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Plans for Management of the Fisheries of the Tidal Potomac River

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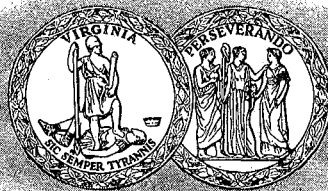
PLANS FOR MANAGEMENT
OF THE
FISHERIES
OF THE
TIDAL POTOMAC RIVER



SRAMSOE NO. 117

CEES - REF. NO. 76-123 CBL

COMMONWEALTH OF VIRGINIA



VIRGINIA INSTITUTE OF MARINE SCIENCE

GLOUCESTER POINT, VIRGINIA 23062

August 13, 1976

Honorable James E. Douglas, Jr.
Chairman, PRFC
C/O Virginia Marine Resources Commission
P. O. Box 756
Newport News, Virginia 23607

Dear Mr. Douglas:

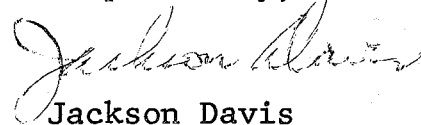
Herewith is a draft of suggested management plans for fisheries of the tidal Potomac prepared at the request of the Commission by CBL and VIMS. This is the first time you have seen the entire package. Previously we have given you various sections and have had some discussion of them.

The next steps, in our view, are for the Commission to modify this plan as it deems desirable and then to adopt the modified plan as its long-range guideline. One of the two plans for the oyster fishery must be discarded. If Plan I is adopted the range of options must be narrowed. If Plan II is adopted, additional monies must be obtained. Other modifications may be desirable.

We recommend including in the adopted plan a schedule of implementation which lays out the actions which need be taken and the agencies which must take them. This schedule should include, to the extent practical, a timetable while recognizing that some elements will not be under control of PRFC.

We hope that these ideas will be useful to the Commission in its deliberations. We remain available to assist with revision if that should be your wish.

Respectfully,



Jackson Davis

JD:at

cc: Commissioners of PRFC
Mr. R. M. Norris
Mr. K. A. Carpenter
Mr. J. Owen Wise

PLANS FOR MANAGEMENT OF THE FISHERIES OF THE
TIDAL POTOMAC RIVER

By

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August 1976

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INTRODUCTION

The Potomac River Fisheries Commission has requested of its scientific advisors suggestions for long range management plans for the fisheries under its jurisdiction. This report presents such plans and brief discussion of their basis and procedure for implementation. The PRFC is charged by the preamble of the Compact with the establishment and maintenance of a program to conserve and improve the Potomac fishery resources.

We have presumed that the goals of management are: 1) to maintain the populations on a sustained yield basis, 2) to provide seafood, 3) to provide recreation, 4) to contribute to economic activity through employment and other business activity in the seafood and recreation industries. We recognize that adoption of a specific plan will require a more detailed definition of goals, especially in economic terms.

In compiling these plans the committee has recognized that fisheries resources are valuable not only because of the food, recreation and employment that they provide, but also because of their interacting roles in the estuarine ecosystem. For example, oysters have been considered not only from their role in the seafood industry, but also from their role in the estuarine web of life. An oyster bed is the habitat of many other kinds of marine life including valuable fishes. Increasing the quantity of oysters can be expected to increase the production of other food and recreational resources.

Constraints under which a management plan must operate are 1) the hydrography of the Potomac River and the adjacent Chesapeake Bay, 2) the biology of the organisms, 3) water quality, and 4) economic, social, and political custom and law. These four constraints are variously amenable to control or modification by the PRFC with the last being most readily changed and the first being the least so.

The fisheries are also variously amenable to control. Migratory fishes and crabs which do not remain within the jurisdiction of PRFC present fewer opportunities for effective management than do the sedentary shellfishes. Therefore we have developed in some detail plans for management of the oyster fishery, whereas for finfishes and crabs we present suggestions for better utilization but cannot design total management programs.

In brief, we recommend as one option (Plan I) expansion of the oyster fishery to make greater use of the tremendous potential of the Potomac as a growing area by leasing barren bottom for privately financed aquaculture. The natural oyster bottoms would be held in the public domain under management much as now exists. A second option (Plan II) would continue the public fishery as it is now managed. We recommend that the soft clam fishery be managed as at present and that consideration be given to development of a fishery for brackish water clams in the future. Slight modification of size limits on crabs is recommended to increase the value of the catch. No fundamental change is recommended in the

finfishery, though some regulations might be changed to maximize the yield.

Although the PRFC does not have jurisdiction over such matters as water quality, sewage treatment, industrial development, and land use in the Potomac watershed, we suggest the Commission continue to use its public position to try to influence decisions in instances which will affect fisheries. Pollution and siltation have damaged fish spawning and nursery areas of the Potomac, perhaps having more effect on some fish populations than does the harvesting, which the Commission regulates. Oxygen depletion, which has extirpated oysters from waters deeper than 20 feet, stems from over-enrichment by sewage effluent and surface runoff. In addition the shellfisheries are sensitive to bacterial pollution.

OYSTER FISHERY

History and Description of the Oyster Fishery

Introduction

The shellfish fishery of the Potomac and its tributaries is largely a public fishery as distinguished from one where private enterprise plays a major role in production, as for example, in Virginia, where most oyster production comes from leased bottoms. The entire main stem of the Potomac consists of public bottoms and no areas are leased to private enterprise. In the Maryland tributaries in 1974, there were only 772 acres under lease (F. Sieling, Pers. Comm., 1975). In the Virginia tributaries in 1972 there were 8,100 acres under lease.

The Potomac and its tributaries today are administered by three agencies which manage the public fishery, collect taxes, conduct repletion efforts and formulate fisheries regulations. These are: the Maryland Department of Natural Resources (MDNR) which administers the tributary creeks in Maryland, the Virginia Marine Resources Commission (VMRC) which has jurisdiction over the tributary systems in Virginia, and the Potomac River Fisheries Commission (PRCF) which administers the main stem of the Potomac. Enforcement of laws and regulations is by joint action of the Maryland and Virginia agencies.

Description of the Oyster Producing Areas

The main stem of the Potomac has extensive areas of bottom suitable for growing oysters extending from Upper Cedar

Point Bar in the upper estuary 54 miles downriver to the mouth. Within this range oysters occur on oyster rocks or oyster bars scattered throughout the system. The depths of these oyster beds range from about 4 to 28 feet; most are located at depths ranging from 5 to 18 ft. Figures 1 and 2 show the approximate location and the names of the more important of these bars which in the past have contained or today contain areas of productive oyster bottoms. Since the summer of 1972 the oyster bars above the mouth of the Wicomico River (above Cobb Island Bar) have been almost completely devoid of oysters as a result of a fresh water kill associated with Tropical Storm Agnes (Haven, et al. 1974). Below Cobb Island Bar oysters occur in widely scattered concentrations within the indicated areas.

