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Potential Effects of the 1986 Drought on the Oyster Industry of Virginia

Virginia Sea Grant Marine Advisory Program

Virginia Sea Grant College Program

VIMS

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INTRODUCTION

The movement of salt water into Chesapeake Bay and its tributaries is of great concern to all Virginians. As a result of reduced rainfall and subsequent decreased freshwater discharges, unusually high salinities and temperatures are being recorded for Virginia rivers.

Salinity will determine the distribution of various marine animals, including both beneficial and harmful ones (Table 1). Oysters, clams, blue crabs and finfish all have specific salinity requirements and preferences. Increased salinities in some areas may permit these animals to expand their areas of preference and hence their distribution. This, in effect, could alter traditional fishing grounds.

Likewise, marine diseases and noxious animals may have their territories expanded by increased salinities. This is particularly true for oyster diseases (MSX and Dermo) and predators (drills). Along with higher salinities, increases in ship-worms (borers) and stinging nettles (jellyfish) could be expected.

Table 1. Representative Chesapeake Bay marine organisms and their salinity tolerance limits. Those with upper limits of 35°/oo can survive in full-strength sea water or even greater in some cases. Lower limits are those salinities at which survival is questionable or death occurs.

Species	Salinity Range (ppt)		
MSX (Haplosporidium nelsoni)	9°/oo	-	35°/oo
Dermo (Perkinsus marinus)	9°/oo	-	35°/oo
Oyster drills (Urosalpinx cinera, Eupleura caudata)	15°/oo	-	35°/oo
Ship-worms (Bankia gouldi)	5°/oo	-	35°/oo
Stinging Nettles (Chrysaora quinquecirrha)	6°/oo	-	35°/oo
Hard Clam (Mercenaria mercenaria)	12°/oo	-	35°/oo
Soft Clam (Mya arenaria)	7°/oo	-	35°/oo
Oyster (Crassostrea virginca)	5°/oo	-	35°/oo
Blue Crab (Callinectes sapidus)	2°/oo	-	35°/oo

SALINITY/TEMPERATURE DATA

The Virginia Institute of Marine Science in cooperation with the State Water Control Board conducts monthly surveys of the major rivers to monitor environmental conditions such as temperature, salinity and dissolved oxygen. This year, these "slackwater" surveys have been taken in the saline portion of the James River from March to July, and in the York and Rappahannock Rivers during July.

For the James River, during June 1986, the salinities were much higher than normal. The salt intrusion limit (how far upriver salinity can be measured) was 15 kilometers (9.3 miles) further upstream than normal for the month of June. Both the salinity level and salt intrusion limit were higher than those observed in the corresponding period of 1981, a very dry year. In July 1986, the 1 part per thousand salinity level had moved an additional 5 kilometers (3.1 miles) upstream from the June distance. If the drought continues, the salt intrusion limit may reach beyond 100 kilometers (62.1 miles, or above Flowerdew Hundred Creek) from the river mouth by the end of August.

The following tables provide a comparison of salinities and water temperatures for the month of July in the James, York and Rappahannock Rivers for the time period 1981 through 1986. Nineteen hundred eighty-one was a very dry year and salinities were higher than normal. Although 1985 began as a period of higher than normal salinties, the abnormally heavy rainfalls of October and November caused dramatic reductions in salinities. Additionally, both salinity and temperature for all rivers during July were constant from surface to bottom, an indication of a well-mixed condition.

Table 2.

