

# Are Sierra lakes becoming acid?

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*Tests show essentially no change in the acidity of Sierra lakes during the past 15 years.*

**I**ncreasing acidity of some lakes outside California, particularly in eastern United States and Canada, and in the Scandinavian countries, is attributed to oxides of nitrogen and sulfur from automobile exhausts and industries. The U.S. Environmental Protection Agency has recently included the Sierra Nevada as part of a larger area in the United States considered to be sensitive to lake acidification. We have studied the problem, because of the presumed sensitivity of these lakes to acidification.

Fortunately, we obtained data on the acid content of 170 Sierra lakes in 1965 ("Trace and major element content of 170 Sierra lakes in California," *Limnology and Oceanography*, Vol. 13, no. 3, July 1968, by Bradford et al.). These data provide a valuable resource to

## Commodity programs, *continued*

planned to expand, and very few intended to sell or reduce size. Several researchers have argued that commodity programs have been one cause of the trend toward fewer and larger farms. The stated intentions indicate that California program participants are no more likely than nonparticipants to enlarge their operations, at least in the short run.

Surprisingly few of the surveyed participants, 1.7 percent, had sought the nonrecourse loans available under the commodity program. Apparently, the low-interest loans were not sufficiently attractive to offset perceived disadvantages and were not an important inducement to program participation.

Survey respondents were asked to rank a list of reasons for participating or not participating in the 1978 programs (tables 2 and 3). Nearly all farmers operate with credit from a variety of sources, but only 2.7 percent of the participants listed the loan officer's influence as their most important reason for participating. More than half (56.8 percent) said their most important reason was that they "expected participation to result in higher net income." Nearly one-fifth (18.9 percent) "expected participation to reduce price and/or yield risk." Overall, when considered as the first or second most important reason for participation, expected higher income was mentioned the most frequently (71.6 percent), and expected risk reduction was the second most mentioned.

Higher expected income was a much less important reason for nonparticipants' decisions. Almost half (46.9 percent) indicated that they primarily were "opposed to govern-

ment involvement in agriculture." Overall, when considered as the first or second most important reason for nonparticipation, opposition to government intervention was mentioned most frequently. Of course, government involvement could be opposed for a number of reasons: a perception that management freedom is restricted, that government control is too pervasive, or perhaps simply that income might be higher in free markets, since many farmers believe that government programs result in a "cheap" food policy that discriminates in favor of consumers and against farmers.

### Conclusion

Most California farmers have chosen not to participate in the federal price and income support programs when required to set aside a portion of their acreage. Many view the cost in foregone income as excessive in comparison with program benefits. Others are philosophically opposed to governmental intervention in agricultural markets. A large number of those who chose to participate anticipated that the program would enhance their income or reduce income risk.

Many farmers probably will continue to choose not to participate in the commodity programs whenever set-asides are in effect. The large investments in machinery and irrigation equipment characteristic of the state's agriculture translate into higher income and perhaps lower risk and thereby reduce incentives for program participation.

California farmers do not seem to gain a great deal from the commodity programs

established by the Food and Agriculture Act of 1977. Although it is difficult to predict the outcome of those deliberations on a new act to be passed in 1981, it appears likely that the disaster program will be phased out in favor of an expanded crop insurance program. Congress has already passed legislation to expand the crop insurance program with subsidized premiums. Because of the stability of yields in California when compared with those in other states, farmers here will probably not be greatly affected by elimination of the disaster program. California taxpayers may be better off with the paid crop insurance program than with the disaster program, depending on the level of subsidization.

The potential elimination of the disaster program illustrates one effect government programs have on decision making in agriculture. The programs are designed in part to reduce price and yield uncertainty in agriculture, but they often introduce another uncertainty—about policy. Frequent changes in program features and requirements make long term planning more difficult for farmers.

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compare possible changes in lake acidity that may have occurred between 1965 and the present.

During July and again in October 1980, 114 random lake water samples were collected by helicopter from Yosemite, Sequoia, and Kings Canyon National Parks. Surface water samples were collected by lowering a plastic container through the open door of the helicopter hovering 3 meters above the surface. Each sample was immediately transferred to a 1-gallon (3.8-liter) polyethylene bottle with a tight-fitting screw cap. About 20 samples were collected before returning to the base camp along Highway 395, where the pH or acid content was immediately measured with a portable pH meter. Sampling by helicopter made it possible to collect more samples in less time and probably at less expense than by any other available methods. All samples were returned to the laboratory within four days, and the pH measurements repeated on two different digital pH meters. All pH measurements in the field and the laboratory were in good agreement.

Rainwater is normally slightly acid (pH 5.6) because of dissolved carbon dioxide from the atmosphere. Pure water with a pH of 7.0 is neutral. The mean and median pH values listed in the table indicate that Sierra lake waters are less acid than "normal" rainwater. This is also true for the 10 lakes where fish kills were reported during the summer of 1980 (see table footnote). The mean pH of these 10 lakes was no different from the mean pH of all other lakes.

The lowest pH (4.7) of one sample collected in 1965 was not observed for the same lake in the 1980 sampling nor in any other of the samples collected. No explanation can be presented for the anomalous value.

The mean pH value for the October 1980 sampling was approximately one-half a pH unit higher than the July sampling. This probably reflects the seasonal effect of increased resident time of the water in the lake and associated buffering action with lake sediments.

Results obtained for pH of lake waters sampled in 1980 compared with those collected in 1965 are also presented in the table. It is most significant that these data show essentially no change in the acidity of lake waters in the Sierras during the past 15 years.

The "acid rain" observed by low pH measurements made in coastal and interior valleys near population centers is probably diluted and possibly neutralized to such a low concentration by the time it reaches the high Sierra that it has no measurable effect on the acidity of the Sierra lakes.

Results of Sampling Sierra Lakes for Acidity

	Date sampled		
	Sept. 1965	July 1980	Oct. 1980
Number of lakes sampled	170	114	124*
pH range	4.7-7.3	5.6-6.9	5.7-7.1
mean	6.0	6.1	6.5
median	6.0	6.2	6.5

\*The October sampling of 124 Sierra lakes included 10 where fish kills had been reported. The pH value of these 10 lake water samples ranged from 6.4 to 6.9 with a mean of 6.6.

Alfred Smith



More than 100 Sierra lakes were sampled by helicopter by researchers John Warnecke (left) and Gordon Bradford.

Total concentrations of alkali and alkaline earth metals in both 1965 and 1980 lake water samples are very low (less than 5 mg per liter), indicating a very low capacity to buffer acid deposition. Complete chemical analyses of the lake waters are in progress and will be reported later.

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