

# **OPERATION OF HYDROLOGIC DATA-COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1989**

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By Alberto Condes de la Torre



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# OPERATION OF HYDROLOGIC DATA COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1989

By Alberto Condes de la Torre

## ABSTRACT

The U.S. Geological Survey operates hydrologic data-collection stations nationwide to serve the needs of all levels of government, the private sector, and the general public for water-resources information. During fiscal year 1989, surface-water discharge was determined at 10,665 stations; stage data on streams, reservoirs, and lakes were recorded at 2,062 stations; and various surface-water quality characteristics were determined at 3,650 stations. In addition, ground-water levels were measured at 34,682 stations, and the quality of ground water was determined at 8,823 stations. Data on sediment were collected daily at 172 stations and on a periodic basis at 1,019 stations. Information on precipitation quantity was collected at 1,235 stations and the quality of precipitation was analyzed at 72 stations. Data-collection platforms for satellite telemetry of hydrologic information were used at 2,742 Geological Survey stations. Funding for the hydrologic stations was derived, either solely or in combination, from three major sources--the Geological Survey's Federal Program appropriation, the Federal-State Cooperative Program, and reimbursements from other Federal agencies.

The number of hydrologic stations operated by the Geological Survey declined in some categories and increased in others from fiscal year 1983 to 1989. Although the number of continuous-record surface-water discharge stations increased by 87, the total number of surface-water discharge stations was reduced by 411 stations; surface-water quality stations declined by 176 stations; ground-water level stations increased by 1,043 stations; and ground-water quality stations increased by 1,175 stations.



## INTRODUCTION

The U.S. Geological Survey operates hydrologic data-collection stations throughout the United States, Puerto Rico, and several Trust Territories. These hydrologic stations are used to monitor the quantity and quality of the water in the Nation's streams, lakes, and reservoirs; changes in ground-water levels; and the quality of ground water.

The purpose of this report is to describe the number, distribution, and source of funding of hydrologic stations operated during fiscal year (FY) 1989. Similar reports were prepared previously for fiscal years 1983, 1985, and 1987 (Condes de la Torre, 1983, 1985, and 1987). A summary and analysis is provided of the number of hydrologic stations operated from FY 1983 to FY 1989. The sources of funding support for the stations are the Geological Survey's Federal Program appropriation, the Federal-State Cooperative Program, and reimbursements from other Federal agencies, or a combination of these (table 1).

In 1983, the Geological Survey established an orderly format for counting hydrologic stations so that the type of stations being counted and compared would be consistent from year to year. In 1985, the number of items to be counted was increased to include daily and periodic sediment sampling data and information on data-collection platforms. For this reason, the hydrologic information presented begins in 1983 and in 1985.

For the purpose of this report, "project" refers to a hydrologic investigation conducted by the Geological Survey, and a "scheduled, long-term operation" station is one at which measurements are made or samples are taken on a fixed-time interval over an indefinite period.

## HYDROLOGIC DATA COLLECTION STATIONS

### Surface Water Data

Surface-water discharge (flow) was determined by the U.S. Geological Survey at 10,665 stations in FY 1989. At 7,239 of these stations, continuous-discharge records were computed. That is, records were kept such that the flow can be determined for any moment during any day. At 3,426 other streamflow stations, partial records were collected. For example, at a station where the sole interest is in peak flows, data are collected and recorded only at stages greater than some predetermined level. The number of stations in each State where continuous surface-water discharge data were collected ranged from 757 in California to 13 in Delaware (figure 1). The Federal-State Cooperative Program funded operation of the largest number of continuous streamflow-discharge stations; it provided sole support for 3,796 stations (figure 2), and in combination with other sources, provided support for 895 more (table 1). The Federal-State Cooperative Program also funded the largest number of partial-record discharge stations; it provides sole support of 2,887 stations (figure 3), and in combination with other sources, 186 more.

The number of continuous-record surface-water discharge stations increased from 7,152 stations in FY 1983 to 7,239 stations in FY 1989 (figure 4). During the same period, the total number of surface-water discharge stations decreased by 411, to 10,665 stations in FY 1989. The change reflects decreases in some States and increases in others (figure 5). In Virginia, for example, 215 partial-record stations were discontinued between FY 1985 and FY 1987 when a multiyear program to develop state-wide low flow regression equations reached the end of the data-collection phase. In Louisiana, 102 partial-record stations were discontinued in 1987 after an analysis showed that, with the data presently available, regression equations could define flood flows well enough to meet existing needs. In California, the increased number of continuous-record discharge stations from FY 1983 to FY 1989 reflects an increase in the monitoring of hydropower development.

Stage-only data were collected by the Geological Survey at 869 stream stations. The number of stage-only data stations on streams ranged from 79 in Florida to none in several States (figure 6). The reimbursement from other Federal agencies supported the largest number of continuous stage-only stations--286 (figure 7)--while the Federal-State Cooperative Program supported the most partial-record stage-only stations--230 (figure 8). The number of continuous-record stations collecting stage-only data on streams increased from 1983 to 1989 (figure 9), whereas the number of partial-record stations decreased.

Stage data were also collected at 1,193 stations on lakes and reservoirs by the Geological Survey. Continuous records of stage were collected at 848 lake and reservoir stations, ranging from 158 in California to none in several States (figure 10). Reimbursements from other Federal agencies supported the largest number of continuous-record stations (figure 11) and the Federal-State Cooperative Program supported the largest number of partial-record (figure 12) stage stations on lakes and reservoirs. The number of stage stations on lakes and reservoirs decreased from 1,246 in FY 1983 to 1,193 in FY 1989 (figure 13), but the number of continuous-record stations increased slightly.

Stream samples were collected and analyzed for water-quality characteristics at 3,650 stations across the Nation (figure 14). The types of water-quality parameters measured vary from site to site. Field determinations could include those for temperature, specific conductance, pH, dissolved oxygen, fecal coliform, and fecal streptococci. Laboratory determinations could include those for common constituents such as calcium, magnesium, fluoride, sodium, potassium, dissolved solids, silica, chloride, sulfate, hardness, bicarbonate, carbonate, and turbidity; for major nutrients such as phosphorus, ammonia, nitrite, and nitrate; trace metals such as arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, selenium, and zinc; and for selected radiochemical parameters. A continuous record was maintained at 661 of these sites (figure 15), mainly for water temperature and conductance, but other properties, such as dissolved oxygen concentrations and pH, were also

Table 1.--Types and number of hydrologic data collection stations operated by the U.S. Geological Survey during the 1989 fiscal year and the sources of funding support

Type of Station	Number of Stations by Source of Funding							Total Stations
	Single Program Support			Combined Support				
	Federal Program	Federal-State Cooperative Program (COOP)	Reimbursement from other Federal agencies (OFA)	Federal, COOP, OFA	Federal, COOP, OFA	Federal, COOP, OFA		
SURFACE WATER								
Discharge								
Continuous record	485	3,796	1,918	396	145	452	47	7,239
Partial record	27	2,887	311	149	15	14	23	3,426
Stage Only - Streams								
Continuous record	12	236	286	5	5	18	0	562
Partial record	9	230	38	28	0	2	0	307
Stage Only - Lakes and Reservoirs								
Continuous record	20	318	401	93	1	14	1	848
Partial record	11	243	79	11	0	1	0	345
Quality								
Continuous record	35	376	216	25	4	5	0	661
Scheduled, long-term operation	409	1,322	480	94	22	13	1	2,341
Short-term or project stations	69	789	340	108	0	3	0	1,309
GROUND WATER								
Water Levels								
Continuous record	87	1,909	130	266	0	12	0	2,404
Scheduled, long-term operation	1,128	21,322	1,159	1,619	0	56	0	25,284
Short-term or project stations	150	5,502	2,349	1,133	218	17	29	9,398
Quality								
Scheduled, long-term operation	156	3,651	446	206	0	13	0	4,472
Short-term or project stations	578	2,397	1,211	109	10	17	29	4,351
SEDIMENT								
Daily Sampling								
Periodic Sampling	21	66	73	2	7	3	0	172
	460	236	210	105	7	0	1	1,019
PRECIPITATION								
Quantity								
Quantity	93	548	561	25	6	1	1	1,235
Quality	34	33	3	2	0	0	0	72

recorded continuously at times. The stations at which a continuous record is maintained are counted as either scheduled, long-term operation stations or as short-term project stations.

There are 2,341 stream sites at which water-quality data were collected as part of a scheduled, long-term operation (figure 16). These include 411 stations, supported in the Survey's Federal Program, which make up the National Stream Quality Accounting Network (NASQAN). NASQAN was established by the U.S. Geological Survey to provide a uniform basis for continually assessing the quality of water in United States streams. An identical suite of water-quality characteristics is measured at each NASQAN station using the same set of procedures concerning sample-collection techniques, frequency of sampling, and analytical methods (Briggs and Ficke, 1977). There were 1,309 stations which were sampled as short-term or project stations (figure 17). The collection of surface-water quality data received its largest funding support from the Federal-State cooperative Program for all types of stations.

The number of stations at which surface-water quality data were collected on a scheduled, long-term basis increased in some States, but the overall total declined from 2,906 in 1983 to 2,341 in 1989 (figure 18). In Wyoming, for example, the number of scheduled, long-term sampling stations was reduced from 1983 to 1989 when the emphasis changed from analyses for major dissolved constituents to more expensive analyses for pesticides and herbicides. Thus, in order to accommodate to a static level of available funds, the number of sampling stations had to be decreased (figure 19). The number of short-term or project stations increased during the same period (figure 20). In North Dakota, the number of short-term or project surface-water quality stations increased as a result of increased interest in the quality of water in the Souris and Red Rivers.

### Ground Water Data

Ground water is one of the most widely available of the Nation's natural resources. It is estimated that 74 billion gallons per day of ground water are withdrawn in the United States for public supply, domestic, commercial, irrigation, livestock, industrial, mining, and thermo-electric uses (Solley and others, 1988). Water-level fluctuations are indicators of the stresses (both natural and man-induced) placed on aquifers, their ability to yield water, and the quantity of water in storage beneath the earth's surface. The U.S. Geological Survey collected information on ground-water levels at 34,682 sites in 1989 (figure 21). Data on water levels were collected continuously at 2,404 sites, of which 1,909 were funded in total by the Federal-State Cooperative Program (figure 22). The stations at which a continuous record is maintained are counted as either scheduled, long-term operation stations or as short-term project stations.

Ground-water levels were collected at 25,284 stations as part of a scheduled, long-term operation to assess long-term trends (figure 23). When special areal studies were conducted, water levels were at times collected at short-term or project stations to supplement the information available in the area from the long-term stations. In 1989,

water-level data were collected at 9,398 stations for these investigations (figure 24). The Federal-State Cooperative Program provided total funding support for 59 percent of these stations.

From FY 1983 to 1989, the number of scheduled, long-term operation ground-water level stations increased from 24,047 in 1983 to 25,284 in 1989 (figure 25). The number of stations at which data on ground-water levels were collected continuously also increased from 1,982 in 1983 to 2,404 in 1989. Meanwhile, the short-term or project stations increased from 9,592 in 1983 to 11,994 in 1985, and then decreased to 9,398 in 1989.

The change in number of stations at which scheduled, long-term operation ground-water levels were collected from 1983 to 1989 varied from an increase of 1,744 stations in New Mexico to a decrease of 753 stations in Louisiana (figure 26). The change in the number of short-term or project stations at which ground-water levels were collected during the same period also varied from State to State (figure 27).

In 1989, samples of ground water from 8,823 stations were analyzed (figure 28). To maintain information on the changes in quality of critical ground-water bodies, samples were collected at 4,472 stations as part of a scheduled, long-term operation (figure 29). Of these, sampling at 3,651 stations was funded in total by the Federal-State Cooperative Program. Ground-water quality data were also collected at 4,351 stations to provide information needed for short-term, generally site-specific studies (figure 30).

Across the country, the number of stations at which ground-water quality samples were collected increased from 7,648 in 1983 to 8,823 in 1989 (figure 31). There were increases in some States and decreases in others. In Iowa, for example, a major ground-water investigation underway in cooperation with two Iowa State agencies, called for an increased number of scheduled, long-term ground-water quality stations (figure 32). In New Jersey, studies of ground-water quality, in cooperation with the State of New Jersey, required additional short-term or project stations (figure 33).

### Sediment Data

Data are needed to evaluate the effect of sediment deposition on reservoir storage; the influence of infrequent large storms on erosion and transport of sediment; and the effects of urban and rural non-point contributions of sediment and the associated transport and fate of nutrients, toxic metals, and organic substances. Burkham (1985) states: "The U.S. Geological Survey (USGS) and other Federal, State, and local agencies obtain records of suspended-sediment discharge at many sites throughout the United States. The use of these records has greatly increased in recent years. Uses involve the evaluation of sediment transport to the oceans, geomorphological studies of denudation and rates of erosion, assessment of soil erosion

and soil loss, reservoir sedimentation, general environmental impact assessment, water treatment problems of sediment-associated nutrients and pollutants, and evaluation of the precise impacts of humans."

New field techniques to collect suspended sediment samples are being tested to determine whether or not they produce a representative sample of sediment for chemical analysis. These techniques will be of use in determining the fate of toxic substances in river systems. The movement of sediment into reservoirs and estuaries, and the associated chemical processes, must be understood because sediment can provide a potential source of toxic substances that could have a serious impact on the local biota and the food chain, as well as directly on water supplies.

To help address the problems and issues of sediment in rivers, the Geological Survey collected daily sediment data at 172 stations, and periodic data at 1,109 other stations (figure 34). This represents a reduction of 40 and 8 stations, respectively, from 1985 to 1989 (figure 35). Reimbursements from other Federal agencies provided support for 42 percent of the daily sampling stations (figure 36), and the Federal program provided support for 45 percent of the periodic sampling stations (figure 37).

### Precipitation Data

Collection of precipitation data by the Geological Survey is undertaken only as part of an investigation of a specific hydrologic system. Most of the time, precipitation data from the National Weather Service are used in Geological Survey investigations. Precipitation data were collected at 1,235 sites nationwide (figure 38). At 72 of these sites, quality of precipitation was determined. The largest support for the collection of precipitation quantity (figure 39) and quality (figure 40) data came from the reimbursements from other Federal agencies and the Federal Program, respectively.

## SATELLITE TELEMETRY OF HYDROLOGIC DATA

Satellite telemetry is playing an increasing role in the collection of hydrologic data in real time. A satellite data-collection system consists of a data-collection platform (which is a small battery-operated radio), an Earth-orbiting satellite, and an Earth receive and data-processing station. The demand for a cost-effective means of collecting hydrologic data in real time for hazard-warning systems and water management has increased rapidly (Paulson and Shope, 1984). Data-collection platforms were located in 2,742 U.S. Geological Survey hydrologic data-collection stations and were transmitting data on one, or a combination, of the following parameters: stream stage or discharge, reservoir stage, water quality, and precipitation (figure 41). There were 2,116 stations at which data-collection platforms were operated by the U.S. Geological Survey and 626 U.S. Geological Survey stations at which the data-collection platforms were operated by others. About two-thirds of the funding for the operation of the data-collection platforms is provided by other Federal agencies (figure 42). The number of data-collection platforms located in U.S. Geological Survey hydrologic stations increased from 1,520 in 1985 to 2,742 in 1989 (figure 43).

## SUMMARY

The U.S. Geological Survey operates an extensive, nationwide network for the collection of hydrologic data. The surface-water data include information on discharge and stage of streams, stages of lakes and reservoirs, and surface-water quality. Data are also collected on ground-water levels and the quality of ground water. Data on sediment are collected on a daily and periodic basis. Data on the quantity and quality of precipitation are usually collected only in selected study areas. Satellite telemetry is being used to collect hydrologic data in real time. From FY 1983 to FY 1989, the total number of surface-water discharge stations declined. The number of continuous-record discharge stations increased, surface-water quality stations declined, and ground-water level and ground-water quality stations both increased.

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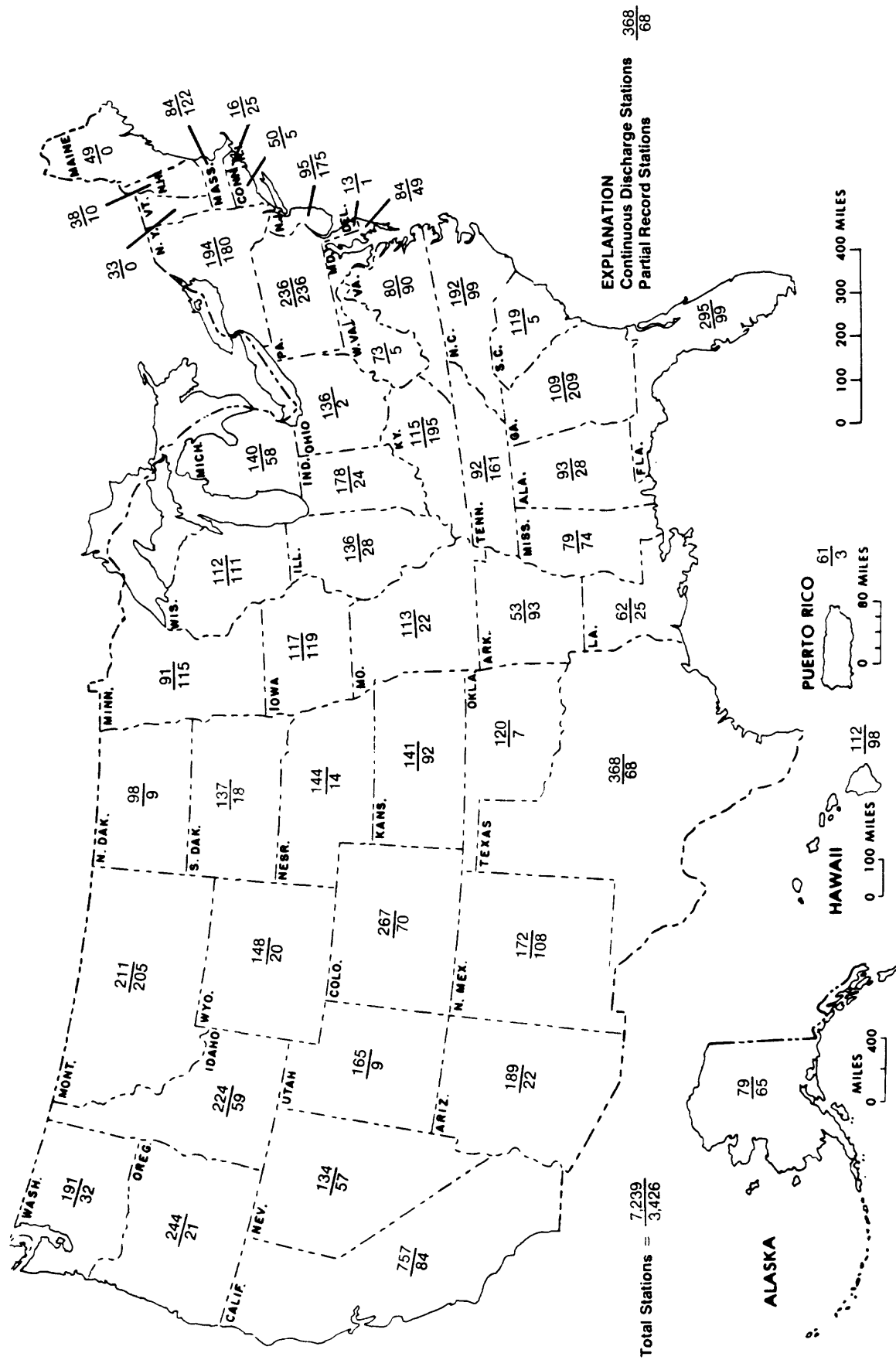
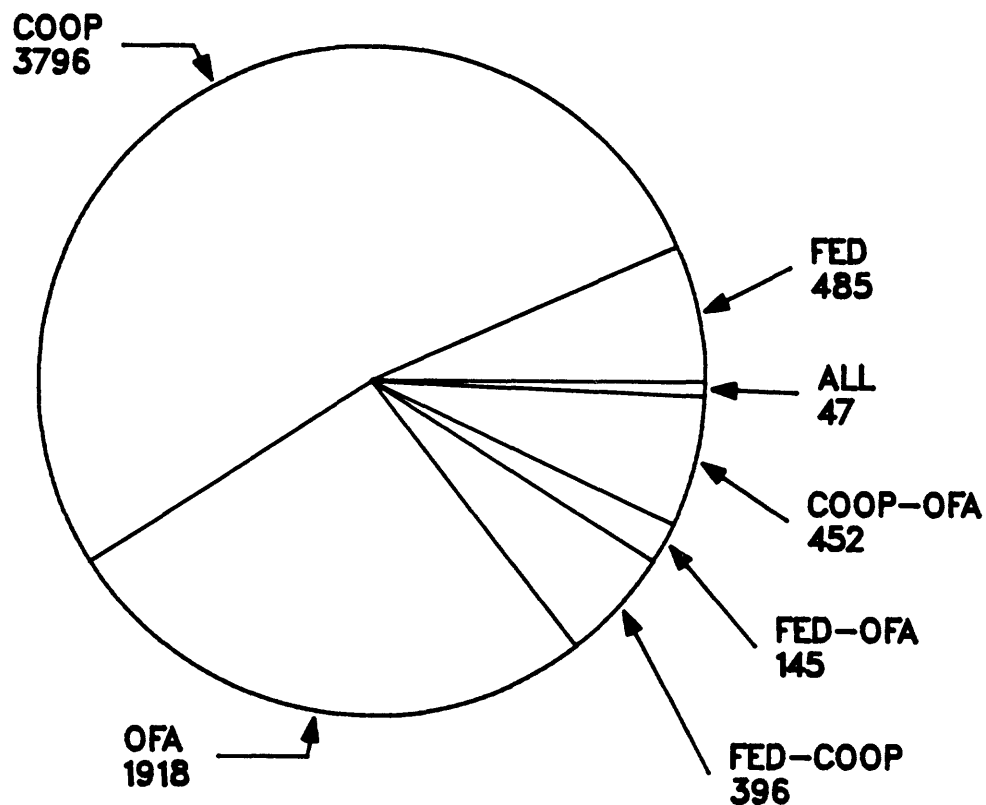


Figure 1.--Number of stations, by State, at which surface-water discharge data were collected in fiscal year 1989.