The productive tributary systems in Maryland include the Wicomico River, Saint Clements Bay, Breton Bay, Saint George's Creek and Saint Mary's River. In Virginia productive public rocks are found in Nomini Creek, Lower Machodoc Creek, the Yeocomico River and the Coan River.

Characteristics of the Oyster Growing Area

The Potomac has several unique characteristics which make it highly suitable for oyster culture, but others which influence production adversely. Survival of oysters is good in the Potomac and its tributaries because salinities are, on the average, too low to allow the establishment of known diseases and predators. Meat quality is high and oysters are usually single and well shaped. These two characteristics

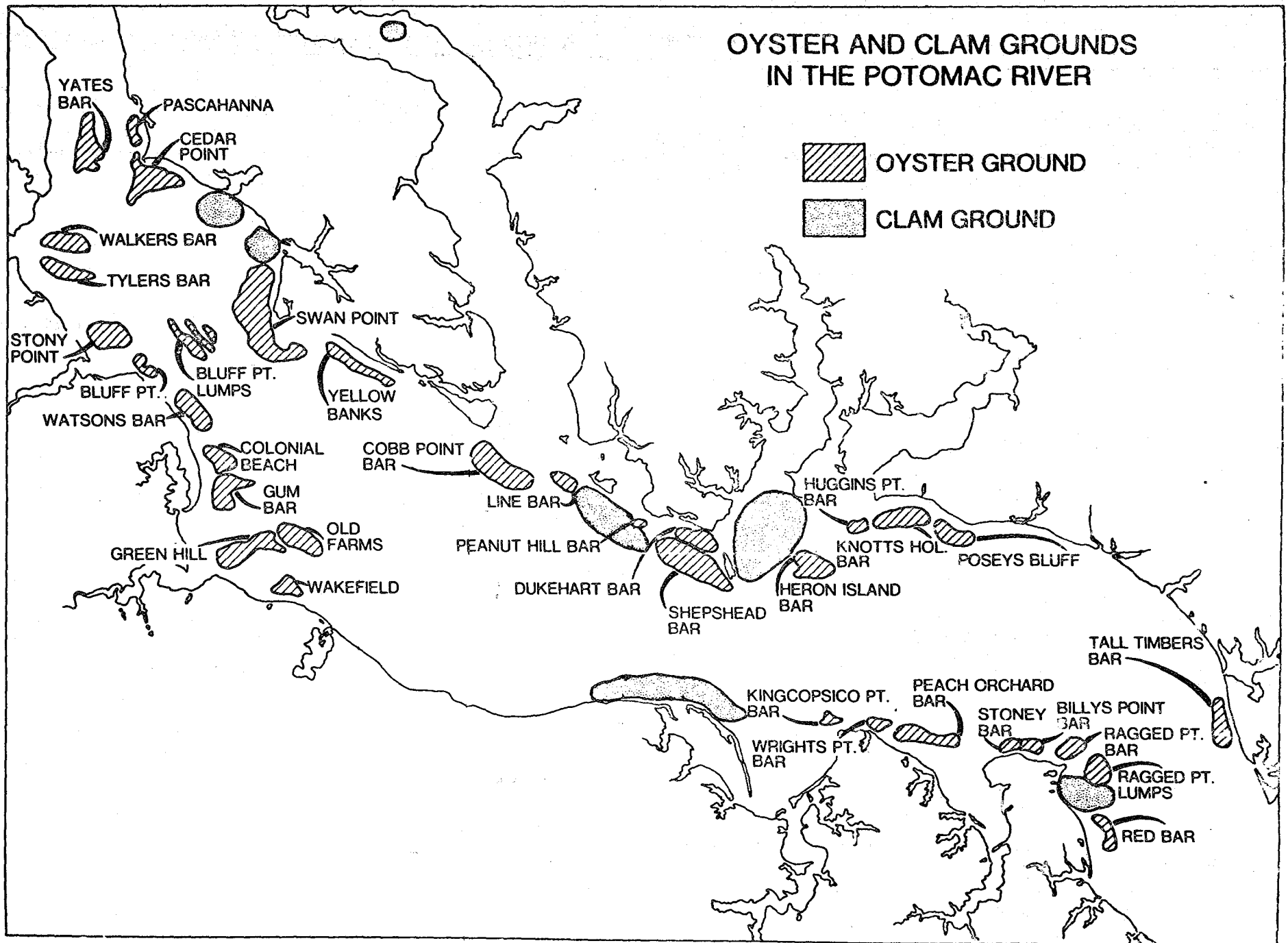


FIGURE 1. Locations Where Oysters and Soft Clams Occur in the Upper Potomac River

