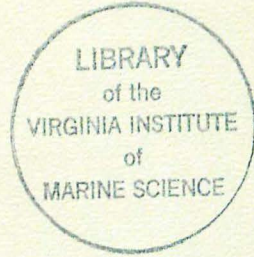


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**A Mark-Recapture Study of Striped Bass in
the James and Rappahannock Rivers, Virginia**

Annual Report 1990/1991

Sport Fish Restoration Project: F77-R-4
Project Period: 1 September 1990 - 31 August 1991
Principal Investigator: Joseph G. Loesch

Prepared by:

Joseph G. Loesch, Bruce W. Hill and Philip W. Sadler

**Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062**

Submitted To:

**Virginia Marine Resources Commission
P.O. Box 756
Newport News, Virginia 23607
November 1991**

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PREFACE

Financial support for this project was provided by the Virginia Marine Resources Commission, research grant F77-R.

The specific objectives of the 1990 through 1991 research were to:

1. Tag and release 1,500 striped bass in the Rappahannock River in fall 1990 and 2,000 in spring 1991.
2. Tag and release 1,500 striped bass in the James River in fall 1990.
3. Cooperate in a multi-state program to tag and release striped bass.
4. Prepare a preliminary analysis of tag return data.

ACKNOWLEDGMENTS

We are indebted to the following commercial fishermen on the Rappahannock River for the capture of wild striped bass for tagging in fall 1990 and spring 1991: Barrack & Wilmer Seafood and S. & A. Oliff. We are also indebted to the following commercial fishermen on the James River for the capture of wild striped bass in fall 1990: Ryland Hazelwood, Peter Pinholster and Charles Tench. All personnel of the VIMS Anadromous Program, and many others from within and outside of VIMS, assisted in the tagging program.

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EXECUTIVE SUMMARY

1. A total of 1,903 striped bass were tagged in fall 1990 and 2,708 in spring 1991 on the Rappahannock River.
2. A total of 2,405 striped bass were tagged in fall 1991 on the James River.
3. In fall 1990, 47.2% of the striped bass tagged on the Rappahannock were less than 425 mm fork length (FL). In comparison, only 13.9% of the fish were less than 425 mm FL in spring 1991.
4. Pound nets in the Rappahannock River accounted for 66.3% of the recaptures, while out of state recaptures accounted for only 2.65% of the total returns.
5. In the fall 1990, the mean fork length of striped bass tagged and released in the James River that were captured by haul seines and fyke nets were 447 mm and 449 mm, respectively.

INTRODUCTION

The need for studies of striped bass (*Morone saxatilis*) in Chesapeake Bay was discussed by Loesch et al. (1987). For succinctness, we extracted the following from the introduction of their report.

Striped bass production in Chesapeake Bay not only affects the commercial and recreational fisheries in Virginia but influences the degree of success attained by the fisheries in other Atlantic coastal states.

Due to the concern about the decline in striped bass stocks along the Atlantic coast since the mid-1970's, an interstate fisheries management plan was developed under the auspices of the Atlantic States Marine Fisheries Commission (ASMFC) as part of their Interstate Fisheries Management Program (ASMFC 1981). Federal legislation was enacted in 1984 (Public Law #98-613, The Atlantic Striped Bass Conservation Act) which enables Federal imposition of a moratorium for an indefinite period in those states that fail to comply with the coastwide plan. To be in compliance with the plan, coastal states imposed restrictions on their commercial and recreational striped bass fisheries ranging from combinations of catch quotas, size limits, and limited moratoriums. In addition, the Striped Bass Management Board has urged the coastal states to monitor the stocks and to institute tagging programs. Mark-recapture studies of striped bass in Virginia

were initiated in the James and Rappahannock rivers; elsewhere, striped bass are being tagged in Rhode Island, New York, and Maryland waters. These studies should provide information about exploitation rates, migration patterns, and the proportions of Hudson River, Maryland and Virginia striped bass in northern waters. The Maryland and Virginia studies will also provide information on the degree of striped bass movement within Chesapeake Bay. The data collected will be an important constituent of the total information base needed to assess present management strategies.

METHODS

Striped bass were obtained from cooperating commercial fishermen. Fish were captured with pound nets at river km 33 to 75 during fall 1990 and spring 1991 from river km 70 to 76 on the Rappahannock River. On the James River during fall 1990, striped bass were also obtained from cooperating commercial fishermen from river km 48 to 95. A Floy internal anchor tag 5 mm X 20 mm, with an 85 mm external tube was used for all fish tagged. The anchor tag was inserted into the body cavity through a small surgical incision made just posterior to the apex of the pectoral fin on the museum (left) side of the fish. Thus, the anchor was inserted into the peritoneal cavity posterior to the pericardial cavity and anterior to the spleen. The tags were treated by the Floy Company with an algicide which reduces algae build-up, reduces drag, and increases retention (Hillman and Werme 1983).

On the Rappahannock River, the VIMS tagging personnel followed the fisherman to the pound net. One side of the pound head was lowered and the fisherman's skiff was pulled inside the head. The bottom of the head was gradually pulled into the boat, thereby concentrating the fish in the remaining portion of the head. Fish were dipped from the pound head and placed in the fisherman's boat, except for striped bass which were placed in a VIMS "live car" (floating pocket) attached to the net. The net was kept open by a float line around the outside of the surface perimeter, a spreader board (1.2 m) inside of the surface perimeter at each end, and lead lines on the bottom of the net. After the fisherman finished, the tagging vessel retrieved the live car and together the vessel and live car drifted with the current while the fish were tagged and

released. Taggers retrieved a fish from the live car, implanted a tag, and recorded its fork length (FL), and, if possible, sex. Several scales were removed from the area above the lateral line midway between the insertion of the first dorsal fin and the origin of the second.

A commercial haul seine (1,000 m) was employed on four occasions during evening hours and high slack tide (27 September 1990, 10 October 1990, 31 October 1990, and 13 November 1990) on the James River. Fishes other than striped bass were removed, and the striped bass were retained in a pocket measuring 13 m x 2.0 m x 6.5 m.

When tagging striped bass captured in fyke nets on the James River, VIMS personnel followed the fisherman to his net. The fisherman would then pull several hoops of the fyke net into his boat and secure them. The tagging vessel would pull near to the side of the fisherman's vessel and place a "live car" (floating pocket) into the area between the two boats. The live car used during the tagging program measured 1.2 m x 2.4 m x 1.2 m with a 25.4 mm mesh. A float line was attached around the perimeter and a lead line around the bottom seam. Striped bass captured in the fyke net were transferred to the live car. Fish were retrieved from the live car, and prior to implanting a tag, fork length (FL), and, if possible, sex was recorded. The fish captured in the haul seine and fyke nets were tagged and released, with scales and physical data collected and processed as described as above.

Scales were prepared for reading by the method described by Merriman (1941), except an acetate sheet replaced the glass slide and acetone. Scales were aged using the microcomputer

program (DISBCAL) of Frie (1982), as modified for a sonic digitizer-microcomputer complex (Loesch et al. 1985). Growth increments were measured from the focus to the posterior edge of each annulus. There was little difficulty in reading the scales when a clear focus was found. Often the first annulus, and sometimes the second, was difficult to define for fish age 6 or older.

Aging was not an objective of the study; scales were to be stored for "reading" at a later date. However, a reading of scales collected in fall 1990 and spring 1991 was accomplished. Striped bass scale annuli form between April and June in Virginia waters; therefore, year classes, other than 0 year class, are considered to be a year older on 1 July (Grant 1974). This aging scheme differs from that utilized in Maryland and North Carolina where age is incremented on 1 January. Thus, the same year class is designated one year older in Maryland and North Carolina six months before age designations are equalized for all three states.

The U. S. Fish and Wildlife Service (USFWS) supplied the Floy anchor tags for our project and to the other coastal states tagging striped bass, and it is functioning as the repository for the tag-return data. The data will be sorted and subsequently returned to the appropriate states. The external tube of the tag, as well as its anchor, is inscribed with instructions to return the tag to, or telephone, the Annapolis, Maryland, office of the USFWS. The National Fish and Wildlife Foundation (Washington, D. C.) forwarded a reward of \$5.00 or a fisherman's cap with a striped bass conservation logo as an acknowledgment for the recapture information.

RESULTS AND DISCUSSION

A total of 1,903 striped bass were tagged and released in fall 1990 on the Rappahannock River between 24 September and 30 October. The maximum number of fish tagged in a day was 421 (29 October) and the fewest was 21 (3 October). In spring 1991 tagging commenced on 13 March and ended on 29 April, with a total of 2,708 fish tagged and released. The maximum number of fish tagged in a day was 747 (12 April) and the fewest was 42 (8 April). The 8 April date is misleading; tagging was terminated due to an injury sustained by one of the field personnel. As of 10 November 1991, the grand total of striped bass tagged and released in the Rappahannock River since fall 1987 is 23,688 (Table 1).

