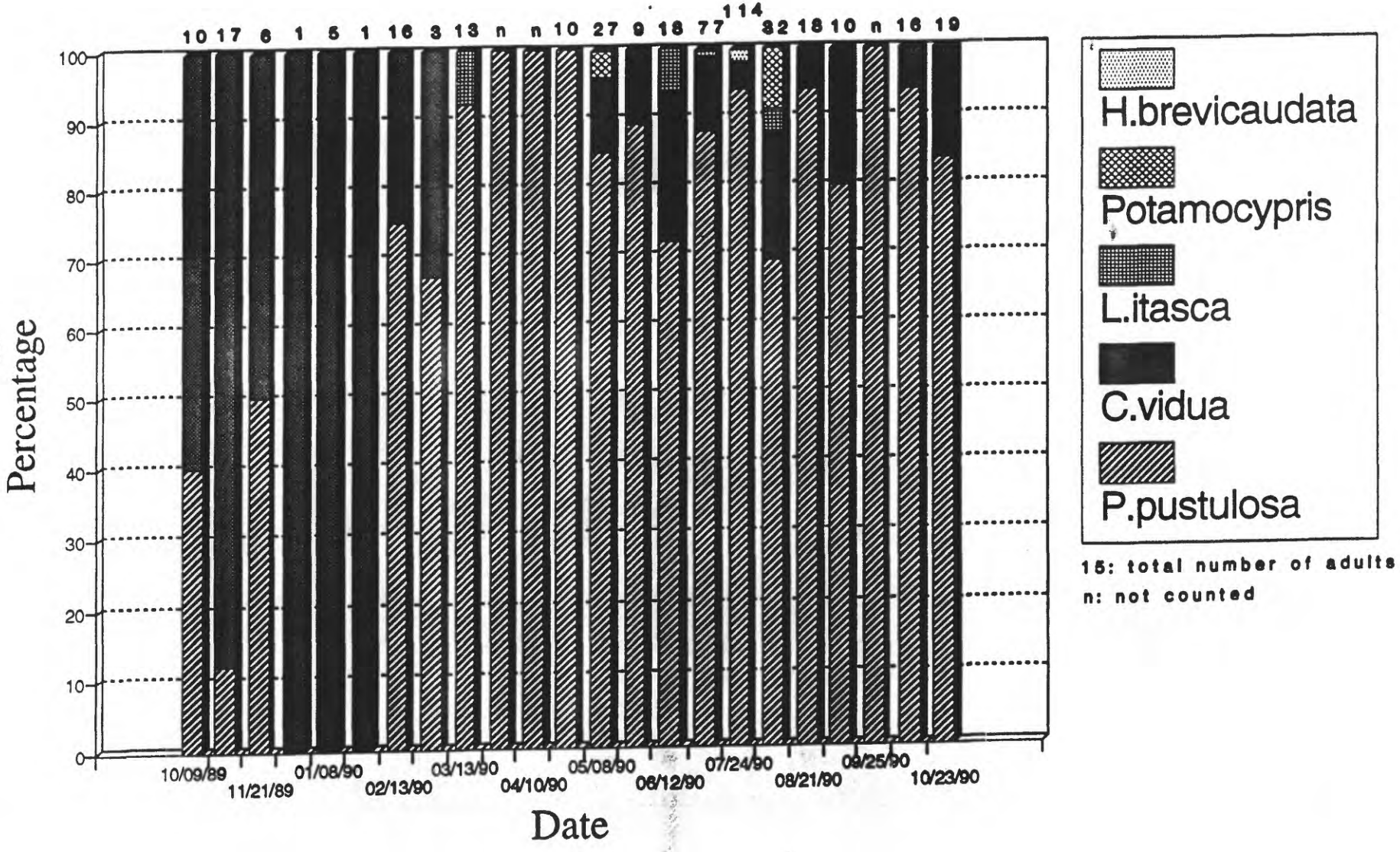

Figure 8. Coast Casey Forebay: Constituent Species of Population

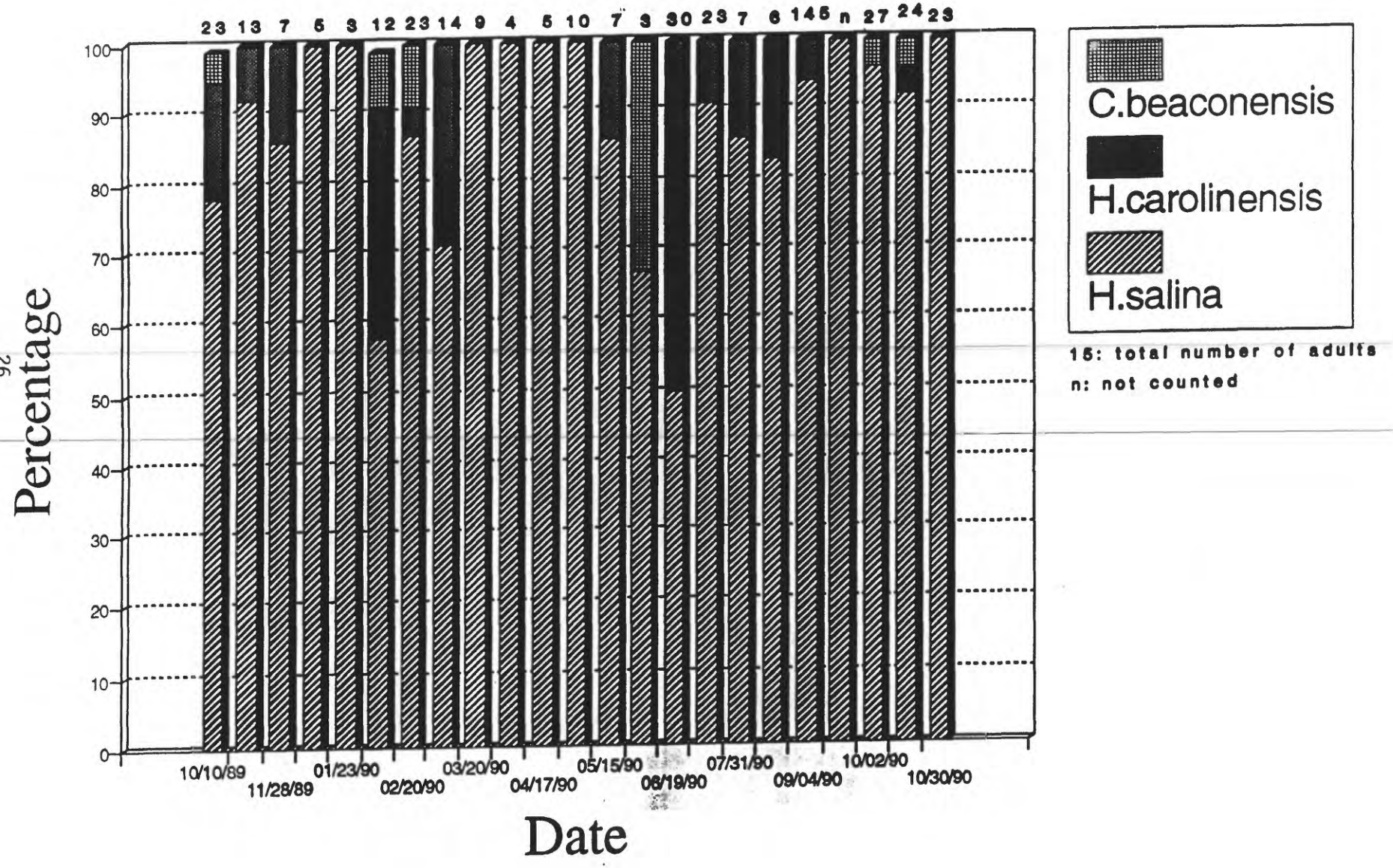

Figure 9. Los Gatos Creek, Subloc. 1: Constituent Species of Population

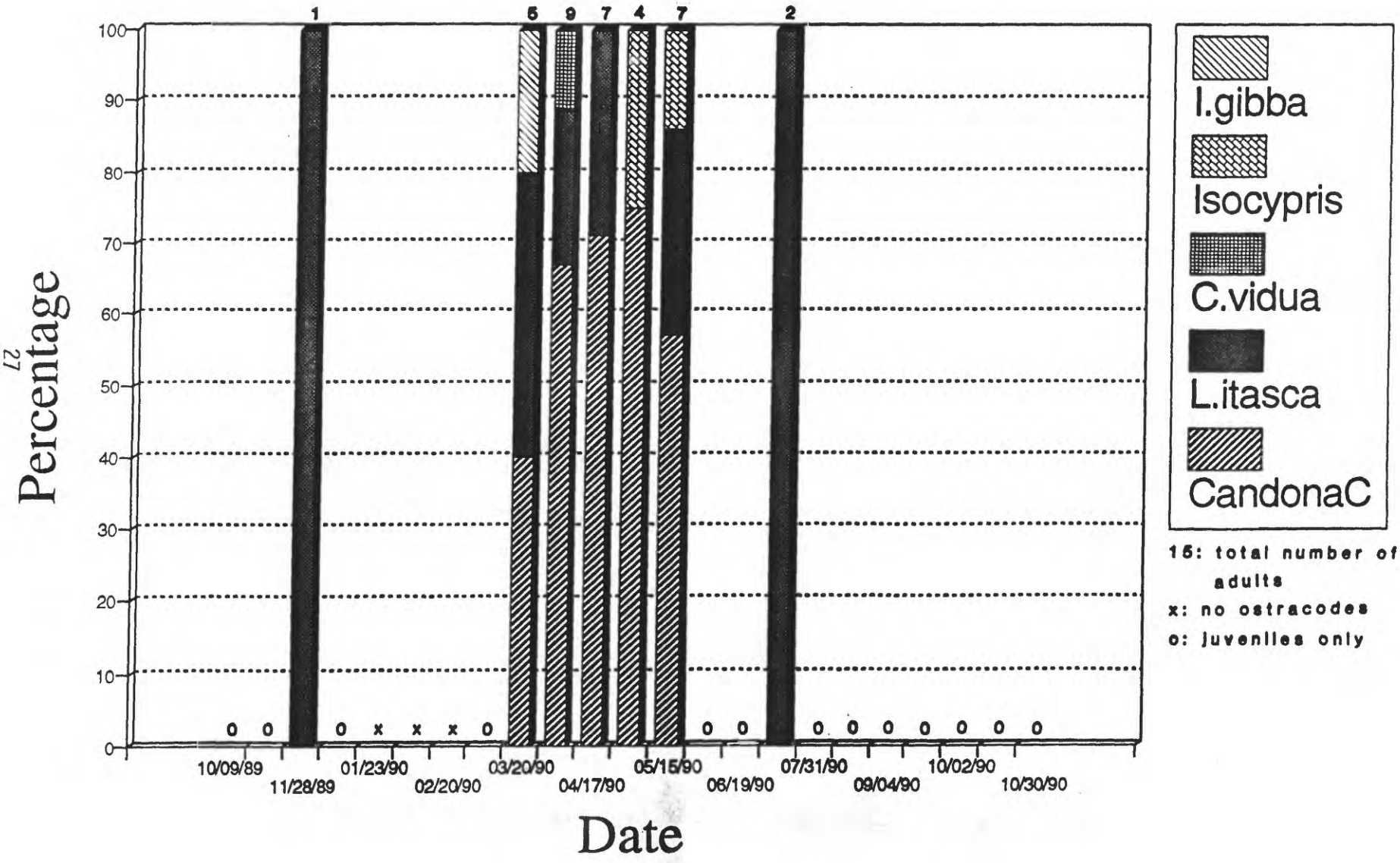

Figure 10. Los Gatos Creek, Subloc. 3: Constituent Species of Population

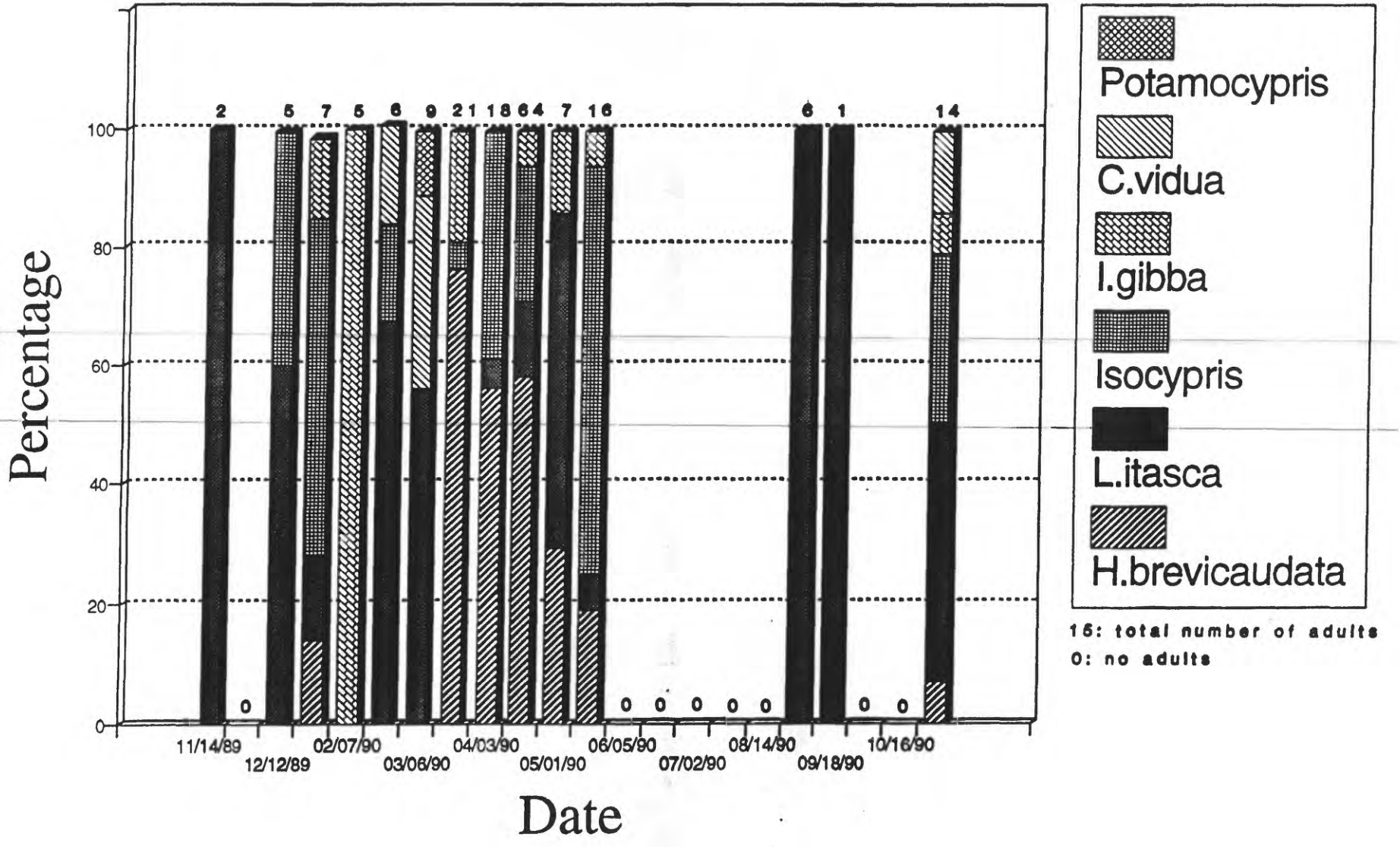

Figure 11: Los Gatos Percolation Pond: Constituent Species of Population

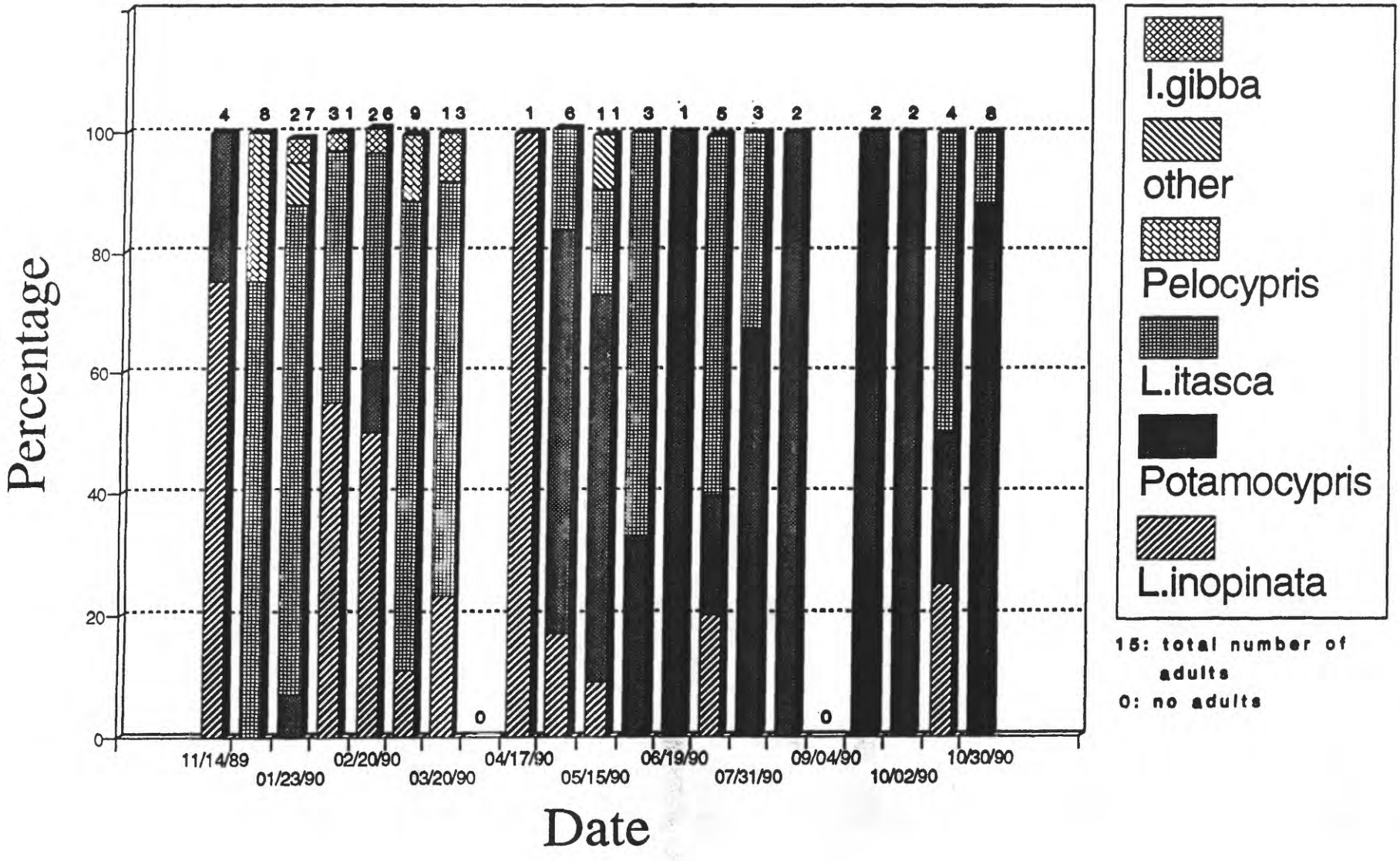