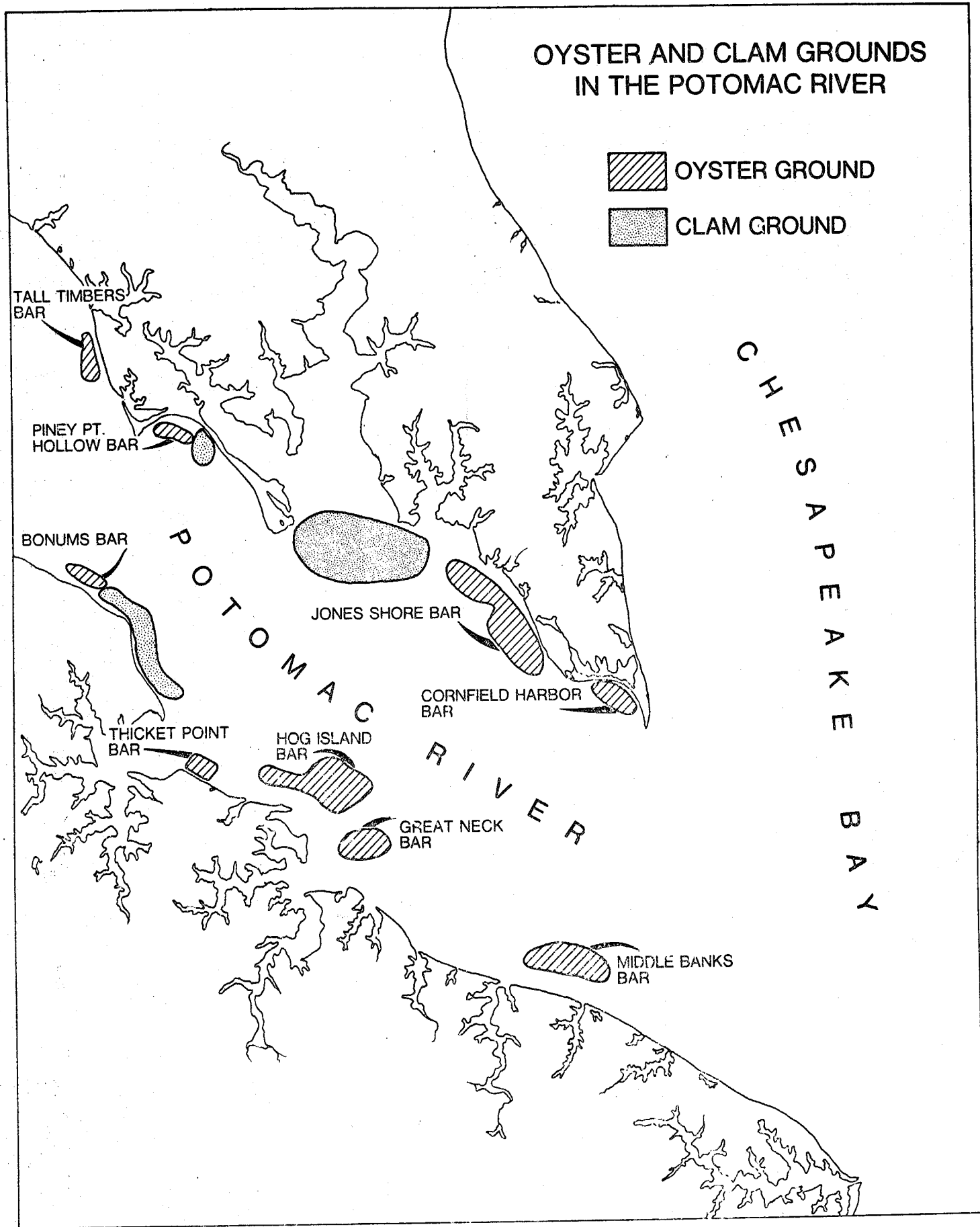


FIGURE 2. Locations Where Oysters and Soft Clams Occur in the Lower Potomac River

are desirable, therefore, Potomac River oysters often bring a premium price. Growth of oysters is rapid over large areas of the Potomac and its tributaries. It is slow only at the upper bars and at the uppermost portions of the tributaries.

There are adverse aspects of the Potomac system which frequently limit oyster production. Low setting levels (attachment of larvae to shell substrate) are the principal cause of low productivity and have been characteristic of the system ever since records have been collected. The setting season extends from late June to September with peaks of set usually occurring in July and sometimes in September. However, in most areas and during most years setting is too sparse or irregular to provide a dependable crop. For example, from 1942 to 1963 set in the upper Potomac averaged only 8 spat per bushel of bottom cultch and 14 spat per bushel in the mid-section off Colonial Beach. The exceptions to this occur in a small area along the Maryland shore below St. George's Island and in the St. Mary's River where average set during the period was 78 spat per bushel. Recent studies by VIMS, the Chesapeake Biological Laboratory (CBL) and the MDNR indicate no change in the basic pattern of setting or setting intensity. Density of oysters in the system depends on the rare heavy set (every 10 to 15 years) which provides stock for many years. Above average or exceptional sets occurred in the upper and mid sections of the river in 1930, 1931, 1943, 1951 and 1963. In the lower Potomac, records since 1942 show above average sets occurring in 1942, 1950, 1951, 1962, 1963 and 1974. Although

these exceptional years produced stocks which were harvested by watermen over several years, production again dropped to very low levels when they were fished out. Because of this irregular setting pattern, the Potomac as well as many of its tributaries, have shown an irregular pattern of production ranging from almost zero to over one million bushels of oysters annually (Figure 3).

The uppermost oyster bars of the main stem of the Potomac as well as in several tributary creeks are subject to fresh water kill during years of excessive freshwater run off. In 1972 (as previously cited) over half of the oysters in the Potomac were killed by fresh water associated with Tropical Storm Agnes. The division between nearly complete mortality and good survival was a line extending from Cobb Island in Maryland across the river to Popes Creek in Virginia. This catastrophic event, however, is regarded as atypical (once in over 200 years) for the system. More frequent (approximately 30 year intervals) fresh water mortalities occur in the populations above the U.S. 301 bridge.

Low levels of dissolved oxygen are another unfavorable aspect of oyster growth in the Potomac. Oxygen characteristically becomes low in the deeper waters of Chesapeake Bay and in the lower Potomac in late summer. In the lower Potomac the amount of dissolved oxygen limits oyster survival in the deeper water. For example, in September 1973 dissolved oxygen was zero at 18 feet or deeper over wide areas in the lower Potomac and a significant mortality of oysters occurred.

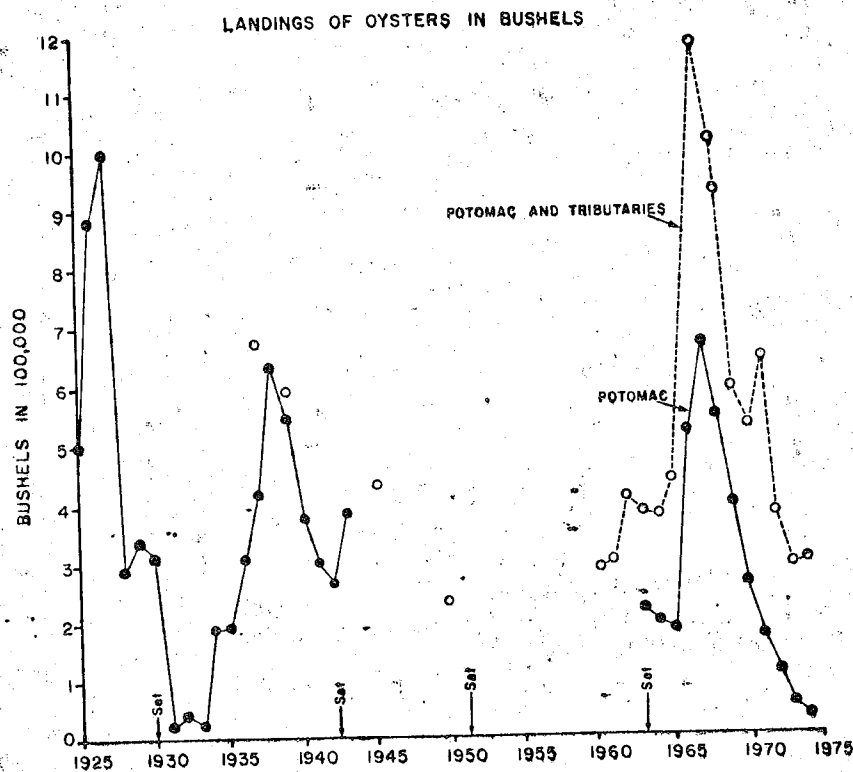


Figure 3. Landings of oysters in the Potomac River 1925 to 1975. Occurrence of river-wide sets of oysters is noted.

