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Status of the Major Oyster Diseases in Virginia 1990 A Summary of the Annual Monitoring Program

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STATUS OF THE MAJOR OYSTER DISEASES IN VIRGINIA - 1990.

A SUMMARY OF THE ANNUAL MONITORING PROGRAM.

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EXECUTIVE SUMMARY

Streamflow into Chesapeake Bay during 1990 was above average for the second year in a row. Only March and April had below average streamflow; however, rainfall during summer was only slightly above average and there were periods of relatively high salinity from May through September. Water temperature was above average for most of the year (41 of 52 weeks) and was unusually high during February, March and December, 1990. Early January was unusually cold following a record cold December in 1989.

No MSX was found in the James River at, or above, Wreck Shoal until August 1990. MSX was eliminated from this region as a result of the record high runoff during May, 1989 and was absent for most of 1990. The parasite gradually reinvaded Wreck Shoal during late 1990, but prevalence remained low; MSX was not found above Wreck Shoal. MSX was also rare in other areas in the lower Chesapeake Bay and on the Eastern Shore. For the first time since monitoring began in 1960, MSX was absent from oysters in the annual monitoring trays. For the second year in a row MSX was not responsible for significant oyster mortality in Virginia during 1990.

The prevalence of *Perkinsus* declined rapidly after the very cold December of 1989. Prevalence of *Perkinsus* was 72% in December, 1989, but was only 24% on 10 January 1990 and remained low, between 8 and 20%, through June. Prevalence increased during late summer and reached 100% by 12 September. The increase in prevalence and the presence of moderate and heavy infections occurred about two months later in 1990 than in 1989. Prevalence of *Perkinsus* continues to increase in the upper James River and attained record high levels at both Deep Water Shoal and Horsehead Rock during late fall of 1990 even though salinity was below 10 ppt for most of that period. Intensity of infections was low at Deep Water Shoal, but heavy and moderate infections did occur at Horsehead Rock. Prevalence and intensity of *Perkinsus* was also high during fall in most other oyster harvesting areas in the Bay and in Burton's Bay on the Eastern Shore. Two years of average to above average rainfall have had little effect on the distribution of *Perkinsus* in the lower Bay and this parasite continues to cause significant oyster mortality in most areas..

INTRODUCTION

The protozoan parasites *Haplosporidium nelsoni*, popularly known as MSX, and *Perkinsus marinus*, popularly known as Dermo, are serious pathogens of oysters in the Chesapeake Bay. MSX first appeared in Chesapeake Bay in 1959 and, in the early 1960s, killed millions of bushels of oysters on lower Bay oyster grounds. The continued presence of the parasite has prevented use of these prime growing areas since that time.

The infection period for MSX begins in early May each year with peak mortality from these early summer infections during August and September. However, infections acquired during late summer and fall may overwinter and develop as soon as water temperature increases in early spring. These overwintering infections may cause oyster mortality as early as June.

Historically, *Perkinsus* has been present at low levels in the lower portions of all Virginia rivers, but the parasite has recently increased in abundance and has spread throughout all public oyster beds. Until recently, *Perkinsus* was not as serious a pathogen as MSX because *Perkinsus* spread slowly within an oyster bed and between adjacent beds, and required three years to cause significant mortality. However, because of the recent increase in the abundance of *Perkinsus*, this parasite is now more important than MSX as an oyster pathogen in the Bay. The population dynamics of *Perkinsus* are complex and not entirely understood. Most mortality occurs during late summer and early fall, but it may begin as early as June following warm winters that allow more overwintering infections.

The distribution and pathogenicity of both diseases are limited by salinity and, in a very general sense, neither parasite causes serious mortality in areas where the salinity remains below about 12-15ppt. MSX seems to be eliminated from oysters after about 10 days below 10ppt; however, *Perkinsus* may persist for years at low salinity although it is not pathogenic.

Because of the detrimental effect of these diseases on the Virginia oyster industry, the Virginia Institute of Marine Science has been monitoring the prevalence of both parasites since 1960. Information on disease severity and distribution each year is provided to management agencies and the oyster industry through publications and special advisories of the Marine Advisory Service office.

SAMPLING METHODS

The oyster disease monitoring program consists of three different sample types—tray samples, native oyster samples and samples provided from private oyster grounds.

Tray Samples. In late April each year, oysters are dredged from either Horsehead Rock or Deep Water Shoal in the upper portion of the James River seed area and placed in 2-foot by 4-foot legged trays in the York River at Gloucester Point and at Wachapreague, Virginia on the seaside of the Eastern Shore. Oysters from the upper James River are known to be highly susceptible to MSX and thus they serve as excellent indicators of annual MSX abundance when placed in an endemic area such as the lower York River. Historically, *Perkinsus* has never invaded the trays during the first year of monitoring so the trays were a good measure of mortality resulting from MSX alone. However, because of the dramatic increase in *Perkinsus* abundance since 1987, oysters in the monitoring trays have become infected with *Perkinsus* in recent years and this has made interpretation of the cause of mortality difficult. Prior to establishing trays, a sample of 25 oysters is analyzed for MSX and *Perkinsus* to determine the level of existing infections at the dredge site. No infections have ever been encountered at these sites during April. At least 400 oysters are placed in each of two trays at each location on 1 May each year. Trays are cleaned every week and counts are made of live and dead oysters in each tray. Samples of 25 oysters are removed on about 1 July, 1 August, 1 September, and 1 October for disease determination; final counts are made about 1 December and trays are removed from the river at that time. New trays are established each May to provide a record of disease prevalence and intensity for each year. Because oysters from the same source have been held at the same location each year since 1960 we have a long–term data base on MSX abundance and it is possible to compare years and to relate disease abundance and distribution to various environmental parameters.