Figure 12. Plot of pH values at Searsville Lake, sublocality 1, from October 9, 1989 to October 23, 1990.

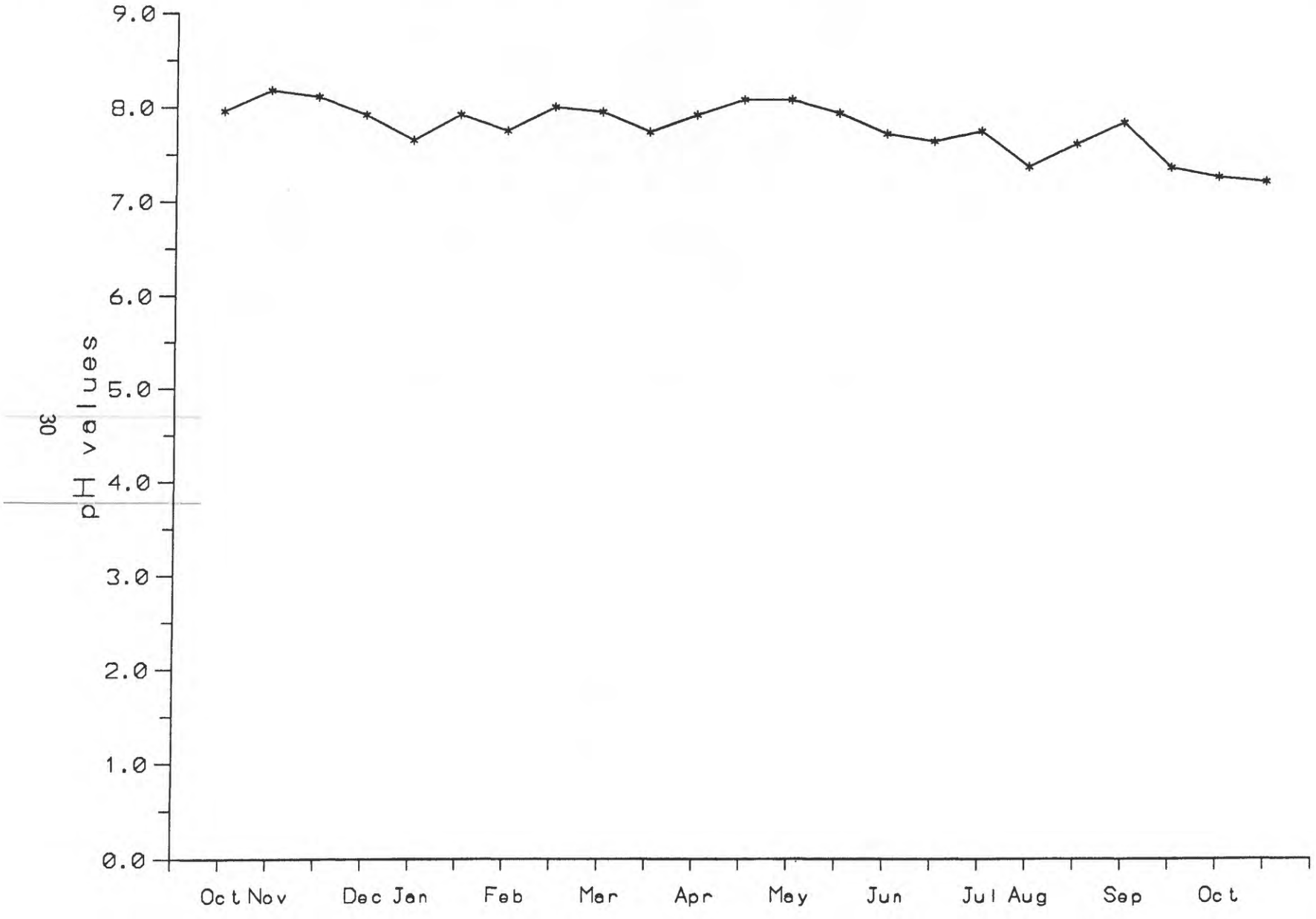

Figure 13. Plot of conductivity at Searsville Lake, sublocality 1, from October 9, 1989 to October 23, 1990.

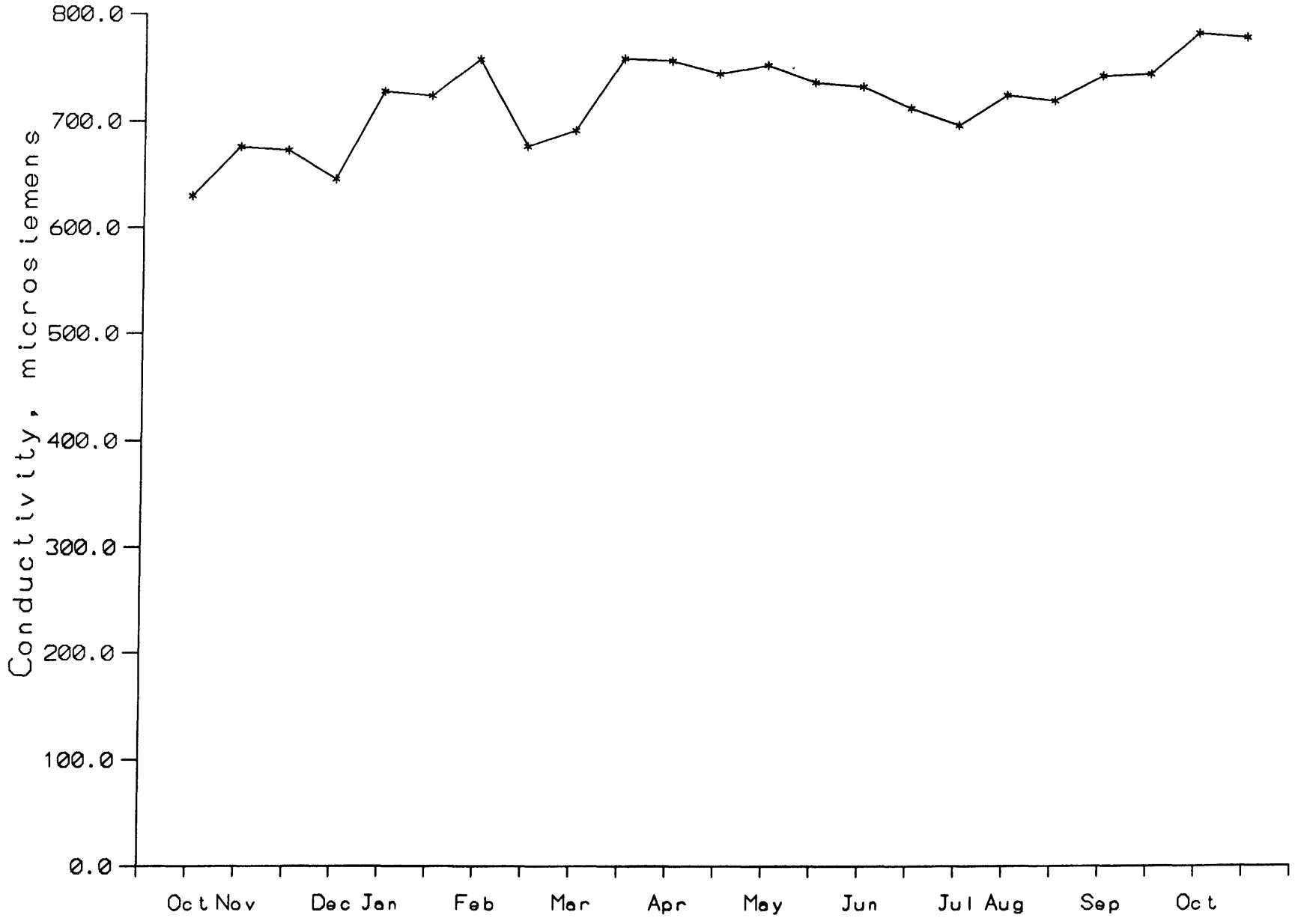

Figure 14. Temperature plot for Searsville Lake, sublocality 1, from October 9, 1989 to October 23, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Woodside Fire Station, Woodside, CA)

