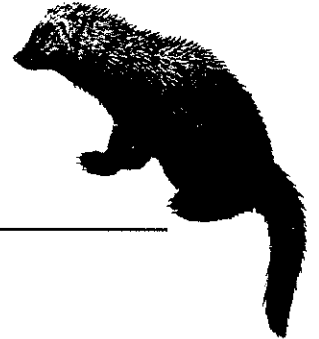




**STATE OF CALIFORNIA  
DEPARTMENT OF FISH AND GAME  
NONGAME BIRD AND MAMMAL SECTION**

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**BIG BEAR SPOTTED OWL STUDY, 1993**

by

**William S. LaHaye and Ralph J. Gutierrez**

April 1994

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**BIG BEAR SPOTTED OWL STUDY, 1993**

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**ABSTRACT**

We conducted surveys in the San Bernardino Mountains, during 1993, to estimate territory occupancy, population trends and demographic characteristics of the Spotted Owl population. Owls were found at 89 sites while 54 previously occupied sites were vacant. Five new owl territories were located during 1993. The empirical estimate of crude density was 0.117 owls/km<sup>2</sup>. Eighty-five percent of 55 pairs checked prior to 1 June, nested. Fifty-five young were fledged by 36 successful pairs. The 1993 turnover rates were 0.35 and 0.34 for females and males, respectively. Replacement rates were 0.38 and 0.58 for females and males, respectively. Survivorship estimates were 0.313 for owls in their first year of life and 0.757 for both sexes and all ages greater than one year. An additional 67 owls were banded in 1993 for future demographic study.

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## INTRODUCTION

The Spotted Owl (*Strix occidentalis*) is found throughout the forested mountains of the southwestern United States, the Pacific Northwest and northern Mexico. The American Ornithologists' Union (1957) currently recognizes three subspecies. Northern Spotted Owls (*S. o. caurina*) are found from southern British Columbia south through the Coast Ranges of northern California. California Spotted Owls (*S. o. occidentalis*) occupy forests from the northern Sierra Nevada to isolated mountain ranges in southern California. Mexican Spotted Owls (*S. o. lucida*) occupy forests and canyons in the southwestern United States and portions of Mexico.

Spotted Owls typically occupy densely forested habitats and exhibit a strong preference for well structured, older seral stage (old-growth) conditions in these forests (Forsman et al. 1984, LaHaye and Gutiérrez 1988, Solis and Gutiérrez 1990, Carey et al. 1990, Bias and Gutiérrez 1992, Call et al. 1992). Forests inhabited by Northern Spotted Owls also provide the raw materials for the Pacific Northwest's timber industry which has harvested at least 70 percent of the original old-growth forests in Oregon and Washington (USDA-Forest Service 1988). The owl's affinity for this rapidly declining habitat type has led to shifts in management goals on many public lands which may conflict with proposed timber harvest schedules (USDA-Forest Service 1988). These conflicts have prompted extensive research on the Northern Spotted Owl throughout its range.

California Spotted Owls occur on the west slope of the Sierra Nevada and in at least eight, apparently isolated, populations in the mountains of southern California (Gould 1986). The San Bernardino Mountains comprise the largest contiguous area of suitable habitat in the region. Thus, the population of Spotted Owls in this mountain range is probably the largest in southern California, and is the subject of this demographic study.

The Spotted Owl population in the San Bernardino Mountains provides a unique situation for studying the demographics of this species. First, the natural vegetation pattern of the region isolates Spotted Owl habitat in the San Bernardino Mountains from similar habitat in the adjacent mountain ranges. Second, this population is large enough (145 known locations) to provide adequate sample sizes for reasonable demographic parameter estimation (LaHaye et al. 1992) and third, this population is small enough to monitor annually. This situation provides the opportunity to closely monitor an entire, naturally bounded population of Spotted Owls.

## STUDY AREA

The San Bernardino Mountains are located approximately 140 km east of Los Angeles, California. They are in the eastern portion of the Transverse Ranges Geological Province and elevations range from 800 m (2,600 ft.) to 3,500 m (11,500 ft.). Average annual rainfall within the study area varies from less than 50 cm (20 inches) to more than 100 cm (40 inches) and is greatly affected by elevation and topography (Minnich 1988). The northern and eastern slopes of the San Bernardino Mountains are in rain shadows and receive substantially less rainfall than southern and western slopes of similar elevation. This is clearly reflected by differences in the vegetation between these areas.

