THE 1989 LAKE GEORGE LAY MONITORING PROGRAM

by

Elizabeth Lawrence, Laboratory Assistant
Lawrence Eichler, Laboratory Supervisor
Dr. Charles W. Boylen, Director

Rensselaer Fresh Water Institute
Rensselaer Polytechnic Institute
Troy, New York 12180-3590

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INTRODUCTION

The summer of 1989 marked the most successful sampling season in the ten year history of the Lake George Lay Monitoring Program - the goal of which continues to be the collection of a large amount of physical lake data through the services of Lake George basin residents. A beneficial side-effect of the Lay Monitoring Program is the opportunity to educate basin residents with hands-on experience about lake water quality and techniques used to study freshwater ecology.

The basic water quality parameters measured by all lay monitors included water temperature and transparency (Secchi depth). In addition, eleven monitors collected chlorophyll samples from their deepest sites on August 5, 1989. As expected, the data collected by the lay monitors closely paralleled information gathered by the RFWI staff, but was sampled more intensively (weekly) than would be possible otherwise.

SAMPLING SITES AND COLLECTION METHODS

This year, with the addition of six eager volunteers and 19 new sampling sites, the Lay Monitoring Program doubled in size leaping to a grand total of 14 Lay Monitors who observed 37 different locations. Most importantly, the monitored sites were spread throughout the lake covering nearly every mile between Plum Point (2 miles from Lake George Village) and Hearts Bay (29.2 miles from the village). Figure 1 shows a map of these locations and Table 1 is a list of lay monitors with their respective sites.

All monitors were equipped with a calibrated thermometer, Secchi disk, and data sheets. They were asked to record, weekly, their observations and measurements of weather conditions (e.g., wind, lighting, air temperature), surface water temperature and Secchi depth during the months of June through September. Data were to be collected between 10 A.M. and 2 P.M. when the sun was as nearly directly overhead as possible. When convenient, measurements were to be limited to days with calm, clear weather in order to reduce the influence of waves and wind on the Secchi disk determinations. Monitors who collected water for chlorophyll _a_ analysis were supplied with a water column sampler.

RESULTS

A total of 388 Secchi depths and corresponding surface water temperatures were reported starting June 8th and continuing to November 4th.

Surface water temperatures varied from an early summer low of 16°C (60.8°F) on June 17th and 18th to a high of 26°C (78.8°F) on July 26th. An early winter low of 11°C (51.8°F) was reported on November 4th, the final sampling date. Figure 2 is a plot of mean surface water temperatures at each site related to distance from the south end of the lake. The Plum Point site two miles from the village was sampled primarily after the summer season and therefore omitted from this graph. Due to the highly variable nature of surface water temperatures, any discussion of a trend for this parameter is speculative. The average surface water temperature for Lake George during the sampling season of 1989 was 21.3°C (71.3°F).

The range of Secchi depths fell between 5.0 meters (16.4 ft) (Woods Point, 07/30/89; Dark Bay, 07/30/89, 08/05/89, 08/12/89; Dunhams Bay, 06/17/89, 07/09/89, 08/08/89, 08/12/89, 09/25/89) and 13.0 m (42.7 ft) (Jenkins Point, 08/22/89; Gull Bay, 08/22/89; Hague Brook 08/22/89). Curiously, these extremes are identical to 1988 Secchi depths, but the whole lake average of 8.5m (27.9 ft) in 1989 is 0.7m (2.3 ft) less than the year before. This is a disappointing decline in water transparency. Since 1983, when the average Secchi depth reported by Lay Monitors was at a low of 7.8m (25.6 ft), there has been a general trend of increased water clarity. This positive trend has been slowed; Secchi depth in Lake George was less during the summer of 1989 than the summers of 1985 through 1988. Figure 3 shows the relationship of yearly Secchi depth averages.

Average Secchi depths per site are plotted against distance from Lake George Village in Figure 4. From the graph, a general trend is apparent; water transparency is greater in the north basin than in the south. In fact, 2m (6.6 ft) is the difference in average clarity between the two basins (southern, 7.7m, 25.3 ft; northern, 9.7m, 31.8 ft). The trend of increasing transparency (Secchi depth) along a transect running from the southern end of Lake George north has been well documented in previous Rensselaer Fresh Water Institute Lay Monitoring Program reports. There does not appear to be a measurable seasonal trend in transparency, possibly due to the variability in Secchi measurements. This variability may be the result of physical conditions at the time of sampling (i.e. wind and wave action and relative cloud cover).

In order to follow Lake George's progression of nutrient enrichment (eutrophication), the lay monitoring data and comparable 1989 RFWI Offshore Monitoring data (Fresh Water Institute, 1990) have been applied to Carlson's (1977) formulae for a Trophic State Index (TSI). The trophic state of a lake relates to the amount of nutrients available for consumption by various organisms in that lake. A lake with a high level of nutrients (and, therefore, primary producers such as algae, phytoplankters, and plants) is generally known as eutrophic. Conversely, a lake with low levels of nutrients and biotic life is called oligotrophic. Mesotrophic is used to describe lakes which fall between the extremes. In order to describe all lakes on a similar scale unbound by the three basic trophic classes, Carlson developed the Trophic State Index which describes all shades of the trophic process on a scale ranging from 0 to 100 (0 being highly oligotrophic). A decrease of 10 points of the TSI (e.g., from 30 to 20) represents a doubling of Secchi depth in meters (e.g., from 8 to 16 meters). Chlorophyll a and total phosphorus values can also be applied to the TSI model.