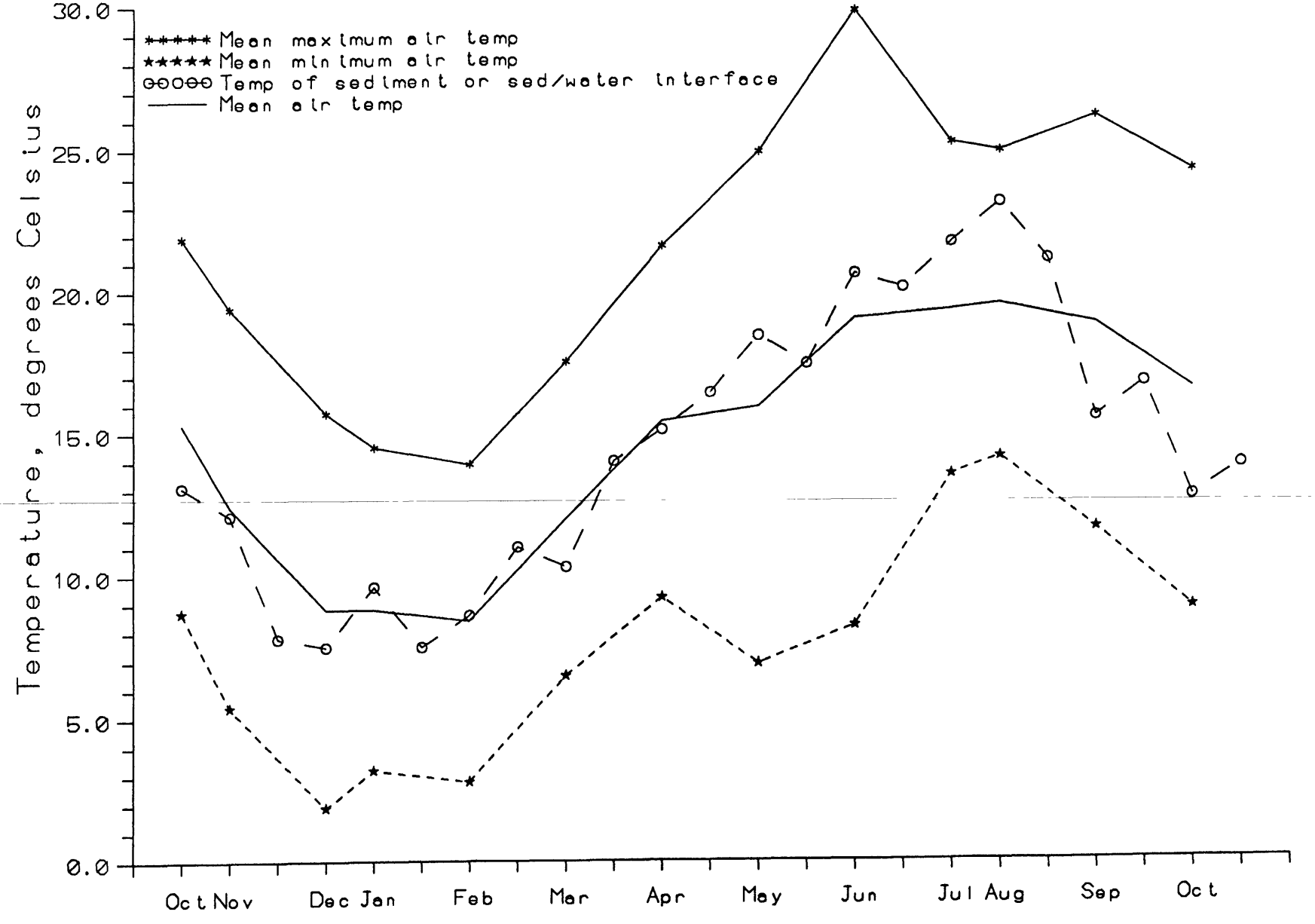

Figure 15. Plot of pH values at Searsville Lake, sublocality 2, from October 9, 1989 to October 23, 1990.

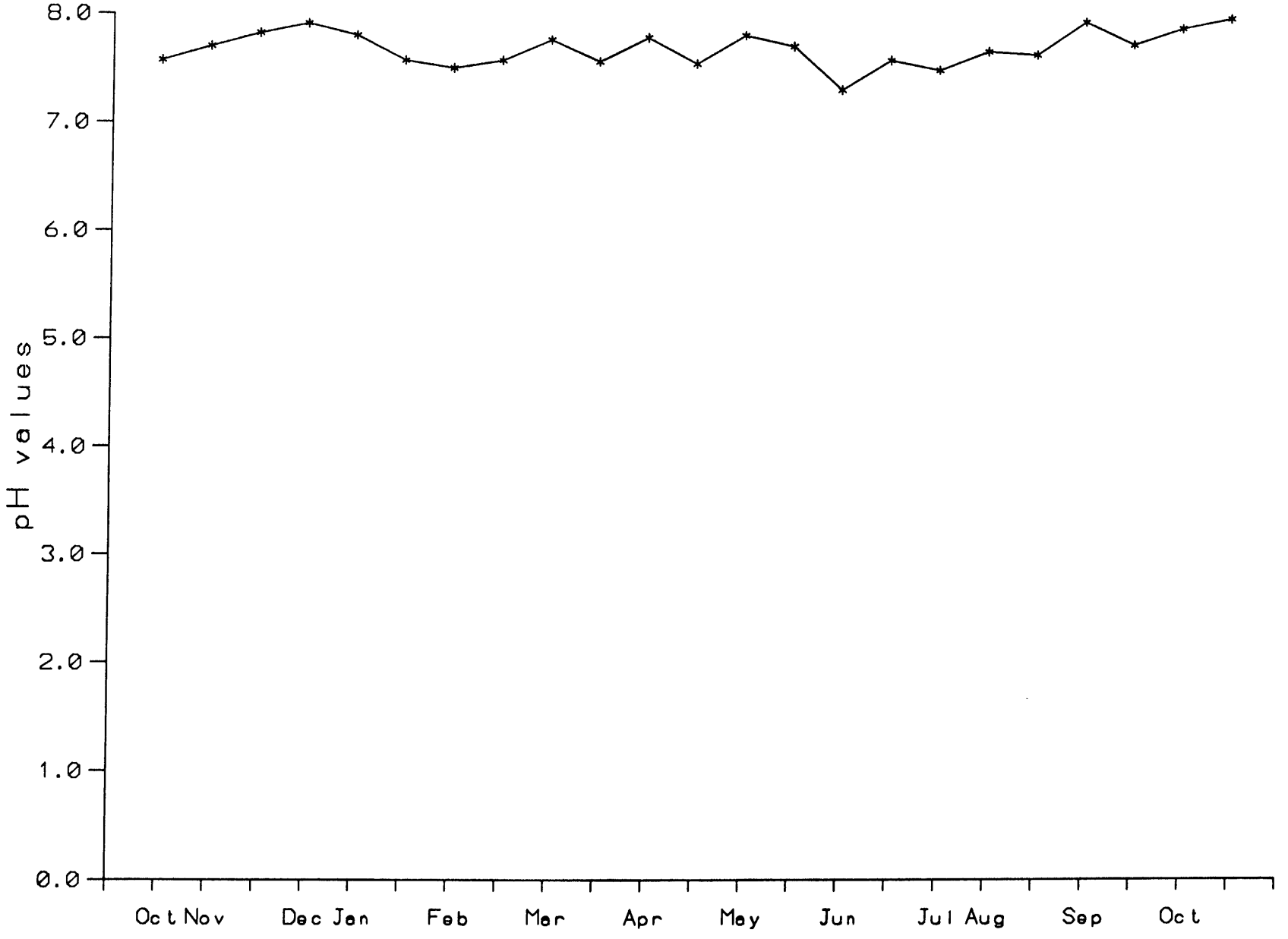

Figure 16. Plot of conductivity at Searsville Lake, sublocality 2, from October 9, 1989 to October 23, 1990.

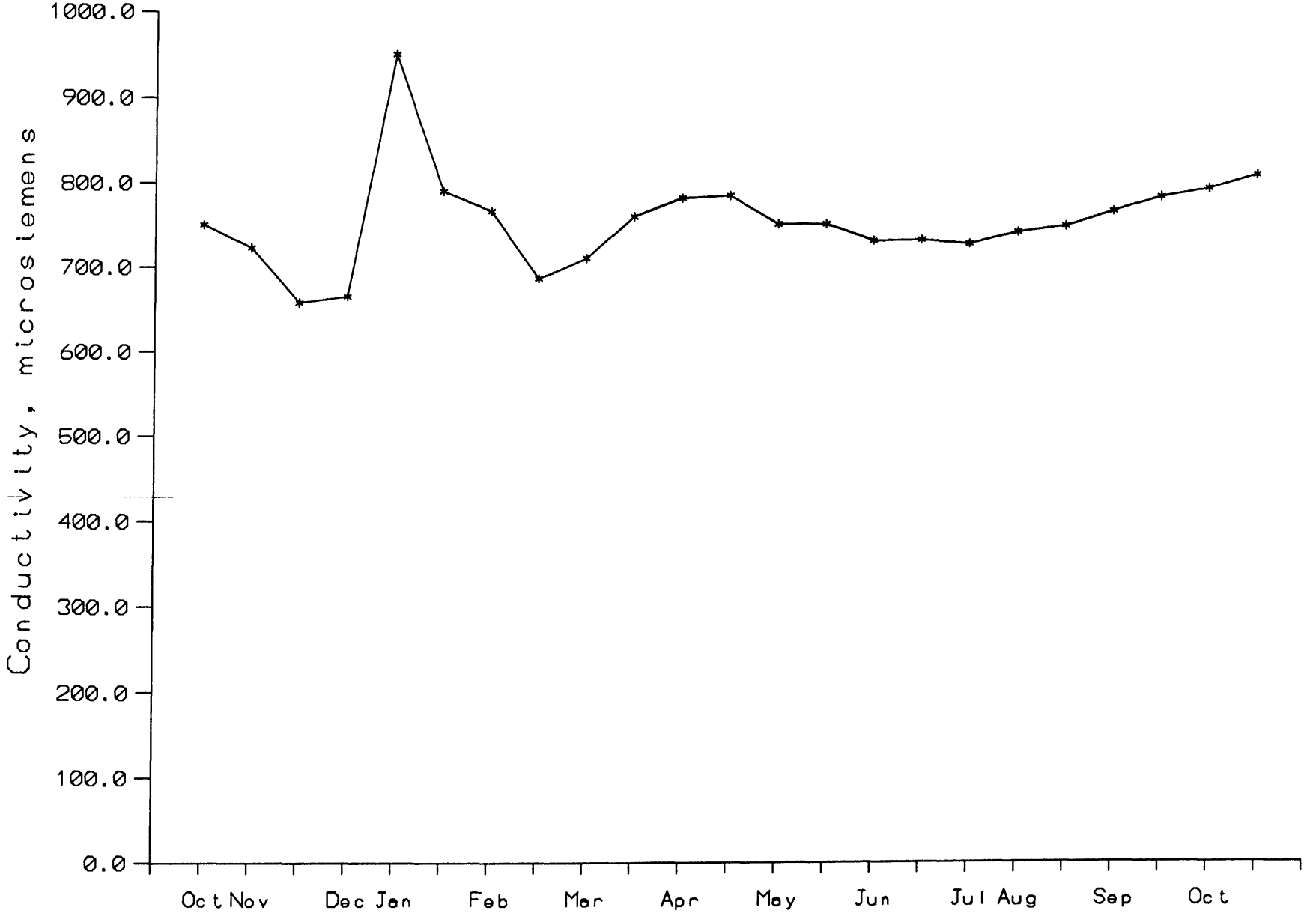

Figure 17. Temperature plot for Searsville Lake, sublocality 2, from October 9, 1989 to October 23, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Woodside Fire Station, Woodside, CA)

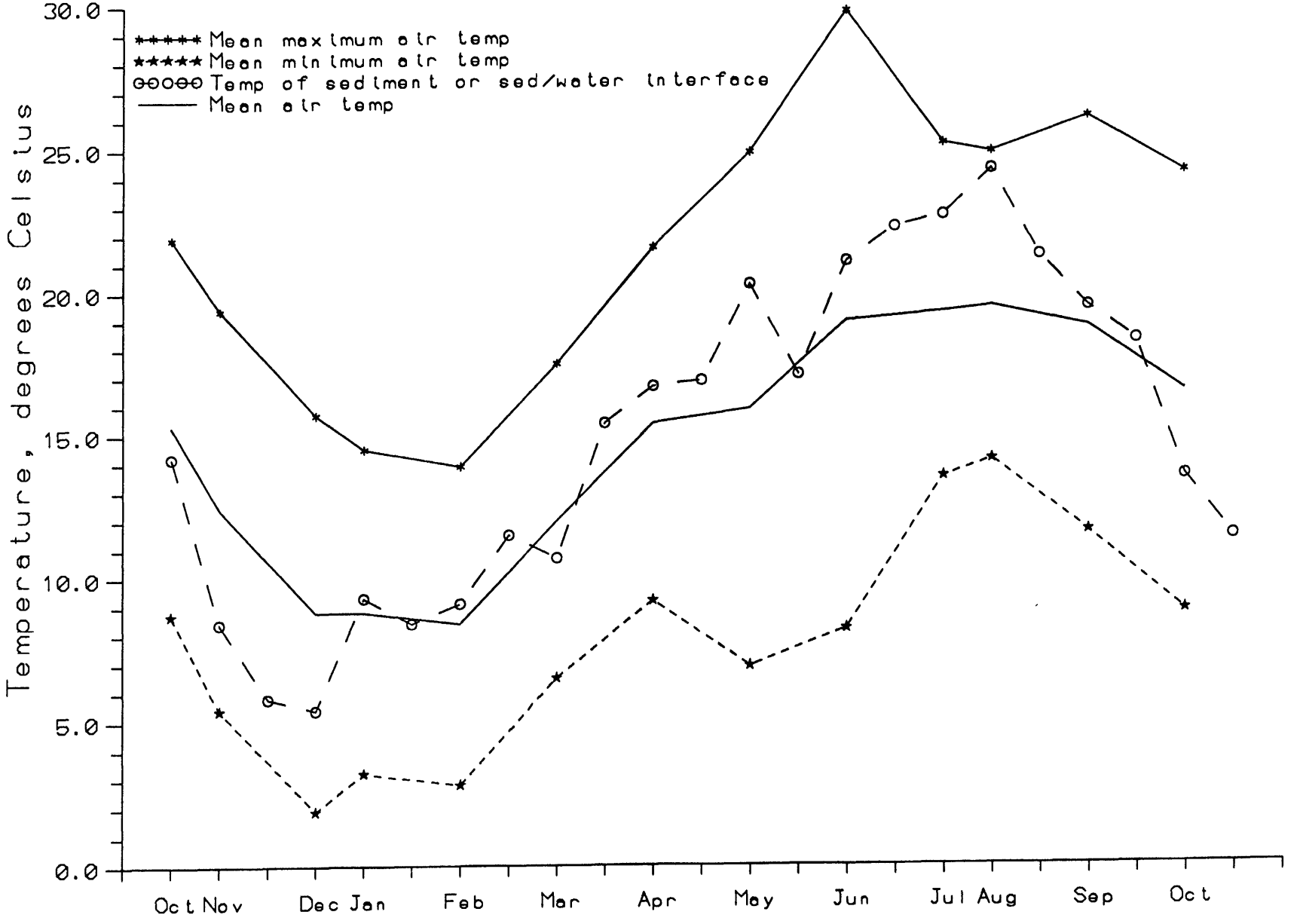

Figure 18. Temperature plot for Arastradero Lake from October 9, 1989 to October 23, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Woodside Fire Station, Woodside, CA)