Two study areas were delineated. The Big Bear Study Area (BBSA, Figure 1), established in 1987, was a 535 km<sup>2</sup> area centered on the majority of the known Spotted Owl locations at that time. The San Bernardino Mountains Study Area (SBMSA), established in 1989, was an 1,890 km<sup>2</sup> area encompassing the entire mountain range. The SBMSA is bounded on the north, east and south by the San Bernardino National Forest Boundary and on the west by Interstate Highway 15.

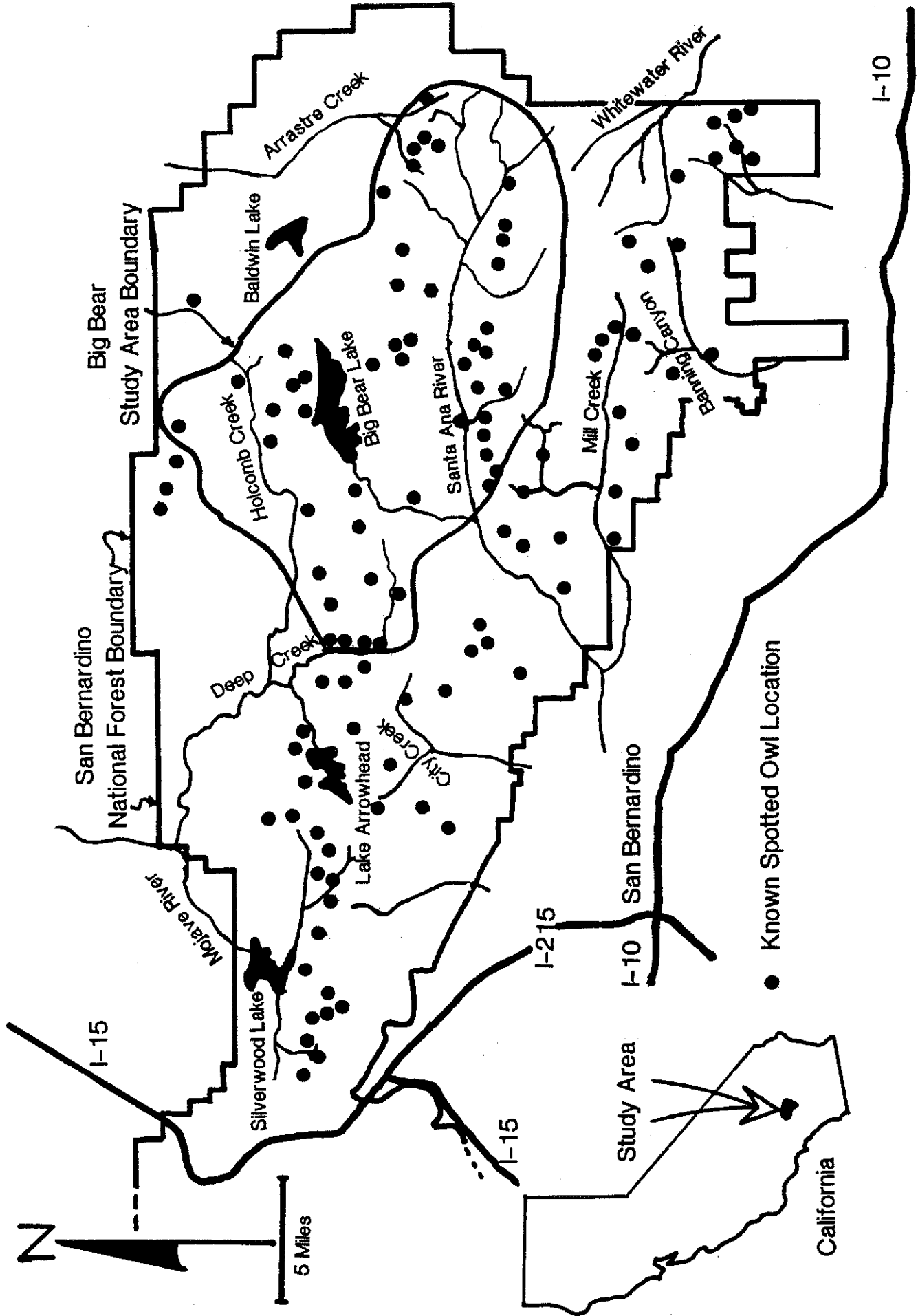


Figure 1. Big Bear and San Bernardino Mountains Spotted Owl Study Areas.