TOTAL STATIONS = 7,239

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

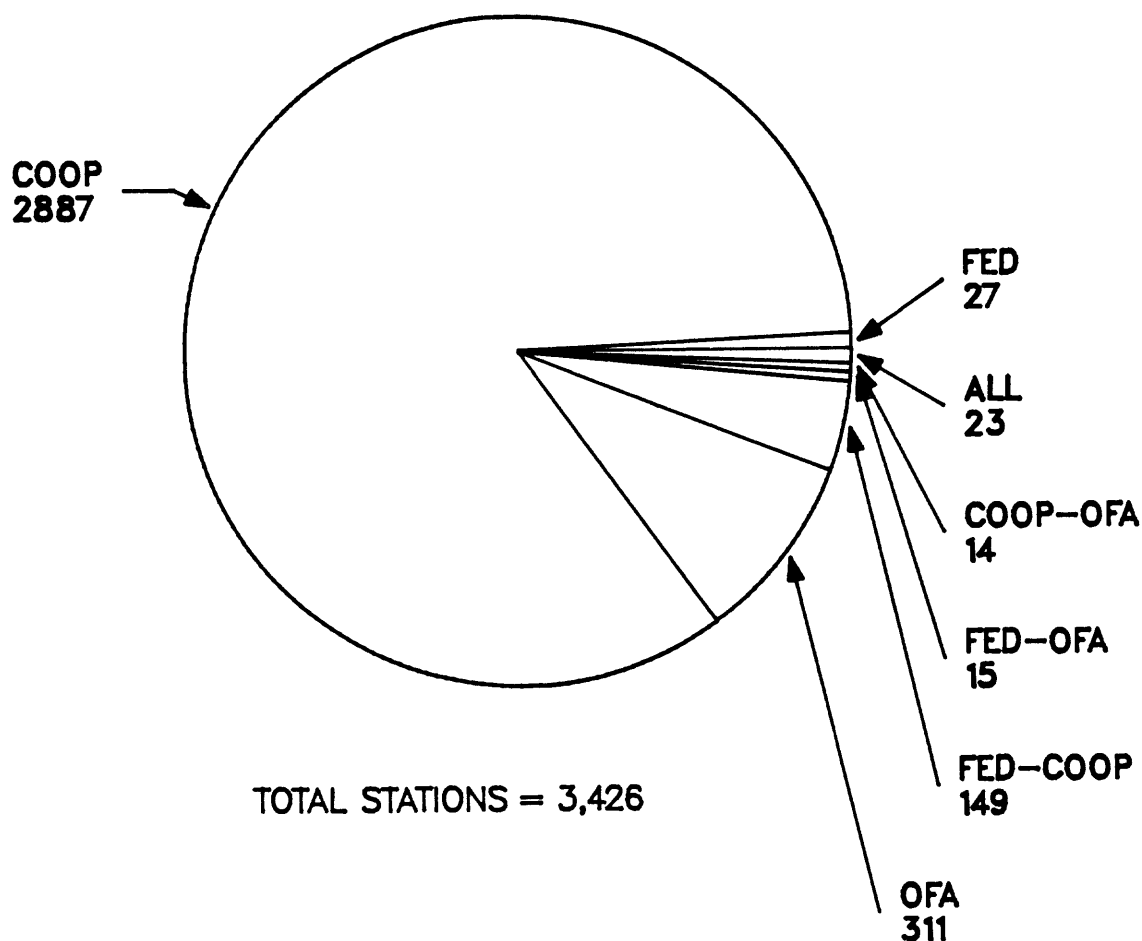
FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP

Figure 2.--Number of continuous surface-water discharge stations,  
and sources of funding support, fiscal year 1989



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP

Figure 3.--Number of partial record surface-water discharge stations,  
and sources of funding support, fiscal year 1989.

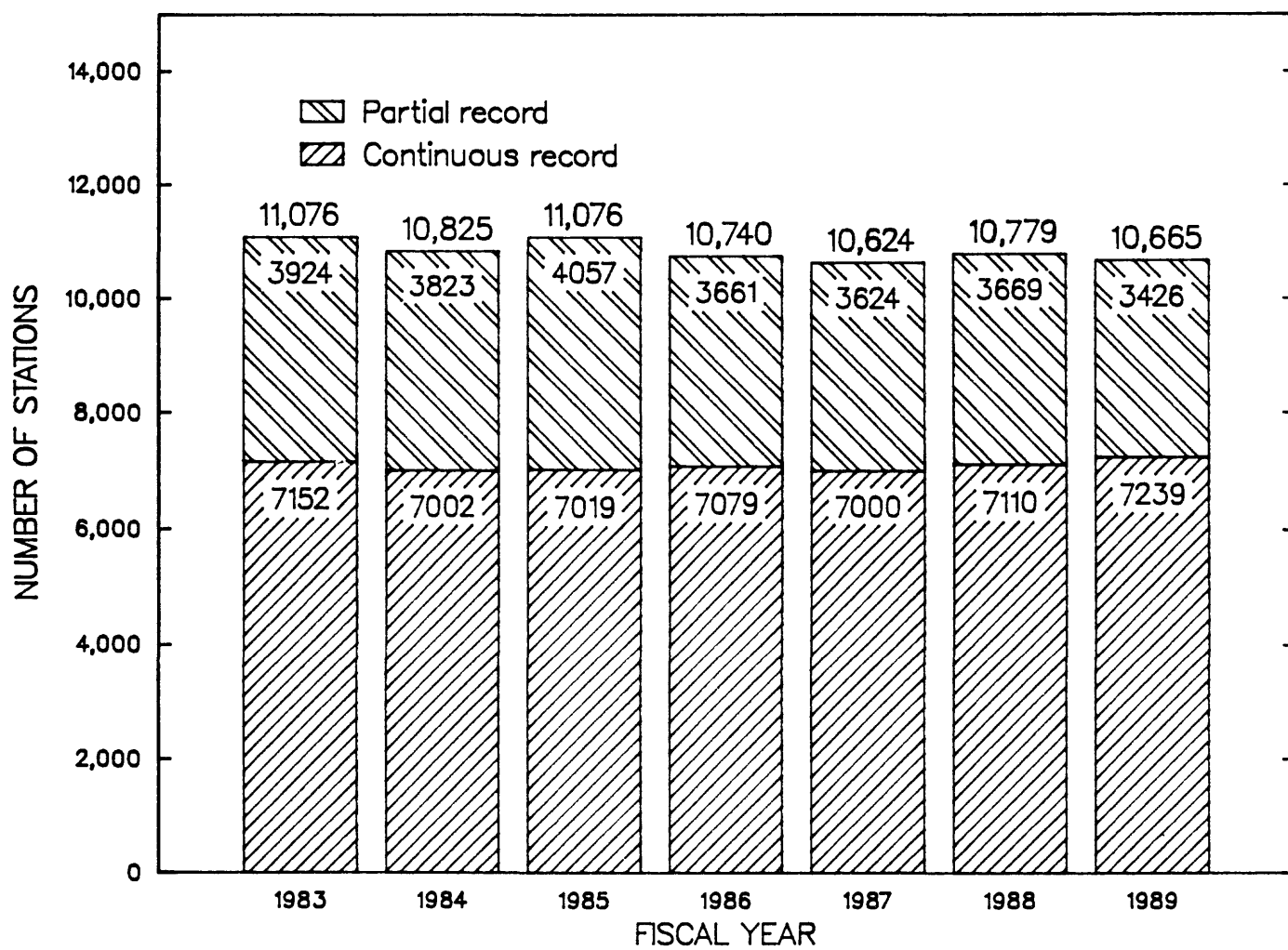


Figure 4.--Number of stations, by year, at which surface-water discharge data were collected from fiscal year 1983 to 1989.

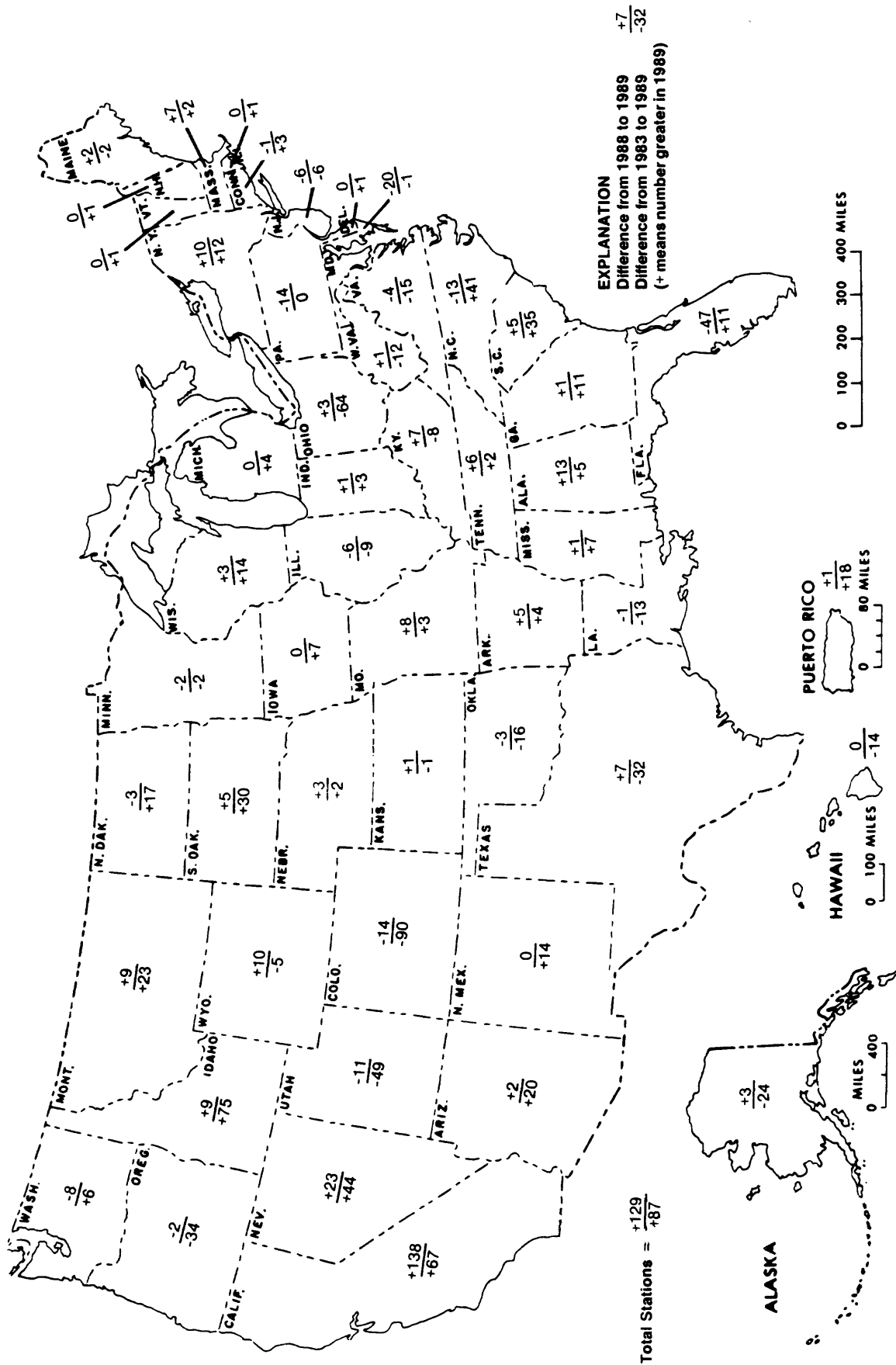


Figure 5.--Change in number of stations, by State, at which continuous surface-water discharge data were collected from fiscal year 1988 to fiscal year 1989, and from fiscal year 1983 to fiscal year 1989.

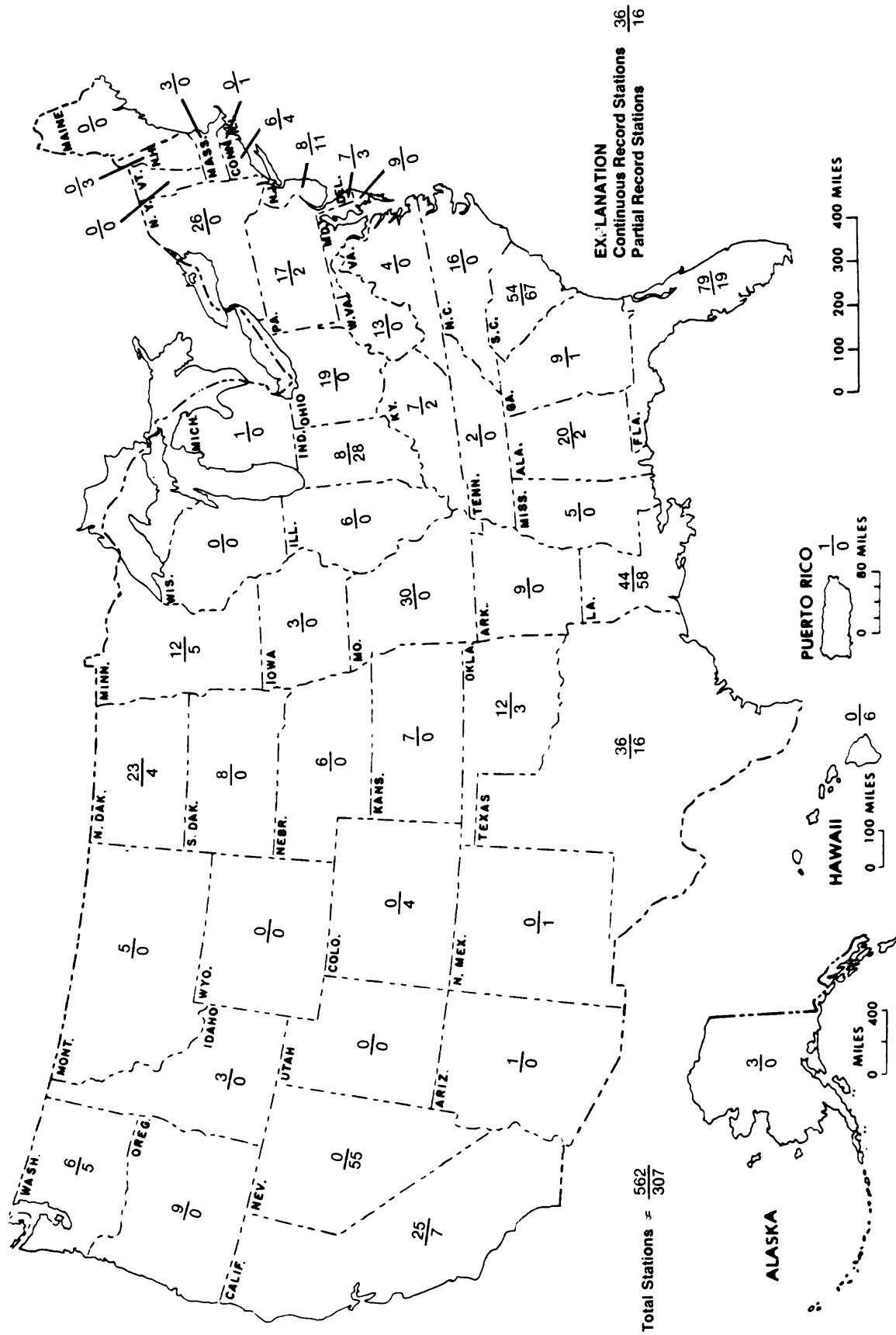
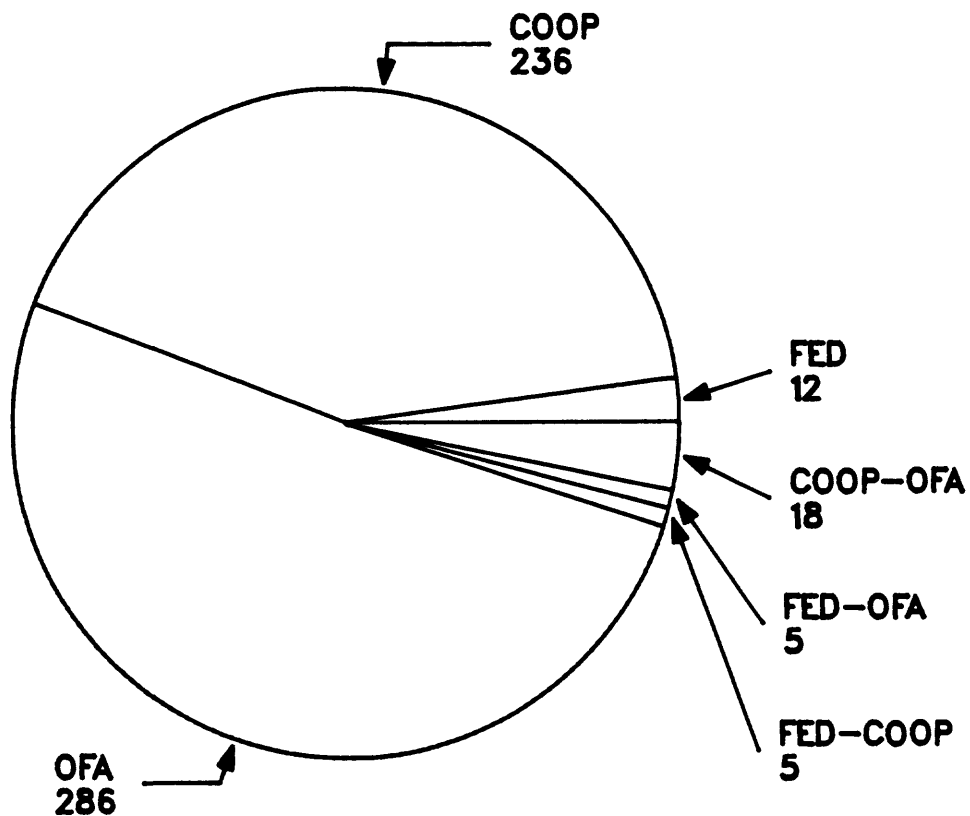


Figure 6.--Number of stations, by State, at which stage-only data were collected on streams in fiscal year 1989.