In 1979, Wood and Fuhs used Carlson's TSI method to determine the trophic state of Lake George for 1978. They discovered a chlorophyll a based TSI value of 38 for the southern basin and 34 for the northern basin. In 1988, averaged chlorophyll a TSI values for the two basins were calculated to be 35 and 33, south and north, respectively. For 1989 chlorophyll a trophic state indices, both lay monitoring data and RFWI data were used. A comparison of the two is seen in Figure 5. Interestingly, both data sets produced a TSI value of 29 for the northern basin. Somewhat less consistant are the values for the southern basin: Lay Monitors - 36, RFWI - 32. Only Offshore Monitoring sites nearest, respectively, to lay monitored sites were chosen for calculations. These data were taken from the RFWI Offshore Monitoring Report (1990). The general decrease in the trophic state indices over the past eleven years represents a reprieve in Lake George's trophic progression.

Phosphorus is generally thought of as a limiting plant nutrient in a lake system. Therefore, with the addition of phosphorus to a lake by means of runoff (urban or natural) and waste effluent, plants and algae may experience uninhibited growth. Usually, reducing the amount of nutrients entering the lake increases the clarity of the water. Total phosphorus (TP) TSI values in 1989 dropped to 26 in the south basin and 22 in the north from 30 and 26, respectively, a year ago. (The same Offshore Monitoring sites used to calculate chlorophyll a TSI values were used for TP TSI values.) This method produced the most positive results in terms of nutrient loading reductions in Lake George.

Using Secchi disk data from 1970 by Ferris and Clesceri (1977), Wood and Fuhs calculated a TSI of 32 for the south end of the lake. Wood and Fuhs' 1978 data for Secchi transparency produced TSI values between 33 and 35 for the same region while 1988 transparency data showed the south end having a TSI of 29 (27 in the north). With a decrease in water clarity comes an increase in the trophic state index for Secchi depth. The southern basin in 1989 had a TSI value of 31 (29, north). Historical Secchi depth data from the Dome Island area has been converted into TSI values and charted in Figure 6.

Figure 7 represents computed TSI values for chlorophyll a, total phosphorus, and Secchi depth graphed by site against the length of Lake George. From this graph, relationships can be seen. Total phosphorus shows lower trophic state indices than either Secchi depth or chlorophyll a, and though Secchi depth and chlorophyll a are quite similar, chlorophyll a has higher TSI numbers. Also represented in this graph is the difference between the southern and northern basins; note the general downward slope across the length of the lake.

In all, the 1989 data indicate that total phosphorus and chlorophyll a levels in the lake are lower than last year, but that Lake George's water clarity has decreased.

CONCLUSIONS

The results of the 1989 Lake George Lay Monitoring Program indicate a number of trends present in the Secchi transparency and chlorophyll a concentrations of the various sites sampled. These trends include:

- Greater Secchi transparency in the North basin than the South basin.

- Lower transparency results for 1989 than those reported between 1980-82 and 1985-88.

- Similar and advanced trophic levels for Trophic State Indices calculated by Secchi depth and chlorophyll a data.

These trends support conclusions reached in the 1989 Lake George Chemical Monitoring Program (FWI, 1990) which were that greater concentrations of nutrients (nitrogen and phosphorus) and greater overall productivity were found in the south basin when compared to the north basin. Higher concentrations of nutrients generally result in more phytoplankton and thus reduced transparency.

The source of the elevated levels of nutrients in the south basin has been the subject of a number of studies (Gibble, 1974; Ferris and Clesceri, 1975; Aulenbach, 1979; Wood and Fuhs, 1979; Sutherland et al., 1983; and Dillon, 1983). Although estimates vary on the precise amounts of nutrient loading from a variety of sources, all investigators agree that atmospheric deposition (rain, snow, and dryfall), erosion, and urban runoff are the major sources of nitrogen and phosphorus to the lake. In addition to these plant nutrients, erosion and urban runoff are the leading causes of sedimentation in Lake George.

When the Trophic State Index values for total phosphorus, Secchi depth and chlorophyll a from 1989 are compared to those in 1988, an interesting conclusion could be drawn. The Secchi depth TSI values increased in 1989 indicating decreased water clarity. Conversely, both chlorophyll a and TP TSI values dropped inferring improved chemical water quality. These assumptions are in direct conflict unless there is a non-chemical contribution to the waters of Lake George, i.e., suspended solids from erosion, urban runoff, and resuspension of bottom sediments. Sediments in the shallower portions of the lake become easily stirred with heavy boat traffic and wave action. Urban runoff includes rainwater that washes tons of road salt and sand into the lake. This is particularly observed at the English Brook, Finkle Brook, and Hague Brook deltas. Erosion, both natural and instigated, occurs all around the basin where bare soil is left open to the elements. Wind, rain and snowmelt all contribute to increased suspended solids, and therefore, decreased water transparency, in Lake George.

Precipitation during May, June, July, September, and October 1989 was highly above average (Figure 8). Hard rains and flashflooding, like that which occurred in June and July, are more destructive to soils, streams and lakes than rain events that dump the same amount of water over a longer period of time. The severity of the storms this summer is suspected of contributing to sedimentation and low water clarity in Lake George.

Erosion and urban runoff may be mediated in a variety of ways including sediment traps, management of vegetation in shoreline and riparian zones, replacement of impermeable with permeable surfaces, reduction in amount of road sanding, and a host of other methods dependent on the type and quantity of surface runoff. It should be the responsibility of all persons interested in the water quality of Lake George to press for more effective runoff controls.

ACKNOWLEDGMENTS

The staff of the Rensselaer Fresh Water Institute would like to thank all of this years Lay Monitors for a job well done. The largely expanded Lake George Lay Monitoring Program continues to provide an enormous amount of valuable data in a very cost effective manner. Results of this program support conclusions generated through this and other RFWI research activities whose overall goal is protection of the water quality of Lake George. You should be justifiably proud of your efforts.