A total of 2,405 striped bass was tagged and released in fall 1990 on the James River between 25 September and 17 December. The total number of striped bass captured, tagged and released from haul seines was 798 and the remainder (1,607) from fyke nets (Table 1). There were four tagging events involving haul seines, (27 September, 10 October, 31 October and 13 November), and the maximum number of striped bass tagged and released in a day was 514 (10 October) and the fewest 4 (13 November). The fyke nets provided the 67% of the striped bass tagged and released in James River in fall 1990 (Table 1). The maximum number of fish tagged in a day was 438 (26 November) and the fewest was 106 (10 December). As of 10 November 1991, the grand total of striped bass tagged and released in the James River since spring 1987 is, 15,097 (Table 1).

There was a noticeable difference in size between the striped bass tagged in fall 1990 and spring 1991 pound net fisheries in the Rappahannock River. During fall 1990 we did not tag a striped bass smaller than 390 mm in FL. The minimum tagging size was increased from that of fall 1989 to increase escapement from the river system. In fall 1990 the tagged striped bass mean fork length of striped bass tagged and released in the Rappahannock River was 464 mm (SE = 1.261 mm) and 42% of the fish were less than or equal to 450 mm FL (Fig 1). However, on the James River, in an attempt to release more fish, a smaller minimum size (320 mm FL) was utilized. The mean fork length for striped bass tagged and released from haul seines in the James River was 447 mm (SE = 2.047 mm) and 57.6% of the fish were less than or equal to 450 mm FL (Fig 2). The mean fork length for striped bass tagged and released from fyke nets in the James River was 449 mm (SE = 1.587 mm) and 53.6% of the fish were less than or equal to 450 mm FL (Fig 2). In fall 1988 the tagged striped bass averaged 387 mm FL (SE = 1.21 mm), and 77.6% of the fish were less than 400 mm FL (Loesch and Hill 1989). However, in fall 1989 the tagged fish averaged 398 mm FL (SE = 0.709 mm) and 63.5% of the fish were less than 400 mm FL (Loesch et al. 1990). Due to the presence of mature coastal migrant striped bass which ascend the system to spawn, fish averaged 554 mm FL (SE = 2.469 mm) in spring 1991 on the Rappahannock River, and 86% of the tagged and released striped bass were 450 mm FL or greater (Fig. 3). During spring 1988 the mean FL was 495 mm (S.E. 2.22) with 31% of the tagged fish between 501 and 550 mm FL (Loesch et al. 1988). The striped bass tagged and released in fall 1990 on the Rappahannock River ranged in size from 390 mm FL to 802 mm FL; however, the striped bass tagged in spring 1991 ranged in size from 347 mm FL to 1109 mm FL. Striped bass tagged and released in the James River in fall 1990 ranged in

size from 320 mm FL to 895 mm FL.

Prior to the total closure of the striped bass fishery in Virginia, there was a minimum size restriction of 24 inches total length (TL) (610 mm TL = 571 mm FL). If the fishery were reopened only in the fall with a 24 inches TL (571 mm FL) minimum, only about 1.9% of the catch could have been retained in the fall 1990 on the Rappahannock River and on the James River about 3.4% of the catch would have been marketable. If the minimum size were set at 18 inches TL (427 mm FL), about 53.4 and 54.9% of the catch could have been retained on the Rappahannock and James rivers, respectively. In fall 1988 the percentages of retainable striped bass for the same minimum size considerations on the Rappahannock River were 1.4% and 10% ,respectively (Loesch and Hill 1989).

A biological concern about the fall fishery is that nearly all of the striped bass are immature. A minimum size limit to protect most of the immature fish would result in a *de facto* fishing moratorium, while the 18 inches TL limit could lead to recruitment overfishing unless the frequency of strong year classes is much higher than it has been in the past 16 years, or other management restrictions are applied during a fall fishery.

In the spring (March, April, and May) the available stock contains mature fish as well as young non-migrant fish. Thus, if the minimum sizes were 24 inches TL (571 mm FL) and 18 inches TL (427 mm FL) about 22.6% and 86% of the striped bass captured would be marketable. In spring 1990, if the minimum size were 24 inches TL (571 mm FL) in spring 1990 about 32.8% could have been harvested (Loesch et al. 1990). If the minimum were 18

inches TL (427 mm FL), over 72.5% of the fish would have been of legal size (Loesch et al. 1990). The corresponding percentages in spring 1989 were 29.8% and 77.3%, respectively (Loesch and Hill 1989). Since larger striped bass tend to spawn early, and spawning is on the wane in May, an alternative management approach would be to have a spring fishery in the latter part of May with a 24 inches TL size limit and eliminate the March fishery, when the striped bass are ascending the riverine systems in preparation for spawning.

The difference in the degrees of vulnerability of the available stock in the fall relative to the available stock in the spring is shown by the recaptures per net-day in pound nets during the tagging periods on the Rappahannock River. There was a total effort of 147 pound net-days, during the fall 1990 tagging season, with 314 recaptures. Of these 314 recaptures all of them were re-released. The recapture per net-day rate during the fall 1990 tagging program was 2.14 fish per pound net-day. During the spring 1991 tagging program there was a total effort of 72 pound net-days, with 91 recaptures. Of these recaptures, 82 individuals were re-released and the remainder were sacrificed (1.26 fish per pound net-day). This is the same pattern that has been observed during the two previous tagging contracts (Loesch et al. 1987, Loesch and Hill 1988, Loesch et al. 1990). The fall recapture rate exceeded the spring recapture rate. In a similar fashion, there was a total of 708 fyke net-days on the James River with 32 recaptures. Of these 32 recaptures 14 were re-released and the remainder were sacrificed. The recapture per net-day during the James River fall tagging program was 0.04 fish per fyke net-day.

The 1987 year class (age 3) made up 61.0% of the fall 1990 primary releases on the Rappahannock River (Fig. 4). The 1987 year class (age 3) composed 42.8% of the fall releases on the James River that were captured by fyke nets (Fig.5). The 1987 year class (age 3) constituted 47.1% of the striped bass tagged that were captured by haul seines (Fig. 5). During spring 1991 the dominant cohort on the Rappahannock River was the 1987 year class, accounting for 38.7% of the individuals that were tagged (Fig. 6). The striped bass tagged in spring 1990 and 1991 on the Rappahannock River had the most diverse age structure to date, with ages ranging to 2-15. The commercial fishermen had their pound nets deployed in mid-March on the Rappahannock, earlier than in previous years. The fall fishery is composed mostly of younger resident fish while the spring fishery contains migratory fish, and the mean size of the tagged fish in the fall is smaller than those tagged in the spring.

As of 31 May 1991 USFWS reported a total of 8,033 recaptures from striped bass tagged in the Rappahannock River (Table 2). The majority of tag returns were captured from pound nets within the Rappahannock River system (66.3%) (Table 3). Out-of-state returns account for 2.65% of the returns (Table 3). The vast majority of these returns have usually occurred during the first 120 days of release for the fall 1987, 1988, and 1989 (45.0%, 41.8%, 67.5%, respectively); for the spring 1988, 1989, and 1990 the percentages were smaller (25.8% , 16.4 and 50.5%, respectively) (Figs. 7-12).

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Table 1. Number of striped bass tagged in Virginia. Gear code: Fyke Net (05); Haul Seine (02); Pound Net (01).

James River	Number Tagged	Gear Code	Rappahannock River	Number Tagged	Gear Code
Spring 1987	1,986	05			
			Fall 1987	3,319	01
Spring 1988	2,048	02	Spring 1988	2,024	01
	97	05	Fall 1988	3,893	01
Spring 1989	3,363	02	Spring 1989	1,317	01
			Fall 1989	6,203	01
Spring 1990	177	02	Spring 1990	2,033	01
	393	05			
Fall 1990	798	02	Fall 1990	1,903	01
	1,607	05			
Spring 1991	1,008	02	Spring 1991	2,708	01
	1,720	05			
Fall 1991*	1,900	05	Fall 1991	288	01
Totals	15,097			23,688	

* Preliminary: Tagging in Progress

Table 2. Total number of striped bass recaptures for Virginia as reported by the USFWS as of 31 May 1991.

Rappahannock River		James River	
Tagging Season	Number of Recaptures	Tagging Season	Number of Recaptures
		Spring 1987	184
Fall 1987	1,788		
Spring 1988	501	Spring 1988	49
Fall 1988	1,563		
Spring 1989	281	Spring 1989	264
Fall 1989	3,615		
Spring 1990	283	Spring 1990	37
Total	8,033		534

Table 3. Number of recaptures of striped bass by gear, state, and season as of 31 May 1991.