## METHODS

### Surveys

Using California Department of Fish and Game records, we systematically surveyed all previously known Spotted Owl locations as well as all other areas containing suitable habitat within the San Bernardino Mountains. Surveys were conducted at night by imitating Spotted Owl vocalizations for a minimum of 15 minutes at each call point or by calling continuously while walking designated survey routes (Forsman 1983). Call points were established along roads and trails approximately every one half mile to provide complete coverage of an area being surveyed.

Upon receiving a response from a Spotted Owl, we recorded the time of the response, sex of the owl and its location. All locations were plotted on U. S. Geological Survey (USGS) 7.5 minute topographic maps. The following morning, we returned to the area of a response and attempted to relocate the owl. When an owl was relocated, standard techniques were used to determine its social and breeding status (Forsman 1983). The location of nests and roosts were plotted on 7.5 minute USGS topographic maps.

### Banding

We attempted to capture and band all owls. Both adults and young were fitted with U. S. Fish and Wildlife Service locking, aluminum leg bands. In addition, adult and subadult owls were fitted with a combination color-band and tab that uniquely identified each individual. Juvenile owls were also fitted with a cohort band. Owls that were banded as fledglings were recaptured and fitted with a unique color-band when they entered the territorial population. We identified ("resighted") previously color-banded birds using binoculars. A band recovery was tallied when we found an aluminum or color-band with the remains of an owl, or when we received a band return report from the U.S. Fish and Wildlife Service.

### Data Analysis

We estimated the proportion of the territorial Spotted Owl population that was banded prior to each field season. This was accomplished by dividing the number of owls in the territorial population that were previously marked by the total number of marked, territorial owls.

The proportion of nesting pairs was computed by dividing the number of pairs confirmed to be nesting prior to 1 June 1993 by the number of pairs checked for nesting, prior to this date. The proportion of pairs fledging young was computed by dividing the number of pairs that fledged young by the number of pairs that were checked for fledging. The number of young fledged per pair was computed by dividing the number of fledged young by the number of pairs checked for fledging. Productivity was computed by dividing the number of fledged young by the number of successful females. Territory occupancy was computed by dividing the number of occupied territories by the number of territories surveyed.

The empirical crude density was calculated by dividing the total number of Spotted Owls known to be within the BBSA by the size of the study area (535 km<sup>2</sup>). We computed crude density for the BBSA only.

A turnover was tallied if an owl identified in year  $t$  was missing in year  $t + 1$ . Turnover rate for females and males was computed by dividing the number of territory turnovers by the total number of banded, territorial owls, of the appropriate sex, known from the previous year (Village 1985). We computed annual replacement rates for females and males by dividing the number of replacement owls by the total number of territory vacancies.

Survivorship was estimated for owls in their first year of life and for all owls greater than one year in age using SURGE (Pradel and Lebreton 1991). SURGE is a software package that analyzes mark-recapture data by allowing the user to employ and evaluate a series of models to determine the model which fits the data best.

## RESULTS AND DISCUSSION

### Surveys

We surveyed 143 Spotted Owl territories in the San Bernardino Mountains in 1993 (Table 1). Five of these were new to the study while 54 previously occupied territories were vacant. Of the 141 territories where we were able to confirm social status, 77 (55%) were occupied by pairs while ten (7%) were occupied by single owls. We were unable to confirm social status at two territories. The mean rate of territory occupancy from 1987-1993 was 80% ( $n = 7$ ,  $SD = 13.0$ ). However, we have observed a steady decline in occupancy rate since 1989 (Table 1).

<b>Table 1.</b> Survey effort and social status of California Spotted Owl territories in the San Bernardino Mountains, 1989-93.					
	1989	1990	1991	1992	1993
Total Known Territories <sup>1</sup>	115	129	134	140	145
Territories Surveyed	115	129	133	137	143
New Territories	35	13	5	6	5
Territories Vacant	11	18	35	49	54
Territories Occupied	104	111	98	88	89
Occupancy Rate (%)	90	86	74	64	62
Social Status:					
Confirmed <sup>2</sup>					
Pair	78	85	86	74	77
Single Female	2	2	5	3	1
Single Male	2	1	4	7	9
Unconfirmed <sup>3</sup>					
Pair	5	5	0	4	1
Single Female	2	5	1	0	1
Single Male	15	13	2	0	0

<sup>1</sup> A territory was defined as an area which had a territorial owl present in at least one year.  
<sup>2</sup> Social status was confirmed by daytime walk-ins.  
<sup>3</sup> Social status was not confirmed by daytime walk-ins.