A special thanks goes to Roger Summerhayes for inspiring new volunteers.

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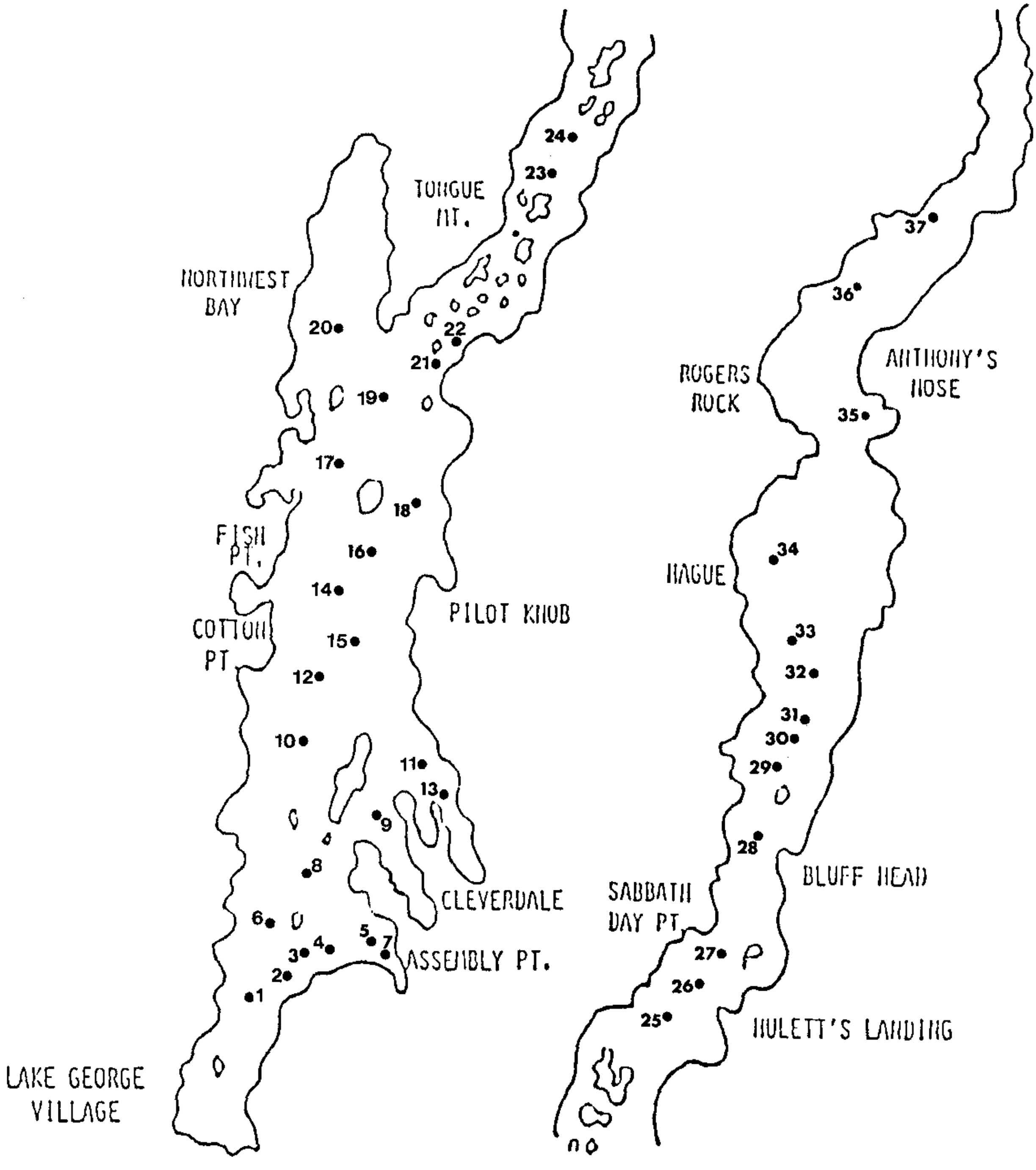

Figure 1. Locations of sampling sites in the north basin (right) and south basin (left) of Lake George.

Table 1. Volunteer Lay Monitors and the sites where they obtained Secchi depth and surface temperature measurements.

Monitor	Site No.	Site	Mile
Harrison	1	Plum Point:West Shore	2.00
Blake	2	Plum Point midlake	1.75
	3	Woods Point	2.50
	4	Dark Bay	2.60
	5	Mouth of Dunhams Bay	2.75
Boehm	6	Cramer Point:Diamond Is.	3.00
	7	Dunhams Bay	3.20
	8	Diamond Is.:Canoe Is.	3.90
Wrigley	9	Assembly Pt.:Ripley Pt.	4.90
	10	Middleworth Bay midlake	5.80
Sebold	11	Kattskill Bay	5.75
	12	Long Is.:Cotton Point	5.50
Kennedy	13	Van Warner Bay	5.60
	14	Basin Bay	7.80
Johnson	15	Cotton Pt.:Barber Bay	7.10
	16	Three Bros. Is.:Phelps Is.	8.60
	17	Dome Is.: Green Is.	9.50
Summerhayes	18	Dome Is.: Watch Pt.	9.30
	19	Crown Is.: Shelving Rock	10.70
	20	Northwest Bay	11.30
Whalen	21	Fourteen Mile Island	11.20
	22	Shelving Rock:Knapps Bay	11.25
Vilmar	23	Hazel Island midlake	13.00
	24	Dollar Is.:Black Mt.	14.00
Olsen	25	Vicars Is.:Burgess Is.	17.60
	26	Vicars Is.:Agnes Is.	18.50
	27	Agnes Island midlake	19.00

Table 1 cont.