Fall 1987	CT	MA	MD	ME	NC	NH	NJ	NY	RI	VA	DE
Anchor Gill Net										391	
Gill Net										20	
Hook & Line	1	13	6	2		1		4	2	107	
Other										2	
Trap			2					2		1,232	
Found Dead										3	
Spring 1988											
Anchor Gill Net			1							128	
Gill Net										2	
Hook & Line	1	8	10	1			4	1	1	103	
Other										2	
Trap				1						228	
Trawl											
Found Dead			1							9	

Table 3. Cont.

Fall 1988	CT	MA	MD	ME	NC	NH	NJ	NY	RI	VA	DE
Anchor Gill Net										581	
Drift Gill Net										1	
Other				1				4	2	6	
Trap										835	
Found Dead					1				1		
Spring 1989											
Anchor Gill Net										48	
Drift Gill Net										1	
Hook & Line		4	3				2	2	1	35	
Other								1		2	
Trawl										181	
Seine										1	
Fall 1989											
Anchor Gill Net										533	
Drift Gill Net										1	
Hook & Line	4	34	10	3		1	1	7	5	125	
Other										1	
Trap			1						1	2885	
Trawl					1					2	
Spring 1990											
Anchor Gill Net										62	
Hook & Line		5	5	2			3	6	4	45	1

Table 3 Cont.

Spring 1990	CT	MA	MD	ME	NC	NH	NJ	NY	RI	VA	DE
Other										2	
Trap										142	
Trawl					1					2	
Found Dead										2	

Fig. 1. Size frequency of striped bass tagged in the Rappahannock River, fall 1990

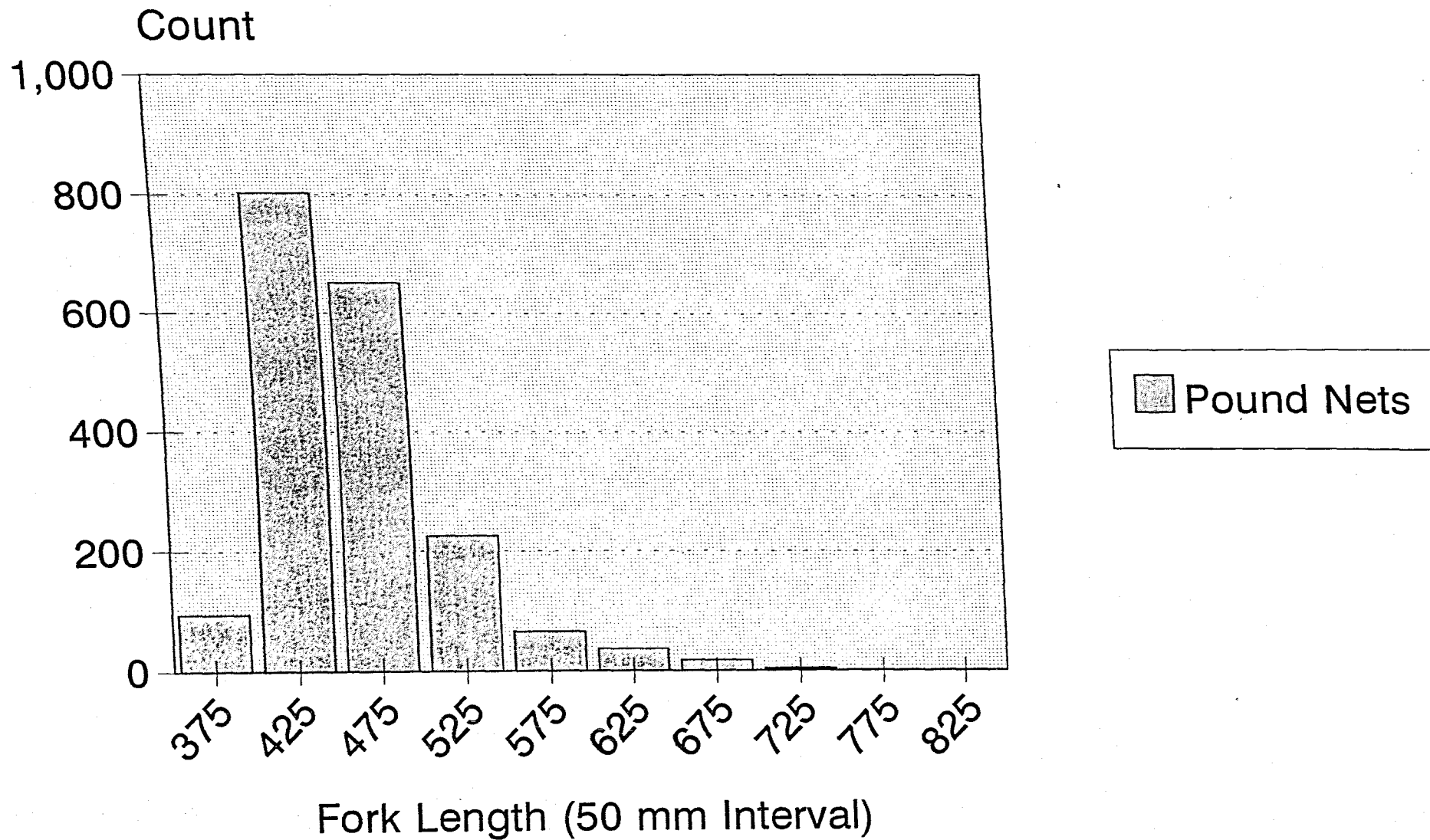


Table 3 Cont.

Spring 1990	CT	MA	MD	ME	NC	NH	NJ	NY	RI	VA	DE
Other										2	
Trap										142	
Trawl					1					2	
Found Dead										2	

Fig. 1. Size frequency of striped bass tagged in the Rappahannock River, fall 1990