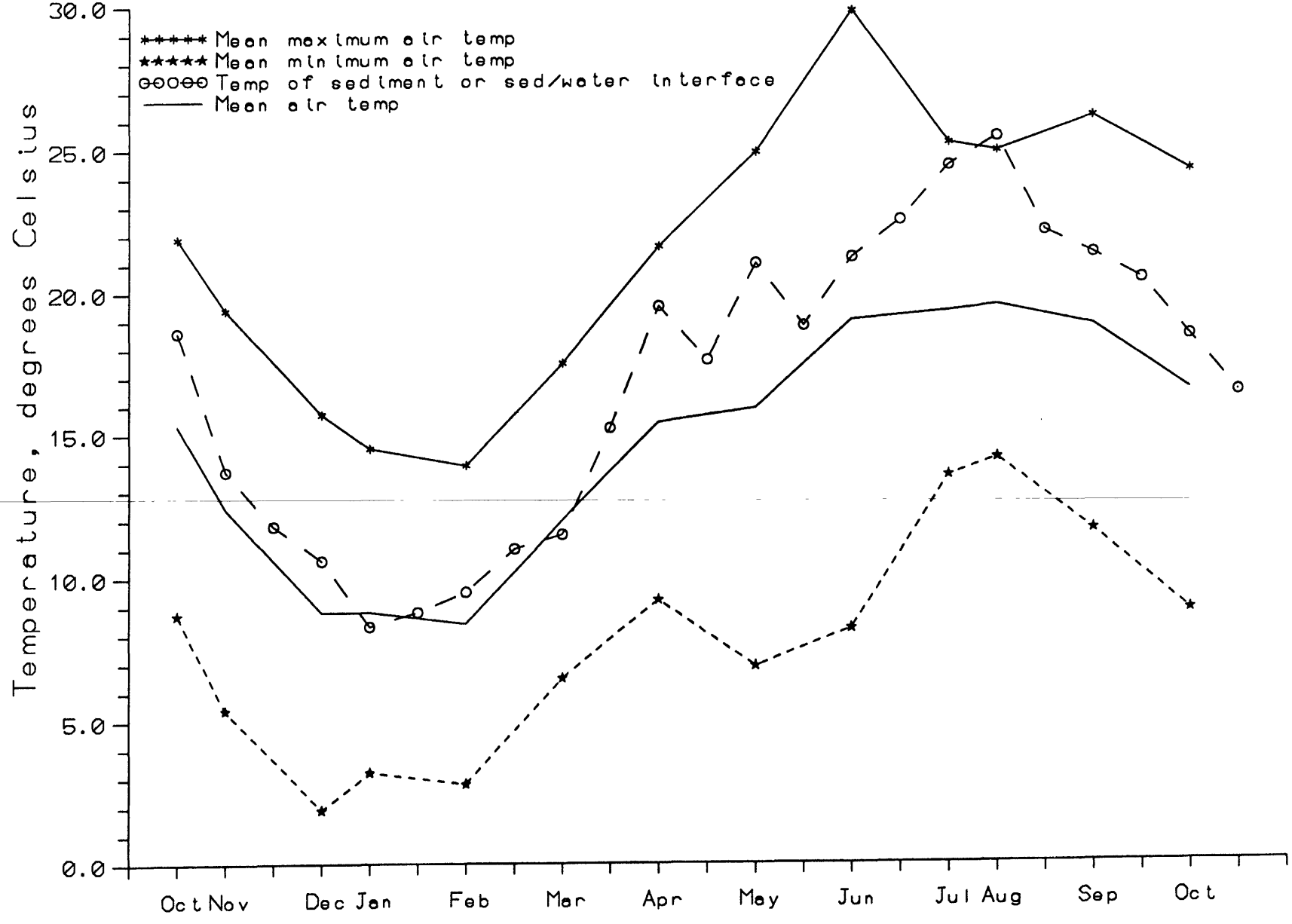

Figure 19. Plot of conductivity at Arastradero Lake from October 9, 1989 to October 23, 1990.

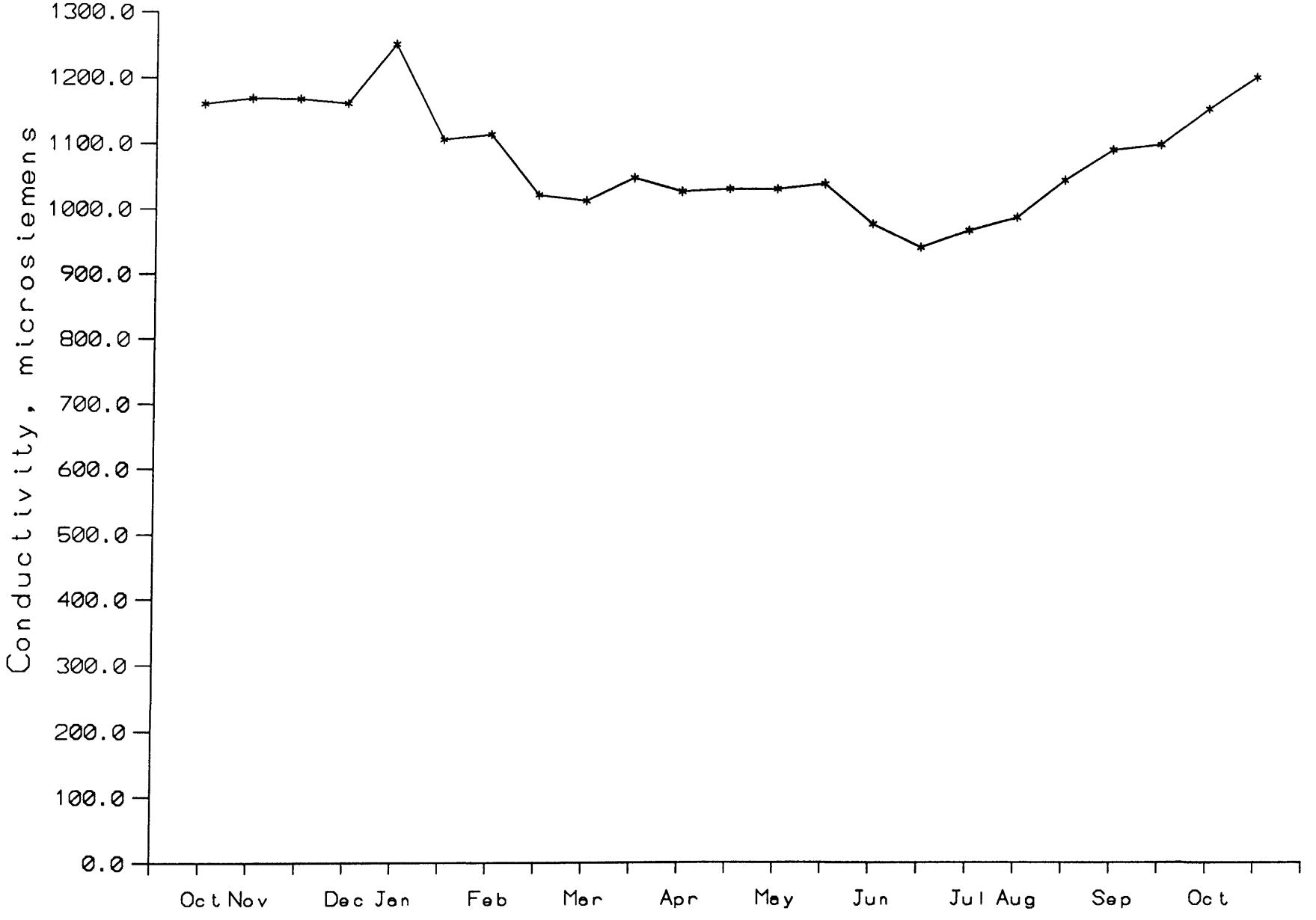

Figure 20. Plot of pH values at Arastradero Lake from October 9, 1989 to October 23, 1990.

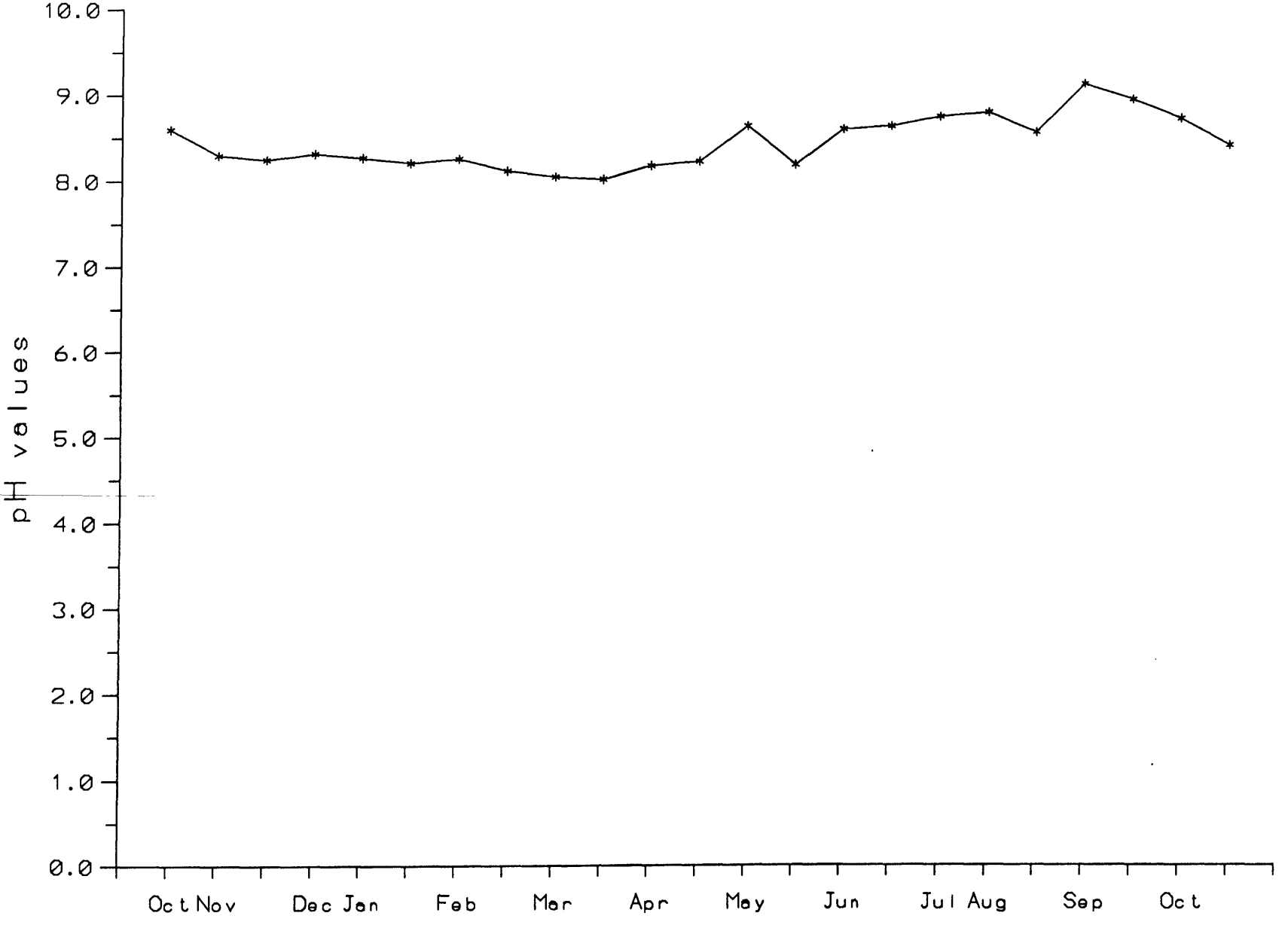

Figure 21. Plot of pH values at Boronda Lake from October 9, 1989 to October 23, 1990.