Monitor	Site No.	Site	Mile
Buck	28	Bluff Head:Werners marina	20.00
	29	Slim Pt.:Odell Is.	20.90
	30	Skipper Is.:Lamb Shanty	22.20
Bryant	31	Scotch Bonnet:Mallory Is.	22.70
	32	Gull Is.:N.Pardo Pt.	23.60
	33	Jenkins Pt.	23.90
	34	Hague Brook	24.50
Martin	35	Blairs Bay - Glenburnie	26.40
	36	Rogers Rock	28.50
	37	Hearts Bay	29.20

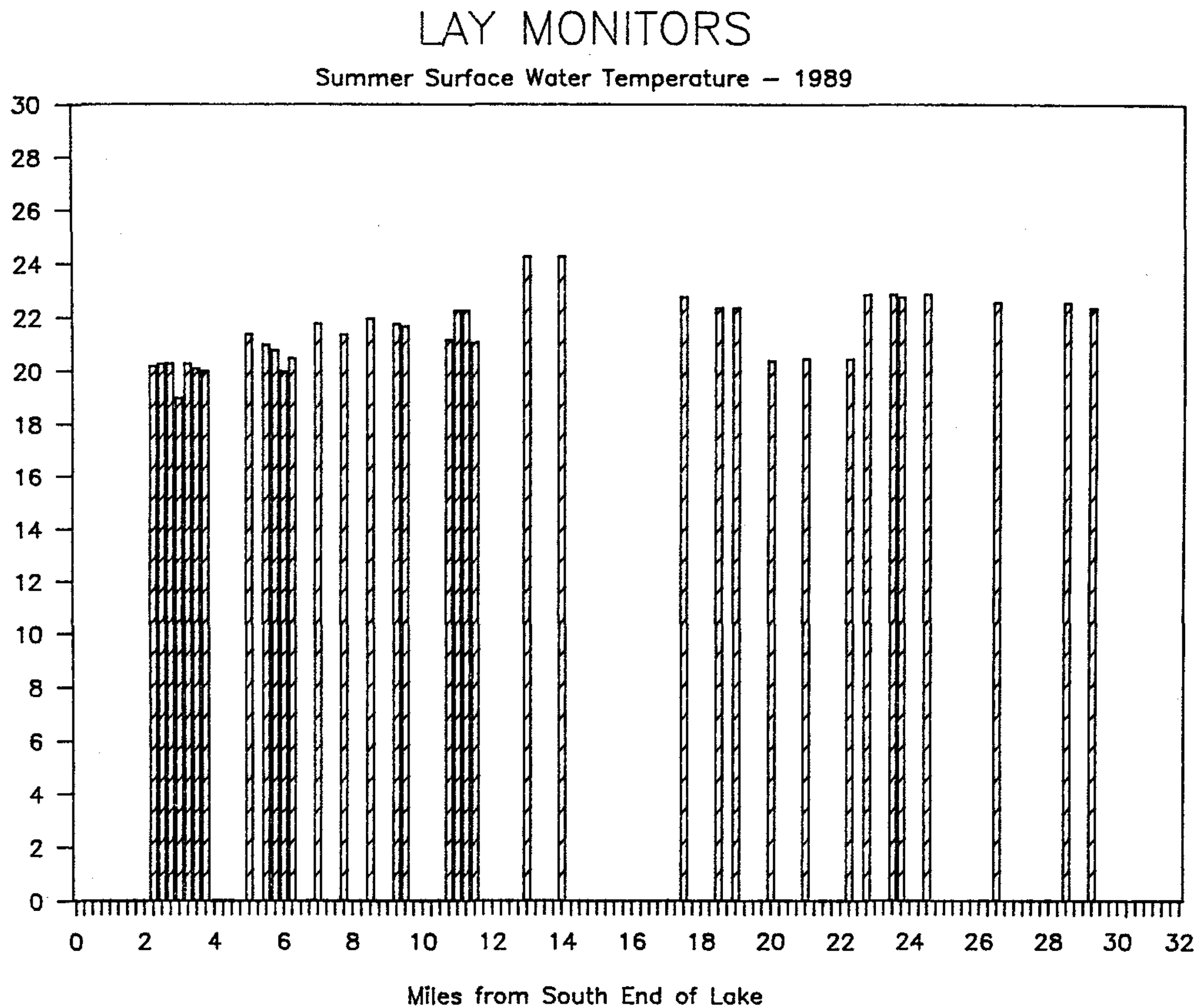

Figure 2. Mean surface water temperatures by site vs. distance from suth end of Lake George.