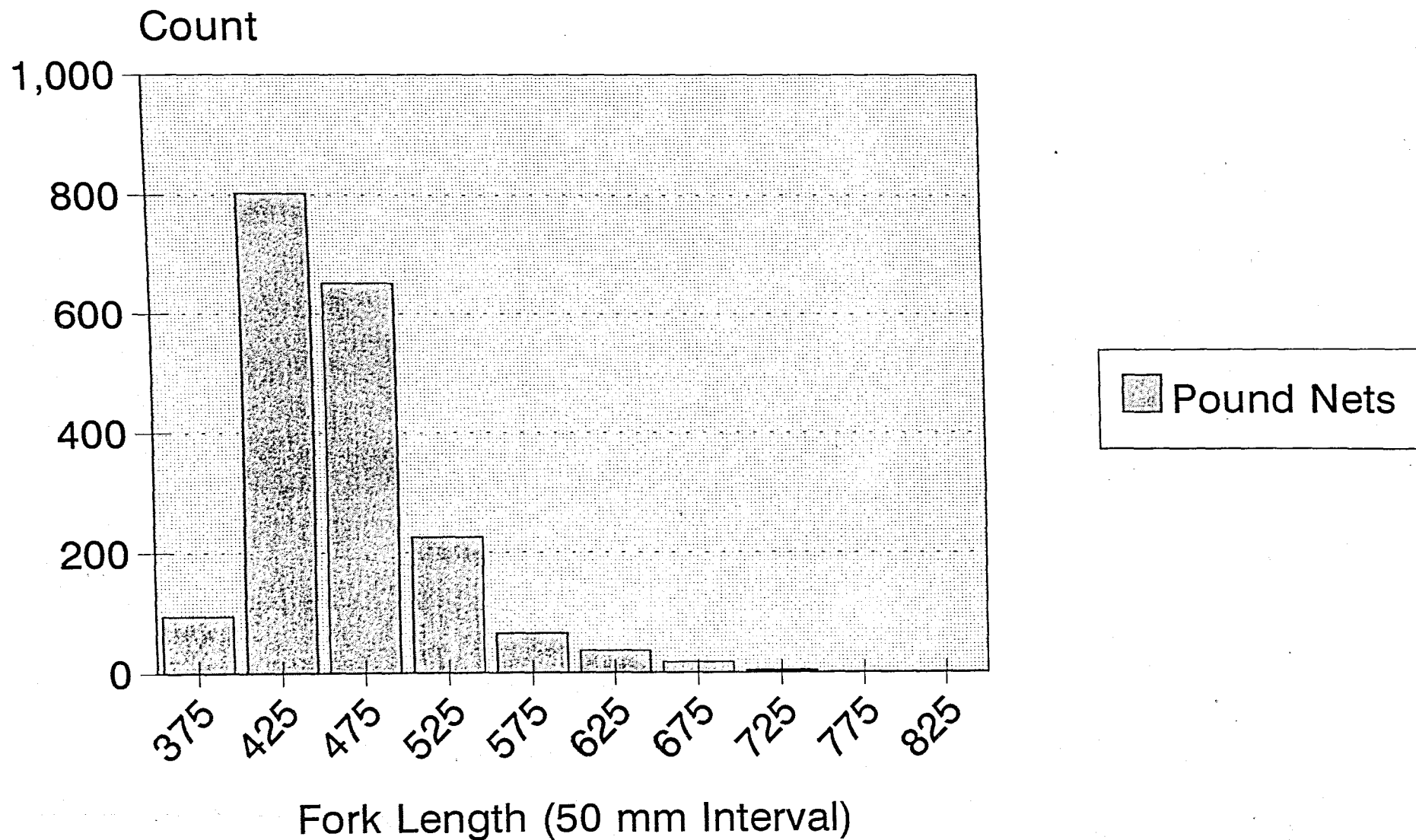


Fig. 2. Size frequency of striped bass tagged in the James River, fall 1990

18

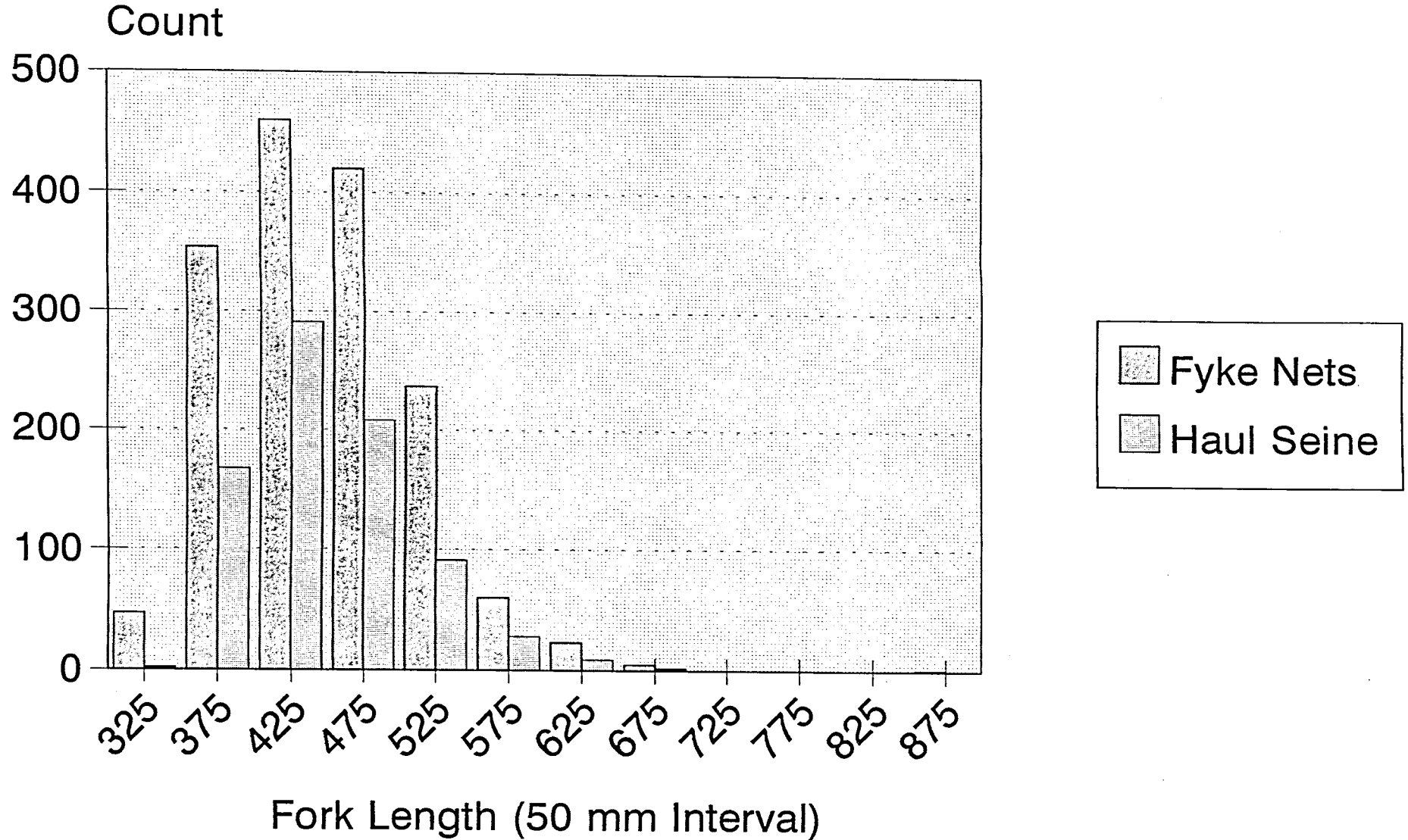


Fig. 3. Size frequency of striped bass tagged in the Rappahannock River, spring 1991

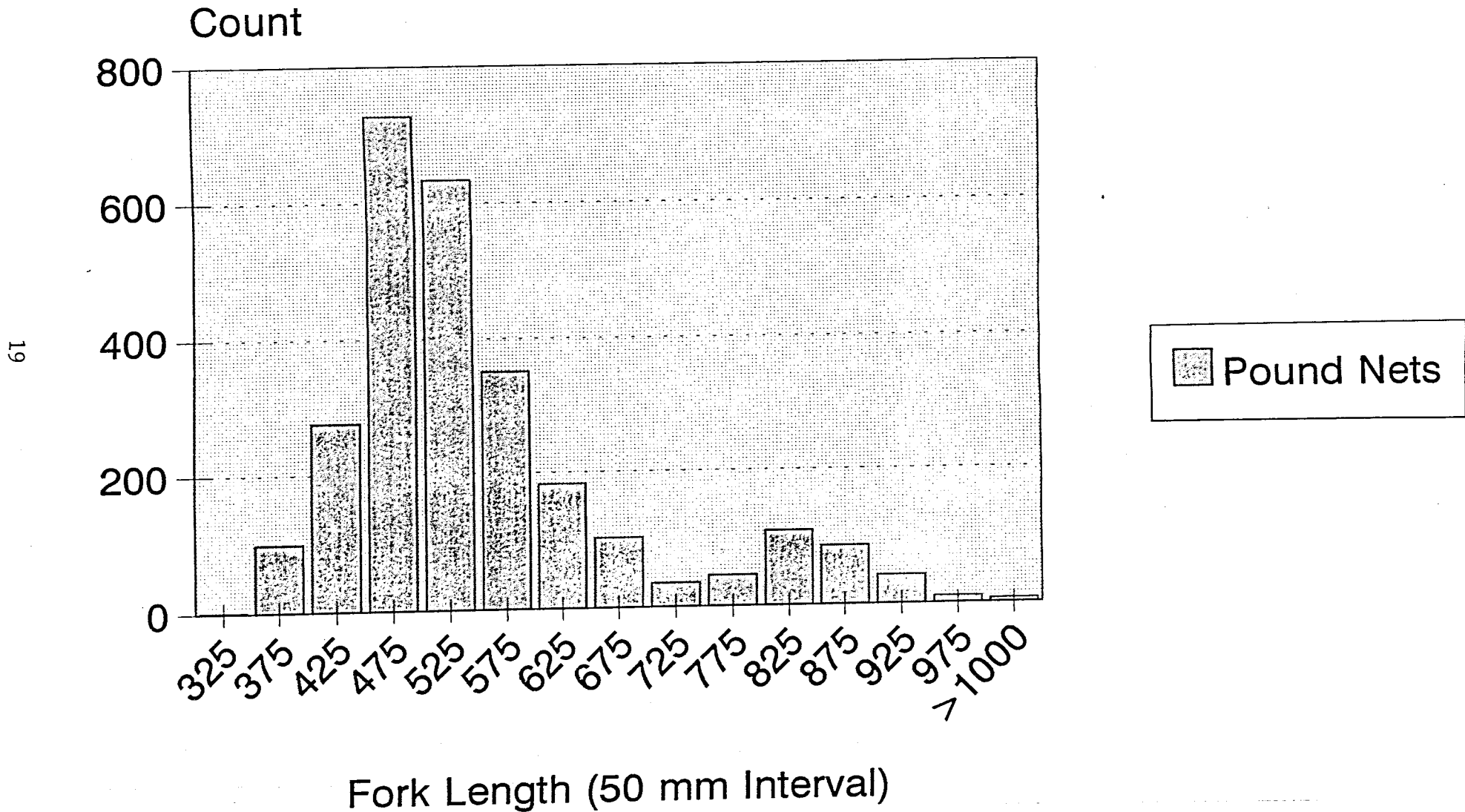


Fig. 4. Year class frequency of striped bass tagged in the Rappahannock River, fall 1990