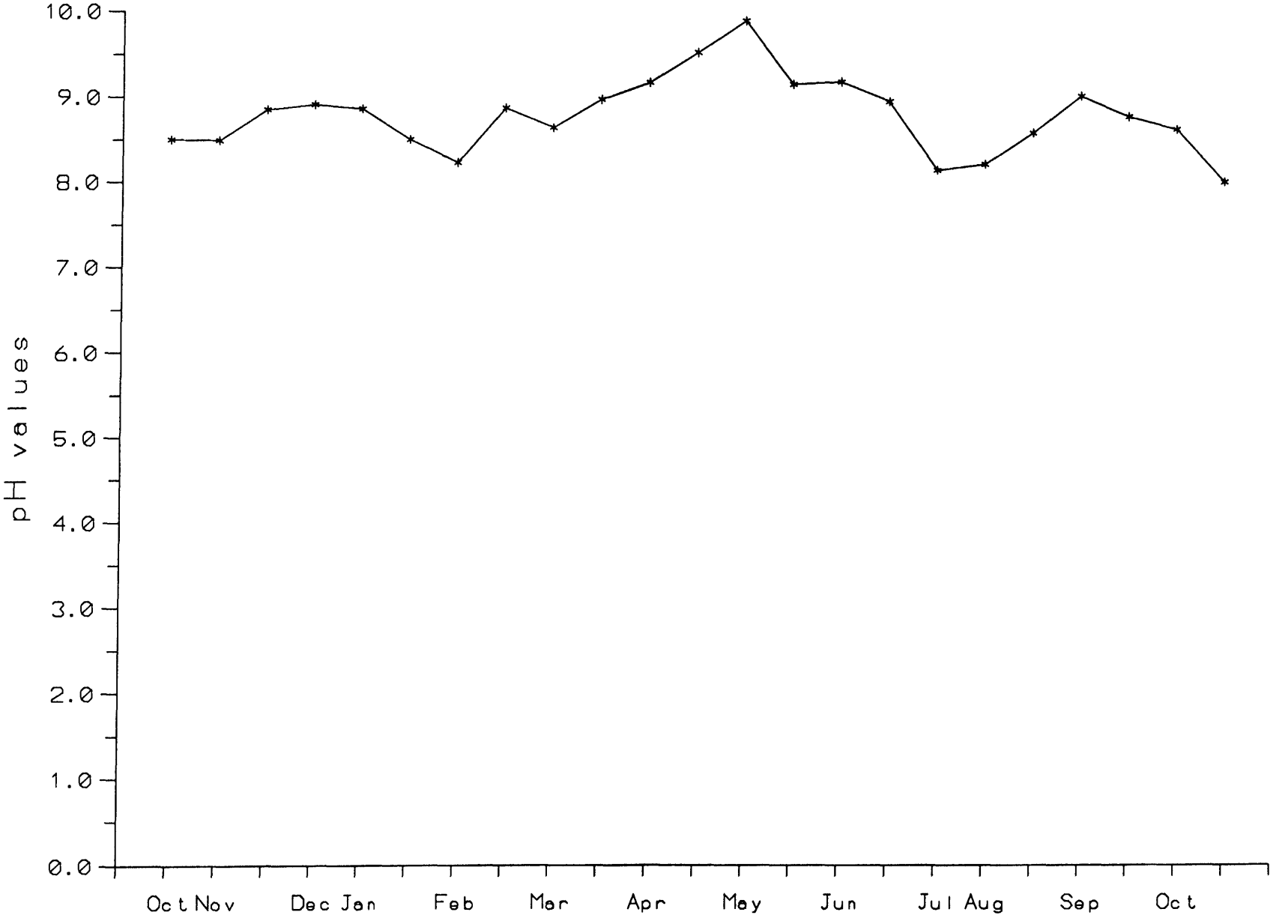

Figure 22. Plot of conductivity at Boronda Lake from October 9, 1989 to October 23, 1990.

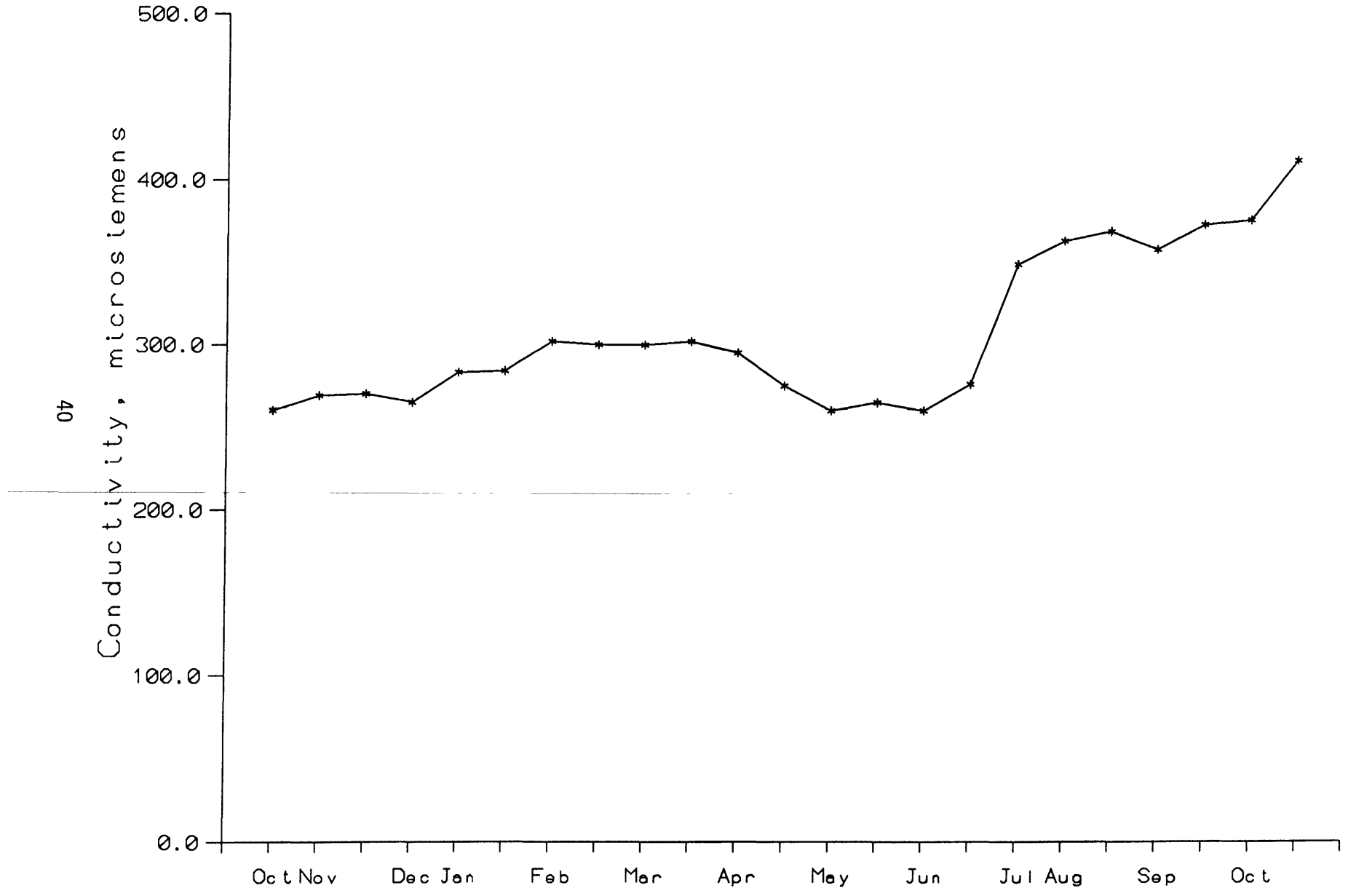

Figure 23. Temperature plot for Boronda Lake from October 9, 1989 to October 23, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Woodside Fire Station, Woodside, CA)

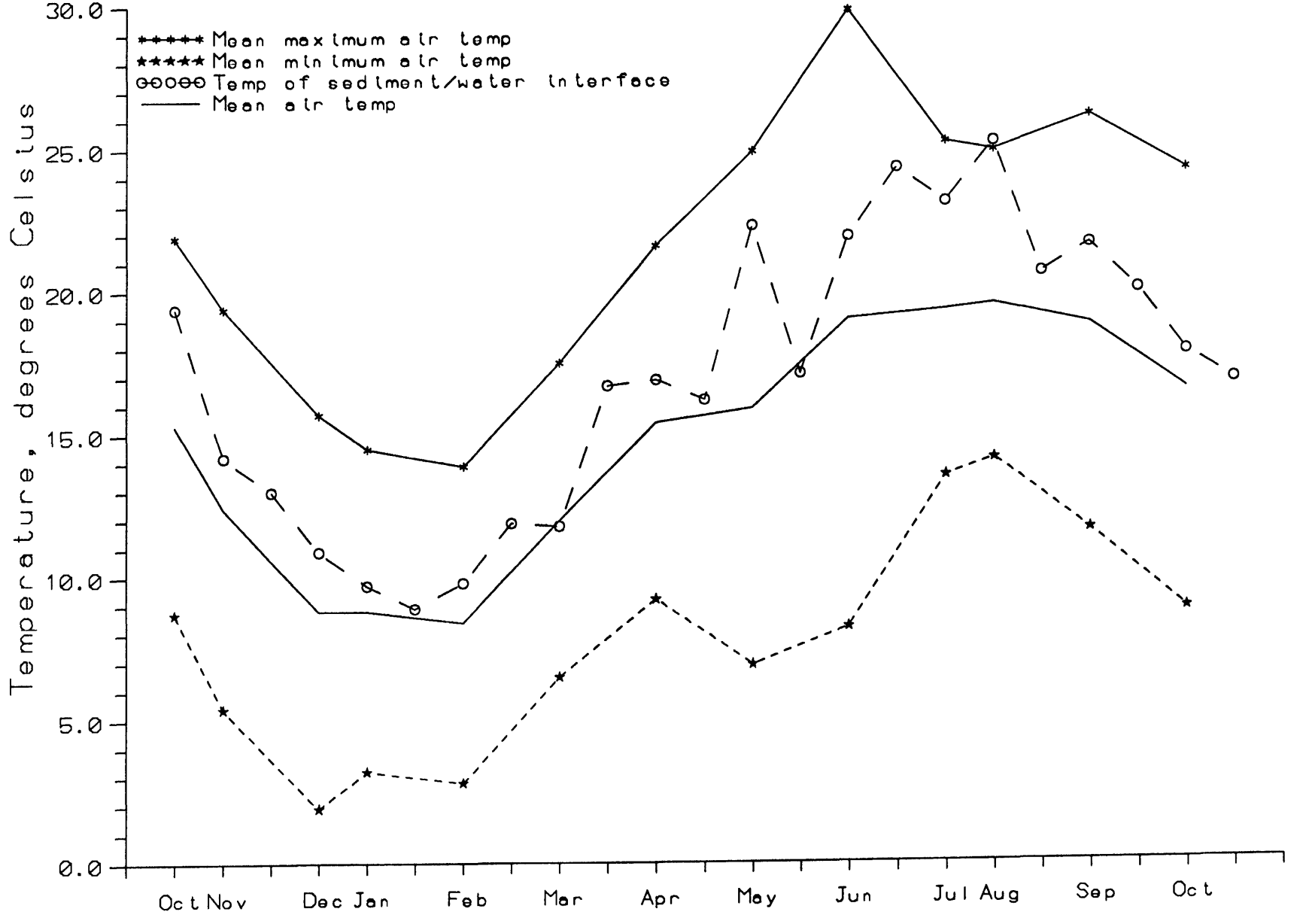

Figure 24. Plot of pH values at Coast Casey Forebay from October 10, 1989 to October 30, 1990.

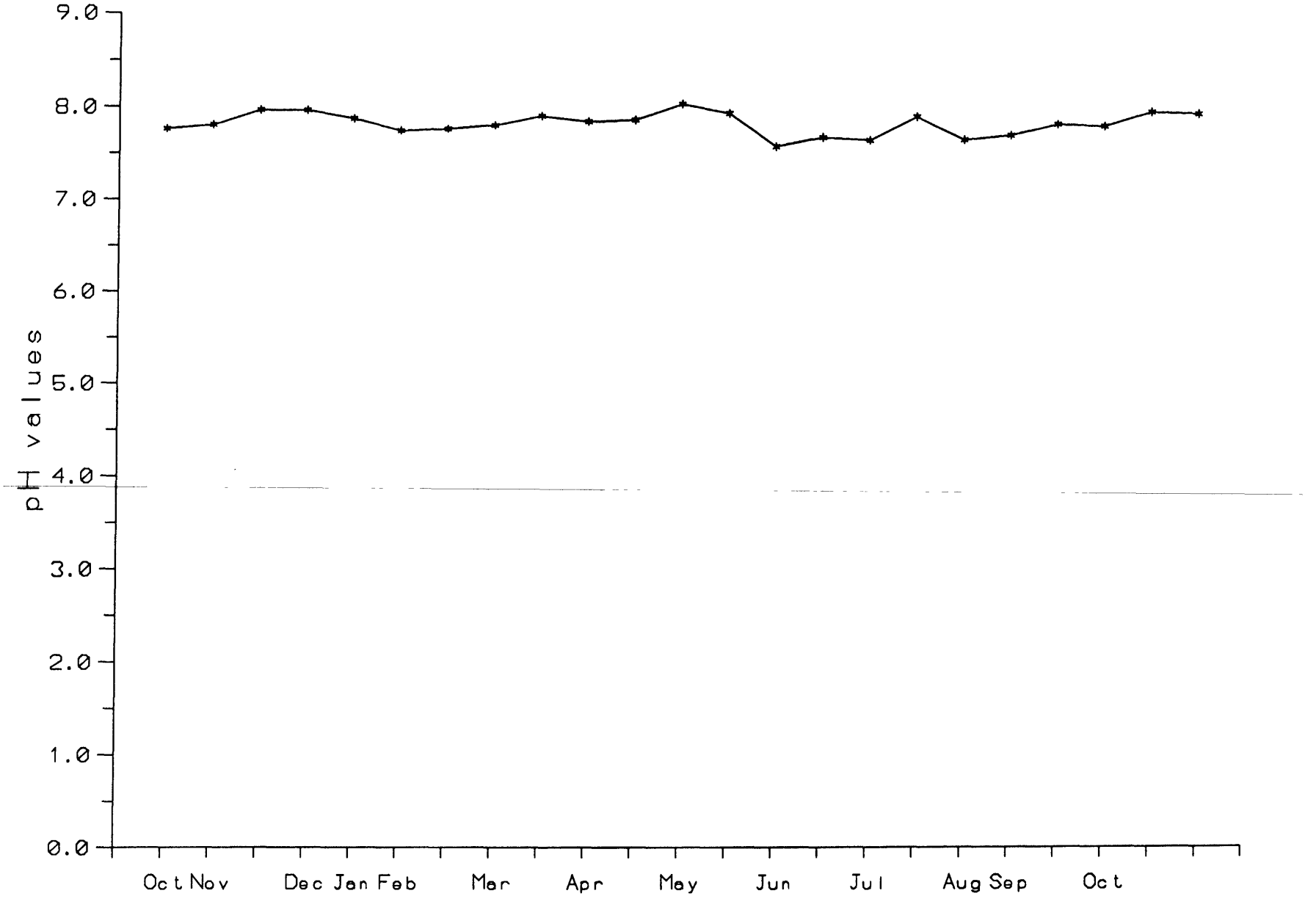

Figure 25. Plot of conductivity at Coast Casey Forebay from October 10, 1989 to October 30, 1990.