Oysters are also usually dredged from the upper James River during August and placed in trays in the lower York River. Mortality and disease prevalence are followed in these trays throughout winter and spring to determine the severity of late summer infections.

Native Oyster Samples. In order to determine the annual distribution and severity of both MSX and *Perkinsus*, samples of native oysters are collected periodically from most major public harvesting areas in Virginia. Samples of 25 oysters are collected approximately 1 June, 1 August and 1 October from many sites in Mobjack Bay, the Rappahannock River, the Great Wicomico River, Pocomoke Sound, and from the seaside of the Eastern Shore. Because of the intense fishing pressure in the James River, samples are collected monthly at Wreck Shoal and periodically at other sites upriver from Wreck Shoal.

Private Oyster Grounds. Private oyster planters submit samples for disease diagnosis and the results are used to make planting and harvesting decisions. In this report these samples are identified by location only and cannot be separated from native oyster samples.

DIAGNOSTIC TECHNIQUES

Prevalence of MSX is determined by histological analysis of paraffin–embedded tissue sectioned at 6µm and stained with hematoxylin and eosin; prevalence of *Perkinsus* is determined by thioglycollate culture.

Monthly mortality in tray samples is determined by dividing the number of dead oysters by the number of live and dead oysters in the tray. This result is divided by the period in days since the last count to yield percent dead per day. This value is then multiplied by 30 to yield monthly mortality.

RESULTS - 1990

Temperature and salinity.

Late January, February and March, 1990 were unusually warm, following a period of prolonged record low temperatures during December, 1989 (Figure 1). Late fall of 1990 was also unusually warm. Streamflow into the Bay was above average during 1990 (Figure 2) for the second year in a row following four years of below average streamflow. Only March and April had below average streamflow although from May through September streamflow was only slightly above average (Figure 2).

Native Oyster Samples.

MSX. The low salinity in late spring 1989, caused by record high streamflow in May, eliminated MSX from oysters in most areas of the lower Chesapeake Bay and the parasite remained rare during most of 1990 (Table 1). Light infections of MSX were found in single oysters in the Great Wicomico River and in Burton's Bay on the seaside of the Eastern Shore, but all other oyster growing areas were free of MSX until late summer. MSX reappeared at Wreck Shoal in the James River in August after an absence of 14 months and from 8 to 12% of the oysters at that location were infected during the last three months of the year (Table 1). MSX was not a source of significant oyster mortality in the lower Chesapeake Bay during 1990.

***Perkinsus*.** The distribution and abundance of *Perkinsus* changed little during 1990. The parasite was still present in all oyster growing areas and prevalence and intensity were very high in most areas during early fall (Table 1). The prevalence of *Perkinsus* continued to increase in the upper James River. The fall 1990 prevalences (Table 1) were the highest prevalences ever recorded at Deep Water Shoal and at Horsehead Rock, and the relatively high number of heavy and moderate infections at Horsehead Rock suggest that there was significant mortality at that location during 1990. It is interesting to note that the prevalence of *Perkinsus* during January and February, 1990 was much lower that during the same months in 1989 and in addition, both prevalence and intensity of *Perkinsus* during spring and early summer was much lower at Wreck Shoal during 1990 than during 1989. This decreased prevalence may have been the result of the unusually cold water temperature during most of December, 1989 and early January, 1990 (Figure 1). Both prevalence and intensity of *Perkinsus* reached typically high levels in September, 1990, approximately two months later than the previous year.

High prevalence and intensity of *Perkinsus* was also observed during fall at most other oyster growing areas (Table 1) although some areas in both the upper and lower Rappahannock River had relatively low prevalence. Burton's Bay on the seaside of the Eastern Shore also had high prevalence of *Perkinsus*, but in other areas the prevalence was much lower. There has been a trend of increasing *Perkinsus* prevalence on the Eastern Shore over the last three years.

Tray Samples.

May (Spring) Imports. Counts of live and dead oysters and prevalence of MSX and *Perkinsus* in the duplicate trays established 1 May 1990 at Gloucester Point are listed in Table 2. Average total mortality for the two trays through 6 December was 76.5%, almost identical to tray mortality during 1989. All of the mortality during 1990 can be attributed to *Perkinsus* on the basis of high prevalence and intensity. Approximately half of the oysters were infected by mid July and prevalence was 100% by the end of August. Mortality was highest in August and September (Table 2). For the first time since tray monitoring began in 1960 no MSX was found in oysters held in trays at Gloucester Point, VA.

Counts of live and dead oysters and prevalence of MSX and *Perkinsus* in duplicate trays established 1 May 1990 at Wachapreague on the seaside of the Eastern Shore are listed in Table 3. Average total mortality for the two trays through 20 November was 37.1%, about half the mortality observed at this site in 1989. Only one case of MSX was observed in the oyster samples, but the prevalence and intensity of *Perkinsus* was high. Thus, the mortality in these trays can be attributed to *Perkinsus*. It is interesting to note that the mortality in the Wachapreague trays was much lower than in the Gloucester Point trays even though the prevalence and intensity of *Perkinsus* was similar.