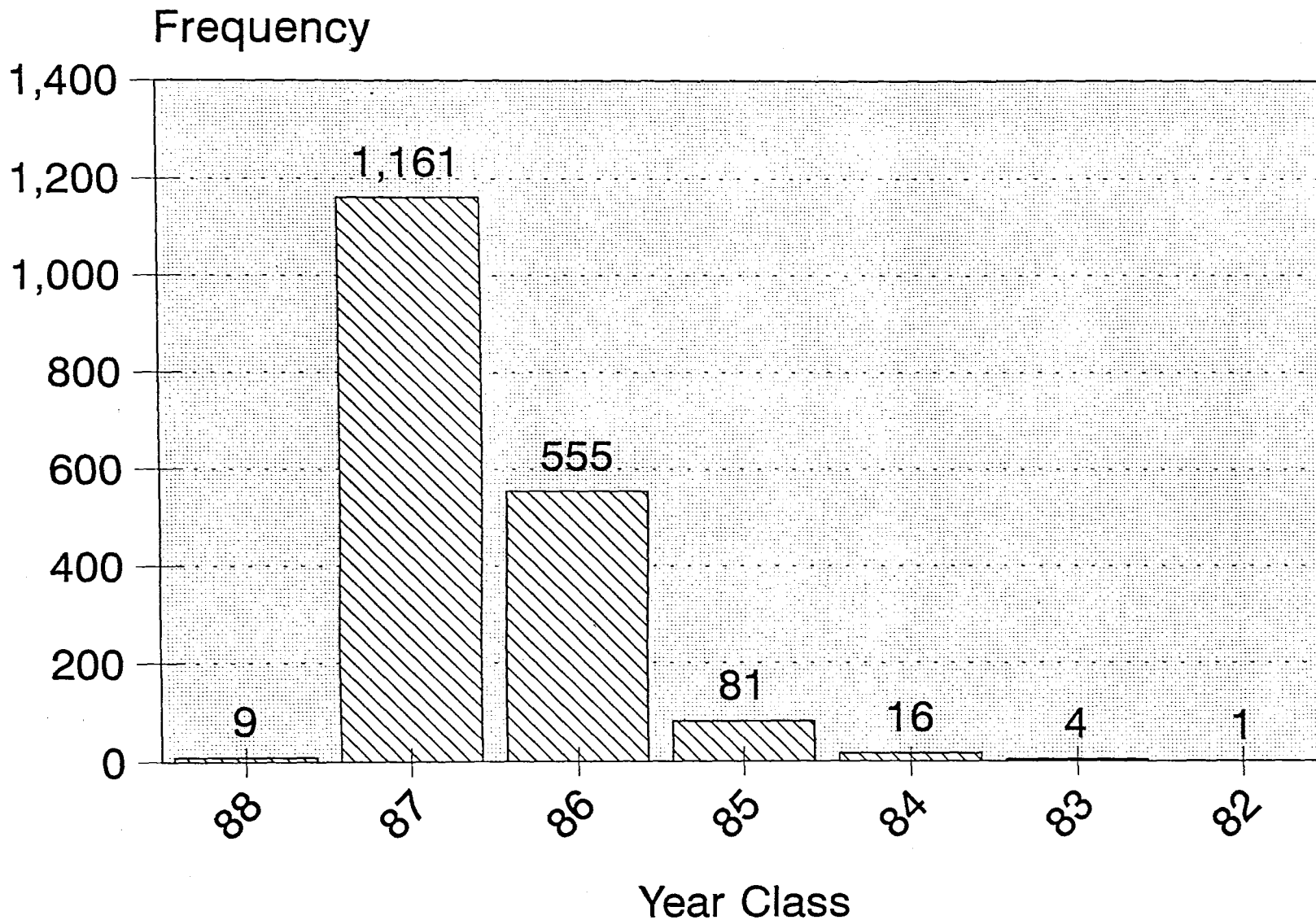
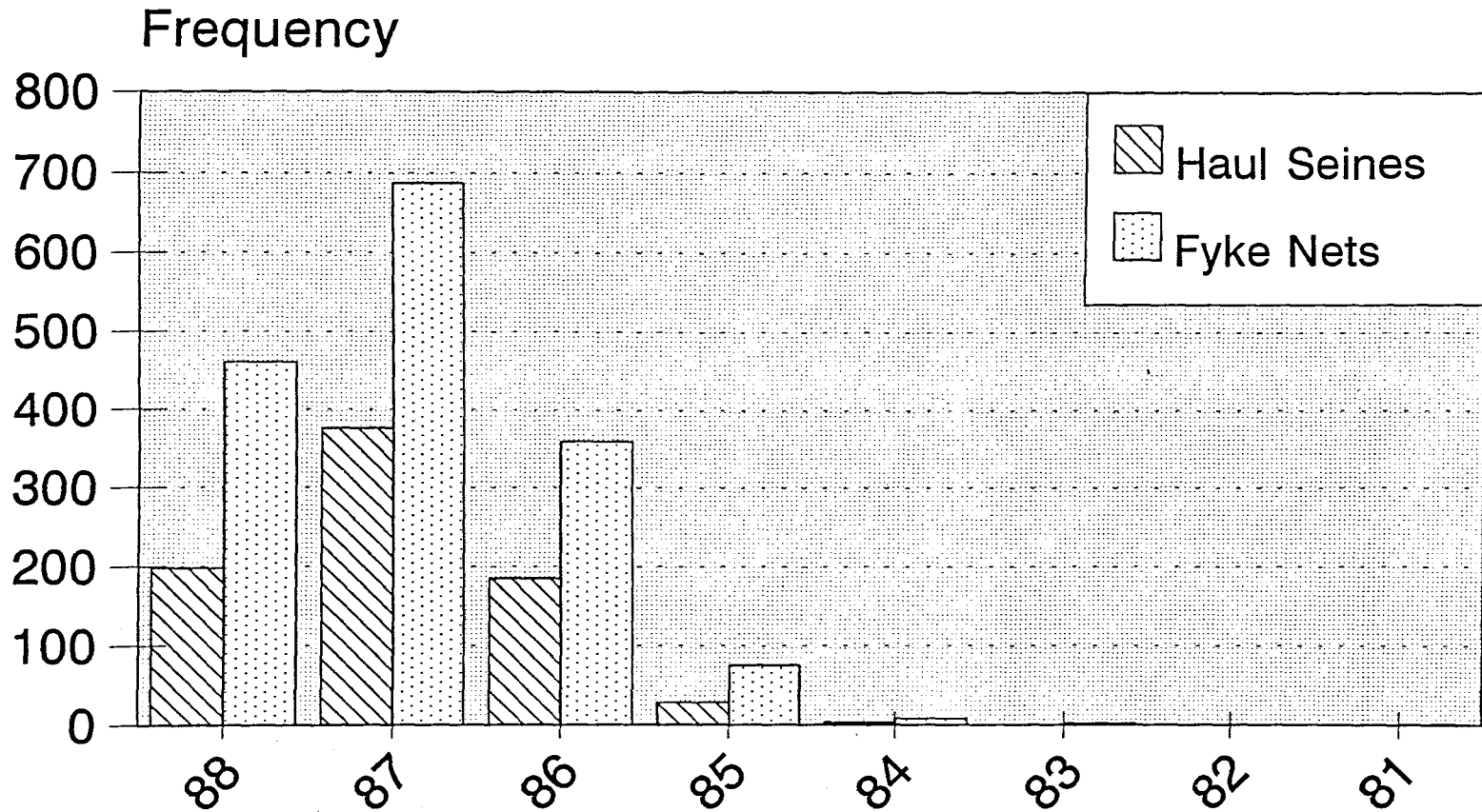


Fig. 5. Year class frequency of striped bass tagged in the James River, fall 1990



Haul Seines	198	376	185	28	3			
Fyke Nets	461	687	359	75	8	2		1

Year Class

Fig. 6. Year class frequency of striped bass tagged in the Rappahannock River, spring 1991