TOTAL STATIONS = 562

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

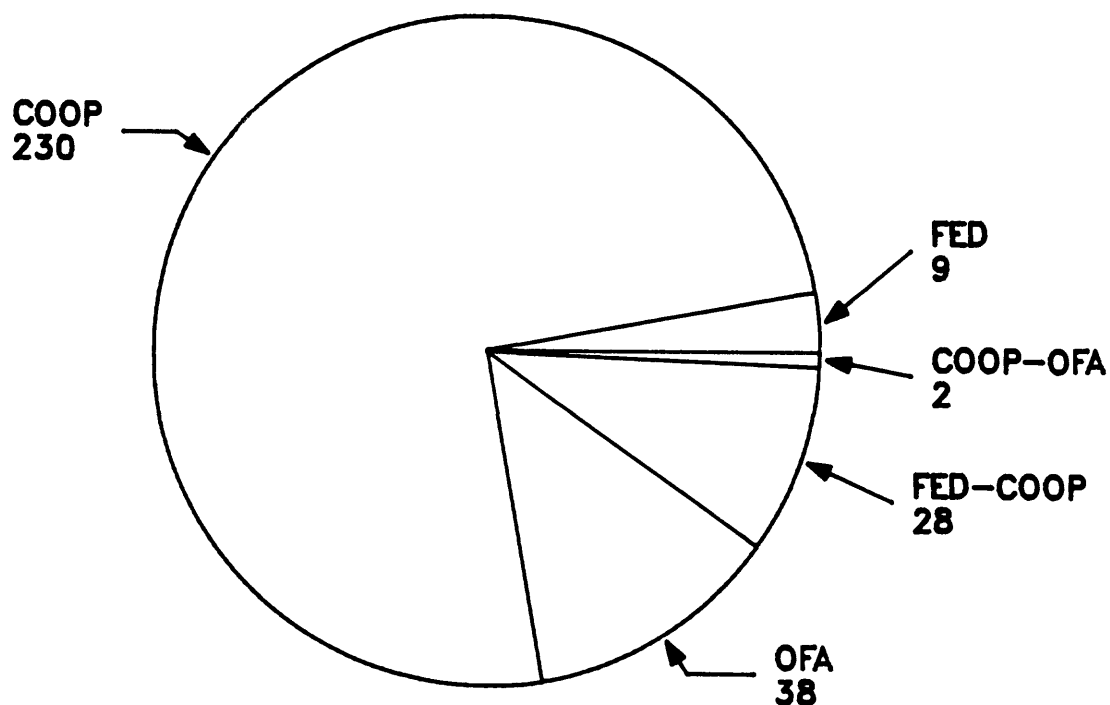
COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

Figure 7.--Number of continuous surface-water stage-only stations on streams, and sources of funding support, fiscal year 1989.



TOTAL STATIONS = 307

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

Figure 8.--Number of partial record surface-water stage-only stations on streams, and sources of funding support, fiscal year 1989.



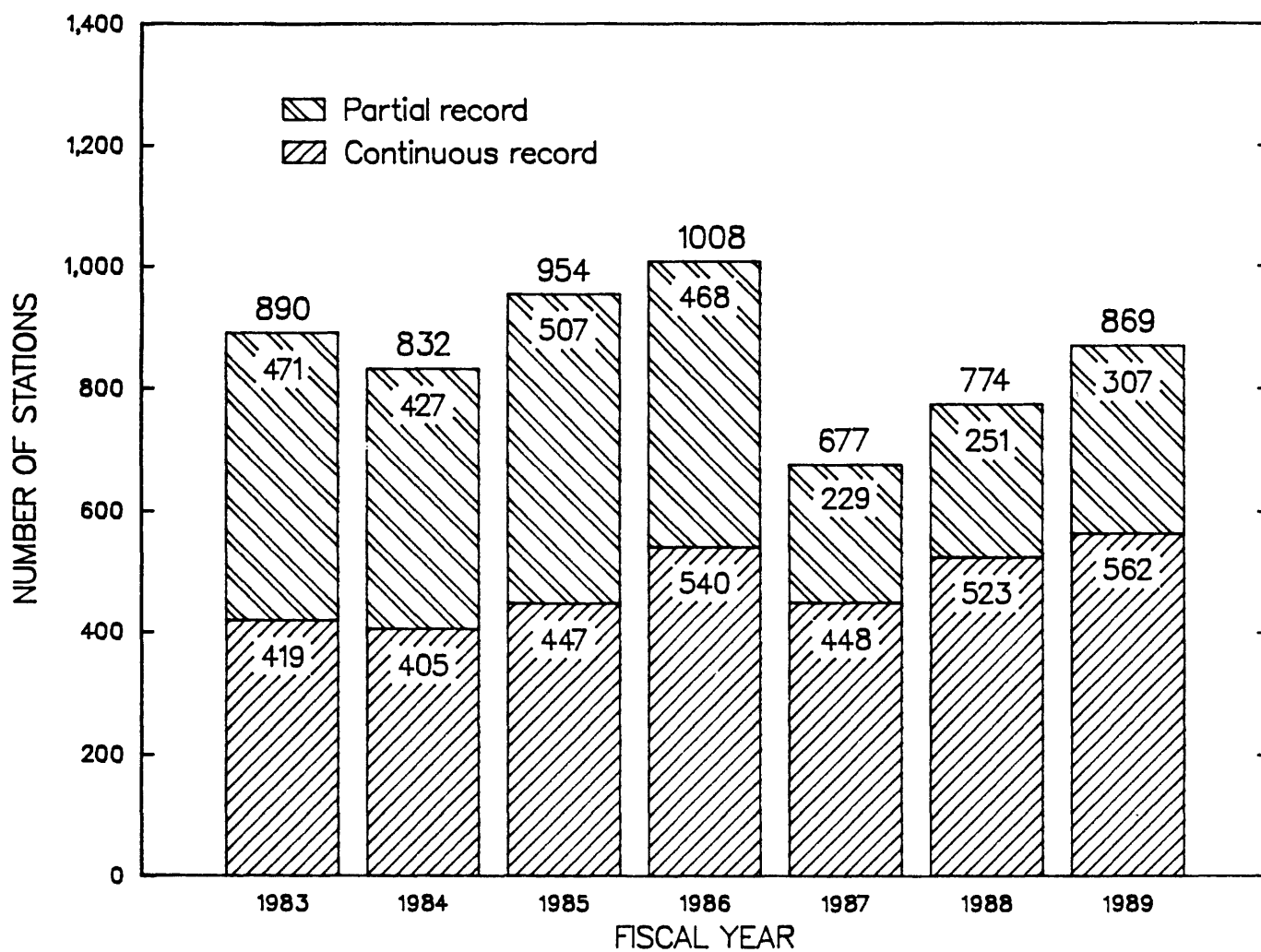


Figure 9.--Number of stations, by year, at which stage-only data were collected on streams from fiscal year 1983 to 1989.

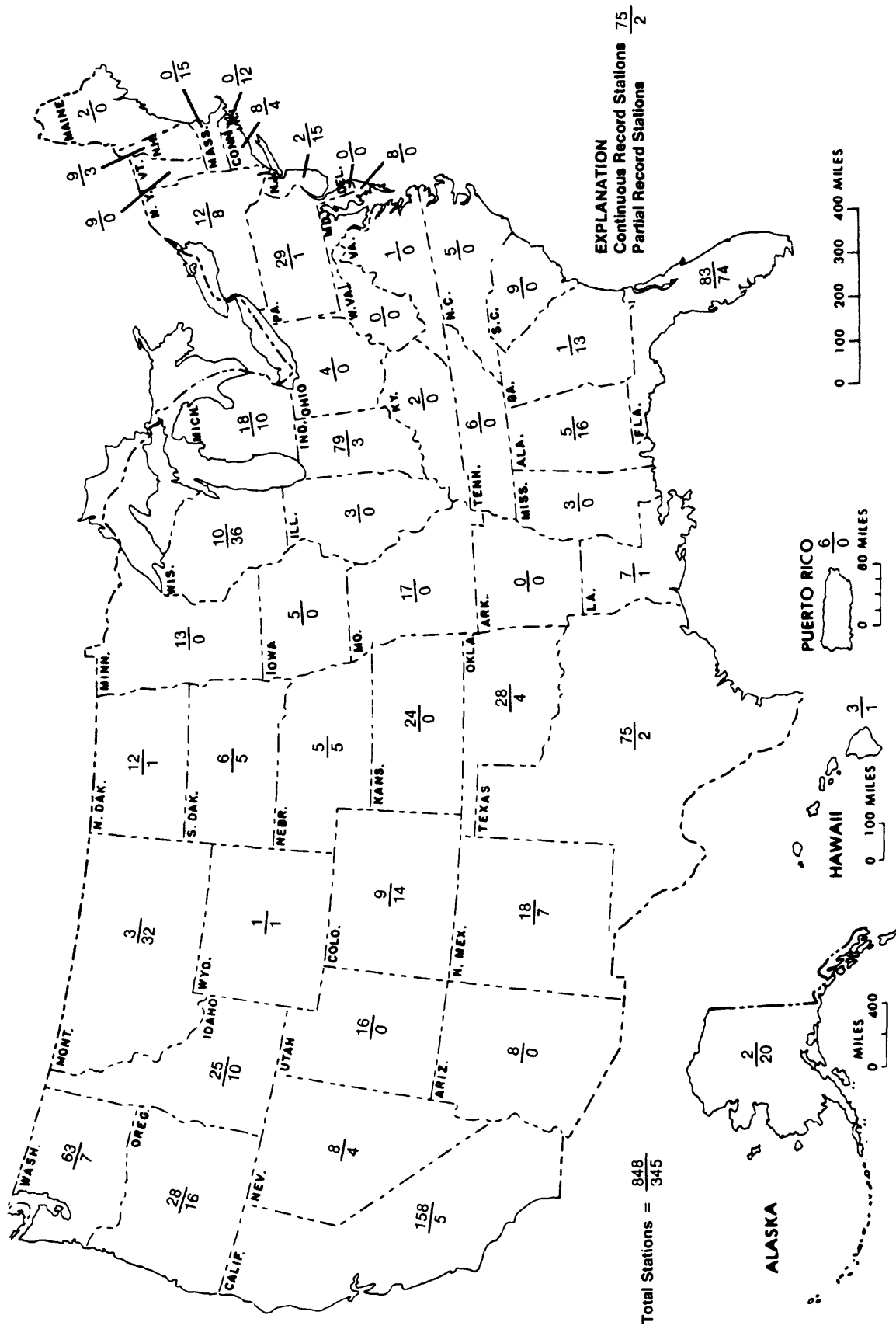
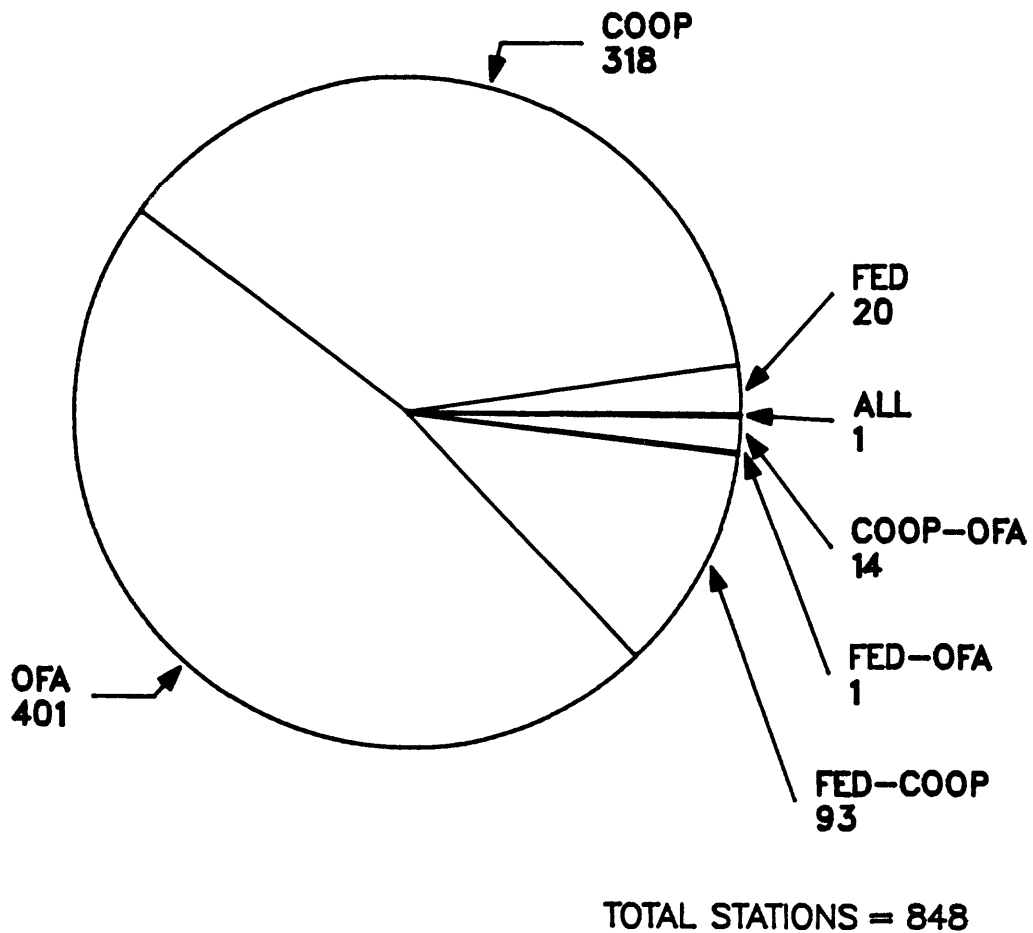


Figure 10.--Number of stations, by State, at which stage data were collected on lakes and reservoirs in fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

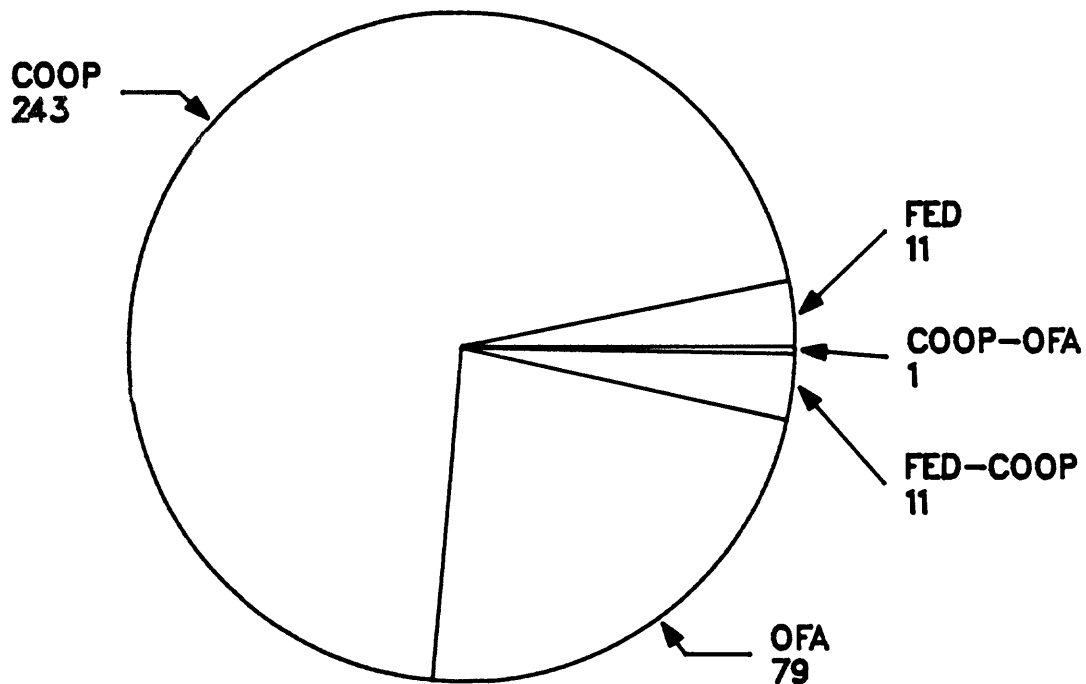
FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP

Figure 11.--Number of continuous surface-water stations on lakes and reservoirs, and sources of funding support, fiscal year 1989.



TOTAL STATIONS = 345

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

Figure 12.--Number of partial record surface-water stage stations on lakes and reservoirs, and sources of funding support, fiscal year 1989.