August (Fall) Imports. Fall import trays were not established during 1989.

DISCUSSION

The return to more typical rainfall and streamflow patterns during both 1989 and 1990 has greatly reduced the distribution and abundance of MSX in the lower Chesapeake Bay. This parasite was very rare during 1990 and was not a source of significant oyster mortality. Even the coastal plain estuaries like the Great Wicomico River that typically don't receive much fresh water input had very low prevalences of MSX. In addition, for the first time since oyster disease monitoring began in 1960, no MSX was found in the monitoring trays. These data reinforce previous observations on the strong association between MSX abundance and salinity.

Each year provides more data on the factors that control the distribution and abundance of *Perkinsus*. Although it is clear that increased salinity can allow *Perkinsus* to spread into previously uninfected areas, data obtained in the James River during 1989 suggested that temperature is more important than salinity as a controlling factor for annual abundance of *Perkinsus* (see 1989 Monitoring Report); data from 1990 support that conclusion. The prolonged cold weather during December, 1989 resulted in a dramatic decrease in *Perkinsus* prevalence at Wreck Shoal in the James River in January, 1990 and prevalence remained low until mid August. In the previous two years prevalence and intensity of *Perkinsus* had been high by early June. The return, in 1990, to a cycle more typical of historical patterns of abundance appears to be the result of the unusually cold December in 1989. However, once the prevalence did increase in late fall it was much higher in the upper James River than in any previous year. Salinity at Horsehead Rock and Deep Water Shoal during this period ranged from about 5.0ppt to 11.0ppt, well below salinity levels thought to be necessary for *Perkinsus* development. The reasons for this increase in abundance at such low salinities are unclear, but may be related to the high susceptibility of the oysters in these areas because of their history of low disease pressure.

The continuing widespread distribution of *Perkinsus,* even after two years of relatively normal rainfall, and its increase in prevalence in low salinity areas is cause for continuing concern. It is clear that the abundance of this parasite, unlike MSX, is not rapidly affected by a return to more normal salinity levels. On the basis of data from the upper James River during 1989 and 1990, *Perkinsus* can persist tenaciously and even increase in abundance at salinities below 10 ppt.

ACKNOWLEDGMENTS

The oyster disease monitoring program could not be conducted without the help of many VIMS scientists and staff. Nita Walker was responsible for sample processing and diagnoses for both MSX and *Perkinsus*. Judy Meyers, Beth McGovern, Lisa Ragone, Gustavo Calvo and Nancy Stokes assisted with sample processing. Judy Meyers and Chris Maclauchlin were responsible for cleaning monitoring trays at Gloucester Point; Mike Castagna and his staff maintained the trays at Wachapreague. Judy Meyers and Kenny Walker collected the monthly James River samples; Dr. Bruce Barber and his field staff assisted with sample collection from other areas. Mike Oesterling of the Marine Advisory Service staff coordinated much of the sample collection from private oyster growers and communicated results of analyses.

Table 1. Prevalence and intensity of MSX and *Perkinsus* in oysters from Virginia harvesting areas in 1990. See accompanying figures for station locations.

Location	Date	MSX Infect./exam.	% Infect.	H-M-L*	*Perkinsus* Infect./exam.	% Infect.	H-M-L*
James River							
Deep Water Shoal	10 Jan	0/25	0		1/25	4	0-0-1
	14 Feb	0/25	0		0/25	0	
	14 Mar	0/25	0		0/25	0	
	16 Apr	0/25	0		0/25	0	
	14 May	0/25	0		0/25	0	
	13 Jun	0/25	0		0/25	0	
	11 Jul	0/25	0		0/25	0	
	15 Aug	0/25	0		0/25	0	
	12 Sep	0/25	0		2/25	8	0-0-2
	16 Oct	nd			9/25	36	0-1-8
	13 Nov	0/25			16/25	64	1-0-15
	12 Dec	nd			12/25	48	0-0-12
Horsehead Rock	10 Jan	0/25	0		1/25	4	0-0-1
	14 Feb	0/25	0		0/25	0	
	14 Mar	0/25	0		0/25	0	
	16 Apr	0/25	0		0/25	0	
	14 May	0/25	0		4/25	16	0-0-4
	13 Jun	0/25	0		3/25	12	0-0-3
	11 Jul	0/25	0		5/25	20	0-0-5
	15 Aug	0/25	0		4/25	16	2-0-2
	12 Sep	0/25	0		22/25	88	1-3-18
	16 Oct	nd			21/25	84	2-7-12
	13 Nov	0/25	0		24/25	96	2-0-22
	12 Dec	nd			21/25	84	1-0-20
Mulberry Island	02 May	nd			4/25	16	0-0-4
Point of Shoal	14 May	0/25	0		7/25	28	0-0-7
	15 Aug	0/25	0		9/25	36	1-0-8
Jail Island	15 Aug	0/25	0		12/25	48	1-1-10
Wreck Shoal	10 Jan	0/25	0		6/25	24	0-1-5
	14 Feb	0/20	0		3/25	12	0-0-3
	14 Mar	0/25	0		4/25	16	0-0-4
	14 Apr	0/25	0		3/25	12	0-0-3
	14 May	0/25	0		5/25	20	0-0-5
	13 Jun	0/25	0		2/25	8	0-0-2
	11 Jul	0/25	0		10/25	40	0-0-10
	15 Aug	1/25	4	0-0-1	17/25	68	1-1-15
	12 Sep	0/25	0		25/25	100	9-10-6
	16 Oct	2/25	8	0-1-1	25/25	100	5-3-17
	13 Nov	3/24	12	0-1-2	25/25	100	5-4-16
	18 Dec	2/25	8	0-1-1	21/25	84	2-1-18
Thimble Shoal	05 Mar	0/25	0		0/25	0	

Table 1. (continued).