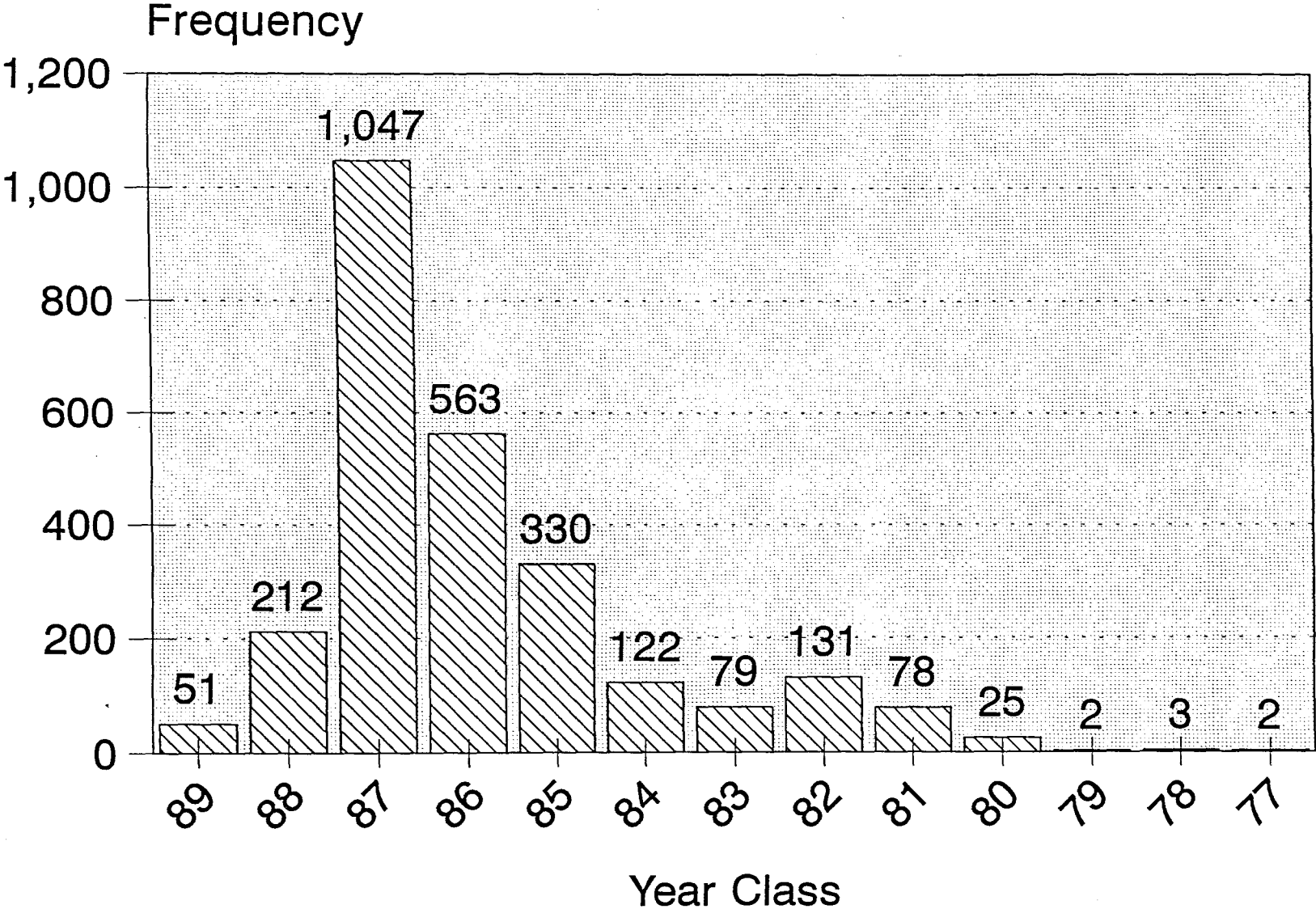
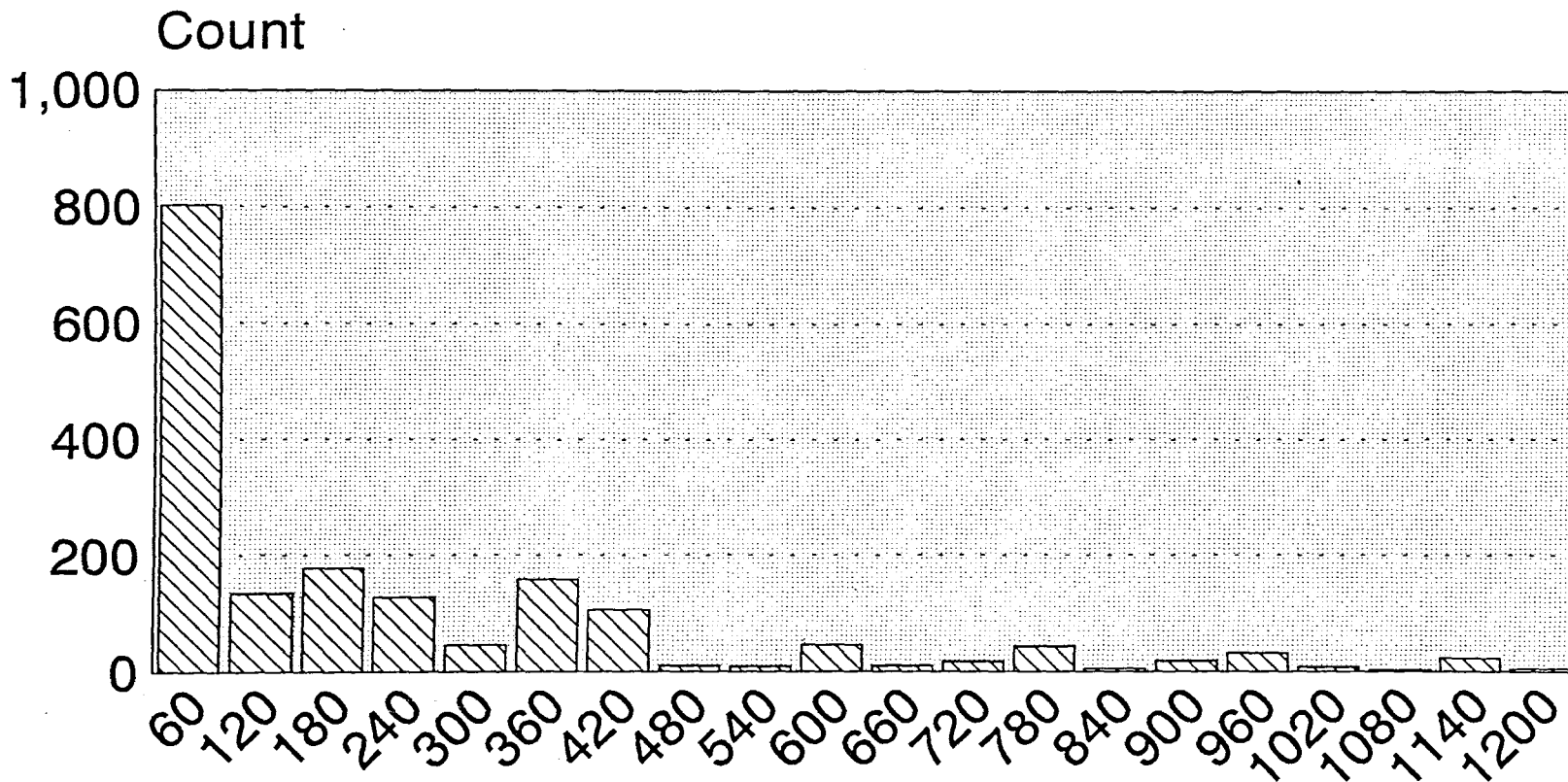


Fig. 7. Days at large of recaptured striped bass tagged in the Rappahannock River, fall 1987