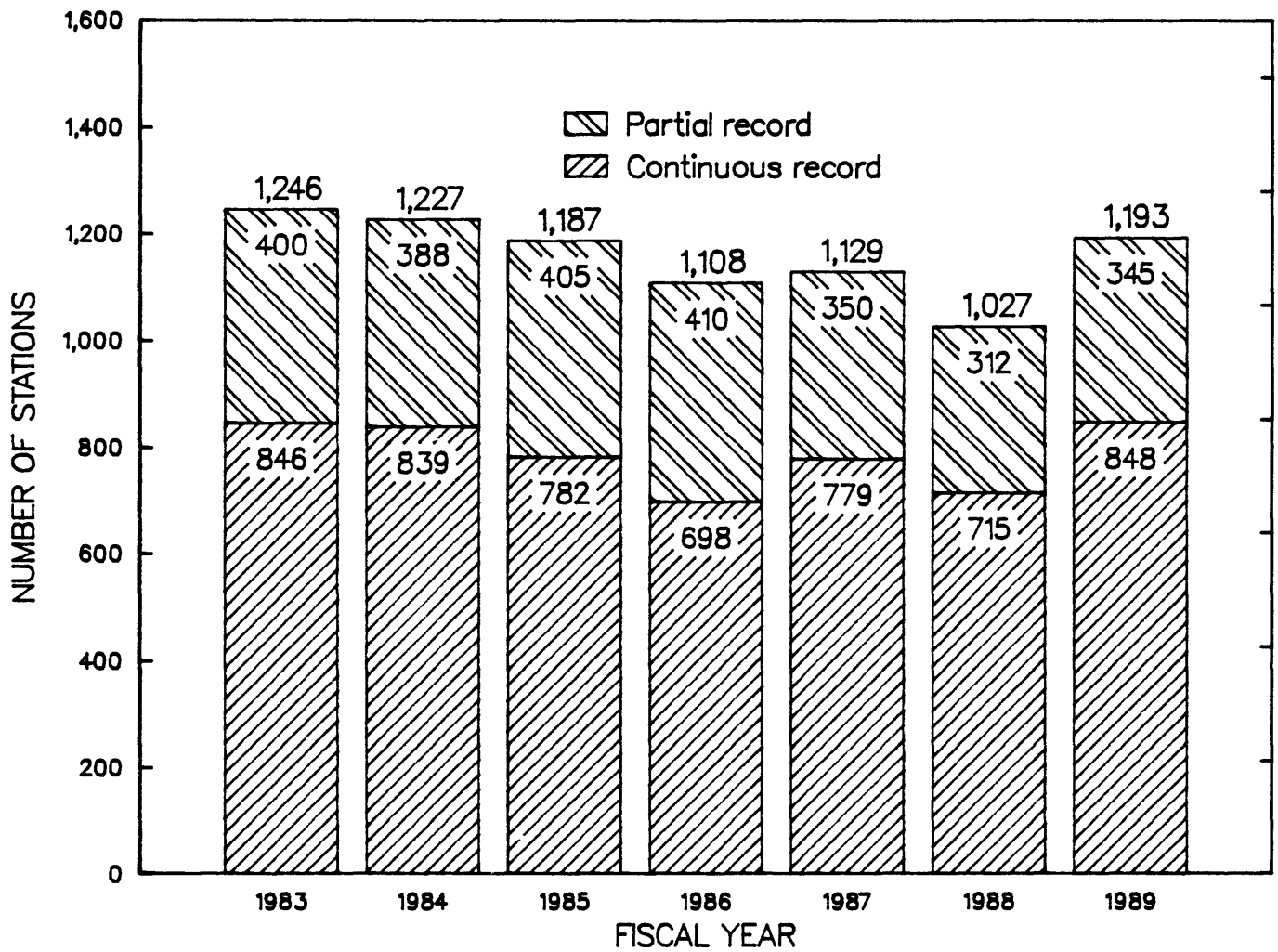
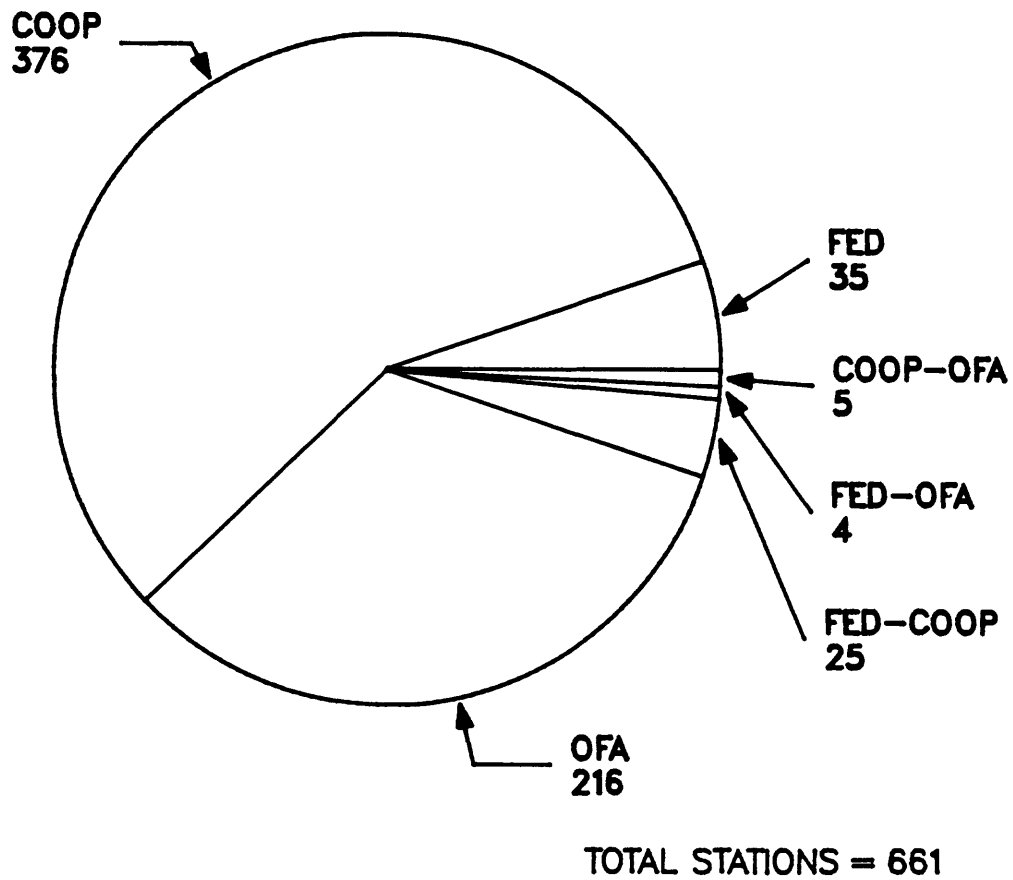


Figure 13.--Number of stations, by year, at which surface-water stage data were collected on lakes and reservoirs from fiscal year 1983 to fiscal year 1989.





EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

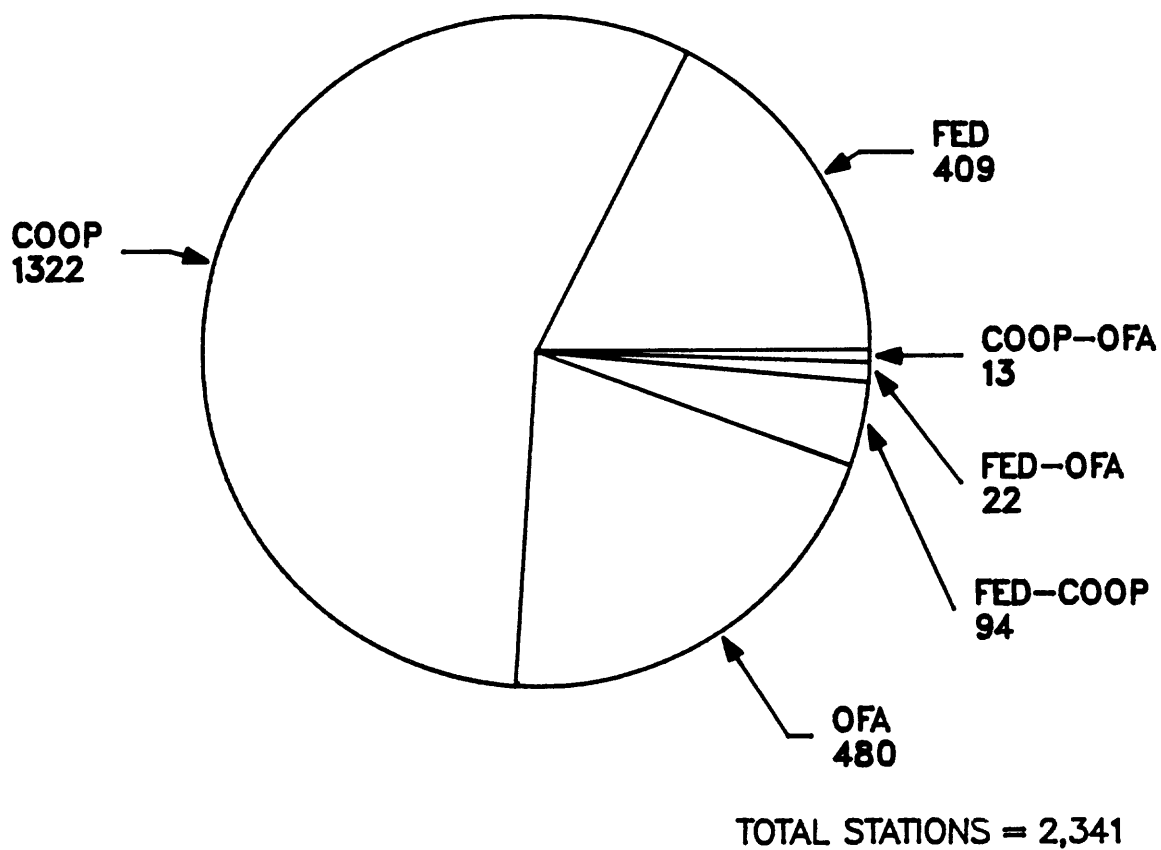
COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

Figure 15.--Number of continuous surface-water quality stations, and sources of funding support, fiscal year 1989.



**EXPLANATION:**

**SINGLE PROGRAM SUPPORT**

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

**COMBINED PROGRAM SUPPORT**

FED-COOP = Federal and Federal-State Cooperative Program

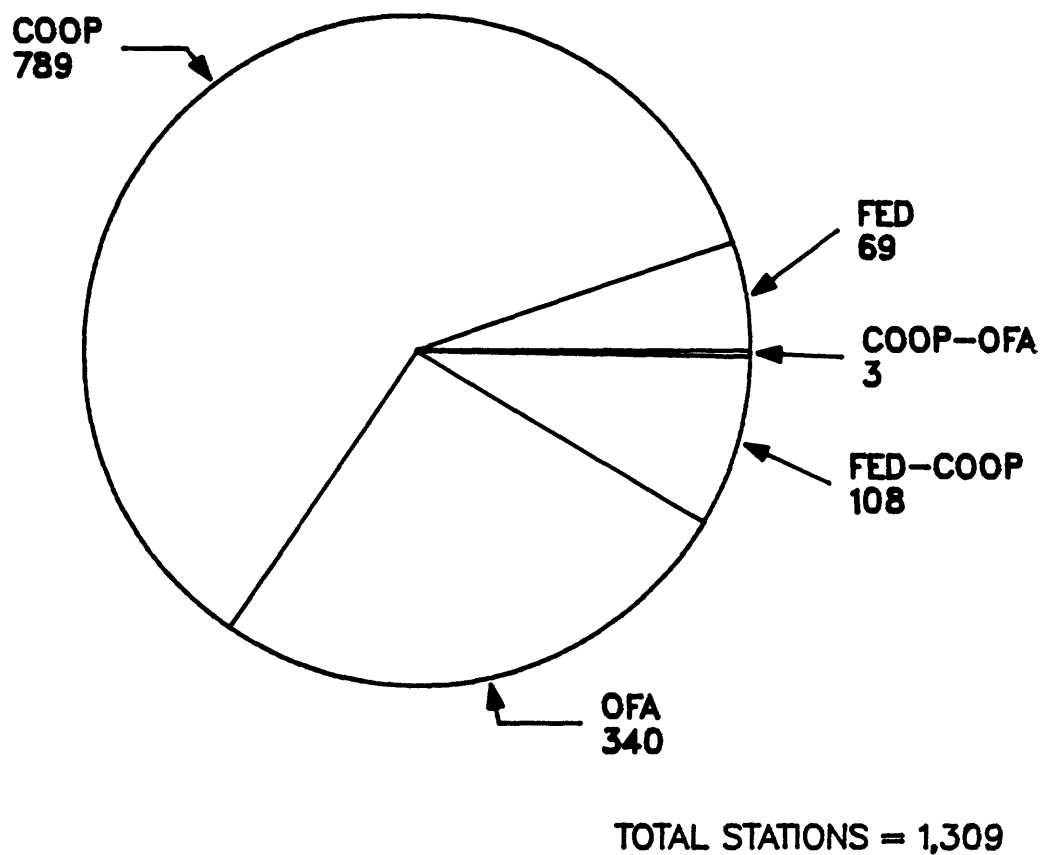
COOP-OFA = Federal-State Cooperative Program and Other Federal Agencies

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP (1 station not shown)

Figure 16.--Number of scheduled, long-term operation surface-water quality stations, and sources of funding support, fiscal year 1989.





EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

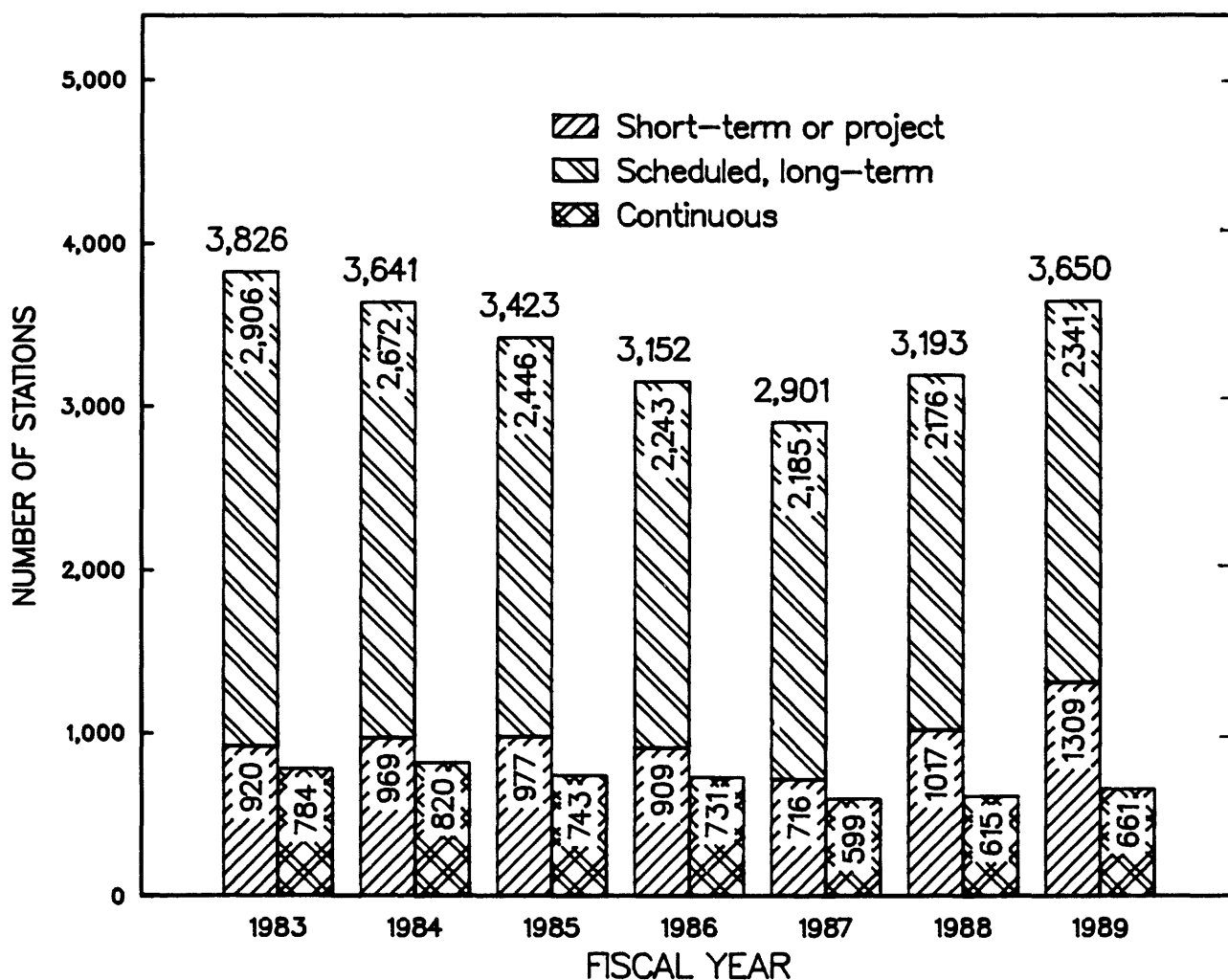
COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

Figure 17.--Number of short-term or project surface-water quality stations, and sources of funding support, fiscal year 1989.



NOTE: The annual totals shown reflect that the number of stations in the "continuous" category are counted in either the "scheduled, long-term" or the "short-term, or project" categories.

Figure 18.--Number of stations, by year, at which surface-water quality data were collected from fiscal year 1983 to 1989.

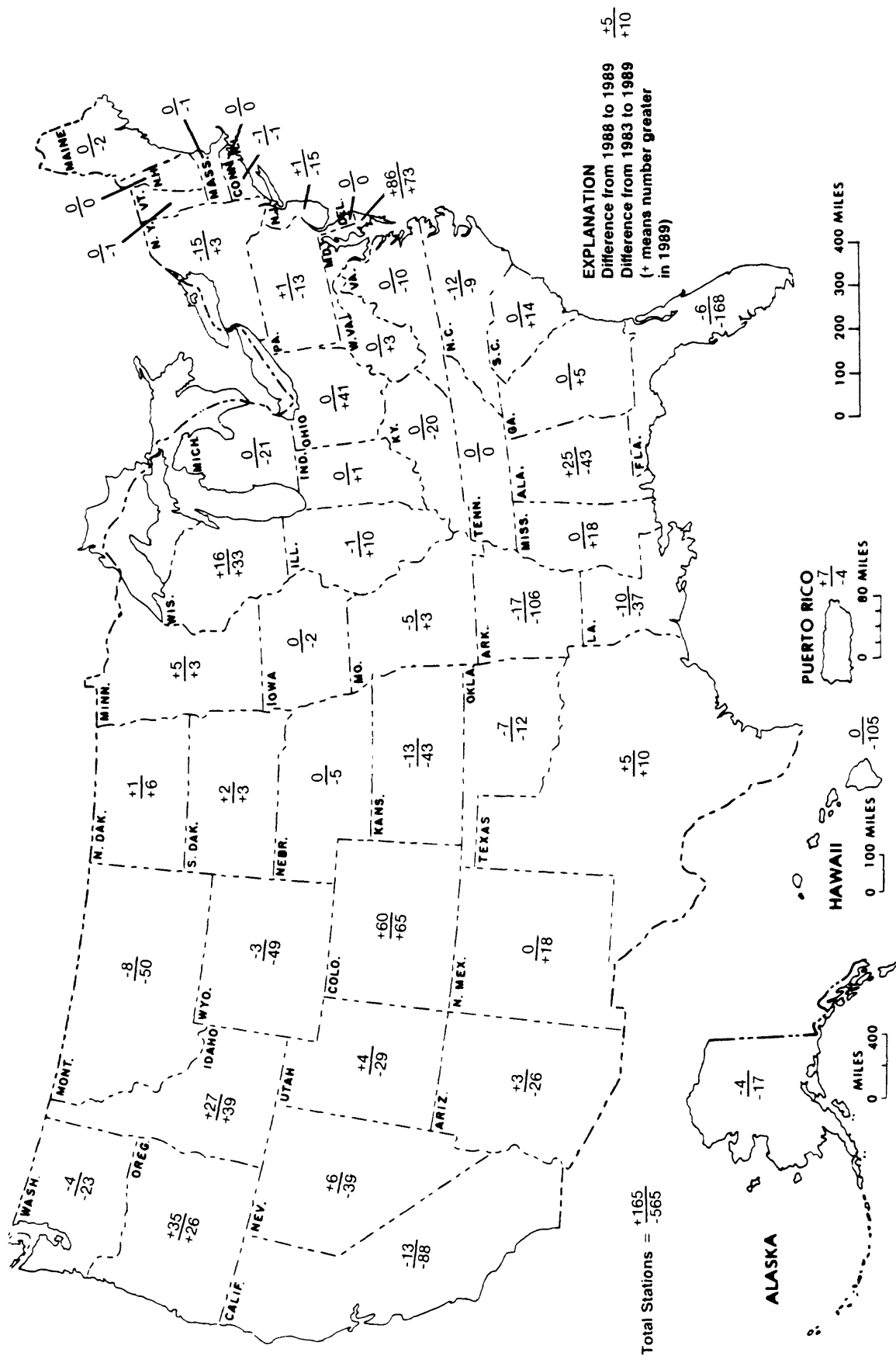


Figure 19.--Change in number of stations, by State, at which scheduled, long-term operation surface-water quality data were collected from fiscal year 1988 to fiscal year 1989, and from fiscal year 1983 to fiscal year 1989.