JAMES RIVER BOTTOM
Salinity (0/00, parts per thousand) and
Temperature (T, degrees centigrade)

LOCATION													
MILES FROM MOUTH	LANDMARK	16 JULY 1981 0/00,	T	13 JULY 1982 0/00,	T	1 JULY 1983 0/00,	T	12 JULY 1984 0/00,	T	17 JULY* 1985 0/00,	T	22 JULY 1986 0/00,	T
6.2	Newport News Bar	20	30	26	21	23	23	22	23	25	25	24	28
12.4	James River Bridge	22	27	22	24	19	25	20	24	24	25	22	28
18.6	below Wreck Shoal	18	27	19	25	15	26	17	25	22	26	19	29
24.8	Deep Water Shoal	12	28	7	26	6	26	9	26	15	27	13	29
31.0	Hog Island	7	29	5	27	2	26	3	26	10	27	10	30
37.2	above Jamestown Island	4	29	2	27	1	26	1	26	6	28	8	30
43.4	below Chickahominy River	2	29	0	27	0	26	0	26	3	28	5	30
49.6	Sandy Point	.5	29	0	27	0	27	0	26	1	28	2	30
55.8	Kennon Marsh	0	29	0	27	0	27	0	26	0	28	1	30

*While July 1985 salinity was high, 2 major rainfalls during October & November 1985 significantly reduced salinity to levels where adverse effects due to low salinity were a concern.

Table 3.

YORK RIVER BOTTOM
Salinity (0/00, parts per thousand) and
Temperature (T, degrees centigrade)

LOCATION													
MILES FROM MOUTH	LANDMARK	17 JULY 1981		14 JULY 1982		5 JULY 1983		16 JULY 1984		18 JULY 1985		23 JULY 1986	
		0/00,	T	0/00,	T	0/00,	T	0/00,	T	0/00,	T	0/00,	T
6.2	above Perrin Creek	26	25	23	23	23	23	22	22	25	24	22	27
12.4	Cedar Bush Creek	23	26	23	24	18	26	18	25	24	25	22	28
18.6	near Clay Bank	22	27	20	25	16	26	15	26	23	25	20	28
24.8	Poropotank River	18	27	16	27	13	27	11	27	21	26	17	28
31.0	Goff Point below West Point	14	27	9	28	8	28	8	27	18	26	16	29

Table 4.

RAPPAHANNOCK RIVER BOTTOM
Salinity (0/00, parts per thousand) and
Temperature (T, degrees centigrade)

LOCATION		15 JULY 1981		12 JULY 1982		28 JULY 1983		11 JULY 1985		23 JULY 1985		21 JULY 1986	
MILES FROM MOUTH	LANDMARK	0/00,	T	0/00,	T	0/00,	T	0/00,	T	0/00	T	0/00,	T
6.2	below Parrot's Island	16	30	16	25	17	28	13	25	17	26	16	26
12.4	above Corrotoman River	16	30	16	25	17	28	13	24	16	26	17	28
18.6	Weeks Creek	15	30	14	25	14	28	23	24	16	26	17	28
24.8	Morattico	15	30	13	25	12	28	--	—	15	26	14	28
31.0	Sharps	12	30	11	26	9	29	--	--	14	27	12	29
37.2		10	31	6	26	7	29	—	--	12	28	11	29
43.4	above Tappahannock Bridge	5	30	2	27	4	29	—	—	8	28	8	29
49.6	below Paynes Island	2	31	0	27	2	29	—	--	6	28	5	29
55.8	below Peedee Creek	1	32	0	28	0	29	—	--	2	28	2	29
62.0		0	32	0	28	0	29	—	--	1	29	2	29
68.2		0	32	0	28	0	29	—	—	0	29	1	29
74.4	Nanzatico Bay	0	32	0	28	0	30	—	—	0	29	0	30

OYSTER CONCERNS

Abnormal salinity conditions always raise concerns within the oyster industry for the health of the oyster fishery. The Institute monitors the effects of these events and alerts the oyster industry of our findings. In particular, questions are voiced regarding the effects on the James River seed beds and the possibilities of disease occurrences. This section will address these two concerns separately, beginning with the oyster resource in the James River.

In the previous tables salinity data for the James during the month of July in each of the previous five years and this year was summarized. The 1986 values for salinity at the four down-river stations (Newport News Bar, James River Bridge, below Wreck Shoal and Deep Water Shoal) were 24, 22, 19 and 13 o/oo respectively and differ very little from the six year mean values of 23.3, 21.5, 18.3 and 10.3 o/oo for the same stations. Salinity values are then not unusually high for these areas, a heartening observation in that high salinities are usually associated with upriver extension of the range of undesireable predators plus the spread of MSX. Perhaps of greater interest are the unusually high water temperatures for the aforementioned stations (28-29^{o}C range) compared to six year means of 25, 25.5, 26.3 and 27^{o}c respectively.