Another unfavorable aspect concerning oyster culture in the Potomac is that shell cultch, which provides a substrate for oyster larval attachment, is becoming less abundant and this aspect is a major limiting factor to oyster production. Oysters occur in the Potomac River and its tributaries on rocks or bars which are nothing more than slightly elevated patches of exposed shell or oysters. In most instances, these areas represent accumulations of shell material over many years and the bed of shell may extend many feet below the surface of the sediment. It is axiomatic that if exposed shell or oysters are absent, or if they become covered with sediment or fouled with marine growth, then there will be no sites for larval attachment and recruitment will be nearly zero. Over the years there has been a major reduction in areas with suitable bottom substrate and this factor undoubtedly has reduced yields in the system.

Commercial Landings of Oysters

Statistics on landings of oysters for the Potomac River and its tributaries have been compiled by the National Marine Fisheries Service (NMFS) since 1935 on the basis of a tax levied on landings. Between 1935 and 1959 these data are available only for occasional years. From 1960 to the present data are given yearly. These data are given for the counties where the shellfish are landed and not for the locations from which they were harvested. The Potomac River catch attributed to Maryland is tabulated for Saint Mary's and Charles County combined and this division includes the Patuxent River

which is not a part of the Potomac. In the similar manner, Virginia landings are for King George, Westmoreland and Northumberland counties and this includes the Great Wicomico River which is also not a part of the Potomac. As a consequence of inclusion of the two unrelated systems the landings would appear to be in excess of their actual value. Many competent management officials, however, feel that the collection of the tax on landings in all areas is incomplete, and therefore, data, even with the combined total of the two systems, may actually underestimate their true magnitude.

In 1963 the PRFC began collecting statistics on landings on all shellfish from the main stem of the Potomac based on a dual system of reporting: a tax levied on landings and information on catch supplied by the harvester. While these data are the most accurate available, they are still believed to be less than actual landings because of under-reporting. Data on catch for the main stem of the Potomac from 1925 to 1943 are available from information collected by the U. S. Army Corps of Engineers under Section II of the Rivers and Harbors Act of 1922 (Frey, 1946).

Landings of oysters from the main stem of the Potomac River indicate major fluctuations in availability over a 50 year period (Figure 3). Peak landings in 1926 in excess of 1 million bushels were followed five years later by a production of less than 25 thousand bushels. A second peak in 1938 of about 625 thousand was followed four years later with a low of about 275 thousand bushels. In 1967 over 650 thousand bushels were landed but this was followed by a rapid decline to only 36 thousand bushels in 1975. In all instances, it can

be seen that good setting years in the mid or upper estuary were followed 4 or 5 years later by a peak in production (Figure 3).

The landings based on NMFS data for the Potomac and its tributaries from 1938 to 1960 are too scattered to form any firm conclusions. They do, however, suggest that a low level of production occurred in 1950. After 1960, production rose from 283 thousand bushels in that year to 1,196 thousand bushels in 1966; thereafter, production rapidly declined to only 295 thousand bushels in 1974. In respect to this decline, it is noted that the downward trend was well established prior to Tropical Storm Agnes in 1972. That is, Agnes merely accelerated a change started several years previously.

It is noted that landings from the main stem of the system averaged from 1/2 to 1/3 that of the entire system. The trend shown by data from the main stem, however, follows that of the entire system suggesting that factors which influence production in the main stem are also common in the tributaries.

Plan I

Private Oyster Fishery on Selected Leased Bottoms, Along with Public Fishery on "Natural" Bottoms

Introduction and Rationale

Management of Potomac fisheries under the Compact of 1785 required concurrent legislation by the Maryland and Virginia legislatures. During the life of that compact, agreement was confined to a few non-controversial matters such as harvest seasons and the minimum size of oysters. Basic policy differences were avoided, including those concerning methods of harvest and bottom utilization. In part because of this inadequate management mechanism, oyster rehabilitative activities were not supported by Maryland.

Significant replenishment and restoration of Potomac oyster bottoms was not undertaken until the Potomac River Compact of 1958 was ratified and fully implemented. Thus for about 175 years the river endured "all take and no put back." Since a large portion of the total harvest of oysters was illegal, and such oysters are not culled where they are caught, even the benefit of culled cultch and submarket oysters returned to the bottom was denied to the river bottoms for much of the harvest.

After years of overfishing with no rehabilitation, the oyster producing part of the Potomac had a lot of catching up to do. The PRFC has done as much as it could, but the resources available have been small compared to the magnitude of the need for restoration. No significant increase in PRFC

rehabilitative capability is foreseen for the near future - in fact, inflation and lower catches are actually reducing it.

From the U. S. 301 bridge to the mouth of the river there are in the neighborhood of 20,000 acres of bottom in the depths between 3 and 18 feet which could be used for oyster culture leases. This approximation was reached after allowing for oyster bars and plantings, clamming areas, channels and other unsuitable bottom, and for buffer zones between public and leasable bottoms.

The rationale for considering a dual oyster fishery management system which includes leasing of bottoms for private oyster culture, along with public bottoms given as much rehabilitative support as possible, can be summarized:

- Survival and growth of oysters is good, and there are many acres of barren bottom without shell which will not produce oysters naturally, but will produce them under cultural techniques which lesses would practice.
- Setting of oysters in the Potomac (except for a few areas near the mouth) is very poor. Populations of oysters over most of the river have stemmed from irregular sets which have occurred only about 5 times in the past 50 years.
- The resources (especially financial) available for management of public bottoms are inadequate for the restoration and maintenance of desirable levels of production.
- The cost of rehabilitative materials (shells, seed, etc.) and activities has increased faster than PRFC sources of funds for rehabilitation.

- PRFC is forced by these circumstances to leave large areas of potentially productive bottom barren or sparsely populated, thus the very great oyster-producing potential of the Potomac is not being fully utilized.
- Infusion of private capital would permit the utilization of extensive potentially productive bottoms which are now barren of oysters.
- Recent natural disasters which have (we hope temporarily) removed much bottom from production, have made necessary the additional rehabilitative effort needed to restore the depleted bars.
- The additional acreage under private culture will significantly add to the oyster brood stock in the river.
- Additional acreage of live oysters is ecologically beneficial because the "oyster community" is the basis of a food pyramid which is utilized by desirable species of fish.

We envision the most likely problems for contiguous public and private oyster culture in the Potomac to be:

- Protection of both areas from poaching.
- Ensuring an adequate seed supply.
- Maintaining clearly recognized, safe territorial markers.
- Preventing monopolistic control of leased bottoms.

- Because of the likely difference in harvest methods on public and private bottoms, there will be a temptation to use more efficient methods on public bottoms that cannot sustain such pressure.
- Maintaining an effective repletion program on public bottoms (some will say - we don't need it now) when there is significant production on adjacent leased bottoms.