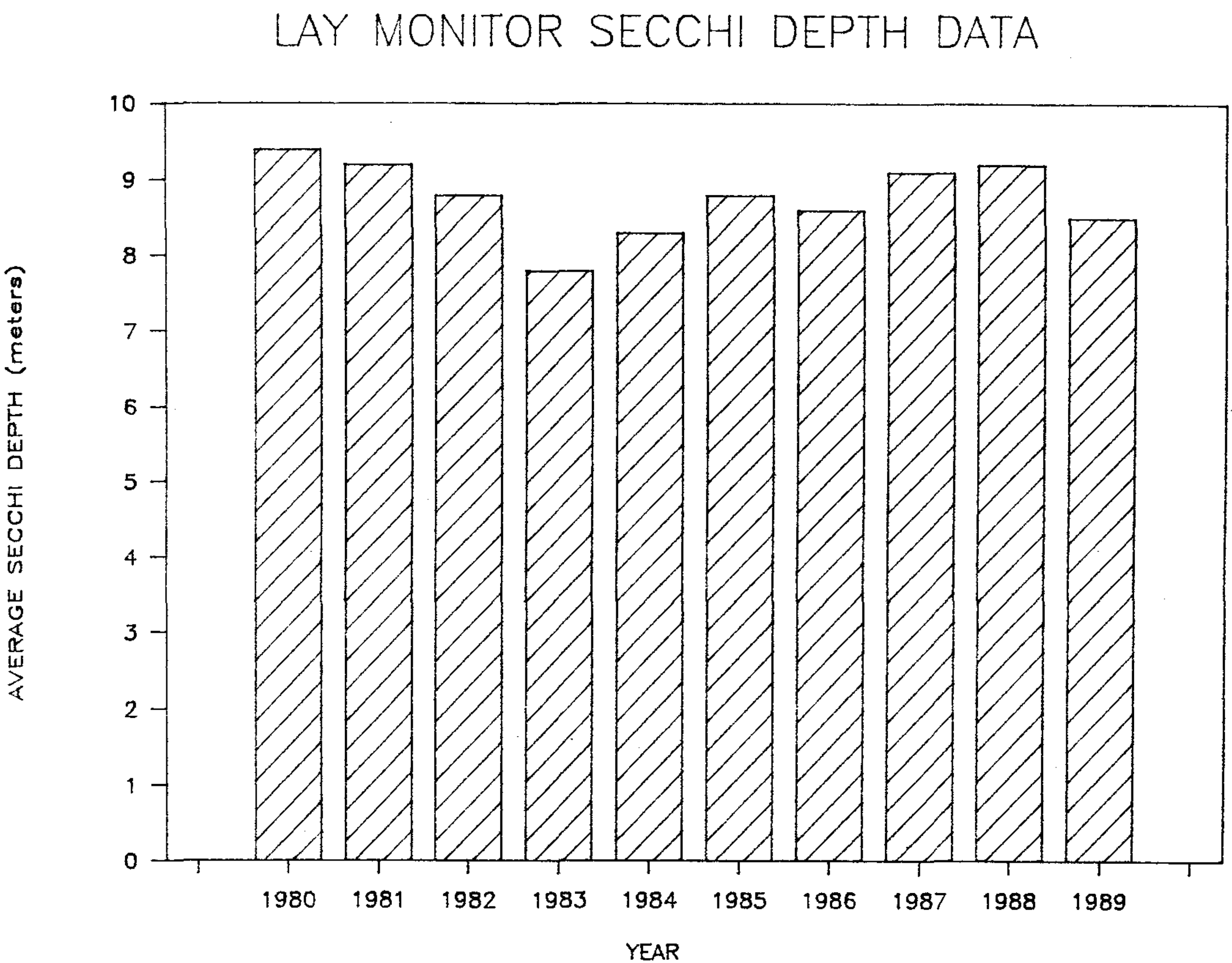

Figure 3. Average whole lake Secchi depths by year.