What might be the influence of elevated temperatures in conjunction with normal salinities on oyster condition, spawning, larval development and setting in the James, and what are our observations so far this year? Elevated temperature increases the rate of gonad production in the spring and stimulates early spawning. The result is a watery meat - an oyster of relatively poor condition. (It is suspected that the high water temperatures in the fall of 1985 which stimulated prolonged spawning in James River oysters was the cause of the relatively poor quality oysters at the opening of the 1985-1986 season. As part of a separate study the Institute has been collecting oysters from sites along the James from Deep Water Shoal to Nansemond Ridge at biweekly intervals since early June, and examining them for spawning condition. The oysters have generally been in poor spawning condition suggesting that they have indeed already spawned this year. However, peak settlement in the James usually occurs in August-September. Consequently, it can be expected that James River oysters will redevelop and spawn again later this summer. The Institute will continue to monitor this activity.

Increased temperatures are not expected to adversely affect larval survival. Extensive studies on the influence of temperature and salinity on the rate of development of oyster larvae suggest that larval survival and growth is optimal in the ranges of 20-30^{o}C and 20-30 o/oo salinity. The conditions in the James would, then, appear amenable to good larval survival; however, there has yet to be a good spatfall at shellstring monitoring stations in the James at any time in 1986. Temperature and salnity cannot be totally implicated in this picture because, in contrast, good sets have already been noted in the Great Wicomico and Piankatank River systems. Also, that settlement in the James is, as mentioned earlier, usually heaviest late in the season. Continuing efforts in spatfall monitoring will provide further information on this sybject as the summer progresses.

In summary, the drought is clearly having major impact on the local agricultural economy; however, present barometers of the health of the oyster resources do not suggest the need for undue worry. Nevertheless, the Institute will continue to monitor the situation.

The chief threat to oysters from the record high salinities now occurring in Virginia rivers is from MSX disease. MSX has demonstrated an ability to spread miles up the Bay in one year. During 1980-81 MSX moved up Bay into Maryland and caused extensive oyster mortality.

There are two areas of concern for Virginia waters. The first is the regions with typically low-level MSX activity such as the lower Rappahannock and Great Wicomico Rivers and Pocomoke Sound will become areas of high-level MSX activity as salinity incrases. Samples collected in early June 1986 from both rivers had MSX prevalences between 4 and 8% - fairly typical for the region. The danger is that these areas may experience greater than normal exposure to MSX infection if salinities remain high during late summer and, if the drought continues and there is no typical low-salinity spring explusion of MSX, this could result in much higher than normal mortalities during early summer of 1987.

The other area of concern is the possible infestation of oysters on the James River seed bed. Salinities are presently favorable for MSX as far upstream as Horsehead Shoal. Transplanting of infected seed oysters from the James River during winter of 1986-87 may result in high mortalities the following summer, if the drought continues and there is no low-salinity explusion of the parasite in the spring.

Results of the VIMS monitoring program to date indicate that this will be a summer with high MSX activity in contrast to the last two years. A sample of James River seed oysters held in trays in Gloucester Point had an MSX prevalence of 48% on 1 August 1986. Five gapers (dead oysters still containing meat) recovered from the trays all had heavy MSX infections. Oystermen can expect higher mortality during August and September 1986 than during the last two years.

The Institute will be conducting additional disease monitoring this fall. At that time a better indication of summer disease infections will be available. If abnormally high occurrences are observed further advisories will be issued to the oyster industry.

Information in this Marine Resource Advisory was provided by Drs. Gene Burreson, Al Kuo and Roger Mann of the Virginia Institute of Marine Science. For additional information contact Sea Grant Marine Advisory Services, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062 (804/642-7164).

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