Location	Date	MSX Infect./exam.	% Infect.	H-M-L	*Perkinsus* Infect./exam.	% Infect.	H-M-L*
York River							
Poropotank Bay	25 Mar	nd			1/25	4	0-0-1
Mobjack Bay							
Tow Stake	25 Sep	0/25	0		25/25	100	4-9-12
Pultz Bar	25 Sep	0/25	0		6/25	24	1-0-5
White's Creek	15 Nov	0/18	0		13/18	72	4-3-6
Patent tong area	15 Feb	0/25	0		21/25	84	1-0-20
Piankatank River							
Ginny Point	27 Sep	nd			24/24	100	3-6-15
Palace Bar	27 Sep	nd			25/25	100	5-8-12
Burton's Point	27 Sep	nd			4/25	16	0-0-4
Rappahannock R.							
Ross' Rock	17 May	nd			0/25	0	
	03 Oct	nd			0/25	0	
Bowler's Rock	16 May	nd			0/25	0	
	03 Oct	nd			21/25	84	0-5-16
Sharps (Long Rock)	16 May	nd			1/25	4	0-0-1
Sharps (Block #4)	26 Jun	nd			18/25	72	0-0-18
Morattico Bar	16 May	0/25	0		1/25	4	0-0-1
	03 Oct	nd			22/22	100	10-4-8
Parrot's Rock	02 Oct	nd			25/25	100	2-4-19
	30 Oct	nd			14/25	56	0-0-14
Monaskon Bluff	30 Oct	nd			22/24	92	2-0-20
Smokey Point	08 Oct	nd			14/25	56	1-5-8
Corrotoman River	02 Oct	nd			21/25	84	0-2-19
Hog House Bar	02 Oct	nd			1/25	4	0-0-1
Broad Creek	02 Oct	0/25	0		24/25	96	1-1-22
Broad Creek (N. side)	02 Oct	nd			23/25	92	1-2-20
Great Wicomico R.							
Haynie's Creek	22 May	1/25	4	0-0-1	11/24	46	0-0-11
	20 Aug	nd			20/25	80	0-1-19
	02 Oct	nd			20/25	80	0-6-14
Crane's Creek	22 May	0/25	0		18/25	72	0-1-17
	20 Aug	nd			19/25	76	0-0-19
Crane's Creek (E. Bar)	22 May	nd			7/16	44	0-0-7
	20 Aug	nd			21/25	84	0-6-15
Whaley's Flats	01 Oct	nd			23/25	92	1-2-20
Fleeton Point	23 May	0/25	0		15/25	60	0-1-14
	20 Aug	0/25	0		21/25	84	0-0-21
	01 Oct	0/25	0		21/25	84	1-2-18

Table 1. (continued).

Location	Date	MSX Infect./exam.	% Infect.	H-M-L	*Perkinsus* Infect./exam.	% Infect.	H-M-L*
Little Wicomico R.	26 Jun	nd			25/25	100	0-0-25
Yeocomico River							
Parker's Island	18 May	nd			3/25	12	0-0-3
Indian Bar	18 May	nd			14/24	58	0-0-14
	10 Jul	nd			21/25	84	1-2-18
Neal's	18 May	nd			6/24	25	1-0-5
Hall's	10 Jul	nd			20/25	80	4-1-15
	01 Aug	nd			19/25	76	2-1-16
Box Hall Cove	10 Jul	nd			18/25	72	0-2-16
	01 Aug	nd			19/25	76	2-1-16
Peck's	01 Aug	nd			24/25	96	1-0-23
Wilkins'	01 Aug	nd			17/25	68	0-1-16
Mill Creek	15 Aug	nd			22/24	92	1-2-19
Eastern Shore							
Burton's Bay	15 Feb	1/25	4	0-0-1	0/25	0	
	18 May	0/25	0		3/25	12	0-0-3
	16 Oct	0/25	0		21/25	84	3-3-15
Upshur Creek	30 Oct	0/25	0		17/25	68	1-1-15
Ram Horn's Rock #1	27 Nov	0/25	0		0/25	0	
Ram Horn's Rock #2	27 Nov	0/5	0		0/5	0	
Thoroughfare	18 May	0/25	0		0/25	0	
	06 Aug	0/25	0		7/24	29	2-0-5
Pungoteague	01 Aug	0/25	0		2/25	8	0-0-2
Red Bank	16 Oct	0/25	0		3/25	12	1-0-2
Chincoteague	06 Aug	0/25	0		4/25	16	0-2-2
Westerhouse Creek	21 Feb	0/25	0		0/25	0	

* H=number of heavy infections, M=moderate infections, L=light infections.
nd=no diagnosis for this parasite in this sample.