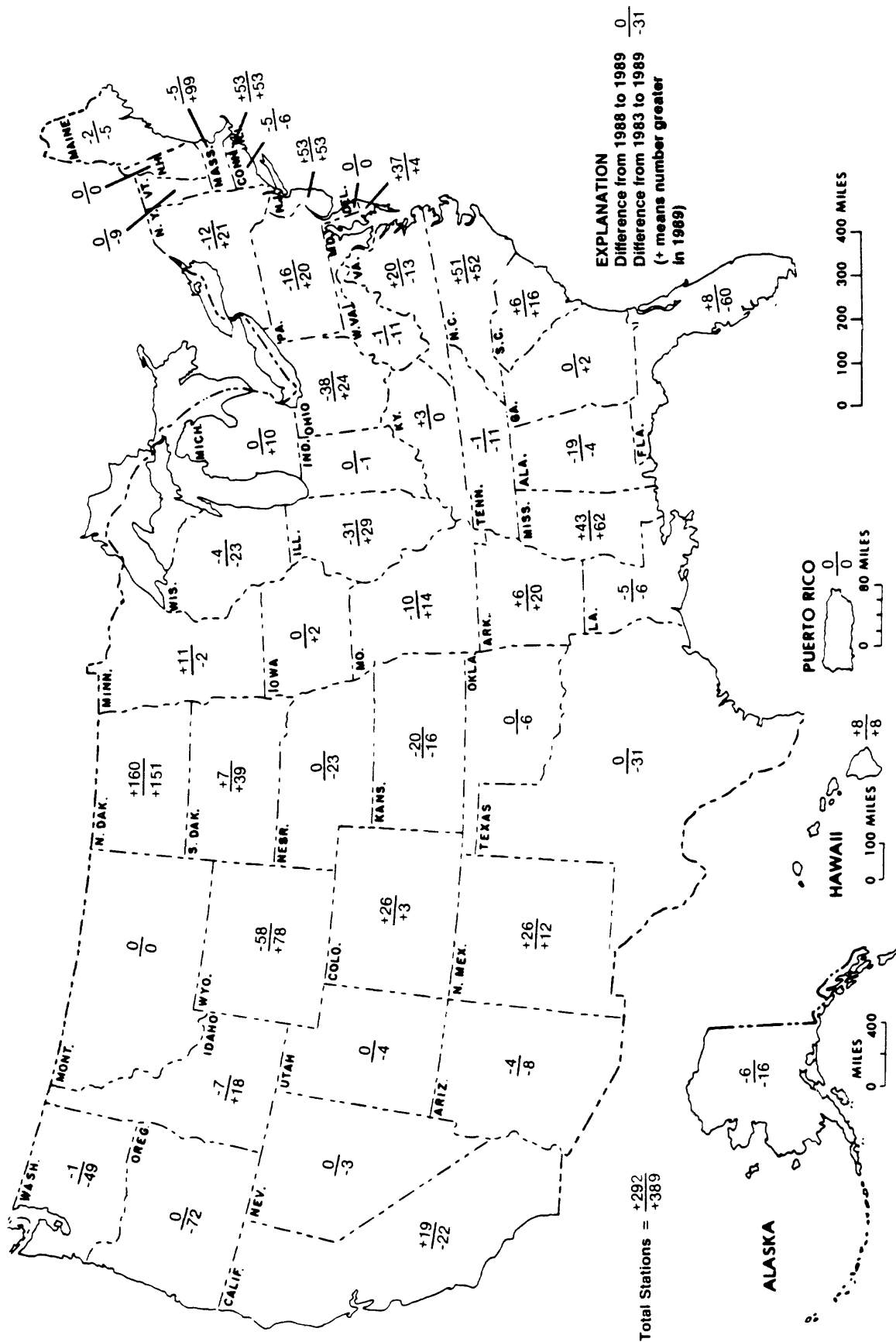


Figure 20.--Change in number of stations, by State, at which surface-water quality data were collected at short-term or project stations from fiscal year 1988 to fiscal year 1989, and from fiscal year 1983 to fiscal year 1989.

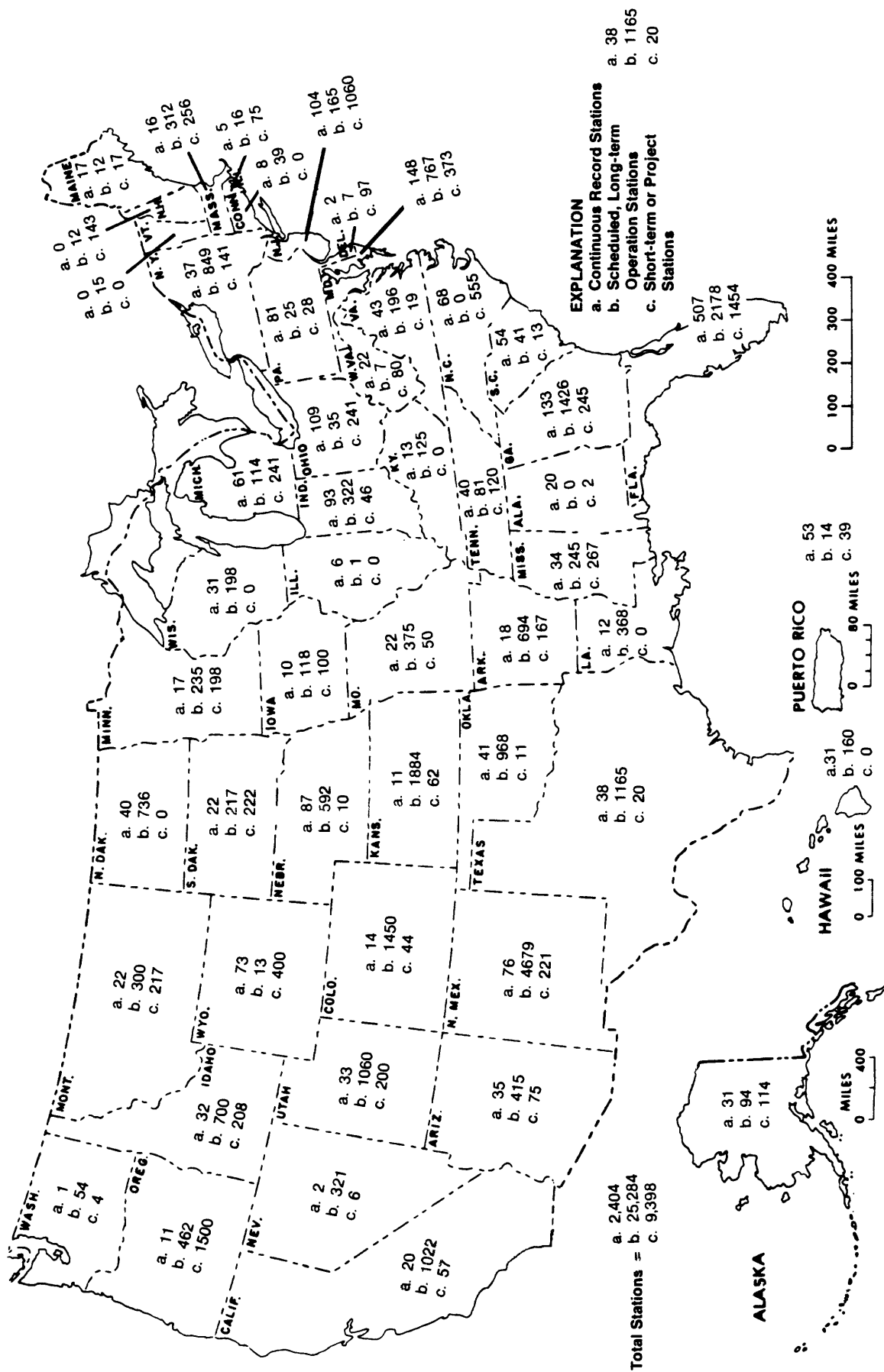
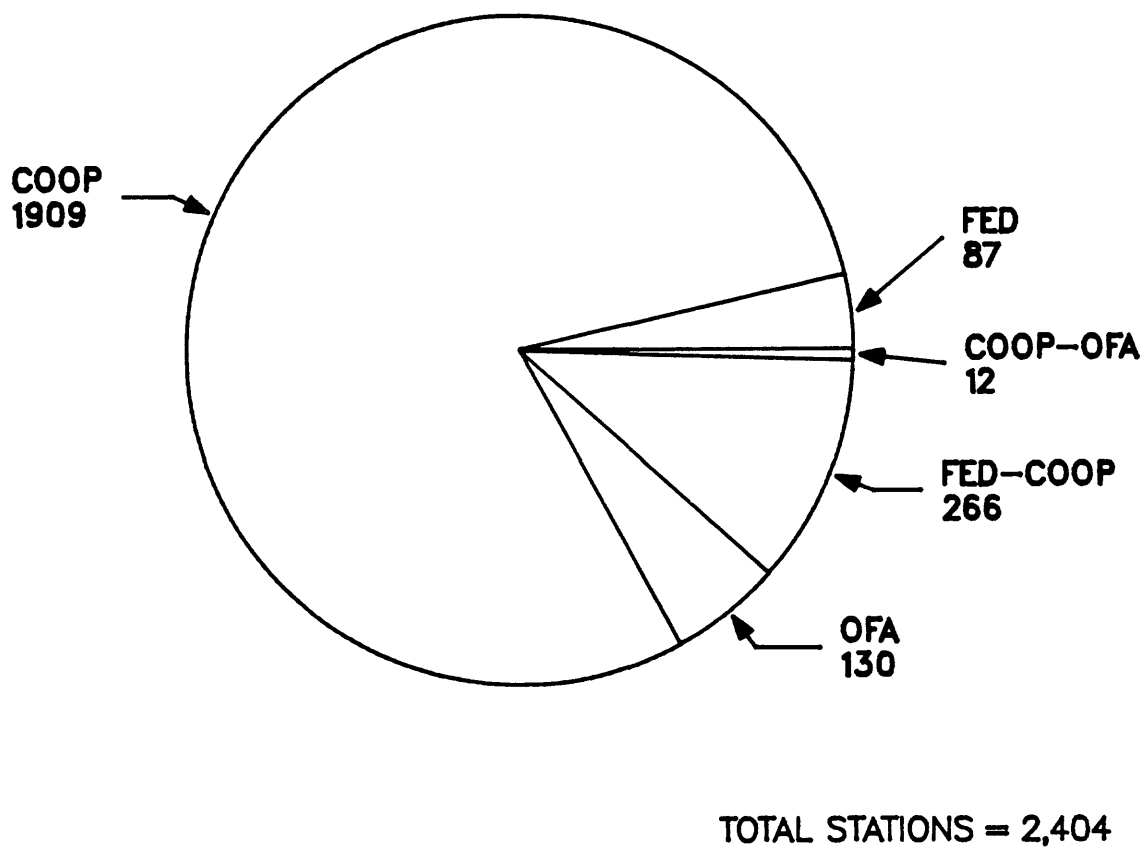


Figure 21.--Number of stations, by State, at which ground-water levels were collected in fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

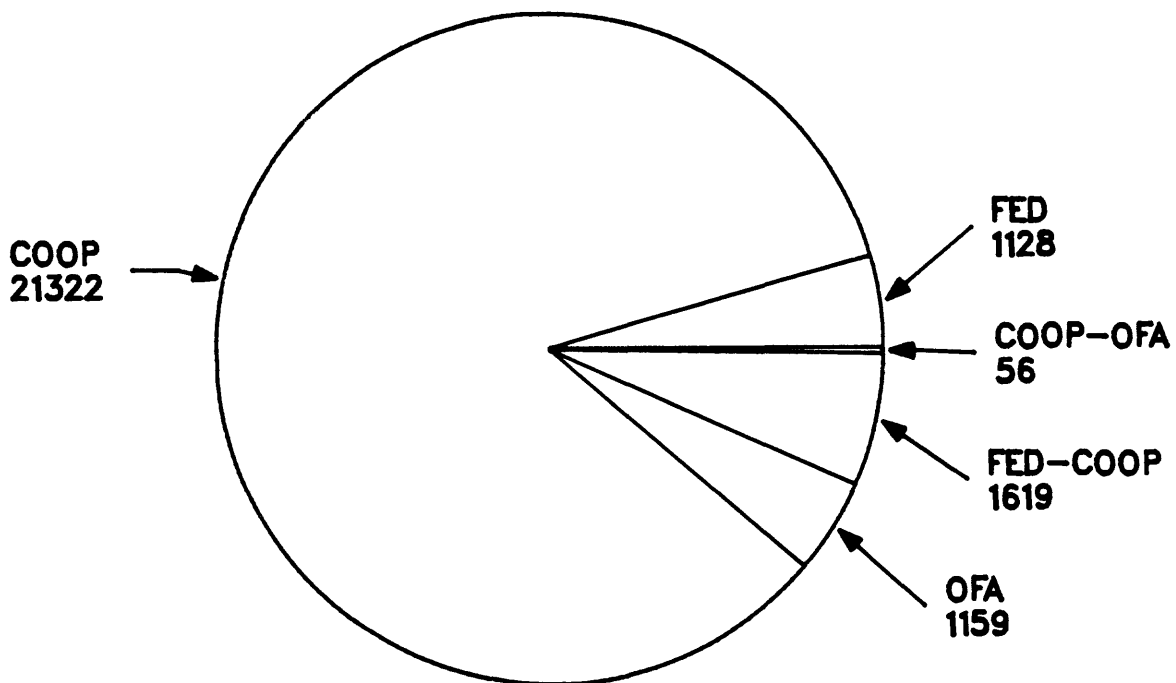
COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

Figure 22.--Number of continuous ground-water level stations, and  
sources of funding support, fiscal year 1989.



TOTAL STATIONS = 25,284

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

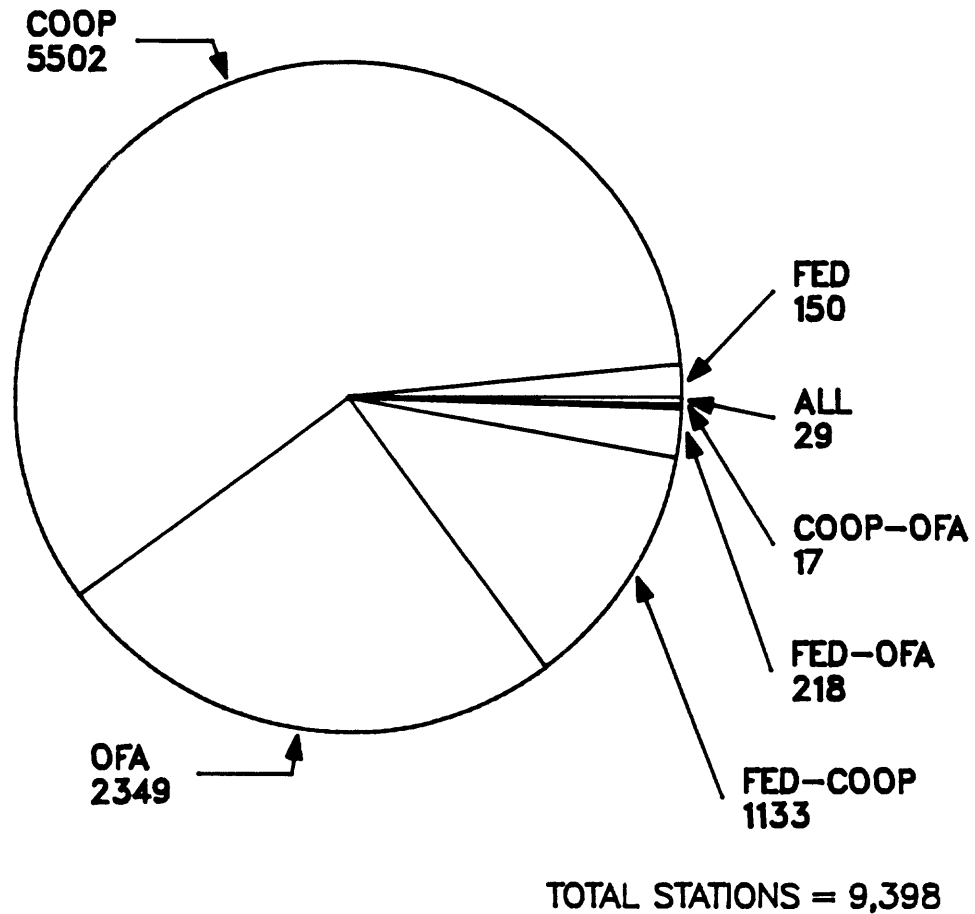
COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

Figure 23.--Number of scheduled, long-term operation ground-water level stations, and sources of funding support, fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

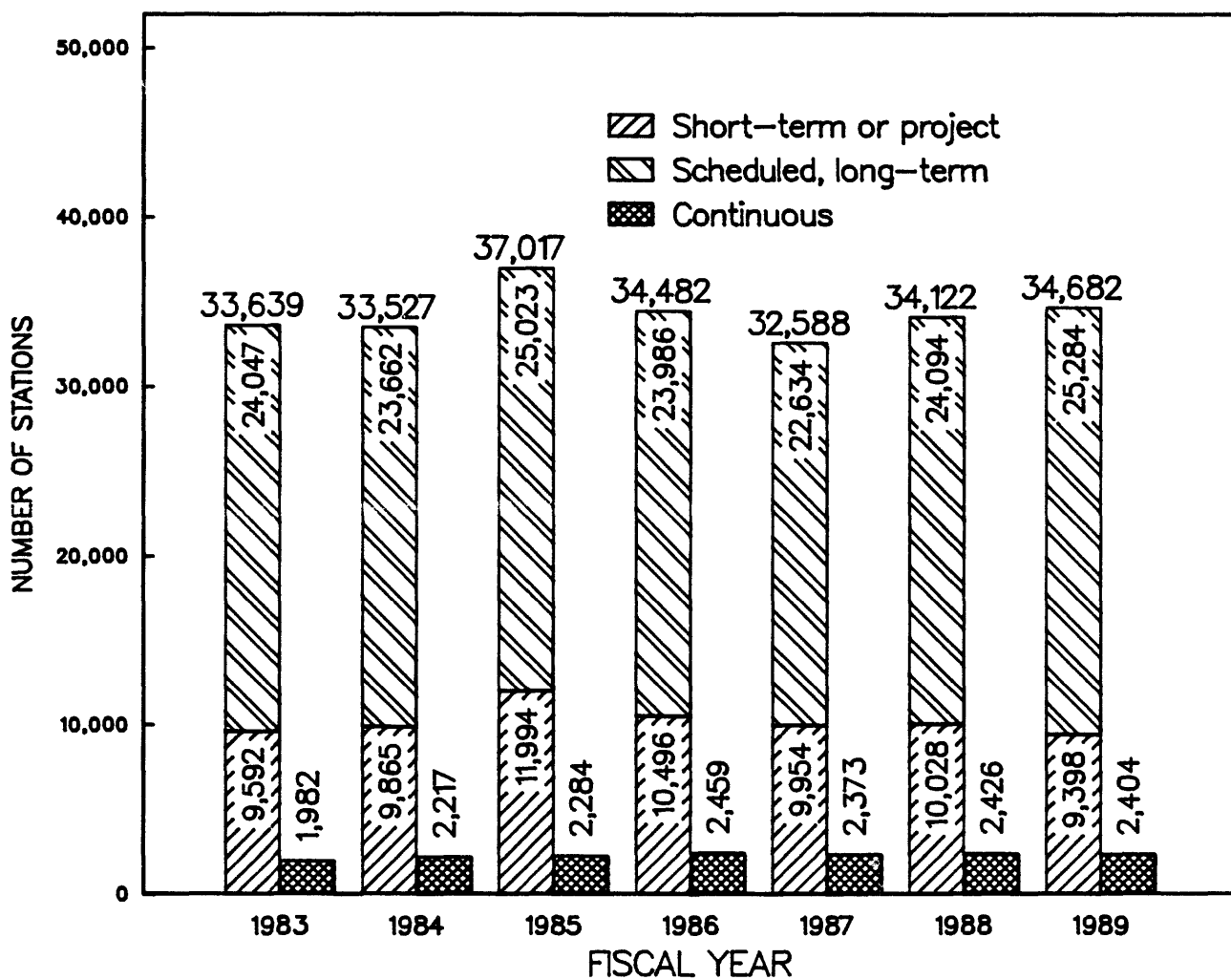
FED-OFA = Federal and Other Federal Agencies

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

ALL = FED and OFA and COOP

Figure 24.--Number of short-term or project ground-water level stations,  
and sources of funding support, fiscal year 1989.