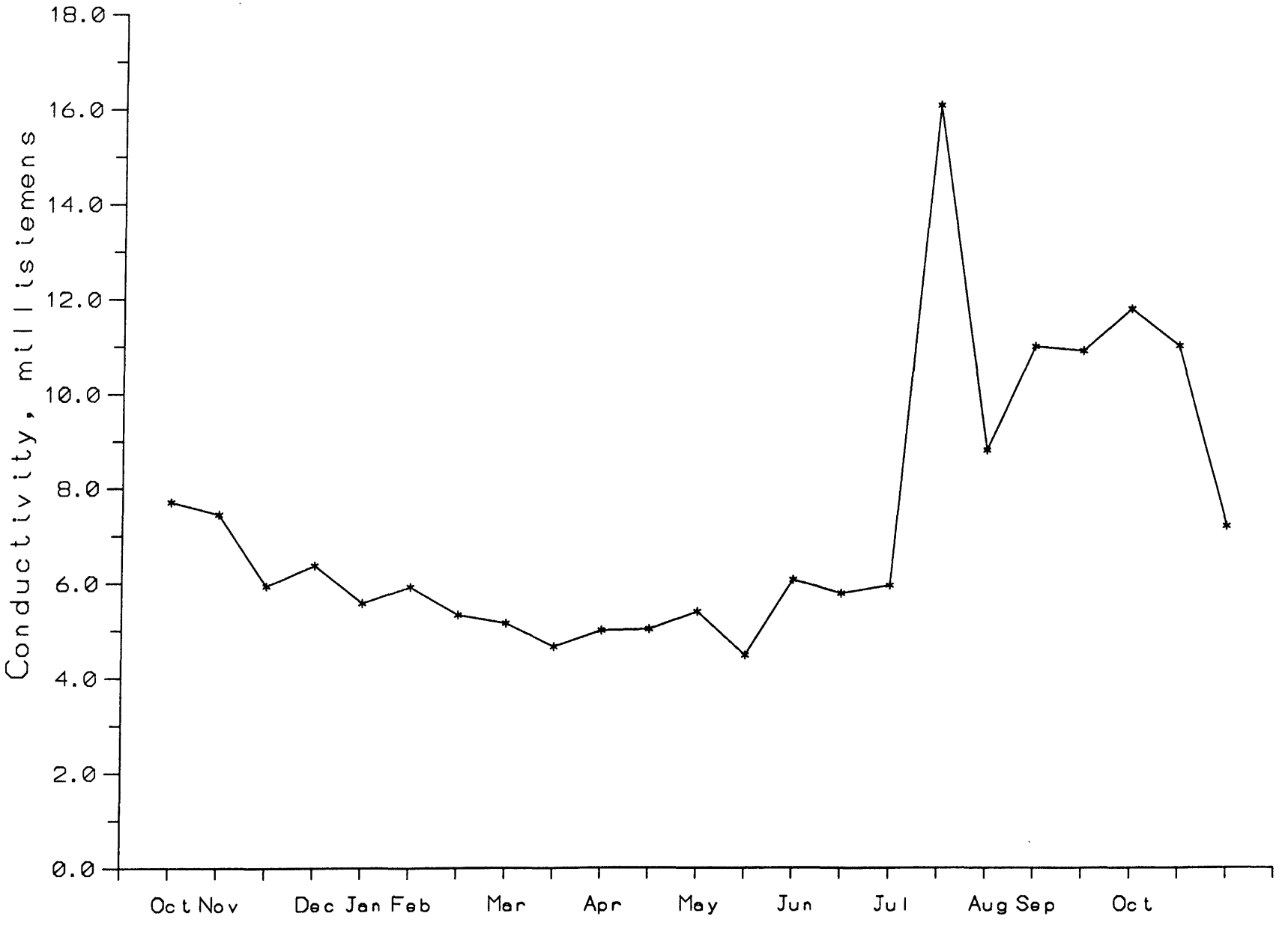

Figure 26. Temperature plot for Coast Casey Forebay from October 10, 1989 to October 30, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Palo Alto, CA)

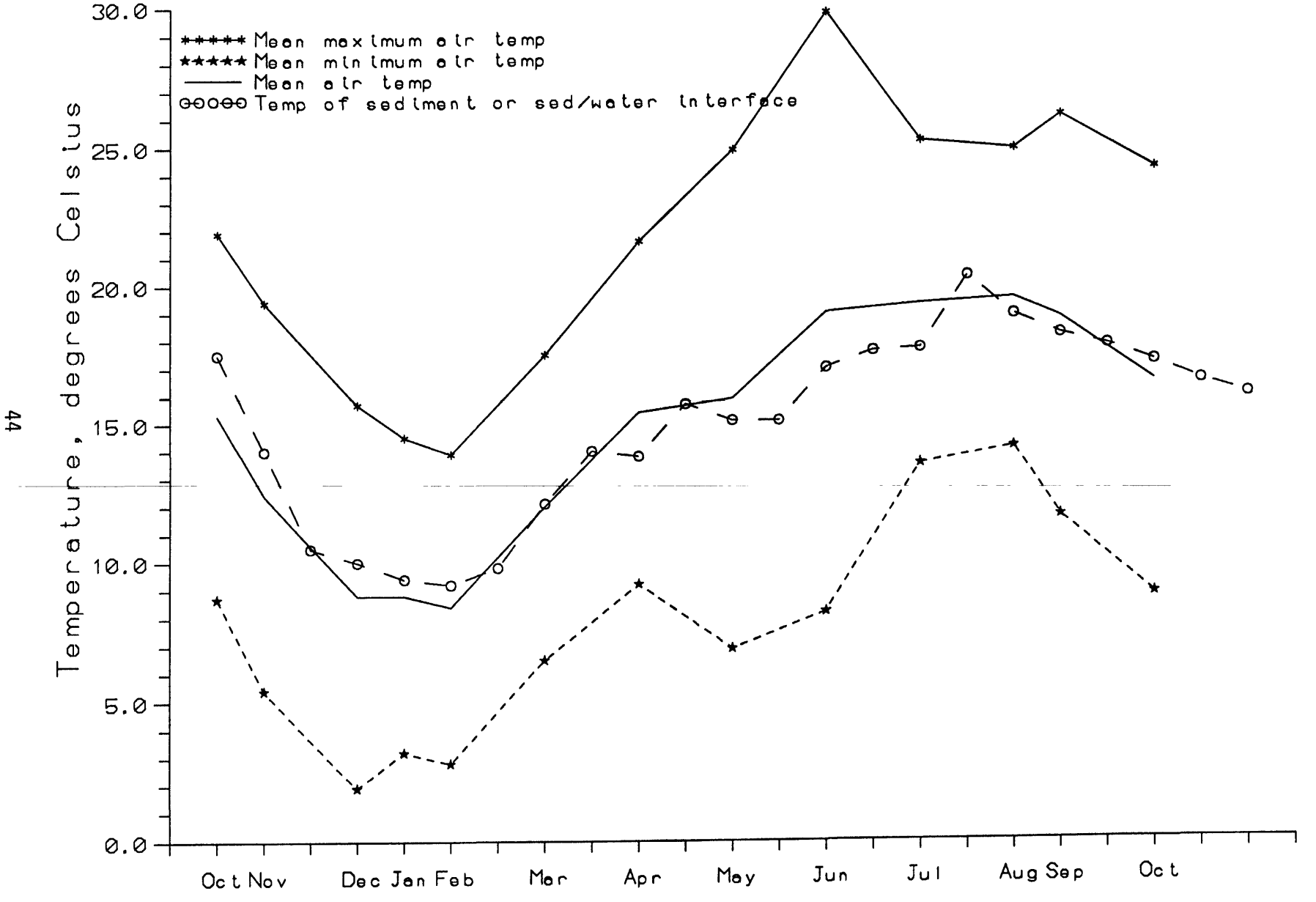

Figure 27. Plot of pH values at Los Gatos Creek, sublocality 1, from October 9, 1989 to October 30, 1990.

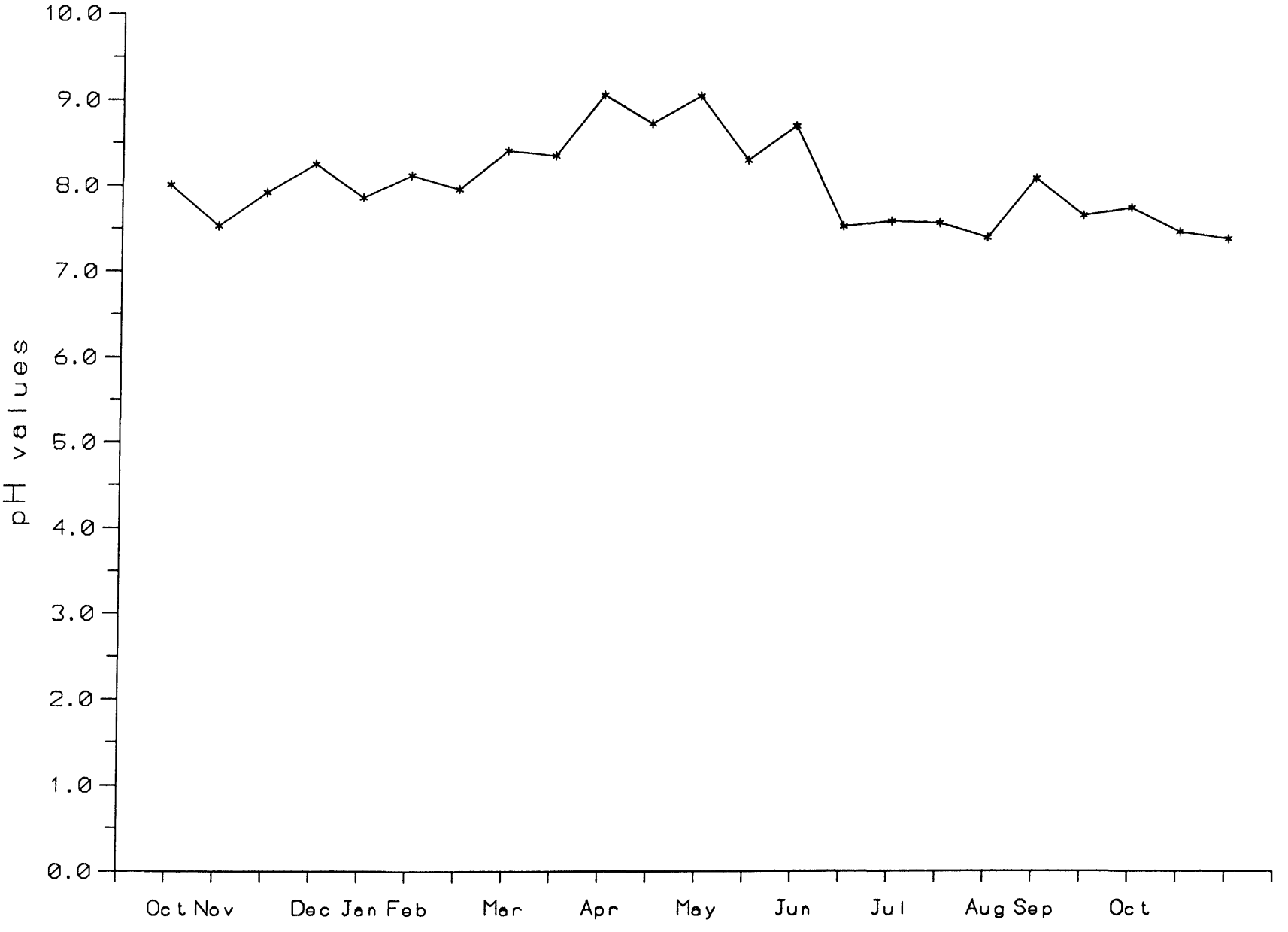

Figure 28. Plot of conductivity at Los Gatos Creek, sublocality 1, from October 9, 1989 to October 30, 1990.