It should be clearly stated and understood that lessees would have no proprietary rights to bottoms per se, but that they would be granted the temporary privilege of using a public resource - and that their use of it would contribute to a total system of management which could only function properly when plantings and yields of all bottoms are known. The leased bottoms would still be part of a biological system which does not recognize political boundaries.

If a dual (public and private) fishery management system is instituted in the Potomac, rehabilitation of the public bottoms, as described above, should still be continued.

Plan I is essentially the program recommended to the PRFC by G. F. Beavan and J. D. Andrews in 1964.

History of Leasing in the Potomac

Leasing of oyster bottoms in the Potomac River is not permitted today, but this has not always been the situation.

In 1906, the Haman Act of Maryland authorized that the waters in Maryland (which includes the main stem of the Potomac) be classed either as natural bars, which would be

maintained for the public, or as barren bottoms, which would be open for leasing, plus an additional classification for clamming and crabbing.

The leasing of bottom under the Haman Act met with considerable opposition on the part of watermen. Consequently, the Maryland legislature (the Sheppard Bill) called for a resurvey of Maryland bottoms and 54,000 acres were added to the public domain. Further restrictions were imposed on leasing as a result of several court cases in 1947, thus it became virtually impossible to lease bottoms in Maryland. This situation still existed when the Potomac River Fisheries Commission assumed jurisdiction of the main stem of the Potomac in 1963.

The Potomac River Fisheries Commission began many needed programs; repletion, collection of statistics, re-writing regulations, etc. However, it inherited from Maryland the concept of public ownership of the resource. It was stipulated in the compact, however, that leasing of bottoms could be authorized by the legislatures of both Maryland and Virginia.

While such joint action would involve considerable effort it was still foreseen as a possibility. Therefore, several options are considered below under which bottoms might be leased at some future date. As a guide in preparing these options, laws and regulations relating to leasing for Atlantic and Gulf Coast States are reviewed.

Leasing in Atlantic and Gulf Coast States

The Potomac River Fisheries Commission is the only regulating agency in the Atlantic and Gulf Coast region which

completely bans leasing.

None of the Atlantic and Gulf Coast states obtain much revenue for their leased bottoms on a per acre basis, and annual fees range from 25¢ an acre in Georgia to \$5.00 per year in Florida. Maryland and Virginia are about in mid range and annual fees are respectively, \$1.00 and \$1.50 for most bottoms. Another aspect of most leasing practices is that states seem to obtain only minimal fees or tax when oysters are harvested. Only in three states, North Carolina, New Jersey and Delaware, where taxes are from 8¢ to 10¢ a bushel is the tax other than a token.

Much variability exists in the period for which leases are issued, and the time extends from 3 to 10 years in Connecticut up to 30 years in New Jersey. Total acreage a lessee may hold also shows much variability. Florida issues leasing units of 25 acres while Virginia allows 3,000 acre as a maximum holding by a corporation or an individual. The remaining states have acreages between these extremes.

Many states have laws or regulations stipulating that a lease must be used to produce oysters or that shell be planted. Failure to comply in states having such regulations results in forfeiting of the lease or a fine. Virginia, New Jersey and Connecticut have no requirements that a lease be used. In contrast, all the remaining states place some responsibility on the lease holder to use or farm his lease. The most rigorous requirements are in Florida where lease holders must (after a period) produce 800 bushels of oysters per acre or

forfeit the lease.

In summary all Atlantic and Gulf Coast regulatory agencies except the Potomac River Fisheries Commission permit leasing. In most instances the regulatory agencies realize only minimal monetary returns from the use of the state bottoms, and in all probability revenues are at best sufficient to cover only administrative costs.

The harvest of oysters on leased bottoms by dredging is permitted in all locations and some states impose no restrictions on the use of other mechanical gear.

Some states require that a lease be used for oyster culture. There are definite advantages to this requirement. When annual rental or leasing fees are low, as they are in nearly all areas, growers may hold title to a lease almost indefinitely with little cost. By doing this they may exclude others (who may wish to grow oysters) from using good growing bottoms. The fine or stipulation that a lease may be forfeited gives the regulatory agency the opportunity to discourage this practice.

Options for Leasing Bottoms in the Potomac

Option 1

Allow the leasing of all barren (unproductive) areas in the Potomac (approximately 20,000 acres). Barren areas would be defined by one of the following:

- a) All areas except those designated as oyster bottoms in the files of the PRFC, and areas planted with shell or oysters by the PRFC and those which were designated as open for soft clam

line on a pilot or trial basis. Do not allow leasing below the line extending from Kingscopsico to Blakiston Island.

Mechanisms of Issuing Leases

Tracts to be offered for lease should be designated by the PRFC. Size and shape of tracts should be such that administrative costs (surveying, marking, plotting) are reasonable. We recommend that tracts be square or rectangular, unless there are pressing reasons to the contrary. Surveying and plotting could be accomplished by a system having the accuracy of Hastings-Raydist.

A buffer zone expected to remain barren of oysters should be maintained between leased tracts and tracts open to the public fishery and tracts used in the PRFC culture program.

Institution of a leasing program involves two aspects, the original issuance of a lease and the year-to-year collection of fees and maintenance of records of compliance with the conditions of the leases.

Several options for issuing leases should be considered as follows:

1. Open or sealed bid
 - a) With established minimum fee
 - b) Without minimum fee
 2. Lottery
 3. First come-first served
 4. Eligibility preference based on historic participation in the Potomac River oyster fishery.
- Lease tracts would be made available first to

those who have held licenses to harvest oysters from the Potomac River. This sort of scheme can rank people in terms of number of years of participation, amount of harvest, proportion of income derived from oystering, etc. Option 1, 2 or 3 would then be applied to the list of eligibles.

Once leases were issued, annual fees could be assessed by one of the following:

1. Fixed annual fee per acre
2. Fixed annual fee per acre plus a fee based on value or volume of oysters harvested.
3. Fixed annual fee per acre, part or all of which is deferred until oysters are harvested, plus a fee based on harvest.

Stipulations of Leases

1. Consideration should be given to establishing maximum and minimum acreage to be held by one lessee. We suggest 25 as a minimum and 200 as a maximum, though we have some reservation concerning the effectiveness of the maximum limitation.
2. Leases should be for 20 years with option to renew, but not guaranteed renewal.
3. Leases must be forfeited if a lease holder after a reasonable time can not show production of at least 50 bu. of oyster/year/acre for each leased tract except that the PRFC may, at its discretion, suspend forfeit in cases where natural disasters have limited or prevented production.