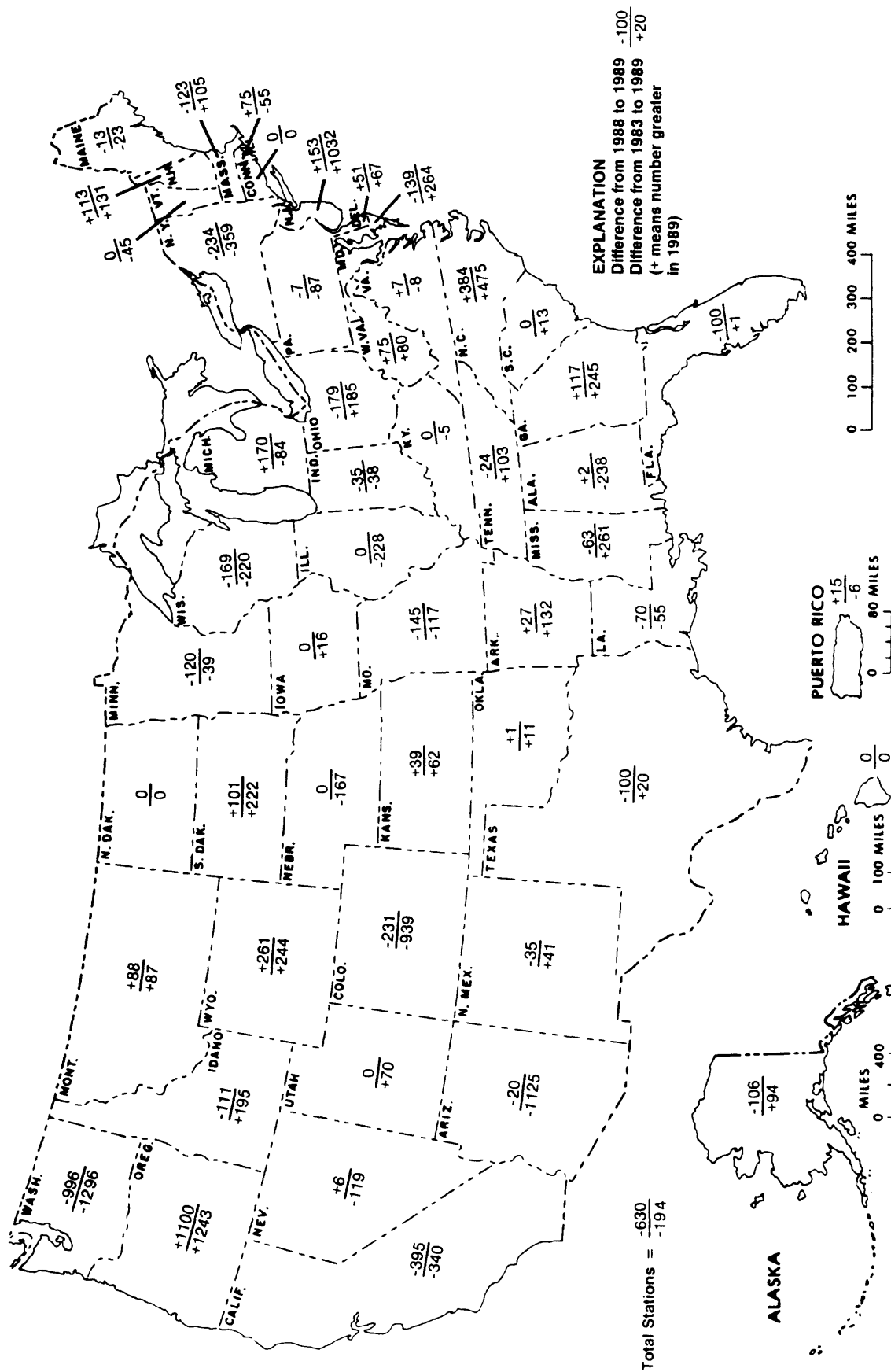




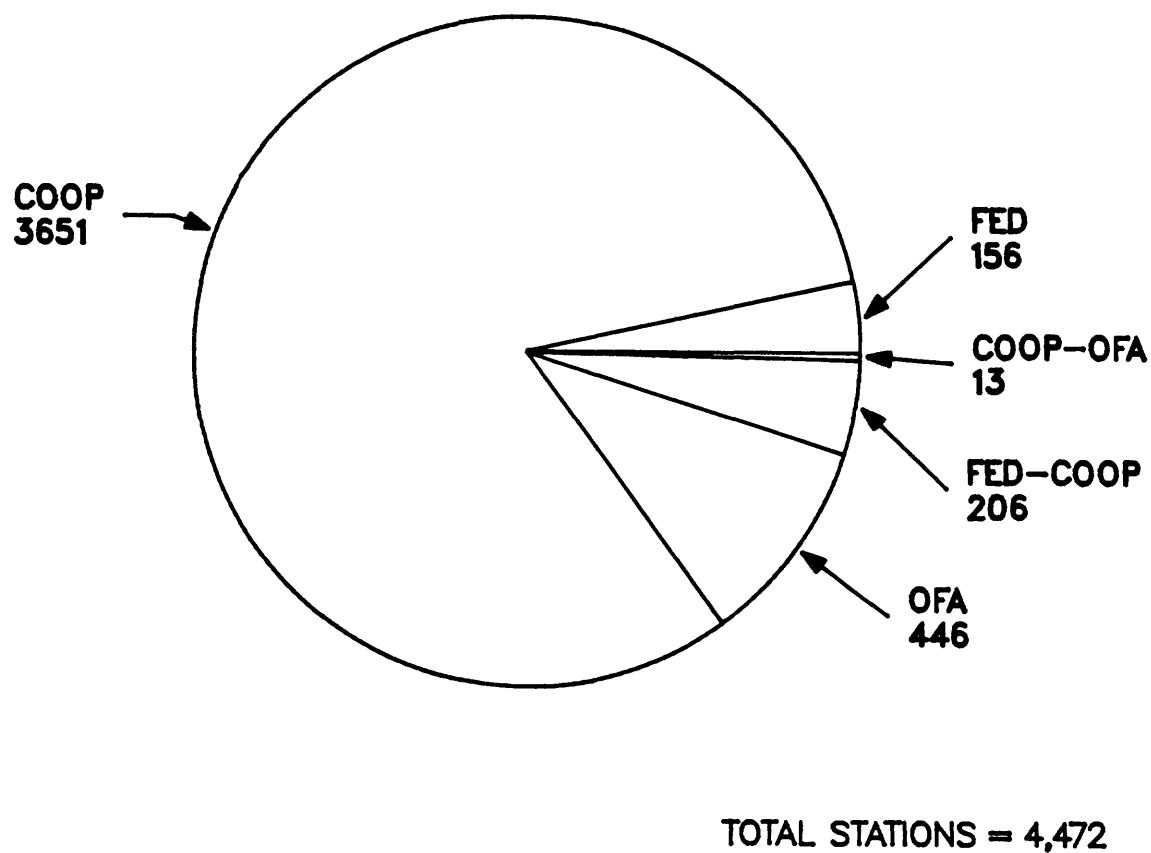
NOTE: The annual totals shown reflect that the number of stations in the "continuous" category are included in either the "scheduled, long-term" or the "short-term, or project" categories.

Figure 25.--Number of stations, by year, at which ground-water levels were collected from fiscal year 1983 to fiscal year 1989.









EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

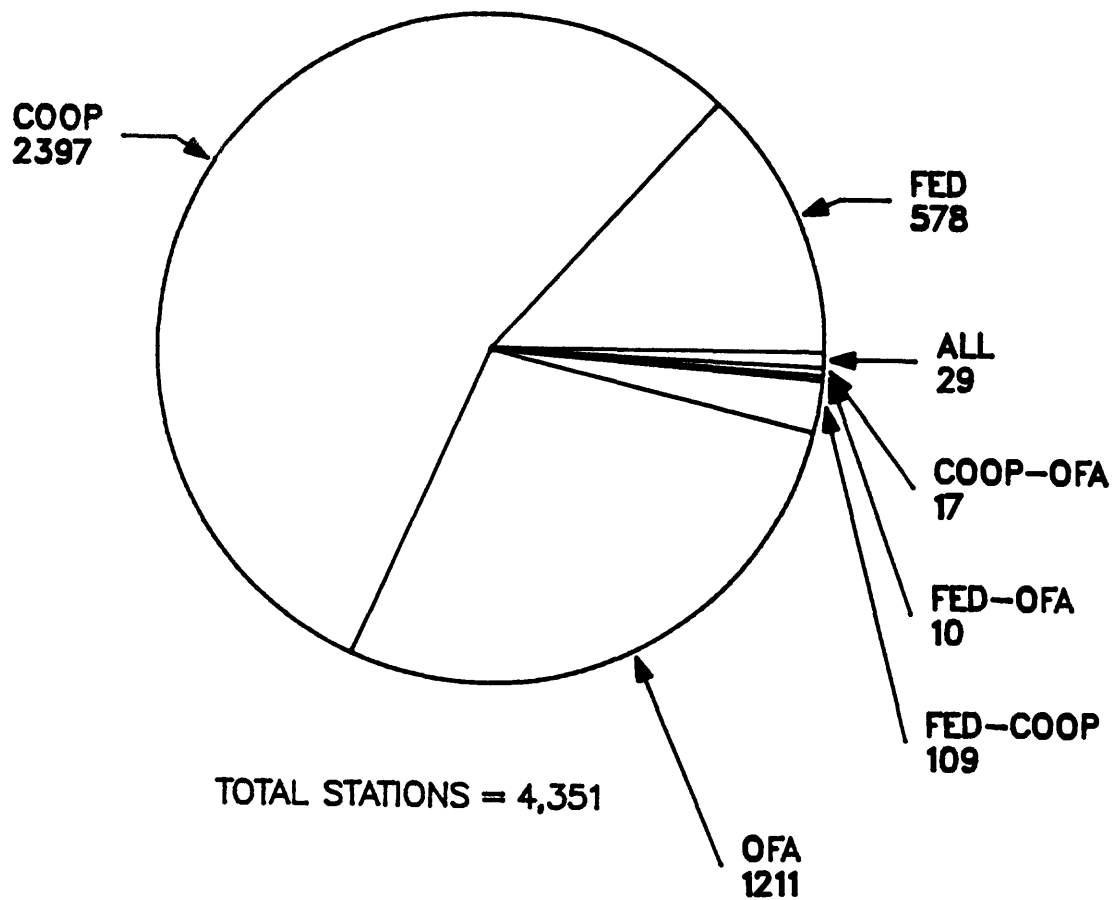
COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA - Federal-State Cooperative Program and Other  
Federal Agencies

Figure 29.--Number of scheduled, long-term operation ground-water quality stations, and sources of funding support, fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

FED-OFA = Federal and Other Federal Agencies

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

ALL = FED and COOP and OFA

Figure 30.--Number of short-term or project ground-water quality stations,  
and sources of funding support, fiscal year 1989.

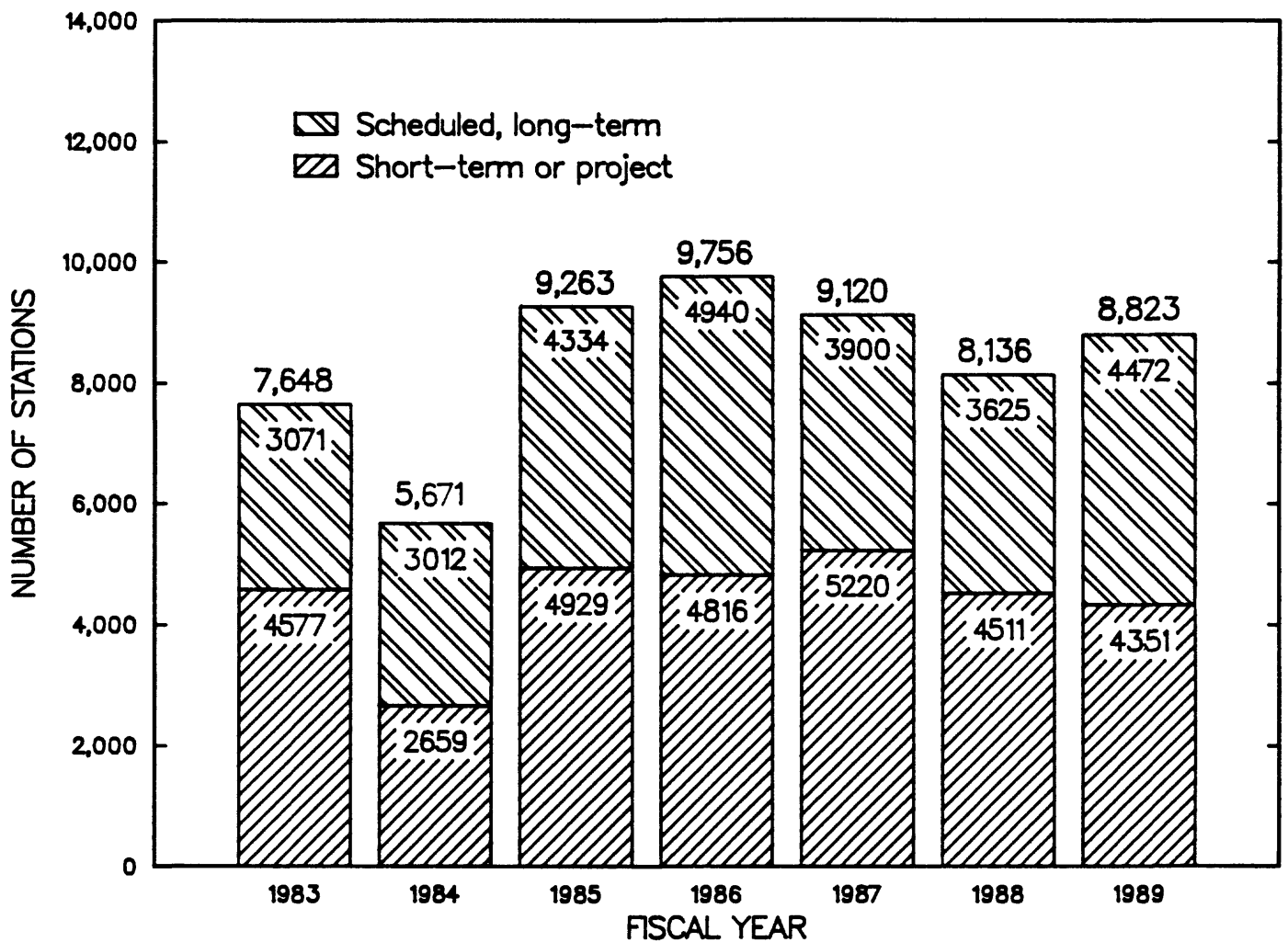


Figure 31.--Number of stations, by year, at which ground-water quality data were collected from fiscal year 1983 to fiscal year 1989.

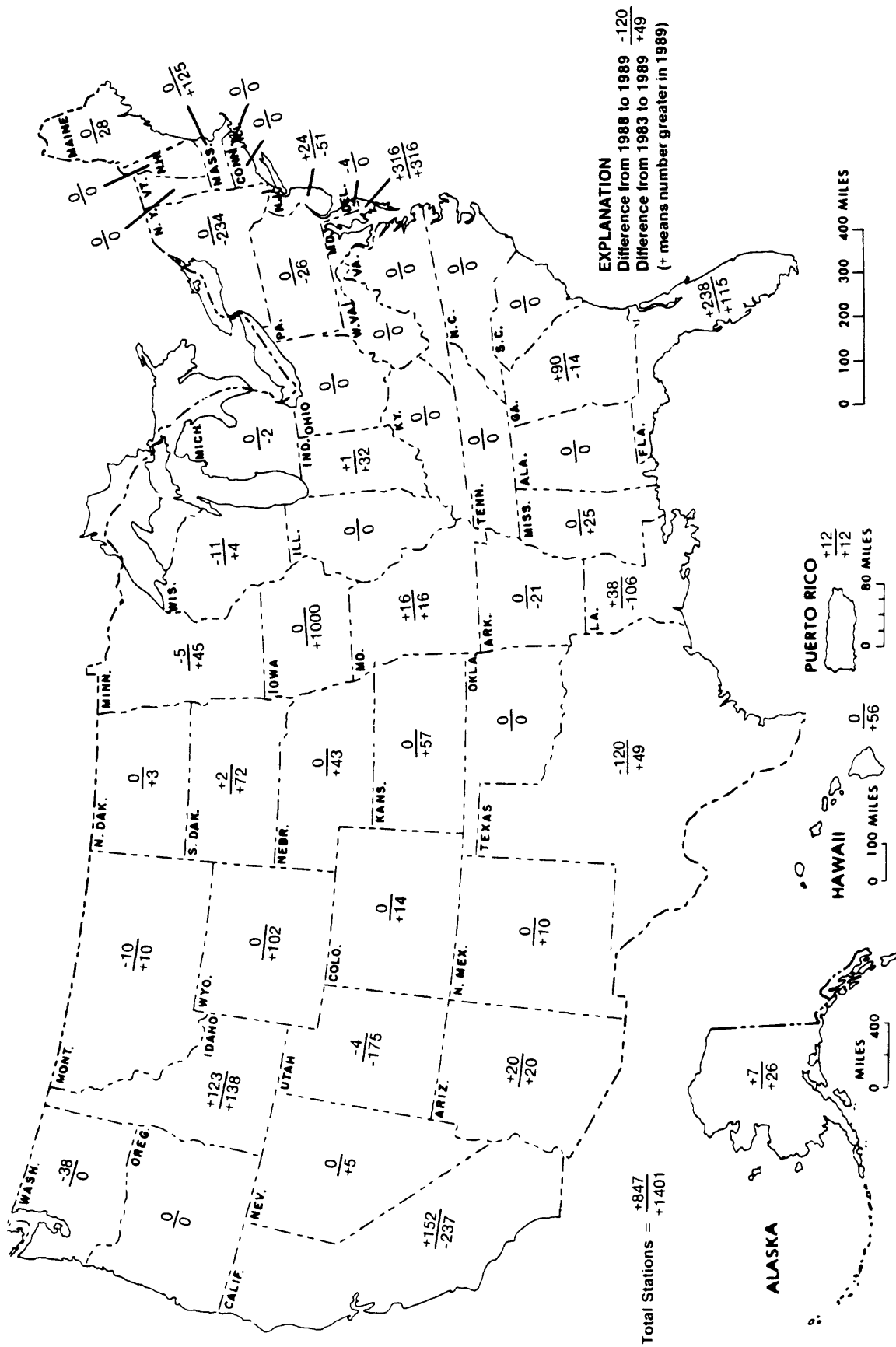


Figure 32.--Change in number of stations, by state, at which ground-water quality data were collected at scheduled, long-term stations from fiscal year 1988, and from fiscal year 1983 to fiscal year 1989.