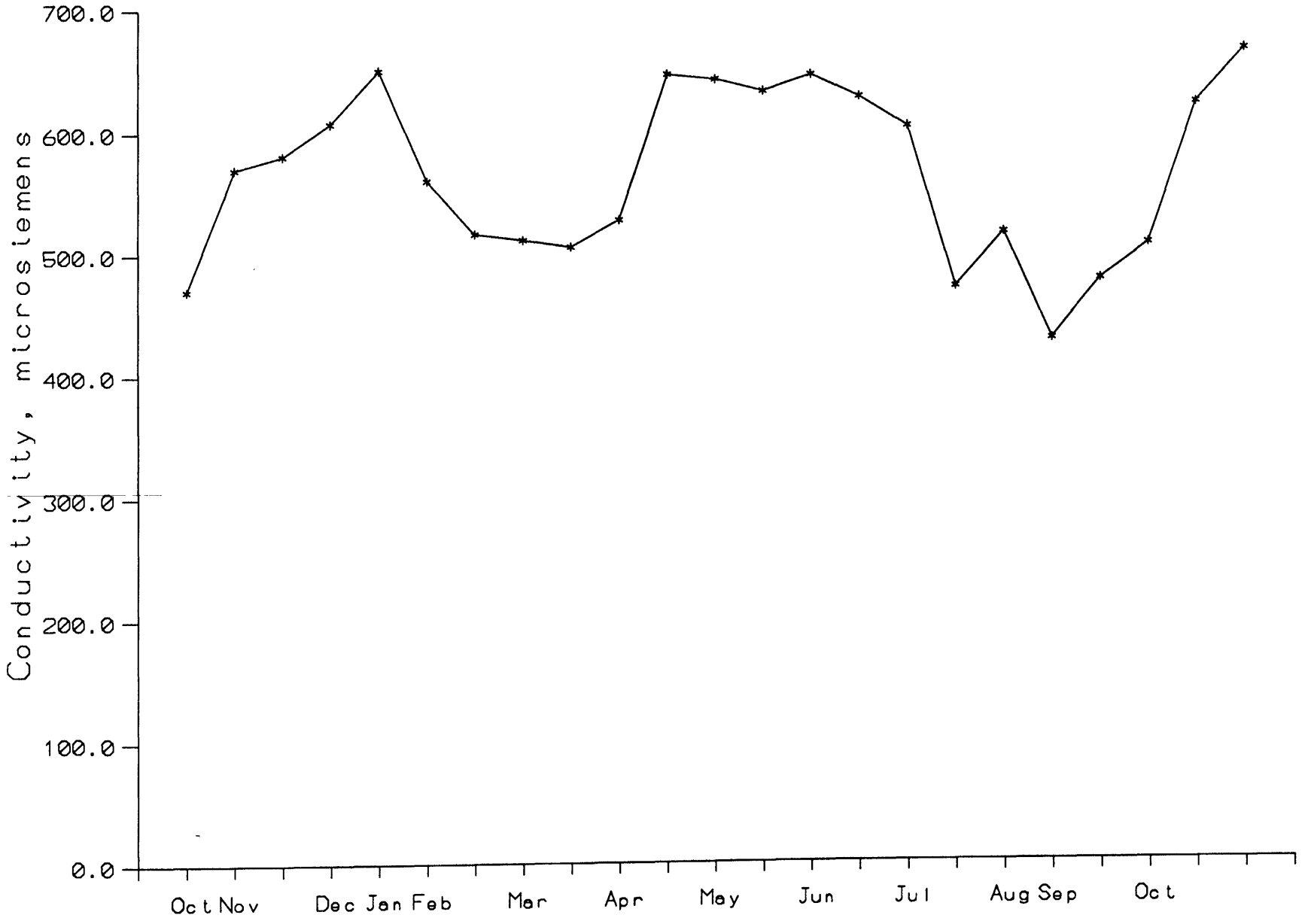

Figure 29. Temperature plot for Los Gatos Creek, sublocality 1, from October 9, 1989 to October 30, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Los Gatos, CA)

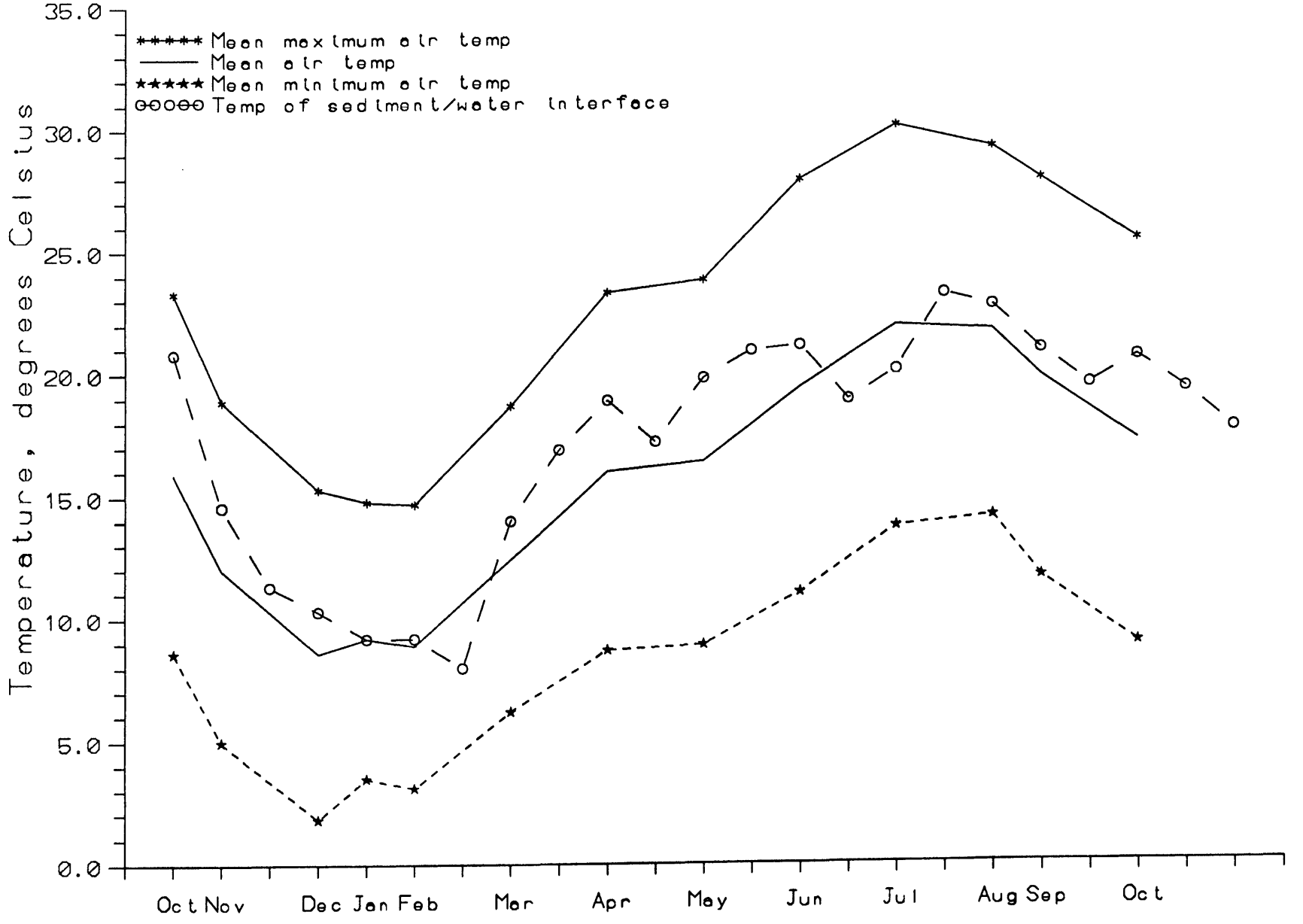

Figure 30. Plot of pH values at Los Gatos Creek, sublocality 3, from November 14, 1989 to October 30, 1990.

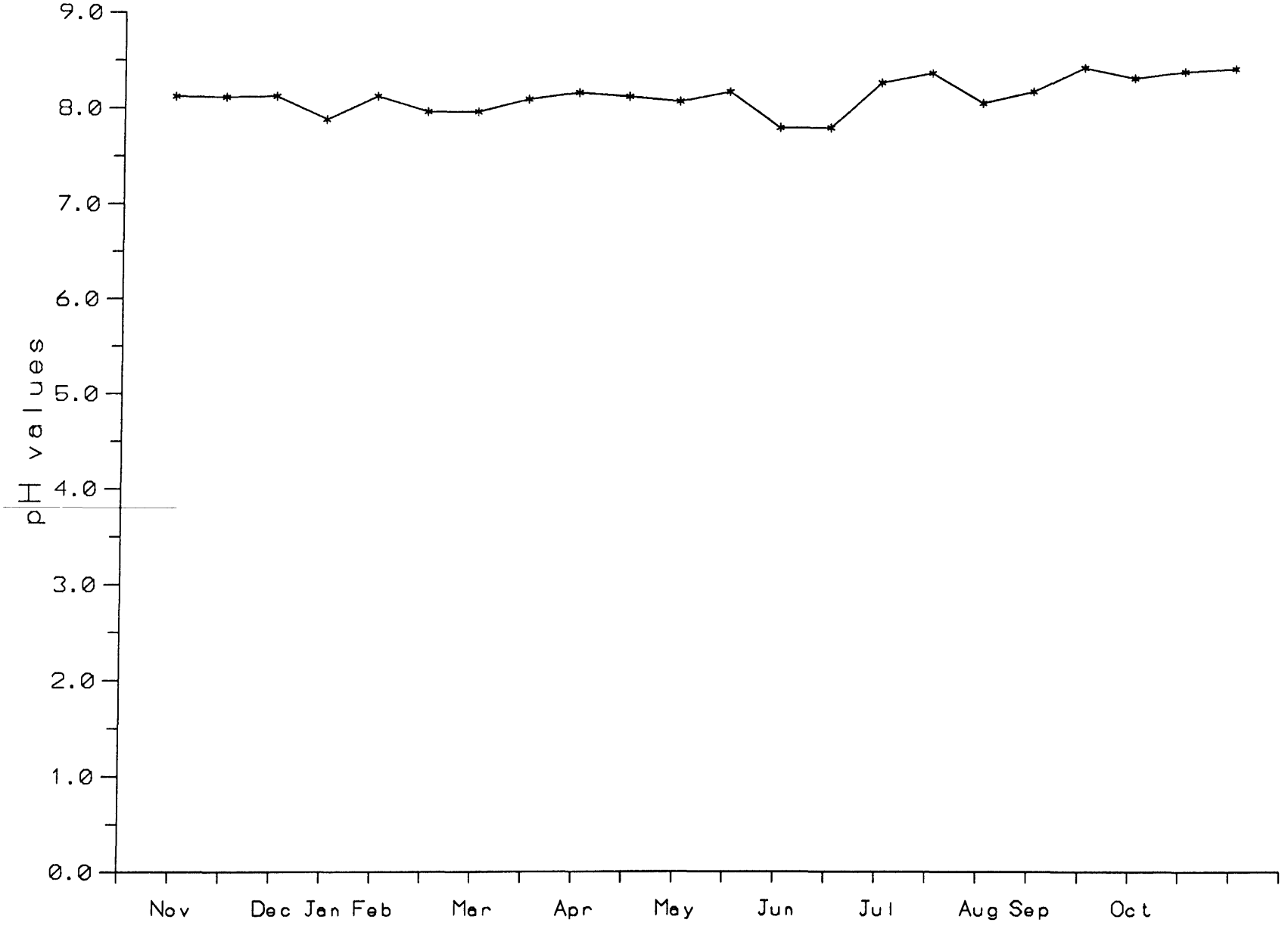

Figure 31. Plot of conductivity at Los Gatos Creek, sublocality 3, from November 14, 1989 to October 30, 1990.

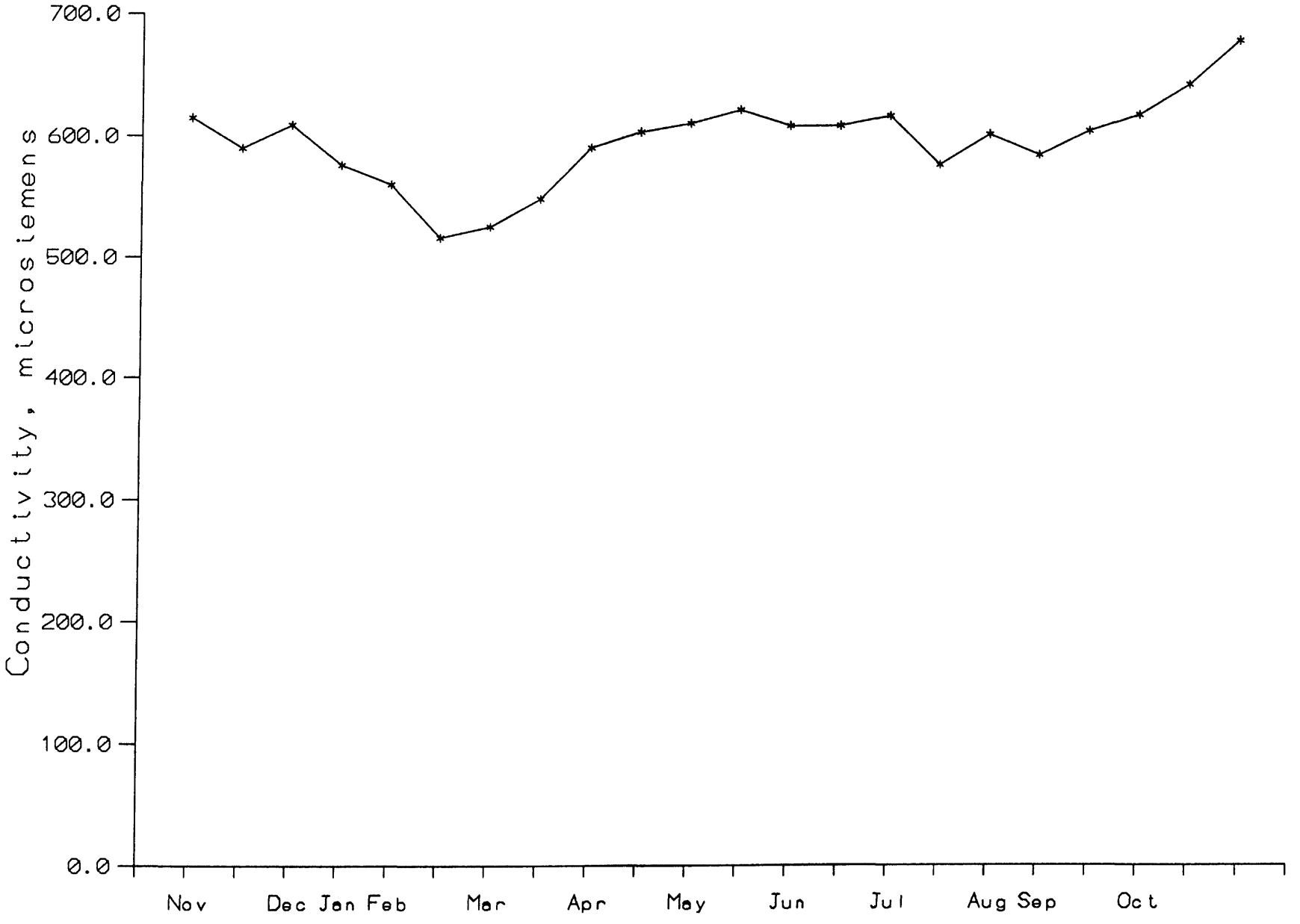

Figure 32. Temperature plot for Los Gatos Creek, sublocality 3, from October 9, 1989 to October 30, 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Los Gatos, CA)