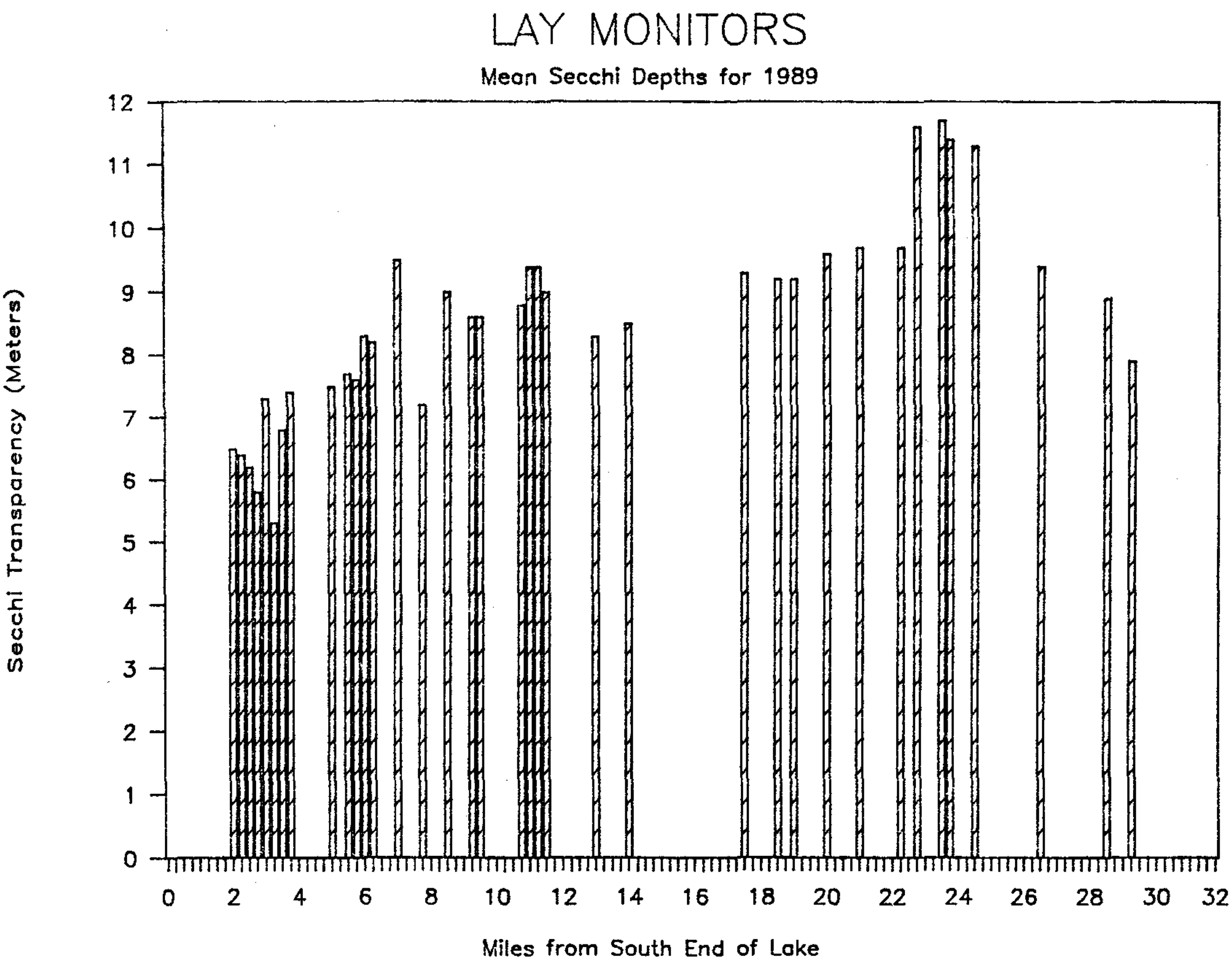

Figure 4. Average water transparencies by site vs. distance from south end of Lake George.

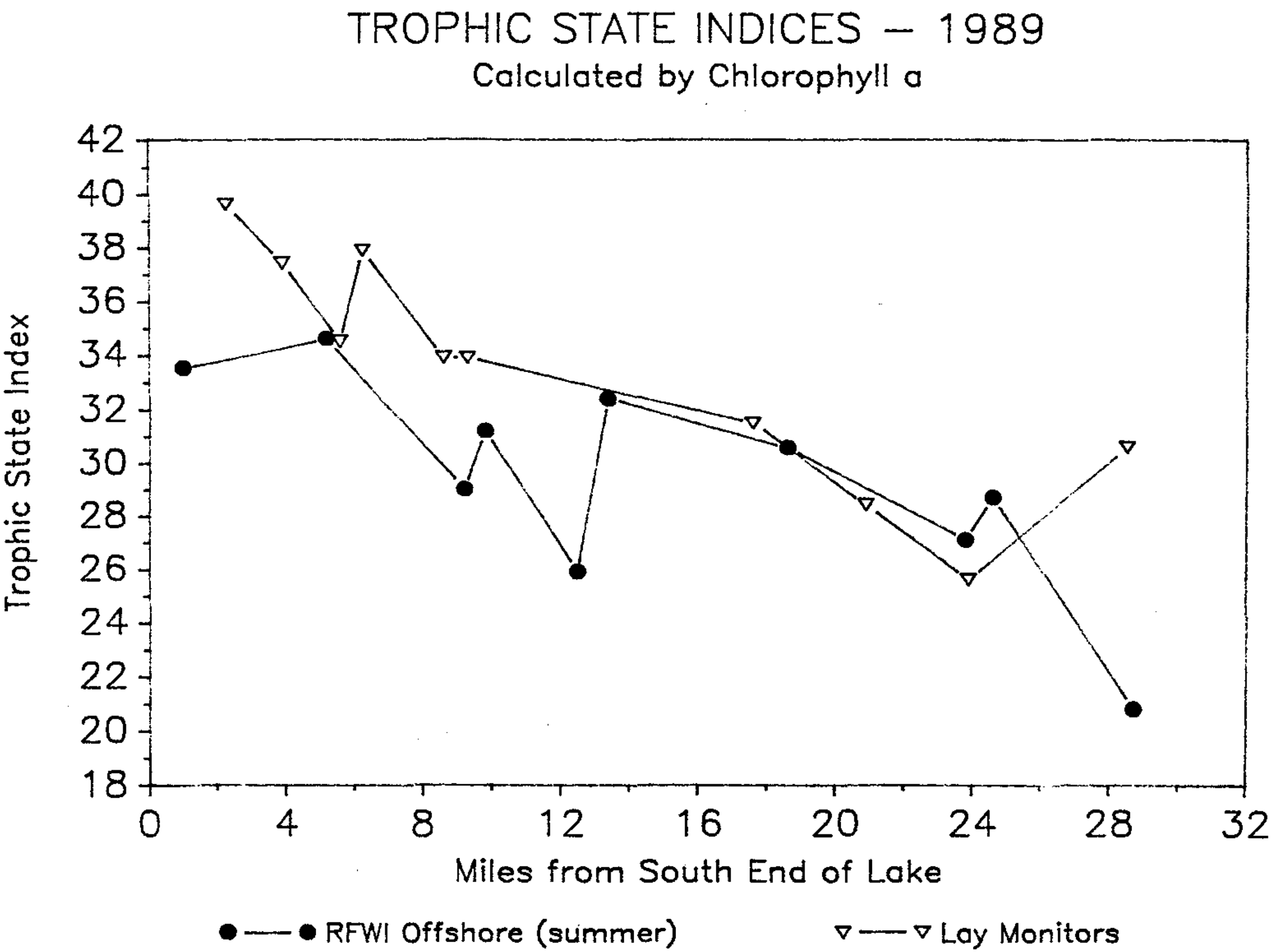

Figure 5. Comparison of Chlorophyll a sampled by RFWI and Lay Monitors in Lake George.