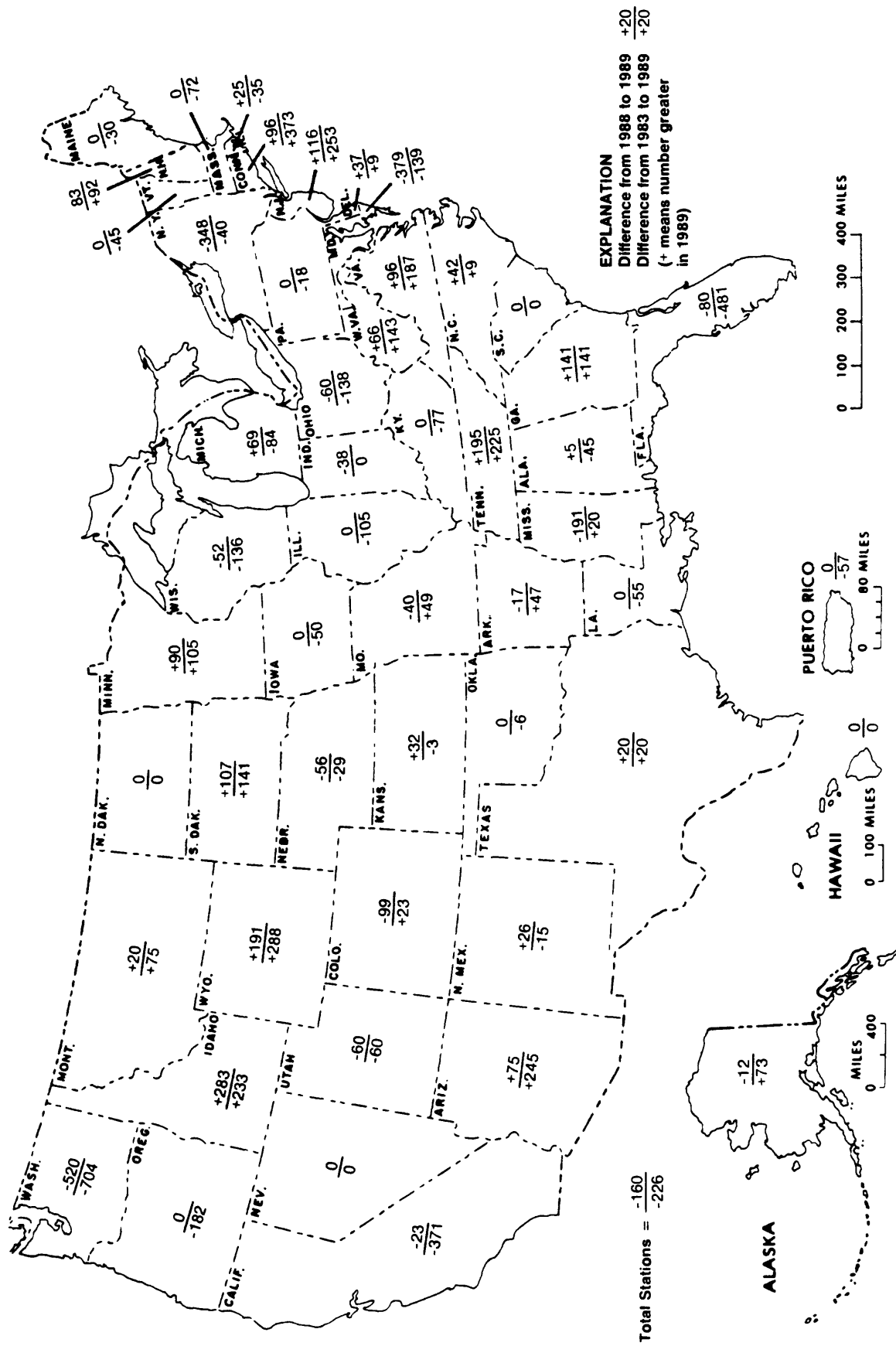


Figure 33.--Change in number of stations, by State, at which ground-water quality data were collected at short-term or project stations from fiscal year 1988 to fiscal year 1989 and from fiscal year 1983 to fiscal year 1989.

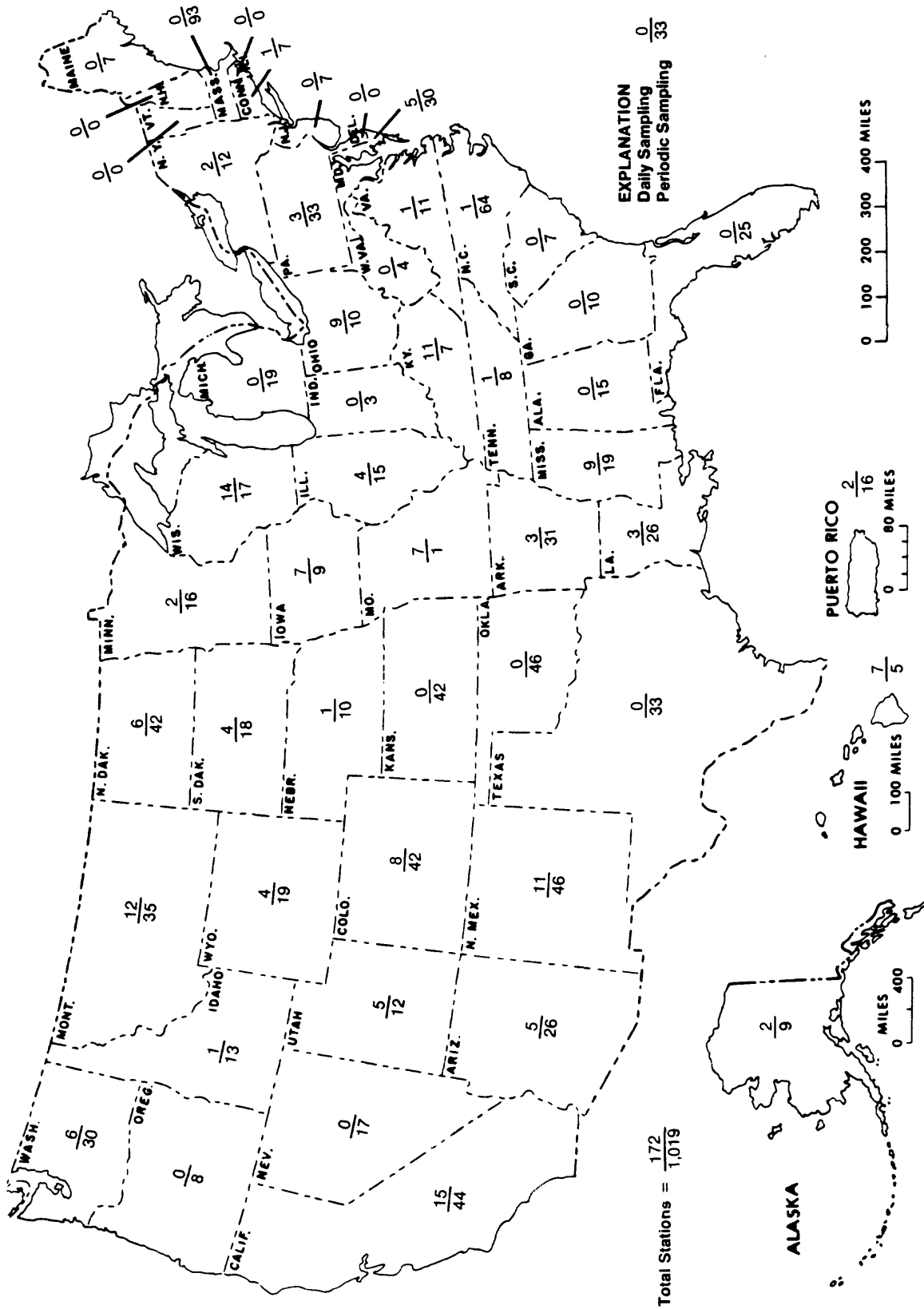


Figure 34.--Number of stations, by State, at which sediment data were collected in fiscal year 1989.

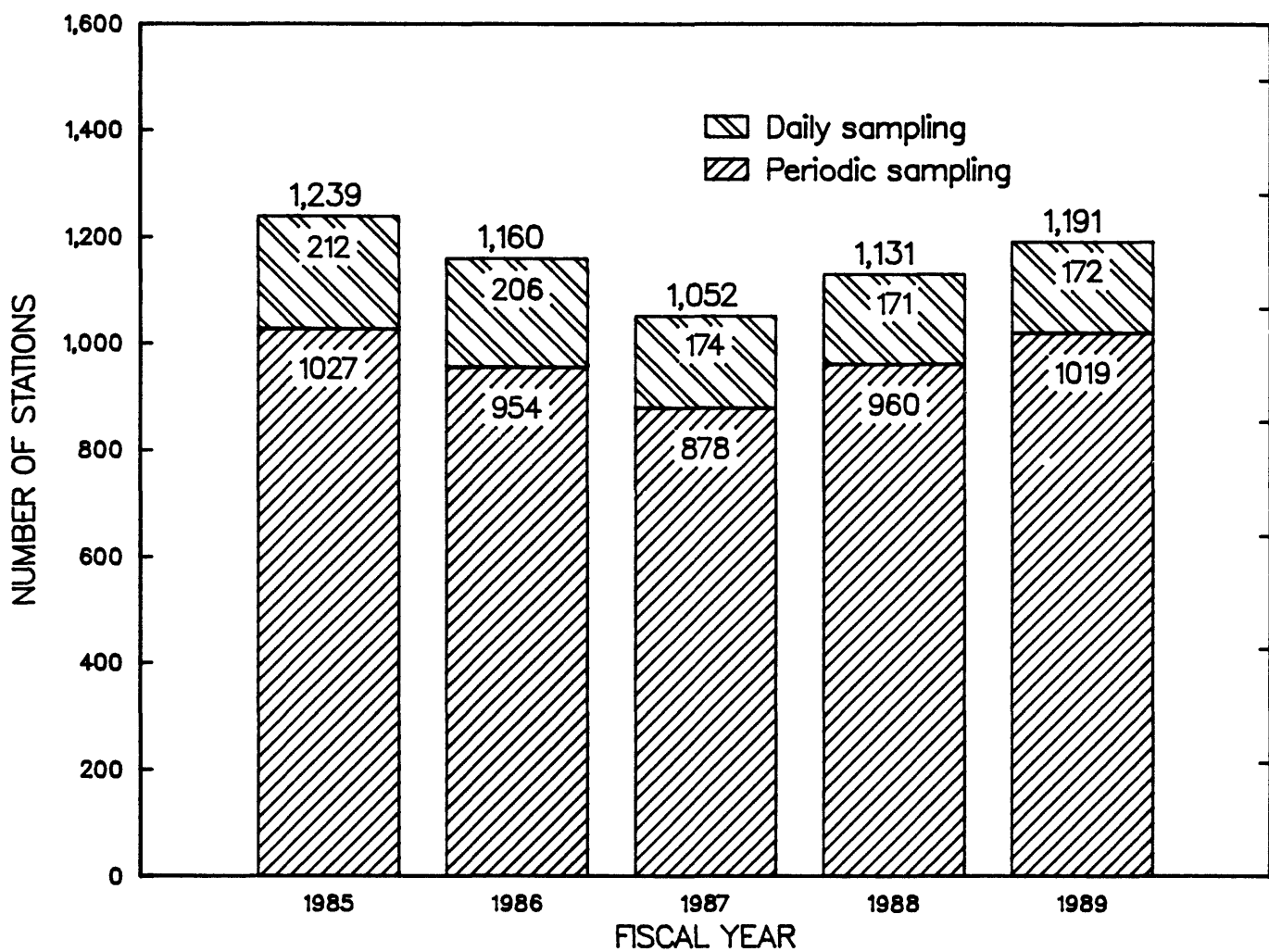
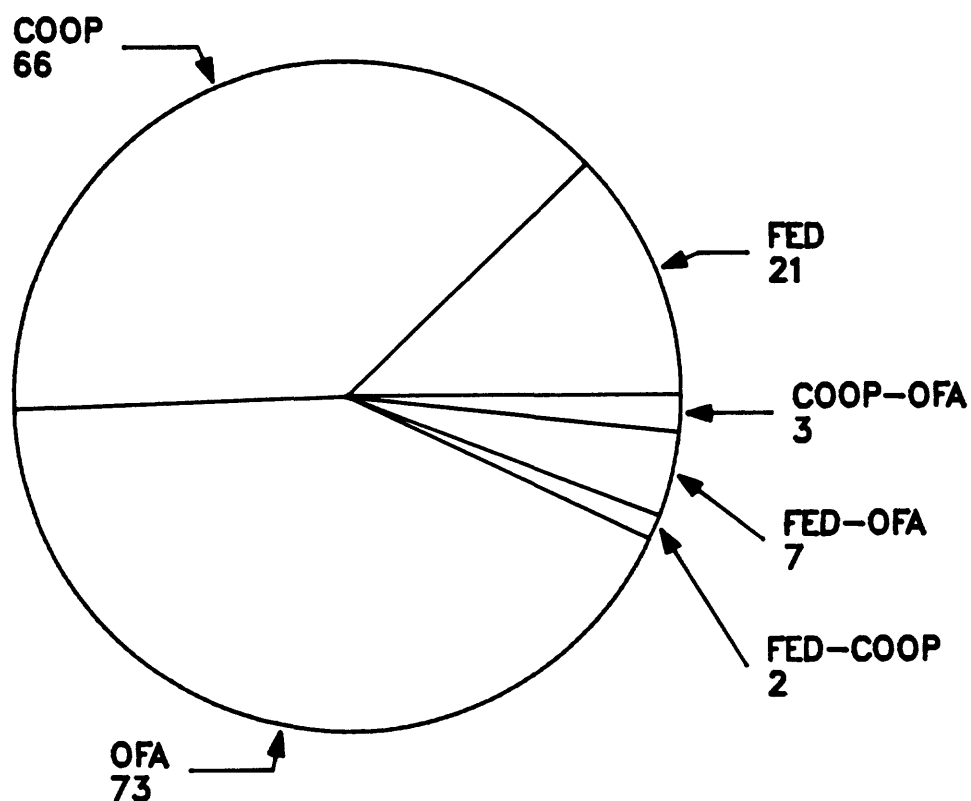


Figure 35.--Number of stations, by year, at which sediment data were collected from fiscal year 1985 to fiscal year 1989.



TOTAL STATIONS = 172

**EXPLANATION:**

**SINGLE PROGRAM SUPPORT**

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

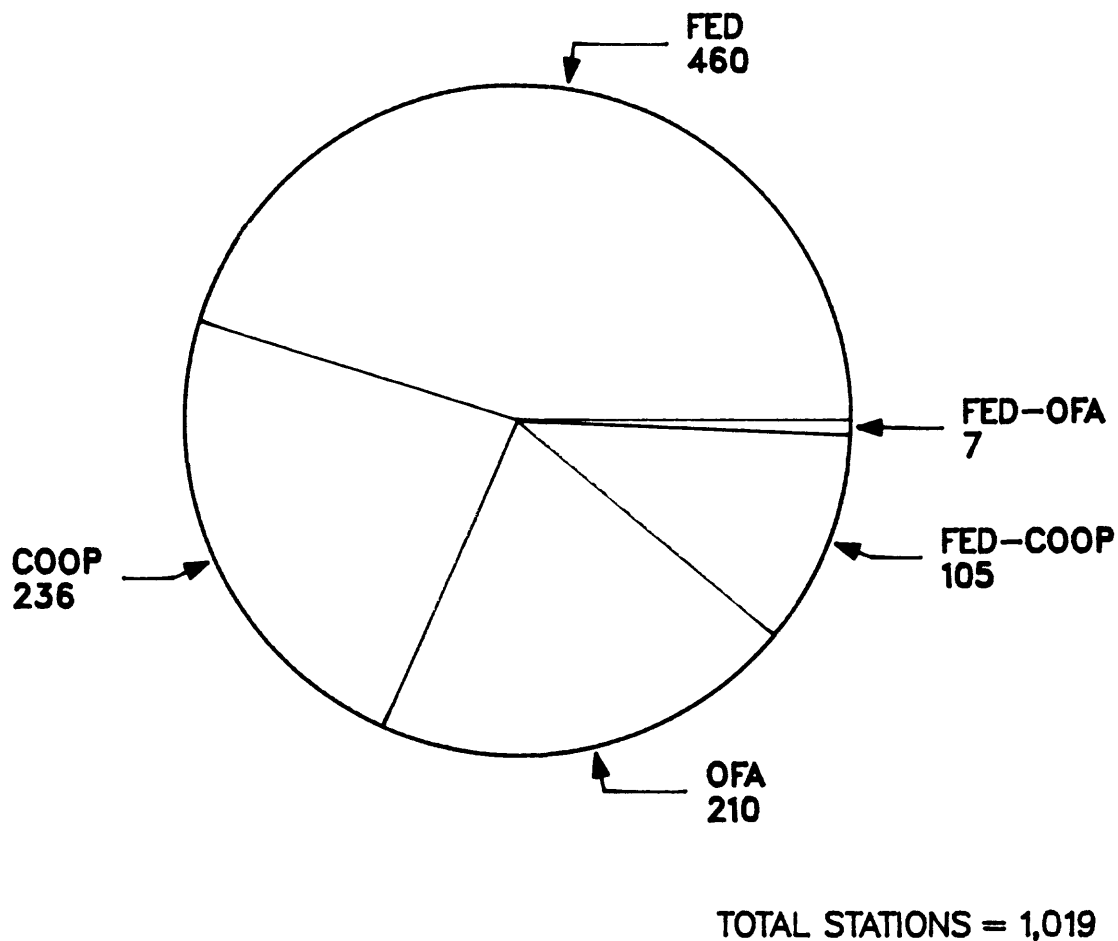
**COMBINED PROGRAM SUPPORT**

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

Figure 36.--Number of daily sampling sediment stations, and sources of funding support, fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP (1 station not shown)

Figure 37.--Number of periodic sampling sediment stations, and sources of funding support, fiscal year 1989.