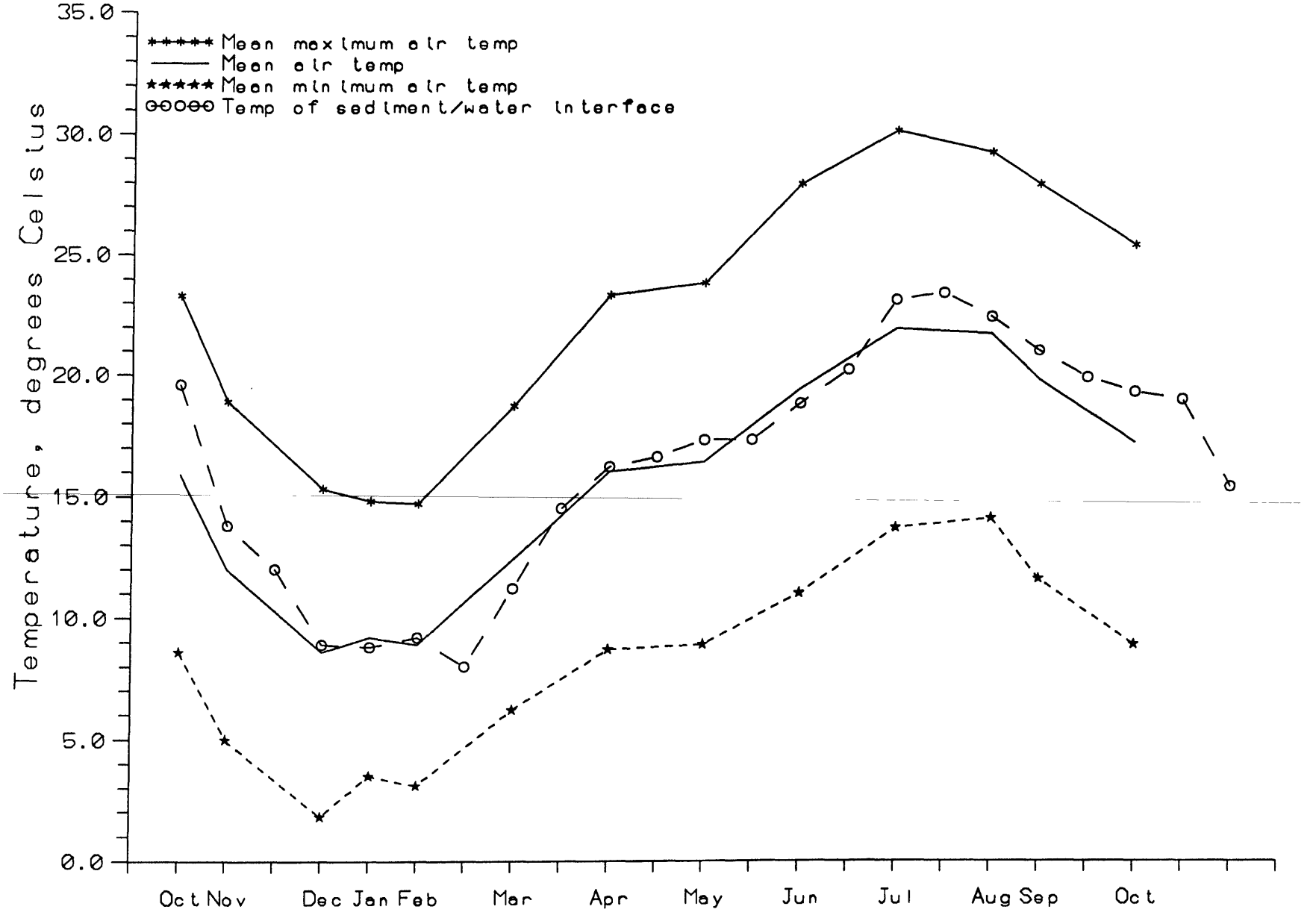

Figure 33. Plot of pH values at Los Gatos Percolation Pond, sublocality 4, from November 14, 1989 to October 30 1990.

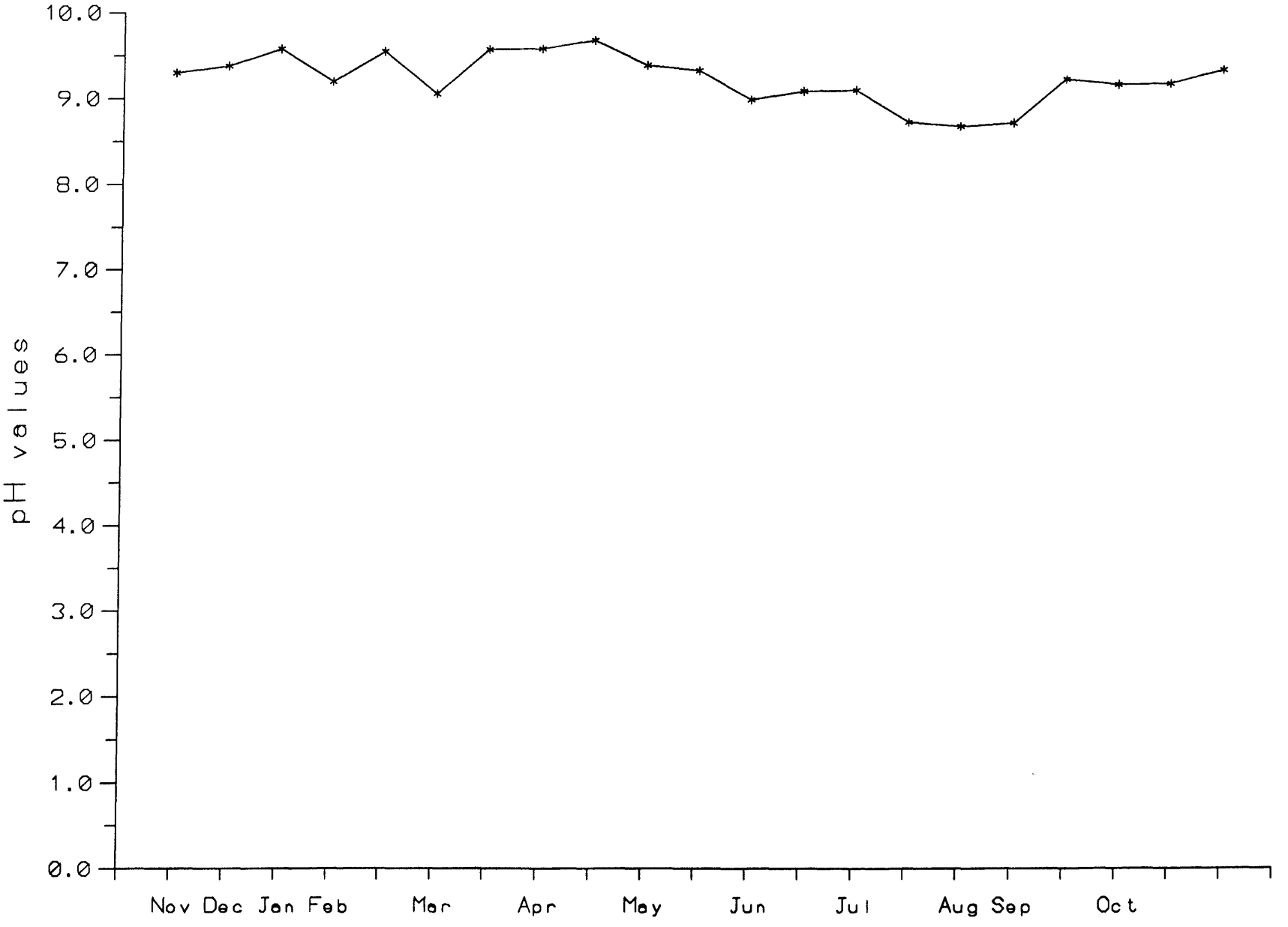

Figure 34. Plot of conductivity at Los Gatos Percolation Pond, sublocality 4, from November 14, 1989 to October 30, 1990.

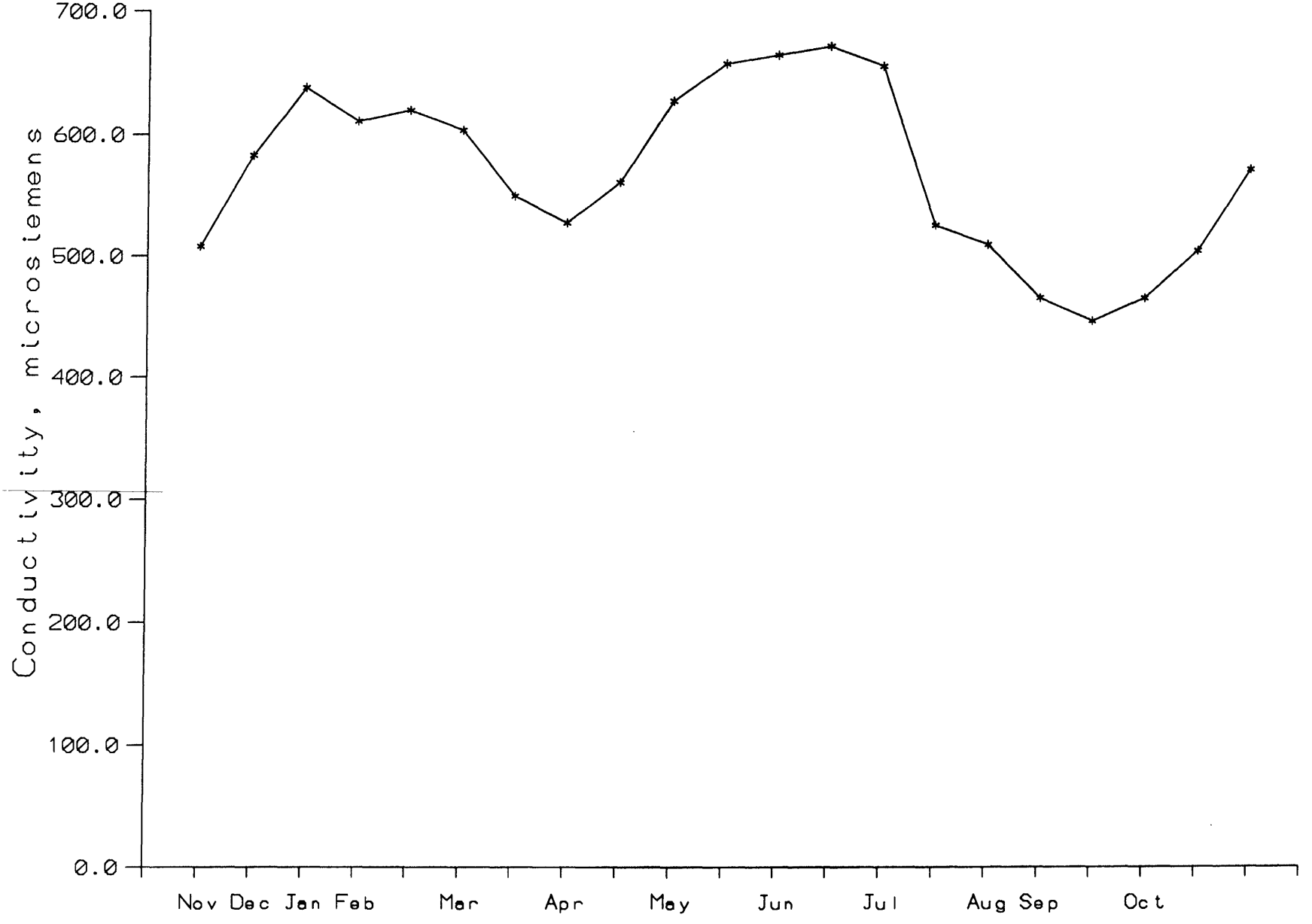

Figure 35. Temperature plot for Los Gatos percolation pond from November 14, 1989 to October 30. 1990. Air temperature data from: Climatological Data, California, vol. 93, no. 10, through vol. 94, no. 10, NOAA (Climate station: Los Gatos, CA)