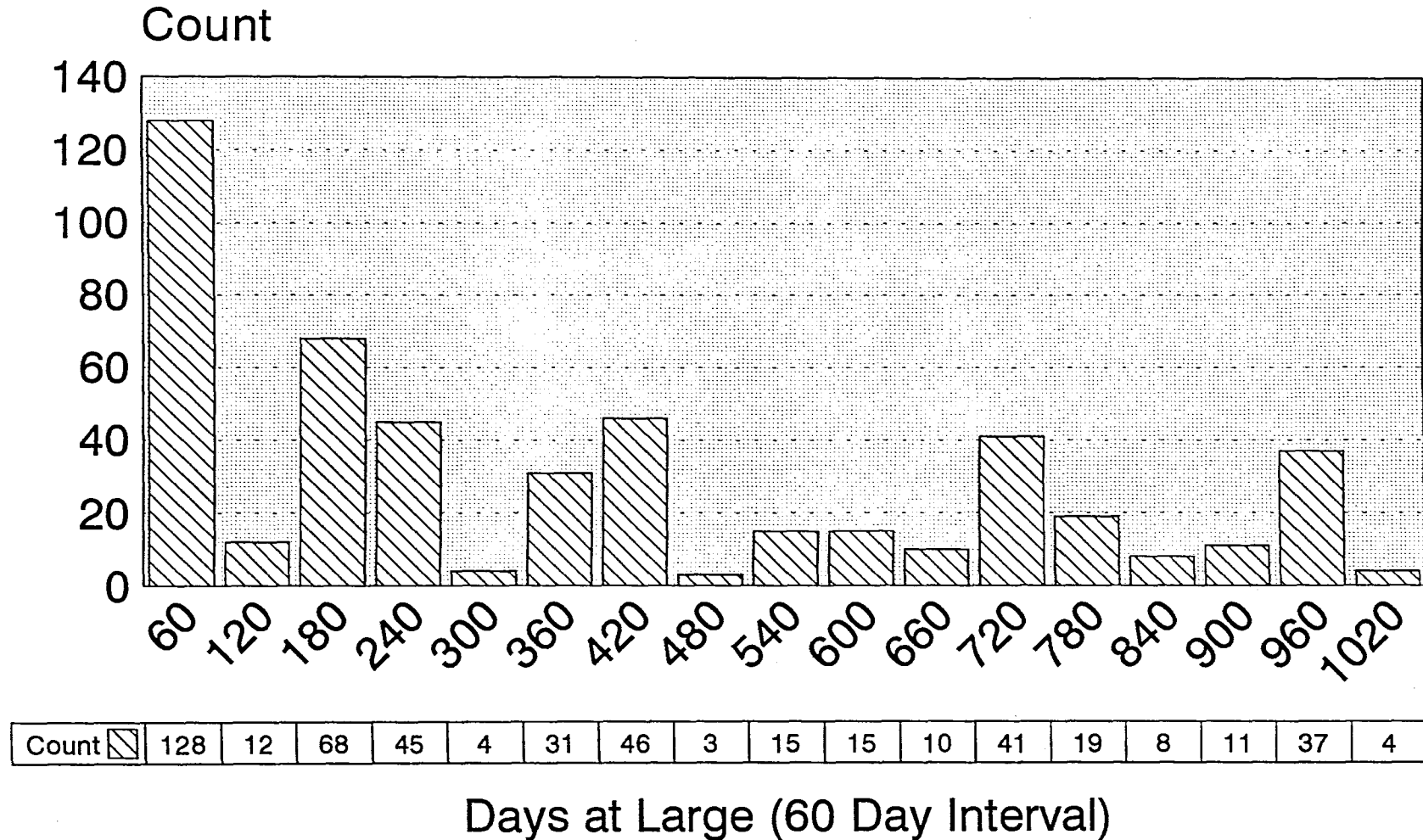


Count	803	135	178	128	46	158	106	10	9	46	10	17	43	5	18	32	8	3	23	5
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Days at Large (60 Day Interval)

As of May 31, 1991

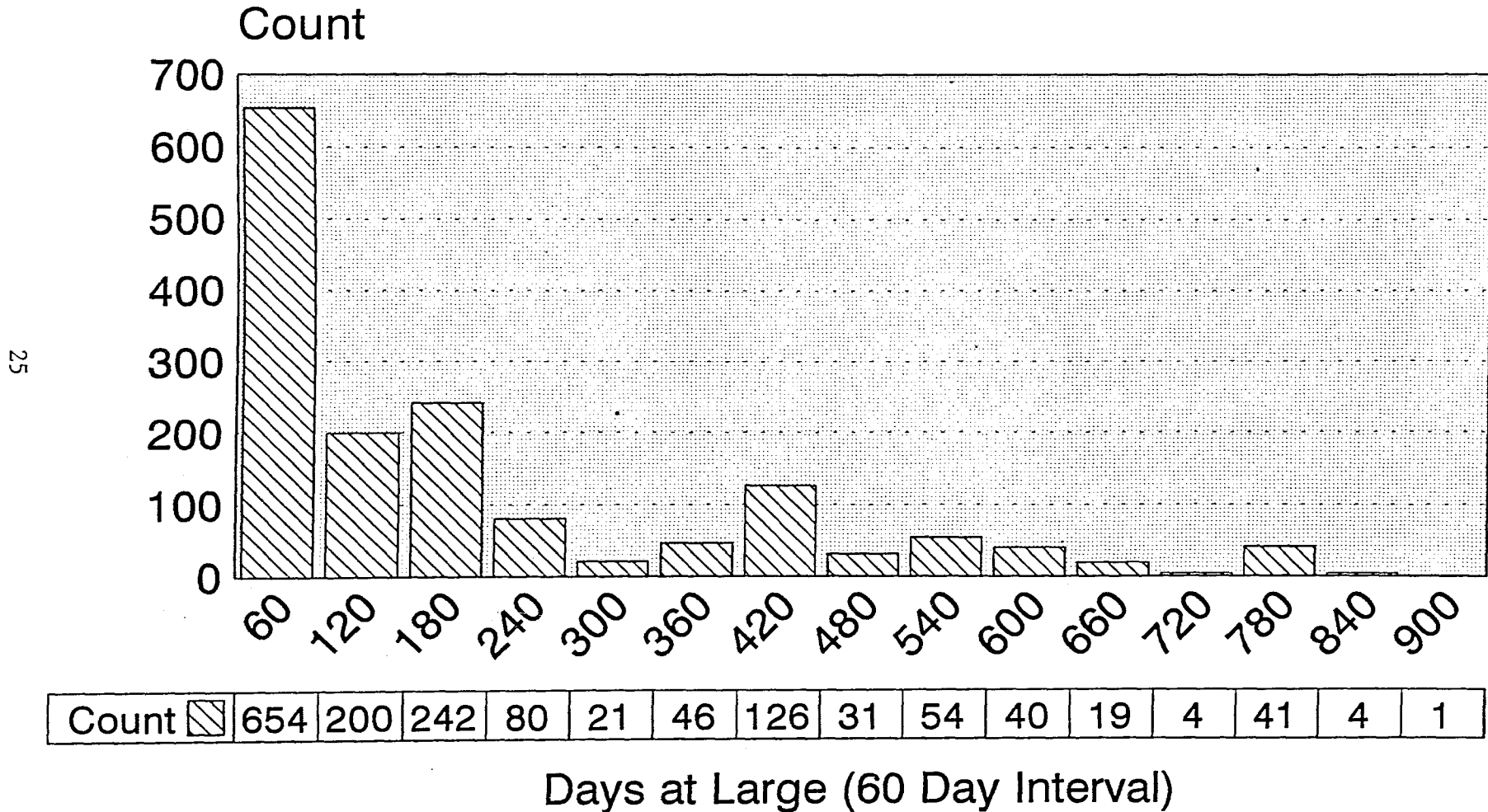
Fig. 8. Days at large of recaptured striped bass tagged in the Rappahannock River, spring 1988



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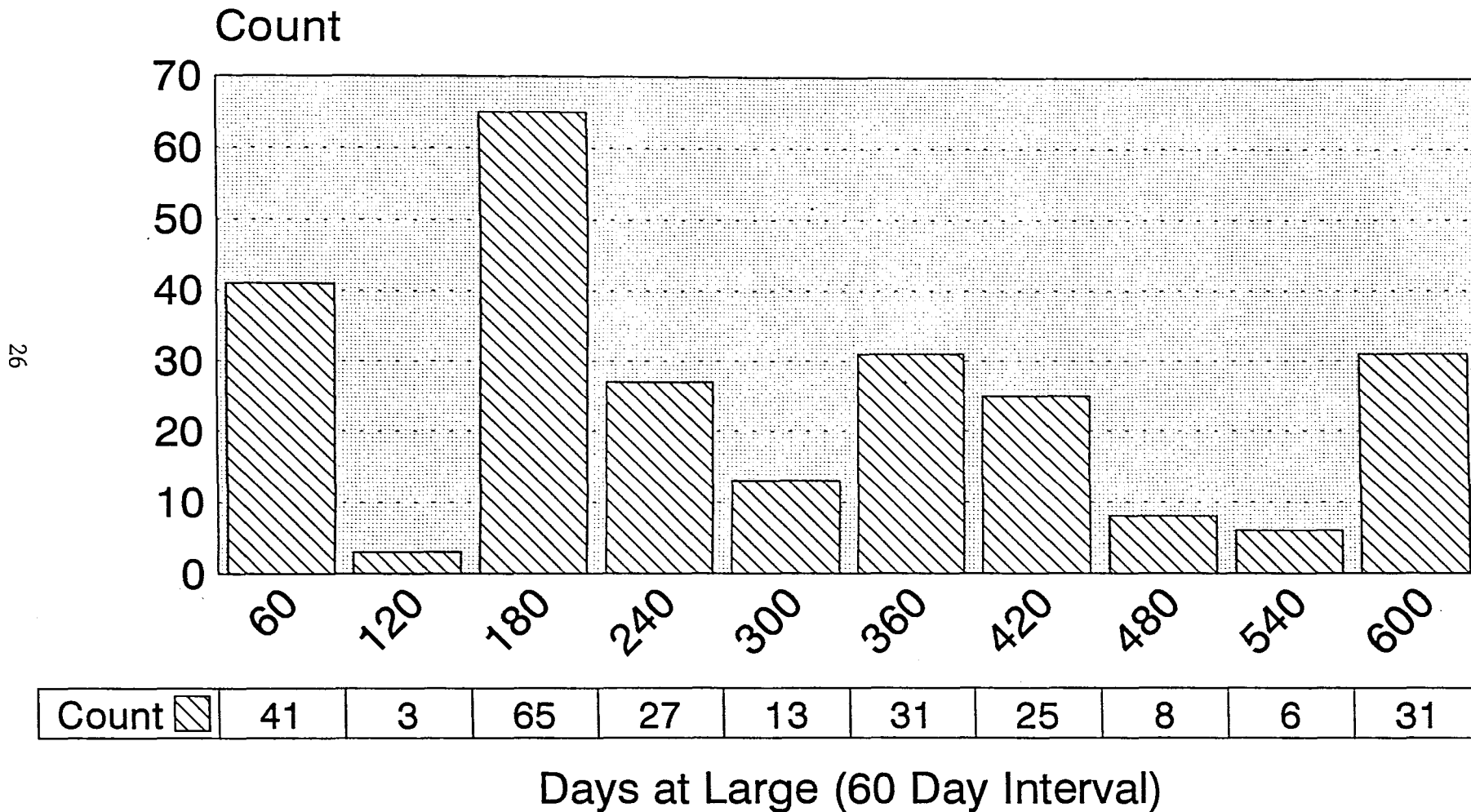
As of May 31, 1991