4. Lessees must report planting and other cultural activities in summary form within 30 days after completion.
5. Lessees must report production within the calendar year in which the oysters were harvested.
6. Oysters may be harvested by any method approved by PRFC (include tongs, dredges of various sorts). Season of harvest is at the discretion of the PRFC.
7. Oyster seed source must be approved by PRFC prior to planting.
8. Lessees must be residents of Virginia or Maryland and may not sublease.
9. Provide for termination in public interest (utility, highway, navigation channel, etc.) with lessee being paid by the condemning authority for proven capital investment and value of the existing crop.
10. PRFC or its agents may inspect leased bottoms.
11. Lease must be marked as prescribed by PRFC.
12. Leases are subject to the rights of others to freely use the superadjacent waters and specifically to the following activities:
 1. Setting and fishing crab pots and eel pots.
 2. Fishing by anchored gill nets, by hook and line, by haul seine. The status of duck blinds should be clarified.
 3. Government activity in fisheries management, public health survey, gathering data for scientific investigations and or environmental management and utilization.
13. Matters related to shellfish culture not stipulated here should be subject to regulation by the PRFC.

14. The lessee will be responsible for all costs involved in surveys of oyster bottoms and resurveying costs in the event markers are lost.
15. Leases are for the culture of oysters, not for the harvest of clams or other seafood organisms.

Plan II

Public Fishery Supported by Natural Yield Supplemented by Publically Financed Oyster Culture

The plan now in effect depends on a combination of natural reproduction and oyster culture by PRFC. Such success as this program has enjoyed stems from an unusually heavy and widespread set in the Potomac River in 1963 and on judicious use by the Commission of its repletion funds.

This plan is fundamentally weak in the degree to which it depends on natural reproduction and in its financial base. Natural reproduction in the Potomac River is both irregular and unpredictable. The last good general spatfall was in 1963. Good general spatfall also occurred in 1951 and perhaps in 1943 (data base is weak for 1943). Some increase in set is technically obtainable, but the cost would be great because hydrography of the Potomac is not conducive of good sets on a regular basis. Only infrequently have conditions resulted in good spatfall throughout the estuary.

The weakness of the financial base stems from the discrepancy between the cost to PRFC of its aquacultural program and the return in taxes from the harvested oysters. One bushel

of seed yields about three bushels of market oysters, but PRFC pays approximately \$2.00 per bushel for seed (average of \$1.90 from 1970 through 1974) and recovers at the most \$0.75 (25¢ per bushel for 3 bushels). Thus for the seed-planting program to break even at least 5 bushels of naturally produced oysters must be harvested for each bushel of seed planted. The cultch-planting program is estimated to cost about \$1.00 for each bushel of oysters harvested; therefore in this case 3 bushels of naturally produced oysters must be harvested for each bushel taken from planted cultch. The basis of our estimate on the cultch program is weak, but the figures probably indicate the order of magnitude of the difference. Thus the oyster culture program is clearly not on a self-sustaining basis under the present tax schedule and natural reproduction falls short of making up the deficit.

Should PRFC decide to continue with this plan, it would seem necessary to obtain more money and more seed oysters than are now readily available.

We recommend that rehabilitative efforts on the public oyster bottoms be continued, with the following priorities:

1. Maximum utilization of the Jones Shore area for seed production by planting shell cultch and harvesting the sets obtained for transplantation to other parts of the river.

If residual populations of spat on the seed areas (less than 300/bushel) are allowed to grow out for harvest as adult market oysters, such areas would be out of use for seed production for 3-4 years. This could be tolerated

as long as there isn't enough money (or shells) to plant all of the usable seed area every year, but when shell planting resources are adequate it would severely limit seed production - not a good choice because the only good seed-producing bottoms in the river would then be limited to one crop of seed out of every 4-5 years.7

2. Transplantation of Jones Shore seed to good growing bottoms in the middle of the oyster-producing portion of the river.
3. Planting shells on other lower river bottoms, the resulting set to be left in place for maturation to market size (set and grow).
4. Maintenance of brood reserves on severely depleted upriver bottoms, supplemented by a sprinkling of spat every other year to improve the sex ratio. These bottoms should remain closed to harvesting until there has been significant reproduction and recovery on them, or until there is sufficient seed to plant them extensively enough to sustain pre-AGNES levels of harvest pressure.

SOFT-SHELL CLAM FISHERY

Commercial harvest of soft-shell clams (Mya arenaria) has been a recent development in the Potomac. They have been a valuable resource in years when they were abundant.

This is essentially a northern species which is at the southern limit of its range in the Chesapeake region. It can be weakened or killed by high temperatures. There is more stress on these clams when high temperatures are accompanied by low salinity. At least one poorly known pathogen is also associated with some mortalities. Soft-shell clams are preyed upon naturally by crabs and by some fishes, and they are an important waterfowl food, thus they are a significant part of the food web for other useful organisms.

In the Potomac they coexist with oysters in the middle and upper portions of the oysters' range, but they prefer mixed sand and mud substrates that usually do not support many oysters. Unlike New England clams, those in the Potomac are subtidal and cannot be harvested by hand digging except during the very infrequent extreme low tides of winter. Spawning occurs in the spring and in the fall but only the fall sets survive. Growth is rapid, and the minimum market size of 2 inches can be reached in about 20 months.

Commercial harvesting does not ordinarily deplete soft-shell clam brood stocks because: (1) there are populations in waters that are either too shallow or too deep for operation of the hydraulic escalator dredge; (2) there are clams in some areas closed to harvesting such as oyster bars; and (3) the usually irregular paths of dredges leave some clams untouched after