## Banding

In 1993, we banded 10 new adults, five subadults, 52 fledglings and resighted 126 owls that had been banded previously (Table 2). Seventeen of these resighted owls were relocated for the first time since they were banded as fledglings.

Table 2. Spotted Owl capture effort in the San Bernardino Mountains, 1987-1993.						
Year	Capture Status	Females		Males		Juveniles
		Adult	Subadult	Adult	Subadult	
1987	New Owls	21	1	30	0	15
1988	New Owls	24	2	26	1	16
	Resightings	14	0	22	0	
	Recoveries	1	0	0	0	0
1989	New Owls	37	0	37	8	52
	Resightings	25	2	27	0	
	Recoveries	0	0	1	0	3
1990	New Owls	19	7	15	3	47
	Resightings	49	3	53	5	
	Recoveries	0	0	2	0	1
1991	New Owls	9	4	17	5	44
	Resightings	52	16	45	12	
	Recoveries	0	0	0	0	0
1992	New Owls	7	0	5	1	49
	Resightings	50	9	51	8	
	Recoveries	0	0	0	0	1
1993	New Owls	3	2	7	3	52
	Resightings	51	10	57	8	
	Recoveries	1	0	1	0	1

We estimated the proportion of the territorial Spotted Owl population that was banded prior to each field season (Table 3). Annual estimates ranged from 0% to 92%. Since 1989, we have attempted to locate and band the entire territorial Spotted Owl population in the San Bernardino Mountains. In 1987 and 1988, we were sampling a subset of the entire population. By 1993, 89 percent of the territorial population was banded prior to the field season (Table 3).

<b>Table 3.</b> Proportion of the territorial Spotted Owl population in the San Bernardino Mountains that was banded prior to each field season, 1987-1993.				
Year	NBTO <sup>1</sup>	NUTO <sup>2</sup>	TNBO <sup>3</sup>	PBTO <sup>4</sup>
1987	0	52	52	0.00
1988	38	50	88	0.43 <sup>5</sup>
1989	59	82	141	0.42 <sup>5</sup>
1990	115	45	160	0.72
1991	135	34	169	0.80
1992	137	12	149	0.92
1993	139	18	157	0.89

<sup>1</sup> Number of banded, territorial owls in the population.  
<sup>2</sup> Number of unbanded, territorial owls in the population.  
<sup>3</sup> Total number of banded, territorial owls at the end of each field season.  
<sup>4</sup> Proportion of banded, territorial owls in the population (NBTO/TNBO) at the beginning of each season.  
<sup>5</sup> Study area boundaries were expanded.

### Nesting Activity and Productivity

We checked 55 pairs for nesting activity before 1 June 1993 and 47 (85%) of these pairs attempted to nest (Table 4). We checked 77 pairs for fledging success and 36 (47%) pairs successfully fledged 55 young. Nineteen pairs (52%) produced 1 fledgling, 15 pairs (42%) produced 2 fledglings and two pairs fledged triplets. The number of young fledged per pair was 0.71 and productivity was 1.53 young per successful female (Table 4).

### Density

We detected 63 owls within the 535 km<sup>2</sup> BBSA in 1993. The empirical density estimate was 0.117 owls/km<sup>2</sup>. This represents a slight decline from previous years.

### Turnover and Replacement

Thirty-six percent of the female Spotted Owls holding territories in 1992 were missing in 1993 and 34% of the female territory vacancies were reoccupied (Table 5). Twenty-nine percent of the 1992 territorial males were absent in 1993 and 32% of the male territory vacancies were reoccupied (Table 6). The mean turnover rates between 1987 and 1993 were 35% and 34% for females and males, respectively, with a coefficient of variation (CV) of 24% and 22%, respectively. The mean replacement rates for this period were 38% for females (CV = 38%) and 58% for males (CV = 33%).