Table 2. Mortality and disease prevalence in James River seed oysters placed in replicate trays at Gloucester Point, VA in May, 1990. PRK = *Perkinsus marinus*, MSX = *H. nelsoni*.

Date–1990	Counts live/dead	Monthly mortality–%†	Infected/examined–%		Intensity H–M–L*
01 May	400/0	0.0	MSX:	0/25–0%	
			PRK:	0/25–0%	
	400/0	0.0			
16 July	326/49	4.4	MSX:	0/25–0%	
			PRK:	12/25–48%	3–4–5
	353/47	4.3			
28 August	127/199	39.6			
	105/223	44.1	MSX:	0/25–0%	
			PRK:	25/25–100%	10–11–4
26 September	55/62	50.5	MSX:	0/10–0%	
			PRK:	10/10–100%	4–5–1
	43/26	25.6	MSX:	0/10–0%	
			PRK:	10/10–0%	3–7–0
06 December	16/39	30.0			
	11/32	31.4			

* H=number of heavy infections, M=moderate infections, L=light infections.

† Total mortality from 1 May through 6 December for the first tray listed was 80.1%. Total mortality for the second tray during the same period was 72.9%. On the basis of prevalence and intensity, *Perkinsus* was responsible for all the mortality.

Table 3. Mortality and disease prevalence in James River seed oysters placed in replicate trays at Wachapreague on the Eastern Shore of Virginia in May, 1990. PRK = *Perkinsus marinus*, MSX = *H. nelsoni*.

Date–1990	Counts live/dead	Monthly mortality–%†	Infected/examined–%		Intensity H-M-L *
01 May	400/0	0.0			
	400/0	0.0	MSX:	0/25–0%	
			PRK:	0/25–0%	
06 August	332/43	3.3	MSX:	1/25–4%	0–1–0
			PRK:	24/25–96%	6–6–12
	350/50	3.9			
16 October	158/151	19.2	MSX:	0/25–0%	
			PRK:	23/23–100%	13–4–6
	270/80	9.7			
20 November	135/23	12.5			
	163/107	33.9			

* H=number of heavy infections, M=moderate infections, L=light infections.

† Total mortality from 1 May through 20 November for the first tray listed was 31.6%. Total mortality for the second tray during the same period was 42.6%. On the basis of disease prevalence and intensity, almost all of the mortality can be attributed to *Perkinsus*.

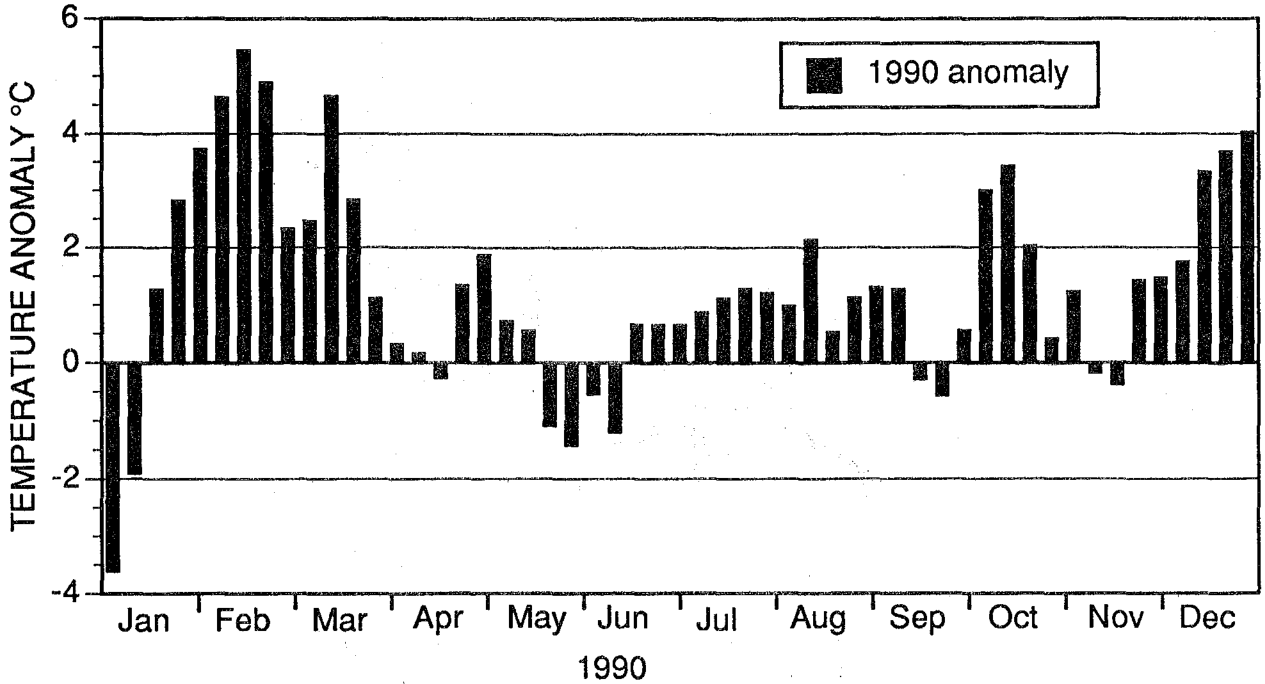


Figure 1. Weekly temperature anomaly at the VIMS pier, Gloucester Point, VA for calendar year 1990 compared with the 43 year average temperature from 1947 through 1990.