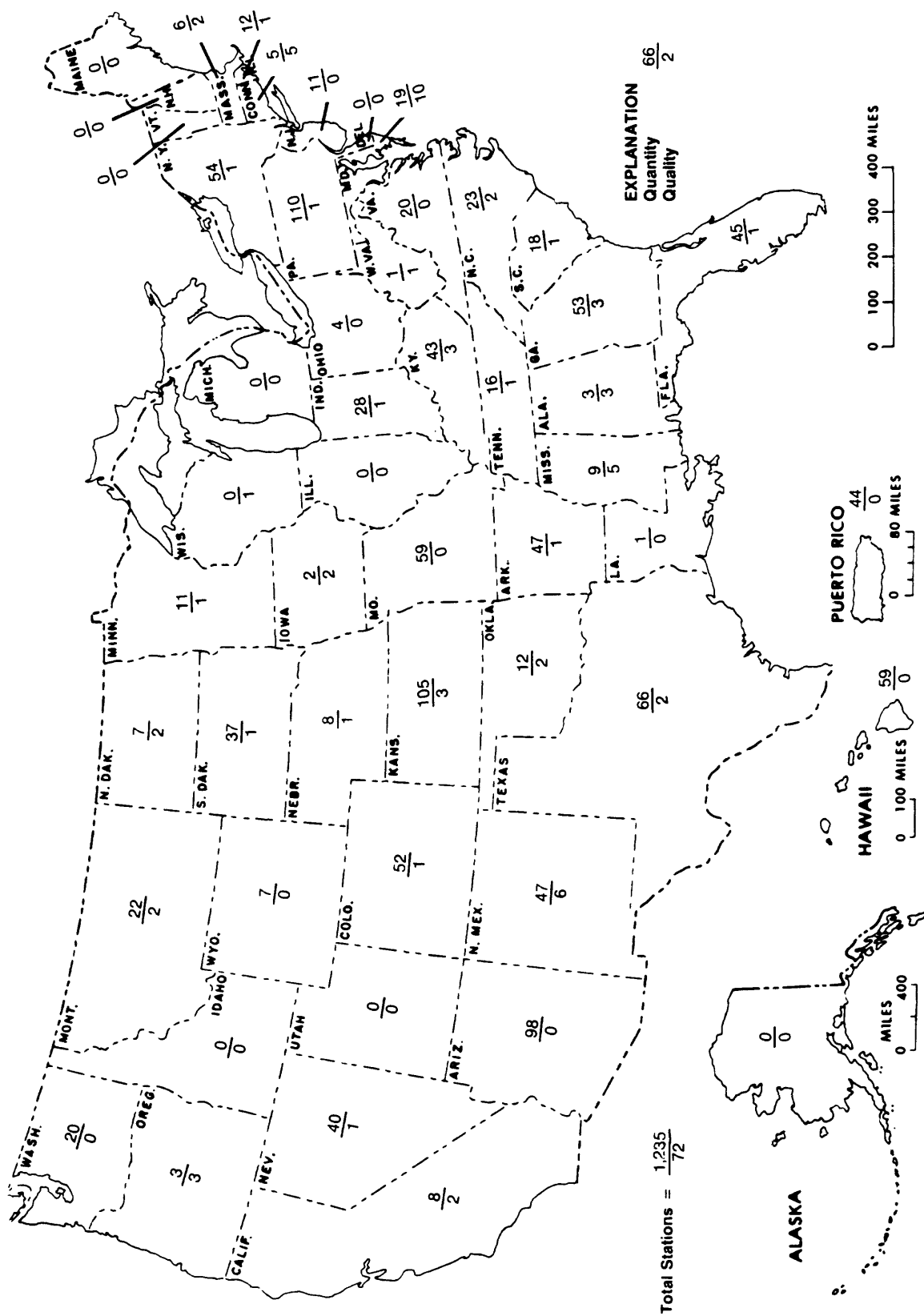
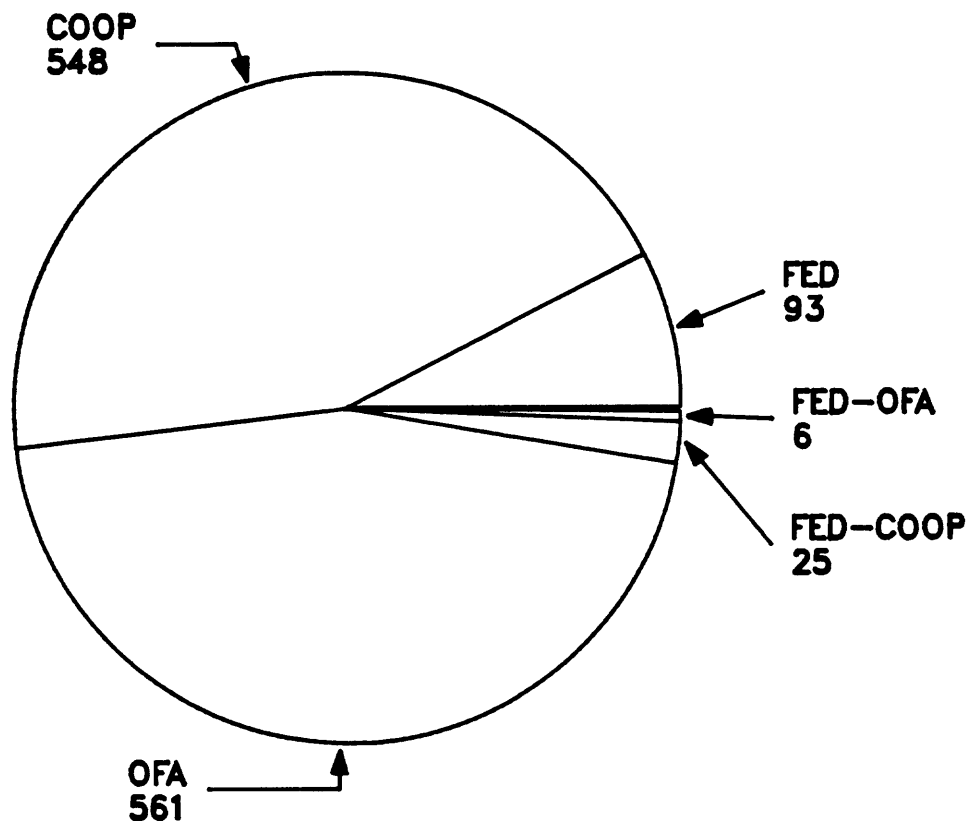


Figure 38.--Number of stations, by State, at which precipitation data were collected in fiscal year 1989.



TOTAL STATIONS = 1,235

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

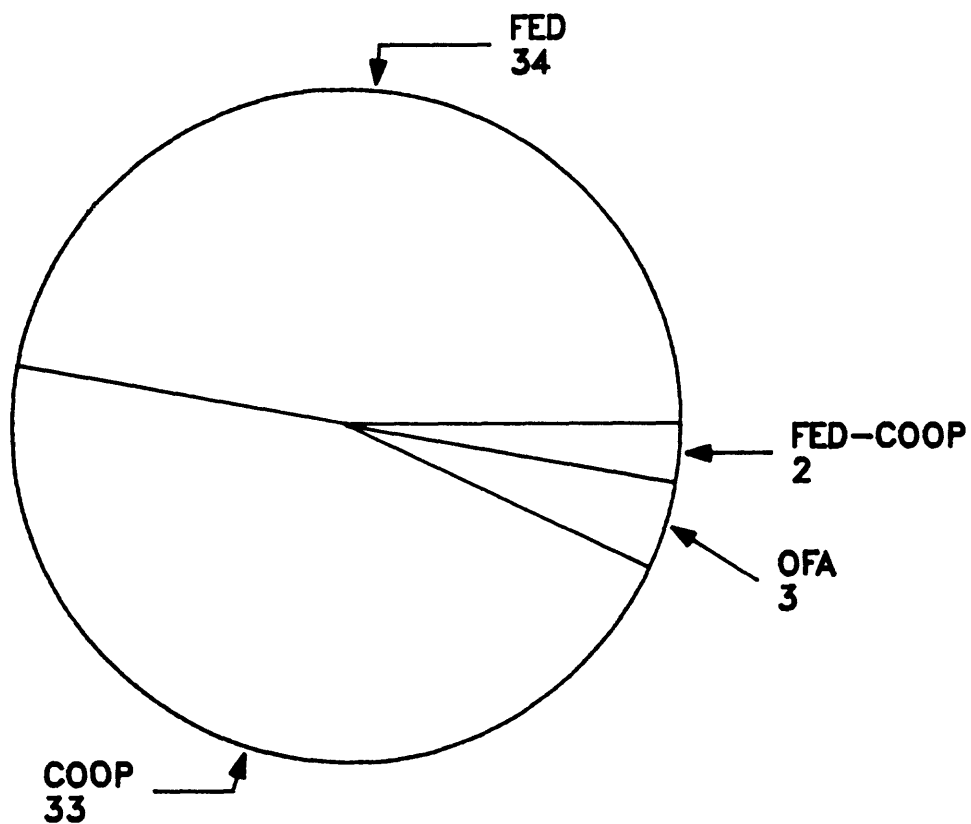
FED-COOP = Federal and Federal-State Cooperative Program

FED-OFA = Federal and Other Federal Agencies

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies (1 station not shown)

ALL = FED and OFA and COOP (1 station not shown)

Figure 39.--Number of precipitation-quantity stations, and sources of funding support, fiscal year 1989.



TOTAL STATIONS = 72

EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

Figure 40.--Number of precipitation-quality stations, and sources of funding support, fiscal year 1989.



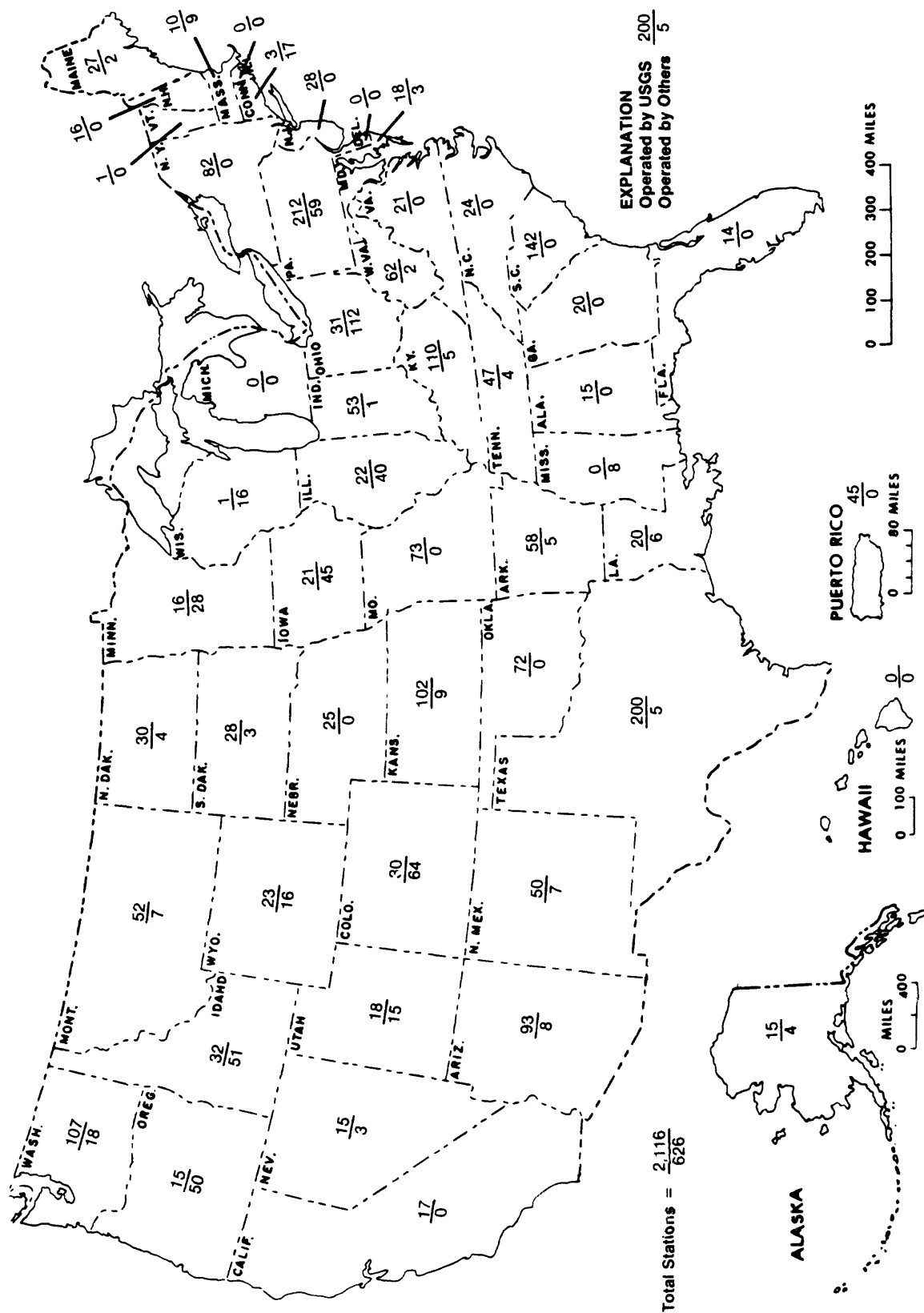
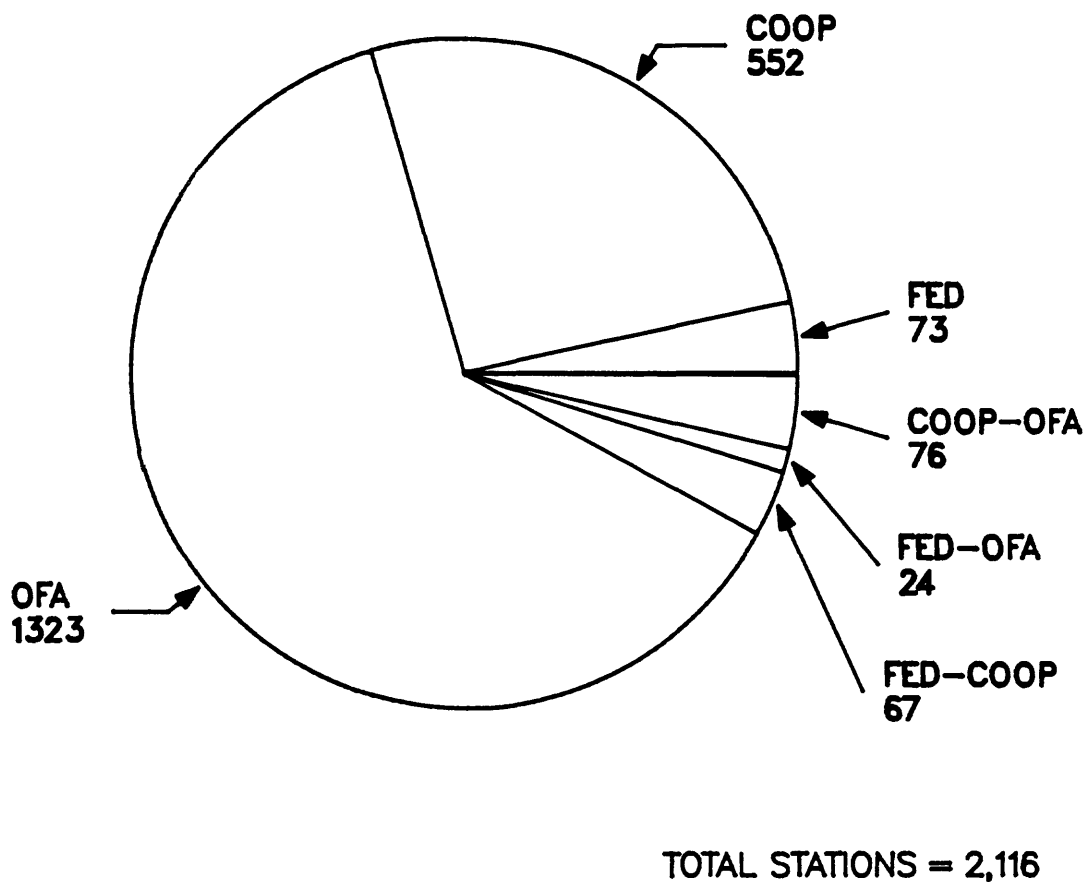


Figure 41.--Number of U.S. Geological Survey stations, by State, at which data-collection platforms for satellite telemetry were operated in fiscal year 1989.



EXPLANATION:

SINGLE PROGRAM SUPPORT

FED = Federal

OFA = Other Federal Agencies

COOP = Federal-State Cooperative Program

COMBINED PROGRAM SUPPORT

FED-COOP = Federal and Federal-State Cooperative Program

COOP-OFA = Federal-State Cooperative Program and Other  
Federal Agencies

FED-OFA = Federal and Other Federal Agencies

ALL = FED and OFA and COOP (1 station not shown)

Figure 42.--Number of stations at which data-collection platforms for satellite telemetry were operated by the U.S. Geological Survey, and sources of funding support, fiscal year 1989.

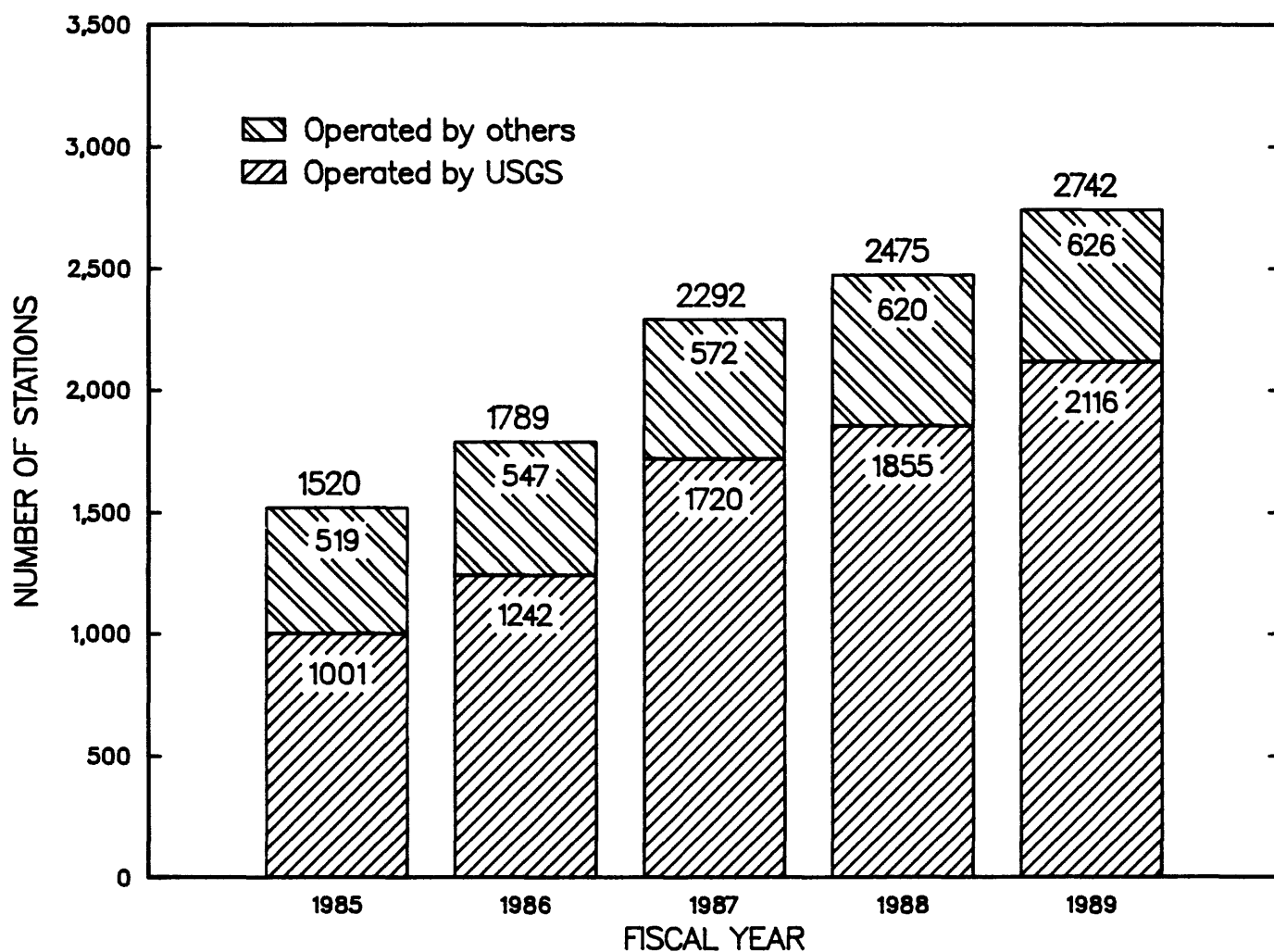


Figure 43.--Number of U.S. Geological Survey stations, by year, at which data-collection platforms for satellite telemetry were operated from fiscal year 1985 to fiscal year 1989.