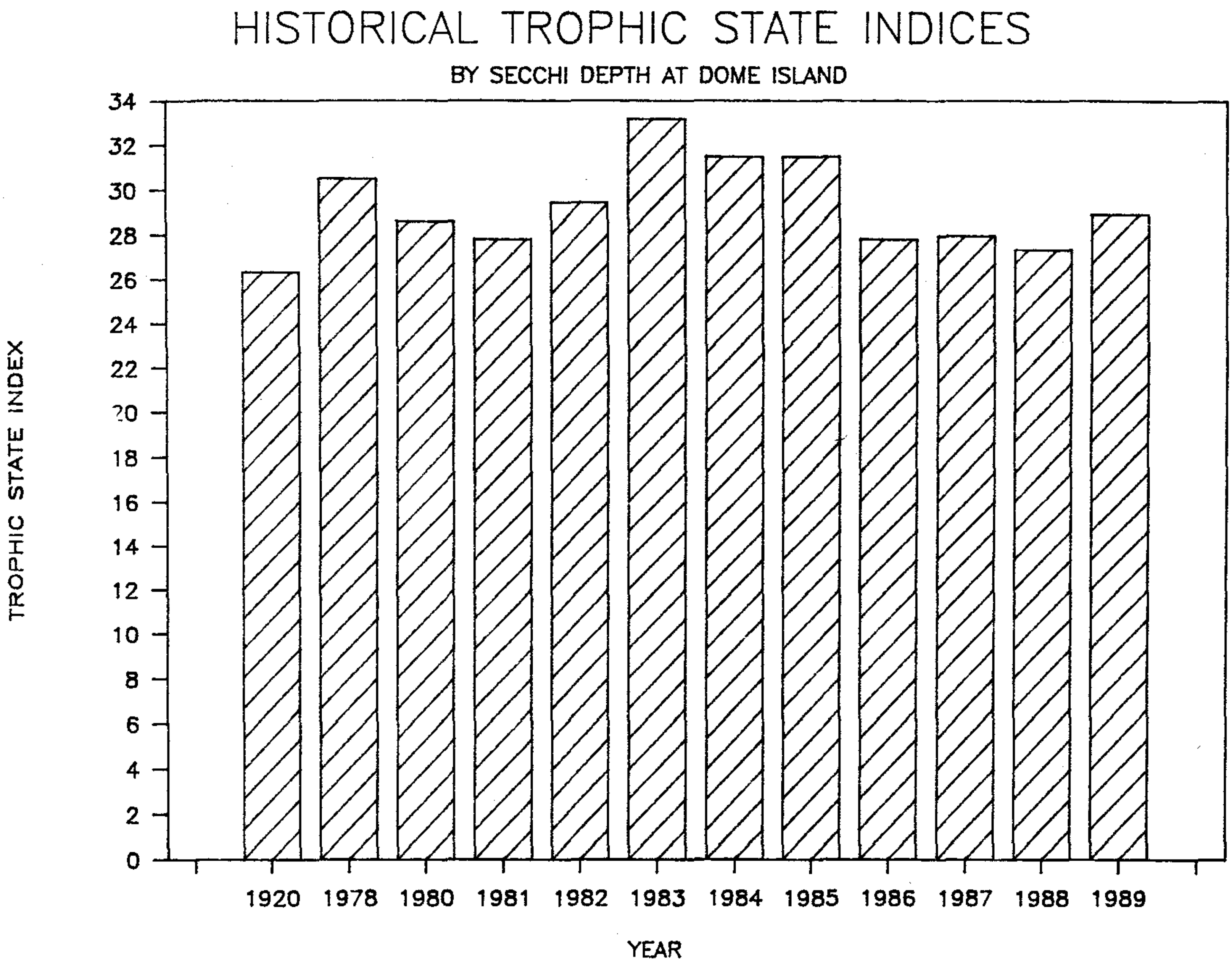

Figure 6. Trophic State Indices from historical Secchi depth data taken from Dome Island, Lake George.