A monthly summary of cumulative streamflow into the Chesapeake Bay designed to aid those concerned with studying and managing the Bay's resources. For additional information, contact the District Chief, U.S. Geological Survey, 208 Carroll Building, 8600 LaSalle Road, Towson, Maryland 21204, Phone 301-828-1535.

December 31, 1990.

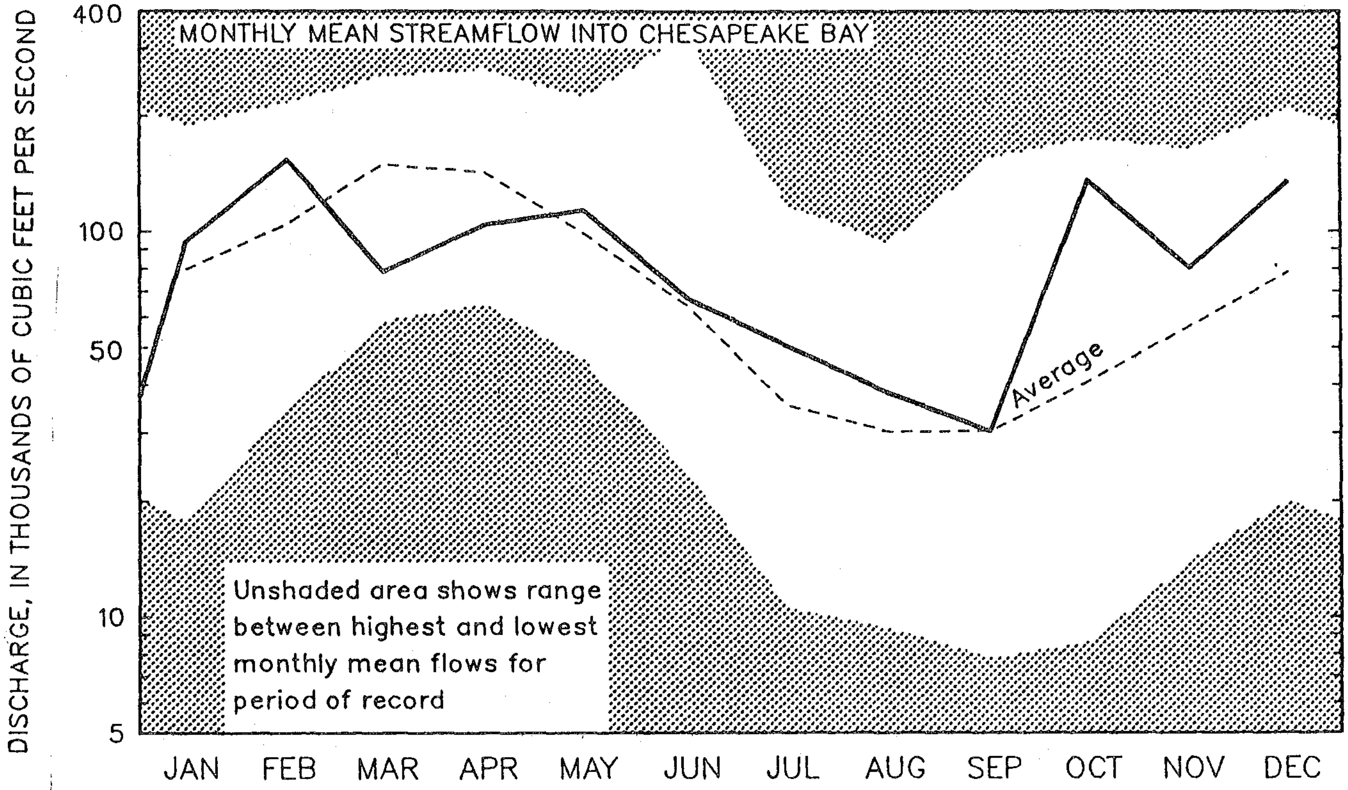
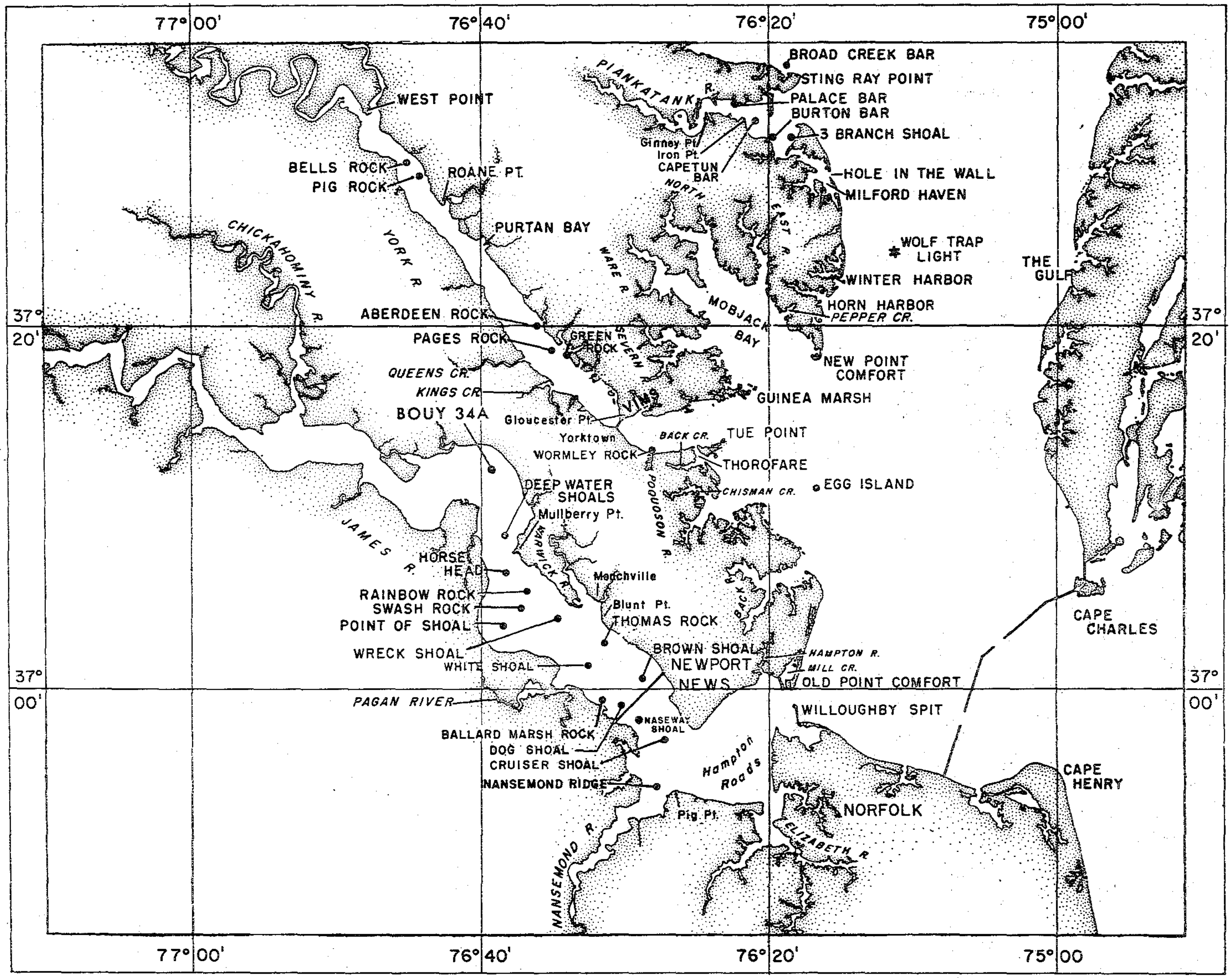
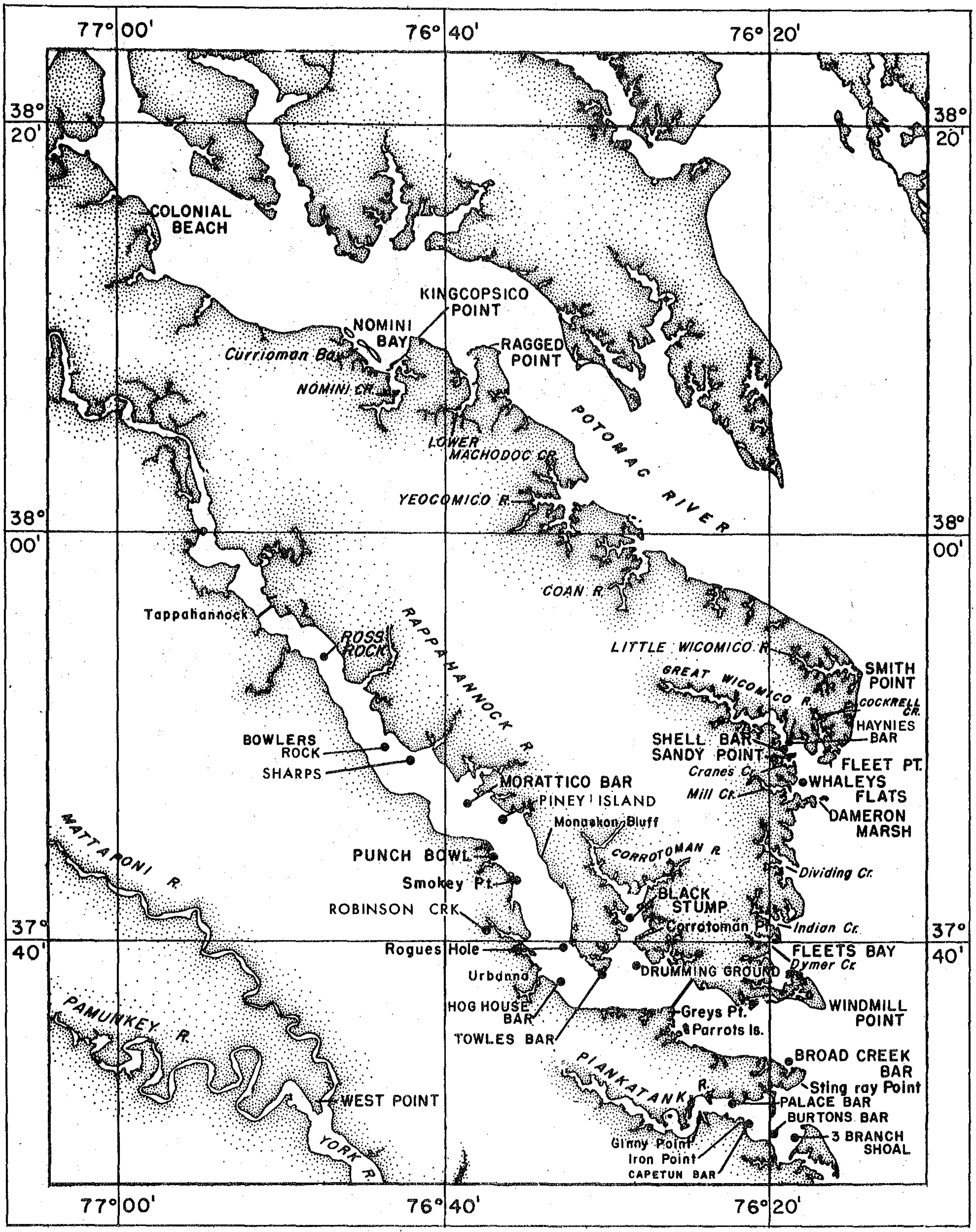