Turnover continues to be high and replacement continues to be low for both male and female Spotted Owls in the San Bernardino Mountains. The most striking feature of the relationship between these two parameters is the continued failure of the replacement rate to keep pace with the turnover rate. This relationship indicates that the Spotted Owl population in the San Bernardino Mountains continues to decline.

<b>Table 4.</b> Summary of Spotted Owl reproduction in the San Bernardino Mountains, 1987-1993.							
Year	Number Pairs Checked Nesting	Proportion Pairs Nesting	Number Pairs Checked Fledging	Proportion Pairs Fledging	Number Owlets	Number Young per Pair	Pro-ductivity
1987	18	0.83	31	0.52	22	0.71	1.38
1988	44	0.50	54	0.26	18	0.33	1.29
1989	48	0.69	78	0.49	60	0.77	1.58
1990	67	0.51	86	0.35	49	0.57	1.63
1991	63	0.56	85	0.35	46	0.54	1.53
1992	40	0.68	77	0.44	56	0.73	1.65
1993	55	0.85	77	0.47	55	0.71	1.53
TOTAL	335	0.66 <sup>1</sup>	488	0.41 <sup>1</sup>	306	0.62 <sup>1</sup>	1.51 <sup>1</sup>
<sup>1</sup> Values are seven year means.							

<b>Table 5.</b> Female California Spotted Owl turnover and replacement rates in the San Bernardino Mountains, 1988-1993.				
Year	Number Females Time $t$ <sup>1</sup>	Number Female Turnovers Time $t+1$	Proportion Female Turnover	Proportion Female Replacement
1988	19	5	0.23 (0.02-0.44) <sup>2</sup>	0.25 (0.00-0.53)
1989	35	12	0.32 (0.17-0.46)	0.43 (0.21-0.64)
1990	58	13	0.32 (0.20-0.43)	0.48 (0.29-0.67)
1991	76	29	0.46 (0.35-0.56)	0.49 (0.35-0.63)
1992	80	33	0.43 (0.33-0.54)	0.29 (0.17-0.40)
1993	80	29	0.36 (0.26-0.47)	0.34 (0.22-0.47)
MEAN			0.35 (CV=24%)	0.38 (CV=38%)
<sup>1</sup> Time $t$ is the year prior to the year listed for each row.				
<sup>2</sup> Ninety-five percent confidence intervals are in parenthesis.				

### Survivorship

Survivorship estimates were 0.313 (95% CI = 0.241-0.395) and 0.757 (95% CI = 0.723-0.787) for first year birds and owls greater than one year old, respectively. We analyzed the data by splitting the data set into all possible

age, sex and time (years) categories. However, the results of these analyses indicated that there were either no age, sex or time related differences in survivorship probabilities or that the data would not support these models at this time.

In 1991, we switched from reporting empirical survivorship estimates to reporting survivorship estimates using SURGE. We made this transition because we now have enough data to use more sophisticated estimation techniques and because empirical estimation of survivorship and recapture probabilities require a set of assumptions that can not be met (Pollock et al. 1990). Interestingly, the estimates for juvenile and subadult/adult survivorship were more optimistic than our empirical estimates (LaHaye and Gutiérrez 1991). While these estimates were more optimistic, they were still considerably lower than similar estimates from populations of the Northern Spotted Owl (Franklin et al. 1990). Several more years of capture-recapture information are needed to evaluate potential sex, age and time differences in survivorship and recapture probabilities in the population.

Table 6. Male California Spotted Owl turnover and replacement rates in the San Bernardino Mountains, 1988-1993.				
Year	Number Males Time $t^1$	Number Male Turnovers Time $t+1$	Proportion Male Turnover	Proportion Male Replacement
1988	28	7	0.23 (0.05-0.41) <sup>2</sup>	0.86 (0.71-1.01)
1989	42	18	0.43 (0.24-0.51)	0.72 (0.57-0.87)
1990	67	22	0.33 (0.23-0.45)	0.55 (0.42-0.68)
1991	68	28	0.41 (0.36-0.57)	0.57 (0.44-0.70)
1992	78	29	0.37 (0.35-0.55)	0.45 (0.27-0.63)
1993	80	23	0.29 (0.18-0.40)	0.32 (0.20-0.44)
MEAN			0.34 (CV=22%)	0.58 (CV=33%)

<sup>1</sup> Time  $t$  is the year prior to the year listed for each row.  
<sup>2</sup> Ninety-five percent confidence intervals are in parenthesis.

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