Fig. 9. Days at large of recaptured striped bass tagged in the Rappahannock River, fall 1988



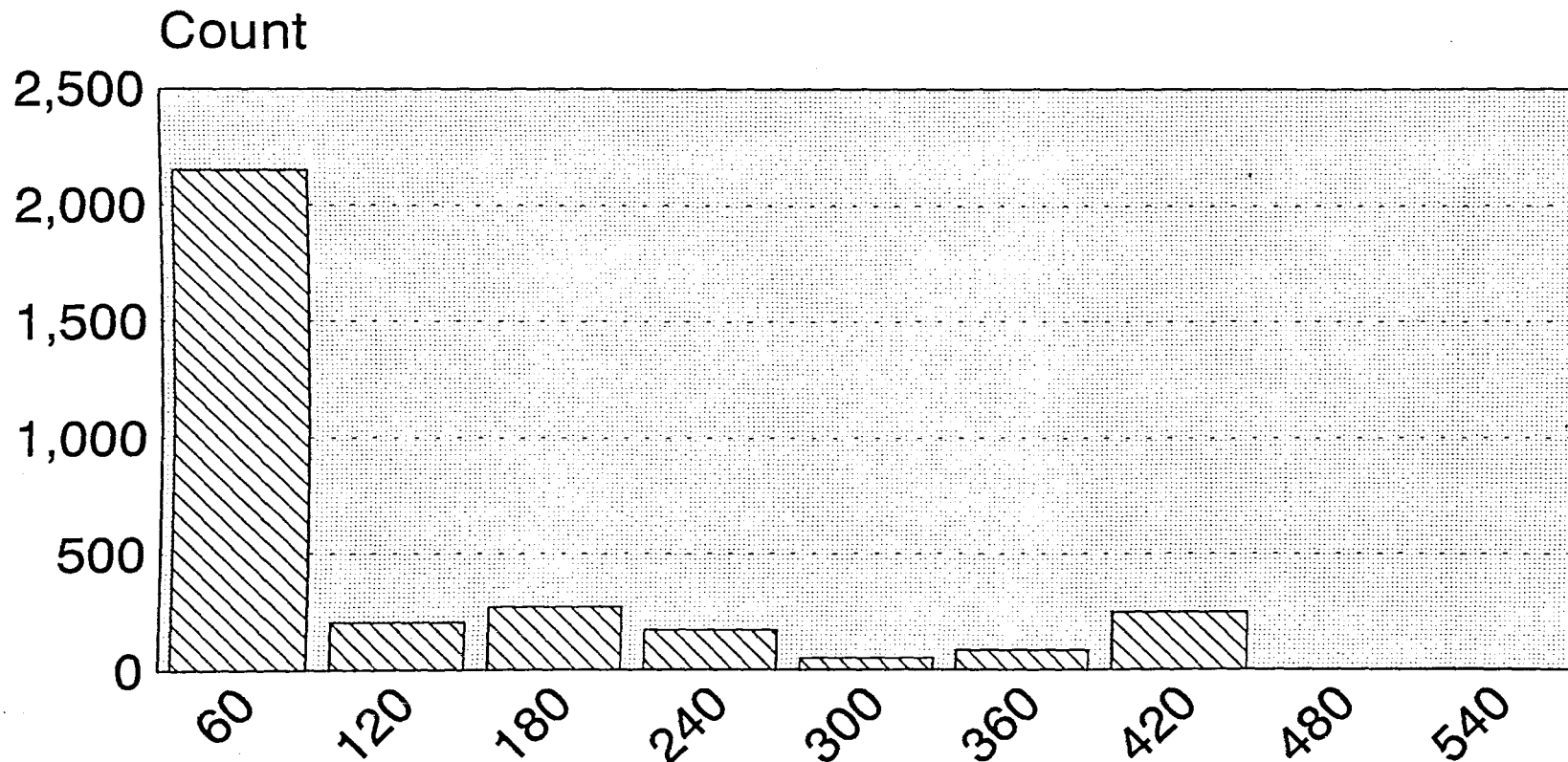
As of May 31, 1991

Fig. 10. Days at large of recaptured striped bass tagged in the Rappahannock River, spring 1989



As of May 31, 1991

Fig. 11. Days at large of recaptured striped bass tagged in the Rappahannock River, fall 1989

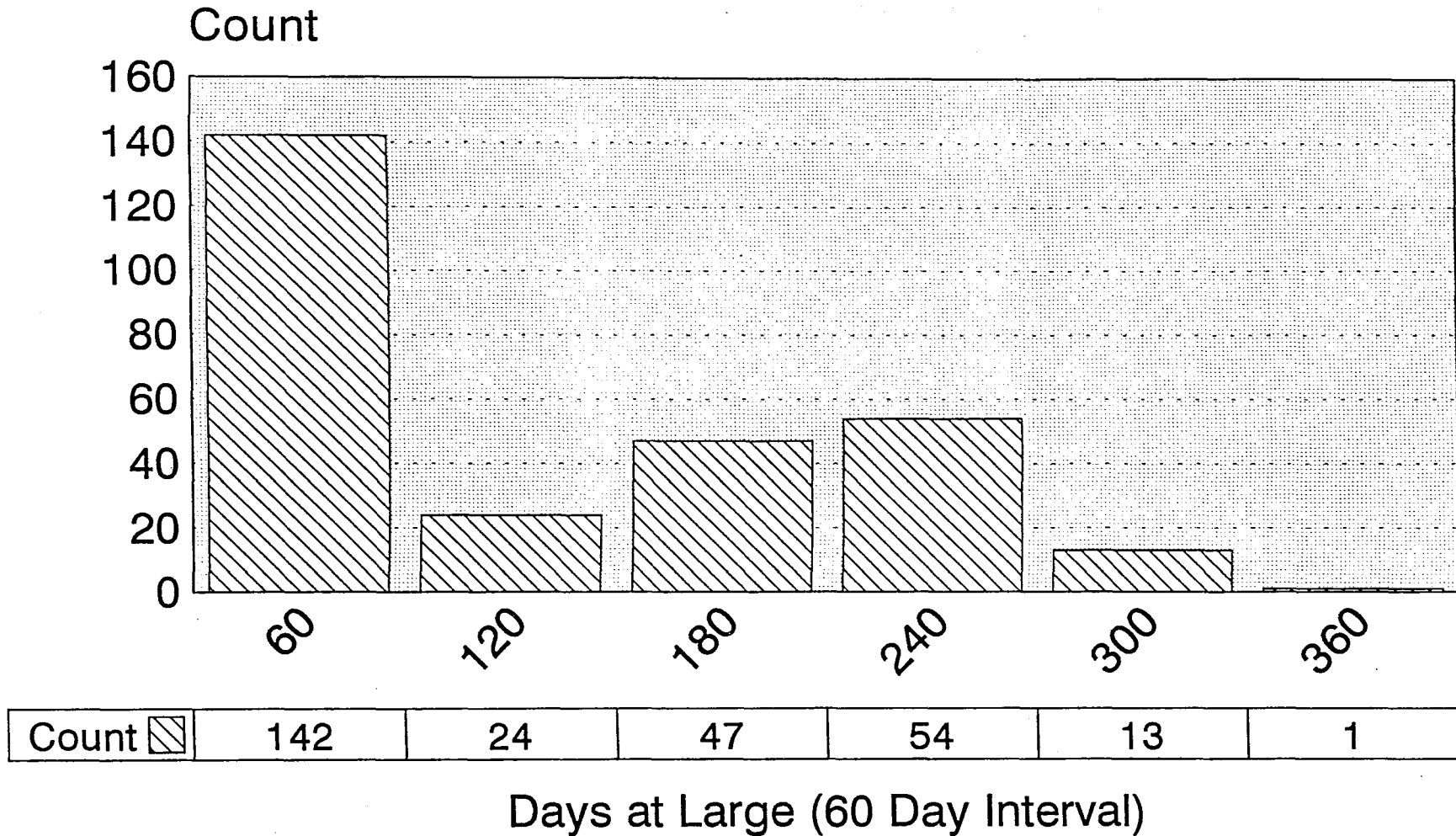


Count	2,152	204	271	171	50	85	249	0	4
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Days at Large (60 Day Interval)

As of May 31, 1991

Fig. 12. Days at large of recaptured striped bass tagged in the Rappahannock River, spring 1990



As of May 31, 1991