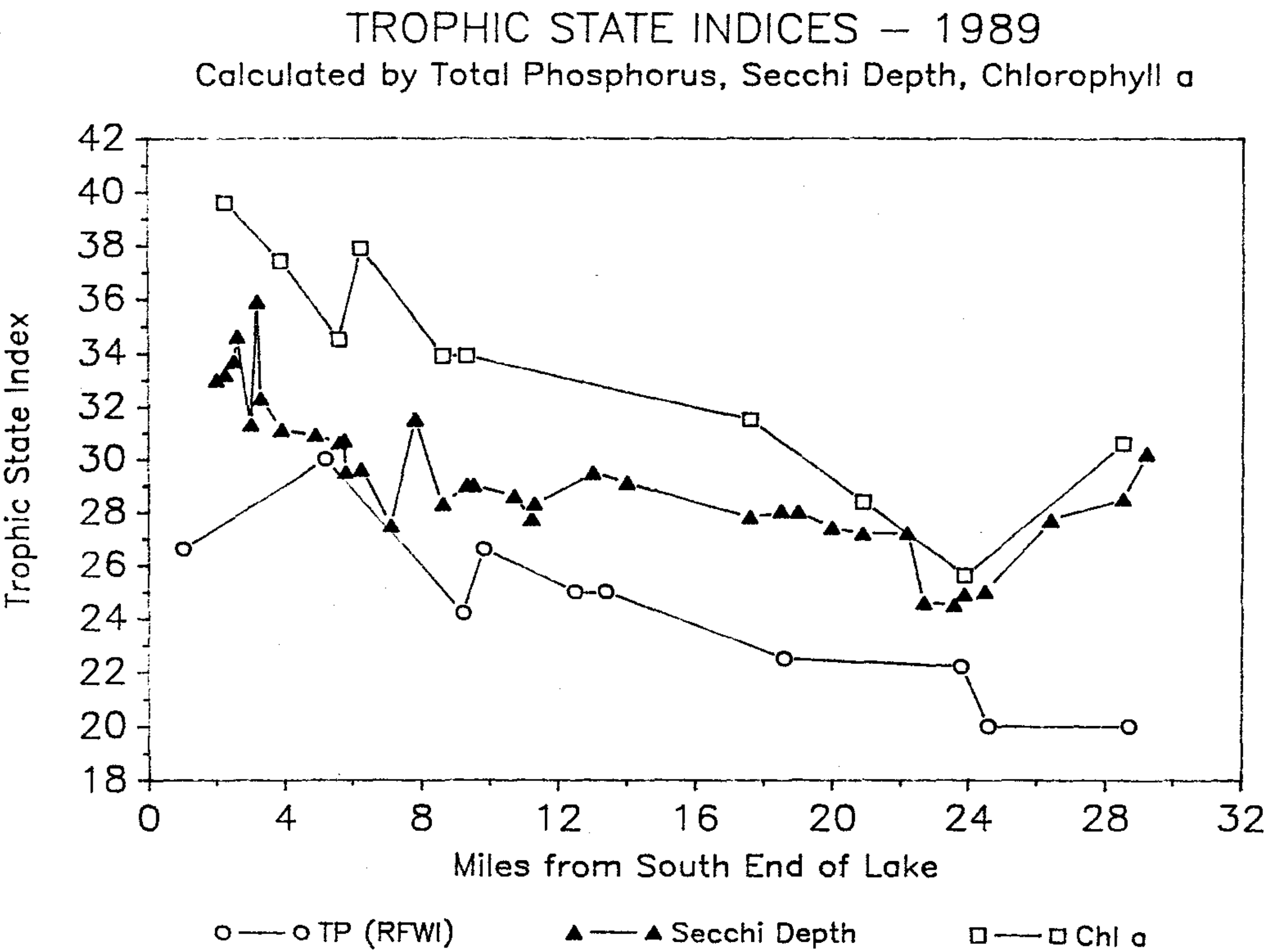

Figure 7. Relationship of Chlorophyll a-, Secchi depth-, and Total phosphorus-based TSI values by site.

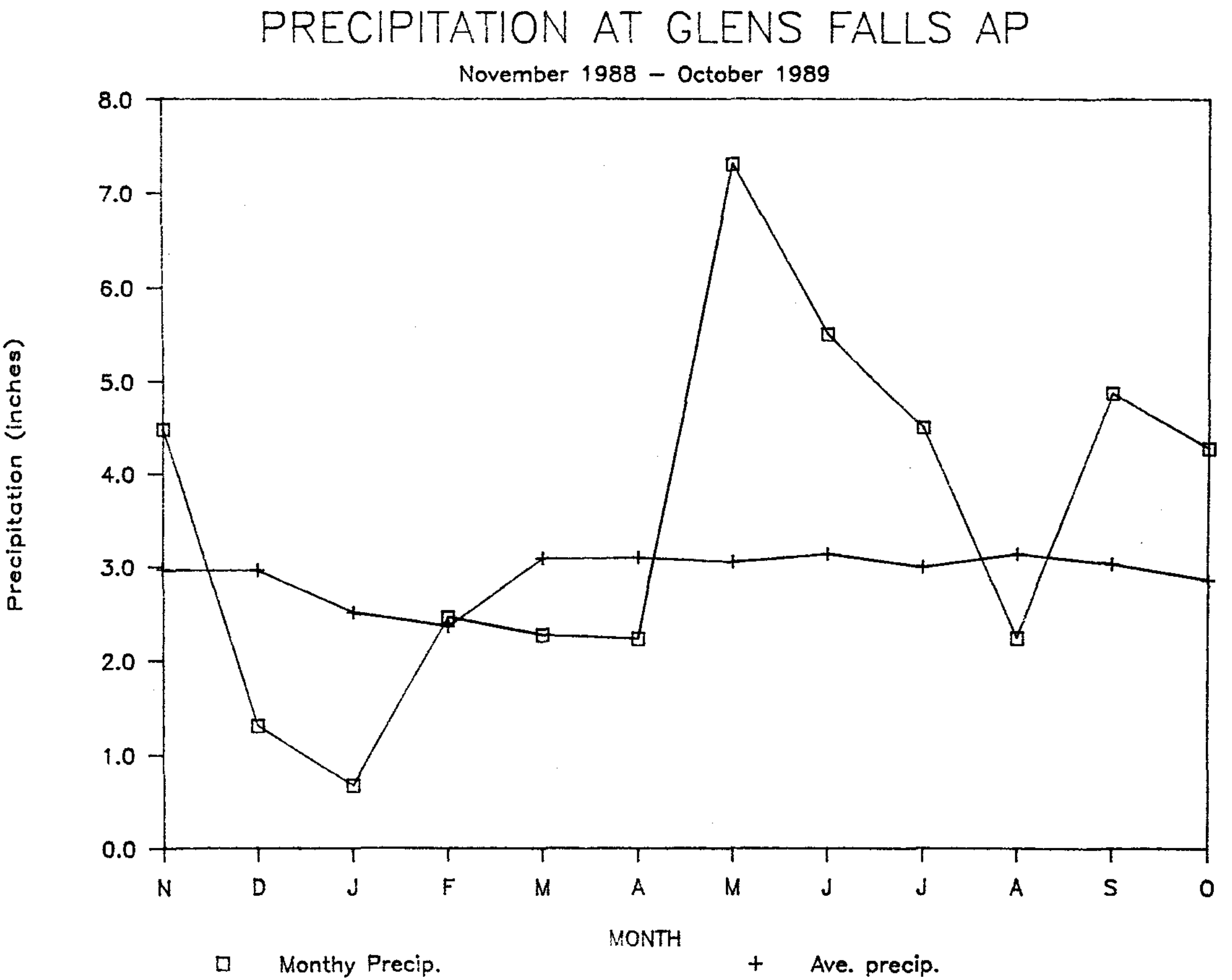

Figure 8. Average precipitation at the Glens Falls Airport from November 1988 through October 1989.