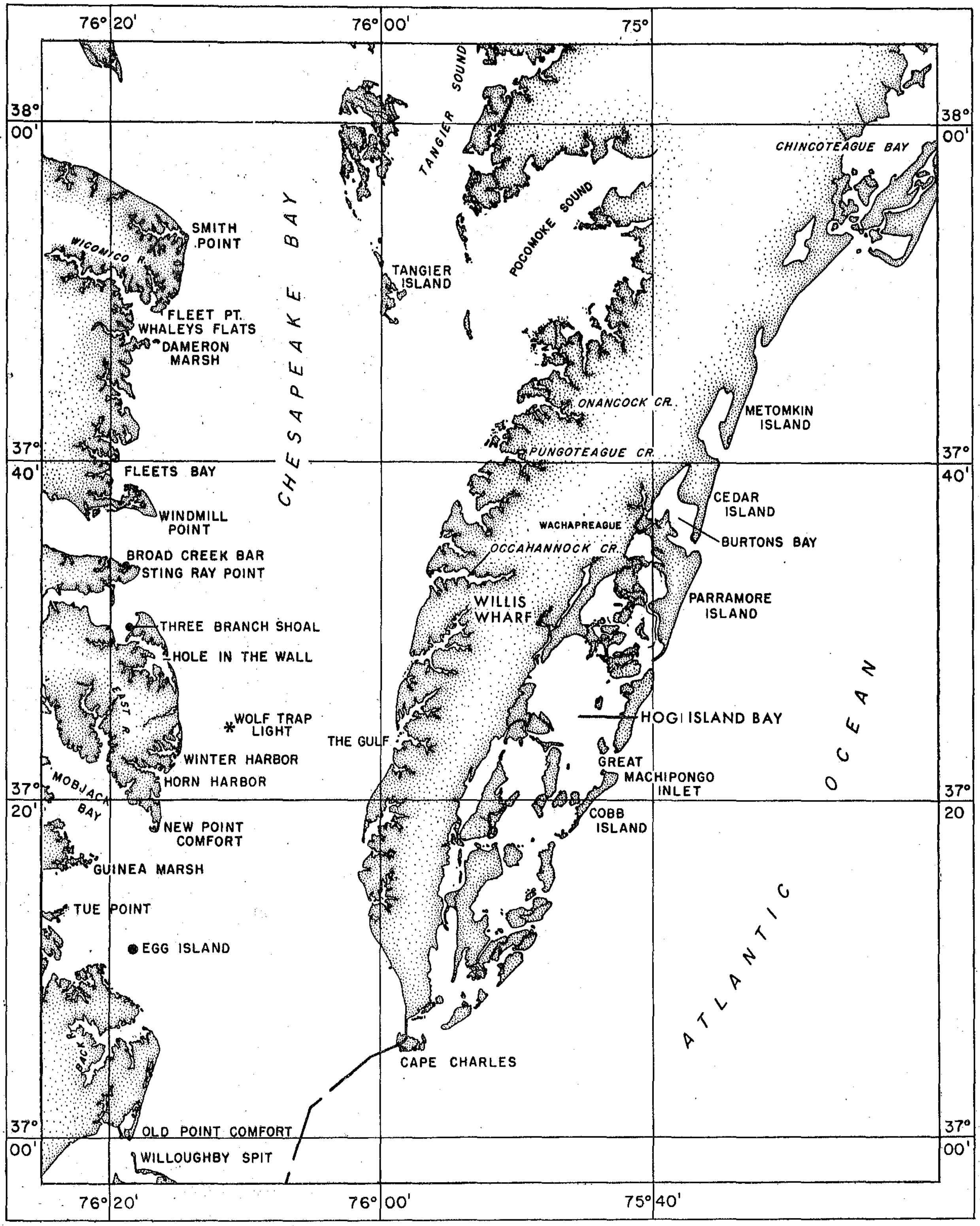
Figure 2. Monthly mean streamflow into Chesapeake Bay during 1990 (solid line) compared with average monthly mean flow for the thirty year period from 1960 through 1990 (dashed line).



Names of oyster rocks, geographical points, towns and bodies of water in James and York rivers.



Names of oyster rocks, geographical points, towns and bodies of water in Rappahannock and Potomac rivers.



Names of oyster rocks, geographical points, towns and bodies of water on Eastern Shore of Virginia.