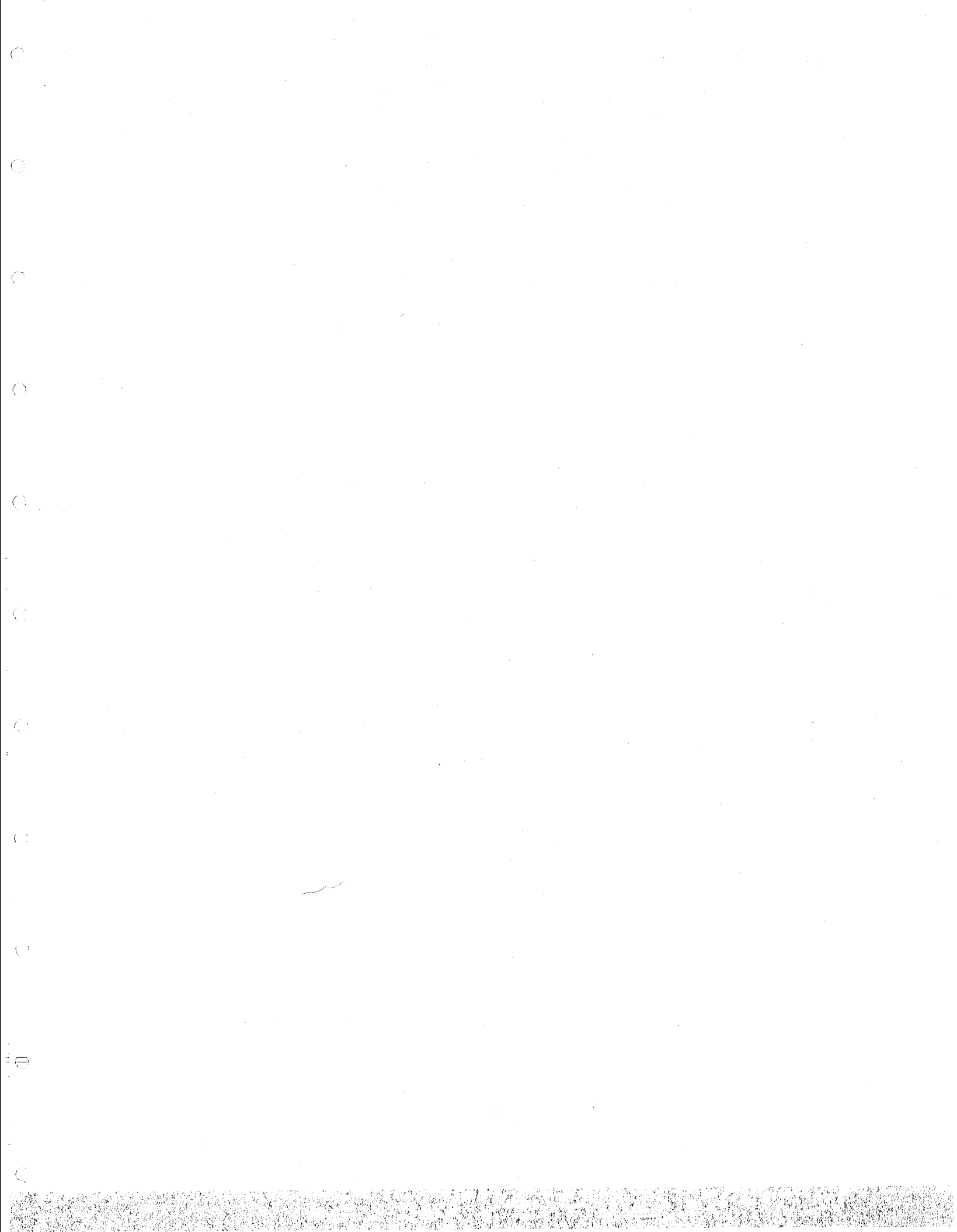
the catch per unit effort has become too low to justify continued dredging. A limited area can be "cleaned" of clams when harvesting is restricted to a small plot and high prices stimulate continued effort, but this has not happened over a large enough area to affect recruitment.

It is believed that the present low population level is part of a natural fluctuation and that clams will return to their former abundance as environmental factors improve. Seeding is neither practical or necessary. The soft-shell clams of the Potomac can be utilized whenever they are available in numbers that will support a dependable fishery. Because there is no active "culture" possible in the way that oysters can be planted and harvested, we recommend that clam bottoms remain a public fishery.

A management program should include the following:

1. Bottom surveys to determine where clams can be harvested. "Best use" criteria should be applied. By "best use" we mean that: 1) Clam bottom should either have a live population of clams, have some evidence of previous clam populations, or have bottom characteristics favorable for clams; and 2) No present oyster bottom, or past oyster bottom which can be rehabilitated for oyster growing, should be zoned for clamming. It is believed that there are enough areas of good clam bottom that are free of oysters to support a useful fishery during periods of clam abundance. (If oyster bottoms are leased in the Potomac, special care

- should be taken to reserve good clam bottoms).
2. Zoning of harvest areas to prevent conflicts with other resources, such as oystering and recreational beach use, or where it threatens to seriously damage rooted vegetation.
 3. Monitoring of population levels through observation of harvest activities, catch records, and periodic surveys.
 4. Closed seasons do not appear to be needed unless bacteria counts become high enough to necessitate short periods of closure - primarily to keep moribund clams off the market.
 5. Continuation of the 2-inch minimum size limit.
 6. Temporary closure of areas where intense harvesting threatens to remove nearly all of the clams.



BRACKISH WATER CLAM

The brackish water clam (Rangia cuneata) has a range which extends from near the limit of detectable salinity upstream to within the low salinity portions of the oyster and soft-shell clam habitat. Its center of abundance is usually upstream of any significant numbers of oysters and soft-shell clams, where it often occupies mud and clay bottoms that are not utilized by other species. The sporadic populations, which at various times are extremely abundant and at others almost nonexistent, are influenced by the reproductive physiology of this clam. Rangia is stimulated to spawn by sharp changes in salinity (which is always a decrease in the Potomac).

Small Rangia are eaten by waterfowl, but they don't eat the large ones which have thick shells.

Because of population fluctuations Rangia could not support a stable fishery. Commercial harvest should be confined to the area above the range of oysters and clams. There is no present justification for size or season limits. If Rangia is harvested commercially, catches and populations should be closely monitored in order to fill gaps in our knowledge of this previously unexploited resource.

BLUE CRAB FISHERY

The Potomac River hard crab catch in recent years, 1968-1975, has been 2.5 to 3 percent of the total catch of the Chesapeake Bay and its tributaries. Generally, trends in catch in the Potomac River parallel trends in the bay catch.

Knowledge of the life history of the blue crab is necessary for an understanding of the time and intensity of the harvest (Fig. 4).

All blue crabs in the Chesapeake Bay are hatched in the high saline waters of the southern part of Chesapeake Bay (or at the bay mouth or in oceanic waters immediately adjacent) and migrate as juveniles to the tributaries of the Bay. Therefore, management of crab stocks in the Potomac River would consist in wise utilization of those crabs which have fortuitously found their way into the Potomac River.

Crabs become commercially available first as peeler crabs (3 1/2 inches in maximum width, current regulation) in the summer (July-August) one year after hatching. Those that hatch late (September-October) and slow-growing crabs, may not reach 3 1/2 inches width until the spring of the third summer of life (two years after hatching).

Most crabs attain a width of five inches or larger (current legal size for hard crabs) between mid-July and October the summer after hatching. Males become sexually mature at a width of three to four inches, may mate with many females, and continue to grow. Most males remain in brackish water after reaching sexual maturity.

BLUE CRAB *Callinectes sapidus*

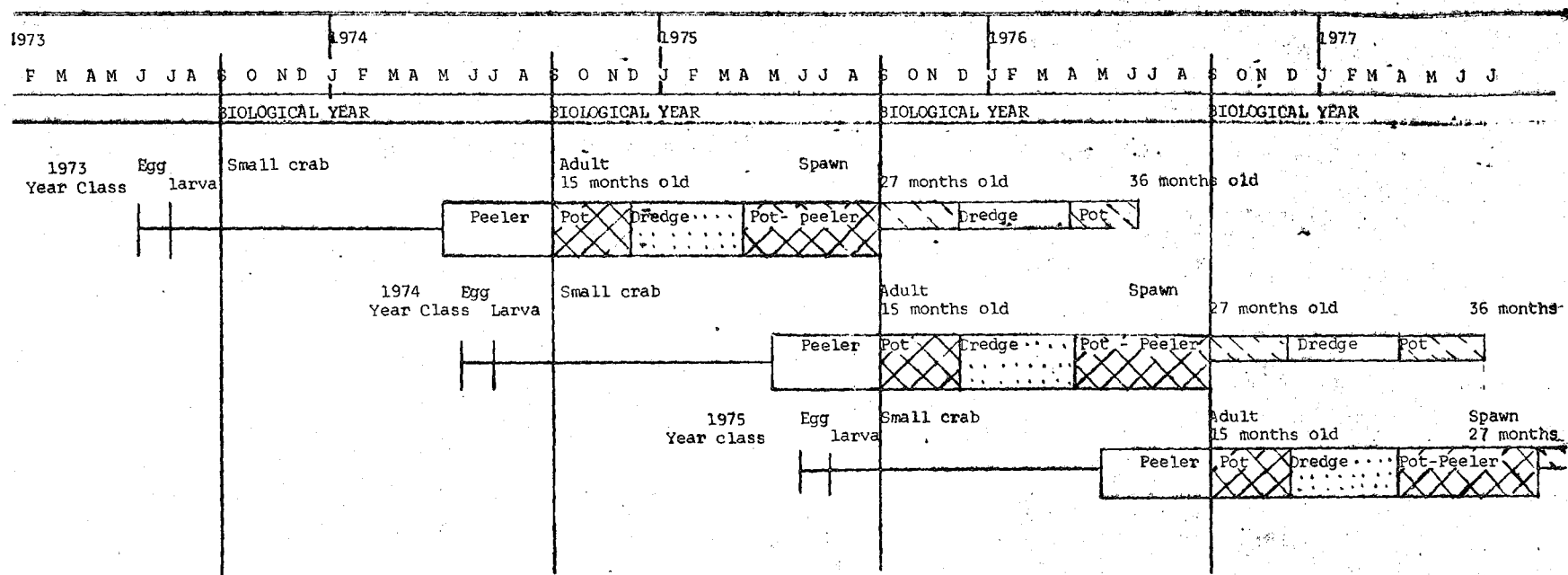


Figure 4. Life cycle of the blue crab in relationship to the fishery.

Females mate only once and do not grow larger after becoming sexually mature. The width of most females just before the last molt is 3 1/2 to 4 1/2 inches. A few may be 5-inches wide or larger. Rarely adult females may be only 2 to 2 1/2 inches wide; they must have been smaller than two inches before the last molt. After reaching sexual maturity, females migrate to high salinity waters in the southern part of the bay, remain there over winter and extrude eggs the next summer when the females are about two years old. About five percent of these adult females survive the third winter of life and attain the maximum age of a little more than three years.

It is evident, then, that a portion of each year's hatch (yearclass) of crabs is available to the Potomac River watermen in the last few months of the first year, as small soft and peeler male and female crabs. Large males and some (or many) females are available the succeeding 12 months. While soft and peeler crabs account for 1.1 to 2.1 percent of the weight (pounds) they contribute from 4.4 to 8.5 percent of the value. In the last eight years, the value of a pound of soft and peeler crabs fluctuated between 41 and 56 cents, about four times the value of a pound of hard crabs.

Effort should be made by the PRFC to encourage a more intensive soft and peeler fishery. Possibly, the current regulations are too restrictive. Since the minimum legal size for peelers is 3 1/2 inches, attained late at the end of the

first year of life or early in the second year, watermen catch and handle many smaller crabs that they are not permitted to keep, undoubtedly damaging or killing many in the process of catching and culling. A reasonable approach would be to lower the minimum size on peelers to 2 1/2 inches, or follow Virginia's example and set no minimum size. The difficulty watermen have in catching and marketing peelers smaller than 2 1/2 inches, and the elimination of the need for inspections by law enforcement officers, make the Virginia law attractive and practical.

Relaxing of a restriction on the capture of hard crabs would encourage larger catches without damaging the crab stock. There should be no minimum size on adult female blue crabs, since they are fully grown and will not shed again if returned to the water. Another argument against their release is the possibility, even a remote one, that the smaller females may produce smaller than normal offspring.

FINFISHERIES

In theory fisheries managers can assure continued productivity of a resource by holding the harvest at or below the level of maximum sustainable yield (MSY) and by establishing size limits or fishing seasons which assure adequate reproduction. Most stocks of fishes inhabit a broader geographic area than the tidal Potomac River and thus are subject to fisheries which are outside of the jurisdiction of the PRFC. In such cases, effective management can stem only from coordinated action of all jurisdictions involved. It follows then that PRFC can be more effective in managing fisheries based on resident stocks such as white perch and catfishes than on migratory species such as croaker, bluefish and spot.

Regarding size limits or seasons fishes present difficulties in that fishes of several different kinds and sizes are frequently caught with one kind of net. Therefore the manager has difficulty in directing action at one particular species. An action taken with one target species in mind will have ancillary effects on other species and on the economics of the fishery.

Despite the limitations imposed by mixed species fisheries and widely distributed stocks, PRFC can maximize the yield by encouraging harvest at the proper size. That is, other things being equal, fish should not be taken during that period of life when the average growth rate of individuals in the population is adding fish flesh faster than the average death rate

is removing it. Accomplishing this goal of maximizing yield per recruit usually will require imposition of size limits, either directly, or preferably, by specifying gear which allows escapement of fishes of uneconomic sizes. Regulation of the gear is preferable to size limits because it is more easily enforced, is biologically more effective, and is more practical in day-to-day fishing operations. Enforcement officers may more readily determine that a unit of gear meets the specifications of mesh size for example than they can measure or weigh the fish caught. Survival of the undersize fish is much greater if they can escape under their own power (or not become trapped) rather than being removed from a net and returned to the water. Many fish are injured when handled and measured or weighed.

Regrettably, allowing escapement of undesirable fishes is simpler in concept than in practical application. Although size selection by gill nets is practical, in pound nets the problem of "gilling" (lodgement of fish in the meshes) increases if the mesh size is increased to allow escapement of young fish. Research leading to more effective fishing gear is needed.

The goal of harvesting at the size giving maximum yield per recruit may be tempered in those species in which the size is attained before reproductive maturity and also in the case of some recreational fisheries where trophy fish are of particular value. While the first of these may cause some concern, the second is a minor problem with the possible exception of striped bass and bluefish.

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